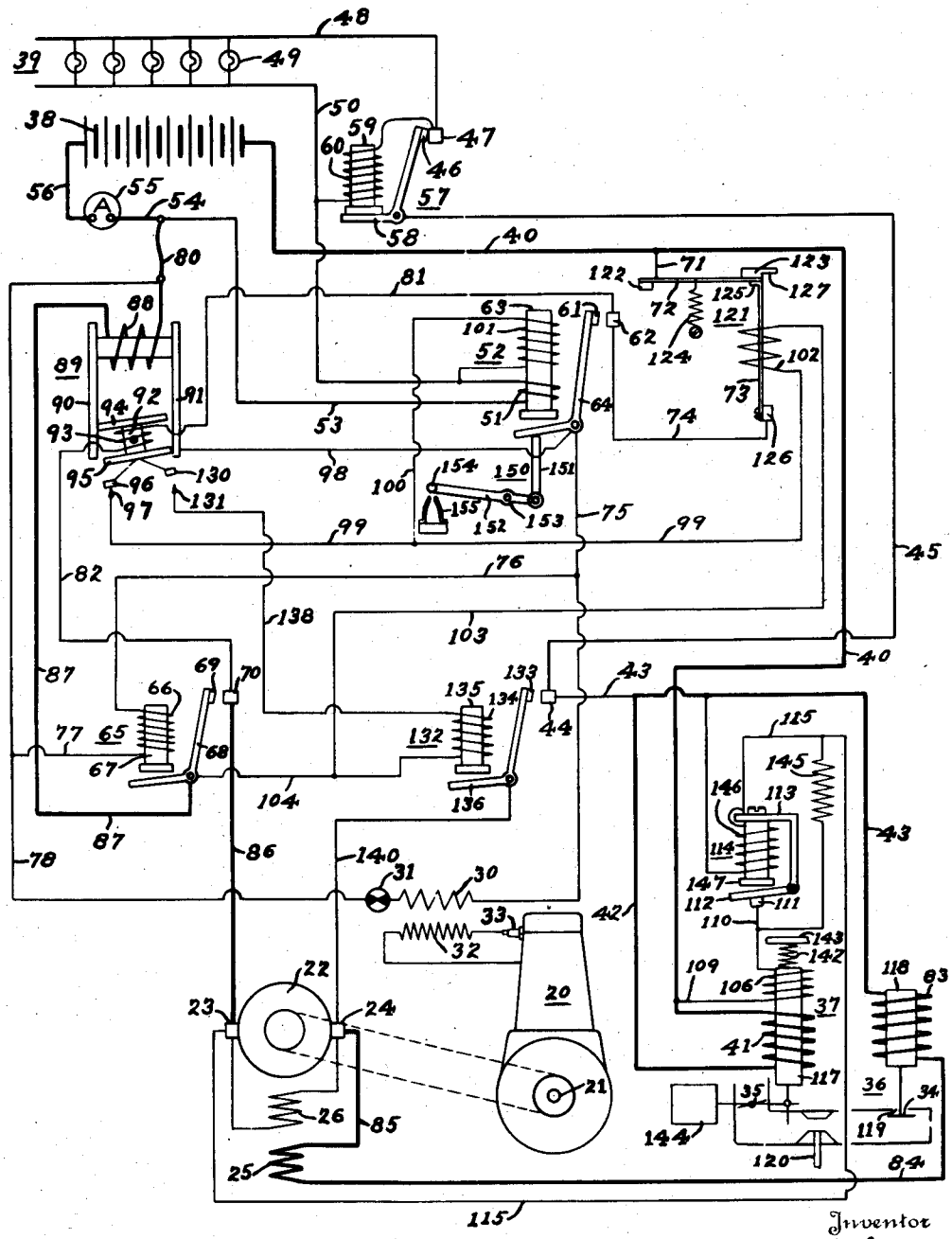
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ELECTRICAL APPARATUS

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ELECTRICAL APPARATUS

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This invention relates to electrical systems of the type which include a prime mover, electrical apparatus adapted to be driven by the prime mover, and more particularly to the automatic control for such systems.

One of the objects of the present invention is to provide improved means for regulating the output of the electrical apparatus adapted to be driven by the prime mover in accordance with a load demand on a work circuit supplied by the electrical apparatus.

Another object is to provide improved means for regulating the speed of the prime mover in accordance with the mechanical load demand upon the prime mover.

Another object is to provide improved means for protecting a storage battery from an over-charge of current and for preventing the burning out of lights on a service line; and this may be accomplished by voltage responsive means adapted to control the output of the electrical apparatus.

Another object is to provide improved means for starting a prime mover, preferably an internal combustion engine, and this may be accomplished by opening a throttle therefor relatively wide during cranking of the engine.

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

In the drawing:

The figure in the drawing is a wiring diagram illustrating the present invention.

In the drawing 20 designates a prime mover herein shown as an internal combustion engine having a shaft 21 which drives the electrical apparatus or dynamo 22 having main brushes 23 and 24 connected with 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 with an engine spark plug 33.

A choke 34 for forming a proper mixture of gasoline and air for starting the prime mover, and a throttle 35 for regulating the speed of the prime mover, are adapted to be actuated by the controls 36 and 37 respectively.

The dynamo 22 is adapted to rotate the shaft 21 of the prime mover 20, when acting as a starting motor, receiving current from the storage battery 38. During the starting of the prime mover 20 the current through the series winding 25 is large enough to produce a sufficient starting torque for cranking the prime mover.

When the load demand on the service line 39 is less than a predetermined value, the storage battery 38 is adapted to supply such demand. The current to the line 39 will flow from the battery 38 through the following circuit: battery 38, wire 40, series winding 41 of the control 37, wire 42, wire 43, contact 44, wire 45, contacts 46 and 47, wire 48, translating devices or lights 49, wire 50, series winding 51 of a starting switch relay 52, wire 53, wire 54, ammeter 55 and wire 56. A low voltage cutout 57 is adapted to break the engagement of contacts 46 and 47 when the voltage of the battery 38 is less than a predetermined low value. The low voltage cutout 57 includes a pivoted armature 58 which carries the contact 46, a metal core 59 and a magnet coil 60 having its ends connected across the line 39. When the voltage of the battery is less than a predetermined low value, the coil 60 will not magnetize the core 59 sufficiently to hold the armature 58. This causes the armature to descend by gravity to separate contact 46 from contact 47, thereby interrupting the flow of current from the battery 38 to the line 39.

When there is a load demand for current

on the line 39 in excess of a predetermined value, for example 9 amperes, the starting switch relay 52 operates in response to such demand to engage contact 61 with contact 62. The closing of contacts 61 and 62 allows current to flow from the battery 38 to the various circuits necessary for rendering the prime mover 20 automatically operative to drive the dynamo 22 to supply current to the line 39 and battery 38. The starting switch relay 52 includes the series winding 51, a metal core 63 and a pivoted armature 64 which carries the contact 61. The current flowing from the battery 38 through the winding 51 to furnish the excess demand of the line 39 magnetizes the core 63 sufficiently to cause the core to draw the armature 64 to the core, thereby closing contacts 61 and 62. The closing of contacts 61 and 62 allows current to flow from the battery 38 to a coil 66 of starting switch 65. The starting switch 65 includes a magnet coil 66, a metal core 67, and a pivoted armature 68 which carries a contact 69. The current flowing from the battery 38 through the coil 66 magnetizes the core 67 to draw the armature 68 upwardly to the core 67 to engage contact 69 with a contact 70. The circuit from the battery 38 through the coil 66 is as follows: battery 38, wire 40, wire 71, bi-metallic blade 72, bi-metallic thermostatic blade 73, wire 74, contacts 62 and 61, wire 75, wire 76, coil 66, wire 77, wire 78, fuse 80, wire 54, ammeter 55, wire 56. The closing of contacts 69 and 70 establishes a cranking circuit between the battery and dynamo which is as follows: battery 38, wire 40, series winding 41 of the control 37, wire 42, wire 43, winding 83 of the control 36, wire 84, series field winding 25, wire 85, dynamo 22, wire 86, contacts 70 and 69, wire 87, series winding 88 of a reverse current relay 89, fuse 80, wire 54, ammeter 55 and wire 56. The current flowing through the series winding 88 of the reverse current relay 89 during cranking is adapted to magnetize the frame of relay 89 including side plates 90 and 91 whereby said plates 90 and 91 will be north and south poles respectively. The relay 89 also includes a rocking armature 92 having a shunt winding 93, which winding is connected across the battery 38. The circuit from the battery 38 through the shunt winding 93 is as follows: battery 38, wire 40, wire 71, blade 72, blade 73, wire 74, contact 62, wire 81, shunt winding 93, wire 82, contacts 70 and 69, wire 87, series winding 88, fuse 80, wire 54, ammeter 55 and wire 56. The armature 92 includes side plates 94 and 95 which plates are adapted to be magnetized north and south poles respectively by said shunt winding 93. When the current flows through the series winding 88 during cranking, like poles of the relay frame and armature will repel to cause the rocking armature 92 to be tipped to the left, as viewed in the drawing, thereby engaging contact 96 with contact 97.

The closing of contacts 96 and 97 allows current to flow from the battery through the following circuit: battery 38, wire 40, wire 71, blades 72 and 73, wire 74, contacts 62 and 61, wire 98, side plate 91 of the relay 89, armature 92, contacts 96 and 97, wire 99, wire 100, a shunt winding 101 of the starting switch relay 52 and also allows the current to flow through the heating coil 102, wire 103, wire 104, wire 87 winding 88, fuse 80, wire 54, ammeter 55, and wire 56. During cranking operation the current flows through the shunt winding 101 to cooperate with the series winding 51 in holding the armature 64 to the core 63 to insure complete closing of the contacts 61 and 62.

The control 37 also includes a shunt winding 106, which winding is connected across the battery 38. The circuit from the battery 38 through the shunt winding 106 is as follows: battery 38, wire 40, wire 109, shunt winding 106, wire 110, contact 111, armature 112 and frame 113 of a voltage limiting relay 114, wire 115, wire 86, contacts 70 and 69, wire 87, winding 88, fuse 80, wire 54, ammeter 55 and wire 56. When the prime mover 20 is cranking, the current from the battery flows through the series winding 41 and the shunt winding 106 in the same direction. During cranking and when the current is flowing in the same direction in the two windings 41 and 106, the series winding is adapted to cooperate with the shunt winding to raise the control plunger 117 upwardly to open the throttle 35, said plunger being operatively connected with the throttle 35. The combined effort of these two windings tends to open the throttle 35 to its fullest extent which is desirable for good starting. The flow of current through the magnet coil 83 of the control 36 tends to raise the control plunger 118 upwardly, which plunger carries the choke 34. The upward movement of the plunger 118 will cause the choke 34 to shut off the air passage 119, thus allowing a greater volume of gasoline to pass through the pipe 120 and into a carburetor. The control 36 is adapted to function for a short interval during starting operation, namely, only when a heavy demand is made on the battery 38 during cranking, and is rendered inoperative after the prime mover becomes self-operative.

The closing of contacts 61 and 62 will connect the ignition primary coil 30 with the battery 38 through the following circuit: battery 38, wire 40, wire 71, blade 72, blade 73, wire 74, contacts 62 and 61, wire 75 ignition primary coil 30, timer 31, wire 78, fuse 80, wire 54, ammeter 55, and wire 56. Thus the prime mover 20 will be started by supplying ignition thereto and cranking by the starting series field 25 of the dynamo 22.

If the prime mover 22 should not start

within a certain length of time, abnormal discharge of the battery is prevented by a cranking cutout 121 which includes the bi-metallic blade 72. The blade 72 is fixed at 122 and has a non-conducting block 123 secured thereto. The blade 72 is urged downwardly by the spring 124 to engage the flanged end 125 of the bi-metallic thermostatic blade 73, said thermostatic blade being fixed at 126. The thermostatic blade 73 is in heat receiving relation to the heating coil 102. While the engine is cranking current is passing through this resistance unit, as previously described, and subjects the blade 73 to an increase of temperature. If the cranking of the engine should continue for an abnormal period, for example one to two minutes, the thermostatic blade 73 will be heated sufficiently to cause it to bow to the right, as viewed in the drawing, until the flanged end 125 moves to the right far enough to break its engagement with the blade 72 and is then retained in a shoulder 127 on the non-conducting block 123 by the downward movement of the blade 72. The separation of blades 72 and 73 will interrupt the flow of the current to the heating coil 102 of the cranking cut-out 121, to the ignition coil, and to the coil 66. When coil 66 is deenergized, the armature 68 will descend by gravity to separate contact 69 from contact 70. 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 88 of the reverse current relay 89 will be reversed from that during cranking, since this winding is in series with the dynamo 22 and battery 38. This causes a reversal of magnetism in the relay side plates 90 and 91, and consequently the like pole of the armature side plates will be moved away from the like pole of the relay side plates and the unlike pole of the armature will be attracted to the unlike pole of the relay side plates causing the armature 92 to pivot and to separate contact 96 from contact 97 and cause contact 130 to engage contact 131. Thus the flow of current through the heating coil 102 and winding 101 of relay 52 will be interrupted, the contacts of relay 52 being then controlled entirely by winding 51.

The closing of contacts 130 and 131 allows current to flow from the dynamo 22 to a series shorting switch 132 which is adapted to engage contact 133 with contact 44. The series shorting switch 132 includes magnet coil 134, a metal core 135 and a pivoted armature 136 which carries the contact 133. The current from the dynamo 22 through the magnet coil 134 is as follows: dynamo 22, wire 85, winding 25, wire 84, coil 83, wire 43, wire 42, winding 41, wire 40, wire 71, blade 72, blade 73, wire 74, contacts 62 and 61, wire 98, armature 92, contacts 130 and 131, wire 138, coil 134, wire 104, wire 87, winding 88, fuse 80, wire 54, ammeter 55, and wire 56.

The closing of contacts 133 and 44 allows the current to flow from the brush 24 of the dynamo 22 through the wire 140 to contact 44, and thus short circuits the series field 25 of the dynamo 22 and the choke coil 83 of the control 36, since the wire 140 offers less resistance than the circuit through the series field 25 and coil 83.

The dynamo then functions as a shunt wound generator and supplies current to the translating devices 49 in the work circuit and supplies charging current to the battery 38. The flow of current from the dynamo 22 through the work circuit is as follows: dynamo 22, wire 140, contacts 133 and 44, wires 45, contacts 46 and 47, wire 48, translating devices 49, wire 50, winding 51, wire 53, fuse 80, series winding 88, wire 87, contacts 69 and 70 and wire 86. The flow of current from the dynamo 22 through the battery charging circuit is as follows: dynamo 22, wire 140, contacts 133 and 44, wire 43, wire 42, series winding 41, wire 40, battery 38, wire 56, ammeter 55, wire 54, fuse 80, series winding 88, wire 87, contacts 69 and 70, and wire 86.

When the dynamo 20 is operative to supply current to the battery 38 and the line 39, the flow of current through the series winding 41 of the control 37 is reversed from that during cranking. The series winding 41 then tends to draw the plunger 117 downwardly to close the throttle 35. Since the shunt winding 106 of the control 37 is connected across the battery the current always flows through this winding in the same direction, therefore the shunt winding 106 will always tend to raise the plunger 117 upwardly to open the throttle 35. In actual practice the series winding 41 is wound around the shunt winding 106, but for the sake of illustration the shunt winding 106 is shown above the series winding 41.

The control 37 also includes a coiled spring 142, interposed between the upper portion of the plunger 117 and the control housing 143, and includes a weight 144. The shunt winding 106 in tending to raise the plunger 117 upwardly, opposes the tension of the spring 142. The weight 144 is arranged to slightly overbalance the plunger 117 and hold same in contact with the spring 142 when the windings 106 and 41 are deenergized. The spring 142 in opposing the shunt winding 106 will prevent the plunger 117 from remaining near the top of the housing 143 until a decided turn of current would take place in the series winding 41. By this arrangement the

plunger 117 will be moved upwardly or downwardly by a steady movement, depending upon the decrease or increase of current in the series winding 41, which movement will be described more fully hereinafter.

The throttle 35 is adapted to be set for causing the prime mover 20, during its operation, to drive the dynamo 22 to supply a trickle charge of a predetermined value to the battery 38, for example 15 amperes, when there is no load on the line 39. Since the throttle 35 is operatively connected with the plunger 117, the setting of the throttle 35 is made with respect to the balancing point of the plunger 117, which balancing point is affected by the 15 amperes flowing through the series winding 41 which tends to draw the plunger 117 downwardly and the shunt winding 106 tending to oppose the series winding 41 until the plunger is balanced.

When the dynamo 22 is operative to supply a trickle charge of 15 amperes to the battery, the placing of a load demand on the line of approximately 10 amperes, for example, will reduce the trickle charge to the battery to approximately 5 amperes since the battery charging circuit and the work circuit are connected in parallel, and because the work circuit offers less resistance than the circuit through the battery 38. The series winding 41 of the control 37 being connected in the battery charging circuit, a reduction of trickle charge will reduce the ampere turns in this winding. The shunt winding 106 of the control 37, being connected across the battery 38, the ampere turns of this winding will remain substantially constant. By reducing the magnetic strength of the series winding 41 when such load is added across the line, the shunt winding 106 will tend to raise the plunger to a point above the balancing point obtained as previously described. This upward movement of the plunger 117 opens the throttle to such extent as will cause the prime mover 20 to drive the dynamo 22 to supply current in accordance with the load demand on the line 39 and provide for a proper trickle charge to the battery 38.

If the spring 142 or its equivalent were not provided and if an increase across the line 39 be applied, the plunger 117 would be raised quickly by the magnet winding 106 opening the throttle to its fullest extent causing the engine to race. Then a heavy current would be impressed on series winding 41 which tend to close the throttle 35 and decrease the speed of the prime mover. In other words, the flow of current would fluctuate considerable and affect the load across the line and the charge to the battery. The spring 142 resists the upward movement of the plunger 117 so that the speed of the engine is gradually increased to its necessary speed and thus remains at the desired position. The arrangement of the throttle control including the spring 142 is such that the charge to the battery gradually decreases as the load across the line increases, the spring 142 gradually increases its opposing force to the shunt winding 106 as the load on the line increases.

As the load demand on the line 39 is reduced the trickle charge immediately increases and the strength of the series winding 41 increases and tends to close the throttle 35 until the speed of the prime mover 20 is just enough to drive the dynamo 22 to furnish the proper trickle charge to the battery and the load demand to the line 39. Thus the series winding 41 opposes the shunt winding 106 to properly regulate the speed of the prime mover 20, the output of the dynamo 22 and the flow of current through the battery charging circuit and the work circuit in accordance with the load demand on the work circuit.

When it is desired to set the throttle 35 for allowing a trickle charge of a predetermined value to the battery 38 and there is no load demand on the line 39 for rendering the prime mover 20 operative, a locking device 150 may be manually operated to engage contact 61 with contact 62 to complete the necessary electrical circuits for starting the prime mover 20. The locking device 150 includes a plunger 151, cross rod 152 which is pivoted at 153, said cross-rod having an arm 154 secured thereto, and a locking clasp 155. The downward movement of the arm 154 will cause the plunger 151 to urge the armature 64 upwardly to engage contact 61 with contact 62. The locking clasp 155 is adapted to receive the arm 154 on its downward movement, and will retain the arm 154 to hold the device in position to prevent contact 61 from becoming separated from contact 62.

The locking device 150 is also used to complete the necessary electrical circuits for rendering the prime mover 20 operative to drive a mechanical load.

When there is a mechanical load applied on the prime mover 20 during its operation, the speed of the prime mover will be reduced in accordance with such load demand, thereby reducing the output of the dynamo 22 and consequently the value of the current through the series winding 41. By reducing the value of the current through the series winding 41 the ampere turns of this winding will be reduced. Thus the shunt winding 106 will tend to raise the plunger 117 to open the throttle 35 to accelerate the prime mover 20 in accordance with the mechanical load demand on the prime mover. As the load demand reduces the speed of the prime mover will immediately increase. As the speed of the prime mover 20 is regulated in accordance with the mechanical load demand, likewise the output of the dynamo will be regulated to supply a charging current to the battery

38. By a mechanical load is meant the operation of a work machine such as a feed grinder or water pump directly by the shaft 21 of the prime mover 20.

The voltage limiting relay 114 is adapted to automatically operate in response to a predetermined voltage of the battery 38 to place a resistance 145 in series with the shunt winding 106 of the control 37 in order to decrease the speed of the engine when the battery voltage is relatively high. The voltage limiting relay 114 includes the frame 113 having the pivoted armature 112 connected therewith, a magnetic coil 146 having its ends connected across the battery 38 and a metal core 147. When the voltage of the battery attains a predetermined high value the current in the coil 146 will magnetize the core 147 sufficiently to draw the pivoted armature 112 upwardly, thereby disengaging the armature 112 from the contact 111. The disengagement of the armature 112 from the contact 111 places the resistance 145 in series with the shunt winding 106. This resistance 145 tends to decrease the effectiveness of the shunt winding 106 causing the engine to be throttled to a certain extent, and thereby limit the speed of the prime mover and consequently limit the output of the dynamo 22 and prevents a high voltage from being impressed across the battery and work circuit.

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 for said prime mover, a storage battery, electrical apparatus, a circuit between the battery and electrical apparatus, said electrical apparatus being adapted to be driven by said prime mover for supplying current to said circuit, a shunt winding connected across the battery tending to open said throttle, and voltage responsive means for controlling the effectiveness of said winding.

2. An electrical generating system comprising in combination a prime mover, a throttle for said prime mover, a storage battery, electrical apparatus operatively connected with the prime mover, a circuit between the battery and electrical apparatus, and an electromagnet for controlling said throttle, said electromagnet including a shunt winding connected across the battery tending to open said throttle.

3. An electrical generating system comprising in combination a prime mover, a throttle for said prime mover, a storage battery, electrical apparatus operatively connected with the prime mover, a circuit between the battery and electrical apparatus, said electrical apparatus being adapted to be driven by said prime mover for supplying current to said circuit, and an electromagnet for controlling said throttle, said electromagnet including a shunt winding connected across the battery and tending to open said throttle and a series winding connected in said circuit opposing said shunt winding and tending to close said throttle.

4. An electrical generating system comprising in combination a prime mover, a throttle for said prime mover, a storage battery, electrical apparatus, a circuit between said battery and electrical apparatus for supplying current to said apparatus for rendering said prime mover operative, and an electromagnet for controlling said throttle including a shunt winding connected across said battery and tending to open said throttle and a series winding connected in said circuit cooperating with said shunt winding and tending to open said throttle when current is being supplied to said electrical apparatus.

5. An electrical generating system comprising in combination a prime mover, a throttle for said prime mover, a storage battery, electrical apparatus, a circuit between said battery and electrical apparatus for supplying current to said apparatus for rendering said prime mover operative to drive said electrical apparatus to supply current to said circuit, and an electromagnet for controlling said throttle including a shunt winding connected across said battery and tending to open said throttle, and a series winding connected in said circuit cooperating with said shunt winding and tending to open said throttle when current is being supplied to said electrical apparatus, said series winding opposing said shunt winding and tending to close said throttle when current is being supplied to said circuit.

6. An electrical generating system comprising in combination a prime mover, a throttle for said prime mover, a storage battery, electrical apparatus operatively connected with the prime mover, a circuit between the battery and electrical apparatus, said electrical apparatus being adapted to be driven by said prime mover for supplying current to said circuit, an electromagnet for controlling said throttle including a shunt winding connected across the battery and tending to open said throttle, and a series winding connected in said circuit opposing said shunt winding and tending to close said throttle, and voltage responsive means for controlling the effectiveness of said shunt winding.

7. An electrical generating system comprising in combination a prime mover, a throttle for said prime mover, a storage battery, electrical apparatus, a circuit between the battery and electrical apparatus, said electrical apparatus being adapted to be

driven by said prime mover for supplying current to said circuit, an electromagnet for controlling said throttle, said electromagnet including a shunt winding connected across said battery and tending to open said throttle, a resistance adapted to be connected in series with said shunt winding for controlling the effectiveness of said winding, and voltage responsive means for controlling said resistance.

In testimony whereof we hereto affix our signatures.

ERNEST DICKEY.
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