(No Model.) 2 Sheets—Sheet 1.

C. LEVER.

CUT-OUT FOR ELECTRIC LAMPS.

No. 300,489. Patented June 17, 1884.

FIG. 1.

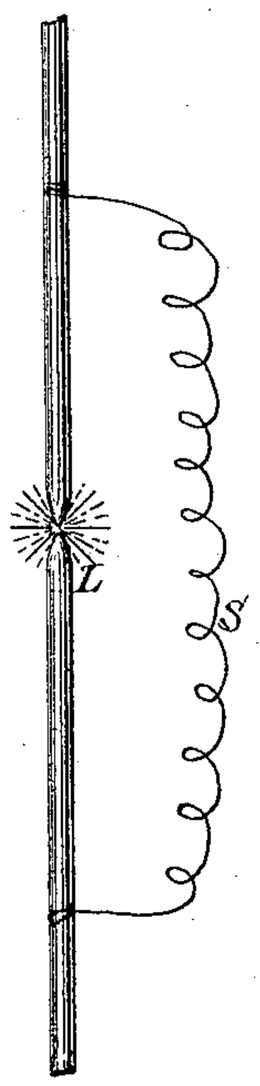


FIG. 2.

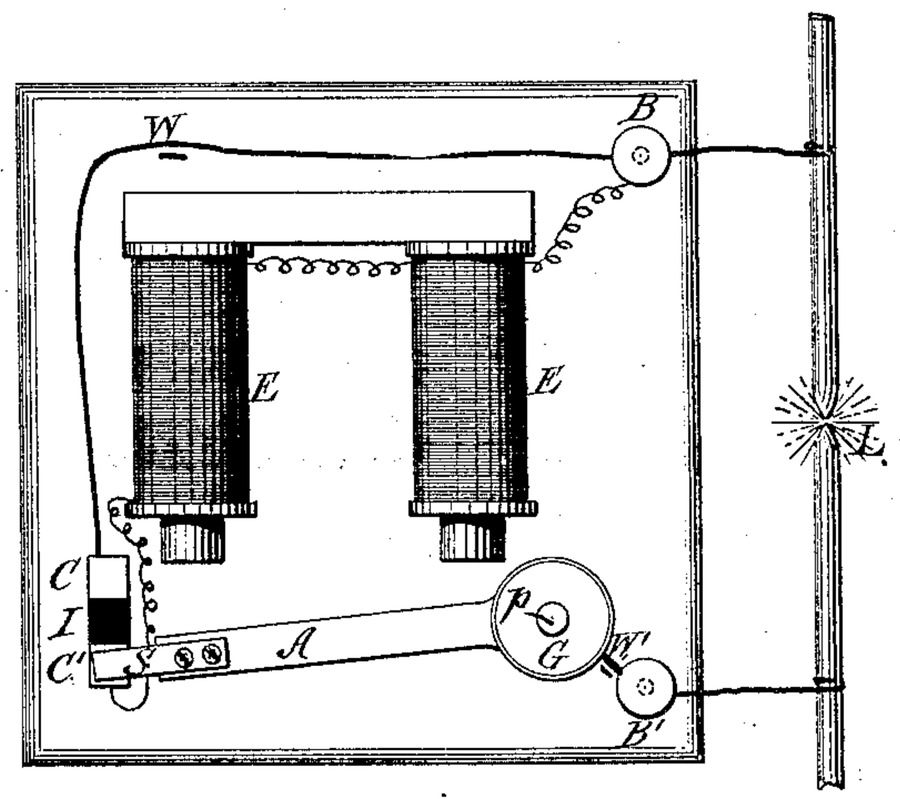
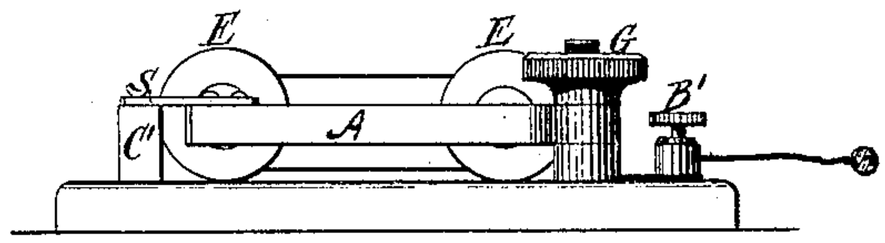


FIG. 3.



Witnesses

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(No Model.) 2 Sheets—Sheet 2.

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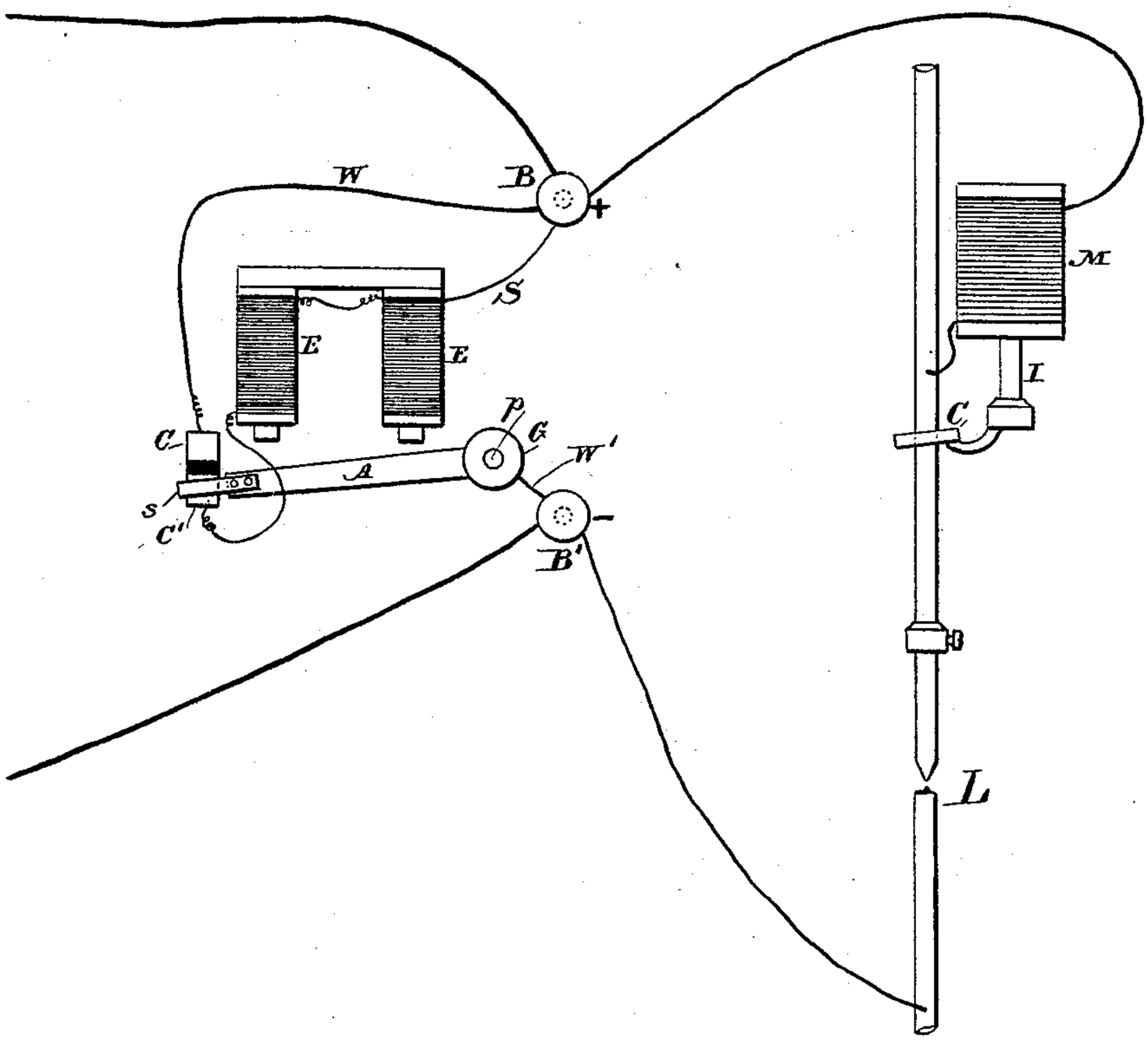
Fig. 4.



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UNITED STATES PATENT OFFICE.

CHARLES LEVER, OF BOWDON, COUNTY OF CHESTER, ENGLAND.

CUT-OUT FOR ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 300,489, dated June 17, 1884.

Application filed November 25, 1881. (No model.) Patented in England August 18, 1881, No. 3,599.

To all whom it may concern:

Be it known that I, CHARLES LEVER, of Bowdon, in the county of Chester, England, have invented new and useful Improvements in Electric Lamps, (for which I have obtained a patent in Great Britain, bearing date the 18th day of August, 1881, No. 3,599,) of which the following is a specification.

The object of this invention is, first, to enable a number of electric-arc lamps to be worked in series or single circuit; and, secondly, to cut out of circuit any lamp or lamps which are in the same series should, from any cause, the circuit through such lamp or lamps be broken. The way I accomplish the first part of my invention is by forming from each electric-arc lamp in the series a shunt-circuit of a considerably greater resistance than that of the arc which it shunts, so that the current which would flow through this shunt-circuit would be very small compared with that which would flow through the arc lamp. The first part which this shunt-circuit performs is simply to offer another path for the current in the main circuit and electric-arc lamp from which it is shunted or derived, so that as the resistance of the arc increases, or, in other words, as the carbons in the lamp are consumed, the current which would flow through the shunt-circuit would also increase, and it would therefore weaken the force of the electro-magnet or solenoid in the lamp, which sustains one of the carbon points or pencils. The electric lamp would therefore allow its carbon rod to fall, thus lessening the distance of the arc, or, in other words, decreasing the resistance of the arc, whereupon more current would flow through the arc lamp and less through the shunt-circuit. It will be seen, then, that by simply forming from each electric-arc lamp a shunt or derived circuit, as described, a number of said arc lamps can be worked in series or single circuit, because the whole combination of the shunt-circuit, being a constant resistance and that of the arc which it shunts being a variable resistance, will act precisely the same as would a constant resistance to the passage of the current, for the amount of current which would flow through the shunt-circuit would always vary or increase and decrease with the resistance of the arc which it shunts. If desired, the said shunt-circuit can be placed at any convenient distance from the arc lamp from which it is derived. With reference to the second part which this shunt-circuit performs—viz., that of cutting out of circuit the arc lamp which it shunts when the circuit through said lamp is broken—the coil of fine wire forming the shunt-circuit is preferably wound over two iron cores connected at one end by a piece of iron or armature, so that the combination will form an electro-magnet with two limbs, or it may be formed as a bar electro-magnet, or simply as a solenoid. The one first named is, however, preferred, for reasons stated hereinafter. The electro-magnet thus formed has in front of its two poles an armature which is capable of moving for a limited distance around a pivot provided with means such as a screw and screw-head, the latter being for the purpose of making the armature move somewhat stiffly. On the end of the armature opposite to the pivot is fixed a piece of metal, preferably a thick spring. Two metal studs, insulated and made flush with each other, are also provided, so that the spring can make contact with either one or the other metallic stud. The shunt-circuit, of fine wire, shunting the arc lamp, is made through the coils on the electro-magnet, one end of which is connected to the metallic stud farthest away from the electro-magnet, and when the arc is burning the spring attached to the armature is made to rest on this stud, so that the shunt-circuit is completed through the contact of the spring with the said metallic stud. The other metal stud nearest the electro-magnet has also a shunt-circuit of low resistance, shunting the arc lamp; but this circuit is broken so long as the spring or metal piece on the armature rests upon the metallic stud farthest away from the electro-magnet, which completes the shunt-circuit of high resistance, as already described. In its normal position—that is, when the electric arc is burning, or the conductivity of the arc lamp is good—the spring of the armature always rests upon the metal stud, completing the shunt-circuit of high resistance, and which has, consequently, not much current flowing through it, so that the electro-magnet, of which it forms part, will only be feebly magnetized, and as the armature will have been adjusted by the screw-head on the screwed pivot to move stiffly, it will not be attracted by the electro-magnet; but should, from any cause whatsoever, the conductivity of the elec-

tric-arc lamp be destroyed, then it is quite clear that all the current which originally flowed through the arc lamp will flow through the shunt-circuit, and therefore the electro-magnet will become powerfully magnetized, and will attract its armature. By so doing the spring attached to the armature will leave the metal stud farthest away from the electro-magnet, and will, in virtue of the attraction of the armature, rest upon the metal stud nearest the electro-magnet, whereupon another circuit of low resistance will be brought into operation, the shunt-circuit and lamp will then be cut out of circuit, and the current from the main will then flow through this new circuit. The action just referred to will take place so quickly that there will be no perceptible heating of the fine wire of the shunt-circuit, and also so that there would scarcely be any perceptible flicker in the other lamps in the series.

In order that my invention may be better understood and readily carried into practice, I will describe the annexed drawings.

Figure 1 represents the carbons and shunt-circuit. Fig. 2 represents the high-resistance magnet, short-circuiting device, carbons, and circuit-connections. Fig. 3 is an end view of the parts shown in Fig. 2. Fig. 4 is a diagram illustrating this invention.

L, Fig. 1, is an electric-arc lamp, the downward motion of one of the carbons being caused, for instance, by gravity; and S is the shunt or derived circuit of much greater resistance than that of the arc L. Then the current which will flow through S will be small compared with that which will flow through the arc L; but as the resistance of the arc L will increase with the consumption of the carbons, more current will flow through the shunt-circuit S. Consequently the force of the electro-magnet or solenoid which sustains one of the carbon rods in the arc lamp L will be lessened, the shunt S having as it were drained off more current from the arc lamp L, and the carbon rod will therefore be lowered, thus decreasing the resistance of the arc L, whereupon less current will flow through the shunt S, and correspondingly more through the arc L. By the simple addition of this shunt-circuit S, which can be placed at any desired distance from the arc lamp L, a number of electric-arc lamps can be worked in series or single circuit, because the whole combination of shunt S and arc lamp L will act precisely the same as a constant resistance to the passage of the current. in order that this said shunt-circuit S, Fig. 1, may cut out of circuit the arc lamp L, which it shunts. Should the circuit through the said lamp be broken, the coil of wire forming the shunt-circuit is wound over the limbs of an electro-magnet, E E, as shown in Fig. 2.

A is an armature which is capable of moving a limited distance round a pivot, *p*, the pivot *p* being provided with a screw and head, G, the use of which will be described further on.

S is a thick piece of metal, preferably a thick spring, which is fixed onto the armature A, and which establishes contact with one of the metal studs C or C′.

Fig. 3 shows another view of the armature A, spring S, screw-head G, metal stud C′, and electro-magnet E E.

B B′ are binding-screws fixed onto a suitable piece of insulating material, upon which are also fixed the electro-magnet E E, armature A, studs C and C′, and pivot *p*. Two insulated wires of low resistance connect the binding-screws B and B′ to the electric-arc lamp L. The ends of the coil of the electro-magnet E E, forming the shunt-circuit, are connected one to the binding-screw B and the other to the metallic stud C′. An insulated wire, W, of low resistance connects the metal stud C with the binding-screw B, and another similar wire, W′, connects the pivot *p* with the binding-screw B′. In its normal position—that is, when the circuit through the arc lamp L is complete—the spring S makes contact with the metal stud C′, which is insulated from the metal stud C by a suitable piece of insulating material, I, the studs C and C′ and insulating-piece I being made flush with each other, so that the shunt-circuit is then completed through the coil of the electro-magnet metal stud C′, metal piece or spring S, armature A, pivot *p*, wire W′, or vice versa. The screw-head G is then screwed down, so that the armature A moves somewhat stiffly, and also so that the small amount of current which will flow through the shunt-circuit coil on the electro-magnet E E will not magnetize it sufficiently to attract the armature A; but should, from any cause, the conductivity of the arc lamp L be destroyed, then all the current which previously flowed through the arc L in the main circuit will flow through the shunt-circuit coil on the electro-magnet E E. Consequently it will become magnetized very much more than it was when the circuit through the arc-lamp L was complete, and the armature A will therefore be almost instantaneously attracted, whereupon the spring S will leave the metallic stud C′ and will make contact with the metal stud C; but immediately this takes place the arc lamp L and shunt-coil on the electro-magnet E E will be cut out of circuit, and the current will then flow through the new circuit of low resistance, which has been opened by the movement of the armature-spring S from metal stud C′ to metal stud C—namely, from B, wire W, metal stud C, spring S, armature A, pivot *p*, wire W′, and binding-screw B′ to the main circuit, or vice versa.

M is a solenoid in the main circuit through the carbon points, which, when the current is sent through the lamp, will attract the core I, tilt and lift up the clutch C, and with it the carbon rod, thus forming the arc L—as in the Brush lamp, for example.

S is the shunt-circuit, of much greater resistance than the resistance of the solenoid M and arc L. The shunt-circuit S is placed in derivation by connecting its ends to the positive

and negative binding-screws B B′ of the lamp. The current entering at the positive binding-screw B (marked by the plus sign) divides itself through the main solenoid and carbons and through the shunt-circuit S to the negative binding-screw B′ (marked by the minus sign) in proportion to the resistances of the solenoid M and arc L and that of the shunt-circuit S. Let the resistance of shunt S be one hundred, and the resistance of the solenoid M and arc L be one, then ninety-nine parts of the whole current which enters at binding-screw B will flow through solenoid M and arc L and one part through shunt S; but as the resistance of arc L increases as the carbons are consumed, the shunt S is gradually draining off more current from the solenoid M and arc L; and if the resistance of arc L has increased to two, then twice as much current will flow through shunt S as when the arc L had resistance 1. The shunt S will therefore have deprived solenoid M of two parts of the current, which could not thus have escaped if no shunt S had been provided. The solenoid M will therefore be weakened through shunt S, having drained off two parts of the current, and the solenoid M will therefore, through the medium of core I and clutch C, allow the carbon rod to fall more easily than it would do if there were no shunt-circuit S. If M were an electro-magnet it would be weakened in exactly the same manner, for, whether a solenoid or an electro-magnet be used in the main circuit to raise and sustain the carbon rod, if the current in the said main circuit is allowed to escape through shunt S, the attractive force of the said solenoid or electro-magnet will be decreased thereby.

Another explanation of the manner in which the shunt-circuit S weakens the solenoid M is as follows: Let one end of shunt S be disconnected either at B or B′, and the arc L be formed as before. Then if the end of the shunt be suddenly connected to B or B′, so as to complete its circuit, a noticeable difference will take place in the intensity of the arc L directly the circuit of shunt S has been thus completed, and the arc L will be less than it was before. The intensity of arc L could not have been so diminished had not the shunt-circuit S weakened the solenoid M (or electro-magnet) by draining off a portion of the current which originally flowed through solenoid M, thus causing the carbon rod, which the solenoid M sustains, to have been lowered; but the shunt circuit S is always performing this operation, because it is always connected to binding-screws B B′, and thus it is always draining the current from solenoid M, and the amount of current which shunt S drains off, and therefore the amount by which shunt S weakens solenoid M is proportional to the resistance of the arc L.

I have found in practice, that the action just referred to takes place so quickly that there is no perceptible heating of the fine wire forming the shunt-circuit, and also that there is scarcely any perceptible flicker in the other lamps which are placed in the same series.

Instead of winding the coil of the shunt-circuit over two limbs of an electro-magnet, it may be wound so as to form a bar electro-magnet, or it may be wound simply as a solenoid. In the latter case, however, an iron core would have to be fixed to the end of the armature A, and be made to move in the interior of the solenoid, so that the solenoid would in this way act exactly the same as an electro-magnet. The form of winding the coil of the shunt-circuit as illustrated is, however, preferred, because in this form a very high resistance can be obtained.

I am aware that cut-off devices have been used with electric lamps to automatically switch the current from a defective lamp, as in Patent No. 219,211. In my improvement the switch is moved by the helix in the shunt, and remains in its position to entirely cut out such defective lamp by opening an unobstructed circuit for the electric current.

I am aware that previous to my invention a differential electro-magnet or solenoid with a helix of low resistance in the main circuit through the lamp and a helix of high resistance in a shunt-circuit have been used in an electric-arc lamp for regulating the feed of the carbons; and I am aware that there has been combined with said differential electro-magnet or solenoid, an electro-magnet or solenoid in a second shunt-circuit for operating a cut-out device, therefore I do not claim the above combination of elements; but,

Having now described the nature of my said invention, and the manner of carrying the same into effect, I would have it clearly understood that what I claim is—

1. The combination, in an electric lamp, of a main circuit containing the carbons and an electro-magnet or solenoid for regulating the arc, a normally-closed shunt-circuit containing a magnet of high resistance and a switch, two insulated frictional contact-points, and a direct connection from one of them to one of the binding-posts, and from the other contact-point to the magnet of high resistance, whereby a portion of the current passes from the main magnet through the shunt-magnet and switch when the lamp is in operation, but the lamp is entirely cut out by the switch if the arc is unduly lengthened, substantially as specified.

2. In a combined regulating and cut-out device for electric-arc lamps, the combination of an electro-magnet in a shunt-circuit, the armature A, metal piece S, metal studs C C′, pivot *p*, and screw-head G, substantially as and for purposes specified.

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