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Underwood et al.

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[54] **DUAL-FUNCTION LINE SWITCH FOR A CAM-ACTUATED TIMER SWITCH**

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[52] **U.S. Cl.** ..... **200/33 R,** 200/38 R, 200/38 A, 200/38 B, 200/38 C, 200/153 L

[51] **Int. Cl.** **H01h 43/10**

[58] **Field of Search** .... 200/35 R, 37 R, 37 A, 38 R, 200/38 A, 38 B, 38 BA, 38 C, 38 CA, 39 R, 153 L, 153 LA, 153 LB, 33 R

[56] **References Cited**

UNITED STATES PATENTS

2,920,153	1/1960	Horstmann	200/153 L X
3,025,366	3/1962	Woolley	200/38 C
3,053,947	9/1962	Bowman et al.	200/38 C
3,060,288	10/1962	Gallagher et al.	200/38 C
3,417,211	12/1968	Wiser	200/38 R
3,581,028	5/1971	Valbona	200/38 R
3,582,582	6/1971	Pauker	200/38 B
3,737,595	6/1973	Simmons	200/38 R X

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[57] **ABSTRACT**

A cam-actuated timer switch includes a dual-function line switch responsive to axial movement of a cam shaft and also to rotation of an independent cam track. The dual-function line switch switches power from a power supply to the timer switch. Included in an embodiment of the invention are a ramping means to move the cam shaft axially at predetermined points during its rotation and a stop means to produce resistance to turning of the cam shaft at preselected points during its rotation.

7 Claims, 8 Drawing Figures

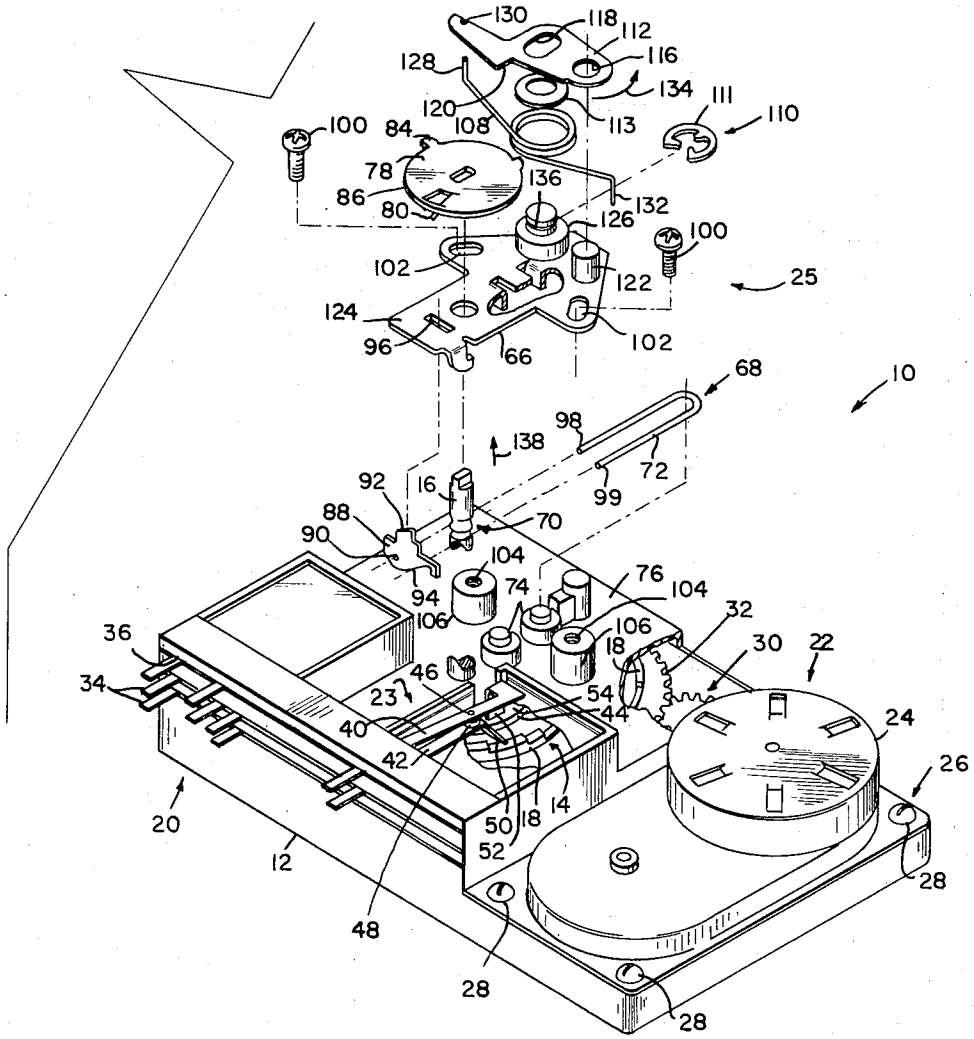
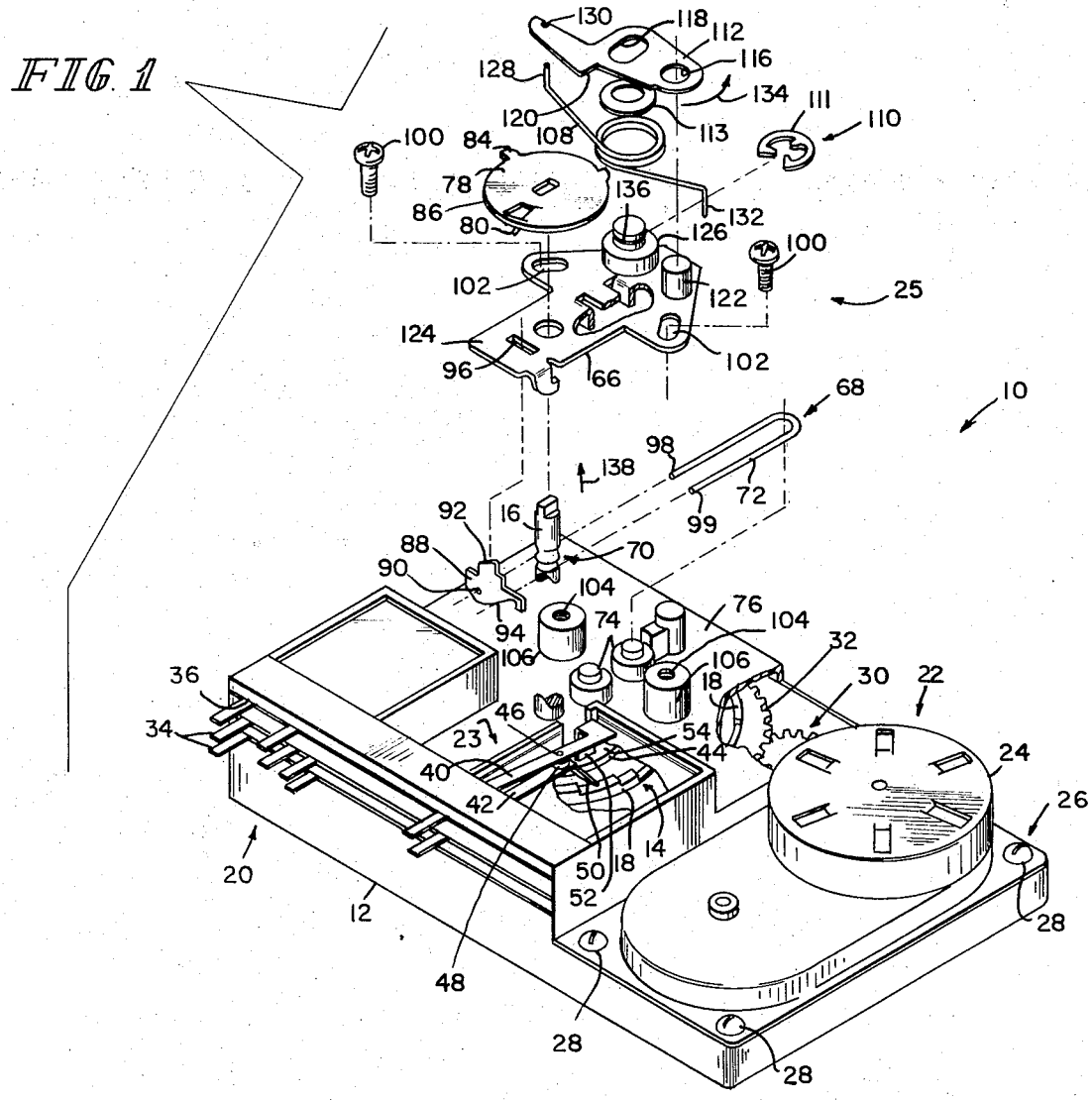


FIG. 1



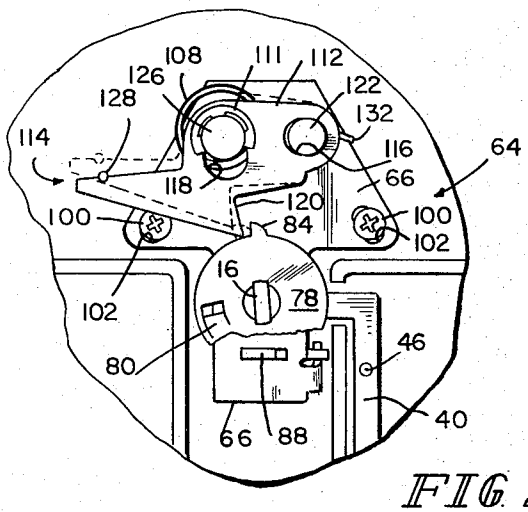


FIG. 2

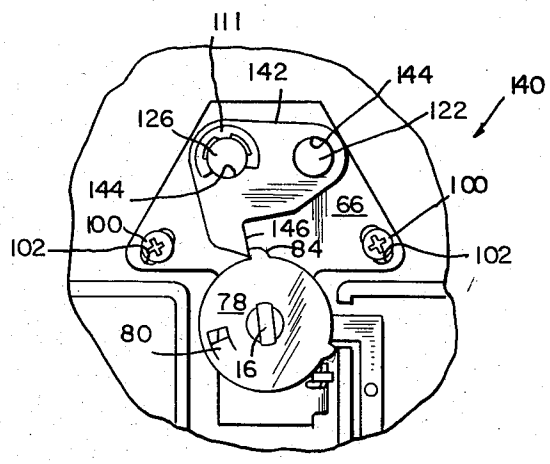


FIG. 3

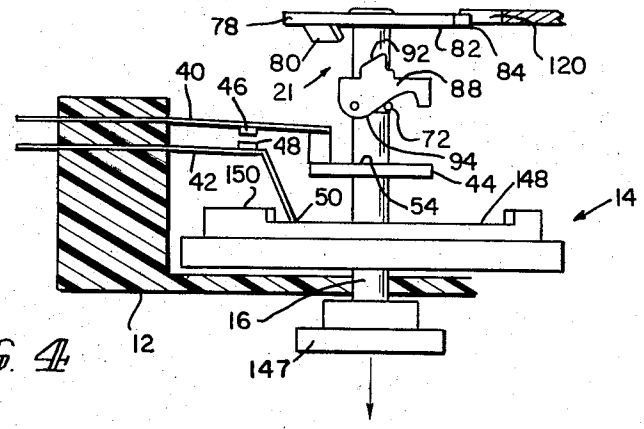


FIG. 4

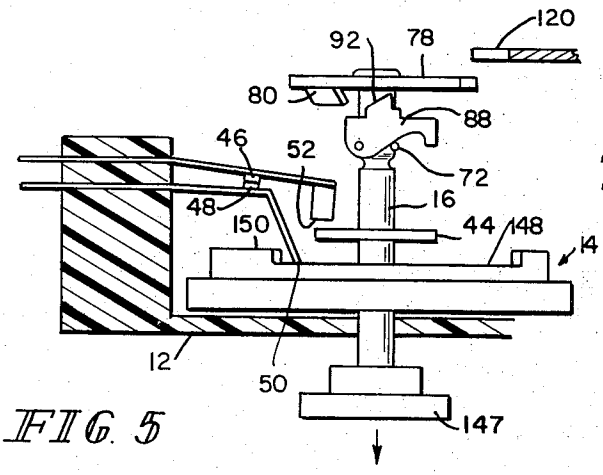


FIG. 5

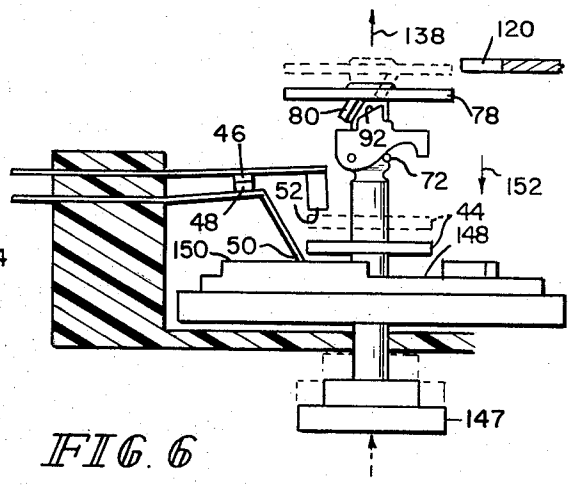


FIG. 6

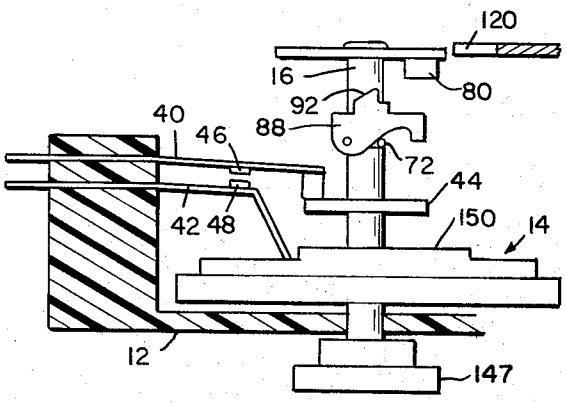


FIG. 7

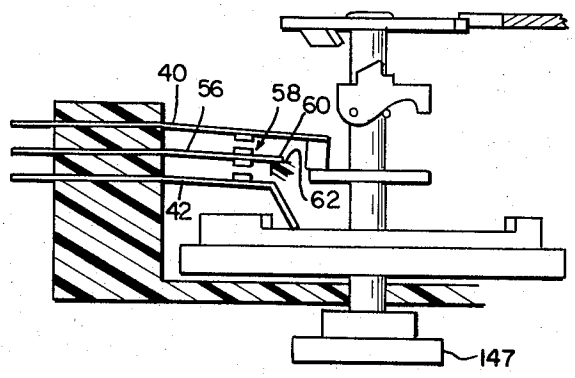


FIG. 8

DUAL-FUNCTION LINE SWITCH FOR A CAM-ACTUATED TIMER SWITCH

Generally speaking, the present invention relates to an improvement to a cam-actuated timer switch having a housing means, a cam means rotatably carried on a shaft within the housing means and having independent cam tracks, switch means responsive to the cam means, and a drive means carried by the housing means driving the cam means, wherein the improvement comprises a line switch means responsive to axial movement of the cam shaft and also to rotation of one of the independent cam tracks.

Line switches utilized for switching the main power to cam-actuated timer switches are well known in the art. A common form of a line switch in a cam-actuated timer switch includes a fixed blade having an electrical contact and a flexible blade also having an electrical contact. The flexible blade is responsive to "in" and "out" indexing of a cam stack, so that the contacts either make or break for one of the indexed positions. A specific example can be found on a clothes washing machine timer wherein the shaft is indexed "out" to make the contacts and provide the timer and machine with power.

In many cam-actuated timer switches, a line switch is actuated directly by the face of one of the cams in an indexable cam stack. In such timer switches, electrical switches are responsive to cam surfaces on the peripheries of each of the cams. It is desirous in some cases to include a bypass switching function in these timer switches to bypass the line switch during certain parts of the timer cycle. Heretofore, this was accomplished by using one cam and one of the electrical switches in combination with the line switch.

The present invention provides for an additional switching function, such as a bypass, to be also carried out by the line switch. This makes the line switch a dual-function switch. As utilized in a timer with a face cam having a plurality of concentric cam tracks disposed on a face and a cam shaft axially indexable independent of the cam, the line switch of the present invention is responsive not only to an indexing "in" and "out" of the cam shaft, but also to rotation of one of the concentric tracks. The result of this dual function of the line switch is the elimination of a relatively expensive set of switch blades and contacts.

The present invention may incorporate other features such as an additional line switch member and positive and overriding stops. The additional line switch member may comprise a double upper blade having electrical contacts and interposed between an actuator switch blade and an indexable switch blade of a line switch. The contact on the double upper blade engages contacts on the other two blades of the line switch. The result is an addition of a third electrical switching function to the line switch of the present invention.

Positive and overriding stops provide for easy and accurate manual setting of a cam-actuated timer switch. It is a well known problem in timer switches that time values are often difficult to set accurately because of the eye-hand coordination required to line up an indicator on a manually set shaft with a specific division on a corresponding scale. Stops provide a definite interference to a manual turning of the shaft at those precise points where timing cycles are to be set, such as the beginning of a wash cycle. All the operator of a timer has to do is rotate the shaft, even without looking at the scale, until resistance is felt, whereupon he knows the correct setting has been reached. In the case of a positive stop, the operator must index the shaft by pulling it out or pushing it in before turning past the stop if he so desires. In the case of an overriding stop, if the operator chooses to rotate the shaft beyond a stop, he merely applies additional turning torque to override the "bump" and continues to rotate the shaft. Embodiments of the present invention provide for positive and overriding stops in combination with the dual-function line switch to achieve heretofore unattained switching and setting combinations in a cam-actuated timer switch.

Accordingly, it is a feature of the present invention to provide an improvement to a cam-actuated timer switch wherein a line switch means is responsive to axially indexed translation of a cam shaft and also to rotation of a cam track of a cam means. Another feature of the present invention is to provide an improvement to a cam-actuated timer switch wherein a line switch means includes an axially indexable contact-carrying switch blade carried by a housing means and engaging an index disc carried by the cam shaft. Another feature of the present invention is to provide an improvement to a cam-actuated timer switch wherein a contact-carrying actuator switch blade carried by a housing means engages a contact-carrying indexable switch blade so that electrical connection is made through contacts in the blades. Still another feature of the present invention is to provide an improvement to a cam-actuated timer switch including a two-position index location means carried by a housing and engaging an axially indexable cam shaft to provide the cam shaft with two positions in spaced relation to the housing means. Yet another feature of the present invention is to provide an improvement to a cam-actuated timer switch including a stop means providing resistance to manually turning of a cam shaft to facilitate accurate setting of the cam shaft. Another feature of the present invention is to provide an improvement to a cam-actuated timer switch including a rigid stop member to positively stop manual rotation of a cam shaft at preselected points. Another feature of the present invention is to provide an improvement to a cam-actuated timer switch including an overriding stop function to provide torque resistance to manual rotation of a cam shaft at preselected points. Another feature of the present invention is to provide an improvement to a cam-actuated timer switch including a contact-carrying double-upper switch blade carried by a housing and electrically cooperative with a line switch means.

These and other features will become more apparent from the following description taken in conjunction with the accompanying drawings wherein:

FIG. **1** is an exploded pictorial view of a cam-actuated timer switch.

FIG. **2** is a top elevation view of an overriding stop version of a stop means.

FIG. **3** is a top elevation view of a positive stop version of a stop means.

FIGS. **4, 5, 6, 7** and **8** are partial diagrammatic sectional views of the cam-actuated timer switch showing different working positions of various components within the timer.

Referring now to FIG. **1**, a cam-actuated timer switch **10** basically comprises a housing **12**, a cam means **14**

rotatably carried on a cam shaft **16** and having independent cam tracks **18**, a switch means **20** responsive to cam means **14**, a drive means **22** carried by housing means **12** and driving cam means **14**, ramping means **21**, a line switch means **23**, and stop means **25**.

Drive means **22** comprises a permanent-magnet synchronous gear motor **24**. Motor **24** is suitably attached to housing means **12** by attachment means **26** which, in the illustrated embodiment, comprises screws **28** threaded into housing means **12**. Gear motor **24** is coupled to cam means **14** through a gear train **30** which engages a gear **32** carried on the outer periphery of cam means **14**. Switch means **20** comprises contact-carrying switch blades **34** affixed into slots **36** in housing means **12**. Blades **34** are responsive to cam tracks **18**.

Line switch means **23** switches power from a power supply (not shown) to motor **24** and includes an indexable switch blade **40**, an actuator switch blade **42**, and an index disc **44**. A first electrical contact **46**, staked to indexable switch blade **40**, engages a second electrical contact **48** which is staked to actuator switch blade **42**. A follower tip **50** disposed at a distal end of actuator switch blade **42** engages a cam track **18** of cam means **14**. An index tip **52** disposed at a distal end of indexable switch blade **40** engages a face **54** of index disc **44**. Blades **40** and **42** are rigidly held in housing means **12**. Another embodiment of line switch means **23** includes a double upper switch blade **56** shown in FIG. **8**. Staked to double upper switch blade **56** is a third electrical contact **58**. Third electrical contact **58** is in a position to interact electrically with first and second electrical contacts **46** and **48**. A tip **60** of double upper switch blade **56** engages stop ledge **62** on housing **12** to prevent it from following actuator switch blade **42** below a position predetermined by the distance between the stop ledge and cam means **14**.

Cam-actuated timer switch **10** includes a two-position index location means **68** to insure that cam shaft **16** resides in one of an "indexed-in" and an "indexed-out" position in relation to housing **12**. Means **68** comprises a pair of circumferential detent grooves **70** disposed on cam shaft **16** and a U-shaped index spring **72** carried by housing **12** and engaging the detent grooves. U-shaped index spring **72** is carried about and restrained by spring bosses **74** projecting from a top face **76** of housing **12**.

Ramping means **21** axially indexes cam shaft **16** as the cam shaft rotates. Ramping means **21** includes a ramp-stop disc **78** rigidly affixed to cam shaft **16** having at least one first ramped projection **80** extending from a bottom face **82** of ramp-stop **78** and at least one cam lobe **84** extending from an outer periphery **86** of ramp-stop disc **78**. Ramping means **21** further includes a spreader bar **88** having an aperture **90** passing therethrough, a second ramped projection **92**, and an arcuate surface **94**. Spreader bar **88** pilots in a spreader bar slot **96** in a frame member **66** and is pivotable about a distal end **98** of U-shaped index spring **72** which passes through aperture **90**. First ramped projection **80** extending from ramp-stop disc **78** cam, upon rotation of cam shaft **16**, engages second ramped projection **92** on spreader bar **88**. Additionally, arcuate surface **94** engages ends **98** and **99** of U-shaped spring **72**. Frame member **66** is secured to housing **12** by screws **100** passed through screw apertures **102** and threaded into holes **104** located in housing bosses **106** extending from rear face **76** of housing **12**.

Stop means **25** provides a definite interference to manual turning of cam shaft **16** at preset points in a timing cycle. Two embodiments of stop means **25** are shown in FIGS. **2** and **3**. FIG. **2** illustrates an overriding stop version **64** of stop means **25**, and FIG. **3** shows a positive stop version **140** of stop means **25**. Overriding stop version **64** includes an overriding stop member **112**, a ramp-stop disc **78**, a torsion spring **108**, and retention means **110**. Overriding stop member **112** includes a notched arm **114**, an overriding stop projection **120**, a first elongated aperture **116** and a second elongated aperture **118**. Stop member **112** is pivotal about a first post **122** which extends from a top surface **124** through first elongated aperture **116**. A second post **126** extending from top surface **124** of frame member **66** through second elongated aperture **118** limits the degree of pivoting of overriding stop member **112**. Torsion spring **108** is carried about second post **126** with a first distal end **128** disposed in a notch **130** in notched arm **114** and a second distal end **132** resting against first post **122** so as to produce a torque on overriding stop member **112** in a direction indicated by arrow **134**. This torque forces stop projection **120** on stop member **112** against outer periphery **86** and cam lobes **84** of ramp-stop disc **78**. Retention means **110**, comprising an E-ring **111** in the illustrated embodiment, fits in a groove **136** in second post **126** to retain overriding stop member **112** on the second post. A compression washer **113** is also added between member **112** and second post **126** to limit the wobble tendency of member **112**.

A positive stop version **140** of stop means **25** is illustrated in FIG. **3**. This version is similar to the overriding stop means version **64** except that overriding stop member **112** is replaced by a positive stop member **142** and torsion spring **108** is eliminated. Positive stop apertures **144** disposed in member **142** are smaller than first and second elongated apertures **116** and **118** in overriding stop member **112** so as to prevent a positive stop projection **146** on member **142** from overriding cam lobes **84** on ramp-stop disc **78**.

In the operation of cam-actuated timer switch **10**, motor **24** drives gear **32** through gear train **30** causing cam means **14** to rotate. Line switch means can be best described by referring to diagrammatical representations of switching within cam-actuated timer switch **10** as illustrated in FIGS. **4**, **5**, **6** and **7**. A manual setting kob **147** is shown connected to cam shaft **16**. An operator can grasp knob **147** in the arrangement of FIG. **4** and rotate cam shaft **16** to set timer switch **10**. Upon reaching the desired setting, the operator then pulls the knob and the cam shaft means to an "indexed-out" position as shown in FIG. **5**. Upon being indexed-out, index disc **44** moves out with cam shaft **16** and causes indexable switch blade **40** to return to a less-flexed position as shown in FIG. **5**. Thereupon, first and second electrical contacts **46** and **48** make contact and complete a circuit between a power source (not shown) and motor **24** causing timer switch **10** to start a timing cycle. At this point, follower tip **50** is resting on a neutral cam track **148** on cam means **14**. During the timing cycle, switching means **20** responds according to a preselected program on independent cam tracks **18**.

As the timing cycle progresses, and ramp-stop disc **78** rotates with cam means **14** and cam shaft **16**, first ramped projection **80** comes into engagement with second ramped projection **92**. In FIG. **6**, this engagement

is just about to occur as shown in solid lines and has just occurred as shown in dotted lines. As cam shaft **16** rotates, projection **80** and projection **92** engages and causes spreader bar **88** to ramp in the direction of arrow **152** and ramp-stop disc **78** to move in the direction of arrow **138.** As spreader bar **88** moves, arcuate surface **94** spreads the ends **98** and **99** of U-shaped spring **72** to relieve tension against concentric detent grooves **70** so that cam shaft **16** can move easier in the direction of arrow **138.** Follower tip **50** rests on a top cam track prior to and during the ramping action just described. Although cam shaft **16** is moved back into an "indexed-in" position, as shown by dotted lines in FIG. **6,** top cam track **150** prevents actuator switch blade **42** from dropping to open electrical contacts **46** and **48.** As the timing cycle progresses, follower tip **50** drops off top cam track **150** onto a neutral track **148,** whereupon contacts **46** and **48** reopen. This removes power from motor **24,** and timer switch **10** is at rest and ready to be manually set again as shown in FIG. **7.**

An additonal switching element in the form of double upper switch blade **56** is ilustrated in relation to actuator switch blade **50** and indexable switch blade **48** in FIG. **8.** Downward movement of blade **56** may be prevented by a tip **60** of blade **56** engaging a stop ledge **62** carried by housing **12.**

The overriding stop version **64** of stop means **25** provides a predetermined amount of torque resistance to manual turning of cam shaft **16.** As shaft **16** is turned a cam lobe **84** on ramp-stop disc **78** engages overriding stop projection **120** on overriding stop member **112.** To continue manual rotation of cam shaft **16,** the force exerted by torsion spring **108** against stop member **112** must be overcome. This force may be adjusted by preselecting the strength of spring **108.**

The positive stop version **140** of stop means **25** provides at least one predetermined positive stop to manual turning of cam shaft **16.** As shaft **16** is turned a cam lobe **84** on ramp-stop disc **78** engages positive stop projection **146** on positive stop member **142.** Cam shaft **16** must be indexed in to disengaged ramp-stop disc with positive stop member **142** before manual rotation of the cam shaft may be resumed.

What is claimed is:

1. In a cam-actuated timer switch having a housing, a cam means having a plurality of independent cam tracks, said cam means being rotatably carried on an axially-indexable cam shaft within said housing, a plurality of contact-carrying switch blades responsive to rotation of said cam means, and an electric motor, carried by said housing means, for driving said cam means, the improvement comprising:

a. a two-position index location means carried by said housing and engaging said cam shaft to provide said cam shaft with two axial index positions in spaced relation to said housing means;

b. ramping means, carried by said housing and coupled to said cam shaft, for moving said cam shaft axially from one of said index positions to the other of said index positions at predetermined angular positions during rotation of said cam shaft;

c. a stop means carried by said housing and coupled to said cam shaft for producing resistance to turning of said cam shaft at a preselected angular position; and

d. a line switch means for switching power to said electric motor in response to said axial movement of said cam shaft and to rotation of one of said independent cam tracks of said cam means.

2. The improvement to a cam-actuated timer switch as recited in claim **1** wherein said line switch means comprises:

a. an index disc connected to said cam shaft;

b. an indexable switch blade, including a first electrical contact, carried by said housing and engaging said index disc; and

c. an actuator switch blade carried by said housing means, including a second electrical contact and a follower tip, wherein said second electrical contact engages said first electrical contact and said follower tip engages one of said cam tracks.

3. The improvement to a cam-actuated timer switch as recited in claim **2** further including a double-upper switch blade carried by said housing and having a third electrical contact interacting electrically with said first and second electrical contacts.

4. The improvement to a cam-actuated timer switch as recited in claim **1** wherein said two-position index location means comprises a pair of circumferential detent grooves disposed on said cam shaft and a U-shaped index spring carried by said housing means and engaging said pair of circumferential detent grooves.

5. The improvement to a cam-actuated timer switch as recited in claim **1** wherein said ramping means includes:

a. a ramp-stop disc rigidly affixed to said cam shaft having at least one first ramped projection extending from a face of said ramp-stop disc and at least one cam lobe extending from an outer periphery of said ramp-stop disc; and

b. a spreader bar carried by said housing including a second ramped projection and an arcuate surface, said second ramped projection engaging said first ramped projection and said arcuate surface engaging said two-position index location means.

6. The improvement to a cam-actuated timer switch as recited in claim **1** wherein said stop means comprises a positive stop member rigidly connected to said housing and including a positive stop projection disengaging said cam lobe in one of said indexed positions of said cam shaft and engaging said cam lobe in the other position, whereby rotation of said cam shaft is prevented upon engagement of said cam lobe with said positive stop projection.

7. The improvement to a cam-actuated timer switch as recited in claim **1** wherein said stop means comprises:

a. an overriding stop member including an overriding stop projection extending therefrom and first and second elongated apertures disposed therein;

b. a first post extending from said housing means through said first elongated aperture about which said overriding stop member pivots;

c. a second post extending from said housing through said second elongated aperture to limit the degree of pivoting of said overriding stop member about said first post;

d. retention means for retaining said overriding stop member on said second post; and

e. a torsion spring carried by said second post and engaging said overriding stop member and urging it generally toward said cam shaft, whereby said overriding stop projection, upon rotation of said cam shaft, is engaged by said cam lobe on said ramp-stop disc, and rotation of said cam shaft is resisted by the force exerted by said spring against said overriding stop member so that additional torque must be applied to said cam shaft to urge said cam lobe to override said overriding stop projection and allow said shaft to continue to rotate.

* * * * *