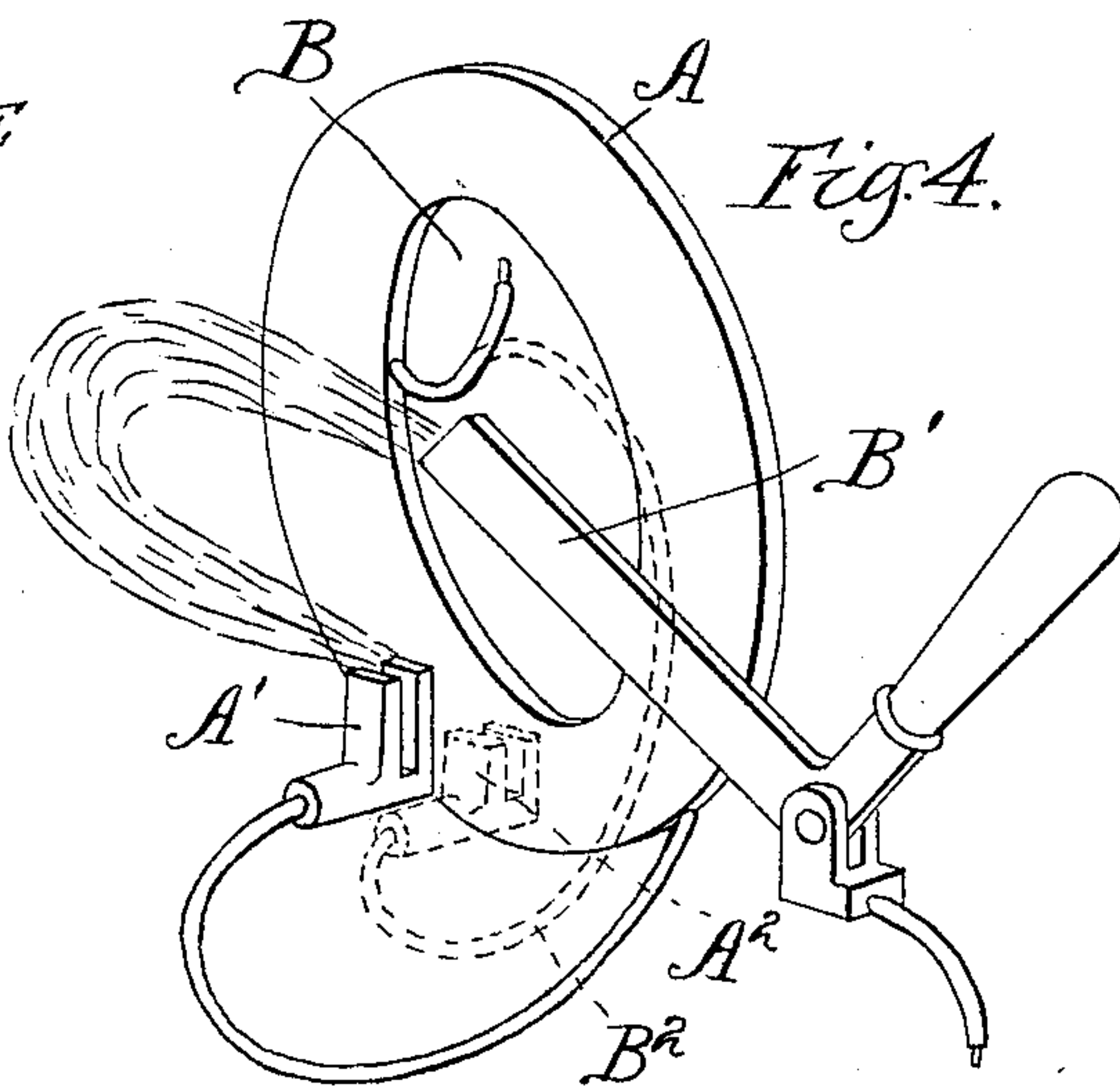
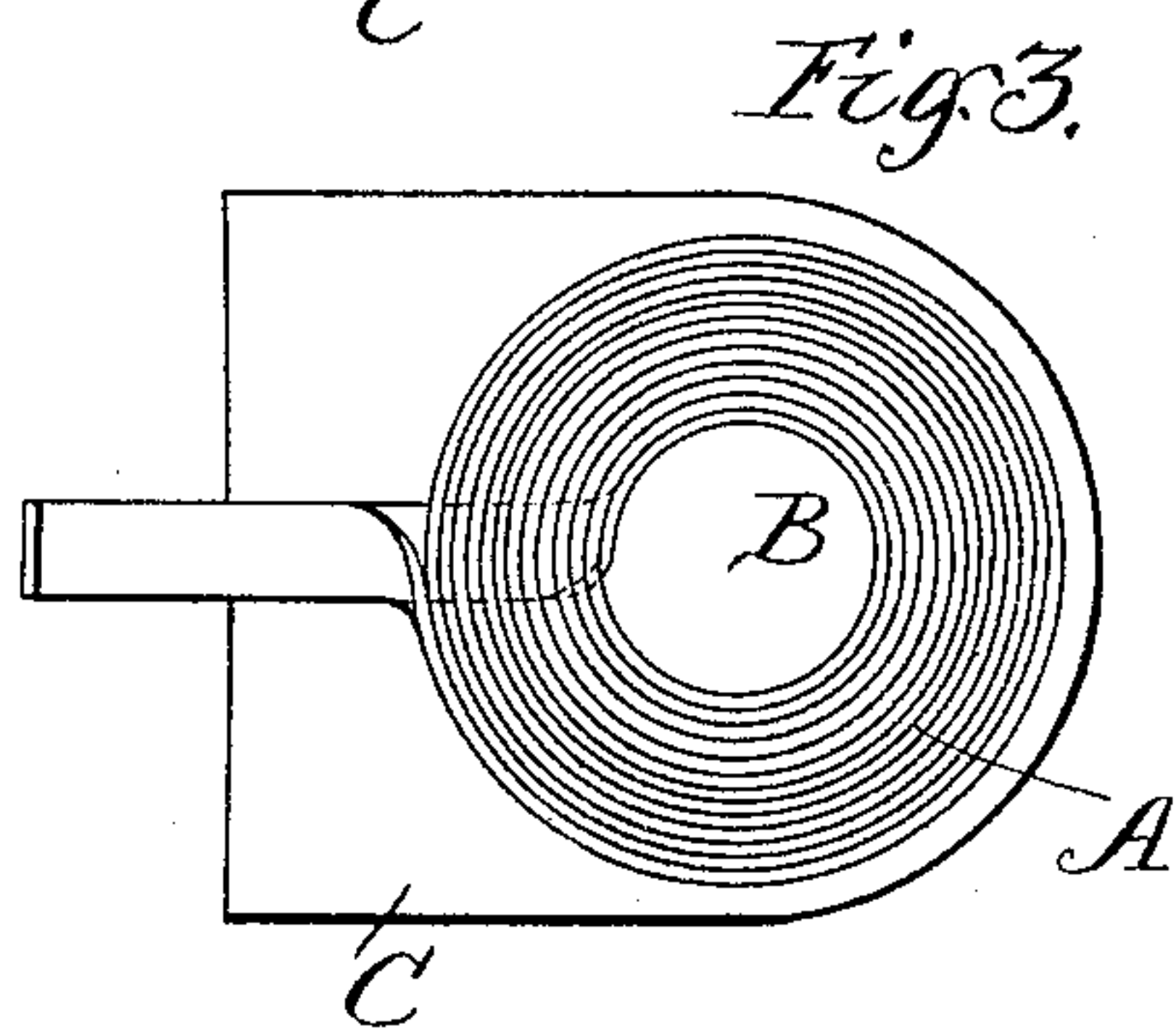
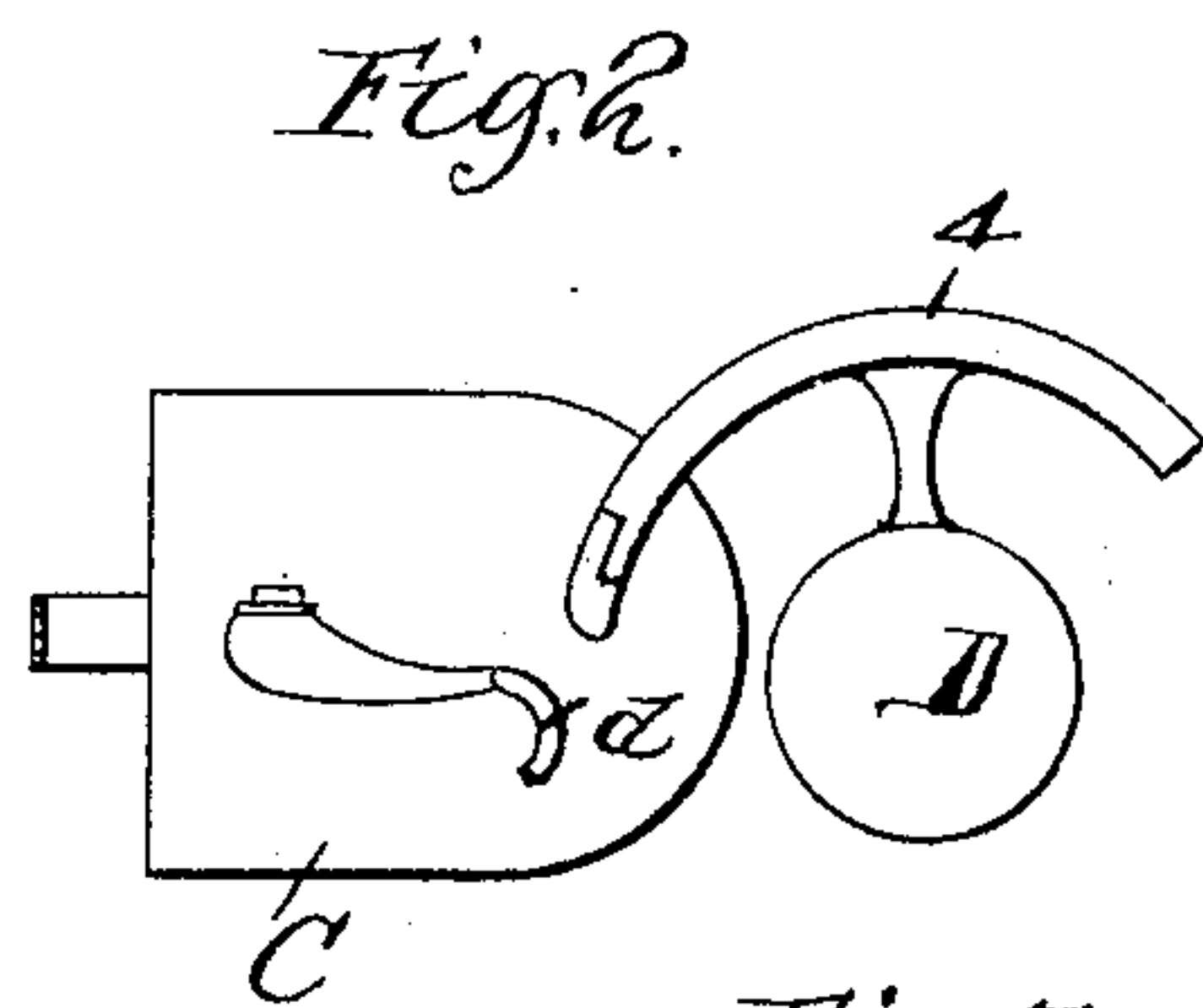
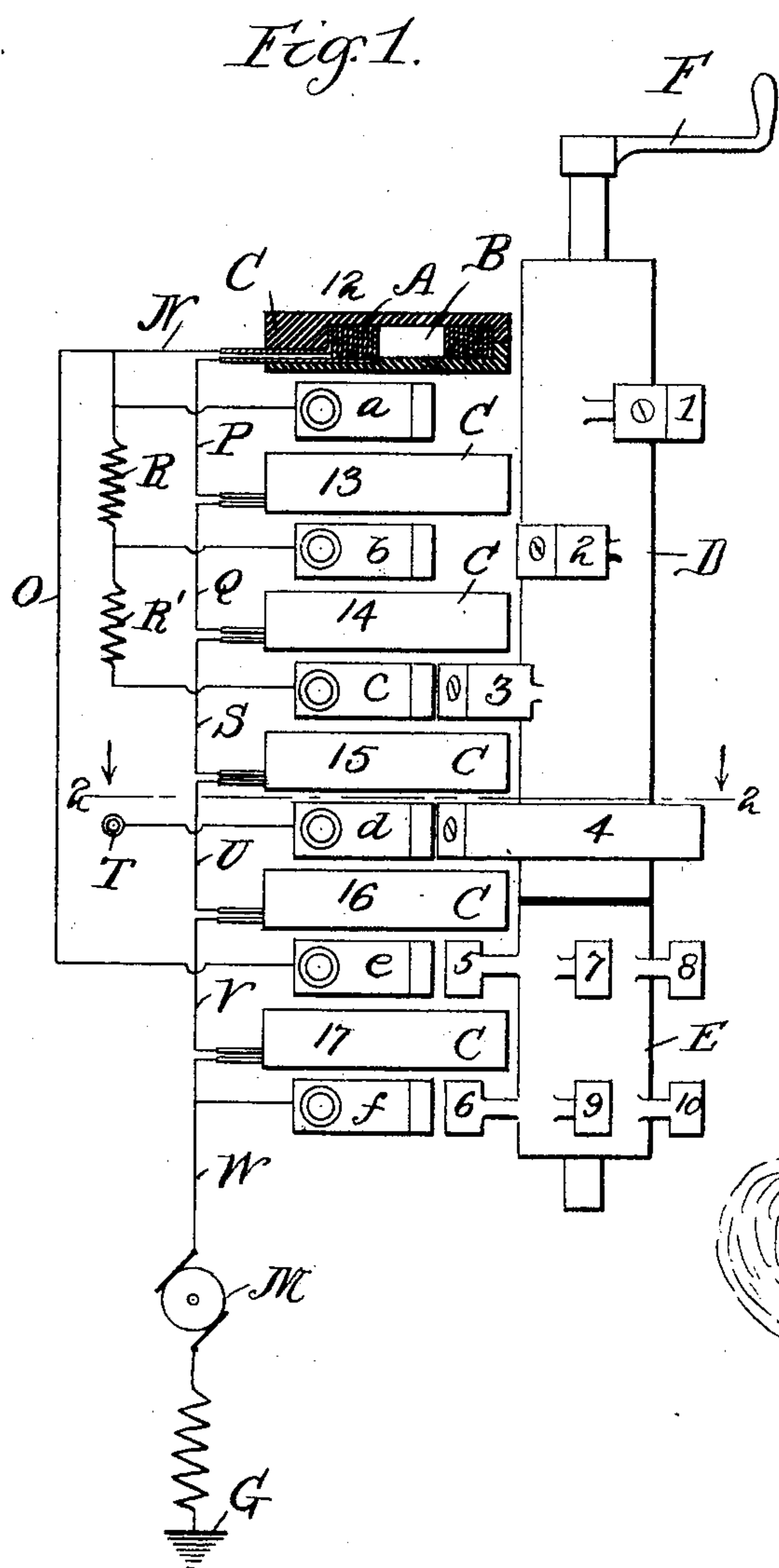


(No Model.)

S. H. SHORT.
SOLENOID BLOW-OUT FOR DISPERSING ARCS FORMED IN BREAKING
ELECTRIC CIRCUITS.

No. 601,717.

Patented Apr. 5, 1898.



Witnesses.

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UNITED STATES PATENT OFFICE.

SIDNEY HOWE SHORT, OF CLEVELAND, OHIO.

SOLENOID BLOW-OUT FOR DISPERSING ARCS FORMED IN BREAKING ELECTRIC CIRCUITS.

SPECIFICATION forming part of Letters Patent No. 601,717, dated April 5, 1898.

Application filed November 1, 1897. Serial No. 657,051. (No model.)

To all whom it may concern:

Be it known that I, SIDNEY HOWE SHORT, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a new and useful Solenoid Blow-Out for Displacing, Dispersing, or Extinguishing Arcs Formed in Breaking Electric Circuits, of which the following is a specification.

This invention relates to a solenoid blow-out for displacing, dispersing, or extinguishing arcs formed in breaking electric circuits.

The object of the invention is to provide simple and efficient means for displacing, dispersing, or extinguishing arcs formed in breaking circuits.

A further object is to provide means for displacing, dispersing, or extinguishing arcs formed in breaking electric circuits wherein the blow-out, displacing, dispersing, or extinguishing power is directly proportional to the strength of the arc-forming current.

Further objects of the invention will appear more fully hereinafter.

The invention consists, substantially, in the construction, combination, location, and arrangement, all as will be more fully hereinafter set forth, as shown in the accompanying drawings, and finally specifically pointed out in the appended claims.

Referring to the accompanying drawings and to the various views and reference signs appearing thereon, Figure 1 is a view in side elevation, a part in vertical section and parts in diagram, of a controller, showing the principles of the invention applied thereto. Fig. 2 is a transverse section on the line 2 2, Fig. 1, looking in the direction of the arrows. Fig. 3 is a detached detail view in plan of the solenoid blow-out coil. Fig. 4 is a view in perspective showing the application of the principles of the invention to another form of circuit-breaker.

The same part is designated by the same reference sign wherever it occurs throughout the several views.

It is well known that when an electric circuit charged with a current is broken a flash or arc is produced at the point where the break is effected. The intensity of this spark is increased in proportion to the strength of the current in the circuit. In the case of

motors or generators employing or generating currents of high potential the sparking resulting from breaks in the circuit is destructive to the contacts employed in effecting the break, and it is a matter of material importance to blow out, displace, disperse, or extinguish such arcs in order to prevent the rapid burning out of the contacts and adjacent parts. Heretofore it has been endeavored to remedy this defect by employing magnets, either permanent or electro magnets, so relatively arranged as to create a magnetic field at the point where the rupture or break in the circuit is to be made in order to break, displace, disperse, or extinguish the arc by virtue of the tendency of an arc to move out of or into a magnetic field according to its direction. I have found, however, that such prior efforts are objectionable by reason of the fact that the conducting-cores of the magnets employed afford short circuits for the arc. In the case of an iron core—such, for instance, as shown in the electromagnets of the blow-outs in the patents to Thomson, No. 283,167, dated August 14, 1883, and Potter, No. 524,396, dated August 14, 1894—the lines of force in the magnetic circuit attain their maximum effect when the magnet-core becomes saturated, and as the current strength in the circuit to be broken increases after the point of saturation is attained the blow-out, displacing, dispersing, or extinguishing effect of the magnetic circuit does not and can not correspondingly increase, and hence the destructive and objectionable sparking is experienced in the case of heavy currents. The same objectionable results follow and in a more marked degree in the case of permanent magnets. In such case the magnetic lines of force in the magnetic field always remain permanent and do not vary in any degree with variations in the current strength of the circuit to be broken, and hence a failure to properly blow out, disperse, or extinguish heavy or excessive arcs results.

It is the purpose of the present invention to provide a construction and arrangement wherein the use of magnets is wholly avoided, thus also avoiding the objectionable features above noted, wherein the blowing-out, dispersing, or extinguishing power is always directly proportional to the strength of the

current in the arc to be blown out, and to this end I employ a different principle from that heretofore employed for the same purpose.

5 In carrying out the principles of my invention I provide a coil A, composed of a suitable number of spiral or convolute layers of suitable conducting material, preferably, though not necessarily, in the form of a ribbon suitably covered with insulating material previous to winding into spiral or convolute form, said coil being suitably tapped over to hold it in convenient shape. This coil
10 A is formed with an open space B of suitable dimensions at the center thereof, and the ends of said coil are suitably coupled up in the circuit to be broken. In use the coil A is arranged with the space B in the center thereof in proximity to the contact to be broken. If desired, and preferably, the coil may be inclosed in a box or casing C of suitable material, such as vulca-boston, whereby it will be protected from the flame of the arc. Thus it will be
20 seen that I provide an arrangement wherein the current in the circuit to be broken flows through the strip of conducting material throughout its entire length, and hence traverses a path encircling many times the open space at the center of the coil, thereby creating in such space an electrical condition
30 possessing the power of displacing, dispersing, or extinguishing any arc formed upon separating the adjacent contacts. It will also be seen that this electrical condition is entirely dependent upon and is at all times directly proportional to the strength of the current traversing the coil, and the suppression, displacement, extinguishment, or blowing out of the arc is accomplished without the
40 use of either permanent or electro magnets.

I will now describe the application of my invention to controllers, particular reference being had to Figs. 1 and 2, wherein reference signs D E designate sections of the controller-cylinder; F, the operating-handle therefor; *a b c d e f*, suitable stationary contacts, and 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 corresponding and cooperating contacts carried by the controller-cylinder. The coils 12, 13, 15, 16, and 17,
50 constructed as above described, are arranged with the open spaces at the center thereof adjacent to or opposite the points, respectively, where the relatively movable and stationary contacts separate from each other when the circuits controlled thereby are to be broken.
55 It will be observed that contacts 3 and 4 are slightly in advance of contacts 5 and 6 and that contact 2 is similarly slightly in advance of contacts 7 and 9 and contact 1 in advance of contacts 8 and 10. The purpose of this relative arrangement of the several contacts will presently more fully appear. The several coils 12, 13, 14, 15, 16, and 17 are connected up in series through conductors P Q
60 S U V. The resistances R R' are connected to contacts *a*, *b*, and *c*.

T represents the trolley connection; M, the

motor; G, the ground connection therefor; O, a conductor connecting one terminal of coil 12 to contact *e*; W, a connection from
70 one terminal of coil 17 to motor M. From this arrangement it will be seen that when the controller-cylinder is moved into position for contacts 3 and 4 to make connection with contacts *c* and *d*, respectively, current will
75 flow from trolley T to contact *d*, contact 4, contact 3, contact *c*, resistances R R', connection N, spiral 12, connection P, spiral 13, connection Q, spiral 14, connection S, spiral 15,
80 connection U, spiral 16, connection V, spiral 17, connection W, motor M, to ground. When, however, the controlling-cylinder is moved into "running" position—that is, into "on" position—contacts 5 and 6 are brought into
85 connection, respectively, with contacts *e* and *f*. Therefore current traverses the path above described through resistances R R', thence through connection O to contact *e*, contacts 5, 6, *f*, and W, through motor M, to ground. Therefore during the operation of the motor
90 with the controller in "on" position the blow-out coils are all cut out of working circuit, and hence there is no consumption of energy of the working current by reason of such current traversing the circuit of said several
95 coils. When, however, the controller-cylinder is moved toward "off" position, the contacts 5 and 6 leave their cooperating contacts *e* and *f*, while contacts 3 and 4 are still contacting with their cooperating contacts *c* and
100 *d*, thereby again cutting into live circuit, the solenoid-coils preparatory to a rupture of the circuit by said contacts 3 and 4 leaving their cooperating contacts *c* and *d*, and hence creating the electrical condition by which the arc
105 resulting from such rupture is dispersed, extinguished, or blown out. By moving the controller-cylinder into position to bring contacts 2 and 1, respectively, into engagement with contacts *b* and *a* the resistances R R' are
110 successively cut out in the ordinary manner of controllers; but by arranging the contacts 2 and 1 slightly in advance, respectively, of contacts 7 and 9 and 8 and 10 it will be readily seen that when the controller is standing
115 in running position with any one or form of controller wherein any desired circuit variation is introduced or regulated and whether one or several motors are employed. The specific form of controller shown, therefore,
120 is merely illustrative of a practical embodiment of the principles of my invention.

It is obvious that the principles of the invention are equally well adapted for any kind of switch or circuit-breaker. For instance, I
125 have shown in Fig. 4 its application to a knife-edge switch. The electrical blow-out coil A is arranged with its central open space B opposite or in proximity to the contact A', between which and the contact-lever B' the arc
130 is formed at the moment said lever leaves said contact, and hence the electrical condition created in said open space by the current in the circuit to be broken traversing the

path encircling many times said open space effects a blowing out of the arc, as indicated.

If desired, an auxiliary contact (indicated in dotted lines at A²) may be arranged in a shunt-circuit, (indicated in dotted lines at B²), whereby when contact-lever B' is in position to close the main circuit through contact A' the coils of the blow-out conductor are shunted, but the arrangement is such that contact between lever B' and auxiliary contact A² is broken in advance of a break between said lever and contact A' when said lever is moved in a direction to open the circuit, thereby again including the spiral coils in the circuit to be broken just prior to the breaking of such circuit, whereby the desired electrical condition is again created which effects a blowing out of the arc, and the blowing-out power is proportional to the strength of the current in the circuit to be broken.

The principles of my invention may be embodied in a wide variety of specific forms of apparatus and still fall within the spirit and scope of my invention. I do not desire, therefore, to be limited or restricted to the exact details of construction and arrangement shown and described. It is also evident that my invention may be applied in any situation where a switch or break in a circuit is required.

What I claim as new and useful and of my own invention, and desire to secure by Letters Patent of the United States, is—

1. The combination with separable contacts arranged in an electric circuit of a spiral conducting-coil arranged in proximity to said contacts and normally in shunt-circuit therewith, said coil adapted to be introduced in the circuit of said contacts at the moment circuit is broken between said contacts, as and for the purpose set forth.

2. The combination with separable contacts arranged in a circuit to be broken, a conducting-coil having a central open space, said central open space being arranged in proximity to said contacts, said coil being normally in shunt-circuit with said contact, and means whereby said coil is introduced into main or direct circuit at the moment circuit is broken between said contacts, as and for the purpose set forth.

3. The combination with separable contacts included in a circuit to be broken, a coil of conducting material arranged in insulated convolutions, said coil being arranged in proximity to said contacts, said coil being normally in shunt-circuit with said contacts, and means for introducing said conducting-coil into working circuit with said contacts at the instant the circuit is broken between said contacts, as and for the purpose set forth.

4. The combination with separable contacts arranged in a circuit to be broken, a conductor normally in shunt-circuit with said contacts and arranged in convoluted coils, an inclosing case for said conductor, and means

for introducing such conductor into the main circuit of said contacts at the moment circuit is broken between such contacts, as and for the purpose set forth.

5. The combination in a controller of a switch including a series of separable contacts, an electric blow-out coil arranged in proximity to each pair of such separable contacts, said electric blow-out coils being normally out of main working circuit with said contacts, and means whereby said coils are introduced into the main working circuit of said contacts at the moment circuit is broken between such contacts, as and for the purpose set forth.

6. The combination in a controller of a switch including contacts, a conductor formed into convoluted coils having a central open space and arranged in proximity to each pair of separable contacts, said coils being normally out of main working circuit with said contacts, and means for introducing such coils into the main working circuit of said contacts in advance of the opening or breaking of said circuit between said contacts, as and for the purpose set forth.

7. The combination of a controller-cylinder having contact-segments, stationary fingers arranged in the main circuit adapted to contact with said segments whereby the main circuit is made or broken and the motor-resistance and motor connections varied, a conducting-coil arranged in proximity to the point where circuit is broken between each finger and its cooperating segment, and contact terminals and segments whereby said coils are out of main working circuit while the controller-cylinder is in running position but adapted to be introduced into main working circuit at the moment circuit is broken between said fingers and segments, as and for the purpose set forth.

8. The combination in a controller of a cylinder, contacts mounted thereon, relatively stationary cooperating contacts, a conducting-coil arranged in the circuit to be broken adjacent to each pair of contacts to be broken, said coils comprising spiral convolutions, a shunt-circuit for said coils and contacts controlling said shunt-circuit, whereby when said controller is in "running" position said coils are cut out of working circuit, but are replaced in circuit in advance of the opening of said circuit, as and for the purpose set forth.

9. In a controller, a series of separable contacts for controlling the main circuit, a corresponding series of conducting-coils arranged in proximity to said separable contacts, said coils being arranged in series with each other and normally out of the main working circuit, and means whereby said coils are introduced to the main working circuit at the moment circuit is broken between said contacts, as and for the purpose set forth.

10. In a controller, a series of separable contacts, a conducting-coil arranged adjacent to

and having a central open space presented toward each pair of contacts, and means for cutting said coils into and out of circuit with said contacts, as and for the purpose set forth.

- 5 11. In an electric controller, the combination with a plurality of fixed fingers and corresponding movable contacts and conducting coils arranged in proximity to and having a central open space presented toward the contact ends of said fingers and adapted to be

cut into and out of the circuit thereof, as and for the purpose set forth.

In witness whereof I have hereunto set my hand, this 27th day of October, 1897, in the presence of the subscribing witnesses.

SIDNEY HOWE SHORT.

Witnesses:

GRANT CLEMONS,
JOHN J. BEVER.