United States Patent

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[73] Assignee **Fedders Corporation Edison, N.J.**

[54] **BEARING WITH CONTROLLED FRICTION**
7 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** ..... **308/238,** 118/77, 68/23.3, 117/132 CF
[51] **Int. Cl.** **F16c 27/60,** D06f 29/00, B05c 11/00
[50] **Field of Search** ..... 308/238; 68/23.3; 117/20, 132 CF; 118/77, 76

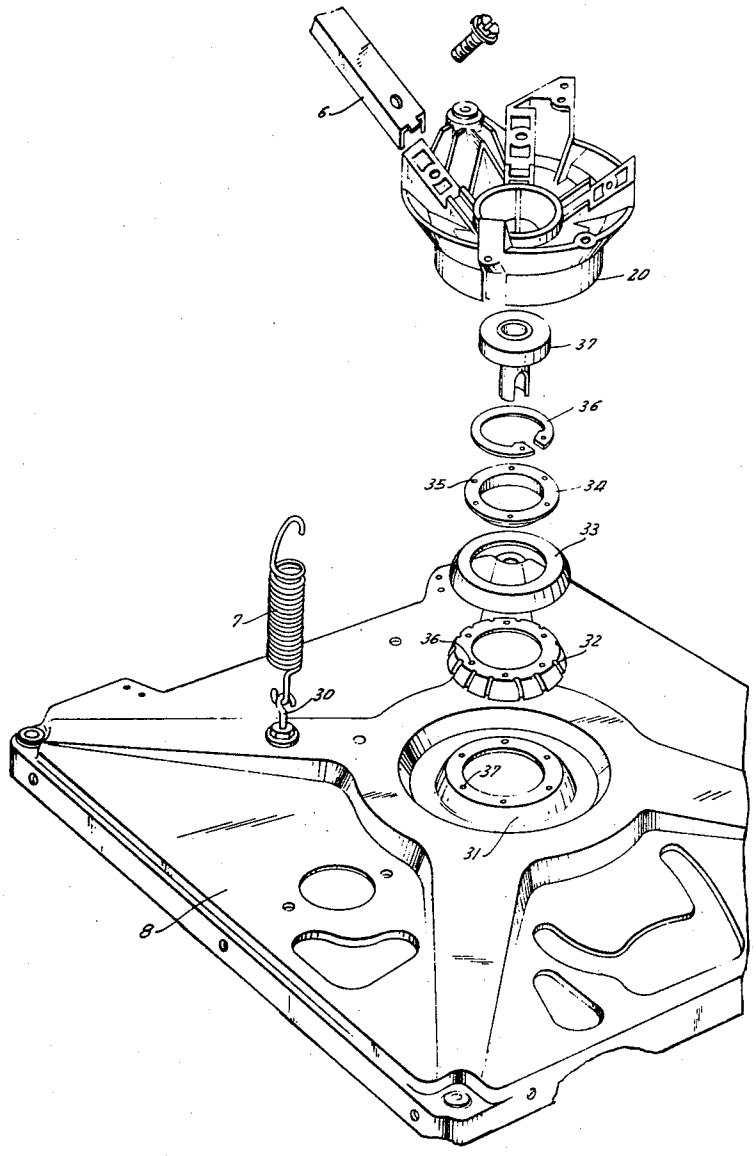
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ABSTRACT: A bearing surface is provided with a lining composed of polytetrafluoroethylene and a second lubricant material and the opposite bearing surface is provided with a roughened surface of controlled degree. On relative motion of the two surfaces, the polytetrafluoroethylene is transferred, at a controlled rate, to the roughened bearing surface to provide lubrication with a controlled degree of friction.

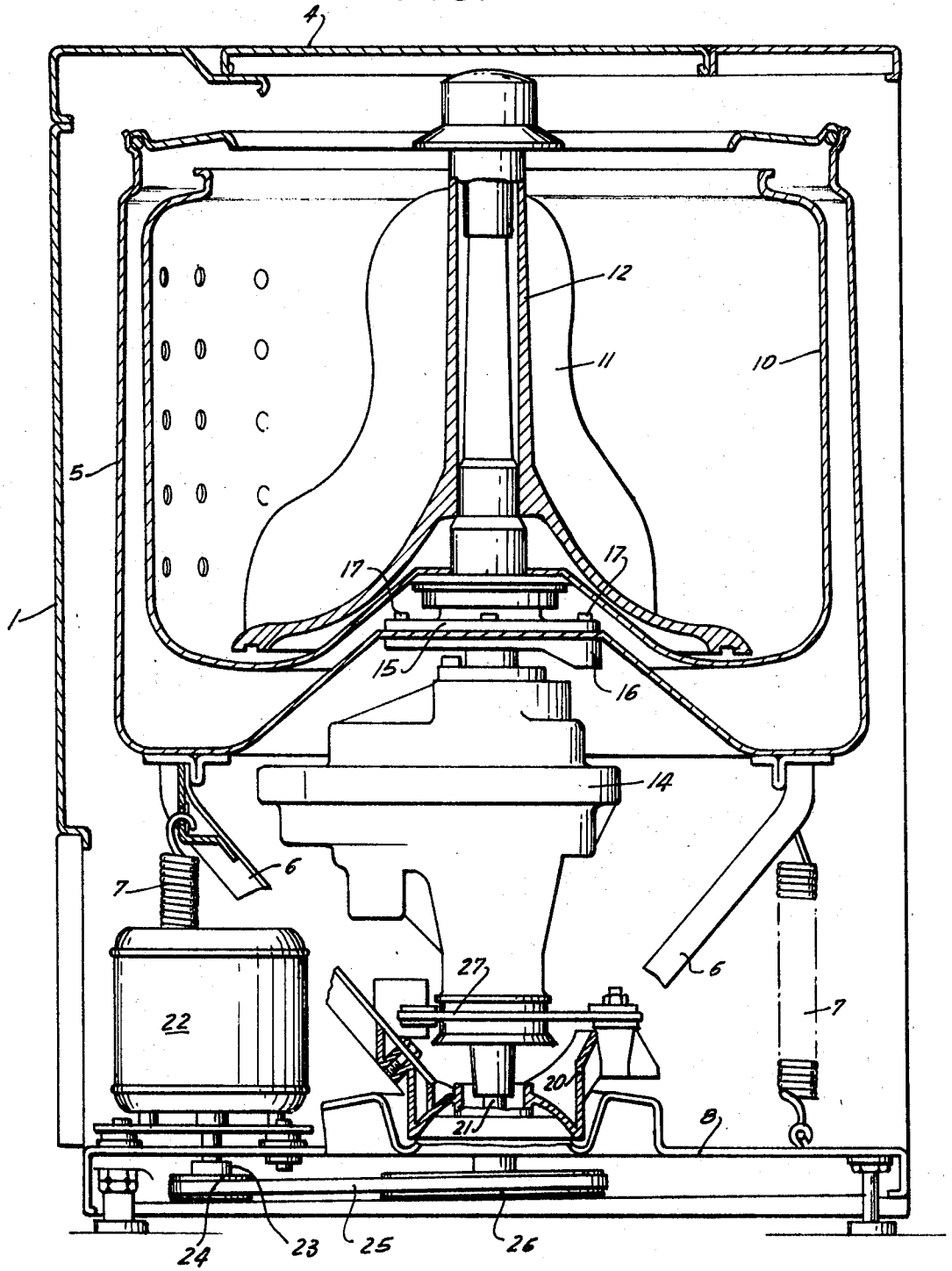


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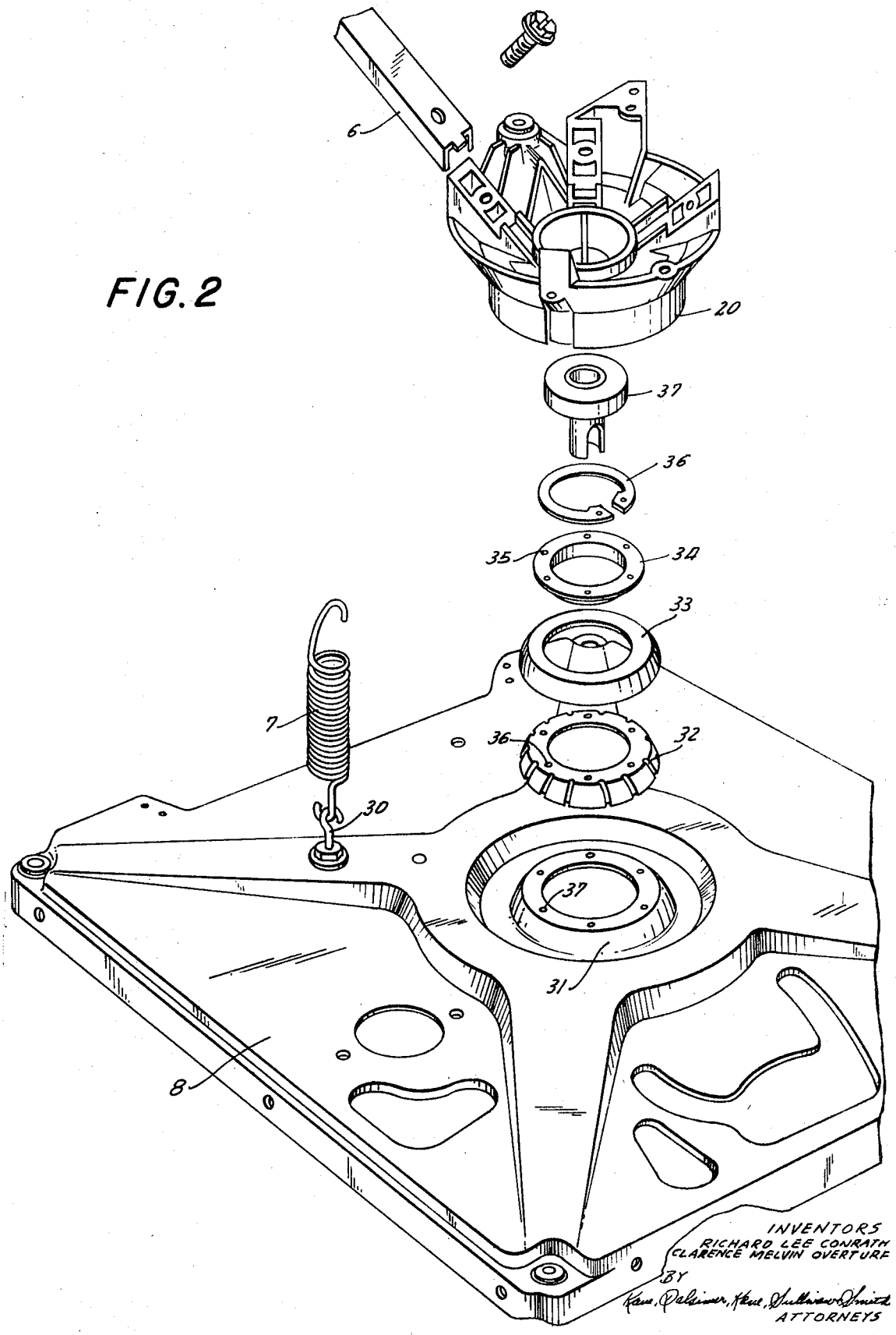
FIG. 1



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FIG. 2



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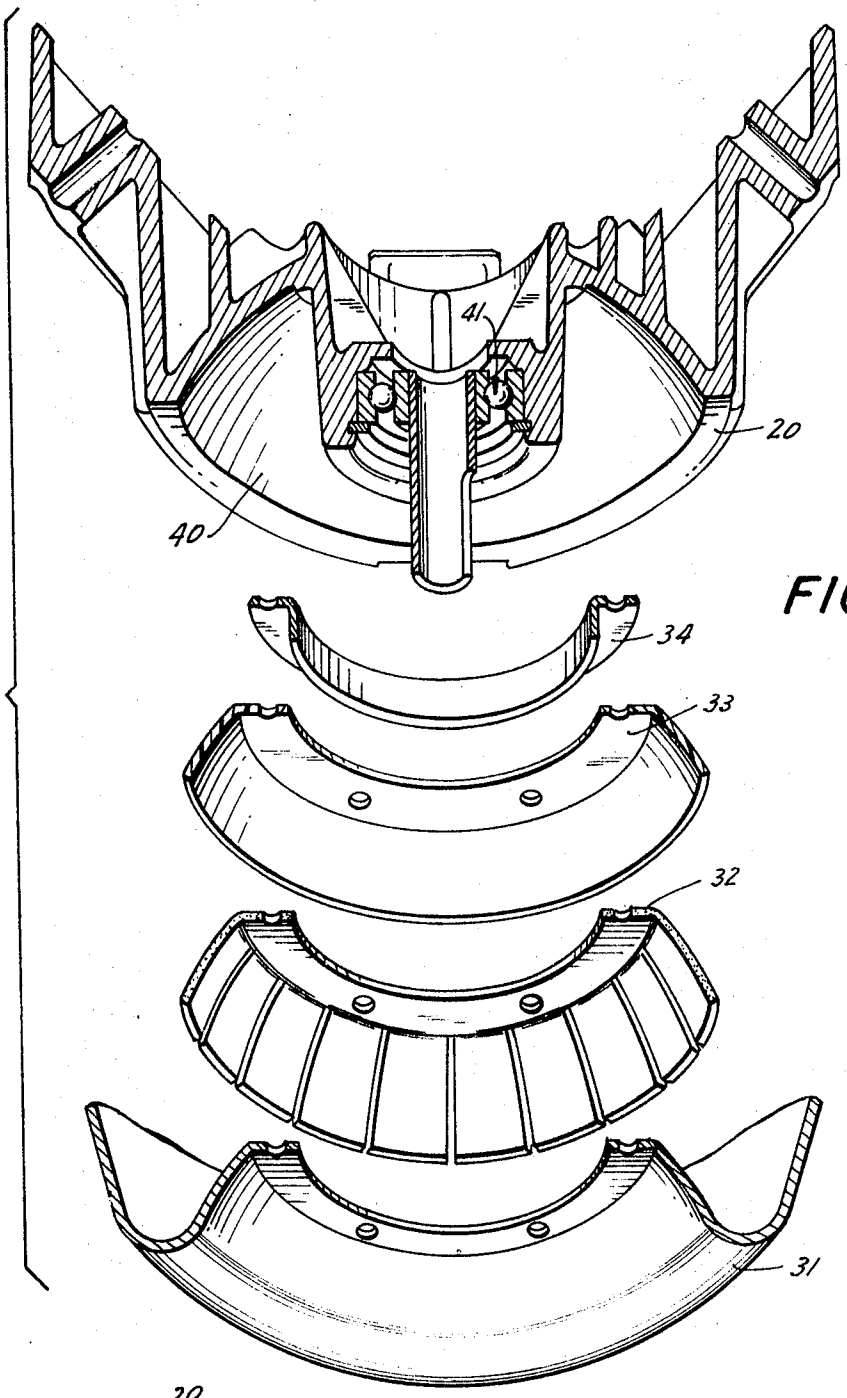
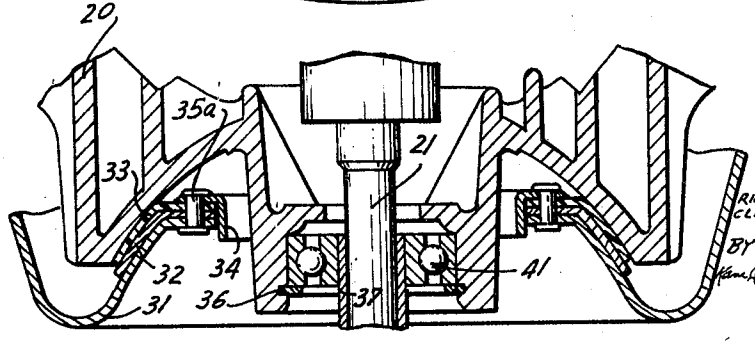


FIG. 3

FIG. 4



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BEARING WITH CONTROLLED FRICTION

BACKGROUND OF THE INVENTION

The lubricating effect of a polytetrafluoroethylene surface has long been know in the art and the material has been extensively used for this purpose. It had also been found that polytetrafluorethylene had a tendency to transfer onto an adjacent running surface during operation of machinery employing it. However, this property has not been heretofore employed in such a manner as to provide for a controlled transfer of the polytetrafluoroethylene in order to provide not only the know n lubricating effect of the polytetrafluoroethylene, but, additionally a controlled degree of friction to restrain relative motion between two moving parts, when this action is desired.

Many vertically mounted automatic washing machines employ a tub or basket spinning at high speeds in order to extract a significant amount of water from the clothing at the end of the washing operation. As the clothing is seldom perfectly balanced about the rotating tub or basket, this tub or basket tends not only to rotate because of the direct drive provided by the machine, but, additionally, to orbit or nutate about a particular pivot. The prior art has described various means of resisting this orbital or nutational movement, including an enclosed ring of heavy material placed around the upper annulus of the tub, weights placed at the sides or bottom of the rotating tub, and frictional snubber leafs placed at the bottom of a stationary tub, within which the rotating tub is contained, and mating frictional surfaces affixed to the shaft of the rotating tub, which passes through the stationary tub. While each of these has had a certain degree of effectiveness, none has provided a full solution to the problem, including the problem of providing for lubrication at the point of support of the rotating axis of the tub.

SUMMARY OF THE INVENTION

In accordance with the present invention, it has unexpectedly been discovered that a combined support, lubricated bearing, and snubber can be formed employing one surface of a particular polytetrafluoroethylene formulation and a second surface which is provided with a controlled degree of roughness. Movement of the surface having the controlled degree of roughness relative to the polytetrafluoroethylene coated surface results in a transfer of a certain amount of the polytetrafluoroethylene onto the roughened surface. Within a short period of time, the desired amount of polytetrafluoroethylene is transferred, and no further transfer results except as necessary for normal wear. Thus, the bearing surface is one with long life.

Because of the controlled degree of roughness of the relatively moving surface, a certain frictional effect is also provided, such that the nutational motion of the roughened surface is retarded in a controlled manner so as to dampen the nutational motion. Because of the presence of the polytetrafluoroethylene, this retardation or dampening is accomplished without significant heat generation or significant wear on the relatively moving parts.

More specifically, for use in a washer having a vertically mounted tub which can be rotated at a rapid rate for water extraction, a truncated, hemispherical bearing is provided with a polytetrafluoroethylene lining. A mating hemispherical surface is placed adjacent this polytetrafluoroethylene lining for relative movement, the mating surface acting as the support for the operational parts of the washer. Thus, the rotating tub, agitator, stationary tub, and transmission are supported by the mating surface. This mating surface is provided with a controlled degree of roughness. As the rotating tub reaches high speed, the unbalanced nature of the wet clothing within the tub, which is a situation generally existing, causes the tub to move away from its center, and toward the center of gravity created by the off balance load. This creates a nutational movement about the pivot of the system, which is about the

hemispherical bearing. As the system starts to operate, there is a controlled transfer of the polytetrafluoroethylene coating to the roughened, mating surface. With the preferred manufacture of the present invention, the transfer of a sufficient quantity of material is accomplished in about 1 hour of operation and, thereafter, additional polytetrafluoroethylene is not transferred except that minute amount needed to compensate for losses due to wear. The net effect is two mating, hemispherical surfaces of polytetrafluoroethylene which provides the necessary lubricity for relative movement of the two surfaces during the nutational movement of the rotating tub. However, because of the controlled roughness of the upper mating surface, there is also a degree of friction between the two surfaces which aids in retarding the nutational movement.

It is thus an object of the present invention to provide a bearing having a controlled degree of transfer of polytetrafluoroethylene to provide both lubrication and a controlled degree of friction.

It is a further object of the present invention to provide a bearing for an automatic washing machine, with the bearing having a controlled degree of transfer of polytetrafluoroethylene to provide for lubricity and, additionally, a frictional force retarding nutational movement or a rotating tub.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. **1** is a sectional view of an automatic washing machine incorporating the bearing of the present invention;

FIG. **2** is an exploded, perspective view of the base of the washing machine and the bearing of the present invention;

FIG. **3** is an exploded, perspective view of the bearing assembly of the present invention; and

FIG. **4** is a sectional view of the bearing of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. **1**, an automatic washing machine is shown including an outer casing **1** of conventional structure with a pivoted clothes door **4** for insertion and removal of the clothing to be washed. The washing machine includes an outer stationary tub **5**, to the bottom of which are affixed braces **6**. Springs **7** are attached to the upper portion of these braces and to the base **8** of the washing machine by means well known in the art. These springs aid in resisting vibrational movement of this outer tub.

Within the outer tub is an inner tub **10** which is supported in such a manner that it can be rotated at rapid speeds for centrifugal extraction of water held within clothing contained in the tub. Within the inner, rotatable tub, is an agitator **11**, mounted on a center post **12** for oscillatory movement, so as to provide a washing action for the clothing placed within the tub. A transmission **14** is provided and operatively connected to both the agitator post and the inner tub so as to oscillate the agitator and rotate the inner tub at the appropriate times. As neither the transmission **14**, nor the means of operatively connecting it to the agitator **11** or inner tub **10** form any part of this invention, they are not described in detail.

Though not critical to the present invention, in the washing machine shown, the weight of the transmission **14**, inner tub **10**, and agitator **11** is supported by the outer tub **5** through the clamp rings **15**, **16** and bolts **17**. This weight is, in turn, carried by the outer tub braces **6** to the upper suspension housing **20**, a portion of the bearing of the present invention. The weight of drive shaft **21** is similarly supported by this suspension housing. Power for the machine is provided by motor **22** through its shaft **23**, drive pulley **24**, drive belt **25**, and driven pulley **26**. The driven pulley, in turn, turns the drive shaft **21**, and, through the transmission, the agitator post **12** and inner tub **10**. A portion of the brake **27** to restrain rotational movement of the driving members at the appropriate time, is also illustrated.

The base of the washer **8**, with one of the suspension springs **7** attached by eye bolt **30** is shown in FIG. **2**, along with the parts of the bearing assembly of the present invention. The center portion of the vase **8** is formed as a truncated hemisphere **31** which acts as the structural supporting member for the bearing assembly and, through it, the operative portions of the washing machine. A snubber lining pad **32** is placed above this truncated hemisphere to act as a slightly resilient support for the polytetrafluoroethylene lining **33**. The polytetrafluoroethylene lining **33** is provided with a contour to conform to the snubber lining pad **32** and structural member **31**. A reinforcement plate **34** is inserted through the center of the polytetrafluoroethylene liner **33**, snubber lining pad **32**, and structural member **31** and this reinforcement plate has a flange which overlies a flattened portion of the polytetrafluoroethylene liner. These four pieces are held together by rivets **35***a*, or other suitable means, which pass through the openings **35** in reinforcement plate **34**, openings **36** in snubber lining pad **32**, and openings **37** in structural portion **31**. Also shown are the retaining ring and sleeve **36** and **37** for rotational bearing of the drive shaft which fits through the openings provided in the reinforcement plate **34**, polytetrafluoroethylene lining **33**, snubber lining pad **32**, and the structural support portion **31** of the washer base **8**. The upper suspension housing assembly **20**, to which the brace **6** is attached, is also shown in this figure.

Similar parts are shown in exploded perspective view in FIG. **3**, including the truncated hemispherical portion **31** of the washer base **8**, the snubber lining pad **32**, polytetrafluoroethylene liner **33**, and retaining ring **34**. The upper suspension housing **20** with the mating surface **40** is shown, in this figure. The surface **40** is the one which has the controlled degree of roughness for providing the combination of lubricity and controlled friction. The radial bearing assembly **41** is shown assembled in this view, while the parts and surfaces in assembled relation are shown in FIG. **4**.

The snubber lining pad **32**, as previously indicated, is provided to give some resilient support to the polytetrafluoroethylene lining **33**. This pad **32** must also be capable of withstanding a certain amount of heat. One of the materials which can be employed for the snubber lining pad **32** is a chloroprene rubber cork. Such a material should have a hardness, in units of Shore A, of from 65 to 80, and specific gravity of approximately 0.8. The compression set should be a maximum of 80 percent, a compressibility, under 300 lbs. per square inch, of from 18 to 28, and a minimum recovery of 95 percent.

The polytetrafluoroethylene lining **33**, as previously indicated, is formed from polytetrafluoroethylene which also contains a further lubricant, such as carbon or graphite. The type of polytetrafluoroethylene is preferably that sold by du Pont under the name Teflon T.F.E. and it preferably comprises from 70 percent to 80 percent of the total composition. Additionally the liner contains from 20 percent to 30 percent carbon and approximately 1 percent of a compatible color identifier. The liner **33** is preferably formed by compacting a powder mixture of the various components and then curing in a flat configuration at a temperature of less than 700° F. After cure, but before cooling the part, it is formed into the truncated, hemispherical configuration shown in the figures. The part may be cooled and reheated between curing and forming. Most preferably, the liner is formed with from about 74 percent to 76 percent polytetrafluoroethylene and from 23 percent to 25 percent carbon filler, along with about 1 percent of a compatible color identifier.

The roughness of the surface **40** of the upper suspension housing **20** is extremely critical in the formation of the bearing of the present invention. The surface is preferably machined to a finish of 35 root mean square, maximum. It is then grit or sand blasted, by any of a variety of methods, to a roughness of 250±50 root mean square with a peak frequency of 328±15 peaks per linear inch. It is important that, during the blasting operation, the surface **40** be maintained in a condition such that it is free of oils, grease, cutting fluids, etc. and that the center portion of the bore, through which the drive shaft **21** and sleeve **37** fit be protected from the blasting operation. After the part is grit blasted, it is subjected to air blasting to remove all grit employed in the blasting operation. A preferable method of accomplishing this grit blasting of the surface **40** is in a centrifugal grit-blasting machine employing steel grit with an average hardness of from 56 to 60 Rc, tested with a Tukon microhardness tester with a Knoop identer. All of the grit should pass a No. 40 sieve.

In operation, as the inner tub **10** is brought up to rotational speed, the tub and shaft achieve a nutational movement about the pivot at the lower structural support member **31**, because of the generally offcenter loading of the wet clothing within the tub. Sufficient pressure is created at the bearing as the upper housing suspension member **20** provides the support for all operating parts of the washing machine, either through the braces **6**, or directly through the drive shaft **21**. The snubber springs provide additional pressure on the bearing. The nutational movement of the upper housing bearing causes the roughened surface **40** to move against the polytetrafluoroethylene liner **33**, causing a transfer of polytetrafluoroethylene from the liner to the roughened surface. Because of the controlled degree of roughness of the surface, a sufficient amount of polytetrafluorethylene is transferred in about 1 hour of operation, ands subsequent to this transfer, little additional polytetrafluoroethylene moves between the surfaces, except that necessary to make up for wear. An extremely long life is realized in the bearing. It is believed that the carbon aids in preventing sloughing of the polytetrafluoroethylene during transfer. The system may thus be described as one w herein the lubricant is replenished.

As is known in the art, and as shown, for example, in U.S. Pat. No. 3,056,637—Shanley et al., the coefficient of friction of polytetrafluoroethylene increases with increasing shaft speed in a rotating bearing. This same phenomenon has been found in the nutational movement of the surface **40** over the liner **33** in the structure of the present invention.

Thus, an improved bearing including a transfer of polytetrafluoroethylene to a specially roughened surface has been shown where the adjoining polytetrafluoroethylene surfaces are replenishing and where the net effect is a bearing having lubricity, with controlled friction for resisting, at least, nutational movement. Such a bearing is characterized by extremely long life.

We claim:

1. An improved bearing including a first surface in the form of a truncated hemisphere, said surface having a lining composed of polytetrafluoroethylene, and a second surface, having a hemispherical configuration mating with the first surface lining, and having a controlled degree of roughness, said second surface becoming coated with polytetrafluoroethylene upon relative motion of the two surfaces.

2. An improved bearing including a first surface with a lining composed of polytetrafluoroethylene and a resilient pad between said first surface and said polytetrafluoroethylene liner, and a second surface mating with the lining and having a controlled degree of roughness, said second surface becoming coated with polytetrafluoroethylene upon relative motion of the two surfaces.

3. In a washing machine having an outer stationary tub, an inner tub capable of rotational movement, and a transmission with a drive shaft below said tubs, the improvement which comprises a hemispherical suspension bearing placed adjacent the base of said washer and supporting the weight of said inner and outer tubs, transmission, and drive shaft, the lower surface of said suspension, bearing being provided with a liner comprises of polytetrafluoroethylene, and the upper surface of said suspension bearing, adjacent said polytetrafluoroethylene liner, being provided with a surface of controlled roughness.

4. The washing machine of claim **3** wherein said polytetrafluoroethylene liner is composed of from 70 percent to80 percent polytetrafluoroethylene and from 20 percent to 30 percent carbon.

5. The washing machine of claim 4 wherein said polytetrafluoroethylene, liner is composed of from 74 percent to 76 percent polytetrafluoroethylene, 23 percent to 25 percent carbon, and approximately 1 percent of a compatible color identifier.

6. The washing machine of claim 3 wherein a resilient pad is placed between said first surface and said polytetrafluoroethylene liner.

7. The washing machine of claim 3 wherein said surface which mates with said polytetrafluoroethylene liner has a roughness of 250±50 root mean square and 328±15 peaks per linear inch.