Feb. 6, 1951

L. M. KAHN

2,540,168

WASHING APPARATUS

Filed June 6, 1945

3 Sheets-Sheet 1

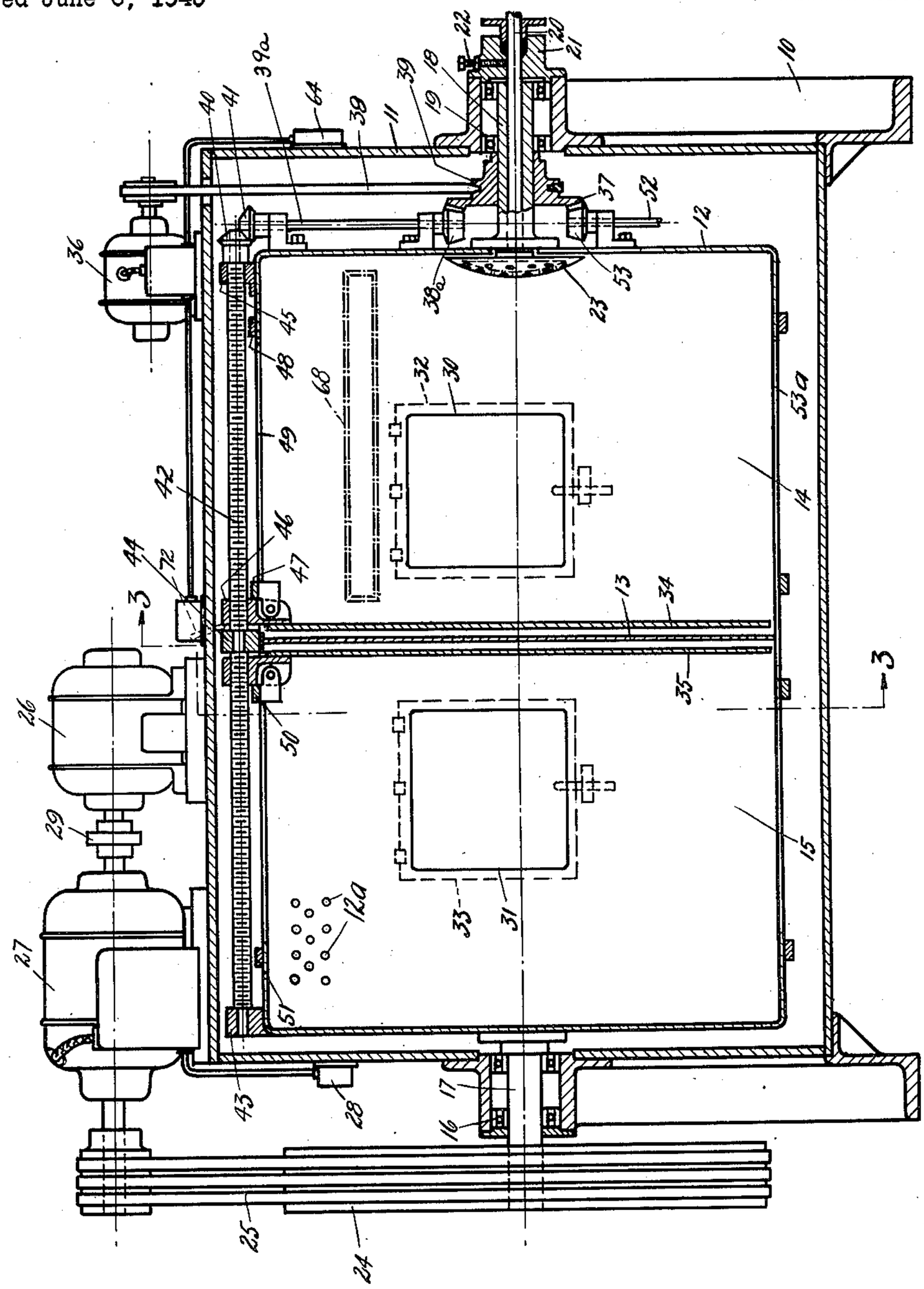

FIG. 1

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WASHING APPARATUS

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3 Sheets-Sheet 2

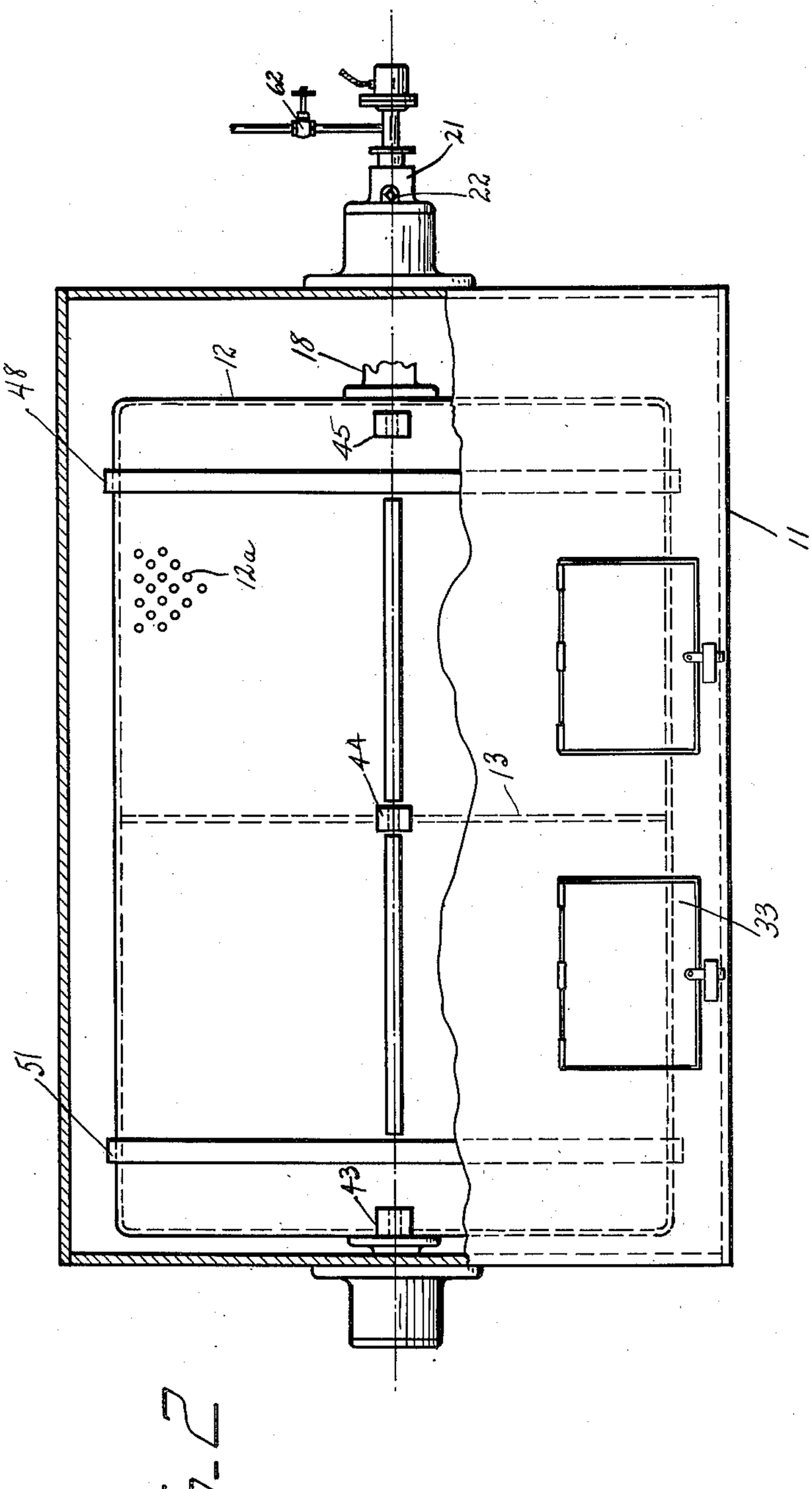

FIG. 2

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WASHING APPARATUS

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3 Sheets-Sheet 3

Fig. 3

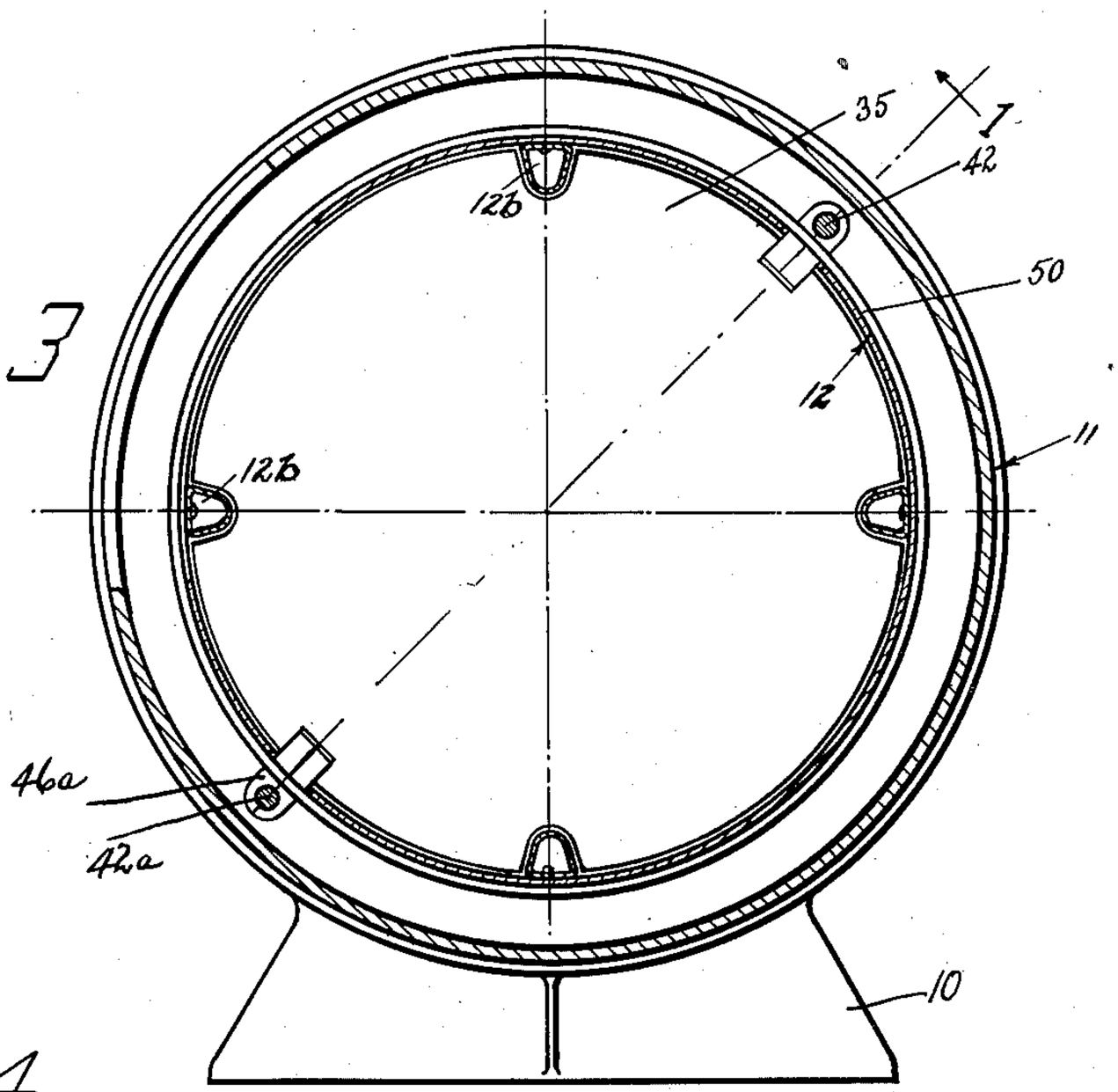
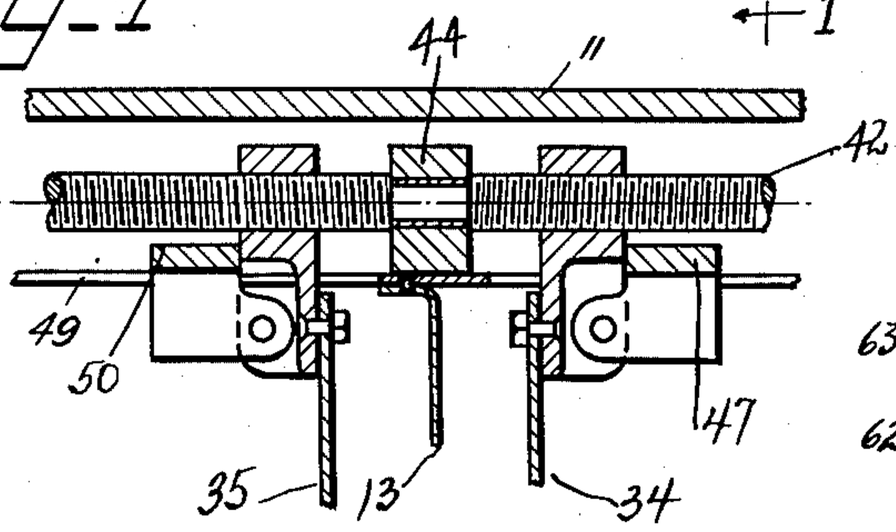


Fig. 4



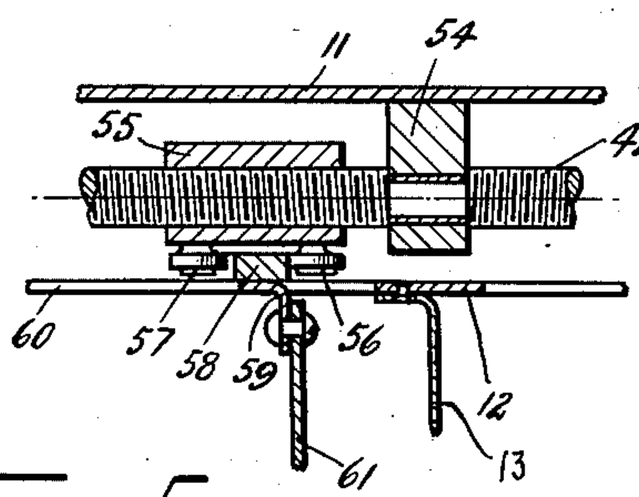


Fig. 5

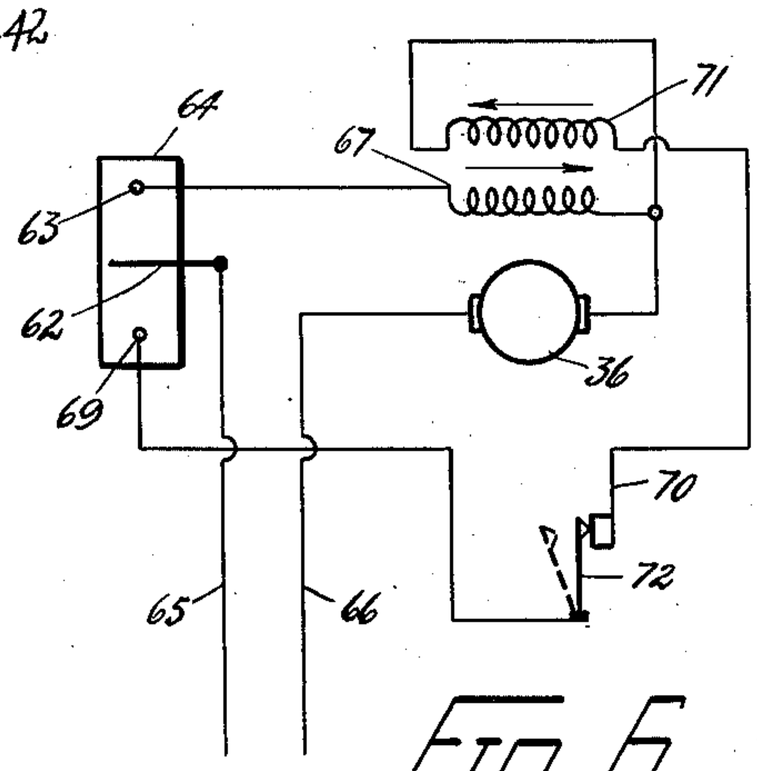


Fig. 6

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WASHING APPARATUS

Leo M. Kahn, Allen Park, N. Y.

Application June 6, 1945, Serial No. 597,897

4 Claims. (Cl. 68—24)

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This invention relates to apparatus for cleaning materials and more particularly to a washing machine incorporating means to dry the washed materials.

This application is a continuation in part of my former application for cleaning or laundry machines filed December 23, 1943, Serial Number 515,356, now Patent No. 2,533,888. In that application I described the advantages and a method of obtaining a proper and symmetrical distribution of the washed materials in the washing cylinder prior to high speed rotation thereof.

As is generally practiced in the art, such high speed rotation serves to eject the water from the washed mass through centrifugal action. As disclosed in said application, my method for obtaining the desired symmetry was to vary the effective volume of the cylinder according to the mass of the washed clothes. By thus causing the effective volume to approach the size of the mass, the method inherently produces a state of symmetry and balance which permits the utilization of increased centrifugal force through high speed rotation without injury to the machine or objectionable vibration of its elements. Since this principle involves the control of the volume of the cylinder according to the bulk of the washed mass, I have used the term "volumetric control" to describe this principle.

Bearing the foregoing in mind, an object of this invention is to produce a washing machine embodying the the above principle and achieving the desired action while substantially minimizing overall space requirements and employing a minimum of moving parts which might constitute a hazard to operating personnel.

Another object of my invention is to produce a washing machine having a plurality of individual and mutually isolated washing chambers, each of which may be provided with volumetric control means powered from a common source. As appreciated in the art, the provision of individual washing chambers is highly desirable because, among other reasons, it is often necessary to separate materials that should not be washed together. Furthermore, the provision of separate chambers prevents the entire mass from crowding one end of a large cylinder.

Another object of my invention is to utilize the principle of volumetric control while automatically strengthening that particular portion of the cylinder which houses the washed mass during the extracting operation. It will be apparent that this portion of the cylinder is subjected to the greatest strain since the washed mass exerts

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pressure against its walls through the centrifugal force generated. Allied with this object is the provision of adequate strengthening ribs which will not influence the size or location of a loading door for the washing chambers even if these ribs must be located in the path of such doors.

Another object of my invention is to produce a washing machine incorporating the above principle by providing power operated means the physical nature of which shall not disturb the beneficial effects of symmetry and balance attainable by varying the volume of the cylinder.

Other objects of my invention will be apparent from the following description, it being understood that the above several statements of the objects of my invention are intended to describe and not to limit it in any manner.

Referring to the drawings:

Fig. 1 is a vertical section through line 1—1 of Fig. 3.

Fig. 2 is a top view thereof with sections of the outer drum and cylinder cut away.

Fig. 3 is a section along the line 3—3 of Fig. 1.

Fig. 4 is a vertical section through the volumetric control means of the washing cylinder.

Fig. 5 is a vertical section illustrating a modification of the volumetric control means.

Fig. 6 is a schematic diagram illustrating the electrical circuit of the volumetric control means.

The illustrated machine includes a suitable frame 10 supporting a stationary fluid tight housing or shell 11 adapted to contain wash water, rinse water or other cleaning materials. Rotatably supported within the housing 11 is the drum 12, having the usual perforations 12*a*, the drum being arranged with its axis horizontal and divided by partition 13 into two chambers 14 and 15. Anti-friction bearings 16 carried by the housing 11 rotatably supports a shaft 17 to the inner or right-hand end of which is secured one end of the perforated drum 12. To the other end of the drum is secured the hollow shaft 18 which is rotatably supported by anti-friction bearings 19. Within the internal passage of shaft 18 is disposed a pipe 20 for introducing wash water into the machine. The pipe 20 is secured to the block 21 as by a set-screw 22. To the inner end of the pipe 20 may be connected a spray nozzle 23.

Rotating action is imparted to the perforated drum 12 by the pulley 24 which is driven by the belts 25 through driving power which originates in the washing motor 26 and the extracting motor 27. The terms washing motor and extracting motor are used because the motors are selectively operative depending upon whether the

washing or extracting operations are being conducted. The selection may be accomplished by automatic means controlled by a timing cycle such as shown in my prior application and various types of which are known in the art. However, the control may be manual as is well understood.

The motors 26 and 27 rotate the drum 12 through shafting connected at 29 which is rotatable by whichever motor is energized and operating, the washing motor 26 being effective to rotate the drum at a slow or washing speed while the extracting motor 27 rotates the drum at a comparatively high speed designed to eject the washing fluid from the washed mass by centrifugal force. However, it is apparent that serving alternative methods, such as a two speed motor, may be employed to effect the necessary multiple speed rotation of the drum.

Entrance to chambers 14 and 15 for loading them with clothes or any other materials is accomplished by means of the doors 30 and 31 respectively. These doors are disposed so as to register with doors 32 and 33 formed in the housing 11.

As shown in Fig. 3, drum 12 is preferably provided with suitably spaced longitudinal ribs 12*b*, which, as the drum rotates, carries the articles upwardly until the angle of repose thereof is exceeded whereupon the articles tumble back toward the bottom of the drum so as to become washed.

Means are provided in the machine to incorporate my principle of volumetric control. Such means takes the form of partitions 34 and 35 arranged for controlled axial movement within the drum 12 to vary the effective volume of the chambers as hereinafter set forth.

The volumetric control motor 36 drives the bevel gear 37 by means of the belt 38 and pulley 39. Bevel gear 37 makes light frictional contact with drum shaft 18 so that the relatively heavy nature of the drum causes the gear 37 to rotate around the shaft 18 due to the consequent slippage when the motor 36 is operated.

Bevel pinion 38*a*, shaft 39*a*, and bevel gears 40 and 41 effect the rotation of screw shaft 42 which is mounted externally of the drum 12 in bearings 43, 44 and 45. Threaded on the screw shaft is the follower 46 to which is secured the control partition 34. Thus, the effective volume of the chamber 14 can be controlled by operation of the motor 36 since the follower 46 will carry the partition 34 when the screw shaft 42 is actuated. Pivotally secured to the follower 46 is the ring 47 which partakes of its axial movement relative to the drum 12. The ring 47 slidably embraces the drum 12 and it functions as a strengthening rib to reinforce the walls of the drum. Since such reinforcement is obviously most beneficial where the strain is greatest, the expedient of thus slidably mounting the ring 47 to accompany the washed mass when it is compressed in the cylinder by the partition 34, automatically secures the most benefit from the strengthening ring 47 and promotes the safety factor of the apparatus to a considerable extent. A stationary strengthening ring 48 is secured at the outer end of the drum 12 so that the washed mass is effectively bounded by strengthening ribs during the extracting process. By this method of reinforcing the walls of the drum, an excess of stationary rings are avoided, a factor that has heretofore imposed considerable problems particularly since the presence of such rings ordinarily interferes with the provision of a loading door. However, in the instant construction the ring 48 is permanently located away from the loading door while the slidable ring 47 is normally so located. The ring 47 is enabled to assume any intermediate position even directly adjacent the loading door and is movable away from the door when access is required.

Entry of the follower 46 into the chamber 14 for connection to the partition 34 is effected through the slot 49 formed in said chamber whereby it is permitted to travel axially of the drum so as to vary the volume of the chamber. This circumferential drive means for the partition 34 avoids the necessity of a shaft for actuating the partition and eliminates the disadvantages of such a shaft which, if disposed on the inner side of the partition, would interfere with the desired circumferential distribution of the clothes while if disposed on the outer side, would present an undesirable rotating protrusion and impose other difficulties such as actuating means therefor, when a plurality of washing chambers exists. However, by arranging the drive means offset with respect to the axis of the cylinder, such difficulties are avoided and end space is conserved.

The construction of the volumetric control means for chamber 15 follows that of chamber 14. However, the partition 35 is arranged to travel in the opposite direction so that it likewise concentrates the washed mass at an end of the drum 12 for the extracting operation. Thus, the washed masses are concentrated adjacent the respective bearings of the drum 12 which not only reduces the overhang weight on each bearing but distributes the total weight so as to improve the overall balance of the drum. Opposite direction of motion of the partition 35 is arranged by reversing the direction of the thread on the screw shaft 42 as it passes through the central bearing 44 as illustrated in Fig. 4. It is also to be observed that the balanced relationship of the concentrated washed masses is attainable if the partitions are arranged to be normally at the ends of the drum and are movable inwardly toward the center thereof.

Partition 35 pivotally carries the ring 50, which, together with the stationary ring 51, bounds the washed and compressed clothes of partition 35 with strengthening ribs.

In order to compensate for the weight of screw-shaft 42 and its associated mechanism and to provide additional and physically balanced driving means for the volumetric controlling partitions 34 and 35, the screw shaft arrangement is repeated along the wall of drum 12 diametrically opposite screw shaft 42. This second screw shaft arrangement, 42*a*, Fig. 3, is driven by shaft 52 whose gear 53 meshes with bevel gear 37. A follower, 46*a*, Fig. 3, travels in the slot 53*a*. However, the number of screw shafts need not be limited to two for best performance since three shafts, spaced 120 degrees apart, or 4 spaced 90 degrees apart will function as well. The desirability of thus balancing the weight of the partition driving means is not necessary when the modification shown in Fig. 5 is utilized.

In the modification, the screw-shaft 42 is secured as by bearing 54 to the housing or shell 11. The other bearings are similarly disposed. The follower 55 does not enter the perforated drum 12 but has instead a pair of rollers 56 and 57 rotatably supported therein. A strengthening ring 58 maintained between these rollers is slid-

ably arranged over drum 12. Ring 58 is connected by bracket 59 through slot 60 to volumetric control partition 61. Since the ring 58 will travel through contact with the rollers, it is obvious that no physical connection need exist between the screw shaft 42 and the partition 61, while the ring 58 performs its bounding and strengthening function and may turn with the drum.

The apparatus is provided, of course, with a water inlet, soap inlet, dump valve or pump as is conventional.

The machine is operated as follows:

Clothes or other material to be cleaned are placed in the drum 12 through the doors described and water controlled by valve 62, Fig. 2, is introduced into the drum 12 and shell 11 through the spray or nozzle 23. When the water reaches the proper level for washing in the shell 11, it is shut off and sufficient soap and any other cleaning material is supplied. Thereafter, washing motor 26 is energized by a conventional switch as at 28. At the conclusion of the washing operation, the dirty wash water is permitted to drain off through a dump or drain valve. One or more rinsing operations may follow.

Then, while the drum 12 is rotating at a slow or washing speed, motor 36 is started by closing contacts 62 and 63 of single pole, double throw switch 64. Contact 62 terminates line voltage lead 65, the return lead of which is lead 66. The current will then go through field winding 67 of the reversible, universal motor 36 and will cause the motor to rotate in the direction of the arrow over field winding 67 in Fig. 6. Bevel gear 37 will then rotate relative to the shaft 18 and will move the partition 34 to the right. This movement should be slow so as to permit the tumbling clothes to circumferentially distribute themselves relative to the axis of rotation of the drum. It will be appreciated that the rotation of the drum causse the ribs 12*b* to lift the clothes so as to carry them adjacent to the inner periphery of the drum 12 until the angle of repose is exceeded whereupon they tumble back toward the bottom of the drum. It is desirable, however, to discourage this tendency to tumble back at this time since the objective is to attain a high degree of circumferential distribution of the clothes before high speed rotation of the drum. This objective is realized by effecting a slow, compressing movement of the partition 34 since the tendency of the clothes to tumble back will be gradually resisted by the compression of the washed mass as the partition travels. Thus, as the clothes are becoming tightly packed they tend to be self-supporting and will not readily tumble back. On the contrary, they will tend to form a loose annulus because of the increasing difficulty of falling from the periphery against which they are continually being carried by the moving ribs 12*a*. I have found that the highest degree of circumferential distribution is attainable by moving the partition 35 slowly so as not to initially impose a high resistance to such distribution by the rotating ribs 12. Thus, the rate of travel of the partition 35 depends, to some extent, on the rotating speed of the drum. As an example I have found that a travelling rate of approximately 1½ to 2½ inches per second produces satisfactory circumferential distribution when a drum of 20'' diameter rotates at about 45 R. P. M. However, these figures are merely illustrative, since wide latitude and considerable departure from best practices are possible without sacrificing the advantages of volumetric control. With drums of larger diameter the washing speed is proportionately less so that the same travelling rate is applicable. I have determined that the advantages of volumetric control are best realized when the travelling rate of the partition does not exceed ⅛ of the peripheral speed of the drum, and have achieved excellent results when the rate is 1/30 the peripheral speed of the drum.

When the partition 35 has compressed the mass of washed clothes, the operator may stop the motor 36 by opening the contacts 62 and 63 of single pole double throw switch 64 which has a neutral position wherein contact 62 is connected to neither terminal. The duration of travel will thus depend upon the will of the operator who may interrupt the travel when he observes the clothes to be concentrated at the end of the drum 12. Visual access to the interior of the drum is permitted by the glass window 68 formed in the housing 11 and the operator may discern the position of the partition through the perforations 12*a*. The partition need not be positioned precisely however, to obtain the desired distribution of the washed clothes.

Thereafter, the extracting motor 27 may be started, as washing motor 26 is stopped. It will be apparent to those skilled in the art that motors 26 and 27 may be connected, if desired, in direct concatenation or direct cascade, and that motor 26 may be used either separately or in such cascade with motor 27 to give two operating speeds. However, a variety of arrangements, well known in the art, may be employed. It may further be noted that an automatic cycle of operations such as shown in my prior applications Serial Nos. 515,456 and 469,609, now Patent No. 2,333,609, may be utilized. If desired, independent motor action for high and low speed rotation may be employed.

At the commencement of the high speed rotation of drum 12, the clothes which have been circumferentially distributed by the moving partition will expand radially due to the centrifugal force to which they are subjected. As they expand radially, they will retain their increased degree of circumferential distribution and will form a tight annulus adjacent the inner periphery of the drum. The uniformity of distribution thus realized will permit substantially higher speeds of rotation to be employed than is permitted in prior art machines of like design. High speed rotation decreases drying time as it increases the rate of drying, and its benefits are highly regarded in the art.

When the extraction operation has been completed, motor 36 may be energized so as to reverse the direction of rotation of the screw shaft 42 to retract the partition 34. This reversal is accomplished by closing contacts 62 and 69 of switch 64. The current will then travel through limit switch 70, reversible field winding 71 and motor 36. Partition 34 will then withdraw to the left as indicated by the arrow over field winding 71, Fig. 5.

Referring to Fig. 1, as partition 34 approaches the central partition 13, its edge will meet contact 72 of limit switch 70 and will open the contacts of the switch as shown by the dotted lines of Fig. 6. This will interrupt the flow of current to the motor and automatically stop the leftward movement of the partition 34. Limit switch 70 is of the micro-switch type wherein contact 72 is normally spring biased to closed position so that the circuit is open at that point only

when partition 34 is adjacent central partition 13. During a subsequent operation when partition 34 again travels prior to the extracting process, limit switch 70 will close in response to its spring bias. However, manual control of the retracting movement of the partition 34 is available since the glass window 68 indicates to the operator the proximity of the partition 34 to the central partition 13 whereupon he may simply open the contacts 62 and 69 of the switch 64.

I have shown a preferred embodiment of my invention but it is obvious that numerous changes and omissions may be made without departing from its spirit. For example, baffles may be provided on the movable partitions to assist in the distributing action if desired. In addition while I have briefly described the operations of washing and extracting, the operation of rinsing may be performed during high speed rotation and in any suitable position of the movable partitions. It is further to be noted that it is unnecessary to maintain the movable partitions in their outward or compressing positions after high speed extraction has commenced since at that time the centrifugal force generated will maintain the clothes in their concentrated state without the support of the partitions. It is also practical, as shown in my previous application mentioned above to form the partition of concave or convex cross section. Similarly, the end walls of the cylinder may likewise assume these forms. While the term "drying machine" is mentioned herein, a degree of drying attainable by centrifugal extraction is referred to.

I claim:

1. In a washing and drying machine having a drum rotatable at low speed for washing operations and at a high speed for centrifugal drying operations, a member normally at one end of the drum and movable axially of said drum and to a position closely adjacent the other end thereof for reducing the effective volume thereof prior to said drying operations, and drive means disposed circumferentially of said movable member for actuating said movable member.

2. In a washing and drying machine having a drum having enclosing end walls and rotatable at low speed for washing operations and at a high speed for centrifugal drying operations, a partition movable axially of said drum from one end wall to the other for reducing the effective volume thereof for treatment of washed articles during said drying operations, and drive means for said partition, said drive means comprising a plurality of rotated screw shafts, disposed laterally and externally of said drum and spaced radially and equidistantly around the outer circumference

of said drum and followers actuated by said screw shafts and communicating with said partition so as to transmit motion thereto through spaced, equidistant slots formed in the wall of said drum.

3. In a washing and drying machine having a drum having enclosing end walls and rotatable at low speed for washing operations and at high speed for centrifugal drying operations, a member movable axially of said drum from one end wall to the other for reducing the effective volume thereof for treatment of washed articles during said drying operations, drive means for said partition, said drive means including a member driven externally of said drum along a path parallel to the longitudinal axis thereof, means to drive said member, and a strengthening ring member slidably embracing said drum cylinder at the entire outer periphery thereof and actuated by said drive means whereby the reduced portion of said drum is bounded by said strengthening ring member.

4. In a washing and drying machine having a drum having enclosing end walls and rotatable at low speed for washing operations and at a high speed for drying operations, a partition movable axially of said drum from one end wall to the other for reducing the effective volume thereof for treatment of washed articles during said drying operations, drive means for said partition, said drive means comprising a rotating shaft secured externally of said drum, a follower adapted for movement in a path parallel to the longitudinal axis of said drum in response to the rotation of said shaft, a strengthening ring slidably embracing said drum and secured to said partition through a slot formed in said drum, and means to transmit the movement of said follower to said ring whereby said partition is actuated axially of said drum to reduce the effective volume thereof.

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