J. BIJUR.

RAILWAY LIGHTING APPARATUS.

APPLICATION FILED DEC. 1, 1910.

1,241,908.

Patented Oct. 2, 1917.

2 SHEETS—SHEET 1.

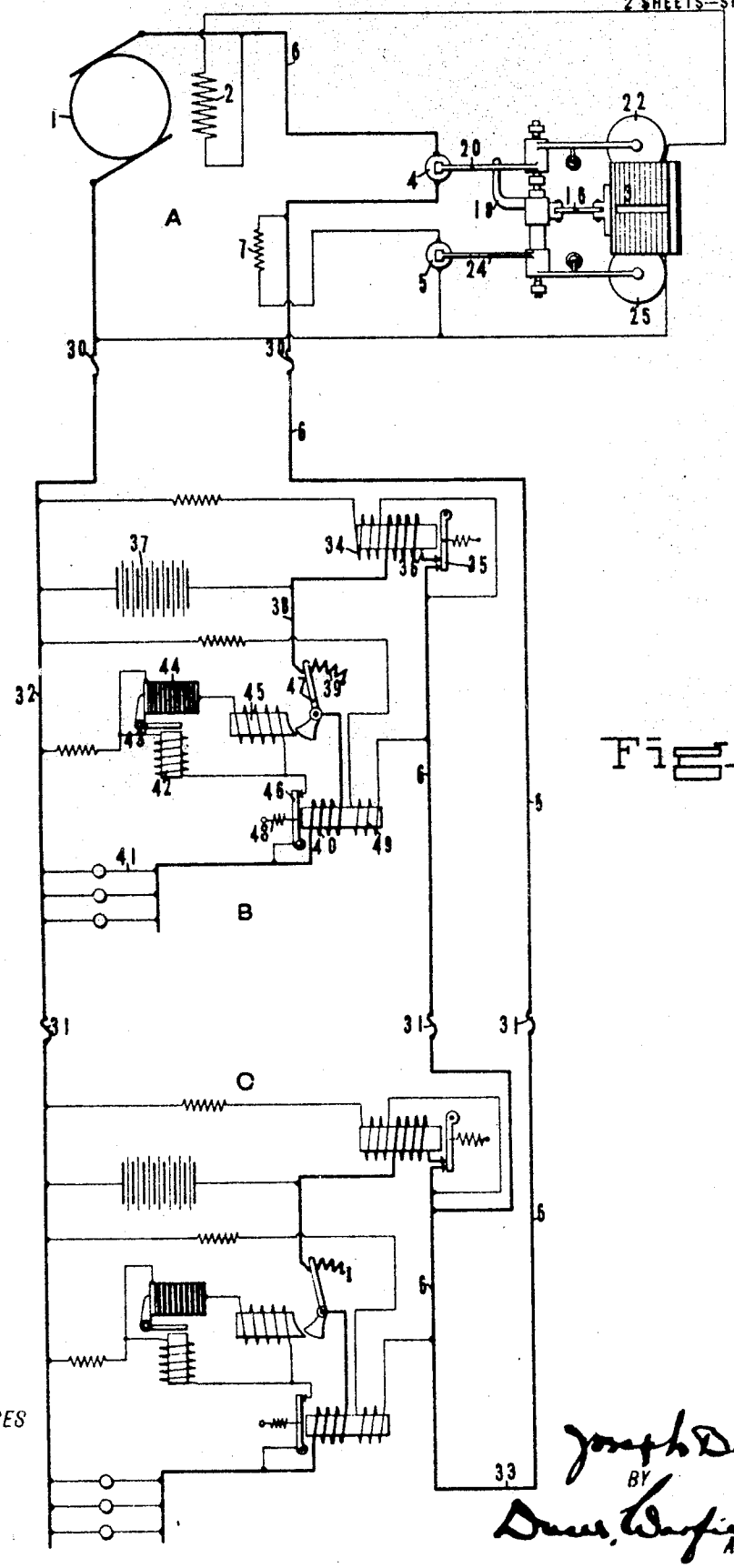


Fig. 1.

WITNESSES

INVENTOR

Joseph Bijur

BY

ATTORNEYS

J. BIJUR.

RAILWAY LIGHTING APPARATUS.

APPLICATION FILED DEC. 1, 1910.

1,241,908.

Patented Oct. 2, 1917.

2 SHEETS—SHEET 2.

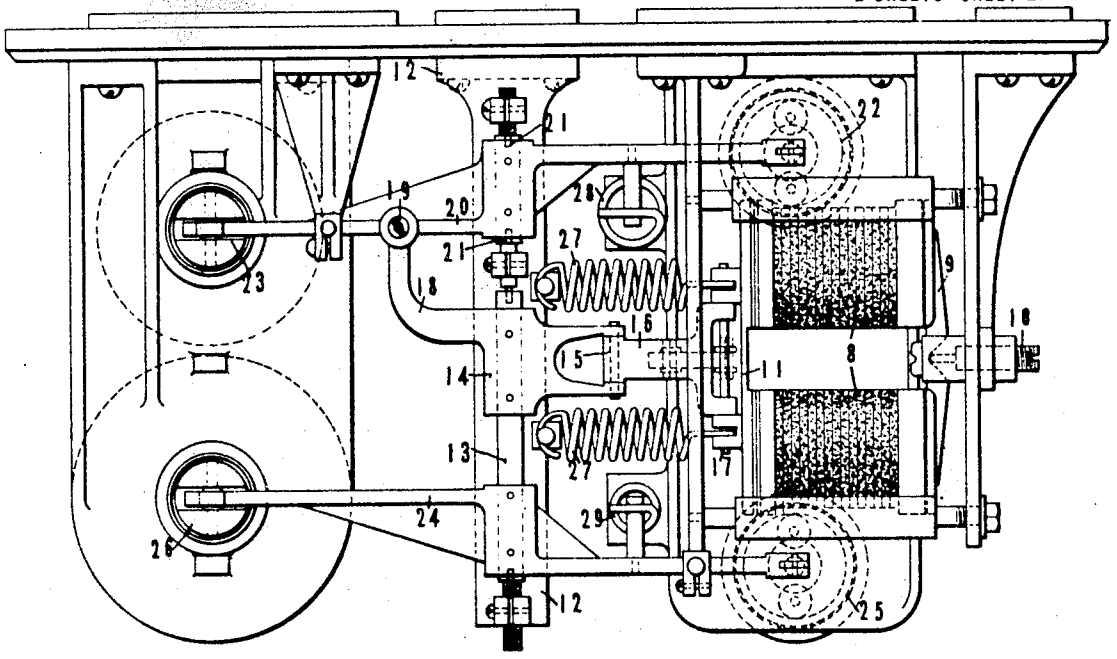
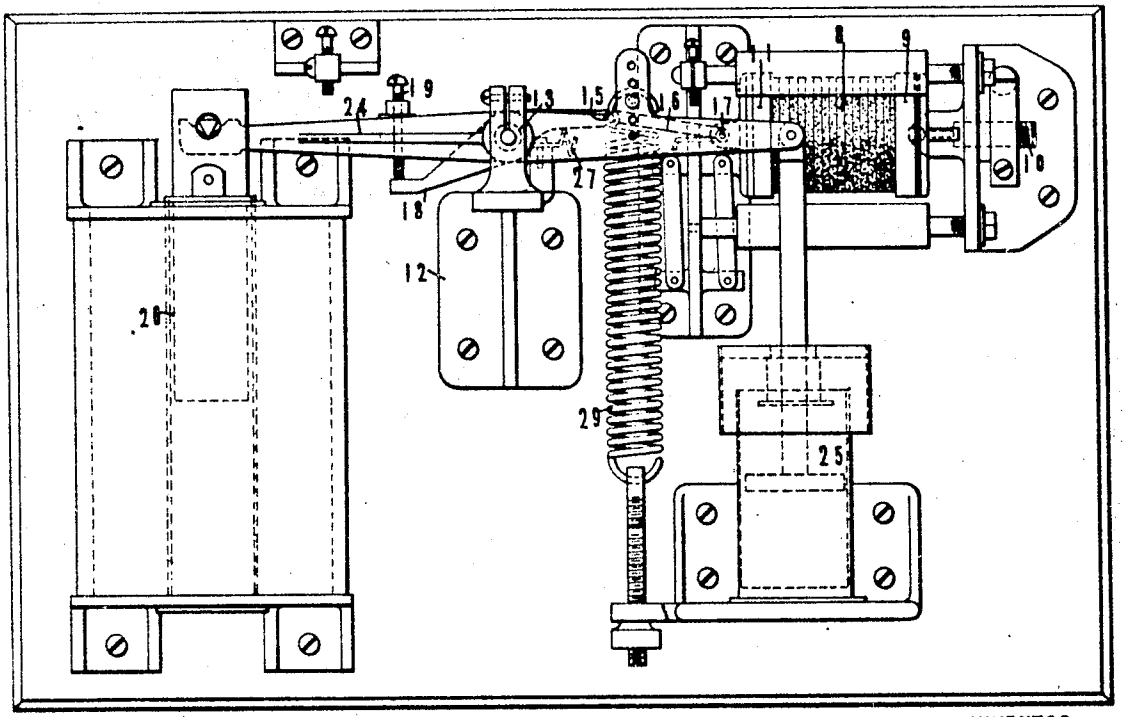


Fig. 2.

Fig. 3.



WITNESSES

INVENTOR

Joseph Bijur

BY

Duell, Mayfield & Duell

ATTORNEYS

UNITED STATES PATENT OFFICE.

JOSEPH BIJUR, OF NEW YORK, N. Y., ASSIGNOR TO THE SAFETY CAR HEATING AND LIGHTING CO., OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

RAILWAY LIGHTING APPARATUS.

1,241,908. Specification of Letters Patent. **Patented Oct. 2, 1917.**

Application filed December 1, 1910. Serial No. 595,070.

To all whom it may concern:

Be it known that I, JOSEPH BIJUR, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Railway Lighting Apparatus, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to electric regulating apparatus. One of the objects thereof is to provide a simple and efficient system of electrical distribution peculiarly adapted for lighting railway trains. Another object is to provide apparatus whereby the output of a generator driven at varying speeds can be properly controlled and regulated for charging storage batteries and meeting other conditions of use in a system of the above nature. Another object is to provide a train lighting system in which the current is economically used under all conditions of service. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings wherein are shown one or more of various possible embodiments of the several features of this invention,

Figure 1 is a diagrammatic plan.

Fig. 2 is a plan, partially in section, showing regulating mechanism.

Fig. 3, is an elevation of the part shown in Fig. 2.

Similar reference characters refer to similar parts throughout the several views.

Referring now to Fig. 1 of the drawings, there is shown a generator 1, connected in series with the shunt field 2 of which is a variable resistance medium 3. The value of the resistance of this medium is affected by coils 4 and 5, the first of which is serially connected in the generator main 6 and the second of which is bridged across the generator terminals to present a field substantially proportional to the voltage of the generator output. This voltage coil as well as the other voltage coils herein have serially connected therewith resistance elements 7 formed of a material of substantially zero temperature coefficient whereby the effect of variations in temperature upon the resistance of these voltage branches is rendered substantially negligible.

Considering in detail the mechanism acting upon the variable resistance 3, it is to be noted by reference to Fig. 2 of the drawings that this resistance comprises a pair of sets of contacting members, as carbon disks 8, these members and sets being serially connected one with another. These disks, which are arranged in upright position, abut at one side against a plate 9, adjustable as by the screw 10, and at the other side against a movable pressure plate 11, suitable insulation being provided.

Mounted upon the frame 12 is a rotatable shaft 13 and secured to this shaft is a rocking member 14 pivoted as shown at 15 to a link 16 which is in turn pivoted to the pressure plate 11 by the pin 17. These parts are so disposed as to form a toggle, as indicated in Fig. 3 of the drawings, and as this toggle is swung into its alined position it tends to compress the carbons, thus balancing the increasing resistance to compression of the carbons by the increasing pressure exerted by the toggle, as hereinafter noted.

The member 14 is provided with an arm 18 which is adapted to be engaged by an adjustable screw 19 upon a lever 20 pivoted at 21 for independent rotation or oscillation. One end of this last lever is provided with a dashpot 22 and the opposite end with a core 23 coacting with the coil 4.

Secured upon the shaft 13 is a lever 24 having at its opposite ends the dashpot 25, and a core 26 coacting with coil 5.

Suitable springs 27 are provided in such position as to tend to retract the pressure plate 11 and adjustable springs 28 and 29 respectively coacting with the levers 20 and 24 to oppose the action of the corresponding solenoids. It will thus be seen that the lever 20 may swing independently of the resistance element 3 throughout a portion of its path, but upon being swung downwardly to a sufficient degree will interlock with the arm 18 and reduce the pressure upon the variable resistance.

By this construction the increasing resist-

ance to compression exerted by the carbons as compression progresses may be substantially compensated by the increasing leverage of the toggle. The increasing or decreasing pull of the solenoids as the cores move up and down may be compensated by the angularity and stretching of the corresponding springs so that, for a constant strength or excitation of the solenoids, their pull is substantially balanced by the mechanical opposition, irrespective of the position of the regulator in its range. In this manner the carbons may be compacted to whatever degree of low resistance is found expedient, and may also be opened to produce as high resistance as may be necessary to limit the generator voltage without substantial disturbance of the balance between the solenoid and the spring, thus giving a wide variation of resistance according with predetermined conditions.

It will also be seen from the above construction that the spring retracting the series solenoid may be set to correspond to any current value desired. Below these current values the arm has a tendency to rotate in a clockwise direction and does not assist the pull of the voltage solenoid. When the current exceeds the set value, the series solenoid shaft tends to rotate anti-clockwise, and so much of the magnetic pull as is in excess of the spring pull is added to the pull of the voltage coil.

As conducive to a clearer understanding of the operation of the above features of this invention, it may be noted that a battery may be operated to a state of substantially full charge by applying to its terminals a constant voltage, the effect being to taper off the charging current until the battery, when full, is taking no material current. Such a charge is advantageous in that injurious overcharging is avoided, since the fuller the battery becomes the less the charging current that goes into it. If the voltage suitable to taper off the charge of the battery be maintained across the terminals of a battery that is completely discharged an excessively high current would flow into it. Accordingly, a dominant aim of this invention is to limit the current flowing into the battery, if in a discharged condition, to some predetermined amount, such as either the limit which is innocuous for the battery, or the limit which the generator will withstand, the value of the series coil may be set to one of these, or some other, limits.

The above apparatus may be placed upon any car of the train and in fact this entire system may be used upon a single car or any desired portion thereof may be so used, but in the illustrative embodiment here described the apparatus above set forth is assumed to be placed upon one car as the tender of the locomotive and this portion of the apparatus down to the couplings, diagrammatically indicated at 30, may be referred to generically by the letter A. In like manner the apparatus between the couplings 30 and couplings 31 is assumed to be upon another car of the train as B and the remaining portion of the system upon a third car C. Moreover the number of cars may be indefinitely increased by an application of the principles of this invention.

It may here be noted that the term "car" is used throughout with a broad significance to denote any vehicle whether it be a locomotive tender, passenger coach or otherwise.

Considering now the apparatus upon car B, which, as above noted, may be placed upon car A if desired, the mains 6 and 32 are connected from car A by any desired form of coupling. Conductor 32 is led directly throughout the train, whereas the conductor 6 passes first to the end of the train as at 33 and then turns upon itself, making a connection with the various sets of apparatus in inverse direction with respect to the conductor 32, and thus neutralizing the effect of potential drop throughout the length of the train.

Connected across the mains is a potential coil 34 and it may here be noted that the term "coil" is used with a broad significance to comprehend either a fixed core magnet or a solenoid and in fact any conductor so disposed as to present a substantial magnetic field. The field of this coil attracts a circuit closing switch 35 which upon acting closes the circuit through the coil 36, also active upon this switch, and thence through storage or secondary battery 37 to conductor 32. Leading from this battery 37 is a conductor 38 which after passing through a variable resistance device 39 and a coil 40 leads to a lamp load or other translating devices 41, the latter being connected between this conductor and the main 32.

A voltage coil 42 acting through suitable mechanism, diagrammatically indicated by the bell crank lever 43, controls the pressure upon a variable resistance element 44 which is serially connected with a voltage coil 45 also connected across the mains. The circuit through both voltage coils 42 and 45 leads through a switch 46. Voltage coil 45 through suitable mechanism indicated by the lever 47 controls the value of variable resistance element 39 and according as the field of coil 42, and consequently of coil 45, increases, the lever 47 cuts more resistance into the main and tends to reduce the abnormal voltage occasioning the increase of the field strength of these coils. An abnormal decrease of voltage is remedied in the reverse manner. The switch 46 is retracted by a spring 48 but is closed upon the flow of

current through the coil 40, above referred to. There is also provided a voltage coil 49 bridged between the conductor 6 and the conductor 32 which is adapted upon the generator being in action to exert sufficient field strength to act of itself to close the switch. Accordingly, if either current is flowing to the lamps through coil 40 or field strength given to coil 49 by the running of the generator, the switch 46 will be closed and the voltage regulating apparatus rendered operative. But if neither of these conditions obtain the spring 48 open circuits the voltage regulating apparatus and does away with the drain of current from the battery through the coils 42 and 45.

The operation of the dynamo regulating apparatus, if no lamp load were on and the battery were in a substantially discharge condition, would be as follows:—Assuming that the spring opposing the current solenoid 4 were set to conform to the current value which the generator could stand continuously and that the spring of the voltage coil 5 were set to such a value as would pass only a slight current into a fully charged battery, upon the car speeding up from rest, the carbons in the regulator remain in a highly compressed state, the generator field strength is nearly the maximum, and at a low speed the generator attains sufficient voltage to equal that of the battery and close the main switch 35. This voltage is materially below that for which the voltage coil is set, and the voltage remains low until the battery is partially charged. The voltage coil, therefore, does not open the carbons. With slightly increasing speed of the car, generator current flows into the battery at a rapidly increasing rate until the value is reached for which the current solenoid is set, whereupon it moves anti-clockwise, adds its pull to that of the voltage solenoid, and begins to open the carbons. A further increase in speed tends to produce increasing current, which causes the series solenoid to over-balance the regulator, opening the carbons until the current is brought back to substantially the set value. The charge continues in this manner accompanied by a rising voltage across the battery terminals until the point is reached at which the voltage coil is set. The current coil at this point would unbalance the regulator if the current in it exceeded its set value, so that as the voltage coil is fully excited the excess pull of the series coil is substantially zero. Further charge causes the battery to maintain the set value of voltage with a lower current input than that for which the current coil is set, whereupon the current arm rotates clockwise, leaving the voltage coil alone controlling the opening of the carbons. The charge proceeds from here on at constant voltage and diminishing current values until the battery is substantially full, at which point the charge current remains small.

Assuming that a full load, of lamps or other translating devices, within the capacity of the generator was thrown on and fed from a battery in nearly discharged condition, the cycle of operations from the start of the car would take place as follows:—The generator would excite and the main switch close as before, the voltage rising until the current into the battery, added to the current flowing to the translating devices, reached the value for which the current coil was set. This would occur at a lower voltage than in the previous instance, since the charging current into the battery would be less. The current solenoid would act to control the opening of the carbons as before, and longer time would elapse before the voltage rose to the point at which the voltage coil alone assumed control. From this point on the voltage will be maintained constant, causing the battery charge to taper as before. If at any time during the charging of a battery starting with no load of translating devices, such a load be thrown on, one of two things will occur. If the battery is still in a state of low charge, the generator will cease delivering its whole current to the battery and will deliver to the battery only so much as is not consumed by the translating devices. If the battery be well charged and the voltage solenoid be controlling the opening of the carbons at the time the load is thrown on, the load, if small, will occasion no change as the proper quantity will flow to the battery and the small additional current will flow to the translating devices. For a large load, which at the set voltage would cause the sum of the battery current and load current to exceed the set value, the current coil will rock its arm in an anti-clockwise direction, opening the carbons and reducing the voltage, and therewith the battery current, until the latter added to the load current falls to the set current value. With the coils set and operating as above described, in case an unusual load is added, the regulator will operate to permit the generator to carry some overload beyond the current value for which the current solenoid is set, since the high current will flow at an unusually low voltage, thus diminishing the usual pull of the voltage coil and calling for an unusual condition on the part of the series coil to make up the balancing value.

Considering now the action of the system upon the entire train, it is to be noted that the potential across the mains at the point of connection with the several batteries is substantially constant, as the short distance between the generator and the adjacent batteries as upon car B along the conductor 32

is compensated for by the correspondingly great distance along the conductor 6. Thus a slight potential drop in conductor 32 is neutralized in effect by an extreme potential drop in conductor 6.

Moreover, with various batteries in different stages of charge, bridged across these conductors, the generator is protected against an unsafe overload by coil 4 and each battery takes a share of the current proportional to its state of discharge. For example, if a battery is nearly charged its back E. M. F. will cut down its charging current to a greater extent than the charging current is cut down in a battery at a lower state of charge. The generator is thus worked to its fullest capacity and the charging current automatically divided in accordance with the needs of the various batteries. Moreover, as the charges of all of the batteries approach completion the potential will rise and the current be cut down in such manner as to place the generator output under control of the potential coil and taper off the charges of the various batteries. Any battery having a higher voltage than the potential difference across the main will, of course, be prevented from back discharge by its corresponding main switch.

It will thus be seen that there is provided apparatus in which the several objects of this invention are achieved and the above and other advantages attained.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention, which, as a matter of language, might be said to fall therebetween.

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

1. In an axle-driven railway lighting system, in combination, a generator having a shunt field, a carbon pile regulating resistance in series with said field, a load circuit including a storage battery and lamps, two coils governing said resistance, said coils having separate cores, and connecting means between said cores and said resistance comprising coacting levers connected to the respective cores and pivoted coaxially, said means permitting regulating movement of one core independently of movement of the other core while insuring movement of the first core conjointly with regulating movement of the other core.

2. In axle-driven railway lighting systems, in combination, a generator having a shunt field, a carbon pile regulating resistance in series with said field, a load circuit including a storage battery and lamps, a current coil connected in series with the generator and at least a portion of the load circuit, a voltage coil connected across the mains, said coils having separate cores, and connecting means between said cores and said resistance comprising coacting levers connected to the respective cores and pivoted coaxially, said means permitting regulating movement of one core independently of movement of the other core while insuring movement of the first core conjointly with regulating movement of the other core.

3. In axle-driven railway lighting systems, in combination, a generator having a shunt field, a carbon pile regulating resistance in series with said field, a load circuit including a storage battery and lamps, a current coil connected in series with the generator and at least a portion of the load circuit, a voltage coil connected across the mains, said coils having separate cores, and connecting means between said cores and said resistance comprising coacting levers connected to the respective cores and pivoted coaxially, said means permitting regulating movement of said voltage core independently of movement of said current core while insuring movement of said voltage core conjointly with regulating movement of said current core.

In testimony whereof I affix my signature, in the presence of two witnesses.

JOSEPH BIJUR.

Witnesses:

ROBERT S. BLAIR,

LEONARD A. WATSON.