A. T. MARSHALL.

ROCKING SOLENOID SWITCH.

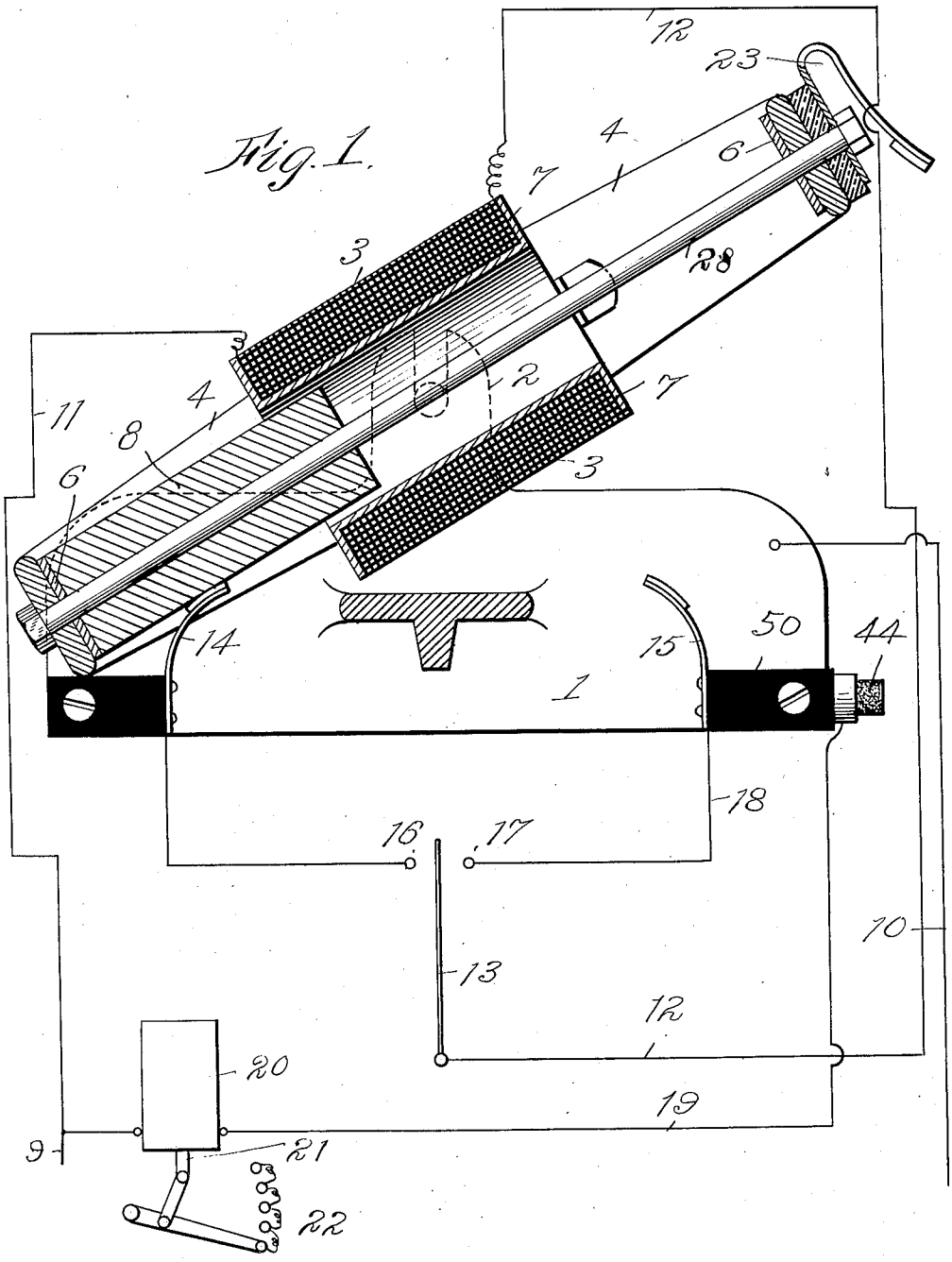
APPLICATION FILED OCT. 1, 1908.

936,648.

Patented Oct. 12, 1909.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
Octavius Knight.
H. Alfred Jaeke.

Inventor
Albert T. Marshall
By his Attorneys

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3 SHEETS—SHEET 2.

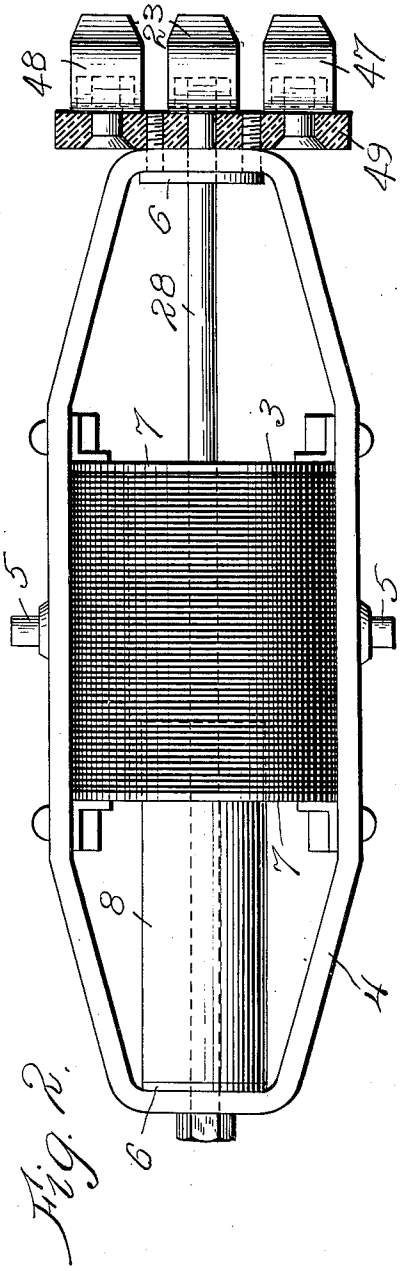

Fig. 2.

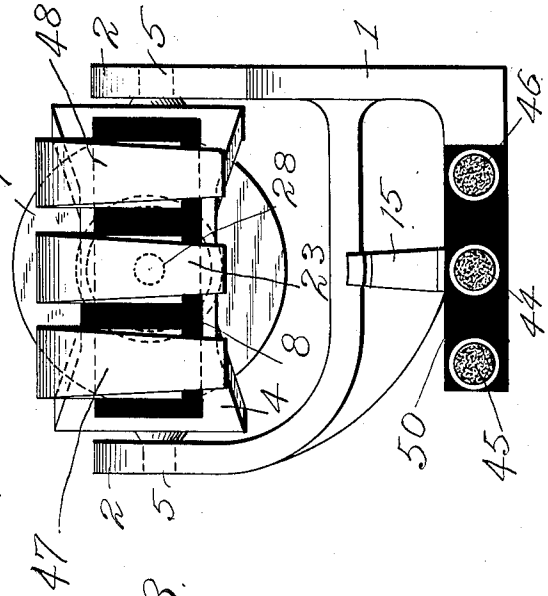

Fig. 3.

Witnesses:
Octavius Knight
H. Aepfenbach

Inventor
Albert T. Marshall
By his Attorneys

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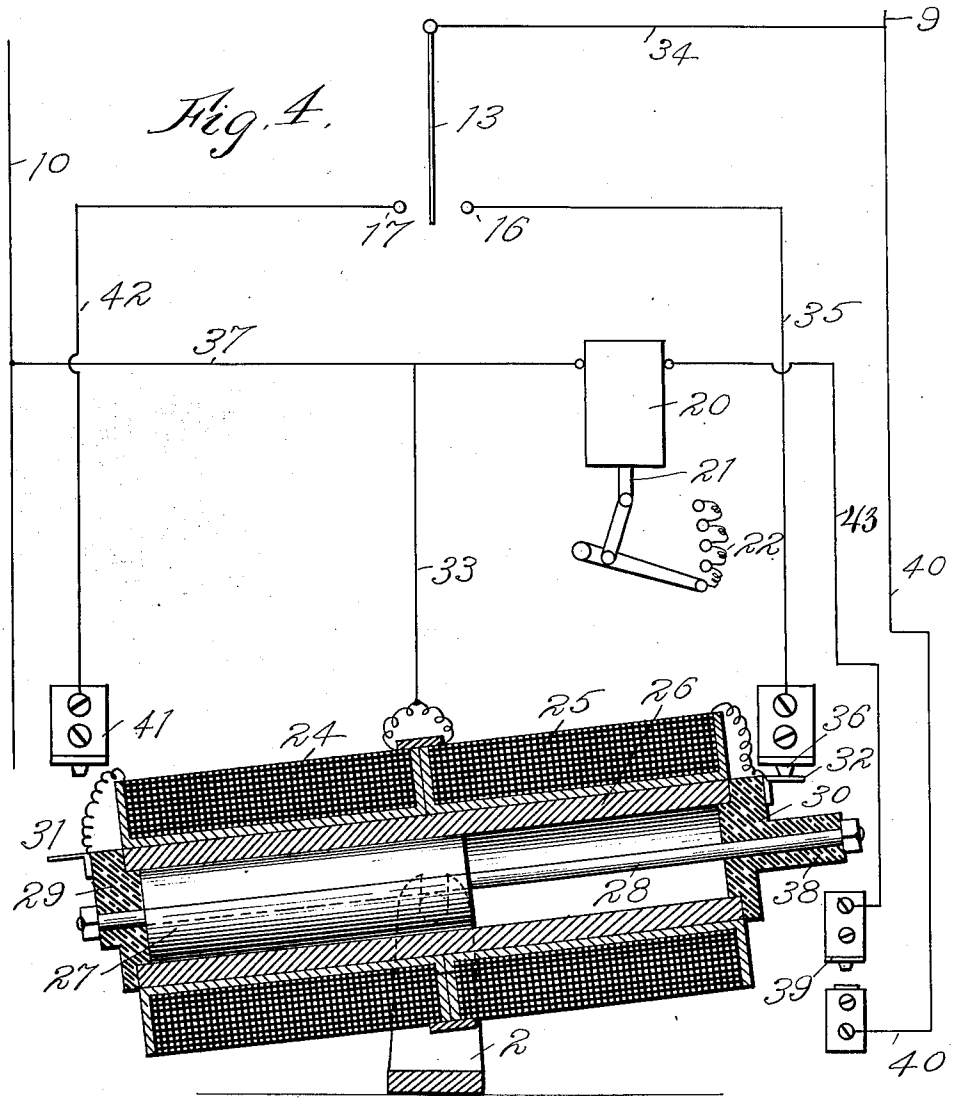
3 SHEETS—SHEET 3.

Fig. 4.



Witnesses:
Octavius Knight
H. Alfred Jahnke

Inventor
Albert T. Marshall
By his Attorneys
Dewey & Co

UNITED STATES PATENT OFFICE.

ALBERT T. MARSHALL, OF HARTFORD, CONNECTICUT, ASSIGNOR TO THE AUTOMATIC REFRIGERATING COMPANY, OF HARTFORD, CONNECTICUT, A CORPORATION OF NEW JERSEY.

ROCKING SOLENOID-SWITCH.

936,648. Specification of Letters Patent. Patented Oct. 12, 1909.

Application filed October 1, 1908. Serial No. 455,641.

To all whom it may concern:

Be it known that I, ALBERT T. MARSHALL, a citizen of the United States, and residing at Hartford, county of Hartford, State of Connecticut, have invented certain new and useful Improvements in Rocking Solenoid-Switches, of which the following is a specification.

The object of my invention is to cause in electrically operated rocking solenoid switches of the kind, which make and break electrical contacts, the current energizing or operating the switch to flow only a very short time through the switch, so that only the least possible amount of current is consumed. In the accompanying drawings, I have illustrated two modifications of this kind of solenoid switch, wherein:

Figure 1 is a longitudinal sectional view of the switch; Fig. 2 is a plan view of the solenoid without its supporting frame; Fig. 3 is a side view seen from the right-hand side of Fig. 1; and Fig. 4 is a modification of the switch shown in Fig. 1, which is also shown in longitudinal sectional elevation.

In Figs. 1, 2 and 3, 1 is a frame which is provided with two brackets 2 disposed on opposite sides of the frame to form a U, between which is arranged a solenoid 3. This solenoid is preferably fastened in the iron yoke 4, as shown in Figs. 1 and 2, which forms the outer circuit for the magnetic flux of the solenoid. On either side of yoke 4 is provided a pivot pin 5 each of which is journaled in one of the brackets 2. Pivot pins 5 are preferably disposed on yoke 4 so that the pivotal axis of the whole combination is slightly below the center. This will cause the solenoid to either tilt to one side or the other side when rocked in the manner hereinafter described. Concentrically with and within the cylindrical opening of coil 3 is disposed rod 28 of non-magnetic material, preferably brass, which is fastened on either end to the ends of yoke 4. On this rod is concentrically slidingly disposed the solenoid core 8 of suitable length in the manner shown in Fig. 1, a brass washer 6 being interposed between the core and the yoke at either end in order to prevent the core from clinging to the yoke through residual magnetism. It will be seen from Fig. 1 that if the solenoid is tilted into the position shown in this figure and coil 3 is energized, the latter will draw the iron core 8 which is resting in the left hand end of the yoke 4 toward the middle so as to assume a symmetrical position relatively to coil 3. The momentum, however, of the core when moving into the central position above referred to will carry it past the center so that its weight will overbalance the solenoid on the right-hand side and cause its right-hand end to tilt down. In the meantime the current energizing the solenoid is interrupted in the manner hereinafter described, and owing to the slanting of the yoke 4 toward the right, core 8 will slide down on rod 28 to the farthest right-hand end of the yoke and hold the solenoid in this tilted position by means of its weight. On reënergizing the solenoid the same action above described will take place and tilt the solenoid back into the position shown in Fig. 1. By pivoting the yoke slightly below the longitudinal axis on which the core slides as described above the further advantage is obtained that the blow struck by the core when drawn into the solenoid will produce a torque which will aid the gravity in tilting the solenoid to the other side, and in fact, by suitably choosing the distance at which the solenoid is pivoted below its longitudinal axis, this torque may be made a very positive agent.

The manner in which the solenoid is energized and deënergized is as follows: Since the solenoid above described may be operated to a particular advantage in thermostat controlled circuits in which by the action of the thermostat two circuits are opened and closed alternately, I shall describe the energizing of the solenoid by means of thermostat controlled circuits. In Fig. 1, 9, 10 are wires of the main line from which the current energizing the solenoid 3 is branched off. From wire 9 is branched off wire 11 leading directly to the solenoid coil, while wire 12 leading to the other end of the coil is connected to the fixed end of thermostat 13. Wire 10 of the main line is connected to frame 1 which is conductively connected to yoke 4 and core 8. On frame 1 are provided two spring contacts 14 and 15 on opposite sides of the frame and insulated therefrom so that core 8 will make contact with either spring when tilted on that side. Besides on the outside of frame 1 near spring 15 is disposed contact 44, insulated from frame 1

and from spring 15, and to the end of yoke 4 coöperating with spring 15 is conductively fastened spring 23 so that when the solenoid is tilted to that side, spring 23 will make contact with contact 44, which latter may be preferably of carbon. Contact points 16 and 17 of the thermostat are connected with contact springs 14 and 15 respectively. Furthermore, contact 44 is connected by conductor 19 with main wire 9 in which conductor may be disposed the device, the operation of which is controlled by the action of the whole solenoid switch, for instance, solenoid 20, which may control by the in and outward movement of its core 21 for instance, a rheostat 22. If now solenoid 3 is tilted into the position shown in Fig. 1, core 8 will be in contact with contact spring 14, and assuming that thermostat 13 is in the middle position between its contact points 16 and 17, no current can flow through solenoid 3 and through solenoid 20. Upon moving of thermostat arm 13 to the left it will close the contact at 16 and the following circuit will thereby be closed. From main conductor 9 over conductor 11 to solenoid coil 3, therefrom over conductor 12 to thermostat 13, to contact point 16, thence over contact spring 14 to core 8. The latter being conductively connected with yoke 4 and frame 1, the current will flow from core 8 through pivots 5 over brackets 2 to conductor 10 of the main line. The current flowing through this circuit will energize the solenoid 3 and draw core 8 toward the right. Upon sliding to the right the core will slide off contact spring 14 and through the momentum gained by the sudden energizing impulse of the coil, pass beyond its central position and thus cause the tilting of the solenoid to the right. The coil being deënergized by the sliding of the core off contact 14 before it has reached the central or symmetrical position will offer no resistance to the core sliding past this central position toward the right-hand end, so that the momentum of the core will act unimpaired to carry the core to the opposite end of yoke 4. The tilting of the solenoid 3 to the right will cause core 8 to make contact with contact spring 15 and spring 23 to make contact with contact 44, and thus cause the closing of the following circuit: from main conductor 9 through solenoid 20 over conductor 19 to contact 44, and thence through spring 23, yoke 4 and frame 2, to main conductor 10. This circuit, hereinafter referred to as the actuating circuit, will cause the energizing of solenoid 20 by which rheostat 22 may be actuated and, for instance, a refrigerating machine not shown in the drawings thrown into operation. Spring 23 should be of sufficient length to yield a sufficient distance when in contact with 44, so as to maintain the contact made by the tilting of the solenoid to that side with contact 44, even if the light contact spring 15 should cause a slight rebound of the solenoid, in order to prevent the circuit through solenoid 20 from being interrupted at 23 and 44 after it has been once closed. When a certain low temperature to which thermostat 13 is adjusted has been reached the thermostat will be thrown to the right and make contact with contact point 17. This will close the following circuit: from main conductor 9 over conductor 11 through solenoid coil 3, thence over conductor 12, thermostat arm 13, contact point 17, conductor 18, contact spring 15, core 8 and frame 1 to main line 10. The current flowing through this circuit will energize solenoid 3 and cause the shifting of core 8 to the left and the tilting of the solenoid to the left in a similar manner as above described. This will interrupt first the branch circuit through the coil 3 last described at the moment core 8 slides off of spring 15, so that core 8 is free to slide to the farthest left-hand end of yoke 4 and to thus bear upon contact spring 14. The tilting of yoke 4 will further interrupt the contact 23—24 and thus cause the deënergizing of solenoid 20, so that the rheostat will be thrown back into the position shown in Fig. 1, and the refrigerating machine above referred to be thrown out of operation. The tilting of solenoid 3 to the left has thus set its energizing circuit through contact point 16, so that when thermostat 13 closes contact 16 upon rising of the temperature to the degree for which the thermostat arm is adjusted, solenoid 3 will again be energized in the manner described above and the refrigerating system thrown again into operation as before.

In order to adapt the apparatus also for controlling a two or more phase actuating current by closing its circuit when the yoke 4 is tilted to the right, I may provide several contacts on insulating piece 50 beside contact 44 and a corresponding number of additional contact springs 47 and 48 besides spring 23 on yoke 4, but insulated from the latter at 49 and from each other, as shown in Figs. 2 and 3. The circuits closed by these additional contacts varying in their arrangement according to the apparatus in which they are used, are omitted in the drawings since their arrangement is not within the scope of this invention.

The tilting of the solenoid switch may be also caused in the manner shown in Fig. 4, in which for the sake of simplicity the yoke 4 forming the outer magnetic circuit is omitted and in which the fixed contacts are shown more in a diagrammatical manner. In this figure the rocking solenoid which may also be pivoted as shown in Fig. 1 in suitable brackets 2 and also slightly below

its longitudinal axis, is formed by two separate solenoid coils 24 and 25, one coil on each end of the whole solenoid. The core tube 26, preferably of brass, on which both coils are mounted, contains the core 27 which is preferably guided by guide rod 28, of non-magnetic material, passing centrally longitudinally through the core, which rod is supported by the covers 29 and 30 of insulating material, closing the ends of core tube 26. On cover 29 is disposed contact piece 31 to which is connected one end of solenoid coil 24, while on cover 30 is provided contact piece 32 which is connected to one end of solenoid coil 25. The two remaining ends of coils 24 and 25 are connected with each other and also connected to conductor 33. It will be seen that in the position shown in Fig. 4 core 27 will cause the tilting of the solenoid to the left. If now coil 25 is energized in the manner hereinafter described core 27 will be drawn to the right, which will cause a downward tilting of the right-hand end of the whole solenoid, while when core 27 is at the right end of the rocking solenoid, the energizing of coil 24 will draw coil 27 to the left and cause a downward tilting of the left-hand end of the solenoid into the position shown in Fig. 4. In this latter position the following circuit is closed when thermostat arm 13 closes the contact at 16. From main line 9, over conductor 34, thermostat 13, contact point 16, conductor 35, contact spring 36 (which may be suitably mounted) contact 32, coil 25, conductor 33, over conductor 37 to main conductor 10. This circuit will cause the energizing of coil 25 and draw the core 27 toward the right-hand end of core tube 26 and thus cause the downward tilting of the rocking solenoid at the right-hand end. By this downward motion end 38 of cover 30 will strike contact spring 39 which in turn will make contact with conductor 40. The left-hand end of the rocking solenoid then moving upward will strike with its contact 31, contact spring 41 which is connected with contact 17 by conductor 42. Upon its downward movement on the right-hand end the rocking solenoid will interrupt the contact 32, 36 and thus deënergize the solenoid 25. The closing of the contact 39 on the downward movement of end 38 of the solenoid will close at the same time the following circuit: from main conductor 9 over conductor 40 through contact spring 39 over conductor 43, to solenoid 20 (which may be the same as described above), thence over conductor 37, to main line conductor 10. This will energize the solenoid 20 in the manner before described. If now the thermostat arm 13 is moved by the change in temperature to make contact with contact point 17, the following branch circuit will be closed. From conductor 9, over conductor 34, through thermostat arm 13, contact 17, conductor 42, to contact spring 41, contact 31, (then in contact with contact spring 41), coil 24, conductor 33, conductor 37, to main conductor 10. The current through this circuit will energize coil 24 which in turn will draw core 27 over to the left-hand end of the solenoid and cause its tilting down on the left-hand end. This will interrupt the contact 31, 41 and thus deënergize coil 24 and also cause the interrupting of the contact at spring 39, so that by the interruption of the latter contact solenoid 20 is deënergized and the apparatus previously set in action by the energizing of solenoid 20 put out of operation. The downward tilting of the solenoid on the left-hand end will close again the contact 32, 36 and set the circuit through coil 25, so that upon moving of thermostat arm 13 over to contact 16 coil 25 will again be energized and the solenoid tilted down on the right-hand end as described above. Thus it will be seen the same effect is obtained by sub-dividing the rocking solenoid into two coils as in case of the modification shown in Figs. 1, 2 and 3, wherein only one coil is used for causing the shifting of the core to either side. One of the main distinctions of the double solenoid over the first modification is, that in the double solenoid the energizing circuit is only broken after the core has been fully pulled to one side of the solenoid and caused its tilting, while in the single solenoid modification the coil is deënergized before the core has reached its central or symmetrical position.

I claim:

1. In a device of the character described, the combination with a make and break circuit system, of a solenoid pivotally supported to tilt to either side and adapted to be alternately energized by the circuits of said system, said solenoid having a sliding core of suitable length, tending to slide toward the tilted end of said solenoid in deenergized condition and causing the solenoid when energized and tending to draw the core into central position to tilt toward the other side and means operated by the motion of said solenoid for deënergizing the solenoid at the time said core is tending to tilt said solenoid.

2. In a device of the character described, the combination of two circuits, a controller for said circuits having a contact stop for each circuit, a solenoid having a sliding core, said solenoid adapted to be energized by each of said circuits to shift said core to either side and suitably pivoted to tilt to either side upon shifting of said core, said solenoid when energized and tilted adapted to break its energizing circuit and set the other circuit to be closed by said controller, and an actuating circuit independent of said two circuits adapted to be opened and closed by the tilting motion of said solenoid.

3. In a device of the character described, the combination of two circuits, a thermostat arm adapted to control said two circuits having a contact stop for each circuit, a solenoid having a sliding core, said solenoid adapted to be energized by each of said circuits to shift said core to either side and suitably pivoted to tilt to either side upon shifting of said core, said solenoid when energized and tilted adapted to break its energizing circuit and set the other circuit to be closed by said thermostat, and an actuating circuit independent of said two circuits adapted to be opened and closed by the tilting motion of said solenoid.

4. In a device of the character described, the combination of two circuits, a controller for said circuits having a contact stop for each circuit, a solenoid having a yoke and a sliding core, a non-magnetic rod fixed within said yoke to form a guide for said core, said yoke extending a suitable distance beyond said solenoid at either end and adapted to form with said core a part of either of said circuits, and solenoid adapted to be energized by each of said circuits to shift said core to either end of said yoke and suitably pivoted to tilt to either side upon shifting of said core, said core upon energizing and tilting of said solenoid adapted to break the energizing circuit of said solenoid and set the other circuit to be closed by said controller, and an actuating circuit independent of said two circuits connected to be opened and closed by the tilting motion of said yoke.

5. In a device of the character described, the combination of two circuits, a controller for said circuits having a contact stop for each circuit, a solenoid having a yoke and a sliding core, a non-magnetic rod fixed within said yoke to form a guide for said core, said yoke extending a suitable distance beyond said solenoid at either end and adapted to form with said core a part of either of said circuits, said solenoid adapted to be energized by each of said circuits to shift said core to either end of said yoke and suitably pivoted to tilt to either side upon shifting of said core, said core upon energizing and tilting of said solenoid adapted to break the energizing circuit of said solenoid and set the other circuit to be closed by said controller, an actuating circuit independent of said two circuits connected to be opened and closed by the tilting motion of said yoke to close one of said two circuits, and an auxiliary contact on said yoke closed by the tilting of said yoke when said actuating circuit is closed and adapted to maintain said actuating circuit closed as long as said yoke is tilted to that side.

ALBERT T. MARSHALL.

Witnesses:
L. H. MARSHALL,
M. F. DONOVAN.