May 13, 1947. A. H. GERHARDT 2,420,592

BALANCING MEANS FOR CENTRIFUGAL MACHINES

Filed June 30, 1944 3 Sheets-Sheet 1

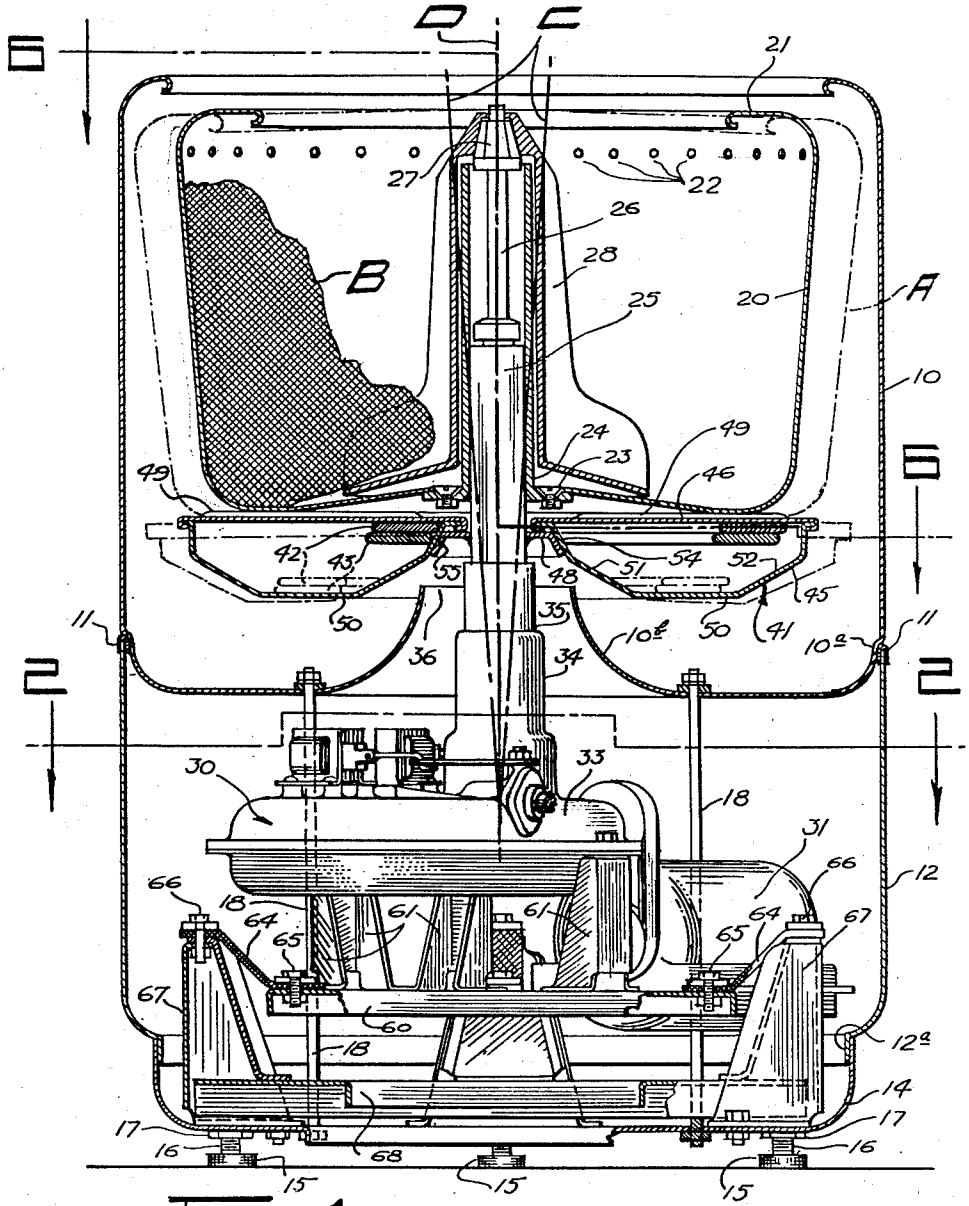


FIG. 1.

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BALANCING MEANS FOR CENTRIFUGAL MACHINES

Filed June 30, 1944 3 Sheets-Sheet 2

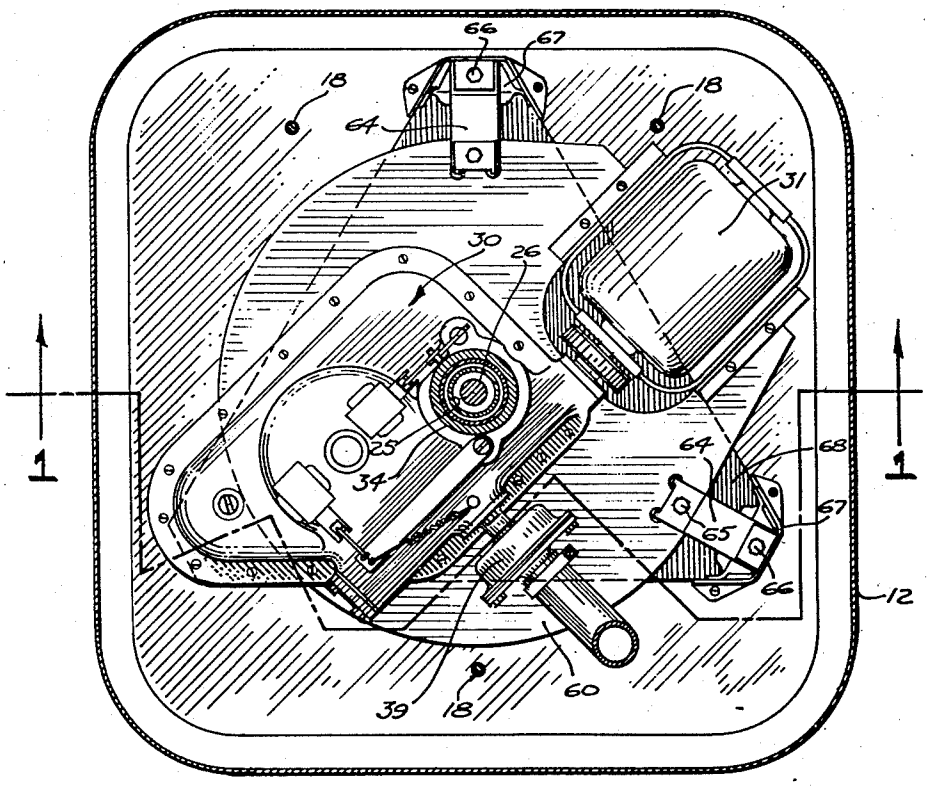


FIG. 2.

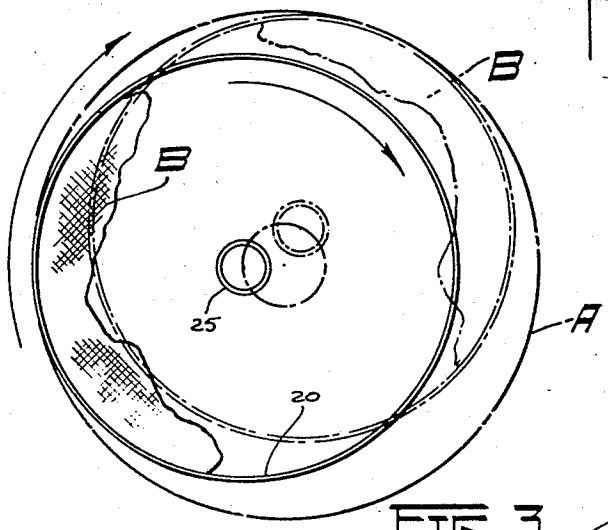


FIG. 3.

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BALANCING MEANS FOR CENTRIFUGAL MACHINES

Filed June 30, 1944 3 Sheets-Sheet 3

FIG. 4.

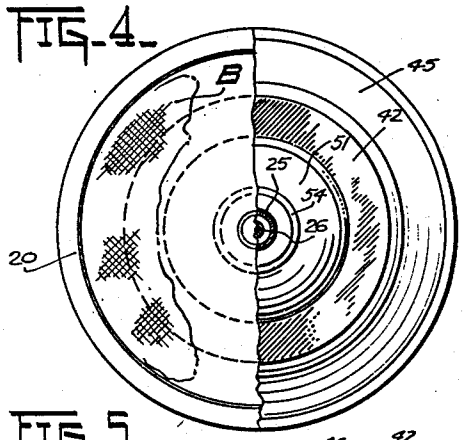


FIG. 6.

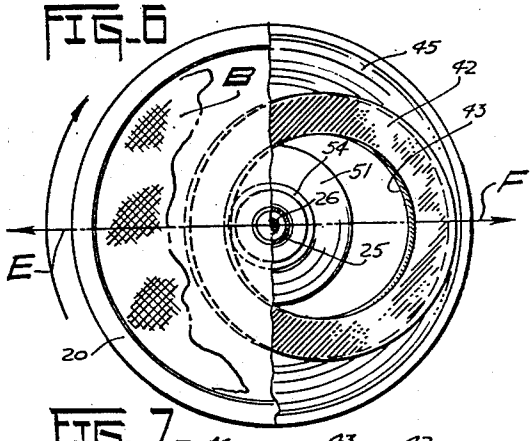


FIG. 5.

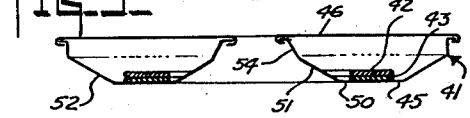


FIG. 7.

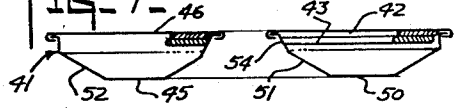


FIG. 8.

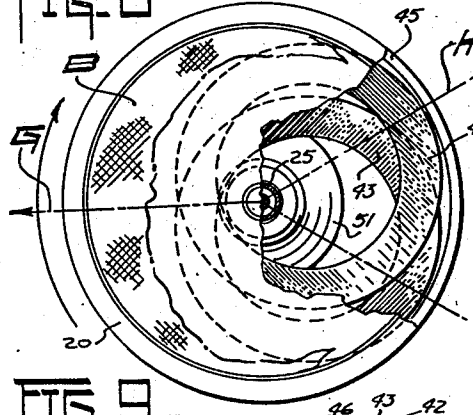


FIG. 10.

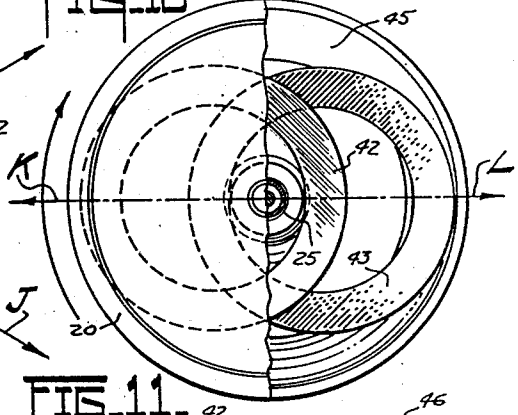


FIG. 9.

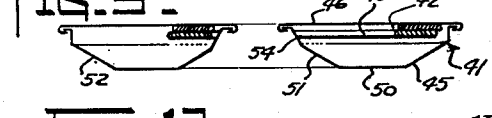


FIG. 11.

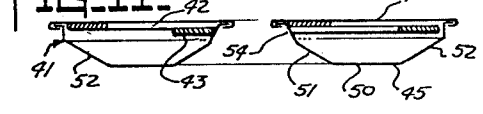
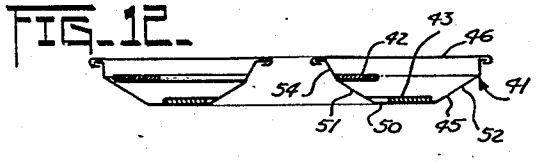


FIG. 12.



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UNITED STATES PATENT OFFICE

2,420,592

BALANCING MEANS FOR CENTRIFUGAL MACHINES

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Application June 30, 1944, Serial No. 542,850

5 Claims. (Cl. 74—573)

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The present invention relates to improvements in centrifugal machines, such as for example, laundering machines. More particularly, this invention is directed to centrifugal machines of the type including a receptacle adapted to be rotated about an upright axis, and wherein the receptacle is adapted to contain solid material, such as clothes, together with a cleansing liquid. The receptacle is constructed and arranged so that when it is rotated at a relatively high rate of speed, a large percentage of the liquid is removed or separated from the solids by the action of the centrifugal force. In machines of this general type, considerable difficulty is experienced in obtaining a uniform distribution of the material around the axis of rotation of the receptacle. When the material within the receptacle is non-uniformly distributed, it produces an out-of-balance or off-center load condition therein, resulting in excessive and undesired vibration when the receptacle is rotated. There have heretofore been proposed numerous constructions for the reduction or elimination of such vibration. In certain constructions of machines, such as those that are fixed to the floor, some suitable form of flexible mountings or suspension means for the extractor receptacle have heretofore been employed, or some suitable form of counter-balancing means is employed. Where the machine is of a portable nature, that is, one adapted to merely rest upon the floor, the problem of eliminating or reducing the vibration, due to out-of-balance load condition, presents the greatest difficulty.

The present invention contemplates the provision of an improved form of counter-balancing means of the type comprising two or more annular weights or rings mounted around the axis of rotation of the receptacle drive shaft. Counter-balancing means of the annular weight or ring type is relatively old and is disclosed in the prior patented art, such as for example, in the Fesca Patent No. Re. 7,455, dated January 7, 1877. The weight rings are capable of independent movement, and are adapted to readily adjust themselves at various angular relationships to each other for counter-balancing and compensating for an off-center or out-of-balance load condition in the receptacle.

For centrifugal machines of the portable type, that is, machines that are not permanently and rigidly anchored in position on the floor, I prefer to utilize in conjunction with my improved weight ring type of counter-balance, suitable flexible suspension means for the receptacle and drive mechanism therefor. It will be apparent, however, for certain other types of machines, depending on their nature of use and the manner of mounting, the improved weight ring counter-balance may be employed without the use of flexible mounting or suspension means.

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One of the objects of this invention is to provide an improved, self-adjusting, counter-balancing means for use with a centrifugal extractor receptacle of a centrifugal machine, for reducing and/or eliminating vibration set up in the machine incident to the rotation of the receptacle with an off-center or out-of-balance load therein.

Another object is to provide an improved counter-balancing means, disposed immediately below the extractor receptacle and, comprising two or more independently movable weight rings disposed in surrounding relation to the rotatable shaft of the receptacle, together with guide means co-acting with the weights to insure self-centering of the weights relatively to the axis of the shaft when the receptacle is at rest.

A further object is to provide an improved counter-balancing means of the character indicated, constructed as a unitary assembly and comprising a totally closed housing of annular form, adapted to be mounted around and driven incident to rotation of the receptacle drive shaft, and two or more annular weight rings normally superimposed one upon the other within the housing and the housing being so formed as to coact with the portions of the weight rings to cause said rings, when the housing is rotated, to move in an upwardly direction in contacting engagement with each other, and the top of the housing.

Still another object is to provide an improved counter-balancing means of the character indicated, which is relatively simple in construction, efficient and effective in operation, and capable of being economically manufactured.

A still further object is to provide an improved centrifugal machine of the character indicated, comprising flexible suspension means for the extracting receptacle and operating mechanism therefor, together with improved counter-balancing means surrounding the drive shaft for the receptacle, to effectively reduce and eliminate vibration set up in the machine incident to an off-center or out-of-balance load condition within the receptacle.

Other objects and advantages of this invention will be apparent from the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is a vertical section through the machine

while operating, the upper portion being a true axial section, and the lower portion representing a staggered section, with parts shown in elevation and taken substantially as indicated at line 1—1 on Fig. 2.

Fig. 2 is a horizontal sectional view through the machine, taken substantially as indicated at line 2—2 on Fig. 1.

Fig. 3 is a diagrammatic view of the extractor receptacle, showing an out-of-balance load condition and representing the orbital path of travel of the receptacle due to such out-of-balance load condition.

Fig. 4 is a staggered diagrammatic view showing a portion of the extractor receptacle in elevation and showing the interior of the counter-balancing means at a condition of adjustment when the receptacle is at rest.

Fig. 5 is a diagrammatic, axial, sectional view through the counter-balancing means showing the position of adjustment of the weight rings when the extractor receptacle is at rest.

Fig. 6 is a diagrammatic view similar to Fig. 4 of the extractor receptacle and counter-balance means, taken substantially as indicated by the staggered section lines 6—6 on Fig. 1, showing the rings in a position of adjustment for counter-balancing an out-of-balance load condition of the receptacle, as represented in Fig. 1.

Fig. 7 is a diagrammatic, axial, sectional view through the counter-balancing means, corresponding to the position of adjustment as represented in Fig. 6.

Fig. 8 is a diagrammatic view similar to that shown in Fig. 6, but depicting a different out-of-balance load conditon, and showing the counter-balancing rings in a compensating position of adjustment for counter-balancing the off-center load condition.

Fig. 9 is a diagrammatic, vertical, axial, sectional view through the counter-balance means, showing the position of adjustment of the weight rings corresponding to that represented in Fig. 8.

Fig. 10 is a diagrammatic view similar to Figs. 4, 6 and 8, and showing the weight rings in a position of adjustment when the load in the extractor receptacle is substantially uniformly distributed relatively to the axis of rotation thereof.

Fig. 11 is a diagrammatic, vertical, axial, sectional view through the counter-balancing means showing the position of adjustment of the weight rings as represented in Fig. 10.

Fig. 12 is a diagrammatic, axial, sectional view through the counter-balancing means showing one of the weight rings in cooperative relation to the housing therefor, by virtue of which it acquires a self-centering action when the extractor receptacle is approaching a condition of rest.

In centrifugal extracting machines, an unbalanced load normally produces vibration which the present invention is intended to reduce or eliminate. Where the machine is fixedly mounted to the floor or other support, the vibration due to unbalanced load, is of relatively minor importance. When, however, the machine is constructed in the nature of a portable machine, and is not fixedly secured to the floor, it is highly important to utilize some suitable form of flexible mounting or suspension for the operating mechanism and rotating parts, and/or counter-balancing means, for the purpose of compensating for unbalance caused by an out-of-balance load condition. The counter-balancing unit serves to compensate for a condition of unbalance due to off-center or out-of-balance load condition, such as results when the material, such as a mass of wet clothes, is not uniformly distributed about the axis of rotation of the extractor receptacle.

The machine illustrated in the drawings is of the type intended primarily for household use as a laundrying machine for performing a washing and extracting or drying operation upon clothes. The machine includes an external liquid collector receptacle 10, having its bottom formed with an offset portion as indicated at 10a, seated in nested relation upon a resilient gasket 11, mounted upon the upper marginal edge of a skirt 12. The lower end of the skirt terminates in an inwardly projecting neck 12a, telescoped into the upwardly extending flanged portion of a base 14. The supporting base is provided with three circumferentially spaced apart feet 15, including threaded shanks 16, cooperating with threaded bosses 17, secured to the bottom of the base, by virtue of which said feet may be properly adjusted vertically for accommodating the machine to any normal irregularities in the level of the floor or surface upon which the machine is to be mounted. The liquid collector receptacle 10, together with the skirt 12, and base 14, are rigidly connected together in assembled, nested relation by a plurality of tie rods 18, which connect the bottom of the collector receptacle 10, directly to the base 14, as seen in Fig. 1 of the drawings. The external contour of the liquid collector receptacle, together with the skirt 12, and base 14, may be of any desired form, and as represented in Fig. 2 of the drawings, is of generally rectangular shape having rounded corners joining the side walls thereof.

Mounted within the liquid collector receptacle 10, is a receptacle 20, in which clothes are adapted to be washed and also subjected to a centrifugal extracting operation for removing the major portion of free liquid in the clothes. The receptacle is of circular contour, and the lateral wall thereof tapers in an upwardly and outwardly direction, and terminates at its upper edge in an inturned marginal flange 21. Adjacent the upper end of the lateral wall of the receptacle is a series of apertures 22, through which the liquid within the receptacle may be discharged into the liquid collector receptacle when the receptacle 20, is rotated, as will hereinafter be described. Said receptacle 20, for convenience, may be termed a washing and extracting receptacle, and has rigidly connected to its bottom, at the center thereof, by means of screws 23, an upstanding tubular sleeve 24, adapted to surround in close-fitting relation, a tubular drive shaft 25, which is adapted to be rotated in one direction. Mounted concentrically within suitable bearings, not shown, within the tubular drive shaft 25, is an oscillatable agitator shaft 26, terminating above the upper end of the sleeve 24, and provided at said upper end with a driving block 27, on which is seated in driving relation, a vaned agitator element 28, adapted to be oscillated within the washing and extracting receptacle 20.

Mounted within the skirt portion 12, is a suitable driving mechanism, as indicated generally at 30, adapted to be driven by an electric motor 31, by virtue of which the tubular drive shaft 25, and the agitator shaft 26, are adapted to be selectively operated. It may be understood that the drive mechanism for operating these two shafts is of the same general type disclosed in my co-pending application, Serial No. 540,332, filed June 14, 1944, and since the drive mechanism per

se does not constitute a part of the present invention, no further detailed description of the construction and operation thereof is believed necessary. The drive mechanism includes a housing 33, provided with upstanding, concentric, tubular members 34, and 35, surrounding the rotating and oscillating shafts. The tubular members 34 and 35, project upwardly into a clearance opening, as indicated at 36. The central area of said receptacle 10, is formed with an upwardly open neck 10b, as clearly seen in Fig. 1 of the drawings. The opening in said portion 10b, provides clearance for accommodation of the tubular portions 34 and 35, of the drive mechanism, when the machine is functioning as an extractor, and during which time the receptacle 20, may be caused to travel in an orbit, as represented in the dot and dash outline at A, when the receptacle contains an out-of-balance load, as represented at B, as may be seen in Figs. 1 and 3.

It is to be understood that the machine as represented in Fig. 1 of the drawings, is constructed so that clothes may be first washed within the receptacle 20, by operation of the agitator element 28, in a conventional manner, and after the washing operation has been completed, the drive to the agitator is disengaged, and the shaft 25, is then driven so that the receptacle 20, is rotated at a relatively high rate of speed, to centrifugally extract the free washing liquid, by causing the same to flow upwardly against the inner lateral wall of the receptacle 20, and discharging through apertures 22, into the liquid collector receptacle 10. It may be understood that the collector receptacle 10, is provided with a suitable drain outlet (not shown), directly connected to a pump, as indicated at 39, of the drive mechanism for discharging the wash liquid to a suitable drain or soil pipe.

The improved counter-balancing means embodying the present invention is in the form of a unitary structure, and comprises a housing 41, of annular form, totally enclosing two freely movable, annular weight rings 42 and 43. The housing is formed of sheet metal and includes a bottom member 45, and a top member 46, the inner and outer marginal edges of which are crimped together, as clearly seen in Fig. 1 of the drawings. If desired, the marginal edges of these two housing members may be welded together, or connected in any suitable manner. The housing containing the weight rings is loosely supported at its center upon a flange 48, rigidly attached to the tubular drive shaft 25, and the entire counter-balance unit is adapted to be frictionally driven by said shaft 25. The top wall member 46, of the housing is formed with a plurality of upstanding ribs 49, upon which the washing and extracting receptacle 20, is supported, and is caused to be frictionally driven incident to the rotation of the counter-balancing means, including the housing and weight rings.

The horizontal, bottom wall portion of the lower housing member 45, as indicated at 50, is of a dimension so as to permit flat seating and accommodation of the rings 42 and 43, when the machine is at rest, such as represented diagrammatically in Figs. 4 and 5 of the drawings, and it is desirable that the dimension of said bottom portion 50, be slightly greater than the width of the rings, so as to allow freedom and instant movement of the rings when the machine is set into motion for causing rotation of the receptacle 20, in the performance of a centrifugal extracting operation. The opposite inner and outer marginal portions of the horizontal section 50, of the bottom housing member terminate in oppositely inclined inner and outer wall portions 51 and 52, which extend at an upward angle of approximately 30 degrees to horizontal, and form frusto-conical wall portions which serve to provide maximum transverse shifting movement of the rings 42 and 43, in horizontal direction, while requiring a minimum amount of vertical movement of said rings. This arrangement insures proper centering of the rings relatively to the axis of rotation of the receptacle 20, when the machine is at rest, as seen in Figs. 4 and 5. The inner frusto-conical wall portion 51, of the lower housing member, merges at its upper end into an inclined wall section 54, of frusto-conical form, preferably disposed at an angle of approximately 30 degrees to vertical, or at a sufficient angle to crowd the weight rings 42 and 43, in an upwardly direction, against each other, and against the top housing member 46, as clearly seen in Fig. 1 of the drawings. This constructional arrangement, it has been found, serves to eliminate slapping of the rings against each other and against the top of the housing, while at the same time avoids restricting relative horizontal movement between the respective weight rings and between the uppermost ring and the top housing member 46.

For convenience in illustrating the path of travel of the washing and extracting receptacle 20, in addition to the representation in Fig. 3 of the drawings, due to an out-of-balance load condition, I have shown by dot and dash outline, as represented by the inclined lines C, in Fig. 1 of the drawings, the gyratory path of travel of the receptacle relative to the true axis D, of the rotating parts of the machine.

While as above stated, the present invention is illustrated in conjunction with a machine adapted for performing both a washing and extracting operation upon clothes, manifestly the invention is adapted for use with a machine constructed for performing solely an extracting operation on various materials.

In the machine as illustrated, after completion of the washing operation, the clothes tend to distribute themselves about the axis of rotation of the receptacle. Due, however, to the nature of the clothes being washed and to peculiarities in the washing action, it frequently happens that a mass of clothes becomes improperly distributed, and results in bunching of the clothes, so as to produce an out-of-balance load condition in the performance of the centrifugal extracting operation of the machine. When the machine is constructed for use solely as a centrifugal extracting machine, it is not always possible, even by hand, to properly distribute the clothes evenly or uniformly about the axis of the receptacle, and hence, the same problem of out-of-balance load condition will frequently result. In machines of this general type, when utilizing an extracting receptacle of approximately 20 inches in diameter, it is possible in operating on a normal batch of clothes to develop a static out-of-balance or off-center load condition, equivalent to three or four pounds. To perform a satisfactory extracting operation in such a machine, the receptacle 20, is preferably rotated in the range of 500 to 700 R. P. M. It will, therefore, be apparent that due to this high-speed rotation of the receptacle 20, and the possibility of a substantial off-center load condition, as above referred to, tremendous centrifugal forces are set

up tending to cause the receptacle 20 and associated elements to travel in an orbit, as represented in dot and dash outlines at A. Such a condition sets up tremendous vibration in the total machine, and may even tend to cause the machine, unless rigidly anchored to the floor, to creep over the floor.

The counter-balancing means embodying the present invention tends to readily compensate for such out-of-balance load conditions. When the out-of-balance load condition is of an aggravated nature, such as represented diagrammatically in Fig. 6, wherein the mass of clothes B are substantially at one side of the receptacle, the two compensating weight rings 42 and 43, assume a position of adjustment as represented in Figs. 6 and 7 of the drawings, wherein said rings move horizontally in an outwardly direction to their maximum extent, in a direction directly opposite the center of the mass of the off-center load B. As represented in Fig. 6 of the drawings, the off-center load B creates an out-of-balance load condition, and the force is represented by the arrow E, and the rings 42 and 43, tend to equalize, oppose, and counteract this force by a force extending in the opposite direction as indicated by the arrow F.

When the load assumes a condition such as represented diagrammatically at C in Fig. 8 of the drawings, the rings 42 and 43, assume an angularly related position of adjustment as seen in Figs. 8 and 9 of the drawings. The center of the force of the out-of-balance load C, as represented by the arrow G, is counteracted by two component forces as represented by the arrows H and J, disposed substantially in axial alignment with the respective rings 42 and 43.

When the load in the receptacle 20, is substantially uniformly distributed about the vertical axis D, the rings 42 and 43, move in diametrically opposite directions so that the compensating forces, as indicated by the arrows K and L in Fig. 10, are diametrically opposed to each other.

No matter what the out-of-balance load condition may be, within the limits of compensation provided, the rings 42 and 43, tend to assume a compensating position of adjustment with respect to the out-of-balance load so that the receptacle 20, is caused to rotate about a substantially true vertical axis, such as represented by the axis D in Fig. 1 of the drawings. While I have herein shown two compensating rings for counter-balancing the out-of-balance load conditions, a greater number of rings, if desired, may be employed. I have found, however, that two rings serve to satisfactorily compensate for practically all out-of-balance load conditions in a machine of the character above described.

Due to the particular construction and design of the housing 41, the rings 42 and 43, are caused, in response to rotation of the housing, to move horizontally in an outwardly direction, and due to the inner marginal edges of the rings engaging the cone-shaped wall portion 51, said rings are caused to move upwardly within the housing to positions such as represented in Figs. 7, 9 and 11. When the centrifugal extracting operation is completed and the drive to the machine is disengaged, the counter-balancing unit is gradually retarded, and the rings 42 and 43, move downwardly in substantially horizontal planes, under guided control of the inclined frusto-conical wall portions 54 and 51, of the lower housing member 45, and finally assume a position of adjustment such as represented diagrammatically in Figs. 4 and 5 of the drawings, in a substantially centered relation to the true axis D of the rotating parts of the machine. This self-centering action is deemed of considerable importance, because if the rings were permitted to remain in an outward position of adjustment when the centrifugal operation is finished, as occurs in prior structures of this type, then the next time that the machine is set in motion, it is possible that the rings may extend in the same direction as the out-of-balance load, so that the receptacle 20, and associated elements, in the initial portion of the centrifugal extracting operation, will tend to surge and travel in an excessively large orbit, and thereby necessitate a machine of greatly increased over-all dimensions and power, for accommodating such excessive movement.

The flange 48, for supporting the counter-balancing unit, is formed with a downwardly sloping conical wall 55, upon which is adapted to seat the cooperatively tapered cone portion 54, of the housing member 45, so that the counter-balancing means is thereby provided with a relatively substantial seat, tending to maintain the counter-balancing unit in true centered relation with respect to the axis of the rotatable parts of the machine.

While the counter-balancing means above described, will function satisfactorily in connection with extracting machines of the type rigidly anchored to the floor or the like, it has been found, in connection with machines of a portable nature, that is, those that are not rigidly connected to a floor or a mounting, that it is necessary to provide, in addition to counter-balancing means, some suitable flexible mounting or suspensioning means for the motor, drive mechanism, and all rotatable parts of the machine, so as to readily permit gyratory or orbital movement of the extracting receptacle 20, due to an out-of-balance load condition.

In the drawings, I have shown a flexible suspension means, which serves as a flexible support for the driving mechanism 30, together with the motor 31, the shafts 25 and 26, and all elements supported by said shafts. The suspension means is of the same general type disclosed in Patent No. 2,334,858, issued to John P. Beattie, November 23d, 1943. The flexible suspension means, as shown in the drawings, includes an auxiliary frame 60, having a plurality of upstanding brackets 61, for supporting the driving mechanism 30, and the motor 31 is directly mounted on the frame 60. The auxiliary frame 60, is supported at three equiangularly spaced apart points, by means of three flexible, non-stretchable straps 64, having their lower ends connected to the auxiliary frame by bolts 65, and their upper ends connected by bolts 66, to upstanding brackets 67, which in turn are connected to a main frame 68, rigidly attached to the base member 14. The straps are of a flexible, non-stretchable nature, such as leather or some suitable composition, and are disposed at an angle in the range of 30 to 50 degrees to vertical.

While I have found my novel counter-balancing means to work successfully and satisfactorily in connection with the flexible suspension means herein disclosed, it will be apparent, however, that other forms of flexible suspension means may be satisfactorily utilized in conjunction with my novel counter-balancing means.

Although I have herein shown and described a preferred embodiment of my invention, manifestly it is capable of modification and re-ar-

rangement of parts without departing from the spirit and scope thereof. I do not, therefore, wish to be understood as limiting this invention to the precise embodiment herein disclosed, except as I may be so limited by the appended claims.

I claim:

1. A self adjusting counter-balancing unit for a centrifugal machine, operable upon rotation about an upright axis, comprising a totally enclosed housing of hollow, annular form, and a plurality of rings loosely mounted within the housing, in surrounding relation to the axis of said housing and adapted to shift, under influence of centrifugal force, transversally of the axis of the housing incident to rotation of said housing, the central wall portion of the housing being formed as a cone and the inner surface thereof constituting cam means adapted to be engaged by the inner peripheral edges of said rings, when the unit is rotated, for guiding and effecting vertical movement thereof incident to relative transverse movement of said rings relatively to the axis of the housing.

2. A self adjusting counter-balancing unit for a centrifugal machine, operable upon rotation about an upright axis, comprising a totally enclosed housing of hollow, annular form, and a plurality of rings loosely mounted within the housing, in surrounding relation to the axis of said housing and adapted to shift, under influence of centrifugal force, transversally of the axis of the housing incident to rotation of said housing, the central wall portion of the housing including a flattened frusto-conical portion, the inner surface of which constitutes cam means for centering the rings within the housing when the unit is at rest, and for guiding the rings in transverse movement, when the unit is rotated, said central wall also including a sharp angle frusto-conical portion adjacent the upper portion of the housing, the inner surface of which constitutes cam means, engageable by the inner peripheral portions of the rings, when the unit is rotated, for crowding the rings together and against the upper wall of the housing.

3. In combination with an upright driving shaft, a supporting member rigidly mounted on said shaft and having a frusto-conical peripheral surface, a self-adjusting counter-balancing unit comprising a housing of hollow, annular form, the inner wall of the housing, surrounding the central opening therein and extending generally in an axial direction being of frusto-conical form for cooperative seating on the frusto-conical surface of the member for supporting and frictionally driving said housing, and a plurality of rings mounted loosely within the housing, in surrounding relation to said central frusto-conical wall, the inner surface of said wall constituting cam means and serving to guide said rings for causing vertical movement thereof incident to transverse movement of said rings caused by centrifugal force incident to rotation of the housing.

4. In combination with an upright driving shaft, a supporting member rigidly mounted on said shaft and having a frusto-conical peripheral surface, a self-adjusting counterbalancing unit comprising a housing of hollow, annular form, the inner wall of the housing, surrounding the central opening therein and extending generally in an axial direction being of frusto-conical form for cooperative seating on the frusto-conical surface of the member for supporting and frictionally driving said housing, and a plurality of rings mounted loosely within the housing, in surrounding relation to said central frusto-conical wall, the inner surface of said wall constituting cam means and serving to guide said rings for causing vertical movement thereof, incident to transverse movement of said rings caused by centrifugal force incident to rotation of the housing, the outer peripheral wall of said housing including an inverted frusto-conical portion, the inner surface of said portion constituting cam means adapted to cooperate with said aforementioned cam means to confine said rings for vertical movement in substantially horizontal planes.

5. In combination with an upright driving shaft, a supporting member rigidly mounted on said shaft and having a frusto-conical peripheral surface, a self-adjusting counter-balancing unit comprising a housing of hollow, annular form, the inner wall of the housing, surrounding the central opening therein and extending generally in an axial direction being of frusto-conical form for cooperative seating on the frusto-conical surface of the member for supporting and frictionally driving said housing, and a plurality of rings mounted loosely within the housing, in surrounding relation to said central frusto-conical wall, the inner surface of said wall constituting cam means and serving to guide said rings for causing vertical movement thereof, incident to transverse movement of said rings caused by centrifugal force incident to rotation of the housing, the outer peripheral wall of said housing including an inverted frusto-conical portion, the inner surface of said portion constituting cam means adapted to cooperate with said aforementioned cam means to confine said rings for vertical movement in substantially horizontal planes, and the bottom wall of the housing, connecting said inner and outer frusto-conical portions, being of flat annular form and disposed in a substantially horizontal plane, the width of said bottom wall being correlated to the diameters of said rings so that when said rings are at a position of rest, they normally tend to assume a position substantially centrally of the width of said annular bottom wall.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
322,069	Rothe	July 14, 1885
331,450	Rothe	Dec. 1, 1885
329,204	Obermaier	Oct. 27, 1885
Re. 7,455	Fesca	Jan. 2, 1877
2,334,858	Beattie	Nov. 23, 1943
2,361,266	Clark	Oct. 24, 1944
2,130,160	Schellenberg	Sept. 13, 1938