March 10, 1959 E. G. LIPSKI 2,876,906

VIBRATION ISOLATING AND CONTROLLING MEANS

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FIG. 1.

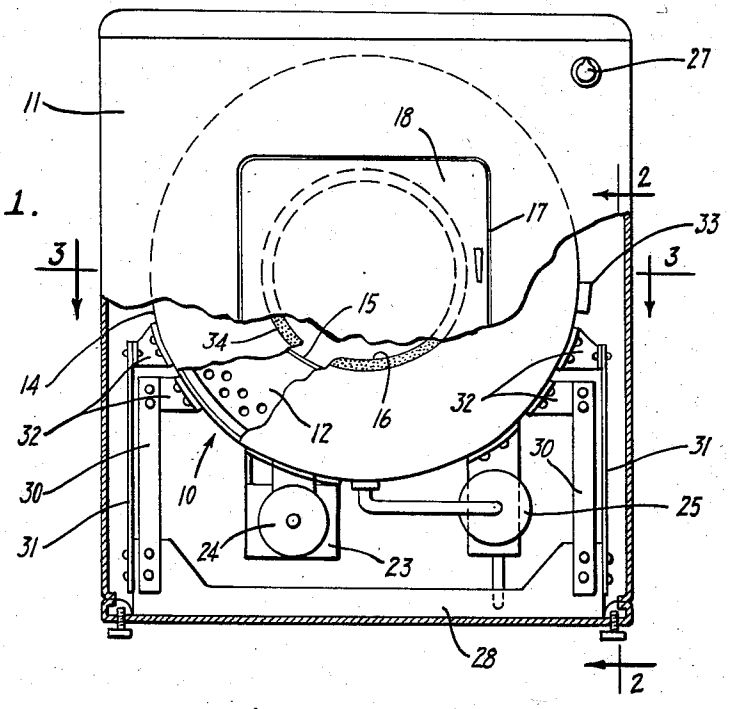
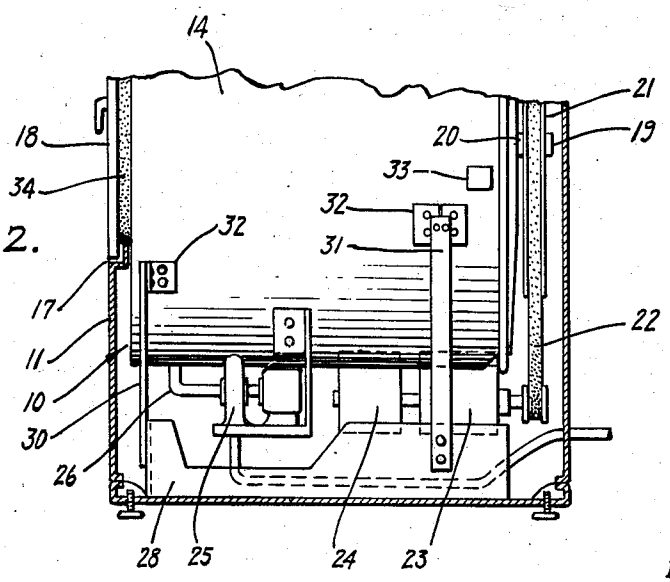


FIG. 2.



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FIG. 3.

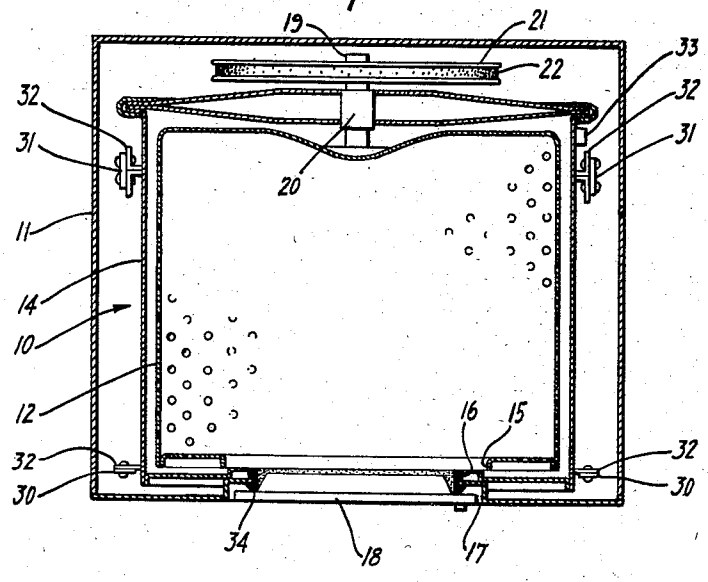


FIG. 4.

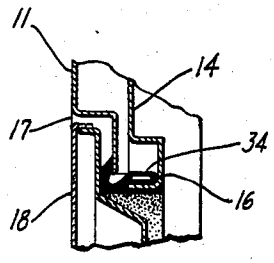
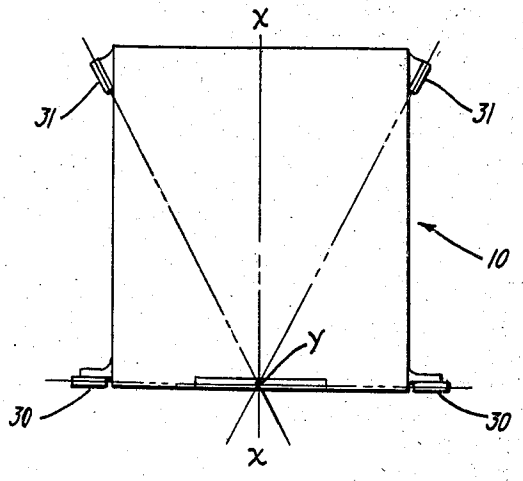


FIG. 5.



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United States Patent Office 2,876,906 Patented Mar. 10, 1959

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VIBRATION ISOLATING AND CONTROLLING MEANS

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Application October 19, 1956, Serial No. 616,980

4 Claims. (Cl. 210—364)

The invention herein disclosed and claimed relates generally to vibration isolating and controlling means and pertains more particularly to means for isolating and controlling vibrational displacements of rotatably driven containers for centrifugally extracting liquid from material placed therein. More specifically, the invention has to do with improved mounting and supporting arrangements for a clothes washing machine of the tumbler type in which a perforate drum is disposed within an imperforate tub and rotated therein about a substantially horizontal axis.

In machines of this type, the drum is driven at predetermined slow speed during washing and rinsing cycles and is spun at predetermined high speed during liquid extracting periods. In the transition from slow speed to high speed, and during spinning at high speed, the drum-and-tub assembly is subject to severe gyratory vibrational forces due to uneven distribution of clothes. In order to prevent these forces from being transmitted to the cabinet enclosing the drum-and-tub assembly, it has been the custom to mount said assembly so as to isolate it from the cabinet. For that purpose, it has been common practice to utilize spring mounting structures which allow the drum-and-tub assembly to vibrate freely with respect to the cabinet. However, known structures of that variety give rise to problems and difficulties, particularly in the mounting of a door for closing the access opening to the drum-and-tub assembly and in the provision of a satisfactory seal between the tub and the cabinet at said access opening. For example, in order to obviate the sealing problems, it has been proposed to mount the door on the drum-and-tub assembly. When so mounted, however, the door moves with the assembly in its vibrational and gyratory displacement and, therefore it is necessary to provide the cabinet with an enlarged door-seating well which leaves a wide unsightly gap between the marginal edges of the door and said cabinet opening. Also, visible movement of the door with respect to the stationary cabinet wall during operation of the machine is objectionable. To overcome these unwanted and objectionable features, it was found desirable to mount the door on the cabinet but, by so mounting the door, it becomes necessary to employ a flexible cylindrical boot extending between and attached to the drum-and-tub assembly and to the cabinet about their access openings. Such a boot must be specially constructed and requires elaborate securing means, all of which add to the cost of the machine.

It is, therefore, an object of this invention to provide a simplified and inexpensive arrangement which overcomes and solves the above noted difficulties and problems.

It is also an object of the invention to provide an improved arrangement which makes it possible to mount the door either on the cabinet or on the drum-and-tub assembly, as desired, and which further makes it possible in either case to fit the door neatly within its accommodating well in the cabinet wall and to render unnoticeable any displacement of the door with respect to said wall during operation of the machine.

Another object of the invention is to do away with the

necessity of employing a costly boot-type sealing member at the access opening of the clothes washing machine.

A characteristic feature of the invention resides in the provision of a spring-mounting arrangement for the liquid-extracting assemblage of a centrifuging machine, which arrangement not only minimizes transmission of vibration to the cabinet enclosing said assemblage, but which also establishes a node for the vibratory system and fixes that node in such manner as to stabilize that portion of the assemblage where the access opening is located.

The invention is further characterized by the fact that vibrational forces transmitted to the drum-and-tub assembly of a clothes washing machine when spinning under unbalanced load conditions, are resisted particularly at the open portion of said assembly, so that motion of said portion with respect to the open portion of a cabinet wall is reduced to a minimum. In this manner, it is possible to provide an effective seal by means of the simple compressible gasket between said assembly and the door for closing said portions.

In a broader aspect, the invention employs simple resilient members for supporting a fluid-extracting assemblage, said members cooperating to allow said assemblage to vibrate without affecting the enclosing cabinet and to control the vibrating assemblage in a positive manner to reduce to an imperceptible degree the vibrational motions of said assemblage at the open portion thereof which confronts the access opening.

In incorporating the principles of the invention in a clothes washing machine of the hereinbefore mentioned general type, use is made of elongated substantially flat spring bars which are angularly related and which are disposed on opposite sides and at opposite end portions of the horizontally arranged drum-and-tub assembly. According to a preferred embodiment, four such spring members are mounted vertically and arranged in two pairs, the bars of one pair being positioned to support the forward end portion of the assembly where the access opening is located, and the bars of the remaining pair being positioned to support the other or rearward portion of the assembly. The forwardly positioned vertical spring bars are disposed so that their flat sides are perpendicular to the longitudinal axis of the drum-and-tub assembly, whereas the rearwardly positioned spring bars are disposed so that their flat sides are either parallel, or slanted to a predetermined degree, with respect to said axis.

The full nature of the invention and the manner in which the above noted objects and features of the invention are achieved, will be fully understood from the following description taken in conjunction with the accompanying drawings in which:

Figure 1 is a front elevational view of a tumbler type washing machine with parts broken away to illustrate the essentials of the invention;

Figure 2 is a fragmentary cross-sectional view looking in the general direction of arrows 2—2 of Figure 1;

Figure 3 is a sectional view taken substantially on line 3—3 of Figure 1;

Figure 4 is an enlarged fragmentary view of a portion of the machine at its access opening;

Figure 5 is a diagrammatic view illustrative of the principles of the invention, while showing a specifically different arrangement of the rear spring members.

With more particular reference to the drawings, the invention is illustrated as applied to a tumbler type clothes washing machine which includes a drum-and-tub assembly 10 enclosed in a cabinet 11. The assembly 10 comprises a perforated cylindrical fluid-extracting drum 12 adapted to rotate about a substantially horizontal axis within an imperforate cylindrical fluid-draining tub 14,

The front wall of the drum **12** and the front wall of the tub **14** are provided with openings **15** and **16** which are disposed concentrically and which register with an access opening **17** formed in the front wall of the cabinet.

In the illustrated embodiment, a door **18** is hingedly mounted on the front wall of the cabinet to close the access opening, although the door could be mounted on the drum-and-tub assembly, if so desired. As best seen in Figure 3, a rigid shaft **19** is affixed to the rearward portion of the drum **12** to extend axially thereof and passes through a bearing structure **20** formed in the rearward portion of the tub **14**. A pulley **21** is keyed to the outer end of the shaft **19** and is actuated by means of a belt **22** which, as shown in Figure 2, is in engagement with a multiple speed transmission **23** driven by a motor **24** and operable to rotate the drum at slow speed throughout washing and rinsing cycles and at high centrifuging speed throughout water extracting cycles. The transmission and motor are attached to the lower portion of the tub **14**, as is a motor-driven pump **25** which communicates through a conduit **26** with said tub to drain the same. The supply of hot and cold water and the operation of the machine through its filling, washing, rinsing, spinning and draining functions are governed by means of well-known sequential mechanisms (not shown) which are selectively adjustable, as through a dial represented at **27** in Figure 1.

The hereinbefore described drum-and-tub assembly **10** is supported as a unit on a base frame **28** by means of a resilient suspension which vibrationally isolates and assembly from the cabinet **11**. As shown, the suspension comprises a pair of forwardly disposed elongated spring bars **30** and a pair of rearwardly disposed elongated spring bars **31**. These pairs of spring bars are mounted in upright position, having their lower end portions rigidly affixed to the base frame **28**, and having their upper end portions fixedly attached to suitable brackets **32** secured to the tub **14**.

In particular accordance with this invention, the pairs of bars are angularly related, that is to say, the bars are so mounted that the flat sides of the bars of one of said pairs lie in planes which extend angularly with respect to the planes in which lie the flat sides of the bars of the other of said pairs. Thus, in the example illustrated in Figures 1, 2 and 3, the forwardly disposed bars **30** are oriented so that their flat sides parallel the front of the drum-and-tub assembly **10** whereas the rearwardly disposed bars **31** are oriented so that their flat sides are parallel to the side of said assembly. In other words, as seen in Figures 1, 2 and 3, the longitudinal edges of the front bars **30** face in directions perpendicular to the axis of rotation of the drum, and the longitudinal edges of the back bars **31** face in directions parallel to said axis. It would of course be understood that, in the broader aspect, the invention contemplates the possibility of employing springs differing specifically from those shown, so long as they afford essentially the same degree of freedom presently to be described.

During operation of the machine under unbalanced load conditions, the pairs of spring bars **30** and **31**, while freely supporting the drum-and-tub assembly within the enclosing cabinet, serve to prevent said assembly from bouncing up and down because said bars provide ties counteracting unbalanced forces in the vertical direction. Also the drum-and-tub assembly is prevented from oscillating toward the front and back of the machine because the rearwardly disposed bars **31** due to their angular orientation with respect to the forwardly disposed bars **30**, that is, with their major cross-sectional dimension generally paralleling the longitudinal axis of the machine, counteract the compliance of said forwardly disposed bars which have their major cross-sectional dimension extending perpendicular to the general direction of the longitudinal axis of said assembly. Similarly, the major cross-sectional dimension of the forward bars is so oriented as to prevent movement of the assembly in the plane of the front access opening. To put it in other words, the forwardly disposed bars **30** are so oriented as to have virtually no compliance in the lateral direction, that is in the direction of their major cross-sectional dimension, so that the unbalance forces tend to resolve themselves into generally torsional forces, with the result that the drum-and-tub assembly swings as if it were pivoted at a nodal point (point *y*, Figure 5) located in the vicinity of the adjacent front walls of the assembly and cabinet, this constituting the only degree of freedom afforded. In fact, the present invention has the advantage that the displacement pattern of the vibratile system can be controlled and the location of the node can be determined by establishing a proper correlation between the front and rear bars **30** and **31**.

For example, by making the rear bars **31** of less thickness, or of greater length, than the front bars **30** there is obtained a condition in which the rearward portion of the drum-and-tub assembly is given greater freedom of motion, whereas the front of said assembly is held comparatively rigid. In this manner, it is possible to utilize the swinging displacement of said rearward portion to control the operation of the machine should excessive unbalance due to unusual misdistribution of clothes give rise to a dangerous condition. For that purpose, a suitable cut-off switch means **33** of known type can be associated with said rearward portion to effect automatic shut-off of the machine in the event of dangerous unbalance.

Furthermore, by correlating the disposition of the pairs of bars **30** and **31**, the node of the vibratile system can be positively located in a fixed predetermined position. This feature can readily be obtained, as illustrated diagrammatically in Figure 5. In the embodiment there illustrated, the rear bars are mounted in planes which converge toward the front of the drum-and-tub assembly and which cross the longitudinal axis of rotation *x—x* of the drum in the plane of the front bars. In other words, as seen in Figure 5, the front bars **30** and the rear bars **31** are so oriented as to face edgewise toward a generally vertical axis *y* intersecting the longitudinally extending axis of rotation of the drum at the front of the drum-and-tub assembly.

By so arranging the pairs of front and rear bars, the node becomes located at the front access opening in a position which coincides substantially with the vertical center line of said opening. The advantage gained by so locating the node is that angular motion of the drum-and-tub assembly at said access opening is reduced to a minimum. However, it is found that when the bars **30** and **31** are mounted and arranged in the manner hereinabove described with reference to Figures 1, 2 and 3, the movement which the front of the drum-and-tub assembly undergoes during operation of the machine is sufficiently small for the purposes of this invention.

Accordingly, in practice, whether the bars **30** and **31** are correlated as in Figures 1, 2 and 3 or as in Figure 5, the angular vibrational excursion of the front end portion of the assembly toward and away from the front wall of the cabinet is negligible. For that reason, it is possible to mount the door **18** on the front wall of the cabinet **11** and yet to provide an effective watertight seal by means of a simple compressible gasket **34** affixed to the tub **14** about the access opening **16** thereof. Also because of the slight angular displacement of the front portion of the drum-and-tub assembly during operation of the machine it is possible, if desired, to mount the door **18** on the front wall of the tub **14** without objectionable result since movement of the door with said tub would not be noticeable.

While the invention has been shown and described with respect to what are presently considered preferred embodiments, it will be recognized that modifications may be made in the specified structural details without

departing from the gist of the invention. Accordingly, it is to be understood that the subjoined claims are intended to cover those changes and modifications which come within the true spirit and scope of the invention as set forth in said claims.

I claim:

1. In a centrifuging machine provided with a liquid-extracting assemblage including a drum, said assemblage having a front wall portion with an opening therein to give access to the drum and also having a rear wall portion with structure thereon to mount the drum for rotation about a horizontal axis; means for supporting the mentioned assemblage and for controlling its vibration comprising two pairs of substantially flat bar springs having major and minor cross-sectional dimensions, one spring of each of said pairs being located on one side of the mentioned axis of rotation of the drum, the other spring of each of said pairs being located to the opposite side of said axis, each of said flat bar springs of one of said pairs being connected to said assemblage in the region of the front wall portion thereof and being disposed with its major cross-sectional dimension extending in a plane substantially normal to and crossing said axis in the region of the plane of the mentioned access opening, and each of said flat bar springs of the other of said pairs being connected to said assemblage toward the rear wall portion thereof and being disposed with its major

cross-sectional dimension extending in a plane crossing said plane of the access opening.

2. Means as set forth in claim 1, in which the mentioned flat bar springs connected to the assemblage toward the rear wall portion thereof are disposed so that their major cross-sectional dimensions extend in planes parallel to the axis of rotation of the drum.

3. Means as set forth in claim 1, in which the mentioned flat bar springs connected to the assemblage toward the rear wall portion thereof are disposed so that their major cross-sectional dimensions extend in planes which converge toward the axis of rotation of the drum and cross said axis adjacent said plane of the mentioned opening.

4. Means as set forth in claim 1, in which the mentioned flat bar springs connected to the assemblage at points toward the rear wall portion thereof are disposed so that their major cross-sectional dimensions extend in planes intersecting the axis of rotation of the drum and in the plane of the mentioned opening.

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