No. 649,797. Patented May 15, 1900.

M. J. BARREAU.

MEANS TO BE EMPLOYED IN ELECTRIC TRACTION.

(Application filed July 22, 1899.)

(No Model.) 5 Sheets—Sheet 1.

Fig.1.

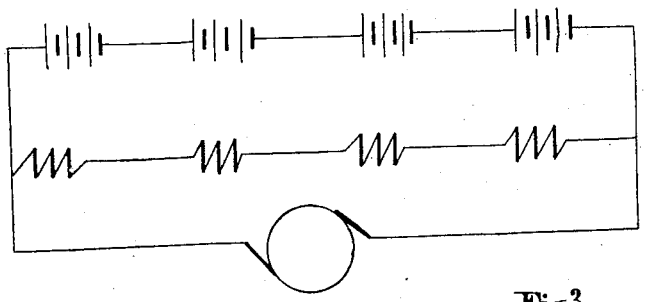

Fig.2.

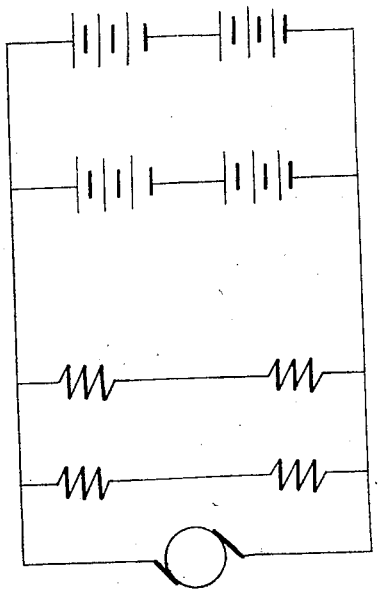

Fig.3.

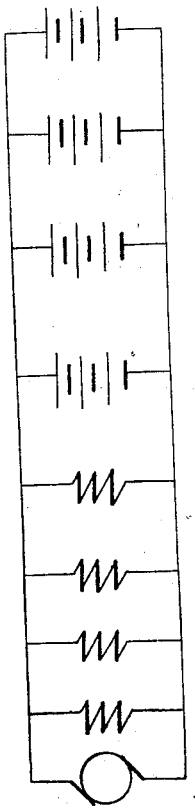

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Fig.4.

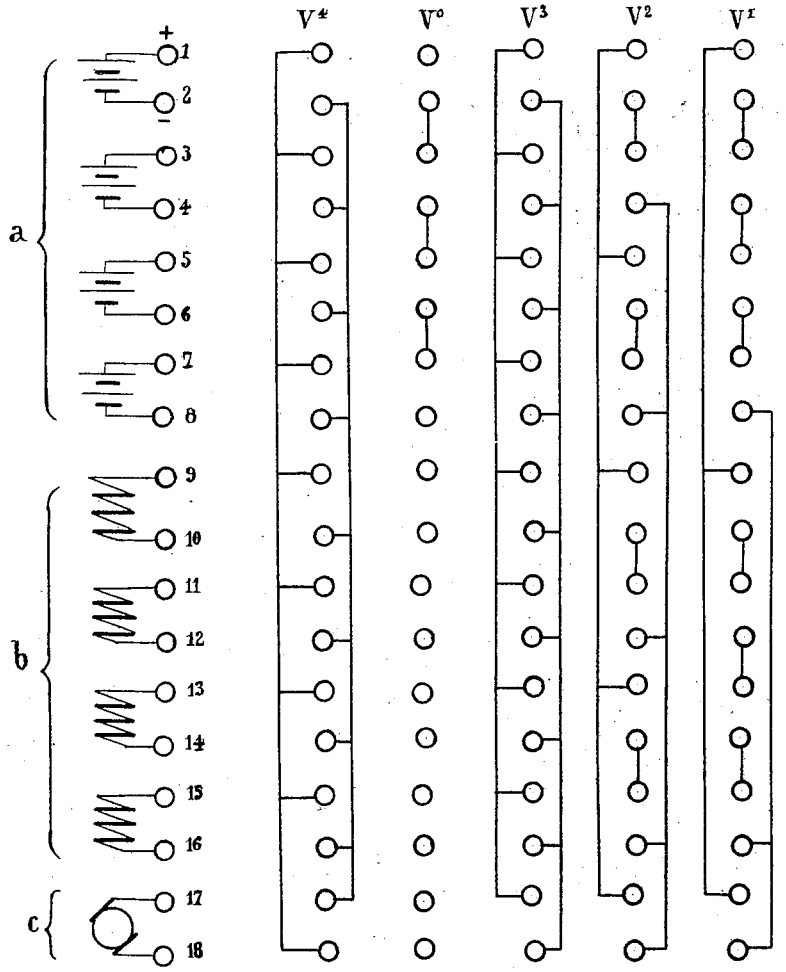

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Fig. 5.

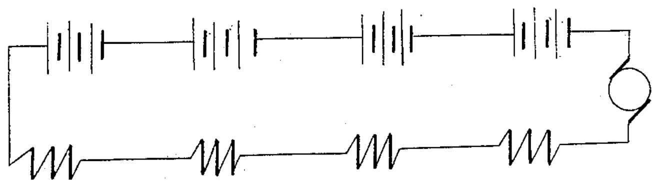


Fig. 6.

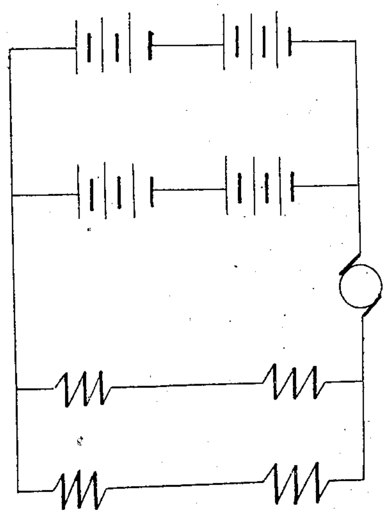
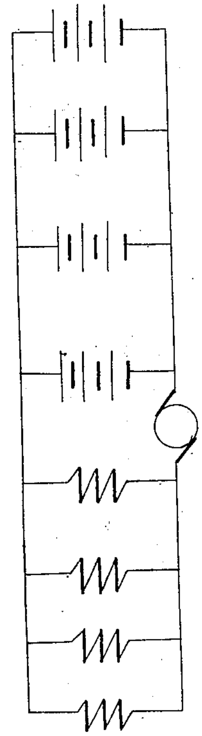


Fig. 7.



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(No Model.) 5 Sheets—Sheet 4.

Fig. 8

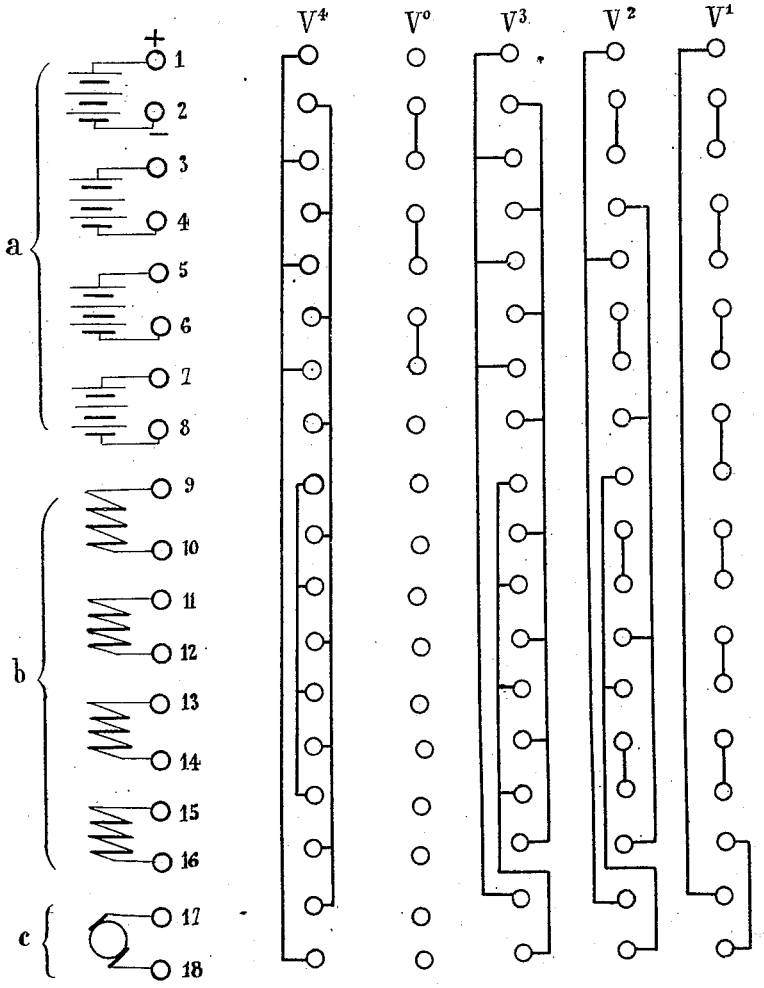

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Fig.9.

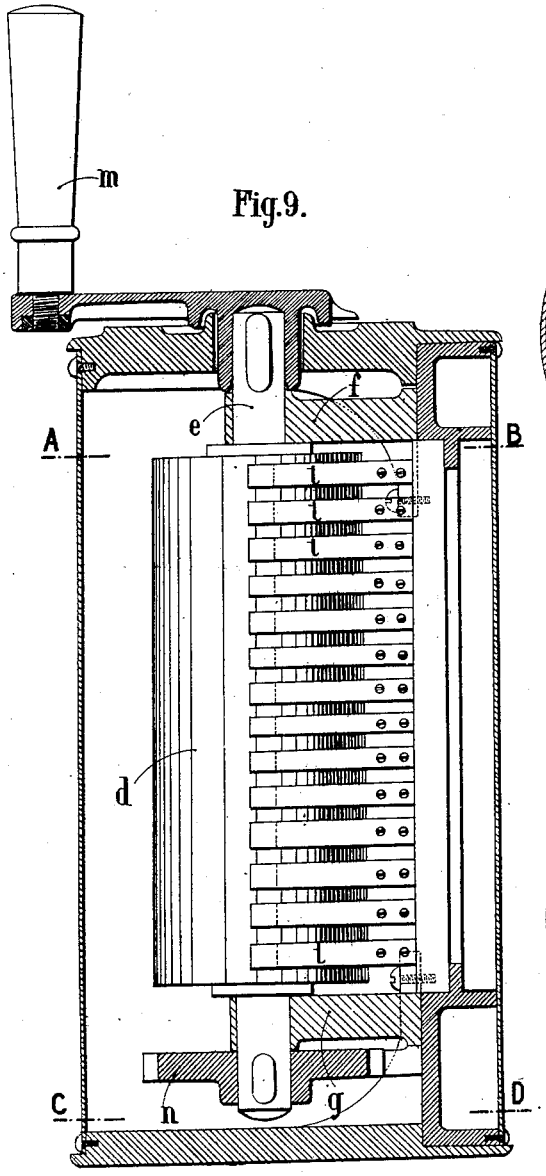


Fig.10.

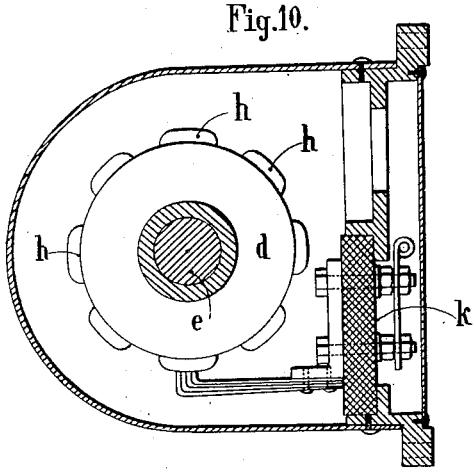
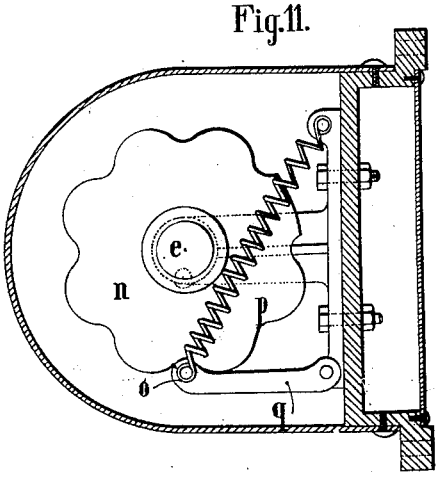


Fig.11.



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UNITED STATES PATENT OFFICE.

MARIE JOSEPH BARREAU, OF PARIS, FRANCE.

MEANS TO BE EMPLOYED IN ELECTRIC TRACTION.

SPECIFICATION forming part of Letters Patent No. 649,797, dated May 15, 1900.

Application filed July 22, 1899. Serial No. 724,865. (No model.)

To all whom it may concern:

Be it known that I, MARIE JOSEPH BARREAU, a citizen of France, residing at Paris, France, have invented certain new and useful Improvements in Means to be Employed in Electric Traction, of which the following is a specification.

This invention relates to electric traction; and it has for its object to render electric motors better adapted for practical use for this purpose than hitherto. In motors of this class as hitherto employed for purposes of traction the amount of effective work varies within wide limits. A motor, for example, constructed to give a normal difference of potential of eighty volts at the terminals and whose useful effect is tolerably good while that standard is maintained does not work efficiently when such normal standard is departed from. While the vehicle travels on a level road and at a slow speed, for instance, the motor will expend far more energy than is necessary for enabling it to operate at that rate of speed.

According to my invention I divide the windings of the field-magnets into sections and connect these sections into sets or groups, and I similarly arrange and connect the cells of the source of electricity, the invention being based upon the fact which I have demonstrated that in order to secure the maximum of effective work notwithstanding variations of speed it is only necessary to maintain the inducing magnetic flux or current at a constant value. So long as this condition is fulfilled the speed will be proportionate to the voltage of the source of electricity.

The invention will be best understood by reference to the accompanying drawings, in which—

Figures 1, 2, and 3 are diagrams illustrating the method of connecting the sections of the field-magnets and the cells of the source of electricity as applied to a "shunt-motor" into sets or groups. Fig. 4 summarizes the three first-mentioned diagrams, and it illustrates the connections to be made both for stoppages and for backward motion. Figs. 5, 6, 7, and 8 are corresponding views of arrangements or connections to be adopted in the case of a "series" motor. Figs. 9, 10, and 11 represent what I term my "combiner," being a device for forming the various groups as required, Fig. 9 being an axial longitudinal section thereof, Fig. 10 a section on the line A B, Fig. 9, and Fig. 11 a section on the line C D, Fig. 9.

The simultaneous and parallel grouping of the sections of the field-magnets and the cells of the battery, respectively, suffices to maintain a constant flux or motion of current, and consequently to impart to the vehicle a speed proportionate to the difference of potential at the terminals of the motor whether such motor be a shunt or a series motor.

Supposing a motor intended to operate at three different rates of speed has to be dealt with, its field-magnets will be divided into four sections, and the battery by which it is fed will also be divided into four parts. To simplify the illustration, I will assume that the four field-magnet sections have the same resistance and that the four parts of the battery are all alike, and I will further suppose that the voltage of the cells of the battery will remain constant, which will be correct if the battery be sufficiently powerful.

Let e express the constant electromotive force of each of the four parts of the battery, r the resistance of each of the four field-magnet sections, and n the number of inducing spirals or convolutions in each section. Then,

First. If the four parts of the battery be connected in series the electromotive force at the binding-screws will be $4\,e$. If the same mode of connection be adopted with regard to the field-magnet sections, their resistance will be $4\,r$. The current passing through them will have an intensity of

$$1 = \frac{4\,e}{43} = \frac{e}{r}.$$

The value of the "inducing-flux," in ampere revolutions, will therefore be

$$f = 4\,i\,n,$$

while the speed of the carriage will be

$$V^1 = k\,\frac{4\,e}{4\,i\,n} = k\,\frac{r}{n},$$

k being a constant coefficient for the motor in question.

Second. If the parts of the battery, and also, consequently, the field-magnet sections, be connected as represented in Figs. 2 and 6, the electromotive force at the binding-screws will be 2 e, while the resistance in the field-magnets will be

$$\frac{r}{2}+\frac{r}{2}=r$$

and the intensity of the current passing through them 2 i; but each section will be traversed only by a current of an intensity i, so that the flux will be

$$f=4\,i\,n$$

and the speed

$$V^2=k\,\frac{2\,e}{f}=\frac{1}{2}\,V^1.$$

Third. If the four parts of the battery and likewise the four field-magnet sections be coupled in parallel, Figs. 3 and 7, the resulting electromotive force will be e, the resistance $\frac{r}{3}$, and the intensity of current 4 i. Through each of the sections there will pass a current i. Hence the flux will always be

$$f=4\,i\,n$$

and the speed

$$V^3=k\,\frac{e}{f}=\frac{1}{4}\,V^1.$$

A current-inverter arranged either in the inducing-circuit or in the induced circuit will while altering the direction of the current produce in the rearward direction three speeds equal to the three different speeds just defined as applying to the forward motion.

Figs. 4 and 8 give diagrams of the connections producing the three speeds hereinbefore mentioned and also the connection required for the stoppage during which the accumulators are charged and that which will bring about one speed in the rearward direction. In these figures the four parts of the battery are shown at a, the four sections of the field-windings at d, and the induced armature at c. All the positive poles are designated by odd numbers from 1 to 17 and all the negative poles by even numbers from 2 to 18.

The connections represented at V^0 correspond to the stoppage of the vehicle. It will be seen that all connections except those of the battery are broken off. By conducting the current from the source of electricity to the contacts or poles at 1 and 8 the storage-cells may be charged.

The connections represented at V^1 correspond to the full speed, Fig. 1. Similarly the position V^3 corresponds to Fig. 2 and the position V^2 to Fig. 3, and the position V^4 corresponds to the position V^3 and to Fig. 3, except that here the poles 17 and 19 of the armature have been exchanged, and consequently the current in this armature takes an opposite direction in each case. My invention is applicable to compound motors by dividing the two inducing-circuits at the same time and connecting them into groups in the manner hereinbefore described. It is quite immaterial what may be the type or construction of the motor. For example, it may be bipolar or multipolar with multiple induced armatures. The number of sections which I provide in the winding of the field-magnet and the number of parts into which I divide the battery may vary according to the number of different groups or connections I wish to obtain. My invention may be applied not only to traction, but to navigation as well as to the transmission of motive power.

I have hereinbefore indicated the conditions which are most favorable to the attainment of the desired result; but in the event of the potential of the source of electricity being constant the division of the field-magnets into sections would result in still further varying the speed by causing the flux of the current to vary. The final result, however, would not be quite as good as in the case first indicated.

The different connections between the cells of the source of electricity and the sections of the field-magnets may be effected by means of apparatus represented in Figs. 9, 10, and 11. This apparatus consists of a cylinder d, of insulating material, secured to a shaft e, which revolves in bearings $f\,g$, secured to the frame of the apparatus. Upon this cylinder are arranged a number of metal keys h, connected with each other, so as to be capable of forming the connections at the different phases illustrated by the diagrams, Figs. 4 and 8. In front of the keys h there are arranged brushes i, connected to the several component elements of the motor and to the cells of the battery by means of connections which secure the supports or "feet" of the brushes to a plate of insulating material k. On one of the extremities of the shaft e a removable crank m can be connected, (by a groove and feather or otherwise,) which serves to throw the mechanism into gear, the said crank m supporting an index-hand which points to any one of a number of guide-marks on the end or top plate or other convenient part of the apparatus. This plate and the crank are of the shape shown, so that when the crank is in position water cannot gain access to the interior of the apparatus through the aperture in the end or top plate. To the opposite end of the shaft there is secured a star-wheel n, in the notches of which a roller o engages, which roller is pressed against the said star-wheel by a spring p and is supported by a short connecting-rod or link q. The recesses in the star-wheel correspond to the positions of the keys h opposite the brushes, and the configuration of the notches or slots is calculated to enable connections to be made and broken instan-

taneously by means of this device, which it is necessary to do to avoid sparking. The apparatus is inclosed in an outer casing. The number of keys and brushes depends upon the number of different connections to be provided for.

Having now particularly described and ascertained the nature of the said invention and in what manner the same is to be performed, I declare that what I claim is—

In combination with electric motors a device adapted to produce varying speeds and to maintain practically constant the amount of effective work of the motor during the various stages of its operation, the said device consisting in a division of the field-magnet windings into sections, and of means for coupling these sections in a parallel and simultaneous manner with the cells of the source of electricity, according to the speeds to be obtained, substantially as hereinabove described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

MARIE JOSEPH BARREAU.

Witnesses:
EDWARD P. MACLEAN,
ALFRED FREY.