

April 21, 1959

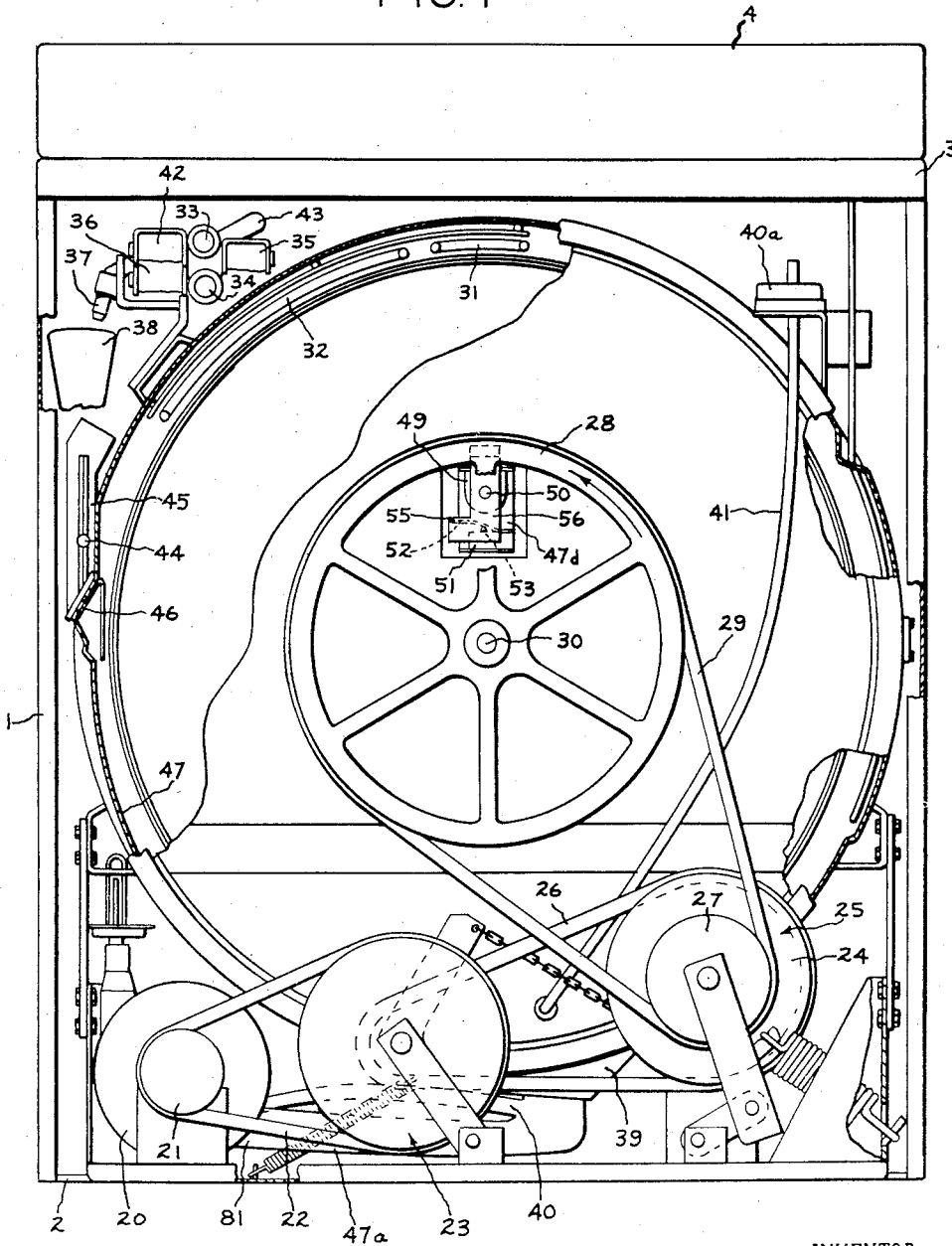
G. N. JENNINGS
ROTATION SENSING DEVICE

2,883,564

Filed Sept. 25, 1958

3 Sheets-Sheet 1

FIG. 1



INVENTOR.
GRESHAM N. JENNINGS

BY *Dred P. Lawrence*

HIS ATTORNEY

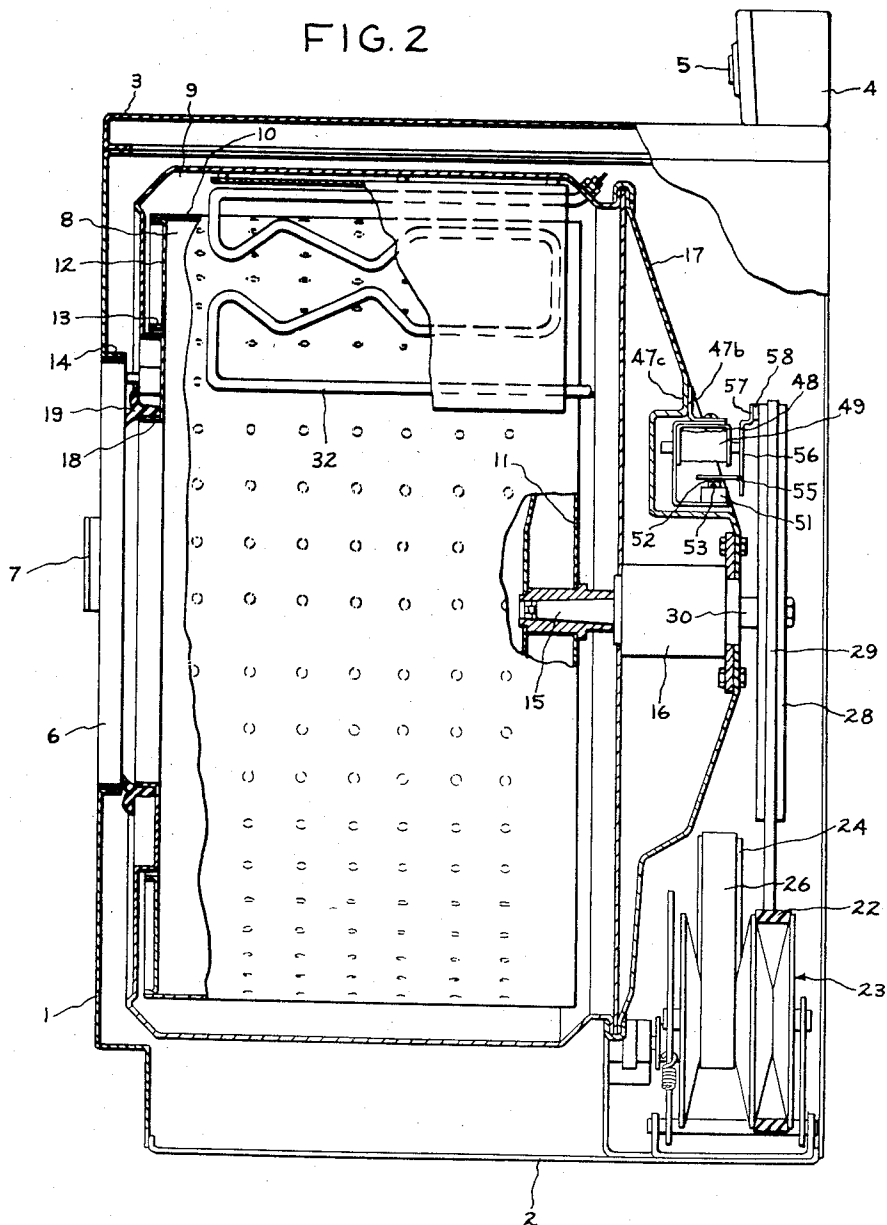
April 21, 1959

G. N. JENNINGS
ROTATION SENSING DEVICE

2,883,564

Filed Sept. 25, 1958

3 Sheets-Sheet 2



INVENTOR.
GRESHAM N. JENNINGS

BY *Der P Lawrence*
HIS ATTORNEY

April 21, 1959

G. N. JENNINGS

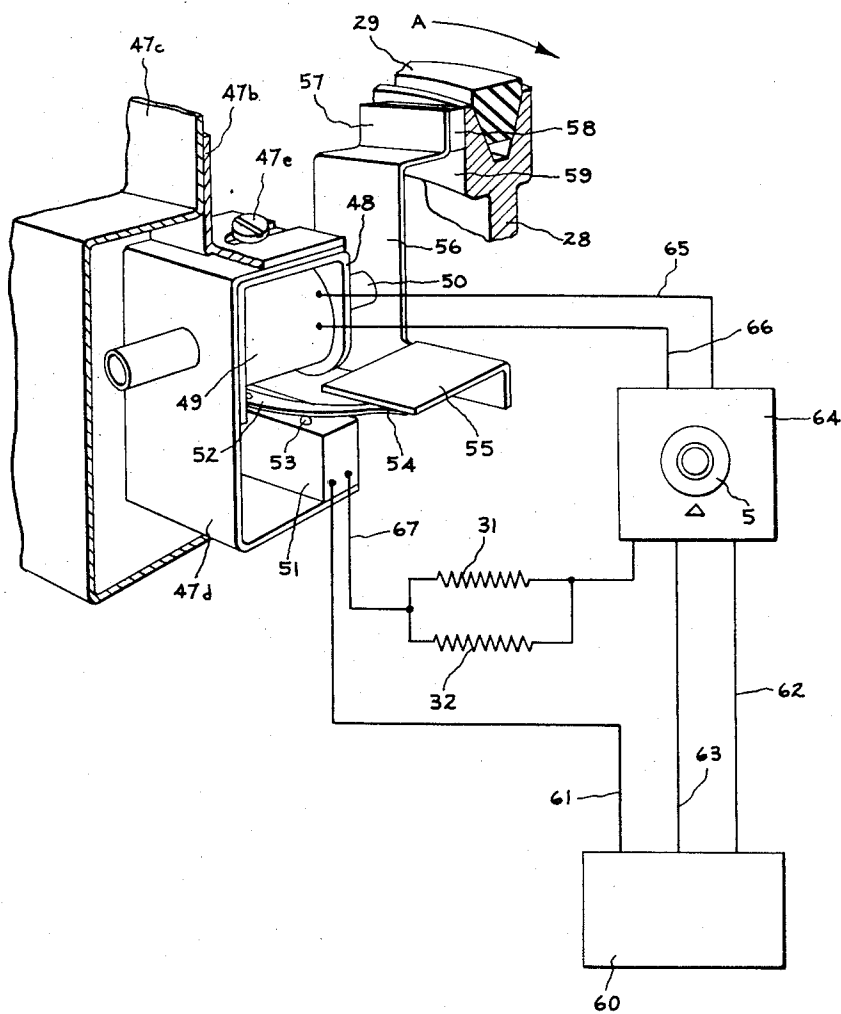
2,883,564

ROTATION SENSING DEVICE

Filed Sept. 25, 1958

3 Sheets-Sheet 3

FIG. 3



INVENTOR.
GRESHAM N. JENNINGS

BY *David P. Lawrence*

HIS ATTORNEY

1

2,883,564

ROTATION SENSING DEVICE

Gresham N. Jennings, Louisville, Ky., assignor to General Electric Company, a corporation of New York

Application September 25, 1958, Serial No. 763,299

4 Claims. (Cl. 307—121)

This invention relates to devices for sensing rotation of a machine part, and more particularly to devices for providing inherent protection to the machine in response to a failure of the machine part to rotate.

To prevent machine damage, it is often important that, if the machinery ceases to rotate for any reason whatsoever, various other functions of the machine also will be interrupted. Typical of such instances is the case of the domestic combination washer-dryer laundry machine; such machines provide a sequence of washing and rinsing clothes, a centrifugal extraction of liquid from the clothes by high speed rotation of the clothes basket, and, finally, a heat drying operation to effect complete drying of the clothes. Throughout the operation the clothes basket is being rotated either at a speed to effect a tumbling pattern of the clothes within the basket (during washing, rinsing and drying) or else at high speed to effect the centrifugal extraction mentioned above.

The heat drying operation is usually provided by heating elements which are positioned so that the heat from them is transmitted to the clothes. If for any reason the rotation of the basket should stop the clothes will, of course, merely lie at the bottom of the basket. In such a case, the heat from the heating elements, if they are allowed to remain energized, may well cause a localized temperature rise within the dryer to an extent where the clothes may become scorched and parts of the machine damaged. Thus, it is important that energization of the heating elements be terminated as soon as rotation of the basket ceases for any reason whatsoever, and to effect this, suitable rotation sensing means for the basket need to be provided. Because of the consequences which can result from malfunctioning of such rotation sensing devices, it is important that they be of simple construction, reliable under all circumstances, yet economical enough to be incorporated in mass production devices without causing a substantial increase in the cost of such devices.

It is therefore an object of the present invention to provide an improved rotation sensing device.

A further object of the invention is to provide such a device which is of a simple yet reliable construction so that the cost of the apparatus in which it is included will not be substantially increased, yet complete dependence may be put on the effectiveness of the device.

In accordance with the invention, I provide a device for sensing the rotation of a member having a substantially continuous annular surface. The device includes a solenoid member which is, as usual, provided with a coil and a movable core. The core carries a part into vibrating engagement with the annular surface of the rotatable member whenever the coil is energized across a source of alternating current power such as is commonly provided for residential use of electrical devices. The part is biased to a predetermined angular position relative to the rotatable member; during simultaneous rotation of the rotatable member and energization of the coil, the vibrating engagement of the part with the annular surface causes the part to move to a different angular posi-

2

tion relative to the rotatable member. Switch means is provided having a first and a second position; the switch means is biased to its first position, and is moved to its second position in response to the movement of the part during rotation of the rotatable member and energization of the coil. Thus, in response to rotation of the member, the switch means is operated to assume a position different from that which it assumes when the rotating member is not operating.

The subject matter which I regard as my invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention itself, however, may best be understood by reference to the following description taken in conjunction with the accompanying drawings.

In the drawings:

Figure 1 is a rear elevational view of a combination washer-dryer which incorporates my improved rotation sensing arrangement;

Figure 2 is a side elevational view of the machine, partly in section and with certain surfaces broken away to show details; and

Figure 3 is a fragmentary view in perspective of the improved rotation sensing device of my invention combined with a schematic illustration of an appropriate control circuit for use therewith.

Referring now to Figures 1 and 2 of the drawing, there is shown a combination clothes washing and drying machine where the operating elements of the machine are included within an outer cabinet structure having a central wrap-around section 1. Section 1 is supported on a base and toe board assembly 2 and carries a separate top 3 on which is supported a backplash panel 4. The control panel 4 is normally provided with an appropriate control device (shown in connection with Figure 3 below) having manually operable dials such as 5 extending therefrom for presetting various types of washing and drying sequences and various drying temperatures. Access to the interior of the machine is provided by a door 6 formed in section 1 which is mounted on concealed hinges and which is opened by means of a knee-operated latch control 7. As best shown in Figure 2, the machine is of the horizontal axis type, that is, it has a substantially cylindrical clothes basket or receptacle 8 mounted for rotation on a generally horizontal axis within an outer enclosing tub structure 9. Basket 8 comprises a cylindrical shell or wall 10 which is closed at its rear end by means of a suitable wall or plate 11. The basket also includes a front wall 12 which is formed so as to define an access or loading opening 13 in registry with an opening 14 in wrap-around section 1 provided for door 6. The basket is rotatably supported by a shaft 15 which is mounted in an elongated bearing 16 supported from rear wall 17 of tub 9. The tub is also provided with an opening 18 aligned with opening 14 and opening 13 so that clothes may be placed into and removed from the basket when door 6 is opened. The door seals against a suitable gasket 19 during operation of the machine.

During the operation of the machine the basket 8 is driven from an electric motor 20 (Figure 1). The drive from the motor to the basket includes a pulley 21 which is secured to the motor shaft so as to rotate therewith and over which passes a belt 22 which drives a sheave assembly, generally indicated at 23, which is adjustable to vary the speed of rotation of basket 8. The assembly 23 drives a pulley 24 of an assembly 25 through a belt 26. A second pulley 27, which is part of assembly 25 and is secured to rotate with pulley 24, drives a main basket pulley 28 through a belt 29. The basket pulley is secured, as shown, at the outer end 30 of the shaft 15. Thus, the drive from the motor 20 passes from pulley 21 through belt 22 to the speed adjusting assembly 23,

through belt 26 to pulley 24 of assembly 25, and then to pulley 27, belt 29, pulley 28, and basket 8. The speed adjusting assembly 23 is of the conventional type. One such typical arrangement is described, for instance, in application Serial No. 731,362, filed on April 28, 1958, by John Bochan and assigned to General Electric Company, assignee of the present invention. For the purpose of this invention, it suffices to state that the assembly 23 is movable to either one of two different positions; in the position shown in the figures, it transmits rotation from motor 20 to basket 8 so as to provide the basket 8 with a rotational speed of about 47 r.p.m. This speed provides the desired tumbling pattern within the basket for the washing, rinsing and heat drying sequences. For the centrifugal liquid extraction operation, the speed adjusting assembly 23 is moved to a position where it provides a basket speed upward of 200 r.p.m. so as to cause the liquid in the clothes to be centrifugally extracted therefrom.

To heat the clothes during the drying portion of the cycle, and also to warm the wash water during the washing portion of the cycle when desired, there is provided in the machine a heater assembly including two heaters 31 and 32. These heaters are mounted within the upper portion of tub 9 so that when energized they heat the basket 8. The heating elements are preferably of the sheathed type in which a resistance wire is maintained in spaced relation with a sheath by a highly compressed granulated heat-conducting electrically-insulating compound such as magnesium oxide. When the heaters are energized during the washing cycle, they heat the water by first heating the basket. Then, as the basket dips into the wash water at the bottom of the tub, it in turn heats the water. In other words, the rotating basket serves as an active heat transfer means between the heating element and the water or other washing liquid. When the heaters are energized during the drying cycle, the heat transferred to the clothes basket is then passed on to the clothes to cause vapor migration out of the clothes. Since the outer cylindrical wall of the basket is perforated by a great many small spaced openings in the conventional manner, some of the heat from the heating elements passes directly to the clothes by radiation.

The means whereby the water is admitted to and discharged from tub 9 during operation of the machine is best shown in Figure 1. The water supply means includes connections 33 and 34 through which hot and cold water is supplied to the machine for the washing operation. A valve controlled by a solenoid 35 admits hot water to the machine and a valve controlled by an opposed solenoid 36 admits cold water to the machine. The hot and cold water valves under the control of the solenoids 35 and 36 discharge through a common outlet conduit 37, through a suitable air gap, and into a funnel 38 to a sump 39 formed at the bottom of tub 9. The connection may be made through a suitable conduit 40, a portion of which is shown adjacent the sump in Figure 1. The air gap provided by the funnel 38 makes it impossible for the water to be syphoned from the machine so as to contaminate the incoming water supply line. A pressure actuated sensing device, or water level control, 40a, controls both solenoids 35 and 36 to maintain the proper water level in the machine during the washing operation. Sensing device 40a is connected to the interior of tub 9 by a suitable line 41.

The illustrated machine is of the type which uses cold water during the drying cycle for condensing the moisture extracted from the clothes. The condenser water is admitted to the machine through an additional solenoid actuated valve controlled by a solenoid 42 which is energized during the drying operation so that the valve passes water at a slow rate sufficient to condense from the air the moisture vaporized from the clothes. As shown, the condenser water valve discharges into a conduit 43. From this conduit the water flows through an appropriate air

gap (not shown) and then through another conduit (not shown) to the inlet 44 of a vent trap 45 which is of the type commonly provided in connection with machines of this type in order to seal off the tub and basket from atmosphere during heat drying of the clothes while leaving the tub vented to atmosphere at other times. An appropriate construction for vent trap 45 is, for instance, fully described and claimed in Patent 2,800,008—Raczynski, issued on July 23, 1957, and assigned to the General Electric Company, owner of the present invention. From the vent trap 45, the condenser water flows into the tub 9 through an opening 46 and then flows in a thin sheet down the lower left wall 47 of the tub so as to cool a substantial portion of the area of the side wall and provide a large cool surface for condensing the moisture extracted from the clothes.

The wash and rinse water used during the washing portion of the operation, and the condenser water and the moisture extracted from the clothes during the drying operation are discharged from the machine through the sump 39 mounted at the bottom of the tub. A suitable discharge hose 47a leads from the sump to a suitable pump (not shown) which may be controlled in the usual manner to drain water from sump 39 at the appropriate time.

Referring now to Figure 3, together with Figures 1 and 2, the improved rotation sensing device of this invention will be described. The device as a whole is secured to a bracket member 47b fastened to a flattened-out portion 47c of tub wall 17. A frame member 47d is secured to bracket 47b by any suitable means such as a screw 47e. A solenoid member 48, having a coil 49 and a core 50 movable both in a rotary direction and in the direction of its lengthwise axis, is secured within the frame member 47d. The axis of core 50 is substantially perpendicular to the plane of rotation of pulley 28. Also secured within the frame member 47d is a switch member 51 which supports a leaf spring member 52. Member 52 extends over a switch actuating button 53 and has an outer end portion 54 engaged by an arm 55 formed on a part 56 secured to the end of movable core 50. Part 56 also supports, at an extremity 57 thereof, a member 58 which is preferably formed of hard rubber or some other material having a similar coefficient of friction. As can be seen by particular reference to Figure 3, member 58 is so positioned that it can engage the continuous annular surface 59 formed adjacent the perimeter of pulley 28.

To provide energization of the electrical elements of the washer-dryer machine, an alternating current source 60 is connected to the machine through a three-wire system which includes supply conductors 61 and 62 and neutral wire 63. In domestic use, the source 60 normally provides 230 volts across conductors 61 and 62, with 115 volts appearing between the neutral line 63 and each of the supply conductors 61 and 62.

A suitable control mechanism 64 is connected across lines 62 and 63 so as to be energized across 115 volts. Control 64 is manually presettable through dial 5 in the conventional manner, and may be of any conventional type as is well known to those skilled in the art. While control 64 controls the sequence of operation of all electrical components of the machine, only those components pertinent to the invention are shown in Figure 3 to facilitate a clear description of the invention. A pair of conductors 65 and 66 are connected to coil 49 of the solenoid 48 so as to energize the coil across 115 volts alternating current. It will, of course, be understood that while varying types of alternating current may be provided, as will be more fully understood below, it is contemplated that the type usually provided will be the 60-cycle alternating current generally provided for domestic power purposes. In other words, the polarity of the magnet created in core 50 by the current in coil 49 changes 120 times per second so that in effect the force main-

5

taining the movable core 50 in its longitudinal position is a vibrating one, with the magnetic force decreasing to zero 120 times per second.

The heater elements 31 and 32 are also energized through the control 64, and are in series with the switch 51 through a conductor 67. When the button 53 is depressed by actuator 52, a complete connection is made to conductor 61, so that the heaters are connected across conductors 61 and 62. When button 53 is returned to its biased position because of the removal of the force of actuating spring 52, the circuit for the heaters is opened.

When the solenoid coil 49 is energized, the resulting movement of the core 50 forces member 58 into vibrating engagement with the surface 59 of pulley 28. Since the movable core 50 is pivotable about its longitudinal axis, the engagement of member 58 with surface 59 will, when pulley 28 is being rotated by belt 29 in the direction of arrow A, cause the member 56 to pivot clockwise as shown in Figure 3 about the axis of movable core member 50. This results because the rotation of pulley 28 and the vibrating engagement therewith of member 58 causes the member to be pulled, so to speak, by the rotating member thereby pivoting the entire member 56 about the axis of core 50. This movement also causes the arm 55 to press down on the end 54 of the switch actuator spring 52 to depress button 53, permitting a heating circuit to be completed through elements 31 and 32 as controlled by the control 64.

When rotation of pulley member 28 tops, for instance, because one of the belts in the system is broken, the pulley member 28 will cease to exert a clockwise force on the member 58. The engagement of the member 58 with surface 59, because of the alternating current power supplied to energize coil 49, is of a vibrating nature. In other words, the force pressing member 58 against surface 59 passes through zero many times a second. Each time this occurs, the member 56 will, under the influence of the end 54 of spring 52 bearing against arm 55, be forced back toward the position shown in Figure 3 until finally it assumes the position shown; switch button 53 is then released and heater elements 31 and 32 are opened. Thus, a stopping of pulley 28 automatically causes member 56 to move back to the position shown to open the heater circuit. The heater circuit is also opened in response to any failure of the rotation sensing device itself, such as for instance a failure of the coil 49; as soon as the solenoid ceases to be energized there is no longer any force whatsoever forcing the core 50 to the position where member 58 engages surface 59. In this manner, the construction shown always insures that no heating of elements 31 and 32 can occur unless the rotation sensing device is operative and rotation of the pulley member 28 is properly providing the desired rotation of basket 8.

While in accordance with the patent statutes I have described what at present is considered to be the preferred embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and I therefore aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. For use with a rotatable member having a substantially continuous annular surface, a rotation sensing device comprising a solenoid member including a coil and a movable core, a part carried by said movable core, means biasing said part to a first predetermined angular position relative to said rotatable member, said

6

part being carried by said movable core into vibrating engagement with said annular surface upon energization of said coil across a source of alternating current power, said part being angularly moved from said first predetermined angular position to a second predetermined angular position relative to said rotatable member while the member rotates and said coil is energized to vibrate it by the vibrating engagement of said part with said annular surface, switch means having a first position and a second position, means biasing said switch means to said first position and said switch means being movable to said second position in response to movement of said part to said second predetermined angular position.

2. For use with a rotatable member having a substantially continuous annular surface, a rotation sensing device comprising a solenoid member including a coil and a core movable on its longitudinal axis substantially perpendicular to the plane of said rotatable member, a part carried by said movable core, means securing said part to said core so that the core is pivotable about the longitudinal axis of said core and is carried by longitudinal movement of said core into vibrating engagement with said annular surface upon energization of said coil across a source of alternating current power, means biasing said part to a first predetermined angular position relative to said rotatable member and said part pivoting about the axis of said core by its vibrating engagement with said annular surface by energization of said coil and while said rotatable member is rotated to a second predetermined angular position relative to said rotatable member thereto, switch means having a first position and a second position, means biasing said switch means to said first position, and means movable by the pivoting of said part to said second angular position thereof to actuate said switch means to said second position.

3. The apparatus defined in claim 2 wherein said switch actuating means includes an arm rigidly secured to said part to be movable therewith, said switch means comprising a switch button biased to an outward position constituting the first position of said switch means, said arm pivoting about the axis of said core member with said part during rotation of said rotatable member and energization of said coil into a position effective to cause depression of said button, depression of said button constituting the second position of said switch means.

4. For use with a rotatable member having a substantially continuous annular surface, a rotation sensing device comprising a solenoid member including a coil and a movable core, a part carried by said movable core, means biasing said part to a first predetermined angular position relative to said rotatable member, a source of alternating current power, conductors connecting said coil across said source of alternating current power, said core carrying said part into vibrating engagement with said annular surface upon energization of said coil across said source, said part being angularly moved from said first predetermined angular position to a second predetermined angular position relative to said rotatable member during the rotation thereof and during energization of said coil by its vibrating engagement with said annular surface, switch means having a first position and a second position, means biasing said switch means to said first position and said switch means being moved to said second position in response to movement of said part to said second predetermined angular position thereof.

No references cited.