Dec. 13, 1955 K. CLARK 2,726,529

WASHING MACHINE AGITATOR

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FIG. 1

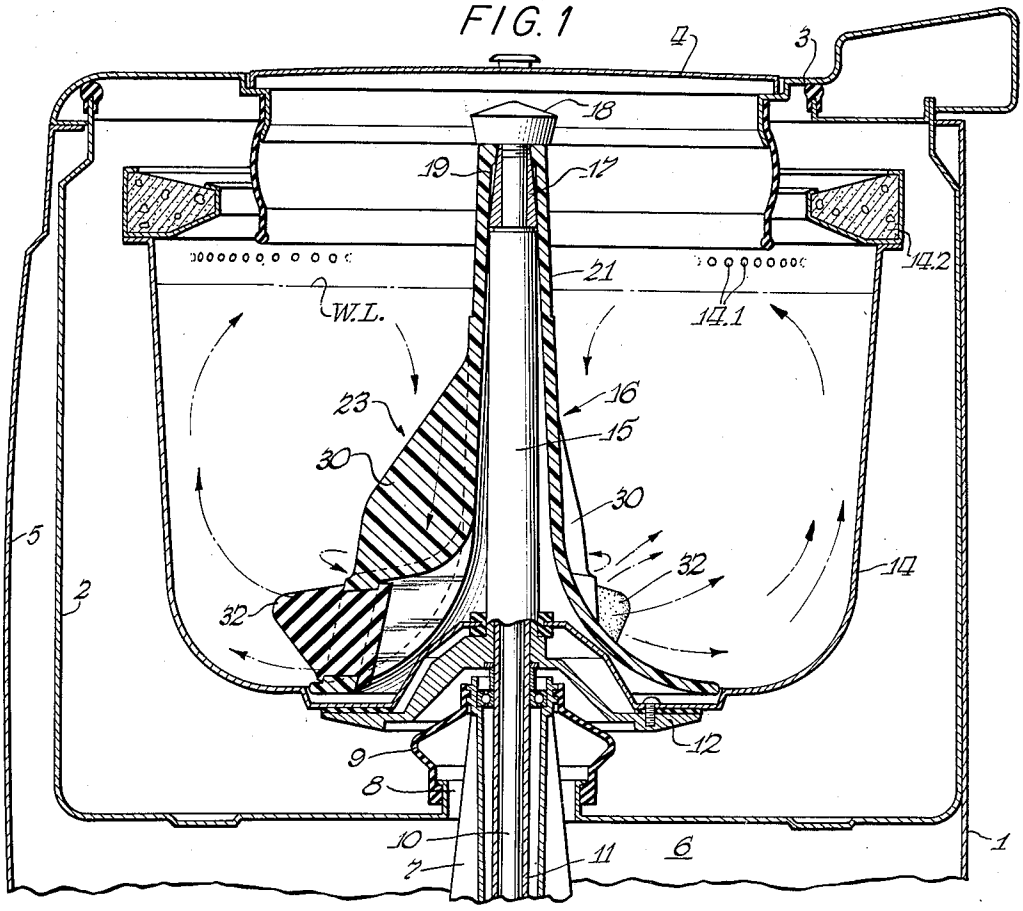
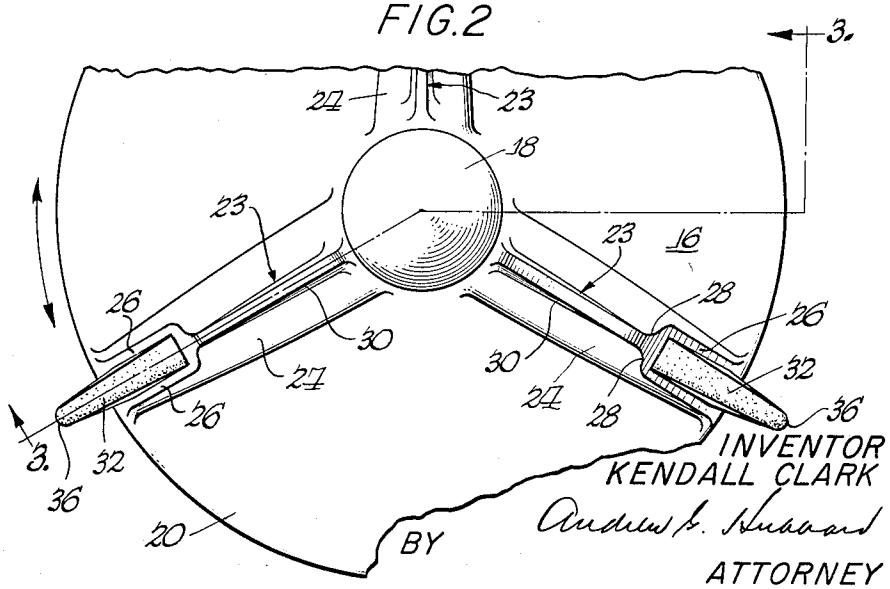


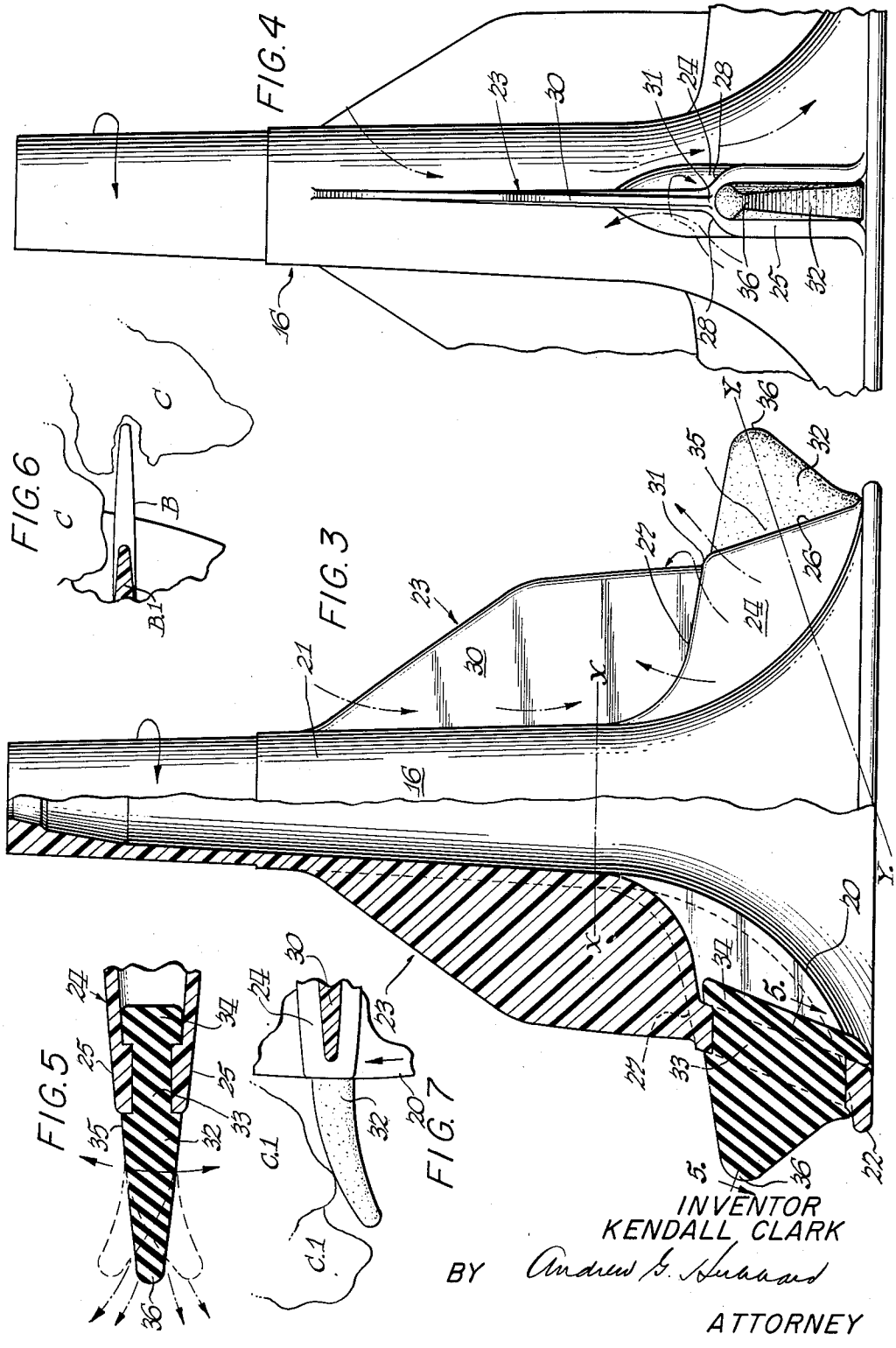
FIG. 2



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WASHING MACHINE AGITATOR

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WASHING MACHINE AGITATOR

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13 Claims. (Cl. 68—133)

This invention relates to washing machine agitators, and in particular to an agitator having composite blades in which rigid and flexible portions cooperate to produce an improved washing action.

Clothes washing machines of the type in which a clothes load of eight or nine pounds is washed, commonly use a submerged agitator or dolly which is oscillated through a suitable arc to produce turbulent water currents in the wash tub. This water action, in combination with the mechanical engagement of the agitator with the clothes, causes the clothes to move within the tub in an erratic toroidal path which causes them to turn over and over, exposing all areas of them to the washing action of the agitator and the pulsing currents of the detergent liquid.

For many years in the washing machine art, washing machine agitators of the oscillatable type have been characterized by a base portion and a post portion extending axially upwardly therefrom, and rigid blades or paddles having a relatively large side elevational area at the base of the agitator and then extending upwardly with varying profile to a point of minimum or zero area where the blade terminates at the post portion. The upward extension of the vanes may be along straight or spiral lines, as well understood in the art. There have been other prior art agitators, characterized by large area flexible blades or paddles, usually washboarded on their side walls, to produce a clothes rubbing action as the blades yield rearwardly of the direction of rotation and wipe or drag across the articles of clothing in the tub. Agitators of the solid blade type frequency grasp and whip portions of the articles of clothing and tear them, whereas agitators of the large-area flexible paddle type may excessively abrade the clothes and tear or otherwise shorten the life thereof.

These and other disadvantages of prior art agitators are particularly apparent in washing machines of the automatic type in which the quantity of water used for any particular washing or power-rinse operation must be held at a minimum for economic reasons. For example, a wringer type or other non-automatic machine may use from 16 to 20 gallons of water for washing, but for a complete washing and wringing operation there is nevertheless a relatively small total volume of water used. An automatic machine, with its plurality of washing and rinsing operations, each of which uses a tubful of water, requires that the water capacity of the tub be as small as is practicable for each operation so as to keep the total gallonage of water at a minimum. For an eight pound (dry weight) clothes load, a wringer machine may have as many as 16 to 20 gallons of water in the tub during washing; there is less confinement of the clothes in a tub of such capacity and more "hydraulic action" of the water and consequently less opportunity for articles of clothing to be caught and torn by the agitator blades. In an automatic machine, however, it is not unusual to wash eight pounds of clothes in a tub having a full-load capacity of from 10 to 14 gallons of water. The clothes

have less freedom of movement within the tub, there is less water action, and there is more opportunity for clothing to be torn or abraded by the solid or flexible fin agitators of the prior art.

It is thus a principal object of my invention to provide a washing machine agitator which will provide improved washability without danger of clothes tearing, even under conditions in which the ratio of clothes load to water volume is in the order of from 60% to 80%.

It is an object of my invention to provide a washing machine agitator which will improve the washing action by improving water action within the tub and by improving the turnover and other movement of the clothes during the washing operation.

It is another object of my invention to provide a washing machine agitator having composite blades in which rigid portions and flexible portions cooperate to produce optimum washing performance with minimum risk of damage to the clothes.

It is another object of my invention to provide a washing machine agitator of the oscillating type, in which the rate of oscillation may be materially higher than in conventional agitators, without tearing or damaging the clothes.

It is a further object of the invention to provide a washing machine agitator having blade members which include rigid and flexible portions of novel shape and arrangement.

In a preferred embodiment of this invention, these objectives are realized in a composite agitator having rigid blade portions and a flexible fin of graduated wall thickness extending outwardly from a suitable base portion of each rigid blade component so as to have the center of effort of the flexible fin radially outward of the center of effort of the rigid blade portion. In particular, I have found that optimum results are derived when the flexible portion is substantially symmetrical with respect to a line extending upwardly and outwardly from the axis of rotation of the agitator. A flexible fin or blade portion so positioned and arranged appears to give a powerful outward and upward water thrust which accentuates the turnover action at the base of the tub and gives a positive outward impulse to the clothes to drive them into the water flow stream. The free flexure of the fins as the agitator oscillates, eliminates the tendency of clothing to be caught on the agitator and to be whipped back and forth thereby. The fixed blade components, which may be of straight or spiral contour, establish a water movement which diminishes in force at the higher levels of the washing liquid, but are nevertheless effective to prevent quiescent areas within which the articles of clothing may inactively float. Additional advantages result from providing the rigid blades with a wall arrangement which produces a water action tending to keep the articles of clothing in movement away from the root of the flexible fin, and thereby into the zone of most effective action of the fin.

Other features and advantages of the invention will be apparent from the following detailed description thereof, read in accordance with the accompanying drawings showing a presently preferred embodiment. In said drawings:

Fig. 1 is a fragmentary side sectional elevation of a washing machine having an agitator embodying the invention;

Fig. 2 is a fragmentary plan view of said agitator;

Fig. 3 is an elevation of the agitator in section on lines 3—3 of Fig. 2;

Fig. 4 is a fragmentary side elevation of the agitator, looking directly at one of the composite agitator blades.

Fig. 5 is a plan section of an agitator fin, taken in section on lines 5—5 of Fig. 3;

Fig. 6 is a schematic representation of the manner in which a rigid fin agitator will engage an article of clothing; and

Fig. 7 is a schematic representation, similar to Fig. 6, but illustrating the action of the flexible fin.

Fig. 1 fragmentarily shows a washing machine of the type in which the articles of clothing are washed and then centrifugally damp-dried in a single tub. As more fully illustrated and described in the J. C. Sharp Patent 2,648,212, granted August 11, 1953, and assigned to my present assignee, such a washing machine may comprise an outer housing **1** having an internal water collector **2**. A top panel **3** is suitably removably fitted to the casing; said top panel has an access door **4**. A removable front panel **5** affords access to a machinery compartment **6**.

The drive mechanism (not shown) is carried by framework (not shown) which includes a rigid tubular column **7**; said column extends upwardly through the collared opening **8** in the bottom of water collector **2**. A tubular flexible boot **9** is suitably fastened between the collector **2** and the column **7** to prevent spillage of liquid through the opening **8** into machinery compartment. Within said column, and supported by bearings of any suitable type, shaft **10** is rotatably housed within a tubular shaft **11**. Shaft **10** is known in the art as an agitator shaft, and is arranged to be connected by suitable clutching mechanism (not shown) to a conventional transmission (not shown) which, when connected to power, produced an oscillation of said shaft **10** through a suitable arc. Typically, the shaft may oscillate about 72 times per minute, oper an arc of the order of 210°. A widely-used transmission for such service is shown in Patch U. S. Patent No. 1,964,440 of June 26, 1934. The tubular shaft **11** is arranged to be rotated in a single direction from a transmission also arranged to be driven by external motor power (not shown). The tubular shaft **11** is directly connected to a bottom fixture **12** on which is mounted a washing and centrifuging tub **14**, it being understood that there is a liquid-tight relationship between said tub and fixture. Hence, when the shaft **11** is rotated, tub **14** will rotate therewith. An extension **15** of fixture **12** houses the upper end of shaft **10** and extends to above the full load water line W. L. to prevent escape of liquid into the space between said shafts **10** and **11**. The full-load capacity of the tub is of the order of fourteen gallons.

To the upper end of shaft **10** is removably affixed the agitator or dolly **16** forming the subject matter of the present invention. The operational relationship or shaft and agitator may be through the agency of the polygonal member **17** secured on the end of shaft **10** and the cap nut **18** which threads onto the end of shaft **10** and urges the appropriately shaped upper socket portion **19** of the agitator into tight engagement with the member **17**.

In the operation of agitator type washing machines, articles of clothing are placed in the tub **14** and detergent solution added to the proper level. Then by means which may include conventional automatic time cycle control apparatus (not shown) the agitator shaft is connected to the transmission and is thereby oscillated to create a turbulence within the tub causing the articles of clothing to be tumbled and subjected to a washing action. At the end of the washing time, the agitator shaft **10** is disconnected from its transmission and the spin shaft **11** is rotated at a speed which causes the detergent solution to be centrifugally discharged through the series of openings **14.1** about the tub below the guard and balance ring **14.2** carried by the upper rim of said tub. The liquid is caught by the collector **2** and is pumped therefrom to a plumbing drain by a suitable pump (not shown) operating continuously during the "spin" operation. The foregoing operation and the subsequent cycles which complete the full sequence of operations of a conventional automatic washing machine are more fully described in the aforesaid Sharp Patent 2,468,212, although it should be understood that agitators embodying this invention are applicable to manually controlled wringer type machines, as well as to the several automatic types now common in the art.

Referring now to Figs. 2, 3, and 4, the agitator **16** comprises a central structure including a belled base portion **20** curving smoothly inwardly and upwardly to a point of junction X—X with a coaxial post portion **21**. The actual bottom of the bell **20** is characterized by the flat rim area **22**. The agitator has a plurality of axially disposed outwardly extending blades **23** arranged equiangularly about the bell and post portion. The blades, which are identical in shape and construction, combine rigid and flexible elements as above noted. For example, each blade has a base portion **24**, the spaced side walls **25** of which provide a strong, relatively thick structure. The forward edges **26** of said side walls slope upwardly and inwardly in a rather steep angle, terminating at the top wall **27**. The top wall is arched to provide the curved shoulders **28**. Said top wall extends rearwardly and upwardly at a relatively small angle with the horizontal and then curves smoothly upwardly to terminate substantially at the juncture X—X of the bell and post portions of the agitator.

The rigid blade portion **30** is in effect carried by the base **24**, the spaced side walls and sloping shoulders of which provide buttress formations of substantial strength. In the illustrated embodiment, the outermost edges of blade portion **30** have a profile extending outwardly and downwardly from a point commencing just below the three-quarter-full level of washing liquid in the tub to a point at about the one-half-full level, whence it curves downwardly into a large radius profile, which as best shown in Fig. 3 approximates the slope of the post wall. The blade portion **30** terminates substantially at the juncture **31** of the top and front walls of the blade base portion **24**, and it will be noted that said juncture is considerably inward of the maximum diameter of bell **20**. It will be understood that the rigid blade portions may be vertical with respect to the plane of the base, as shown, or may rise spirally along the post.

The foregoing structure is advantageously molded of a suitable thermosetting plastic and the central structure and rigid blade elements are therefore integral parts of the whole.

The final component of the respective blades is the flexible fin **32** which projects from the agitator blade base element **24**. The fin is advantageously molded from rubber or other suitable elastomeric material having a hardness of the order of 50 on the durometer scale. It will be apparent from Figs. 3 and 5 that the element **24** also forms the base for the fin **32**; and as a convenient and satisfactory means of removably securing the fin to its associated base, the radially innermost portion of the fin is channelled to provide the neck **33** and head **34** for cooperation with the appropriately contoured inner faces of the side walls **25**. Fig. 3 indicates that the fins **32** are preferably of substantially ogival shape and are symmetrical with respect to a line normal to and bisecting the front walls **26** of the blade base element **24**. It will also be noted that said reference line intersects the base of the agitator at the axis of rotation thereof.

The front elevation and sectional views in Figs. 4 and 5 show that the fin **32** tapers from its root **35** to its tip **36**, said taper being advantageously at a uniform rate along the upper and lower walls thereof. This shape provides controlled flexibility which produces as the fin oscillates within the loaded tub, a smooth deflection, as suggested in Fig. 5. The fin is also free to distort in a torsional manner in the event it encounters some exceptional obstruction during the washing operation.

The advantages of the present agitator are predicated upon the shape and arrangement of the solid portions of the blades and the shape and disposition of the flex-

ible fins **32**. Solid blade agitators of the prior art, with which I am acquainted, have usually been characterized by a rigid paddle-like portion at the base of the agitator and a rigid graduated area portion extending upwardly therefrom along the agitator post. Except for those devices in which the agitator blades are convoluted or grooved to produce a washboard effect, the blades of prior art agitators are smooth-faced, and without abrupt changes in wall thickness. In such structures, the forces applied to the surrounding liquid by the oscillation of the agitator are essentially normal to the face of the agitator blades. The curvature of the tub and the rush of liquid into the zone behind the trailing face of the agitator produce the water current patterns necessary to wash the clothes load. The tendency of rigid blade agitators to tear clothing evidently results from the action schematically shown in Fig. 6. The blade B is typical of the lower large area portion of an agitator blade and the portion B.1 represents the portion of the blade which extends along the agitator post (not shown). With the blade oscillating in the counterclockwise portion of its stroke, the leading face of the blade may engage a portion of an article of clothing C and carry it along in the same direction. Water currents behind the blade move a trailing portion of the article C in behind the blade. Then at the end of the counterclockwise stroke, the blade suddenly reverses its direction of rotation. The movement of the clothing is suddenly stopped and is whipped or snapped into reverse movement, with a resulting strain on the fabric which often causes it to rip or tear. Frequently, the combination of the whipping action and the water action produced by the blades also causes the clothes to tangle. The rate of occurrence of such damage is greater in automatic machines, in which a smaller volume of water is used for a given clothes load, than in the non-automatic types, in which a large tub and correspondingly large water volume give the clothes more freedom of movement.

In an agitator having blades embodying the invention, the water action established by the flexible fin and by the sloping shoulder of the thick blade base **24**, and the mechanical action of the fin **32** on the clothing, substantially eliminates tangling and tearing of the clothes, even in machines in which the volume of water is small. Considering the water action initially, as represented by the broken-line arrows in the several views, the flexing of the fin creates water currents which are in a substantially radially outward direction as indicated in Figs. 1 and 5. Even though the fins are of individually small area as compared to the solid blade portions, and the volume of water small with respect to the clothes load, the disposition of the fins radially outward of the base of the agitator, and the flexing of the fins during each oscillation create a powerful hydraulic action, manifested by currents flowing in an essentially angularly upward direction. The flexible fins are beneath the greater portion of clothes in the tub, and the hydraulic action created by the fins lifts the articles of clothing into the upper portion of the tub whence they are driven inwardly and downwardly by reason of the effective toroidal flow pattern established within the tub. This, plus the sideward thrust of the fin near its root, sweeps any trailing ends of clothing away from the broad base rim **22** of the agitator. The curved shoulders **28** of the blade-base portions **24** help establish a water action which keeps clothing clear of the area of the intersection **31**. In Fig. 3, it is assumed that the agitator is rotating clockwise. Water climbs the slope of the shoulders **28**. At the junction **31** of the fin **32** and the blade portion **30**, the water action is in part outward and upward and in part up and about the lower edge of the blade portion **30**. These water actions are effective to move the ends of the articles, and particularly any trailing ends thereof, in a generally outward direction to bring them into the main outward and upward current. Inevitably, of course, some portion of the articles will be engaged by the leading face of the fins. But, as indicated by the relationship of the fin **32** to the articles of clothing C.1 in Fig. 7, the fin will have been deflected and the curvature of the fin, plus the outward water action, eliminates the "wraparound" of the articles which so often accompanies the operation of the solid fin agitator types. As the direction of oscillation reverses, the flexible fin straightens out before reversing its curvature, and in so doing gives the adjacent clothing article an outward flip which helps keep the article in a loose, or free, association with the agitator blades and aids the turnover of the clothes.

The clothing articles are kept well away from the lower wide area of rigid blade portion **30** by reason of the powerful water action produced by the fin **32**. These rigid blade areas, however, establish strong water currents which contribute to the effective turbulence of the water in the tub. In the upper areas of the blade portion **30**, the lessened mechanical effect of the small surface area and the proximity of its center of effort to the axis of rotation of the agitator are complete protection against tearing or damage of the clothing. These upper areas, however, effectively keep the clothing from gathering about the agitator post.

Certain dimensional relationships of the agitator components appear to contribute importantly to the superior performance of the illustrated embodiment. In an agitator having a maximum base diameter of 11.375 inches and an overall height (exclusive of cap nut **18**) of the order of 15.6 inches, the vertical radius of curvature of the belled bottom portion is of the order of 4.5 inches. Fins **32** project approximately 1.8 inches from the forward ends of the rigid blade base portions **24**, as measured along reference line Y—Y. Said reference line inclines 22° 30′ from the horizontal. The maximum reach of the fin is approximately .875 inch beyond the maximum diameter of the base, at a point approximately 2.25 inches above the base.

The maximum radial extent of the rigid blade portion **30** is approximately 4.125 inches, measured from the axis of the agitator post, and it is therefore apparent that the center of hydraulic effort of the rigid blade portions is considerably above, and radially inward of that of the fins **32**. The mechanical effort of the fins **32** against the clothes, and the center of hydraulic effort of the fins, is low in the tub, although slightly above that of the rigid blade base **24**. The water currents induced in the tub during oscillation of the agitator subject all portions of the clothes eventually to the mechanical and hydraulic action of the fins, which thereby act to keep the clothes moving up and away from the base of the agitator, and thus cause them to move into the zone of influence of the thin blade portions **30**. Even heavy articles are prevented from settling or gathering at the bottom of the tub.

It has previously been noted that the fins **32** effectively sweep trailing ends of clothing away from the base rim **22** of the agitator. This is thought to be essentially the result of the upward and outward slope of the bottom edge of the fins, and the resulting rather large angular space between the bottom of the fin and the bottom of the tub. In the wide areas thus formed below the fins, the currents induced by the oscillation of the fins move the articles outwardly, and prevent them from being dragged into the space between the agitator base and the tub bottom. In conventional agitators in which a rigid blade element overlies the bottom of the tub in close proximity thereto, or in which there is less free space between the lower edge of the agitator blade and the tub, the tearing and abrading of articles which have worked underneath the agitator has been a serious problem and source of user dissatisfaction.

A composite blade agitator constructed according to the present invention performs efficiently, and with free-

dom from clothes tearing, even at rates of oscillation up to 300 or 330 per minute and arcs of movement ranging from 30° to 210°. Regardless of the rate of oscillation and the length of stroke the deflection or vibration of the flexible fins produces the improved hydraulic action and clothes movement and turnover above noted.

The fins **32** are easily inserted into or removed from the agitator blade base **24**. In assembly, the fin **32** is soaped or otherwise lubricated and inserted through the opening in said blade base. Then, by grasping and pulling outwardly on the protruding tip **36** of the fin, and pressing outwardly on the head **34**, the fin will move easily into final position. If removal is necessary, the fin is compressed at its root portion so that it will enter the space and therefore permit radially inward movement of the entire fin into the hollow center portion of the agitator.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

I claim:

1. A washing machine agitator, comprising a central body structure including a belled bottom portion and a shaft portion extending coaxially therefrom; a plurality of rigid, relatively thick agitator blade base members disposed equiangularly about said bottom portion and extending radially from substantially the periphery of said bottom portion to the juncture of said bottom and shaft portions, the radially outermost end wall of said blade members sloping toward said shaft and the upper wall of said blade base members sloping toward said shaft at a substantially lesser angle to the horizontal than said outermost end wall; a resilient fin extending radially of said belled bottom portion from said outermost end wall of each of said agitator blade base members, said fin having an ogival shape symmetrical with respect to a line normal to said end wall; and a rigid, relatively thin agitator blade portion bottomed on each said base member and projecting axially outwardly from said shaft, the outermost edge of said agitator blade portions extending, for a relatively large portion of its length, in substantial parallelism with said shaft, and then extending inwardly and upwardly to a point of juncture with said shaft.

2. A washing machine agitator, comprising a central hollow body structure including a belled bottom portion and a shaft portion extending coaxially therefrom; a plurality of rigid, relatively thick agitator blade base members disposed about said bottom portion and extending radially from substantially the periphery of said bottom portion to the juncture of said bottom and shaft portions, the radially outermost end wall of said blade members extending upwardly toward said shaft and the upper wall of said blade base members sloping upwardly toward said shaft at a substantially lesser angle to the horizontal than said outermost end walls; a resilient fin extending radially of said belled bottom portion from the outermost edge of each of said agitator blade base members, said fins having a shape substantially symmetrical with respect to a line normal to and substantially bisecting said end walls; and a rigid agitator blade portion of substantially less thickness than said base member bottomed on each said base member and projecting outwardly from said shaft along a substantial portion of the length of said shaft, the outermost edge of each said agitator blade portion extending, for a relatively large portion of its length, upwardly and gradually inwardly toward said shaft from the tip of the associated blade base member to provide a relatively large area lower portion immediately above said base member and then extending upwardly and inwardly to a point of juncture with said shaft; the outer edge of said lower area portion forming an obtuse angle with respect to the upper edge of said flexible fin.

3. A washing machine agitator as in claim 2, in which the juncture of the top wall of the blade base member and the outermost edge of the rigid blade portion bottomed thereon is within the circumference of the bottom portion of the said central body structure and the radially outermost portion of said flexible fin is substantially radially outward of said circumference.

4. A washing machine agitator as in claim 2, in which all of the exposed area of said flexible fin is disposed radially outward of the outermost edge of said rigid blade portion.

5. A washing machine agitator, comprising a central hollow body structure including a belled bottom portion and a shaft portion extending coaxially therefrom; a plurality of rigid, relatively thick agitator blade base members disposed equiangularly about said bottom portion and extending substantially radially from substantially the periphery of said bottom portion to the juncture of said bottom shaft portions, said base members having spaced side walls, the radially outermost ends of which slope toward said shaft, the upper wall portions of said blade base members sloping toward said shaft at a substantially lesser angle to the horizontal than the outermost ends of said side walls; a resilient fin extending radially of said belled bottom portion from each of said agitator blade base members, said fins being confined between the sidewalls of said base members and having an ogival shape symmetrical with respect to a line normal to the outermost ends of said side walls; and a rigid agitator blade portion bottomed on each said base member and projecting outwardly from said shaft, the outermost edge of said agitator blade portions extending from a point at the outermost end of said base member top wall upwardly and inwardly to a point of juncture with said shaft.

6. A washing machine agitator as in claim 5, in which the exposed area of said flexible fin is substantially less than the exposed area of said rigid blade portion.

7. A washing machine agitator as in claim 5, in which the upper wall portions of said agitator blade base members curve upwardly and inwardly toward the blade portions bottomed thereon.

8. A washing machine agitator as in claim 5, in which the said line normal to the ends of the side walls of the blade base member bisects said walls and intersects the base of the agitator bottom portion at substantially the axis thereof.

9. A washing machine agitator as in claim 5, in which the resilient fin tapers in thickness from its root portion to its radially outermost tip portion.

10. A washing machine agitator as in claim 5, in which the resilient fin is of elastomeric material having a hardness of the order of 50 durometer.

11. A washing machine agitator as in claim 5, in which said resilient fin is removably secured within said agitator blade base member by an interfitting engagement of wall portions of said base member and wall portions of said fin.

12. A washing machine, comprising a tub having a wash capacity in which the ratio of the maximum weight of clothes in pounds per wash load to the maximum quantity of washing liquid in gallons is in the range of from six-tenths to eight-tenths, and an oscillatable agitator within said tub, said agitator having a base portion disposed at the bottom of said tub, a post extending axially upwardly from said base portion, a plurality of thin, rigid blade members extending outwardly from said post along a substantial portion of the length thereof, the width of said blade members being at a maximum near the bottom of said post, and a plurality of flexible fins secured about said base portion wholly beneath said rigid blade members and extending outwardly thereof beyond the maximum radial projection

of said rigid blade members, the plane of said flexible fins being in the plane of the immediately above portions of the rigid blade members.

13. A washing machine, including a tub in which articles of clothing and the like are to be washed by movement within a body of washing liquid, and an agitator arranged within said tub for oscillation therein, comprising a base portion and a post portion, said base portion being substantially at the bottom of said tub and said post portion comprising a substantially cylindrical structure, the center of which is coaxial with the axis of oscillation; a plurality of substantially arch-shaped flexible fins supported with respect to said base portion and extending outwardly beyond the circumference thereof, the radially outermost extension of said fins being disposed well above said base portion, the bottom edge of said flexible fins sloping upwardly relative to the bottom of said tub and thereby presenting a relatively large

angular space between the bottom of said fins and the bottom of said tub, and a plurality of relatively thin, rigid, blade members extending outwardly from said post portion, the radially outermost extension of said blades being substantially less than that of said fins and said thin blade members commencing substantially at the upper edge of said fins and being disposed wholly above said fins.

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