Aug. 15, 1961 K. W. NEIDENTHAL ET AL 2,995,918

LAUNDRY MACHINE

Filed Jan. 11, 1957 2 Sheets-Sheet 1

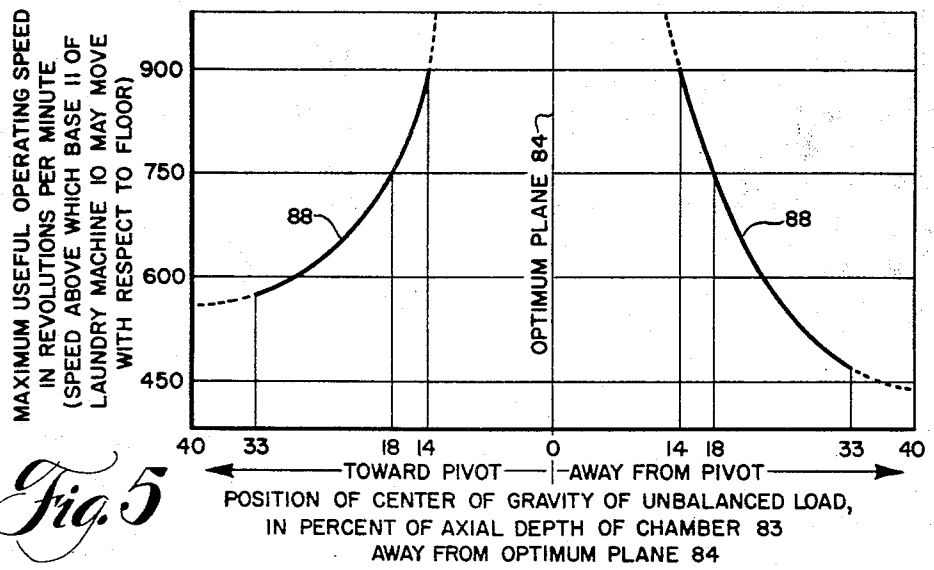


Fig. 5

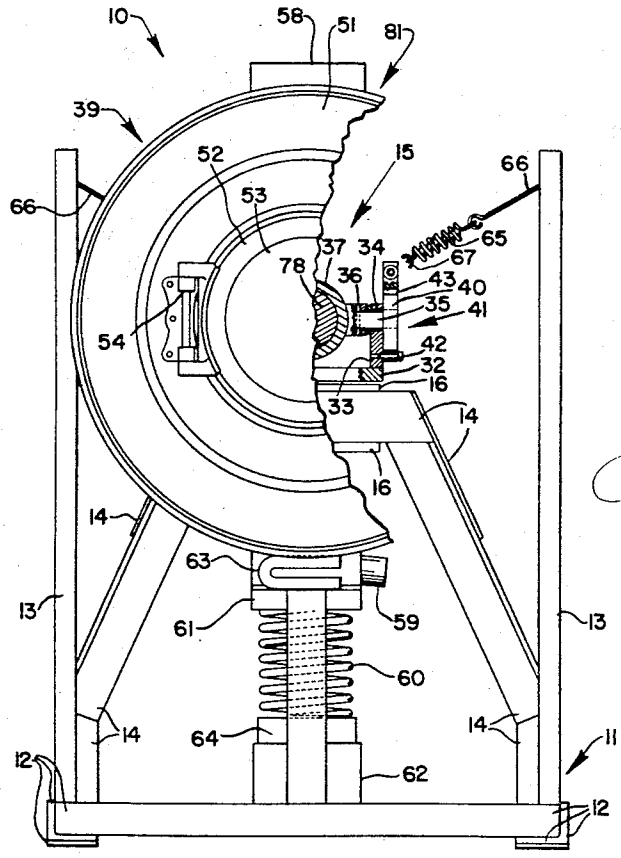


Fig. 1

INVENTORS
KENNETH W. NEIDENTHAL
JAMES E. BALLMER
ALBERT M. ROCKWOOD
BY Gray, Mase & Dunson
ATTORNEYS

Aug. 15, 1961 K. W. NEIDENTHAL ET AL 2,995,918

LAUNDRY MACHINE

Filed Jan. 11, 1957 2 Sheets-Sheet 2

Fig. 4

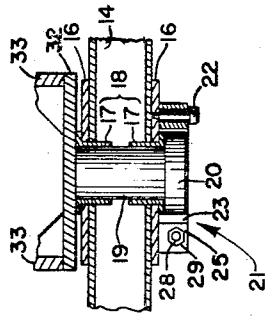


Fig. 3

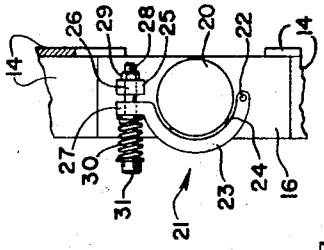
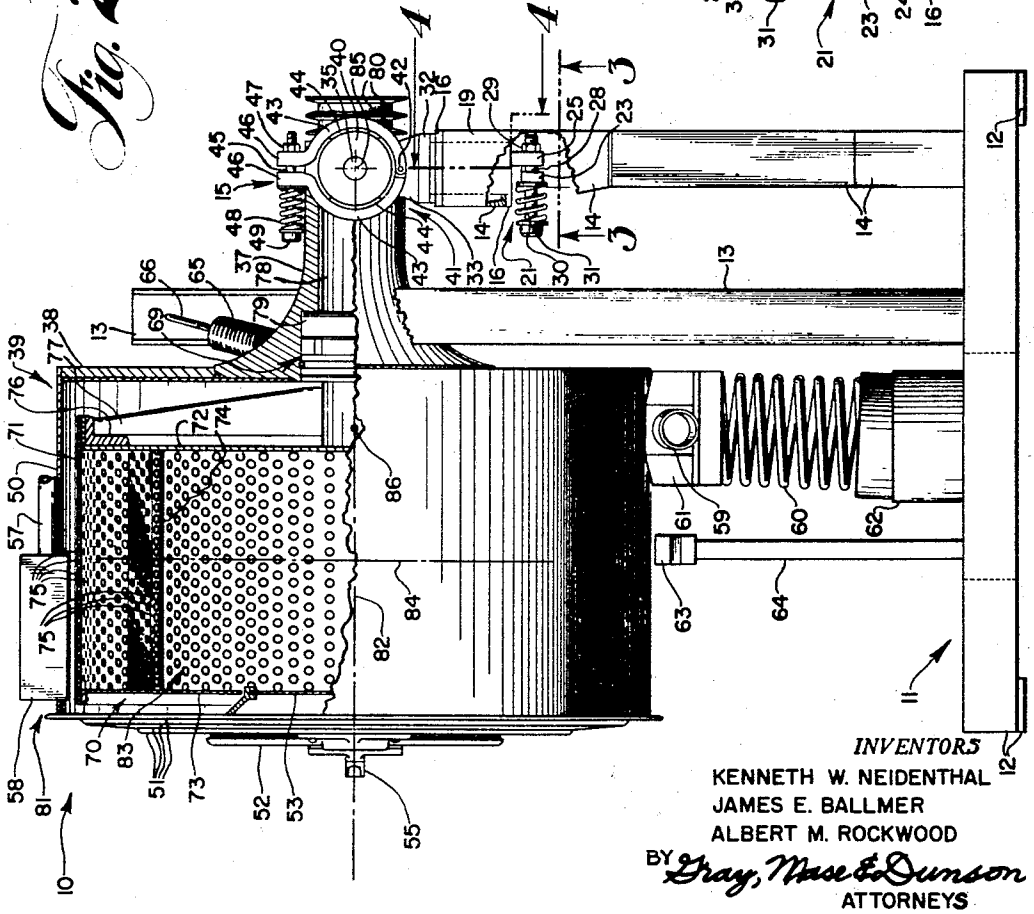


Fig. 2



INVENTORS
KENNETH W. NEIDENTHAL
JAMES E. BALLMER
ALBERT M. ROCKWOOD
BY Gray, Mase & Dunson
ATTORNEYS

United States Patent Office 2,995,918 Patented Aug. 15, 1961

2,995,918

LAUNDRY MACHINE

Kenneth W. Neidenthal, Columbus, Ohio, James E. Ballmer, Fort Worth, Tex., and Albert M. Rockwood, Columbus, Ohio, assignors, by mesne assignments, to McGraw-Edison Company, Elgin, Ill., a corporation of Delaware

Filed Jan. 11, 1957, Ser. No. 633,595
8 Claims. (Cl. 68—24)

This invention relates to laundry machines, particularly to machines for washing laundry and centrifugally extracting fluid therefrom, and to machines used only for centrifugal extraction of fluid from articles placed therein.

A primary object of the present invention is to provide a laundry machine that can be operated at high speeds of rotation for extraction of fluid from articles therein without requiring that the base of the laundry machine be fastened to the floor on which it stands. Other objects and advantages are apparent from the disclosure herein.

The efficiency and speed of extraction of fluid from laundry are increased rapidly with increasing speed of rotation of the laundry. In the past it has been necessary to operate extractors at relatively low speeds of rotation, or else to bolt them to the floor. The present invention makes possible the use of much higher operating speeds in a laundry machine that need not be bolted to the floor.

In a laundry machine that is not fastened to the floor, all operating speeds must be below the speed at which the base of the machine may move with respect to the floor. To minimize the forces on the base of a laundry machine during rotation, it is customary to make the rotating structure symmetrical about its axis of rotation. During a substantial portion of the time, however, the laundry inside the machine is not evenly distributed about the axis of rotation, and the composite center of gravity of the laundry ordinarily is located at a substantial distance from the axis of rotation. The unbalance introduced into the machine by the laundry results in undesirable forces, the effects of which must be minimized in order to make possible the use of high operating speeds of rotation.

In a preferred form of laundry machine according to the present invention the axis of rotation is substantially horizontal. The composite center of gravity of the laundry spinning about a horizontal axis cannot conveniently be made to coincide with the axis of rotation, but it can be made to lie approximately in a given vertical plane perpendicular to the axis of rotation. It has been found as a part of the present invention that in a laundry machine having a suspended assembly, including a rotatable member, connected at one end to a supporting frame by a universal pivot, and resiliently supported at a position away from the pivot, greatly increased operating speeds are made possible by positioning the laundry in the machine with the composite center of gravity of the laundry approximately in a plane, herein called the optimum plane, perpendicular to the axis of rotation at a distance from the pivot equal to the moment of inertia of the suspended assembly divided by the product of its mass and the distance from its center of gravity to the

pivot, plus approximately 11 percent of the axial depth of the chamber in the suspended assembly in which the laundry is located. The composite center of gravity of the laundry should be within about 18 percent, and preferably within about 14 percent, of the axial depth of the chamber of the optimum plane.

Best results are obtained where the universal pivot comprises two perpendicular pivotal connections. Preferably friction means engageable at each pivotal connection are provided for reducing the gyration of the suspended assembly during rotation of the rotatable member while passing through the critical speeds. The resilient supporting means preferably should be a soft compression spring providing a substantially vertical upward force through the axis of rotation. The soft spring has a low natural resonant frequency and thus provides low critical speeds of rotation, so that the exciting forces resulting from the unbalanced laundry load are relatively low at the critical speeds.

In accordance with the above and other features of the present invention, a preferred embodiment of a centrifugal extractor includes a supporting frame and a suspended assembly connected at one end to the frame by a universal pivot. The suspended assembly comprises an outer container and an inner container therein, each substantially symmetrical about a substantially horizontal axis. Resilient supporting means connected to the frame supports the suspended assembly at a position away from the pivot. Means are provided for rotating the inner container about the axis.

Means which may include the resilient supporting means and the chamber in the inner container are provided for positioning articles in the chamber with the composite center of gravity of the articles approximately in an optimum plane perpendicular to the axis at a distance from the pivot equal to the moment of inertia of the suspended assembly divided by the product of its mass and the distance from its center of gravity to the pivot, plus approximately 11 percent of the axial depth of the chamber. The composite center of gravity of the articles should be within about 18 percent, and preferably within about 14 percent of the axial depth of the chamber of the optimum plane.

Friction means engageable with the universal pivot preferably are provided for reducing the gyration of the suspended assembly during rotation of the inner container while passing through a critical speed. The universal pivot preferably comprises two perpendicular pivotal connections including a trunnion member connected to the suspended assembly and pivotably received by a horizontal bearing in the universal pivot connector and a vertical shaft in the universal pivot connector pivotably received by a bearing in the frame, the pivot axis in the frame intersecting the pivot axis of the trunnion member. The friction means are engageable with each pivotal connection.

The resilient supporting means preferably comprises a compression spring connected to the frame and supporting the suspended assembly, at a position away from the pivot, from beneath the suspended assembly by providing a substantially vertical upward force through the substantially horizontal axis of rotation. The compression spring preferably is so constructed as to provide a higher

critical speed of rotation for the inner container of less than about 90 revolutions per minute.

Resilient positioning means are connected between the frame and the suspended assembly at a position circumferentially spaced from the resilient supporting means, for confining the gyration of the suspended assembly to positions substantially above the resilient supporting means.

A laundry machine for washing laundry as well as centrifugally extracting washing fluid from the laundry preferably includes also a support member, connected to the frame in a position to support and restrain the gyration of the suspended assembly during washing, the position of the support member being beyond the range of gyration of the suspended assembly during extraction.

In the drawings:

FIG. 1 is a front view, partially cut away and partially in section, of a laundry machine according to the present invention;

FIG. 2 is a side view, partially cut away and partially in section, of the laundry machine of FIG. 1;

FIG. 3 is a sectional view of a portion of the laundry machine, taken along the line 3—3 of FIG. 2;

FIG. 4 is a sectional view of a portion of the laundry machine, taken on the line 4—4 of FIG. 2. To facilitate understanding, FIG. 4 is located in orthographic projection both with FIG. 2 and with FIG. 3, and

FIG. 5 is a graph, in rectangular coordinates, of the maximum useful operating speed against the position of the center of gravity of an unbalanced load in the laundry machine, illustrating an important feature of the invention.

Referring particularly to FIGS. 1 and 2, a preferred form of laundry machine **10** according to the present invention includes a supporting frame **11**. The supporting frame **11** comprises base members **12—12** fixedly connected together as shown, as by welding; side support members **13—13** fixedly connected to the base members **12—12** as shown, as by welding; and rear support members **14—14** fixedly connected together and to the base members **12—12** as shown, as by welding.

Mounted on the horizontal rear frame members **14—14** is a universal pivot **15**. (See also FIGS. 3 and 4.) Fixedly connected to the horizontal rear frame members **14—14** are upper and lower plates **16—16** which receive upper and lower bearing sleeves **17—17** respectively. The sleeves **17—17** together provide a vertical bearing **18** in which is placed a vertical shaft **19** of the universal pivot **15**.

Engageable with an extension **20** that is fixedly connected to the lower end of the vertical shaft **19** is a horizontal damper **21**, which provides a frictional force to oppose horizontal rotation of the vertical shaft **19**. The horizontal damper **21** includes a pivot pin **22** connected to the lower plate **16** and pivotably holding one end of a sickle shaped brake arm **23**, to the inner surface of which is attached a friction liner **24** made of suitable friction material such as ordinary brake liner material. A bracket **25** fixedly connected to the lower plate **16** is provided with a cylindrical hole **26** in line with a similar hole **27** in the brake arm **23**. A bolt **28** through the holes **26, 27** is held in place by a nut **29**. A compression spring **30** mounted on the bolt **28** between the head **31** of the bolt **28** and the straight end of the arm **23** presses the arm **23** toward the shaft extension **20**, and thereby presses the lining **24** against the shaft extension **20**.

Fixedly connected at its center to the upper end of the vertical shaft **19** is a horizontal support plate **32**, to two opposite ends of which are fixedly connected vertical brackets **33—33**. In each bracket **33** is mounted a horizontal sleeve bearing **34** (FIG. 1) which serves as a bearing for a horizontal trunnion member **35**. Each trunnion member **35** is fixedly connected as by a pin connection **36** to one end of a tub extension **37**, the other end of which is fixedly connected to the rear plate **38** of an outer container or tub **39**. At the outwardly projecting end of each trunnion member **35** is fixedly connected a cylindrical end disk **40**.

A vertical damper **41** frictionally engageable with the end disk **40** of the trunnion **35** is mounted on each bracket **33**. The vertical damper **41** includes a pivot pin **42** fixedly connected to the bracket **33** and pivotably holding a pair of sickle-shaped brake arms **43—43** oppositely disposed about the trunnion member **35** and surrounding the end disk **40**. Attached to the inner surfaces of the brake arms **43—43** are friction liners **44—44** made of suitable friction material such as brake liner material. A bolt **45** passing through cylindrical holes **46—46** in the straight ends of the brake arms **43—43** and held in place by a nut **47** presses the brake arms **43—43** toward each other by means of a compression spring **48** mounted around the bolt **45** between the head **49** of the bolt **45** and the straight end portion of one brake arm **43**. Thus friction liners **44—44** are pressed into frictional engagement with the end disk **40** of the trunnion member **35**. The vertical dampers **41—41** oppose vertical motion of the tub **39** about the horizontal axis of the trunnion members **35—35** in the horizontal bearings **34—34**. The horizontal pivot axis of the trunnion members **35—35** intersects the vertical pivot axis of the vertical shaft **19**.

Connected to the perimeter of the rear plate **38** of the tub **39** is one end of a cylindrical tub body **50**, to the opposite end of which is connected a front face member **51** of concentric rib construction. A door **52** which may include a transparent central portion **53** is pivotably mounted, as by a hinge connection **54**, in the center of the front face **51** of the tub **39**. Conventional locking means, such as a handle and slot as indicated at **55**, are provided to hold the door **52** shut during operation. The central portion **53** of the door **52** projects into the tub **39** a substantial distance.

An inlet pipe **57** connected to a source of water supplies water to the tub **39**. A receptacle **58** in the tub **39** is provided for supplying detergent to the laundry machine **10**. A drain outlet **59** at the bottom of the tub **39** provides for drainage of the laundry fluid and rinse water during the washing and rinsing cycles.

A main support spring **60**, mounted between an upper receptacle **61** connected to the tub **39** and a lower receptacle **62** connected to the frame **11**, resiliently supports the tub **39** except when, as during washing and rinsing, the tub **39** contains a substantial quantity of water sufficient to force it down against the compression force of the spring **60** to a stiff U-shaped spring **63** which is fixedly connected to the upper end of a vertical support member **64** the lower end of which is fixedly connected to the frame **11**.

The tub **39** is resiliently held in a central position between the side frame members **13—13** by a pair of centering springs **65—65** each of which is connected at end by a hook member **66** to the adjacent side frame member **13** and at the opposite end by a hook member **67** to the rear extension member **37** of the tub **39**.

An inner container or cylinder **70** is coaxially mounted inside the outer container or tub **39**. The cylindrical body **71** of the cylinder **70** is fixedly connected to a flat rear wall **72** and to a flat front wall **73**. The front wall **73** has a circular central opening just large enough to provide a small clearance around the inner portion **53** of the door **52** which projects inwardly just beyond the plane of the front wall **73** of the inner container **70**. The cylinder body **71** includes a plurality of inwardly projecting vanes **74—74**, preferably three or four, equally spaced circumferentially in the inner container **70**. Perforations **75—75** are provided in the vanes **74—74** as well as in the cylindrical body **71**. A backing ring **76** and a ribbed reinforcing plate **77** are fixedly connected to the rear of the cylinder body **71** and to the rear wall **72** of the inner container **70**. The ribbed plate **77** is fixedly connected to one end of a drive shaft **78** which is

rotatably mounted in the tub extension **37** through a rotary seal **69** and a bearing **79**.

The opposite end of the shaft **78** extends beyond the universal pivot **15** and is fixedly connected to pulleys **80—80**, which may be driven by a conventional motor and belt drive (not shown) which may be conveniently mounted on the frame **11** below. The axis **82** of the drive shaft **78**, which is also the axis of symmetry of the entire inner container **70** and the axis of symmetry of the entire outer container **39**, is substantially horizontal and perpendicularly intersects the axis of the vertical shaft **19** and the axis of the horizontal trunnions **35—35** of the universal pivot **15**, as is indicated at **85**.

The outer container **39** and the inner container **70**; which include everything mounted in the universal pivot **15**, supported by the support spring **60**, and centered by the tension springs **65—65**; comprise a suspended assembly **81** that is substantially symmetrical about its substantially horizontal axis **82**, which coincides with the axis of the shaft **78**.

The chamber **83**, formed by the cylinder body **71**, the rear wall **72**, and the front wall **73**, is constructed and positioned so as to position any laundry placed therein with the composite center of gravity of the laundry approximately in the optimum plane **84** which is perpendicular to the axis **82** at a distance from the universal pivot **15** (the distance being measured from the intersection of the pivot axes at **85**) equal to the moment of inertia of the suspended assembly **81** divided by the product of its mass and the distance from its center of gravity, indicated at **86**, to the pivot **15**, plus approximately 11 percent of the axial depth (the distance between the front wall **73** and the rear wall **72**) of the chamber **83**.

In the preferred form of laundry machine **10** illustrated in FIGS. 1 and 2, the chamber **83** is cylindrical and is located with its axis substantially horizontal. Thus the composite center of gravity of the laundry therein is located approximately midway between the front wall **73** and the rear wall **72**. The chamber **83** is therefore located with its mid-plane approximately coinciding with the optimum plane **84**. The main support spring **60** preferably is located approximately below the center of gravity **86** of the suspended assembly **81**, to provide optimum support of the weight, and its length and stiffness are selected so as to maintain the axis of rotation **82** approximately horizontal during extraction, when most of the water used during washing and rinsing has been removed from the tub **39**. If it were desired to perform the extraction operation with the suspended assembly tipped forward or backward at a substantial angle, the composite center of gravity of the laundry would be shifted forward or backward and the location of the chamber **83** would be modified accordingly to locate the composite center of gravity approximately in the optimum plane **84**. One or more of the walls **71**, **72**, **73** of the container **83** could be made arcuate in shape, if desired, particularly if the axis of rotation **82** were to be located at an angle to the horizontal. Many other obvious means for positioning the laundry in the chamber **83** could of course be used if desired.

Operation

The articles to be washed and spin-dried are placed in the chamber **83** of the inner container **70** and the door **52** is closed and fastened shut. The laundry machine **10** may utilize any conventional manual or automatic controls or combinations thereof to supply water and detergent to the tub **39**; to drive the inner container **70** through the shaft **78** to provide the customary washing and rinsing cycles at a slow speed of the order of 40 revolutions per minute; to drain the washing water and rinsing water and distribute the laundry at the appropriate times at an intermediate speed of the order of 80 revolutions per minute; and, after the washing and rinsing cycles, to rotate the inner container **70** at a high speed, in the order of 750 to 900 revolutions per minute, for the spin-drying or extraction of the water retained by the laundered articles.

During the washing and rinsing, when a substantial amount of water is present in the tub **39** the suspended assembly **81** rests on the stiff U-shaped spring **63**. The rotation of the inner container **70** is slow enough that the suspended assembly **81** does not tend to gyrate appreciably about the pivot **15**, and the suspended assembly **81** remains in contact with the stiff spring **63** during washing and rinsing. When the bulk of the water is removed from the tub **39**, the main support spring **60** forces the suspended assembly **81** upward off the stiff spring **63**, as shown in FIG. 2, and supports the assembly **81** during the high speed rotation for extraction of the liquid retained in the laundered articles. Because the chamber **83** positions the laundered articles with their composite center of gravity approximately in the optimum plane **84**, the reaction at the universal pivot **15** from the gyration of the suspended assembly **81** is minimized.

The main support spring **60** is a soft compression spring so constructed as to provide a lower critical speed of rotation preferably of the order of 15 revolutions per minute and a higher critical speed of rotation preferably of the order of 60 revolutions per minute. The critical speeds are those at which, because of natural resonance conditions, the gyration of the suspended assembly **81** is greatest. By using a supporting spring **60** that provides low critical speeds this gyration is much smaller than it would be if the critical speeds were higher, because the exciting forces from the unbalanced laundry load are lower at lower speeds of rotation. The laundry machine **10** is not operated at either of the critical speeds but must pass through these speeds momentarily before reaching the operating speeds. While the critical speeds mentioned above are preferable, critical speeds of up to about 90 revolutions per minute may be used without encountering excessive gyration.

While the universal pivot **15** permits gyration of the suspended assembly **81** about the pivot **85**, the suspended assembly **81** does not contact the stiff spring **63** during the extraction cycle. The minimizing of the effect of the gyration on the supporting frame **11** by positioning the composite center of gravity of the laundered articles approximately in the optimum plane **84** make it possible to use higher speeds of rotation during extraction than would otherwise be possible without bolting the frame **11** to the floor. Thus rapid, efficient extraction is obtained with a laundry machine that need not be bolted to the floor.

Numerous tests were made of a laundry machine **10** as shown in the drawings. The diameter of the chamber **83** was 30 inches and its axial depth was 15 inches. In each test a load weighing 10 pounds was placed in the chamber **83** with its center of gravity approximately 14¾ inches from the axis of rotation **82**. This provided an unbalanced load condition more severe than that obtained with any load of laundry that would be placed in the chamber. The tests were made with the center of gravity of the unbalanced load at various distances from the optimum plane **84**. During each test run the load was fastened in place to maintain its center of gravity in a definite predetermined location. Beginning at a low speed, in each test the speed of rotation was gradually increased until the effect of the gyration of the suspended assembly **81** resulting from the unbalanced laundry load was sufficient to begin to move the base **11** of the laundry machine **10** with respect to the floor. The curves **88—88** of FIG. 5 show the results of the tests. In FIG. 5 the maximum useful operating speed, in revolutions per minute (the speed above which the base **11** laundry machine **10** may move with respect to the floor), is plotted against the position of the composite center of gravity of the laundry, in percent of the axial depth of the chamber **83** away from the optimum plane **84**.

As is apparent from the curves 88—88 in FIG. 5, operating speeds of at least 900 revolutions per minute can be used without causing the laundry machine 10 to move on the floor when the composite center of gravity of the articles in the chamber 83 is kept within about 14 percent of the axial depth of the chamber 83 of the optimum plane 84. When the composite center of gravity of the articles is maintained within about 18 percent of the axial depth of the chamber 83, speeds up to 750 revolutions per minute may be used. For a smaller load unbalance the maximum useful operating speed curves lie generally above the curves 88—88 of FIG. 5. As the distance from the optimum plane 84 increases, the maximum useful operating speed drops off rapidly. Thus it is clear that the location of the composite center of gravity of the laundered articles in the chamber 83 is critical, and must be maintained in the vicinity of the optimum plane 84 to permit the most efficient high-speed extraction.

Where it is desired to use the laundry machine 10 only as a centrifugal extractor, the inlet pipe 57, the detergent receptacle 58, the stiff support spring 63, and the vertical support member 64 can be omitted.

To summarize, a centrifugal extractor 10 according to the present invention includes a supporting frame 11, and a suspended assembly 81 connected at one end to the frame 11 by a universal pivot 15. The suspended assembly 81 comprises an outer container 39 and an inner container 70 therein, each substantially symmetrical about a substantially horizontal axis 82. Resilient supporting means 60 connected to the frame 11 supports the suspended assembly 81 at a position 61 away from the pivot 15. Means 78, 80 are provided for rotating the inner container 70 about the axis 82.

Means which may include the resilient supporting means 60 and the chamber 83 in the inner container 70 are provided for positioning articles in the chamber 83 with the composite center of gravity of the articles approximately in a plane 84 perpendicular to the axis 82 at a distance from the pivot 15 (85) equal to the moment of inertia of the suspended assembly 81 divided by the product of its mass and the distance from its center of gravity 86 to the pivot 15 (85), plus approximately 11 percent of the axial depth (73 to 72) of the chamber 83. The composite center of gravity of the articles should be within about 18 percent, and preferably within about 14 percent of the axial depth of the chamber 83 of the optimum plane 84.

Friction means 21, 41 engageable with the universal pivot 15 preferably are provided for reducing the gyration of the suspended assembly 81 during rotation of the inner container 70 while passing through a critical speed. The universal pivot 15 preferably comprises two perpendicular pivotal connections 18—19, 34—35 including a trunnion member 35 connected to the suspended assembly at 36 and pivotably received by a horizontal bearing 34 in the universal pivot connector 15 and a vertical shaft 19 in the universal pivot connector 15 pivotably received by a bearing 18 in the frame 11, the pivot axis in the frame 11 intersecting the pivot axis of the trunnion member 35 as is indicated at 85. The friction means 21, 41 are engageable with each pivotal connection as is indicated at 20, 24 and 40, 44.

The resilient supporting means 60 preferably comprises the compression spring 60 connected (62) to the frame 11 and supporting the suspended assembly 81 at a position 61 away from the pivot 15, from beneath the suspended assembly 81 by providing a substantially vertical upward force through the substantially horizontal axis 82. The compression spring 60 preferably is so constructed as to provide a higher critical speed of rotation for the inner container 70 of less than about 90 revolutions per minute.

Resilient positioning means 65—65 are connected between the frame 11 and the suspended assembly 81 at a position circumferentially spaced from the resilient supporting means 60, for confining the gyration of the suspended assembly 81 to positions substantially above the resilient supporting means 60.

A laundry machine 10 for washing laundry as well as centrifugally extracting washing fluid from the laundry preferably includes also a support member 63, connected (64) to the frame 11 in a position to support and restrain the gyration of the suspended assembly 81 during washing, the position of the support member 63 being beyond the range of gyration of the suspended assembly 81 during extraction.

The reference characters in the above summary indicate generally the primary components shown in the drawings corresponding to the recited features, to facilitate understanding of the claims. The reference characters are used merely by way of example, however, and not in any limiting sense.

While the form of the invention herein disclosed constitutes a preferred embodiment, it is not intended to describe all of the possible equivalent forms or ramifications of the invention. It will be understood that the words used are words of description rather than of limitation, and that various changes may be made without departing from the spirit or scope of the invention herein disclosed.

What is claimed is:

1. A centrifugal extractor comprising: a supporting frame; a suspended assembly connected at one end to said frame by a universal pivot; said suspended assembly comprising an outer container and an inner container therein, each substantially symmetrical about a substantially horizontal axis; resilient supporting means connected to said frame and supporting said suspended assembly at a position away from said pivot; means for rotating said inner container about said axis; said inner container defining a chamber including space for containing articles therein, the center of said space lying within about 18 per cent of the axial depth of said chamber of a plane perpendicular to said axis at a distance from said pivot equal to the moment of inertia of said suspended assembly divided by the product of its mass and the distance from its center of gravity to said pivot, plus approximately 11 percent of the axial depth of said chamber.

2. A centrifugal extractor comprising: a supporting frame; a suspended assembly connected at one end to said frame by a universal pivot; said suspended assembly comprising an outer container and an inner container therein, each substantially symmetrical about a substantially horizontal axis; resilient supporting means connected to said frame and supporting said suspended assembly at a position away from said pivot; means for rotating said inner container about said axis; friction means engageable with said universal pivot for reducing the gyration of said suspended assembly during rotation of said inner container while passing through a critical speed; said inner container defining a chamber including space for containing articles therein, the center of said space lying within about 18 percent of the axial depth of said chamber of a plane perpendicular to said axis at a distance from said pivot equal to the moment of inertia of said suspended assembly divided by the product of its mass and the distance from its center of gravity to said pivot, plus approximately 11 percent of the axial depth of said chamber.

3. A centrifugal extractor comprising: a supporting frame; a suspended assembly connected at one end to said frame by a universal pivot comprising two perpendicular pivotal connections; said suspended assembly comprising an outer container and an inner container therein, each substantially symmetrical about a substantially horizontal axis; resilient supporting means connected to said frame and supporting said suspended assembly at a position away from said pivot; means for rotating said inner container about said axis; friction means engageable with each said pivotal connection for reducing the gyration of said suspended assembly during rotation

of said inner container while passing through a critical speed; said inner container defining a chamber including space for containing articles therein, the center of said space lying within about 18 percent of the axial depth of said chamber of a plane perpendicular to said axis at a distance from said pivot equal to the moment of inertia of said suspended assembly divided by the product of its mass and the distance from its center of gravity to said pivot, plus approximately 11 percent of the axial depth of said chamber.

4. A centrifugal extractor comprising: a supporting frame; a suspended assembly connected at one end to said frame by a universal pivot connector by means of a trunnion member connected to said suspended assembly and pivotably received by a horizontal bearing in said connector and a vertical shaft in said connector pivotably received by a bearing in said frame, the pivot axis in said frame intersecting the pivot axis of said trunnion member; said suspended assembly comprising an outer container and an inner container therein, each substantially symmetrical about a substantially horizontal axis; resilient supporting means comprising a compression spring connected to said frame and supporting said suspended assembly, at a position away from said pivot, from beneath said suspended assembly by providing a substantially vertical upward force through said substantially horizontal last-mentioned axis, so constructed as to provide a higher critical speed of rotation for said inner container of less than about 90 revolutions per minute; means for rotating said inner container about its axis; friction means engageable at each said bearing for reducing the gyration of said suspended assembly during rotation of said inner container while passing through a critical speed; resilient positioning means connected between said frame and said suspended assembly at a position circumferentially spaced from said resilient supporting means, for confining the gyration of said suspended assembly to positions substantially above said resilient supporting means; said inner container defining a chamber including space for containing articles therein, the center of said space lying within about 18 percent of the axial depth of said chamber of a plane perpendicular to said axis at a distance from said pivot equal to the moment of inertia of said suspended assembly divided by the product of its mass and the distance from its center of gravity to said pivot, plus approximately 11 percent of the axial depth of said chamber.

5. A laundry machine for washing laundry and centrifugally extracting washing fluid therefrom comprising: a supporting frame; a suspended assembly connected at one end to said frame by a universal pivot; said suspended assembly comprising an outer container and an inner container therein, each substantially symmetrical about a substantially horizontal axis; resilient supporting means connected to said frame and supporting said suspended assembly at a position away from said pivot; means for rotating said inner container about said axis for washing said laundry and for extracting washing fluid therefrom; said inner container defining a chamber including space for containing said laundry therein, the center of said space lying within about 18 percent of the axial depth of said chamber of a plane perpendicular to said axis at a distance from said pivot equal to the moment of inertia of said suspended assembly divided by the product of its mass and the distance from its center of gravity to said pivot, plus approximately 11 percent of the axial depth of said chamber.

6. A laundry machine for washing laundry and centrifugally extracting washing fluid therefrom comprising: a supporting frame; a suspended assembly connected at one end to said frame by a universal pivot; said suspended assembly comprising an outer container and an inner container therein, each substantially symmetrical about a substantially horizontal axis; resilient supporting means connected to said frame and supporting said suspended assembly at a position away from said pivot; means for rotating said inner container about said axis for washing said laundry and for extracting washing fluid therefrom; friction means engageable with said universal pivot for reducing the gyration of said suspended assembly during rotation of said inner container while passing through a critical speed; said inner container defining a chamber including space for containing said laundry therein, the center of said space lying within about 18 percent of the axial depth of said chamber of a plane perpendicular to said axis at a distance from said pivot equal to the moment of inertia of said suspended assembly divided by the product of its mass and the distance from its center of gravity to said pivot, plus approximately 11 percent of the axial depth of said chamber.

7. A laundry machine for washing laundry and centrifugally extracting washing fluid therefrom comprising: a supporting frame; a suspended assembly connected at one end to said frame by a universal pivot comprising two perpendicular pivotal connections; said suspended assembly comprising an outer container and an inner container therein, each substantially symmetrical about a substantially horizontal axis; resilient supporting means connected to said frame and supporting said suspended assembly at a position away from said pivot; means for rotating said inner container about said axis for washing said laundry and for extracting washing fluid therefrom; friction means engageable at each said pivotal connection for reducing the gyration of said suspended assembly during rotation of said inner container while passing through a critical speed; a support member connected to said frame in a position to support and restrain the gyration of said suspended assembly during washing, said position being beyond the range of gyration of said suspended assembly during extraction; said inner container defining a chamber including space for containing said laundry therein, the center of said space lying within about 18 percent of the axial depth of said chamber of a plane perpendicular to said axis at a distance from said pivot equal to the moment of inertia of said suspended assembly divided by the product of its mass and the distance from its center of gravity to said pivot, plus approximately 11 percent of the axial depth of said chamber.

8. A laundry machine for washing laundry and centrifugally extracting washing fluid therefrom comprising: a supporting frame; a suspended assembly connected at one end to said frame by a universal pivot connector by means of a trunnion member connected to said suspended assembly and pivotably received by a horizontal bearing in said connector and a vertical shaft in said connector pivotably received by a bearing in said frame, the pivot axis in said frame intersecting the pivot axis of said trunnion member; said suspended assembly comprising an outer container and an inner container therein, each substantially symmetrical about a substantially horizontal axis; resilient supporting means comprising a compression spring connected to said frame and supporting said suspended assembly at a position away from said pivot, from beneath said suspended assembly by providing a substantially vertical upward force through said substantially horizontal last mentioned axis, so constructed as to provide a high critical speed of rotation for said inner container of less than about 90 revolutions per minute; means for rotating said inner container about its axis for washing said laundry and for extracting washing fluid therefrom; friction means engageable at each said bearing for reducing the gyration of said suspended assembly during rotation of said inner container while passing through a critical speed; resilient positioning means connected between said frame and said suspended assembly at a position circumferentially spaced from said resilient supporting means, for confining the gyration of

said suspended assembly to positions substantially above said resilient supporting means; a support member connected to said frame in a position to support and restrain the gyration of said suspended assembly during washing, said position being beyond the range of gyration of said suspended assembly during extraction; said inner container defining a chamber including space for containing said laundry therein, the center of said space lying within about 18 percent of the axial depth of said chamber of a plane perpendicular to said axis at a distance from said pivot equal to the moment of inertia of said suspended assembly divided by the product of its mass and the distance from its center of gravity to said pivot, plus approximately 11 percent of the axial depth of said chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

408,791	Cairns	Aug. 13, 1889
2,230,345	Bradbury	Feb. 1, 1941
2,396,105	Kirby	Mar. 5, 1946
2,512,847	Conterman	June 27, 1950
2,625,031	Kreitchman	Jan. 13, 1953
2,637,514	O'Connor	May 5, 1953
2,706,899	Meyer	Apr. 26, 1955

FOREIGN PATENTS

77,038	Denmark	Feb. 1, 1954