Sept. 22, 1942. F. BRECKENRIDGE ET AL 2,296,261

LAUNDRY APPARATUS

Filed Nov. 7, 1939 3 Sheets-Sheet 1

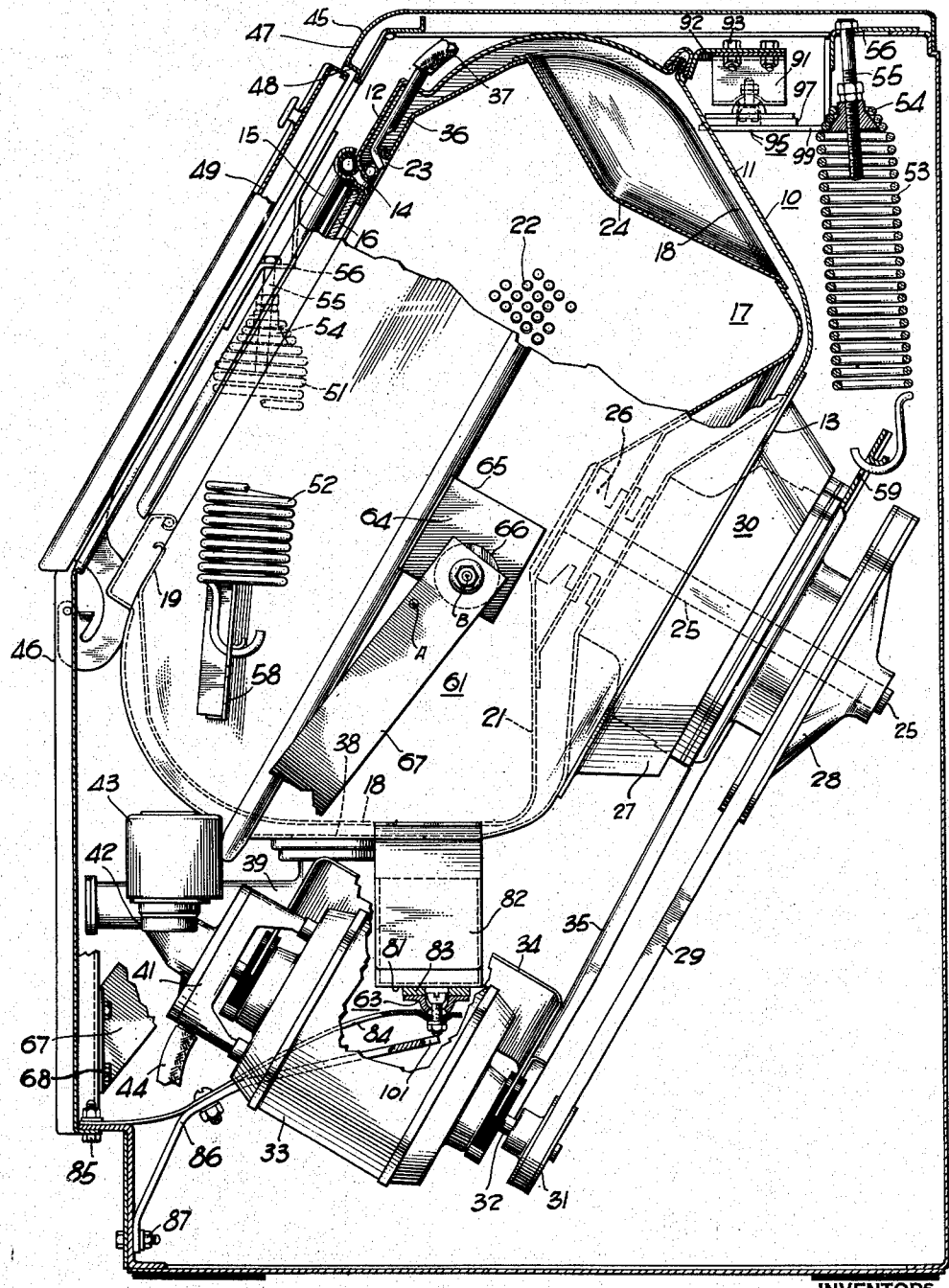

Fig. 1.

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LAUNDRY APPARATUS

Filed Nov. 7, 1939 3 Sheets-Sheet 2

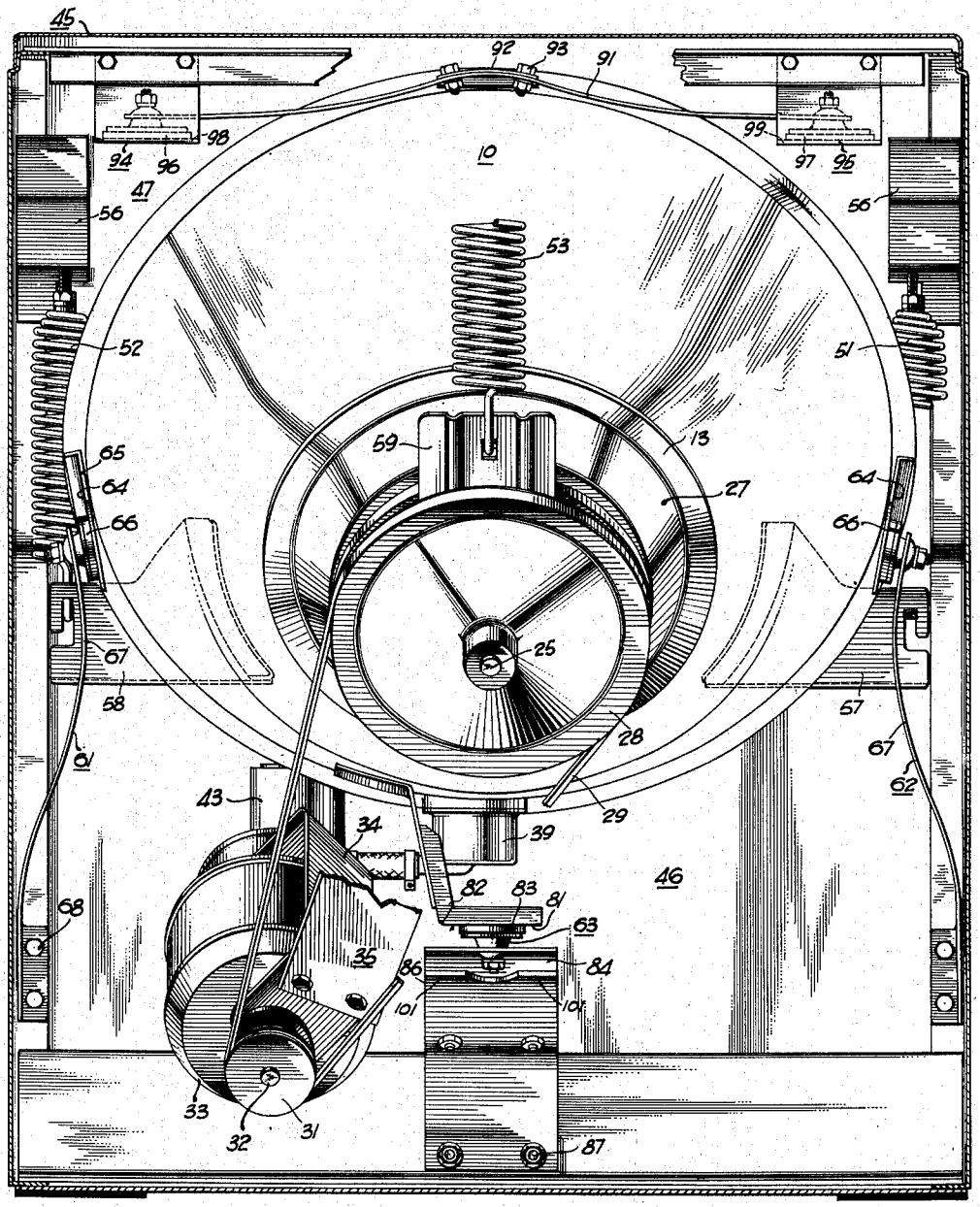

Fig. 2.

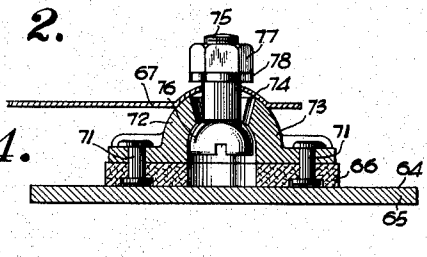

Fig. 4.

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LAUNDRY APPARATUS

Filed Nov. 7, 1939 3 Sheets-Sheet 3

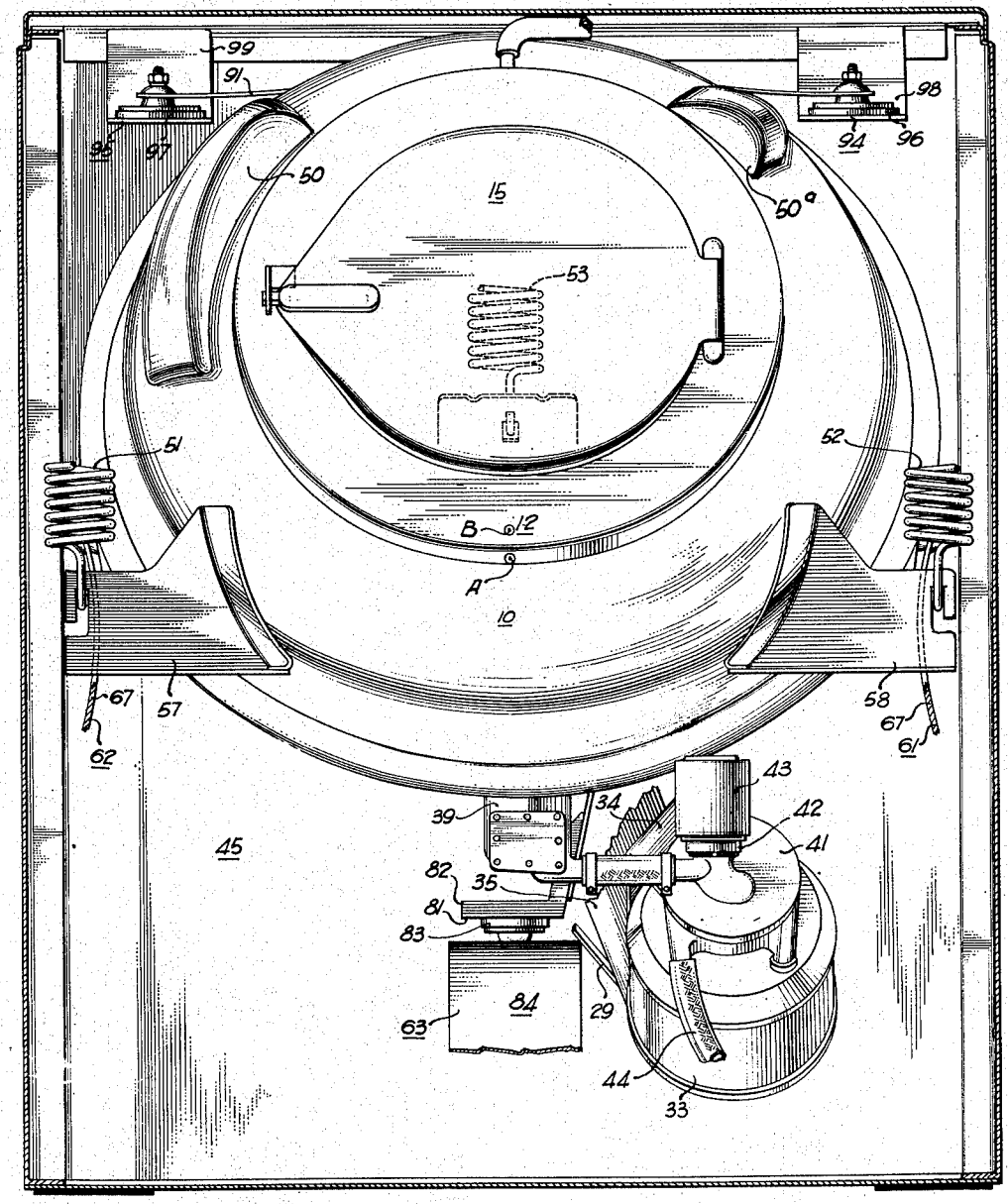

Fig. 3.

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Patented Sept. 22, 1942 2,296,261

UNITED STATES PATENT OFFICE

2,296,261

LAUNDRY APPARATUS

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Application November 7, 1939, Serial No. 303,202

27 Claims. (Cl. 68—24)

Our invention relates to laundry apparatus and has for an object to provide improved apparatus of this kind.

A further object of the invention is to provide an improved flexibly supported washing machine wherein the vibratory forces imparted to the foundation thereof are minimized.

A further object of the invention is to provide a laundry machine having an improved organization of flexible or resilient elements and damping elements for supporting the rotating parts utilized to effect the washing action.

A further object of the invention is to provide an improved flexible mounting which is particularly adapted for application to a machine that rotates in a single direction at relatively low speed for washing fabrics and rotates in the same direction at relatively high speed for centrifuging fluid therefrom, and wherein the axis of rotation is inclined substantially from the vertical.

It is a still further object of our invention to provide, in laundry apparatus, improved means for varying the resiliency of the mounting and the damping thereof between low and high speed operation, whereby the amplitudes of vibration are minimized and whereby higher extracting speeds may be employed than have been used heretofore.

It is a still further object of our invention to provide improved damping means for a flexibly supported washing and spinning unit wherein the damping means functions to position the unit with respect to the foundation thereof.

Laundry machines in which both washing of the fabrics and extraction of the wash water therefrom are accomplished in a single cylinder are very desirable because such machines lend themselves readily to automatic operation. It has been found, however, that objectionable vibration occurs when such machines are operated and this is particularly true of those machines in which the basket or cylinder for retaining the clothes is rotated about a substantially horizontal axis. Such vibration is particularly objectionable in clothes washing machines of the domestic type because such machines should operate properly while freely or movably supported on floorings of light construction. We have, therefore, devised a form of suspension for a washing machine, which suspension is not restricted to but is particularly adapted to machines of the domestic type in which the axis of the clothes containing cylinder extends in a general horizontal direction. It has been found that our suspension will permit such machines to operate free of objectionable vibration and the noises incidental thereto.

The foregoing and other objects are effected by our invention as will be apparent from the following description and claims taken in connection with the accompanying drawings forming a part of this application, in which:

Fig. 1 is a side view partially in section and partially in elevation of a laundry machine constructed and arranged in accordance with the invention; certain portions of the machine being broken away for the sake of clearness;

Figs. 2 and 3 are rear and front views, respectively, of the machine shown in Fig. 1, the outer casing being shown in section and certain of the enclosed elements being broken away in both views; and,

Fig. 4 is a sectional view of the damper elements shown in Figs. 1 and 2.

Reference will now be had to the drawings wherein we have disclosed our invention applied to a laundry machine of the type disclosed and claimed in the copending application of Frank Breckenridge, Serial No. 203,804, filed April 23, 1938, and assigned to the assignee of the present invention. It will be understood that our invention may be applied equally well to other forms of laundry machines and that the type of machine disclosed in the present application is shown by way of example. As stated heretofore, the invention is particularly applicable to a machine having the axis of rotation extending generally horizontal, which we define as an axis that extends horizontal or within 45° from the horizontal. The apparatus illustrated is designed essentially for domestic service and has an efficient washing capacity of nine pounds of dry clothing although larger loads may be accommodated with slightly reduced washing efficiency. The cubical contents of the tube and basket of this machine are 5685 cubic inches and 3663 cubic inches, respectively.

Reference will now be had particularly to Figs. 1 to 3, inclusive, for a description of the laundry machine. The machine includes a tub structure, generally indicated at 10, of substantially frusto-conical configuration, the axis of the tub being inclined at an acute angle to the vertical. The tub 10 includes side walls 11 and end walls 12 and 13 at its large and small ends, respectively. An access opening 14 is formed in the large end wall 12 and is closed by a suitable

gasketed door 15 having a transparent central portion 16.

A washing and spinning element or basket, shown generally at 17, is also of substantially frusto-conical configuration and concentrically disposed within the tub 10. The basket 17 includes side walls 18 and end walls 19 and 21 at its large and small ends, respectively, the end wall 21 being dished inwardly of the basket 17 as best shown in Fig. 1. The basket 17 is perforate, a number of perforations being shown at 22. It will be understood that substantially the entire side wall 18 of the basket is perforate. An access opening 23 is formed in the large end wall 19 of the basket and registers with the access opening 14 of the tub structure.

As shown, the axes of the basket and tub are inclined at an angle of approximately 30° from the horizontal so that the access opening 14 is rendered more accessible to the operator for loading and unloading the basket. Futhermore, the inclined structure provides an improved washing action and facilitates distribution of the fabrics in the basket 17 when it is accelerated to high speed during the initiation of the water extracting period, as described and claimed in said copending application, Serial No. 203,804.

A plurality of inwardly extending baffles or vanes 24 are circumferentially spaced within the basket 17 for agitating the fabrics contained in the basket in the wash water during washing periods. The vanes may be constructed and arranged in any suitable manner within the basket 17, the preferred form and arrangement of the vanes being described and claimed in the copending application of Stuart Baird, Serial No. 268,103, filed April 15, 1939, and assigned to the assignee of the present invention. Preferably, four vanes equally spaced within the basket are employed.

The basket 17 is actuated about its inclined axis during both washing and fluid extracting periods by means of a shaft 25 that is fixed or attached to a hub structure 26 of any suitable form and defining a portion of the basket structure. The shaft 25 is suitably journaled in a housing 27 carried by the end wall 13 of the tub structure. In other words, the basket is rotatably supported from the tub structure by the shaft 25 and the shaft 25 is supported from the tub structure by the housing 27. A pulley 28 is fixed to the outer end of the shaft 25 and is driven by means of a belt 29 from a pulley 31, the latter being carried by a shaft 32 driven by a suitable electric motor 33 of the type and size commonly employed for driving domestic washing machines. The motor 33 is carried by a bracket structure 34 that is fixed to the lower portion of the tub structure 10 in any well understood manner. Preferably, the bracket structure 34 includes a member 35 that is secured to the tub structure 10 adjacent its end wall 13.

During washing periods, the basket 17 is rotated about its axis by the motor 33 at relatively low frequency. In the embodiment shown, the motor 33 effects rotation of the basket at this time at a speed of approximately 52 R. P. M. While our invention is particularly applicable to washing machines in which the basket is actuated in a single direction such as shown in the embodiment illustrated, it is to be understood that it may also be applicable to machines in which a different form of actuation is employed. During water extracting periods or when the washing fluid is centrifuged from the clothes, the motor 33 drives the basket at relatively high speed of the order of about 460 R. P. M. The mechanism for effecting the different basket speeds may comprise a two-speed transmission disposed within the housing 27 at 30. As such transmissions are well known and as the specific construction thereof forms no part of the present invention, a detailed showing of the same is deemed unnecessary. One form of two-speed transmission is disclosed in the copending application of Frank Breckenridge, Serial No. 305,512, filed November 21, 1939, and assigned to the assignee of the present application, the arrangement of the tub, basket, two-speed mechanism and motor being claimed in this copending application.

Washing and rinse water may be admitted to the tub structure 10 through a nozzle 36 that is connected by means of a flexible conduit 37 to a source of water. A valve, not shown, is employed for controlling the passage of water through the conduit 37 and nozzle 36. The water discharged through the nozzle 36 is directed inwardly of the basket 17 and passes through the perforations therein to the tub structure. The vitiated water is discharged through a suitable opening 38 formed in the bottom of the tub 10 to a sump 39 that connects with the inlet of a pump 41 carried and driven by the motor 33. A solenoid valve 42 controls communication between the sump 39 and pump 41, the solenoid of the valve being shown at 43. Water is discharged from the pump 41 through a flexible conduit 44 that leads to a point of discharge. The solenoid 42 and pump 41 may be of any well known construction so that a detailed description of these elements is deemed unnecessary.

From the foregoing it will be apparent that the tub 10, the basket 17 and the driving mechanism including the motor 33, define a unitary or self-contained washing and spinning structure. This structure is housed within a suitable casing generally indicated at 45 and having a front wall 46, a portion of which is inclined as shown at 47. The front wall portion 47 includes an access opening 48 which is closed by a suitable door 49 during periods when the laundry apparatus is inactive. During operating periods of the apparatus, the door or cover 49 is opened so that the gasketed door 15 is rendered accessible to the operator for the insertion and removal of the fabrics being treated.

In accordance with our invention, the washing and spinning structure is flexibly supported within the casing 45 so that it is free to vibrate at all times in all modes. As shown, the flexible supporting structure includes a plurality of tension springs 51, 52, and 53, the upper ends of which are secured to respective spring nuts 54 that are carried by studs 55, the latter being carried by brackets 56 forming a part of the casing structure 45. The springs 51 and 52 are disposed on opposite sides of the tub 10 at the front side thereof and carry brackets 57 and 58, respectively, which are secured to the tub structure 10. The spring 53 is disposed on the rear side of the tub at the center thereof and carries a bracket 59 which is secured to the tub adjacent its end wall 13 and which may be formed integrally with the bracket member 35. The springs 51, 52, and 53 define a three-point support for the tub 10 and its associated parts and afford movement of the tub in all directions.

The springs 51, 52, and 53 which define the principal support for the suspended body are

very flexible and are of the lowest permissible spring constant for the weight to be supported so that the natural frequency of vibration of the suspended body is of a value that is nearer to the frequency of the periodic movement of the basket during washing periods than during spinning periods. Accordingly, the amplitudes of vibration of the suspended body during spinning periods will be relatively small and will be greater during washing periods. Due to the weight of the water, the springs 51, 52 and 53 afford downward and upward movement of the tub 10 as water is admitted to and discharged therefrom, respectively. As shown, the tub 10 is in its elevated position or the position assumed during spinning periods.

In the illustrated embodiment of our invention, the weight of the flexibly suspended washing and spinning unit is of the order of 189 pounds when the tub is empty. The two front springs 51 and 52 each have a 13 pound constant and the rear spring 53 has a 20 pound constant, the total constant of the three point support being 46 pounds per inch deflection. As set forth hereinafter, some additional spring support is provided for the unit in the present embodiment so that the total spring constant is of the order of 56 pounds per inch deflection. With this construction, the average natural period of the six modes of vibration of the unit when devoid of water is approximately 86 cycles per minute. In order to equalize as nearly as possible the natural periods of all modes of vibration of the suspended unit and to minimize the amplitudes of vibration in all modes, we secure inertia stabilizers of suitable mass to the suspended unit in spaced relation with the center of inertia thereof. The centers of inertia of the suspended unit during periods when the tub is loaded with water and when it is devoid of water are shown at A and B, respectively, Figs. 1 and 3. In this embodiment, two stabilizers 50 and 50*a* are employed, but it will be understood that the number and weight of the stabilizers and their disposition on the suspended unit will vary for different types of washers. The stabilizers 50 and 50*a* are shown secured to portions of the end wall 2 of the tub in spaced relation, radially and circumferentially, with the motor 33 which in itself functions as a stabilizer and, as will be obvious, lends additional mass to the spring supported body which is very desirable. Accordingly, the moments of inertia of the suspended unit about a plurailty of different axes which intersect the center of inertia are increased and adjusted to desired values which afford, as nearly as possible, equalization of the natural periods of vibration about these axes. In this connection, we have found that the natural periods in all modes are more readily equalized by the inertia stabilizers when combined with the three point spring support referred to heretofore. Furthermore, the increased moments of inertia reduce the amplitudes of vibration about the center of inertia and the added mass to the suspended unit reduces translatory vibrations or vibrations in which the center of inertia is moved. The stabilizers may be secured to the suspended unit by bolts (not shown) or in any other well understood manner.

In order that the amplitudes of vibration may be reduced or maintained within predetermined limits, we provide an improved damping arrangement during both the washing and the fluid extracting periods of operation. The dampers which are active, generally, during the spinning portion of the cycle will now be described. These dampers are shown, generally, by reference numerals 61, 62, and 63, the dampers 61 and 62 being disposed on opposite sides of the tub 10 and the damper 63 being disposed beneath the tub.

The damper 61 includes a friction surface 64 defined by a plate 65 carried on the side of the tub 10 and movable with the tub 10. A friction pad 66 frictionally engages the surface 64 and is supported adjacent one end of a resilient spring 67, the latter being supported in any suitable manner at its opposite end by the casing 45. As shown at 68, the spring member 67 is bolted to the frame 45. A detail view of the method of connecting the spring 67 to the friction pad 66 is shown in Fig. 4, which figure shows in detail the method of connecting all of the friction pads, to be referred to hereinafter in connection with the other dampers, to the springs supporting the same. As shown in Fig. 4, the pads 66 are secured as by rivets 71 to a socket 72 having a portion 73 defining a segment of a hollow sphere. The spherical portion 73 engages a concave portion 74 formed in the spring 67. A bolt 75 having a head 76 formed as a portion of a sphere engages the inner spherical portion 73 of the socket 72, the bolt 75 passing through an opening formed in the spring 67. A nut 77 maintains a washer 78 in engagement with the spring 67 and secures the spring 67, the socket member 72 and the pad 66 together as a unit.

The spherical portions of the bolt 75 and of the socket 73 and the concave portion 74 of the spring 67 define a universal connection or ball-and-socket joint so that all of the friction surface of the pad 66 is uniformly held in engagement with the movable friction surface 64 at all times regardless of movement of the tub 10 and flexure of the spring 67. The construction of the damper 62 is similar to that described in connection with the damper 61 so that a description thereof is deemed unnecessary.

The dampers 61 and 62 bias the tub structure inwardly of the casing and tend to center the same therewithin. Sideways or lateral or horizontal movement of the tub 10 within the casing 45 is permitted by the flexible spring supports 67 forming a part of the dampers 61 and 62. Movement of the tub structure in vertical or longitudinal directions or any component of these directions in vertical planes extending from the front to the rear of the tub structure is permitted, although resisted somewhat by the sliding connection between the friction pads 66 and the friction surfaces 64 of both dampers 61 and 62, which movement is resisted by the frictional engagement of the pads 66 and the movable friction surfaces 64. The amount of damping afforded by the dampers 61 and 62 may be adjusted to the desired value by varying the bias of the spring 67.

Movement of the tub structure 10 longitudinally or transversely in horizontal directions is resisted by the damper element 63 disposed beneath the tub. This damper 63 includes a friction surface 81 movable with the tub and defined by a bracket 82 secured to the bottom of the tub. The damper 63 also includes a friction pad 83 carried at the end of a spring 84 that is secured to the casing 45 by a bolt 85 and by an auxiliary spring member 86, the latter being secured to the casing 45 by a bolt 87. The connection between the damper spring 84 and the friction pad 83 is similar to that described in connection with

the damper 61 and need not be further described.

As stated hereinbefore, when water is admitted to the tub for washing, the additional weight carried by the springs 51, 52, and 53 effects a downward movement of the tub. In the present embodiment the additional weight is of the order of 92 pounds which includes 9 pounds of clothing to be washed. We have found that satisfactory operation may be obtained where the relation of the aggregate spring constant in pounds per inch of deflection of the machine when empty to the weight of the load in pounds is between 1.25 to 1 and 1 to 3. In the present embodiment this relation is of the order of 56 to 92. It is desirable that both the total or aggregate spring constant of the suspended unit and the amount of damping be increased in order to damp vibrations excited during slow speed operation of the basket for washing. This is desirable as the amplitudes of vibration are greater when the speed of the basket more nearly approaches the natural period of the suspended unit. The increase in the spring constant and the increase in the damping effect during washing periods maintains the amplitudes of vibration at this time within practical limits and prevents objectionable bouncing or wobbling of the suspended unit within the casing 45.

An increase in the spring constant is afforded mainly by the spring 86 which becomes effective to aid in supporting the suspended unit when the latter is moved downwardly by the admission of water to the tub. The spring constant may also be increased by a leaf spring 91, secured intermediate its ends to the upper side of the tub 10 by means of bracket 92 and bolts 93. In the present embodiment, the total constant of the spring support during washing periods is of the order of 96 pounds per inch deflection.

The natural mode frequencies are preferably increased during the washing period so that, in effectiveness, the increase in spring constant overcomes the increase in mass due to the weight of the load. The increase in mass and spring constant in the present embodiment effects an average natural frequency of all modes of the order of 107 cycles per minute during washing periods. The increase in the natural mode frequencies during washing periods is very desirable, since the washing speed is then below the natural frequency range sufficient to avoid any condition of resonance. The opposite ends of the leaf spring 91 carry damper elements, generally indicated at 94 and 95 and having friction pads 96 and 97, respectively. The friction pads 96 and 97 engage respective stationary brackets 98 and 99, the latter being carried in any suitable manner by the casing 45. The connections between the leaf spring 91 and the friction pads 96 and 97 carried thereby are similar to the connection between the leaf springs 67 and the friction pad 66.

During spinning operations, or when the tub 10 is in its elevated position, the deflection of the leaf springs 91 and 84 is a minimum so that the amount of damping afforded by the dampers 94, 95, and 63 is minimum. While, in the present embodiment, we have shown the friction pads 96 and 97 in engagement with the stationary brackets 98 and 99 in the elevated position of the tub, it is to be understood that at this time the pads may be disengaged from their respective brackets so that no damping is afforded by the dampers 94 and 95 and no support for the tub 10 effected by the spring 91. However, we prefer to have the springs 91 and 84 afford some support for the tub during spinning periods. In the present embodiment, they assist the springs 51 and 53, inclusive, at this time and the total spring constant during spinning periods is of the order of 56 pounds per inch deflection. During washing operations or when the tub 10 is in its depressed position, the leaf spring 91 is deflected and increases the pressure between the pads 96 and 97 and their respective supports 98 and 99. Accordingly, maximum damping is effected by the dampers 94 and 95 at this time.

The increase in the constant of the total flexible supporting mechanism is effected mainly by the spring 86 associated with the lower damping structure 63 by extending the spring 86 to a region beneath the spring 84 where it may be engaged by the spring 84 as it moves downwardly with the tub. As shown, the spring 86 includes laterally spaced portions 101 at the end thereof which engages the spring 84 immediately below the friction pad 83. It will be apparent, that when the tub is in its lowered position during the washing period, additional support for the tub is provided by the spring 86. At this time, the total spring constant is approximately 96 pounds per inch deflection. Furthermore, the friction between the pad 83 and its friction surface 81 is increased so that additional damping is afforded by the damper 63 at this time. From the foregoing description, it will be apparent that the tub is supported by first and second spring systems during the respective spinning and washing periods. The first spring system includes the springs 51, 52, 53, 84, and 91 and the second spring system includes, in addition to these, the spring 86.

It will be understood that the amount of damping necessary will vary with different designs, suspended mass, spring constant, etc. In the present embodiment, we employ approximately 18.7 pounds of damping during the spinning operation and approximately 34.7 pounds during the washing operation, which values represent the total forces necessary to move the suspended body against the action of all of the dampers. A reduction in the amount of damping effects an increase in the amplitude of vibration while too great an increase in the amount of damping effects an undesirable increase in the value of the alternating forces imparted to the stationary foundation. We have found that desirable operation may be obtained if the total value of damping in pounds is within the range of $(KXm)2$ as a maximum and

$$\frac{KXm}{5}$$

as a minimum wherein K is total spring constant in pounds per inch deflection and Xm is one-half the maximum amplitude of vibration in inches of the suspended body effective during operating speed other than critical speed.

The springs 67 associated with the dampers 61 and 62, the spring 84 forming a part of the lower damper 63 and the spring 91 associated with dampers 94 and 95 are preferably formed of relatively wide strips of spring material and so disposed that they are very flexible in the planes normal to their respective damping surfaces but are relatively rigid in the planes of their associated damping surfaces. Accordingly, the friction surfaces formed on the tub may slide upon their respective pads in a smooth manner and without chatter, as the tendency to bend or vibrate the supporting springs in the plane of

the engaging friction surfaces is opposed by the rigidity afforded the spring by its width.

It will be apparent that damping of all modes of vibration is afforded by the cooperative efforts of dampers 61, 62, 63, 94, and 95, at least two of the dampers being always effective.

In the copending application of Frank Breckenridge, Serial No. 232,511, filed September 30, 1938, there is disclosed and claimed a washing machine of the angular axis type wherein the axis is tilted or disposed at a more acute angle to the vertical during spinning periods than during washing periods. As described in this copending application, Serial No. 232,511, improved washing action and improved distribution of the fabrics prior to spinning are obtained. This tilting operation is readily effected by the washing apparatus disclosed herein by the proportionment of the constants of the springs 51 and 52 relative the constant of the spring 53, and the disposition of the springs 51 to 53, inclusive, relative the center of gravity of the suspended body. In other words, the springs 51, 52, and 53 are so constructed that, as water is admitted to the tub 10, the springs 51 and 52 will expand more than the spring 53 so that the angularity of the axis to the vertical is increased. As will be apparent, the dampers 94 and 95 are disposed rearwardly of a vertical line through the center of inertia of the suspended unit and the damper 63 is disposed approximately beneath the center of inertia. Furthermore, because of the shape of the tub, the center of inertia moves forwardly from portion "B" to portion "A" as water is admitted to the tub, so that tilting of the suspended structure is assured. Accordingly, the washer operates during washing periods with its axis at a greater angle to the vertical than during fluid-extracting periods.

From the foregoing description, it will be apparent that we have provided an improved flexibly supported laundry machine for washing fabrics and spinning fluid therefrom, wherein less flexibility and more damping for the suspended body is afforded during washing periods than during spinning periods. Accordingly, compensation is effected for the different amounts of vibration excited by the different operating speeds during these periods so that the amplitudes of vibration of the suspended washing and spinning unit are minimized during both the washing and spinning operations. Furthermore, by providing an extremely flexible support for the unit during spinning periods, with reduced damping, the alternating forces imparted to the casing 45 and the support therefor are minimized and therefore the machine is susceptible of installation on relatively light floor structure. At the same time, due to the extreme flexibility afforded by the support, higher spinning speeds than have been permissible heretofore in domestic apparatus of this character may be employed so that the duration of the spinning period is substantially reduced.

The present invention defines an improvement over the flexible support described and claimed in the copending application of Frank Breckenridge, Serial No. 226,853, filed August 26, 1938, and assigned to the assignee of the present application. In this copending application a flexible support which is less flexible during washing periods than during spinning periods is claimed. Our invention defines an improvement over the apparatus disclosed in said copending application.

The arrangement of dampers of the friction type, which are operated dry, properly positions the suspended unit in the casing and is effective at all times even after long periods of use to provide the proper amount of damping. By using metal flexible springs, the resiliency afforded by the mounting remains constant over long periods.

While we have shown our invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and we desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What we claim is:

1. In apparatus for cleaning fabrics and the like and for abstracting cleaning fluid therefrom, the combination of a basket for containing the fabrics to be treated, said basket having an axis extending generally in a horizontal direction, means for moving the basket angularly about its axis at relatively slow speed for cleaning the fabrics and at relatively high speed for extracting fluid from the fabrics, a spring system resiliently supporting the basket, a second spring system resiliently supporting the basket, said second system being relatively inactive during extracting periods but active during the cleaning period for assisting the first-mentioned spring system and means for damping vibrations of the basket.

2. In apparatus for cleaning fabrics and the like and for abstracting cleaning fluid therefrom, the combination of a basket for the containing fabrics to be treated, said basket having an axis extending generally in a horizontal direction, means for moving the basket angularly about its axis at relatively slow speed for cleaning the fabrics and at relatively high speed for extracting fluid from the fabrics, a spring system resiliently supporting the basket, a second spring system resiliently supporting the basket, said second system being relatively inactive during extracting periods but active during the cleaning period for assisting the first-mentioned system and damping means associated with both of said systems, said damping means being more effective during cleaning periods than during extraction periods.

3. In apparatus for cleaning fabrics and the like and for abstracting fluid therefrom, the combination of a support, a tub, a rotatable basket disposed within the tub, said basket and tub having their axis inclined from the vertical and extending in a generally horizontal direction, means resiliently supporting the tub and basket from the support, and damping means interposed between the supporting structure and the tub and primarily resisting vertical and longitudinal movements of the tub, or any component of the latter two movements, in substantially vertical planes extending in a direction from the front towards the rear of the apparatus.

4. In apparatus for cleaning fabrics and the like and for abstracting cleaning fluid therefrom, the combination of a support, a tub, a rotatable basket disposed within the tub, said basket and tub having their axis inclined from the vertical and extending in a generally horizontal direction, means resiliently supporting the tub and basket from the support during both the cleaning and fluid-extracting periods of operation, and damping means interposed between the supporting structure and the tub and limiting horizontal movements of the tub in transverse or

longitudinal directions or in components of the latter two directions to predetermined values.

5. In apparatus for cleaning fabrics and the like and for abstracting cleaning fluid therefrom, the combination of a support, a rotatable basket having its axis extending in a generally horizontal direction, means resiliently supporting the basket from the support, and damping means for resisting vibratory movements of the basket in vertical, longitudinal, and transverse directions and any component thereof.

6. In apparatus for cleaning fabrics and the like and for abstracting cleaning fluid therefrom, the combination of a support, a rotatable basket having its axis inclined from the vertical, means flexibly supporting the basket and affording vibratory movement thereof in all modes, and a plurality of damper elements interposed between the basket and said support and resisting vibratory movement of the basket, said damper elements being circumferentially spaced about the basket and at least two of the damper elements being effective at all times to damp vibratory movement of the basket.

7. In laundry apparatus, the combination of a tub, a basket rotatably carried therein for containing fabrics to be treated and having its axis of rotation extending generally in a horizontal direction, means carried by the tub for rotating the basket at high speed for centrifugally extracting water therefrom, means resiliently supporting the tub, basket and driving means as a unitary structure, and a plurality of inertia stabilizers carried by said unitary structure in spaced relation with its center of inertia, the mass and location of said stabilizers on the unitary structure being such that the respective natural periods of all modes of vibration of the unitary structure are of substantially equal values.

8. In apparatus for cleaning fabrics and for abstracting fluid therefrom, the combination of a tub structure, a basket disposed therein for containing the fabrics and rotatable about an axis extending generally horizontal and fixed with respect to the tub structure, means for moving the basket angularly about said axis at relatively low speed for cleaning the fabrics and at relatively high speed for extracting fluid from the fabrics, means resiliently supporting the tub structure, and damping means for resisting vibratory movement of the basket and including relatively movable members having frictional engaging surfaces, one of said members being carried by the tub structure.

9. In apparatus for cleaning fabrics and for extracting fluid therefrom, the combination of a container for fabrics and having its axis of rotation extending in a generally horizontal direction, means for moving the container angularly about its axis at low speed for cleaning the fabrics and at high speed for extracting fluid therefrom, first and second means resiliently supporting the container, said first supporting means being effective to support the container during cleaning and extracting periods and said second supporting means being relatively inactive during extracting periods and more active to assist the first supporting means during cleaning periods, a plurality of dampers positioning the container and resisting vibratory movement thereof, said dampers including friction members movable with the container and other members in frictional engagement, respectively, with the movable members and resilient means for supporting said other members and for biasing the same into engagement with their associated movable members.

10. In apparatus for cleaning fabrics and for extracting cleaning fluid therefrom, the combination of a support, a cleaning and spinning unit including a container for cleaning fluid and including means movable angularly about an axis that extends generally horizontal for agitating the fabrics in the fluid during cleaning periods and for centrifuging fluid from the fabrics during fluid extracting periods, flexible means carried by said support and resiliently supporting the washing and spinning unit and a plurality of dampers resisting vibratory movement of the cleaning and spinning unit and disposed in opposing relation on opposite sides of the unit, said dampers being effective to position the washing and spinning unit relative the support.

11. In apparatus for cleaning fabrics and for extracting fluid therefrom, the combination of a supporting structure, a cleaning and spinning unit including a container for cleaning fluid and a basket journaled within the container and movable about an axis that extends generally horizontal for agitating the fabrics in the fluid during cleaning periods and for centrifuging fluid from the fabrics during fluid extracting periods and means for supporting the container and including a resilient member associated with the top side of the container, said resilient member being relatively inactive to support the container during fluid-extracting periods and rendered active to support the container during cleaning periods.

12. In cleaning apparatus, the combination of a container for cleaning fluid, a supporting structure, a basket carried by and movable within the container angularly about an axis that extends generally horizontal for agitating the fabrics in the cleaning fluid during cleaning periods and for centrifuging fluid from the fabrics during fluid extracting periods, resilient means carried by the supporting structure and resiliently supporting the container, means defining a friction surface on the under side of the container, a friction element engaging the friction surface, and spring means biasing the friction element upwardly.

13. In apparatus for cleaning fabrics and the like and for abstracting fluid therefrom, the combination of a rotatable basket having its axis of rotation extending generally in a horizontal direction, a tub enclosing the basket, means supporting the basket from the tub whereby the tub and the basket form a single structure, a fixed frame structure disposed on the sides and above the tub, suspension spring means supporting the tub and basket structure from an upper part of the frame structure, a spring extending laterally from both sides of the upper portion of the tub structure, means carried by the frame structure engaging the outermost ends of said spring, a spring secured to a lower portion of the framework and engaging the underside of the tub structure, and springs secured to the frame structure and engaging opposite sides of the tub structure.

14. In apparatus for cleaning fabrics and the like and for abstracting fluid therefrom, the combination of a rotatable basket having its axis of rotation extending generally in a horizontal direction, a tub enclosing the basket, means for supporting the basket from the tub whereby the tub and the basket form a single structure, a fixed frame structure disposed on the sides and

above the tub, suspension spring means supporting the tub and basket structure from an upper part of the frame structure, said spring means embodying two springs engaging, respectively, the forward portion of the tub structure and one spring engaging the rear portion of the tub structure, a spring extending laterally from both sides of the upper portion of the tub structure, means carried by the frame structure engaging the outermost ends of said spring, a spring secured to a lower portion of the frame work and engaging the underside of the tub structure, and springs secured to the frame structure and engaging opposite sides of the tub structure.

15. In apparatus for cleaning fabrics and for extracting fluid therefrom, the combination of a substantially stationary supporting structure, a container for cleaning fluid, a basket disposed within the container and rotatable about an axis that extends in a generally horizontal direction, a plurality of springs carried by the supporting structure and supporting the container during cleaning and extracting periods, means defining a plurality of friction surfaces carried by the container, a plurality of friction members engaging said surfaces, respectively, means resiliently supporting the friction members from the supporting structure, an auxiliary spring supporting the container during washing periods, said auxiliary spring being relatively ineffective to support the container during extracting periods, and damping means resisting vibratory movement of the container during periods when the auxiliary spring is most effective to support the container.

16. In apparatus for cleaning fabrics and extracting fluid therefrom, the combination of a tub structure for containing the cleaning fluid and the fabrics, means for admitting and discharging fluid to and from the tub structure, a basket arranged within the tub structure and rotatable about an axis that extends generally in a horizontal direction, means for moving the basket angularly about its axis at relatively low and high speeds for respectively washing and drying the fabrics, means resiliently supporting the tub structure in an elevated position when substantially devoid of fluid and affording downward movement of the tub structure as fluid is admitted thereto, damping means for resisting vibratory movement of the tub structure, second means resiliently supporting the tub structure during cleaning periods or when the tub structure contains a predetermined amount of fluid, said second resilient means being substantially ineffective during periods when the tub structure is in its elevated position, and second damping means including relatively movable friction members associated with the second flexible supporting means.

17. In apparatus for cleaning fabrics and for centrifugally extracting fluid therefrom, the combination of a tub for containing the cleaning fluid, a basket for enclosing the fabrics and arranged within the tub so that its axis of rotation extends in a generally horizontal direction, means for moving the basket angularly about its axis at relatively low frequency during cleaning periods, means for rotating the basket about its axis at relatively high speed for centrifuging fluid therefrom during fluid extracting periods, means for admitting and discharging fluid to and from the tub, a plurality of springs resiliently supporting the tub in an elevated position when substantially devoid of cleaning fluid, said springs affording downward movement of the tub as cleaning fluid is admitted thereto, damping means resisting vibratory movement of the tub and including relatively movable friction members, an auxiliary spring resiliently supporting the tub during cleaning periods, said auxiliary spring being relatively inactive when the tub is in an elevated position and primarily effective, when the tub is in a lower position, for assisting the first-mentioned springs in supporting the tub, and damping means associated with said auxiliary spring and effective in a lower position of the tub for resisting vibratory movement thereof.

18. In apparatus for cleaning fabrics and for extracting fluid therefrom, the combination of a tub structure for containing cleaning fluid, basket means movable angularly about an axis that extends generally horizontal for agitating the fabrics in the fluid during cleaning periods and rotatable at high speed for spinning fluid from the fabrics during fluid extracting periods, a supporting structure, means carried by the supporting structure for flexibly supporting the tub structure, means defining a plurality of friction surfaces located adjacent the sides, top and bottom of the tub structure, a plurality of friction members engageable with said friction surfaces, and means resiliently supported by the supporting structure for biasing the friction members into engagement with the friction surfaces for resisting vibratory movement of the tub structure and for positioning the same within the supporting structure.

19. In a machine for cleaning fabrics and for centrifugally extracting fluid therefrom, the combination of a structure including a rotatable basket, means for rotating said basket at relatively low frequency in one direction for cleaning the fabrics and for rotating the basket at relatively high frequency and in the same direction for extracting fluid from the fabrics, and resilient means for flexibly supporting said structure and affording vibration thereof in all modes, said flexible means and said structure being so constructed and arranged that the natural frequencies of vibration in all modes of the structure are greater than the relatively low frequency of rotation of the basket during cleaning periods and less than the relatively high frequency of rotation of the basket during fluid extracting periods.

20. In a machine for cleaning fabrics and for centrifugally extracting fluid therefrom, the combination of a structure including a rotatable basket, means for rotating said basket about its axis in one direction and at relatively low frequency for cleaning the fabrics and for rotating the basket in the same direction and at relatively high frequency for extracting water therefrom, and resilient means for flexibly supporting said structure, said resilient supporting means and structure being so constructed and arranged that the natural frequencies of all modes of vibration of the structure are closer to the relatively low frequency of the rotation of the basket during cleaning periods than the relatively high frequency of rotation of the basket effective during fluid extracting periods.

21. In a machine for cleaning fabrics and for centrifugally extracting fluid therefrom, the combination of a structure including a rotatable basket, means for rotating said basket about its axis in one direction and at relatively low frequency for cleaning the fabrics and for rotating the basket about its axis in the same direction and at relatively high frequency for extracting

fluid from the fabrics, and resilient means for flexibly supporting said structure, said resilient means and structure being so constructed and arranged that the natural frequencies of vibration in all modes of the structure are greater than the relatively low frequency of rotation of the basket during cleaning periods and less than the relatively high frequency of rotation of the basket during fluid extracting periods; the natural frequencies of the structure being nearer to the cleaning frequency than to the fluid extracting frequency.

22. In apparatus for cleaning fabrics and for extracting fluid therefrom, the combination of a tub for containing cleaning fluid, a basket for enclosing the fabrics, means for actuating the basket at relatively low frequency in the cleaning fluid for washing the fabrics and at relatively high frequency for centrifuging fluid from the fabrics at which time the tub is substantially devoid of fluid, said tub and basket comprising a suspended structure, and first and second spring systems resiliently supporting the suspended structure during the respective cleaning and fluid extracting periods; the relation of the aggregate spring constants of the first and second spring systems expressed in pounds per inch deflection to the different weights of the suspended structure during washing and fluid extracting periods being such that the average natural frequency of the various modes of vibration of the suspended structure is greater during the cleaning periods than during the fluid extracting periods.

23. The combination as claimed in claim 22 wherein the difference between the average natural frequencies of the various modes of vibration of the suspended structure during cleaning periods and during fluid extracting periods is of the order of 21 cycles per minute.

24. In apparatus for cleaning fabrics and for extracting fluid therefrom, the combination of a tub for containing cleaning fluid, a basket disposed therein, means for rotating the basket at relatively low speed for cleaning the fabrics and at relatively high speed for extracting fluid therefrom, and resilient means for flexibly supporting the tub and basket; the relation of the aggregate spring constant, expressed in pounds per inch deflection, to the weight of the cleaning fluid and fabrics, expressed in pounds, being within a range of one and one quarter to one and one to three.

25. In apparatus for cleaning fabrics and for extracting fluid therefrom, the combination of a basket for containing fabrics to be cleaned, means for actuating the basket at relatively low frequency for cleaning the fabrics and at relatively high frequency for extracting fluid therefrom, a plurality of springs for flexibly supporting the basket; and dry friction damping means for resisting vibratory movement of the basket; the amount of damping afforded by the damping means expressed in pounds being between $(KXm)2$ as a maximum, and

$$\frac{(KXm)}{5}$$

as a minimum, in which K is the total spring constant, expressed in pounds per inch deflection, and Xm is one-half the maximum amplitude of vibration of the basket, expressed in inches.

26. In apparatus for cleaning fabrics and the like and for centrifugally extracting fluid therefrom, the combination of a tub, a rotatable basket disposed within the tub, said basket and tub having their axis extending in a generally horizontal direction, means resiliently supporting the tub and basket as a unitary structure, said resilient supporting means defining a three-point support for said structure, means for rotating said basket about its axis at relatively low frequency for cleaning the fabrics and at relatively high frequency for extracting fluid therefrom, and inertia stabilizing means carried by the unitary structure and spaced from the center of inertia thereof for reducing the amplitudes of vibration of the suspended structure in the various modes and for substantially equalizing the natural period of vibration in the various modes.

27. In apparatus for cleaning fabrics and for centrifugally extracting fluid therefrom, the combination of a basket rotatable about a generally horizontal axis and in a single direction for containing fluid and the fabrics to be cleaned, and means resiliently supporting the basket, said resilient supporting means being so constructed and arranged that the average natural period of the various modes of vibration of the basket when substantially empty is of the order of 86 cycles per minute.

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