Aug. 20, 1957 L. W. GUTH 2,803,715

TIME SWITCH APPARATUS

Filed Feb. 3, 1956

FIG. 4

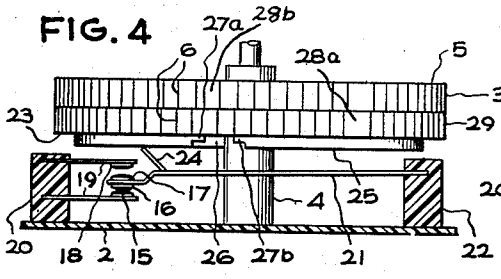


FIG. 2

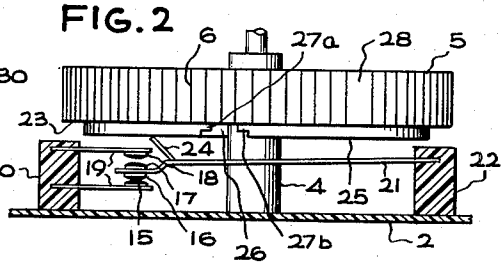


FIG. 3

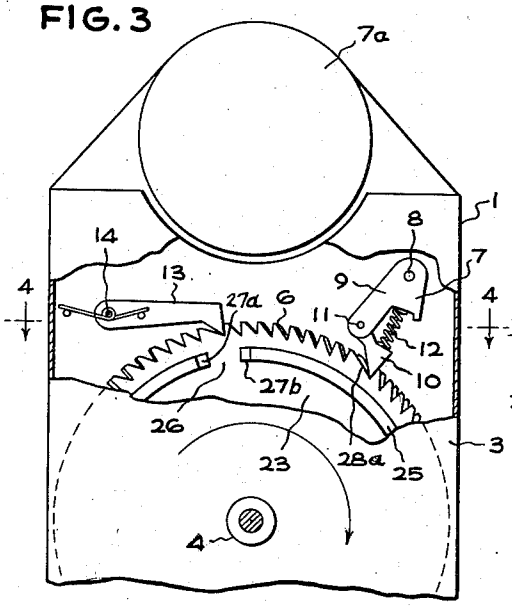
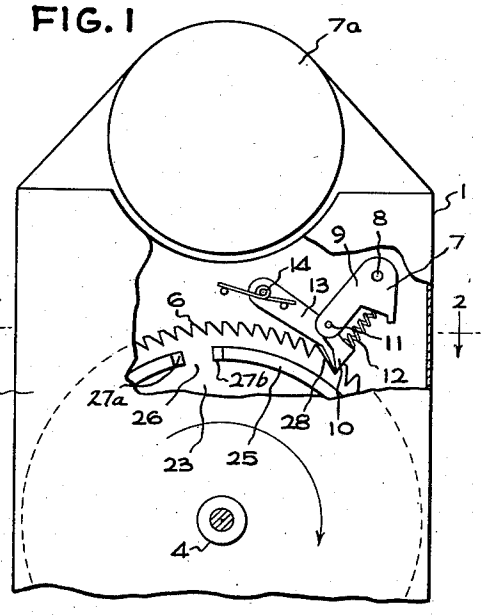


FIG. 1



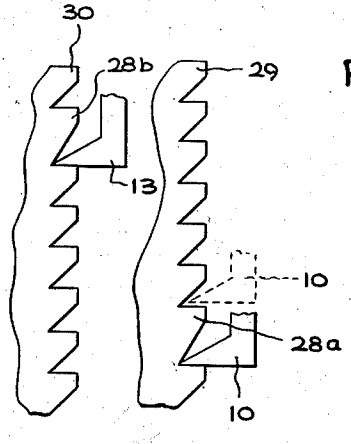


FIG. 5

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TIME SWITCH APPARATUS

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5 Claims. (Cl. 200—38)

The present invention relates to time switch apparatus and more particularly to such apparatus arranged to provide actuation of contacts for opening and closing electrical circuits in a predetermined sequence.

A principal object of my invention is to provide an improved timer mechanism for controlling the actuation of electrical switches.

More specifically, it is an object of my invention to provide a ratchet-type timer indexing mechanism for making and breaking contacts and which assures the breaking of one circuit before the making of a second circuit.

Another object of my invention is to provide an improved timer indexing mechanism which will assure the requisite contact opening and closing accuracy and still provide an optimum time cycle for the various operations of the mechanism controlled thereby.

Further objects and advantages of my invention will become apparent as the following description proceeds, and the features of novelty which characterize my invention will be pointed out with particularly in the claims annexed to and forming a part of this specification.

In one form of my invention, the foregoing objectives are achieved by providing a pawl driven ratchet wheel associated with switch actuating mechanism and switch contacts in such a way that the contacts are periodically and sequentially opened and closed upon predetermined rotary movement of the ratchet wheel, and by further providing teeth on the ratchet wheel which are evenly spaced and of equal angular extent with the exception of those which are engaged by the driving pawl during a switching operation, the latter being of relatively greater angular extent so that the step-by-step movement of the ratchet wheel proceeds in relatively short increments until an actual switching operation takes place, during which the ratchet wheel is rotated through a relatively larger angle, whereby the total time required for a complete revolution of the ratchet wheel may be maximized while providing sufficient angular movement for effecting contact operation, or even rapid sequential operation of two or more pairs of contacts.

For a better understanding of my invention, reference may be had to the accompanying drawing in which:

Fig. 1 is a plan view with some parts broken away, of a timing device embodying my invention.

Fig. 2 is a fragmentary cross-sectional view taken substantially along the line 2—2 in Fig. 1.

Fig. 3 is similar to Fig. 1 but shows another embodiment of my invention.

Fig. 4 is a fragmentary cross-sectional view taken substantially along the line 4—4 in Fig. 3.

Fig. 5 is a schematic layout of the ratchet in the embodiment of Fig. 3.

Referring now to Figs. 1 and 2 of the drawing, I have shown a timing device enclosed in a suitable housing 1, having walls 2 and 3 which provide bearing support for a shaft 4 which is rotatably mounted between the walls. Secured to the shaft 4 for rotation therewith, is a ratchet

wheel or disc 5 which has a series of ratchet teeth 6 around its periphery.

For the purpose of rotating the ratchet wheel 5 and shaft 4 intermittently step-by-step, I provide a drive pawl assembly 7 which engages the ratchet teeth 6. The drive pawl assembly 7 includes a shaft 8 to which a reciprocating motion is applied by means of any suitable actuating mechanism, including a constant speed electric motor 7*a*, for example. A lever 9 keyed to the shaft 8 transmits reciprocating motion to a spring-loaded feed member 10 which engages the individual ratchet teeth 6 on the periphery of the ratchet wheel 5. The feed member 10 is pivotally joined to the end of lever 9 through pin 11 and biased toward the ratchet teeth 6 by compression spring 12.

In order to prevent the ratchet wheel from reversing on the return stroke of the drive pawl assembly, I provide a stop pawl 13 which, during the feed stroke of the drive pawl assembly 7, is dragged over the back of the tooth engaged by the feed member 10 and which springs into engagement with the face of the tooth at the end of the feed stroke of the drive pawl assembly 7, thereby locking the ratchet disc against reverse motion upon the return stroke of the drive pawl assembly. The stop pawl is spring-loaded and pivoted about pin 14 supported between walls 2 and 3.

Now referring to Fig. 2, according to one embodiment of my invention, I have provided a switch mechanism consisting of two pairs of electrical contacts, 15, 16 and 17, 18, which are in engageable relationship and which are electrically connected to separate circuits such that closing of one pair of contacts will energize one circuit and closing of the other pair will energize another circuit. The outer contacts 15 and 18 are mounted upon suitable conductors 19 attached rigidly to an insulated support 20 mounted upon side 3. The inner contacts 16 and 17 are mounted on opposite sides of a cantilever conductor arm 21 supported by an insulator support 22 extending from side 3. The cantilever conductor arm is biased or spring-loaded toward the face 23 of the ratchet wheel 5.

A follower projection 24 extending from the cantilever conductor arm 21 engages a cam, comprising a plurality of arcuate cam elements 25 forming a circular path, and located upon the face 23 of the ratchet wheel 5. I provide spaced depressed portions 26 between the cam elements 25, and intermediate dwell portions 27*a* and 27*b* located at the ends of the cam elements 25. Thus, the follower projection 24 riding on depressed portion 26, must rise on to dwell portion 27*b* before again rising on to the main cam element 25. This causes the cantilever conductor arm 21 to travel from a position in which contacts 15 and 16 are closed, to an intermediate position opening contacts 15 and 16, and then to a position where contacts 17 and 18 are closed, the intermediate dwell assuring that there will be a complete break between contacts 15 and 16 before contact is made between contacts 17 and 18.

Those familiar with the art will realize that in order to obtain the greatest latitude of design in regard to the numbers of possible switching operations required, and the total time transpiring between the operations, it is necessary to have a large number of teeth around the periphery of the ratchet wheel. To do this, it is necessary to employ teeth of small angular extent, which also results in a short angular throw of the ratchet wheel 5 for each pulsation or stroke of the feed assembly 7. But it is also necessary to have the individual switching operations entirely completed during the throw of one individual ratchet tooth. Furtermore, it is sometimes necessary to provide rapid sequential switching of two separate pairs of contacts during a single increment of movement of the ratchet. This requires very accurate manufactur-

ing and location of the cam elements in order to obtain all the necessary camming actions within the stroke provided through action of the drive pawl assembly **7** upon one of the relatively small ratchet teeth **6**. To come within reasonable manufacturing tolerances and capabilities, it has been necessary to compromise and use a somewhat larger tooth size than might otherwise be desirable, thus reducing the over-all time cycle.

In accordance with the present invention, I provide a tooth or several teeth **28** of greater angular extent or length positioned at predetermined locations around the periphery of the wheel so that switch actuation takes place during movement resulting from engagement of the drive pawl with a relatively large tooth. The cam elements **25** and depressed portions **26** are thus positioned in relation to large teeth **28** so that camming motion of the follower projection **24** takes place only during rotation of the ratchet wheel **5** through engagement of the feed pawl **10** with a tooth **28**. Teeth of various relative sizes may be utilized to achieve any desired switching program so long as the total angular extent of each pair of adjacent ratchet teeth is less than the angular throw of the drive pawl. This provides the requisite time cycle relationships through use of the relatively smaller teeth **6** and also provides greater angular distance, more within the capabilities of factory tolerances, in which to locate cam elements **24** in order to assure proper actuation of the various electrical contacts in their correct sequence.

For one particular ratchet wheel, it was determined that an 8° angular extent tooth was necessary to obtain proper operation of switching members and to allow manufacture within easily met factory tolerances. In this mechanism the feed pawl assembly **7** makes a stroke or throw of 9° at 45 second intervals. When using all ratchet teeth of the 8° angular extent the total over-all time for one complete cycle of the ratchet wheel is less than 34 minutes. But when using the 8° angular extent teeth only at those positions where the camming member is to actuate a switch or switches, and using 5° angular extent teeth during the remaining operation, it is possible to increase considerably the over-all time cycle. For example, where five switching operations take place per cycle, it is possible to obtain an over-all time cycle of more than 51 minutes.

In Figs. 3 and 4, I show an alternative embodiment of my invention which differs from that of Figs. 1 and 2 in that it utilizes a pair of identical ratchet wheels **29** and **30** instead of a single ratchet wheel **5**. Similar parts in this embodiment are represented by the same numerals as in the first embodiment. Here the reciprocating feed pawl assembly **7** and the stop pawl **13** are spaced from each other around the periphery of the ratchet wheels **29** and **30**. The ratchet wheels **29** and **30** are displaced a similar angular distance so that when the feeding member **10** engages a tooth on the periphery of ratchet wheel **29**, the stop pawl **13** engages a like tooth on the periphery of ratchet wheel **30**.

Fig. 5 is a layout showing the ratchet teeth of ratchet wheels **29** and **30** in developed form. This shows the relationship of the feed member **10** and the stop pawl **13** with respect to the ratchet teeth, including larger teeth **28*a*** and **28*b***, on the two ratchet wheels **29** and **30**. The feed stroke of the feed pawl assembly has just been completed, and the dotted lines portray the feed member **10** in the next stroke just prior to its engagement with a tooth of greater angular length.

From the above description, it will be seen that I am able to secure the advantage attained through use of relatively small teeth for those periods between the operation of the switches and yet still attain ease of manufacture through use of the relatively longer teeth of those positions in the time cycle where switching operations take place. This results in a greater over-all time period for one revolution of the ratchet wheel and allows a greater design latitude in determining the time

available for the various operations such as drying or washing. It gives a greater angular distance in which to locate the camming elements necessary to perform the switching operations and allows a greater possible margin of error in their location. This is especially suited for those situations in which two or more pairs of electrical contacts must be actuated in proper sequence during a single impulse or movement step of a ratchet, or where actuation of one pair must be completed prior to actuation of a second pair.

While I have shown and described two specific embodiments of my invention, other applications will readily occur to those skilled in the art and I intend, therefore, by the appended claims to cover all modifications within the true spirit and scope of my invention.

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

1. Time switch apparatus comprising a shaft, a disc rotatable with said shaft, said disc having ratchet teeth spaced circumferentially about the periphery thereof, at least one of said teeth being of greater angular extent than the remaining teeth, a feed member in engagement with said ratchet teeth for advancing said disc step-by-step in intermittent rotation; a switch mechanism, and cam means supported by said shaft for rotation therewith, said cam means being in operating engagement with said switch mechanism, said cam means being so positioned relative to said tooth of greater angular extent that actuations of said switch mechanism occur during rotation of said disc by engagement of said feed member with said tooth of greater angular extent.

2. Time switch apparatus comprising a shaft, a disc rotatable with said shaft, said disc having ratchet teeth spaced circumferentially about the periphery thereof, at least one of said teeth being of greater angular extent than the remaining teeth, a feed member in engagement with said ratchet teeth for advancing said disc step-by-step in intermittent rotation, at least one pair of electrical contacts, and cam means supported by said shaft and rotatable therewith, said cam means being in engageable relation with one of said electrical contacts for actuating said pair of electrical contacts, said camming means being so positioned relative to said tooth of greater angular extent that actuations of said electrical contacts occur during rotation of said disc by engagement of said feed member with said tooth of greater angular extent.

3. Time switch apparatus comprising a shaft, a disc rotatable with said shaft, said disc having ratchet teeth spaced circumferentially about the periphery thereof, at least one of said teeth being of greater angular extent than the remaining teeth, a feed member in engagement with said ratchet teeth for advancing said disc step-by-step in intermittent rotation; a switch including at least one pair of electrical contacts, and cam means including a plurality of arcuate cam elements disposed upon the face of said disc, said cam means being engageable with one of said electrical contacts for actuating said switch, said cam elements being so positioned upon the disc relative to said tooth of greater angular extent that actuations of said switch occur only during rotation of said disc by engagement of said tooth of greater angular extent.

4. Time switch apparatus comprising a shaft, first and second identical ratchet wheels rotatable with said shaft, said ratchet wheels having ratchet teeth spaced circumferentially about the periphery thereof, at least one tooth on each of said ratchet wheels being of greater angular extent than the remaining teeth, said ratchet wheels being displaced a predetermined angle from each other, a feed member engageable with the ratchet teeth of said first ratchet wheel for advancing said wheels and shaft step-by-step in intermittent rotation, a stop pawl engageable with said second ratchet wheel, said stop pawl being angularly spaced said predetermined angle from said feed member whereby said stop pawl engages a tooth on the periphery of said second ratchet wheel corresponding to

the tooth engaged by said feed member on said first ratchet wheel, a switch including at least one pair of electrical contacts, and a switch actuating cam engageable with said switch supported by said shaft for rotation therewith, said cam being so positioned relative to the tooth of greater angular extent on said first ratchet wheel that actuations of said switch occur only during rotation of said ratchet wheels by engagement of said feed member with said tooth of greater angular extent.

5. Time switch apparatus comprising a shaft, a disc rotatable with said shaft, said disc having ratchet teeth spaced circumferentially about the periphery thereof, at least one of said teeth being of greater angular extent than the remaining teeth, a feed member in engagement with said ratchet teeth for advancing said disc step-by-step in intermittent rotation, a stop pawl engageable with said ratchet teeth mounted adjacent said feed member, said feed member and said stop pawl being arranged to engage

successively and simultaneously each of said ratchet teeth, a first pair of contacts in engageable relation, a second pair of contacts in engageable relation, first cam means rotatable with said shaft and said disc, said first cam means being in engageable relation with said first pair of electrical contacts for periodically actuating said first pair of contacts, and second cam means rotatable with said shaft and said disc, said second cam means being in engageable relation with said second pair of electrical contacts for periodically actuating said second pair of contacts, said first and second cam means being so positioned in relation to said tooth of greater angular extent that actuation of said first pair of contacts and said second pair of contacts take place during rotation of said disc by engagement of said feed member with said tooth of greater angular extent.

No references cited.