No. 634,198. Patented Oct. 3, 1899.

# C. L. BUCKINGHAM & E. GERMANN.

## METHOD OF AND MEANS FOR PREVENTING ELECTRIC SPARKING.

(Application filed June 26, 1896.)

(No Model.)

*Fig. 2,*

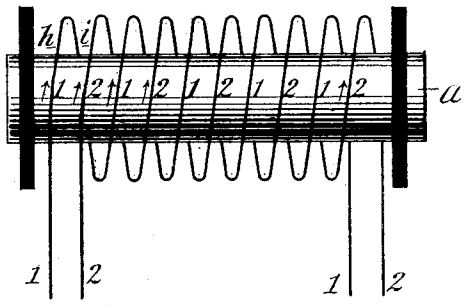



*Fig. 1,*

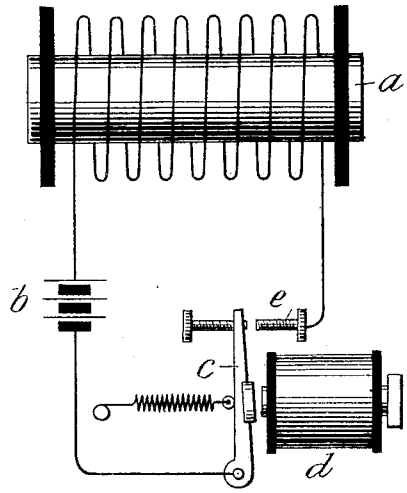



*Fig. 3,*

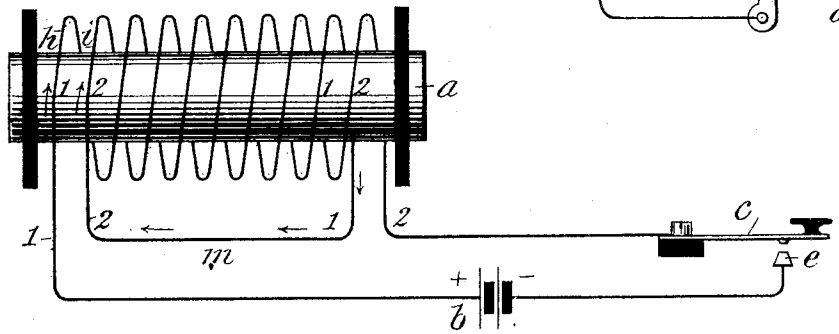



*Fig. 4,*

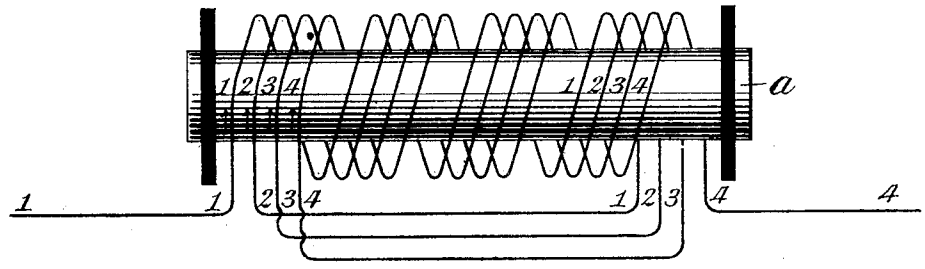
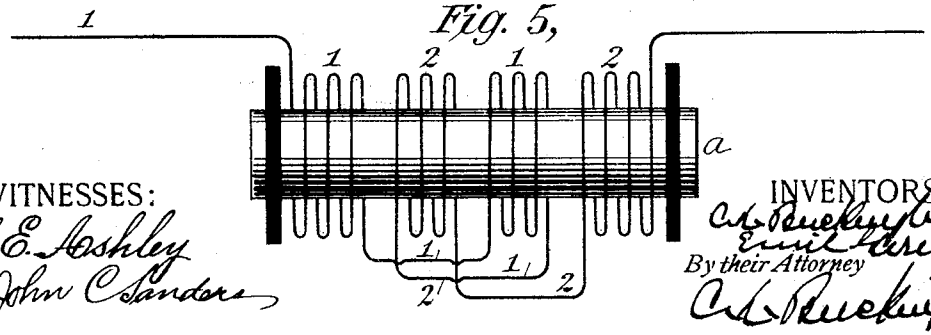



*Fig. 5,*

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# UNITED STATES PATENT OFFICE.

CHARLES L. BUCKINGHAM AND EMIL GERMANN, OF NEW YORK, N. Y., ASSIGNORS, BY DIRECT AND MESNE ASSIGNMENTS, TO THE WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK.

## METHOD OF AND MEANS FOR PREVENTING ELECTRIC SPARKING.

SPECIFICATION forming part of Letters Patent No. 634,198, dated October 3, 1899.

Application filed June 26, 1896. Serial No. 597,064. (No model.)

*To all whom it may concern:*

Be it known that we, CHARLES L. BUCKINGHAM, of the city and county of New York, and EMIL GERMANN, of New York, (Brooklyn,) county of Kings, and State of New York, citizens of the United States, have discovered a new and useful improvement in the method of and means for preventing electric sparking at contacts in circuits, including electromagnet-coils or other coils or conductors in which a self-inductive or sparking capacity exists, of which the following is a specification.

Ordinarily in a circuit, including a coil of wire surrounding an iron core, large sparks will appear upon breaking said circuit. This, however, we have found may be very largely avoided by a special winding involving no greater length of wire for an equal magnetic pull or additional expense in construction.

In the drawings, Figure 1 represents a circuit, including an electromagnet-coil surrounding an iron core, and an apparatus for opening and closing the circuit. In this case there is a continuous winding from one convolution to the next throughout the coil. Fig. 2 shows a magnet wound with two parallel wires 1 2. In this case adjoining convolutions are parts of separate coils or wires. Fig. 3 shows an electromagnet of the form shown in Fig. 2, with the two separate coils joined together to form a circuit, including battery *b*, with a key *c* and contact *e*, or other suitable device for opening and closing the circuit. Fig. 4 shows an arrangement of four wires instead of the two shown in Fig. 2. Fig. 5 shows a magnet wound with alternate sections rather than with a single winding of two wires side by side.

With the arrangement shown in Fig. 1 upon opening the circuit between armature-lever *c* and contact *e* a large spark will appear. Between the lever *c* and contact *e* in Fig. 3, however, the spark is many times reduced.

In the arrangement of Fig. 3 the right end of the wire 1 is carried back to the left end of wire 2, thus forming the convolutions of the magnet into a continuous circuit, but in this case the convolution *h* of wire 1 and the convolution *i* of wire 2 are separated by practically one-half of the voltage consumed by the coil or electromagnet, and the same is true of neighboring convolutions throughout the coil—that is to say, every two neighboring convolutions are separated by one-half of the voltage between the two extreme terminals of the device. This is apparent from the fact that current proceeding from the positive pole of battery *b* will run throughout all the convolutions of the wire 1 before it reaches the convolution *i* of wire 2. Of course if the magnet were wound, as in Fig. 1, adjoining convolutions would be separated by only a very small voltage.

It is of course not necessary that the two wires 1 and 2 be wound side by side as two strands of one, as approximately the same result will be obtained if the two wires were wound in small alternate sections, as shown in Fig. 5.

Thus it is found that by winding an electromagnet or solenoid with two wires and connecting them as shown in Fig. 3 the spark at points of rupture may be almost wholly eliminated. The same result may also be approximately obtained by winding the magnet with three, four, or more wires and connecting them in such manner that all the convolutions of the magnet shall be brought into one continuous circuit. An arrangement of four wires instead of two is shown in Fig. 4.

It is well known that the presence of an iron core will greatly increase sparking effects. Our invention, however, is useful, though in a less degree, where only solenoids are used.

What we claim, and desire to secure by Letters Patent, is—

The method of protecting contacts against destructive sparking in circuits including electromagnets or solenoids traversed by currents which would otherwise produce such sparking, which consists in winding the magnets with two or more wires and connecting

said wires in such manner that when two are employed the terminal end of the first shall be joined with the beginning of the second, or when three are employed the terminal of the first shall be joined with the beginning of the second and the terminal of the second with the beginning of the third, and so on, depending upon the number of strands employed, the reciprocal action of the windings upon each other serving to practically neutralize the tendency to destructive sparking, in the manner shown and described.

New York city, New York, June 25, 1896.

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Witnesses:
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