Nov. 26, 1968 H. J. LOVEGROVE 3,413,425

ELECTRIC TIME SWITCHES

Filed Oct. 27, 1965 5 Sheets-Sheet 1

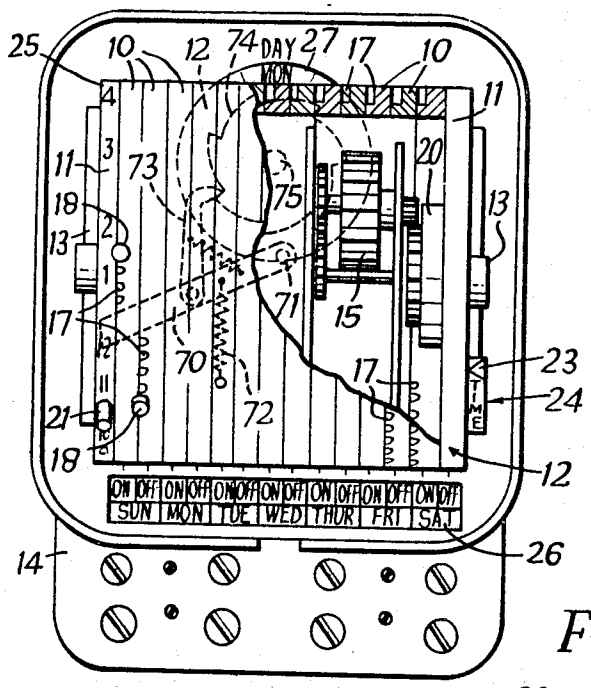


Fig. 1.

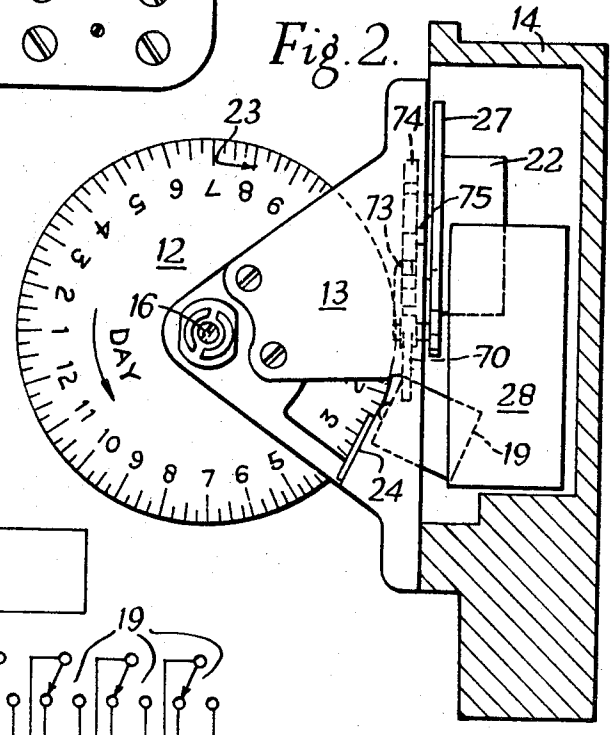
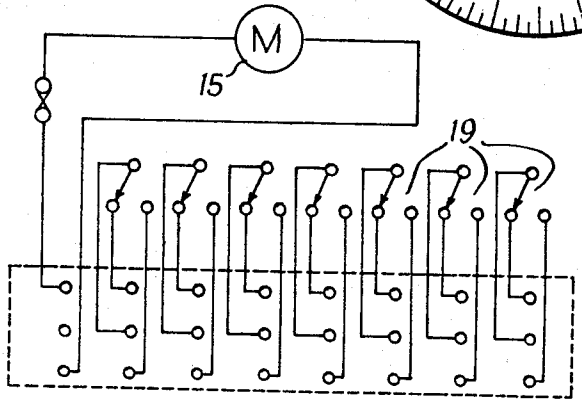


Fig. 2.

Fig. 4.



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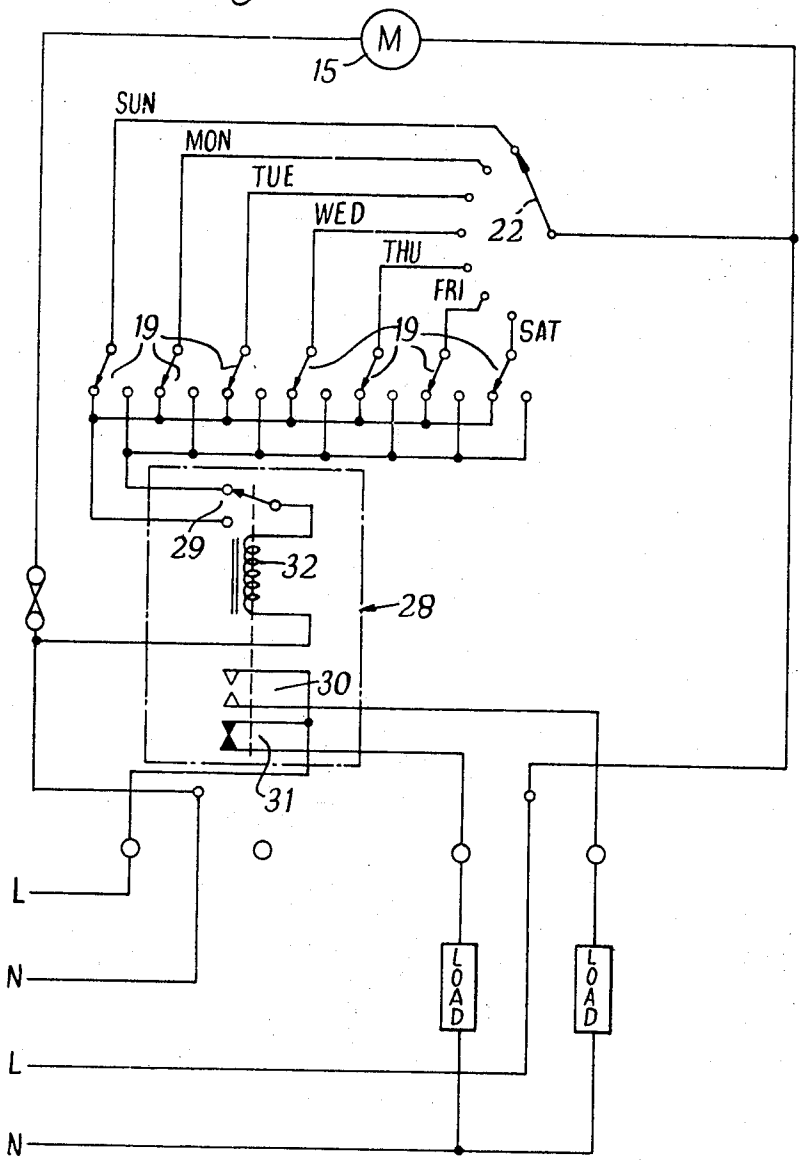
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ELECTRIC TIME SWITCHES

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Fig. 3.



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Fig. 5.

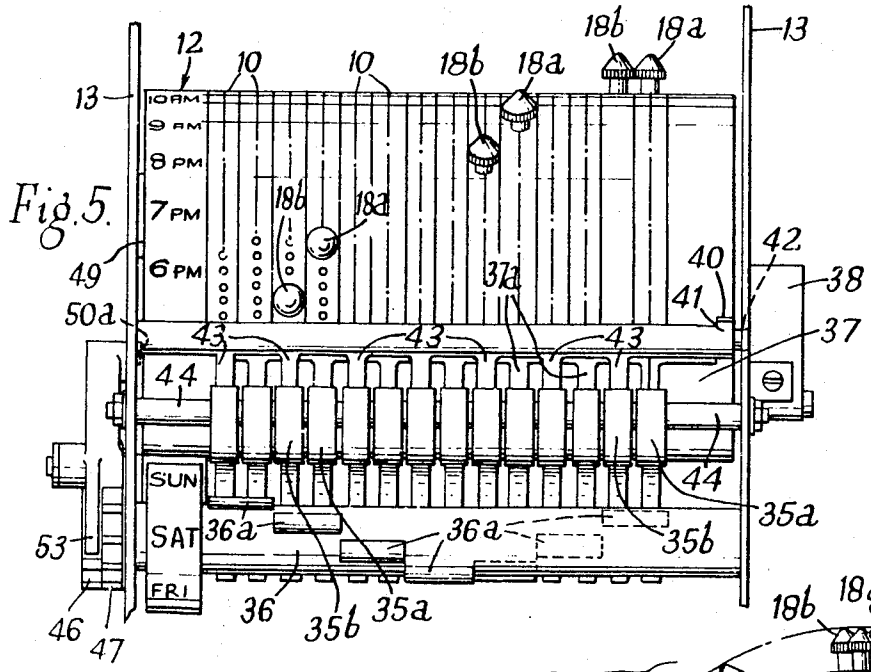


Fig. 6.

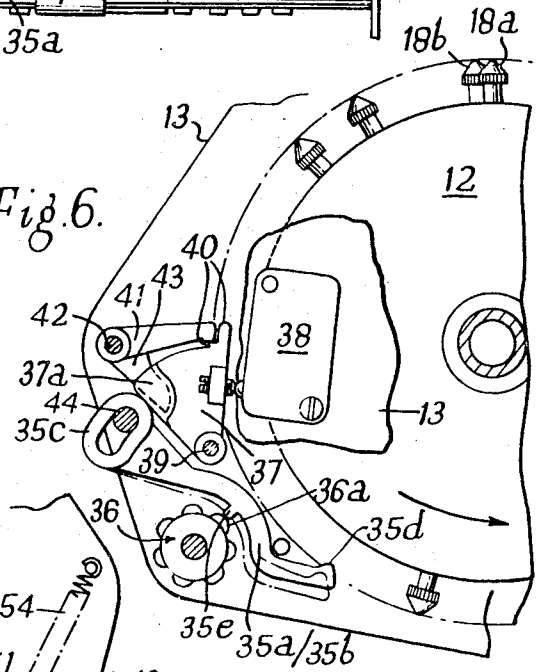
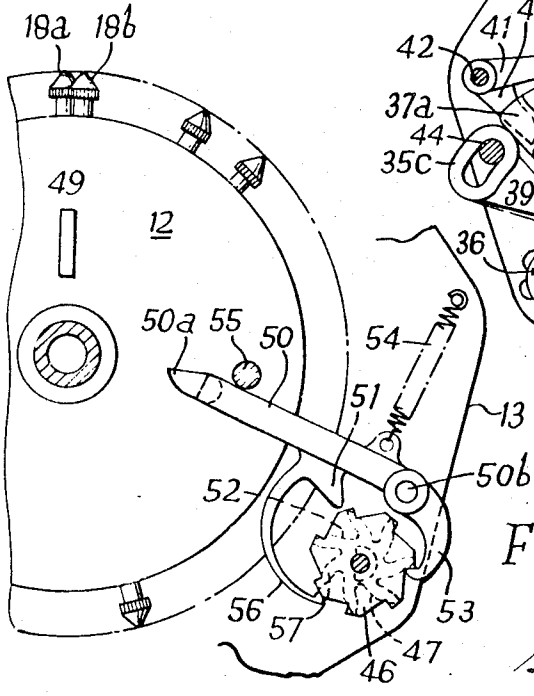


Fig. 7.



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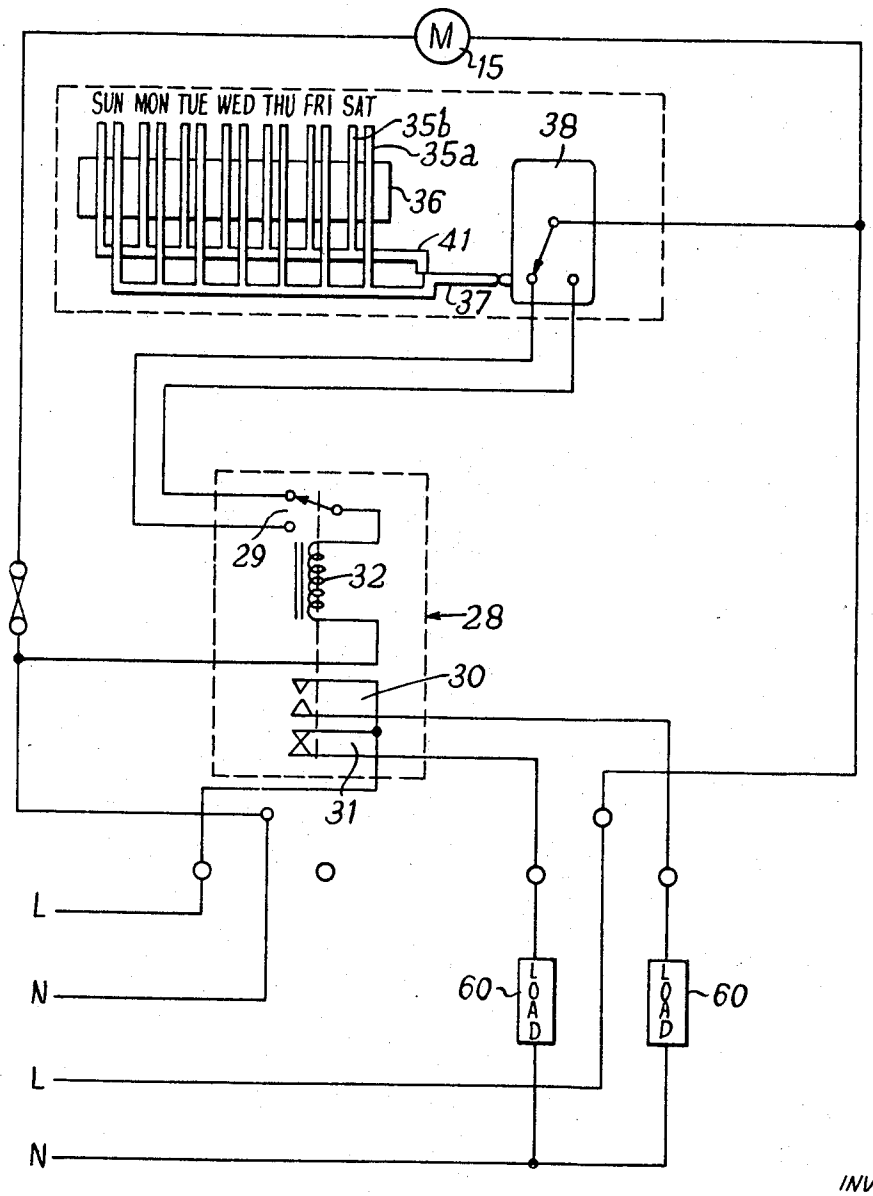
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Fig. 8.



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Fig. 9.

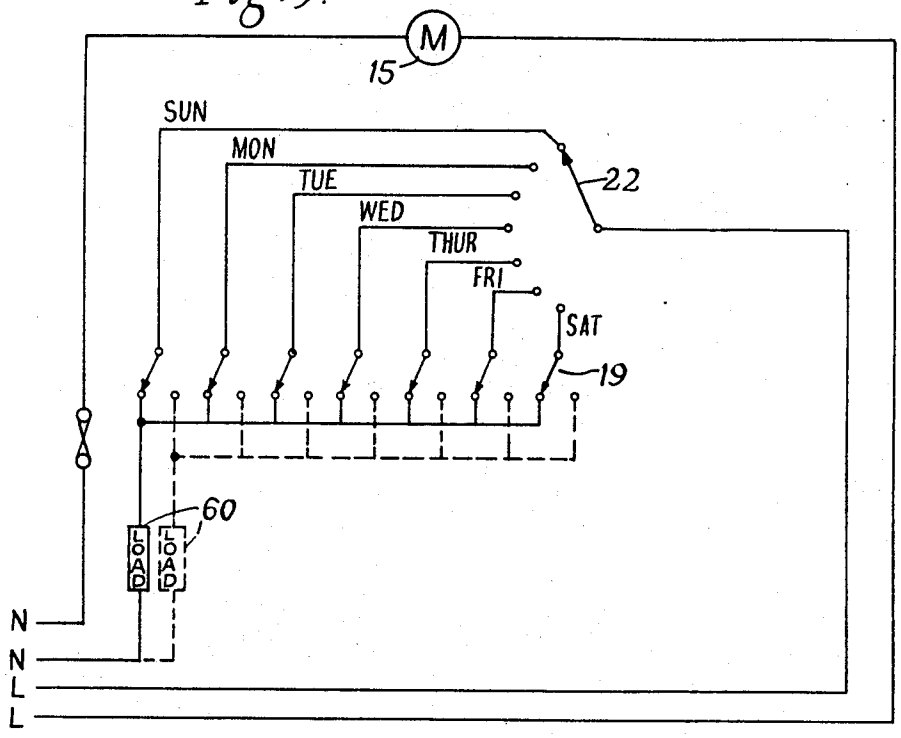
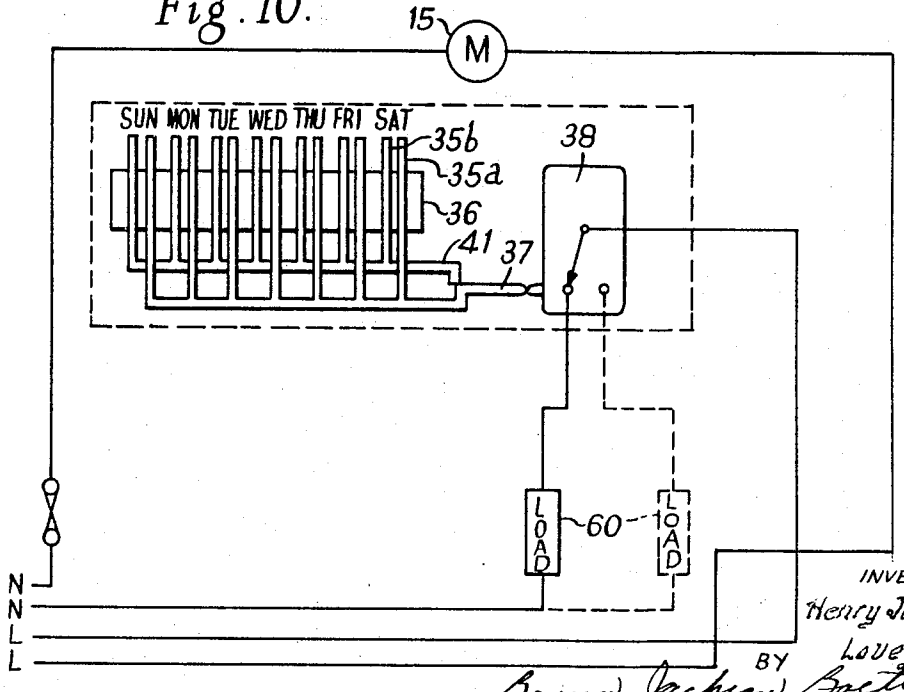


Fig. 10.



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United States Patent Office 3,413,425
Patented Nov. 26, 1968

3,413,425

ELECTRIC TIME SWITCHES

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Filed Oct. 27, 1965, Ser. No. 505,327
Claims priority, application Great Britain, Oct. 30, 1964, 44,417/64
12 Claims. (Cl. 200—38)

ABSTRACT OF THE DISCLOSURE

A switch mechanism for controlling one or more electric circuits in timed relation comprising a plurality of continuously rotatable annular tracks disposed in axially paired relation, a plurality of switch operating abutments disposed in selected spaced relation about the peripheries of the tracks, first switch means operatively associated with each pair of tracks through lever rockers movable by the abutments, second switch means associated with the first switch means for controlling an electric load circuit, and an electric selector switch operative through pawl and ratchet means for selectively establishing electrical connection between the first and second switch means.

This invention relates to electric time switches and is more particularly concerned with arrangements for providing a plurality of time-controlled switching operations each of which is independently variable with regard to its time of occurrence such as, for example, a seven-day time switch allowing independent setting of the switch-on and switch-off times on each of the seven days of a week.

Known forms of time switch designed to have a seven-day switching program usually comprise a dial which rotates once during the whole of the seven-day period and in order to accommodate at least two adjustable switch operating targets on each of the sections assigned to the different days of the week, the diameter of such dial must necessarily be large if reasonably easy setting and accuracy of timing is to be achieved.

One object of the present invention is to provide an alternative form of such a time switch which avoids the use of a large diameter dial and which is easy to set, which has a high degree of setting accuracy and which permits, if necessary, a number of successive switch operations in each unit, e.g. day time period. Other objects include the provision of a device which is readily usable or adaptable to provide a plurality of separate time switch programs which may be used selectively to control a single circuit or simultaneously to control a number of independent circuits.

According to the invention there is provided a time switching mechanism comprising a continuously rotating member including a plurality of separate circular tracks in coaxial relationship with each other, each track being arranged to carry at least one switch operating abutment or target adjustable in position therearound, timing means for continuously rotating said rotatable member at a uniform speed once during each of a plurality of successive time cycles of equal duration, stationary electric switch means, and a plurality of separate electric switch operating members associated one with each of said tracks and each arranged to be capable of operating said switch means by engagement thereof with an abutment or target in such track.

The aforesaid circular tracks are preferably arranged in pairs for operating the said electric switch means to a first of two alternative switching positions by means of an abutment or target in one track and to the second of the alternative switching positions by means of an abutment or target in the other track.

In one form of the invention a plurality of separate switches are provided, one for control by each of the pairs of tracks. Such switches may be arranged each to control an associated separate electric circuit thereby, to provide simultaneous time switch control of an equivalent number of circuits each according to its own chosen program. Alternatively, by means of a multiple position selector switch, any one of said plurality of separate track-operated switches may be connected into a single time-controlled switching circuit to provide time-switch control according to any chosen one of the plurality of programs as set up by the positions of the targets in the different pairs of tracks. Such multiple position selector switch may be arranged to be operated in step-by-step manner by each revolution of the rotating track carrying member so as to provide a predetermined sequence of switching programs, e.g. one for each day of a week.

In another form of the invention only a single two-position electric switch is employed and this is arranged to be placed under the operational control of any one of the pairs of tracks by adjustment of the position of intermediate selector mechanism. Such selector mechanism may be arranged for manual control to allow choice of any one of the different switching programs as defined by the target positions in the different pairs of tracks or, as with the aforementioned selector switch, it may be arranged to be altered automatically step-by-step with each complete revolution of the rotating track-carrying member to provide a predetermined sequence of switching programs.

In order that the nature of the invention may be better understood several practical embodiments thereof will now be described by way of illustrative example and with reference to the accompanying drawings in which:

FIGURE 1 is an elevational view of one embodiment in which the outer casing has been removed and part of the drum-like rotatable member cut away.

FIGURE 2 is a side elevation of the structure shown in FIGURE 1.

FIGURES 3 and 4 are electrical circuit diagrams illustrating the alternative use of the mechanism shown in FIGURES 1 and 2 as a time switch providing a seven day switching program and seven separate switching programs per day respectively;

FIGURE 5 is a fragmentary elevational view, similar to FIGURE 1, of an alternative embodiment of the invention using only a single time-controlled switch.

FIGURE 6 is a side elevation of the mechanism shown in FIGURE 5 as viewed from the right;

FIGURE 7 is a side elevation, similar to FIGURE 6, of the mechanism of FIGURE 5 as viewed from the left.

FIGURE 8 is a circuit diagram, similar to FIGURE 3, and applicable to the embodiment of FIGURES 5–7 while

FIGURES 9 and 10 are circuit diagrams illustrating simplified arrangements in which the controlled switches of the mechanisms of FIGURES 1 and 2 and FIGURES 5–7 effect direct switching of their respective loads.

Referring first to FIGURES 1 and 2, the device shown comprises a bank of fourteen rings **10** of moulded plastic material assembled in coaxial and clamped relationship between two circular end plates **11** to form a drum-like member **12** which is rotatable about its longitudinal axis on bearings carried by fixed brackets **13** projecting from a stationary housing **14**. Timing means **15**, which may be either in the form of a synchronous electric motor, a manually wound storage spring or an electric motor wound storage spring, is mounted inside the member **12** and is arranged to rotate the latter at a uniform speed of one revolution every 24 hours. If a manually wound spring is employed as the timing means **15**, this may be wound through a hollow axle **16**.

The rings **10** are arranged as seven pairs, i.e. one pair

for each 24-hour or day period and each ring **10** is provided with a number of radially directed holes **17** equally spaced around its outer surface to accept switch operating abutments or target pins **18** as required, the number of different positions provided on each ring being conveniently 96 to provide for switching control at any 15-minute interval of the 24-hour unit time period.

The drum-like rotatable member **12** rotates in front of the housing **14** and upon the latter is secured seven single-pole change-over switches **19**, each switch being adapted to be moved to one position by means of any target pin **18** in one of the two rings of a related pair of rings **10** and to be moved to its opposite position by any target pin in the other ring of the same pair. Such switches are conveniently of the rocker-bar type. Each pair of adjacent rings **10** accordingly can be used to provide one or more switching-on and subsequent switching-off operations of the related switch **19** during each 24-hour period.

One of the end plates **11** of the rotatable drum member **12** carries a projecting pin **21** adapted to engage and move a lever arm **70** which is pivoted at **71** on the housing **14** and biased by means of spring **72** in an anti-clockwise direction, FIGURE 1. Upon this lever arm **70** is mounted a pawl **73** spring biased into engagement with a seven-toothed ratchet wheel **74** secured to the operating shaft **75** of a seven position rotary selector switch **22** which is mounted in the housing **14**. During each revolution of the drum member **10**, the pin **21** engages and lifts the lever arm **70** thereby to raise the pawl **73** to engage the next tooth of the ratchet wheel **74**. When the pin **21** eventually slips from beneath the arm **70** the spring **72** returns the arm to its lowermost position and simultaneously advances the switch **22** by one step. The position of the pin **21** on the member **12** is such that each switch stepping operation takes place at a chosen time instant, say midnight, of each day.

A time scale **23** provided on one of the end plates **11** co-operates with a time index **24** secured to the adjacent bracket **13** to ensure correct setting of the member **10** with reference to local time. One or each of the end plates **11** is preferably also provided around its circumferential edge surface with a further time scale **25** to facilitate setting of the target pins **18** while a further fixed indicator plate **26** allows ready identification of the particular ring **10** assigned to "on" or "off" switching on the different days of the week. A rotatable indicator disc **27** secured to the shaft **75** of the switch **22** is rotated once per week in the above described step manner at each midnight time instant and indicates the particular pair of rings **10** effective at any given time. The drum member **12** is arranged to be capable of being rotatable manually in the forward direction to allow correct setting thereof with relation to local time by the provision of a friction clutch **20** between the timing means **15** and such member **12**.

Within the housing **14** is located an electromagnetic impulse contactor **28** arranged to be operated through the switches **19** and itself controlling one or more load circuits by its own contacts.

As shown in FIGURE 3, the seven-position stepping switch **22** serves to connect each one of the seven change-over switches **19** into the circuit of the operating coil **32** of the contactor **28** in turn, such circuit including a further change-over switch **29** which is linked to and controlled by the position of the contactor plunger. The contactor **28** is shown as having alternative pairs of heavy current contacts **30, 31** one being open while the other is closed and vice versa to provide change-over control of two loads.

As will be evident from the description so far given, upon continuous operation of the timing means **15** a first one of the single pole change-over switches **19** will be connected in circuit by means of the selector switch **22** during the period of one day of the week, for example, Sunday, so that upon reversal of the position of such a switch **19** by an "on" target pin **18** in the first ring **10** of the first pair of rings, the contactor operating coil **32** will be momentarily energized and the contactor shifted to its opposite switching position. The consequent movement of switch **29** prepares for subsequent reversal of the switch **19** when it is engaged by an "off" target pin **18** of the adjacent ring **10** of the same pair. This again reverses the contactor **28**. As many target pins **18** as desired may be inserted into each ring **10** to cause a plurality of switching operations during any 24-hour unit time period. At midnight on the first day the switch **22** is operated forwardly by one step to put the second change-over switch **19** into operation instead of the first whereby the contactor **28** will now be controlled according to the setting of the target pins **18** in the third and fourth, i.e., the second pair of rings **10**. On subsequent days of the week each of the other pairs of rings **10** become effective in turn in like manner.

The device so far described, suitable for providing a seven-day switching program in which the program for each day may be quite independent of those for the other days, may readily be modified for other uses. Thus, if the seven-position selector switch **22** is arranged for direct manual operation through an external control knob instead of automatically by each rotation of the member **12**, a series of seven alternate switching programs are made available on a daily basis for a single load circuit or a pair of load circuits. Such a device is suitable, for instance, for providing a range of different operation cycles in a domestic or other central heating system using gas, oil or electric power. Another modification, shown schematically in FIGURE 4, resides in the omission of the selector switch **22** and the provision of external connection terminals for each of the switches **19** whereby seven separate load circuits or pairs of load circuits may be controlled simultaneously on a daily basis.

Referring now to FIGURES 5 to 8 which illustrate a second embodiment of the invention, the drum-like member **12** is arranged to rotate once per day as before and has "on" and "off" target pins **18***a* and **18***b* positioned respectively in each pair of rings **10** to provide "on" and "off" switching.

The pins **18***a*, **18***b* of each pair of rings **10** are arranged to co-operate with corresponding rocker arms **35***a*, **35***b* respectively. Each rocker arm **35***a*, **35***b* is shaped with an eye **35***c* at one end, a pin-engaging nose **35***d* at its opposite end and a fulcrum projection **35***e* at an intermediate position opposite a selector cam roller **36** which is mounted in the brackets **13** for rotation about an axis parallel to that of the member **12**.

The arms **35***a*, **35***b* are supported by a horizontal rod **44** passing through the respective eyes **35***c* with each arm in alignment with the rotational path of the related target pins **18***a*, **18***b*. The cam roller **36** is provided with seven proud portions **36***a* which are spaced axially to align respectively with the seven pairs of rocker arms **35***a*, **35***b* and which are also angularly displaced relative to one another whereby, in any adjusted position of the cam roller **36**, only one portion **36***a* can be located beneath the fulcrum projections **35***c* of one pair of rocker arms **35***a*, **35***b*.

Rotation of the various target pins **18***a*, **18***b* will be ineffective on all of the rocker arms **35***a*, **35***b* except the pair whose fulcrum projections **35***c* are resting upon a portion **36***a* of the cam roller **36** owing to the nose ends **35***d* of such other arms being lowered below the level of the pin heads. With the operative or raised pair, however, the "on" target pin **18***a* is adapted to strike the nose end **35***d* of the arm **35***a* thereby rocking the latter about the fulcrum projection **35***e* to bring the other end **35***c* of this arm into contact with an aligned arm **37***a* which is formed integrally with six other similar arms and a switch operating sector plate **37** as a horizontal element pivotally mounted in the end plates **13** for rocking movement about the pivot axis **39**. The resultant movement of the engaged arm **37***a* is transmitted to the sector plate **37** which in turn

operates a single pole change-over micro-switch **38**. The sector plate **37** has a shoulder **40** behind which a pawl arm **41** engages to latch the sector plate and this holds the switch in its altered position even when the rocker arm **35***a* is released by onward movement of the target pin **18***a*. The pawl arm **41** is formed integrally with a group of seven release arms **43** as a further horizontal element which is pivotally mounted in the end plates **13** for rocking movement about the pivot axis **42**. The various arms **43** lie in alignment with the related rocker arms **35***b* of each pair. The "off" target pin **18***b* is adapted to engage and move the nose end **35***d* of the arm **35***b* which bears by its opposite eye end **35***c* against the aligned arm **43**, thereby lifting the pawl arm **41** and releasing the sector plate **37** to return the switch to its original position.

Selection of the particular pair of rocker arms **35***a*, **35***b* to be operative at any time is effected by rotating the day selection cam roller **36**. As in the previous embodiment, change of position of this roller is preferably arranged to take place at midnight of each day and in no way alters the then-existing condition of the micro-switch **38** as the eye parts **35***c* of the arms in that region merely pivot about the rod **44**.

The mechanism for automatically rotating the day selection cam roller **36** is shown generally in FIGURE 7. Such mechanism is mounted at the end of the drum-like member **12** opposite that of the switch **38** and comprises a seven-tooth ratchet wheel **46** and a seven-tooth stop wheel **47** both secured to the spindle of the cam-roller **36**.

An axially projecting ear **49** on one side face of the drum-like member **12** and corresponding to the projecting pin **21** of FIGURES 1 and 2, engages the free end **50***a* of a day change lever **50** pivoted at **50***b* on the adjacent end plate **13** while a horn **51** on the lever **50** meshes with a notch **52** on the ratchet wheel **46** to prevent the latter turning backwards. Simultaneously a resilient pawl **53** integral with or fixed to the day change lever **50** commences to ride over a tooth of the ratchet wheel **46**.

A tension spring **54** connected between the lever **50** and a fixed anchorage point becomes tensioned by the movement of the lever **50** and provides the force which returns the day change lever to its rest position when it is so released from behind the ear **49**; the pawl **53** which has become engaged behind the next tooth of the ratchet wheel then rapidly turns the latter and the combined day selection cam roller **36** by one step. To prevent continued rotation of this assembly owing to inertia after the day change lever has come to rest against a fixed stop member **55**, locking arm **56** fixed to or integral with the lever **50** carries a pawl end which engages a step **57** on the stop wheel **47** locking it and the rest of the assembly until the next cycle when the day change lever is again operated.

The circuit diagram of this embodiment is shown in FIGURE 8 and closely resembles that of the first embodiment shown in FIGURE 3 in both construction and manner of operation apart from the omission of the selector switch **22**. In either circuit arrangement additional means, such as a manually operable push button switch, may be provided for altering the position of the contactor **28** independently of the program set by the drum **12**. The two ("on" control and "off" control) rings **10** of each pair in either embodiment may be of different colors for easy identification.

While the particular examples described are arranged to operate with a total program period of one week in seven successive 24-hour or day unit time periods, it will be clear that each revolution of the drum which defines the unit time period may take place in any chosen period of time, e.g., 1 hour or 12 hours while the number of successive unit time periods may similarly be altered by increasing or decreasing the number of pairs of target-receiving rings with corresponding alteration of the number of stepping positions of the selector switch **22** or the cam roller **36**. The number of target positions in each ring may likewise be altered as required. The form of the contactor **28** and the number of load circuits controlled thereby may obviously be modified to suit different requirements.

It is not essential for either of the embodiments to control the external load circuits through contactors as shown in FIGURES 3 and 8. They may be connected directly to loads **60** within the capacity of the switches themselves as shown in FIGURES 9 and 10.

I claim:

1. Electric time switching mechanism for use with a time controlled switching circuit and the like comprising a continuously rotatable member including a plurality of separate circular tracks in co-axial relationship with each other, each track carrying at least one switch operating abutment adjustable in position therearound, timing means disposed within said rotatable member for continuously rotating said rotatable member at a uniform speed once during each of a plurality of successive time cycles of equal duration, stationary electric switch means, a plurality of separate electric switch operating members associated one with each of said tracks and each adapted to operate said switch means by engagement thereof with an abutment in such track, and means operatively associated with said rotatable member for placing the time controlled switching circuit under the operational control of selected pairs of said tracks in time phase relation with rotational movement of said rotatable member.

2. Electric time switching mechanism according to claim **1** in which said plurality of tracks are arranged in pairs for operating said electric switch means to a first of two alternative switching states by means of an abutment in one track and to the second of said alternative switching states by means of an abutment in the other track.

3. Electric time switching mechanism according to claim **2** in which said electric switch means comprises a plurality of separate electric switches associated one with each of said pairs of tracks.

4. Electric time switching mechanism according to claim **3** wherein said means operatively associated with said rotatable member includes a multiple position electric selector switch operatively associated with said rotatable member and adapted to connect any one of said plurality of separate electric switches into the time controlled switching circuit.

5. Electric time switching mechanism according to claim **2** wherein said electric switch means comprises a single electric switch, and wherein said means operatively associated with said rotatable member includes selector mechanism for placing said single switch under the operational control of any chosen one of said pairs of tracks.

6. Electric time switching mechanism according to claim **5** wherein said means operatively associated with said rotatable member further includes pawl and ratchet means operable during each revolution of said rotatable member at a predetermined angular displacement position thereof for altering said selector mechanism so as to effect time control of the switching circuit in accordance with abutment positions in different pairs of tracks.

7. Electric time switching mechanism according to claim **4** wherein said means operatively associated with said rotatable member includes pawl and ratchet means operable during each revolution of said rotatable member at a predetermined angular displacement position thereof for altering said selector switch so as to effect time control of the switching circuit in accordance with abutment positions in different pairs of tracks.

8. Electric time switching mechanism according to claim **5** wherein said selector mechanism includes a rotatable cam-roller having a plurality of axially spaced projections thereon, each of said projections corresponding to a pair of said tracks, and wherein said switch

operating members comprise rocker arms pivotally supported in selected pairs such that each pair of rocker arms is selectively movable into operative position through engagement with an associated one of said cam-roller projections.

9. Electric time switching mechanism according to claim **6** wherein said selector mechanism includes a rotatable cam-roller having a plurality of axially spaced projections thereon, each of said projections corresponding to a pair of said tracks and adapted to engage corresponding switch operating members, said cam-roller being rotatable through said pawl and ratchet means, and said rotatable member having an abutment thereon adapted to actuate said pawl and ratchet means.

10. Electric time switching mechanism according to claim **2** wherein said timing means comprises a synchronous electric motor.

11. Electric time switching mechanism according to claim **2** wherein each circular track has a plurality of

equidistantly spaced radially directed holes on its outer rim to accept removable abutments.

12. Electric time switching mechanism according to claim **11** in which each of said tracks is constituted by a separate ring shaped element.

References Cited

UNITED STATES PATENTS

1,245,485	11/1917	Martyn	307—141
2,212,868	8/1940	Strong	200—38
2,504,002	4/1950	Crum	200—38X
2,580,787	1/1952	Johnson	307—141.8
2,992,299	7/1961	Saunders	200—38
3,198,967	8/1965	Roberts	307—141.4
3,215,791	11/1965	Fontaine	200—38

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