

M. C. COSGRAY.
ENGINE CONTROLLER.
APPLICATION FILED JAN. 28, 1918.

1,397,503.

Patented Nov. 22, 1921.

3 SHEETS—SHEET 1.

Fig. 1.

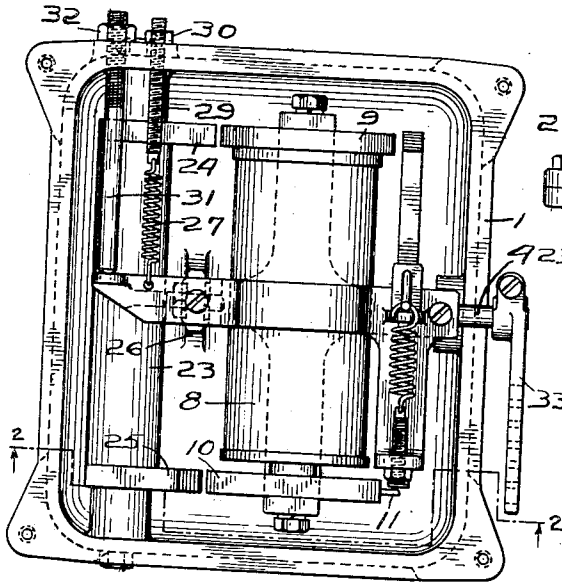


Fig. 2.

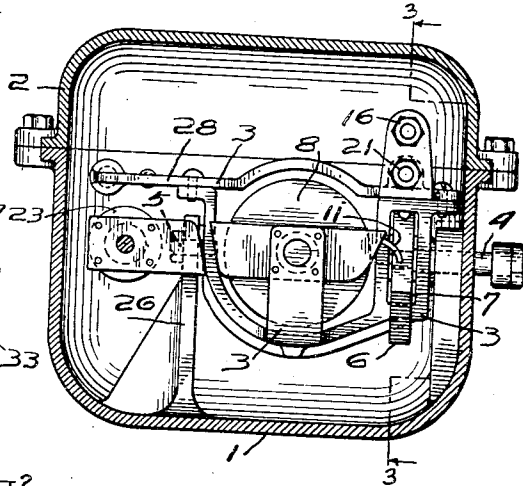


Fig. 3.

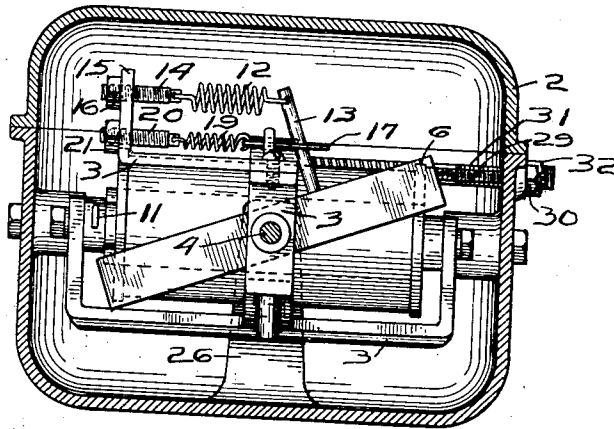
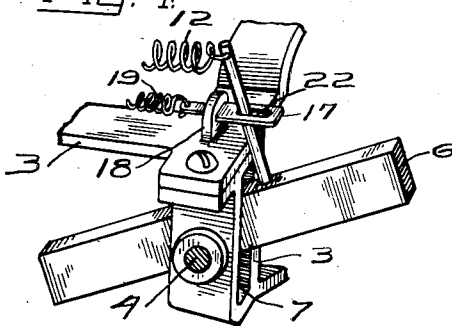


Fig. 4.



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3 SHEETS—SHEET 2.

Fig. 6.

The graph plots Battery Charging Current (Y-axis) against Load Current (X-axis). The Y-axis ranges from 0 to 30, and the X-axis ranges from 0 to 50. Two solid lines represent the charging current limits. Dashed lines illustrate the effect of varying a parameter, with a horizontal dashed line at 5 and a diagonal dashed line from (10, 5) to (25, 0). A schematic of a battery is shown in the top right corner.

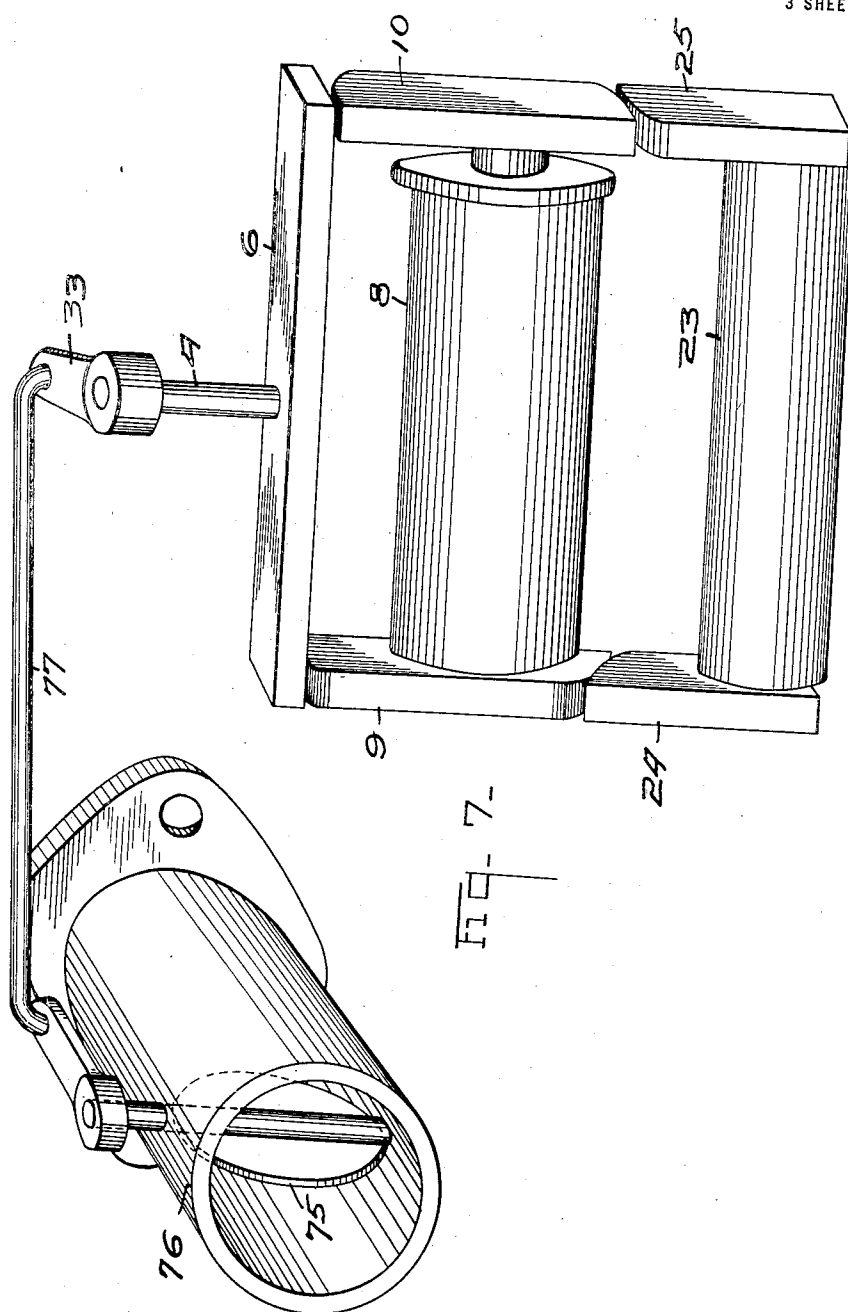
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3 SHEETS—SHEET 3.



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ENGINE-CONTROLLER.

1,397,503.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, MARK C. COSGRAY, a citizen of the United States, and a resident of Sandusky, in the county of Erie and State of Ohio, have invented a certain new and useful Engine-Controller; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the characters of reference marked thereon, which form a part of this specification.

My invention relates to means for electrically controlling the output of an engine. It particularly has for its object to provide a means which will not only control the speed of the engine but also to regulate the supply of fuel to the engine according to the load that is placed on the engine.

The invention also has for its object to provide in a system having an engine driven dynamo and another source of electrical supply, a means whereby the engine will be caused to carry a certain load that may be placed on the system and prevent the other source of supply from carrying the load until the load maintained by the engine reaches a predetermined amount. The invention is particularly applicable to a system where the current is supplied by a dynamo operated by an engine and by a storage battery, the storage battery being charged under certain conditions by the dynamo.

The engine regulator may partake of different forms and the details of construction may be greatly varied and yet such modifications may still contain the invention. It may also be used in connection with a great variety of electric systems for regulation of the supply current and other purposes for which the invention is particularly adapted. I have selected as an illustration one form of construction containing the invention and shall describe it hereinafter. The construction selected is illustrated in the accompanying drawings.

Figure 1 of the drawing illustrates a front view of the construction selected, the cover of the case in which the construction is inclosed, being shown removed. Fig. 2 is an end view of the construction partly in section taken along the lines 2-2 of Fig. 1. Fig. 3 is a side view also partly in section taken along the line 3-3 indicated in Fig.

2. Fig. 4 is a perspective view showing the adjustable resilient members that control the operation of one of the elements of the construction. Fig. 5 is a diagram of the system containing my invention. Fig. 6 is a diagrammatic illustration of the performance of the regulator in an electric system such as that illustrated in Fig. 5. Fig. 7 illustrates diagrammatically the relative positions of the butterfly valve of the engine to the movable elements of the controller.

1, Fig. 1, is an inclosing shell or case of non-magnetic material, which may be provided with a cover 2 that is secured by a suitable means on the shell 1. 3 is a frame which is pivotally supported in the shell on a pin 4 that extends through a wall of the shell, and a pin 5 that is located in a bracket 26. An armature 6 is pivotally supported in the frame 3 for pivotal movements independent of the pivotal movement of the frame 3. The armature is located in a slot 7 formed in the frame 3 and is keyed to the pin 4. A magnet 8 having poles 9 and 10 is secured in the frame 3. The frame 3 is formed of suitable non-magnetic material to prevent short-circuiting of the lines of force of the magnet. The armature 6, when the magnet 8 is energized, moves in a plane extending across the poles of the magnet. The ends of the poles extending toward the armature terminate in inclined surfaces to produce movements of the armature according to the intensity of the magnetization and to prevent concentration of the magnetization at certain points which would otherwise decrease the responsiveness of the armature. The armature is limited in its movements by a suitable stop such as the pin 11 which is secured in one of the poles of the magnet 8. To prevent sticking of the armature, the pin 11 is made of suitable non-magnetic material. To counteract the effect of the magnetization of the magnet 8, a spring 12 is provided which is secured to an arm 13 that protrudes from the armature 6 and to a threaded pin 14, that is threaded into an ear 15 formed on the frame 3. For securing the threaded member 14 in place, a nut 16 may be threaded onto the threaded member 14 and screwed against the ear 15. To prevent disproportionate rotation of the armature relative to the poles of the magnet when the armature approaches the magnet beyond a certain point, a means is provided so that it will operate to counteract the effect of mag-

netization when the armature has rotated beyond a certain degree. This is accomplished by means of a slotted strip 17 through which the arm 13 extends. A spring 19 connects the slotted strip 17 with a threaded pin 20 which also is threaded into the ear 15 and is secured in position by a nut 21. When the armature 6 moves beyond a certain degree in its rotation, the arm 13 strikes the outer end of the slot 22 located in the strip 17 and upon further rotation the armature pulls against the springs 12 and 19 until the armature 6 strikes the stop 11.

The frame 3 is also rotated in the shell 1 by means of a magnet 23 having poles 24 and 25 which extend toward the poles 9 and 10 of the magnet 8. The coacting poles 9, 24 and 10, 25, also terminate in ends having inclined surfaces to permit extended rotation of the frame relative to the distance that the poles move toward each other and also to prevent concentration of magnetism at certain points which would otherwise cause uneven pull between said poles. The coils 8 and 23 may be so wound as to produce attraction between the poles or to produce repulsion. In the form of the construction shown, the magnets are so wound that attraction is produced between the poles.

The magnet 23 causes rotation of the frame 3 counter to the rotation of the armature 6 produced by the magnet 8. The position of the armature 6 relative to the frame 3 being determined by the magnet 8 and the springs 12 and 19, the magnet 23 also causes movement of the armature 6 relative to the shell or case 11, in that it moves with frame 3 as a whole. Frame 3 is moved by attraction between poles 24, 9 and 25, 10. The action of the magnet 23 is countered by the spring 27 which is connected to an arm 28 forming a part of the frame 3 and to a threaded pin 29 that is threaded into the case 1. A nut 30 may be threaded on to a pin 29 to secure the threaded pin 29 into position. A stop pin 31 may also be threaded in the casing 1 and secured in position by the nut 32. The pin 31 is located in the path of movement of the extension 28 and limits the movement of the frame 3 caused by the spring 27.

In view of the fact that the magnet 23 by induction modifies the magnetic effect produced between the poles of the magnet 8 and the armature 6 and to prevent the armature 6 from losing its relative position due to the magnetization of the magnet 8, a second coil 39 (shown in Fig. 5) is placed on the magnet 8 having the desired number of turns sufficient to counteract the demagnetizing effect of the coil 23 on the armature 6 as described hereinafter.

A suitable means may be connected to the pin 4 for transmitting the movements produced by the armature 6 to an adjust-

able means which controls any device such as to the throttle valve of the gasoline engine. In the form of construction shown, an arm 33 is keyed to the pin 4 and is connected to the throttle valve 75 located in the intake 76 of the gasoline engine by a suitable link 77, as shown diagrammatically in Fig. 7.

The construction illustrated in the figures may be connected in a system wherein the translating devices will be supplied by an electric current from a storage battery or from a dynamo, or from both storage battery and dynamo. Suitable controlling devices are also connected in the system for regulating the flow of the current, for selecting the source of supply and for keeping the storage battery charged.

In Fig. 5 of the drawings is illustrated a system in which the controller illustrated in Figs. 1, 2, 3 and 4 may be used. The engine 42 is mechanically connected by a shaft 43 with the dynamo 40. The dynamo is a shunt wound dynamo and when connected with a storage battery will cause rotation of the shaft 43 and thus give the engine 42 an opportunity to start which when once started, will increase the rotation of the armature of the dynamo 40 and cause it to produce a current in the lines connected therewith. The dynamo 40 is connected to the storage battery 34 and the translating device 41 through the main line 35 on one side and with the storage battery and the translating devices through controlling and regulating means on the other side. The dynamo 40 is connected through the line 44 with an armature 45 that is moved in one direction or the other by magnets 46 and 47, to complete a connection through the Sangamo meter 48 with the storage battery 34. The armature 45 completes a connection through a line 49, the Sangamo meter 48 and the line 50. The line 50 is connected with the storage battery 34. Current through the lines 49 and 50 causes rotation of the switch or contact member 51 of the Sangamo meter. The Sangamo meter is provided with contact points 52 and 53 that are located in the path of movement of the switch or contact member 51 whereby a circuit may be completed either through contact 52 or contact 53, from the storage battery 34 to lines 50 and either line 54 or line 55. The line 54 is connected with the magnet 47 while the line 55 is connected with a magnet 46. The magnets 46 and 47 are connected with the storage battery through the line 56 so that the circuit of the storage battery may be completed through the magnet 46 or through the magnet 47 according as the switch member 51 makes contact with either contact 53 or contact 52, respectively. A current through the lines 49 and 50 causes clock-wise or

counterclock-wise rotation of the armature 51 depending upon the direction of the current through the lines 49 and 50. When the storage battery 54 has discharged a certain number of its stored coulombs of electricity, contact will be made between the switch member 51 and the contact member 53 which will complete a circuit through the storage battery through the magnet 46. This will close the circuit between the lines 44 and 49 through the armature 45 and thus complete a circuit through the field 57 and armature of the dynamo 40 from the storage battery 34. The dynamo 40 will operate as a motor to drive the engine 42 whereupon the engine 42 will catch the spark and drive the dynamo 40 to produce a current in the opposite direction and charge the storage battery, the connection being completed through the lines 44, 49, 50, 58 and 35. If the storage battery is charged, the current passing through the Sangamo meter 48 causes clock-wise rotation of the contact or switch arm 51 until contact is made with the contact 52 which will complete the circuit from the battery 50 with the magnet 47 through lines 50 and 54. The magnet 47 will pull the armature 45 away from the magnet 46 and break the connection between the lines 44 and 49 and thus break the circuit through the dynamo 40 and the storage battery 34.

The storage battery and the dynamo are also connected with the translating device 41 through controlling devices so that when the switches of the translating devices are closed, the current will be supplied by either the storage battery 34 or the dynamo 40 or by both the storage battery and the dynamo depending upon the operations of the controlling devices and the amount of current consumed by the translating devices. The storage battery 34 is connected to the translating devices through the line 50, the meter 48, line 49, the solenoid 36, the line 59, the coils 38 and 39. The current returns to the storage battery through the line 35. The solenoid 36 is provided with a movable core 61. The weight of the core 61 and the windings of the solenoid are such that when the current through the solenoid 36 increases to a certain point, the core 61 will be lifted and close the contacts 62 which will complete a parallel circuit from the line 59 through the contacts 62, lines 63, 55 and 56 to the line 58. The magnet 46 is located in the parallel circuit and operates the armature 45 to close the circuit of the dynamo through the lines 44, 49 and 50 to the storage battery 45 and line 35 which causes the dynamo to operate as a motor to start the engine 42. When the engine has been started, the circuit of the dynamo is through the lines 44, 49, 64, 59, 60 and 35

whereby the current is fed to the translating devices 41 located between the main lines 60 and 35. The quantity of the current supplied by the dynamo to the translating devices because of the high speed of the engine, may be sufficient to meet the requirements of the translating devices 41 and in addition thereto to charge the storage battery 34 to keep the storage battery 34 up to its full charge. If, however, the amount consumed by the translating devices 41 is beyond that which may be produced by the dynamo 40, the storage battery 34 which is connected in a parallel circuit will cooperate to supply the additional demand of the translating devices.

If for any reason it is desired to turn the load of the system from the storage battery on to the dynamo before the solenoid 36 operates to close the contact 62, it may be then operated by the push button 64 which will cause the dynamo to operate as a motor to start the engine 42 in the same way that the closing of the contact 62 will start the dynamo 40, since the contact points of the push button 64 are in parallel relation with the contacts 62 in the circuit.

The coil 38 of engine regulator is connected in series between the translating devices and the circuit closing devices 64 and 62 while the coil 66 of the regulator is connected in a shunt circuit across the terminals of the dynamo. The coil 66 is located on the magnet 8 of the engine regulator while the coil 38 is located on the magnet 23 of the regulator. The coil 66 of the magnet 8 operates to cause the armature 6 to be rotated in one direction, while the coil 38 of the magnet 23 operates to cause the armature 6 to rotate in the opposite direction. The butterfly valve to which the arm 33 of the governor is connected is normally held open by the action of the spring 12 which pulls the arm 13 to the end of the slot formed in the strip 17 to give the engine plenty of gasoline for starting purposes. As the current passes through the coil 66 of the magnet 8, the armature 6 is pulled so as to reduce the gasoline supplied to the engine. When the voltage is built up to charging point, the armature 6 is drawn over so as to bring the pin 13 against the opposite end of the slot 22 in the strip 17, by the action of the current passing through the coil 66 which is connected across the terminals of the dynamo through the lines 35 and 37. If for any reason, the line between the generator and battery should become broken the voltage in the shunt wound generator greatly increases whereupon the armature will be strongly attracted by the shunt coil 66, thus closing the throttle of the engine and preventing the engine from racing at the same time, the spring 19 will cooperate

with the spring 12 to prevent the armature from being pulled over so far that the engine would be shut down.

When the dynamo charges the battery, the drop in voltage of the generator reduces the attraction exerted on the armature 6 by the shunt coil 66 so that the pull of spring 19 is greater than the attraction of the magnet 8 and the pin 13 pulls back the armature 6 to a position such that the engine will produce a current that will not overheat the battery and which is of a strength that the battery will be charged with reasonable quickness without warping the plates and doing other damages.

Variable currents supplied to the translating devices 41 passing through the series coil 38 of the magnet 23 regulates the position of the armature with reference to the load that is being carried by the dynamo, inasmuch as the magnetization of the magnet 23 on which the coil 38 is located varies the position of the frame 3 so that the butterfly valve will be opened the greater the load that is placed upon the system, that is, the greater the current passing through the series coil 38.

In order to prevent the coil 38 from super-inducing a magnetic effect in the poles of the magnet 8, the magnet 8 is also wound with a coil 39 having substantially the same number of turns as the coil 38 and connected in series with the coil 38 whereby an effect is produced in the magnet 8 that is counter to the effect that may be produced by the coil 38 on the armature 6.

The ignition means of the engine 42 is also connected with the armature 45 in order that the engine 42 may be stopped after the same has been started. The spark plugs are connected to a contact which may be closed by a contact which is located on the armature 45 to which is connected a magneto, or an induction coil and a spark controller which are conventionally indicated at 70. The dynamo continues to run until the battery 34 is charged to the full charge so as to bring the contact member 51 in contact with the contact 52 which establishes a current as heretofore described through the magnet 47. The magnet 47 pulls the armature 45 away from the contact 71 connected with the spark plug 72 through the line 73 to break the ignition circuit whereupon the engine will stop.

The operation of the controller is illustrated diagrammatically in Fig. 6 where the system is designed to carry a certain load, particularly what has been termed "a one kilowatt size unit or system." The same conditions will exist in connection with systems for carrying other loads except that the proportionate amounts indicated in the diagram will vary and consequently the line indicating the proportions of the current

supplied to the translating devices and to the battery will vary.

The diagram therefore, is merely illustrative of what is accomplished by the governor. Without the governor, the current to the battery would be abnormal when the dynamo had become started under no load or a very light load. This would be when the contact member 51 had closed the circuit through the contact 53 whereupon the dynamo would supply all its current to the storage battery. This would cause in connection with the particular system selected for the purpose of illustration, a current of thirty amperes to be turned on to the battery which would overheat the plates and cause them to warp and do great damage in the system, where the load is to be carried by the dynamo up to about thirty two amperes, and the battery of only approximately 80 amperes hour capacity which is standard for a plant of this size and operation and furthermore as large as is required on an automatic system of this kind. The diagonal line running from 30 to 42 shown in Fig. 6, indicates the drop in the battery charging current as the load increases until the battery begins to cooperate with the dynamo in maintaining the load in systems without the controller. By using the governor in connection with the system, the dynamo will supply fifteen amperes to the battery when operating under no load and when the load increases only to five amperes, the current supplied to the battery will be only about ten amperes which the battery can easily sustain until the plant shuts down. When the load current passes the ten ampere point the coil 38 will operate to control the gas supply to the engine so as to cause the engine to maintain a substantially constant supply of five amperes to the battery besides maintaining the load current. The governor will thus cause the dynamo to maintain the current consumed by the translating devices from the ten ampere point to about twenty seven ampere point at the same time allowing only approximately five amperes to flow into battery whereupon if the amount of current consumed by the translating still increases beyond the approximate twenty seven ampere point, the amount of current supplied to the battery will decrease until at full load on generator it passes through zero point and the battery will then supply a share of the current that is consumed by the translating devices, namely, at about the thirty-two ampere point to the maximum point that can be carried by the storage battery and the dynamo. It will thus be seen that the governor provides a means whereby a comparatively small battery may be used in conjunction with the dynamo which at the same time will have a sufficient area of plates that

will not be overheated by the current from the dynamo, particularly during no loads or during the period of very light loads. The governor thus provides a means which enables the use of small capacity batteries where ordinarily very large batteries would be required to prevent early destruction of the battery plates.

Furthermore, inasmuch as the shunt coil is movably supported with relation to the series coil, and also inasmuch as the magnetizing effect of the two coils counteract to operate the shunt coil relative to the fixed coil, the armature and the movable coil are disposed in their relation to the series coil according to the watts that are consumed in the translating devices of the line. The armature is first set with reference to the shunt coil, according to the current passing to the shunt coil, that is, according to the potential of the battery, or, generally speaking, of the line which potentially depends upon the relative condition or voltage of the battery and the generator, and then the armature and the shunt coil is moved according to the intermagnetic effect of the shunt coil and the series coil. The armature is thus actuated according to the voltage of the line and is further actuated to move relative to the shunt coil according to the changes of the voltage of the line and also according to the watts consumed by the translating devices.

I claim:

1. In an electric system, the combination of an engine driven shunt wound dynamo, a storage battery connected to the dynamo, a circuit having translating devices connected to the battery and the dynamo, means for regulating the speed of the engine, an electromagnetic means connected to the regulating means and located in the circuit of the battery and the translating devices and in the circuit of the terminals of dynamo, for keeping a substantially constant difference between the voltages of the dynamo and the battery notwithstanding the changes of the current flow in the circuit having the translating devices.

2. In an electric system, the combination of an engine driven shunt wound dynamo, a storage battery connected to the dynamo, a circuit having translating devices connected to the battery and the dynamo, means for regulating the speed of the engine, a pair of magnetic means, one of the magnetic means connected to the regulating means and the other magnetic means for magnetically actuating the first magnetic means, one of said magnetic means controlled by the potential of the generator, and the other of the said magnetic means controlled by the current to the translating devices, whereby a substantially constant difference between the voltages of the battery and the

dynamo, notwithstanding the changes of the load, is maintained.

3. In an electric system, the combination of an engine driven shunt wound dynamo, a storage battery connected to the dynamo, a circuit having translating devices connected to the battery and the dynamo, means for regulating the speed of the engine, electromagnetic means connected to the regulating means for maintaining a constant difference between the voltages of the dynamo and the battery, a second electro-magnetic means for magnetically actuating the first means for increasing the speed of the engine as the current through the translating devices increases, whereby a substantially constant current to the battery is maintained notwithstanding the variations in the flow of the current to the translating devices.

4. In an electric system, the combination of an engine driven shunt wound dynamo, a storage battery connected to the dynamo, a circuit having translating devices connected to the battery and the dynamo, means for regulating the speed of the engine, a movable coil for magnetically actuating the regulating means and connected in shunt across the circuit of the battery, the dynamo and the translating devices for maintaining a constant difference between the voltages of the battery and the dynamo, a second coil for magnetically actuating and affecting the action of the first coil on the regulating means and connected in series with the translating devices, whereby a substantially constant current to the battery is maintained notwithstanding the variations of the flow of the current to the translating devices.

5. In a regulator, the combination of an armature, an electromagnet for operating on the armature, a movable frame for supporting the electromagnet, a second magnet for moving the frame, the first magnet having two coils, one for actuating the armature, the other for counter acting the effect of the coil of the second magnet on the armature.

6. In an electric system, the combination of a dynamo and storage battery connected in shunt with the dynamo, translating devices, a controlling device located in the circuit of the translating devices, an internal combustion engine for operating the dynamo and having a valve for regulating the fuel of the engine, an armature for operating the valve, a rotatable coil connected in parallel with the storage battery for operating the armature relative to the coil, a second coil connected in series with the dynamo and the translating devices for rotating the first coil to cause corresponding movement in the armature.

7. In an electric system, the combination of translating devices, a storage battery connected to the translating devices, a dynamo

- for supplying current to the storage battery and the translating devices, an internal combustion engine for operating the dynamo and having a valve for regulating the fuel supply to the engine, an armature for operating the valve, a rotatable coil for operating the armature relative to the coil and connected in shunt with the storage battery, a second coil for rotating the first named coil and connected in series with the dynamo and the translating devices.
8. In an electric system, the combination of translating devices, a storage battery connected to the translating devices, a dynamo for supplying current to the storage battery and the translating devices, an internal combustion engine for operating the dynamo and having a valve for regulating the fuel supply to the engine, an armature for operating the valve, a rotatable coil for operating the armature and connected in shunt with the storage battery, a second coil for rotating the first named coil and connected in series with the dynamo and the translating devices, a third coil connected in series with the second named coil to counteract the magnetic effect that the second named coil may have on the effect that the first named coil may have on the armature.
9. In an electric controlling device, an armature, a magnet for actuating the armature, a second magnet for actuating the first named magnet and the armature.
10. In an electric controlling device, a rotatable armature, a rotatable magnet for actuating the armature, a stationary magnet for actuating the first named magnet and the armature.
11. In combination with an electric system having a source of current supply and translating devices, an electric controlling device having a rotatable armature, a rotatable magnet having a coil connected in shunt with the source of current supply for actuating the armature, a stationary magnet having a coil connected in series with the source of current supply for actuating the first named magnet and the armature.
12. In combination with an electric system comprising an engine driven dynamo, a storage battery, and translating devices, an electric controlling device having an armature, a coil for actuating the armature, a second coil for actuating the first coil, according to the watts consumed by the translating devices.
13. In combination with an electric system comprising an engine driven dynamo, a storage battery and translating devices connected in parallel, an electric controlling device having an armature, a coil for actuating the armature, a second coil for further actuating the armature according to the watts consumed by the translating devices.
14. In combination with an electric system comprising an engine driven dynamo, a storage battery, and translating devices connected in parallel, an electric controlling device having an armature, means for actuating the armature according to the voltage of the source of current supply, and means for modifying the actuation according to the watts consumed by the translating devices.
15. In combination with an electric system having a source of current supply and translating devices, an electric controlling device having an armature, a retractile member operating on the armature, a coil for setting the armature relative to the coil according to the current passing through the coil, a retractile member connected to the said coil, means for setting the coil and armature according to the watts consumed by the translating devices.
16. In combination with an electric system having a source of current supply and translating devices, an electric controlling device having an armature, a retractile member operating on the armature, a coil for setting the armature relative to the coil according to the current passing through the coil, a retractile member connected to the said coil, a second coil for setting the armature and the first coil according to the currents through both of said coils.
17. In combination with an electric system having a source of current supply and translating devices, an electric controlling device having an armature, a retractile member operating on the armature, a frame connected to the retractile member, a coil for setting the armature relative to the coil according to the current through the coil and supported on the frame, a retractile member operating on the said coil and connected to a fixed member, a stationary coil for setting the armature and the first named coil according to the currents through both of said coils.
18. In combination with an electric system having a source of current supply and translating devices, an electric controlling device having an armature, a retractile member operating on the armature, a frame connected to the retractile member, a coil supported on the frame and connected in shunt with the source of current supply for setting the armature relative to the coil and according to the voltage of the line, a retractile member operating on the said coil, a fixed member connected to the retractile member, a stationary coil connected in series with the translating devices and the source of current supply for modifying the position of the armature according to the watts consumed by the translating devices.

In testimony whereof, I have hereunto signed my name to this specification.

MARK C. COSGRAY,