

No. 772,872.

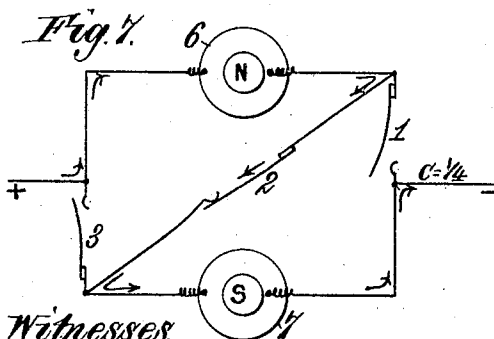
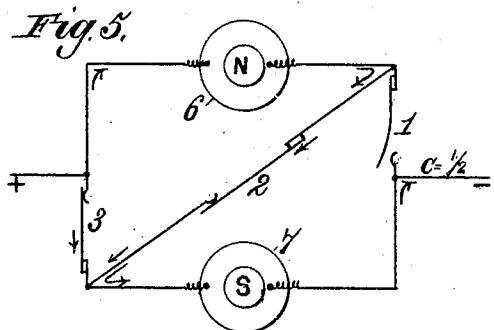
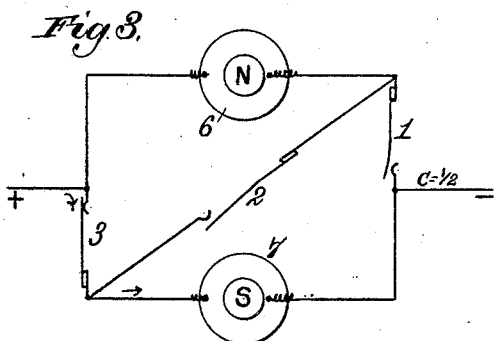
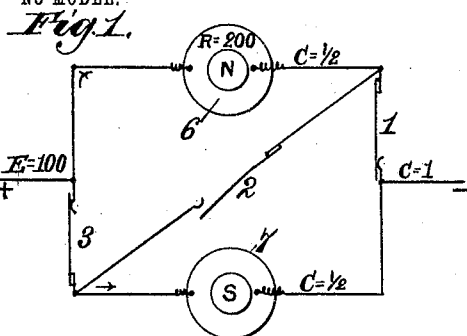
PATENTED OCT. 18, 1904.

G. H. DAVIS.

CURRENT SAVING AND SPARK REDUCING DEVICE FOR ELECTROMAGNETS.

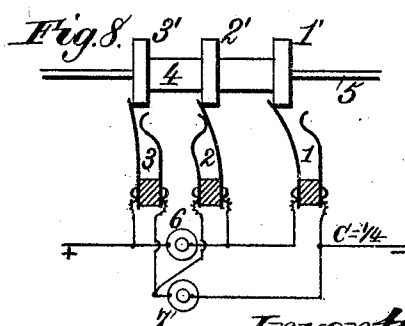
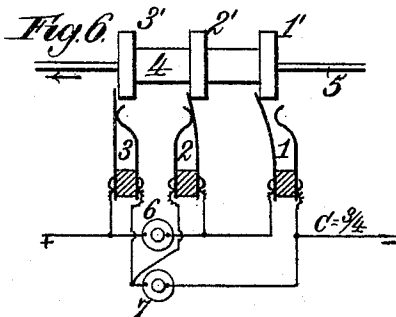
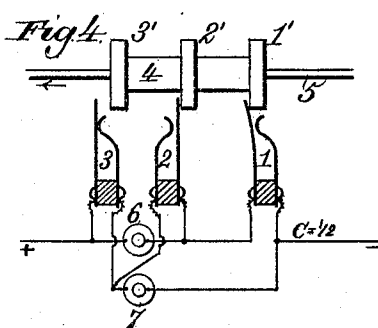
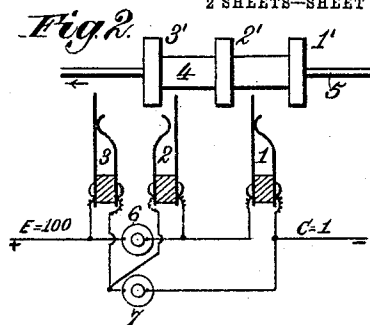
APPLICATION FILED DEC. 8, 1900.

NO MODEL.



Witnesses
Robert Swatt
J. Granville Meyers

2 SHEETS—SHEET 1.



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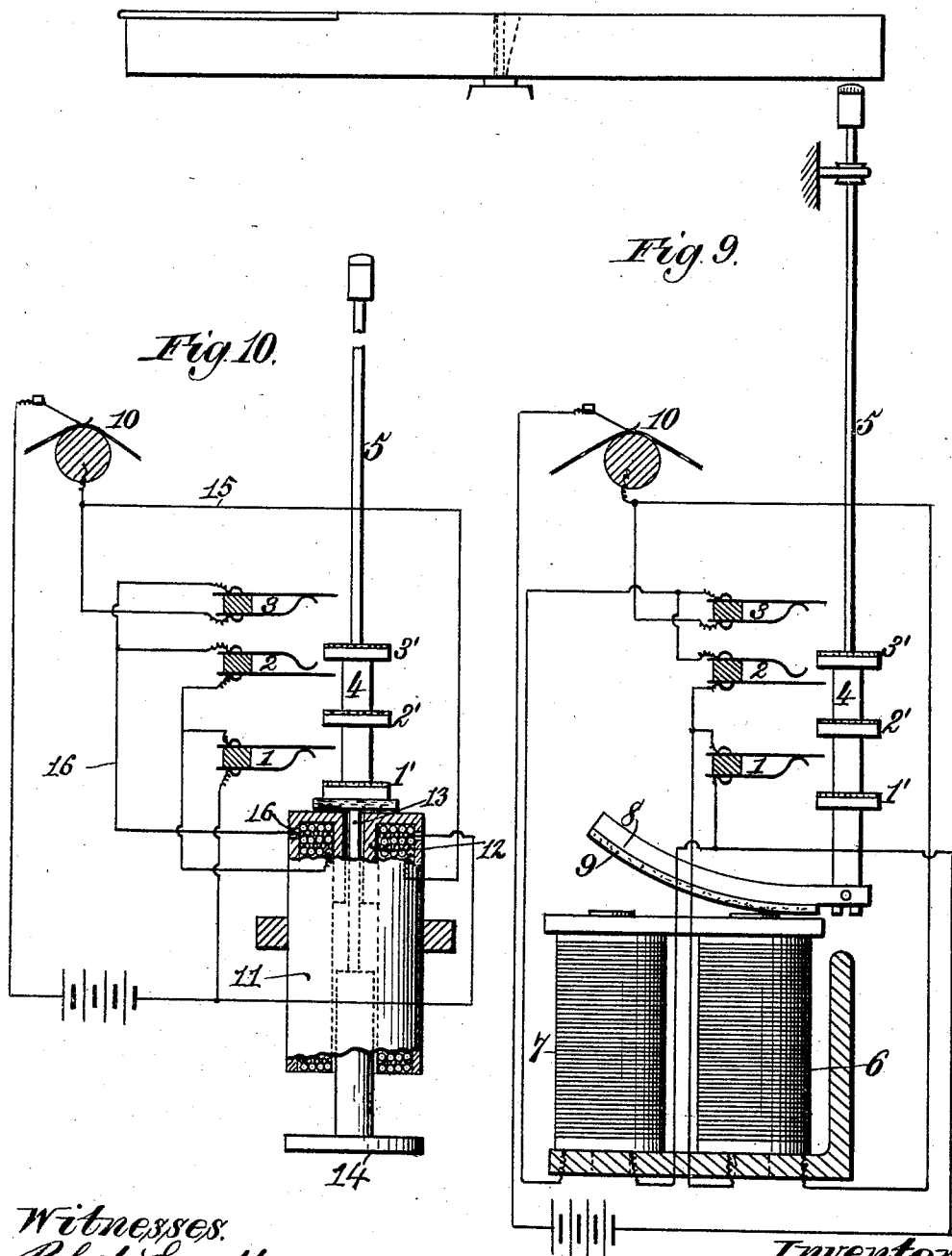
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CURRENT SAVING AND SPARK REDUCING DEVICE FOR ELECTROMAGNETS.

APPLICATION FILED DEC. 8, 1900.

NO MODEL.

2 SHEETS—SHEET 2.



Witnesses:
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UNITED STATES PATENT OFFICE.

GEORGE HOWLETT DAVIS, OF BROOKLYN, NEW YORK.

CURRENT-SAVING AND SPARK-REDUCING DEVICE FOR ELECTROMAGNETS.

SPECIFICATION forming part of Letters Patent No. 772,872, dated October 18, 1904.

Application filed December 8, 1900. Serial No. 39,150. (No model.)

To all whom it may concern:

Be it known that I, GEORGE HOWLETT DAVIS, a citizen of the United States of America, and a resident of Brooklyn, in the county of Kings, State of New York, have invented certain new and useful Improvements in Current-Saving and Spark-Reducing Devices for Electromagnets, of which the following is a specification.

As before recited, my present invention relates to improvements in current-saving and spark-reducing devices for electromagnets, and is especially valuable in all instances where it is desirable to either reduce the expenditure of electrical energy to a minimum or where it is desired to minimize the spark at the point where the contact is made and broken—as, for instance, when the perforations in a thin sheet of paper are made to open or close an electric circuit, as in the case of an electrically-operated musical instrument, such as the pianophone.

In a low-voltage circuit, such as that generated by two cells of a storage battery, the sparking at the point of contact is not usually great enough to char or cut a thin paper sheet at the breaking of the current; but where storage batteries or any form of primary battery is employed the highest possible efficiency is necessary, as otherwise the charge or life of the battery would soon be exhausted, and in such cases as this my invention tends to greatly increase the life of a battery by greatly reducing the current which would ordinarily flow through the magnets.

In devices or magnets made to operate from a high voltage, such as the ordinary one-hundred-and-ten-volt lighting-circuits, the thing of prime importance is to reduce the sparking at the point of contact, and this my invention effects, while at the same time it necessarily saves current, although when a device such as a self-player is attached to a lighting-circuit the amount of current consumed is seldom calculated or thought of.

Having given an instance in which the saving of current was of prime importance and another instance in which it was not only important, but absolutely necessary to reduce the current prior to the breaking of the circuit,

I will now proceed to a detailed description of my invention.

In the accompanying drawings, Figures 1, 3, 5, and 7 are diagrammatical views especially designed to clearly illustrate the four different phases of resistance that the two helices of any ordinarily-wound electromagnet assumes when controlled by my device. Figs. 2, 4, 6, and 8 are views of my devices in the four different operative positions shown by their corresponding Figs. 1, 3, 5, and 7. Fig. 9 illustrates my improvement as applied to an ordinary two-helix electromagnet having as its only novel feature a rocking armature. Fig. 10 shows my invention as applied to a differentially-wound solenoid the two parallel windings of which are both connected to my devices.

The broad spirit of this invention is the provision of means whereby any ordinary electromagnet of the horseshoe or other two-helix form may be so connected that when its armature or some part connected thereto moves its connections are successively changed from (first) multiple, (second) to single series, (third) to a compound multiple series, and (fourth) to double series, all of the changes being diagrammatically shown in the order named by Figs. 1, 3, 5, and 7 and semistructurally by Figs. 2, 4, 6, and 8.

Like numerals of reference indicate corresponding parts throughout the several views.

Numeral 1 then indicates what I will term the "first" contact, 2 the "second" contact, and 3 the "third" contact. Likewise 1', 2', and 3' indicate coöperating collars or projections upon a sleeve 4, secured to a rod 5, connected to and moving with any form of armature of any style of magnet having two helices or windings.

One helix-winding, N, of the magnet is indicated by 6 and the other, S, by 7.

We will assume that each of the windings 6 and 7 have a resistance of two hundred ohms R and that the line has an electromotive force E of one hundred volts. Now as the current C is equal to the electromotive force divided by the resistance expressed by $C = \frac{E}{R}$, then

when the contact-collars 1' 2' 3' are in their normal position the current flows in through contacts 1 and 3 in multiple through their respective windings 6 and 7, and the one-half ampere of current thus passing through each winding causes a powerful attraction of the armature to which the rod 5 is supposed to be connected at the point of its greatest movement, as shown in Fig. 9. Now after the armature and rod 5 have made half their movement, as shown in Figs. 3 and 4, then contact-collar 1' has opened contact 1, as clearly shown in Fig. 4, and opens the current through magnet 6, thus leaving only one-half ampere to pass to line through winding 7 only. When the rod 5 has advanced, say, to one-eighth inch farther, as shown in Figs. 5 and 6, contact-button 2' closes contact 2 and the current, as more clearly shown in Fig. 5, passes in compound multiple series through windings 6 and 7, allowing momentarily one-half amperes to pass to the line. A final movement of the rod of one-eighth inch farther and contact-button 3' opens contact 3, thus throwing the windings into regular and direct series and allowing a passage of only one-fourth amperes to the line, as clearly shown by Figs. 7 and 8.

So long as the current remains closed, which in musical instruments is regulated by the length of perforation in the music-sheet, then only one-fourth of the original or initial current can pass, and therefore when an imperforate portion of the thin sheet representing the end of a perforation intervenes between the main points of contact the breakage of the reduced current produces but a slight spark, whereas if the full current or one ampere were flowing at the time the paper, if thin, would be charred or cut to an extent sufficient to run one perforation into another.

Provided a contact is quickly made there is no sparking caused by the making of such contact.

All of the changes above described take place during the infinitesimally short period of time that an actively-energized magnet takes to move at its free end the distance of only one-half inch.

In Fig. 9 the rocker-armature 8 has a felt facing 9, and, as shown, in its normal position the main contact at point 10 would when closed cause a current momentarily to pass through both windings 6 and 7, as will be ascertained by carefully tracing up the circuits. The movement of the armature and rod 5 effects the change, as heretofore described. With my improvements it is possible to get a sufficient blow to strike a piano-key properly with helices only one-half inch in diameter.

The form of solenoid shown in Fig. 10 forms the general subject-matter of my application, Serial No. 36,651, series of 1900, filed November 16, 1900, and need be but briefly described. The helices of the solenoid are surrounded by

an iron jacket 11, and surrounded by the helices is an iron core 12. Through the core 12 loosely passes a rod 13, and attached to the lower end of the rod is the armature 14. The solenoid is provided with two helices or a compound winding, one winding, as 15, being of large wire and the other, 16, of relatively small or fine wire, the latter being so wound as to occupy the spaces left between the larger wire and acts as a resistance and greatly reduces the current when thrown into series with the larger wire. The two helices are successively thrown from multiple to single series, to compound multiple series, and to double or direct series in the same manner as before described.

In Letters Patent No. 576,342, granted to me on February 2, 1897, I show means whereby external resistances are thrown into series with the magnets to diminish the sparking at the break of the line-contacts and also means for effecting the same result by cutting out one winding after the initial movement of the armature, and thereby diminishing the current flowing, because only one winding or helix was left closed for its passage.

It is an important point to be noted that in each of the above instances and likewise in all known means for reducing sparking far more wire is necessary to effect a given resistance than is required in cases where my present invention is applied, and as my device is applicable to every possible form of magnet having two or more winding or helices the monetary saving which this invention effects is only secondary to the saving of current and sparking.

In order to make clear the economy of construction above claimed, we will take the form of magnet shown in Fig. 10 as an example and assume, as before, that each of its helices is wound to a resistance of two hundred ohms and that four hundred ohms is in circuit at time of breaking contact—say by the imperforate portion of a thin paper sheet—and that the initial flow of current should be one ampere in order to effect a given work—such, for instance, as actuating a piano-key—all of which assumption I have found to be true and real in practice.

Now under any other method of producing the same initial and final flow of current an extra resistance of at least two hundred ohms is necessary either in the form of an external resistance or as an added resistance to the windings, and in either case the added resistance is dead after the initial movement, whereas with my present invention applied to an ordinary magnet the windings are not dead for any conceivable period of time. In automatically-operated musical instruments there are generally either fifty-eight or sixty-five magnets employed, and to obviate the employment of two hundred ohms on each magnet is an important monetary saving.

The adoption of some one or the other of the methods of reducing sparking as invented by me and covered by the patent and patent application before enumerated is absolutely essential to the proper working of an electrical piano-player operated by a thin perforated sheet, and while this present invention has been disclosed in connection with this class of apparatus because of my great familiarity therewith still I wish it to be distinctly understood that I do not in any degree limit the scope of this present invention to any class of apparatus, but rather seek to extend my invention to all classes of electromagnets however and wherever used.

What I claim as new, and desire to secure by Letters Patent, is—

1. The combination with an electromagnet having two or more helices or windings, of an armature controlled by said magnet, a rod movable with the armature, and means carried by said rod for changing the flow of current through said helices from multiple to series without interrupting said current.

2. The combination with an electromagnet having two helices or windings, of contacts or switches to which the four or more ends of said windings are connected, an armature controlled by said magnet, a rod movable with the armature, and means carried by said rod for opening and closing said contacts and thereby throwing the current from a multiple connection to a series connection without interrupting said current.

3. The combination with an electromagnet having two or more helices or windings, one of said helices being included in a normally closed circuit, and an armature controlled by said magnet, of means actuated by said armature for throwing the other helix out of circuit with said first-named helix or into multiple or series circuit therewith, substantially as described.

4. The combination with an electromagnet having two or more helices or windings normally connected in multiple or parallel, of an

armature movably located within the magnetic field of the magnet, and means thrown into operation by the movement of the armature for successively changing the connections of the two helices from multiple to single series, to compound multiple series, and to double or direct series, without actually interrupting the current through both helices, substantially as described.

5. The combination with an electromagnet having two helices or windings normally connected in multiple or parallel, of an armature movably located within the magnetic field of the magnet, a rod movable with the armature, switch-contacts to which the terminals of the helices are connected, and collars on the said rod and arranged to successively engage said switch-contacts to change the connections of the two helices from multiple to single series, to compound multiple series, and to double or direct series, in the order named and without interrupting the current, substantially as described.

6. The combination with an electromagnet having two or more helices or windings, of an armature controlled by said magnet, and means actuated by said armature for changing the flow of current through said helices from multiple to series without interrupting said current.

7. The combination with an electromagnet having two helices or windings, of switches to which the ends of said windings are connected, an armature controlled by said magnet, and means actuated by the armature for opening and closing said switches and thereby throwing the current from a multiple connection to a series connection without interrupting said current.

Signed by me at Brooklyn, New York, this 5th day of December, 1900.

GEORGE HOWLETT DAVIS.

Witnesses:

WM. H. AITKEN,
CLEMENT T. TAYLOR.