This invention relates to controls for a sequence of apparatus operations and, more particularly, to timing mechanisms such as are used in connection with automatic domestic washing machines. It is an object of our invention to provide an improved timing mechanism for conducting a selected one of a plurality of sequences of operations including provision for selecting the desired sequence. Another object is to provide an improved timing mechanism including an improved drive for a switch-operating cam shaft rotatable in accordance with a selected one of a plurality of sequences of operations.

A further object is to provide an improved timing mechanism including provision for releasably locking a sequence selector at a position corresponding to a selected sequence of operations.

While the invention is particularly useful when applied to the control of a domestic washing machine, it is to be understood that this is only one application for it and that the invention may be used wherever found applicable. A particularly difficult requirement, however, is imposed upon the controls of such washing machines and the capabilities of our invention are well illustrated when applied to this particular usage. Many types of fabrics, such as found in delicate lingerie, in more durable synthetics, in woolen blankets, or in an average family wash are required to be processed in the same machine, even though the most efficient processing of each of these fabrics requires different times of treatment, different water temperatures, and different speeds for agitation and spinning. Thus, a plurality of sequences of operation, each of which is most suitable for a particular kind of wash, is required.

In carrying out our invention, we satisfy this requirement by providing a timing mechanism for conducting a selected one of a plurality of sequences of apparatus operations where a main shaft, driven by a timing motor is provided with a plurality of interrupted gears. Each gear has the interruptions thereof arranged to provide a particular sequence of operations. A cam shaft is provided having suitable cam means for controlling switches in the circuits of the apparatus to be operated and also is provided with a full gear. The full gear and the interrupted gears are linearly movable relative to each other in the sense that they can be moved toward and away from each other as well as having their normal rotational relationship. This permits the full gear to be selectively engageable with any one of the interrupted gears, so that the desired sequence of operations can be chosen.

The novel features, which we believe to be characteristic of our invention, are set forth with particularity in the appended claims. Our invention, itself, however, both as to its organization and method of operation, may be best understood by reference to the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a plan view of the timing mechanisms with the cover removed.

Fig. 2 is a side elevation view of the mechanism shown in Fig. 1, with portions shown in section.

Fig. 3 is a sectional view taken along line 3—3 of Fig. 1, and

Fig. 4 is a side elevation view of the selector locking assembly in relation to the framework and selector support.

Referring now to the drawings, we have shown there-in a timing mechanism or controller embodying the invention in one form thereof for use with a domestic clothes washing machine. The mechanism is preferably mounted upon a framework having a bottom portion 1 and an upper portion 2 and, the entire mechanism being compactly arranged and suitable for mounting upon the washing machine at a convenient accessible location, as on the back splash panel. At one end a suitable pedestal 4 rigidly affixed to end plate 2 and supporting a timing motor 5, as for example, a low speed synchronous clock motor adapted to run in only one direction. This motor drives a gear train indicated generally at 6 and terminating in a main shaft driving gear 7 mounted in a bushing 8 loosely surrounding main shaft 9 and rotatably mounted in end wall 10. The main shaft is rotatably mounted in bushing 8 and in a second bushing 10 in end wall 3 and at one end terminates in a collar 11 and at the other end in a reset dial 12 keyed to the shaft by a pin 13. Interposed between collar 11 and drive gear 7 is a suitable clutch such as a spring clutch 14 permitting shaft 9 to be rotated freely in a first direction by dial 12, but engaging collar 11 and gear 7 as torsion is applied to the spring by rotation of gear 7 and thus driving shaft 9 in a second direction while motor 5 is energized. As shaft 9 rotates in its clutch-engaged relation, the dial 12 in turn is slowly rotated during the complete sequence of operation of the washing machine, one complete revolution of the shaft 9 being accomplished for example in about 36 minutes and corresponding to a complete washing cycle. When it is desired to provide more time for any particular stage of a sequence of operation and represented by non-driving engagement of the interrupted and full gears, it is merely to be described, the operator may, by turning dial 12 in the first direction, thus reset shaft 9 and cause the complete cycle to be extended in time.

Upstanding from bottom portion 3 of the framework at one side thereof is a bracket 15, and rigidly mounted in this bracket and in end wall 3 is a rod 16 serving as a pivot for a rocking U-shaped selector support 17 having a linear upper edge 18 located on an opposite side of shaft 9 from the pivot rod 16. As shown in Fig. 3, the selector support has recessed portions on each side to accommodate shaft 9, one such recess having an irregular cam surface 20 adapted to match a corresponding recessed surface on cam 21 which is rigidly attached to shaft 9 at a location for lifting engagement with selector support 17. As will later appear, when shaft 9 is positioned with these cam surfaces in engagement, the U-shaped selector support occupies the reset position for the timing mechanism and the selector support rests in the solid line position of Fig. 3 and the selector may be readily moved to the next selected sequence of operations.

Rigidly mounted upon shaft 9 within the confines of the U-shaped selector support is a plurality of intermit-
tently toothed gears 22, 23, 24 and 25 spaced longitudinally of the shaft and herein called "interrupted gears." These gears serve as a means for advancing a cam shaft carrying order cams, later to be described, and which determine the order in which the machine operations are conducted. Each interrupted gear accordingly has its teeth arranged differently and corresponds to a particular sequence of operations among which a selection may be manually made by the operator of the washing machine. It will be understood that each gear represents a sequence of operations which is most suitable for the washing of the order typed wash load, as, for example, one particular type of fabric. At one plane parallel to the axis of main shaft 9 each of gears 22, 23, 24 and 25 is devoid of teeth along a common line of their peripheral surfaces, which line represents a position at which a selector member may be freely moved across the peripheries of these gears and longitudinally of shaft 9. This position is suitably indicated on the surface of reset dial 12 and serves as a reference point for the operator.

Positioned in a plane above shaft 9 parallel thereto and suitably journaled for rotation in walls 2 and 3 of the framework is a cam shaft 26 carried to a plurality of cylindrical cams here shown as six and as indicated at 27, 28, 29, 30, 31 and 32. A U-shaped bracket 33, mounted on end wall 2 and upon bottom portion 1 of the framework, and having an insulating cross bar 34 through which insulating plungers (not shown) project into the path of the cams, supports a plurality of switches connected in the conventional manner to control the electric circuits of the washing machine. As the cam shaft is rotated, the cams actuate the switches in the usual appropriate manner. These switches may have their connecting leads to the electric circuits embedded in insulating blocks, shown at 35, 36, 37 and 38 with suitable conductor bars projecting therefrom, all to form a compact assembly. Slightly mounted upon cam shaft 26 for longitudinal movement therealong is a hollow tube 40 having an aperture therein defined by spaced walls 41 and 42 and between which is a full gear 43 keyed to the cam shaft, but elidable with the hollow tube. It will be readily seen that through this arrangement gear 43 is movable relative to gears 22, 23, 24, and 25. Rigidly affixed to this tube and projecting laterally therefrom is a selector member having a handle 44 projecting over the top edge of the selector support 17 and a locking arm 45 having a notch 46 in an extreme end thereof projecting over the fixed rod 18. The length and weight of the handle 44 preferably is such as to retain the handle normally in contact with the linear edge 18 of the U-shaped selector support 17, as seen in Fig. 3.

Outlet of end wall 3, the cam shaft 26 is provided with a gear 47 meshing with gear 48 attached to the inner disc 49 rotatably journaled upon the end of main shaft 9 and freely rotatable within the reset dial 12. Preferably, the reset dial is formed of a transparent material and the disc 49 bears indicia on its periphery related to the extent of rotation of cam shaft 26 from a starting point, and hence the stages of operation accomplished by the washing machine at a given time.

Inboard of end wall 2, a spring actuated detent 50 engageable with registering slots in a hub 51 projecting from cam 27 serves to prevent improper adjustment of the cam shaft through backlash in gears 47, 48.

Beneath the floor portion 1 of the framework adjacent the U-shaped bracket 33 is a support for a microswitch 52 which conveniently may serve as the conventional master switch for the washing machine circuits, such switch, when operated, in one direction, establishing the beginning of a sequence of operations and when operated in a second direction terminating the sequence of operations. In addition, we provide two separate microswitches 53 and 54 beneath the floor and forming part of the conventional washing machine circuits which determine the speed at which the agitator and spin basket are driven, and the temperature of the water used. As an example, the switch 53 when inoperative may be included in a circuit permitting normal speed of the agitator and spin basket, as in a sequence during the washing cycle of delicate lingerie, and the switch 54 when inoperative may be included in a side circuit permitting a slow speed of the agitator and spin basket, as in a sequence during the washing of delicate lingerie. Likewise, the switch 54 when inoperative, may be included in a side circuit permitting water at a modified temperature to be used, but when operative may be included in a circuit permitting water at normal temperature to be used.

A master switch locking plate 55 is journaled for rocking movement at its ends upon rod 16 and normally rests in a position out of contact with selector locking arm 45. At its extreme upper edge, the locking plate has an inwardly extending shoulder 56 having a length at least equal to the displacement of gear 43 along gear 43 and adapted for engagement with the notch 46 in the selector locking arm. At its lower edge, the locking plate has an extension 57 projecting into operative position with respect to the contacts of master switch 52 and adapted to actuate that switch when the plate is rocked into locking position by engagement of the selector locking arm therewith.

Also mounted for rocking movement upon rod 16 is a U-shaped guide plate 60 having a plurality of slots 61, 62, 63 and 64 for reception of locking arm 45 and corresponding to the spacing of the several interrupted gears. Each slot has an inclined cutaway edge at its upper corners, as best seen in Fig. 4, serving to guide the locking arm and thus to center the full gear 43 encompassed by the selector in a proper plane for engagement with the selected interrupted gear. At its lower edge, the guide plate has an extension 65 projecting into operative position with respect to the contacts of switch 54 and adapted to actuate that switch when the guide plate is rocked inwardly toward the main shaft by engagement of the locking arm with the bottom of slots 62, 63, and 64. Slot 61, however, is of greater length and serves only to guide the locking arm and when the arm is in that slot it does not contact the bottom of the slot and thus plate 60 is not rocked inwardly and switch 54 is not actuated. Such a condition corresponds, for example, to a sequence of operations represented by gear 25 and in which the agitating and wash steps of the machine are to be at a slow speed and a modified water temperature is to be employed. The handle 44 preferably may represent a sequence of operations corresponding to gear 24 and in which the agitating and wash steps are to be at a slow speed and a normal water temperature is to be employed. Slots 63 and 64 may represent two sequences of operations corresponding respectively to gears 23 and 22 in which the agitating and wash steps may be at normal speeds but with different cam shaft and with normal water temperature being employed in each cycle.

These different operating conditions, selected by our timing mechanism are made possible while retaining the compact nature of the mechanism and by employing an intermediate U-shaped plate 66 having a stepped upper edge 67—68, the edge 67 lying beneath slots 61, 62 and the edge 68 lying beneath slots 63, 64. Plate 66 likewise is rockably pivoted upon rod 16 and its upper edge 68 is engageable by locking arm 45, whereas its upper edge 67 is engageable by the gear 43. The position of plate 66 is such that as the arm 45 engages in its movement toward locking position upon shoulder 56 of locking plate 55, plate 66 rocks inwardly toward shaft 9 at the same time that guide plate 60 rocks inwardly through its contact with the same locking arm 45. Intermediate plate 66 also carries an extension 70 projecting into operative position with respect to the contacts of switch 53 and adapted to actuate that switch as the inter-
mediate plate is rocked inwardly. Each of plates 55, 66 and 60 are closely nested within the selector support 57 as best seen in Fig. 4 and are biased into a position away from the main shaft 9, as by means of resilient springs (not shown), so that their movement to switch actuating position is dependent upon the lowering of selector locking arm 45.

With the foregoing description in mind, the operation of our improved timing mechanism is as follows: with the machine at rest, and in starting position, as indicated by dial 12 and disc 49, the cam 21 on main shaft 9 permits the selector support 17 to be in its lowered position and the locking arm 45 to be raised as seen in Fig. 9. At this time, the interrupted gears 22, 23, 24 and 25 are so positioned that along a common line there are no teeth present to interfere with movement of gear 43 lengthwise of cam shaft 26. Depending upon the particular wash load to be processed, the operator then moves handle 44 to a selected position and pivots the same about shaft 26, engaging notch 46 in shoulder 56 of the locking plate. As this occurs, plate 55 rocks inwardly, actuates switch 52 and starts timing motor 5. In case the locking arm is engaged in either of slots 63 and 64 at this time, guide plate 60 and Intermediate plate 66 are also actuated and switching 53 and 54 are also actuated, without actuation of plate 66 and switch 53, but if in slot 61, neither the guide plate nor plate 66 are actuated and hence neither switch 53 nor switch 54 are actuated.

As shaft 9 begins to turn, selector support 17 is raised, locking arm 44 against linear edge 18 of that support and the cycle of operation of the machine then continues, through its entire selected sequence. As main shaft 9 rotates, the interrupted gear which is in mesh with full gear 43 turns that gear, cam shaft 26, dial 49, and the array of cams 27, 28, 29, 30, 31 and 32 simultaneously, and through actuation of the array of switches by those cams, thus operates the washing machine in its selected sequence of operations and with such modification as to wash and spin speeds and as to water temperature as dictated by switches 53 and 54. At the completion of the cycle, cam 21 on shaft again reaches its starting position, with which selector support 17 drops. This permits arm 45 to be moved out of the selected ones of slots 61-64 and out of engagement with locking plate 55. Thus, if the next sequence of operations is to be performed on a different type of wash load, the operator then shifts the selector to a new position, and the new type of load and proceeds as above described. Of course, if at any time during the cycle the operator should desire to stop all operations, it is only necessary to move handle 44 down manually. Support 17 is far enough below this handle so that arm 45 can be moved out of engagement with plate 55 which then operates switch 52. MSRM 45 does not move out of the selected slot and thus proper operation is resumed by moving handle 44 to cause arm 45 to engage plate 55 to again trip switch 52.

In accordance with the patent statutes, we have described what is present is considered to be the preferred embodiment of our invention, but it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the true spirit and scope of the invention and we, therefore, aim to cover in the appended claims, all such equivalent variations and modifications.

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

1. In a timing mechanism for conducting a selected and plurality of sequences of apparatus operations, the combination comprising a framework, a rotatable main shaft mounted on said framework, a timing motor for driving said main shaft, a plurality of interrupted gears of the same diameter positioned on said main shaft, each gear corresponding to a different sequence of operations, a cam shaft mounted on said framework parallel to said main shaft and having cam means for controlling switches in the circuits of the apparatus to be operated, a full gear on said cam shaft axially movable relative to the interrupted gears, and means for moving said full gear into selective engagement with any one of said interrupted gears.

2. In a timing mechanism for conducting a selected one of a plurality of sequences of apparatus operations, the combination comprising a framework, a rotatable main shaft mounted on said framework, a timing motor for driving said main shaft, a master switch for said motor, a plurality of interrupted gears of the same diameter positioned on said main shaft, each gear corresponding to a different sequence of operations, a cam shaft mounted upon said framework parallel to said main shaft and having cam means, an array of switches controlling circuits of the apparatus to be operated and mounted upon said framework for actuation by said cam means, as said cam shaft rotates, a full gear key to said cam shaft and selectively shiftable therealong, selector means for positioning said full gear for engagement by a selected interrupted gear, a movable locking plate mounted upon said framework for engagement by said selector means thereby to hold said full gear in a selected position on said cam shaft, and a master switch actuating means connected to said locking plate for actuating said master switch as said plate moves to locking position.

3. In a timing mechanism for conducting a selected one of a plurality of sequences of apparatus operations, the combination comprising a framework, a rotatable main shaft mounted on said framework, a timing motor for driving said main shaft, a master switch for said motor, a plurality of interrupted gears of the same diameter positioned on said main shaft, each gear corresponding to a different sequence of operations, a cam shaft mounted upon said framework parallel to said main shaft and having cam means for controlling switches in the circuits of the apparatus to be operated, a full gear key to said cam shaft and selectively shiftable therealong, selector means for positioning said full gear for engagement by a selected interrupted gear, a movable locking plate mounted upon said framework for engagement by said selector means thereby to hold said full gear in a selected position on said cam shaft, and a master switch actuating means connected to said locking plate for actuating said master switch as said plate moves to locking position.

4. In a timing mechanism for conducting a selected one of a plurality of sequences of apparatus operations, the combination comprising a framework, a rotatable main shaft mounted on said framework, a timing motor for driving said main shaft, a master switch for said motor, a plurality of interrupted gears on said main shaft, each gear corresponding to a different sequence of operations, a cam shaft mounted upon said framework and having cam means for controlling switches in the circuits of the apparatus to be operated, a full gear key to said cam shaft and selectively shiftable therealong, selector means for positioning said full gear for engagement by a selected interrupted gear, a movable guide plate engageable by said selector means for guiding said full gear into said selected position, a switch actuating means connected to said guide plate for actuating a switch in a circuit of said apparatus upon locked engagement of said guide plate and selector upon locked engagement of said guide plate and selector
means, a movable locking plate for engagement by said selector and a master switch actuating means connected to said locking plate for actuating said master switch as said locking plate moves to locking position, each of said plates being mounted upon said framework.

5. In a timing mechanism for conducting a selected one of a plurality of sequences of apparatus operations, the combination comprising a framework, a rotatable main shaft mounted on said framework, a gear train, a timing motor for driving said gear train, a clutch for engaging said main shaft and gear train, a dial attached to said main shaft for resetting said main shaft with respect to said gear train, a plurality of interrupted gears on said main shaft, each gear corresponding to a different sequence of operations, a cam shaft mounted on said framework and having cam means for controlling switches in the circuits of the apparatus to be operated, a full gear keyed to said cam shaft and selectively shiftable therealong, selector means for positioning said full gear for engagement by a selected interrupted gear, means for locking said selector means thereby to hold said full gear in a selected position on said cam shaft, a rotatable disc mounted adjacent said dial for indicating the stage of operation accomplished at a given time, and means attached to said cam shaft for driving engagement with said disc thereby to relate the position of said disc to the angular position of said cam shaft at said given time.

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