The invention relates to washing machines and more particularly to the construction of a tub, the construction of an agitator, and a cooperative relation between a tub and agitator in a power driven washing machine.

There has been extensive use of the so-called oscillating agitator type washing machine in which an agitator having a base, a center post and radial blades extending outward from the post and upward from the base is located in the lower portion of the tub and oscillated, with clothes and washing fluid in the tub, to cause a so-called "roll-over" action for carrying out a washing operation.

Innumerable shapes of agitators have been used with innumerable tub shapes; and provisions have been made, either by casting parts on the tub and agitator, or by locating the agitator base in a recess or well in the tub bottom, for preventing clothes from entering under the agitator base between the base and tub bottom where they may be damaged or torn during oscillating movement of the agitator. The tub, of necessity, must be capable of complete drainage after washing operations have been completed, and drainage formations must be provided in the tub bottom.

The shape of the tub bottom in an agitator type washing machine has therefore been complicated in order to provide against damage to clothes between the agitator base and tub bottom and to satisfy drainage requirements. Such tubs are usually drawn in one piece from a sheet steel blank and provided with a vitreous enamel protective surface. Thus, the complicated shape of the tub bottom renders the manufacture of a one-piece enamelled sheet steel tub difficult and expensive.

It has always been believed necessary to provide a base for the agitator of an agitator type washing machine in order to obtain the desired roll-over water action, and in order to prevent clothes from catching, sticking, tearing and ripping between the tub bottom and agitator blades when the agitator is oscillated.

Considerable scum, dirt and other foreign matter collect on the underside of the agitator base in an agitator type washing machine; and buttons, pins and other foreign objects collect beneath the base of the agitator. Therefore, it has always been necessary to provide for the ready removal of the agitator from the tub by the user upon completing washing operations to enable the agitator to be cleaned and maintained in a suitable condition, and to enable foreign matter to be removed from the tub bottom.

These requirements have complicated the construction of an agitator in order to provide the base, the center post, the radial blades, and for ready removability. As a result, the manufacture of such agitators has been complicated and expensive regardless of the character of material from which the agitators are made, such as cast aluminum, zinc, or other light metal, plastics, sheet metal stampings, and the like.

There have been washing machines including paddle-like or propeller type blades mounted on a center shaft in a tub and located a substantial distance above the tub bottom. These constructions eliminate some of the foregoing difficulties. The machines have been very inefficient in washing and do not produce the characteristic roll-over action to any substantial degree.

Accordingly, it is a primary object of the present invention to eliminate the complications and reduce the cost of manufacture of agitator type washing machines.

Furthermore, it is an object of the present invention to provide a tub construction for an agitator type washing machine having a simplified bottom shape which may be readily formed as a one-piece tub deep drawn from a single blank of sheet metal.

Likewise, it is an object of the present invention to provide an agitator construction for an agitator type washing machine which may be readily and inexpensively formed from any desired material.

Furthermore, it is an object of the present invention to provide an agitator construction for an agitator type washing machine in which the agitator may be advantageously formed from simple sheet metal stampings and tube elements.

I have unexpectedly discovered, contrary to prevailing beliefs, that clothes are not caught, pinched, damaged, or torn between the blades of an agitator and the tub bottom if the agitator base is eliminated in an agitator type washing machine; provided that the bottom edges of the agitator blades are located closely adjacent the tub bottom and have the same contour as the adjacent tub bottom.

Furthermore, I have discovered that if the tub bottom is provided with a central conical shape having an outer base diameter approximately ½ of the tub diameter and with a cone angle of approximately 20° to 30°, preferably about 25°, and with a sweeping quarter-round curved wall formation connecting the cone wall and tub side wall; and if such a tub bottom is associated with an agitator having blades terminating closely adjacent and conforming to the contour of the tub bottom conical and curved surfaces, that a violent, swirling, sweeping, whirling, turbulent water action results. This water action produces a much more rapid "roll-over" than has heretofore been obtained in agitator type washing machines.

As a result, washing machines constructed in accordance with the present invention can wash a given load of clothes much more rapidly than
prior art agitator type washing machines of the same size, or can wash a larger load of clothes in the same time required for washing a smaller load of clothes in the same sized prior art washing machine.

Furthermore, I have discovered that there is a characteristic result in operating washing machines of the present invention—apparently due to the violent turbulence, or to the more rapid roll-over, or to strong water currents at the tub bottom as the agitator blades sweep across and closely adjacent to the tub bottom—of substantially eliminating any tangling, balling up or bunching of clothes which normally occurs in the operation of prior art agitator type washing machines.

Accordingly, it is a further object of the present invention to provide an improved cooperative agitator and tub bottom construction for agitator type washing machines which eliminates a base on the agitator and substantially increases the violence of the water action and turbulence, the efficiency of washing, and the load which may be washed, and which decreases the time of washing.

Also, it is an object of the present invention to provide an improved tub bottom and related agitator construction in which the bottom edges of the agitator blades sweep back and forth and closely adjacent to the tub bottom without catching or getting between the blades and tub bottom.

Furthermore, it is an object of the present invention to provide an improved agitator and tub bottom construction for an agitator type washing machine which when operated reduces tangling, balling and bunching of clothes to a minimum.

Also, it is an object of the present invention to generally improve, simplify and reduce the cost of manufacture of tubs and agitators for agitator type washing machines.

Finally, it is an object of the present invention to incorporate the foregoing desiderata in the construction of agitator type washing machines.

These and other objects and advantages are apparent to those skilled in the art from the following description and claims may be obtained, the stated results achieved, and the described difficulties overcome, by the devices, constructions, arrangements, combinations, sub-combinations, parts, elements, discoveries and principles which comprise the present invention, the nature of which is set forth in the following general statement, a preferred embodiment of which is illustrative of the best mode in which the applicant has contemplated applying the principle is set forth in the following description and shown in the drawings, and which is particularly and distinctly pointed out and set forth in the appended claims forming part hereof.

The nature of the improvements in washing machines of the present invention may be stated in general terms as preferably including in an agitator type washing machine, a tub preferably formed in one piece from sheet metal having preferably cylindrical side walls terminating in any desired upper open end formation and having an integral bottom wall, the bottom wall being formed to have a central shallow conical shape at an angle of about 20° to 30°, and preferably about 25°, the base of the cone having a diameter approximately 1/2 to 1/3 the diameter of the tube side walls, the conical formation being joined with the side walls by a sweeping curved preferably approximately quarter round wall preferably formed on a radius equal to approximately that of the cone base or 1/2 of the radius of the tub side walls, there being a drain opening formed in the bottom wall adjacent the base of the cone shape where it merges with the curved bottom wall portion, a central opening in the tub bottom, means for the washing machine including a shaft extending through said central opening, an agitator operatively mounted on and connected to the blades sweeping across and closely adjacent to the tub bottom, and said drive means including means for oscillating said agitator.

By way of example, a preferred embodiment of the improved washing machine construction is illustrated in the accompanying drawings.

Figure 1 is a vertical sectional view taken through a washing machine provided with the improved tub and agitator construction;

Fig. 2 is a plan view of the improved tub and agitator forming part hereof wherein;

Fig. 3 is an enlarged vertical view, with parts in section, illustrating one form of improved agitator formed of sheet metal stampings and tubular parts; and

Fig. 4 is an enlarged sectional view taken on the line 4—4, Fig. 3.

Similar numerals refer to similar parts throughout the various figures of the drawings.

The washing machine comprises a tub generally indicated at 1 supported in any desired manner on an under base structure 2 within which the driving mechanism generally indicated at 3 is housed, the base 2 preferably being provided with legs 4 supported on casters 5. Any desired type of drive mechanism may be used, including a motor 6 and mechanism for transmitting oscillating rotation or rotary reciprocatory movement to the agitator drive shaft 7.

The tub 1 includes preferably cylindrical side walls 8 terminating in an upper open end 9. Although a beaded upper edge for the tub side walls 8 is illustrated at 9, it is to be understood that the upper open end of the tub 1 may have any desired formation frequently used for washing machine tubs, such as illustrated in the French et al. Patent No. 2,131,627, the Bohm Patent No. 2,238,696 or the Gonda Patent No. 2,356,457, or in the Bohm application Serial No. 406,366, filed August 11, 1941, now Patent No. 2,425,986, issued August 19, 1941.

The bottom wall of the tub is formed with a central shallow convex truncated conical shape 10 having a straight line contour in cross-section, as shown, extending approximately to the zone 11 so that the base of the cone has a diameter approximately 1/2 to 1/3 of the diameter of the tub side walls, as shown. The bottom of the tub then has a central shallow curved wall 12 extending immediately from the conical wall 10 and directly connecting or joining the conical formation 10 and the tub side walls 8; and the curved wall 12 is preferably formed on a radius about a point indicated at R equal to approximately that of the cone base or to approximately
\( \frac{1}{2} \) of the radius of the tub side walls. The curved portion 12, however, need not necessarily be formed on a radius, so long as it has a sweeping curve shape and extends through approximately one-quarter of the tub diameter at each side thereof.

The angle which the conical wall 10 makes with a horizontal plane is, in accordance with the present invention, about 20° to 30° and preferably about 25°. A drainage opening 13 is also provided in the tub located in the intermediate trough where the curved wall 12 merges with the conical wall 11.

The central portion of the tub bottom wall is provided with a flat ring-like portion 14 forming a central opening 15. The ring-like portion 14 is clamped on top of a tubular housing post 16 by nut 17. The drive shaft 7 extends upward from housing 16 through nut 17 and any desired packing may be provided at 18. The drive shaft 7 extends upwardly to the top region of the tub and may be provided with spline formations 19 or any other drive formation means for driving an agitator, generally indicated in Fig. 1 at 20.

In accordance with the present invention, the agitator 20 includes a center post 21 and blades 22 of any desired number, four blades being shown. The upset blades preferably extend radially outward from the center post and at right angles to the tub bottom wall, and the lower edges 23 of the blades are located closely adjacent to the bottom wall of the tub. The space between the lower edges 23 of the blades and the bottom wall of the tub is very small and only that necessary for proper operating clearance between the blades and tub bottom wall when the tub is assembled and the agitator is oscillating with water and clothes in the tub.

Furthermore, the shape of the bottom edges 23 of the blades 22 conforms to the cross-sectional shape of the tub bottom, as best shown in Fig. 1. The blades, as shown, extend outward slightly beyond the end of the conical formation and conform to the curved wall 12 of the tub bottom. The diameter to the outer edges 24 of the blades should be approximately \( \frac{1}{2} \) of the diameter of the tub 1 although the blades may be a little shorter or a little longer than such an exact dimension; and the curved tub wall 12 sweeps upward from the outer edges of the blades.

Furthermore, the exact formation of the side and top edges of the blades 22 is not important so long as the blades have substantial depth and length, as shown, and so long as the lower edges 23 thereof conform to the shape of and are located closely adjacent the tub bottom wall.

The upper end of the agitator center post 21 is preferably provided with a sleeve 25 formed with splines meshing with the splines 19 at the top of drive shaft 7; and a cap 26 may be provided at the top of the agitator post 21 by means of which the agitator is secured to the drive shaft by a screw 27. Another sleeve 28 is provided at the lower end of the agitator post 21 for locating and centering the agitator 20 on drive shaft 7.

In operating the washing machine, the tub 1 is filled with washing fluid approximately to the water line indicated at 29, the drive mechanism is actuated and the desired load of clothes is inserted in the tub. As the agitator 20 oscillates back and forth, and as the blades 22 sweep back and forth, the tub bottom wall, strong water currents are set up producing violent turbulence and inducing a very rapid roll-over action to the clothes therein. The rate of roll-over is increased to a marked degree, in many cases being substantially twice that of prior art agitator type washing machines of the same size with the same load of clothes and having similarly shaped agitator blades and with a base on the agitator but without the specific central conical and sweepingly curved tub bottom shown in the drawings.

Moreover, in operation, clothes such as shirts, or aprons with strings do not become tangled and balled up when being washed in the washing machine of the present invention.

Furthermore, contrary to prevailing beliefs, the clothes do not catch and stick between the bottom edges 23 of the agitator blades of the tub bottom when the washing machine is operated. The reason for this unexpected result is not clearly understood, but it is believed to occur because of the violent water currents set up by the moving blades as the same sweep back and forth across and closely adjacent the stationary tub bottom wall, which sweep the clothes away from the center of the tub with more violent force than in prior art machines.

As a result of the high velocity water currents produced and of the increased roll-over action occurring and of the reduced tendency to tangle clothes, a larger load of clothes may be washed in the same time that it takes to wash a smaller load of clothes in the same sized agitator type washing machine of the prior art. With equal sized loads, the washing machine of the present invention can carry out a washing operation much more rapidly.

The tub 1, in accordance with the present invention may be formed of any desired material but it is preferably formed of sheet steel with a vitreous enamel coating or may be deep drawn from stainless steel stock. In either case, the specific formation of the tub bottom wall described is most advantageous to carrying out a deep drawing operation for making the tub and the cost of fabricating the tub is thereby substantially reduced because of the elimination of a relatively flat bottom, drainage formations, an agitator base recess, and the like, which have characterized tubs in prior art agitator type washing machines.

Likewise, the agitator 20 may be made from any desired material in any desired manner. It may be formed of cast metal, or it may be formed of sheet metal and enameled, or it may be formed of stainless steel. In any event, the elimination of a base for the agitator avoids many manufacturing complications and an agitator constructed in accordance with the present invention may be manufactured at substantially reduced cost.

The present invention also comprehends improvement in the fabrication and construction of the agitator 20, per se. Referring more particularly to Figs. 2, 3 and 4, the agitator 20 may comprise the central tubular post 21, the upper sleeve 25 and the lower sleeve 26. The sleeves 25 and 26 may be formed from tubular or bar stock by automatic machine tool operations and welded or brazed within the ends of the tube 21.

The blades 22 may be formed on the agitator post 21 by providing two identical A-shaped or saddle-like stampings 30, each including two blades 22 connected by a curved saddle portion 31. The stampings 30 may be formed in the flat. A bead 33 is then formed along the entire peripheral of the stamping. The stampings 30 is then preferably formed with reinforcing and stiffening corrugations 34 running up one blade.
22, around the saddle portion 31 at 35 and down the other blade 22 of the stamping 39. The stampings 30 may then be formed and bent to the A or saddle shape shown.

Thus, the beaded edge 33 avoids sharp edges on the agitator blades and the reinforcing corrugations 34-38 supply substantial rigidity and stiffness to the blades and to the saddle portion 31.

The saddle portions 31 of each of the two stampings 30 may be welded, brazed or otherwise secured to the tubular agitator center post 21, with each blade 22 thereof at right angles to the other blade 22. Thus, when two stampings are secured to the agitator post 21, there are four blades spaced 90° apart.

Since the agitator construction eliminates a base, there are no complications in forming the agitator 20 from simple sheet metal stampings and tubular parts; and a strong rigid sheet metal agitator may be made by the foregoing simple operations described.

The tub and agitator of the present invention are each characterized by simplicity of construction and manufacture. Thus the costs of fabricating the same are substantially reduced. Moreover, the particular cooperative relation between the agitator and tub base shapes obtains the described new results in operation.

Accordingly, the present improvements eliminate the complicated prior art tub bottom shape; eliminate the necessity for a base for an agitator; eliminate the necessity of removing the agitator from the tub after each washing operation; eliminate complications and reduce the cost of manufacturing tubs and agitators; eliminate catching, pinching, tearing, or damning of clothes between the agitator and tub; provide for increased washing efficiency, increased loads and reduced time of washing; reduce tangling or bunching of clothes when washing; and provide constructions accomplishing each of the foregoing objects and avoiding the described prior art difficulties.

In the foregoing description, certain terms have been used for brevity and understanding; but no unnecessary limitations are to be implied therefrom beyond the requirements of the prior art, because such works are utilized for descriptive purposes herein and not for the purposes of limitation and are intended to be broadly construed.

Moreover, the embodiments of the improved construction illustrated and described are by way of example and the scope of the present invention is not limited to the exact details of construction of the various parts.

Thus, various shapes of agitator blades may be used, provided that the agitator omissions a base and has the bottom edges of its blades located closely adjacent and conforming to the contour of the tub bottom. Likewise, the tub bottom shape may be varied in dimension from the exact shape shown in the drawings, so long as there is a conical central portion beneath the agitator blades and a sweeptingly curved portion joining the conical base and tub side walls extending sweepingly upwardly from approximately the outer edge of the blades.

Having now described the features of the invention, the manufacture of a preferred embodiment of the improved tub construction, the manufacture of a preferred embodiment of the improved agitator construction, an improved cooperative relation between an agitator and tub bottom, and the advantageous, new and useful results attained thereby; the new and useful devices, constructions, arrangements, combinations, subdivisions, parts and elements, and reasonable mechanical equivalents thereof, obvious to those skilled in the art, are set forth in the appended claims.

1. A washing machine agitator including a tubular center post, a plurality of saddle-shaped, sheet metal stampings, each stamping comprising two terminal blades each extending radially from the center post and a curved saddle portion connecting the blades, each stamping being formed with a bead throughout its periphery around the two blades and intervening saddle portion, and the curved saddle portion of each stamping being secured to the tubular center post.

2. A washing machine agitator including a tubular center post, a plurality of sheet metal stampings, each stamping including a blade extending radially from the center post and a curved saddle portion, the curved saddle portion of each stamping being secured to the tubular center post, and reinforcing corrugation means extending outwardly in each blade and around its curved saddle portion.

3. A washing machine agitator including a tubular center post, a plurality of saddle-shaped, sheet metal stampings, each stamping comprising two terminal blades each extending radially from the center post and a curved saddle portion connecting the blades, reinforcing corrugation means extending continuously along one blade around a connecting saddle portion and along the other blade of each stamping, and the curved corrugated saddle portion of each stamping being secured to the tubular center post.

4. A washing machine agitator including a tubular center post, a plurality of saddle-shaped, sheet metal stampings, each stamping comprising two terminal blades each extending radially from the center post and a curved saddle portion connecting the blades, each stamping being formed with a continuous peripheral bead extending entirely around the outer edge of its blades and connecting saddle portion, reinforcing corrugation means extending along one blade around a connecting saddle portion and then along the other blade of each stamping, and the curved, corrugated, beaded, and each stamping being secured to the tubular center post.

5. In a washing machine, a deep drawn, one-piece, sheet metal tub including imperforate cylindrical side walls, an integral bottom wall, the bottom wall consisting of an imperforate, upwardly projecting, truncated conical wall portion having a base diameter within the approximate range of \( \frac{1}{3} \) to \( \frac{1}{2} \) of the diameter of the tub side walls, the conical wall being angled at about 20° to 30° from the horizontal, a substantially quarter round, imperforate, curved wall portion extending immediately from the conical wall portion and joining the conical wall portion with the cylindrical side walls, the curved wall being formed on a radius approximating the radius of the conical wall base, an agitator free of a base including a center post, blades extending radially outwardly and downwardly from the center post, the diameter of the outer edges of the blades being approximately \( \frac{1}{3} \) the diameter of the tub side walls, the bottom edges of the blades being located closely adjacent and conforming in contour to the shape of the tub bottom wall, there being only an operating clearance provided between the bottom edges of the blades.
and the tub bottom wall, there being a drain opening in the tub bottom wall where the curved wall merges with the conical wall, and means for imparting rotary reciprocation to the agitator.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,720,975</td>
<td>Steelsmith</td>
<td>July 16, 1929</td>
</tr>
<tr>
<td>1,723,314</td>
<td>Szekely</td>
<td>Aug. 6, 1929</td>
</tr>
<tr>
<td>2,023,013</td>
<td>Faber</td>
<td>Dec. 3, 1935</td>
</tr>
<tr>
<td>2,053,158</td>
<td>McCabe</td>
<td>Sept. 1, 1936</td>
</tr>
<tr>
<td>2,185,821</td>
<td>Skinner</td>
<td>Jan. 2, 1940</td>
</tr>
<tr>
<td>2,212,872</td>
<td>Barker</td>
<td>Aug. 27, 1940</td>
</tr>
<tr>
<td>2,260,822</td>
<td>Berg</td>
<td>Oct. 28, 1941</td>
</tr>
<tr>
<td>2,374,155</td>
<td>Landgraf</td>
<td>Nov. 25, 1941</td>
</tr>
<tr>
<td>2,303,940</td>
<td>Kuhn</td>
<td>Dec. 1, 1942</td>
</tr>
<tr>
<td>2,405,404</td>
<td>Clark</td>
<td>Aug. 6, 1946</td>
</tr>
<tr>
<td>2,411,654</td>
<td>Gottschalk</td>
<td>Nov. 26, 1946</td>
</tr>
<tr>
<td>2,471,876</td>
<td>Kuhn</td>
<td>May 31, 1949</td>
</tr>
</tbody>
</table>