April 19, 1960 C. A. STICKEL 2,932,962

WASHING MACHINE

Filed June 12, 1957 2 Sheets-Sheet 1

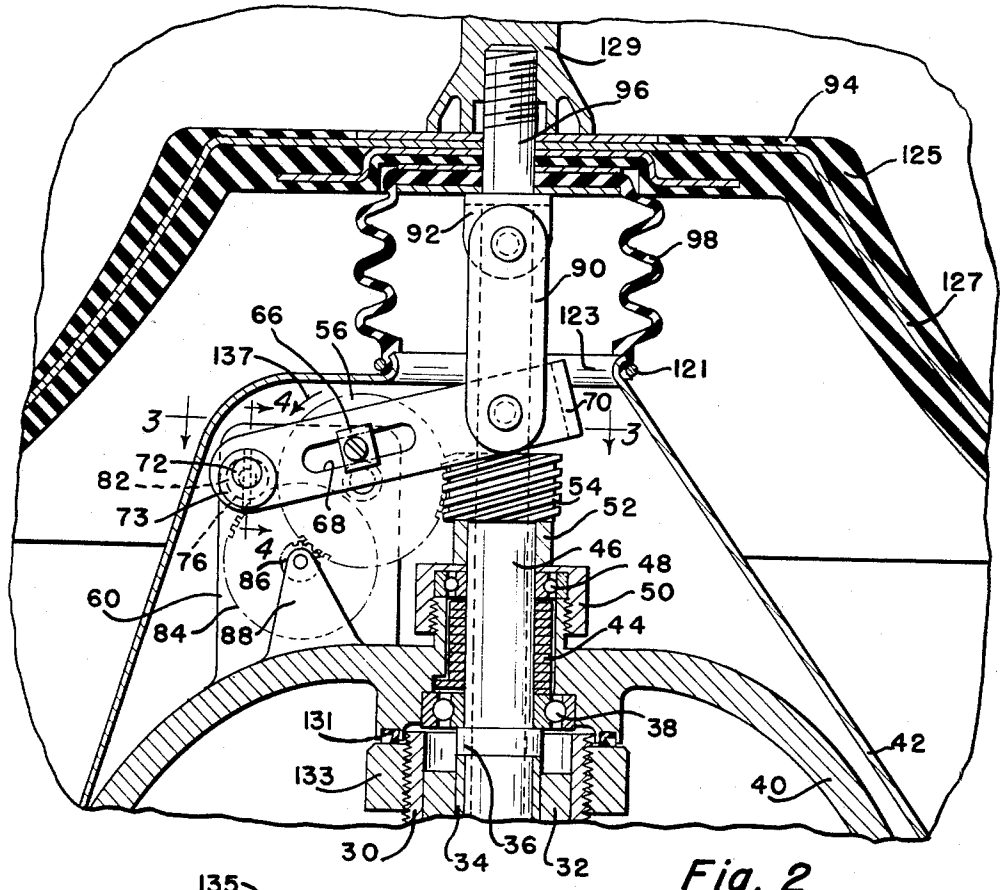


Fig. 2

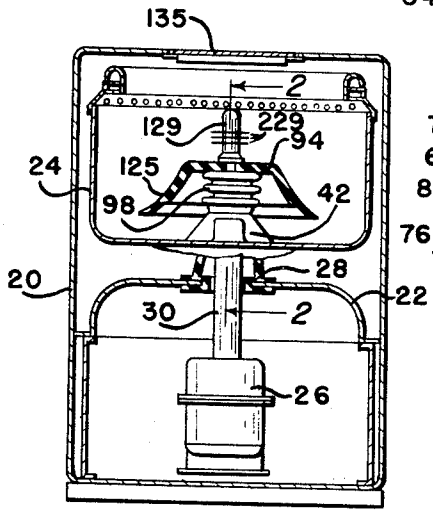


Fig. 1

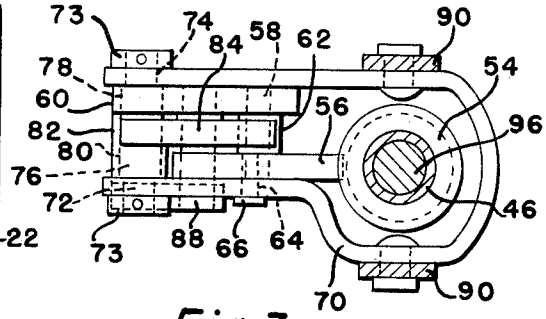


Fig. 3

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WASHING MACHINE

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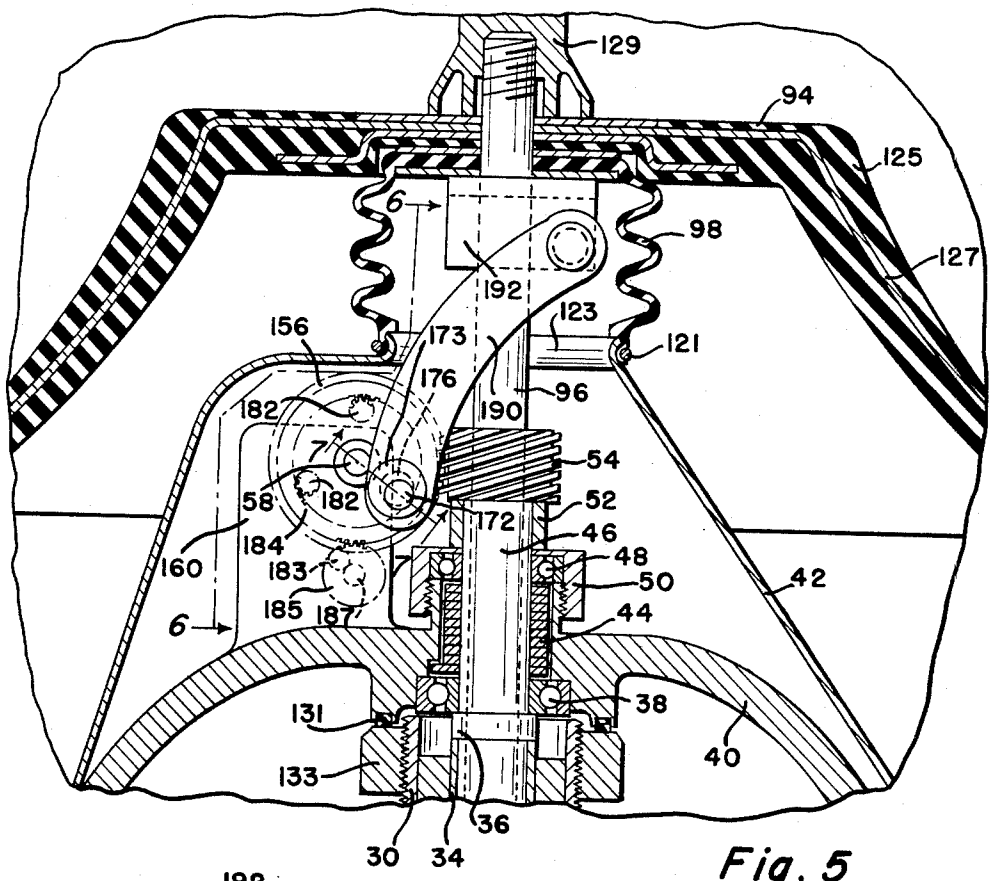


Fig. 5

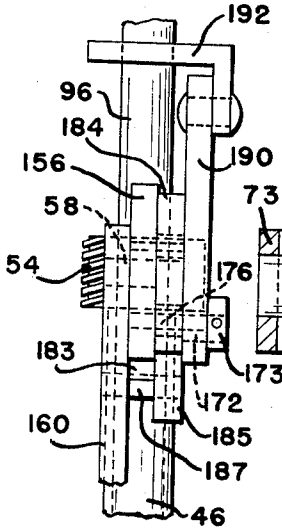


Fig. 6

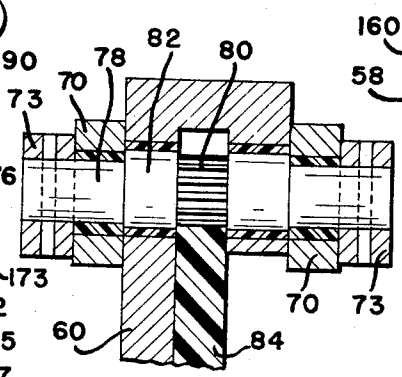


Fig. 4

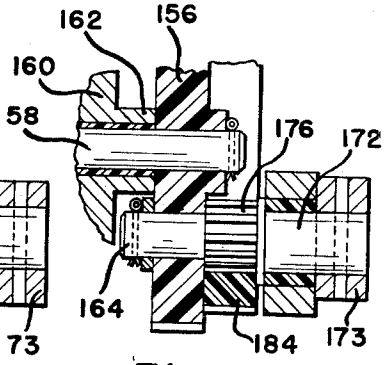


Fig. 7

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United States Patent Office 2,932,962 Patented Apr. 19, 1960



2,932,962

# WASHING MACHINE

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Application June 12, 1957, Serial No. 665,208

7 Claims. (Cl. 68—131)

This invention relates to a domestic appliance and more particularly to clothes washing machines.

Clothes washing by supersonic vibrations has demonstrated that the clothes in the liquid in the tub must be circulated through the area nearest the source of the vibrations to obtain uniform and complete washing.

It is an object of this invention to provide a single agitating means for imparting both the circulation of the liquid and clothes as well as the supersonic vibrations to the liquid.

It is another object of this invention to provide an agitator with a simple operating mechanism which will simultaneously impart to it reversing movements of low frequency and large amplitude and supersonic vibrations of small amplitude.

It is still another object of the invention to provide a vertically reciprocating agitator with a quick downward movement and a slower upward movement.

These and other objects are attained in the form shown in the drawings in which the tub containing the liquid and clothes is rotatably mounted upon a reversible vertical drive shaft. A wound spring clutch connects the drive shaft to the tub in one direction of rotation. In the opposite direction the tub will remain substantially stationary and the drive shaft rotates relative to the tub. Above the tub bearing and clutch, the drive shaft is provided with a worm driving a helical gear rotating upon a horizontal axis.

In one form, the gear operates a pivoted sliding block lever linked to a vertically reciprocating agitator in the tub to provide a quick downward movement and a slower upward movement. At the same time, through step-up gearing, the pivot for the lever is eccentrically rotated at a high speed to supersonically vibrate the lever, the link and the agitator simultaneously with its reciprocation. In the second form, the sliding block lever is eliminated and the helical gear is provided with a ring gear system rotating an eccentric bearing thereon at a high speed. The vertically reciprocating agitator is linked to this eccentric bearing so that the agitator is supersonically vibrated as it is reciprocated. The helical gear is offset from the axis of reciprocation to provide a quicker downstroke than up-stroke of the agitator.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Figure 1 is a vertical sectional view, partly diagrammatic, of one form of clothes washing machine embodying my invention;

Figure 2 is an enlarged fragmentary sectional view of a portion of the agitator and one form of its agitating mechanism;

Figure 3 is a fragmentary sectional view taken substantially along the line 3—3 of Figure 2;



Figure 4 is a fragmentary vertical sectional view taken along the line 4—4 of Figure 2;

Figure 5 is a fragmentary vertical sectional view, partly diagrammatic, of the agitator and the second form of agitating mechanism;

Figure 6 is a fragmentary irregular vertical sectional view taken substantially along the line 6—6 of Figure 5; and

Figure 7 is a fragmentary sectional view taken along the line 7—7 of Figure 5.

Referring now more particularly to Fig. 1, there is shown a washing machine including a cabinet 20 provided with a transverse bulkhead 22 separating the upper compartment containing a centrifuging tub 24 and a lower portion containing a driving motor 26. The bulkhead 22 is provided with a central aperture therein which is lined with the lower portion of a truncated cone-type of resilient support 28. This support 28 fastens at its upper end to the upper end of an upright sleeve 30 connected at its lower end to the motor 26 and connected at its upper end to the tub 24. As shown in Fig. 2, the sleeve 30 is provided with bearings 32 which support a hollow reversible drive shaft 34 which extends down through the sleeve 30 to connect with the reversible driving motor 26.

This drive shaft 34 carries a shoulder 36 provided as a part of a reduced upper section upon which rests the ball bearing 38. The ball bearing 38 supports a casting 40 which connects to the sheet metal portion 42 forming the remainder of the tub 24. Directly above the bearing 38 is a wound spring clutch 44 wrapped around the upper portion 46 of the shaft 34 within the hub of the casting 40 to connect the shaft 34 to the casting 40 of the tub 24 in one direction of rotation and to disconnect the shaft 34 from the tub 24 in the opposite direction of rotation. The hub of the casting 40 is provided with an upper ball bearing 48 held in place by the threaded cap 50.

The motor 26 drives the shaft 34 at least in one direction of rotation at the speed such as 900 to 1,150 r.p.m. at which it is desired to spin the tub 24 for centrifuging. The motor 26 may drive the shaft 34 in the opposite direction at the same or a different speed of rotation. In this opposite direction of rotation, the shaft 34 will be disconnected by the wound spring clutch 44 from the tub 24 so that it will turn relative to the tub 24.

Above the cap 50 is a spacer 52 surrounding the shaft. Above the spacer 52 is a multiple threaded worm 54 which is in threaded engagement with a helical gear 56. This helical gear 56 is fixed to a shaft 58 rotatably mounted in the bearing support 60 which is provided with a boss 62 for assisting in the rotatable support of the shaft 58. The gear 56 is preferably made of polyamide resin such as nylon and all the other either alternate gears or all the gears may be made of the same material to minimize lubricating requirements. The bearings may be of the oilless or prelubricated type, also to minimize lubricating requirements. The ratio between the worm 54 and the gear 56 may be selected to provide the desired rate of reciprocation of the agitator. The gear 56 is provided with a bearing boss 64 eccentrically located, which has a bearing within the slide block 66 which slides within the slot 68 in the irregular lever 70. If desired, a roller may be substituted for the slide block 66. The lever 70 extends around the worm 54 and is provided with nylon sleeve bearings on each side at the opposite ends upon the synchronized eccentrics 72 and 74 provided upon the opposite ends of a pinion shaft 76. These eccentrics 72 and 74 are 1/16" off-center, providing a total throw of 1/8". Beyond the eccentrics 72 and 74 are the counterweights 73 pinned to the ends of the eccentrics for counterbalancing the eccentrically movable masses. The bearing support 60 is provided with bearings 78 and

80 for the pinion shaft 76. In between the bearings 78 and 80, the pinion shaft 76 is provided with a pinion 82 meshing with a large gear 84 fixed to a pinion 86 meshing with the helical gear 56. The gear 84 and the pinion 76 are rotatably mounted upon the support 88. The gear 56 is about five times the diameter of the pinion 86 and the gear 84 is about four times the diameter of the pinion 82, so that the eccentrics 72 and 74 are revolved eccentrically at a rate about twenty times the rate of rotation of the gear 56. For example, if the gear 56 rotates at 200 r.p.m. the eccentrics 72 and 74 will be revolved at 4,000 r.p.m.

The lever 70 is linked on opposite sides by the links 90 to a connector 92 upon the bottom of the bell-shaped agitator 94. The agitator 94 is fastened to the upper portion of a vertically reciprocating rod 96 which is slidably mounted without any keys or splines within the upper portion 46 of the shaft 34 so that the upper portion 46 may rotate relative to the rod 96 and the tub 24. The agitator 94 is connected to the closed upper end of a flexible bellows 98 of synthetic rubber. The lower end of the bellows 98 is fastened by a wire clamp 121 to the curled upper inner rim 123 of the sheet metal portion 42 of the tub 24. The agitator 94 is preferably of molded synthetic rubber 125 containing sheet metal reinforcements 127 which stop short of the periphery of the agitator. The agitator is provided with an upper cylindrical portion 129 which is threaded to the top of the shaft 96 in a manner to fasten the agitator 94 to the shaft 96 with the connector 92 serving as a stopping shoulder. The upper cylindrical portion is provided with a plurality of wide rings 229 to transmit the vibrations to the upper zone. The space between the casting 40 and the sheet metal portion 42 of the tub 24 may be permanently filled with a lubricant. The hub of the casting 40 may be provided with a seal 131 engaging a collar 133 threaded onto the sleeve 30 to retain the lubricant. If desired, there may be provided some form of brake between the sleeve 30 and the casting 40 to completely prevent rotation of the tub when the drive shaft 34 is disconnected by the clutch 44 from the tub 24. This, however, is not essential since the slight friction between the seal 131 and the collar 133 will minimize rotation of the tub 24.

In operation, the tub 24 may be filled automatically with water or other washing liquid and detergent, preferably after the clothes are inserted through the lid 135 in the top of the washing machine. The motor 26 is then started in such a direction as to cause the wound spring 44 to disconnect the drive shaft 34 from the tub 24. The worm 54 drives the gear 56 in the direction indicated by the arrow 137 so that a quicker down-stroke of the agitator is provided when the slide block 66 is revolved in a counter-clockwise direction, as viewed in Fig. 2, to quickly pull the lever 70, the links 90 and the agitator 94 downwardly.

This will cause a downward circulation of the liquid and clothes adjacent the bell-shaped agitator 94 in the central portion of the tub 24 and causes the liquid to flow outwardly across the bottom of the tub, upwardly along the sides, inwardly across the upper portion and back to the central portion. This slow reciprocation at a rate of about 200 cycles per minute and an amplitude of about 1½" takes place, accompanied by the revolving of the eccentrics 72 and 74 at a rate of about 4,000 r.p.m. These eccentrics 72 and 74 cause the lever 70 to be given a small amplitude vibration about the pivot pin 64 as it revolves with the gear 56 to cause a vibration of the agitator 94 also through the links 90 at a rate of about 4,000 vibrations per minute. The bell-shaped agitator 94 as well as the rings upon the portion 129 impart supersonic vibrations to the liquid in the central zone of the tub as the circulation of the liquid and clothes is imparted by the agitator. The clothes are subjected to this supersonic vibration in the liquid as they pass the agitator, thus quickly washing the clothes.



This method of circulation keeps the clothes uniformly distributed within the liquid and the supersonic vibration causes the washing of the clothes in such a short time that tangling is minimized. After washing is completed, the motor 26 is reversed to cause the clutch 44 to connect the drive shaft 34 to the tub 24. At the same time the brake is released, if one is provided. The agitator and the agitating mechanism rotate with the tub at centrifuging speeds to cause the washing liquid to be centrifuged through apertures in the upper rim of the tub. The centrifuged liquid is collected by the bulkhead 22 in the cabinet 20 and conducted to a drain. One or more rinse-fills followed by agitating and centrifuging periods similar to that just described, may follow.

In the form shown in Figs. 5–7 the parts are the same with the exception of the agitating mechanism and its connection to the agitator 94. In Figs. 5–7 the worm 54 drives the helical gear 156. This helical gear is supported by the bearing support 160 provided with a boss 162 for rotatably supporting the shaft 58 to which the helical gear 156 is fixed. In this form, the helical gear is provided with an eccentrically located rotatable shaft 164 carrying on the same or opposite sides thereof a pinion 176 and an eccentric 172. The pinion 176 is rotated by a ring gear 184 having teeth on both the inside and the outside. This ring gear 184 is also supported by two other inner idler pinions 182 rotatably mounted on the helical gear 156. This ring gear is driven in the direction opposite the rotation of the gear 156 by the gear 185 which is driven from the periphery of the gear 156 through an idler pinion 183 and a pinion 187 fixed to the gear 185. The gear 156 is about six times the diameter of the pinion 187 and the gear 185 is about two and one-half times the diameter of the pinion 176. The rotation of the ring gear 184 in the opposite direction to the gear 156 adds one to this effective multiplication. This causes the eccentric 172 to be revolved at more than twenty times the rate of rotation of the gear 156. The eccentric 172 is connected by the curved link 190 to the connector 192 which is fixed to the agitator shaft 96. If desired, the bearings may be provided with nylon sleeves. The eccentric 172 has pinned onto its end a counterweight 173 for counterbalancing the eccentrically movable masses to minimize vibration. The washer, in general, in the form shown in Figs. 5–7 operates in substantially the same manner as the first form. The gear 156 rotates in a counter-clockwise direction, as viewed in Fig. 5. Because of its offset position relative to the shaft 96, the agitator 94 will be pulled downwardly more quickly than its upward movement. This form has advantages similar to the advantages of the first form.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. A washing machine including a tub, an agitator within the tub, a driving means, a rotatable means driven at a relatively low speed by said driving means, said rotatable means having a crank connection, an operating means for operating said agitator, and a small amplitude high frequency vibration creating means connecting said crank connection and said operating means for imparting a large amplitude low frequency alternating movement combined with a small amplitude high frequency vibration to said agitator.

2. A washing machine including a tub, a vertically reciprocable agitator within the tub, a driving means, a rotatable means having a horizontal axis of rotation driven at a relatively low speed by said driving means, said rotatable means having a crank connection, an operating link connected to said agitator, and a small amplitude high frequency vibration creating means connecting said crank connection and said link for imparting a

large amplitude low frequency alternating movement combined with a small amplitude high frequency vibration to said agitator.

3. A washing machine including a tub, a vertically reciprocable agitator within the tub, a driving means, a rotatable means having a horizontal axis of rotation driven at a relatively low speed by said driving means, an operating link connected to said agitator, a pivoted slide member provided with a slideway and a sliding block within the slideway, said rotatable means having a crank connection with said sliding block, and a pivotal connection pivotally connecting said slide member and said link.

4. A washing machine including a tub, a vertically reciprocable agitator within the tub, a driving means, a rotatable means having a horizontal axis of rotation driven at a relatively low speed by said driving means, an operating link connected to said agitator, a pivoted slide member provided with a slideway and a sliding block within the slideway, said rotatable means having a crank connection with said sliding block, and a pivotal connection pivotally connecting said slide member and said link, a pinion provided with an eccentric forming a pivot for said pivoted slide member, and means for driving said pinion at a much higher speed than said rotatable means for vibrating said pivoted member and said agitator.

5. A washing machine including a tub adapted to contain a washing liquid and material to be washed, a single agitator within the tub, said agitator having an upright axis fixed relative to said tub, power driven means connected to said agitator for imparting concurrently in the same type of movement a large amplitude low frequency alternating movement to said agitator relative to said axis combined with a small amplitude high frequency vibration to said agitator both in the same relation to said axis, said power driven means including means for imparting a large amplitude low frequency alternating movement to said agitator upon its axis and means acting between said last means and said agitator for superimposing upon said alternating movement a small amplitude high frequency vibration in the same relation to the axis of said agitator as said large amplitude movement to provide high frequency vibration while the washing liquid and the clothes are circulated.



6. A washing machine including a tub, a single agitator mounted for up and down movement within the tub, a rotary driving motor, a combined large amplitude low frequency and small amplitude high frequency motion converting means connecting said motor and said single agitator having means for converting the rotating force and power of said motor into a superimposed large amplitude low frequency up and down reciprocating movement and small amplitude high frequency up and down reciprocating vibration of said single agitator.

7. A washing machine including an upright tub, a single agitator within the tub, said agitator having liquid impelling surfaces and an upright axis fixed relative to said tub, power driven means connected to said agitator for imparting concurrently in the same type of movement a large amplitude low frequency alternating movement to said agitator transverse to its liquid impelling surfaces combined with a small amplitude high frequency vibration to said agitator also transverse to its liquid impelling surfaces, said power driven means including means for imparting a large amplitude low frequency alternating movement to said agitator transverse to its liquid impelling surfaces and means acting between said last named means and said agitator for superimposing upon said alternating movement a small amplitude high frequency vibration also transverse to its liquid impelling surfaces in the same relation relative to said axis as said low frequency alternating movement.


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