United States Patent

Steele

[15] **3,703,091**

[45] **Nov. 21, 1972**

[54] **CENTRIFUGAL EXTRACTION MACHINES**

[72] Inventor: **Johathan Peter Steele,** London, England

[73] Assignee: **The Hoover Company,** North Canton, Ohio

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[52] **U.S. Cl.** **68/23.1,** 210/364

[51] **Int. Cl.** **D06f 23/02,** F16f 15/00

[58] **Field of Search** 210/364; 68/23.1, 24

[56] **References Cited**

UNITED STATES PATENTS

3,509,742 5/1970 Bauer 68/23.1

FOREIGN PATENTS OR APPLICATIONS

1,383,101 11/1964 France.....68/23.1

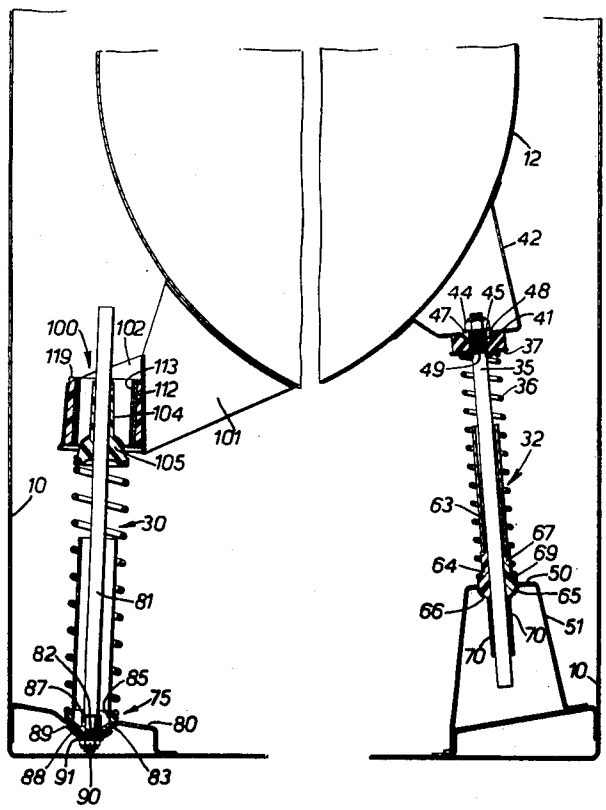
Primary Examiner—William I. Price

Attorney—Alfred G. Gross

[57] **ABSTRACT**

A centrifugal extraction machine is disclosed which incorporates a resiliently mounted assembly within which clothes are contained during washing. The assembly is supported by an outer casing entirely from below by a number of legs each incorporation a spring. There may be two or three such legs which may be connected to the casing or assembly by universal joints at one or other end. In at least one of the legs, the universal joint incorporates a friction damper bush split longitudinally of a supporting strut of the leg, and arranged so as to frictionally engage the leg and be forced thereagainst to cause frictional damping by compression of the spring during operation.

17 Claims, 11 Drawing Figures



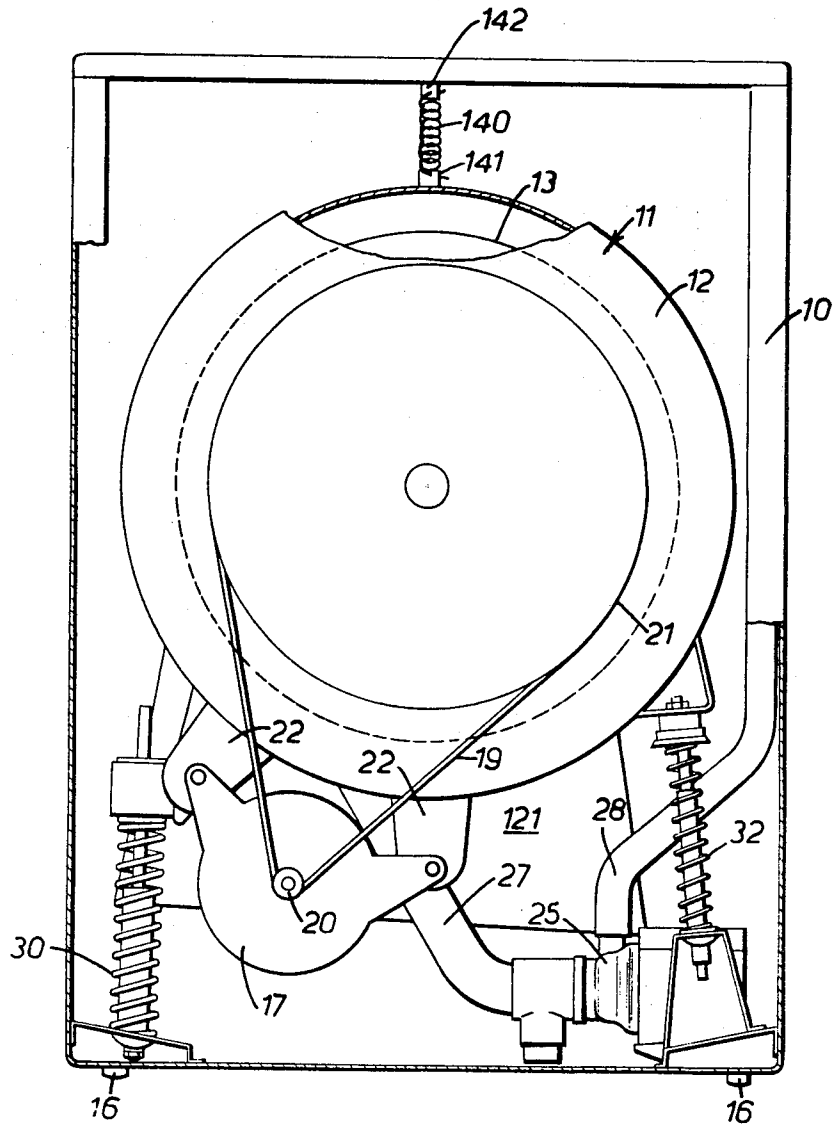


FIG. 1.

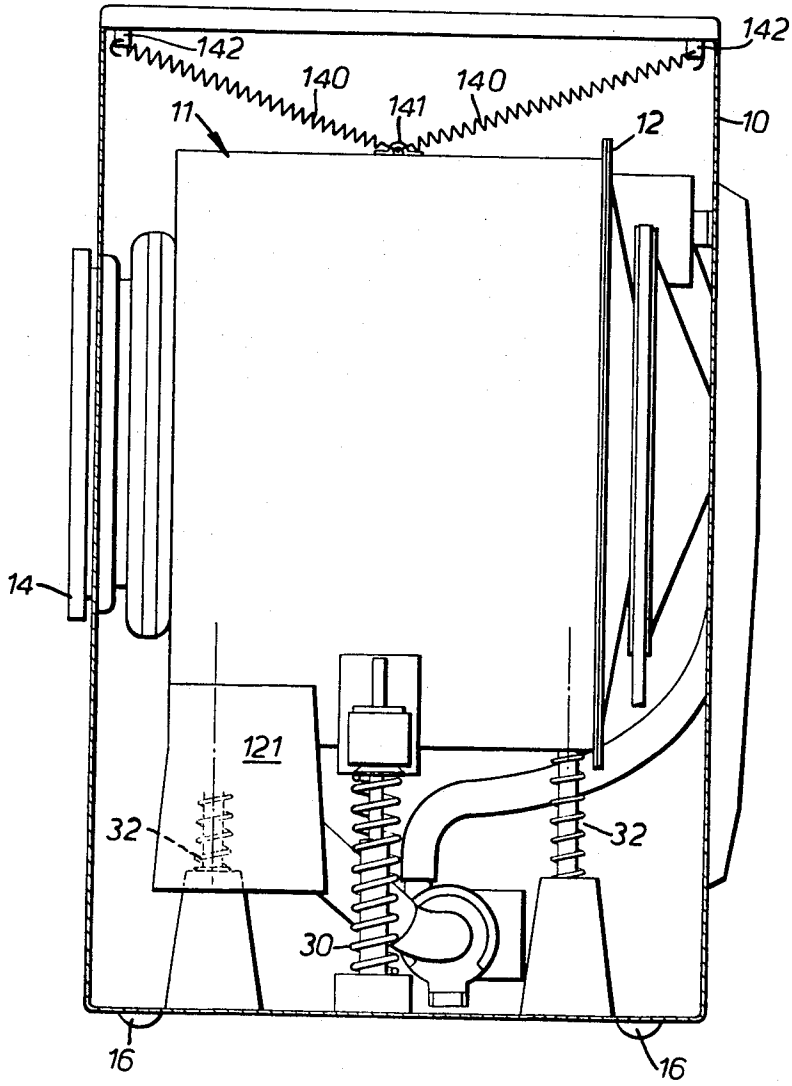


FIG. 2.

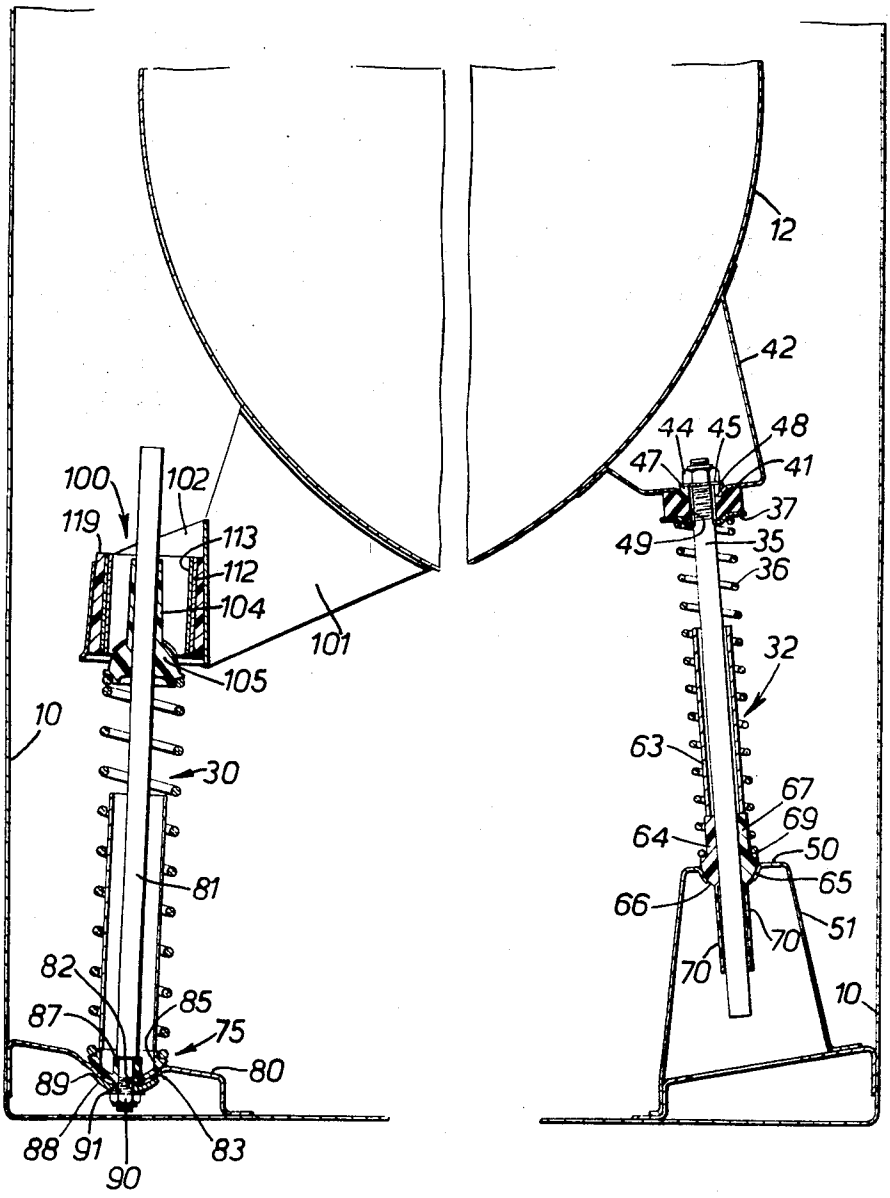

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FIG. 3

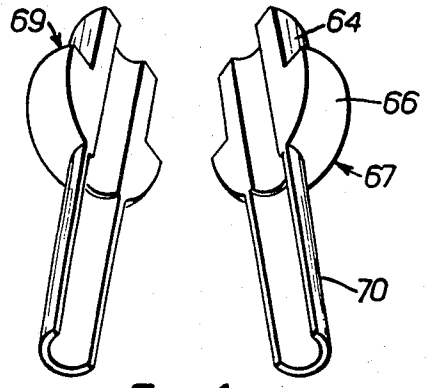

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FIG. 4

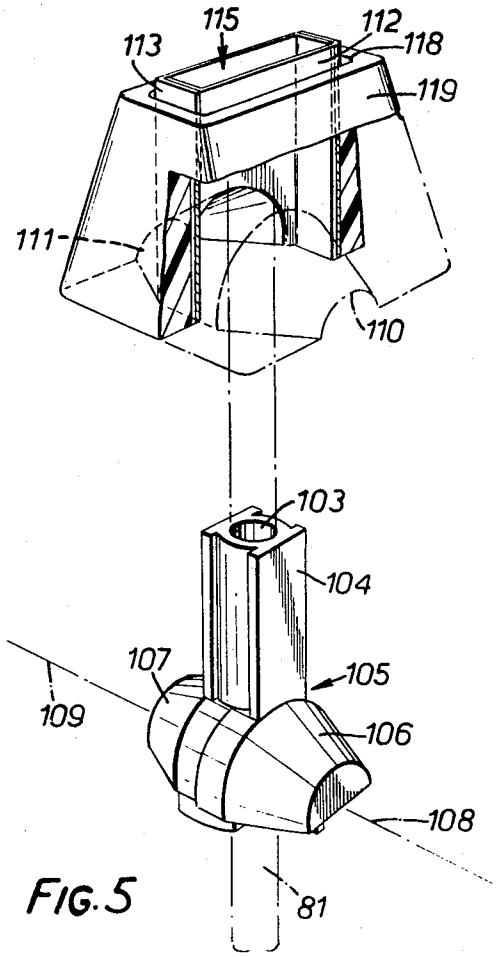

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FIG. 5

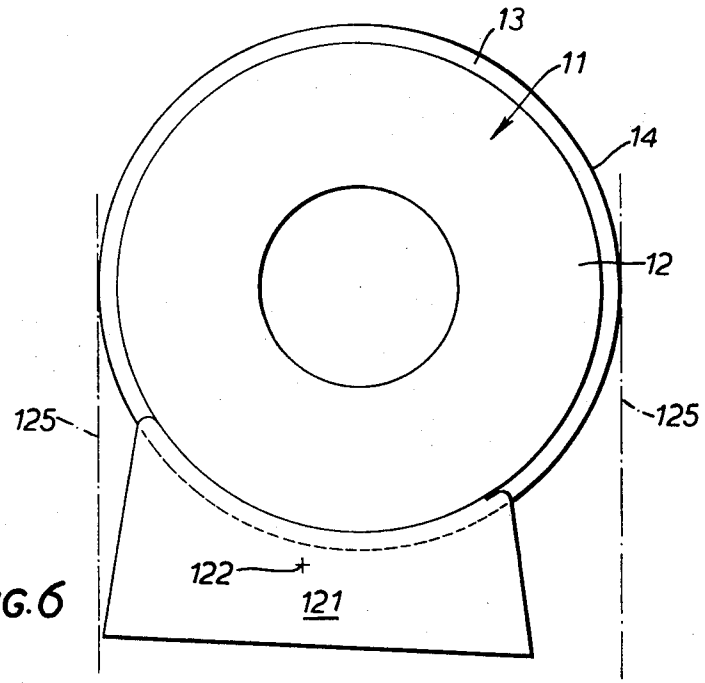


FIG. 6

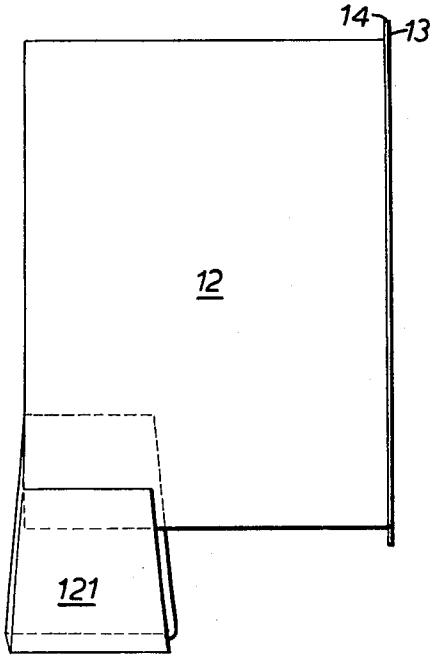


FIG. 7

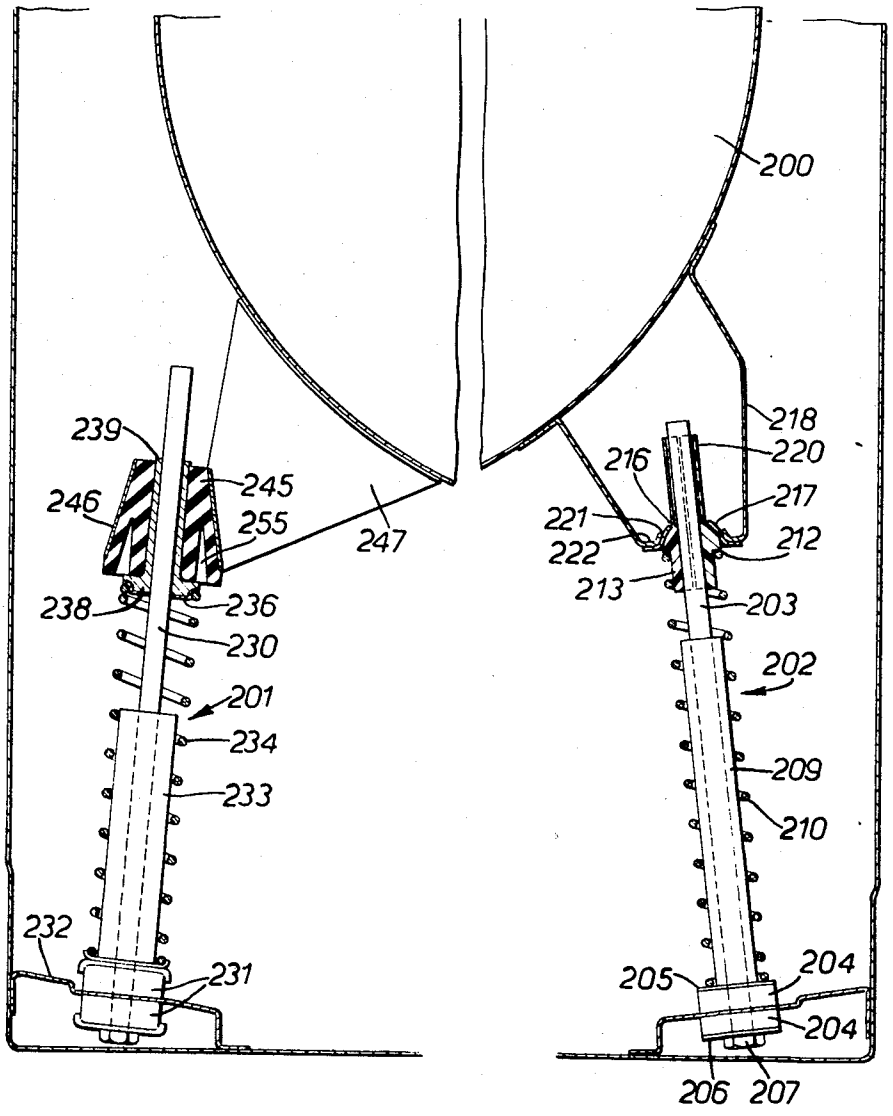

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FIG. 8

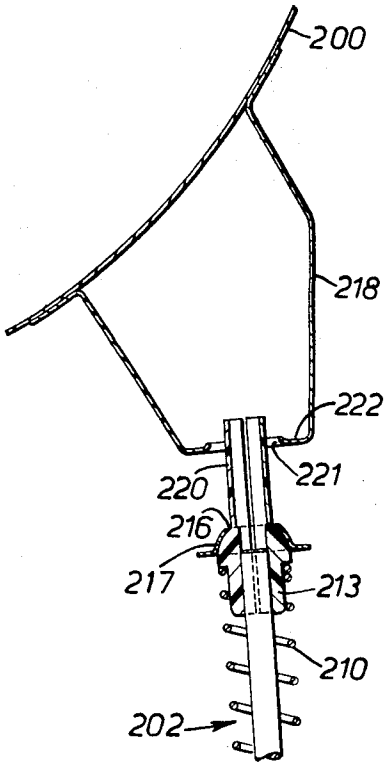

200
218
222
221
220
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217
213
210
202

FIG. 9.

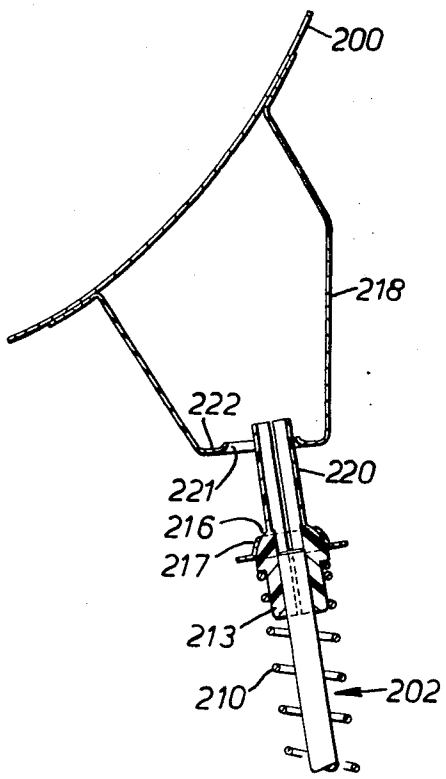

200
218
222
221
220
216
217
213
210
202

FIG. 10.

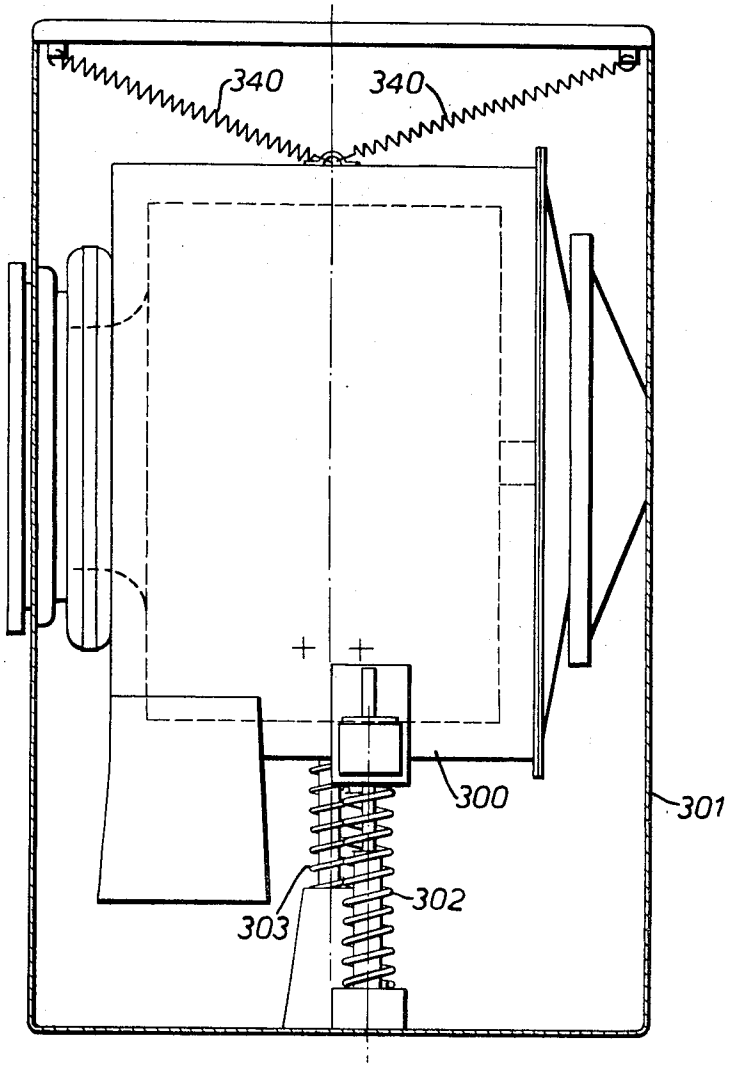


FIG. 11.

CENTRIFUGAL EXTRACTION MACHINES

BACKGROUND OF THE INVENTION

This invention relates to washing and/or centrifugal extraction machines. Vibration is a common problem in the design of machines of the type which include a resiliently mounted assembly comprising a container for liquid within which is mounted a rotary clothes drum for rotation about a horizontal axis. Many efforts have been made either to suspend the assembly from above within an outer casing or frame but in general these constructions have been complicated in design with consequent expense. There have been certain prior proposals for the mounting of these assemblies from below but in general they have been difficult to assemble or to take apart for service and in many cases they have incorporated expensive damper units.

SUMMARY OF THE INVENTION

It is accordingly a principal object of the present invention to provide a very simple configuration for supporting the resiliently mounted assembly in a washing machine. It is another object of the invention to provide a construction in which the assembly is supported by springs having guide struts which are secured at one end or the other to the assembly or the outer frame by novel forms of connection which permit unrestrained tilting of the strut.

It is a further object of the invention to provide an assembly with a novel inertia mass system which enables the construction of a machine with an outer casing lying very much closer to the container for liquid than has previously been possible.

According to one aspect of the present invention a washing and/or centrifugal extraction machine includes an assembly comprising a container for liquid within which a clothes drum is mounted for rotation about a substantially horizontal the springs supported by an outer frame from below by a plurality of springs and including at least one damper unit associated with one of the springs, the damper unit including a strut which extends between lower and upper end connections respectively on sections of the frame and the assembly. One end connection is of a non-rigid nature to permit tilting of the strut with respect to the section at that one end. The second end connection includes an annular damping member surrounding a portion of the strut and having a part-spherical surface engaging a corresponding part-spherical seat secured to or located with respect to the section at the second end to permit substantially unrestrained tilting of the strut with respect to the section at the second end. The associated spring of the damper surrounds the strut with one end of the spring bearing on an abutment surface which is secure against longitudinal movement with respect to either a portion of the strut adjacent the said one end or the section at the said one end, the second end of the spring bearing directly or indirectly on the damping member. The damping member has at least one longitudinal split which permits the cross section of its bore to be reduced by compression of the spring thereby frictionally to engage the strut upon downward movement of the assembly.

Preferably the annular damping member comprises an at least part-spherical bush having a longitudinal split dividing it unto two portions along the axis of the strut. If desired the damping member may be similarly split into more than two portions.

The lengths of the spring and strut are preferably such that the damping member is disposed on the strut in such a position that the strut remains within a bore of the damping member when the spring is extended to its unloaded free length.

According to specific embodiments of the invention the assembly may be supported by two or three springs. With what may be called a three-legged construction, two of the springs may each have a damper unit associated therewith and extend between the frame and the assembly below and to one side of the axis, in which case the third spring extends between an end connection on the frame and an end connection on the assembly below and to the other side of the axis, the end connections of the third spring providing no or negligible damping.

With a so-called two-legged construction where only two springs are employed, one on each side of the axis one spring may have a damper unit associated therewith and the other spring have no damper unit associated therewith. Alternatively each of the springs may have a damper unit associated therewith.

According to a further aspect of the present invention a washing and/or centrifugal extraction machine includes an assembly comprising a container for liquid within which a clothes drum is mounted for rotation about a substantially horizontal axis with the assembly supported by an outer frame from below by at least two springs extending between sections of the assembly and the frame, at least one of the springs surrounding a guide strut secured at one end to one of the sections and at the other end extending through a single universal joint which permits unrestrained tilting of the strut and spring with respect to the section at that end.

According to yet another aspect of the invention a washing and/or centrifugal extraction machine includes an assembly comprising a container for liquid within which a clothes drum is mounted for rotation about a substantially horizontal axis with the assembly supported from below within an outer casing by a plurality of springs, the assembly carrying an inertia mass system comprising at least one weight secured to the container, the whole of the inertia mass system being disposed below the axis of rotation of the drum.

The invention may be carried into practice in a number of ways but three specific embodiments will now be described by way of example with reference to the accompanying drawings in which:

FIG. 1 is an elevational view partly in sections of a horizontal axis washing machine according to the invention;

FIG. 2 is a side elevational view partly in section of the washing machine of FIG. 1;

FIG. 3 is a fragmentary sectional end view to an enlarged scale of parts of each side of the washing machine of FIG. 1 to show the detailed construction of the spring leg units incorporated therein;

FIG. 4 is a perspective view of the two halves of a friction damper bush incorporated in two of the spring leg units of the embodiment of FIGS. 1 to 3;

FIG. 5 is a perspective view of the form of mount incorporated at the upper end of a spring leg unit shown on the left-hand side of FIG. 1;

FIG. 6 shows, in a diagrammatic manner, part of the washing machine and the general configuration of a concrete weight as viewed from the front;

FIG. 7 is a side elevation of FIG. 6;

FIG. 8 is a view similar to FIG. 3, but showing an alternative embodiment;

FIG. 9 illustrates an out-of-balance condition in which one of the spring leg units of the construction of FIG. 8 has separated from the assembly it supports;

FIG. 10 illustrates the manner in which the parts shown in FIG. 9 are arranged to remain located with respect to one another so that they return to a correct position when such extreme out-of-balance condition has ceased, and

FIG. 11 is a sectional side elevation of a third embodiment in which a washing machine assembly is supported merely by two legs, the construction otherwise being similar to that of FIGS. 1 to 7.

Referring first to FIG. 1 this illustrates an outer casing 10 with the rear panel thereof removed to show a resiliently mounted assembly 11 which includes an outer tub 12 within which is mounted a horizontal axis rotary drum 13 for containing clothes to be washed. The clothes are loaded into and removed from the drum 13 through a front opening normally closed by a door 14 as shown in FIG. 2. The casing 10 is mounted on wheels 16.

The drum 13 is driven by an electric motor 17 via a belt 19 and pulleys 20 and 21. The motor 17 is mounted on the underside of the resiliently mounted assembly 11 by means of a pair of brackets 22. The drum 13 is filled through plumbing not shown and is emptied by means of an emptying pump 25 receiving liquor from the tub 12 through a flexible pipe 27 and discharging this liquor upwardly through an outlet hose 28 which can be connected to a drain or sink. The parts so far described are conventional and do not form any part of the present invention.

The assembly 11 is supported within the casing 10 substantially entirely from below by means of three so-called spring leg units. One of these units 30 comprises a straightforward spring leg having no damping facility and as can be seen from FIG. 2 this is disposed substantially centrally along the fore and aft axis of the assembly 11. On the right-hand side of the assembly as viewed in FIG. 1 the assembly is supported by a pair of spring leg units 32 each incorporating a damper and spaced apart in the manner shown in FIG. 2.

The detailed form of the spring damper leg units 32 is shown on an enlarged scale on the right-hand side of FIG. 3. Thus each incorporates a spring 36 which, at its upper end, bears on a plate 37 forming part of an upper resilient mounting for a longitudinal guide strut 35. The plate has a center aperture surrounding a reduced diameter end section of the strut so as to prevent downward movement of the plate 37. The mounting includes a rubber bush 40 surrounding the strut 35 and mounted under compression between the plate 37 and a substantially horizontal section 41 of a bracket 42 secured to the underside of the tub 12. The horizontal section 41 is apertured in order to permit the strut 35 to pass upwardly therethrough. The upper end of the strut 35 carries a nut 44, a washer 45 and a hemispherical nylon bush 47, the latter having a downwardly facing convex surface which engages in a concave seat 48 forming the periphery of the aperture in the section 41 through which the strut 35 passes. A spacer sleeve 49 extends between the plate 37 and the washer 45 to control the degree of compression of the bush 40. This form of connection of the upper end of the leg 32 provides for restrained universal movement of its upper end with respect to the assembly 11.

At its lower end, the leg 32 has the lower end of the strut 35 passing through an aperture in a substantially horizontal section 50 of a bracket 51 mounted within the casing 10. The periphery of the aperture provides a concave seat 65 to receive a downwardly facing part-spherical surface 66 afforded by a friction damper bush 67 formed in two halves as shown in detail in FIG. 4. The two halves together afford an upwardly facing shoulder 69 upon which the lower end of the spring 36 bears. Above the shoulder 69 the two halves of the bush 67 provide a skirt 64 extending within the spring 36 for location purposes. Mounted above the skirt 64 and surrounding the strut 35 within the spring 36 is a spacer tube 63 which maintains the spring in its longitudinal alignment. As shown in FIG. 4 each half of the bush 67 has a downwardly extending semi-circular sleeve section 70 the two sections 70 together substantially surrounding the lower end of the strut 35 but normally being spaced therefrom. The purpose of the two sections 70 is to provide for location of the bush 67 with respect to the concave seat 65 even in the case of extreme out-of-balance conditions when the strut 35 can move upwards to a considerable extent and might carry the bush 67 with it away from the concave seat 65. The two halves of the bush 67 co-operate with the concave seat effectively to provide the leg 32 with a universal joint at its lower end, this joint being of an unrestrained nature. During operation of the machine downward movement of the resiliently mounted assembly 11 will cause compression of the spring 36. Such downward compression of the spring will force the two halves of the damper bush 67 into the seat 65 which in turn will cause inward loading of the halves of the bush against the surface of the strut 35 so increasing the frictional effect between the halves of the bush and the strut. Accordingly the amount of friction damping caused by the halves of the bush will be proportional to the displacement of the assembly 11 downwards. The amount of friction damping afforded by each of the legs 32 (which are of identical form) also depends on the radius of the surface 66 and the shape of the concave seat 65. The material used for the manufacture of the friction damper bush can vary according to requirements but material such as acetal, sintered iron, sintered bronze, etc., running in grease are found suitable. Even with plastics materials it may be desirable for some lubrication to be provided between the bush and the strut. Although the bush has been shown in two halves in FIG. 4 it is envisaged that it could be formed in a single piece provided with merely one longitudinal split. Alternatively it could be divided into more than two parts; indeed the greater the number of parts the greater spread of contact pressure there will be on the surface of the strut 35.

Turning now to the specific form of the unit 30 by which the assembly 11 is supported on the left-hand side, the lower end of this unit 30 is connected to a section 80 of the outer casing 10 by a universal joint

generally indicated at **75**. Thus a strut **81** of this unit passes through an aperture **82** in the section **80**, the margin of the aperture **82** forming a concave seat **83** for a downwardly facing hemispherical surface on a plastics bush **85**. The material of the bush is relatively hard but provides a suitable bearing for the universal movement to be obtained between it and the seat **83**. The bush **85** has a central hub **87** a lower part of which extends through the aperture **82**, a concave washer **88** surrounding this section and being of such diameter that its periphery **89** is located at all times beneath the section **80**. The parts are secured in place by a nut **90** and a washer **91** on a lower, threaded, end of the strut **81**.

Turning now to the upper end of the unit **30** shown in FIGS. **1** and **3**, this provides for substantial restraint against tilting of the strut **81** with respect to the assembly **11** in a fore and aft plane but provision is made for very considerable freedom of movement in a lateral plane. This is attained by the form of mounting **100** shown in detail in FIG. **5**.

The tub **12** has a bracket **101** to which is secured a generally frusto-conical metal housing **102** for the mounting **100**. The strut **81** extends through the housing **102** with the part of the strut within the housing being received within a bore **103** of a guide sleeve **104** which forms an integral part of a guide and pivot member **105** the detailed configuration of which is shown in FIG. **5**. Thus the member **105** has, at the lower end of the guide sleeve **104**, a pair of bearing portions **106** and **107** the axes **108** and **109** respectively of which are substantially in line with one another. The bearing portions **106** and **107** are received in downwardly facing curved seats **110** and **111** respectively. These seats are formed by outwardly directed portions of a pair of overlapping U-shaped metal stationary guide plates **112** and **113** respectively. The two guide plates are shown in position in FIG. **5** within a substantially rectangular space **118** in a frusto-pyramidical rubber block **119** which is received within the housing **102** shown in FIG. **3**. The longer side of the block **119** i.e. that which extends at right angles to the axes **108** and **109**, extends substantially at right angles to the axis of the washing machine assembly **11**.

The guide sleeve **104** is normally positioned as shown in FIG. **3**, i.e. closely within the rectangular space **115** formed within the guide plates **112** and **113**, with the surfaces **106** and **107** in contact with their respective seats **110** and **111** so that limited pivotal movement of the strut **81**, which is guided by the guide sleeve **104**, can take place with respect to the mounting **100** in a plane at right angles to the axis of the washing machine assembly **11**.

Any fore and aft tilting of the strut **81** however is restrained by the block of rubber **119** within the housing **102**.

This in effect provides the unit **30** with a mounting at its upper end which, with respect to the washing machine assembly **11**, has considerable freedom of movement in one plane i.e. transverse to the washing machine axis, but is subject to considerable restraint against movement in any other direction. The mounting provides no restraint to upward and downward excursion of the assembly **11** since the strut **81** can slide quite freely in the bore **103** of the guide sleeve **104**.

It will be appreciated that this embodiment incorporates connections between the three units and the casing at their lower ends which are each of a universal nature. This type of configuration will of course produce an inherently unstable assembly **11**. In order to provide the necessary stability for operational purposes a pair of relatively light stabilizing springs **140** are provided as shown in FIG. **2**. These extend from a bracket **141** secured to the top of the assembly **11** centrally along its fore and aft length. The springs extend one forwards and one rearwards to suitable end connections **142** on the outer casing **10**. Bearing in mind that FIG. **2** is viewing the machine from the side, this provides restraint against tilting forwards or rearwards of the assembly since the springs **140** are under tension. Due to this tension however any tendency of the assembly to tilt sideways will cause elongation of each of the springs **140** so that these springs, whilst normally axially in line with one another immediately above the horizontal axis of the assembly **11**, do also provide for lateral restraint as well as fore and aft restraint against tilting. The springs are however, of a very light nature, and to all intents and purposes play no part in supporting the assembly **11** against downward movement, this being performed by the spring leg units **30** and **32**.

The springs **140** clearly act in opposite senses when the assembly tends to tilt in a fore or aft direction. The springs, while providing a restoring force, substantially cancel one another out and therefore the transmission of vibration to the top of the casing of the washing machine is very slight.

FIGS. **6** and **7** illustrate the tub **12** of the assembly **11**. In FIG. **6** it will be seen that the outermost periphery of a rear flange **13** of the tub is indicated by the circular line **14**. The spacing required between the assembly **11** and the outer casing **10** of the washing machine will be determined by the lateral excursion of the flange **13**. It is to be noted that a single inertia weight **121** formed of concrete is secured to the underside of the assembly **11** on its front end. This inertia weight is so designed, as with convential inertia weights, to provide added weight to the sprung mass to absorb energy. By virtue of the novel supporting system, it is found possible to utilize the configuration of the weight **121** shown which lies entirely within the downward plan projection of the outermost parts of the sides of the assembly **11**. Thus the two dotted vertical planes **125** indicate that the weight **121** is between these planes. Therefore there is no fear of the weight contacting the outer casing of the machine during lateral excursion of the assembly. This is in contrast to many prior constructions where the inertia weight or weights extend to a substantial extent laterally of the plan projection of the sprung mass so that the space provided between the sprung mass and the outer casing has to take into account the positions and sizes of such weight or weights which is not the case with the present design. Thus lateral weights are completely avoided. It is also significant with this form of suspension of the washing machine that no inertia weights are required on the top of the machine nor on the front of the assembly. Moreover the center of gravity of the weight **121**, indicated by the point **122** lies below the lowermost point of the container **12**. These features individually and collectively have enabled the overall

dimensions of the outer casing **10** to be considerably reduced in size since the casing can be brought much closer to the washing machine assembly **11** than heretofore.

FIGS. **8** to **10** illustrate an alternative embodiment in which an assembly **200**, similar in many respects to that of FIGS. **1** to **7**, is again supported by three spring leg units. As with the first embodiment, on the left in FIG. **8**, the assembly **200** is supported by a single spring leg unit **201** which provides no damping but, on the right-hand side a pair of spring damper legs **202** are incorporated.

The legs **202** are substantially the same as the units **32** of the first embodiment except that they are inverted. Thus the legs each incorporate a strut **203** mounted in a resilient manner at its lower end by a pair of rubber bushes **204** each under compression between upper and lower support plates **205** and **206** respectively, the requisite amount of compression being provided in the bushes **204** by clamping up a nut **207** at the lower end of the strut **203**. The strut **203** is surrounded by a spacer sleeve **209** and a compression spring **210**, the lower end of which bears on the plate **205**. The upper end of the spring **210** bears on a shoulder **212** of a split friction damper bush **213** substantially identical to the bush **67** in FIG. **3**. Thus the bush **213** is formed in two longitudinally separated halves through which the upper end of the strut **203** extends. In this case however, the two halves of the bush **213** afford an upwardly facing part-spherical surface co-operating with a cap **217** having an aperture **216**. The cap is formed by pressing to provide a part-spherical seat for engagement with the upper surface of the bush **213** and thereby forming a universal joint. The cap is located in position within an aperture **221** in a horizontal section **222** of a bracket **218** secured to the assembly **200**.

As with the first embodiment the halves of the damper bush **213** together form a sleeve **220** surrounding the end of the strut **203**. In this way the strut is provided with means to ensure that it will remain located with respect to the bracket **218** even in the case of extreme out-of-balance conditions.

FIGS. **9** and **10** illustrate such out-of-balance conditions when a very high out-of-balance load is included in the rotary drum of the assembly and it is run up through the critical speed. It is to be understood that this very high out-of-balance load is one which would amount to a fault condition or be due to misuse of the machine, but nevertheless it is found that with this design, the machine can cater for such high out-of-balance conditions. As shown in FIG. **9** the bracket **218** can in fact become completely separated from the upper end of the leg **202** but if the assembly **200** rises away from the spring **210** it will leave the cap **217** and the bush **213** still located on the end of the spring **210**. Even in this extreme condition however the sleeve **220** does not leave the aperture **221** in the bracket **218**. Thus when the assembly **200** falls again, even after lateral displacement with respect to the top end of the spring as shown in FIG. **10**, there will still be locational relationship between the assembly **200** and the leg **202** so that, as the assembly **200** falls again it will naturally settle satisfactorily on the cap **217** and resume its normal operational function. In this way the sleeve **220** ensures that with extreme out-of-balance loads, where the assembly can rise away from the spring damper leg, there is no fear of the assembly becoming completely separated from the spring damper leg and falling away from it during operation.

The detailed construction of the spring leg **201** of FIG. **8** will now be described. Like the unit **202** on the right-hand side it incorporates a strut **230** connected ky a pair of rubber bushes **231** to a bracket **232** at its lower end. Surrounding the strut **230** is a spacer sleeve **233** and a spring **234** the upper end of which abuts an abutment plate **236** bearing against the underside of a flange **238** formed on the lower end of a sleeve **239** closely surrounding the upper end of the strut **230**. The sleeve **239** is received within a circular bore extending through a rubber block **245** which nests within a socket **246** secured to a bracket **247** on the underside of the resiliently mounted assembly **200**. As shown in FIG. **8** the block **245** is of generally frusto-pyramidical form. Like the block **119** in the embodiment of FIG. **5** the block **245** is relatively thin when considered the fore and aft direction of the axis but relatively wide when considered from side-to-side. In contrast to the arrangement of FIG. **5** however, there is no free articulation, but the block **245** within the socket **246** causes the assembly **200** on this die to have a high restraint against fore and aft pivotal movement but a relatively low sideward restraint. This sideward freedom of movement is enhanced by the provision of wedge-shaped hollow relief spaces **255** within the lower end of the block **245**. This joint at the upper end of the spring leg **201** provides little or no resistance to upward or downward movement of the assembly **200** on this side due to the sliding of the upper end of the strut **230** within the sleeve **239** which is formed of a suitable low friction material. On the other hand the assembly on this side is provided with a high fore and aft restraint but a low sideward restraint. The ratio of these restraints may for example be between 10:1 and 15:1.

A third embodiment is illustrated in FIG. **11**. In this case a resiliently mounted assembly **300** is provided within an outer casing **301** simply by two spring legs **302** and **303**. The spring leg **302** is identical to the leg **30** of the first embodiment whilst the spring leg **303** is a damper leg identical to the Unit **32** of the first embodiment. As with the first embodiment therefore, these two legs provide a construction which has universal joints on each of the lower ends of the two legs so that springs **340** are again provided as in the first embodiment in order to maintain the assembly in a stable equilibrium condition. The precise position of the legs **302** and **303** with respect to the fore and aft axes of the machine can vary according to requirements but, in the specific embodiment shown, the spring leg **302** is situated slightly to the rear of the spring damper leg **303** when viewed from the side in FIG. **11**.

Whilst the two-legged configuration of FIG. **11** provides one spring damper leg unit on one side and a non-damped leg unit on the other side, an alternative arrangement would be to support the assembly by two identical spring damper leg units of the type shown on the right-hand side in either of FIGS. **3** or **8**.

With any of the configurations described the angle which the various legs subtend to the vertical can vary according to requirements. One possibility, for example with a two-legged construction, would be for one leg to be vertical and the other inclined to the vertical.

It is to be noted that the configuration of the various spring strut or spring damper leg units illustrated in the three embodiments of the drawings each incorporate a strut which at one end passes freely through a guide member there being no attachment to the strut end beyond the guide member. This enables the end of the guide member to be inserted into the appropriate aperture during machine construction in a very simple manner. It also permits simple disconnection of the assembly by bodily lifting it off the appropriate connections when required without disconnection of any nuts and bolts, etc.

In the first embodiment the two spring damper leg units **32** are each accurately located with respect to the assembly **11** by virtue of the resilient bushes **40** at the upper ends of the struts **35**. The friction damper bushes **67** can be retained in position on the struts during machine construction for example by the use of a small rubber band to hold the two halves of the bush in light frictional engagement with the strut. These two struts can therefore be accurately located with respect to their concave seats **65**. In a similar way the strut **81** on the left-hand side with its guide sleeve **104** prior to placing the assembly in position can be held in its required spacial position since the form of the joint **75** of the strut **81** at its lower end, although of a universal nature, does permit the strut to be free-standing.

With the second embodiment where the spring damper units are connected by rubber bushes **204** at their lower ends these are again capable of providing the upper ends of the struts with correct spacial alignment to receive the apertures afforded by the assembly as this is lowered into position. The spring strut **201** on the left-hand side is similarly held in its correct location prior to dropping the assembly into position and therefore the assembly can be merely lowered on to the upper ends of the three struts in this embodiment and can be readily removed without disconnection of any parts of the damper units or the spring strut units.

With the third embodiment of FIG. **11** the same considerations apply as have been discussed in connection with the embodiment of FIGS. **1** to **7**.

The provision of the rubber bushes as a form of connection at one end of the struts both of the friction damper units and the spring strut units enables the use of a light-weight casing and wheels on the washing machine as a whole. It is envisaged however that in certain configurations the struts could be secured rigidly at their upper ends to the assembly in the first embodiment or at their lower ends in the second embodiment, the struts then flexing along their lengths during operation.

Furthermore, whilst substantially semi-spherical friction damper bushes have been shown with a longitudinal bore therethrough it is envisaged that in some circumstances a substantially spherical external surface could be provided in which case the spring of the damper unit could act on a part spherical seat on one end of the bush and the fixed spherical seat on the appropriate section of the assembly or frame would act on the other end of the bush. This again would increase the frictional effect and spread the friction effect over the length of the bush more then in the case of the semi-spherical arrangements previously described.

Whereas the embodiments described above in relation to the drawings utilize the split bushes for friction damping purposes in each case, it is envisaged that the very simple configuration of the bushes with their associated form of mounting could be used effectively in some environments where no damping is required. In such cases the bushes would have no longitudinal split so that the associated rod can merely slide in the bore of the bush. This would accordingly provide an alternative form of spring-strut unit without damping but having a high degree of freedom of movement of the seat relatively to the part-spherical surface of the bush.

Such units could be employed in association with a form of spring-strut which would afford the desired degree of restraint. Thus a pair of the modified units could be used on one side. Alternatively only one unit might be used, either alone on one side, or in association with one unit which does act as a spring damper on that side.

What we claim as our invention and desire to secure by Letters Patent is:

1. A centrifugal extraction machine comprising a resiliently mounted assembly including a container for liquid and a clothes drum mounted within said container for rotation about a substantially horizontal axis, upper connection sections associated with said resiliently mounted assembly, a base frame, lower connection sections associated with said base frame, and support means extending between said upper and lower sections so as to support said resiliently mounted assembly from below, said support means comprising

a. a plurality of springs, each generally extending between said base and said resiliently mounted assembly,

b. a damper unit associated with at least one of said springs, said damper unit comprising a strut which extends between one lower and one upper section, a first end connection for said strut associated with one of said sections being of non-rigid nature so as to permit tilting of said strut with respect to its said one section, a second end connection associated with the other of said sections comprising a split annular damping member surrounding a portion of said strut and having a part-spherical surface engaging a part-spherical seat associated with said other section so as to permit substantially unrestrained tilting of said strut with respect to said other section, and said associated spring of said damper unit surrounding said strut and generally between said upper and lower sections.

2. A machine as claimed in claim **1** wherein said first end connection comprises a mounting having at least one block of resilient material which permits restrained tilting of said strut with respect to said one section.

3. A machine as claimed in claim **1** wherein said second end connection is associated with said lower section.

4. A machine as claimed in claim **1** wherein said second end connection is associated with said upper section.

5. A machine as claimed in claim **2** wherein said block of resilient material is compressed between a plate and said one section, said plate providing a seat for said associated spring of said damper unit.

6. A machine as claimed in claim **1** wherein the lengths of said associated spring and said strut are such that said damping member is disposed on said strut in

such a position that said strut remains within a bore of said damping member when said associated spring is extended to its unloaded free length.

7. A machine as claimed in claim 1 wherein said damping member has a sleeve portion associated therewith which extends away from said part-spherical surface of said damping member to provide location for said damping member with respect to said other section in the event of said part-spherical surface of said damping member moving away from said other section.

8. A machine as claimed in claim 1 wherein said other section has an aperture through which said strut passes and said part-spherical seat is formed by an integral margin of the aperture.

9. A machine as claimed in claim 1 in which said other section has an aperture through which said strut passes and said part-spherical seat is formed by an annular member separable from said aperture.

10. A machine as claimed in claim 1 wherein said damping member has at least two longitudinal splits to divide it into at least two portions.

11. A machine as claimed in claim 1 wherein said resiliently mounted assembly is supported by three springs, two of said springs having a damper unit associated therewith and extending between said base frame and said assembly below and to one side of the horizontal axis of said assembly, and a third spring extending between a lower end connection on said base frame and an upper end connection on said assembly below and to the other side of the horizontal axis, said end connections of said third spring providing negligible damping.

12. A machine as claimed in claim 1 in which said assembly is supported by two springs each extending between said base frame and said assembly, one of said springs on each side of the horizontal axis of said assembly, one of said springs having a damper unit associated therewith and the other of said springs having no damper unit associated therewith.

13. A machine as claimed in claim 1 in which said assembly is supported by two springs, each of said springs having a damper unit associated therewith, said springs extending between said base frame and said assembly with one spring on each side of the horizontal axis of said assembly.

14. A centrifugal extraction machine comprising a resiliently mounted assembly including a container for liquid and a clothes drum mounted within said container for rotation about a substantially horizontal axis, upper connection sections associated with said resiliently mounted assembly, a base frame, lower connection sections associated with said base frame, and support means extending between said upper and lower sections so as to support said resiliently mounted assembly from below, said support means comprising

a. a plurality of springs, each generally extending between said base and said resiliently mounted assembly,

b. a strut unit associated with at least one of said springs, said strut unit comprising a strut which extends between one lower and one upper section, a first end connection associated with one of said sections comprising a sleeve surrounding said strut, seat means for said sleeve associated with said one section, said seat means permitting free movement of said sleeve relative to said seat means in a first plane and restraining movement of said sleeve relative to said seat means in a second plane perpendicular to said first plane, a second end connection for said strut associated with the other of said sections, and said associated spring of said strut unit surrounding said strut and biasing said sleeve into contact with said seat.

15. A machine as claimed in claim 14 wherein said seat means has at least one downwardly facing curved seat having an axis perpendicular to said first plane, said sleeve means having at least one pivot member having an axis perpendicular to said strut surrounded by said sleeve means, wherein said downwardly facing curved seat of said means receives said pivot of said sleeve.

16. The machine as claimed in claim 14 wherein said seat means has a rectangular opening formed of two identical channel members, the major axis of said rectangle being in said first plane, and the minor axis of said rectangle being in said second plane.

17. The machine as claimed in claim 16 wherein said seat means is received within a resilient block.

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