Nov. 1, 1966 R. J. DYKINGA ETAL 3,282,126

MOTOR DRIVEN TIME SWITCH

Filed Jan. 15, 1965

4 Sheets-Sheet 1

Fig. 1.

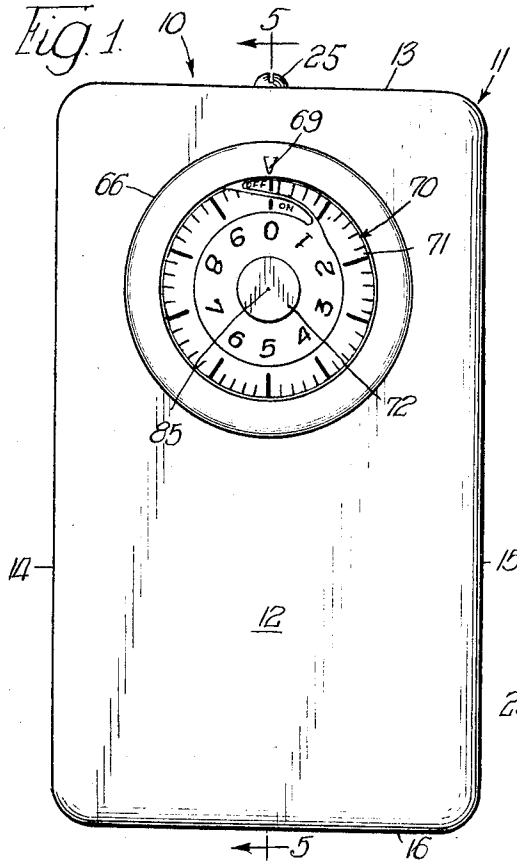


Fig. 2.

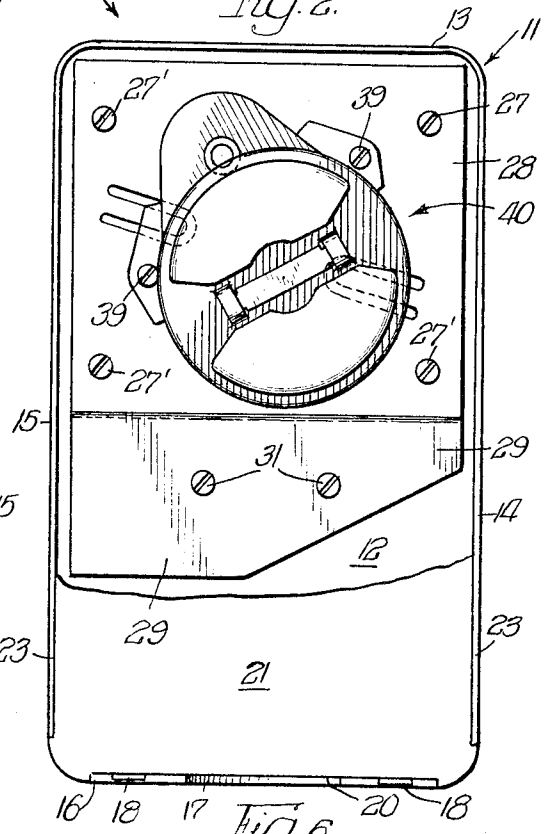


Fig. 3

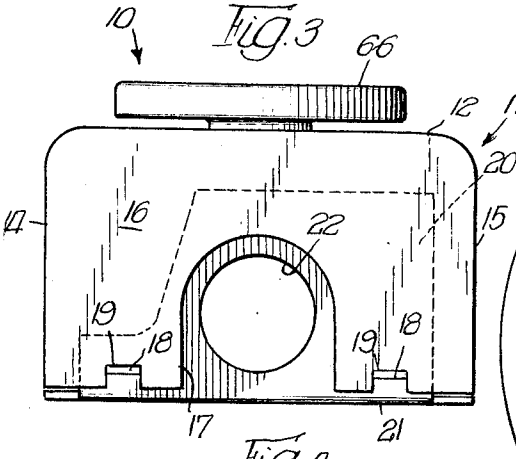


Fig. 6.

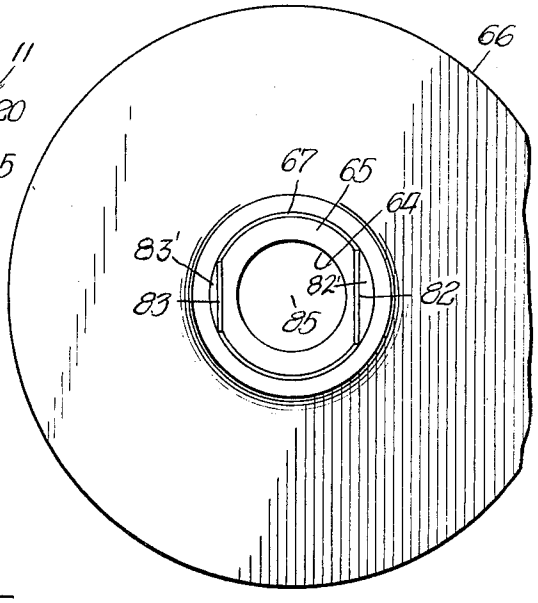
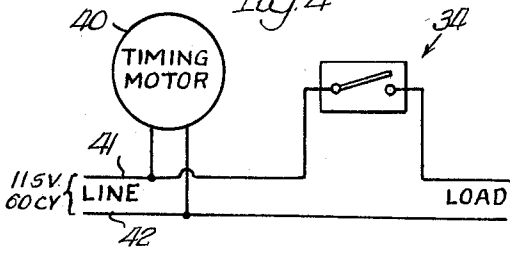


Fig. 4



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Fig. 5.

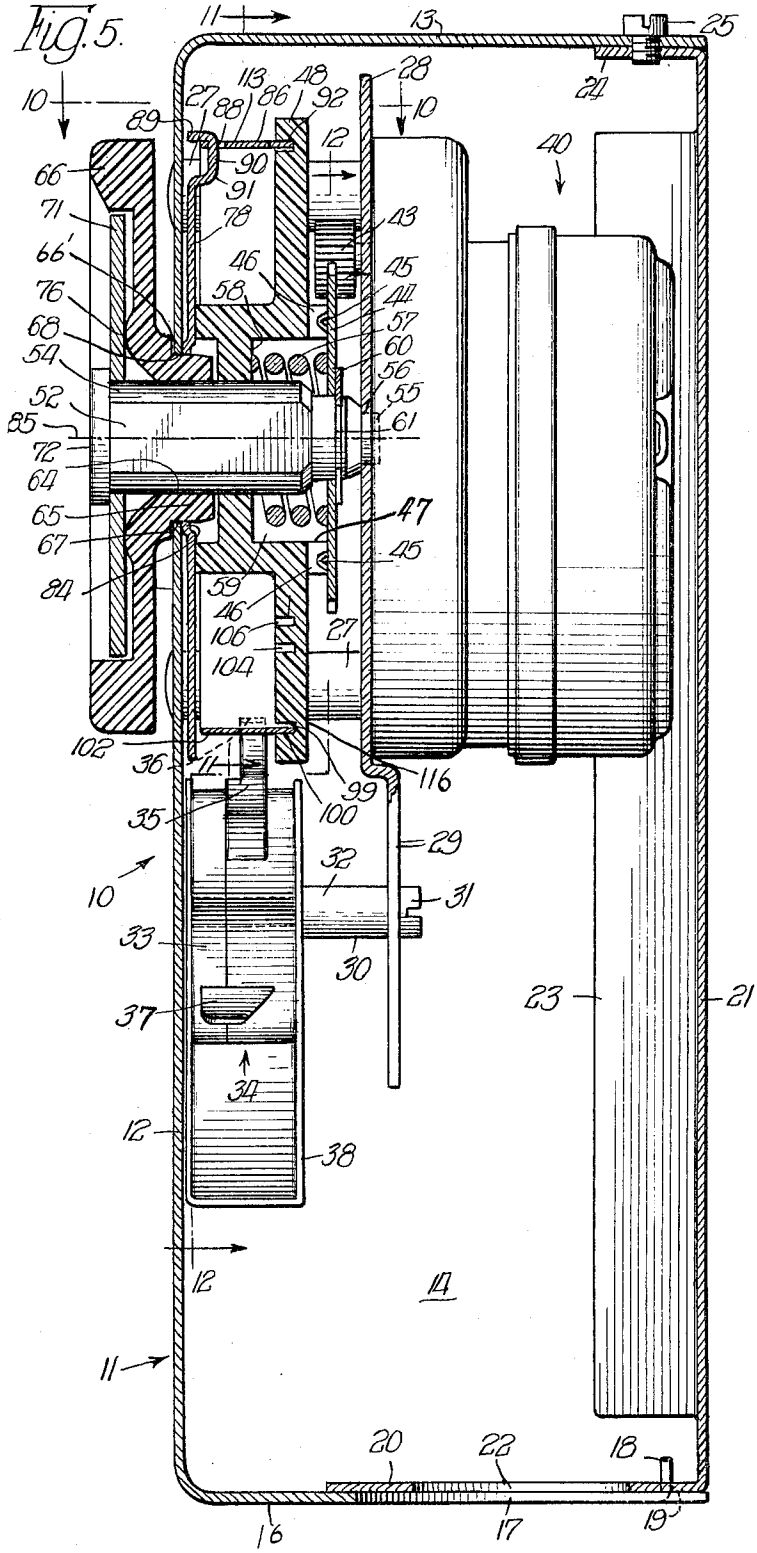


Fig. 13

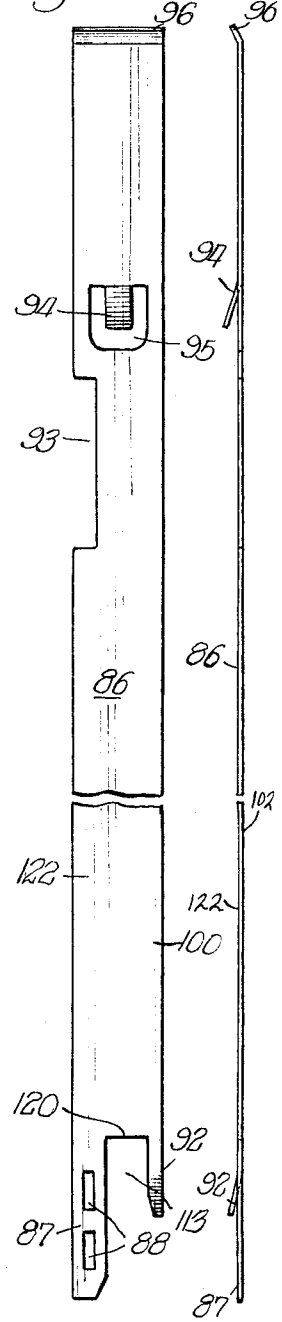


Fig. 14

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Fig. 7

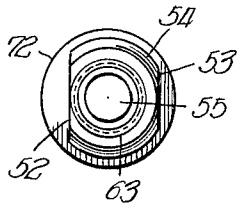


Fig. 9

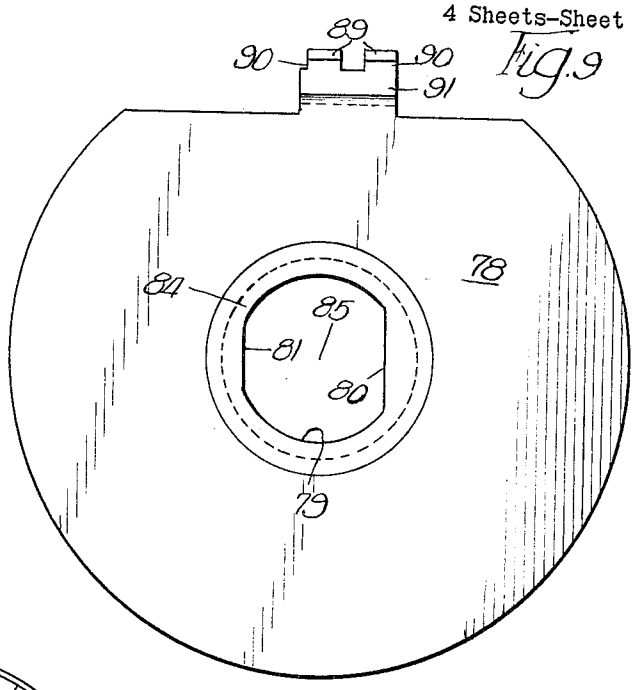


Fig. 8

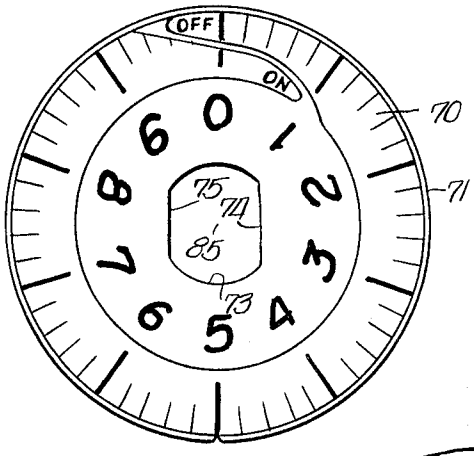
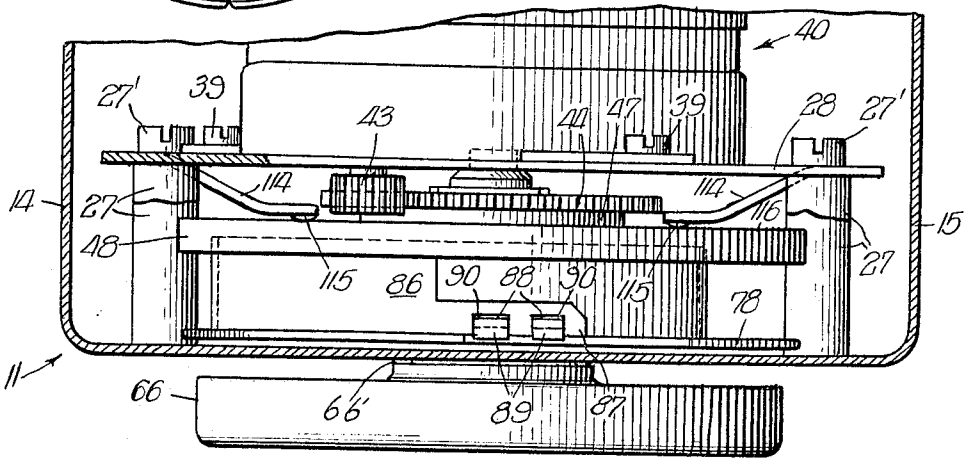


Fig. 10



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Fig. 11

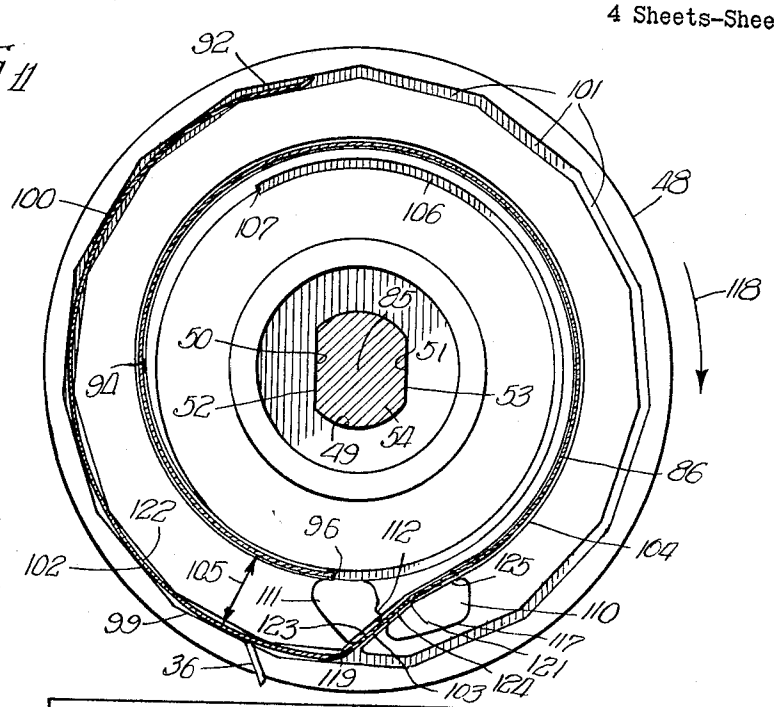
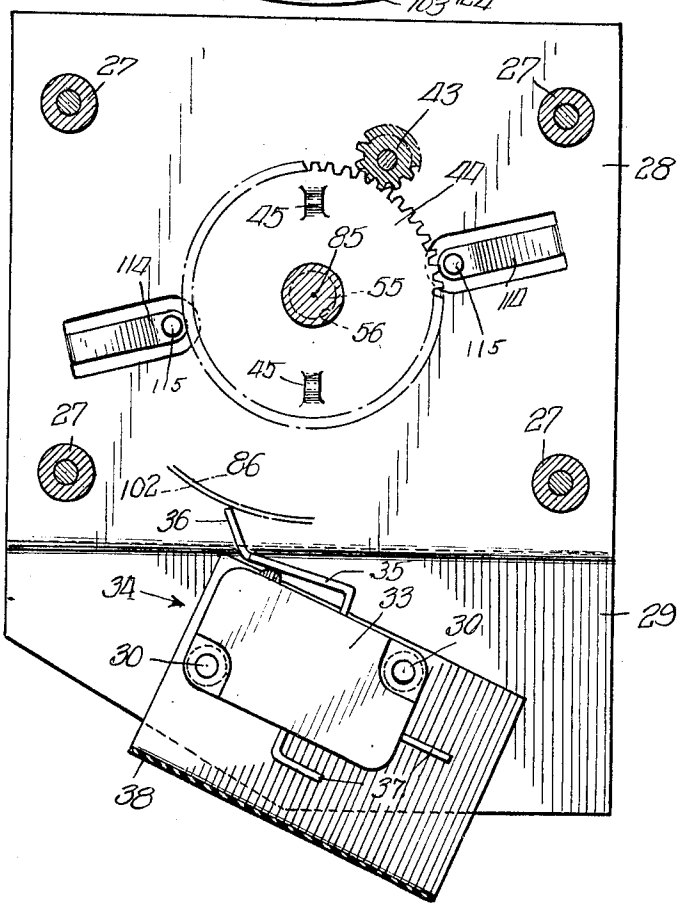


Fig. 12



United States Patent Office

3,282,126

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3,282,126

MOTOR DRIVEN TIME SWITCH

Richard J. Dykinga and Robert K. Pfleger, Miami, Fla., assignors to International Register Company, Chicago, Ill., a corporation of Illinois

Filed Jan. 15, 1965, Ser. No. 425,752
16 Claims. (Cl. 74—568)

This invention relates, generally, to motor driven devices, such as time switches, and it has particular relation to cam operated switches.

Among the objects of this invention are: To provide for varying in a new and improved manner the portion of a time interval that a switch operator occupies one of two positions; to vary the portion of the time interval from 0% to 100% in an infinite number of steps; to provide for moving the switch operator from one position to the other position by its engagement with a cam blade that is endwise shiftable along coaxial circular paths of different radii in a cam plate rotated at a fixed speed, the relative extents of said paths occupied by said cam blade determining the portions of the time interval that the switch operator occupies the two positions, the axis of said paths being the axis of rotation of the cam plate and the time interval being the time required for one revolution thereof; to eliminate error resulting from variation in the radius of the outer surface of that portion of the cam blade in the outer groove resulting from application of endwise stress thereto in opposite directions; and to limit the endwise movement of the cam blade with respect to the cam plate in the 0% and 100% positions of the cam blade.

According to this invention a cam plate is rotated about a fixed axis at a constant speed with the time required to make one complete revolution being the time interval during which an operator, such as a switch operator, is to occupy one position for all or a part of the interval or another position for all or the remaining part of the interval. A cam lever plate is mounted for rotation with and in parallel spaced relation to the cam plate and is relatively rotatable through a complete revolution. In the face of the cam plate toward the cam lever plate there is an outer circular groove whose axis is the axis of rotation of these plates and it communicates by a transverse groove with an inner groove having a circular portion coaxial with the outer groove, the inner groove extending in a somewhat spiral fashion through more than 360° and terminating in an innermost circular portion coaxial with the outer groove. A flexible and inextensible cam blade is positioned between the cam plates with one edge portion extending into the grooves in the cam plate while the opposite edge is juxtaposed to and is guided by the adjacent side of the cam lever plate. The outer end of the cam blade is attached to and rotates with the cam lever plate and thereby tension or compression stress is applied to the cam blade for moving it along the grooves between a position extending throughout the entire outer groove and a position extending throughout the entire inner groove and into the innermost portion thereof. Outer and inner bosses are provided on opposite sides of the transverse groove against which opposite sides of the cam blade have frictional engagement thereby providing surface loading or a clutch action to prevent the cam blade from moving with respect to the cam plate when the distal end of the switch operator engages the cam blade. The outer groove is formed as a seres of chords to eliminate variations in the radial position of the outer surface of the portion of the cam blade therein due to the direction in which stress is applied thereto for moving it endwise along the grooves. In one extreme position the cam blade is prevented from further endwise movement by a central tongue engaging a shoulder on the inner boss.

The cam blade is prevented from further movement in the opposite direction when the inner end of the innermost groove is engaged by the inner end of the cam blade. A scale, calibrated from 0% to 100%, is carried by a dial plate that is secured to a center shaft for rotation therewith. The cam plate also is secured to the center shaft. An index is carried by a set knob that is relatively rotatably mounted on the center shaft and it indicates with respect to the scale on the dial plate a percent of the time interval that an operator is engaged by the outer surface of the cam blade along the portion thereof in the outer groove, the operator being spaced from the outer surface of the cam blade along the portion thereof in the inner groove for the remaining portion of the interval except for the 0% and 100% settings of the index in which case for a complete revolution of the cam plate the operator engages the outer surface of the cam blade in the outer groove or is spaced therefrom in the inner groove as the case may be. The change in radial position of the operator effects a corresponding operation of a switch by shifting it, for example, from the open position to the closed position for the preset percent portion of the interval. Acceleration of the cam plate by snap action of the spring biased operator is prevented by frictional engagement of the back surface of the cam plate by lugs struck from a base plate on which the motor is mounted for driving the cam plate and parts rotatable therewith.

In the drawings:

FIG. 1 is a view, in front elevation and at full scale, of a motor driven time switch or percentage timer embodying the present invention.

FIG. 2 is a view, in rear elevation, of the construction shown in FIG. 1, a portion of the back cover being broken away in order to show certain interior details.

FIG. 3 is a view, in bottom plan, of the construction shown in FIG. 1.

FIG. 4 illustrates diagrammatically the circuits employed in practicing this invention.

FIG. 5 is a vertical sectional view, at an enlarged scale, taken generally along the line 5—5 of FIG. 1, certain parts being shown in elevation.

FIG. 6 is a view, in rear elevation, of the set knob shown in FIG. 5.

FIG. 7 is a view, in end elevation and looking from right to left, of the center shaft shown in FIG. 5.

FIG. 8 is a view, in front elevation, of the dial plate and the scale mounted thereon.

FIG. 9 is a view, in front elevation, of the cam lever plate, the view being taken looking from left to right in FIG. 5.

FIG. 10 is a horizontal sectional view taken generally along the line 10—10 of FIG. 5.

FIG. 11 is a vertical sectional view taken generally along the line 11—11 of FIG. 5 to show only the cam plate, cam blade and the distal end of the switch operator.

FIG. 12 is a vertical sectional view taken generally along the line 12—12 of FIG. 5 and at a slightly reduced scale.

FIG. 13 is a plan view of the cam blade.

FIG. 14 is a view, in side elevation, of the cam blade shown in FIG. 13.

In FIGS. 1, 2 and 3 the reference character 10 designates, generally, a motor driven time switch or percentage timer which includes a metallic case, indicated generally at 11. The metallic case 11 is formed by a front wall 12 that is united integrally with a top wall 13, side walls 14 and 15, and a bottom wall 16. A slot 17 is formed in the bottom wall 16 for receiving a conduit or the like to facilitate connection of the necessary electrical conductors to the time switch 10. Up struck tabs 18 are formed on the bottom wall 16 for insertion through openings

19 in a bottom flange 20 that is integral with a metallic back cover 21, FIG. 5, thereby providing a detachable hinge construction. A circular opening 22 is formed in the bottom flange 20 to register with the slot 17. Side flanges 23 extend forwardly from the back cover 21 for fitting inside of the side walls 14 and 15. A top flange 24 extends underneath the top wall 13 of the metallic case 11 and a screw 25 extends through the latter into the former to secure the back cover 21 in place.

In FIG. 5 base plate studs 27 extend rearwardly from the front wall 12 for supporting a metallic base plate 28. Screws 27' extend through the metallic base plate, FIG. 2, for securing it in position within the metallic case 11.

The base plate 28 has an offset lower portion 29 from which switch studs 30 extend forwardly and are held in position by screws 31. Forwardly of spacer sections 32 on the switch studs 30 there is mounted an insulating housing 33 of a switch that is indicated, generally, at 34 and is shown more clearly in FIG. 12. The switch 34 is a spring biased over center switch and can be a single pole, single throw switch, a single pole, double throw switch, a double pole, single throw switch or double throw, etc. An operator 35 is arranged to shift the movable element of the switch 34 from one significant position to another in which the over center biasing action of the switch opens or closes its contacts as the case may be and with a snap action. Its distal end 36 is arranged to be moved in a manner to be described against a biasing spring incorporated in the switch 34, the biasing spring acting to move the operator 35 and the switch to one significant position while pressure applied to the distal end 36 against the force exerted by the biasing spring is effective to move the operator 35 and the movable part of the switch 34 to another significant position. A U-shaped insulator 38, formed of relatively thin material such as fish paper, overlies the insulating housing 33 of the switch 34, one side having the switch studs 30 extending therethrough.

Mounted on the rear side of the base plate 28 by screws 39, FIG. 2, is a synchronous timing motor that is indicated, generally, at 40. The timing motor 40 is indicated diagrammatically in FIG. 4 where it is shown as being connected for energization across conductors 41 and 42 that may be energized from a suitable alternating current source such as 115-volt 60-cycle source. The switch 34 is illustrated as being interposed on the conductor 41 between the line and the load. The motor driven time switch 10 is arranged to maintain the contacts of the switch 34 in closed position for a preset percent portion of a time interval, for example for one-half minute or 20% of a two and a one-half minute interval.

FIG. 5 shows the motor 40 arranged to drive a pinion 43 that is positioned on the front side of the base plate 28. The pinion 43 is driven through a suitable gear reduction by the motor 40 so that it rotates at a relatively slow speed. For example, it may rotate at a speed of 2 revolutions per minute. The pinion 43 drives a gear 44 and the gear ratio is such that the gear 44 is rotated at a speed of 1 revolution each two and one-half minutes. Obviously, other gear ratios can be employed as may be desired.

Extending forwardly from and formed integrally with the gear 44 are lugs 45. They project into slots 46 that are located in a ring portion 47 formed integrally with the rear side of a cam plate 48 that may be formed of nylon or like plastic material. FIG. 11 shows the cam plate 48 as being provided with a central opening 49 having flat sides 50 and 51 for nonrotatable mounting on flat sides 52 and 53, respectively, of a center shaft 54 an end view of which is shown in FIG. 7. One end 55 of the center shaft 54 is journaled in a bearing opening 56, FIG. 5, in the base plate 28. A coil compression spring 57 is interposed between the front side of the gear 44 and a bottom surface 58 of a cavity 59 which is formed

in the rear side of the cam plate 48. The spring 57 functions to hold the cam plate 48 in its proper position along the center shaft 54 in conjunction with certain other associated parts to be described. The assembly is held in place on the center shaft 54 by a C-snap washer 60 which fits into an annular groove 61 at the inner end of the center shaft 54. Both the gear 44 and the cam plate 48 rotate together with the center shaft 54 as driven by the pinion 43 from the motor 40.

Adjacent its forward end the center shaft 54 is journaled in a circular bearing opening 64, FIG. 6, that is formed in a hub 65 which is integral with a set knob 66, preferably formed of nylon or like material, and mounted in front of the front wall 12 of the metallic case 11 as shown in FIGS. 1 and 5 with a slight clearance 66' therebetween. The hub 65 of the set knob 66 has a circular bearing surface 67 that is journaled in a bearing opening 68 in the front wall 12. It will be understood that the set knob 66 is arranged to rotate on manual setting relative to the center shaft 54 and that, once set, is arranged to rotate conjointly therewith. The set knob 66, FIG. 1, carries an index 69 that is movable with respect to a scale 70, FIG. 8, which is carried by a dial plate 71. The scale 70 is provided with markings ranging from 0% to 100% for registration with the index 69 with respect to which the scale 70 and dial plate 71 are arranged to rotate through 360° in one direction or the other. This provides for full range of adjustment from 0% to 100% of the time interval.

FIG. 5 shows the dial plate 71 mounted for rotation with the center shaft 54, the cam plate 48 and the gear 44. For this purpose the dial plate 71, FIG. 8, has a central opening 73 with flat sides 74 and 75 that are arranged to overlie the flat sides 52 and 53 of the center shaft 54. Since the set knob 66 is rotatable relative to the dial plate 71 for adjustment purposes, it is desirable to have controlled frictional engagement therebetween without deformation of the dial plate 71. Accordingly, the set knob 66 has an annular rib 76, FIG. 5, that is formed integrally therewith and is arranged to have contact engagement along a circle with the rear surface of the dial plate 71 with sufficient friction to prevent slippage due to frictional loading applied to the cam plate 48 by the spring 57.

Mounted for rotation with the set knob 66 is a metallic cam lever plate 78. FIG. 9 shows the cam lever plate 78 as provided with a central opening 79 having flat sides 80 and 81 to overlie flat sides 82 and 83, FIG. 6, on the hub 65 of the set knob 66. The cam lever plate 78 has an offset central flange 84 surrounding the central opening 79 for engaging on its front surface rearwardly facing surfaces 82' and 83' on the hub 65 that extend outwardly at right angles from the flat sides 82 and 83, respectively.

As pointed out the construction and arrangement of the center shaft 54 are such that the gear 44, cam plate 48 and dial plate 71 are rotatable therewith while the set knob 66 and the cam lever plate 78 are rotatably mounted on the center shaft 54 for adjustment of the index 69 along the scale 70. A circular head 72 at the outer end of the center shaft 54 functions to hold the set knob 66 and dial plate 71 in proper position. The axis of rotation of the center shaft 54 is indicated by broken line 85. It will be apparent that this is also the axis of rotation of the cam plate 48 and the lever plate 78 that is mounted in parallel spaced relation forwardly thereof. Also it is the axis of rotation of the set knob 66 and of the dial plate 71.

The time during each rotation of the cam plate 48 that the operator 35 occupies the position shown in FIG. 12 is controlled by a cam blade 86, FIGS. 11, 13 and 14. The cam blade 86 is preferably formed of a flexible inextensible relatively thin material such as an elongated sheet of stainless steel. At one end cam blade 86 has a finger 87 which is provided with openings 88 for re-

ceiving ends 89 of hooks 90, FIGS. 5, 9 and 10, which are formed with a radially extending offset section 91 of the cam lever plate 78. Through the connection thus provided between the cam lever plate 78 and the cam blade 86 it is possible to apply a tension or a compression stress thereto for moving it in one direction or the other depending upon the direction in which the cam lever plate 78 is rotated on rotation of the set knob 66. Opposite the finger 87 and at the same end there is provided the guide finger 92 the function of which will be set forth presently. Near the other end of the cam blade 86 a slot 93 is provided in the same side from which the finger 87 extends for the purpose of clearing it and its connection to the cam lever plate 78 when the time switch is set for the 100% position. In order to arrest further movement of the set knob 66 in the 100% position there is formed a stop tongue 94 intermediate the sides of the cam blade 86. The stop tongue 94 is formed by cutting away a U-shaped opening 95. The other end 96 of the cam blade 86 is turned upwardly to prevent cutting into the walls of the inner groove 104 when the cam blade 86 is pushed inwardly therealong. The turned up end 96 functions as a stop to limit further movement of the cam blade 86 in the 0% setting.

FIG. 11 shows the cam plate 48 as being provided with an outer circular groove 99 the center of which is the axis 85 of rotation of the center shaft 54 and of the cam plate 48. An edge portion 100 of the flexible cam blade 86 is located within the outer circular groove 99 as shown in FIG. 11. It will be noted that the outer circular groove 99 is formed by a series of relatively short chords 101. The reason for this is to make certain that the outer surface 102 of the cam blade 86 against which the distal end 36 of the operator 35 bears is always at a fixed radius from the axis 85 and that this radius does not vary, depending upon whether a tension or a compression stress is applied to the cam blade 86 by the set knob 66. The outer circular groove 99 is opposite the hooks 90 to which the finger 87 is attached.

The cam blade 86 is somewhat longer than the circumference of the outer circular groove 99. Its edge portion 100 extends through a transverse groove 103 to an inner groove 104 which has a circular portion the center of which is the axis 85. The radial distance 105 between the outer surface 102 of the cam blade 86 in the outer circular groove 99 and the outer surface 102 in the inner groove 104 is substantially greater than the minimum distance required to effect positive movement of the operator 35 from one significant position to the other significant position.

The inner groove 104 extends in a somewhat spiral fashion along an innermost circular portion 106 which is of sufficient length together with the initial portion of the inner groove 104 to accommodate the entire length of the cam blade 86. In this position the outer surface 102 of the cam blade 86 is located at the minimum radial distance from the axis 85 and is spaced from the distal end 36 of the operator 35. Thus for a complete revolution of the cam plate 48 with the cam blade 86 in the position just described the distal end 36 of the operator 35 is free of engagement with the cam blade 86 and it occupies a position which may be considered to be the 0% position during which the operator 35 is in the corresponding significant position. When the other end 96 of the cam blade 86 engages the end 107 of the innermost circular portion 106, further inward movement of the cam blade 86 is arrested. This forms one of the stops for endwise movement of the cam blade 86.

FIG. 11 shows outer and inner bosses 110 and 111 integral with the cam plate 48 and flanking the transverse groove 103 on opposite sides for directing the edge portion 100 of the cam blade 86 in its movement from the outer circular groove 99 to the inner groove 104. A stop shoulder 112 on the inner boss 111 is arranged to be engaged by the stop tongue 94 on the cam blade 86 to limit further rotation of the set knob 66 in a position that corresponds to the 100% position of the index 69 with respect to the scale 70 in which the cam blade 86 extends substantially throughout the entire extent of the outer circular groove 99 so that, for this setting, the operator 35 is held in the significant position shown in FIG. 12 for a complete revolution of the cam plate 48.

A slot 113, FIG. 13, between the finger 87 and guide finger 92 accommodates movement of the distal end 36 of the operator 35. The guide finger 92 acts as an extension of the edge portion 100 of the cam blade 86 to direct it in its movement along the outer circular groove 99.

When the distal end 36 of the operator 35 moves radially inwardly from engagement with the outer surface 102 of the cam blade 86 in the outer circular groove 99, there is a tendency for it to accelerate the movement of the cam plate 48. In order to prevent this, lugs 114, FIGS. 10 and 12, are struck from the base plate 28 and extend forwardly. They are provided with bumps 115 which have small area contact engagement with the rear side 116 of the cam plate 48. This provides sufficient frictional engagement to dampen such acceleration.

It will be noted in FIG. 11 that the outer surface 117 of the outer boss 110 is at a slightly less radial distance from the axis 85 than is the outer surface 102 of the cam blade 86 in the outer circular groove 99. Thus, when the distal end 36 of the operator 35 is disengaged from the outer surface 102 as the cam plate 48 is rotated in the direction indicated by arrow 118, it is transferred to the outer surface 117 of the outer boss 110. Where the cam blade 86 extends from the outer circular groove 99 to the transverse groove 103, a small radius bend 119 is formed. As the distal end 36 is engaged by the bend 119, it is moved inwardly by the action of the over center spring of the switch 34. This movement is sufficient to effect over center operation of the switch 34 which, because of its individual spring action, is independent of the speed at which the bend 119 is rotated by the motor 40.

On the continued rotation of the cam plate 48 in the direction of the arrow 118, the distal end 36 of the operator 35 engages edge 120 of the slot 113 between the fingers 87 and 92 and thus is moved to a position where the outer surface 102 of the cam blade 86 in the outer circular groove 99 is engaged, thereby effecting a corresponding shift in the position of the switch 34.

As noted, the cam blade 86 extends along a small radius bend 119, FIG. 11, in its transition from the outer circular groove 99 to the transverse groove 103. Likewise it extends along a small radius bend 121 in its transition from the transverse groove 121 to the inner groove 104. Thus inner surface 122 of the cam blade 86 is directed into frictional engagement with a flat surface 123 on the inner boss 111 and the outer surface 102 is directed into frictional engagement with flat surfaces 124 and 125 on the outer boss 110. These frictional engagements effect surface loading or a slippable clutch action between the cam plate 48 and the cam blade 86 which prevents relative movement therebetween while permitting such movement on manual rotation of the set knob 66 which applies a tension or compression force to the cam blade 86 to pull or push it along the outer and inner circular grooves 99 and 104 depending on the direction of rotation of the set knob 66.

What is claimed as new is:

1. A device for controlling the portion of a time interval that a shiftable operator occupies one of two positions comprising: a cam plate adapted to be rotated about an axis at a predetermined speed, said cam plate having in one face a circular outer groove coaxial with said axis and an inner groove connected by a transverse groove to said outer groove with that portion of said inner groove extending from said transverse groove being circular and coaxial with said axis, a cam lever plate adapted to be

manually rotated about said axis and having one side in parallel spaced relation to said face of said cam plate, and a flexible cam blade secured at one end to said cam lever plate, with one edge being juxtaposed to and guided on said one side of said cam lever plate; the other edge of said cam blade extending into and being guided by said outer groove, transverse groove and inner groove and slidable therealong in accordance with relative rotation of said cam lever plate with respect to said cam plate; the outermost surface of said cam blade being engageable with said shiftable operator for effecting movement thereof from one of said positions to the other in accordance with the position of said cam blade along said grooves.

2. A device for controlling the portion of a time interval that a shiftable operator occupies one of two positions comprising: a cam plate adapted to be rotated about an axis at a predetermined speed, said cam plate having in one face a circular outer groove coaxial with said axis and an inner groove connected by a transverse groove to said outer groove with that portion of said inner groove extending from said transverse groove being circular and coaxial with said axis, said inner groove having another portion extending from said circular portion thereof and within said circular portion, a cam lever plate adapted to be manually rotated about said axis and having one side in parallel spaced relation to said face of said cam plate, and a flexible cam blade secured at one end to said cam lever plate with one edge being juxtaposed to and guided on said one side of said cam lever plate; the other edge of said cam blade extending into and being guided by said outer groove, transverse groove and inner groove and slidable therealong in accordance with relative rotation of said cam lever plate with respect to said cam plate; the outermost surface of said cam blade being engageable with said shiftable operator for effecting movement thereof from one of said positions to the other in accordance with the position of said cam blade along said grooves.

3. A device for controlling the portion of a time interval that a shiftable operator occupies one of two positions comprising: a cam plate adapted to be rotated about an axis at a predetermined speed, said cam plate having in one face a circular outer groove coaxial with said axis and an inner groove connected by a transverse groove to said outer groove with that portion of said inner groove extending from said transverse groove being circular and coaxial with said axis, said inner groove having another portion extending from said circular portion thereof and within said circular portion, a cam lever plate adapted to be manually rotated about said axis and having one side in parallel spaced relation to said face of said cam plate, a flexible cam blade secured at one end to said cam lever plate with one edge being juxtaposed to and guided on said one side of said cam lever plate; the other edge of said cam blade extending into and being guided by said outer groove, transverse groove and inner groove and slidable therealong in accordance with relative rotation of said cam lever plate with respect to said cam plate; the outermost surface of said cam blade being engageable with said shiftable operator for effecting movement thereof from one of said positions to the other in accordance with the position of said cam blade along said grooves, the other end of said cam blade being engageable with an end of said other portion of said inner groove to limit relative rotation of said cam plate and cam lever plate in one direction, and stop means on said cam blade engageable with abutment means on said cam plate to limit relative rotation thereof with respect to said cam lever plate in the opposite direction.

4. The device as claimed in claim 1 wherein said circular outer groove is formed in part at least as a series of chords to maintain the outer surface of that portion of said cam blade in said outer groove at a substantially uniform distance from said axis regardless of the direction in which force is applied endwise to said cam blade in moving it along said grooves.

5. The device as claimed in claim 1 wherein said transverse groove is flanked by inner and outer bosses to direct sliding movement of said flexible cam blade along said transverse groove and between said outer and inner grooves and to effect a slippable clutch action between surfaces of said bosses and the juxtaposed surfaces of said cam blade.

6. The device as claimed in claim 5 wherein the transition portions of said cam blade at the ends of said transverse groove are small radius bends and opposite sides of said cam blade have surface contact engagement with flate surfaces on said bosses.

7. The device as claimed in claim 5 wherein said cam blade carries stop means engageable with a shoulder on said inner boss to limit relative rotation in one direction of said cam plate and said cam lever plate.

8. A device for conrtolling the portion of a time interval that a shiftable operator occupies one of two positions comprising: a shaft adapted to be rotated at a predetermined speed, a cam plate mounted on said shaft for rotation therewith, said cam plate having in one face a circular outer groove coaxial with the axis of rotation of said shaft and cam plate and an inner groove connected by a transverse groove to said outer groove with that portion of said inner groove extending from said transverse groove being circular and coaxial with said axis, a dial plate mounted on said shaft for rotation therewith and carrying a circular scale, a set knob rotatably mounted on said shaft adjacent said dial plate, an index on said set knob for variably registering with said scale, a cam lever plate mounted on said set knob for rotation therewith and having one side in parallel spaced relation to said face of said cam plate, and a flexible cam blade secured at one end to said cam lever plate with one edge being juxtaposed to and guided on said one side of said cam lever plate; the other edge of said cam blade extending into and being guided by said outer groove, transverse groove and inner groove and slidable therealong in accordance with relative rotation of said index with respect to said scale; the outermost surface of said cam blade being engageable with said shiftable operator for effecting movement thereof from one of said positions to the other in accordance with the position of said cam blade along said grooves.

9. The device as claimed in claim 8 wherein said inner groove has another portion extending from and within said circular portion thereof.

10. The device as claimed in claim 9 wherein the other end of said cam blade is engageable with an end of said other portion of said inner groove to limit relative rotation of said cam plate and cam lever plate in one direction, and stop means on said cam blade engageable with abutment means on said cam plate to limit relative rotation thereof with respect to said cam lever plate in the opposite direction.

11. The device as claimed in claim 8 wherein said circular groove is formed throughout substantially its entire extent as a series of chords to maintain the outer surface of that portion of said cam blade in said outer groove at a substantially uniform distance from said axis regardless of the drection in which force is applied endwise to said cam blade in moving it along said grooves.

12. The device as claimed in claim 8 wherein said transverse groove is flanked by inner and outer bosses secured to said cam plate and extending toward and in spaced relation to said one side of said cam lever plate to direct sliding movement of said one edge of said flexible cam blade along said transverse groove and between said outer and inner grooves and to provide a slippable clutch action therebetween.

13. The device as claimed in claim 12 wherein the transition portions of said blade at the ends of said transverse groove are small radius bends and opposite sides of

said cam blade have surface contact engagement with flat surfaces on said bosses.

14. The device as claimed in claim 12 wherein said cam blade has a stop tongue engageable with a shoulder on said inner boss to limit relative rotation in one direction of said cam plate and said cam lever plate.

15. A device for controlling the portion of a time interval that a shiftable operator occupies one of two positions comprising: a cam plate adapted to be rotated about an axis at a predetermined speed, said cam plate having in one face a circular outer groove coaxial with said axis and an inner groove connected by a transverse groove being circular and coaxial with said axis, a cam lever plate adapted to be manually rotated about said axis and having one side in parallel spaced relation to said face of said cam plate, and a flexible cam blade secured at one end to said cam lever plate at a location opposite said outer groove, one edge of said cam blade being juxtaposed to and guided on said one side of said cam lever plate; the other edge of said cam blade extending into and being guided by said outer groove, transverse groove and inner groove and slidable therealong in accordance with relative rotation of said cam lever plate with respect to said cam plate; the outermost surface of said cam blade being engageable with said shiftable operator for effecting movement thereof from one of said positions to the other in accordance with the position of said cam blade along said grooves.

16. A device for controlling the portion of a time interval that a shiftable operator occupies one of two positions comprising: a shaft adapted to be rotated at a predetermined speed, a cam plate mounted on said shaft for rotation therewith, said cam plate having in one face

a circular outer groove coaxial with the axis of rotation of said shaft and cam plate and an inner groove connected by a transverse groove to said outer groove with that portion of said inner groove extending from said transverse groove being circular and coaxial with said axis, a dial plate mounted on said shaft for rotation therewith and carrying a circular scale, a set knob rotatably mounted on said shaft adjacent said dial plate, an index on said set knob for variably registering with said scale, a cam lever plate mounted on said set knob for rotation therewith and having one side in parallel spaced relation to said face of said cam plate, and a flexible cam blade secured at one end to said cam lever plate at location opposite said outer groove, one edge of said cam blade being juxtaposed to and guided on said one side of said cam lever plate; the other edge of said cam blade extending into and being guided by said outer groove, transverse groove and inner groove and slidable therealong in accordance with relative rotation of said index with respect to said scale; the outermost surface of said cam blade being engageable with said shiftable operator for effecting movement thereof from one of said positions to the other in accordance with the position of said cam blade along said grooves.

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FRED C. MATTERN, JR., *Primary Examiner.*

W. S. RATLIFF, *Assistant Examiner.*