Oct. 16, 1945. E. E. HOOD 2,387,216

VARIABLE SPEED GEARING FOR WASHING MACHINES

Filed March 26, 1941 3 Sheets-Sheet 1

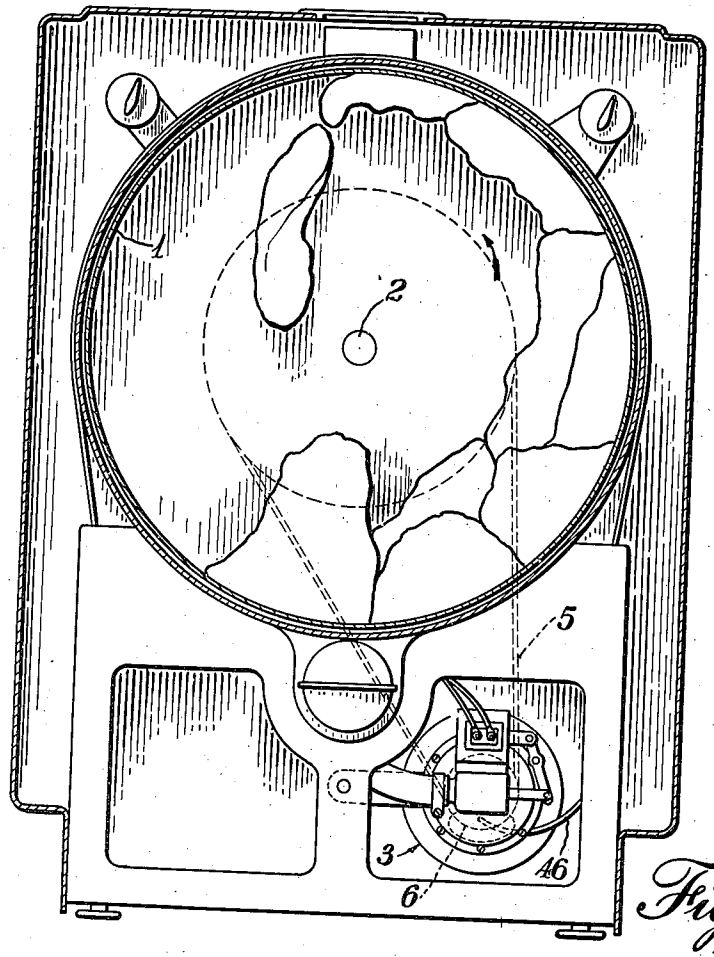

Fig. 1

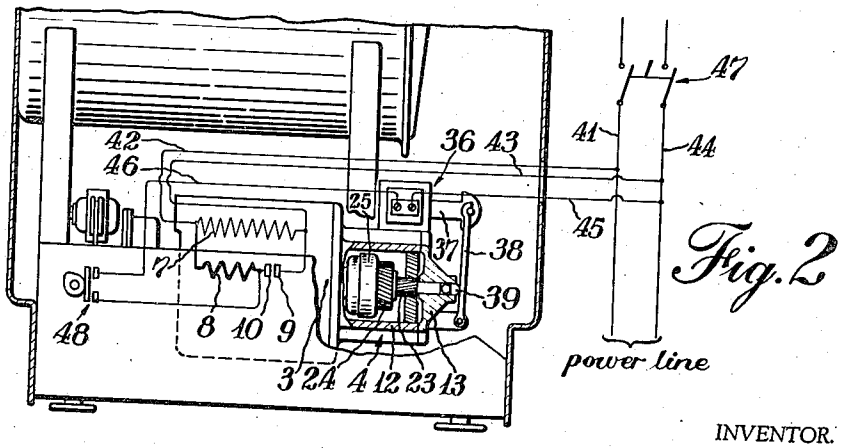

Fig. 2

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VARIABLE SPEED GEARING FOR WASHING MACHINES

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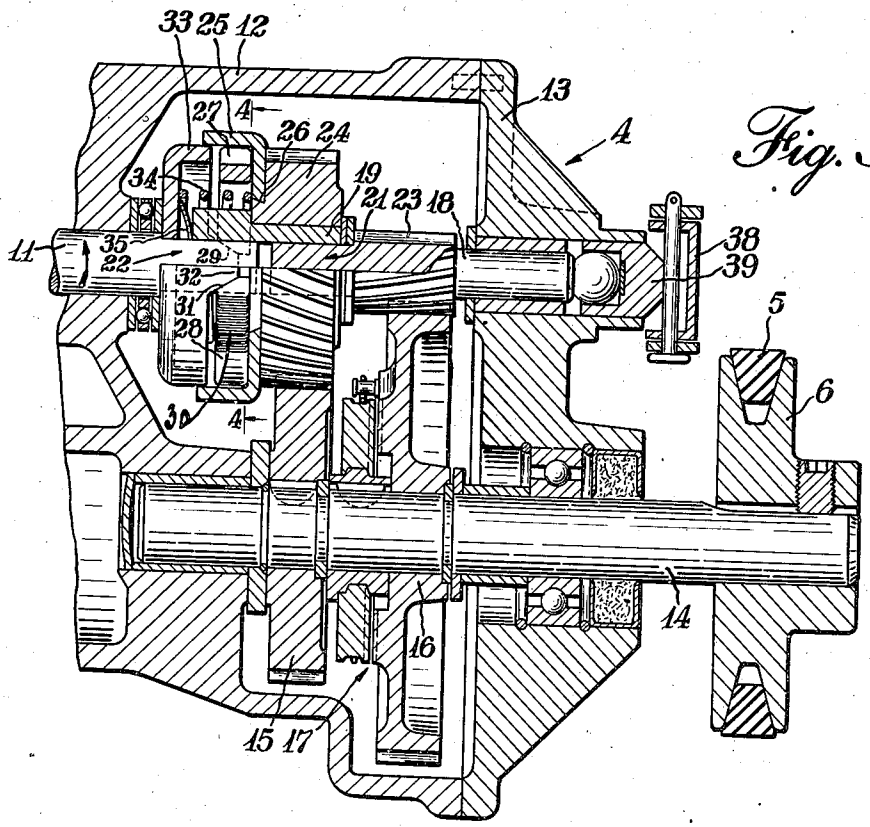

Fig. 3

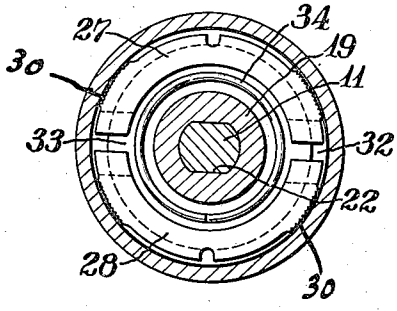

Fig. 4

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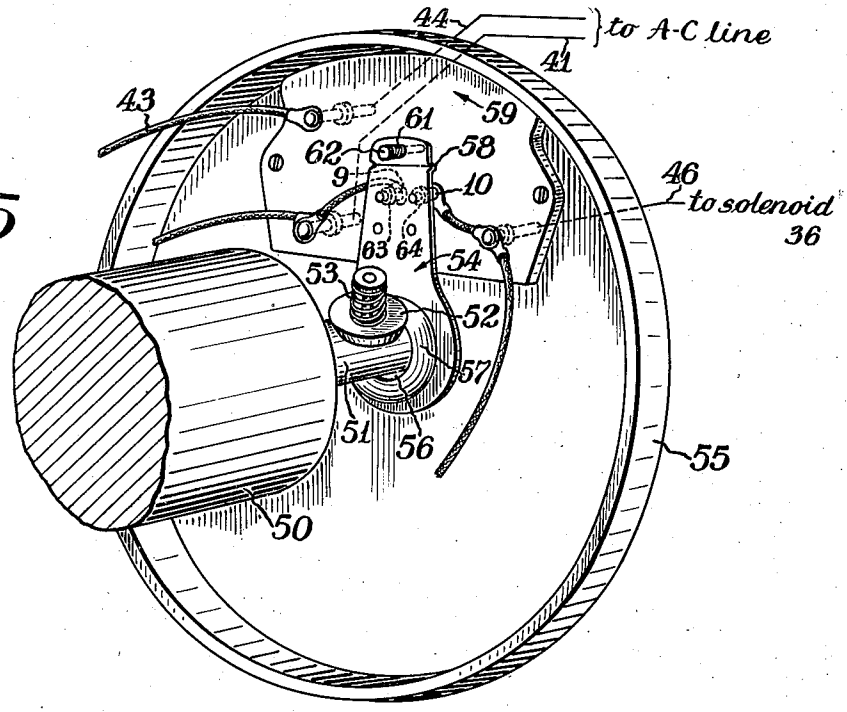
Fig. 5



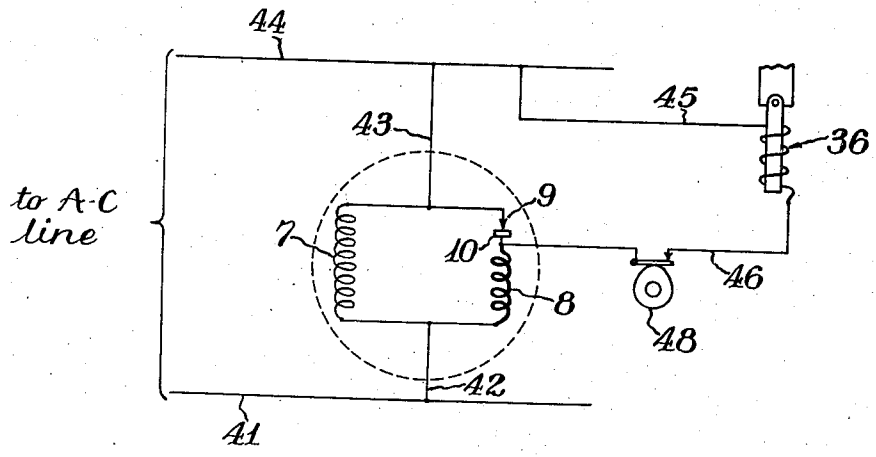


Fig. 6

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Patented Oct. 16, 1945

2,387,216

UNITED STATES PATENT OFFICE

2,387,216

VARIABLE-SPEED GEARING FOR WASHING MACHINES

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Application March 26, 1941, Serial No. 385,283

1 Claim. (Cl. 210—71)

The present invention relates to variable speed gearing for washing machines and more particularly to automatic transmissions providing a low speed drive for the washing operation and a high speed drive for the fluid extraction operation.

Electrical washing machines for domestic use are customarily powered by a fractional horse power alternating current motor. Motors of this type usually employ a separate winding for starting purposes, which winding is controlled by contacts held open by centrifugal force while the motor is running. When a heavy load is suddenly placed on such a motor, the armature may slow down enough to permit the starting contacts to close, thus energizing the starting winding, and since this winding is of low resistance, a heavy current will be caused to flow therethrough from the power line. If this condition is permitted to continue for more than a few seconds, the motor is liable to overheat and the protective fuses in the power line may melt.

In domestic washing machines of the above type in which a washing drum has to be accelerated to high speed for the extraction process, the shift of the transmission to high gear is commonly brought about by closure of a clutch in the high speed gear train. If this clutch engages abruptly, the motor is so overloaded that the starting winding is brought into action for an appreciable length of time, with the disadvantages above pointed out. On the other hand, if the clutch is arranged to slip continuously during the accelerating period, the parts are subject to wear so as to require comparatively frequent readjustment of the clutch actuating mechanism.

Moreover, in washing machines of this type in which the acceleration of the washing drum is smooth and continuous, there is sometimes a tendency for the clothes to pile up on one side of the drum and cause undesirable vibration of the washing machine during the extraction periods.

It is an object of the present invention to provide a novel washing machine of the above type having an automatic variable speed transmission for rotating the washing drum which is effective and reliable in operation and simple and economical in construction.

It is another object to provide such a device which incorporates a drum rotating means including a high speed gear train having a clutch and an automatic control mechanism for the clutch.

It is another object to provide such a device in which the high speed clutch is adapted to engage positively without any appreciable amount of slippage.

It is a further object to provide such a device in which the control means for the high speed clutch is arranged to release the clutch when the motor is so overloaded as to cause energization of the starting windings thereof, and to re-engage the clutch when the motor has accelerated sufficiently to deenergize said windings, whereby the clutch is caused to accelerate the drum by a series of jerks so as to level off the clothes in the drum.

Further objects and advantages will be apparent from the following description taken in connection with the accompanying drawings in which:

Fig. 1 is an end elevation partly broken away and in section of a washing machine incorporating a preferred embodiment of the present invention, showing the parts in the positions assumed during the washing operation;

Fig. 2 is a detail in semi-diagrammatic form showing the operating mechanism of the washing machine partly in side elevation and partly broken away, the wiring circuit for the motor being shown diagrammatically;

Fig. 3 is an enlarged detail partly in side elevation and partly in section of the transmission gearing employed for driving the washing drum;

Fig. 4 is a section taken substantially on the line 4—4 of Fig. 3.

Fig. 5 is a detail in perspective on an enlarged scale showing one commercial form of centrifugally controlled starting contacts for an alternating current motor; and

Fig. 6 is a wiring diagram of the electrical circuits which energize the motor and the solenoid controlling the high speed clutch.

In Fig. 1 of the drawings there is illustrated a washing machine comprising a horizontally arranged washing drum 1 arranged to be rotated on a horizontal axle 2 by means of a motor 3. The drum is connected to be driven by the motor through a variable speed transmission 4 actuating a belt 5 by means of a pulley 6 (Fig. 3). The motor is provided with a running winding 7 and a starting winding 8 controlled by contacts 9, 10, provisions being made for holding said contacts open during normal running of the motor and permitting them to close when the motor is running below a predetermined minimum speed. In Fig. 5 of the drawings there is illustrated a commercial form of starter control for alternating current motors which is suitable for the purposes of the present invention. As

there shown the armature 50 of the motor is provided with a shaft 51 on which a conical roller 52 is mounted with freedom for radial movement against the pressure of a spring 53. A hinged contact operating member 54 is mounted on the end plate 55 of the motor, one end of said member being provided with an opening 56 loosely receiving the end of the armature shaft 51 and having a conical lip 57 surrounding the opening adapted to engage the conical roller 52.

The member 54 has a projecting rib 58 forming a rocker which bears on a mounting bracket 59 fixed to the end plate 55 of the motor. The upper end of the plate 54 is yieldingly pressed toward the bracket 59 by suitable means such as a spring 61 mounted on a pin 62 fixed in said bracket and loosely traversing the plate 54. Contacts 9 and 10 are fixed in any suitable manner in the bracket 59 while being insulated therefrom, and cooperating contacts 63 and 64 are mounted in the plate 54 and are electrically connected by said plate.

When the motor is at rest, the spring 53 presses the roller 52 against the conical surface 57 of plate 54 and thereby holds contacts 63 and 64 in engagement with contacts 9 and 10, thereby electrically connecting said contacts. When the armature 50 of the motor rotates at sufficient speed to cause centrifugal force to move the roller 52 radially out of engagement with the plate 54, spring 61 acts on said plate to move contacts 63, 64 out of engagement with the starting contacts 9, 10 so as to deenergize the starting winding 8 controlled thereby. This structure is illustrated and claimed in the patent to Werner 2,182,977, dated December 12, 1939.

The variable speed transmission is provided for the purpose of rotating the drum 1 at a slow speed for the washing operation so as to tumble the clothes in the washing fluid until the foreign matter is detached from the clothes, and a high speed drive which is automatically brought into operation at the conclusion of the washing cycle and after the wash water has been drawn off, to extract the fluid from the clothes and leave them in a semi-dried condition.

As shown in Fig. 3, this transmission comprises a driving shaft 11 which may be the extended armature shaft of the motor and is journalled in a suitable casing 12 having a cover 13. A driven shaft 14 is journalled in the casing 12 and cover 13 in parallel relation to the driving shaft 11 and has fixed thereon a high speed gear 15 while a low speed gear 16 is journalled thereon and connected thereto by an overrunning clutch 17.

An intermediate shaft 18 is slidably journalled at one end in the cover 13 of the casing and at its other end is coupled to the driving shaft 11 by means of a quill shaft 19 which is slidably but non-rotatably mounted on adjacent flattened portions 21 and 22 of said shafts.

A pinion 23 is rigidly mounted on or formed integrally with the intermediate shaft 18 in position to mesh with the low speed driven gear 16 whereby the driven shaft 14 may be rotated at low speed by the drive shaft. A high speed gear 24 is journalled on the quill shaft 19 in position to mesh with the high speed driven gear 15 on the driven shaft and is provided with a clutch barrel 25 rigidly fixed thereto in any suitable manner as indicated at 26. A pair of arcuate clutch shoes 27, 28 (Fig. 4) are loosely mounted in the barrel 25 and are provided at their ends with beveled portions 29 and 31 adapted to engage correspondingly beveled wedge members 32 on a cup member 33 non-rotatably mounted on the flattened end 22 of the drive shaft 11.

The high speed clutch members are normally loose in the barrel 25 by virtue of a coiled spring 34 which tends to separate the clutch barrel 25 from the cup member 33. The action of spring 34 is supplemented by a disc spring 35 located between the end of the quill shaft 19 and said cup member. Means are provided for engaging the high speed clutch comprising a solenoid 36 (Fig. 2) adapted to actuate a plunger 37 which is connected by a lever 38 and thrust bearing 39 with the end of the intermediate shaft 18 whereby actuation of the solenoid causes the intermediate shaft to move to the left in Fig. 3, thus forcing the clutch members 27, 28 against the wedges 32 of the cup member 33 on the driving shaft whereby the clutch members 27 and 28 are expanded into driving engagement with the clutch barrel 25 and are rotated by the driving shaft to rotate the driven clutch member and high speed gear 24.

The clutch members 27 and 28 are preferably constructed as segments of a cylinder having a slightly larger diameter than the internal diameter of the clutch barrel 25. When they are wedged into engagement with the interior of the clutch barrel, they are thus caused to first engage said clutch barrel near their ends and the movement of the clutch members is not normal to the engaging surfaces but is at a rather small wedging angle to the chord of said surfaces. In other words the driving clutch members are in effect wedged between the widely separated portions of the interior surface of the clutch barrel 25 with which they engage, the engagement thus having a positive gripping effect which establishes the rotary connection without permitting substantial slippage. This positive gripping action of the clutch may be assisted by knurling the engaging portions of the clutch members 27 and 28 as illustrated at 30 in Figs. 3 and 4. The ridges of the knurls cut through any grease which may be present on the surfaces of the engaging members. An immediate metal-to-metal contact between the driving clutch members 27 and 28 and the driven clutch barrel 25 is thus secured, such as to prevent slippage therebetween under any conditions of load.

According to the present invention, the high speed clutch is caused to engage in a fluttering or jerky manner in order to prevent prolonged energization of the starting winding of the motor and to distribute the clothes evenly within the washing drum during the accelerating period thereof. As illustrated in Fig. 2, this is accomplished by connecting the solenoid 36 in such a manner as to be short-circuited by the contacts 9 and 10 of the starting winding when said contacts are closed. This arrangement causes the solenoid to be effective only when the driving motor is rotating above its predetermined minimum speed and causes the high speed clutch to be disengaged as soon as the starting winding of the motor is energized. As illustrated, one cable 41 of the power line is connected by a lead 42 to one end of each of the motor windings. A lead 43 connects the other line cable 44 to the opposite end of the running winding 7 and to the starting contact 9. A lead 45 connects the line cable 44 with one end of the solenoid 36 and the opposite end of said solenoid is connected by

lead 46 to the junction of the starting winding 8 with the starting contact 10. A switch 48 is inserted in the lead 46 for controlling the energization of the solenoid. It will thus be seen that when contacts 9 and 10 are open and the line switch 47 and control switch 48 are closed, the running winding 7 of the motor will be energized by current flowing through leads 42 and 43 and the solenoid 36 will also be energized by current flowing through the circuit comprising lead 42, starter winding 8, and lead 46 including switch 48. It will be understood that the resistance of the solenoid is sufficiently greater than the resistance of the starting winding to insure proper operation of the solenoid irrespective of the fact that it is in series with said starting winding.

When the starting contacts 9, 10 are closed by application of load to the motor as hereinafter set forth, the solenoid 36 is short-circuited thereby and the starting winding 8 is placed directly across the line, thus deenergizing the solenoid and opening the high speed clutch while the starting winding is in service.

In the operation of the device, the washing, rinsing and drying cycles may be controlled by any suitable automatic form of mechanism for determining the proper sequence. Since this mechanism forms no part of the present invention, it is not here illustrated. It will be understood, however, that during the low speed rotation of the washing drum for washing or rinsing purposes, the clothes will tumble in the drum as indicated in Fig. 1 and will cause said drum to be unsymmetrically weighted. At the termination of the washing or rinsing cycle and after the drum has been drained, closure of the energizing circuit for the solenoid 36 by the switch 48 which is preferably automatically controlled completes the circuit through the solenoid 36, causing the latter to actuate the high speed clutch to connect the drum to the motor through the high speed gear train. This sudden load thrown on the motor causes it to decelerate to a point where the starting contacts 9, 10 close, whereupon the solenoid 36 is momentarily deenergized and the motor thereby permitted to accelerate. When contacts 9, 10 are thereby opened, the solenoid is re-energized and the high speed clutch again engaged. The repetition of this jerking action at short intervals during the accelerating of the drum causes the clothes to be properly arranged around the interior of the drum so as to balance the drum and permit high speed rotation thereof without undue vibration. The positive form of clutch illustrated is particularly well adapted for the use intended in that engagement takes place without slippage and therefore without appreciable wear over long periods of use so that the original adjustment of the parts is maintained. It will be understood that the elasticity of the belt connecting the transmission to the drum is sufficient to prevent any objectionable shocks to the operating parts.

Although but one form of the invention has been shown and described in detail, it will be understood that other forms are possible and various changes may be made in the design and arrangement of the parts without departing from the spirit of the invention as defined in the claim appended hereto.

What is claimed is:

In a washing machine, a drum, a motor having a starting winding and a running winding, transmission means actuated by the motor for rotating the drum comprising a driven shaft connected to the drum, a drive shaft connected to the motor, gearing interposed between the shafts, said gearing including a low speed gear train and a high speed gear train, an overrunning clutch in the low speed train, a normally open clutch associated with the high speed train, a longitudinally movable gear in the high speed train, said high speed clutch including a barrel fixed to said longitudinally movable gear, segmented driving shoes in the barrel, means cooperating with said shoes to expand the shoes into gripping engagement with the barrel upon longitudinal movement of the movable gear and barrel, said shoes being constructed as segments of a cylinder having a slightly larger diameter than the interior diameter of the barrel, so that when the shoes are expanded into engagement with the barrel, they first engage the barrel near the ends so as to positively grip the barrel without substantial slippage, an electrical circuit including power leads, said starting and running windings being connected in parallel across said power leads, normally closed contacts in said connection from said starting winding to the power leads, to provide a circuit for operating the motor at a predetermined low speed, means operated by the motor for opening said contacts when the motor rotates above said predetermined speed, a second circuit from said power leads including said starting windings, an electromagnet, and a normally open control switch, in series, and means adapted to close and open said control switch to energize and deenergize said electromagnet for moving said high speed gear and barrel to engage said high speed clutch, said operating means for said control switch being adapted to close said second circuit to energize said electromagnet when said contacts are open.

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