(No Model.) 2 Sheets—Sheet 1.

G. F. C. ADAM.

APPARATUS FOR REGULATING AND MODIFYING ELECTRIC CIRCUITS.

No. 578,182. Patented Mar. 2, 1897.

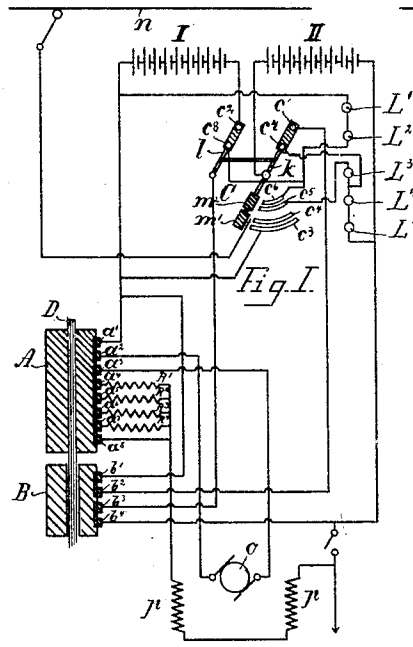

Fig. I.

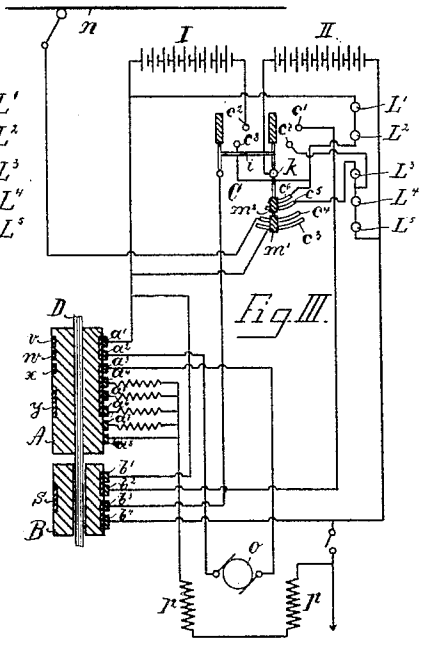

Fig. III.

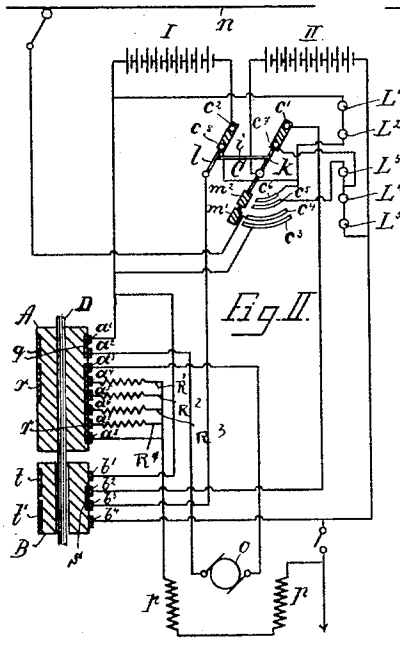

Fig. II.

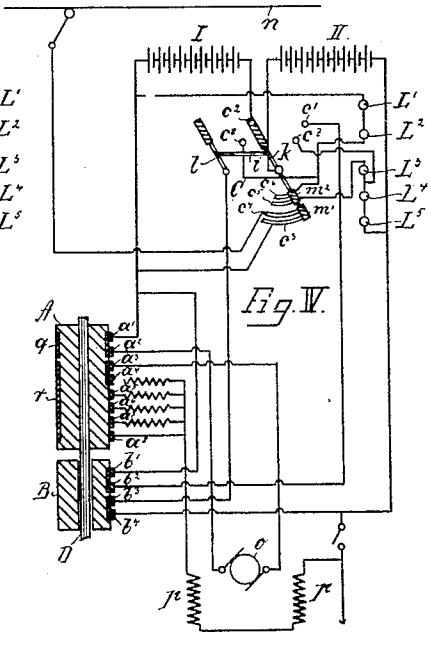

Fig. IV.

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N. M. Flanney

INVENTOR
G. F. C. Adam
by HIS ATTORNEY
Oscar F. Guss.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 2 Sheets—Sheet 2.

G. F. C. ADAM.

APPARATUS FOR REGULATING AND MODIFYING ELECTRIC CIRCUITS.

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Fig. VII.

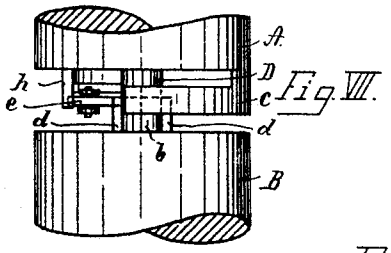


Fig. XIV.

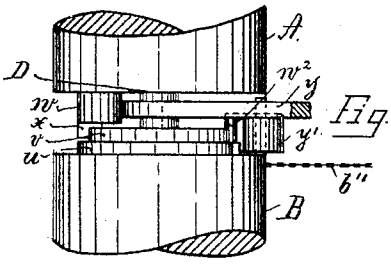


Fig. V.

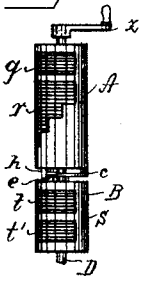


Fig. VI.

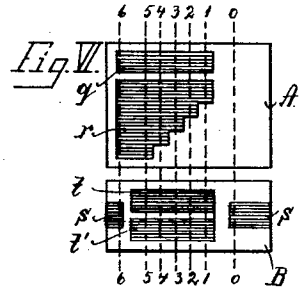


Fig. XII.

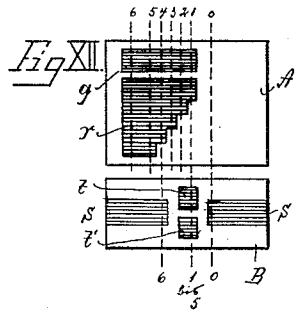


Fig. XIII.

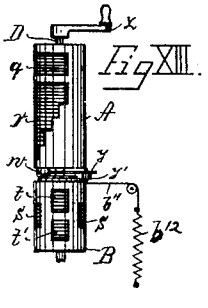


Fig. VIII.

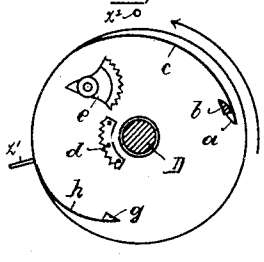


Fig. IX.

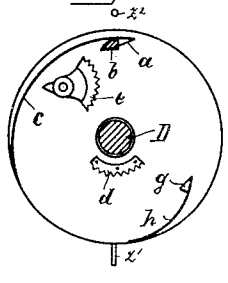


Fig. XV.

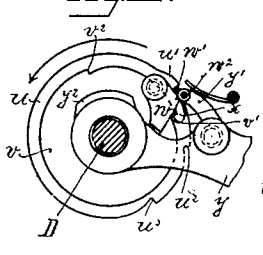


Fig. XVI.

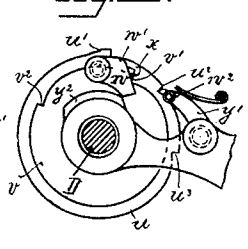


Fig. X.

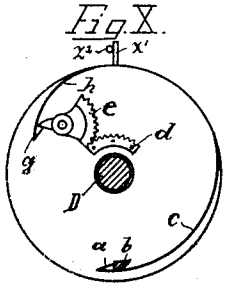


Fig. XI.

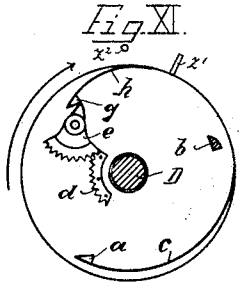


Fig. XVII.

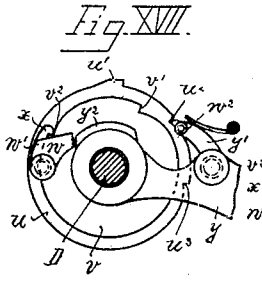
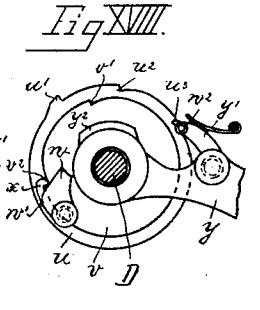


Fig. XVIII.



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By HIS ATTORNEY
Oscar F. Gunn

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

GUSTAV FRIEDRICH CLEMENS ADAM, OF HANOVER, GERMANY.

APPARATUS FOR REGULATING AND MODIFYING ELECTRIC CIRCUITS.

SPECIFICATION forming part of Letters Patent No. 578,182, dated March 2, 1897.

Application filed July 7, 1896. Serial No. 598,329. (No model.)

To all whom it may concern:

Be it known that I, GUSTAV FRIEDRICH CLEMENS ADAM, engineer, a subject of the King of Saxony, and a resident of the city of Hanover, German Empire, have invented certain new and useful Improvements in Apparatus for Regulating and Modifying Electric Circuits, of which the following is a specification.

This invention relates to a new and improved electric switching device for electric-motor cars which are run part of the way by current taken from a line-wire and part of the way by a current taken from a storage battery. In cars of this kind it is essential to distribute the electrical energy in a rational manner at all times. The storage battery must be charged during the time the car is running with current taken from the line-wire and after having been charged must be cut out. The storage battery must be switched in without a serious loss of current through resistances and the like as soon as the car ceases deriving its current from the line-wire. Furthermore, the battery must be switched in two sets in parallel when running slowly, and the incandescent lamps in the car must be so arranged that they can permanently stand the high initial tension of the storage batteries and still produce sufficient light with the low discharging tension. All this can be accomplished by means of the well-known electric switches, but this would require a great number of switches, which must all be manipulated by the motorman, who would be very apt to work the wrong switch, whereby the danger would be increased and the lines short-circuited.

My improved switch is very simple and avoids all unnecessary waste of energy and prevents interfering with the proper service by short-circuiting, &c., which might be produced by working wrong switches.

In the accompanying drawings, forming part of this specification, and in which like letters of reference indicate like parts in all the views, Figures 1 to 4 show in diagram my improved switching device for various positions and connections. Figs. 5 to 18 show details.

My improved switching device has two switch-drums coupled in a special manner, of which one cuts the current in or out when starting and stopping the car respectively and the other connects the batteries in parallel or in series, whereas the main switch assumes various predetermined positions, for the purpose of conducting current at the same time into the motor and into the storage battery from the line or into the battery only, or from the line-wire to the motor only, or from the battery to the motor.

In the drawings the three switch-sections are designated by A, B, and C, respectively, of which the the drums A and B are mounted on a common shaft D, the drum A being fixed and the drum B loose. The two drums are coupled in a manner that will be set forth hereinafter.

The main switch C has two arms k and l, connected by the cross-piece i, the four contacts c' c^2 c^7 c^8, the arms m, forming an extension of the arm k, the contacts m' and m^2, and the concentric contact-segments c^3 c^4 c^5 c^6.

The main switch is so arranged that it can assume three different positions. (Illustrated in Figs. 1 to 4.) In the position shown in Figs. 1 and 2 the arm k rests on the contact c' and the arm l on the contact c^2. The contacts c' c^7 and c^2 c^8 are connected with each other, and the contacts c^3 c^4 c^5 c^6 are disconnected from the contact-pieces m' m^2. In the position shown in Fig. 3 the contacts c' c^2 c^7 c^8 are disconnected from the arms k and l, whereas the contacts c^3 and c^4 are connected by the contact-piece m' and the contacts c^5 and c^6 are connected by the contact-piece m^2. In the position shown in Fig. 4 the contacts c', c^7, and c^8 are disconnected from the arms k and l and the arm l rests on the contact c^2 only. At the same time the contacts c^3 and c^4 are connected by the contact-piece m' and the contacts c^5 and c^6 are connected by the contact-piece m^2.

The connections of the several contacts and brushes with the battery-sections I and II with the line-wire n, the two switch-drums A and B, the armature o, the coils p, the resistances R', R^2, R^3, and R^4, and the lamps L' L^2 L^3 L^4 L^5 are clearly shown in the drawings and require no further explanation. In the position shown in Fig. 1 the battery-sections I and II in parallel and in Fig. 2 the battery-sections I and II in series serve for

supplying the motor with current. At the same time the lamps L' L^2 are connected with the battery-section I and the lamps L^4 L^5 with the battery-section II, the lamps L^3 being cut out. In the position shown in Fig. 3 the battery is cut out entirely. The current passes now from the line-wire *n* through the motor to the earth. At the same time the lamps L' to L^5 are connected in series and the current also passes from the line-wire *n* through said lamps to the earth. In the position shown in Fig. 4 the current passes from the line-wire *n* to the motor and then through the battery-sections I and II connected in series to the earth. At the same time the five lamps connected in series are in a shunt-circuit.

The above relations remain unchanged for each of the three positions of the main switch, but for each position of the main switch C the necessary connections or cut-outs can be performed by means of the switch-drums A and B.

The switch-drums A and B are so connected that the lower drum B is at times carried along by the upper drum A and is brought back to its starting or initial position as soon as the upper drum A is brought to its starting or initial position. The clutch used can be constructed in various ways. Figs. 6 to 11 show one construction and Figs. 12 to 18 another. Figs. 6 and 12 show the peripheries of the drums shown in Figs. 5 and 13, respectively, on one plane. The contact-pieces *q r s t t'* are arranged as shown in Figs. 6 and 12 respectively. On the same the contact-brushes *a'* to a^8 and *b'* to b^4 slide, which are arranged one above the other in a vertical row.

The several different positions of the drums are shown by the dotted lines 0, 1, 2, 3, 4, 5, and 6, and in which the brushes *a'* to a^8 and *b'* to b^4 touch the drums A and B. The positions shown in Fig. 1 correspond to the dotted line 5 5, the battery-sections I and II being connected in parallel and the resistances R' to R^4 short-circuited. The positions shown in Fig. 2 correspond to the dotted line 6 6, in which the battery-sections are in series and the resistances also short-circuited. The positions shown in Fig. 3 correspond to the dotted line 3 3, and Fig. 4 to the line 1 1.

The drum A is turned by means of a crank-handle Z, Fig. 5, the movements of the drum being limited by a pin *z'* and a stop z^2, so that the initial position can only be obtained from any other position by turning the crank-handle Z backward.

In the construction shown in Figs. 5 to 11 the drum B is provided with a lug *b*, and on the drum A a spring *c* is fastened, which is provided with a tooth *a*, so that when the drum A is turned in the direction of the arrow the tooth *a* engages the lug *b* and carries the drum B along, but when the drum A is turned in reverse direction the tooth *a* cannot engage the lug *b*.

The drum B is provided with a toothed segment *d*, which is engaged by the toothed segment *e*, which is mounted between the adjacent ends of the drums and is attached to the drum-casing and acted upon by a spiral spring, which tends to hold the same in the positions shown in Figs. 8, 9, and 10.

If the drum A is turned in the direction of the arrow, the tooth *g* on the end of the spring *h* slides over the point of the toothed segment *e*, but by a movement in the reverse direction the tooth *g* turns the toothed segment *e* and thereby rotates the drum in reverse direction.

If the drum A is turned in the direction of the arrow, Figs. 8 to 10, the tooth *a* engages the lug *b* of the lower drum and carries the same along. The positions designated by the dotted lines 1 to 6 are taken by both drums at the same time. (See Figs. 6 and 12.) Shortly before the position 6 is reached the tooth *g* slides over the point of the toothed segment *e*. During the return movement from the position 6 the tooth *g* turns the toothed segment *e*, and as the latter engages the toothed segment *d* the drum B is turned until it arrives at the initial position, Fig. 11. The tooth *g* slides off the point of the segment *e*, and the latter is thrown by its spiral spring into the positions shown in Figs. 8 to 10. As soon as the drum A has arrived at the initial position the hook *a* again engages the lug *b*, Fig. 8, and the operation can be repeated.

In the construction shown in Figs. 12 to 18 the drum A is provided with a pivoted dog *w* and a pawl *x*, attached rigidly to said dog. The pawl *x* slides on circumference of the neck *v* on the drum B, and on the rim of the shoulder *u* a spring-pawl *y'* slides, which is pivoted on an arm *y*, located between the drums and attached to the drum-casing. The shaft D passes through the inner end of said arm. The arm *y* is provided with a cam-ridge y^2, on which the dog *w* slides during parts of its movements.

In the position shown in Fig. 15 the spring-pawl *y'* engages the recess *u'* of the shoulder *u* and the pawl *x* engages the recess *v'* of the neck *v*. By turning the drum A in the direction of the arrow the drum B is carried along by the spring-pawl *y'* until the dog *w* is raised by the cam-ridge y^2. This occurs when the drums have the positions indicated by the dotted lines 1 1, Figs. 6 and 12. By the lifting of the dog *w* the pawl *x* is disengaged from the recess *v'* and the spring-pawl *y'* engages the recess u^2, Fig. 16. Upon further rotation of the drum A the dog *w* slides on the cam-ridge y^2 until the drum A has the position 5 5. As the pawl *x* is disengaged the drum B remains stationary during this time, Fig. 17.

Shortly before the position shown in Fig. 17 is reached the dog *w* slides off the cam-ridge y^2 and the pawl *x* engages the recess v^2 and upon further rotation of the drum A the drum B is carried along until both drums have the position indicated by dotted lines 5 5

in Fig. 12. In this position the spring-pawl y' engages the recess u^3, Fig. 18.

A cord b^{11}, connected with a spring b^{12}, is connected with the drum B in such a manner that the tension of said spring is increased when the drum B is turned in the direction of the arrow. If the drum A is then turned back to zero or initial position, the drum B first remains at rest, as the spring-pawl y' engages the recess u^3. The dog w slides over the cam-ridge y^3 and its edge w' strikes against the roller w^2 of the spring-pawl y', whereby the latter is disengaged from the recess u^2 and kept in the position shown in Fig. 16. At this position of the dog w the spring b^{12} acts and turns the drum B back to the initial position, in which the spring-pawl y' engages the recess u', and so on.

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

1. In an electric car, deriving its motive current partly from a line-wire and partly from a storage battery, which in turn is charged from the line-wire during the trip a current-switching device composed of a main switch for connecting the motor with the line-wire or storage battery and also connecting the battery with the line-wire, and two additional switches of which one controls the motor and resistances and the other switches the battery in series or parallel, which two switches are so connected as to permit each to perform its function but to return to the initial position together, substantially as herein shown and described.

2. In a switch for electric-motor cars the combination with the switch-drums A and B of the dog w on the drum A the pawl x fixed on said dog, the neck v on the drum B provided with recesses v' v^2, the fixed support y, the spring-pawl y' on the same, the cord b^{11} and spring b^{12} substantially as herein shown and described.

3. In an electric-motor car, the combination of a main switch, two auxiliary switches, a motor, electric lamps and a storage battery in sections, in such manner that the main switch serves for connecting the motor with the line-wire or storage battery and also connecting the storage battery with the line-wire for charging the battery, the lamps being connected in series and parallel with the motor or battery respectively when the current is taken from the line-wire for power or for charging battery, and when the current for the motor is taken from the battery, two lamps are connected with each battery-section, the auxiliary switches serving for connecting the motor with resistances and for connecting the battery-sections in series or parallel, substantially as herein shown and described.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 4th day of May, 1896.

GUSTAV FRIEDRICH CLEMENS ADAM.

Witnesses:
FRIEDRICH NORTEN,
LUDWIG LOEFFEL.