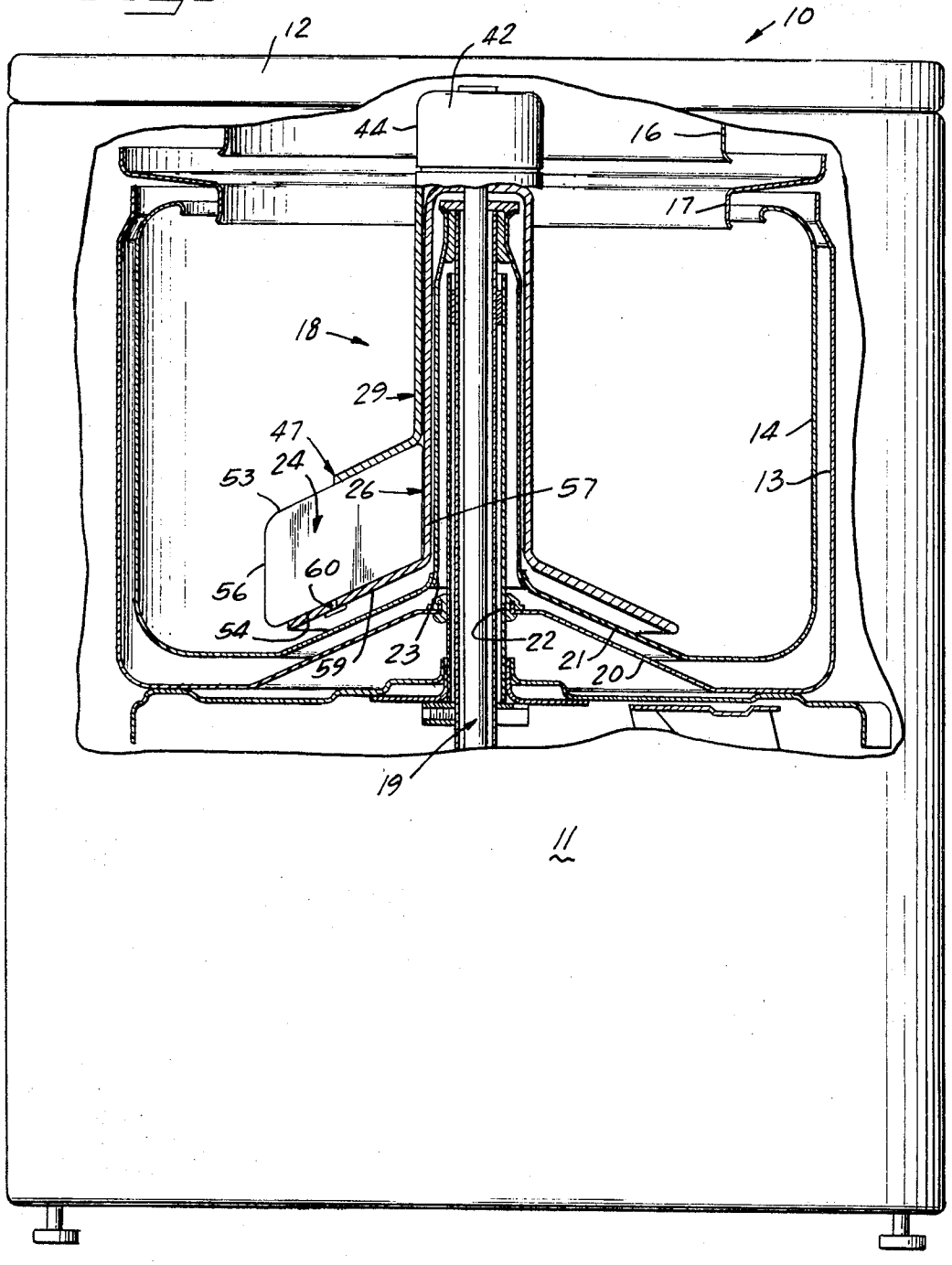
May 12, 1970 D. A. MATZEN 3,511,067

VARIABLE VANE AGITATOR WITH SELF-COMPENSATING AND RESETTING MEANS

Filed July 3, 1968 2 Sheets-Sheet 1

Fig. 1



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Filed July 3, 1968 2 Sheets-Sheet 2

Fig. 3

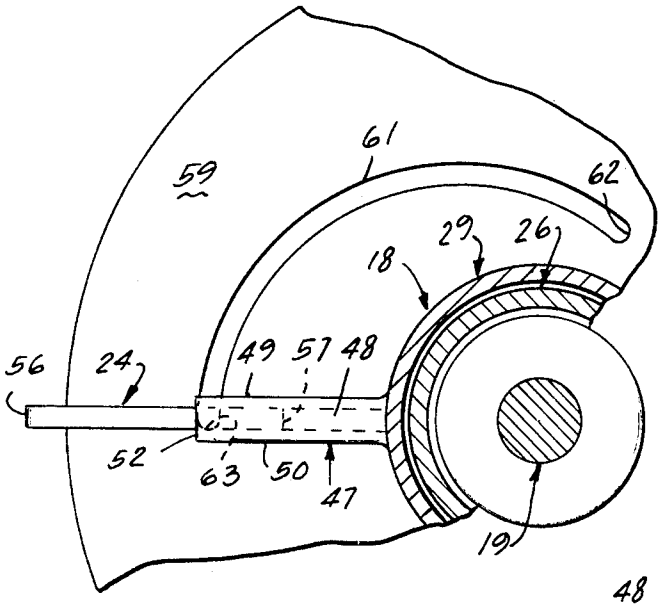
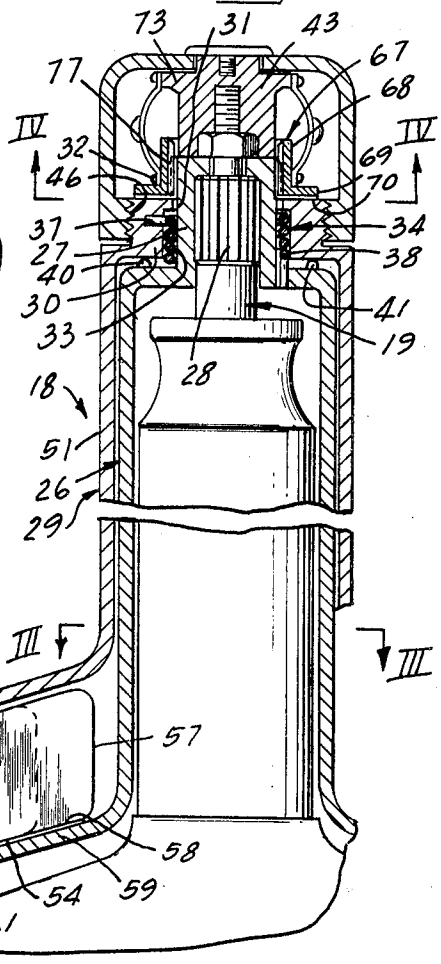


Fig. 2



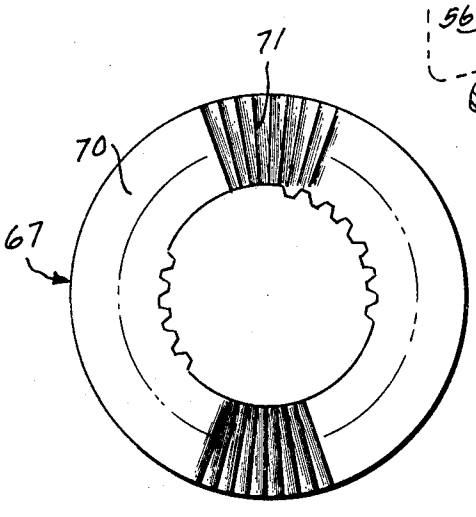


Fig. 4

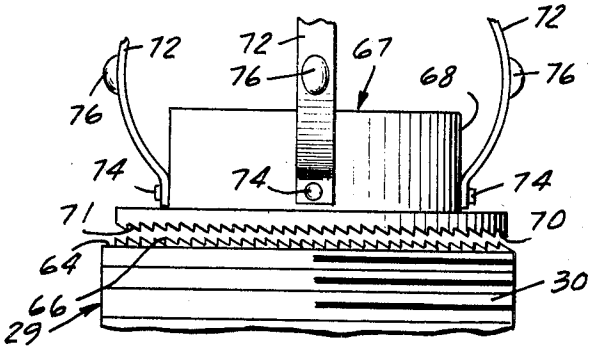


Fig. 5

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United States Patent Office 3,511,067 Patented May 12, 1970

3,511,067

VARIABLE VANE AGITATOR WITH SELF-COMPENSATING AND RESETTING MEANS

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Filed July 3, 1968, Ser. No. 742,212
Int. Cl. D06f 17/08, 17/10, 23/04
U.S. Cl. 68—23.7 14 Claims

ABSTRACT OF THE DISCLOSURE

A washing machine having an agitator assembly for agitating the laundered material therein. The agitator assembly is oscillated by a drive shaft at low speed during a wash cycle and is rotated by the drive shaft at high speed in only one direction of rotation during a spin cycle. The agitator assembly includes an agitator shell and a plurality of radially movable agitation vanes carried by the agitator shell for joint rotation and operatively connected to the drive shaft for radial movement in response to angular displacement of the drive shaft and the agitator shell from a relatively neutral position. A helical spring connects the drive shaft and the agitator shell so that during the wash cycle when the drive shaft turns in one direction of rotation the agitator shell is angularly displaced from the neutral position relative to the drive shaft by an angle which corresponds to the size of the load of laundered material and to the turn-resisting force produced thereby to which the agitator shell is subjected. During rotation of the drive shaft in the other direction of rotation the agitator shell is maintained in its displaced position by a one-way clutch mechanism providing joint rotation of the drive shaft and the agitator shell. A centrifugal-force producing weighted member mounted on the clutch mechanism disengages the clutch mechanism during the spin cycle to enable the agitator shell and the drive shaft to return to the relatively neutral position thereof.

BACKGROUND OF THE INVENTION

This invention relates generally to the field of washing machines and more particularly to washing machines of the agitator type.

Agitator type washing machines generally employ an agitator which oscillates rotatably on a vertical axis during a wash cycle and then spins in one direction and at high speed during a spin cycle. One or more adjustable agitation vanes extend radially from the agitator to increase the level of agitation of the laundry liquid and the laundered material during the wash cycle.

It is generally desirable to vary the level of agitation during the wash cycle in response to variations in the size or quantity of the load of laundered material. For example, a relatively low level of agitation is desired when the size of the wash load is low. On the other hand, as the quantity of laundered material increases the level of agitation should also increase.

It is known in the prior art to vary the level of agitation by manually adjusting the agitation vanes. This arrangement is not entirely satisfactory, however, since it not only consumes time and effort on the part of the operator but also often results in an improper adjustment of the agitation vanes due to miscalculation on the part of the operator with respect to the size or quantity of the wash load in the machine.

SUMMARY OF THE INVENTION

The present invention overcomes the disadvantages of the prior art by providing apparatus for automatically adjusting the agitation level of the washing machine to correspond with the size of the load of laundered material. Briefly, the invention comprises an agitator washing machine operable through a low speed wash cycle and a high speed spin cycle and includes an agitator assembly having an axis of rotation and including agitation vanes movable between a low and a high level agitation position, means for oscillating said agitator assembly during a wash cycle and for spinning said agitator assembly during a spin cycle, means responsive to and corresponding to the size of the load of laundered material in the machine during the wash cycle for moving the agitation vanes from said low level to a higher level agitation position, and speed-responsive means for automatically returning said agitation vanes to said low level agitation position during the high speed spin cycle.

This invention features a resilient member between the drive shaft and the agitator assembly whereby the agitator assembly lags behind or is angularly displaced from the drive shaft during the wash cycle by an angle which is proportionate to the magnitude of the turn-resisting force imposed on the agitator assembly by the laundered material. The agitation vane adjustment mechanism operates in response to this angular displacement.

During each back-and-forth cycle of oscillation the velocity of the agitator assembly is reduced to zero as it changes directions. The two "zero-velocity" positions of the agitator assembly may be conveniently referred to as the limiting positions. Since the turn-resisting force acting on the agitator assembly is sharply reduced at these limiting positions the agitation vanes would normally have a tendency to move from the low level agitation position to a high level agitation position and then back to the low level agitation position as the agitator assembly oscillates in each direction between the limiting positons thereof.

In order to prevent this continual adjustment of the agitation vanes the present invention features a one-way clutch mechanism which permits the drive shaft and the agitator assembly to rotate relative to one another as the drive shaft oscillates in one direction but couples the two together for joint rotation as the drive shaft oscillates in the opposite direction. The clutch mechanism therefore effectively maintains the angular displacement between the drive shaft and the agitator assembly after such angular displacement has once been established by virtue of the turn-resisting force of the laundered material.

In order to return the drive shaft and the agitator assembly to the relatively neutral positions thereof after the wash and spin cycles have been completed and before the next wash cycle begins the present invention features a clutch release mechanism operable in response to increased contrifugal forces produced by the increased speed of the drive shaft during the spin cycle. As a consequence of the clutch release mechanism the agitation vanes are always disposed at the low level agitation positions thereof at the beginning of each wash cycle.

In view of the foregoing it is an object of the present invention to provide, in an agitator-type washing machine, means for automatically adjusting the agitation level of the machine to correspond to the size of the load of laundered material.

Another object of the invention is to reduce the time and effort required in adjusting the agitation vanes.

Another object is to eliminate the necessity for readjusting the agitation vanes at the beginning of each wash cycle.

Many other features, advantages and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheets of drawings, in which preferred structural embodiments incorporating the principles of the present invention are shown by way of illustrative example only.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of an agitator type washing machine constructed in accordance with the principles of the present invention with portions thereof broken away and other portions shown in section to reveal the relative disposition of parts.

FIG. 2 is an enlarged fragmentary vertical sectional view of the agitator assembly of the machine shown in FIG. 1.

FIG. 3 is an enlarged fragmentary horizontal sectional view taken along lines III—III of FIG. 2.

FIG. 4 is an elevational view of one of the clutch surfaces of the one-way clutch mechanism of the invention and is taken along lines IV—IV of FIG. 2.

FIG. 5 is a fragmentary side elevational view of the one-way clutch mechanism.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, an agitator type washing machine constructed in accordance with the principles of the present invention is indicated generally at reference numeral **10**. Various components of the washing machine **10** include an outer cabinet **11** at the top of which is mounted a hinged cover **12**, and imperforate tub **13** for receiving a supply of laundry liquid, a perforate drum **14** for receiving the material to be laundered, registered openings **16** and **17** through which the laundry material is loaded into the drum, an agitator assembly **18** which is mounted for rotation on a vertical axis and a drive shaft **19** which drives the agitator assembly **18**. The drive shaft **19** is connected to a suitable driving mechanism such as an electric motor mounted in the lower portion of the cabinet **11** so that the drive shaft oscillates back and forth during a wash cycle and spins at high speed in one direction of rotation during a spin cycle. Bottom walls **20** and **21** of the tub **13** and the drum **14** slope upwardly at the central portions thereof and are provided respectively with openings **22** and **23** through which the drive shaft **19** projects up into the agitator assembly **18**.

The level of agitation produced by the agitator assembly **18** is regulated by the adjustment of a plurality of circumferentially spaced radially movable agitation vanes, one of which is indicated in the drawings at reference numeral **24**. As the vanes **24** are moved radially outwardly from the axis of rotation or oscillation of the agitator assembly **18**, the area of the effective agitation or action surface is increased to increase the level of agitation. Conversely, when the agitation vanes **24** are moved radially inwardly the level of agitation decreases.

The drive shaft **19** is part of a drive mechanism which includes an inner agitator shell **26** having a reduced diameter portion **27** at the upper end thereof which is axially bored and splined to receive a splined upper end **28** of the drive shaft **19**. The inner agitator shell **26** is, therefore, connected to the drive shaft **19** for joint oscillation and rotation.

The agitator assembly **18** includes an outer agitator shell **29** having a reduced diameter portion **30** at the upper end thereof which is centrally bored as at **31** to receive the upper end portion **27** of the inner agitator shell **26**.

An outer cyclindrical wall **32** of the inner agitator shell end portion **27** as well as an inner cylindrical wall **33** of the outer agitator shell end portion **30** are smooth and spaced radially from one another to provide a chamber therebetween in which is disposed a helical spring **34**. An upper end **36** of the spring **34** projects radially into an aperture **37** formed in the outer agitator shell **29** and a bottom end **38** projects into an aperture **39** formed in the inner agitator shell **26** for joint rotation therewith. An annular bead **40** is formed on the top surface of a radial wall **41** of the inner agitator shell **26** for supporting

and for providing a bearing surface for the outer agitator shell **29** as it rotates relative to the inner agitator shell **26**.

An agitator cap **42** is mounted on a cylindrical member **43** which inturn is connected for joint rotation with the drive shaft **19**. A side wall **44** of the cap **42** comprises an inner cylindrical wall **46** which is threaded to the reduced diameter portion **30** of the outer agitator shell **29**.

The agitation vane **24** is disposed within a vane guide **47** which comprises a top wall **48** and a pair of spaced parallel vertical side walls **49** and **50**. The vane guide **47** is formed on and projects radially outwardly of a body portion **51** of the outer agitator shell **29** and a distal end **52** thereof is open so that the vane **24** is movable within the confines of the side walls **49** and **50** from a radially inner or low level agitation position shown in the solid lines in FIG. 2 to a radially outer or high level agitation position as shown in the dashed lines in FIG. 2.

The agitation vane **24** comprises spaced parallel top and bottom walls **53** and **54** and spaced parallel end walls **56** and **57**. The bottom wall **54** is supported in sliding engagement on a top wall **58** of a skirt **59** extending radially outwardly from the bottom end of the inner agitator shell **26**. A pin or cam follower member **60** projects downwardly from the bottom wall **54** and is received in a curved slot **61** formed in the skirt **59**, the side walls of the slot **61** providing cam surfaces for the pin **60**.

Preferably a plurality of agitation vanes **24** and vane guides **47** are spaced equally about the circumference of the outer agitator shell **29**. The slots **61** each extend from an inner end **62** to an outer end **63** disposed not only in circumferentially spaced but also radially outwardly spaced relation to the inner end **62**. It will be apparent from FIG. 3 that as the inner and outer agitator shells **26** and **29** are rotated with respect to one another the agitation vanes **24** rotate with the outer agitator shell **29** and also move radially outwardly to a high level agitation position as shown in the dashed lines at reference numeral **24**.

In operation the inner agitator shell **26**, which is directly coupled to and driven jointly with the drive shaft **19**, drives the outer agitator shell **29** through the helical spring **34**. As the drive shaft **19** begins turning in one direction of rotation during a wash cycle the inner agitator shell **26**, of course, turns with it. However the load of laundry material within the drum **14** imposes a counterforce or a turn-resisting force on the outer agitator shell **29** proportionate to the quantity of laundry material within the drum **14**.

Since the outer agitator shell **29** is subjected to a torque acting against the torque being applied by the inner agitator shell **26**, the outer agitator shell **29** does not immediately rotate jointly with the inner agitator shell **26** but instead lags behind the inner agitator shell **26**, thus producing a winding force on the spring **34** until the torsional force applied to the outer agitator shell **29** by the spring **34** exceeds the turn-resisting force to which the outer agitator shell **29** is subjected by virtue of the washing load in the drum **14**.

As the inner and outer agitator shells **26** and **29** rotate relative to one another, however, the agitation vanes **24** are moved radially outwardly a distance which corresponds to the angle of relative rotation between the inner and outer agitator shells **26** and **29** which, in turn, depends upon the magnitude of the turn-resisting force being applied to the outer agitator shell **29** by the laundry material. Thus as the quantity of laundry material within the drum **14** is increased the angle of lag or relative rotation between the inner and outer agitator shells **26** and **29** increases proportionately. As a consequence the level of agitation, which varies as a function of the position of the agitation vanes **24**, corresponds proportionately to the size of the load of laundry material in the drum **14**.

As the drive shaft **19** oscillates and approaches a limiting position of oscillation or a position at which the direction of rotation is reversed, the turn-resisting force

acting on the outer agitator shell **29** is substantially reduced and the tendency of the spring **34** is to cause the outer agitator shell **29** to rotate relative to the inner agitator shell **26** to bring the two shells back from a relatively rotationally displaced position to the relatively neutral position which they assumed initially or at rest. If this were to occur, of course, the agitation vanes **24** would be extended to the proper high level agitation position only when the drive shaft **19** rotated in one direction of rotation during each cycle of oscillation, since when the drive shaft is rotated in the opposite direction the outer agitator shell **29** would lag behind the inner agitator shell **26** in a manner causing the agitation vanes **24** to be moved to their radially innermost positions.

In order to maintain the agitation vanes **24** in an extended or high level agitation position commensurate with the quantity of wash load in the washing machine means are provided for rotating the outer agitator shell **29** jointly with the inner agitator shell **26** in one direction of rotation as the agitator assembly **18** oscillates back and forth during the wash cycle. As shown in the drawings, the outer agitator shell **29** comprises a radial top wall **64** which has formed thereon a series of radially extending circumferentially continuous clutch teeth **66**. Disposed above the radial wall **64** is a clutch member **67** comprising a tubular body portion **68** and an outturned shoulder **69**. A bottom wall **70** of the clutch member **67** has formed thereon a complementarily arranged series of clutch teeth **71** disposed in face-to-face relation with the clutch teeth **66**.

The tubular body portion **68** is arranged in circumferentially surrounding relation to the cylinder wall **32** of the inner agitator shell **26** and is splined thereto as indicated at reference numeral **77** so that the clutch member **67** rotates jointly with the inner agitator shell **26** but is movable axially with respect thereto.

The clutch member **67** is normally biased into abutting engagement with the radial wall **64** of the outer agitator shell **29**. The clutch teeth **66** and **71** are arranged so that when the drive shaft **19** and the inner agitator shell **26** are oscillated in one direction of rotation the outer agitator shell **29** can lag behind the inner agitator shell **26** by an angle corresponding to the size of the wash load.

To illustrate, assume in the embodiment shown in FIG. 5 that the clutch member **67** which rotates jointly with the inner agitator shell **26** and the drive shaft **19**, is rotated in a clockwise direction as this would appear from above FIG. 5. It is apparent that the clutch teeth **71** would merely slide across the clutch teeth **66**. As the direction of rotation of the clutch member **67** is reversed, however, the clutch teeth **71** would meshingly engage with the clutch teeth **66** to rotate the outer agitator shell **29** jointly with the inner agitator shell **26**.

In the embodiment illustrated the biasing force acting on the clutch member **67** is provided by a plurality of circumferentially spaced generally axially extending leaf springs indicated at reference numeral **72**. Each of the springs **72** is connected in fixed assembly at opposite ends to the tubular portion **68** of the clutch member **67** and to a flange **73** of the cylindrical member **43**. The fastening connection may be provided by any suitable fastening means such as, for example, rivets or the like as indicated at reference numeral **74**. After the wash cycle has been completed the washing machine **10** operates through a spin cycle during which the drive shaft **19** rotates at a higher speed in a single direction of rotation. It is desirable for the inner and outer agitator shells **26** and **29** to assume a relatively aligned or neutral position with respect to one another so that at the commencement of the next wash cycle the shells will be adjusted to an angle of displacement and the agitation vanes **24** will be extended to a higher level agitation position corresponding to the quantity of laundry material which has been loaded into the washing machine for the next wash cycle.

In order to begin each wash cycle with the inner and outer agitator shells **26** and **29** in a relatively neutral position a plurality of weighted members indicated at reference numeral **76** are mounted on the leaf springs **72** and, by virtue of the centrifugal force provided thereby at the high speed of rotation during a spin cycle, cause the leaf springs **72** to bend outwardly and contact axially to force the clutch member **67** axially upwardly and move the clutch teeth **66** and **71** out of gripping engagement with one another. As the speed of the drive shaft **19** is reduced at the end of the spin cycle the inner and outer agitator shells **26** and **29** are biased into a neutral relative position by reason of the biasing effect of the helical spring **34** and consequently as the two shells come to rest and the clutch member **67** is again biased axially into engagement with the outer agitator shell **29** the two agitator shells **26** and **29** again assume the neutral position thereof. Thus the relatively angularly displaced position which the shells will assume upon commencement of the next wash cycle will be determined only by the size of the wash load being laundered during such subsequent wash cycle.

Although minor modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably come within the scope of my contribution to the art.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A washing machine operable through successive wash and spin cycles comprising:
- a drive shaft having an axis of rotation,
- a rotatable agitator assembly including adjustable agitation vane means movable between low and high level agitation positions,
- means for oscillating said drive shaft at a given speed during the wash cycle and for rotating the drive shaft in one direction and at a higher speed during the spin cycle,
- coupling means drivingly interconnecting said drive shaft and said agitator assembly for oscillating said agitator assembly during a wash cycle and for spinning said agitator assembly during the spin cycle,
  - said coupling means further comprising means responsive to the turn-resisting force to which the agitator assembly is subjected during the wash cycle for moving said agitator vane means from said low level agitation position to a higher level agitation position corresponding to the size of the wash load in the machine and being further responsive to the speed of rotation of the agitator assembly during the spin cycle to return the agitation vane means to said low level agitation position.

2. The washing machine as defined in claim **1** wherein said coupling means includes a resilient member between said drive shaft and said agitator assembly to enable said agitator assembly to lag behind said drive shaft during the wash cycle by an angle which corresponds to the magnitude of said load-imposed turn-resisting force.

3. The washing machine as defined in claim **1** wherein said agitator vane means comprises an agitation vane movable radially with respect to the axis of rotation of said agitator assembly.

4. The washing machine as defined in claim **1** wherein said speed responsive means comprises a one-way clutch mechanism having a pair of clutch members and means for engaging the clutch members at wash cycle speed and for disengaging the clutch members at spin cycle speed.

5. The washing machine as defined in claim **4** wherein said clutch engaging and disengaging means comprises biasing means for biasing said clutch members together during the slo wspeed wash cycle and means including weighted members arranged for joint rotation with said

drive shaft for overcoming the force of said biasing means and for separating the clutch members during the high speed spin cycle.

6. In a washing machine operable through a low speed wash cycle and a righ speed spin cycle, the improvement of

means for automatically adjusting the agitation level of the machine during the wash cycle to correspond to the size of the load of laundry material in the machine comprising,

an agitator assembly having adjustable agitation vane means,

drive means including a rotatable drive shaft and means for oscillating said drive shaft during the wash cycle and for spinning the drive shaft in one direction of rotation during the spin cycle, coupling means between said agitator assembly and said drive shaft including means responsive to the magnitude of the torque to which the agitator assembly is subjected during the wash cycle by virtue of the size of the load of laundry material in the machine for adjusting said agitation vane means from a low level agitation position to a higher level agitation position corresponding to the magnitude of said load-imposed torque,

said coupling means further including means responsive to the higher speed of the spin cycle for returning said agitation vanes to said low level agitation position.

7. The washing machine as defined in claim **6** wherein said coupling means comprises,

a resilient member between said drive shaft and said agitator assembly enabling said agitator assembly to lag behind said drive shaft during the wash cycle by an angle corresponding to the magnitude of said load-imposed torque, and

means responsive to the angle of lag between said drive shaft and said agitator assembly for adjusting said agitation vane means.

8. The washing machine as defined in claim **6** wherein said coupling means comprises,

resilient means interconnecting said drive shaft and said agitator assembly so that said agitator assembly lags behind said drive shaft during the wash cycle as the drive shaft is oscillated in one direction of rotation by an angle corresponding to the magnitude of the load-imposed torque acting on said agitator assembly,

means responsive to the magnitude of the angle by which said agitator assembly lags behind said drive shaft for adjusting said agitation vane means accordingly, and

means for locking said drive shaft and said agitator assembly together for joint rotation as said drive shaft is oscillated in an opposite direction of rotation.

9. An agitator type washing machine operable through a low speed wash cycle and a high speed spin cycle comprising,

an agitator assembly having an axis of rotation and including agitation vanes movable between low and high level agitation positions,

means for oscillating said agitator assembly during the wash cycle and for spinning said agitator assembly during the spin cycle,

means responsive to the size of the load of laundry material in the machine for moving the agitation

vanes from said low level agitation position to a higher level agitation position corresponding to the size of the load of laundry material during the wash cycle and for maintaining said agitation vanes at said higher level agitation position during the wash cycle, and

means for automatically returning said agitation vanes to said low level agitation position upon completion of said spin cycle.

10. A washing machine operable through a low speed wash cycle and a high speed spin cycle comprising,

a rotatable drive shaft mechanism, means for oscillating said drive shaft during the wash cycle and for spinning said drive shaft in one direction of rotation during the spin cycle,

a rotatable agitator assembly including an agitator shell and agitation vanes carried for rotation by said agitator shell and operatively connected to said drive shaft mechanism for radial movement in response to relative rotation between said agitator shell and said drive shaft mechanism,

a resilient lost-motion coupling member between said drive shaft mechanism and said agitator shell, one-way clutch means between said drive shaft and said agitator shell for joint rotation thereof in one direction of rotation during the wash cycle, and

speed-responsive means for disengaging said one-way clutch means during the spin cycle.

11. The washing machine as defined in claim **10** wherein said resilient lost-motion coupling comprises a helical spring having one end affixed to the drive shaft mechanism and the other end affixed to the agitator shell.

12. The washing machine as defined in claim **10** wherein said one-way clutch means comprises,

means forming a first radial wall on said agitator shell having one-way clutch teeth formed thereon,

means including a clutch member having a complementarily toothed second radial wall formed thereon and connected to said drive shaft mechanism for joint rotation therewith and for axial movement relative thereto for moving said radial walls into and out of engagement with one another, and biasing means for biasing said radial walls axially into engagement with one another.

13. The washing machine as defined in claim **12** wherein said biasing means comprises a plurality of axially extending circumferentially spaced leaf springs.

14. The washing machine as defined in claim **13** and including,

weighted members mounted on said springs for disengaging said radial walls in response to the high speed of the drive shaft mechanism during the spin cycle.

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WILLIAM I. PRICE, Primary Examiner

U.S. Cl. X.R.

68—133, 134

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,511,057 Dated May 12, 1970

Inventor(s) BRUNO SUTER

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 4, "Hubertushone" should be --Bensberg bei Koln--column 1, line 7, insert --Claims priority, application Germany, Oct. 13, 1967, P 16 58 631.5--

Column 4, line 75, "furtherest" should be -- furthest --;

Column 6, line 2, "suppport"(2nd occurrence) should be -- support --; line 14, "assemblying" should be -- assembling --.

SIGNED AND
SEALED
SEP 15 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents