Dec. 17, 1957 G. D. CONLEE 2,816,450

WASHING MACHINE TRANSMISSION

Filed June 25, 1956 4 Sheets-Sheet 1

Fig. 1.

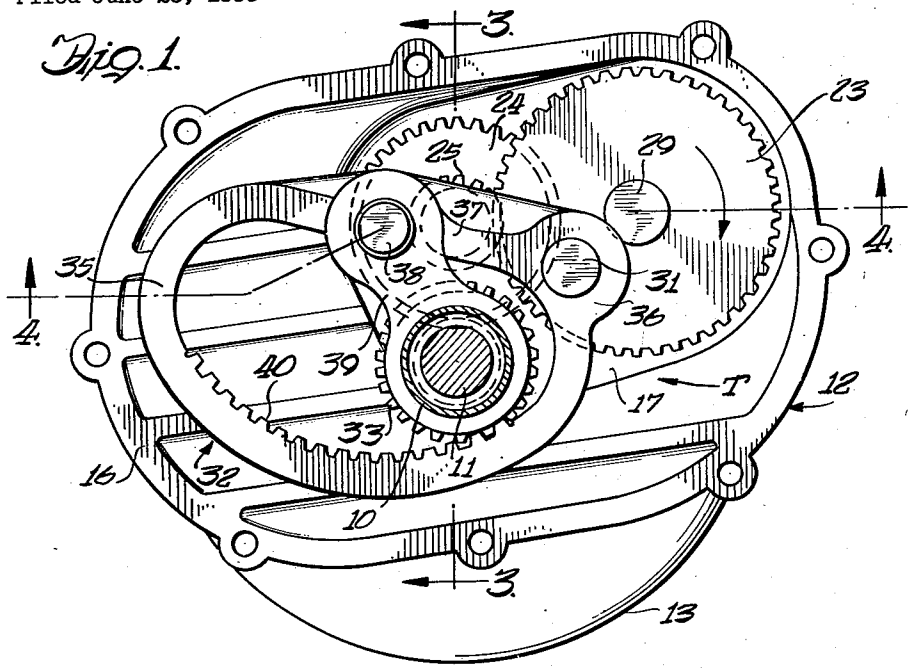
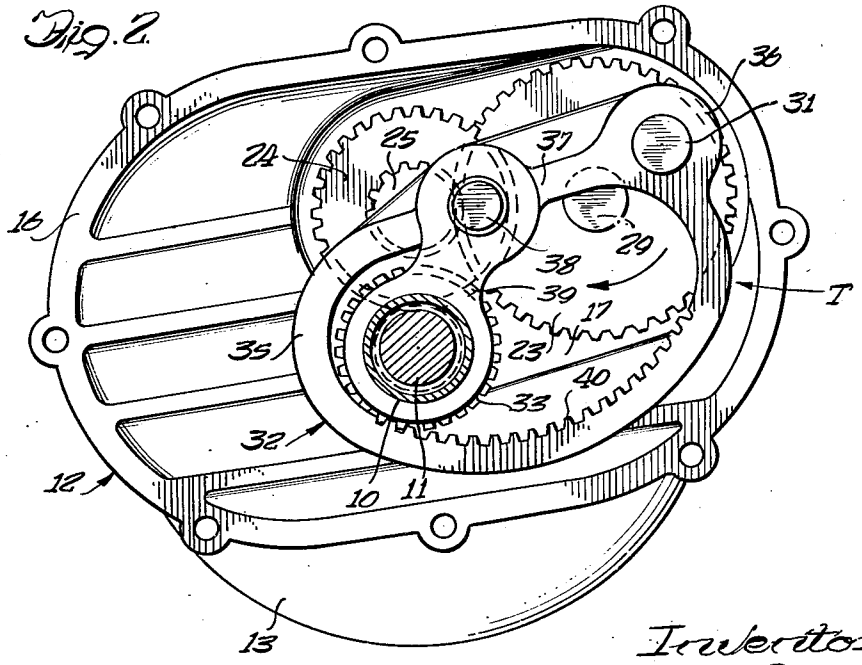



Fig. 2.



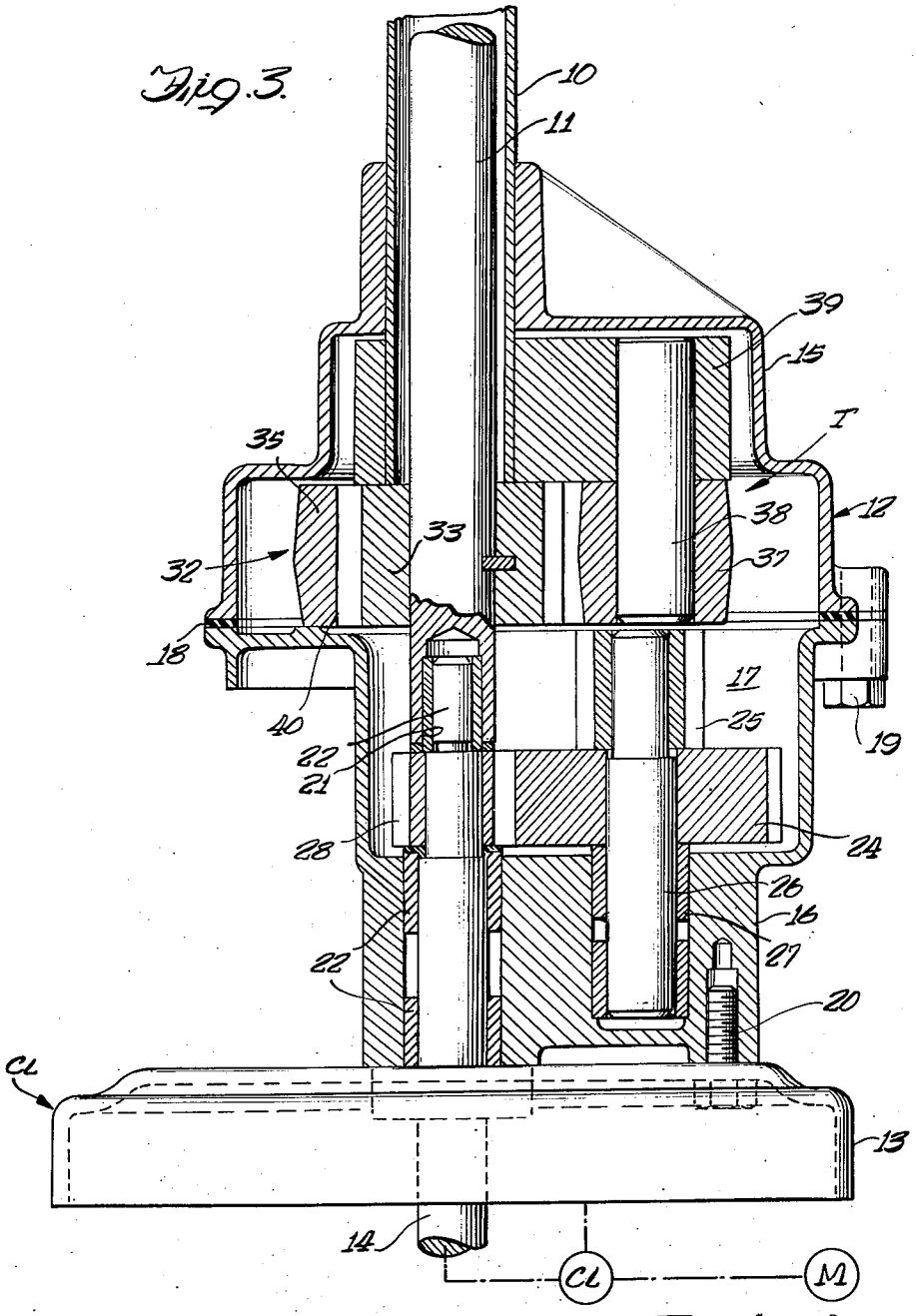

Inventor
George D. Conlee
By Carlson, Pitzner, Hubbard & Wolfe
Attorneys

Dec. 17, 1957 G. D. CONLEE 2,816,450

WASHING MACHINE TRANSMISSION

Filed June 25, 1956 4 Sheets-Sheet 2

Fig. 3.



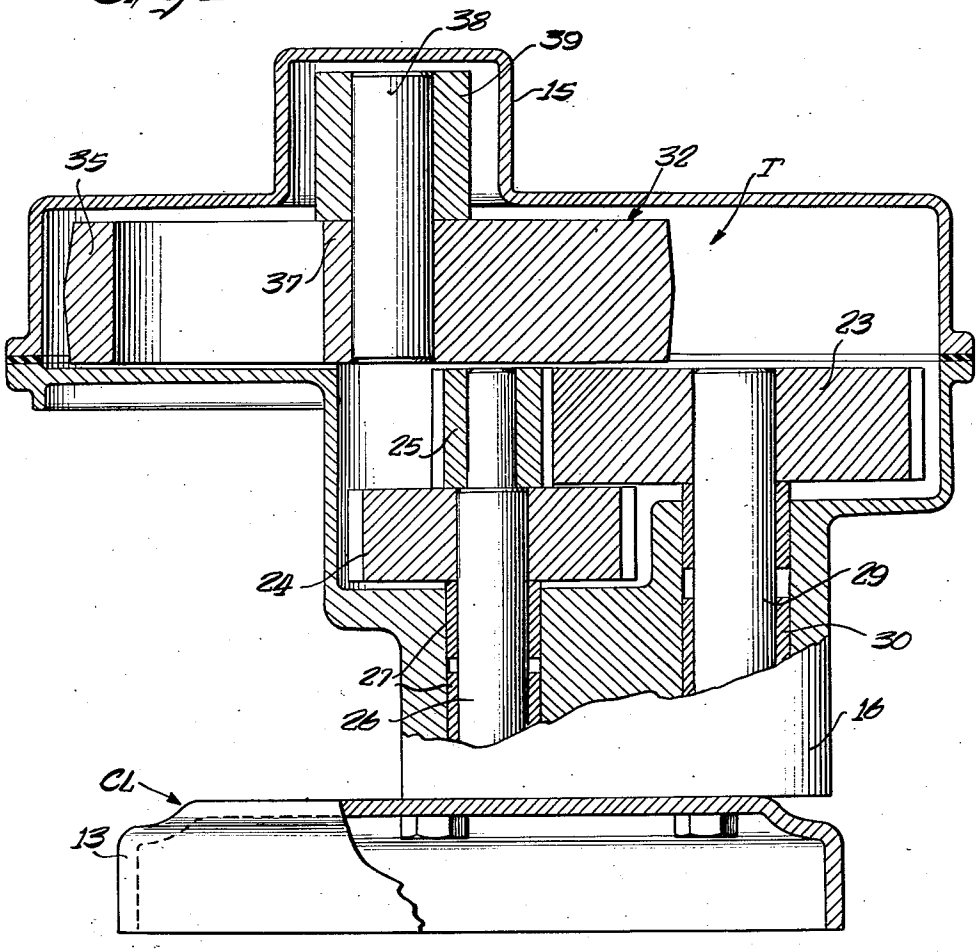

Inventor
George D. Conlee
By Carlson, Pitzner, Hubbard & Wolfe
Attorneys

Dec. 17, 1957 G. D. CONLEE 2,816,450

WASHING MACHINE TRANSMISSION

Filed June 25, 1956 4 Sheets-Sheet 3

Fig. 4.




Inventor
George D. Conlee
By Carlson, Price, Hubbard & Wolfe
Attorneys

Dec. 17, 1957 G. D. CONLEE 2,816,450

WASHING MACHINE TRANSMISSION

Filed June 25, 1956 4 Sheets-Sheet 4

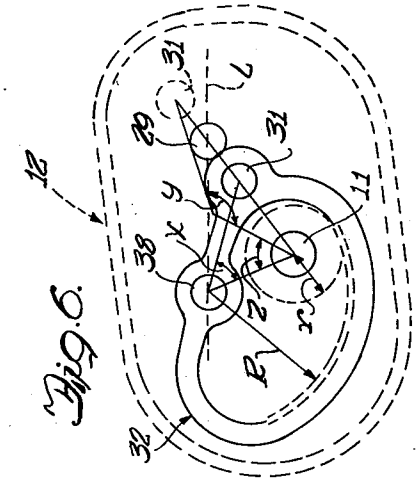



Fig. 6.

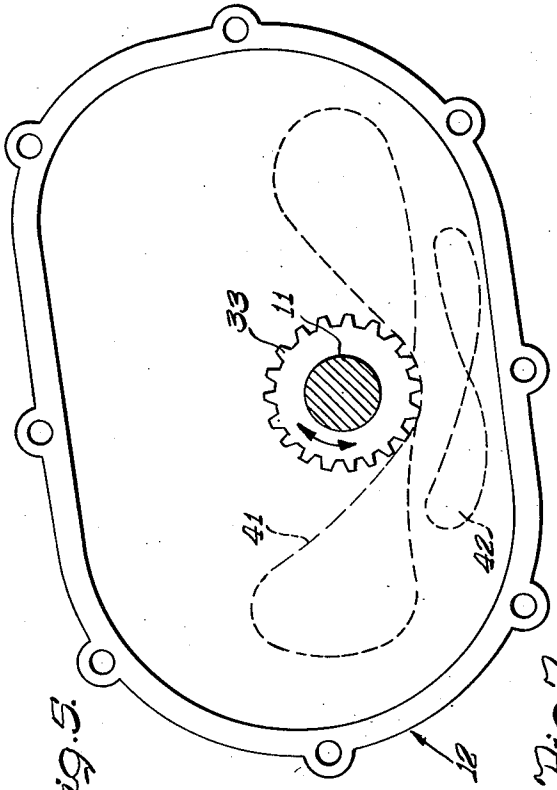



Fig. 5.

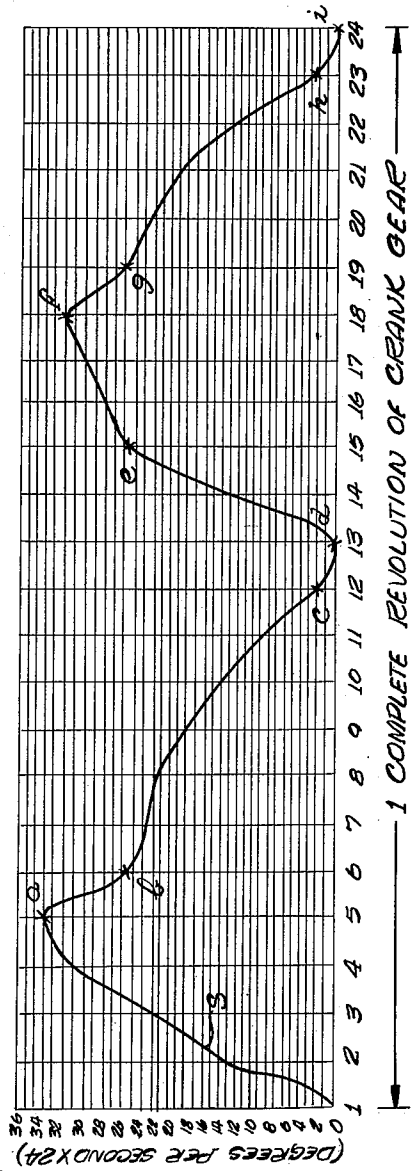



Fig. 7.

Inventor
George D. Conlee
By Carlson, Patzner, Hubbard & Wolfe
Attorneys

United States Patent Office 2,816,450 Patented Dec. 17, 1957



2,816,450

# WASHING MACHINE TRANSMISSION

George D. Conlee, Ripon, Wis., assignor, by mesne assignments, to McGraw-Edison Company, a corporation of Delaware

Application June 25, 1956, Serial No. 593,678

7 Claims. (Cl. 74—79)

The invention relates to a drive mechanism or transmission for clothes washing machines of the type which utilize the oscillatory motion of an agitator or the like for effecting the washing action and unidirectional high speed rotation or spinning of a receptacle for extracting water from the washed clothes; and it is more particularly concerned with an improved transmission for converting the unidirectional rotary movement of the machine driving motor into an oscillatory movement for driving the agitator.

In machines of the above general character the agitator drive shaft is commonly housed within the upright tubular shaft which supports and drives the receptacle. One object of the invention is to provide a transmission which is sufficiently compact and light in weight to be mounted on and rotate with the receptacle shaft and yet is capable of oscillating the agitator shaft through an angle adequate for all washing purposes.

Another object is to provide a transmission in which the elements are compactly assembled and arranged so that very little added weight is required to obtain dynamic balance.

Another object is to provide a transmission operative to accelerate and decelerate the clothes washing agitator in its oscillatory motion in a manner which materially reduces "whip" of the clothes around the edges of the agitator paddles when the agitator reverses its direction of movement.

A further object is to provide a washing machine transmission of simple rugged construction which is dependable and efficient in operation and which can be manufactured at relatively low cost.

Other objects and advantages of the invention will become apparent from the following detailed description of the preferred embodiment illustrated in the accompanying drawings, in which—

Figure 1 is a plan view of a transmission embodying the features of the invention showing the elements of the mechanism in the positions occupied at one end of an oscillatory stroke.

Fig. 2 is a view similar to Fig. 1 showing the elements of the mechanism in the positions occupied at the other end of the oscillatory stroke.

Fig. 3 is a sectional view of the improved transmission taken in a vertical plane substantially on the line 3—3 of Fig. 1.

Fig. 4 is a sectional view taken in a vertical plane substantially on the line 4—4 of Fig. 1.

Fig. 5 is a fragmentary plan view of the transmission showing diagrammatically the path followed by selected points on the segmental driving gear in one operating cycle of the mechanism.

Fig. 6 is a diagram showing the angular relation of the elements of the transmission at their limit positions in the operating cycle.

Fig. 7 is a diagram showing the angular velocity of the agitator shaft driven by the transmission constituting the present invention.



While a preferred form of the invention and its application to a particular type of washing machine have been shown and will be described in detail herein, this is not intended to limit the invention to the particular construction or application shown. The intention is to cover all modifications, adaptations and alternative constructions of the invention and its application to other types of machines to which it is suited consistent with the spirit and scope of the invention as expressed in the appended claims.

Referring to Figs. 1 and 3 of the drawings, the invention has been shown by way of illustration as embodied in a washing machine having an upright tubular drive shaft **10** for supporting and driving a rotatable clothes receptacle. A shaft **11** extends axially through the tubular shaft for driving an agitator positioned within the receptacle. Provision is made for driving either of the shafts individually from a motor M through the medium of a suitable clutch CL which may be set to determine selectively the shaft to be driven.

A transmission T constituting the present invention is interposed in the drive for the shaft **11** to translate the rotary motion of the shaft of the motor M to an oscillatory motion as applied to the shaft **11**. The transmission is enclosed in a housing **12** rigidly anchored to the lower end of the shaft **10** and equipped with a drum **13** forming the driven element of the clutch CL by which the housing and shaft are rotatably driven by the motor M upon appropriate setting of the clutch CL. When the clutch CL is set in its alternate position, the transmission housing is restrained from rotation by a suitable brake coacting with the drum **13** and the motor M serves to drive a shaft **14** constituting the input shaft of the transmission.

In accordance with one aspect of the invention the transmission T embodies novel features of construction which make it extremely compact and light in weight.

In particular, by reason of the improved construction the dimensions of the transmission and its housing **12** measured radially of the shaft **10** are minimized, thus reducing the inertia effect when the transmission assembly is rotated at high speed with the spinning receptacle. Moreover, the elements of the transmission and the housing are located relative to the axis of rotation so that the entire assembly may be dynamically balanced with the addition of a very small added weight.

As shown in Figs. 1 and 3 of the drawings, the housing **12** is formed of two hollow sections, namely, an upper section **15** and a lower section **16** assembled to define an oil tight chamber **17** for the transmission gearing. The housing sections, which may be die castings of light weight metal, are flanged at their abutting edges for cooperation with a sealing gasket **18**. Integral lugs adjacent the flanges are apertured for the reception of screws **19** by which the sections are secured together. The drum **13**, which is also preferably made of light weight metal, is disposed concentrically with respect to the shaft **10** and in this instance secured to the bottom of the lower housing **16** as by screws **20**.

The motor M is connected in driving relation to the transmission through the input shaft **14** which, in this instance, is journalled in sleeve bearings **22** seated in a bore in the housing section **16** as shown in Fig. 3. The lower end of the shaft extends into the drum **13** for connection with the driving member of the clutch CL when the drive to the drum is disengaged. The upper end of the shaft **14** is piloted in and provides support for the lower end of the agitator shaft **11**. For this purpose the shaft **14** is formed with an end section **21** of reduced diameter engageable in a bearing sleeve **22** seated in a recess in the lower end of the agitator shaft.

In the exemplary transmission the input shaft **14** is

arranged to drive a crank gear **23** (Fig. 4) through speed reduction gearing comprising a cluster gear including a large diameter gear **24** (Figs. 1 and 3) and a small diameter pinion **25**, the latter meshing with the gear **23**. As shown in Fig. 3, the cluster gear is mounted on a stub shaft **26** journalled in spaced bearings **27** seated in a recess in the housing section **16**. A pinion **28** fixed to the input shaft **14** meshes with the gear **24**.

The crank gear **23**, as shown in Fig. 4, is carried by a stub shaft **29** journalled in spaced bearings **30** seated in a recess in the housing section **16**. As shown in Fig. 1, the crank gear is fitted with an eccentric crank pin **31** through which oscillatory movements are imparted to an internally toothed segment gear **32** meshing with a pinion **33** keyed to the agitator shaft **11**. The form of the segment gear, its mounting and its relationship to the other elements of the transmission provides a very compact structure and yet enables the crank gear to oscillate the agitator shaft through a relatively large angle. Moreover, the foregoing considerations enable the segment gear to accelerate and decelerate the agitator shaft in a manner which substantially eliminates or materially reduces "whip" of fabrics being washed around the agitator paddles when the agitator reverses its direction of movement.

As best shown in Figs. 1 and 2 of the drawings, the segment gear **32** in its preferred form comprises a generally oval open center member **35** with a projection **36** adjacent one end apertured to provide a bearing for the reception of the crank pin **31**. Spaced from the projection **36**, in this instance, approximately half way along the adjacent longer side of the member, is a pad **37** apertured to receive a pin **38** pivotally connecting the member with one end of a slave link **39**. This link, at its other end, is journalled on the lower end of the shaft **10** so as to swing about an axis concentric with that shaft and with the axis of the agitator shaft **11**.

The side portion of the member **35** opposite that formed with the pad **37** is shaped to define a segment of a circle having its center at the central axis of the pivot pin **38**. This segment is formed on its inner face with gear teeth **40**. The dimensions of the parts are such that the internally toothed gear segment has a pitch radius R (see Fig. 6) equal to the sum of the length of the link **39** (measured from the axis of the pivot pin **38** to the axis of the agitator shaft **11**) and the pitch radius *r* of the pinion **33**. The gear teeth **40** accordingly mesh with the teeth of the pinion **33** in all positions to which the member **32** may be rocked about the pivot **38**.

By reason of its pivotal connection with the link **39** and with the crank pin **31**, the segment gear **32** receives a compound motion from the crank action of the pin including the lateral swinging through an arc on the link **39** and a superimposed rocking movement resulting from the translation of the projection **36** through a circular orbit with the crank pin **31**. In this latter movement the angle between the planes through the axes of the shaft **11** and crank pin **31** intersecting at the axis of the pivot pin **38** varies from the minimum value indicated at *x* in Fig. 6 and the maximum value indicated at *y*. At the same time, the crank **39** swings through the angle indicated at *z*.

The location of the crank gear **23** relative to the parts driven by it and the direction of rotation of the gear are such that the torque load on the gear is maintained relatively low even as the acceleration of the agitator begins. To this end, the crank gear is mounted so that its axis and the axis of the pin **31** in both limit positions all lie in the same line L and the gear is rotated clockwise (as viewed from above).

The net result of the compound movements of segment gear **32** is that the tooth segment **40** is translated in a path effective to rotate the pinion **33** first in one direction and then in the other direction. The path followed by the toothed segment is such that the teeth **40** do not come into



mesh with the teeth of the pinion **33** in the usual tangential manner but the meshing relation is both tangential and radial as shown by the broken line **41** in Fig. 5 which is in the form of an elongated and somewhat distorted figure 8.

The lobe of the figure defined by line **41** to the left of the gear **33** (as viewed in Fig. 5) represents the path traversed by the pitch point of the tooth **40** at the left end of the gear segment. The lobe at the right of the gear represents the path traversed by the pitch point of the tooth at the right end of the segment. It will be observed that the paths followed by these teeth, while generally similar, are not identical. This accounts for the advantageous accelerating and decelerating characteristics afforded by the improved transmission, as will appear presently.

The unique motions of the segment gear **32** enables it to impart a relatively large angular movement to the agitator shaft **11** while the gear itself moves within a comparatively small area. This, combined with the novel manner in which the various gears and pinions are arranged in vertically stacked relation, materially reduces the radial dimensions of the transmission and its enclosing casing and substantially dynamically balances the assembly with a corresponding improvement in the inertia characteristics which is highly advantageous in view of the high speed rotation required for spinning the receptacle.

The manner in which the segment gearing accelerates and decelerates the agitator shaft is illustrated by the graph in Fig. 7. In this graph, the agitator speed has been plotted in degrees per second, based upon an agitator speed of sixty oscillations per minute. In each revolution of the crank gear **23** the segment gear **32** is swung from its extreme leftward position shown in Fig. 1 to the extreme rightward position shown in Fig. 2 and then back to the first-mentioned position. For convenience, the abscissa of the graph (Fig. 7), which represents one complete revolution of the crank gear, has been divided into twenty-four increments. The ordinates representing instantaneous angular speed of the agitator shaft are divided into twenty-fourths of a degree per second. This, of course, is merely exemplary.

Referring more in detail to Fig. 7, it will be observed from the curve S that at the beginning of a cycle the agitator starts fast and builds up to maximum speed of 792 degrees per second at a point *a* in approximately five time increments. The speed then drops sharply to point *b* in a single time increment and then more gradually to approach a dwell period *c*—*d* between the twelfth and thirteenth time increments. The return movement of the agitator also proceeds very rapidly to a point *e* for two time increments and then at a slightly slower rate for three time increments to point *f* where the maximum speed of 732 degrees per second is reached in five time increments after reversal of the agitator. There is also a fast drop in speed after passing the peak, such drop extending through a single time increment to point *g* followed by a gradual decrease terminating in a substantial dwell period between points *h* and *j* between the twenty-third and twenty-fourth time increments. In other words, while the agitator shaft is rapidly accelerated and decelerated in each half of its oscillatory cycle, there is a very substantial slowing down which amounts almost to a dwell before the direction of movement of the agitator reverses. This materially reduces the "whip" of the clothes around the paddles of the agitator and consequently avoids tangling of the clothes or any damage thereto in the washing operation.

The improved transmission can easily be adapted for use with any specific machine since the dimensions of the parts are readily calculated by the formula:

$$O=\left[\frac{R}{r}(y-x)\right]-z$$

in which:

O is the oscillating range of the agitator shaft **11** in degrees.

R is the pitch radius of the internal segment gear **32**.

*r* is the pitch radius of the drive pinion **33** for the agitator shaft.

*x* is the angle in degrees defined by planes respectively through the axes of the shaft **11** and the crank pin **31** intersecting at the axis of the pivot pin **38** when the segment gear **32** is in one limit position (to the left as viewed in Fig. 6).

*y* is the angle in degrees defined by the above-mentioned intersecting planes when the segment gear is in the other limit position.

*z* is the angle in degrees defined by planes extending through the axis of the pivot pin **38** at its two limit positions and intersecting at the axis of the agitator shaft **11**.

It will be apparent from the foregoing that the invention provides a novel washing machine transmission characterized by extreme compactness which particularly adapts it for use with automatic and similar washing machines employing centrifugal drying. The transmission is rugged and capable of troublefree operation over long periods and with a minimum of attention. Moreover, it is made up of simple parts well adapted for mass production and capable of being manufactured at relatively low cost.

I claim as my invention:

1. A transmission for imparting oscillatory movement to the agitator shaft of a washing machine comprising, in combination, a pinion fixed on the agitator shaft, a link pivoted at one end concentric with the agitator shaft and having a pin adjacent the other end parallel to its pivotal axis, an open centered member embracing the agitator shaft and having one side journalled on said pin, said member having at its other side a segment formed with gear teeth centered on said pin and having a pitch radius effective to mesh said gear teeth with the teeth of said pinion, and means for oscillating said member about the axis of said pin and simultaneously oscillating said member and said link about the axis of the agitator shaft.

2. A transmission for imparting oscillatory movement to the agitator shaft of a washing machine comprising, in combination, a pinion fixed on the agitator shaft, a link pivoted at one end concentric with the agitator shaft and having a pin adjacent the other end parallel to its pivotal axis, an open centered member embracing the agitator shaft and having one side journalled on said pin, said member having at its other side a segment formed with gear teeth centered on said pin and having a pitch radius effective to mesh said gear teeth with the teeth of said pinion, a continuously rotating driving member, and a crank pin on said driving member connected to said open centered member operative to impart a compound oscillating movement to said member.

3. The combination with a shaft to be oscillated about its longitudinal axis and having a pinion fixed thereon, of a continuously rotated member supported with its axis parallel to and spaced laterally from the axis of the shaft, a crank pin mounted eccentrically on said member, an internal segment gear meshing with said pinion and pivotally connected to said crank pin, and a rigid link pivoted to rock about the axis of said shaft and having a pivotal connection with said segment gear at its pitch center effective to constrain the segment gear to movements in an orbit such that the teeth at opposite ends of the gear segment are traversed through a path having the general form of an elongated figure eight.

4. The combination with a shaft to be oscillated, of a pinion fixed to said shaft, an internal segment gear in mesh with said pinion, a pivot for said gear, and means for maintaining said pivot spaced from said shaft so as to maintain the teeth of the gear in mesh with the teeth of the pinion, and means permitting said pivot to swing through an arc centered on the axis of the shaft.

5. The combination with a shaft to be oscillated, of a pinion fixed to said shaft, an internal segment gear in mesh with said pinion, means constraining one pivot on said gear to movement in an arc centered on said shaft and spaced from the axis of the shaft so as to maintain the gear and pinion in mesh, and means constraining another pivot on said gear to revolve in a circular path centered at one side of said shaft, the combined motions of said pivots serving to traverse the teeth of the gear in a path having the general form of a figure eight.

6. The combination with a shaft to be oscillated, of a pinion fixed to said shaft, an internal segment gear in mesh with said pinion, a crank pin revolving in a circula path with its center spaced laterally from the axis of said shaft, said gear having a bearing pivotally engaging said crank pin, and a rigid link extending between said shaft and a pivot on said gear spaced from said bearing operative to maintain said gear in mesh with said pinion as said gear is oscillated by said crank pin.

7. A driven shaft to be oscillated, a pinion on said driven shaft, a gear segment in mesh with said pinion, said gear segment having a pivotal support positioned at the center of the pitch circle of said segment, said pivotal support constrained to move in an arc about said driven shaft at a distance therefrom adapted to maintain said gear segment and pinion in mesh for moving the pitch center of said segment gear in an arc about said pinion, a driving eccentric and a pivotal connection between said eccentric and said gear segment, said pivotal connection being offset laterally from said driven shaft and said pivotal support for imparting an arcuate rocking motion to said pivotal support about said pinion and a rocking motion to said gear segment about the point of contact of said segment and said pinion.

No references cited.