

Sept. 22, 1959

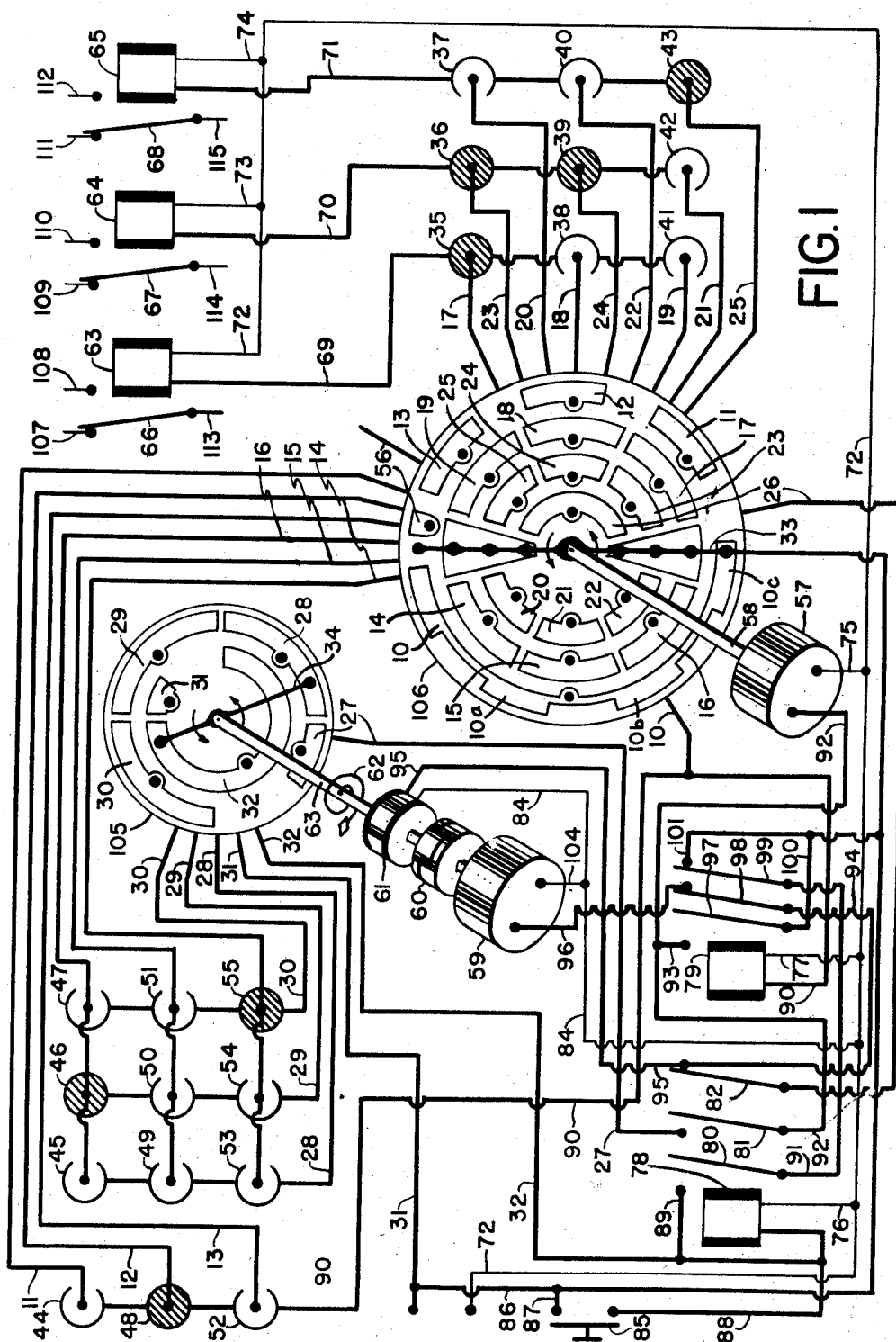
H. G. DIETZ

2,905,239

MULTIPLE CIRCUIT TIMER WITH ADJUSTABLE TIME INTERVALS

Filed Sept. 30, 1954

2 Sheets-Sheet 1



Sept. 22, 1959

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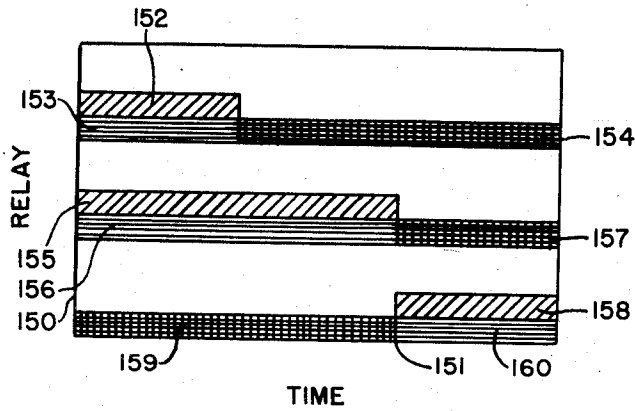
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2 Sheets-Sheet 2

FIG. 2



RELAY ENERGIZED
NORMALLY OPEN CONTACTS
NORMALLY CLOSED CONTACTS

FIG. 3

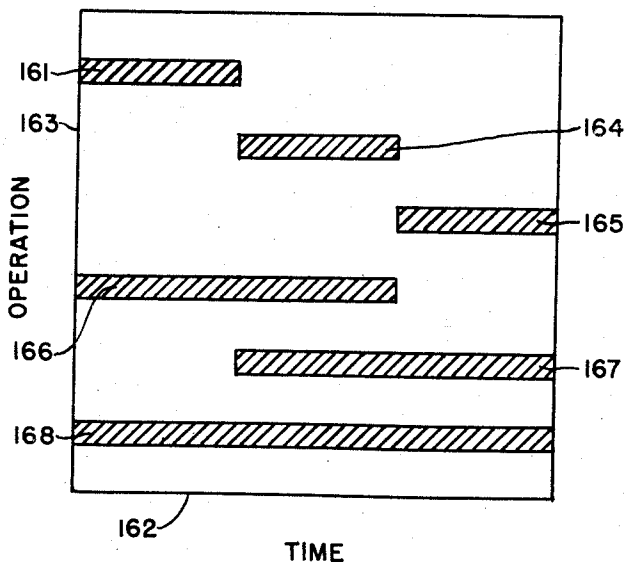
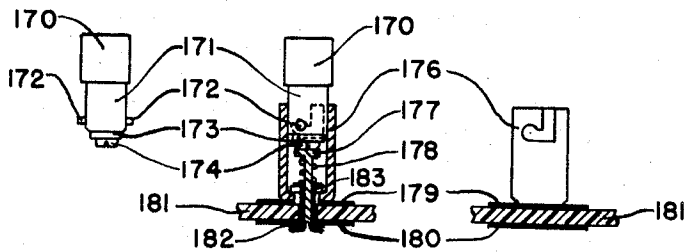


FIG. 4



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MULTIPLE CIRCUIT TIMER WITH ADJUSTABLE TIME INTERVALS

Henry G. Dietz, Forest Hills, N.Y., assignor to Henry G. Dietz Co., Inc., Long Island City, N.Y., a corporation of New York

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11 Claims. (Cl. 161—1)

This invention relates to automatic control apparatus and is more particularly concerned with timers having multiple circuits.

The primary object of the invention is to provide a timer with multiple circuits that has the ability to vary, correct, add or eliminate one or more time intervals independently without changing any of the other preselected time intervals.

A further object of the invention is to provide a timer suitable for use with complicated processes and methods of manufacture which consist of varied individual timed operations following a preselected sequence or formula.

An undesirable feature found in present multiple circuits timers now in existence is that, although they have circuits capable of being independently varied without having changes affected in other circuits, they require all of the circuits to be changed everytime a single time interval is corrected, added or eliminated.

It is, therefore, an object of my invention to make it possible to change time intervals which affect only the circuits desired and which do not require manual changes to be made in all the other circuits.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings in which:

Figure 1, the wiring diagram presents in simple form means for explaining the principles of operation of my invention.

Figure 2 is a graphical presentation of the operation of relays in Figure 1 to show how each relay may be preselected for energized operation for any one or more time intervals.

Figure 3 is a graphical presentation of the multiple circuits obtainable from Figure 1, and clearly indicates a method of expanding the functions of a few relays to the equivalent functions of a larger number of relays than contained in the timer shown in Figure 1.

Figure 4 is a composite group of views including: A front elevation of one of the shorting plugs used in conjunction with the apparatus shown in Fig. 1, including the metal cup and the bayonet lock pins projecting radially outward therefrom. The right-hand section of Fig. 4 is a composite front elevation of the shell which is provided to receive and support the shorting plug, also a vertical section through the base and the metal foil elements attached thereto.

The central portion of Fig. 4 represents a schematic composite assembly of the shorting plug, including a vertical section through the base thereof and the metal foil elements attached thereto, also showing the means provided for connecting the two metal foil sections when the shorting plug is inserted into the shell and locked in place. It is composed of the component parts 35 through 39, and 40 through 55 (shown in Figure 1) and illustrates one of the ways of making connections in the desired circuits by means of an inexpensive component.

With reference to the drawing Figure 1, my invention

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comprises in general; a switch 106, and a timer 105, which are both motor driven; a zero time selection circuit preselected by component parts 44, 48, and 52; a time selection circuit preselected by component parts 45, 46, 47, 49, 50, 51, 53, 54 and 55; relays 78 and 79 which control the operation of timer 105, switch 106, motors 59 and 57, and clutch 61, after switch 85 is momentarily closed; a relay selection circuit which preselects any one or more time intervals for any one or more of the relays 63, 64, and 65, which are preselected by the component parts 35 through 43.

The construction of commutators (timer) 105 and (switch) 106 of Figure 1 are fabricated of a suitable sheet of material possessing excellent dielectric insulating properties. On each side of the material a highly conductive foil is bonded to create a facsimile of the desired circuit accomplished by use of either the additive or subtractive processes of printed circuits which are well known to the prior arts and can be economically fabricated.

Figure 4 indicates how the component parts 44 through 55, and 35 through 43 may be constructed. The base 181 is a dielectric material possessing excellent insulating properties having a highly conductive metal foil 179 and 180 bonded to each side. An eyelet 182 is used to fasten insulating washer 183 and component shell part 176 (similar to a bayonet base type shell) to the base 181. Component shell part 176 is electrically connected to foil 179. The hollow end rivet 177 is placed through spring 178, and after passing through the eyelet 182, the hollow end is pressed over making electrical contact to foil 180. The shorting plug (170, 171, 172, 173, and 174) consists of a top 170 (made of plastic or other similar insulating material) inserted into a metal cap 171 (similar to a bayonet type lamp base) provided with locking pins 172. A screw 174 is placed through washer 173 and is screwed into a tapped hole in top 170. Placing the shorting plug into the shell, then depressing and turning it with a circular twist, results in the assembly being locked into place, and connecting foil 179 and 180 together.

Referring to Figure 1, it will be noted that a light line is used to connect; one lead of the coil of relays 78, 79, 63, 64, and 65; one lead of the motors 59 and 57; and one lead of clutch 61; hence this line renders it easy to denote the one side of the power line connection to terminal 72. The other side of the power line connection is made to terminal 31 and is represented by a heavy line which is broken by switches or contacts of relays which are wired in series to any motor or relays which are capable of being energized in Figure 1.

Momentary closing of switch 85 results in power lines 88 and 72 energizing coil 78, which is instantly locked in the energized position by normally open contact 80 if relay coil 79 is not energized. When coil 78 is energized, motor 57 rotates in a counter-clockwise direction as shown by the arrow on commutator (switch) 106, providing the circuit 92 is completed through connections made from normally open contact 81, wire 27, switch contact 27, shorting contact arm 34 (whose normal position when not energized is such as to result in contact 27 and 31 being shorted together, both being located on diametrically opposite sides of the timer commutator), which completes the circuit to terminal 31 through switch contact 31. As the relay coil 79 is directly connected to the sockets represented by the left-hand vertical row of components 44, 48, 52, relay coil 79 is energized only when a plug is inserted in one of the left-hand sockets, such as component 48. When no plug is inserted in any of the left-hand sockets relay coil 79 is de-energized, unless relay 79 receives its current from the line 10, which is connected to the saw-tooth contact 10 of the switch commutator 106. Relay coil 78 remains energized until relay coil 79 is energized. Relay coil 79 is energized

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when the wiping contact arm 33, which is rotated by the switch motor 57 reaches the angular position at which it engages contact 10. When relay coil 79 is deenergized it breaks the circuit between relay contact 80 and line 89, thereby energizing coil 78.

While all of the other contacts shown in the switch commutator 106 shown in Fig. 1 are indicated as short individual segments, the long band 10 which is interrupted by a series of gaps cut through the outer portion thereof, thus breaking the band up into a series of radial segments 10, 10a, 10b, and 10c, which are separated by the gaps through the outer portion thereof.

In the first step in the operation of the switch commutator 106, when the wiping contact arm 33 reaches the upper edge of segment 10, the motor 57 is energized in a manner hereinafter described in greater detail.

In order to bridge the gap between segments 10, 10a, 10b and 10c, and the overlapping segments 14, 15 and 16 on the switch commutator 106, when the wiping contact arm 33 reaches the gap between segments 10 and 10a, the rotation of the contact arm is stopped if no shorting plug is inserted in socket 46.

As the socket 46 is connected to segment 29 of the timer commutator and segment 14 of the switch commutator, the rotation of the contact arm 33 will be arrested when the contact arm reaches the end of segment 10a.

If however a plug such as that inserted in socket 48 is used, the motor 57 will continue to move the arm 33 until the contact is transferred from segment 15 to saw tooth segment 10b, which represents the start of the third time interval.

Fig. 1 shows an overlap between the gaps between the three outer segments 10, 10a and 10b, and the adjacent row of segments 14, 15 and 16, so that the current to the wiper contact arm can flow either through the outer segments 10, 10a and 10b, or through the next row of segments 14, 15, and 16, where continuous operation is desired. Thus if no intermediate time interval is desired the sockets connected to the segments 14, 15 and 16, will enable the wiping contact arm to bridge the gap between the outer saw tooth segments 10, 10a and 10b.

If a time interval is desired at any of these points, a plug is inserted into a socket connected to segment 14, or one of the other intermediate segments, thus establishing contact between segment 14 and one of the segments such as 29 on the timer commutator. Details of these operating steps for each time interval are hereinafter described. While the segmental contact 10 is continuous, there are breaks between the outer portions of the segment, between segments 10a, 10b, 10c respectively, thus enabling the circuit to be broken at the outer portion of the segmental contacts 10a, 10b, 10c.

The rotation of the contact arm 33 of the switch commutator is normally arrested, when the contact arm reaches one of the gaps between the outer portion of the segments 10a, 10b, 10c, unless a plug is inserted in one of the sockets represented by one of the three rows of sockets shown at the left-hand side of Fig. 1. If a plug is inserted in one of the sockets representing a particular time interval, such as those represented by the vertical rows 45, 46, 47 of the components, the rotation of the contact arm 33 is continued, under control of the second row of segments 14, 15, 16, on the face of the commutator switch 106, which overlap the gaps between the segments 10a, 10b, 10c, of the outer saw-tooth segment 10.

When wiping contact arm 33 is rotated by motor 57 to a position where the upper portion of the wiping contact arm 33 engages the outer radial contact 10, the wiping contact arm 33 completes the circuit through contact 10 from terminal 31 through wire 86, which is connected directly to the wiping contact arm 33 which is directly connected to the wiping contact arm 33 of the switch commutator, it causes coil 79 to be energized,

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which results in normally open contact 97 closing and thus supplying power through the line 92 to keep motor 57 operating so long as wiping contact arm 33 is completing the circuit through contact 10 on commutator (switch) 106. While the wiping contact arm 33 of the switch commutator 106 is in engagement with contact 10, the switch motor 57 no longer receives current through the normally open contact 81 of the relay whose coil 78 is no longer energized. When wiping contact arm 33 reaches the position where contact 10 is no longer completing the circuit, motor 57 stops, and, synchronous motor 59 and electrically energized mechanical clutch 60 (which is energized by its coil 61) operate. Synchronous motor 59 and clutch 60 and coil 61 operate since they are supplied power through connections made from wire 96, the normally closed contact 98, wire 94, normally closed contact 82, wire 26 and contact 26 on commutator (switch) 106 which completes the circuit through wiping contact arm 33 to terminal 31. The synchronous timer motor 59 operates only when relay coils 78 and 79 are both deenergized.

Contact 26 on commutator (switch) 106 provides for operation of synchronous motor 59 of the timer commutator, only when wiping contact arm 33 is moved from the position shown in Figure 1 which is the normal position when the timer is not in operation or when the timer has completed a cycle of operations, to another angular position, in which the contact arm 33 is in engagement with the long segmental contact 10 and contact 26, of the switch commutator.

The length of time that synchronous motor 59 runs is determined by what plug is inserted in components 45, 46, and 47. Figure 1 shows component 46 shorted out by means of a plug as illustrated in Figure 4. The simplified circuit Figure 1 provides for three time intervals only, which are presented by the three horizontal rows of components; first row 44, 45, 46, 47 is the first time interval; second row 48, 49, 50, 51 is the second time interval; third row 52, 53, 54, 55 is the third time interval of which the first component 44, 48, 52, or socket in each row, represents a zero time interval. The first vertical row 44, 48, 52 represents zero time adjustment, and shorting out any one or more of these result in dropping out any of the corresponding time intervals. How this is accomplished will be described later. The second vertical row of components 45, 49, 53 represents a short time adjustment; the third row of components 46, 50, 54 a medium length time adjustment; and the fourth row of components 47, 51, 55 a long time adjustment. Therefore, it is possible to use one shorting plug in each horizontal row to adjust the length of time for each individual time interval.

Figure 1 illustrates a shorting plug inserted in component 46. The socket or component 46 into which the shorting plug is inserted is connected by line 29 to the contact 29 on the timer commutator. The component 46 is also connected to contact 14 on the switch commutator by means of line 14, as shown in Fig. 1. Thus when a shorting plug is inserted into the socket 46 in the manner shown in Fig. 4, a direct contact is established between segment 29 on the timer commutator and contact segment 14 on the switch commutator in the manner shown in Fig. 1. Thus when the synchronous motor 59 turns shaft 63 through clutch 60 when clutch coil 61 is energized, contact arm 34 will move in a counterclockwise direction as indicated until a connection is made from contact 32 to contact 29, the arc of contact 32 subtending a large angle representing an angle of approximately 270° which results in coil 78 becoming energized due to wire 29 being connected to wire 14 by shorting plug and socket 46, wire 32, which is directly connected to the long segmental contact 32 being directly connected to the coil 78, thus completing connection to contact 14 which is connected to wire 86 by wiping contact arm 33 which is in a position directly over contact

14 by the previously described operation. Thus a time of desired length has been preselected for the first time interval, and this desired time has been accurately determined by means of the angular rotation of contact arm 34 which has travelled a fixed number of degrees or a fixed rate of part of one revolution per minute. This rate of rotation of a synchronous motor is very accurate and need not be described here. In like manner, a time adjustment can be provided for any other time interval or intervals.

When the above cycle of operations is completed, wiping contact arm 33 will move to the next position over contact 15 in a manner exactly similar to that already described for the first time interval.

The circuits described for three time intervals can be expanded to any number of time intervals and the time adjustments can be expanded to provide any number of time adjustments.

To eliminate or drop out the second time interval, a shorting plug is inserted in component 48, which connects wire 90 to coil 79, which is energized when wire 12 connected to contact 12 through wire 86 receives line voltage from terminal 31, through wiping contact arm 33 which has moved in a counterclockwise position from the first time interval. Wiping contact arm 33 moved when motor 57 was energized as a result of the completion of the first time interval which resulted in coil 78 being energized and locked in the energized position through normally open holding contact 80 when wire 32 was connected to contact 29 by contact arm 34 of the timer commutator 105, as previously described. Energizing coil 78 opened normally closed contact 82, opening circuit 95 to clutch coil 61, opening clutch 60, which resulted in spring 62 rotating shaft 63 in a counterclockwise direction until contact arm 34 was in a position directly over contacts 27 and 31. Contact 27 is one of the outer radial contacts of the timer commutator 105. Contact 34 which is located in the second circumferential row of timer commutator contacts is located on a diametral line connecting contacts 27 and 31, so that when the lower portion of the contact arm 34, Fig. 1, is in engagement with contact 27, the upper portion of the contact arm 34 opposite the center of rotation thereof is in engagement with contact 31. The full counterclockwise rotation is stopped at this location by a mechanical stop.

At this position of contact arm 34, motor 57 is energized by wire 92, contact 81 (which is closed due to 78 being energized), through wire 27, contact 27, contact arm 34, contact 31 of the timer commutator 105, to terminal 31. When wiping contact arm 33 of the switch commutator, reaches the beginning of the saw tooth contact 10, motor 57 is energized because relay 79 is energized by wire 90, contact 10 by wiping contact arm 33 of the switch commutator, which is connected to terminal 31, by means of wire 86, which is directly connected thereto. Motor 57 no longer receives energy through contact 81 of relay whose coil 78 is no longer energized.

As shown in Fig. 1, the outer contacts 10, 11, 12, 13 are radially positioned around the outer circumference of the commutator (switch) 106, a gap being formed between the edge of each contact at the outer circumferential edge of the contact, as i.e. between contact 10 and the adjacent contact, so that when the wiping contact arm 33, which is rotated in a counterclockwise direction passes the left-hand edge of contact 10 the circuit is broken, until the wiping contact arm 33 reaches the adjacent end of the next contact.

Contact 11 which is located on the opposite side of the commutator (switch) 106, is so positioned that when the upper end of the wiping contact arm 33 is in engagement with contact 10, the lower portion of the wiping contact arm 33 passes over the gap between the left-hand edge of contact 11, and the adjoining outer contact.

Contact 11 is so located radially that when the upper portion of the wiping contact arm 33 passes the left-hand edge of contact 10, thus breaking the circuit through contact 10, the lower portion of the wiping contact arm engages contact 11, thereby completing the circuit through contact 11, until the wiping contact arm 33 reaches the right-hand edge of contact 12, and passes over the gap between contacts 11 and 12. During the period in which the wiping contact arm passes over the radial gap between the contacts 11 and 12, no current flows through the lower portion of the wiping contact arm. This contact construction has hereinbefore been referred to as the "saw tooth" contact construction.

Wiping contact arm 33 continues until it reaches the open center of the saw tooth contact 10 which is in radial alignment with a portion of contact 15, of the switch commutator, and will stop if a preselected time adjustment is to take place. However with plug 48 which represents a zero time interval, in place, the motor will continue to turn and pass the second time interval contacts 18, 24, 21, and 15 without stopping until the third time interval is reached.

Relay coils 63, 64, and 65 are energized whenever a shorting plug is inserted into components 35 through 43. The horizontal rows of components represent time intervals; the first row of components 35, 36, and 37 represents the first time interval; the second row of components 38, 39, and 40 represents the second time interval; the third row of components 41, 42, and 43 represents the third time intervals. The first vertical row of components 35, 38, 41 represents coil 63 and makes possible energization for any desired one or more time intervals. In like manner, vertical row of components 36, 39, 42 are used for coil 64; and vertical row of components 37, 40, 43 are used for coil 65.

As previously described, wiping contact arm 33 of the switch commutator is moved in a counterclockwise direction and is stopped for a specific preselected time over a row of contacts 17, 23, and 20 for the first time interval. Whenever wiping contact arm 33 is stopped on any row of radial contacts, the contacts are supplied with power from terminal 31 which is connected by wire 86 to wiping contact arm 33, of the switch commutator. Coils 63 and 64 would be energized for the medium time adjustment previously set for the first time interval. In like manner, each coil can be preselected for energization during one or more time intervals, the number of time intervals being controlled by the number of components in a vertical row connected to a particular relay coil.

The operation of the apparatus is substantially as follows:

When the switch 85 shown in Fig. 1, is closed, the power lines 88 and 72, energize the solenoid coil 78, which is instantly locked in the energized position by the normally open contact 80, if the relay 79 is not energized.

When the coil 78 is energized, the switch motor rotates in a counterclockwise direction, as shown by the arrow on the commutator switch 106, provided the circuit 92 is completed in a manner hereinafter described.

The circuit 92 is closed by means of connections made from the normally open contact wire 81, which, when closed, engages the contact wire 27, which in turn energizes the timer contact 27a, shown on the face of the commutator timer 105, with the contact arm 34 located in an angular position, so that it simultaneously engages contact 27 and switch contact 31 on the dial of the commutator timer 105. The circuit to terminal 31 is thus completed through the switch contact 31, by means of the pivoted arm 34.

The normal position of the contact arm 34 when not energized is such as to simultaneously short contacts 27 and 31 on the dial of the commutator timer 105.

When the wiping contact arm 33, of the switch commutator 106 is rotated by means of the switch motor 57,

to a position where the contact arm 33 completes the circuit through contact 10 from terminal 31, through the wire 86, it causes solenoid coil 79 to be energized, which results in the closing of normally open contact 97, and thus supplying the power to keep the switch motor 57 operating, as long as the contact arm 33 is completing the circuit through the segmental contact 10 on the commutator switch 106.

When the wiping contact arm 33 of the commutator switch 106 reaches a position where the contact 10 is no longer completing the circuit, the motor 57 of the switch commutator is arrested, and the synchronous motor 59 and the electrically energized mechanical clutch 60, which rotates the arm 34 of the commutator timer 105 are placed in operation, the clutch 60 being controlled by its coil 61.

The power to drive the synchronous motor 59, the clutch 60 connected thereto, and the clutch coil 61, is received through connections made from the wire 96, the normally closed contact 98, the wire 94, the normally closed contact 82, the wire 26, which is connected to the contact 26a of the commutator switch 106, and the contact 26a on the commutator switch 106, which completed the circuit through the wiping contact arm 33, to the terminal 31.

Contact 26a on the switch commutator 106 provides for the operation of the synchronous motor 59 of the time commutator 105, only when the wiping contact arm 33 of the switch commutator 106 is moved from the position shown in Fig. 1, which is its normal position, when the timer is not in operation, or when the timer has completed a particular cycle of operations.

The length of time during which the synchronous motor 59 remains in operation, is controlled by the selected shorting plug, which is inserted in one of the sockets 45, 46, 47 at the left-hand side, Fig. 1.

Fig. 1 shows the component 46, shorted out by means of a plug 170 fitted to the socket 176 in the manner shown in detail in Fig. 4.

The simplified circuit shown in Fig. 1, provides for three time intervals only, which are represented by three horizontal rows of components; each row, as for example 45, 46, 47, representing a separate and distinct time interval, with component 44 in the same row, representing a zero time interval.

The first vertical row of components, 44, 48, 52, shown at the extreme left-hand side, Fig. 1, represents a zero time adjustment, or interval, the time intervals being progressively increased, the right-hand vertical row 47, 51, 55, representing the longest time interval.

Therefore it is possible to use one shorting plug 170 in each horizontal row of sockets, as evidenced by the cross-hatched sockets, or components shown in Fig. 1, to select the length of time for each individual time interval.

In the setting illustrated in Fig. 1, a shorting plug 170 is inserted in a socket represented by component 46 in the upper row of sockets. When the synchronous motor 59 rotates the shaft 63, by means of the clutch 60, when the clutch coil 61 is energized, the contact arm 34, which is attached to the shaft 63, will be rotated in a counterclockwise direction, as indicated by one of the arrows, until a connection is made from the contact 32 to the contact 29 on the face of the commutator timer 105. This results in solenoid coil 78 being energized, due to the fact that the wire 29, which is connected to the contact 29, and to the component 46 in one direction, being connected through component 46, to the wire 14, which is also connected to component 46, the opposite end of wire 14 being connected to one of the contacts 14 of the commutator switch 105. This completes a connection between contact 14 on the face of the commutator switch, to the wire 86, which is connected to the wiping contact arm 33 of the commutator switch, the wiping contact arm being located directly over and in engage-

ment with the contact 14 in the manner hereinbefore described.

This provides for the preselection of the first time interval, as represented by component 46, the desired time interval having been determined by the angular movement of the contact arm 34, which has been rotated through a fixed angular range, or a fixed portion of the full revolution, the time for each full revolution being determined by the speed of the synchronous motor 59.

The rate of rotation of the synchronous motor is accurate, thus providing for an accurate measurement and determination of each time interval, which represents a fraction of a revolution of the synchronous motor, which is of course fixed.

By changing the range of angular movement of the wiping contact arm 34, under control of one of the other components 45, 47 in the same horizontal row, a time adjustment can be provided, for the first time interval.

In the same manner, by selecting a component in one or more of the other horizontal rows, shown at the left-hand side of Fig. 1, an additional time interval, the time range of each of which may be correspondingly varied, is established in each horizontal row of components.

When the above cycle of operations is completed, the wiping contact arm 33, of the commutator switch 106, will be moved counterclockwise to the next contact 15, under control of the motor 57, to which the contact arm is attached, in a manner substantially the same as that for the first time interval.

To eliminate, or drop out the second time interval, a shorting plug 170 is inserted in one of the sockets indicated as component 48, which connects wire 90 to coil 79, which is energized when wire 12, which is directly connected to component 48, and connected to contact 12 on the dial of the commutator switch, by wire 86, which is connected to the wiping contact arm 33, of the switch commutator, wires 12 and 86 receiving line voltage from terminal 31, through the wiping contact arm 33, which has been moved in a counterclockwise direction, since the first time interval was established. The wiping contact arm 33 was moved when the motor 57 was energized as a result of the completion of the first time interval, which resulted in coil 78 being energized and locked in its energized position through the normally open holding contact 80, when wire 32 was connected to contact 29 of the timer commutator, by the contact arm 34 in the manner hereinbefore described.

The energizing of coil 78 opens the normally closed contact 82, thereby opening the circuit through wire 95 to clutch coil 61, thereby opening the clutch 60. The opening of the clutch 60, allows the coiled torsion spring 62, shown schematically in Fig. 1, to rotate the shaft 63 in a counterclockwise direction, until the contact arm 34 of the timer commutator 105 is in a position directly over contacts 27 and 31. A mechanical stop is provided to arrest the rotation of the contact arm 34 at this point.

The circuits described while limited to three time intervals may be expanded to any number of time intervals, by providing additional horizontal rows of components, or sockets and shorting plugs to be used in conjunction therewith.

Additional time interval adjustments may be provided by expanding the number of components in each horizontal row, thus expanding the range of time represented by each group of time intervals.

In the arrangement shown in Fig. 1, the second time interval is cut out by inserting a shorting plug into a socket represented by component 48 located at the extreme left-hand side, Fig. 1.

The detailed method of operation of the circuit of the apparatus, as controlled by the component 48, set at zero time interval was hereinbefore described.

This procedure continues until a third time interval, represented by a plug inserted in one of the sockets rep-

represented by one of the components in the third horizontal row, such as component 55 shown in Fig. 1, is reached.

The relays 63, 64, 65, shown at the right-hand side, Fig. 1, are energized wherever a shorting plug 170 is inserted into one of the sockets represented by components 35-43, shown at the right-hand side, Fig. 1.

The horizontal rows of components at the right-hand side represent time intervals, the first row of components 35, 36, 37 representing the first time interval, and the third row of components 41, 42, 43, the third time interval.

The selected component in the first vertical row 35, 38, 41, is connected to the first relay 63, and those of the third vertical row 37, 40, 43, connected to the third relay 57, the relays 63, 64, 65 representing externally mounted apparatus which are controlled by the time intervals established by the apparatus.

Thus a separate and distinct time interval may be established for each of the relays 63, 64, 65, by the selection of the proper time interval component in each vertical row.

As hereinbefore described, the wiping contact arm 33 of the commutator switch is rotated in a counterclockwise direction, and is stopped for a specific preselected time over an angularly positioned row of contacts 17, 23, and 20, on the dial of the commutator switch, for the first time interval.

Whenever the wiping contact arm 33 of the switch commutator 105 is stopped on any row of radial contacts, the contacts are supplied with power from terminal 31, which is connected by the wire 86 to the wiping contact arm 33.

The solenoid coils 63 and 64, shown at the right-hand side, Fig. 1, could be energized by the medium time adjustment previously set for the first time interval. In a similar manner each solenoid coil 63, 64, 65 can be preselected for energization during any one time interval, or a combination of time intervals, depending upon whether a single plug is inserted in the vertical row of sockets, or components connected to the particular solenoid coil, or two or more plugs in the sockets located in the same vertical row, as indicated by components 36, 39 on the second vertical row of Fig. 1.

Figure 2 shows energized relay coil 63, represented graphically by bar 152; relay coil 64 represented graphically by bar 155; relay coil 65 represented graphically by bar 158. The horizontal base line 151 represents time. Relay coil 63 is shown energized for the first time interval only. Relay coil 64 is shown energized for first and second time intervals. Relay coil 65 is shown energized for third time interval only. Figure 2 is not representative of the action shown set up in Figure 1 for coil 63, 64, and 65, but is intended to show one of the multitude of adjustments that can be made.

The graphical presentation of Figure 2 clearly indicates the position of contacts 107, 108, 109, 110, 111, and 112 for the various modes of operations.

Figure 3 shows some of the possible circuits that can be obtained from the various modes of operation shown in Figure 2.

Bar 161 indicates a closed circuit for the first time interval, obtained by using relay 152 and the normally open contact 153 which would be closed when relay 152 is energized.

Bar 164 indicates a closed circuit for the second time interval, using relay 155 and the normally open contact 156 (which would be closed when relay 155 is energized) wired in series with the normally closed contact 159 which would be opened when relay 150 is energized.

In similar manner, the other closed circuits 165, 166, 167, and 168 are obtained.

The timer shown in Figure 1 may be made to automatically repeat its operations after completing the formula of preselected time intervals by connecting contact 56 to terminal 88. In like manner, one or more units

can be ganged for operations, and for this type of operation contact 56 would be connected to terminal 88 of the following ganged timer. This would be the equivalent of closing switch 85 initiating operation previously described.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of number of time intervals, number of time adjustments, methods of initiating the time intervals, number of relays, repetitions of circuits and their combination and arrangements as well as numerous changes in the details of construction and the combination and arrangements of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

I claim as my invention:

1. A time controlling apparatus comprising a timer commutator having a plurality of radially positioned contacts with a gap formed between adjoining contacts, a contact wiping arm mounted adjacent one face of the contacts operative to selectively engage the radially positioned contacts, means for rotatably supporting the contact arm, an electrically driven motor for driving the contact arm support means, means for controlling the flow of current to the motor, means for selectively connecting and disconnecting the motor from the contact arm support means, and means for manually and selectively controlling the time intervals during which the contact wiping arm is rotated, and a switch commutator co-ordinated with the timer commutator for regulating the time intervals during which the current flows to a remotely mounted apparatus, said switch commutator having a plurality of rows of radially positioned contacts mounted adjacent one face thereof, with a radial gap between adjacent contacts, a rotatably supported wiping contact arm adapted to selectively engage diametrically opposite pairs of switch contacts, located adjacent the outer face of the switch commutator contacts, a motor adapted to rotatably drive the wiping contact arm, the contacts of the switch commutator being adapted to control the flow of current to the motor driving the wiping contact arm of the timer commutator, when the timer commutator has completed a cycle of operations, a plurality of rows of sockets connected to the timer commutator, and a plurality of shorting plugs adapted to be selectively inserted in said sockets to selectively control the time intervals established by the timer commutator, the wiping contact arm of the switch commutator being rotated to a first angular position relative to the switch commutator, with the switch contact arm completing a circuit between a pair of diametrically aligned contacts located on the face of the switch commutator, the timer commutator which is controlled by inserting shorting plugs into pre-selected sockets connected to mating contacts of the timer commutator, setting off a time interval of predetermined length, when the wiping contact arm of the timer commutator is rotated through an angular range determined by the limitations established by a pair of diametrically opposite switch commutator contacts and a radially positioned contact on the timer commutator, which is connected to a socket into which a shorting plug is inserted.

2. A time regulating apparatus comprising a timer commutator having a plurality of radially positioned contacts adjacent one face thereof, a contact arm rotatably mounted adjacent one face of the radial contacts operative to selectively engage the radially positioned contacts, means for rotatably supporting the contact arm, an electric motor for driving the contact arm support means, electrically controlled means for selectively connecting and disconnecting the motor from the contact arm support means, a switch commutator co-ordinated with the timer commutator for regulating the time intervals during which current flows to remotely mounted

apparatus, said switch commutator having a plurality of radially positioned contacts mounted adjacent one face thereof, with a radial gap between adjacent contacts, a wiping contact arm operative to selectively engage the switch commutator contacts rotatably supported adjacent one face of the switch commutator contacts, means for rotatably driving the wiping contact arm, and means for regulating the time intervals during which the wiping contact arm is in engagement with the radially positioned switch contacts, the wiping contact arm of the switch commutator being rotated to a preselected angular position relative to the switch commutator disc with the switch contact arm completing a circuit between a pair of diametrically aligned contacts mounted on the face of the switch commutator, the timer which is controlled by inserting shorting plugs into preselected sockets connected to corresponding radially positioned contacts on the timer commutator disc setting off a time interval of predetermined length, when the timer contact arm is rotated through an angular range determined by the limitations established by a pair of diametrically opposite switch commutator contacts and a radially positioned contact on the timer commutator which is connected to a socket into which a shorting plug is inserted, the shorting plug serving to connect one timer commutator contact with a preselected switch commutator contact, the flow of current to the synchronous motor being controlled by the switch commutator contacts and the wiping contact arm thereof, the angular movement of the contact arm attached to the synchronous motor being controlled by the shorting plug inserted in a preselected socket which is connected to the corresponding radially positioned contacts on the switch commutator disc.

3. A time regulating apparatus comprising a timer commutator having a plurality of radially positioned contacts adjacent one face thereof, a contact arm rotatably mounted adjacent one face of the radial contacts operative to selectively engage the radially positioned contacts, means for rotatably supporting the contact arm at substantially the center thereof, a synchronous motor for driving the contact arm support means, clutch means for selectively connecting and disconnecting the synchronous motor from the contact arm support means, a switch commutator co-ordinated with the timer commutator for regulating the time intervals during which current flows to remotely mounted apparatus, said switch commutator having a plurality of radially positioned contacts mounted adjacent one face thereof with a radial gap between adjacent contacts, a wiping contact arm operative to selectively engage the switch commutator contacts rotatably supported adjacent one face of the switch contacts, a motor attached to the contact arm operative to rotatably drive the wiping contact arm, a shorting plug controlled relay for selectively energizing predetermined radially positioned switch contacts for controlling the flow of current through the wiping contact arm, a plurality of shorting plugs connected to control relays for selectively controlling the momentary angular position of the wiping contact arm relative to the switch contacts to selectively engage predetermined radially positioned switch commutator contacts, and a plurality of relays connecting the timer motor to the switch contact arm for regulating the time intervals during which the wiping contact arm is in engagement with selected radially positioned switch commutator contacts, the wiping contact arm of the switch commutator being rotated to a first angular position relative to the switch commutator disc, with the switch contact arm completing a circuit between a pair of diametrically aligned contacts mounted on the face of the switch commutator, the synchronous timer motor being energized when the circuit is no longer completed through the switch wiping contact arm, the timer, which is controlled by selected shorting plugs connected to selected radially positioned contacts setting off a time interval when the contact arm attached to the synchronous motor

is rotated through an angular range determined by the limitations established by a pair of diametrically opposite switch commutator contacts and a radially positioned contact on the timer commutator which is connected to a socket into which a shorting plug is inserted, the shorting plug serving to connect one timer commutator contact with a preselected switch commutator contact, the time interval during which the synchronous motor is operated being controlled by selected shorting plugs which are connected to a diametrically opposite pair of contacts on the timer commutator disc through a control relay.

4. A time regulating apparatus for regulating the time intervals during which remotely mounted apparatus are operated, comprising a timer commutator having a plurality of radially positioned contacts adjacent one face thereof, a contact arm rotatably mounted adjacent one face of the radial contacts operative to selectively engage the radially positioned contacts, a rotatable shaft supporting the contact arm at substantially the center of the contact arm, a synchronous motor operative to rotate the contact arm support shaft, an electrically controlled clutch for selectively connecting the synchronous motor to the contact arm support shaft, a plurality of timer control sockets connected to preselected timer commutator contacts, a plurality of plugs operative to selectively fit into the timer control sockets to energize selected timer commutator contacts, a switch commutator co-ordinated with the timer commutator for regulating the time intervals during which current flows to selected remotely mounted apparatus, said switch commutator having a plurality of radially positioned contacts mounted adjacent one face thereof, with a radial gap between adjacent contacts, a wiping contact arm operative to selectively engage the switch commutator contacts rotatably supported adjacent one face of the switch commutator contacts, a motor for rotatably driving the wiping contact arm, a relay operative to selectively connect individual timer commutator contacts to the switch commutator motor, and means for transmitting the flow of current during preselected time intervals from preselected switch commutator contacts to a plurality of selected remotely mounted apparatus, the wiping contact arm of the switch commutator being rotated to a predetermined angular position relative to the switch commutator disc, with the switch contact arm completing a circuit between a pair of diametrically aligned contacts mounted on the face of the switch commutator disc, the synchronous timer motor being energized when the current ceases to flow through the switch wiping contact arm, the timer which is controlled by selected shorting plugs connected to the radially positioned contacts on the timer commutator, setting off a time interval when the contact arm attached to the synchronous motor is rotated through an angular range determined by the limitations established by a pair of diametrically opposite switch commutator contacts and a radially positioned contact on the timer commutator, which is connected to a socket into which a shorting plug is inserted, the shorting plug serving to connect one timer commutator contact with a preselected switch commutator contact, the time interval during which the synchronous timer motor is operated being controlled by a selected shorting plug which is connected to one of pair of diametrically opposite contacts on the timer commutator disc through a control relay.

5. A time regulating apparatus for regulating the time intervals during which a plurality of remotely mounted apparatus are operated, comprising a timer commutator having a plurality of radially positioned contacts adjacent one face thereof, a contact arm rotatably mounted adjacent one face of the radially positioned contacts operative to selectively engage the radially positioned contacts, a rotatable shaft fixedly attached to substantially the center of the contact arm, a synchronous motor operative to rotate the contact arm shaft, an electrically controlled clutch for selectively connecting the synchronous motor

to the contact arm shaft, means for selectively energizing pairs of timer commutator contacts, a switch commutator coordinated with the timer commutator for regulating the time intervals during which current flows to remotely mounted apparatus, said switch commutator having a plurality of radially positioned contacts adjacent one face thereof with a radial gap between adjacent contacts, a wiping contact arm operative to selectively engage the switch commutator contacts rotatably supported adjacent one face of the switch contacts, the wiping contact arm extending diametrically across pairs of radially positioned switch commutator contacts, a motor for rotatably driving the wiping contact arm, means for selectively energizing preselected radially positioned switch commutator contacts for controlling the flow of current through the wiping contact arm, a relay operative to selectively connect individual timer commutator contacts to the switch commutator motor, a plurality of transmission sockets connected to individual contacts, a plurality of plugs selectively fitted to the transmission sockets to transmit current flow time intervals therefrom, and a plurality of relays connected to the transmission sockets for transmitting the current flow time intervals to a plurality of preselected remotely mounted apparatus, the wiping contact arm of the switch commutator being rotated to the first angular position relative to the switch commutator disc, with the switch wiping contact arm completing a circuit between a pair of diametrically aligned contacts located on the face of the switch commutator disc, the synchronous timer motor being energized when the current flow through the switch wiping contact arm ceases, the timer which is controlled by inserting shorting plugs into preselected sockets connected to mating radially positioned contacts on the timer commutator disc, setting off a time interval of predetermined length when the contact arm of the timer disc is rotated through an angular range regulated by the synchronous motor to which it is attached, the angular movement of the timer contact arm being limited by the shorting plugs which are inserted in preselected sockets, which are connected to corresponding radially positioned contacts on the timer commutator disc, a relay selectively connecting a pair of radially positioned timer commutator contacts to the switch wiper contact arm motor, to reinitiate the angular movement of the switch wiper contact arm to a second angular position, after the first angular movement thereof is arrested, preselected external loads being energized by means of shorting plugs inserted in sockets attached to selected radially positioned contacts on the switch commutator disc, the cycle of operations being continued, the selected time intervals during which the contact arm of the timer is rotated being controlled by inserting shorting plugs in sockets connected to the radially positioned contacts on the timer commutator disc.

6. A time regulating apparatus for establishing time intervals for regulating remotely mounted apparatus, comprising a timer commutator having a plurality of radially positioned contacts adjacent one face thereof, a contact arm rotatably mounted adjacent one face of the radial timer commutator contacts operative to selectively engage the radially positioned contacts, a rotatably mounted shaft fixedly attached to the contact arm at substantially the center of the contact arm, a synchronous motor operative to rotate the contact arm shaft, an electrically controlled clutch for selectively connecting the synchronous motor to the contact arm shaft, a plurality of control sockets connected to preselected timer commutator contacts, a plurality of plugs operative to selectively fit into the timer control sockets to energize selected timer commutator contacts, a switch commutator co-ordinated with the timer commutator for regulating the time intervals during which current flows to remotely mounted apparatus, said switch commutator having a plurality of radially positioned contacts mounted adjacent one face thereof with a radial gap between adjacent contacts, a

wiping contact arm operative to selectively engage the switch commutator contacts rotatably mounted adjacent one face of the switch commutator contacts, a motor for rotatably driving the wiping contact arm, a first relay operative to selectively connect individual timer commutator contacts to the switch commutator motor, means for locking the first relay in its energized position, a second relay connected to the switch commutator motor operative to retain the switch commutator motor in operation while the wiping contact arm is in engagement with preselected switch commutator contacts, a plurality of transmission sockets connected to individual switch commutator contacts, a plurality of plugs selectively fitted to the transmission sockets to transmit current flow time intervals therefrom, and a plurality of relays connected to the transmission sockets for transmitting the current flow time intervals to selected remotely mounted apparatus, the wiping contact arm of the switch commutator being rotated to a first angular position relative to the switch commutator disc, with the switch contact arm completing a circuit between a pair of diametrically aligned contacts mounted on the face of the switch commutator, the synchronous timer motor being energized when the circuit is no longer completed through the switch wiping contact arm, the timer which is controlled by selected shorting plugs connected to the radially positioned contacts on the timer commutator setting off a time interval when the contact arm attached to the synchronous motor is rotated through an angular range determined by the limitations established by a pair of diametrically opposite switch commutator contacts and a radially positioned contact on the timer commutator which is connected to a socket into which a shorting plug is inserted, the shorting plug serving to connect one timer commutator contact with a preselected switch commutator contact, the time interval during which the synchronous motor is operated being controlled by selected shorting plugs which are connected to preselected angularly positioned contacts on the timer commutator disc through a control relay, the contact arm of the switch commutator being restored to a rest position when the time interval is completed, to permit further movement of the switch contact arm drive motor, while preselected external loads are energized by means of plugs inserted in sockets attached to radially positioned segmental contacts on the switch commutator disc.

7. A time regulating apparatus for regulating the time intervals during which remotely mounted apparatus are operated, comprising a timer commutator consisting of a dielectric sheet, a plurality of radially positioned contacts with means selectively connecting said contacts formed of a conductive material printed on the dielectric sheet, a contact arm rotatably mounted adjacent one face of the radial contacts operative to selectively engage the radially positioned contacts, a rotatably mounted shaft supporting the contact arm at substantially the center thereof, a synchronous motor operative to rotate the contact arm shaft, an electrically controlled clutch for selectively attaching the synchronous motor to the contact arm shaft, a plurality of timer control sockets connected to preselected timer commutator radial contacts, a plurality of plugs operative to selectively fit into the timer control sockets to energize selected timer control sockets, a switch commutator co-ordinated with the timer commutator for regulating the time intervals during which current flows to remotely mounted apparatus, said switch commutator consisting of a dielectric sheet, a plurality of radially positioned contacts having a gap between adjacent contacts with means selectively connecting said contacts formed of a conductive material printed on the dielectric sheet, a wiping contact arm operative to selectively engage the switch commutator contacts rotatably mounted adjacent one face of the switch commutator contacts, a motor for rotatably driving the wiping contact arm, means for selectively energizing predetermined radially positioned

switch contacts for controlling the flow of current through the wiping contact arm, a relay operative to selectively connect pairs of timer commutator contacts to the switch contact arm motor, and means for selectively transmitting time intervals of current flow from preselected switch commutator contacts to selected remotely mounted apparatus, the wiping contact arm of the switch commutator being rotated to a preselected angular position relative to the switch commutator disc with the switch contact arm completing a circuit between a pair of diametrically aligned contacts mounted on the face of the switch commutator, the timer which is controlled by inserting shorting plugs into preselected sockets connected to corresponding radially positioned contacts on the timer commutator disc setting off a time interval of predetermined length, when the timer contact arm is rotated through an angular range determined by the limitations established by a pair of diametrically opposite switch commutator contacts and a radially positioned contact on the timer commutator which is connected to a socket into which a shorting plug is inserted, the shorting plug serving to connect one timer commutator contact with a preselected switch commutator contact, the synchronous timer motor being energized when the current ceases to flow through the switch wiping contact arm, the flow of current to the synchronous motor being controlled by the switch commutator and the contact arm of the switch commutator, the angular movement of the contact arm attached to the synchronous motor being controlled by the shorting plug inserted in a preselected socket which is connected to the corresponding radially positioned contact on the timer commutator disc, a relay selectively connecting a pair of radially positioned timer commutator contacts to the switch contact arm motor, to reinitiate the movement of the switch contact arm to a second angular position after the initial angular movement thereof is arrested, preselected external leads being energized by means of plugs inserted in sockets attached to radially positioned contacts of the switch commutator disc.

8. A time regulating apparatus for regulating the time intervals during which remotely mounted apparatus are operated, comprising a timer commutator having a plurality of radially positioned contacts adjacent one face thereof, a contact arm rotatably mounted adjacent one face of the radial contacts operative to selectively engage the radially positioned contacts, a rotatable shaft supporting the contact arm at substantially the center of the contact arm, a synchronous motor operative to rotate the contact arm support shaft, an electrically controlled clutch for selectively connecting the synchronous motor to the contact arm support shaft, a plurality of timer control sockets connected to preselected timer commutator contacts, each of said sockets consisting of a tubular bayonet type shell, a contact member reciprocally fitted to said shell, spring means fitted to said contact member operative to move the contact member outward within the tubular shell, a plug removably fitted to each selected timer control socket, each plug consisting of a body, a head attached to the body operative to fit into and be retained by the tubular socket shell and means attached to the plug head operative to engage the reciprocating contact member to energize selected timer commutator contacts, a switch commutator co-ordinated with the timer commutator for regulating the time intervals during which current flows to remotely mounted apparatus, a relay operative to selectively connect individual timer commutator contacts to the switch commutator motor, a plurality of transmission sockets connected to individual switch commutator contacts, each of said transmission sockets consisting of a tubular shell, a contact member reciprocally fitted to the tubular shell, spring means fitted to the contact member operative to press the contact member outward within the tubular shell, a plug removably fitted to each selected transmission socket, each plug consisting of a body, a

head attached to the body operative to fit into the transmission socket shell, means attached to the plug head operative to engage the reciprocating contact member to transmit current flow time intervals therefrom, and a plurality of relays connected to the transmission sockets for transmitting current flow time intervals to preselected remotely mounted apparatus, the wiping contact arm of the switch commutator being rotated to a first angular position relative to the switch commutator disc, with the switch contact arm completing a circuit between a pair of diametrically aligned contacts mounted on the face of the switch commutator, the synchronous timer motor being energized when the circuit is no longer completed through the switch wiping contact arm, the timer, which is controlled by selected shorting plugs connected to the radially positioned contacts on the timer commutator setting off a time interval when the contact arm attached to the synchronous motor is rotated through an angular range determined by a pair of radially positioned contacts on the timer commutator disc, which are connected to sockets into which selected shorting plugs are inserted, the synchronous timer motor being energized when the current ceases to flow through the switch wiping contact arm, the time interval during which the synchronous motor is operated being limited by selected shorting plugs which are connected to a diametrically opposite pair of contacts and the timer commutator disc through a control relay, the contact arm of the switch commutator being restored to a rest position when the time interval is completed to permit further movement of the switch contact arm drive motor, while preselected external loads are energized by means of plugs inserted in sockets attached to radially positioned segmental contacts on the switch commutator disc.

9. A time regulating apparatus for regulating the time intervals during which a plurality of remotely mounted apparatus are operated, comprising a timer commutator having a plurality of radially positioned contacts adjacent one face thereof, a contact arm rotatably mounted adjacent one face of the radial timer contacts operative to selectively engage the radially positioned contacts, a rotatable shaft supporting the contact arm at substantially the center of the contact arm, a synchronous motor operative to rotate the contact arm support shaft, an electrically controlled clutch for selectively connecting the synchronous motor to the contact arm support shaft, a plurality of timer control sockets connected to preselected timer commutator contacts, a plurality of plugs operative to selectively fit into the timer control sockets to energize selected timer commutator contacts, a switch commutator co-ordinated with the timer commutator for regulating the time intervals during which current flows to remotely mounted apparatus, said switch commutator having a plurality of radially positioned contacts mounted adjacent one face thereof with a radial gap between adjacent contacts, a wiping contact arm operative to selectively engage the switch commutator contacts rotatably supported adjacent one face of the switch commutator contacts, a motor for rotatably driving the wiping contact arm, a relay operative to selectively connect individual timer commutator contacts to the switch commutator motor, means for automatically repeating the cycle of preselected time intervals and the sequence thereof, and means for transmitting the flow of current during preselected time intervals from preselected switch commutator contacts to a plurality of selected remotely mounted apparatus, a starting switch operative to initiate the flow of current to the apparatus, the wiping contact arm of the switch commutator being rotated to a first angular position relative to the switch commutator disc, with the switch wiping contact arm completing a circuit between a pair of diametrically aligned contacts located on the face of the switch commutator disc, the timer which is controlled by inserting shorting plugs into preselected sockets connected to corresponding radially posi-

tioned contacts on the timer commutator disc setting off a time interval of predetermined length, when the timer contact arm is rotated through an angular range determined by the limitations established by a pair of switch commutator contacts, and a radially positioned contact on the timer commutator which is connected to a socket into which a shorting plug is inserted, the synchronous timer motor being energized when the current ceases to flow through the switch wiping contact arm, the flow of current to the synchronous motor being controlled by the switch commutator contacts and the contact arm of the timer commutator, the angular movement of the contact arm attached to the synchronous motor being controlled by the shorting plug inserted in a preselected socket which is connected to the corresponding radially positioned contact on the timer commutator, the wiping contact arm of the switch commutator being restored to a rest position, preselected external loads being energized by means of plugs inserted in sockets attached to radially positioned contacts of the switch commutator disc, a relay selectively connecting a pair of radially positioned timer commutator contacts to the switch wiper contact arm motor, to reinitiate the movement of the switch contact arm to a second angular position after the initial angular movement thereof is completed, the cycle of operations being repeated when a selected radially positioned contact on the switch commutator is connected to one terminal of the starting switch.

10. A time regulating apparatus for regulating the time intervals during which a plurality of remotely mounted apparatus are operated, comprising a timer commutator having a plurality of radially positioned contacts adjacent one face thereof, a contact arm rotatably mounted adjacent one face of the radial contacts operative to selectively engage the radially positioned contacts, a rotatable shaft fixedly attached to substantially the center of the contact arm, a synchronous motor operative to rotate the contact arm shaft, an electrically controlled clutch for selectively connecting the synchronous motor to the contact arm shaft, means for selectively energizing pairs of timer commutator contacts, a switch commutator coordinated with the timer commutator for regulating the time intervals during which current flows to selected remotely mounted apparatus, said switch commutator having a plurality of radially positioned contacts adjacent one face thereof with a radial gap between adjacent contacts, a wiping contact arm operative to selectively engage the switch commutator contacts rotatably supported adjacent one face of the contacts, the wiping contact arm extending diametrically across pairs of radially positioned switch contacts, a motor for rotatably driving the wiping contact arm, means for selectively energizing preselected radially positioned switch contacts for controlling the flow of current through the wiping contact arm, a relay operative to selectively connect individual timer commutator contacts to the switch commutator motor, a plurality of transmission sockets connected to individual switch commutator contacts, a plurality of plugs selectively fitted to the transmission sockets to transmit current flow time intervals therefrom, means for automatically repeating the cycle of preselected time intervals, and a plurality of relays connected to the transmission sockets for transmitting the current flow during preselected time intervals to a plurality of preselected remotely mounted apparatus, a starting switch operative to initiate the flow of current to the apparatus, the wiping contact arm of the switch commutator being rotated to a first angular position relative to the switch commutator disc, with the switch wiping contact arm completing a circuit between a pair of diametrically aligned contacts located on the face of the switch commutator disc, the synchronous timer motor being energized when the current ceases to flow through the switch wiping contact arm, the timer which is controlled by inserting plugs into preselected

sockets connected to mating radially positioned contacts on the timer commutator disc setting off a time interval of predetermined length, when the contact arm of the timer disc is rotated through an angular range regulated by the limitations established by a pair of diametrically opposite switch commutator contacts and a radially positioned contact on the timer commutator which is connected to a socket into which a shorting plug is inserted, the wiping contact arm of the switch commutator being restored to a rest position, preselected external loads being energized by means of shorting plugs inserted in sockets attached to selected radially positioned contacts on the switch commutator disc, a relay selectively connecting a pair of radially positioned timer commutator contacts to the switch wiper contact arm motor, to reinitiate the angular movement of the switch wiper contact arm to a second angular position after the first angular movement thereof is completed, the cycle of operations being repeated when a selected radially positioned contact on the switch commutator is connected to one terminal of the starting switch.

11. A time regulating apparatus for regulating the time intervals during which remotely mounted apparatus are operated, comprising a timer commutator having a plurality of radially positioned contacts located adjacent one face thereof, a contact arm rotatably mounted adjacent one face of the radial contacts operative to selectively engage the radially positioned contacts, a rotatable shaft supporting the contact arm at substantially the center of the contact arm, a synchronous motor operative to rotate the contact arm shaft, electrically controlled means for selectively connecting the synchronous motor to the contact arm support shaft, a plurality of timer control sockets connected to preselected timer commutator contacts, each of said timer control sockets consisting of a tubular bayonet type shell, a contact member reciprocally fitted to said tubular shell, spring means fitted to said reciprocating contact member operative to move the reciprocating contact member outward within the tubular shell, a plug removably fitted to each selected time control socket, each of said plugs consisting of a body, a head attached to the body operative to fit into and be retained by the tubular socket shell, and means attached to the plug head operative to engage the reciprocating contact member to energize selected timer commutator contacts, a switch commutator for transmitting selected time intervals to remotely mounted apparatus, manually controllable means connected to the switch commutator for selecting time intervals from the timer commutator, manually controllable means connected to the switch commutator for transmitting selected time intervals from the timer commutator to remotely mounted apparatus, and means connected to the manually controllable means and the selected remotely mounted apparatus for transmitting selected time intervals to the selected remotely mounted apparatus, a starting switch operative to initiate the flow of current to the apparatus, the wiping contact arm of the switch commutator being rotated to the first angular position relative to the switch commutator disc, with the switch wiping contact arm completing a circuit between a pair of diametrically aligned contacts located on the face of the switch commutator disc, the synchronous timer motor being energized when the current ceases to flow through the switch wiping contact arm, the timer which is controlled by inserting shorting plugs into preselected sockets connected to mating radially positioned contacts on the timer commutator disc, setting off a time interval of predetermined length when the contact arm of the timer disc is rotated through an angular range regulated by the limitations established by a pair of diametrically opposite switch commutator contacts, and a radially positioned contact on the timer commutator which is connected to a socket into which a shorting plug is inserted, the wiping contact arm of the switch commutator being restored to a rest

position, preselected external loads being energized by means of shorting plugs inserted in sockets attached to selected radially positioned contacts on the switch commutator disc, a relay selectively connecting a pair of radially positioned timer contacts to the switch wiper contact arm motor, to reinitiate the angular movement of the switch wiper contact arm to a second angular position after the first angular movement thereof is completed, the cycle of operations being repeated when a selected radially positioned contact on the switch commutator is connected to one terminal of the starting switch.

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