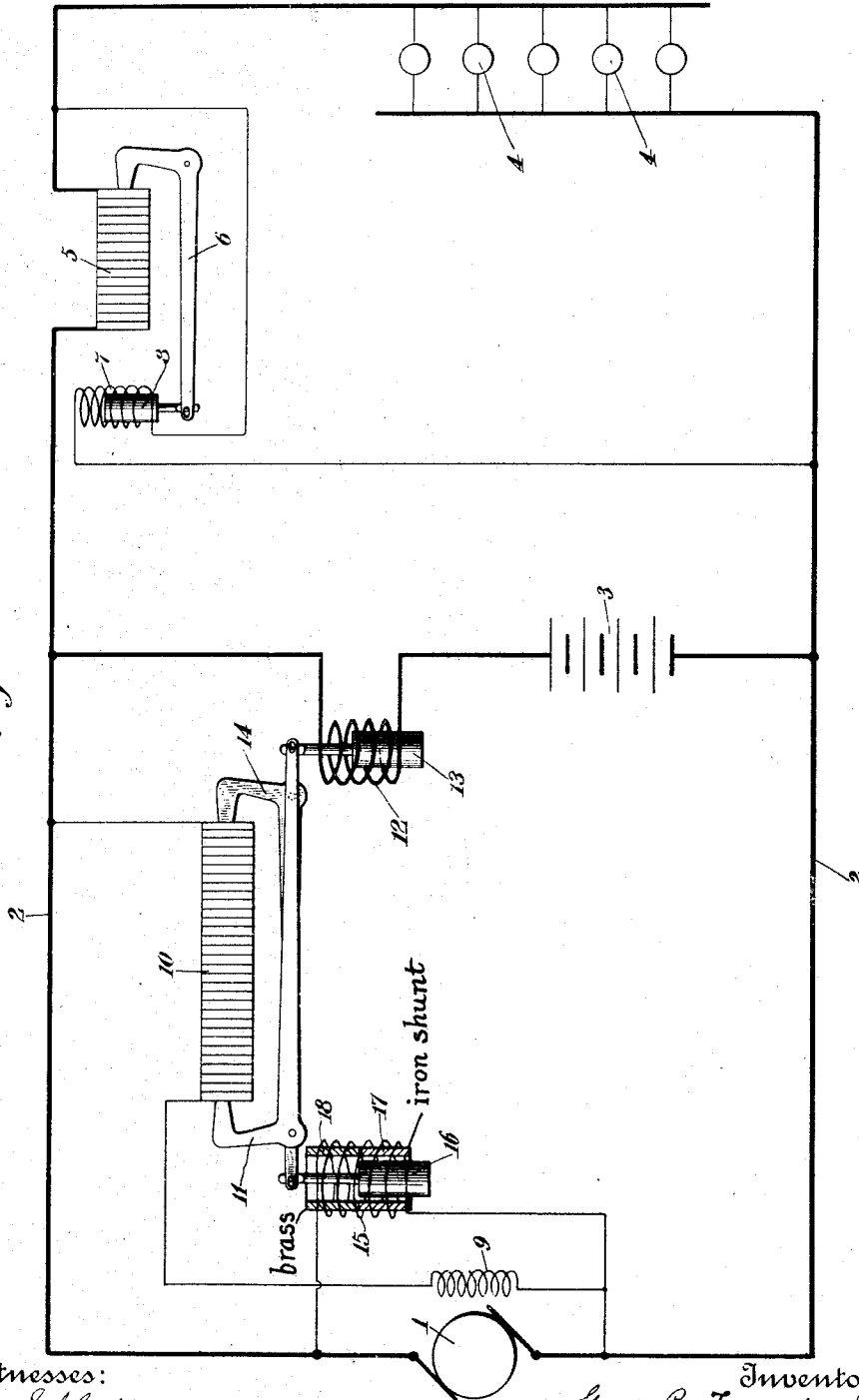


G. R. FESSENDEN, JR.
 REGULATING ELECTRICAL SYSTEMS.
 APPLICATION FILED DEC. 21, 1911.

1,205,181.

Patented Nov. 21, 1916.
 2 SHEETS—SHEET 1.

Fig. 1



Witnesses:
 George Schlatt.
 John O. Gempfer

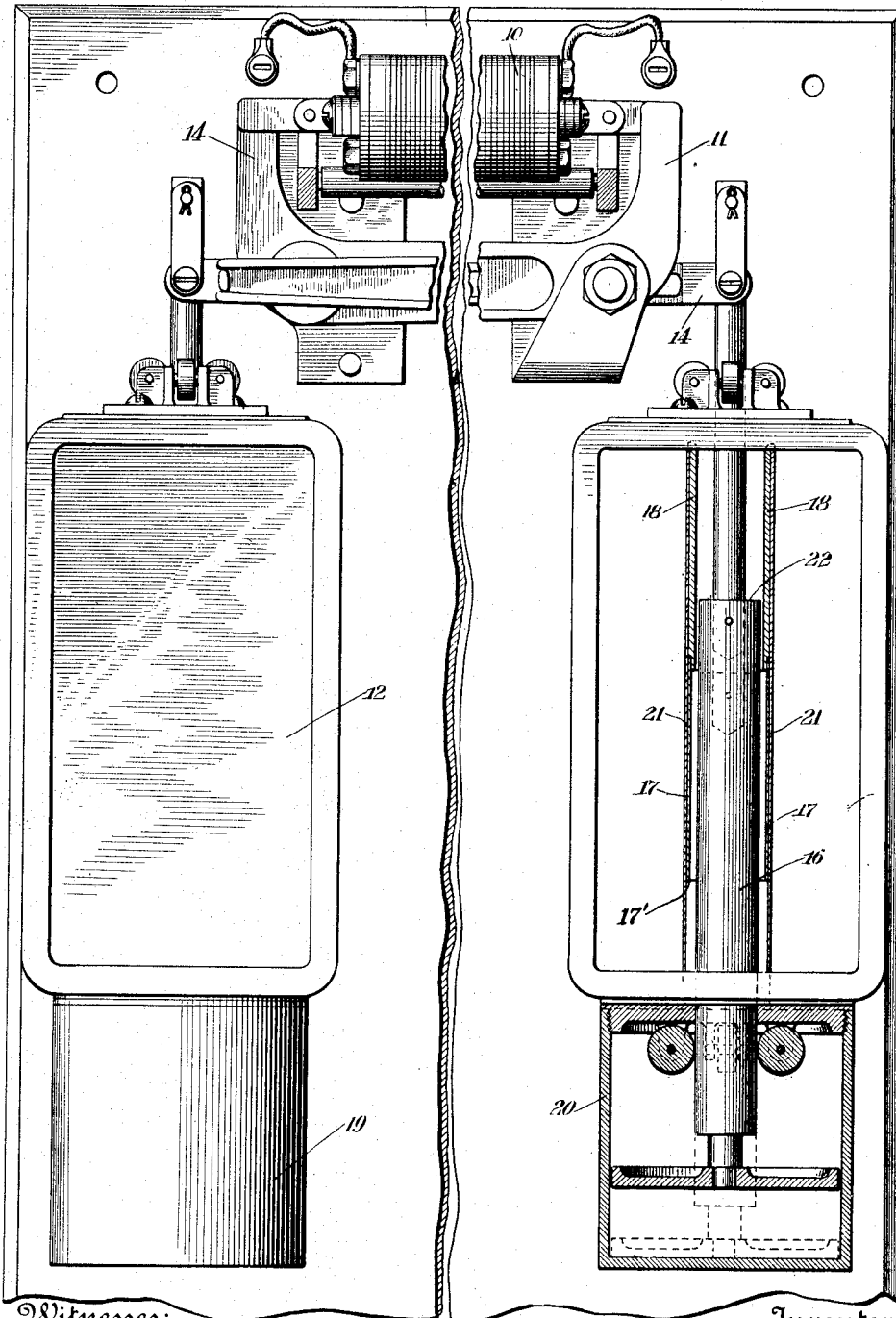
Inventor
 George R. Fessenden Jr.
 By his Attorneys
 Kenyon Henyon

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 George Schlatt
 John O. Gump

Fig. 2

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UNITED STATES PATENT OFFICE.

GEORGE R. FESSENDEN, JR., OF LANCASTER, NEW YORK, ASSIGNOR TO GOULD COUPLER COMPANY, A CORPORATION OF NEW YORK.

REGULATING ELECTRICAL SYSTEMS.

1,205,181.

Specification of Letters Patent.

Patented Nov. 21, 1916.

Application filed December 21, 1911. Serial No. 667,235.

To all whom it may concern:

Be it known that I, GEORGE R. FESSENDEN, Jr., a citizen of the United States, and a resident of Lancaster, Erie county, State of New York, have invented certain new and useful Improvements in Regulating Electrical Systems, of which the following is a specification.

My invention relates to improvements in regulating electrical systems, and is especially directed to improvements in regulating the voltage of a source of electromotive force used for charging a storage battery, such as is common in electrical car lighting systems in which a generator driven at variable speed by the movement of the car acts as a source of electromotive force.

One object of my invention is to provide improvements whereby when the battery has become sufficiently charged the charging current will not only be cut down to a small value, as is now common, but will be entirely wiped out.

A further object of my invention is to provide an arrangement for bringing about the above result, which arrangement is simple, efficient and easily applied to apparatus now in use.

Further objects, features and advantages will more clearly appear from the detailed description given below, taken in connection with the accompanying drawings which form a part of this specification.

In the drawings, Figure 1 is a diagram illustrating a car lighting system with one form of my improvements applied thereto. Fig. 2 is a detailed view showing more fully the generator regulator of Fig. 1.

Referring to Fig. 1, 1 represents a main generator which may be driven from the car axle and which acts as a source of electromotive force supplying the mains 2—2. Connected across the mains 2—2 is a storage battery 3. Also connected across the mains 2—2 are lamps 4 or other translating devices. In series with one of the mains 2 between the lamps 4 and battery 3, is a lamp regulator comprising a carbon pile 5 operated by a lever 6, which in turn is controlled by a solenoid 7 with a core 8, the solenoid 7 being connected across the work circuit 4, so as to be responsive to voltage variations thereof. Any variations in voltage at the work circuit cause the regulator 5 to so adjust itself as to main-

tain the voltage of the work circuit substantially constant, in a well known manner.

The generator 1 is provided with a shunt field 9 having in series therewith a compressible resistance rheostat or carbon pile 10. Acting upon one end of the pile 10 is a lever 11 controlled by a solenoid 12 and a core 13. The solenoid 12 is arranged in series with the battery 3 so as to be responsive to variations in the battery charging current. Operating upon the other end of the carbon pile 10 is a lever 14 which in turn is controlled by a solenoid 15 and core 16, the solenoid 15 being connected in shunt across the mains 2—2 so as to be responsive to the voltage variations of the generator and battery. Encircling the core 16 for part of its length, is a cylinder, the lower part 17 of which is made of iron, while the upper part 18 of which is made of brass. When the core 16 is in its lower position the top thereof is substantially opposite the top of the lower portion 17 of the encircling cylinder. This encircling cylinder is arranged between the solenoid 15 and the core 16 so that the lower portion 17 thereof will act as a magnetic shunt for the solenoid to shunt part of the magnetic lines of force from the core 16.

In operation, with the battery in a discharged condition the generator 1 will furnish charging current thereto, and this charging current upon exceeding a predetermined value will operate upon the carbon pile 10 by means of the solenoid 12 and core 13 to introduce resistance into the field of the generator so as to keep down the voltage of the generator and prevent the battery charging current exceeding a predetermined value. As the battery becomes substantially charged in this manner its voltage rises, in consequence of which the voltage of the generator 1 rises. When the battery has become substantially charged to the desired predetermined point, the voltage across the mains 2—2 has risen to such a value that the solenoid 15 has sufficient strength to lift the core 16, so that it will operate upon the carbon pile 10 to put more resistance in series with the generator field, thereby limiting the generator voltage to a predetermined value. At this stage the charging current drops off.

Without the cylinder 17—18 operating as

a magnetic shunt when the solenoid 15 becomes effective it reduces the potential of the source to a sufficient degree to cause the charging rate to decrease, but with the reduction of the charging current the battery drops its potential so that the operative voltage of the potential coil 15 is sufficient to allow current to again flow to the battery, but not in the same degree as before. With the generator still in operation and the batteries not being drawn upon for current, this cycle will repeat many times until a point is reached where only sufficient current is passing into the battery to create slight gassing. It is thought that if this small current which is sufficient to create slight gassing, is eliminated, the results will be more advantageous. I therefore provide the encircling cylinder 17—18, the iron portion of which acts as a magnetic shunt for the solenoid 15 and its core 16. The function of this tube or cylinder, when inserted as shown in the drawings, is to rob the core 16 of sufficient amount of flux so that while full charging potential is required to start to lift the core from its position of rest to cause it to commence to operate to regulate the potential of the source, a materially lower potential is required by the solenoid 15 to maintain the core 16 lifted and operating upon the pile 10, after the core is once lifted from within the iron section of the pirate tube 17—18. The iron portion of the tube is so adjusted and proportioned as to cause the potential coil 15 to govern at approximately floating potential of the batteries when the core is once raised from within the iron portion of the pirate and the potential coil 15 is regulating. It will therefore be seen that the electromagnetic regulating apparatus embracing the solenoid 15 and core 16 is normally inoperative to control or regulate the voltage of the source until the voltage of the source and battery have reached a predetermined value, but that after the solenoid 15 and core 16 have commenced to operate to regulate the voltage of the source, then a much lower applied potential is required by the solenoid 15 to regulate the potential of the source, since the magnetic density in the protruding part of the plunger is greatly increased which in turn increases the attractive force over that, when the core 16 was at rest. In other words, with the core 16 in the position shown in Fig. 1, or at rest, a certain number of magnetic lines of force are shunted through the iron part 17 of the pirate tube, but when the core 16 is raised then the upper portion of the tube 18 being of brass, more of these magnetic lines of force pass through the core 16 so that it may be operated with a much lesser potential applied to the coil 15.

The particular manner in which I prefer

to apply the pirate tube 17—18, is more clearly shown in Fig. 2, in which figure, 10 represents the carbon pile resistance, 11 the lever operating upon one end thereof, 12 the solenoid operating upon the lever 11, 14 the lever operating upon the other end of the carbon pile 10, 16 the core operating within the solenoid 15 responsive to voltage variations of the system. Such an apparatus without the pirate tube 17—18 is fully described in copending application Serial No. 587,003, filed October 14th, 1910. Dash pots 19 and 20 are provided for the respective cores 13 and 16, the construction and operation of which will be clearly understood by those skilled in the art, from Fig. 2.

As shown in Fig. 2 there is provided a brass tube 21, on the inside of the coil 15, and surrounding the plunger 16. Inside of this brass tube is slipped the pirate tube or magnetic shunt comprising a lower portion 17 of iron, extending down to the point 17', and an upper portion 18 of brass. With the plunger 16 in its lowest position at rest, as shown by the dotted lines, the top 22 of the core 16 is substantially opposite the top of the lower portion 17 of the pirate tube. When however, the solenoid 15 operates upon the core 16 to raise the same, the magnetic density in that part of the core 16 above the iron part 17 is much greater, so that a much lesser potential is required to hold the same up and keep it operating upon the carbon pile 10.

From the above it will be clear that I have provided an especially simple and efficient means for accomplishing the objects stated, and an arrangement which will wipe out the small "gassing current" which usually remains in such systems after the battery has become charged to the desired point.

Although I have described my improvements in great detail and with respect to one particular embodiment thereof, nevertheless I do not desire to be limited to such details except as clearly specified in the appended claims since many changes and modifications may well be made without departing from the spirit and scope of my invention in its broadest aspects.

Having fully and clearly described my improvements, what I claim as new and desire to secure by Letters Patent, is:

1. In an electrical system, a source of electromotive force, a storage battery connected to be charged thereby, electromagnetic means for controlling the voltage of the source responsive to voltage variations of the system, and means whereby a materially lower potential is required for said electromagnetic means to control the voltage of said source after said electromagnetic means has commenced to control the voltage of said source.

2. In an electrical system, a source of elec-

tromotive force, a storage battery connected to be charged thereby, electromagnetic means for controlling the voltage of the source, and means whereby a materially lower potential is required for said electro-

3. In an electrical system, a source of electromotive force, a storage battery connected to be supplied thereby, electromagnetic means for controlling the voltage of the source responsive to voltage variations of the system and arranged to remain inoperative to control the voltage of said source until the voltage of the source has reached a predetermined value, and means whereby a materially lower potential difference is required for said electromagnetic means to control the voltage of said source after said electromagnetic means has commenced to control the voltage of said source.

4. In an electrical system, a source of electromotive force, a storage battery connected to be supplied thereby, electromagnetic means for controlling the voltage of the source responsive to voltage variations of the system and arranged to remain inoperative to control the voltage of said source until the voltage of the source has reached a predetermined value, said electromagnetic means embracing a carbon pile, an electromagnet operating on the pile and means for increasing the effect of said electromagnet after it has commenced to operate on the pile.

5. In an electrical system, a source of electromotive force, a battery connected to be charged thereby, a compressible resistance rheostat and an electromagnet operating on the rheostat for controlling the voltage of said source responsive to voltage variations of the battery and arranged to remain inoperative upon said rheostat until the voltage of the battery has reached a predetermined value and means whereby a materially lower potential is required for said electromagnet to operate on said rheostat after it has commenced to operate.

6. In an electrical system, a source of electromotive force, a battery connected to be charged thereby, a rheostat for regulating the voltage of the source, a solenoid and core operating upon said rheostat responsive to voltage variations of the system and arranged to remain inoperative to operate on said rheostat until the battery voltage has reached a predetermined value, and means whereby a materially lower potential difference is required for said solenoid and core to operate on said rheostat after said solenoid and core have commenced to operate.

7. In an electrical system, a source of electromotive force, a storage battery connected

to be charged thereby, electromagnetic means for controlling the voltage of the source, and means whereby a materially lower potential is required for said electromagnetic means to control the voltage of said source after said electromagnetic means has commenced to control the voltage of said source, said last mentioned means embracing a magnetic shunt for the electromagnetic means, the effect of which on the electromagnetic means is varied as the electromagnetic means operates.

8. In an electrical system, a storage battery to be charged, electromagnetic means for regulating the charging voltage, and means whereby a materially lower potential is required for said electromagnetic means after it has commenced to operate.

9. In an electrical system, a storage battery to be charged, electromagnetic means for regulating the charging voltage, and means whereby a materially lower potential is required for said electromagnetic means after it has commenced to operate, said last mentioned means embracing a magnetic shunt for the electromagnetic means, the effect of which on the electromagnetic means is varied as the electromagnetic means operates.

10. In an electrical system, a storage battery to be charged, an electromagnet and core for regulating the charging voltage responsive to voltage variations of the battery and arranged to remain inoperative to regulate the charging voltage until the battery voltage has reached a predetermined value, and means whereby a materially lower potential difference is required for the electromagnet and core to regulate the charging voltage after it has commenced to regulate the charging voltage.

11. In an electrical system, a source of electromotive force, a battery connected to be charged thereby, a rheostat for regulating the voltage of the source, an electromagnet and core operating upon said rheostat, and a hollow iron member surrounding the core and acting as a magnetic shunt for the core and so situated that the core protrudes from the shunt after it commences to operate, whereby a materially different potential difference is required for said electromagnet and core to operate on said rheostat after it has commenced to operate thereupon.

12. In an electrical system, a storage battery to be charged, an electromagnet and core for regulating the charging voltage responsive to voltage variations of the battery and arranged to remain inoperative to regulate the charging voltage until the battery voltage has reached a predetermined value, and a magnetic shunt for said core so situated that more of the core is situated within the coil of the electromagnet and

unshunted after the core commences to operate, whereby a materially lower potential difference is required for the electromagnet and core to regulate the charging voltage after it has commenced to regulate the charging voltage.

13. In an electrical system, a storage battery to be charged, an electromagnet and core for regulating the charging voltage responsive to voltage variations of the battery and arranged to remain inoperative to regulate the charging voltage until the battery voltage has reached a predetermined value, and an iron shunt for said electromagnet and core so situated that when the core is not moved by the electromagnet a portion of the core is shunted by said iron shunt and after the electromagnet commences to move the core, more and more of the core within the electromagnet coil is unshunted by said iron shunt, whereby a materially lower potential difference is required for the electromagnet and core to regulate the charging voltage after it has commenced to regulate the charging voltage.

14. In an electrical system the combination of a circuit to be regulated, a rheostat for regulating said circuit, an electromagnet and core controlling said rheostat, and means whereby less current is required in the electromagnet to operate the core when the magnet attracts the core.

15. In an electrical system the combination of a circuit to be regulated, a carbon pile in said circuit for regulating the same, an electromagnet and its core for operating said pile, and means whereby less energy is required for the magnet to operate its core as the magnet continues to attract the core.

16. In an electrical system the combination of a circuit to be regulated, a carbon pile in said circuit for regulating the same, an electromagnet and its core for operating on said pile, and means for increasing the pulling effect of said electromagnet on the core as it operates on the pile.

17. In an electrical system the combination of a circuit to be regulated, a rheostat for regulating said circuit, electromagnetic means for controlling said rheostat, and means whereby less current is required in the electromagnetic means to control the rheostat after the electromagnetic means has commenced to control the rheostat.

18. In an electrical system the combina-

tion of a circuit to be regulated, a rheostat for regulating said circuit, electromagnetic means for controlling said rheostat, and means whereby less current is required in the electromagnetic means to control the rheostat after the electromagnetic means has commenced to control the rheostat, said last mentioned means embracing a magnetic shunt for the electromagnetic means the effect of which on the electromagnetic means is varied as the electromagnetic means operates.

19. In an electrical system the combination of a circuit to be regulated, a rheostat for regulating said circuit, an electromagnet and core controlling said rheostat, and means whereby less current is required in the electromagnet to operate the core when the magnet attracts the core, said last mentioned means embracing a hollow iron member surrounding the core and acting as a magnetic shunt for the core and so situated that the core protrudes farther from the shunt the farther the core is operated by the electromagnet.

20. In an electrical system the combination of a circuit to be regulated, a carbon pile in said circuit for regulating the same, an electromagnet and its core for operating said pile, and means whereby less energy is required for the magnet to operate its core as the magnet continues to attract the core, said last mentioned means embracing a magnetic shunt for the electromagnetic core the effect of which on the core is varied as the electromagnet operates the core.

21. In an electrical system the combination of a circuit to be regulated, a carbon pile in said circuit for regulating the same, an electromagnet and its core for operating on said pile, and means for increasing the pulling effect of said electromagnet on the core after it has commenced on the pile, said last mentioned means embracing a magnetic shunt for said core so situated that more of the core is situated within the coil of the electromagnet and unshunted by the magnetic shunt after the core commences to operate.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

GEORGE R. FESSENDEN, Jr.

Witnesses:

P. W. ENGLISH,

J. L. WALKER.