

May 8, 1945.

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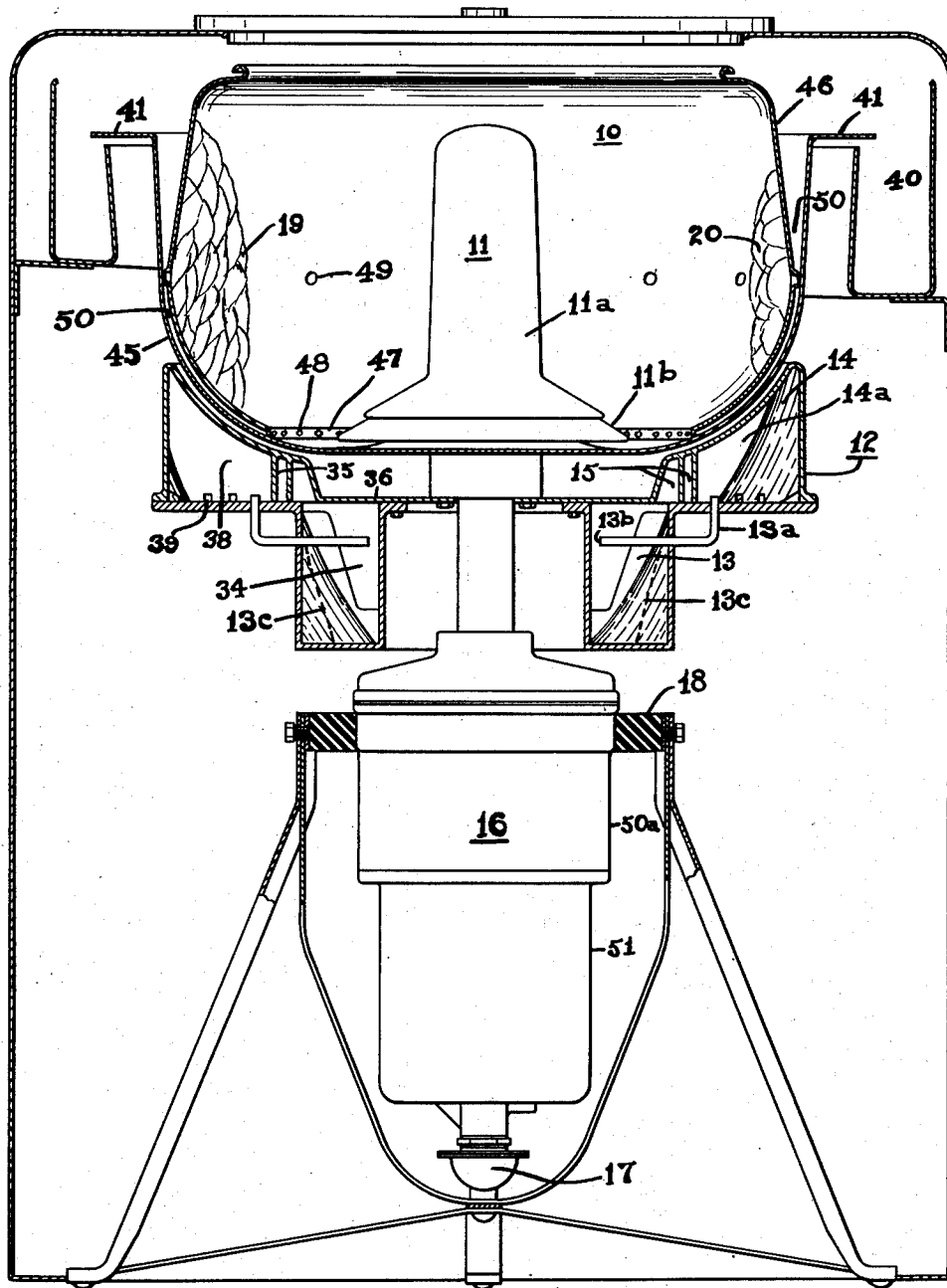
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DOMESTIC APPLIANCE

Filed June 29, 1940

6 Sheets-Sheet 1

Fig. 1.



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DOMESTIC APPLIANCE

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Fig. 2.

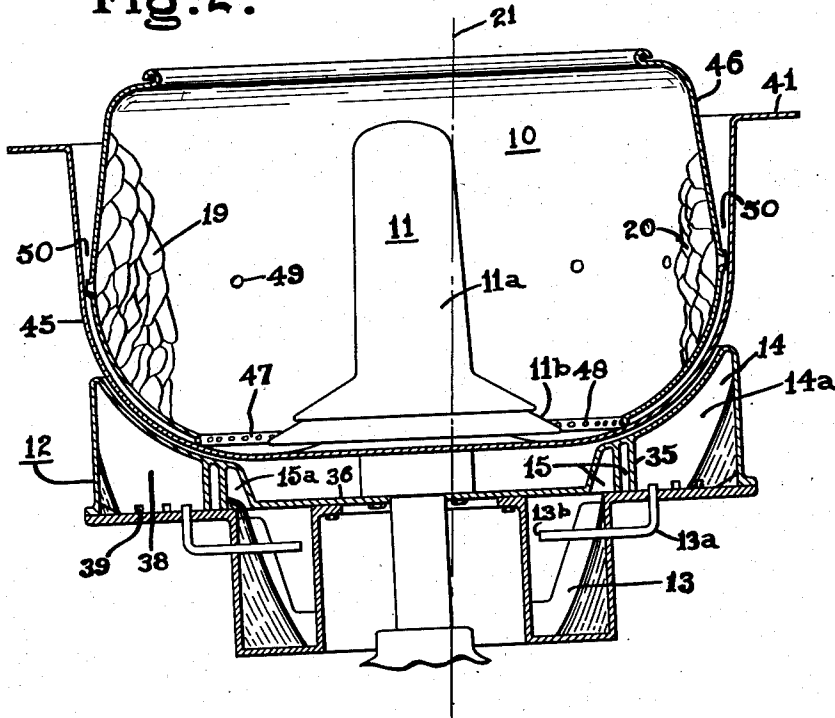
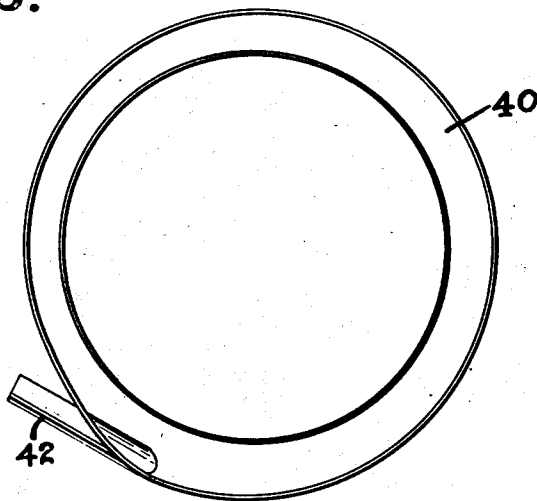


Fig. 3.



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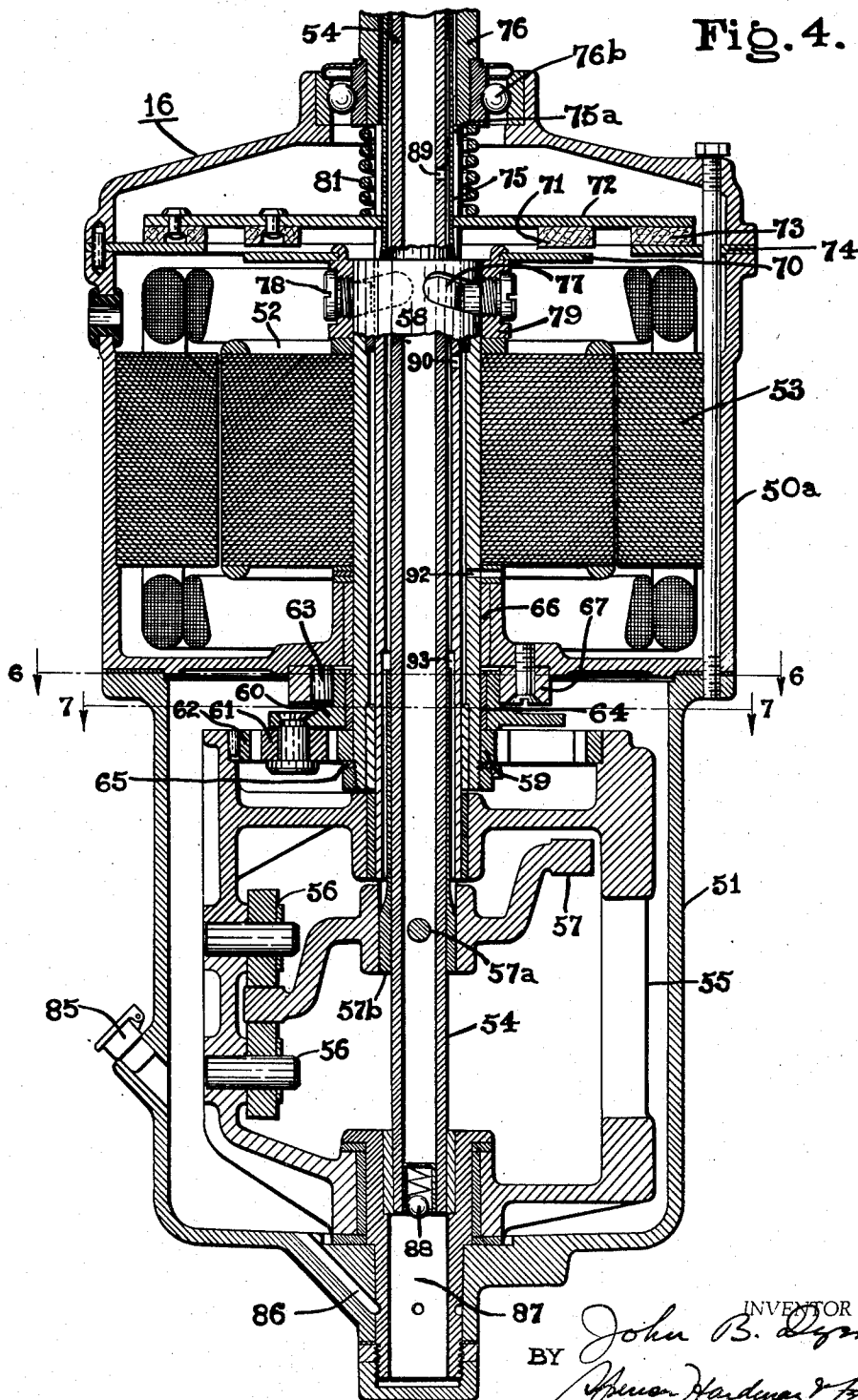
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DOMESTIC APPLIANCE

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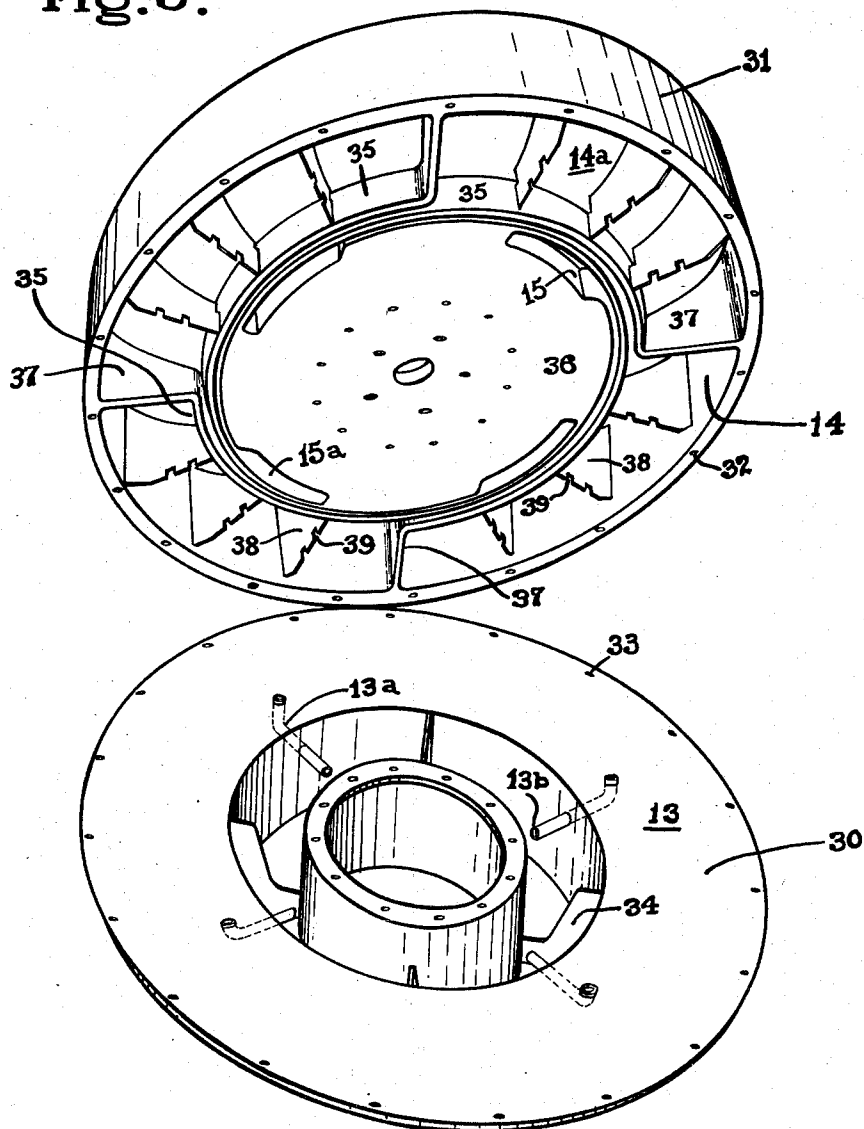
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DOMESTIC APPLIANCE

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Fig. 5.



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DOMESTIC APPLIANCE

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Fig. 6.

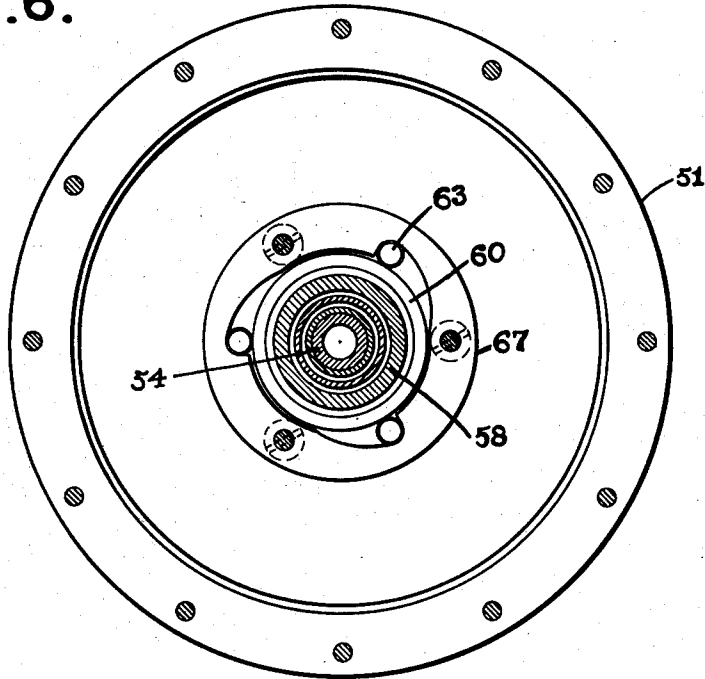
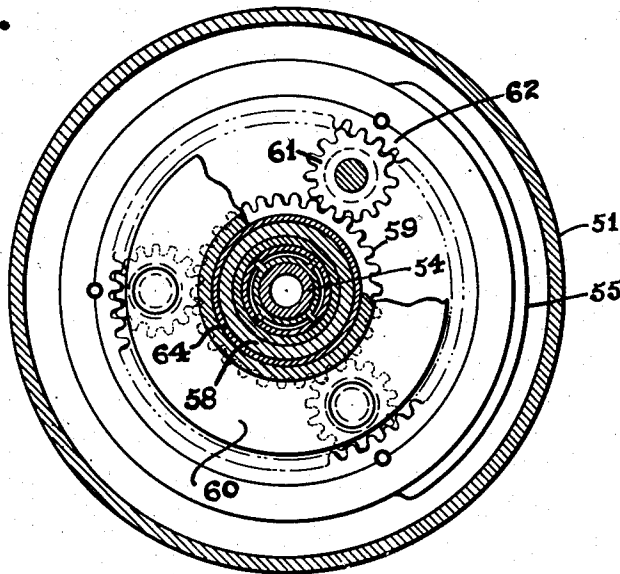


Fig. 7.



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DOMESTIC APPLIANCE

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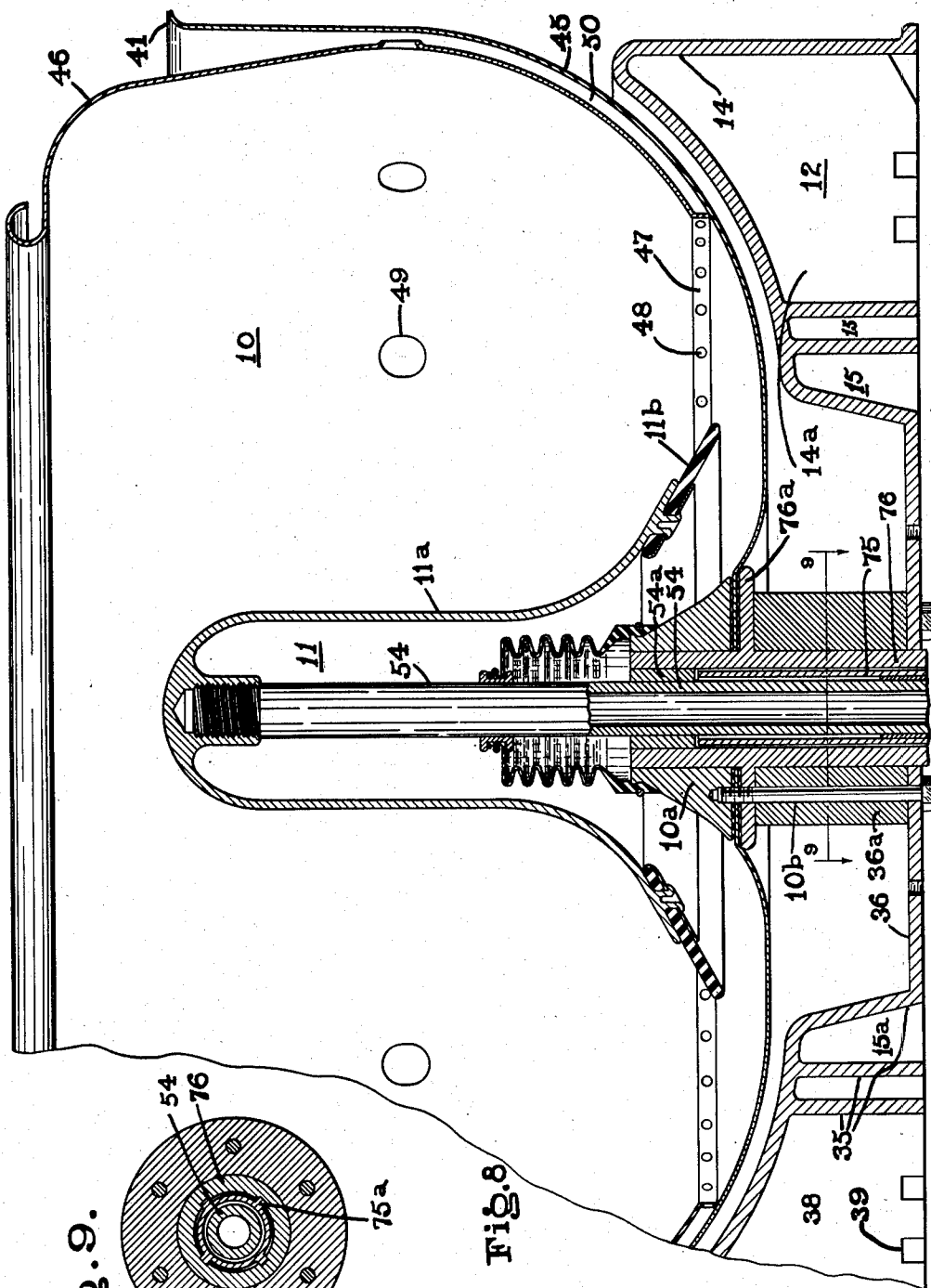


Fig. 9.

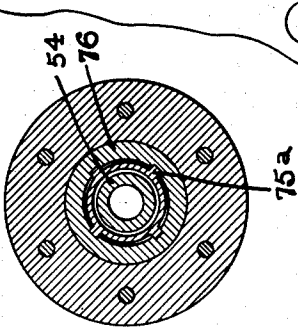


Fig. 8

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UNITED STATES PATENT OFFICE

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DOMESTIC APPLIANCE

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Application June 29, 1940, Serial No. 343,206

9 Claims. (Cl. 74—573)

This invention relates to domestic appliances, and the like.

An object of this invention is to provide a method of balancing a rotating movable form-changing load, such as a rotating centrifugal clothes basket.

Another object of this invention is to provide a machine which is properly balanced while rotating, notwithstanding that it contains a movable form-changing load.

Another object of this invention is to provide a washing machine with a vertically reciprocating agitator and a centrifugally rotating tub, in such a manner that the machine may be used to wash clothes and thereafter to dry them centrifugally.

Another object of this invention is to provide a transmission for rotating the basket and vertically reciprocating the agitator.

Another object of this invention is to provide an improved trough for receiving the liquid discharged from a centrifugal basket.

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:

Fig. 1 is a view, partly in section and partly in elevation of a washing machine embodying my invention, the view being partly diagrammatic;

Fig. 2 is a view of a portion of the machine, showing the same in the process of being automatically balanced while being centrifugally rotated;

Fig. 3 is a plan view of my improved trough;

Fig. 4 is a vertical cross-section of the transmission mechanism for imparting rotation to the tub and reciprocation to the agitator;

Fig. 5 is an exploded view of the counter-balancing device;

Fig. 6 is a horizontal cross-section taken along the lines 6—6 of Fig. 4;

Fig. 7 is a horizontal cross-section taken along the line 7—7 of Fig. 4;

Fig. 8 is an enlarged cross-sectional view of the upper part of the machine; and

Fig. 9 is a cross-sectional view taken along the line 9—9 of Fig. 8.

A washing machine embodying my invention includes a rotatable tub 10 and an agitator 11 therein, preferably vertically reciprocable. An automatic counter-balancing device 12 is attached to the machine below the tub 10 and in-

cludes a mass of counter-balancing liquid, such as water, mercury, or heavy oil or its derivatives, which is automatically distributed in the machine during the pick-up of rotation so that the same automatically balances the unbalance created by any unequal distribution of clothes within the tub.

The counter-balancing device 12 includes a receptacle 13 (see Fig. 5) and liquid pocket means 14 located above the receptacle 13. The receptacle 13 and pocket means 14 are connected by proper liquid passageways 15 in such a manner that the passageways 15 receive liquid from the receptacle 13 and distribute it to the pocket means 14 in such quantities that any unbalance in the machine tends to be correctly counter-balanced by the liquid.

The tub 10, and its driving mechanism 16 preferably are mounted on a universal joint 17 to allow a slight movement about the joint 17 as a fulcrum. The mechanism is maintained in a vertical position by the resilient rubber-like supports 18. While the tub 10 is in a stationary condition, the counter-balancing liquid held in the receptacle 13 remains in readiness to be distributed when the tub starts to rotate. When rotation is started, the clothes within the tub 10 may be in an unevenly distributed condition as indicated by the large collection of clothes 19 and the small collection of clothes 20 which are intended to indicate a ring of clothes of uneven thickness. Such an uneven distribution of clothes causes the tub to gyrate away from the normal vertical axis 21 as indicated in Fig. 2. As the speed of rotation increases, the liquid in receptacle 13 rises; but a larger quantity of liquid tends to collect on the same side of the receptacle 13 as the heavier unbalance 19. The liquid, as it continues to rise, finally overflows into the passageway 15a, on the same side as the heavier unbalance 19. This liquid then flows along the spiral passageway 15a into the pocket 14a, substantially 180° away. The liquid in receptacle 13 may not all flow into one passageway 15a; but a large portion of the liquid tends to flow to that passageway or passageways nearest to the heaviest unbalance in the load. For this reason the liquid is automatically distributed to pockets which are displaced substantially 180° away from the heaviest portion of the load; and this tends to balance the machine automatically. The passageways 15, and 15a, are so related to the receptacle 13, that when the machine stops, the liquid in the pockets 14 and 14a flows by gravity back into the receptacle 13.

As shown in Fig. 5, the receptacle 13 preferably is made of one piece with a large flange 30. The pocket means 14 and 14a preferably is in the form of a dome 31 which may be bolted to the flange 30 through the bolt holes 32 and 33. Radial baffles 34 are placed in the receptacle 13 to insure rotation of the liquid. The passageways 15, 15a are formed in the dome 31 by vertical webs 35, in cooperation with a horizontal plate 36. The pockets are divided by the radial portions 37 of the vertical webs into a plurality of pockets (4 being shown in Fig. 5). The pockets are sub-divided by baffles 38, provided with notches 39 at their lower portions, to stabilize the liquid in the pockets after it is received therein.

Air relief pipes 13a are provided to prevent trapping of air in the pocket means 14. These pipes 13a extend from the floor of the pocket means 14a to a point 13b near the inner wall of the receptacle 13 and above the normal liquid level in receptacle 13. The position of these pipes is such that air relief is afforded the pocket means 14; but liquid does not flow upwardly through them, because the terminal 13b is so located that such flow is prevented.

A trough 40 is placed around the centrifugal basket 10 and is adapted to receive liquid discharged over the flange 41 of the basket. The trough 40 preferably has a tangential discharge 42, and the trough is shaped with increasing cross-section as it approaches the trough 42, as shown in Fig. 3. This allows the liquid discharged into the trough to flow rotationally through the trough as it is discharged by the tub, and is more readily discharged through the tangential opening 42 without danger of overflowing the trough.

The particular construction of the tub 10, while it may be varied, preferably is as indicated in Figs. 1, 2 and 8. Thus the tub may include an outer cylindrical imperforate portion 45 within which is nested an annular shell 46. The annular shell 46 is provided with a lower flange 47 provided with openings 48 and is also provided with openings 49 approximately along the middle. The total discharge capacity of the openings 48 preferably is more than that of the openings 49. The object of this construction is to remove the scum from the washing liquid before the same has been deposited on the clothes 19, 20 during the centrifugal action. The scum is removed automatically because, as the tub begins to rotate, the liquid takes the form of a vortex, with a large amount of liquid being discharged through the openings 48 and flowing up through the passage 50 over the rim 41. The scum tends to flow along the surface of this vortex down near the openings 48 where the scum is removed along with the liquid flowing through the openings 48.

The agitator 11 preferably is of the vertically reciprocated type, and includes the metal cone-shaped portion 11a and the resilient, rubber-like flange 11b along the lower periphery. This agitator is reciprocated with short strokes of about one and one-half inches in length at about 450 R. P. M. to produce a toroidal action in the clothes and washing liquid while the tub 10 is stationary. This tends to distribute the clothes within the tub 10 somewhat evenly in a ring about the agitator 11. However, this distribution obviously is not always exactly even, and larger masses of clothes may be gathered along one side of the machine, as indicated at 19. After

agitation has been completed, the agitator preferably is stopped, and the tub is rotated (along with the agitator 11), to discharge the liquid and scum through the openings 48 and 49. During the pick-up of this rotation, the liquid in receptacle 13 is automatically distributed to the pockets 14, 14a as previously described, in a manner to effect a substantial counter-balance of the unequally distributed clothes 19, 20.

Any suitable mechanism for actuating the agitator and rotating the tub may be used, but I prefer to use the mechanism disclosed in Figs. 4, 6, 7, 8 and 9, which is constructed as follows:

A transmission casing 50, 51 is provided and is bolted together as shown. This casing contains a motor having rotor 52 and a stator 53. This motor is reversible. When rotated in one direction, it causes the agitator shaft 54 to reciprocate vertically. When the motor rotates in the other direction, it rotates the tub 10, along with the agitator 11.

The agitator shaft 54 is vertically reciprocated by causing the motor to rotate the cage 55. This cage carries pulleys 56 which straddle a non-rotatable undulating track 57, which is fixed to the shaft 54. As the pulleys 56 rotate, they cause the track 57 to reciprocate vertically, and impart a reciprocating motion to the shaft 54 to which it is attached by means of the bolt 57a, passing through the bearing 57b.

The cage 55 is rotated by means of planetary gears. The motor shaft 58 is fixed to the sun gear 59. The sun gear 59 drives a ring 60 carrying planetary gears 61, which are meshed to the outer gear ring 62 carried by the cage 55. The planet ring 60 extends vertically inside a set of unidirectional clutches 63, such that, when the planet ring is urged in one direction, its rotation is stopped by the clutches 63; but is allowed to rotate when it is urged in the other direction. As a result, when the motor shaft 58 rotates in one direction, the planet ring 60 is held stationary with the result that the gear 59 drives the gear 62 through the planet gears 61, thus rotating the cage 55 and causing vertical reciprocation of the agitator 11.

For the purpose of facilitating construction, the planet ring 60 rides about a bearing ring 64. The sun gear 59 is pressed on the shaft 58 and is secured thereto by the nut 65. The shaft 58 rides in bearing 66 carried by the casing 50. The unidirectional clutches 63 are carried by a stationary ring 67 secured to the casing 50.

Rotation of the tub 10 is accomplished by rotation of the motor in the opposite direction. Such rotation causes the clutch plate 70 to rise into engagement with the clutch face 71 and causes the combined clutch and brake plate 72 to be lifted. This disengages the brake band 73 from the stationary brake plate 74 and allows the plate 72 to rotate along with the rotating clutch plate 70. The plate 72 is keyed to the shaft 75, which in turn is keyed at 75a to the tub carrying shaft 76. The shaft 76 has a tub carrying plate 76a to which the tub is bolted by bolts 10b along with the plate 36 and spacer ring 36a. The shaft 76 is carried by thrust ball bearings 76b.

The rotating plate 70 is lifted into engagement with the clutch band 71 by means of the spiral drive 77. The motor shaft 58 is provided with spiral slots 77 in which screws 78 extend. The screws 78 are carried by the vertical sleeve 79 which carries the clutch plate 70. As a result of this, when the shaft 58 is rotated in the proper

direction, the plate 70 is lifted by the well-known spiral action into engagement with the clutch band 71. The plate 72 is urged downwardly by the spring 81 to insure a driving engagement between the plate 70 and band 71 and also to bring the brake band 73 into engagement with the plate 74 when the motor is stopped or reversed. The agitator shaft 54 is held in alignment at the upper end by bearing 54a. A flexible bellows 54b, made of rubber or metal is secured to the shaft 54 and to the cone washer 10a which is held by the bolts 10b.

Proper lubrication is provided. To this end the casing 51 is provided with a lubricant cup 85, and lubricant is poured to the proper level. It flows through passages 86 into the space 87, from whence it is pumped through the valve 88 into the interior of the shaft 54 by the reciprocating action of shaft 54. This oil is pumped up to the oil hole 89 to provide proper lubrication between the shaft 54 and the shaft 75. The oil flows down between these two shafts and may pass out through the oil hole 90 for further lubrication of the parts and may be discharged through the opening 92. Other portions of the oil stream may flow down to the opening 93 and lubricate the parts at this portion of the mechanism.

The shaft 54, and track 57, are held non-rotationally, when the tub is stationary, by the brake 73, since brake plate 72 is keyed to shaft 75, which in turn is keyed to bearing 57b which is bolted to shaft 54. Thus when the brake is applied to the tub, the shaft 54 and track 57 are held non-rotationally, to enable them to be vertically reciprocated by the wheels 56 when agitation is required.

There are several characteristics of this type of machine which tend to cooperate beneficially to produce proper balance. One such characteristic is the behavior of a centrifugal machine below "critical speed." Another such characteristic is the fact that when the tub first starts to rotate, it must pump the washing liquid in the tub upwardly to the flange 41; and as this requires some power, it insures a relatively long period of slow rotation below the "critical speed." Another such characteristic is that the driving clutch 70, 71 can slip during the start of rotation, and this prevents an overload of the motor and further increases the length of rotation at slow speed.

A centrifugal machine of the character shown, without applicant's liquid counter-balancing means, ordinarily would have a "critical speed" of approximately the same number of revolutions per minute as the number of vibrations per minute, while not rotating, about the fulcrum 17. When such a tub rotates below the "critical speed," the tub swings outwardly in the same direction as the unbalanced load. When critical speed is reached and is passed, the tub starts to swing in the opposite direction from the unbalanced load. That is, if applicant's tub were not counter-balanced by the liquid, the tub would swing outwardly in the direction of the large collection of clothes 19 up to critical speed, and from that point on would gradually tend to swing outwardly in the direction of the small collection of clothes 20. It is during the rotation below the "critical speed," that applicant's counter-balancing liquid is distributed to the proper pocket means 14, and this distribution tends to prevent any great outward swinging of the basket at any speed of the basket.

When the tub starts to rotate, the washing liquid gradually rises along the outer side of the

tub until it reaches the flange 41. At this time there is a pumping action from the liquid inside of tub 46 to the flange 41. This pumping action has an increasing head to combat as the level of the washing liquid falls inside the tub 46. This pumping action also requires a substantial amount of power and this prevents the motor from accelerating the rotation of the tub for a considerable length of time. During this time, the counter-balancing liquid is properly distributed from the receptacle 13 to the pocket means 14.

The extra load imposed on the motor to accelerate the tub and also to pump the liquid out of the tub, is compensated by the construction of the clutch 70 and 71 which allows it to slip during this starting period and thus relieves the motor from too heavy a burden and at the same time further extends the period of rotation below the "critical speed." This further insures proper distribution of the balancing liquid from receptacle 13 to pocket means 14.

From the foregoing it is evident that the ordinary characteristic of a centrifugal basket to sway with the unbalanced load below "critical speed" cooperates with the delaying washing liquid pumping action and with the delaying slipping action of the clutch 70, 71 to insure proper distribution of the balancing liquid.

The amount of counter-balancing liquid provided in the machine should be approximately sufficient to counter-balance any expected maximum unbalanced load in the basket 46. That is, the centrifugal pull of the properly distributed counter-balancing liquid in pocket means 14 should be substantially equal to the maximum expected unbalanced load produced by unequal distribution at 19. In a machine capable of washing approximately 8 lbs. dry clothes, such maximum unbalanced load may be expected to be about 3 lbs. Therefore, the radius of the pocket means 14 and the amount of liquid distributed therein should be sufficient to counter-balance this. It is to be noted that if the clothes should be distributed more evenly than that illustrated in Fig. 1, then the counter-balancing liquid also would tend to become more evenly distributed in the pocket means 14, so that the counter-balancing liquid distributes itself automatically to compensate for any distribution of clothes in the tub 46.

While I have referred to a "critical speed" in centrifugal machines not provided with my counter-balancing means, it is to be noted that my counter-balancing means, tends to eliminate "critical speed" in my machine. The reason for this is that, as the tub starts to rotate, the clothes start to be distributed along the wall of the tub 46. As the speed increases, any unevenness in this clothes distribution tends to cause the tub to sway in the direction of the heaviest load. This causes a greater centrifugal force along the outer wall of the receptacle 13 nearest this unbalanced load, and the counter-balancing liquid tends to rise higher at this side. The amount of sway, however, need not be very great in order to accomplish this. As the speed increases, the counter-balancing liquid rises and overflows at 15a, as indicated in the exaggerated showing of Fig. 2. As this distribution of the counter-balancing liquid begins, further outward sway (which would be present in an unbalanced machine) is prevented by the distribution of liquid which continues until all of the liquid has been distributed.

While I have shown the outer wall of receptacle

13 as vertical, it is to be understood that this wall may have the shape of a truncated cone as indicated by the dotted line 13c, the purpose of this being to insure complete distribution of the liquid in the early stages of rotation.

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, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A centrifugal machine comprising a rotatable device to be counter-balanced, storage means for counter-balancing liquid connected to rotate with said device, liquid pocket means distributed about the axis of rotation of said device in a position to receive liquid centrifugally from said storage means, and liquid passageway means connected to said storage means and pocket means, said passageway means extending from one side of said axis to the opposite side.

2. A centrifugal machine comprising a rotatable device to be counter-balanced, storage means for counter-balancing liquid connected to rotate with said device, liquid pocket means distributed about the axis of rotation of said device above and at a greater radial distance from the axis of rotation than said storage means, said storage means having overflow means, liquid passageway means connected to said overflow means and pocket means and extending from one side said axis to the opposite side said axis to receive liquid from said overflow means during rotation and to convey said liquid to said pocket means on the opposite side said axis and to return said liquid from said pocket means to said storage means by gravity when said machine stops.

3. A centrifugal machine comprising a rotatable device to be counterbalanced, a storage receptacle for counterbalancing liquid secured to said device, liquid receiving means above said storage receptacle and having a receiving portion at a greater radial distance from the axis of rotation than said storage receptacle, overflow means on said storage receptacle, a liquid conveying conduit extending from said overflow means on one side the axis of rotation of said device to said liquid receiving means on the opposite side said axis.

4. A centrifugal machine comprising a rotatable device to be counterbalanced, a storage receptacle for counterbalancing liquid secured to said device, liquid receiving means secured to said device at a greater radial distance from the axis of rotation than said storage receptacle and connected in liquid flow relationship with said storage receptacle by means for directing the

counterbalancing liquid from one side of the axis of rotation to the other, and an air relief passage connecting said receptacle and liquid receiving means.

5. A centrifugal machine comprising a rotatable device to be counterbalanced, a storage receptacle for counterbalancing liquid secured to said device, liquid receiving means secured to said device at a greater radial distance from the axis of rotation than said storage receptacle and connected in liquid flow relationship with said storage receptacle by means for directing the counterbalancing liquid from one side of the axis of rotation to the other, and a pivotal support for said machine below said storage receptacle.

6. A centrifugal machine comprising a rotatable device to be counterbalanced, a cylindrical storage receptacle for counterbalancing liquid secured to said device, circumferentially disposed liquid receiving pockets secured to said device above said storage receptacle at a greater radial distance from the axis of rotation than said storage receptacle, and conduits extending from said storage receptacle to said pockets, the inlet and outlet of each of said conduits being on opposite sides of the axis of rotation of said device.

7. A centrifugal machine comprising a rotatable device to be counterbalanced, a cylindrical storage receptacle for counterbalancing liquid secured to said device, circumferentially disposed liquid receiving pockets secured to said device above said storage receptacle at a greater radial distance from the axis of rotation than said storage receptacle, and conduits extending from said storage receptacle to said pockets, said conduits extending 90° or more around the axis of rotation.

8. A centrifugal machine comprising a rotatable device to be counterbalanced, a cylindrical storage receptacle for counterbalancing liquid secured to said device, circumferentially disposed liquid receiving pockets secured to said device above said storage receptacle, and conduits extending from said storage receptacle to said pockets, said conduits extending 90° or more around the axis of rotation and increasing in distance from said axis from the inlet to the outlet.

9. A centrifugal machine comprising a rotatable device to be counterbalanced, a storage receptacle secured to said device for counterbalancing liquid, said receptacle having an overflow rim, means to convey liquid centrifugally overflowing a portion of said rim to a place on the opposite side of the axis of rotation of said device and means for centrifugally retaining said liquid at said place during rotation of said device.

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