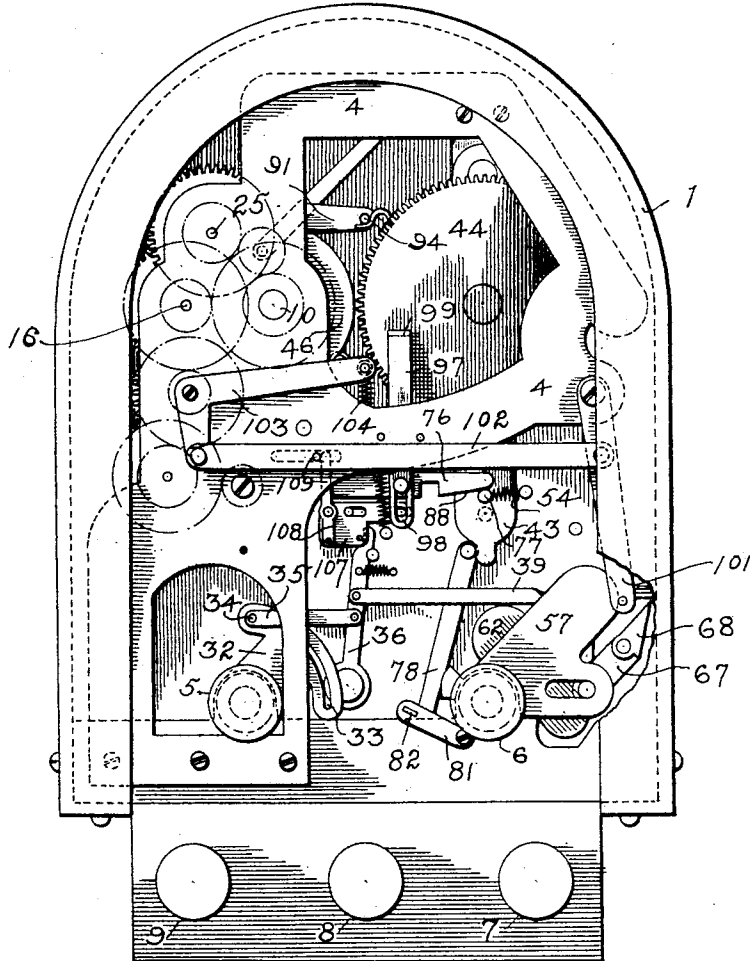


F. R. HOYT,
CIRCUIT CONTROLLER.
APPLICATION FILED OCT. 24, 1910.

1,135,285.

Patented Apr. 13, 1915.
10 SHEETS—SHEET 1.

Fig. 1



Witnesses
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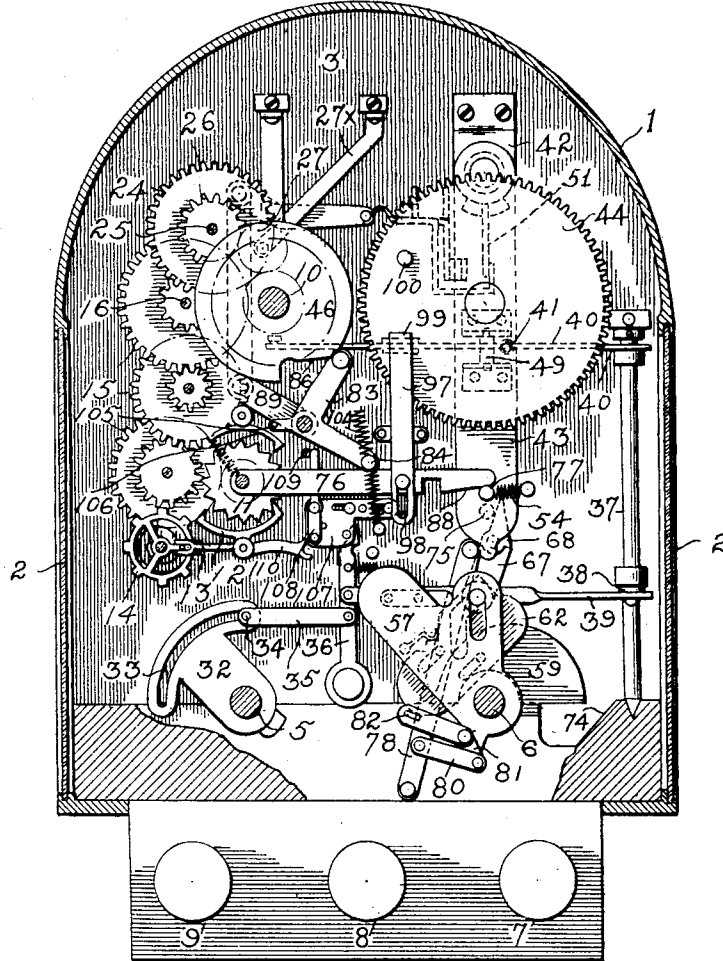
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APPLICATION FILED OCT. 24, 1910.

1.135,285.

Patented Apr. 13, 1915.

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Fig. 2



Witnesses

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APPLICATION FILED OCT. 24, 1910.

1,135,285.

Patented Apr. 13, 1915.

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Fig. 3

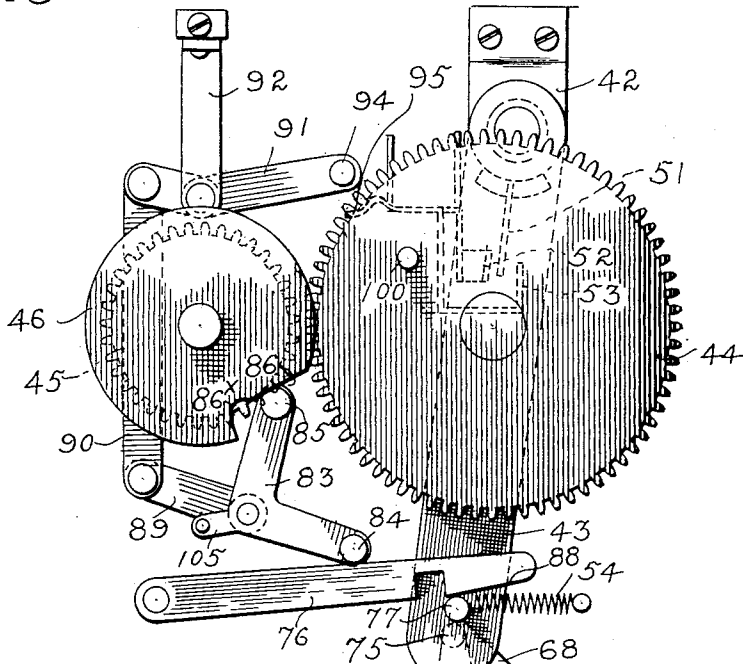
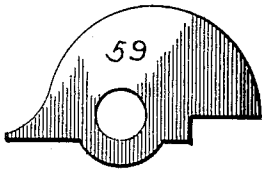
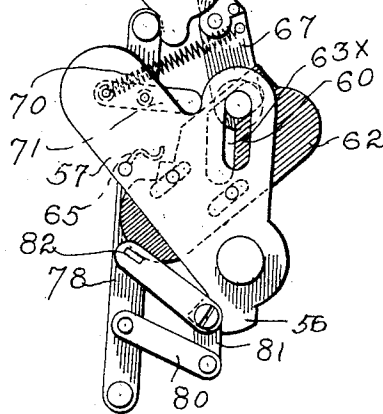


Fig. 19.



Witnesses

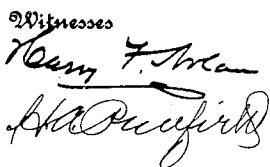
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APPLICATION FILED OCT. 24, 1910.

1,135,285.

Patented Apr. 13, 1915.

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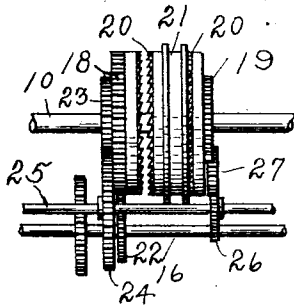


Fig. 5.

Fig. 10.

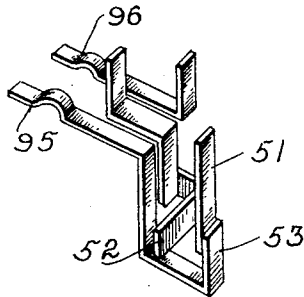
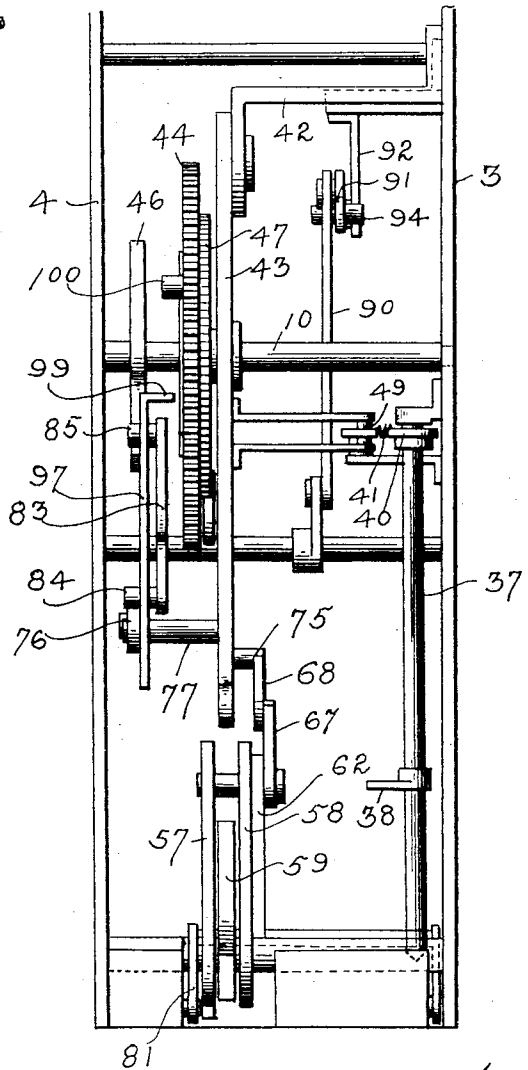


Fig. 11.



Witnesses
Henry F. Allen
Attest

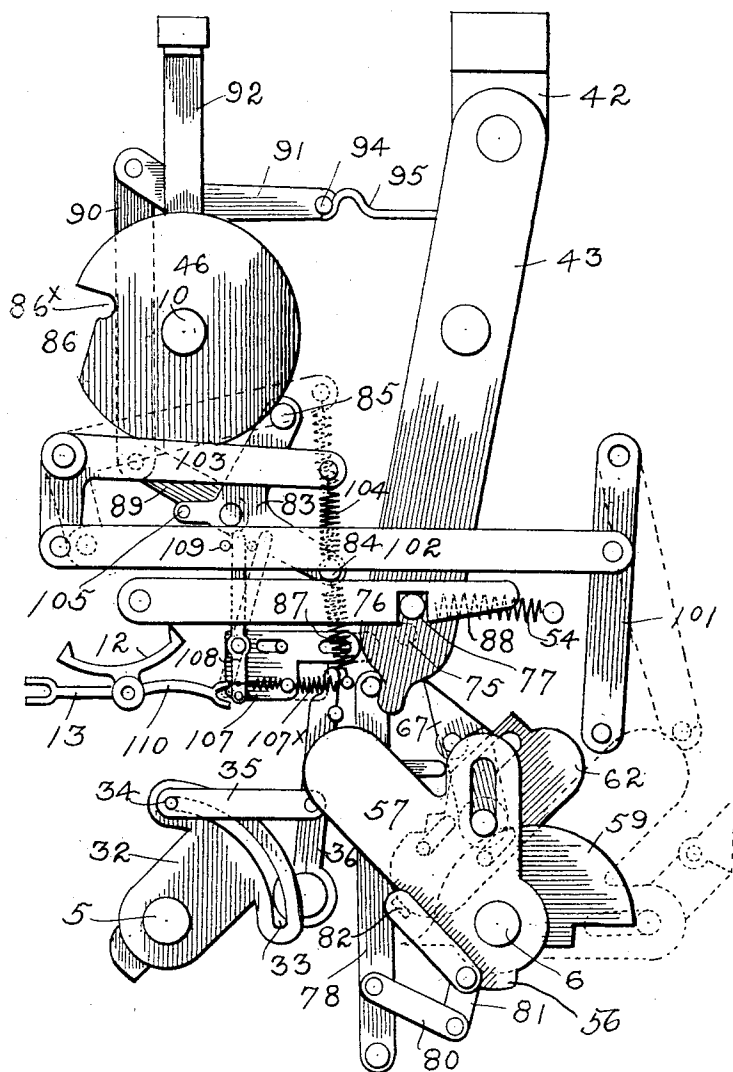
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APPLICATION FILED OCT. 24, 1910.

1,135,285.

Patented Apr. 13, 1915.
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Fig. 6



Witnesses

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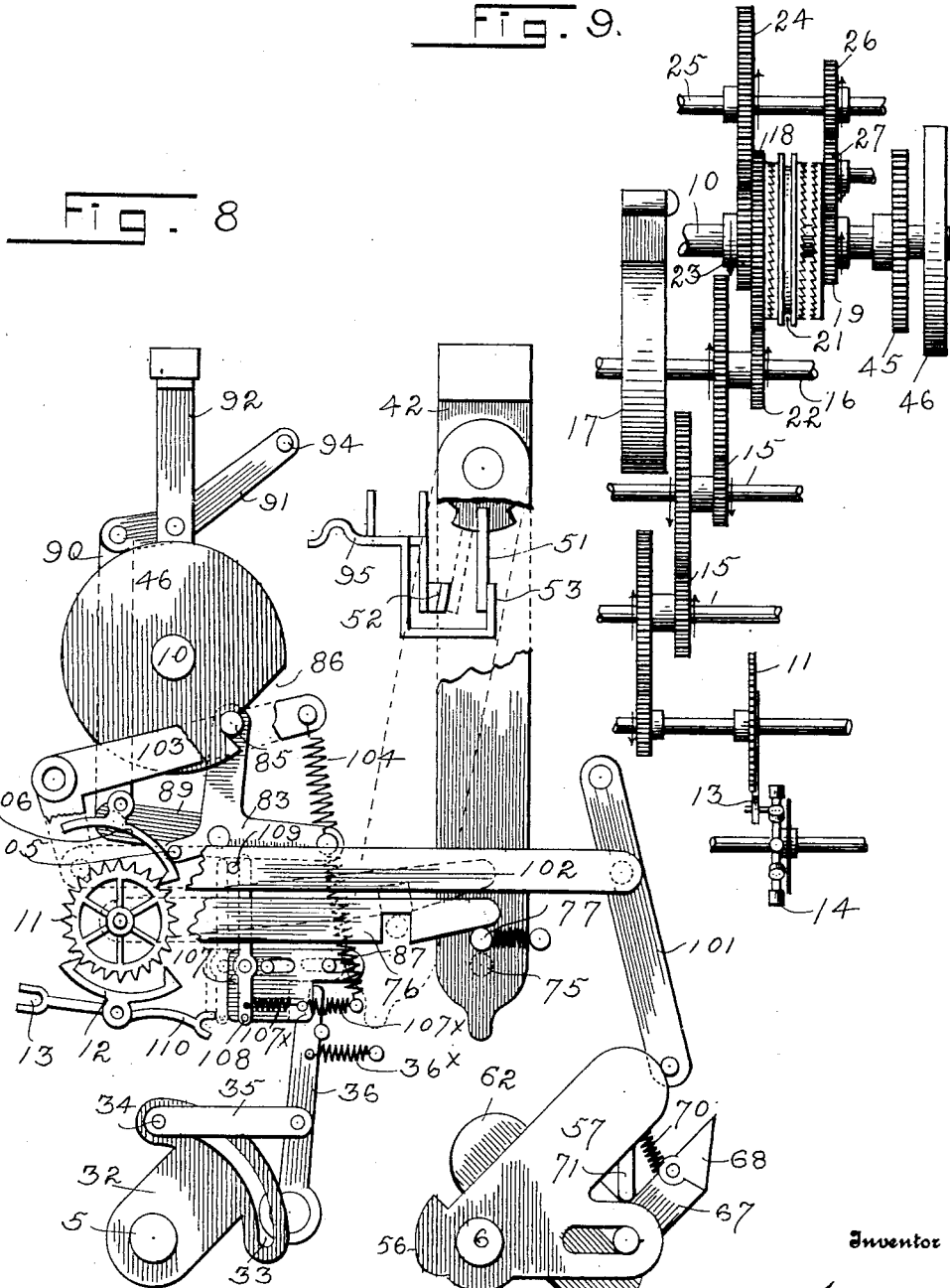
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10 SHEETS—SHEET 8.



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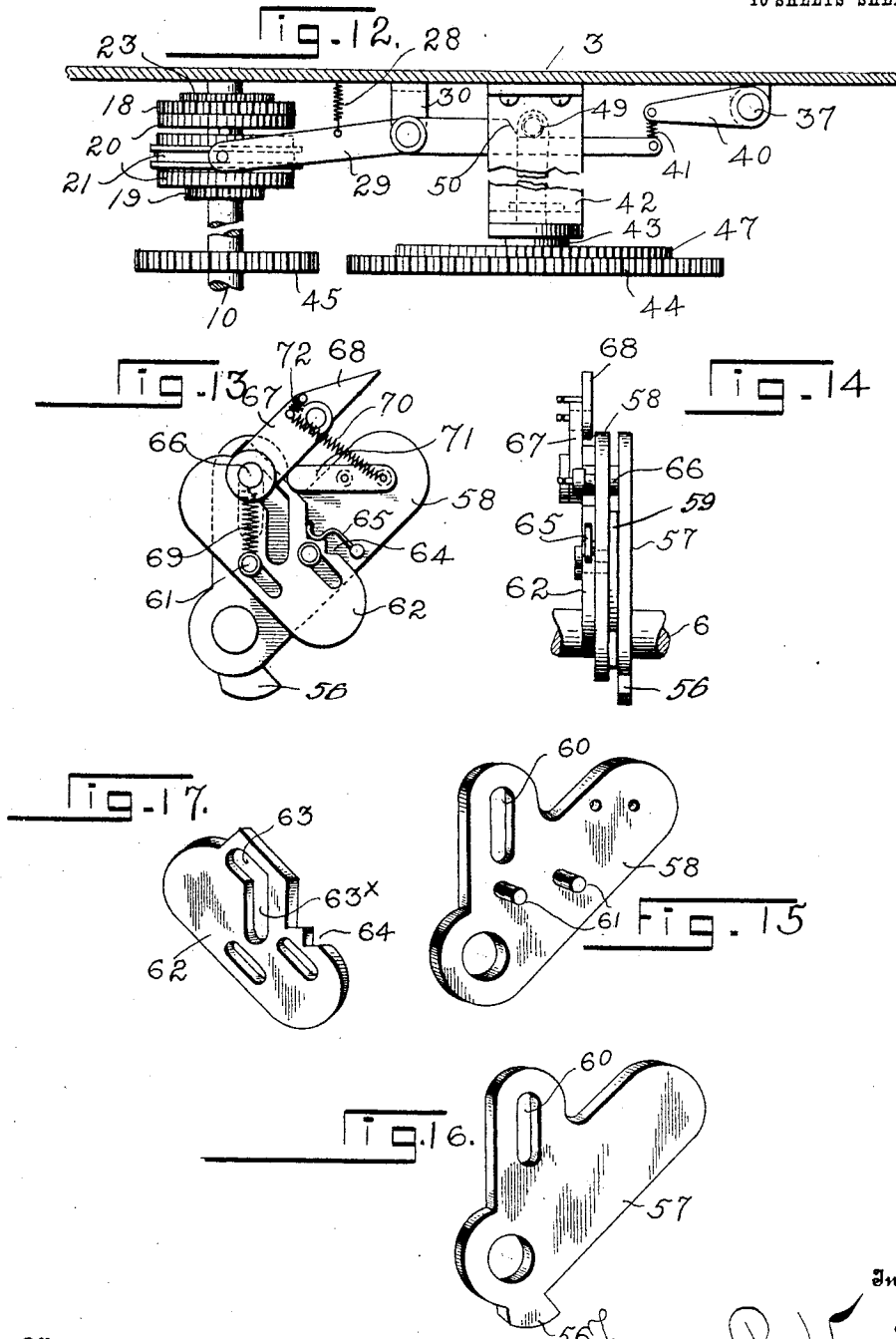
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APPLICATION FILED OCT. 24, 1910.

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Patented Apr. 13, 1915.

10 SHEETS—SHEET 9.



Witnesses
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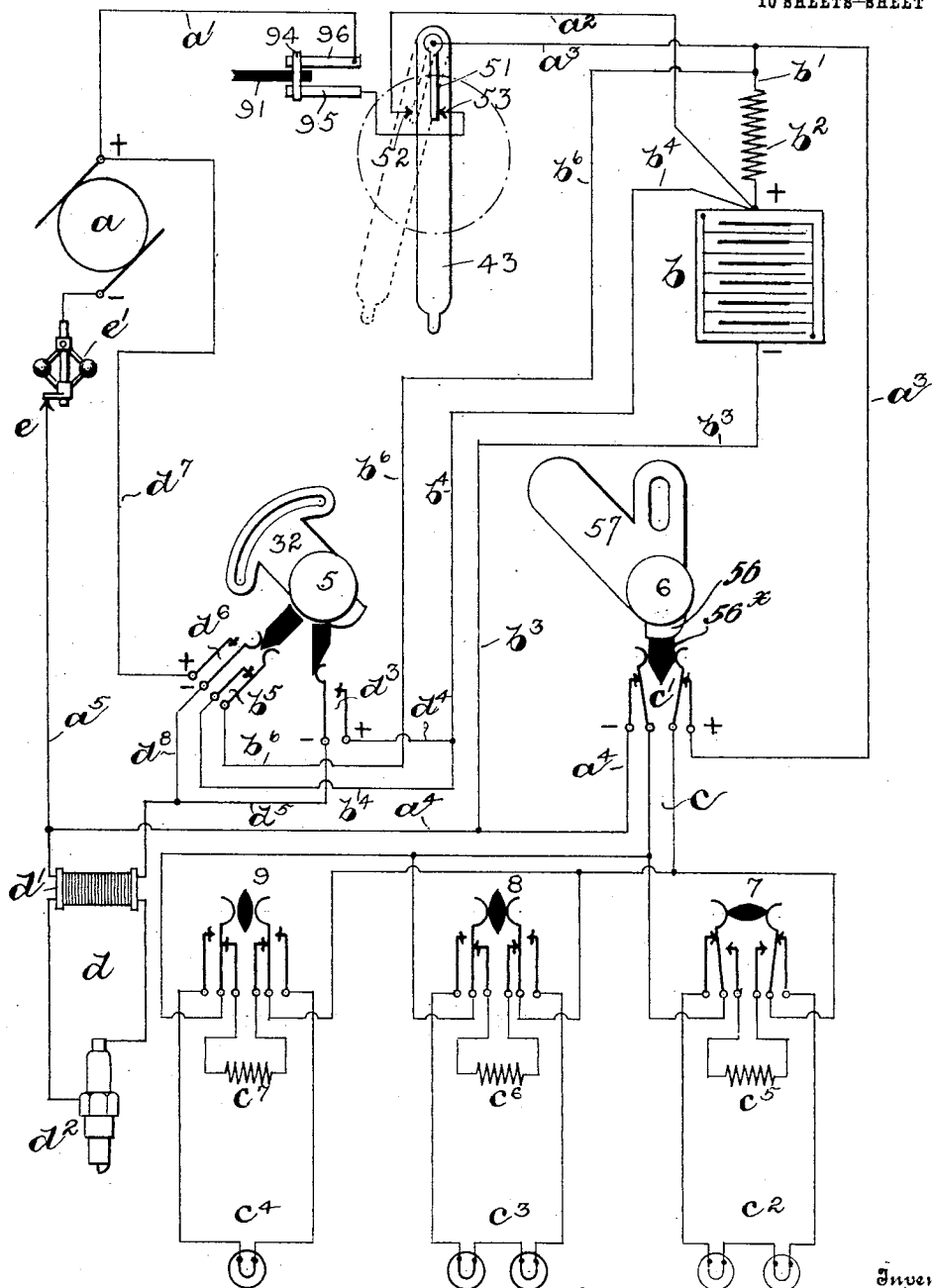
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APPLICATION FILED OCT. 24, 1910.

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10 SHEETS—SHEET 10.



Witnesses
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FIG. 20.

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UNITED STATES PATENT OFFICE.

FRANCIS R. HOYT, OF INDIANAPOLIS, INDIANA, ASSIGNOR, BY MESNE ASSIGNMENTS,
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CIRCUIT-CONTROLLER.

1,135,285.

Specification of Letters Patent.

Patented Apr. 13, 1915.

Application filed October 24, 1910. Serial No. 588,848.

To all whom it may concern:

Be it known that I, FRANCIS R. HOYT, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented certain new and useful Improvements in Circuit-Controllers, of which the following is a specification.

My invention relates to automatic controlling devices for electric circuits, and particularly to means for controlling the charging and discharge circuits of storage batteries, whereby the battery will be alternately charged and discharged throughout predetermined periods of time, and the circuit terminals automatically shifted from charging to discharging positions or vice versa when predetermined points in the capacity of the battery have been attained.

The object of the invention is to simplify the structure as well as the means and mode of operation of such devices whereby they will not only be cheapened in construction, but will be rendered more efficient and reliable in operation, entirely automatic in the control of the battery circuits, and unlikely to get out of repair.

With the above primary and other incidental objects in view as will more fully appear in the specification, the invention consists of the means, mechanism, features of construction, parts and combinations thereof, and the mode of operation or their equivalents, as herein after described and set forth in the claims.

Referring to the drawings Figure 1 is a front elevation of the assembled mechanism, with the parts in position as during the charging period, with the ignition key in operative or "on" position, that is with the engine and generator running and charging the battery, and the master key controlling the light or other circuit as here after described in its inoperative or "off" position. Fig. 2 is a similar view of the apparatus with the frame removed to better display the mechanism, and the ignition and master keys reversed from the positions shown in Fig. 1. Fig. 3 is an enlarged detail view of a portion of the apparatus, showing the master key in its operated position, and the parts partially operated toward the discharging position. Fig. 4 is a similar view showing the parts completely operated or in position for discharging the battery. Fig. 5 is a side eleva-

tion of the assembled apparatus. Fig. 6 shows the relation of the parts, particularly the locking mechanisms during the discharging period with both ignition and master keys in "on" position. Fig. 7 is a similar detail view during the charging period with both ignition key and master key in "off" positions. Fig. 8 illustrates the automatic locking of the motor at the end of the charging period if the master key is in "off" position. Fig. 9 is detail view somewhat diagrammatic of the gear train of the time motor. Fig. 10 is a detail plan view of the reversing clutch and driving connections of the main shaft. Fig. 11 is a detail perspective view of the movable contact and stationary terminals. Fig. 12 is a detail plan view of the shifting lever and connections. Fig. 13 is a rear elevation of the shifting mechanism carried by the master key. Fig. 14 is a side elevation of same. Figs. 15 and 16 are detail perspective views of the frame members of the shifting mechanism carried by the master key. Fig. 17 is a detail perspective view of the sliding cam plate of the shifting mechanism. Fig. 18 is a detail perspective view of the pawl arm and shift pawl. Fig. 19 is a detail view of the elevating cam for the pawl arm. Fig. 20 is a diagrammatic view of the electrical connections.

Like parts are indicated by similar characters of reference throughout the several views.

The apparatus forming the subject matter hereof is designed to alternately connect and disconnect with a main circuit a generator and a storage battery at predetermined intervals of operative time, regardless of the purpose for which the main circuit is employed.

The apparatus is herein described as forming a part of an automobile lighting system, in which the battery is charged from the magneto driven by the engine during successive periods of time that the engine is in operation until the battery has received its full charge.

When the battery is fully charged the charging circuit is automatically disconnected, and the lights are operated upon the battery charge until the battery is exhausted, or nearly so, when the charging circuit will again be connected by the automatic action of the apparatus.

It is to be understood that the invention is not limited to electrical lighting systems as described herein, but is applicable to other systems in which an electric motor, or
 5 other electrically controlled or actuated mechanism may be substituted for the series of lights in the present system, or it may be employed in a system of house or car lighting, or in other analogous combina-
 10 tions.

It is well known that to attain the highest efficiency of a storage battery, it should in charging receive a full charge each time, but should never be over charged. Also
 15 that the discharge each time should be to the same extent, preferably to a degree equal to substantially ninety percent. of the preceding charge.

It is further conducive to the long life and efficiency of the battery to charge it at a constant rate of amperage over an extended period of time.

For convenience of illustration it is assumed that the battery with which the apparatus forming the subject matter hereof is
 25 to be used, has a maximum capacity of ninety ampere hours, of which sixty ampere hours is the working charge and discharge, to which the normal working of the apparatus limits the battery, leaving thirty ampere
 30 hours as a surplus or emergency supply.

It is assumed that the capacity of the generator is nine amperes, of which one ampere is required for ignition purposes,
 35 and the light circuit when being operated requiring two and a half amperes. The battery is adapted to be charged at the rate of five and a half amperes per hour, thus consuming the remainder of the total out-
 40 put of the generator, amounting to a total of nine amperes. The apparatus is designed, (as shown in the drawing) to make the charging period twelve hours, making the complete charge sixty six amperes, or ap-
 45 proximately ten percent. greater than the corresponding discharge. When the battery is fully charged the apparatus automatically shifts the connections and the bat-
 50 tery is discharged at the rate of two and a half amperes the amount required for the light circuit, for a period of twenty four hours making sixty amperes discharge, which plus the battery losses equals the prior charge. It is to be understood that
 55 these capacities and amounts are merely arbitrary, assumed for the purpose of this description, and are not essential proportions, but that the capacities, rates and proportions may be varied to meet different
 60 conditions of service.

In constructing the apparatus there is employed a casing 1 adapted to be supported on the dash of the automobile or in other convenient location. In order that the de-
 65 vice may present a pleasing appearance the

front and sides of the case are preferably though not necessarily formed of glass as shown at 2 in Fig. 2, thereby exhibiting the operating parts. The back plate 3 of the casing and the frame member 4 adjacent to
 70 the front of the case constitute the supporting frame for the several moving parts. Adjacent to the lower portion of the case are two switch buttons or keys, the ignition key 5 which controls the spark coil circuit
 75 and thereby the ignition of the engine, and the key 6 here after referred to as the "master key" which controls the main circuit for whatever purpose it may be used, in this instance it is the lighting circuit in
 80 which are located the several lamps of the automobile. Below these keys are shown three additional switch keys or buttons 7, 8 and 9, which are individual light keys controlling the head, side and tail lights re-
 85 spectively. Supported in the frame of the structure is a clock work or time motor adapted to drive the revoluble main shaft 10 at a predetermined rate of speed. This actuating motor includes the escapement
 90 wheel 11 controlled by the escapement 12 from which projects the usual fork 13 engaging with the balance wheel 14 by which the escapement is regulated. The movement is transmitted through the gear train
 95 comprising the intermediate gears and pinions 15 to the final shaft 16 of the gear train, from which the movement is transmitted as here after described to the revoluble main shaft 10 at a constant speed
 100 such as to cause one revolution of the main shaft in an operating period of twelve hours.

The driving connections of the main shaft are best shown in Fig. 10. The final shaft
 105 16 carries at one end the actuating or motor spring 17 which is the general source of power. The particular spring time motor as shown is not essential to the proper working of the apparatus, but any suitable driv-
 110 ing mechanism may be employed, which is adapted to cause the movement of the main shaft 10 at a constant predetermined rate of speed. Loosely journaled on the main shaft 10 are two gear pinions 18 and 19
 115 having on their adjacent faces clutch teeth 20 adapted to inter engage with corresponding clutch teeth on a sliding clutch member 21 located intermediate the gears 18 and 19. The clutch member 21 is engaged with the
 120 shaft 10 by a spline and groove connection whereby it may be moved laterally to engage either of the gears 18 or 19, thereby causing the main shaft 10 to rotate in unison with either of the said gears.
 125

The final shaft 16 of the motor gear train carries the gear pinion 22 which meshes with the gear 18 driving said gear counter clock-
 wise or as indicated by the arrow in Fig. 9. The gear 18 carries therewith a gear pin-
 130

ion 23 attached to the gear 18, which pinion meshes with a gear 24 on a counter shaft 25. The counter shaft 25 carries adjacent to the opposite end a gear 26 meshing with an idler pinion 27 journaled on a bracket 27^x carried by the supporting frame. The idler pinion 27 in turn meshes with the loose gear 19 on the main shaft 10, driving said gear 19 clockwise or in a direction opposite the rotation of the gear 18.

Thus the gears 18 and 19 are rotated in opposite directions and by shifting the clutch member 21 from engagement with one of said gears into engagement with the other the direction of rotation of the main shaft 10 may be reversed. The clutch member 21 is normally engaged with the gear 18. It is always so engaged during the discharging period of the battery, and also during such time as the ignition key may be in its operated position during the charging period; that is when the engine is running, maintaining the lights and charging the battery at the same time. A spring 28 tends to oscillate the clutch lever 29 pivoted to the lug 30, to move the clutch member 21 into engagement with the gear 18. There are two forces in addition to the spring 28 which under certain conditions act upon the clutch lever 29 to shift the clutch 21 into and out of engagement with the gear 19. These are the movement of the ignition key to "off" position or when the engine is at rest, providing the parts are in their charging positions which causes the clutch to engage said gear and second, the movement of the swinging arm and traveling gear hereafter described from charging to discharging position which in the event the clutch 21 has been previously shifted into engagement with the gear 19, by the operation of the ignition key, will cause the reversal of the clutch to engagement with the gear 18. The ignition key comprises an oscillatory stem carrying a segmental plate 32 having therein a concentric slot 33.

The ignition key is revolvably adjustable to three predetermined positions. First, the "off" position in which the spark coil circuit is broken and the engine is at rest; second, the intermediate or starting position in which the spark coil and ignition devices are connected in circuit with the battery; and third, the "on" or operated position in which the spark coil is brought in circuit with the magneto or generator. These different connections are made by means of a cam carried by the stem which in its different positions engages and operates plungers which in turn operate electric switches as shown in the diagrammatic view Fig. 20. Engaging in the concentric slot 33 of the segmental plate 32 is a stud 34 carried in a link 35, the opposite end of which is pivotally connected to the lever 36 pivoted to the

main frame. At the right of the casing, (Fig. 2) there is journaled an upright shaft 37 having a rock arm 38 to which is attached a reciprocating link 39 attached at its opposite end to the lever 36. The relation of the parts is such that as the ignition key is moved to its "off" position or to the left as shown in Fig. 2, the stud 34 in the link 35 engages the end of the slot 33 in the segmental plate 32, and the slight additional movement of the plate 32 drawing the link 35 to the left oscillates the lever 36 the motion being transmitted through the link 39 and rock arm 38 causes a partial rotation of the vertical shaft 37.

At its upper end the vertical shaft 37 carries a rock arm 40, connected by a resilient connection or spring 41 with the extremity of the clutch lever 29. The spring 41 forming the flexible or resilient connection of the rock arm 40 and the clutch lever is possessed of sufficient resistance to overcome the tension of the spring 28, and if the lever 29 is free to move the clutch 21 from its normal position into engagement with the gear 19, the partial rotation of the vertical shaft 37 due to the operation of the ignition key to "off" position will oscillate the lever 29 to shift the clutch. However if the parts are in discharging position the clutch lever 29 will be locked against oscillation, and the movement of the vertical shaft 37 and rock arm 40 will be compensated for by the elasticity of the connecting spring 41, and the clutch will remain in engagement with the gear 18. Journaled in a suitable bracket 42 is a swinging arm 43 on which is journaled the traveling gear 44. By the oscillation of the swinging arm 43 the traveling gear 44 is moved into and out of mesh with the master pinion 45 carried by the main shaft 10.

Carried by the main shaft 10 adjacent to the master pinion 45 is a revoluble cam disk 46. Upon its rear side the traveling gear 44 is provided with a ratchet wheel 47 engaged by a spring pawl 48 which maintains the traveling gear in its operated position when out of engagement with the master pinion 45 and prevents undue rotation thereof. Carried on the rear side of the swinging arm 43 is a roller 49, adapted to engage an inclined cam face 50 on the clutch lever 29 and oscillate said lever to return the clutch 21 to normal or into engagement with the gear 18 if it has been moved therefrom. If the clutch lever has not been oscillated from normal position, the engagement of the roller 49 with the cam face 50, upon the swinging movement of the arm to discharging position, will lock the lever 29 and clutch 21 in their normal positions. It is to be understood that during the discharging period of the battery, the traveling gear 44 is maintained in mesh with the master

pinion 45, and during the charging period the swinging arm 43 is in such position that the traveling gear 44 is disengaged from the master pinion 45. Carried by the swinging arm 43 is a shifting terminal or contact 51, connected directly with the lighting or main circuit, and also by a shunt circuit containing suitable resistance with the battery, as shown in the diagrammatic view Fig. 20, the said shunt circuit being the battery charging circuit. The movable contact member 51 is adapted to engage either one of two stationary contacts and thereby complete either one of two circuits according to the position of the swinging arm 43.

When the swinging arm is in its operated position, that is when in the discharging position with the traveling gear in mesh with the master pinion 45, the movable contact 51 engages with the stationary contact 52, which is connected directly to the battery. When the traveling gear is disengaged from the master pinion 45, that is during the charging period the movable contact is engaged with the stationary contact 53, which is connected with the magneto or generator. The relation of these contacts is clearly shown in detail in Fig. 11, and by reference to the diagrammatic view Fig. 20 the connections will be made plain. The swinging arm 43 is oscillated from its disengaged position into its discharging position with the traveling gear 44 in mesh with the master pinion 45, against the tension of the retracting spring 54, by the operation of the master light key in its movement toward "on" position.

The master light key comprises a revolvable shaft or stem adapted by its rotation to close an electric switch in the main or lighting circuit. The particular switch operating devices are not essential, but as shown comprise a cam member 56 carried by the shaft or stem and adapted when moved to "on" position to depress a plunger 56* which in turn flexes the switch blades to complete the circuit. This construction is clearly shown in the diagrammatic view Fig. 20. Secured to the key shaft are two parallel frame members 57 and 58, movable with the key shaft. Projecting intermediate the frame members 57 and 58, is a stationary eccentric cam member 59.

The master key construction is best shown in Figs. 7 to 12 inclusive. The frame members 57 and 58 are of similar shape and register with each other, except that one of the said members has formed integral therewith the cam 56. This cam 56 however might be otherwise carried by the key shaft. The frame members 57 and 58 are each provided with radial slots 60, the slots of the respective members being in registry. Slid-

ingly mounted on two studs 61 projecting from the frame member 58 is a sliding cam plate 62, having therein an angular slot 63, the arm 63* of which may be brought into registry with the slots 60 of the members 57 and 58, by a sliding movement of the cam plate 62. The cam plate 62 is provided with two notches 64 engaged by a spring pawl 65 to retain the cam plate in its adjusted positions. Pivotally supported on a stud 66 which projects through the slot 63 of the cam plate and the slots 60 of both frame members is a pawl arm 67, carrying at its extremity a pivoted spring actuated pawl 68. The engagement of the pivotal stud 66 in the several slots 60 and 63 is such that when the cam plate is in such position, as in Fig. 7, that the slot portion 63* is out of registry with the slots 60 the transverse stud 66 will be held at the top or outermost portion of the frame slots 60. Upon the longitudinal movement of the cam plate the slot portion 63* is brought into registry with the frame slots 60 and the pivotal stud 66 and pawl arm 67 are allowed to drop downward to the inner ends of the registered slots as shown in Fig. 4. In Fig. 3 the cam plate is shown as partially operated and the parts in position just before the pawl arm moves down the slots. In its downward or inward movement the stud 66 and pawl arm are assisted by a retracting spring 69 attached at one end to the stud 66 and at the other to one of the studs 61. The pawl arm 67 is movable about its pivotal connection in the slots 60 and 63, against the tension of the retracting spring 70.

The movement of the pawl arm in one direction is limited by the stop arm 71 with which the spring 70 tends to hold the pawl arm in engagement, as shown in Fig. 7. The pawl 68 is movable about its pivotal connection with the pawl arm 67 against the tension of the spring 72, the movement of the pawl in one direction being limited by the engagement of a lug 73 with a shoulder on the pawl arm 67 as shown in the detail view Fig. 18.

Upon the rotation of the master key to the right or "off" position, the pivotal stud 66 of the pawl arm 67 riding on the periphery of the stationary cam 59 is elevated to the upper or outer ends of the slots 60 and 63, against the tension of the spring 69. As the master key approaches the limit of its stroke to the right or "off" position, the end of the sliding cam plate 62 contacts a portion 74 of the main frame and is arrested thereby, the frame members 57 and 58 continuing to move causes the cam plate 62 to be shifted in relation to the frame members 57—58, thereby moving the slot 63* of the cam plate out of registry with the frame slots 60 engaging the stud 66 of the pawl arm in the angular extremity of the slot 63, and maintaining the pawl arm in its ele-

vated position. Upon the rotation of the master key toward the left or toward "on" position, the pawl 68 of the pawl arm 67 which is being held in elevated position by the sliding cam plate 62, engages a stud 75 in the lower portion of the swinging arm 43 and moves the swinging arm toward the left causing the traveling gear 44 to engage with the master pinion 45 and shifting the movable contact to discharging position in engagement with the stationary contact 52. This movement of the swinging arm is against the tension of the retracting spring 54. The swinging arm is retained in its operated position by a latch bar 76 which engages a stud 77 in the swinging arm.

The swinging arm as it is moved by the pawl 68, engages a pivoted lever 78, and oscillates said lever in unison with the swinging arm, against the tension of a spring 79. The lever 78 is connected by a link 80 with one end of a pivoted bell lever 81, the opposite end of which carries a lug 82. The oscillation of the lever 78 as the swinging arm is moved by the master key, causes the bell lever 81 and lug 82 to be advanced to meet the approaching cam plate 62 of the master key. Before the master key has completed its movement the end of the sliding cam plate 62 engages the lug 82 of the bell lever 81, and as the master key continues to move, causes the sliding cam plate to be again shifted relative to the frame members 57 and 58, thereby bringing the slot portion 63* of the cam plate into registry with the slots 60 of the frame members allowing the pawl arm 67 to drop under the influence of the spring 69, out of engagement with the stud 75 of the swinging arm. This operation is most clearly shown in Figs. 1, 2, 3 and 4. In Fig. 1 the master key is shown in its normal or "off" position, with the swinging arm and connecting parts in "charging" positions. In Fig. 2 the master key has been moved to the point of engagement of the pawl 68 with the stud 75 of the swinging arm but the swinging arm has not yet been moved from its original position. In Fig. 3 the parts are shown partially operated, the stud 77 of the swinging arm is about to enter the recess of the latch bar 76, the lug 82 of the bell lever 81 is in engagement with the cam plate 62 and is shifting the cam plate by advancing to meet the frame members as the key is operated, the slots 63* of the cam plate being in partial registry with the slots 60 of the frame members, but the movement of the cam plate not having been sufficient to permit the drop of the pawl arm 67 which does not occur until the limit of the stroke has been reached and the stud 77 is engaged by the latch bar 76 and the slots 63* and 60 are in complete registry. In Fig. 4 the parts are shown in operated positions, the swinging arm being retained by

the latch bar and the pawl arm withdrawn from engagement therewith. During the discharge period, that is while the traveling gear is engaged with the master pinion and the swinging arm is retained in its operated position by the latch bar 76, the master key may be operated to turn the lights on or off as many times as may be desired, the pawl arm being elevated by the stationary cam 59 upon each document to "off" position and depressed upon the engagement of the cam plate 62 with the lug 82 upon each movement to "on" position, the movement being an idle one, the pawl having no work to perform, the only result of the movement being the operation of the electric switch. If the discharge period is terminated and the swinging arm returned to normal position during the time that the master key is in the "on" position, upon the return of the master key to the right or "off" position, the pawl 68 will engage the stud 75 of the swinging arm but will yield against the tension of the pawl spring 72 allowing the arm and pawl to pass the stud on the "off" stroke of the key.

It is to be understood that the swinging arm is not moved to discharging position every time that the master key is turned to "on" position although the swinging arm is in normal position with the stud 75 in the path of the pawl 68. The master key may be operated as frequently as desired during the time that the swinging arm 43 is in its normal or charging position with the traveling gear disengaged from the master pinion, but the swinging arm is operated only at the termination of the charging period or when the main shaft 10 has made a complete rotation and the master cam disk 46 has reached a predetermined position. At all other times the swinging arm is locked against movement by the locking of the latch bar 76. During such time as the swinging bar is locked against movement the engagement of the pawl 68 with the stud 75 of the swinging arm arrests the movement of the pawl and pawl arm 67 of the master key, while the frame portions of the key continue to move thereby placing the spring 70 extending between the pawl arm and key frame under tension. The tension of the retracting spring 70 of the pawl arm is sufficient to overcome the tension of the retracting spring 54 of the swinging arm 43. If during the time the master key is in its operated or "on" position with the pawl 68 engaged with the stud 75 of the swinging arm, and the retracting spring 70 under tension, the charging period should be terminated and the cam disk 46 reach a position whereby it will unlock the latch bar 76, to permit the raising thereof and the consequent release of the swinging arm, the pawl arm 67 through the in-

fluence of the spring 70 will at such time move the swinging arm against the tension of the spring 54 to discharge position or with the traveling gear in mesh with the master pinion. Thus if the master key is operated at the time the battery is fully charged the latch bar 76 will be unlocked and the swinging arm 43 will be operated synchronously with the operation of the master key. If however the charging period is not complete the operation of the master key places the pawl arm spring 70 under tension and the swinging arm 43 is oscillated subsequent to the operation of the key upon the completion of the charging period through the influence of the retracting spring 70.

The lock mechanism by which the swinging arm 43 is locked in either its normal or operated positions and released to permit the movement thereof only at the termination of the charging or discharge period, comprises primarily a bell lever 83 having in one arm a stud 84 bearing upon the latch bar 76, and in the other arm a stud or roller 85 riding upon the concentric periphery of the cam disk 46. The periphery of the cam disk 46 has therein a depression 86. The relation of the bell lever 83, the latch bar 76 and the cam disk 46 are such that so long as the stud or roller 85 rides upon the concentric periphery of the cam disk the stud 84 in the other arm of the bell lever will bear upon the latch bar and prevent the elevation thereof. The bell lever is further held in contact with the latch bar 76 by the spring 87 against the tension of which the latch bar is elevated to permit the operation of the swinging arm. However when the cam disk has made a complete rotation and the depression 86 of the cam disk has been brought in registry with the stud 85 of the bell lever 83, the bell lever is free to oscillate against the tension of the spring 87, the stud 85 passing into the depressed portion of the cam disk periphery, thereby permitting the latch bar to rise.

The latch bar is elevated by the action of the stud 77 of the swinging arm acting on the inclined cam face 88 of the latch bar as the swinging arm is forced over by the pawl arm 67 under the influence of the spring 70 which is strong enough to overcome the tension of both the spring 54 and the spring 87. The latch bar continues to raise and the swinging arm to move (toward the left in the drawings) until the stud 77 reaches the recess of the latch bar when the latch bar immediately engages the stud 77 of the swinging arm through the influence of the spring 87 and retains the swinging arm in its operated position. At this time the stud 85 of the bell lever again passes onto the concentric portion of the cam periphery and the latch bar is again locked, this time with the swinging arm in its operated position.

Connected with the supporting shaft of the bell lever 83, or otherwise movable with said bell lever is a rock arm 89 connected by a link 90 with a lever 91 pivotally supported on a suitable bracket 92. The lever 91 carries the transverse pin 94, insulated from the supporting lever 91, which contacts and forms an electrical connection between the arm 95 of the circuit terminal 53 and a similar terminal arm 96 connected with the generator.

The construction is such that during the entire charging and discharging periods, while the stud 85 of the bell lever 83 rides the concentric portion of the cam disk 46 and while the latch bar 76 is in normal position, the transverse pin 94 will contact the terminal arms 95 and 96 and complete the circuit. However upon the elevation of the latch bar 76 to permit the shifting of the swinging arm 43, and the consequent oscillation of the bell lever 83, the movement of the bell lever is transmitted to the lever 91, and the transverse pin 94 is lifted from the terminal arms 95 and 96, as shown in Fig. 8, thereby breaking the circuit at this point. On account of the difference in leverage of the rock arm 89 and the arms of the lever 91, the movement is multiplied and the make and break connection of the transverse pin 94 and the arms 95 and 96 is accomplished by a quick movement which reduces to minimum the tendency of the contacts to arc at each operation. Immediately upon the return of the latch bar to normal the pin 94 likewise returns to contact with the terminal arms 96 and 95 where it is locked by the engagement of the stud 85 with the concentric portion of the cam disk.

The several parts remain in their operated positions with the contact 51 engaging the terminal 52 and the traveling gear engaging the master pinion 45 in which positions they are retained by the engagement of the latch bar 76 over the stud 77 of the swinging arm throughout the discharge period as determined by one rotation of the traveling gear 44. In the theoretical case stated as an example for which the device of the drawings is especially adapted, the discharge period would be twenty four operating hours, during which the battery would be discharged at the rate of two and a half amperes per hour making a total of sixty amperes the amount received by the battery in the previous charging period of twelve hours at the rate of five amperes per hour. It is to be understood that the charging period and discharge period do not necessarily consist of twelve and twenty four consecutive hours respectively, but may be intermittent periods of operation to the total of twelve and twenty four hours respectively. At the termination of the discharge period the swinging arm, the traveling gear and the

contact 51 are returned to normal position upon the disengagement of the latch bar 76 from the stud 77.

Slidably mounted in the supporting frame is a vertically movable lifting bar 97 having at its lower extremity a slot 98 engaging a stud in the latch bar 76, whereby when said lifting bar is elevated it will move a distance limited by the length of the slot independent of the latch bar, and any additional movement will elevate the latch bar to disengage the stud 77 of the swinging arm. At its upper end the lifting bar is bent at right angle or provided with a lug 99. Projecting from the face of the traveling gear is a stud 100. When the traveling gear is in mesh with the master pinion the lug 99 of the lifting bar extends into the path of the stud 100, and as the traveling gear completes its rotation the lug of the lifting bar is engaged by the stud 100 and the bar is elevated thereby. As the stud is about to disengage from the lug 99 on account of the curvature of its path the end of the slot engages the stud of the latch bar and lifts same to disengage the swinging arm. The cam disk is so timed that the stud 85 will pass into the depression 86 as the latch is lifted.

In order that the timing devices shall not continue to register discharge during the time that the parts may be held in discharge position but with the lights turned off, and therefore consuming no current, means are provided for locking the actuating motor and thereby arresting the registration of the discharge mechanism. Means are also provided for arresting the time motor during the charging period when the engine is at rest so that the device will register only the actual charging time. Further the time motor is arrested at the termination of the charging period if at that time the master key happens to be in its "off" position until such time as the master key is turned to "on" position.

Considering the last named condition first, the arrest of the motor at the end of the charging period, with particular reference to Fig. 1, it will be seen that the master key when turned to "off" position engages and oscillates a lever 101 pivoted to the supporting frame. To the lever 101 is connected a reciprocating link 102 attached at its opposite end to one end of the bell lever 103, the opposite arm of which is connected by a spring 104 with the stud 84 of the bell lever 83. Under normal conditions the bell lever 83 is not influenced by the spring 104, as the said spring is placed under tension only when the master key is in "off" position and engaged with the lever 101. Under ordinary conditions the bell lever 83 is oscillated against the tension of the spring 87 by the action of the stud 77 engaging the inclined cam face 88 of the latch bar 76 when the

stud 84 of the said bell lever passes into the depression 86 of the cam disk. At such times the bell lever 83 is oscillated only to an extent sufficient to permit the latch bar to engage or disengage the stud 77 of the swinging arm, after which the bell lever is immediately returned by the spring 87. When however the master key has been operated to its "off" position, (see Fig. 1) the lever 101 has been oscillated to rock the bell lever through the reciprocating link 102, and by the oscillation of the bell lever 103 the spring 104 has been placed under tension.

The tension of the spring 104 when affected by the oscillation of the bell lever 103 is sufficient to overcome the spring 87, and when in the course of rotation of the cam disk the stud 85 of the bell lever 83 passes into the depression 86 of the cam disk, the bell lever 83 is oscillated independent of the latch bar 76. Projecting from the bell lever 83 is a third arm 105 adapted upon the extreme oscillation of said bell lever to contact a pivoted spring actuated detent 106 and force said detent into engagement with the escapement wheel 11 to arrest the movement of the escapement wheel and thereby the motor.

When the bell lever 83 is oscillated under normal conditions by the elevation of the latch bar 76 to engage or release the swinging arm, the movement of the bell lever is not sufficient to cause the engagement of the detent 106 with the escapement wheel. When however the bell lever is acting under the influence of the spring 104 the bell lever is oscillated to the extreme degree of movement, the stud 85 of said bell lever entering a recess 86* at the bottom of the depression 86 in the cam disk permits an additional movement of the bell lever sufficient to force the detent 106 into engagement with the escapement wheel by the contact of the arm 105 with said detent.

As a means of arresting the motor under the other condition mentioned, there is provided adjacent to the escapement a reciprocating plate 107 to which is pivoted a stop lever 108. The reciprocating plate 107 is adapted to be moved toward the escapement mechanism or toward the left in the drawings against the tension of a retracting spring by the engagement therewith of the swinging arm 43 as it moves into discharge position, or by the oscillation of the pivoted lever 36 upon the movement of the ignition key to "off" position or toward the left in the drawing. The upper end of the stop lever 108 engages with a pin 109 projecting from the reciprocating bar 102 and through a slot in the supporting frame as shown by dotted lines in the drawing, and thence into the path of the stop lever. The lower end of the stop lever carries a stud adapted to engage a bifurcated arm 110 projecting from

the escapement 12. If the reciprocating plate 107 is in its operated position, that is if moved toward the left in the drawing by the engagement therewith of the swinging arm 43 or the pivoted lever 36 (when the ignition key is "off" and the engine at rest) the stop lever will not engage the bifurcated arm 110 until the master key is turned to "off" position which oscillates the lever 101 to reciprocate the bar 102 and cause the projecting pin 109 to oscillate the stop lever 103 into engagement with the bifurcated arm 110, and thereby stop the motor.

With the several parts in the positions shown in Fig. 1, the movement of the ignition key to "off" position, (to the left) will cause the lever 36 to shift the reciprocating plate 107; the pin 109 is already in engagement with the stop lever 103, since the reciprocating bar 102 is in its operated position due to the engagement of the master key with the lever 101, the reciprocation of the plate 107 will therefore cause the stop lever to be oscillated, advancing the lower end into engagement with the bifurcated arm 110 and arresting the motor. If the ignition key is not turned to "off" position with the parts remaining as shown in Fig. 1, which shows the lever 101, the bar 102 and bell lever 103 operated and the spring 104 under tension, the motor will be arrested at the completion of the rotation of the shaft 10 which will bring the depression 86 of the cam disk to a point to be entered by the stud 84 of the bell lever 83, and the motor will be arrested by the action of the detent 106.

Each time that the swinging arm is operated to discharge position, it engages and shifts the plate 107 in the same manner that the plate is shifted by the lever 36. However in as much as the swinging arm is moved to discharge position only by the operation of the master key to "on" position, the tension on the lever 101, the bar 102, the bell lever 103 and the spring 104 will be relaxed and the pin 109 will have been moved away from the stop lever 103, and the movement of the plate will only carry the stop lever with it and will not cause the oscillation of the stop lever to cause its engagement with the bifurcated arm 110. However if after the swinging arm has been moved to discharge position and has served to shift the reciprocating plate 107, the master key be then turned to "off" position its engagement with the lever 101 will reciprocate the bar 102 to cause the pin 109 to engage and oscillate the stop lever to cause it in turn to engage the bifurcated arm 110 and arrest the motor during such time as the lights may remain turned off. The adjustment of the arm 110 and the detent 106 is such that the balance wheel is each time arrested at the limit of

its stroke, in order that upon its release the motor will again resume operation.

Electrical circuits.—The various circuits and electrical connections are illustrated on Sheet 10. Referring to the diagrammatic view Fig. 20, *a* represents the generator or magneto adapted to synchronously charge the storage battery *b*, and supply the main circuit *c*, until the battery has received a full charge, after which the circuit *c* is supplied by the battery alone until the battery charge is exhausted. The main circuit as shown in the drawings is a lighting circuit containing the head lights *c*², the side lights *c*³ and tail light *c*⁴, and is controlled directly by the master key 6. The engine by which the generator *a* is driven is controlled through the ignition circuit *d* with its spark coil *d*¹ and spark plug *d*², by the ignition key 5 as hereafter described.

Leading from the positive side of the generator *a* is a line *a*¹ connecting with the spring arm 96 connected by the transverse pin 94 with the corresponding spring arm 95 which in reality is a portion of the stationary terminal 53. See Fig. 11. From the stationary terminal 52 a line *a*² leads directly to the positive side of the storage battery *b*. Oscillating between, and alternately engaging the stationary terminals 52 and 53, is the movable contact 51 connected by the line *a*³ with the positive side of the switch *c*¹. From the opposite side of the switch *c*¹ is a line *a*⁴ connecting with the line *a*⁵ leading to the negative side of the generator. The storage battery *b* is bridged across this circuit by the connection *b*¹ leading from the line *a*³ through the resistance *b*² to the positive side of the battery, and the connection *b*³ from the negative side of the battery to the return line *a*⁴. Thus during the charging period at which time the movable contact 51 is in engagement with the stationary terminal 53, as shown in the drawing, the current passes from the generator *a* through the line *a*¹, the spring arm 96, the transverse pin 94, the arm 95 to the stationary terminal 53, thence through the movable contact 51 to the line *a*³, the current dividing and a portion passing through the connection *b*¹ and resistance *b*² into the battery *b*. The resistance *b*² is such that the battery receives a constant supply and the line *a*³ will continue to carry sufficient current to supply the lights *c*², *c*³ and *c*⁴, or such other electrical apparatus as may be connected in the main circuit. The current continuing past the connection *b*¹ through the line *a*³ connects through the positive side of the switch *c*¹ with the main circuit *c*, when said switch is operated by the movement of the master key 6 as shown in the drawing, and passing through the main circuit and the negative side of the switch thence through the line *a*⁴, to which is at-

tached the negative connection b^3 of the battery, the current returns to the negative side of the generator through the line a^5 , thus completing the circuit from the generator through the lights and through the battery.

When the battery has received a full charge the movable contact 51 is shifted by the mechanism before described whereby the contact 51 is connected with the stationary terminal 52, thereby disconnecting the generator from the circuit by the breaking of the contact between the movable contact 51 and terminal 53. The shifting of the movable contact while disconnecting the generator connects the battery b in series with the main circuit and lights. During the time the movable contact is in its operated position as shown by dotted lines or as before named the "discharge" period, the current passes from the positive side of the battery b through the line a^2 to the stationary terminal 52, thence through the movable contact 51 and line a^3 to the switch c^1 , through the positive side of the switch to the main circuit c , thence through the negative side of the switch and the line a^4 as far as its connection with the line b^3 which completes the circuit to the negative side of the battery. It is to be understood that when the master key 6 is in "off" position the switch c^1 is open and main or lighting circuit is disconnected from the generator and battery circuits. However when the contact is in "charging" position, in engagement with the terminal 53, as shown in the drawing, the generator will continue to charge the battery b , even though the switch c^1 is open. In this event the entire current passes through the line a^2 , the connection b^1 and resistance b^2 to the battery, thence through the line b^3 , line a^4 and line a^5 to the negative side of the generator. The ignition circuit of the driving engine is adapted to be supplied first from the battery until the engine and generator are in running order, after which the ignition circuit is supplied by the generator.

The ignition key 5 assumes three different positions. In its off position the connection of the ignition circuit d with both the generator and battery is open or broken at the switches d^3 and d^6 as shown in the drawing. With the ignition circuit open, the engine and generator are of course at rest. Under this condition with the battery and generator in series as shown in the drawings and connected, there would be a tendency for the battery to discharge itself by running the generator as a motor. To prevent such discharge, there is provided a make and break connection e in the line a^5 , controlled by a centrifugal governor e^1 actuated by the generator or engine, whereby when the generator is at rest the governor e^1 will cause the circuit to be broken at e . Also under

the same condition, that is with the engine and generator at rest during the "charging" period, as shown in the drawing, it may be desired to operate the lights, for instance while the automobile is stationary on the street. In this case, without providing a shunt for removing the resistance b^2 from the circuit, the light would burn but dimly, the current therefor passing from the battery through the resistance. To overcome this difficulty there is provided a shunt circuit comprising the line b^4 leading from the positive side of the battery to the switch b^5 , which is closed at all times when the ignition key is in "off" position, and the ignition circuits therefore open and the generator at rest thence from the switch b^4 through the line b^6 to the connection b^1 at the opposite side of the resistance b^2 . The main circuit is therefore supplied from the battery through said shunt circuit to the line a^3 , and around the resistance b^2 , thence through the line a^3 to the main circuit c and returning through the line b^3 as before.

When moved from "off" position to its first operative position, the ignition key 5 closes the switch d^3 which connects the battery through the line b^4 and connection d^4 with the line d^5 forming one side of the ignition circuit, the current passing through the coil d^1 and for a short distance through the line a^5 to the line a^4 thence through the line b^3 to the negative side of the battery. This ignition circuit from the battery is used for starting the engine and generator, after which the ignition key 5 is again shifted to its extreme "on" position in which it closes the switch d^6 and at the same time opens the switch b^5 . The closing of the switch d^6 connects the line d^7 leading from the positive side of the generator a with the line d^8 , by means of the connection d^8 . The ignition current passing from the generator through the line d^7 , the switch d^6 , connection d^8 , and line d^5 to the coil d^1 , returns through the line a^5 to the negative side of the generator, thus completing the ignition circuit.

It will be noted that in the drawing each of the individual lamp circuits, c^2 , c^3 and c^4 are provided with resistance, c^5 , c^6 and c^7 , brought into circuit by the switches 7, 8 and 9 when the lamps are cut out, whereby the main circuit always consumes the same amount of current regardless of the number of lights used. This lighting circuit however is merely incidental and not essential to the working of the apparatus. It is to be understood that other electrically operated or controlled apparatus may be substituted for the lamps shown in the drawing. So long as the main circuit consumes current at the same rate each time the master key is operated, it is immaterial for what purpose the current is used.

The operation.—It will be assumed that at the middle of the charging period the engine is at rest, the lights turned off, that is both the ignition and master keys in "off" position, and the battery partially charged, which is the condition shown by the relation of the parts in Fig. 7. It will be seen that under these conditions the time motor is held inoperative by the engagement of the stop lever 108 with the bifurcated arm 110. In order to start the engine and therewith the generator, the ignition key 5 is turned to its intermediate position which closes the switch d^3 connecting the ignition circuit d with the battery b through the lines b^3 and b^4 . The initial movement of the ignition key releases the tension on the lever 36 allowing said lever to be retracted by the spring 36*. Upon the withdrawal of the lever 36 the shifting plate 107 is retracted by its spring 107*, which withdraws the stop lever 108 from engagement with the arm 110 and releases the time motor which resumes its operation. The ignition switch is then shifted to its extreme position which connects the ignition circuit d with the generator through the switch d^6 and the lines d^7 and a^5 . The time motor rotates the main shaft 10 and therewith the master cam 46 at a constant rate of speed until the recess 86 of said cam is entered by the stud or roll 85, at which time the battery has received its full charge. If the master key 6 is in "off" position, (as shown in Figs. 1, 7 and 8) at the end of the charging period, the bell lever 103 is held in operated position by the bar 102 and lever 101, and the spring 104 is under tension tending to oscillate the bell lever 83 to its extreme limit of movement which it does when the stud or roll 85 enters the notch 86* in the master cam. This extreme movement of the bell lever 83 under the influence of the spring 104 causes the arm 105 to operate the detent 106 to arrest the time motor, and at the same time operates through the arm 89 and link 90 to lift the arm 91 and break the connection of the generator with the battery by removing the transverse pin 94 from engagement with the springs arms 95 and 96. Fig. 8 shows the several parts under such condition, that is when the end of the charging period has been reached during the time that the main circuit is disconnected by the master key being in off position. The time motor is shown locked by the detent 106 and the contact 94, 95 and 96 broken. If however before the end of the charging period is reached, that is if before the stud or roll 85 enters the recess 86, the master key is operated to "on" position, the pawl 68 will engage the stud 75 of the swinging arm and as the master key continues to move the spring 70 actuating the pawl arm 67 is placed under tension, and the parts assume the positions

shown in Fig. 2. In this position the bell lever 103, the bar 102 and lever 101 have returned to normal position as shown in Fig. 6, and the tension on the spring 104 is relieved, and the bell lever 83 is influenced only by the spring 87 which tends to hold the latch bar 76 down where it is locked by the bell lever 83, until the end of the charging period when the stud or roll 85 enters the recess 86, which allows the bell lever 83 to oscillate against the tension of the spring 87. The pawl 68 bearing on the stud 75 under the influence of the spring 70 tends to move the swinging arm to shift the contact 51. The stud 77 bearing on the inclined face 88 of the latch bar tends to lift the bar, but is prevented from doing so until the stud 85 of the bell lever 83 enters the recess 86, whereupon the latch is free to rise, and the pawl arm 67 shifts the swinging arm against the tension of the spring 54. In Fig. 2 the parts are shown with the pawl arm under tension ready to shift the swinging arm and contact at the end of the charging period when the stud 85 of the bell lever enters the recess 86. In Fig. 3 the parts are shown partially operated, and in Figs. 4 and 6 the operation has been completed.

This movement of the swinging arm disconnects the generator and supplies the main circuit solely from the battery through the line a^2 and terminal 52. The movement of the swinging arm also brings into mesh the traveling gear which serves to measure the discharge period and to release the swinging arm and contact when the gear has made a complete revolution. Fig. 6 shows the parts during the discharge period. Each time the master key 6 is turned to "off" position thereby disconnecting the main circuit the stop lever 108 is operated by the pin 109, bar 102 and lever 101 as shown in dotted lines, to arrest the time motor. Each time the master key is operated to "on" position the time motor is released. The time motor therefore is in operation only during the time current is being used, and is inoperative at other times and operates to rotate the traveling gear to register only the actual operating time. When the gear 44 has completed its rotation it releases the swinging arm by means of the lifting bar 97 and the arm is returned to normal by the spring 54.

If during the charging period the ignition key is turned "off" during the time that the master key is also "off" and the circuit disconnected, as shown in Fig. 7, the lever 36 will engage and shift the shifting plate 107 to cause the stop lever 108 to engage the arm 110 and arrest the time motor. The reversal of the ignition key to "on" position will permit the release of the motor (see Fig. 1) whereby the motor will again resume operation. Thus the motor is operated only when the generator is operated during the charge

ing period, and arrested when the generator is at rest, providing the master key is in "off" position as shown in Fig. 7, thus accurately measuring the actual charging time.

5 However the condition may arise where the lights are desired during the charging period at a time when the generator is at rest such as when an automobile is allowed to stand idle at the street curb, after night, and it is desired to display head and tail lights for safety. As before stated when the master key is in "off" position during the charging period the time motor is operated in unison with the generator, being set in motion when the ignition key is turned to "on" position, and arrested when the ignition key is turned to "off" position (see Fig. 7). However this statement of operation is not true if the master key is in its "on" position as shown in Figs. 2, 3, 4 and 6. When the master key is in "on" position the time motor will operate to measure the operating time regardless of the position of the ignition key. When the master key is moved to "on" position it permits the lever 101, the bar 102 and therewith the pin 109 to assume normal position which allows the stop lever 108 to disengage the arm 110 and release the motor. In Fig. 2 the parts are shown with the master key "on," that is with the lights burning during the charging period as shown by the positions of the swinging arm 43 and the master cam 46, and the ignition key 5 "off" or with the generator at rest, the ignition circuit being open. At this time (the condition shown in Fig. 2) the main circuit is being supplied from the battery through the shunt circuit b^4-b^6 , and the uncompleted battery charge is being diminished. The movement of the ignition key 5 to "off" position during the charging period causes a movement of the link 39 and arm 38 to rock the shaft 37 and arm 40 to cause the shift lever 29 to move the clutch member 21 from engagement with the gear 18 into engagement with the gear 19 (as shown in Fig. 10) which rotates in a direction the reverse of the gear 18, thereby reversing the direction of rotation of the main shaft 10.

This reversal of the shaft 10 rotates the master cam 46 in reverse direction or moves the recess 86 backward from the point of engagement with the stud 85 of the bell lever, and thereby delays the unlocking and shifting action of the parts a period equivalent to the diminishing of the battery charge. Thus the decrease in the battery charge before the charging operation is completed is measured by the reverse movement of the parts.

Upon the return of the ignition key 5 to "on" position, the shift lever is permitted to return the clutch to engagement with the gear 18 under the influence of the spring 28,

thus restoring the parts to normal direction of operation. Upon the return to normal rotation of the shaft 10 and cam 46 at the movement of the ignition key and resumption of operation of the generator, the master cam must again travel through the same arc it previously traveled in reverse direction, during which time the generator is charging the battery and making up the amount the battery charge was diminished by the operation of the lights while the generator was at rest.

The ignition key 5 only serves to operate the shift lever 29 and clutch 21 during the charging period, as during the discharge period the engagement of the roller 49 carried by the swinging arm engaging on the cam face 50 of the shift lever locks the shift lever against movement, and the movement of the rock shaft 37 and arm 40 is compensated for by the resiliency of the connection 41.

Inasmuch as the battery is charged at a more rapid rate than it is discharged, in the illustration given herein the rates being five and a half amperes and two and a half amperes per hour respectively, the reverse movement of the main shaft and master cam by which the temporary discharge is measured as described above, must be at less speed than its forward movement by which the charging period is measured. In the present instance the reverse movement must be at one half the speed of the forward movement. This variation is accomplished by varying the speed of rotation of the gears 18 and 19. Referring particularly to Figs. 9 and 10, the gear 24 is provided with twice the number of teeth possessed by the gear 23, which is secured to and rotates with the gear 18. The gear 26 on the shaft 25 with the gear 24 is equal in size to the gear 19 which it drives through the medium of the intermediate idler 27 at a rate of speed different from that of the gear 18.

It will be noted that the bell lever 83, held immovable between the master cam 43 and the latch bar 76, which it in turn holds immovable, positively locks the swinging arm and movable contact in their adjusted position and prevents the accidental movement of said parts prior to the appointed time through the jar or jolting of the automobile or by any tampering with the device by uninformed persons.

From the above description it will be apparent that there is thus produced a device of the character described possessing the particular features of advantage before enumerated as desirable but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts, without departing from the principle involved or sacrificing any of its advantages.

It is to be understood that the means and mechanism herein described is but one mode of putting the invention into effect and that the invention is claimed broadly in any of its possible forms and modifications within the scope of the appended claims.

Having thus described my invention, I claim:

1. In a controlling device for electric circuits, a generator, a battery, a main circuit, a movable contact whereby either the battery or the generator may be made the source of electrical supply of the main circuit, a regulator for determining operative periods of charge and discharge; means set in operative condition by manual effort controlled by the regulator for automatically shifting the contact to alternate the source of electrical supply at the termination of predetermined operative periods as determined by the regulator.

2. In a controlling device for electric circuits, a generator, a battery, a main circuit, a movable contact adapted to alternately connect the main circuit with the generator and battery, a regulator for determining operative periods of charge and discharge; controlling the movement of the movable contact, a switch in the main circuit, actuating means for the movable contact set in operating condition by the operation of said switch said actuating means being adapted to move the contact when the regulator has registered a predetermined period of operation.

3. In a circuit controlling device, a generator, a battery, a main circuit, a movable contact in said circuit, a traveling control member normally locking the movable contact against motion, means for shifting the movable contact when the control member has reached a predetermined point in its path of travel whereupon the contact is released thereby causing the generator and the battery to alternately become the source of electrical supply.

4. In a circuit controlling device, a generator, a battery, a main circuit, a movable contact in said circuit, a traveling control member normally preventing the movement of the contact, means for shifting the movable terminal when the control member has reached a predetermined point in its path of travel, means for reversing the direction of travel of the control member when the generator is at rest, thereby delaying the movement of the contact.

5. In a circuit controlling device, a generator, a battery, a main circuit, the said battery being bridged across the main circuit, a movable contact connecting the circuit with the generator whereby the generator will simultaneously supply the main circuit and the battery, a manually operated switch controlling the main circuit, means

placed under tension by the manual manipulation of the switch for automatically disconnecting the generator at the termination of a predetermined total period of generation, and means to automatically reestablish the connection at the termination of a predetermined total period of operation of the main circuit.

6. In a circuit controlling device, a main circuit, a generator, a storage battery bridged across the circuit, whereby the generator will simultaneously supply the main circuit and the battery, an intermittently operated regulator for determining periods of charge and discharge, means set in operative condition by manual effort for automatically disconnecting the circuit from the generator when the regulator has registered a predetermined total operative period, and means to reestablish such connection when the subsequent operations of the regulator have totaled a predetermined operative interval.

7. In a circuit controlling device, a generator, a battery a main circuit alternately supplied by the generator and battery, a manual operated control switch in said circuit, a regulator for determining the operative charge and discharge; controlling the alternate connection of the circuit with the generator and battery, means for automatically arresting the regulator at the termination of a predetermined total period of operation, and means for releasing the motor by the manual operation of the circuit switch.

8. In a circuit controlling device, a main circuit, a battery in said circuit, a movable contact whereby the circuit and battery may be disconnected, a regulator for determining the operative charge and discharge controlling the operation of the movable contact whereby said contact may move only when the timing device has completed a predetermined total period of operation, a manually operated switch in the main circuit, means for arresting the timing device when the switch is operated in one direction and for releasing the timing device when the switch is operated in the opposite direction.

9. In a circuit controlling device, a main circuit, a storage battery, a generator adapted to simultaneously charge the battery and supply the main circuit, a movable contact whereby the generator may be disconnected and the circuit supplied from the battery, a regulator for determining the operative charge and discharge, actuating means for the movable contact, locking mechanism for securing the contact in adjusted position and adapted to permit the shifting of the contact when the battery has been charged throughout a predetermined total period of generation, and to permit the return of the

contact to again connect the generator at the termination of an equivalent total period of discharge of the battery, as determined by the regulator.

5 10. In a circuit controlling device, a main circuit, a storage battery, a generator adapted to simultaneously charge the battery and supply the circuit, a movable spring actuated contact whereby the generator may be disconnected and the circuit supplied from the battery, a regulator for determining the operative charge and discharge controlling the movable contact, said regulator being adapted to release the actuating spring to permit the contact to shift only when the battery has been charged throughout a predetermined total charging period, and releasing the return spring to effect the return of the contact at the termination of a predetermined total discharging interval, and means for arresting the regulator during inactive periods of the charging and discharging times.

11. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied by either the generator or battery, means controlling the movement of the contact including a control shaft, means carried thereby to prevent the movement of the contact until the shaft has been rotated to a predetermined point, loose gears carried by said shaft, a motor adapted to drive said gears in opposite directions, a movable clutch member adapted to engage the shaft with either of the gears, thereby causing the shaft to rotate in either direction, and means to shift said clutch member.

12. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied by either the generator or battery, means controlling the movement of the contact including a revoluble shaft, a master cam having a recess therein carried by said shaft, a lever adapted by its oscillation to permit the movement of the contact, and bearing on the master cam whereby it is prevented from oscillating to release the contact until the said lever engages the recess in said cam, and means to rotate the shaft at a predetermined rate of speed.

13. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the battery or the generator, a movable control member preventing the movement of the contact until the control member has reached a predetermined position, an electric switch independent of the contact adapted upon operation to arrest the generator and connect the circuit with the battery, and means controlled by said switch for reversing the direction of movement of the control member.

14. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the main circuit may be supplied from either the generator or battery, a revoluble shaft adapted to permit the movement of the contact when the shaft has been rotated to a predetermined position, means to rotate the shaft in reverse directions including oppositely rotating gears, a shifting clutch member adapted to engage either of the gears, a switch controlling the generator, and means for shifting said clutch controlled by the operation of said switch.

15. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the generator or battery, a revoluble shaft adapted to permit the movement of the contact when the shaft has been rotated to a predetermined position, means to rotate the shaft in reverse directions including oppositely rotating gears, a shifting clutch member adapted to engage either of the rotating gears, a shift lever for said clutch, a yielding operating connection for the shift lever, a switch adapted by its operation to arrest the generator and by the same movement cause the operation of said shift lever or place the yielding connection under tension whereby the lever will be subsequently operated to reverse the direction of the revoluble shaft.

16. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the generator or battery, a movable control member preventing the movement of the contact until the control member is in a predetermined position, reversing mechanism whereby the control member may be actuated in either direction, including a shift lever, a manually operated rock arm, and a yielding connection between the rock arm and shift lever whereby the operation of the rock arm will normally operate the shift lever but whereby independent operation of said parts will be compensated for by said yielding connection.

17. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the main circuit may be supplied from either the generator or battery, a movable control member preventing the movement of the contact until the control member has reached a predetermined position, a key adapted upon its movement to arrest the generator and means operated by said key to reverse the direction of movement of the control member.

18. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the generator or battery, actuating means therefor, a lock member adapted to maintain the movable contact in its adjusted

position, a time motor controlling the lock member whereby said member will release the contact and permit the movement thereof only at the termination of predetermined total periods of operative engagement in either position.

19. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the generator or battery, a latch adapted to lock the contact in its adjusted position, a revoluble shaft, a cam carried by said shaft, an engaging connection between the cam and latch whereby the latch will be maintained in engaging position until the cam has been rotated to a predetermined position.

20. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the battery or generator, actuating means therefor, means for locking the contact in its engaging positions, a traveling control member adapted to release the contact when said control member has moved to a predetermined position, a switch independent of the movable contact for connecting the circuit with the battery, reversing mechanism controlled by said switch whereby the control member will be operated in reverse direction during the time the circuit is connected with both generator and battery.

21. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the generator or battery, an arm movable in unison with said contact, means for oscillating said arm, a latch adapted to maintain the arm in adjusted position, a lever engaging said latch, a moving cam also engaged by the said lever whereby the oscillation of the lever is prevented until the engaging portion of said lever passes into a recess in the cam whereby the lever is permitted to oscillate to release the latch.

22. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the generator or battery, a swinging arm moving in unison with the movable contact, means for moving said arm, a lock adapted to maintain the arm in its adjusted position, a traveling control member maintaining the lock in engagement with the arm until the control member has moved to a predetermined position.

23. In a control device for electric circuits, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the battery or generator, a swinging arm moving in unison with the movable contact, means for moving said arm, a latch bar, a stud in said arm engaged by the latch bar to maintain the

arm in adjusted position, a rotary cam adapted to hold the latch bar in engagement with the arm until the cam has been rotated to a predetermined position, and a time motor for operating said cam at a predetermined rate of speed.

24. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the battery or generator, a swinging arm in unison with which the contact is shifted, means for oscillating the arm, a gear carried by the swinging arm, a driving pinion into and out of mesh with which the gear is moved by the oscillation of the arm, means for locking the arm in adjusted position, means operated by said gear for releasing the arm when the gear has been rotated to a predetermined position, whereby said arm may move the gear out of mesh with its driving pinion.

25. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the main circuit may be supplied from either the generator or battery, a swinging arm in unison with which the contact is shifted, means for oscillating the arm, a gear carried by the swinging arm, a driving pinion into and out of mesh with which the gear is moved by the oscillation of the arm, a latch adapted to maintain the arm in adjusted position, a link attached to said latch, a stud carried by the gear into the path of which the link projects, whereby the engagement of the stud with the link will disengage the latch thereby permitting the arm to oscillate to shift the contact and disengage the gear from the driving pinion.

26. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the generator or battery, actuating means for the contact, means for locking the contact in adjusted position, a driving pinion, a traveling gear movable in unison with the contact into and out of mesh with the driving pinion, and adapted when rotated to a predetermined position to cause the release of the contact.

27. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the generator or battery, means for moving the contact, means for maintaining the contact in adjusted position, an intermittently operated gear, means for actuating said gear only when the contact is connecting the circuit with the battery, and means controlled by the gear for reversing the contact when the gear has been rotated to a predetermined position.

28. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the battery or the generator, a mov-

able control member permitting the movement of the contact only when the control member has reached a predetermined position, a switch in the main circuit, actuating means for the movable contact, set in condition to operate the contact by the adjustment of said switch, said actuating means operating the contact subsequent to the operation of the switch when the control member has reached a predetermined position.

29. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the battery or the generator, a movable control member permitting the movement of the contact only when the control member has reached a predetermined position, a spring adapted to shift said contact, a manually operated device for placing the spring under tension whereby the spring will move said contact when the control device has moved to release position.

30. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the battery or generator, a movable control member permitting the movement of the contact only when the control member has reached a predetermined position, a key, a spring actuated pawl arm placed under tension by the operation thereof, said pawl arm being adapted to move the contact member when released by the control member.

31. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the battery or generator, a movable control member permitting the movement of the contact only when the control member has reached a predetermined position, a key, a frame member movable with the key, a pivoted pawl arm, a spring connecting the pawl arm with the frame member, said pawl arm being adapted to engage the shifting connection of the movable contact and be arrested thereby while the frame member advances to place the spring under tension whereby the pawl will subsequently move the contact when released by the control member.

32. In a circuit controller, a generator, a battery, a main circuit, a movable contact whereby the circuit may be supplied from either the battery or generator, a movable control member permitting the movement of the contact only when the control member has reached a predetermined position, a swinging arm movable with the contact, an operating key, a pawl arm carried by the key and adapted to engage and oscillate the swinging arm and thereby shift the contact when permitted to do so by the movable control member.

33. In a circuit controller, a main circuit, a

movable contact stationary terminals adapted to be alternately engaged by the movable contact, a movable control member permitting the movement of the contact only when the control member has reached a predetermined position, a swinging arm movable in unison with the contact, an operating key, a pawl arm carried by the key and adapted to engage the swinging arm, a spring placed under tension by the operation of the key whereby the pawl arm will be caused to oscillate the swinging arm subsequent to the operation of the key, when permitted to do so by the control member.

34. In a circuit controller, a main circuit, a movable contact, two stationary terminals alternately engaged by the movable contact, means for locking the contact in adjusted position, means for releasing the contact at the termination of a predetermined period of operative engagement, an operating key, actuating devices for the movable contact placed under tension by the operation of the key, whereby the contact will be shifted subsequent to the operation of the key when released by the lock mechanism.

35. In a circuit controller, a main circuit, a movable contact, two stationary terminals alternately engaged by the movable contact, means for locking the contact in adjusted position, means for releasing the contact at the termination of a predetermined period of operative engagement, means for shifting said contact, including a key, a pawl arm carried by the key, means for shifting said pawl into and out of engaging position as it approaches the limit of its stroke in either direction.

36. In a circuit controller, a main circuit, a movable contact, two stationary terminals alternately engaged by the movable contact, means for moving the contact including an oscillating frame member, a pawl arm pivoted to said frame and adapted by its oscillation to cause the shifting of the contact, means for shifting the pivotal connection of the pawl arm in relation to the oscillating frame whereby the pawl arm is moved into and out of engaging position.

37. In a circuit controller, a main circuit, a movable contact, two stationary terminals alternately engaged by the movable contact, means for moving said contact including an oscillating frame having a slot therein, a pivoted pawl arm the pivotal stud of which engages in and is movable within the limits of said slot and a cam member engaging the pivotal stud and shifting said pawl arm into and out of engaging position.

38. In a circuit controller, a main circuit, a movable contact, two stationary terminals with which the contact alternately engages, means for moving the contact including an oscillating frame having a radial slot therein, a movable member carried by said frame

having a slot therein, a portion of which slot is adapted to be moved into and out of registry with the slot of the frame member by the shifting of said movable member, a
 5 pawl arm the pivotal stud of which engages in the slots of the said members, and movable therein when the aligned portion of said slots are in registry, and means to shift the movable slotted member as the oscillating
 10 frame approaches the limit of its movement.

39. In a circuit controller, a main circuit, a movable contact, two stationary terminals with which the contact alternately engages, a swinging arm movable in unison with the
 15 contact, an oscillatory member, a pawl arm carried by said member, and adapted to oscillate said arm, said pawl arm being adjustable upon the oscillating member to operative and inoperative positions, means for
 20 moving the pawl arm upon the oscillatory member into and out of the path of the swinging arm as the oscillatory member approaches the limit of its stroke.

40. In a circuit controller, a main circuit, a movable contact, two stationary terminals adapted to be engaged by the movable contact, a swinging arm movable in unison with the contact, an oscillating frame member, a
 25 pivoted pawl arm adapted to engage and oscillate the swinging arm, an actuating spring for said pawl arm placed under tension by the oscillation of the frame member, a shiftable pivotal connection for the pawl arm and means to shift said pawl arm into
 30 and out of engaging position by the variation of the pivotal connection thereof.

41. In a circuit controller, a main circuit, a movable contact, two terminals alternately engaged by the movable contact, a motor
 40 controlling the movement of the contact, a locking device for arresting the operation of the motor, a switch in the main circuit, actuating means for the locking device placed under tension by the operation of the switch
 45 whereby the motor will be arrested at the termination of a predetermined period of operation.

42. In a circuit controller, a main circuit, a movable contact, two terminals engaged alternately by said contact, a motor controlling the movement of the contact, a locking
 50 device for arresting the operation of the motor, a switch in the main circuit, a make and break device in the connection to the source of electrical energy, means controlled by the main circuit switch for simultaneously breaking the supply connection of the circuit and arresting the motor.
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43. In a circuit controller, a main circuit, a movable contact, two terminals with which the contact is adapted to alternately engage, a retracting member adapted to return the contact to engagement with one of the terminals when moved therefrom, an actuating
 60 member of greater tension than the retract-

tory member, adapted to move the contact against the tension of its retracting member from engagement with one contact into engagement with the other, when the total
 70 period of engagement with one terminal exceeds the period of engagement with the other terminal a predetermined amount.

44. In a circuit controlling device, a main circuit, a movable contact, two stationary terminals alternately engaged by the contact, a motor controlling the movement of the contact, a movable stop member adapted to arrest the movement of the motor, a shiftable support for said stop member, means for independently shifting the support and
 80 moving said stop member to arrest the motor.

45. In a circuit controller, a main circuit, a movable contact, two stationary terminals alternately engaged by the contact, a motor controlling the movement of the contact, a stop member movable into and out of engagement with the motor, a shiftable support for the stop member whereby the stop member is moved into and out of operative
 90 position, a control switch in the main circuit, means for operating the movable stop in unison with the operation of the switch, means independent of the switch for shifting the support.
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46. In a controlling device for circuits, a main circuit, a movable contact, two stationary terminals alternately engaged by the movable contact, a motor controlling the movement of the contact, a movable stop member adapted to arrest the movement of the motor, a movable support for said stop member, said stop member engaging and arresting the motor only when both the stop and the support thereof have been operated,
 100 means whereby one of said members is operated in unison with the contact, and manually operated means for moving the other member whereby the motor will be arrested.
 105

47. In a circuit controller, a main circuit, a movable contact, two stationary terminals alternately engaged by the contact, a motor controlling the movement of the contact, a movable stop member adapted to arrest the movement of the motor, a movable support
 115 for the stop member, the stop member arresting the motor only when both the stop and the support thereof have been operated, independent manually operated means for separately operating the stop and its support into operative positions.
 120

48. In a circuit controller, a generator, a battery intermittently charged thereby, a main circuit adapted to be intermittently supplied from the battery, and for automatically disconnecting the generator and the battery when the total of the intermittent charging periods equals a predetermined excess over the total of the intermittent discharge periods.
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49. In a construction as described, a generator, a battery charged thereby, a main circuit, means for automatically connecting and disconnecting the generator and battery at the termination of alternate discharge and charging periods, means for temporarily supplying the main circuit from the battery when the generator is arrested during the charging period, means for measuring such temporary discharge period and correspondingly increasing the subsequent charging period.

50. In a construction as described, a generator, a battery charged thereby, a main circuit, normally supplied from the generator during the charging period, means for temporarily supplying the circuit from the battery when the generator is at rest during the charging period, measuring mechanism for measuring the charging period, and means for causing such measuring mechanism to operate in reverse direction during the temporary discharge period.

51. In a construction as described, a generator, a battery charged thereby, a main circuit supplied alternately by the generator and battery, measuring mechanism for automatically measuring the charge and discharge periods, means for temporarily supplying the circuit from the battery during the charging period, means for operating the measuring mechanism during such temporary discharge period at a rate of speed different from its normal rate of speed.

52. In a circuit controlling device, a main circuit, a generator, a battery, a movable contact whereby the battery and generator will alternately become the source of electrical energy of the main circuit, a regulator determining the alternate charge and discharge of the battery, a switch in the main circuit, actuating mechanism for the movable contact energized by the operation of said switch whereby said contact will be shifted at the termination of a predetermined period of operation determined by the regulator.

53. In a circuit controlling device, a generator, a battery, a main circuit, a movable contact adapted to alternately connect the main circuit with the generator and battery, a regulator for determining the operative charge and discharge of the battery, actuating mechanism for the movable contact placed under tension by manual effort and adapted to shift said contact at the termination of a predetermined period of operation determined by the regulator.

54. In a circuit controlling device, a generator, a battery, a main circuit, a movable contact adapted to alternately connect the main circuit with the generator and battery, a regulator for determining the operative charge and discharge of the battery, a spring adapted to shift said contact at the

termination of a predetermined period of operation, and a second spring placed under tension by the operation of the first adapted to return said contact at the termination of the succeeding period of operation.

55. In a circuit controlling device, a generator, a battery, a main circuit, a movable contact adapted to alternately connect the main circuit with the generator and battery, a regulator for determining the operative charge and discharge of the battery, a switch in the main circuit, a spring placed under tension by the operation of said switch adapted to shift said contact when a predetermined period of operation has been determined by the regulator, and locking means for the contact released by the action of the regulator.

56. In a circuit controlling device, a generator, a battery, a main circuit, a movable contact adapted to alternately connect the main circuit with the generator and battery, a regulator for determining the operative charge and discharge of the battery, an oscillating member, an actuating arm carried thereby and adapted to shift said contact upon the oscillation of said oscillating member, means for moving said actuating arm into and out of operative position, means for neutralizing the effect of said actuating arm when the contact is in discharge position.

57. In a circuit controlling device, a generator, a battery, a main circuit, a movable contact adapted to alternately connect the main circuit with the generator and battery, a regulator for determining the operative charge and discharge of the battery, a manually operated device, actuating mechanism for the contact set in operating condition by the operation of the said manually operated device during the time the contact is in charging position, but inoperative under the influence of the said manually operated device while the contact is in discharging position.

58. In a circuit controlling device, a generator, a battery, a main circuit, a movable contact adapted to alternately connect the main circuit, with the generator and battery, a regulator for determining the operative charge and discharge of the battery, an oscillating member, an actuating arm for the movable contact radially adjustable in relation to said oscillatory member, a cam slide adapted by its alternate movement to shift said actuating arm to and from operative position, a variable stop varied in unison with the movement of the contact, said stop being moved into the path of the cam slide when the contact is shifted to a predetermined position whereby the engagement of the cam slide with the variable stop will cause an adjustment of the actuating arm in relation to the oscillating member.

59. In a circuit controlling device, a gen-

erator, a battery, a main circuit, a movable contact adapted to alternately connect the main circuit with the generator and battery, a regulator for determining the operative charge and discharge of the battery, a switch in the main circuit, means for locking the regulator controlled by the switch during the discharge period, but unaffected by the operation of the switch during the charging period, substantially as specified.

60. In a circuit controlling device, a generator, a battery, a main circuit, a movable contact adapted to alternately connect the main circuit with the generator and battery, a regulator for determining the operative charge and discharge of the battery, a switch in the generator circuit and means controlled by the operation of said switch for arresting the regulator, substantially as specified.

61. In a circuit controlling device, a generator, a battery, a main circuit, a movable contact adapted to alternately connect the main circuit with the generator and battery, a regulator for determining the operative charge and discharge of the battery, a switch in the main circuit, regulator arresting

means controlled by said switch whereby the regulator will be arrested when the switch is operated in one direction and released when operated in the opposite direction, substantially as specified.

62. In a circuit controlling device, a generator, a battery, a main circuit, a movable contact adapted to alternately connect the main circuit with the generator and battery, a regulator for determining the operative charge and discharge of the battery, a switch in the main circuit and a switch in the generator circuit, regulator arresting means arresting the operation of the regulator when both said switches are open, said arresting means being rendered inoperative by the closing of either of the switches whereby the regulator will be released, substantially as specified.

In testimony whereof, I have hereunto set my hand this 17th day of October, 1910.

FRANCIS R. HOYT.

Witnesses:

HARRY F. NOLAN,
F. L. WALKER.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."