

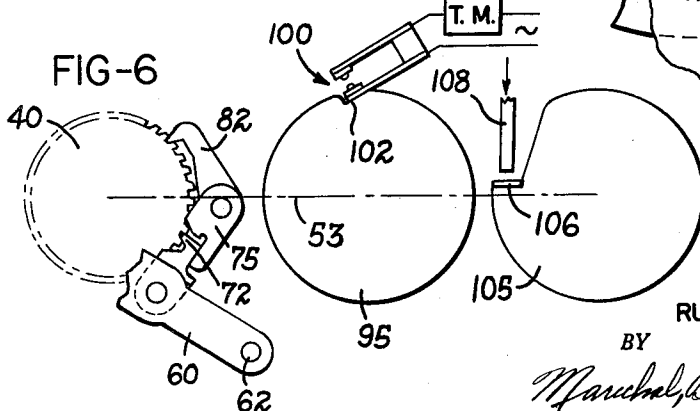
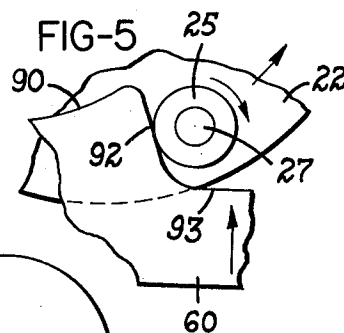
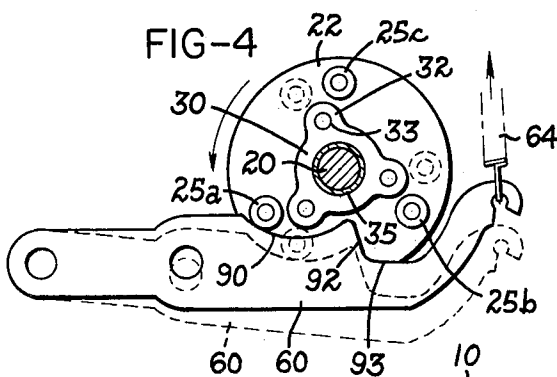
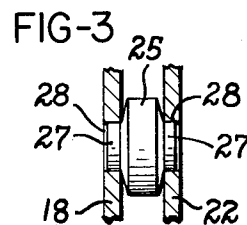
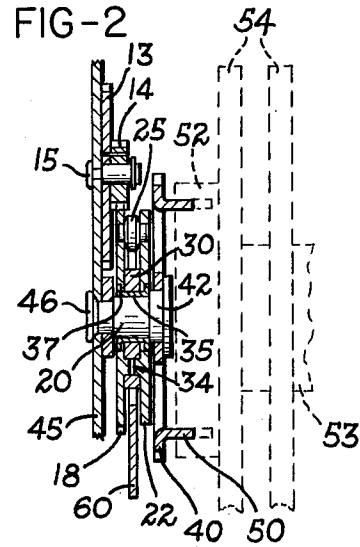
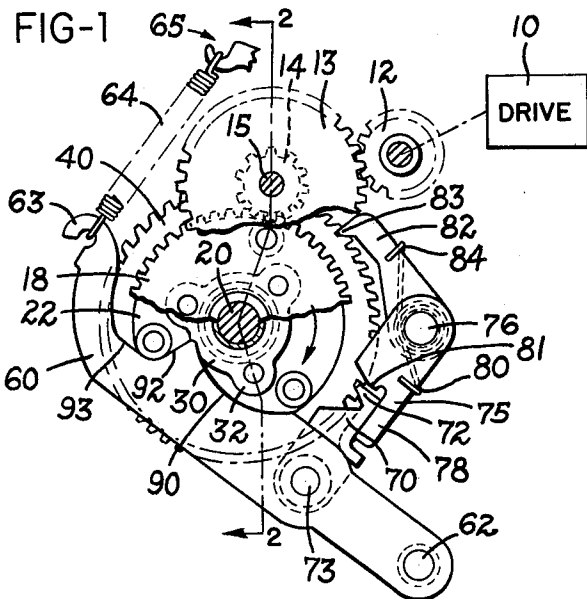
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3,099,164

ESCAPEMENT DRIVE

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ESCAPEMENT DRIVE

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This invention relates to an intermittent drive, and particularly to such a drive as applied to timing apparatus used to control the sequence of operations in the functions cycle of a dishwashing machine or similar machines.

Intermittent drive mechanisms broadly have utility in the conversion of input, usually continuous, rotary motion into intermittent motion, either rotary or linear, of predetermined increments. One particular use of mechanism of this type is in the driving of multiple cams which control the opening and closing of switch contacts to form in combination a programming or sequencing timer construction. By connecting the intermittent output to the timer cams, they can be advanced in a step by step fashion which will promote rapid opening and closing of the switch contacts, giving an abrupt operation of the various switching elements of the timer and thus minimizing arcing and eventual destruction of the contacts, as well as giving a precise control over the several differently timed functions of the machine being controlled by the timer. At the same time, the drive to the mechanism can be from a continuously rotating small electric motor.

Of course, it is desirable to provide a timer construction which is durable and has a relatively long life, since in dishwashing machines and the like it is preferable to avoid as much maintenance work on the timer as possible. On the other hand, the driving parts of the mechanism operate continuously through each running cycle of the machine, and thus these parts are subjected to extensive use.

Accordingly, it is important to reduce the friction, and particularly the wear in the parts due to friction, in the timer drive as much as possible, and the primary object of this invention is to provide a novel intermittent and drive, particularly adapted for the driving of timer mechanisms, in which the friction between moving parts of the mechanism is minimized to a considerable extent, and frictional wear is correspondingly reduced.

Another object of this invention is to provide an intermittent drive in which the intermittent driving motion imparted to a ratchet wheel by a driving dog is carefully controlled to maintain the acceleration and deceleration of the driving dog during its actuating motion within controlled limits, thus minimizing the tendency of the dog to throw the ratchet wheel beyond the normal step of its intermittent motion, and providing a step by step output which is more clearly constant as to changes in rotational velocity.

An additional object of this invention is to provide a novel intermittent drive in which a pivotal driving arm is provided having a cam surface engaged in sequence with a plurality of rollers driven in planetary fashion, and in which such cam surface is contoured to maintain a predetermined contact between a roller and the arm during rising and descending motion of the arm to produce a driving action of the driving dog of the drive mechanism.

Another object of this invention is to provide such a

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timer drive which, in combination with the timer controls, functions to stop the drive mechanism at a position where the lock-in mechanism of the driving dog is not fully applied, and the timer ratchet wheel is therefore maintained relatively free for subsequent manual movement to start a new cycle of timer operation.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings—

FIG. 1 is a plan view, with some parts broken away, of an intermittent drive in accordance with the invention;

FIG. 2 is a sectional view, taken on line 2—2 of FIG. 1, and showing in addition, in dotted lines, a portion of a timing apparatus which may be driven by the intermittent drive;

FIG. 3 is an enlarged detail section showing the beveled construction of one of the drive rollers;

FIG. 4 is a view of a preferred form of cam and roller drive in accordance with the invention, showing the movement of the drive cam arm in full and dotted lines, respectively;

FIG. 5 is an enlarged detail view illustrating the relationship of a drive roller and a ramp portion of the cam by means of which the reciprocating arm is controlled during its advancing or descending motion; and

FIG. 6 is a somewhat schematic view of the timer mechanism, illustrating particularly the relationship of the parts at the end of the cycle, where the timer drive motor is stopped.

Referring to the drawings, which illustrate a preferred embodiment of the present invention, the drive is illustrated in combination with a timer device such as disclosed in United States Patent No. 2,916,923, issued December 15, 1959. The essential parts of such timer mechanism include a drive motor 10, shown schematically, which is connected to rotate a pinion 12, preferably continuously, although the drive could be intermittent if desired. This pinion in turn is meshed with a reduction gear unit including a relatively large gear 13 and a smaller drive gear 14 both of which are carried on, and fixed, to a countershaft 15. The smaller gear 14 is in mesh with the main gear 18, and this main gear is mounted for free rotation about the main supporting shaft 20 of the mechanism.

The gear 18 cooperates with a wheel 22 to form a support and drive for a plurality of planetary drive rollers 25. In the embodiment shown, there are three such rollers located symmetrically, 120° apart, and thus capable of producing a driving stroke for every one-third revolution of the main gear 18, as will be described. The rollers 25 include a hub 27 which extends into holes 28 formed in the gear 18 and the wheel 22, respectively. These parts are maintained in properly spaced relation to permit free rotation of rollers 25 by a center spider 30. The edges of rollers 25 are preferably beveled (FIG. 3) to minimize frictional resistance to rotation of any roller in its mounting.

The spider construction preferably includes a plurality of outwardly extending ears 32 provided with holes 33, and the gear 18 and wheel 22 are dimpled or otherwise suitably deformed, as shown generally at 34 in FIG. 2, to maintain the sub-assembly of spacer, main gear, and wheel. The gear 18, wheel 22, and spider 30 are all

mounted on a bushing 35 which is provided with a head which fits into an appropriate recess in wheel 22, as shown, and the other end of which is peened over the hub of gear 18, as indicated at 37. This bushing preferably has a knurled outer surface to maintain alignment of the parts thereon. The bushing is received on main shaft 20, and next to the toothed ratchet wheel 40, the latter being mounted upon an enlarged hub portion 42 of the main shaft. The main shaft also projects through a mounting frame or plate 45, and the end 46 of shaft 20 is staked or deformed beyond or behind the frame plate to maintain the sub-assembly in position. Similarly, the countershaft 15 is mounted in the frame plate 45, with the gears 13 and 14 thereon. The ratchet wheel 40 includes a plurality of driving dogs 50 which preferably are provided by deforming sections of the ratchet wheel to one side thereof as shown in FIG. 2, and the resultant drive dogs are engaged with the hub 52 of timer shaft 53, this shaft carrying one or more switch controlling cams 54 which provide the timer circuit control functions, as is well known in that art.

The rotary drive from pinion 12 is transmitted to the main gear 18, and the planet rollers 25 are revolved accordingly. The rollers engage with a drive cam arm 60 during their course of travel around the main shaft 20. This arm is pivotally mounted at 62 and includes a hook portion 63 at its outer end which is engaged with a spring 64, and the other end of this spring is anchored to a fixed point shown generally at 65. This may be, for example, a fixed point on the frame. The arm 60 carries a driving dog 70 including a tooth 72 which is engageable with any of the teeth on ratchet wheel 40. The dog 70 is in turn pivotally mounted at 73 to arm 60, and thus as the arm is swung counterclockwise (as viewed in FIG. 1) the tooth 72 will cam or drag over the ratchet wheel teeth, and as the arm swings in the opposite direction the driving dog will engage a tooth on the ratchet wheel and rotate it in a counterclockwise direction (as viewed in FIG. 1).

In order to assure engagement of dog 70 with the ratchet wheel, a so-called "lock-in" lever or pawl 75 is provided, mounted for pivotal movement on a fixed stud 76. The lock-in pawl includes an arm portion 78 extending in back of the tooth 72 on the driving dog 70 (FIG. 1) and assuring continuous contact between the driving dog and ratchet wheel 40. The biasing action of pawl 75 is obtained through a suitable hair spring 80 hooked around this pawl and anchored about stud 76. While this lock-in pawl construction is not essential to the present invention, it is advantageous in promoting positive contact between the driving dog and the toothed ratchet wheel, and this feature is explained in greater detail in said United States Patent No. 2,916,923.

Another feature of the lock-in pawl concerns its function as a stop forming a limit to the driving or descending motion of the arm 60 and driving dog 72. This stop is formed by the shoulder 81 on lock-in pawl 75. The driving dog 72 engages this shoulder at the end of its stroke, and at this time the lock-in pawl functions to maintain the driving dog positively engaged with a tooth of the ratchet wheel, requiring that substantial force be exerted to rotate the ratchet wheel further in its driven direction. Thus, the lock-in pawl also functions to promote a precise advance of the ratchet wheel, as explained in the aforementioned patent.

In order to prevent reverse or retrograde rotation of the ratchet wheel, for example as might be caused by the dog tooth 72 dragging over the ratchet wheel during its rising or non-driving motion, a holding dog 82 is provided, having a tooth 83 engageable with any tooth on ratchet wheel 40, and pivotally mounted on stud 76. The dog 82 is urged into continuous contact with the ratchet wheel teeth by a hair spring 84 which likewise may be anchored about stud 76.

The cam drive arm 60 is provided with a linear cam

surface which is engaged by the planetary driving rollers 25. This cam surface may be considered as divided into three portions, as shown particularly in FIG. 4, these portions being an entrance and driving or raising ramp 90, a drive control ramp portion 92, an exit ramp portion 93.

For purposes of explanation, assuming that three planetary drive rollers are to be used as shown in FIG. 4, these rollers have been designated 25a, 25b and 25c. They are in fact identical in construction, and each performs the same function in its sequence of rotation about the main shaft 20. In the assembly shown in FIG. 4, the arm 60 is shown in full lines at the beginning of its ascending stroke, at which time the drive roller 25a has just engaged the entrance or driving cam ramp portion 90, while the roller 25b has passed off the end of the exit ramp portion 93. The roller 25c is, of course, on the opposite side of the main shaft from arm 60 and may be considered non-operative at this time.

As the drive gear continues its forward rotation, which is now considered to be counterclockwise in FIG. 4 (but corresponds to clockwise rotation of this gear as viewed in FIG. 1) the roller 25a will cause arm 60 to swing downward toward its dotted line position in FIG. 4, acting against the bias of spring 64. At this time the driving dog 70 is being raised or dragged across the teeth of ratchet wheel 40, while this wheel is held stationary by the holding dog 82. The lock-in pawl 75 functions at this time to maintain contact between the driving dog and ratchet wheel 40.

When roller 25a leaves the raising or entrance ramp portion 90 and passes beyond the intersection thereof with the control ramp portion 92, spring 64 will pull arm 60 through its descending or driving stroke, and roller 25a will pass over to the control ramp portion 92, as shown particularly in FIG. 5. As this occurs, and arm 60 is descending, the driving dog 70 engages with a tooth on ratchet wheel 40, and carries this wheel forward, producing an output rotation thereof (counterclockwise as viewed in FIG. 1), the angular extent of which is determined by the total descending or driving movement of arm 60.

In many prior art devices the drive arm is at this time permitted to drop with an abrupt motion which inherently results in rather large acceleration and deceleration of the drive arm. However, in accordance with the present invention the roller remains in contact with the control ramp portion 92 and this maintains a control over the rate of descending or driving movement of arm 60, resulting in a smooth driving stroke which minimizes the tendency of driving dog 70 to "throw" the ratchet wheel forward. It has been found that in some instances such "throwing" action could lead to an angular movement of the ratchet wheel beyond that of the predetermined motion of the driving dog. This action has actually been observed in some cases to cause a significant uncontrolled advance rotation of the ratchet wheel and timer cams. In any event, even if this "throwing" action might be only to the extent of one or two teeth passing under the driving dogs, such additional and unpredicted motion can result in an inaccurate cycle in the timer which obviously produces unwanted results, whatever may be the apparatus controlled by the timer.

As the roller 25a advances beyond the control ramp portion 92, it will engage with the exit ramp section or portion 93, and thus maintain its contact with the arm 60. Continued rotation of gear 18 and wheel 22 will cause roller 25a to move down the exit ramp portion 93 and the driving or descending stroke of arm 60 (and driving dog 72) is completed with the driving dog 72 engaged against shoulder 81 on the lock-in pawl 75. When the parts are in this position, and the next roller 25c has not as yet engaged the entrance ramp portion 90, the rollers

will be momentarily out of contact with the cam surface

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on the arm. It should be noted, however, that at no time after its engagement with entrance ramp portion 90 does the active roller become momentarily disengaged from the cam on the arm 60 until that active roller has completed its traverse of the cam and moved beyond the exit ramp portion 93 when the stroke of arm 60 is completed as just described.

One significant advantage of this type of construction results from the distribution of surfaces subject to wear. Thus, for example, each of the rollers 25 rotates within its bearing surfaces 28 on the gear 18 and wheel 22, respectively. This rotation occurs during traverse of the roller in question over the cam surface on the drive arm. Such traverse, however, is a rolling action rather than a sliding one, and thus there is very little if any wear due to friction on the peripheral surfaces of rollers 25 which engage the cam on the drive arm, and likewise of course there is little frictional wear on the respective cam portions. Furthermore, the pressure exerted by spring 64 through arm 60 against the rollers is transmitted to the bearing surfaces 28 which are in the form of journals, which are cylindrical and of a width roughly equivalent to the thickness of gear 18 and wheel 22. There are a plurality of rollers, in a preferred construction according to the invention, and thus the wear due to friction, which is a rolling bearing type of wear, is distributed further. The result is an intermittent drive construction which exhibits a substantially prolonged life in comparison to prior art devices.

The present invention also includes another novel feature which is particularly clear from an inspection of FIGS. 1 and 6. As explained above, ratchet wheel 40 drives the timer main or output shaft 53 which rotates the timer control cams 54. In one embodiment of a timer, used particularly to control the cycling of an automatic dishwashing machine, the shaft 53 carries (in addition to other cams not illustrated) a terminal control cam 95 which maintains the contacts 100 closed during one complete operating cycle of the timer, and these contacts complete an energizing circuit through the timer motor 10, this portion only of such circuit being shown in FIG. 6.

At the end of the cycle, the following contact drops into a niche 102 in the surface of cam 95, and contacts 100 open to deenergize motor 10, stopping the timer and terminating the cycle. In order to initiate a new cycle it is necessary to advance shaft 53, and particularly cam 95, to close contacts 100 again. One convenient way of accomplishing this function is by use of a start cam 105 also carried in fixed relation on shaft 53, and presenting a starter surface 106 which can be engaged by a shaft or pin 108 which is depressed in the direction indicated by the arrow, either manually or through some convenient mechanism, to engage surface 106 and advance the timer shaft 53 by an amount sufficient to close contacts 100 and initiate a new cycle of operation.

During such starting of the timer the ratchet wheel 40 is rotated in an advancing direction while the drive dog 72 and holding dog 83 remain stationary, the respective biasing forces on these dogs being resilient as previously described, and permitting such advancement of the timer parts relative to their driving mechanism. However, if driving dog 72 is seated against shoulder 81, and "locked" into the ratchet wheel, it has been discovered that the force necessary to rotate shaft 53 for starting purposes is substantially increased over the force necessary for such purpose if the drive dog is maintained out of contact with the shoulder at this time. Accordingly, the cams 95 and 105 are so arranged on shaft 53 that when the end of a cycle is reached, and the contacts 100 part, that roller 25 which is then contacting the arm 60 has just completed its traverse of the cam control portion 92, and rests upon the initial part of the exit ramp portion 93. This condition is shown in FIG. 1. In such a position, the driving dog 72 is maintained slightly away from the shoulder 81

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on the lock-in pawl, and starting rotation of ratchet 40 requires the lesser force previously mentioned.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that this invention is not limited to this precise form of apparatus and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. A ratchet drive particularly adapted for positive advancing of a timer mechanism, comprising a toothed ratchet wheel including an output drive thereon for intermittent rotary driving, means engaged with said wheel and normally preventing rotation of said wheel in one direction, a driving dog engageable with the teeth on said wheel and movable to rotate said wheel in the other direction through a predetermined angular motion, a drive cam arm connected to said driving dog, means mounting said arm for motion in a predetermined path with respect to said wheel to move said driving dog along the teeth on said wheel, a rotatable driving wheel and a plurality of drive rollers mounted thereon for independent free rotation while moving concurrently with said driving wheel to engage said arm and cause oscillating motion thereof, said arm having a cam surface engageable with said rollers and contoured to be continuously in contact with said rollers in succession during rising and descending motion of said arm relative to said driving wheel producing driving motion of said driving dog with controlled acceleration and deceleration, means connected to rotate said driving wheel, and means maintaining contact between said cam surface and said rollers during relative movement therebetween.

2. Mechanism for producing intermittent rotary motion of predetermined increments, comprising a rotatable drive means, a drive wheel rotated by said drive means, at least one drive roller mounted on said wheel at a predetermined distance from the axis of rotation of said wheel, said roller being freely rotatable on said wheel, a drive cam arm pivotally mounted to extend in a plane intersecting the axis of said wheel and including a cam surface thereon engageable with said roller, said cam surface including an entrance ramp portion, a control ramp portion, and an exit ramp portion which are engaged in that succession with said roller during a single rotation of said wheel, means biasing said arm toward said wheel to maintain contact between said cam surface and said roller during passage of said roller across said cam surface portions, a ratchet wheel having an output drive thereon adapted for intermittent rotary driving, means normally preventing rotation of said wheel in one direction, and a driving dog carried by said arm and engageable with said ratchet wheel to rotate said ratchet wheel in the other direction through a predetermined angular motion related to the movement of said arm by interaction of said roller and said cam surface.

3. Mechanism for converting continuous rotary action into intermittent rotary motion of predetermined increments, comprising a continuously rotatable drive means, a drive wheel rotated by said drive means, a plurality of drive rollers mounted on said wheel at a common distance from the axis of rotation of said wheel, each of said rollers being freely rotatable on said wheel, a drive cam arm pivotally mounted to extend in a plane intersecting the axis of said wheel and including a cam surface thereon engageable with said rollers, said cam surface including an entrance ramp portion, a control ramp portion, and an exit ramp portion which are engaged in that succession with each of said rollers during a single rotation of said wheel, means biasing said arm toward said wheel to maintain contact between said cam surface and said rollers continuously during passage of said rollers across said cam surface portions, a ratchet wheel having an output drive thereon adapted for intermittent rotary driving, means normally preventing rotation of said wheel in one direction, a driving dog carried by said arm and

engageable with said ratchet wheel to rotate said ratchet wheel in the other direction by interaction of successive ones of said rollers and said cam surface, and a terminal control cam driven by said ratchet wheel and controlling said drive means, said terminal cam being related to said arm cam surface such that it stops said drive means with the active roller passing onto said exit ramp portion.

4. A drive for a timer mechanism as defined in claim 1 wherein said means mounting said arm includes a pivotal mounting for said arm providing for swinging movement thereof toward and away from the path of said rollers.

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