

March 25, 1941.

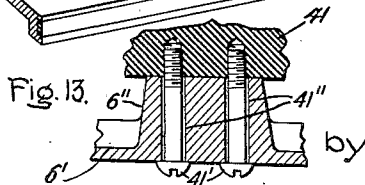
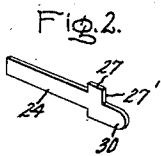
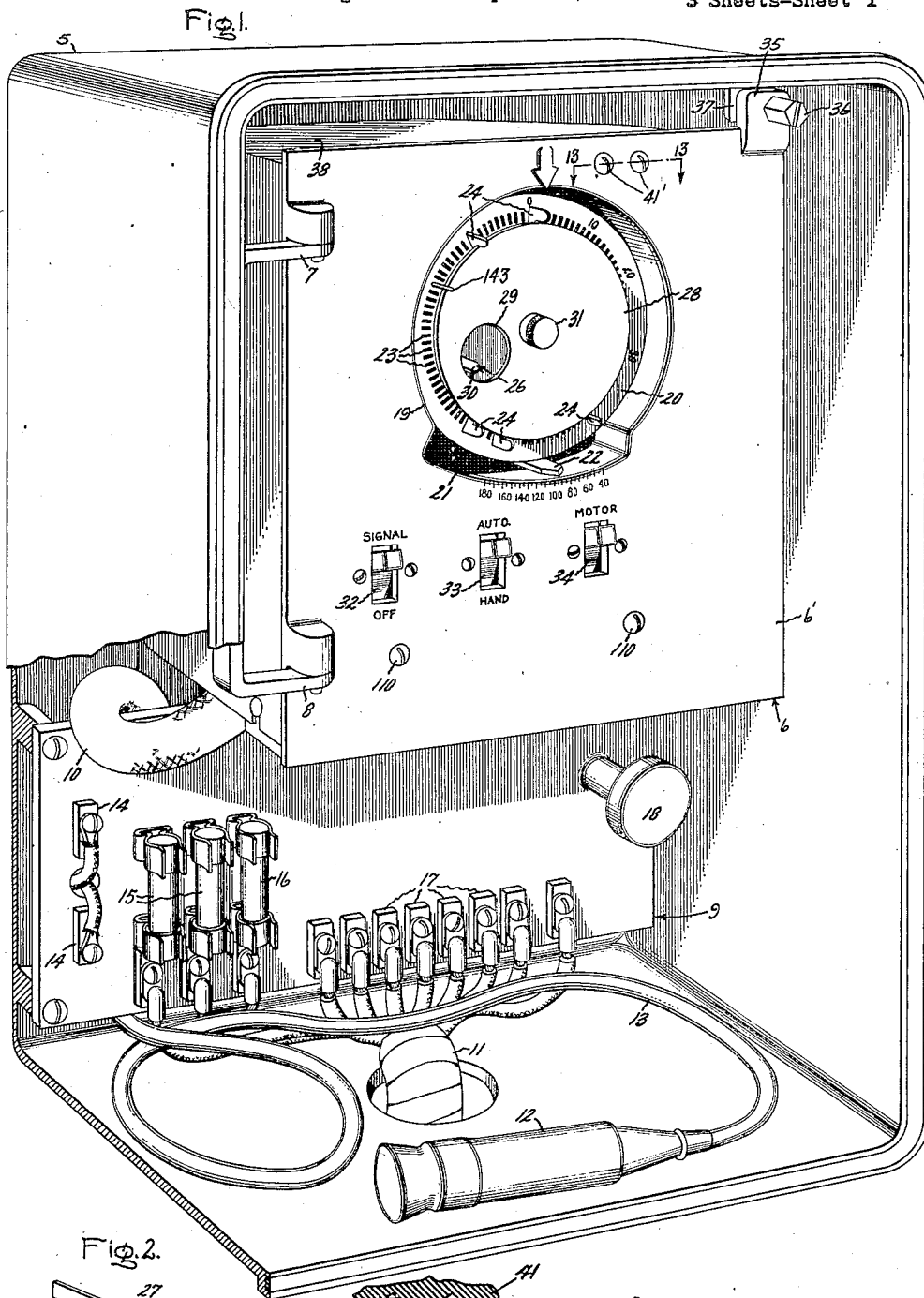
R. A. REID

2,236,299

TRAFFIC SIGNAL CONTROLLER

Original Filed April 23, 1938

3 Sheets-Sheet 1



Inventor:
Ralph A. Reid,
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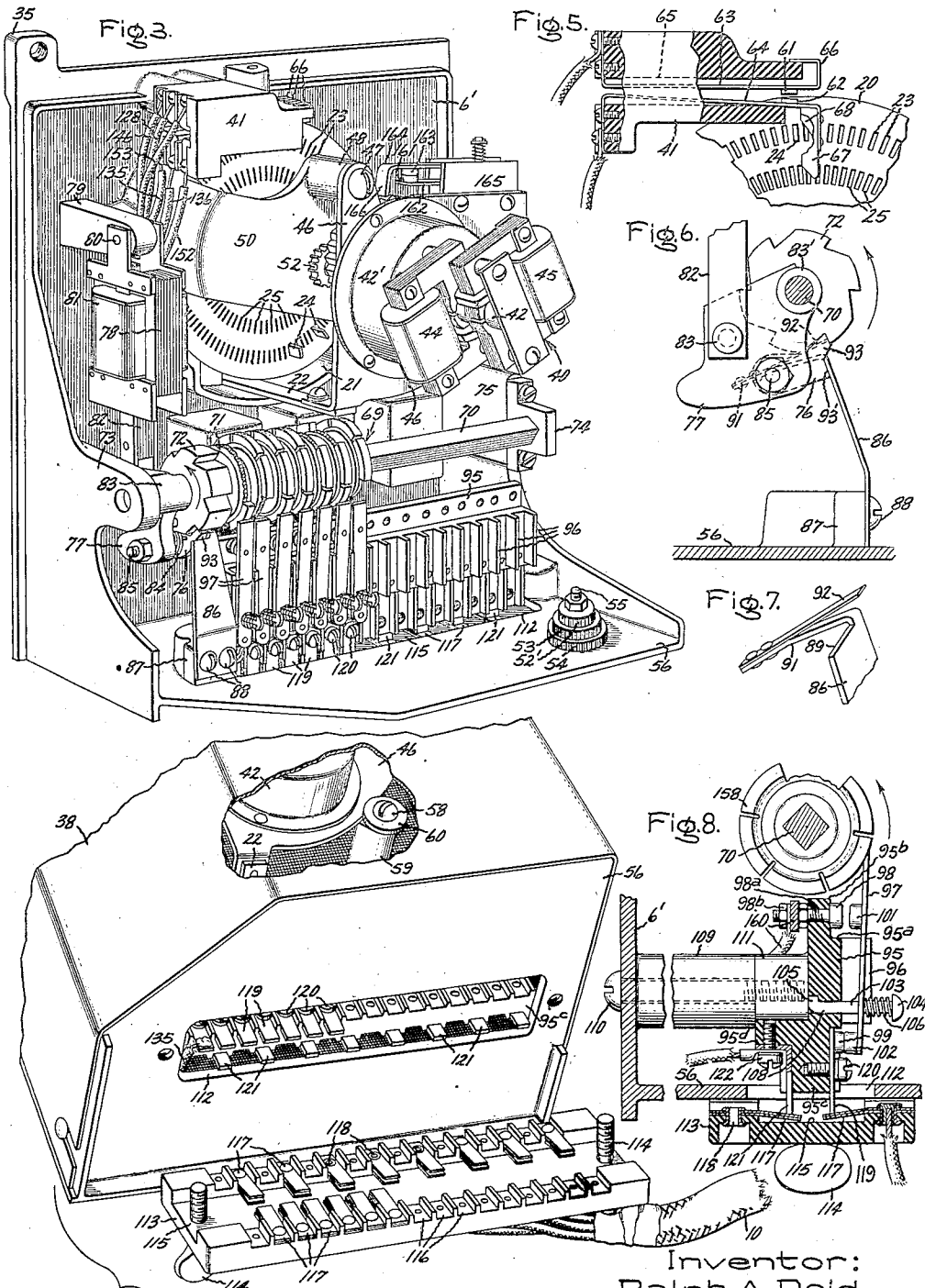
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TRAFFIC SIGNAL CONTROLLER

Original Filed April 23, 1938

3 Sheets-Sheet 2



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TRAFFIC SIGNAL CONTROLLER

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3 Sheets-Sheet 3

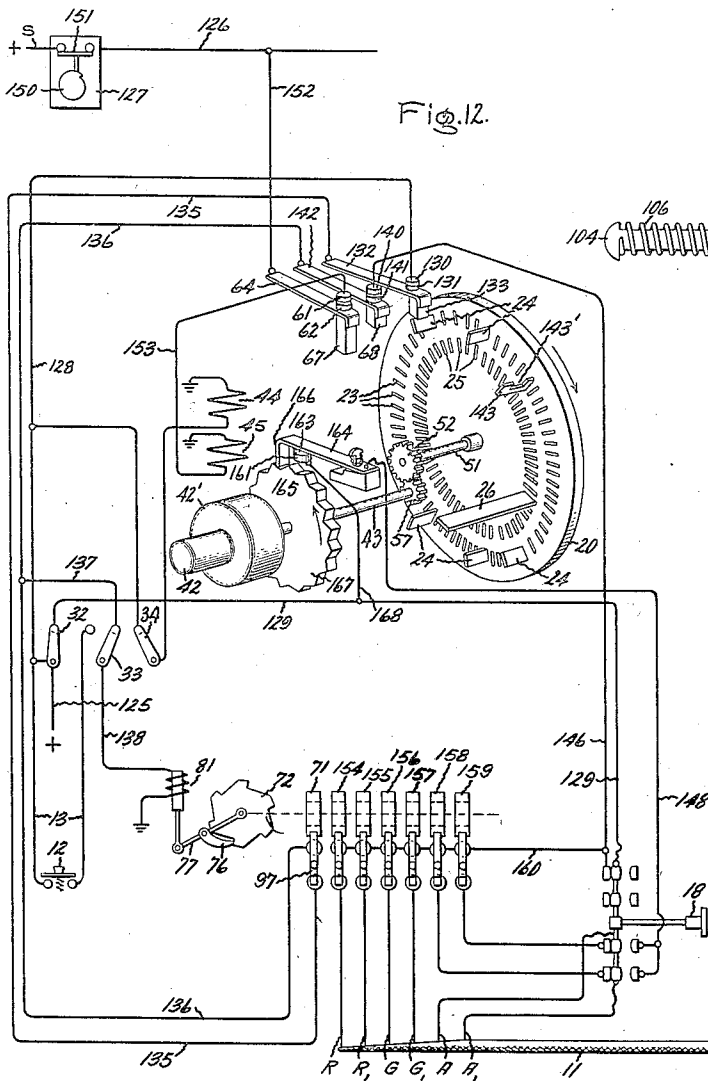
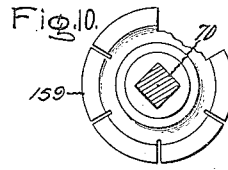
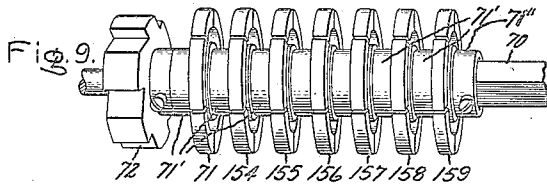
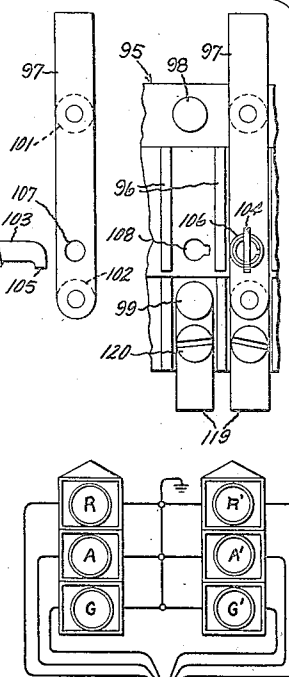


Fig. 11.



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UNITED STATES PATENT OFFICE

2,236,299

TRAFFIC SIGNAL CONTROLLER

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Original application April 23, 1938, Serial No. 203,888. Divided and this application March 21, 1940, Serial No. 325,137

21 Claims. (Cl. 200—27)

My invention relates to signal controllers, and more particularly to traffic signal controllers. This application is a division of my application S. N. 203,888, filed April 23, 1938, which is a continuation in part of my application S. N. 105,684, filed October 15, 1936.

One object of my invention is to provide an improved traffic signal controller which is simple in construction, reliable in operation, and capable of performing respectively the several functions required of apparatus of this type.

Another object of my invention is to provide an improved indicating means for the cycle length setting of the traffic signal timer.

Another object of my invention is to simplify the structure of the controller to increase its reliability and thereby decrease the cost of maintenance.

For a better understanding of my invention, together with other and further objects thereof, reference is had to the following description, taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims.

The term "timer" is herein used to designate the timing mechanism and the contacts for controlling the timing and sequence of energization of a group of traffic signals. It includes the driving motor and the mechanism necessary to accomplish an accurately timed and adjustable control of the circuits to the signals. The term "controller" is used to designate the complete apparatus for controlling a group of signals for an intersection, including a casing in which is mounted the timer, the switchboard, the manual control switch and any other auxiliary device that may be required to accomplish the necessary control of the traffic signals.

In the accompanying drawings, Fig. 1 is a front perspective view of my improved traffic signal controller; Fig. 2 is a perspective view of a key used in the setting of the timer; Fig. 3 is a perspective rear view of the timer; Fig. 4 is an exploded view of the bottom of the timer and the terminal board normally attached thereto; Figs. 5, 6, 7, 8, 9, 10, and 11 are fragmentary views of elements of the timing mechanism; Fig. 12 is a diagram of connection of a controller and a group of intersection signals; and Fig. 13 is a sectional view looking in the direction of arrows 13—13 in Fig. 1.

Referring to the drawings in detail, Fig. 1 illustrates a front perspective of an intersection controller comprising a casing 5, a timer 6 supported on hinges 7 and 8, and a terminal and

switchboard 9 mounted on the rear wall of the casing 5 below the timer 6. A flexible cable 10 connects the timer 6 to terminals on the switchboard 9 and a cable 11 connects the switchboard terminals to the intersection signals. A hand-operated switch 12 with a suitable length cable 13 is connected to the switchboard terminals 14. It is used to manually operate the traffic signals, and when not in use is stored in the bottom of the casing 5. The switchboard has mounted thereon line fuses 15 and a fuse 16 connected into the system synchronizing conductor, terminals 17 for the conductors in cable 11, and a hand-operated switch 18 used for changing the controller from normal sequence operation to flashing amber signal operation.

In Fig. 1, only the control panel 6' of the timer 6 is illustrated in detail. It is provided with a circular opening 19 in which a dial 20 rotates. On the lower side of this opening, a notch 21 having an arcuate length of about 60° is provided in which a pointer 22 is positioned to indicate the length of time required for a complete revolution of the dial 20, or in other words, the length of a complete time cycle. In the specific timer illustrated, the indicia markings under the pointer indicate that a range of time cycle length is provided which is adjustable between 40 and 180 seconds.

The dial 20 is provided with radial slots 23 arranged in a circle about the center of the dial in which keys 24 and 143 as shown in Fig. 2, are placed. The relative position of these keys to each other determines the relative lengths of the individual signal periods. A second group of radial slots 25 (see Fig. 3) arranged in a smaller circle about the center of the dial 20 is provided to receive a key 26 which is similar to key 24, but is longer. The placing of this key in one of the slots 25 determines the relationship of the signal time cycle to other cycles in the system.

Fig. 2 illustrates in perspective a key 24. It is an elongated sheet metal member having a body of such cross-section that it may be easily moved through a slot 23 and of such length as to engage and operate contacts mounted in back of the dial. It is provided with a head 27 which is notched to form a shoulder 27' and a handle 30. The key 26 is the same as key 24, except that its body is longer. The key 143 is similar to key 24, except that it is longer and is provided with a notch 143' (Fig. 12). In operation, the keys are placed in their respective slots until each head 27 engages the surface of the dial and pre-

vents any further movement inwardly. A disc 28 provided with an opening 29 is then mounted on the dial by means of a thumb screw 31. This disc is of such diameter that it engages the shoulders 27' of the keys 24, and the opening 29 is so placed that its edge engages the shoulder 27' on the key 26. Disc 28 thus serves to hold the keys in position. The handle ends of the keys 24 project over the edge of the disc 28 and thereby indicate their respective positions. The handle 30 of the key 26 projects through the opening 23 and indicates its position relatively to the keys 24.

The panel of the timer 6 is further provided with three control switches mounted in a horizontal row below the timer dial. Switch 32 controls the signal circuits. Switch 33 controls the automatic and hand operation of the signals and switch 34 controls the timer motor circuit.

The panel 6' is further provided at its upper right-hand corner with a lug 35 in which a screw 36 is mounted which engages a threaded opening in a lug 37 on the casing 5. By means of this lug and screw arrangement, the timer may be secured in the casing, and if desired, may be unlocked and swung outwardly about its hinges 7 and 8.

The mechanism of the timer is illustrated in Fig. 3. This figure is a perspective rear view of the timer having a cover 38, shown in Figs. 1 and 4, removed to expose the mechanism. This mechanism consists essentially of a driving motor connected to drive the dial 20, a contact block which supports contacts actuated by the keys in the dial 20, and of a drum controller with its operating mechanism arranged to operate the drum controller step by step in response to actuations of the contacts by the keys in the dial.

The driving motor indicated generally by the numeral 40 is preferably a self-starting synchronous motor of the type disclosed in U. S. Patent 1,430,867 issued to H. E. Warren. It comprises a tubular casing 42 attached to a larger casing 42'. The tubular casing encloses an armature shaft which is connected to speed reducing gears in the casing 42'. The speed reducing gears drive the shaft 43 (see Fig. 12) which is referred to as the motor shaft. A field 44 mounted on the casing 42 effects a rotation of the armature and motor shaft, when it is energized. The motor 40 is a modification of the motor described in the above Warren patent in that the casing 42 is lengthened and two armatures are provided on the shaft therein. One of the armatures cooperates with the field 44 and the second armature cooperates with a field 45. The two fields 44 and 45 are mounted on the casing 42 in operative relation to the two armatures, respectively, to effect a rotation of said armature shaft in opposite directions. The fields are of equal strength, so that if they are simultaneously energized, the armature and motor shafts are stopped. Only one field, field 45, is therefore normally energized and the second field, field 44, is energized only when it is desired to stop the motor instantly.

This self-starting synchronous motor which may be stopped instantly provides a precise control of the timer, from a remote point since the motor will not coast after the braking current is applied. The above-described motor stops and starts instantly and no inaccuracy results when the timer resynchronizes with the master timer.

As stated in the description of Fig. 1, the dial 20 rotates in the opening 19 of the panel. In order to support the dial it is mounted on a

shaft 51 (see Fig. 12) which projects through a bearing in a yoke 50. The yoke 50 is attached to the back of the panel 6' near the rim of the opening 19 and extends across the opening. The front surface of the dial is substantially parallel to and spaced slightly inwardly from the surface of the panel and the surface of the yoke is sufficiently spaced from the back surface of the dial to permit the keys extending from the back surface of the dial to move freely with the dial. A gear 52 is attached to the end of the shaft 51, projecting through the yoke. This gear is removable and may be replaced by other gears 52', 53, and 54. These latter gears are stored, for convenience, on a pin 55 on shelf 56 which projects from the lower edge of the panel 6'.

The gear 52 on the dial shaft is driven by a pinion 57 on the end of the motor shaft 43. In order to support the motor 40 to maintain a driving relation between the pinion 57 and the gear 52, or one of the other available gears, the motor is mounted on a plate 46. This plate is pivoted at one corner on a screw 47 which is screwed into a lug 48 projecting from the yoke 50. The cycle length indicating pointer 22 is attached to another corner of the plate and moves with the plate 46 when the latter is moved about its pivot to place the motor pinion 57 into engagement with one of the gears placed on the dial shaft. Since each gear corresponding to a desired cycle length is of a definite diameter, the position of the plate about its pivot, and therefore the position of the pointer, will be in a specified position for each cycle length.

In order to lock this plate in the desired position, a lug 59 (see Fig. 4) projecting from the inner surface of the panel is provided. This lug projects to the under surface of and partly under the plate. It is provided with a screw 58 at its end. A washer 60 is placed under the head of this screw and projects over the edge of the plate 46. When the screw 58 is tightened, it pinches the edge of this plate 46 between the end surface of the lug and the surface of the washer thereby preventing any movement of the plate about its pivot.

The motor 40 being a synchronous motor, runs at a speed dependent upon the frequency of the current which is supplied thereto. This frequency being maintained constant, the dial speed is determined by the gear ratio between the motor and dial shafts. The time required by the dial to make one complete revolution determines the length of a cycle of operation, and the physical spacing of the keys in the dial slots determines the time intervals into which a cycle is divided. This possibility of changing the dial speed together with the large number of possible changes in spacing between keys provides a flexibility which adapts the timer for use at substantially all traffic intersections.

In order to convert the above-mentioned dial speeds and key spacings into correspondingly timed traffic signal operations, contacts are provided on the back of the panel and placed in the path of movement of the keys, so that the keys will actuate the contacts and close circuits which set into motion the operating mechanism of the drum controller at the desired time intervals to change the traffic signal circuits. The contacts which are to be operated by the dial keys are mounted in the contact block 41 mounted above the dial on the back surface of the panel.

In Fig. 5 the contact block 41 is illustrated in cross-section to expose one of three pairs of con-

tacts mounted therein. The three pairs of contacts are mounted side by side, the pair nearest the surface of the panel being arranged to be actuated by keys 24, in the slots 23, the second pair is actuated by the key 143 also in a slot 23 and the third pair being arranged for operation by the longest key 26 in one of the slots 25. The cross-sectional view of Fig. 5 exposes the third pair of contacts which are to be actuated by the key 26. These contacts 61 and 62 are respectively mounted on resilient contact springs 63 and 64 which are respectively attached to the back end of the block 41 and project through a slot 65 in the block to the other end thereof. The free end of the upper contact spring is bent upwardly to form a hook 66 the end of which engages the upper surface of the block and limits its own movement downwardly. Considerable space is left, however, for it to move upwardly with the contact 61 when the lower contact spring 64 with contact 62 is lifted so that the two contacts engage. The springs and contacts of the other two pairs of contacts are the same as the pair just described. To enable the keys 24, 143 and 26 to move the lower contact of each pair upwardly, each lower contact spring is provided with a block preferably formed of insulating material and provided with a beveled end. The block on contact spring 63 is shown at 67 and the blocks on the other two lower contact springs are shown at 68 and 133. (See Figs. 5 and 12.) In Fig. 5, block 67 is partly broken away to show block 68 which in this view is directly behind it. The block 67 stands in the path of movement of key 26; the block 68 stands in the path of movement of the key 143 and the block 133 stands in the path of movement of key 24. The purpose of the notch 142' in key 143 is to permit key 143 to pass block 133, without engaging it. The dial 20 revolves in a clockwise direction, as viewed in Fig. 12, and as the respective keys reach the blocks 67, 68, 133, they engage the beveled surfaces thereof to lift the respective contacts.

It is of considerable advantage to mount these three pairs of contacts in the common block 41 since they may in this manner be together adjusted in relation to the dial, and their relation to each other remains unchanged. The circuits operated by each of these three pairs of contacts will be described in connection with the connection diagram Fig. 12.

The manner of mounting the block 41 on the panel 6' is illustrated in Fig. 13. This view is taken through the center line of a boss 6'' projecting from the back surface of the panel. The block 41 is attached to the end surface of this boss 6'' by screws 41' projecting through holes 41''. The holes are made larger than the screws so as to permit a range of movement of the screws laterally of the holes. When assembling the block upon the panel, the block is loosely held by the screws against the end surface of the boss until the block is adjusted, within the range of lateral movement of the screws, so as to simultaneously position the three pairs of contacts in their proper relation to the dial. The screws are then tightened and the block is held stationary in this position.

The traffic signal circuits are controlled by a drum controller which operates in response to the contact actuations by the dial. This drum controller designated generally by the numeral 69, includes a drum comprising a shaft 70, a group of discs 71, 150, 155, 156, 157 and 158, and a ratchet wheel 72. The shaft is horizontally

mounted below the driving motor 40 by bearings at each end thereof. One bearing is located in a lug 73 projecting from one side of the panel and the other bearing is located in a bearing member 74 attached to a lug projecting from the other side of the panel.

Fig. 9 is a front perspective of the drum illustrating the ratchet wheel 72 at one end of the shaft 70 and the group of discs adjacent to each other and next to the ratchet wheel. The discs 10 are illustrated, in this figure, with all their rim sections in place; the desired sections being broken off just before the drum is placed into the controller. The discs and ratchet wheel may be attached to the shaft 70 in any convenient manner. In the illustrated drum, the ratchet wheel is fastened to shaft 70 by a set screw and the discs are mounted on the square portion of the shaft, are spaced from each other by spacing collars 71' which may or may not be integral with the discs, and are held in fixed position by a collar 71'' placed against the last disc and fastened to the shaft by a set screw.

Fig. 10 discloses an end view of one of the discs, for example; disc 159. The disc is made of an insulating material, preferably a molded insulating compound such as a phenolic condensation product with a filler. A number of radial slots divide the rim of the disc into sections. Directly under the rim the disc is reduced in thickness so that any one of the rim sections may be readily broken off. The disc 159 is shown with one such section broken away. The purpose of this will become apparent by reference to Fig. 8. In this figure, an end view of disc 158, which is similar to disc 71 and has one rim section broken away, is illustrated with a contact arm 97 riding on the rim of the disc. The contact arm holds the contacts 98 and 101 separated as long as it rides on the rim. When the drum is turned to the position at which the broken away section of the rim is in line with the end of contact arm 97, the arm moves inwardly until the contacts 98 and 101 engage and close an electric circuit.

For the purpose of rotating the drum in response to the contact actuations by the dial keys, a solenoid with a pawl and ratchet mechanism is provided. This mechanism may be described by reference to Figs. 3 and 6. It comprises a pawl 76 pivotally mounted on a crank 77 which in turn is pivoted on the shaft 70, and a solenoid having its armature plunger attached to the free end of the crank for intermittently raising it. This solenoid includes a laminated rectangular core 78 which is pivotally suspended on a lug 79, by a pin 80, at one side of the dial. A coil 81 in the core raises an armature 82 when it is energized and releases it when deenergized. The armature is connected to the crank by a pin 83.

When the coil 81 is energized by the closure of contacts operated by the dial, it draws the armature 82 upwardly, thereby lifting the crank 77, causing it to rotate clockwise about the shaft 70. The pawl 76 slides over the teeth of the wheel 72 during this clockwise movement. When coil 81 is deenergized, armature 82 and crank 77 move downwardly and during the downward movement pawl 76 engages a tooth of wheel 72, thus effecting a turning movement of the drum. A spring 84 wound about the pivot pin 80 for the pawl, and having its ends respectively attached to the pawl and crank, maintains the free end of the pawl in contact with the ratchet wheel 72 and causes it to engage a tooth face when the crank 77 moves

counter-clockwise. In the present arrangement the ratchet wheel 72 together with the shaft 70 and discs 71 are rotated on the counter-clockwise movement of the crank when the coil 81 becomes deenergized and the crank drops due to its own weight and that of the armature 82 connected to it. This is contrary to the usual arrangement of ratchets but has a definite advantage. The advantage thereof is that since the weight of the crank and armature is constant a uniform force is available for turning the drum at each deenergization of the coil 81.

In order to limit the movement of the drum to a predetermined arc at each operation, an improved spring assembly is provided. This spring assembly may be described by reference to Figures 3, 6 and 7. It comprises a leaf spring 86 attached at one end to a lug 87 on the shelf 56 by screws 88. It extends upwardly at a slight angle to the vertical, and at its upper end it is provided with a shoulder 89 extending across a portion of its width and an extension 91 extending across the remainder of its width. The extension 91 is bent approximately at right angles to the body of the spring and supports at its end, a second spring 92 which extends back along the extension 91, its end rising slightly above the extension and ending slightly forward of the shoulder 89. As best shown in Fig. 3, the upper end of leaf spring 86 terminates adjacent to the free end of pawl 76. Pawl 76 is provided with a notch which forms a forward end or nose 93 adapted to engage the teeth of ratchet wheel 72 and an abutment, or end surface 93', spaced back from the end of nose 93. Pawl 76 is narrower in width than ratchet wheel 72 and when in the position shown in Figs. 3 and 6, which may be termed its normal position, abutment 93' engages the top edge of leaf spring 86 at one side of spring extension 91 with nose 93 projecting over and beyond such top edge. At this time, nose 93 lies along side the second spring 92 with its end in line with the end thereof and with the end of nose 93 and the end of spring 92 both in engagement with the same tooth of the ratchet wheel 72. The function of this spring assembly is threefold. First, it prevents a clockwise rotation of the ratchet wheel when the coil 81 is energized to move the pawl 84 clockwise, second, on return movement of the pawl, it prevents a movement of the drum due to its own momentum beyond the point to which it is carried by the pawl, and thirdly, it limits the travel of the pawl on the return movement. When the pawl 76 moves clockwise, due to the energization of coil 81, the forward end of the spring 92 which is in engagement with the face of a tooth on the ratchet wheel 72, prevents this wheel being dragged by the pawl 76 which slides over the teeth of the ratchet wheel during this movement. Upon the return movement of the pawl during which it engages a tooth face and rotates the ratchet wheel and drum, it moves toward the shoulder 89. At the end of its movement, its forward end 93 is directly over the shoulder 89 and is thereby locked into the tooth notch in which it happens to be. Any tendency on the part of the drum, therefore, to move beyond the position to which it is carried by the pawl is overcome and it is locked into that position. At this moment the end surface 93' of pawl 76 engages the upper end of spring 86. This stops the return movement of the pawl, the spring thereby forming a resilient stop for limiting the return movement of the pawl and crank.

The combining of the two springs 86 and 92 in the manner described greatly simplifies the adjustment of the shoulder 89 and the spring 92 with respect to pawl 76 and ratchet wheel 72. The spring 92 is made of such length that when abutment 93' on pawl 76 is in engagement with the upper end of spring 86, as shown in Fig. 6, the end of spring 92 is in line with the free end of pawl 76. This forms a simple means for obtaining initially a correct relationship between the cooperating pawl and the spring surfaces. Spring 86 can be bent forward or backward to adjust it to the desired position with respect to ratchet wheel 72 so that when the drum is actuated, return movement of the pawl will be stopped to position correctly the ratchet wheel and the drum discs; and when thus adjusted, it will be noted that since springs 86 and 92 form a unitary structure and are moved simultaneously, the relationship between the upper end of spring 86, which is engaged by pawl 76, and the end of spring 92 will be always maintained.

As stated above the controller drum controls the traffic signal circuits by actuating certain contacts. The contacts operated by the drum are illustrated in detail in Figs. 3, 8 and 11. A contact carrying block 95 of suitable insulating material is mounted underneath the controller drum and is supported in back of and in spaced relation to panel 6' by a suitable number of bolts 110 which thread into bosses 111 on block 95 and clamp the bosses against lugs 109 projecting from the face of panel 6'. In shelf 56, directly beneath block 95, is a rectangular opening 112 which extends the length of the block. Block 95 has a central forwardly projecting longitudinally extending portion 95^a above and below which are upper and lower contact and terminal carrying portions 95^b and 95^c. At its rear, block 95 is provided with a longitudinally extending terminal carrying portion 95^d. Extending transversely of portion 95^a are dividing walls 96 which provide contact arms receiving grooves. In signaling systems of the type in which a controller of the character embodying my invention is used, the number of contact arms which may be required varies according to the particular conditions to be taken care of in any particular instance and block 95 is made long enough to provide a sufficient number of contact arm receiving grooves, or channels, to take care of maximum requirements. The contact arms are indicated at 97 and in the present instance, as will be seen from Fig. 3, seven contact arms 97 located in the seven left-hand contact arm receiving grooves are shown. Each contact arm 97 comprises a flat strip of metal, for example, a sheet metal stamping, of suitable length provided with a contact 101 spaced inwardly from one end and a contact 102 at the other end. In each contact arm, just above contact 102, is an opening 107. The stationary contacts 98 and 99 are mounted in rows above and below the dividing walls 96 and in line with the channel between each pair of walls 96. Contacts 98 are mounted in the upper contact and terminal receiving portion 95^b of block 95 and comprise contact heads carried by threaded bolts 98^a which project through portion 95^b and are provided on their inner ends with terminal bolts 98^b. Stationary contacts 99 are carried by contact strips 119 fastened to contact and terminal carrying portion 95^c by screws 120. The lower ends of contact strips 119 project below block 95 and through opening 112 in shelf 56 terminating below the lower face of the shelf. The contacts 101 75

and 102 on each contact arm 97 cooperate respectively with a contact 98 and a contact 99. Each contact arm 97 is held resiliently in position to cooperate with the stationary contacts by a key 103 which is provided with a head 104 and a bit 105. As best shown in Fig. 3, key 103 extends through the opening 107 in the contact arm and through a keyhole shaped opening 100 in block 95, the bit 105 on the end of the key engaging a notch in the rear face of the block. A helical spring 106 is mounted on the key between the head 104 and the arm 97. For simplicity in manufacture, the key 103 may be stamped out of sheet metal. In assembling a contact on the block, the forward end of the key is inserted by simply hooking the bit end of the key through the hole 107 in the arm and thereafter moving the head end of the key upwardly until it is perpendicular to the arm. The bit end of the key is then moved through the keyhole shaped opening 100 in the block after which the key is turned 90° and the bit 105 hooked into a suitable notch in the back surface of the block. The contact arm with its contacts is then held against the stationary contacts by the pressure of the spring 106 which is under compression between the head 104 and the contact arm. This method of holding the contact arm enables a quick removal of the arm for replacement or contact examination. When assembled, contact 102 is held firmly in engagement with contact 99 and contact 101 is moved into and out of engagement with contact 98. Thus each contact arm functions to connect and disconnect its corresponding pair of contacts 98 and 99.

Mounted on terminal carrying portion 95^d of block 95 are angularly shaped terminal strips 121, each having one arm fastened to the underside of portion 95^d by terminal screws 122 and the other arm extending down through opening 112 in shelf 56 in parallel relation to strips 119.

In order to control the engagement of the movable contacts 101 with the stationary contacts 98 the contact arms 97 extend upwardly so that their ends ride on the rims of the discs 71 and 154 to 159 inclusive. In the positions of the drum, in which a disc presents an unbroken rim to the end of a contact arm 97, the contact 101 on such arm is out of engagement with the corresponding stationary contact 98. When a disc is turned by the rotation of the drum to a position where a broken away portion of its rim is brought into line with the end of a contact arm, the contact arm moves inwardly to bring its contact 101 into engagement with a stationary contact 98.

For the purpose of providing a convenient connection between the contacts on the block 95 and the conductors in cable 10, there is provided a terminal board fastened by means of screws 114, over opening 112.

The terminal board 113 is a rectangular board provided on its inner surface with a channel 115 extending lengthwise of the board from end to end and with grooves 116 not as deep as the channel, extending across the width of the board at right angles to the channel 115. Terminals 117 comprising resilient leaves are attached to the board by means of eyelets 118 into which conductors from the cable 10 are soldered. The leaves of the terminals extend outwardly of the grooves and over and above the surface of the channel. When the board is attached to the under side of the shelf 56 these leaves engage the ends of terminal strips 119 and 121 which extend through the opening in the shelf.

The terminals 117 on the board 113 are ar-

ranged in two rows along the opposite sides of the board, each row extending over and above the channel surface 115 and engaging the two rows of terminal strips 119 and 121 projecting down from the block 95. Terminals 117 are connected to the terminals on switchboard 9 by cable 10 and the terminals on the switchboard are connected to the outgoing circuits of cables 11 and 13.

Terminal board 113 is provided with a number of terminals 117 sufficient to make the required number of connections to terminal strips 119 and 121. The number required and the arrangement varies in accordance with the requirements in any particular case.

With this arrangement, it will be seen that a timer as a unit may be completely disconnected electrically by unscrewing the screws 114 and removing terminal board 113, a thing which disturbs none of the wiring of the timer nor of the cable connections. This is a feature in the construction which is of substantial importance in that it enables the timer to be wired complete as a unit after which it may be mounted in casing 5 and connected in the circuit by merely attaching a terminal board 113. Likewise, switchboard 9 and terminal board 113 may be wired together as a unit, the wires being made into the cable 10.

In constructing a controller for a particular application, the timer may be assembled except for the drum and the contact arms 97, and completely wired. Following this, a drum may be made up by taking a shaft 70 and mounting thereon the required number of discs with the correct segments broken out and a ratchet wheel having the required number of ratchet teeth and mounted in place in the timer. And then the required number of contact arms 97 may be slipped into place. This completes the timer. The timer may be now mounted in the controller casing. Next, a switchboard 9 and a terminal board 113 may be made up with the required number and arrangement of terminals and wired together as a unit and assembled in the controller casing, the terminal board being attached to the shelf to make the electrical connections to the timer. This completes the controller, it being now ready to be wired into the system in which it is to be used. It is wired into the system through the terminal connections on the front of the switchboard 9 as shown in Fig. 1.

Referring now to the diagram of connections, Fig. 12, we may trace the circuit connections and the sequence of operations of the apparatus just described. This figure discloses a circuit diagram including a perspective view of the dial 20 with its keys and a skeleton view of the contacts operated thereby. A conventional traffic signal having the well known three color signals designated by the letters R, A, and G is shown. Two faces of this unit are illustrated one for each of two intersecting streets.

Current is supplied to the controller from a local source through a conductor 125 and from a second source S through a conductor 126 which is common to a group of controllers. The conductor 125 is permanently connected to a conductor 128 and through the panel switch 32 to a conductor 129.

Conductor 129, which is permanently energized carries current to contact 130 which is one of the stationary contacts in the block 41. The co-operating contact of this pair is contact 131 mounted on the spring 132. The contacts 130-131 are the pair of contacts in the block 41

which is nearest to the dial 20. The lower contact 131 of this pair is lifted into engagement with upper contact 130 by each key 24 as the dial rotates.

5 Contacts 130 and 131 are in a circuit which includes the drum operating coil 81 and which may be termed the normal operating circuit. This circuit may be traced as follows: Source conductor 125, conductor 128, contacts 130—131, contact arm 132, conductor 135, set of contacts 10 99—102—97—98—101 (as illustrated in Fig. 8) controlled by drum disc 71, conductor 136, conductor 137, switch 33, conductor 138, coil 81, to ground. Contact arm 97 controlled by disc 71 15 is in closed circuit position for all positions of the control drum except one. To this end, all but one of the segments of disc 71 are broken away. In the present instance, ratchet wheel 72 has six teeth so that the drum has six positions, 20 in five of which such contact arm is in closed circuit position and in the sixth in open circuit position. When contact 131 is moved into engagement with contact 130 by a key 24 at a time when the contact arm controlled by disc 71 is in closed 25 position, the normal operating circuit through coil 81 is closed, thus energizing coil 81 and advancing the drum one step. Thus successive operations of the contacts 130—131 by the keys 24 result in a step-by-step movement of the drum at intervals 30 determined by the spacings of the keys 24. However, if when contact 131 is moved into engagement with contact 130, the contact arm controlled by disc 71 is in open circuit position, the normal operating circuit is not closed, and hence the 35 drum is not advanced. Now, to effect a further movement of the drum, there is provided through coil 81 a second circuit, which may be termed a local synchronizing circuit, which circuit is in shunt with the normal operating circuit and includes the contacts 140 and 141 which are re- 40 moved into engagement by local synchronizing key 143. When during rotation of dial 20, key 143 engages block 68 to move contacts 141 into engagement with contact 140, a circuit is closed through coil 81 as follows: From source conductor 45 125 through switch 32, conductor 129, switch 18, conductor 146, contacts 140—141, contact spring 142, conductor 136, conductor 137, switch 33, conductor 138 and coil 81 to ground. Closing of this 50 circuit energizes coil 81 and causes the drum to be advanced one step. It will thus be seen that under normal operating conditions during each complete rotation of dial 20, the drum is given one complete turn in six successive steps, one step, 55 which may be considered the first step, being effected by local synchronizing key 143 and the five following steps being effected by the five keys 24. The contact arms actuated by drum discs 154 to 159 inclusive control the circuits R, R₁, G, G₁, and 60 A, A₁ to the signal lamps, and discs 154—159 inclusive are arranged in the drum controller with their broken away sections located in such relation to each other that with successive actuations of coil 81, first by local synchronizing key 143 65 and then by the five keys 24, the desired sequence of operation of the lamps is effected. And the keys 143—24 are spaced apart around the dial 20 to give the desired duration of signals for each drum position. Thus there is a definite correct 70 relationship between the drum position and the dial position which must be maintained for correct operation of the signal lamps. This correct relationship obtains as long as the drum position is in such relationship to the dial position that 75 key 143 operates contacts 141, 140 at a time when

drum disc 71 has moved its contact arm 97 to open circuit position; that is, when the drum disc is moved to such position by the key 24 just in advance of key 143. If the controller is started 5 into operation with the drum and the dial not in correct relationship relatively to each other, then if it so happens that the drum is in the position in which contact arm 97 is in open circuit position, no energization of coil 81 and operation of 10 the drum will occur until key 143 actuates contacts 141, 140, keys 24 being ineffective to close the normal operating circuit since this circuit is opened by the drum disc 71. On the other hand, 15 if the controller is started into operation with the drum and dial not in correct relative relationship but at a time when drum disc 71 is in a position such that contact arm 97 is in closed circuit position, then keys 24 will effect operation of the drum until contact arm 97 is moved to open 20 circuit position after which no further operation of the drum can occur until key 143 actuates its contacts 141, 140. Thus it will be seen that if at any time the controller is started up when the drum and dial are not in correct relationship 25 relatively to each other, or if at any time during operation the drum and dial should for any reason get out of such correct relative relationship, they will be quickly brought into correct relationship during the first complete rotation of dial 20.

For automatic operation as described above, 30 switch 33 is in the position shown in Fig. 12, wherein it connects conductor 138 to conductor 137. To shift the signals from automatic to manual control, switch 33 is moved to connect conductor 138 to conductor 13. This connects coil 35 81 in circuit with push button 12 so that the drum may be turned manually step by step by successively closing switch 12. At any time, the signals may be shifted back to automatic control by moving switch 33 back to the Fig. 12 position. And 40 during the first complete rotation of dial 20, the dial and drum will be brought automatically into correct synchronous relationship and thereafter maintained in such relationship as already explained. 45

The second source of power S, is used for synchronizing a group of controllers with each other and with a master controller 127. The master controller 127 is diagrammatically illustrated as 50 being provided with a cam 150 which periodically opens a switch 151. The switch 151 is connected in a circuit which includes contacts 61 and 62 and the field winding 45 of motor 42 which circuit may be traced as follows: Source S, switch 55 151, conductor 126, conductor 152, arm 64, contacts 62, 61, and conductor 153. Switch 151 is normally closed and is opened periodically once during each complete rotation of cam 150. Contacts 61, 62 are normally separated and are closed 60 once during each complete rotation of dial 20 by key 26 engaging block 67. During operation, if the controller at an intersection is in synchronism with the master controller, the time is such that at the instant key 26 effects a closing of 65 contacts 61, 62, cam 150 effects an opening of switch 151 with the result that the circuit through motor winding 145 is not completed and the intersection controller continues to operate in a normal manner. If, however, when key 26 effects a closing of contacts 61, 62, cam 150 is in a 70 position such that switch 151 is closed, (which indicates that the intersection controller is out of the desired time relationship with the master controller), the circuit through motor windings 45 is completed and motor 42 is stopped due to the 75

field 45 opposing field 44, and when thus stopped, contacts 61, 62 are held closed by key 26. The circuit thus established through field winding 45 remains closed until cam 150 has moved to a position to permit switch 151 to open whereupon motor 42 will start operating and move key 26 to permit contacts 61, 62 to open. This means that the dial 20 is again started in synchronous relation to the master controller. Each controller of a group being similarly equipped will actuate a similar pair of contacts at an instant during its operating cycle. If it is in synchronism it will continue to operate. If it is out of synchronism, it will stop and will start at the instant at which 151 is opened. The positioning of the key 26 in the slots 25 will therefore determine the relationship in which the controller and the signals operated thereby will be maintained by the above mechanism, in relationship to other controllers in the system.

The drum illustrated in the example controller is provided with seven discs of which disc 71 regulates the position of the drum relatively to the dial and the discs 154 to 159 control the red, green, and amber signals for two intersecting highways. As above stated, the contacts operated by each disc are normally separated and closed in only one or more positions of the drum, dependent upon the signalling cycle. The current for the signals is received through the switch 32, conductor 129, contacts of the switch 18, and a conductor 160 which is connected to each of the contacts 98 under the discs 154 to 159. When the discs are in proper position, the proper contacts close and the corresponding signals are energized through the cable 11.

The switch is provided to control the circuits of the traffic signals and of a flashing mechanism to make it possible to operate only the amber signals and to operate them as periodically flashing signals. This type of operation is practical during periods of light traffic. In the position shown in Fig. 12, the switch is in a position to connect the amber conductors A and A₁ to the contacts of the drum controller, so that these signals are under control of the discs 158 and 159. When the switch is thrown to its second position, the conductor 129 which supplies the local current for operating the signals is separated from conductors 146 and 160 and no current flows to the drum contacts 99 through the conductor 160. Simultaneously, the conductors A and A₁ are connected to a conductor 148. This conductor 148 is connected to a flashing mechanism mounted on the supporting plate 46 of the driving motor.

This flashing mechanism comprises a stationary contact 161 mounted on a contact arm 162 and a movable contact 163 mounted on a contact arm 164. The contact arms are both mounted on a contact block 165 which is suitably attached to the motor supporting plate 46. The arm 164 is pivoted to the block at its back end and is bent at right angles at its forward end to provide a nose 166. The end of this nose 166 rides on the periphery of a star wheel 167. When the star wheel rotates the nose 166 riding the periphery of the wheel causes an intermittent engagement of the contacts 161, 163. Conductor 148 is connected to contact arm 164. Contact 161 is connected by a conductor 168 to the current supply conductor 129.

In operation, therefore, when the switch 18 is thrown to its second position it shuts off the current supply to the green and red lamps of the traffic signal unit and connects the amber

lamps to the current supply through the flashing mechanism so that as star wheel 167 rotates, it operates contacts 161, 163 to intermittently energize the amber lamps. Simultaneously, switch 18 disconnects conductor 146 and the re-synchronizing contact 140 from the current supply, thus opening the local synchronizing circuit. After this circuit has been opened, the drum will continue to be advanced by keys 24, operating contacts 130, 131 until it reaches the position at which disc 71 opens the drum advance coil circuit. The drum will then remain in that position until switch 18 is again thrown to normal operating position.

The panel switches 32 and 34 may be opened respectively to extinguish the signal lamps or to stop the dial motor. When switch 32 is opened, the source of current to conductor 129 is interrupted whereby the continuing movement of the dial will effect a movement of the drum up to the main street green position at which the disk 71 opens the drum advance coil circuit. The drum then remains stationary. This operation is the same as takes place when switch 18 is operated to break the same circuit, by separating conductors 146 and 129, at the switch contacts.

The switch 34 may be opened to stop the dial at any chosen instance. By merely opening the switch 34 during the amber signal period, for example, it is possible to obtain a steady amber indication instead of a flashing amber indication as is the case when switch 18 is operated to its second position. An opening of both switches 32 and 34 effects a complete shutdown of the controller.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A traffic signal timer having contacts, a drum controller for operating said contacts, and means for rotating said drum controller step by step including a ratchet wheel mounted on said drum controller, a pawl operable to rotate said wheel when moving in one direction and to slide over the teeth of said wheel when moving in the other direction, and means for holding said drum controller in the position to which it is moved by said pawl comprising a spring provided with a shoulder arranged to engage and hold the pawl in engagement with the said ratchet wheel when said pawl reaches the end of its movement when rotating said drum controller, and a second spring supported by said first spring arranged to engage the face of a tooth on said ratchet wheel whereby said drum controller is prevented from overrunning its position in the first instance and is prevented from moving in a reverse direction with the pawl when the latter slides over the periphery of said ratchet wheel.

2. A traffic signal timer comprising a rotatable drum, a ratchet wheel attached to said drum, a pawl cooperating with said ratchet wheel, means for reciprocating said pawl to advance said ratchet wheel and drum to successive positions, and means for retaining said drum in each of its positions including a spring which engages the ratchet wheel to hold it against rotation in one direction and against which the pawl strikes for simultaneously stopping said pawl and holding it in engagement with said ratchet wheel to prevent rotation of said ratchet wheel in the other direction.

3. In a traffic signal timer, the combination of a panel, an opening therein, a dial mounted in said opening, a motor arranged to rotate said dial, a group of switch contacts operated by said

dial mounted on the back of said panel above said dial, a drum controller provided with a cam shaft mounted horizontally below said dial, a solenoid mounted on said panel and provided with a movable plunger, means connecting the plunger to said cam shaft, electric conductors connecting said solenoid to said dial-operated contacts, and a second group of contacts operable by said cam shaft mounted on said panel below said drum controller.

4. In a traffic signal timer, the combination of a panel provided with a base, a dial mounted on said panel, a motor mounted on said panel and connected to drive said dial, switch contacts mounted on said panel and intermittently operable by said dial, a drum controller shaft mounted on said panel below said dial, cams on said shaft, means for moving said cam shaft, electric conductors connected between said means and said dial-operated contacts and a group of contacts mounted on the base of said timer in operating relation to said cam shaft.

5. In a traffic signal timer, the combination of a panel provided with an opening, a yoke attached to said panel and disposed across said opening, a dial mounted in said opening and on said yoke, a motor mounted on said yoke and connected to operate said dial, a contact control drum mounted on said panel below said motor, means for operating said drum, keys in said dial the position of which may be adjusted, switching contacts operated by said keys and electric conductors connected between said switching contacts and said drum operating means.

6. In a traffic signal timer, the combination of a panel, a dial supported on said panel, means for rotating the dial, a plurality of spaced actuating keys carried by the dial and arranged to move in different paths when the dial rotates, a mounting block, switch contacts mounted in fixed relation to each other on said mounting block and having parts which stand in the paths of movement of said actuating keys whereby when the dial rotates, the keys effect operations of said contacts, and means for supporting the block on said panel to bring all said contacts into fixed operative relation to said actuating keys.

7. In a traffic signal timer, the combination of a signal controller, a dial, means for rotating said dial, a pair of contacts operated by said dial and adapted to be connected to control the operation of said signal controller, a second pair of contacts operated by said dial, and a common block for supporting said two pairs of contacts in definite relation relatively to each other and in relation to said dial, whereby the positioning of said block simultaneously determines the operating relationship between the said several pairs of contacts and the dial.

8. In a traffic signal controller, the combination of a support, a signal controlling member rotatably mounted on the support and adapted to effect a cycle of operations, a motor for rotating said member, said motor being adjustable to different positions to effect rotation of said member at rates corresponding to different cycle lengths, and indicating means positioned by the positioning of said motor for indicating the cycle length for which the motor is positioned.

9. In a traffic signal controller, the combination of a support, a signal controlling member rotatably mounted on the support and adapted to effect a cycle of operations, a motor for rotating said member mounted at the rear of said support and adjustable to different positions to effect ro-

tation of said member at rates corresponding to different cycle lengths, and indicating means positioned by the positioning of said motor and visible from the front of the support for indicating the cycle length for which the motor is positioned.

10. In a traffic signal controller, the combination of a support, a shaft rotatably mounted on the support, a signal controlling member mounted on the shaft and adapted when rotated to effect a cycle of operations, a frame, a motor having a shaft carried by the frame, gears connecting said shafts through which the motor drives the signal controlling member, adjustable means mounting the frame on the support whereby gears of different sizes may be utilized between the shafts to effect rotation of said signal controlling member at rates corresponding to different cycle lengths, and indicating means positioned by the positioning of said frame for indicating the cycle length for which the frame is positioned.

11. In a traffic signal controller, the combination of a support, a shaft rotatably mounted on the support, a signal controlling member mounted on the shaft and adapted to be rotated to effect a cycle of operations, a motor having a shaft, a pair of gears between said shafts through which the motor drives the signal controlling member, said motor being adjustable to vary the distance between said shafts whereby gears of different sizes may be utilized between the shafts to effect rotation of said signal controlling member at rates corresponding to different cycle lengths, and indicating means positioned by the positioning of said motor for indicating the cycle length for which the motor is positioned.

12. A controller having a contact operating drum, means for imparting step by step turning movement to the drum comprising a toothed ratchet wheel connected to the drum, a pawl engaging teeth on the ratchet wheel, means for lifting the pawl relatively to the ratchet wheel to bring the pawl into engagement with a tooth of the ratchet wheel and then release said pawl to permit it to return to effect a movement of the ratchet wheel, and a spring member having a surface against which the pawl strikes at the end of its return movement to arrest downward movement of the pawl and further turning of the ratchet wheel and a part which engages a tooth of the ratchet wheel to prevent reverse turning movement of the ratchet wheel.

13. A controller having a contact operating drum, means for imparting step by step turning movement to the drum comprising a toothed ratchet wheel connected to the drum, a pawl engaging teeth on the ratchet wheel, means for lifting the pawl relatively to the ratchet wheel to bring the pawl into engagement with a tooth of the ratchet wheel and then release said pawl to permit it to return to effect a movement of the ratchet wheel, and a spring member having an end against which an under part of the pawl strikes at the end of its return movement to yieldably arrest the movement of the pawl and further turning of the ratchet wheel and an angularly extending part which engages a tooth of the ratchet wheel to prevent reverse turning movement of the ratchet wheel.

14. A controller having a contact operating drum, means for imparting step by step turning movement to the drum comprising a toothed ratchet wheel connected to the drum, a pawl engaging teeth on the ratchet wheel, said pawl being narrower than the ratchet teeth, means for lifting the pawl relatively to the ratchet wheel

to bring the pawl into engagement with a tooth of the ratchet wheel and then release the pawl to permit it to return to effect a movement of the ratchet wheel, and a spring member having an extension against which an under part of the pawl strikes at the end of its return movement to yieldably arrest the movement of the pawl and further turning of the ratchet wheel and an angularly extending part which engages a tooth of the ratchet wheel at the side of the pawl to prevent reverse turning movement of the ratchet wheel.

15. In a traffic signal timer, a support, a cam shaft mounted on the support transversely to a surface thereof and having a series of cams removably mounted thereon, a contact block mounted on the support transversely of such surface and directly adjacent to said shaft, said support having a transversely extending opening adjacent to said block, contact arms removably mounted on said block having ends which engage said cams and ends presented to said opening, a connection block fastened to the support having terminal contacts, and means connecting said last named ends to said terminal contacts through said opening.

16. In a traffic signal timer, a support comprising a panel and a shelf which extends at an angle to the panel and is provided with an opening, a contact actuating member mounted on the support, a motor mounted on the support and connected to drive the contact actuating member, a drum controller mounted on the support transversely thereof above the shelf, a contact block mounted on the support adjacent to said controller, contact arms mounted on the contact block having ends which engage with the drum controller and ends which stand in line with said shelf opening, and a connection block which is fastened to the shelf and has terminal contacts connected to said last named contact arm through said opening.

17. In a traffic signal timer, a support, a cam carrying shaft detachably mounted on and extending across the support in spaced relation thereto, cam disks removably mounted on said shaft, said shaft being of a length to have placed thereon the maximum number of cam disks which may be required in the use of the controller, a contact block mounted on the support adjacent to said shaft, contact arms detachably mounted on said contact block, said block being of a length to have placed thereon contact arms corresponding in number to the number of cam disks mounted on said shaft, said contact arms presenting one end to said cams and said support being provided with a slot extending across it of a length corresponding to the length of said block and to which the other ends of said contact arms are presented, a terminal block detachably connected to said support to cover said opening and provided with fixed contact terminals which are connected to the contact arm ends

presented to said opening when the terminal block is mounted over the opening.

18. In a traffic signal timer, a support, a drum controller comprising a plurality of cams mounted on the support, said support having an opening which extends throughout the length of said drum controller, a block mounted on the support adjacent to said opening, contact strips fixed on said block with one end in line with said opening, contact arms detachably connected to said block having one end in engagement with said cams and the other end in engagement with said contact strips, a second block detachably connected to said support, and terminal contacts on the second block which when such block is fastened to the support engage the ends of said contact strips which are in line with said opening.

19. In a traffic signal timer, a support, a unitary structure mounted on the support comprising a shaft and a ratchet wheel and a plurality of cam disks carried by the shaft; a second unitary structure mounted on the support comprising a block having thereon detachable contact arms having ends presented to the cam disks and a third unitary structure mounted on the support comprising a block and terminal contacts carried thereby which when such third unitary structure is attached to the support are electrically connected to said contact arms; each of said structures being adapted to be applied to and removed from said support as a unit.

20. In a traffic signal controller, a support, a shaft mounted on the support, cams carried by the shaft, a mounting block adjacent to the shaft, spaced contact buttons carried by the block adjacent to its longitudinal edges, and spring pressed contact fingers detachably fixed to the block intermediate between their ends, the outer ends of said fingers pivoting on the contact buttons at one edge of the block and the inner ends of said fingers riding on the cams and being moved by the cams into and out of engagement with the contact buttons at the other edge of said block.

21. In a traffic signal controller, a support, a shaft mounted on the support, a series of removable cams on the shaft, a mounting block adjacent to the shaft having a series of spaced openings and a row of contact buttons above and below the openings, contact fingers the outer end of which engage the lower row of contact buttons, and the inner ends of which ride on the cams, keys which extend through openings in said fingers and detachably fasten in the openings in said block to fasten the fingers to the block, and springs carried by said keys for holding the fingers in engagement with the lower row of contact buttons and with the cams, rotation of the cams effecting pivotal movement of the fingers on the lower contact buttons to move the fingers into and out of engagement with the other row of buttons.

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