May 16, 1933. W. C. WELLS 1,909,139

ELECTRICAL APPARATUS

Filed Sept. 14, 1929 2 Sheets-Sheet 1

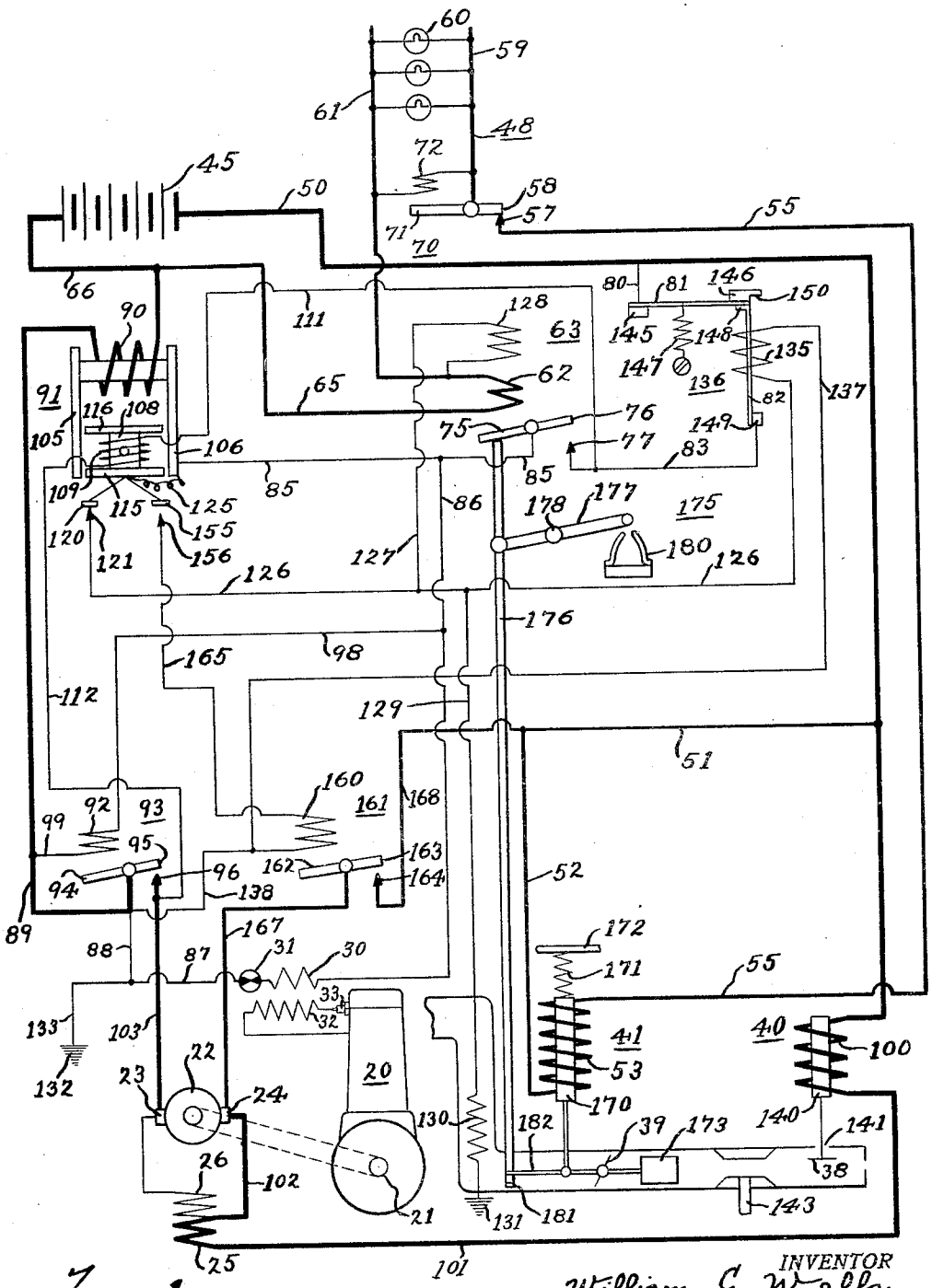


Fig. 1.

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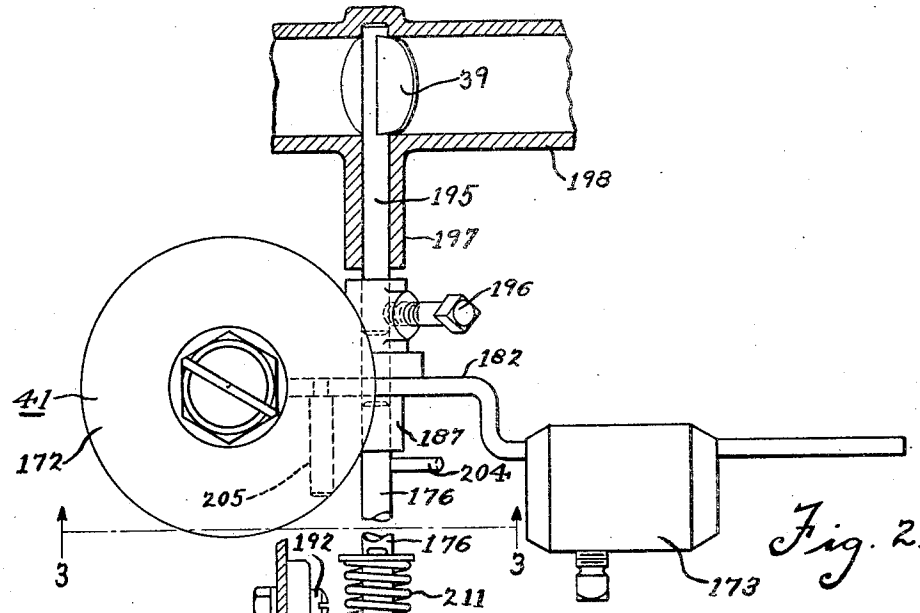


Fig. 2.

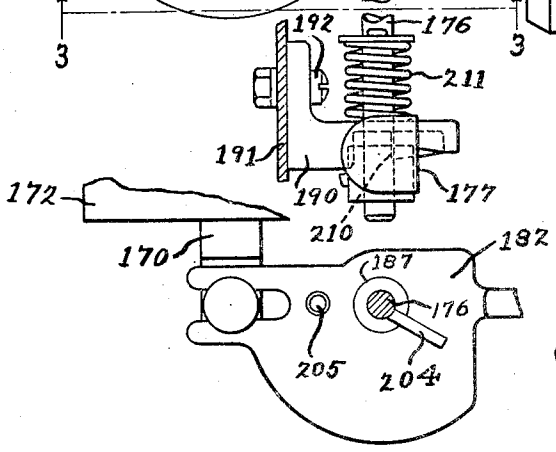


Fig. 3.

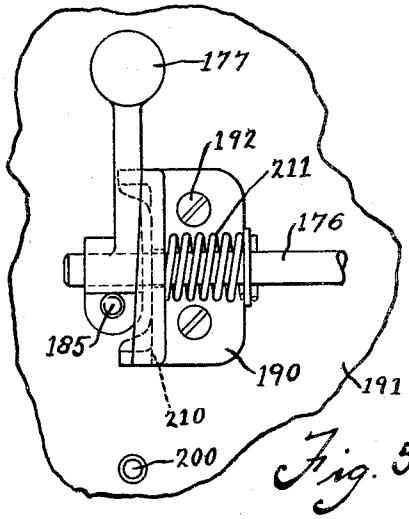


Fig. 5.

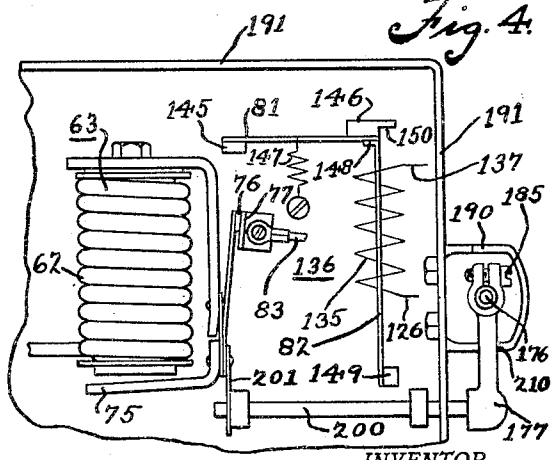


Fig. 4.

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UNITED STATES PATENT OFFICE

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ELECTRICAL APPARATUS

Application filed September 14, 1929. Serial No. 392,605.

The present invention relates to electrical generating systems and more particularly to the type of systems which include a prime mover such as an internal combustion engine, electrical apparatus such as a dynamo adapted to be driven by the prime mover, and a storage battery, which system is adapted to be rendered automatically operative in response to a demand for current.

One of the objects of the present invention is to provide for rendering the system operative when there is no demand for current which would automatically render the system operative, for example to supply a charging current to the storage battery, and at the same time provide for controlling a throttle valve for the prime mover to aid in starting same and to maintain the proper speed for causing the electrical apparatus to supply a battery charge of a proper value to the storage battery. One manner of carrying out this idea is to provide a single manually operated device for closing the control circuit of the system for rendering the system operative and for simultaneously opening the throttle valve to a predetermined position.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the invention is clearly shown.

In the drawings:

Fig. 1 is a wiring diagram illustrating the present invention;

Fig. 2 is a plan view partly in elevation and partly in section and showing a detailed construction of the invention;

Fig. 3 is a view taken on the line 3—3 of Fig. 2;

Fig. 4 is a view showing a portion of a switchboard with the manually operated device in operating position; and

Fig. 5 is a side view of the manually operated device.

Referring to the drawings 20 designates generally a prime mover herein shown, for the purpose of illustration, as an internal combustion engine having a shaft 21 which drives an electrical apparatus or dynamo 22 having main brushes 23 and 24 connected to the armature of the dynamo, and having a starting series field winding 25 and a shunt field winding 26.

The ignition apparatus comprises an ignition coil primary 30, an ignition timer 31 and an ignition coil secondary 32 which is connected to an engine spark plug 33.

A choke 38 for forming a proper mixture of gasoline and air for starting the prime mover, and a throttle 39 for regulating the speed of the prime mover, are adapted to be actuated by the controls 40 and 41 respectively.

The dynamo 22 functions as a motor or as a generator, and is adapted to rotate the shaft 21 of the prime mover 20, when acting as a starting motor, receiving current from a storage battery, 45. During the starting of the prime mover 20, the current through the series winding 25 and the shunt winding 26 is cumulative to produce a sufficient starting torque for cranking the prime mover.

When the load demand on a work circuit 48 is less than a predetermined value, the storage battery 45 is adapted to supply such demand. The current to the work circuit 48 will flow from the battery 45 through the following circuit: battery 45, wire 50, wire 51, wire 52, winding 53 of control 41, wire 55, contacts 57 and 58, service main 59, translating device 60, service main 61, current coil 62 of a starting switch relay 63, wire 65 and wire 66 to the other side of the battery.

A low voltage cut-out 70 is adapted to separate contacts 57 and 58 when the voltage of the battery is abnormally low. The low voltage cut-out 70 includes a pivoted armature 71 which carries the contact 58, and a magnet coil 72 having its ends connected across the work circuit 48 in parallel with the translating devices 60. When the voltage of the battery 45 is less than a predetermined low value, the coil 72 will not be energized sufficiently to hold the armature 71 in the position shown in the Fig. 1. Thus the armature 71 will descend by grav-

ity to separate contact 57 from contact 58, thereby interrupting the flow of current from the battery 45 to the work circuit 48.

When there is a load demand for current by the work circuit 48 in excess of a predetermined value, for example seven amperes, the ampere turns of the current coil 62 of the starting switch relay 63 are sufficient to lift an armature 75 upwardly to engage a contact 76 with a contact 77. The closing of contacts 76 and 77 allows current to flow from the battery 45 through the ignition and various other circuits necessary for rendering the prime mover 20 automatically operative to drive the dynamo 22 to supply current to the work circuit 48 and the battery 45. The circuit from the battery 45 to the ignition is as follows: battery 45, wire 50, wire 80, blade 81, bi-metallic thermostatic blade 82, wire 83, contacts 77 and 76, wire 85, wire 86, ignition coil primary 30, timer 31, wire 87, wire 88, wire 89, series winding 90 of a reverse current relay 91 and wire 66 to the other side of the battery. The closing of contacts 76 and 77 also allows current to flow from the battery 45 to a magnet coil 92 of a starting switch 93. The starting switch 93 includes the coil 92 and a pivoted armature 94 which carries a contact 95. The energizing of the coil 92 will cause the armature 94 to be drawn upwardly to engage contact 95 with a contact 96. The circuit from the battery 45 through the coil 92 is as follows: battery 45, wire 50, wire 80, blades 81 and 82, wire 83, contacts 77 and 76, wire 86, wire 98, magnet coil 92, wire 99, wire 89, winding 90, and wire 66 to the other side of the battery.

The closing of contacts 95 and 96 of the starting switch 93 establishes a cranking circuit between the battery and the dynamo which is as follows: battery 45, wire 50, winding 100 of the control 40, wire 101, series winding 25 of dynamo 22, wire 102, dynamo 22, wire 103, contacts 96 and 95, wire 89, series winding 90 of reverse current relay 91, and wire 66 to the other side of the battery.

The current flowing through the series winding 90 of the reverse current relay 91 during cranking is adapted to magnetize the frame of relay 91 including side plates or pole pieces 105 and 106 whereby said plates 105 and 106 will be, for example, north and south poles respectively. The relay 91 also includes a rocking armature 108 having a shunt winding 109, which winding is connected across the battery 45. The circuit from the battery 45 to the shunt winding 109 is as follows: battery 45, wire 50, wire 80, blades 81 and 82, wire 83, wire 111, shunt winding 109, wire 112, contacts 96 and 95, wire 89, series winding 90 and wire 66 to the other side of the battery. The armature 108 includes side plates 115 and 116 which plates are adapted to be magnetized north and south poles respectively by the shunt winding 109. When no current is flowing in the windings 90 and 109, armature 108 is in the position shown, it being resiliently held in such position by a spring (not shown). When the current flows through the series winding 90 during cranking, like poles of the relay frame and armature will repel to further assist in maintaining the rocking armature 108 in the position shown, whereby contact 120 maintains engagement with contact 121.

The engagement of contacts 120 and 121 allows current to flow from the battery through the following circuit when contacts 76 and 77 of relay 63 are closed: battery 45, wire 50, wire 80, blades 81 and 82, wire 83, contacts 77 and 76, wires 85, side plate 106 of relay 91, wire 125, contacts 120 and 121, wire 126, wire 127, shunt winding 128 of the starting switch relay 63, then back to the opposite side of the battery through the winding 62 and wires 65 and 66; also current from wire 126 flows through wire 129 to a pre-heater 130 grounded at 131, the circuit being completed through the ground 132, wire 133, wire 88, wire 89, winding 90 and wire 66; and current also flows from wire 126 through a heating coil 135 of a cranking cut-out 136, wires 137 and 138, wire 89, winding 90 and wire 66 to the other side of the battery. The preheater 130 is adapted to heat the starting fuel mixture for the prime mover 20. During cranking operation the current flows through the shunt winding 128 of relay 63 to cooperate with the current coil 62 to insure maintaining of contact between contacts 76 and 77. For the purpose of simplifying illustration I have shown the windings 62 and 128 one above the other. In actual construction the series winding 62 is wound outside of the winding 128.

The flow of current through the magnet coil 100 of the choke control 40 tends to raise the control plunger 140 upwardly which plunger carries the choke 38. The upward movement of the plunger 140 will cause the choke 38 to shut off the air passage 141, thus decreasing the quantity of air and consequently allowing a greater volume of gasoline to pass through a pipe 143 and into the carburetor to thus provide a relatively rich starting fuel mixture for the prime mover. The control 40 is adapted to function for a short interval, namely, only when a heavy demand for current is made on the battery 45 during cranking which heavy demand is present for a short interval.

Thus when there is a demand for current of a predetermined value by the work circuit 48 the prime mover 20 will be started by supplying ignition thereto and cranking

by the starting series field winding 25 in conjunction with the shunt field winding 26 of the dynamo 22. The starting being aided by enriching the fuel mixture and heating such mixture.

If the prime mover 20 should not start within a certain length of time, abnormal discharge of the battery is prevented by the cranking cut-out 136 which includes the blade 81, the bi-metallic thermostatic blade 82, and the heating coil 135. The blade 81 is fixed at 145 and has a non-conducting block 146 secured thereto. The blade 81 is urged downwardly by a spring 147 to engage a flanged end 148 of the bi-metallic thermostatic blade 82, said blade being fixed at 149. The thermostatic blade 82 is in heat receiving relation to the heating coil 135. While the prime mover is cranking current is passing through this heating coil as previously described. If the cranking of the prime mover should continue for an abnormal period, for example, one to two minutes, the thermostatic blade 82 will be heated sufficiently to cause it to bow to the right, as viewed in the drawing, until the flanged end 148 moves to the right far enough to break its engagement with the blade 81 and is then retained in a shoulder 150 of the non-conducting block 146 by the downward movement of the blade 81. The separation of blades 81 and 82 will interrupt the flow of current to the ignition, shunt 128 of relay 63, shunt winding 109 of reverse current relay 91, heating coil 135 of the cranking cut-out 136, the fuel pre-heating coil 130 and the coil 92 of starting switch 93. When coil 92 is deenergized the armature 94 will descend by gravity to separate contact 95 from contact 96, thus the starting circuit will be interrupted.

During normal operation, when the prime mover becomes self-operative and attains a certain speed the dynamo will function as a differentially wound generator, the current flowing from the dynamo to the battery over the cranking circuit. The current flowing through the series winding 90 of the reverse current relay 91 will be reversed from that during cranking, since this winding is in series with the dynamo 22 and battery 45 and in series with the work circuit 48. This causes a reversal of magnetism in the relay side plates 105 and 106, and consequently the like pole of the armature side plates 115 and 116 will be moved away from the like pole of the relay side plates causing the armature 108 to pivot and to separate contact 120 from contact 121 and cause contact 155 to engage a contact 156. Thus the flow of current through the pre-heater 130, heating coil 135 and winding 128 of relay 63 will be interrupted, the contacts 76 and 77 of relay 63 then being controlled entirely by the winding 62.

The closing of contacts 155 and 156 allows current to flow from the dynamo 22 to a magnet coil 160 of a series shorting switch 161. The switch 161 also includes armature 162 which carries a contact 163. The energizing of coil 160 will draw the armature 162 upwardly to engage contact 163 with a contact 164. The current from the dynamo through the magnet coil 160 is as follows: dynamo 22, wire 102, series winding 25, wire 101, magnet coil 100, wire 50, wire 80, blades 81 and 82, wire 83, contacts 77 and 76, wire 85, side plates 106, wire 125, contacts 155 and 156, wire 165, magnet coil 160, wire 138, contacts 95 and 96, wire 103 to the other side of the dynamo.

The closing of contacts 163 and 164 allows current to flow from the brush 24 of the dynamo 22 through the wire 167, contacts 163 and 164, wire 168, and wire 51 which joins with wire 50 and thus short-circuits the series field 25 of the dynamo 22 and the choke coil 100 of the control 40 since the circuit just described offers less resistance than the circuit through the series field 25 and coil 100.

The dynamo 22 then functions as a shunt wound generator and supplies current to the translating devices or lights 60 in the work circuit 48 and supplies charging current to the battery 45. The flow of current from the dynamo 22 through the work circuit is as follows: dynamo 22, wire 167, contacts 163 and 164, wire 168, wire 52, magnet coil 53 of the throttle control 41, wire 55, contacts 57 and 58, service main 59, translating devices 60, service main 61, current coil 62 of relay 63, wire 65, wire 66, series winding 90, wire 89, contacts 95 and 96 and wire 103. The flow of current from the dynamo 22 through the battery charging circuit is as follows: dynamo 22, wire 167, contacts 163 and 164, wire 168, wire 51, wire 50, battery 45, wire 66, series winding 90, wire 89, contacts 95 and 96 and wire 103.

When the dynamo 22 is operative to supply current to the battery 45 and work circuit 48, the control 41 functions to regulate the speed of the prime mover 20 to drive the dynamo 22 to supply current in accordance with the demand for current by the work circuit 48. The control 41 includes the winding 53, a plunger 170 operatively connected with the throttle 39, a spring 171 interposed between a control housing 172 and the plunger 170, and a weight 173. Current flowing through the winding 53 tends to draw the plunger upwardly to open the throttle, while the spring 171 tends to oppose the winding 53 to move the plunger 170 downwardly to close the throttle. As the current through the winding 53 increases the ampere turns are thereby increased, consequently the magnetic effect of the winding 53 will be increased sufficiently

to move the plunger 170 upwardly to open the throttle to such an extent as will be necessary to accelerate the prime mover 20 to drive the dynamo 22 to supply current in accordance with the demand by the work circuit. As the flow of current through the winding 53 is decreased the opposing force of the spring 171 will be sufficient to move the plunger 170 downwardly to close the throttle proportionally to the load demand. The weight 173 is adapted to slightly overbalance the weight of the plunger 170 and hold the same in contact with the spring 171 when the winding 53 is deenergized. By this arrangement the plunger will be moved upwardly or downwardly by a steady movement depending upon the increase or decrease of current in the winding 53. Since the winding 53 is disposed in the supply circuit to the service mains, the speed of the prime mover will be controlled automatically in accordance with the demand of the work circuit.

In the event there is no demand for current by the work circuit 48 and it is desired to operate the system, for example, to supply a charging current to the battery 45, an actuating and locking device 175 may be manually operated to engage contact 76 with contact 77 to complete the necessary electrical circuits for starting the prime mover and for simultaneously opening the throttle valve to a predetermined position to accelerate the prime mover to the proper speed for driving the dynamo 22 to supply a battery charge of a proper value to the battery 45. As illustrated diagrammatically the device 175 includes a shaft 176, lever 177 which is pivoted at 178, and a locking clasp 180. The downward movement of the lever 177 will cause the shaft 176 to urge the armature 175 upwardly to close the contacts 76 and 77. The upward movement of the shaft 176 will cause a hooked end 181 thereof to engage the oscillating member 182 to thus open the throttle to a predetermined position. The locking clasp 180 is adapted to receive the lever 177 to prevent contact 76 from becoming separated from contact 77.

In actual construction the device 175 is constructed preferably as shown in Figs. 2, 3, 4 and 5. The lever 177 is rigidly secured to the shaft 176 by the screw 185. The shaft 176 is journaled freely at one end in a bushing 187 and at the other end in a mounting 190 which mounting is secured to a switch board cover 191, which houses the switches and relays shown in Fig. 1, by bolts 192. The bushing 187 which holds the shaft 176 on one end in rigidly secured to the oscillating member 182, preferably by a pressed fit. On the opposite end of the bushing 187 there is rigidly secured a throttle shaft 195 by the screw 196. The shaft 195 is journaled in a bearing 197 which is formed integral with an intake manifold 198, and is adapted to rotate to regulate the throttle 39 by a movement of the member 182.

In house lighting plants it has been found very desirable to have the throttle control located in the supply circuit, and in this manner control the throttle in accordance with the load demand in the work circuit. By this arrangement, however, the throttle will be maintained in a partially closed position when there is no demand for current by the work circuit, the throttle being maintained in such position in order that the same may be opened proportionately as the demand for current by the work circuit increases. Thus I have provided the device 175 for rendering the system operative when there is no demand for current by the work circuit for causing automatic operation thereof, and at the same time to open the throttle to a predetermined position. On the downward movement of the lever 177 it will engage a push-rod 200 which is operatively connected with the armature 75 by a non-conducting member 201. As the lever 177 engages the rod 200 the armature 75 will be moved upwardly to move the contact 76 into engagement with the contact 77. Thus the starting circuit will be complete as previously described and the plant will be operating with the device 175 in the position shown in Fig. 4. Also, as the lever 177 is moved downward the shaft 176 will rotate causing a pin 204 carried thereby to engage a pin 205 which pin is stationary with the oscillating member 182. By this movement the pin 204 will move the pin 205 upwardly to move the member 182 to thereby rotate the throttle shaft 195 to a predetermined point. In this manner the throttle 39 will be opened to a predetermined position. However, further opening of the throttle is not retarded by this device, the winding 53 of the control 41 being responsive to the demand for current, in the event there is a demand for current at this time, and will open the throttle further to accelerate the prime mover in the event the demand is such that would necessitate the opening of the throttle to a position greater than the position obtained by the operation of the device 175.

In order to maintain the plant in operating condition, the mounting 191 is provided with a recessed portion 210. As the lever 177 moves downwardly a spring 211 will tend to move the lever toward the recessed portion, and cause the lever to be received therein when it is in its lowermost position. In this manner the contacts 76 and 77 will be maintained closed and the system will remain operative to supply a charging current of a proper value to the battery 45.

In the event it is desired to render the

system inoperative, the lever 177 may be moved to the left as viewed in Fig. 5, to thereby clear the recessed portion 210 and then moved upwardly until it is in the position shown in Figs. 2 and 5. When this occurs the armature 75 will descend by gravity to move the rod 200 to the right, as viewed in the drawing, thereby separating contact 76 from contact 77 to render the system inoperative in the manner previously described provided, of course, that there is no demand in the work circuit.

From the foregoing description it will be noted that I have provided an electrical generating system which will be rendered automatically operative by a demand for current by the work circuit to supply current to the work circuit and to the storage battery. I have also provided a single manually operated device which is adapted to render the system operative and for opening the throttle valve to a predetermined position in the event there is no demand for current by the work circuit for automatically rendering the system operative and for automatically controlling the throttle valve. In this manner the storage battery may be supplied with charging current of a proper value at any desired time.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. An electrical generating system comprising in combination a prime mover, a throttle valve for the prime mover, automatic means adapted for rendering the prime mover operative and for controlling the operation of said throttle valve, and a single manually operated device adapted to be actuated for rendering the prime mover operative and for actuating said throttle valve, said manually operated device being adapted when actuated for rendering the prime mover operative to at least partially prevent said automatic means from controlling said throttle valve.

2. An electrical generating system comprising in combination a prime mover, a throttle valve for the prime mover, a control circuit, a switch in said circuit, automatic means adapted to close said switch for rendering the prime mover operative and for controlling the operation of said throttle valve, and a single device adapted to be manually actuated for closing said switch and for actuating said throttle valve, said manually operated device being adapted when actuated for rendering the prime mover operative to at least partially prevent said automatic means from controlling said throttle valve.

3. An electrical generating system comprising in combination a prime mover, a throttle valve for the prime mover, a work circuit, electrical apparatus adapted to be driven by the prime mover for supplying current to the work circuit, means responsive to a demand for current by the work circuit for automatically rendering the prime mover operative and for controlling the operation of said throttle valve, and a single manually operated device for rendering the prime mover operative and for actuating said throttle, said manually operated device being adapted when actuated for rendering the prime mover operative to at least partially prevent said means from controlling said throttle valve.

In testimony whereof I hereto affix my signature.

WILLIAM C. WELLS.