

March 14, 1967

P. F. POWDER

3,308,954

DOMESTIC APPLIANCE

Filed May 4, 1964

6 Sheets-Sheet 1

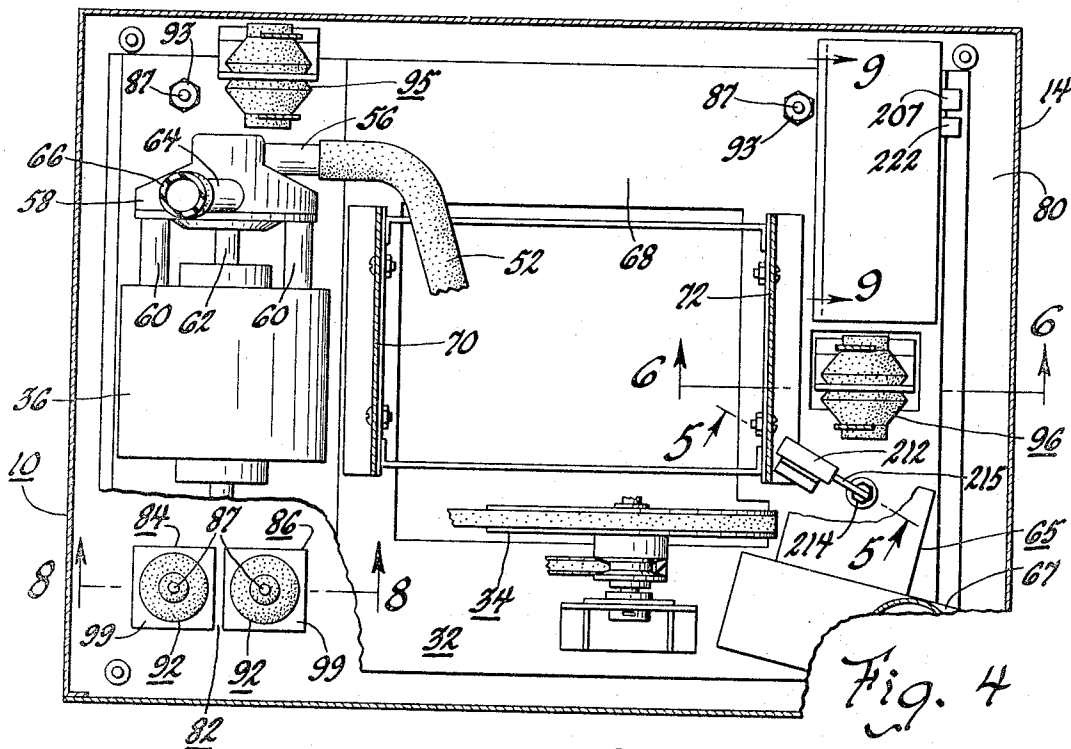


Fig. 4

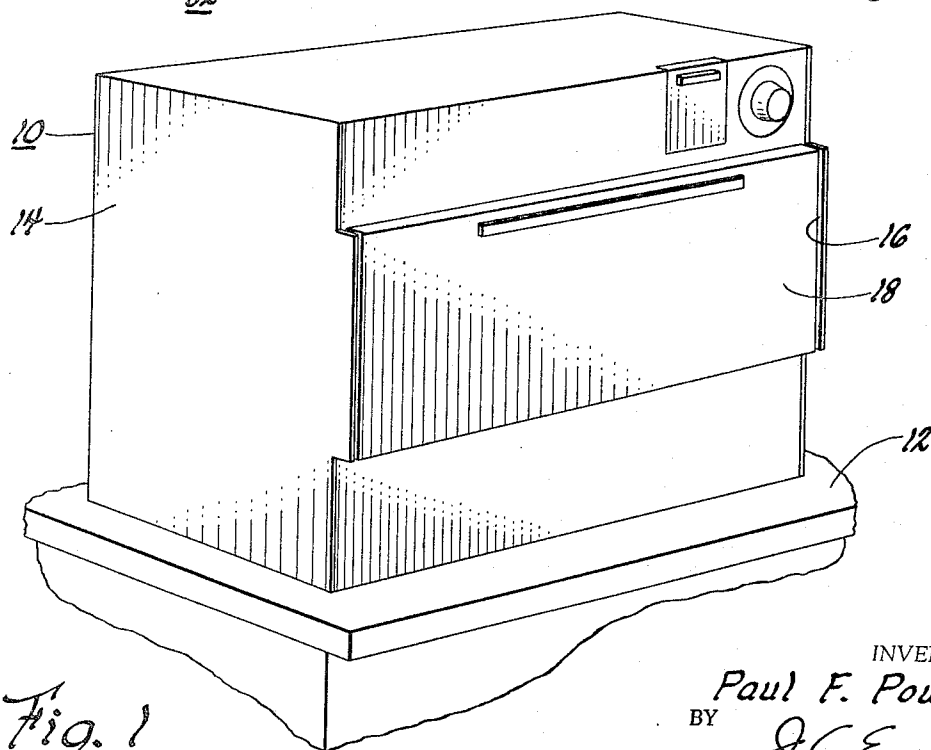


Fig. 1

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6 Sheets-Sheet 2

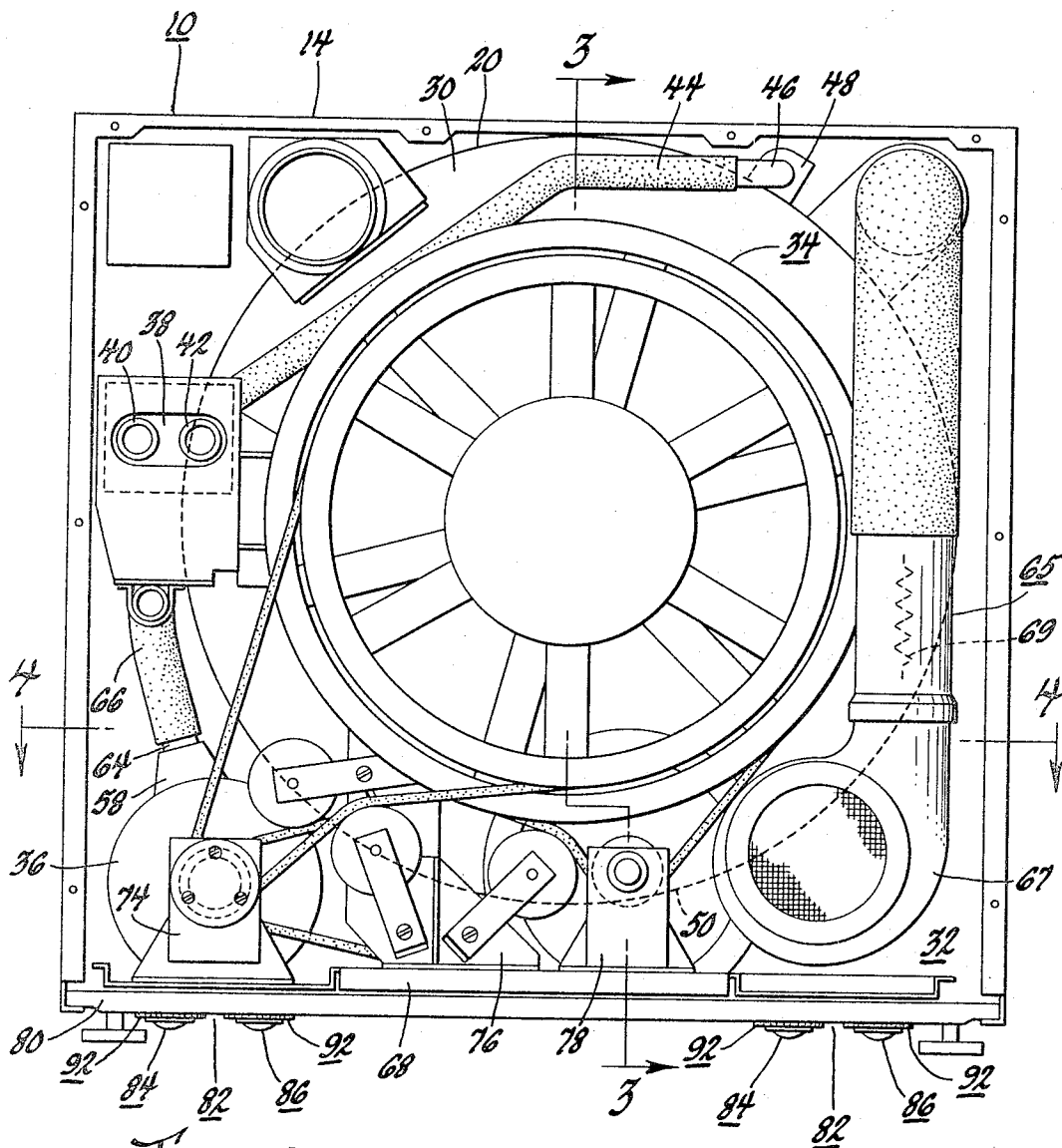


Fig. 2

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6 Sheets-Sheet 3

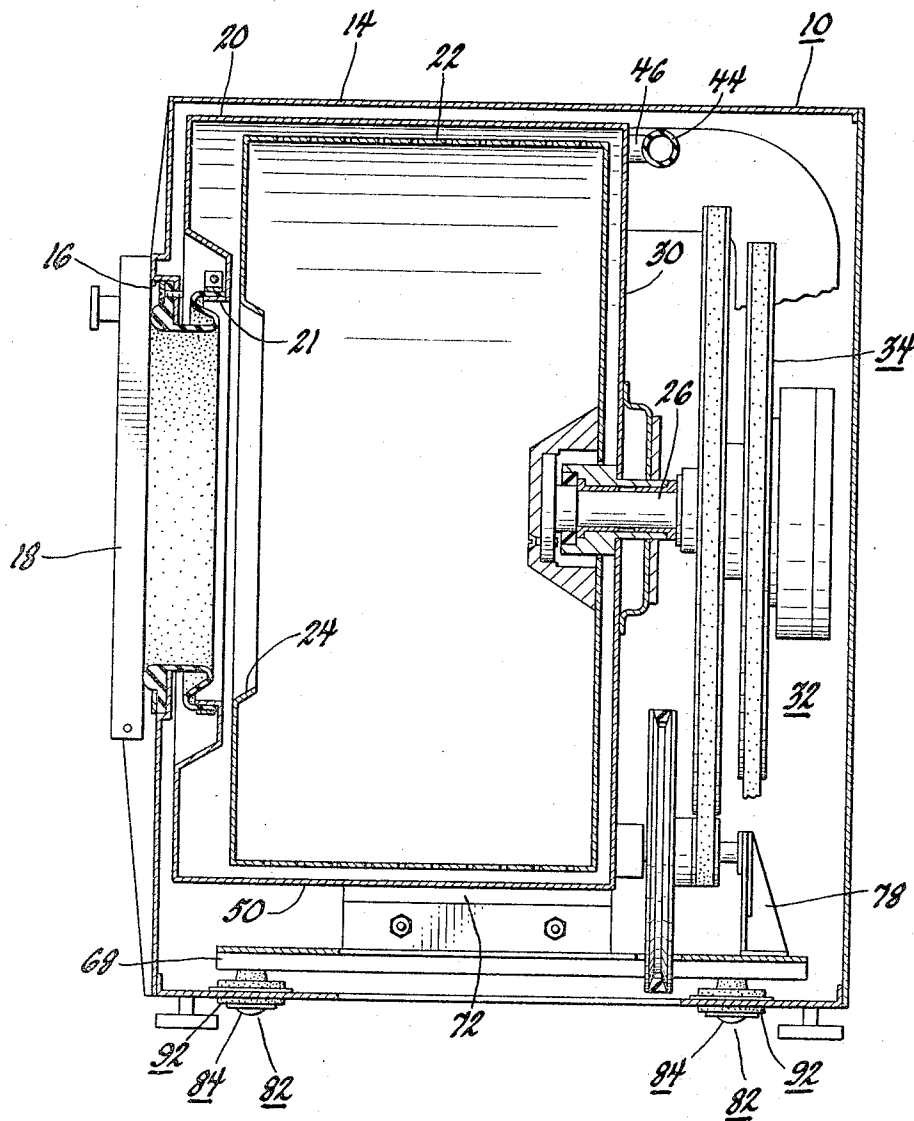


Fig. 3

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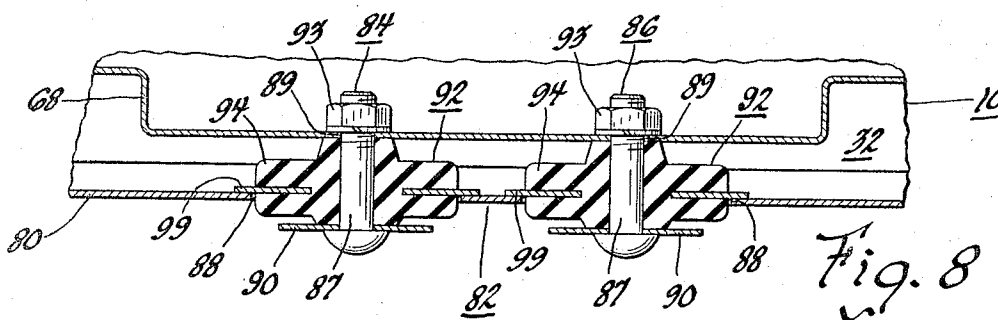
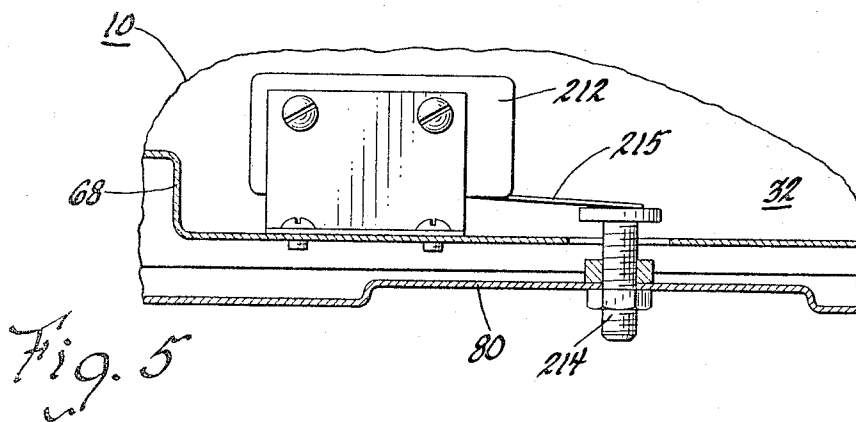
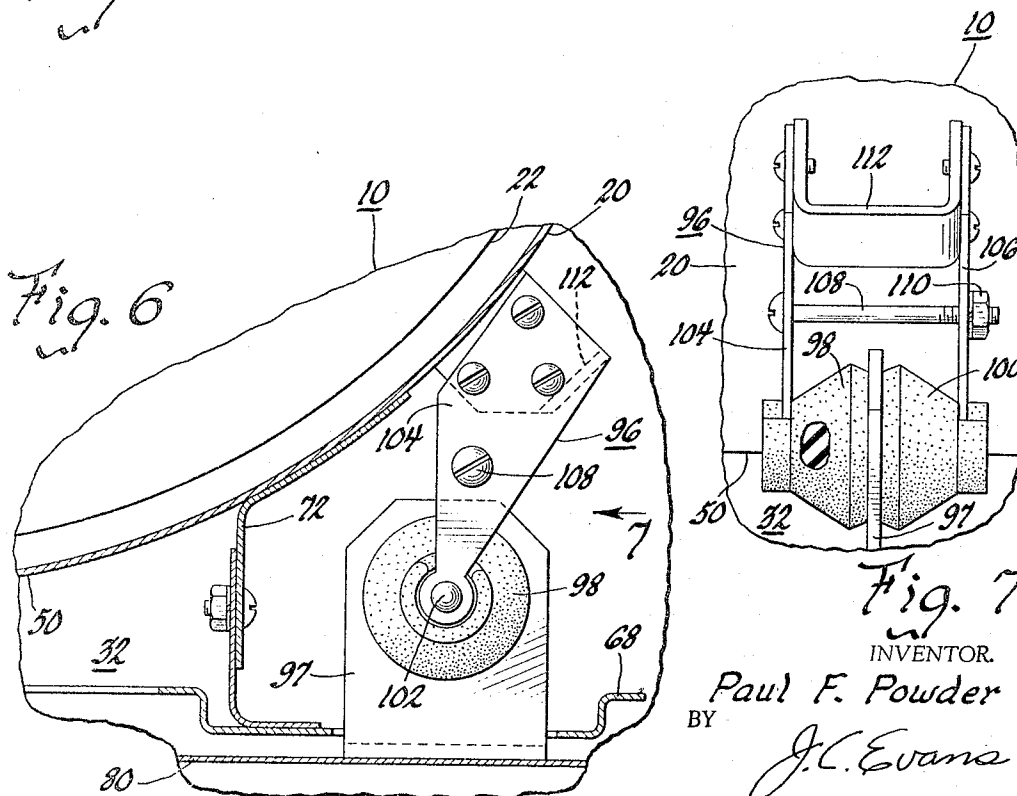
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6 Sheets-Sheet 4



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6 Sheets-Sheet 5

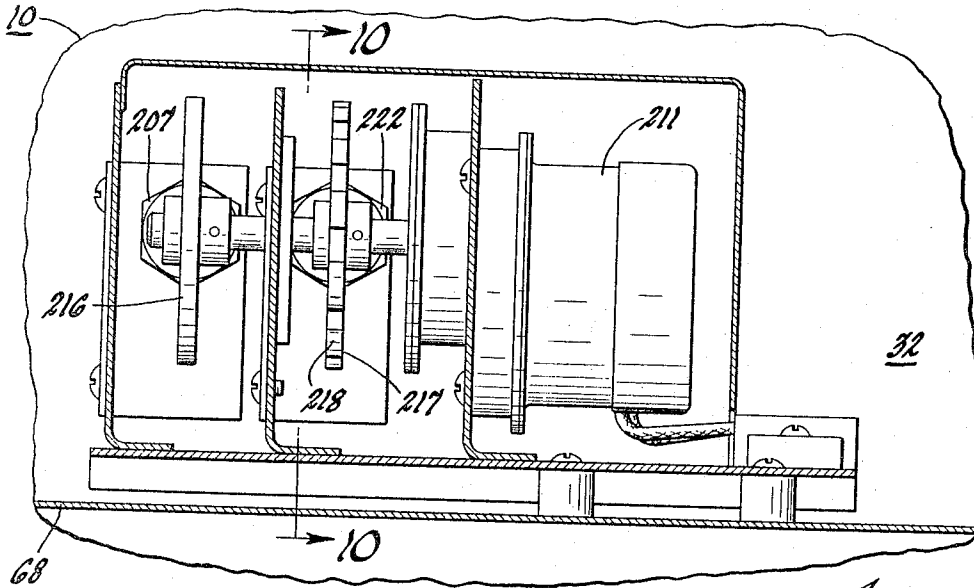


Fig. 9

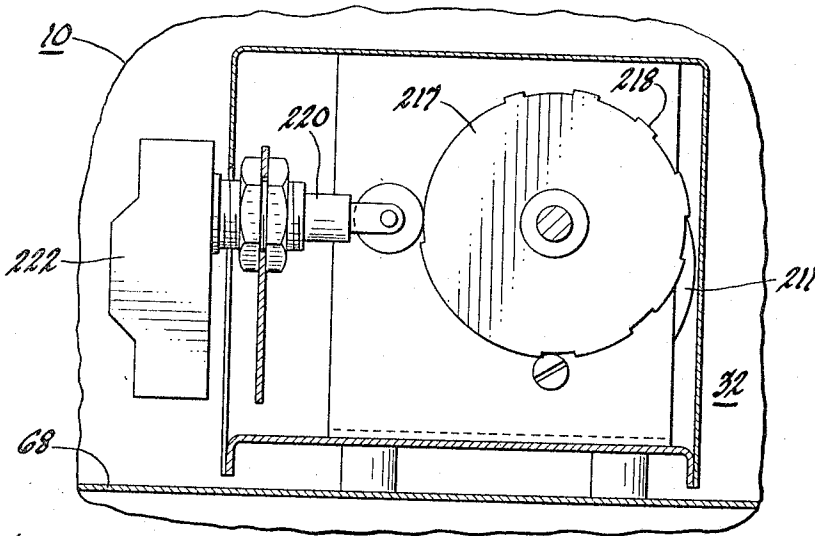


Fig. 10

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DOMESTIC APPLIANCE

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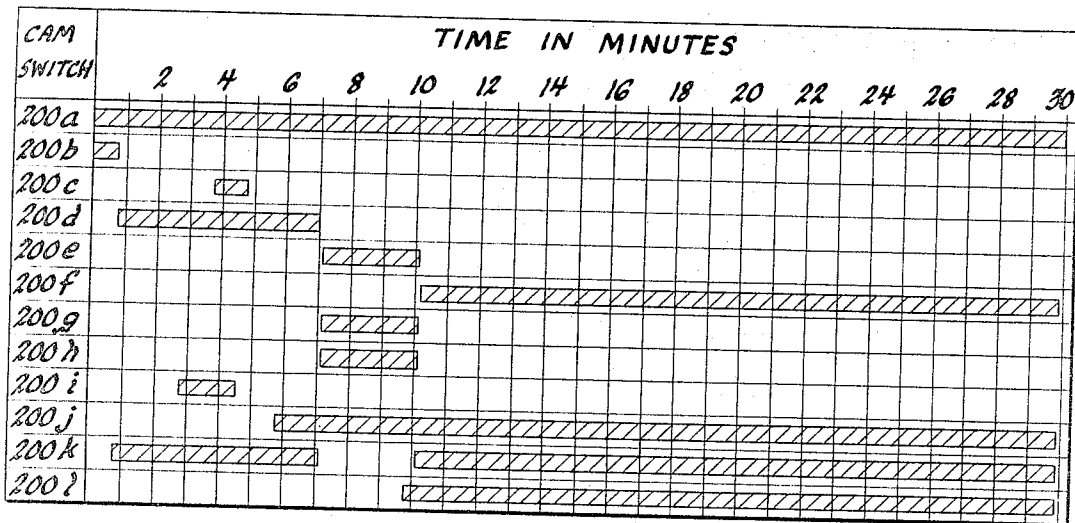


Fig. 11

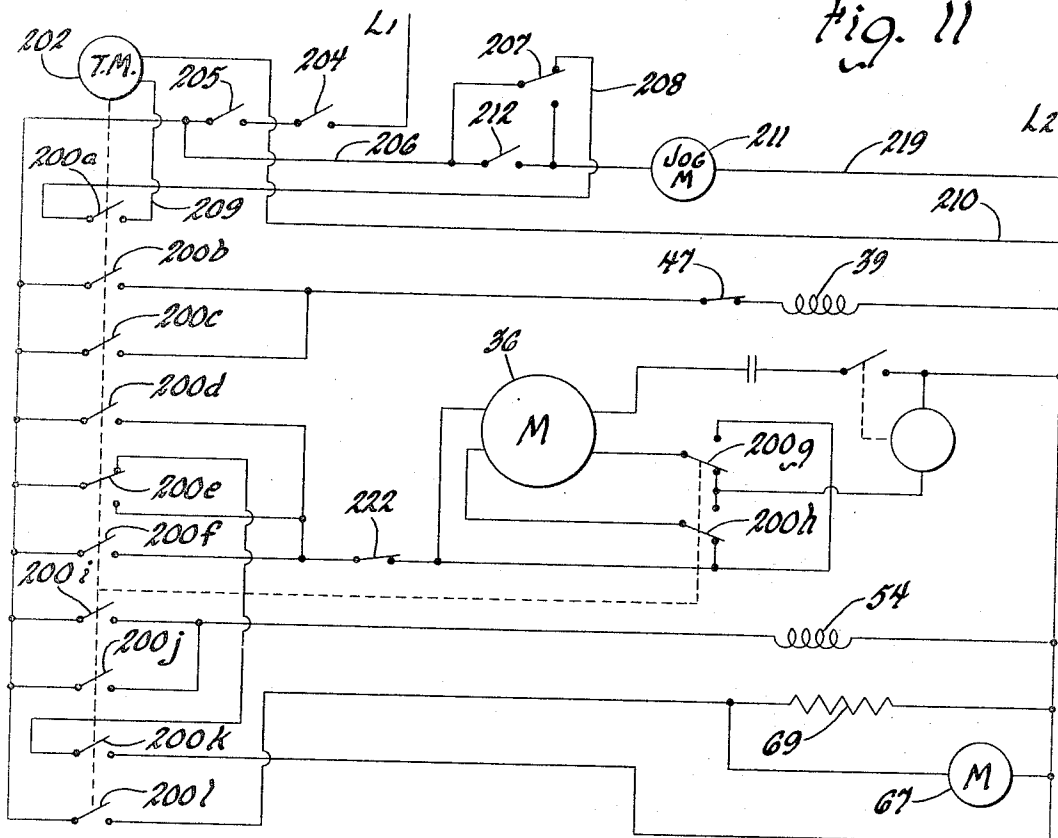


Fig. 12

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3,308,954

DOMESTIC APPLIANCE

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Filed May 4, 1964, Ser. No. 364,455

7 Claims. (Cl. 210-138)

This invention relates to domestic appliances and more particularly to stabilizing a small capacity portable type cleaning device.

One problem in designing a small capacity cleaning device having a rotatable article container therein occurs during a high-spin speed cycle of operation for extracting cleaning fluid. Because of being scaled down, the machine has a reduced weight and, hence, vibrations produced during high speed operation can result in substantial instability, as, for example, the machine may vibrate, unless tied down, sufficiently to walk about on the supporting surface associated therewith.

An object of the present invention, therefore, is to substantially eliminate the transmissibility of vibrations from a rotating mass portion of a small capacity cleaning device to a supporting platform associated therewith.

An object of the present invention, therefore, is to substantially eliminate the transmissibility of vibrations from a rotating mass portion of a small capacity cleaning device to a supporting platform associated therewith.

A further object of the present invention is to stabilize an improved small capacity cleaning device including a horizontally disposed rotatable drum by the provision of support means for the drum and its drive system including a first vibration damping system between a floating drum support and a fixed machine base and a second damping system interposed directly between the drum and the fixed base.

Another object of the present invention is to reduce vibrations in an automatic laundry appliance by modifying a timer programmed sequence of operation upon the occurrence of eccentric loading of articles therein whereby the timer modification prevents advancement of a pre-programmed cycle of operation by the timer and pulsatingly reduces the power input to a drive motor for the machine so as to reduce its drum speed to a point where articles will be redistributed therein to prevent excessive vibrations.

A further object of the present invention is to provide an improved control system for an automatic laundry appliance having a rotatable drum including a first timer means for producing a desired sequence of operation in the machine including a high-spin speed cycle of operation and further including means for sensing a predetermined level of vibration produced by load eccentricity or the like to deactivate the first timer means and energize a second timer means operatively associated with pulsating switch means for reducing power input to a drive means for reducing drum speed to compensate for load eccentricity with the second timer means being operable following a predetermined period of time to reinstate the progressive sequential action of the first timer means.

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 embodiment of the present invention is clearly shown.

In the drawings:

FIGURE 1 is a view in perspective of the cleaning device of the present invention;

FIGURE 2 is a rear elevational view of the device with its rear cover plate removed;

FIGURE 3 is a view in vertical section taken along the line 3-3 of FIGURE 2;

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FIGURE 4 is a view in horizontal section taken along the line 4-4 of FIGURE 2;

FIGURE 5 is an enlarged view in vertical section taken along the line 5-5 of FIGURE 4;

FIGURE 6 is an enlarged view in vertical section taken along the line 6-6 of FIGURE 4;

FIGURE 7 is an elevational view looking in the direction of arrow 7 in FIGURE 6;

FIGURE 8 is an enlarged view in vertical section taken along the line 8-8 of FIGURE 4;

FIGURE 9 is an enlarged view in vertical section taken along the line 9-9 of FIGURE 4;

FIGURE 10 is a view in vertical section taken along the line 10-10 of FIGURE 9;

FIGURE 11 is a program chart for cam switch operation in the control sequence of the present invention; and FIGURE 12 is a diagrammatic view of a circuit for automatically controlling the operation of the machine.

Referring now to the drawings, in FIGURE 1 a small capacity cleaning device 10 constructed in accordance with the principles of the present invention is illustrated as being supported on a table 12 or the like. The device 10, as will be more apparent from the subsequent discussion, is dimensionally somewhat equivalent to the present-day portable television set and is to be suited for use in relatively tight quarters, as, for example, small apartments, trailers or other similar locations. The device 10 includes an outer cabinet 14 having a front access opening 16 therein closed by a door 18 which, when open, provides access interiorly of the outer cabinet 14 into an outer drum 20 through access opening 21 therein and thence into a rotatable, perforated inner drum 22 having an access opening 24 in the front thereof in axial alignment with the opening 16 and 21 in cabinet 14 and outer drum 22, respectively. The inner drum 22 is rotatably supported on a shaft 26 by suitable bearing means in the rear wall 30 of the outer drum 20 where the shaft 26 extends rearwardly into a machinery compartment 32 formed by the outer cabinet 14. A multiple clutch belt-pulley drive system 34 located in compartment 32 is operatively associated with a reversible electric motor 36 for producing, in conjunction with drive system 34, a multiple-speed rotation of the inner drum 22 for carrying out desired washing, spin dry and dry cycles of operation.

The device further includes a fluid circulation system comprising an inlet water valve 38 having a solenoid coil 39 seen in FIGURE 12. The valve 38 also has a pair of inlet fittings 40, 42 adapted to be connected to suitable exteriorly located sources of hot and cold water or the like and an outlet fitting fluidly communicating with one end of a flexible tubular conduit 44 that terminates at its opposite end in a nozzle 46 supported by a bracket 48 secured to the outer drum 20. From nozzle 46, fluid flow passes across a gap into the outer drum 20 on one side thereof as best illustrated in FIGURE 2, whereby water from the inlet valve 38 is fed interiorly of the drum 20 and thence through the perforated outer surface of interior drum 22. Water level is controlled by a water level switch 47 in FIGURE 12. Following a predetermined washing operation, water is drained from the interior of the machine through a sump (not shown) communicating with a lower portion 50 of the outer drum 22 as seen in FIGURE 6. Drainage from the sump passes through a drain conduit 52 under the control of valve means including a solenoid coil 54 (FIGURE 12) and thence is directed to the inlet 56 of a rotary drain pump 58 supported by brackets 60 forwardly of the reversible motor 36 to be driven by a shaft 62 of the motor so as to force fluid through an outlet 64 and a discharge conduit 66 to a suitable drain located exteriorly of the machine.

In addition to the water circulation system, the machine still further includes an air circulation system 65 includ-

ing a motor-driven fan 67 and a heater 69 for heating and circulating air during a predetermined desired drying cycle of machine operation.

The detailed features of the cabinet construction, drive arrangement and water and heated air circulation systems are more particularly set forth in the copending application of Robert F. Smith, Serial No. 364,553 filed May 4, 1964. Such details are merely representative with it being understood that other drive arrangements and auxiliary systems might be equally well suited for association with the present invention.

One problem resulting from scaling down a machine to have a limited capacity, such as that of the machine illustrated and discussed above, is the unsuitability that results from having a low resultant gravitational force. The critical phase of operation of the machine is when the tumbling drum 22 enters a high-spin speed phase of operation capable of producing dynamic unbalance forces in the machine that will produce a noticeable vibration in the outer cabinet thereof and, in some cases, where the unbalanced loading is extreme, to produce substantial walking or other noticeable movements of the machine on its supporting base.

In accordance with certain of the concepts of the present invention, an improved arrangement is included in association with the illustrated machine for producing a damping of machine vibrations that are produced during periods where articles to be cleaned by the machine are substantially uniformly distributed about the inner periphery of the rotatable tumbling drum 22. To effect such damping of vibrations during this period of operation in the illustrated embodiment of the invention, the outer drum 20 is supported at the base thereof on a floating platform 68 by means of support brackets 70, 72 located on either side of the centerline of the drum 20, as best illustrated in FIGURES 3, 4 and 6.

In addition to supporting the outer drum 20, the floating platform 68 has the drive system 34 and reversible electric motor 36 fixedly secured thereto in supported relationship thereon by means representatively shown as including a motor shaft bearing bracket 74, and idler pulley brackets 76, 78 serving to support portions of the drive system 34 as more specifically set forth in the copending Smith application. The floating framework 68 is supported at each corner thereof on a fixed base 80 of the outer cabinet 14 by a shock mounting assembly 82. One of these shock mounting assemblies 82 is shown in FIGURES 4 and 8 with it being understood that like structure exists at the other corners of platform 68. Each of the shock mount assemblies 82, more particularly, includes a pair of units 84, 86 each including a stud element 87 directed upwardly through openings 88, 89 in the fixed base 80 and movable platform 68, respectively. The stud portion 87 carries a washer 90 on its head and is directed through a resilient cylindrical element 92 of a material such as rubber or the like having an enlarged diameter portion 94 between the ends thereof. The diameter portion 94 is grooved to receive a plate 99 fixedly secured to base 80 around opening 88 therethrough. The upper end of element 92 is thereby arranged to supportingly engage the underside of platform 68 by nut 93 on a threaded upper end of stud 87 whereby vibrations produced in the drive assembly 34, rotating drum 22, and the like, and transmitted to the floating platform 68 are damped to reduce the transmissibility thereof to the outer cabinet 14 through the fixed base 80 thereof.

The illustrated corner shock mount assemblies 82 are most effective against lateral and vertical components of vibration within the movable parts of the illustrated device and any angular rotational components of vibration are compensated by means of a pair of damper assemblies 95, 96. In FIGURE 4, assembly 95 is shown located adjacent the front wall of the outer cabinet 14 interiorly thereof at an offset location with respect to the

center line of the outer drum 20 and the assembly 96 is arranged at a similarly offset location on the opposite side of drum 20 rearwardly of assembly 95. Each of the damper assemblies 95, 96 is fixedly secured to the fixed base 80 by a bracket 97 which serves to support a pair of annular resilient damping pads 98, 100 having a radially inner surface portion thereof surrounding an elongated fastener element 102 in engagement therewith. The fastener 102 is directed transversely through the pads 98, 100 so that the ends thereof extend exteriorly thereof where each end thereof holds a pair of spaced arms 104, 106 together. Arms 104, 106 are reinforced by a stud 108 and a nut 110 at an intermediate point thereon and have the terminal ends thereof fixedly connected to a bracket 112 fixedly secured to the outer periphery of the drum 20 on either side thereof. By virtue of the described damper assembly structure, angular components of vibration induced in the drum 20 by the drive assembly 34 are effectively damped by the resilient tubular pads 98, 100 upon movement of fastener 102 that results from angular movement of bracket 112 and depending arms 104, 106 thereon about the central axis of the outer drum.

The combined effect of the corner shock mount assemblies 82 and the pair of offset damper assemblies 95, 96 combine to produce a highly effective damping of vibrations in the operative portions of the machine so that, notwithstanding the substantial reduction of weight of the small capacity washer-dryer, it nevertheless will remain substantially stable upon a platform, such as table 12, illustrated in FIGURE 1.

The foregoing discussion presupposes that the clothes being cleaned by the machine are substantially evenly distributed about the inner periphery of the rotating tumbling drum 22. As is recognized by those skilled in the art, there may be a tendency for such clothes to be located eccentrically of the tub so that, when the drive 34 is conditioned to operate the tumbling drum 22 at its high speed of operation, there will be a substantial unbalance force acting thereon which cannot be effectively damped by the above-discussed improved damping system. In such case, in order to prevent an undesirable transmission of unbalanced forces into the supporting platform for the machine, improved vibration sensing means have been provided to temporarily reduce the speed of rotation of the tumbling drum 22 sufficiently to enable the clothes to be evenly redistributed therein.

To appreciate the improved vibration limiting feature of the present invention, it is necessary to refer to the circuit for controlling the preprogrammed cycles of operation of the machine as shown in FIGURE 12. This circuit is more specifically set forth in the copending application to Clark, Serial No. 364,703 filed May 4, 1964 with unnecessary portions thereof being omitted. For purposes of this specification, it is only necessary to point out that the circuit includes a plurality of timer actuated cams 200a-200l sequentially advanced by a timer motor 202 that is connected across lines L₁, L₂ of a 115 volt, 60 cycle A.C. source through a timer control knob switch 204, a door switch 205, conductor 206, a jog hold switch 207, conductor 208, cam switch 200a and conductors 209, 210. The circuit further includes a jog timer motor 211 connected across lines L₁, L₂ in a circuit including a normally open balance switch 212.

When the timer motor 202 is energized, it sequentially advances the cams of the circuit to produce the program of cam switch operation illustrated in FIGURE 11.

When the circuit is conditioned for high speed spin, the tumbling drum 22 is rotated by the drive motor 36 and pulley assembly 34 counterclockwise at a high-spin speed for extracting liquid from the clothes supported within the drum through the above-discussed fluid circulation system including the drain outlet therefrom and, so long as the clothes are substantially evenly distributed

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on the inner periphery, the control will proceed without any delay through the spin dry cycle to the dry cycle which occurs shortly after ten minutes have transpired in the controlling cycle. In the event that the articles are unevenly or eccentrically disposed within the tumbling drum, the unbalanced force acting on the drum will be transmitted into the fixed base 80 so as to cause an adjustable stop element 214 threadably secured in the base to engage a movable arm portion 215 of the balance switch 212 so as to close the circuit through the jog motor 211. Then a cam 216 on the shaft of motor 211 moves the plunger of a jog hold switch 207 so that it is conditioned to open the timer motor circuit and close the jog motor circuit for a predetermined correction cycle. Hence, the programmed cycle of operation illustrated in FIGURE 11 is a temporarily terminated for a predetermined period of time. The jog motor 211, once energized, advances a cam wheel 217 thereon to move the notched cams on the outer periphery 218 thereof with respect to a reciprocable plunger arm 220 of a jog switch 222 in the drive motor circuit.

The drive motor 36 is thereby selectively de-energized so as to slow the speed of rotation of the drum sufficiently to produce a redistribution of clothes therein sufficient to overcome the unbalanced or eccentric loading and, consequently, reduce unbalanced forces acting on the system. Following a predetermined period of time, the jog timer motor cam 216 will reposition the plunger of jog hold switch 207 so as to interrupt the circuit through line 219 and re-energize the timer motor through conductors 206, 208. Assuming that the unbalanced or eccentric loading condition has been corrected, the unbalanced switch will also be opened so that the jog motor will not be able to condition the jog hold switch to open the timer motor circuit and, consequently, the timer motor will take up the programmed sequence of control illustrated in FIGURE 11 where it was previously terminated.

By virtue of the above-described arrangement, both normal and abnormal vibrational forces in the improved compact washer-dryer combination are isolated from the supporting platform for the machine whereby the machine progresses through all phases of the cycle of operation without any substantial noise or vibration transmission that might be undesirably noticeable to the user of the machine.

While the embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In a domestic appliance having a high-speed spin cycle of operation during which a rotatable receptacle spins at a relatively high speed, the combination of, an electric motor for effecting the high-speed spin of the receptacle, circuit means including first switch means for electrically connecting said motor to a source of power, first timer means in said circuit means for sequentially conditioning said first switch means to effect a predetermined sequence of operating cycles, second switch means responsive to vibrations in the appliance, second timer means operative upon a predetermined appliance vibration sensed by said second switch means for conditioning said circuit means to de-energize said first timer means to interrupt said sequence of operating cycles, third switch means responsive to operation of said second timer means for pulsatingly energizing said electric motor while said first timer means is de-energized to effect a step-wise deceleration of the rotatable receptacle to a predetermined slower speed to redistribute articles therein sufficiently to reduce the appliance vibration sensed by said second switch means.

2. In the combination of claim 1, said second timer means including means operative following a predetermined correction period to re-energize said first timer means to re-initiate said predetermined sequence of operating cycles.

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3. In a domestic appliance having a high-speed spin cycle of operation during which a rotatable receptacle spins at a relatively high speed, the combination of, an electric motor for effecting the high-speed spin of the receptacle, circuit means for electrically connecting said motor to a source of power, first timer means including a first timer motor for sequentially programming said circuit means to produce plural cycles of appliance operation, a floating frame for supporting the rotatable receptacle, a fixed frame, means for mounting said floating frame on said fixed frame for flexible movement relative thereto, a limit switch, coacting means on said fixed and floating frames for conditioning said limit switch upon a predetermined relative movement between said frames, second timer means including a second timer motor, said second timer motor responding to conditioning of said limit switch for programming said circuit means to de-energize said first timer motor, and switch means responsive to said second timer means for pulsatingly energizing said electric motor while said first timer motor is deenergized to effect a step-wise deceleration of the rotatable receptacle to a predetermined slower speed to redistribute articles therein sufficiently to reduce excessive movement between said fixed and floating frames.

4. In a domestic appliance having a high-speed spin cycle of operation during which a rotatable receptacle spins at a relatively high speed, the combination of, an electric motor for effecting the high-speed spin of the receptacle, circuit means including first switch means for electrically connecting said motor to a source of power, first timer means in said circuit means for sequentially conditioning said first switch means to effect a predetermined sequence of operating cycles, a floating frame for supporting the rotatable receptacle, a fixed frame, means for mounting said floating frame on said fixed frame for flexible movement relative thereto, a limit switch secured for movement with said floating frame, stop means on said fixed frame for engaging said limit switch upon a predetermined relative movement between said floating frame and said fixed frame to actuate said limit switch, second timer means including a timer motor, said timer motor responding to actuation of said limit switch for conditioning said circuit means to de-energize said first timer means to interrupt said sequence of operating cycles, said second timer means including second switch means for pulsatingly energizing said electric motor while said first timer means is de-energized to effect a step-wise deceleration of the rotatable receptacle to a predetermined slower speed to redistribute articles therein sufficiently to reduce the excessive movement between said fixed and floating frames.

5. In a small capacity cleaning device the combination of, a rotatable drum having a driven shaft, drum support means including bearing means for supporting said driven shaft during rotation thereof, a reversible electric motor having a drive shaft, drive means for operatively connecting said drive shaft to said driven shaft, a floating platform, means for fixedly connecting said drum support means, said electric motor and said drive means to said floating platform, a fixed platform, resilient shock absorbing means connected between said floating platform and said fixed platform for reducing the transmissibility of lateral and vertical modes of vibration from said floating platform to said fixed platform, and vibration damping means connected between said drum support means and said fixed platform for reducing the transmissibility of angular modes of vibration to said fixed platform, said vibration damping means including a torsional damping pad on either side of the axis of rotation of said drum for damping angular modes of vibration induced thereby upon rotation thereof in either direction.

6. In a limited capacity cleaning device the combination of, a horizontally disposed rotatable drum including a driven shaft thereon, a reversible electric motor having

a drive shaft, drive means for operatively connecting said drive shaft to the driven shaft, a floating platform, means for fixedly supporting said rotatable drum, motor and drive means to said floating platform, a fixed platform, resilient shock absorber means at each corner of said floating platform resiliently supporting said floating platform on said fixed platform to reduce the transmission of vertical and lateral vibrations from said floating platform to said fixed platform, first vibration damping means disposed on one side of the center line of said drum including a portion thereon fixedly secured to said drum support means and another portion fixedly connected to said fixed platform, said first vibration damping means including a resilient torsional damping pad for reducing the transmissibility of angular vibration modes induced by a first rotation of said drum in said support means therefor, and second vibration damping means located on the opposite side of said drum from said first damping means including first and second portions thereof fixedly connected to said drum support means and said fixed platform respectively, said second vibration damping means including a torsional damping pad for reducing transmissibility of angular vibration induced by said drum upon reverse rotation thereof.

7. In a limited capacity cleaning device the combination of, a horizontally disposed rotatable drum including a driven shaft thereon, a reversible electric motor having a drive shaft, drive means for operatively connecting said drive shaft to the driven shaft, a floating platform, means for fixedly supporting said rotatable drum, motor and drive means to said floating platform, a fixed platform, resilient shock absorber means at each corner of said floating platform resiliently supporting said floating platform on said fixed platform to reduce the transmission of vertical and lateral vibrations from said floating platform to said fixed platform, first vibration damping means disposed on one side of the center line of said drum including a portion thereon fixedly secured to said drum support means and another portion fixedly connected to said fixed platform, said first vibration damping

means including a resilient torsional damping pad for reducing the transmissibility of angular vibration modes induced by a first rotation of said drum in said support means therefor, and second vibration damping means located on the opposite side of said drum from said first damping means including first and second portions thereof fixedly connected to said drum support means and said fixed platform respectively, said second vibration damping means including a torsional damping pad for reducing transmissibility of angular vibration induced by said drum upon reverse rotation thereof, circuit means for electrically connecting said motor to a source of power, first timer means in said circuit means for sequentially conditioning said circuit means to effect a predetermined sequence of operating cycles, a limit switch secured for movement with said floating platform, stop means on said fixed platform for actuating said limit switch upon a predetermined relative movement between said floating and fixed platforms, second timer means including a timer motor, said timer motor responding to actuation of said limit switch for conditioning said circuit means to de-energize said first timer means to interrupt the sequence of operating cycles, said second timer means including second switch means for pulsatingly energizing said electric motor while said first timer means is de-energized to effect a step-wise deceleration of the rotatable drum to a predetermined slower speed to reduce excessive relative movement between said fixed and floating platforms.

References Cited by the Examiner

UNITED STATES PATENTS

2,920,470	1/1960	Bochan	210—138 X
2,990,706	7/1961	Bochan	68—24 X
3,084,799	4/1963	Decatur	210—144
3,098,372	7/1963	Bochan	210—144 X

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