United States Patent [19]

Hauser

[11] **3,878,345**

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[54] **MULTIPLE STATION CONTROL TIMING DEVICE**

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[52] **U.S. Cl.** ..... **200/38 R;** 307/141; 200/153 L

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

[58] **Field of Search** ..... 74/3.5, 3.52, 3.54; 200/37 R, 37 A, 38, 153 L, 25, 27 R, 27 B; 307/141, 141.4, 141.8; 318/102, 443, 444

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Attorney, Agent, or Firm—Miketta, Glenny, Poms & Smith

[57] **ABSTRACT**

In a multiple station control timing device, a timing lever is movable in an orbital path relative to a plurality of timing units. Each unit has a cam face adjustable into various positions in the path of the lever to cause the lever to be deflected for selectable durations. The duration of lever deflection controls the duration of a timing period being controlled by the device. The cam faces are mounted for adjustable movement in directions generally toward and away from the center of the orbital path, and the cam face is of such shape that the duration of deflection of the lever by the cam face is selectively variable in a predetermined manner through movement of such cam faces generally toward and away from the center of the orbital path. The cam face may be provided with at least two distinct areas of different configurations to provide two different rates of lever deflection duration for the same incremental advancement of the cam face relative to the lever when the lever is engaging the two areas respectively.

6 Claims, 7 Drawing Figures

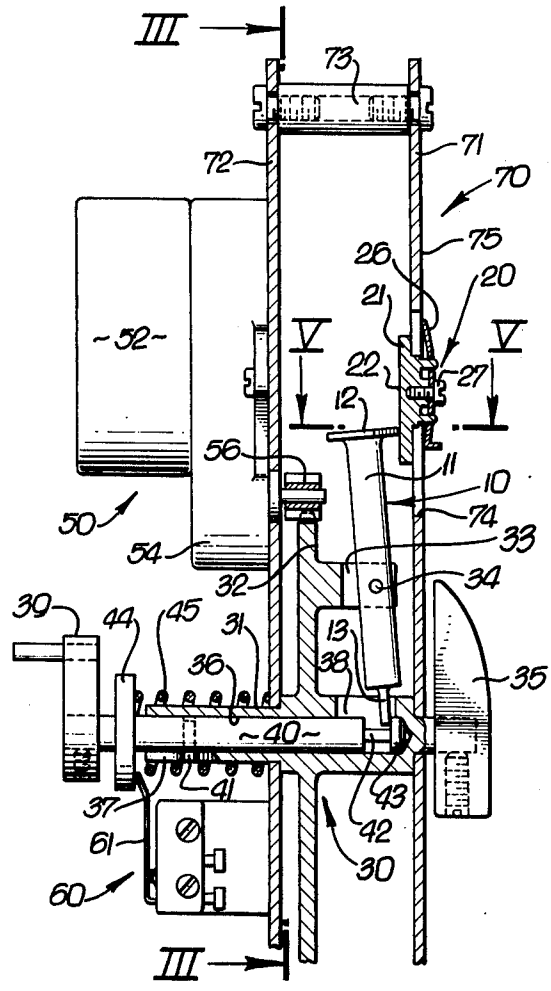

FIG. 1.

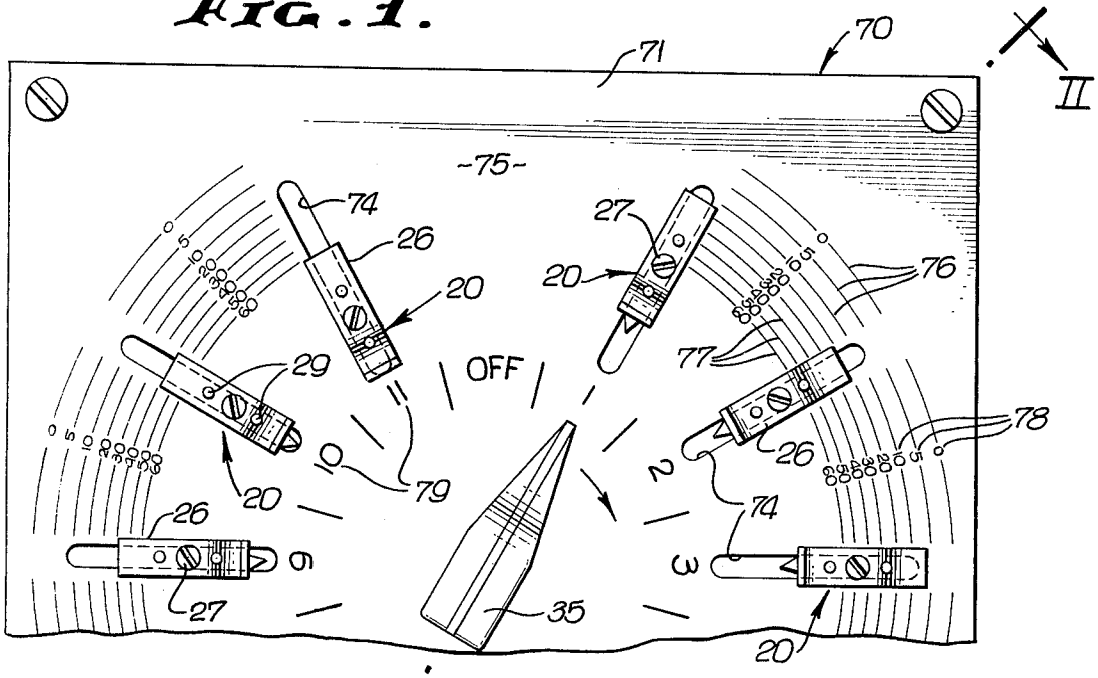

FIG. 2.

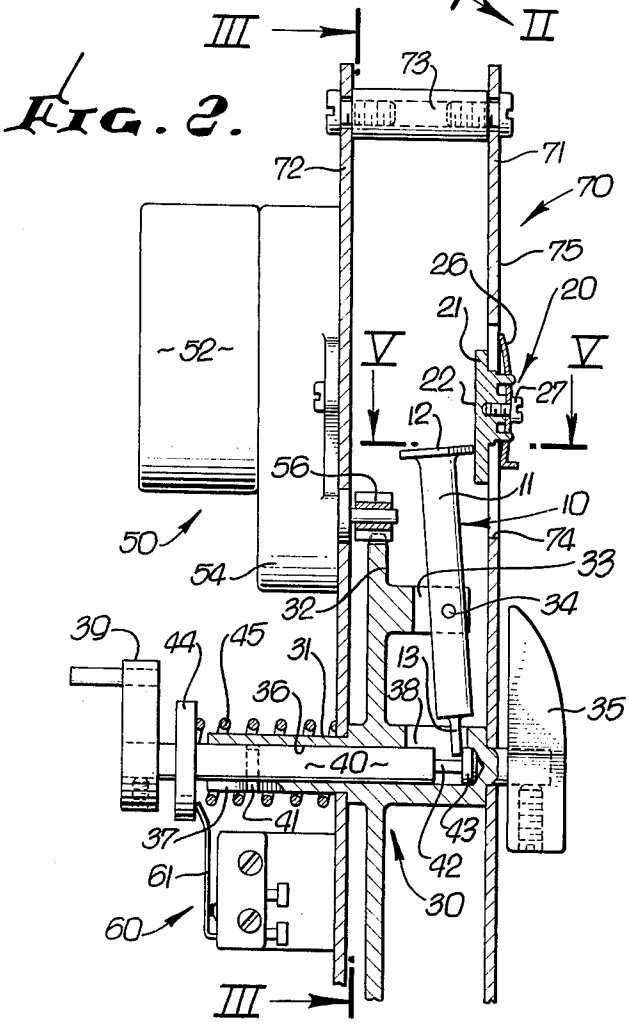

FIG. 5.

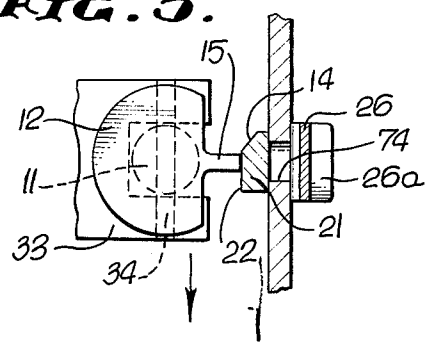

FIG. 6.

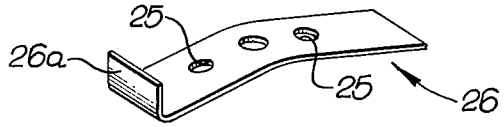

FIG. 7.

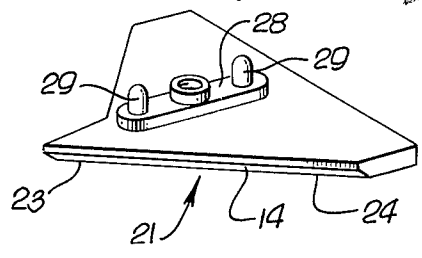

FIG. 3.

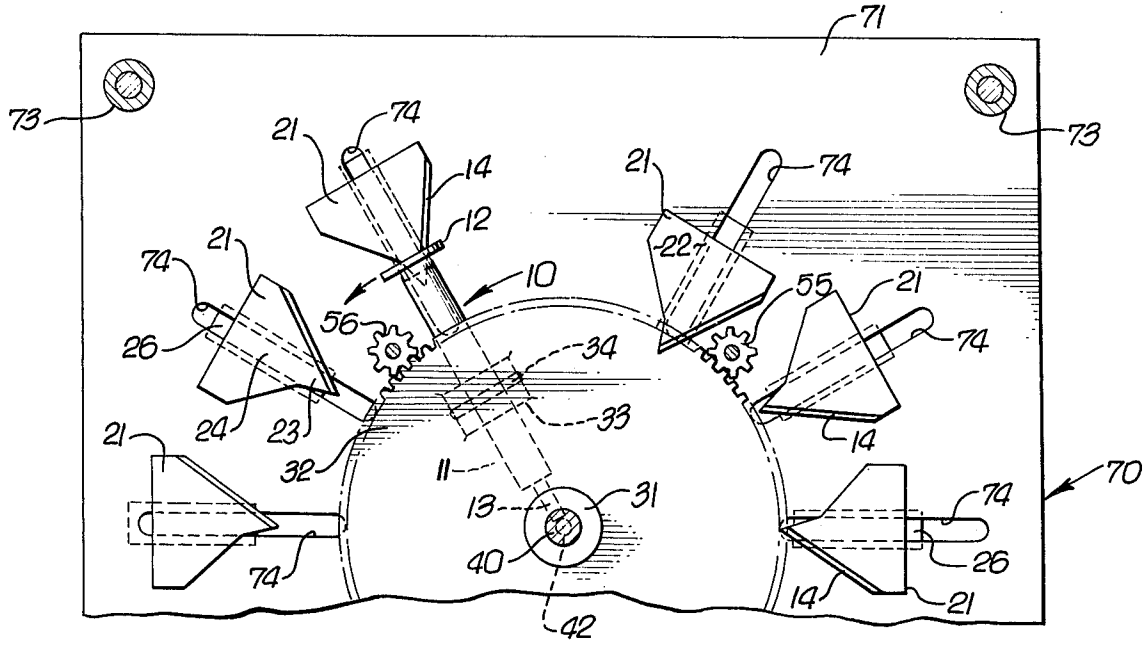
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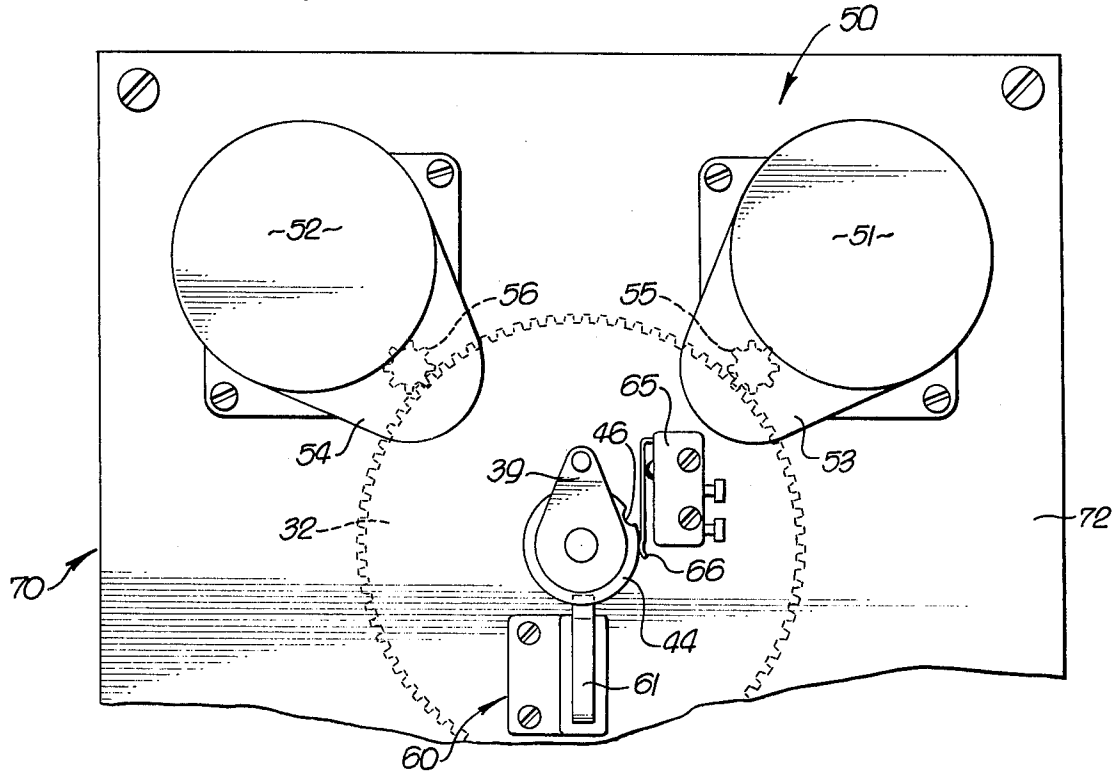
FIG. 4.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MULTIPLE STATION CONTROL TIMING DEVICE

BACKGROUND OF THE INVENTION

This invention relates generally to devices which control a plurality of sequential events of different duration. In such devices, it is advantageous to provide accurate timing for each operation and yet have the length of time between operations held to a minimum. This invention has its greatest applicability in such devices as sprinkling systems, laundry equipment, or other automatic devices having a plurality of sequential operations where the control device may operate an electric switch or a pilot valve.

Systems to accomplish sequential operation have been proposed. Such devices include that disclosed in U.S. Pat. No. 3,244,912 and those patents discussed in column 1 therein.

Generally, the prior art teaches an orbital moving timing cam which interferes with projectable portions of stationary timing units. The distance which the projectable portion projectes into the path of the timing cam determines the duration of the timing period.

One problem with such an arrangement is that not only does the distance which the projectable portion of each unit projects into the path of the timing cam determine the duration of the timing period, it also moves the timing cam a distance proportioanl to the distance which the portion of each timing unit is projected. Therefore, the cam will be moved a different distance for each setting of the timing unit. The continual passing of the cam over the extended projectable portion of the timing unit may eventually result in wearing of that extended portion which may yield a shortening of the distance which the projectable portion extends into the path of the cam which may eventually change the calibration of each timing unit. It is, therefore, a primary object of the invention to provide compact compacy timing device which does not have the problems inherent in prior art timing devices. Another object of the invention is to provide a timing device wherein the timing units are not stationary but are movable. The device should be accurate, especially for timing short durations and should be reliable having the minimum number of parts to decrease cost and increase reliability.

SUMMARY OF THE INVENTION

To accomplish such objects, the multiple control station timing device has a timing lever movable in an orbital path past a plurality of timing units. Each unit includes a cam adjustable into various positions into the path of the lever. The adjustment causes selectable durations of deflections of the lever, which in turn controls the durations of the timing period being controlled by the device. The improvement in the device is the provision of having one or more of the adjustable cam faces mounted to allow for movement in directions generally toward and away from the center of the orbital path. Each cam face is of such a shape that the duration of deflection of the lever by the cam face is selectively variable in a predetermined manner through movement of the cam face generally toward and away from the center of the orbital path. At least two distinct areas of different configurations may be provided on the cam faces to provide two different rates of lever deflection duration for the same incremental advancement of the cam face relative to the lever.

The device includes a drive shaft and a connection from the shaft to a controlled device. Each of a plurality of timing units corresponds to a given station for the controlled device. Motor means selectively rotate the drive shaft at a timing speed and at a faster indexing speed of rotation, and a switch switches the motor between the timing speed mode and the indexing speed mode. The lever means are associated with the drive shaft and the switch for rotation with the shaft past the plurality of control stations. The lever operates the switch upon deflection of the lever during adjustable engagements with portions of the timing units in order to drive the drive shaft at a timing speed during engagements between the lever and protions of the timing units and at indexing speeds between such engagements. The timing units are mounted for radial movement relative to the drive shaft in a plane generally perpendicular to the axis of rotation of the drive shaft. One or more of the timing unit portions includes a body presenting a face of varying lateral width for engagement by the lever for varying the duration of engagement between the timing unit portion and the lever means through selectable radial adjustment of the portion relative to the drive shaft.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of the upper portion of the device.

FIG. 2 is a sectional view taken along line II—II in FIG. 1.

FIG. 3 is a sectional view taken along line III—III in FIG. 2

FIG. 4 is a rear view of the device.

FIG. 5 is a sectional view taken along line V—V in FIG. 2.

FIG. 6 is a perspective view of the spring clip used in the instant invention.

FIG. 7 is a perspective view of the timing body of the instant invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A timing device operates a controlled device through a sequence of timed positions of adjustment. The device is generally supported within a frame 70 which includes a front plate **71** and a rear plate **72** held in spaced apart relationship by spacer **73.**

A drive shaft and a means for connecting the shaft to a controlled device in driving relationship is provided in the instant invention. In the exemplary embodiment, such drive shaft is shown at **30** and includes a main shaft **31** and a gear **32** through which rotational motion is applied to the shaft. The shaft is connected in driving relation to the controlled device by means of a crank arm **39** to cause operation of the sequential operations of the controlled device.

Motor means are provided for selectively rotating the drive shaft at a slower timing speed and at a faster indexing speed of rotation. In the exemplary embodiment, motor means **50** includes two motors, slower timing motor **51** and faster indexing motor **52.** These motors are connected to gear **32** by pinions **55** and **56** through overrunning clutches **53** and **54** which allow the gear **32** and consequently the shaft **31** to rotate at a speed corresponding to the speed of the faster motor which is operating. Timing motor **51** operates continuously but indexing motor **52** operates only intermit-

tently. The overrunning clutch associated with timing motor **51** allows motor **52** to drive the shaft at the indexing speed when indexing motor **52** is operating without interference from slower timing motor **51.** The overruning clutches **53** and **54** allow the drive shaft means **30** to be rotated manually by knob **35** even when both motors are operating. The motor means could also consist of a single two-speed motor adapted to operate two different speeds.

Switch means are provided for selectively switching the motor means between the timing speed mode and the indexing speed mode. In the exemplary preferred embodiment, such switch means **60** operates in a manner to be described hereinafter. Switch means **60** is adapted to turn on or off indexing motor **52.** When the switch means has the motor means in the indexing mode, motor **52** will be driving the gear **32,** and the clutch **53** associated with the timing motor **51** will be overrunning. However, when the switch has the motor means in a timing mode, the indexing motor **52** will be stopped and timing motor **51** will drive the gear **32.**

A plurality of timing units are provided, each of the units corresponding to a given position for the controlled device. In the preferred embodiment, such timing units **20** are generally disposed in a paths around the control shaft on the front plate **71.**

Lever means are associated with the drive shaft and the switch means for rotation with the shaft past the plurality of timing units. The lever means operates the switch means upon deflection of the lever means upon adjustable engagement with portions of the timing units in order to drive the drive shaft at the timing speed during engagements between the lever means and portions of the timing units and at the indexing speed between such engagements. In the exemplary embodiment, such lever means are generally indicated at **10** and include an arm **11,** a disc **12** at one end of the arm **11,** and a diametrically reduced portion **13** of the arm opposite the disc. The lever means **10** is mounted to revolve around the axis of rotation of the shaft in association with the rotation of the shaft. In the preferred embodiment, arm **11** fits between a forked projection **33** on the face of gear **32** and is held therein by pin **34** so that it can pivot about pin **34** while revolving about the axis of rotation of the drive shaft means **30.**

A bore **36** extends through the main shaft **31.** Switch actuating means includes a rod member mounted concentrically within the main shaft bore for rotation therewith and for axial movement relative thereto. In the exemplary embodiment, such switch actuating means include a rod member **40** mounted within the bore **36** of the main shaft. Slot **37** on the main shaft **31** engages pin **41** extending from rod **40** to cause rod **40** to rotate with rotation of the drive shaft but to allow axial movement between the rod member and the main shaft. The rod member is biased toward a first position relative to the switch means wherein the switch means is switched into the indexing speed mode for the motor means. In the preferred embodiment, such biasing is accomplished by a spring **45** which biases enlarged portion **44** to the left as shown in FIG. **2.** Switch **60** is designed so that when arm **61** is moved to the left because of the spring biasing, the switch means will be switched into the indexing speed mode so that indexing motor means **52** will be actuated to rotate drive shaft **30** at its indexing speed.

The plurality of timing units each of which corresponds to a given position of the controlled device are shown in FIG. **1** to be arranged about the axis of the drive shaft on the front plate **71.** Such timing units **20** comprise, in the preferred embodiment, body means **21** mounted on the opposite side of the face **75** of front plate **71** and held thereon by suitable mounting means. In the preferred embodiment, such mounting means includes a spring clip **26** with a bent gripping assist protion **26***a* extending therefrom mounted adjacent the face **75.** Plate **71** is provided with slots **74,** and a screw **27** extends through the slot and connects the fastening plate **28** on timing body **21** with the spring clip **26** to hold the timing body tightly against the rear face of the front plate **71.** The fastening plate **28** is of approximately the same width as slot **74** so that it is free to slide longitudinally in the slot yet cannot rotate therein. Pins **29** extend from the fastening plate **28** into holes **25** on the spring clip **26** to prevent rotation of the spring clip relative to the fastening plate and consequently relative to the timing body **21** and the front plate **71.**

In the position shown in FIG. **2** the disc **12** is shown in contact with the face **22** of the timing body **21.** That position is shown in more detail in FIG. **5** wherein the disc portion **12** includes a projection **15** which is contacting the face portion **22** of the timing body. In the preferred embodiment timing body **21** is provided with a sloped portion **14** on the side on which the disc **12** enters the face portion **22.** The sloped portion allows the disc **12** to ride smoothly up on the timing body.

As the disc rotates in the direction shown by the arrow in FIG. **5,** the projection **15** will move out of contact with the face **22** of the timing body **21,** and the disc **12** will quickly move to the right as shown in FIG. **5.** This movement to the right is caused by the spring **45** which urges rod **40,** its diametrically reduced portion **42** and the head **43** attached thereto to the left in FIG. **2.** The reduced portion **13** of the arm **11** fits within a slot **38** of the drive shaft **30** and also fits adjacent the diametrically reduced portion **42** and head **43.** The resulting biasing of head **43** urges the arm **11** in a clock-wise direction in FIG. **2.**

When the disc **12** contacts the face portion **22** of the timing body **21,** rotation in a counterclockwise direction of arm **11** causes reduced portion **13** to force the head **43** to the right in FIG. **2** to move the rod **40** against the bias of the spring **45.** Thereafter, enlarged portion **44** moves the arm **61** of the switch **60** which turns off the indexing motor **52.**

In the position shown in FIG. **5,** disc **12** is moving in the direction of the arrow under the drive of the timing motor **51** and therefore moves slowly across the face **22** of the timing body **21.** When the projection **15** passes the end of the timing body **21,** disc **12** will thereafter move to the right which will allow the spring **45** to move the rod **40** to the left in FIG. **2** which will cause switch **60** to turn on the indexing motor to drive the shaft and the associated cam at a faster rate between timing units.

Each face portion of the timing body is of such a shape that the duration of deflection of the disc **12** by the timing body is selectively variable in a predetermined manner through movement of the timing units generally toward and away from the center of the orbital path of the disc **12.** The lateral width of face portion **22,** i.e., the width of the face portion measured along the path of the disc traverse, determines the du-

ration of cam deflection. The lateral width of the face presented to the disc is varied by moving the timing body toward or away from the axis of rotation of the drive shaft.

Frequently, it is desirable that the controlled device be timed more accurately for shorter duration operations than for longer ones. Therefore, the face portion **22** has two distinct areas thereon, area **23** for shorter duration timing periods and area **24** for longer duration timing periods. An equal displacement of timing unit **20** toward or away from the axis of the drive shaft will equal less change in the lateral width presented and consequently less change in the timing duration if the disc is contacting the portion **23** with less change in lateral width for a given displacement of the timing body than if the disc is contacting the portion **24** with a greater differential in lateral width for the given displacement.

Calibration lines **76** and **77** are shown on the front face **75** of the front plate **71.** When the top portion of the timing unit is nearer the zero mark, the cam disc would be contacting the narrower portion **23** of the face portion of the timing body so that the lines representing the duration of operation of the controlled device are farther apart for shorter durations at **76** and are closer together for longer durations at **77.** Calibration marks **78** indicate the time period in either seconds, minutes, hours or multiples thereof.

Unit numbers **79** represent the different stations for the controlled device and knob **35** point to the station being timed. Normally, the knob **35** is moved from the off position to point to control unit 1. Thereafter, the shaft, disc and knob are indexed by the indexing motor between adjacent stations. The knob could also be rotated manually to any desired operation. When the desired station is reached, the controlled device will be actuated. Because of the previously overrunning overruning clutch means **53** and **54** only clockwise rotation of the shaft is allowed.

Notch **46** on enlarged portion **44** allows arm **66** on switch **65** to move therein throwing switch **65** to the off position to stop motors **52** and **51.** In order to restart the timing device, knob **35** must be manually moved toward position 1 until arm **66** no longer engages notch **46.** Thereafter, the indexing motor will start indexing the main shaft until disc **12** contacts the body portion **21** at position 1. The timing device may also be started automatically by receiving an electrical signal from an actuating device similar to the one illustrated in my copending application, Ser. No. 443,380 filed Feb. 19, 1974. The signal acts in a circuit parallel to switch **65** to override the switch to activate the timing device.

Thus, a multiple station control timing device has been shown which employs a timing lever **10** movable in an orbital path relative to a plurality of timing units **20.** Each unit has a face portion **22** adjustable into various positions into the path of the lever to cause selectable duration of deflections of the lever. The duration of deflection of the lever controls the duration of the timing period being controlled by the device. Mounting means are provided for movably mounting one or more of said adjustable face portions for movement in directions generally toward and away from the center of the orbital path. Each face portion is of such a shape that the duration of deflection of the lever by the face portion is selectively variable in a predetermined manner through movement of the face portion generally toward and away from the center of the orbital path. The face portions may be provided with at least two distinct areas **23, 24** of different configurations to provide two different rates of cam deflection duration for the same incremental advancement of the face portions relative to the cam when the cam is engaging the two areas respectively.

I claim:

1. In a multiple station control timing device employing a timing lever movable in an orbital path relative to a plurality of timing units, each unit having a face portion adjustable into various positions into the path of said lever to cause selectable durations of deflection of said lever, the duration of deflection of said lever controlling the duration of a timing period being controlled by said device, the improvement comprising the provision of:

mounting means for movably mounting one or more of said adjustable face portions for movement in directions generally toward and away from the center of said orbital path, each face portion being of such shape that the duration of deflection of said lever by said face portion is selectively variable in predetermined manner through movement of such face portion generally toward and away from the center of said orbital path.

2. The improvement in timing device of claim **1** wherein:

one or more of said face portions is provided with at least two distinct areas of different configurations to provide two different rates of lever deflection duration for the same incremental advancement of said face portions relative to said lever when said lever is engaging said face portion.

3. In a timing device for operating a controlled device through a sequence of timed positions of adjustment including:

a drive shaft and means for connecting said shaft to a controlled device in driving relation:

a plurality of timing units, each of said units corresponding to a given position of said controlled device;

motor means for selectively rotating said drive shaft at a timing speed and a faster indexing speed of rotation;

switch means for selectively switching said motor means between a timing speed mode and an indexing speed mode;

lever means associated with said drive shaft and said switch means for rotation with said shaft past said plurality of timing units and for operating said switch means upon deflection of said lever means upon adjustable engagements with portions of said timing units in order to drive said drive shaft at the timing speed during engagements between said lever means and portions of said timing units and at the indexing speed between such engagements, the improvement comprising the provision of:

means for mounting one or more of said control timing units for radially adjustable movement relative to said drive shaft in a plane generally perpendicular thereto; and wherein

said one or more of said timing unit portions includes a body presenting a face of varying lateral width for engagement by said lever means for varying the duration of engagement between such timing unit portion and said lever means through selectable ra-

dial adjustment of said portion relative to said drive shaft.

4. The improvement in timing device of claim **3** wherein:

said face of varying lateral width has a first portion varying at a first linear rate and a second portion varying at a second linear rate to provide two differing timing zones thereon.

5. In a timing device for operating a controlled device through a sequence of timed positions including:

a drive shaft and means for connecting said shaft to a controlled device in driving relation;

a plurality of timing units, each of said units corresponding to a given position for said controlled device;

motor means for selectively rotating said drive shaft at a timing speed and at a faster indexing speed of rotation;

switch means for selectively switching said motor means between a timing speed mode and an indexing speed mode;

lever means associated with said drive shaft and said switch means for rotation with said shaft past said plurality of timing units and for operating said switch means upon deflection of said lever means upon adjustable engagements with portions of said timing units in order to drive said drive shaft at a timing speed during engagements between said lever means and portions of said timing units and at said indexing speed between such engagements,

the improvement comprising the provision of:

a bore in said drive shaft;

switch actuating means including a rod member mounted concentrically within said drive shaft bore for rotation therewith and for axial movement relative thereto, said rod member being biased toward a first position relative to said switch means wherein said switch means is switched into the mode of the indexing speed for the motor means; and

lever engaging means on said switch actuating means for engaging said lever means, whereby deflection of said lever means upon engagement with a portion of any one of said plurality of timing units moves said switch actuating means axially of said drive shaft to operate said switch means to switch the motor means to the mode of the slower motor.

6. The timing device of claim **5** further including:

means for mounting one or more of said timing unit portions for radial adjustable movement relative to said drive shaft in a plane generally perpendicular thereto; and wherein

said one or more of said timing unit portions includes a body presenting a face of varying lateral width for engagement by said lever means varying the duration of engagement between such timing unit portion and said lever means through selectable radial adjustment of said portion relative to said drive shaft.

* * * * *