(No Model.)

A. G. WATERHOUSE.

ELECTRIC ARC LAMP.

No. 366,614. Patented July 12, 1887.

Fig. 1.

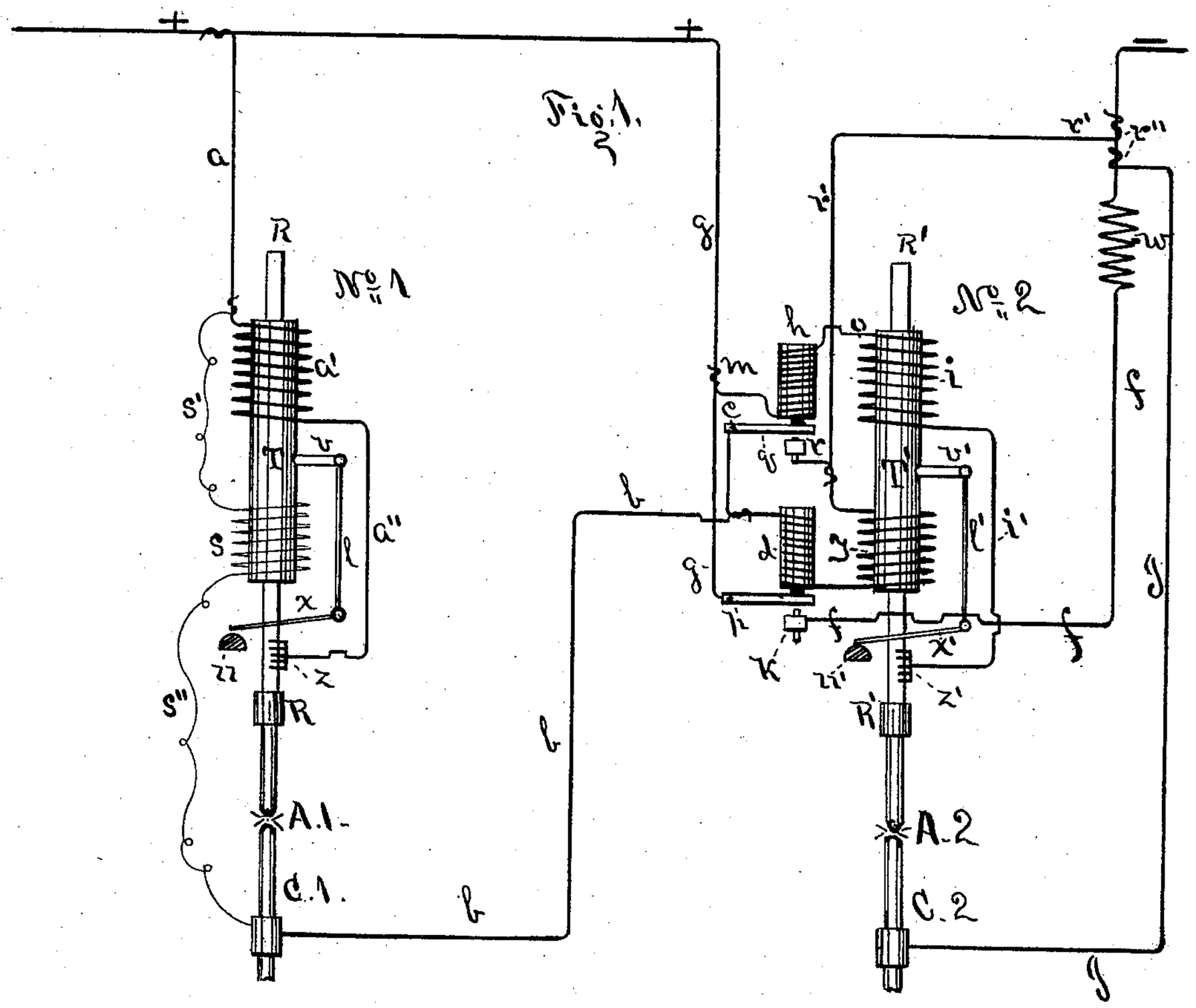
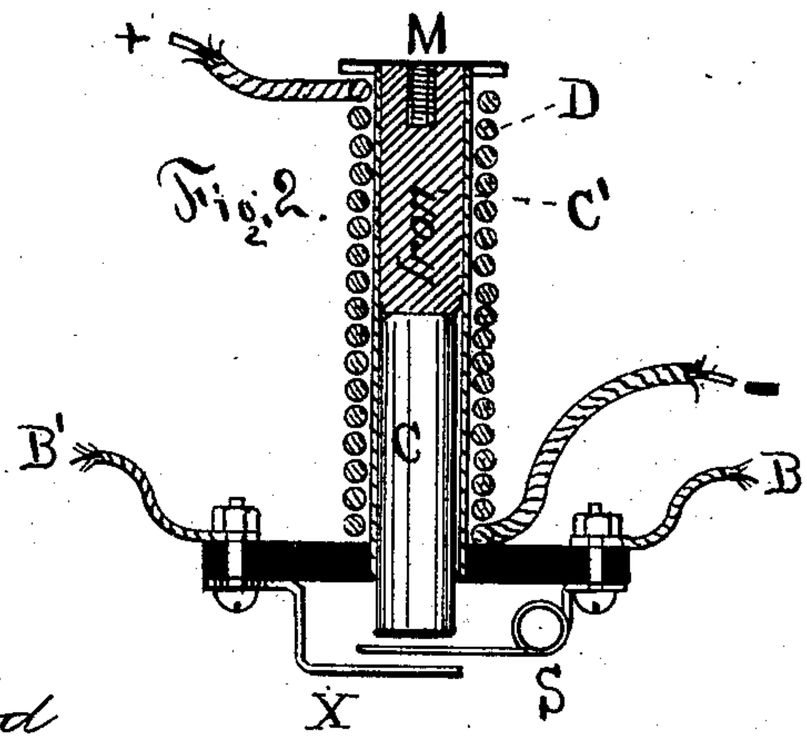


Fig. 2.



Witnesses-

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ADDISON G. WATERHOUSE, OF HARTFORD, CONNECTICUT, ASSIGNOR TO THE WATERHOUSE ELECTRIC AND MANUFACTURING COMPANY, OF SAME PLACE.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 366,614, dated July 12, 1887.

Application filed September 13, 1886. Serial No. 213,453. (No model.)

To all whom it may concern:

Be it known that I, ADDISON G. WATERHOUSE, of the city of Hartford, in the State of Connecticut, have invented a new and useful Improvement in Electric-Arc Lamps, of which the following is a description.

My invention relates more particularly to that class of arc lamps known as "divided arcs," or lamps constructed to burn in multiple arc upon a branch of a single circuit; and it consists more particularly in improvements in a certain patent dated January 12, 1886, and numbered 334,317, to F. G. Waterhouse, of which the following is a specification, reference being had to the accompanying drawings, of which—

Figure 1 represents the essential elements of two arc lamps, (marked "No. 1" and "No. 2,") adapted to burn on two branches of the main circuit, which enters on the positive wire, (marked +,) then divides and passes through the two lamps, and then unites and passes out on the negative wire, (marked —.)

Lamp marked "No. 1" is of the class known as "series" lamps, consisting of the main magnet a' and shunt-magnet s. The half of the current that passes through this lamp enters at wire a, passing around magnet a', and then down conductor a'' to contact-point z to carbon rod R. This current in passing around magnet a' raises the armature T, and with it the link l, clutch x, carbon rod R, and the upper carbon, thus producing the arc marked A′. The current then crosses the arc to lower carbon, C′, and out on wire b, where its further use will be hereinafter described. This lamp is caused to feed by means of the shunt-wire leading from main wire a, then passing down wire s' to the shunt-magnet s, then through the arc by way of wire s'', and by acting on shunt-magnet s the armature T is drawn down, and with it the clutch x, until it strikes the liberating-point n, which tilts the clutch and allows rod R to gravitate through, all in the manner common to shunt or series lamps. This shunt-coil s leads or forms a by-path around the arc, as stated, but is arranged so that as the current is passing through the arc of lamp No. 1 the shunt-coil s remains connected; but as soon as the current ceases to pass through the arc the shunt-coil s is disconnected, so that no current passes through it. This shunt-circuit is connected and disconnected automatically by mechanism not shown. By a proper adjustment of the strength of this shunt a certain length of arc can be maintained.

The lamp marked No. 2 takes its half of the current from positive wire + down through conductor g, then through connection m to magnet h, then through conductor o to the arc-producing magnet i, then down conductor i' to contact z on carbon rod R′. This current, acting in magnet i, raises the armature T, and with it the link l', clutch x', and upper carbon rod, R′, and carbon, thus producing the arc A^2. Then the current crosses the arc to lower carbon, C^2, and up conductor J to the negative wire of the main line. So far in this lamp I have shown provision for raising the arc, but not the means for causing it to feed. The feeding action of lamp No. 2 is as follows: The negative current from lamp No. 1 passes through wire b, around magnet d, then around magnet y, then up wire r to the negative wire — of the main line, where it joins the part of the current which passes through lamp No. 2. As shown, the negative current from lamp No. 1 passes around magnet y of lamp No. 2. The purpose of this magnet y is to cause the carbons to feed together, the same as described regarding shunt-magnet s of lamp No. 1. Now, as the negative current of lamp No. 1 is used to cause lamp No. 2 to feed the carbons together, I arrange the strength of the two magnets i and y in such relation that when the resistance of both lamps is equal, and consequently the current of both being equal, then the strength of the magnet i will be such as to overcome the magnet y and raise the carbon to the same length of arc of that held by lamp No. 1. Now, if the length of arc A′ becomes longer than arc A^2, the less current flows around lamp No. 1 and less around magnet y, and as the opposition it offers to the pull of magnet i is weakened, and as at the same time more current is flowing around magnet i it becomes stronger, therefore the arc A^2 is increased to balance that of A′. Thus in case the arc of lamp No. 1 is shortened by the ac-

tion of its shunt *s*, then its resistance becomes less than that of lamp No. 2, which results in more current flowing through lamp No. 1 and magnet *y* of lamp No. 2, which strengthens the pulling-down magnet *y*, while at the same time less current is going through lamp No. 2 and lifting-magnet *i* becomes weakened, which causes the armature to be acted upon by the superior strength of magnet *y*, and thus the armature is drawn down and the lamp caused to feed until the lengths of the two arcs A′ and A² become of equal length.

In short, lamp No. 1, which I call the "pilot-lamp," has its length of arc maintained and regulated by the resistance between its carbons acting upon the shunt-magnet *s*, while lamp No. 2 is regulated by the negative current from lamp No. 1, in addition to the tendency of each lamp to be regulated in itself by more or less current passing through it, according as its arc becomes greater or less than the other lamp.

So far as I have described these lamps I know that the same is described and covered by the said patent to F. G. Waterhouse; but what is especially new in my invention is the following: Heretofore difficulties have been experienced in burning lamps in multiple arc, and some of said difficulties are, when a current is divided between two arc lamps and the current in one of these breaks, and the carbon should remain stuck up, either by defective mechanism or by the shunt coil or coils which remain in circuit holding up the armature and carbon rod, or from any other causes peculiar to various forms of lamps, in such cases all of the current would pass through the remaining lamp, which, being incapable of regulating with such an increase of current, would result in too long an arc, and, finally, the destruction of the lamp. To avoid this difficulty I have invented the following: In Fig. 1 the negative wire *b* of lamp No. 1, in passing to lamp No. 2, first passes to cut-out magnet *d*, then passes through magnet *y*, for the purpose before described, and out on the wire *r* to the line —, while the current which passes to lamp No. 2 first passes down wire *g*, then from connection *m* to a second cut-out magnet, *h*, then around magnet *i* to the arc, and out by way of wire J to the line —. Now, the duty of these cut-out magnets *h* and *d* is as follows: In case both lamps were burning properly, the currents passing through the lamps would also pass around these magnets and cause them to raise their respective armatures—that is, magnet *h* would raise its armature *q* and magnet *d* would raise its armature *p*—and the route of the currents would be through the lamps, as above described; but in case, say, lamp No. 1 should break, owing to too long an arc, or from any other causes, then the current would stop in its passage through this lamp, and also through the cut-out magnet *d* in lamp No. 2, and in doing so the armature *p* would drop away and come in contact with point *k*. This would open a short passage for the current by way of wire *g*, armature *p*, contact-point *k*, wire *f*, resistance *w*, to the negative line; and in the current taking this route the lamp No. 2 would also be short-circuited and its carbons would drop together until the carbons of lamp No. 1 came together. Then the current, being slightly opposed by resistance *w*, would pass through lamp No. 1, and would also pass around magnet *f*, which would raise the armature *q* and place lamp No. 2 also in circuit to take its part of the current. Again, in case the lamps were both burning and lamp No. 2 should break its arc, then that branch of the current ceasing in its passage through lamp No. 2 would also cease passing through magnet *h*, which would cause its armature *q* to drop, and in doing so would strike on the contact-point *r*, which would short-circuit magnet *d*, causing armature *p* to drop again, opening the route by way of wire *g*, armature *p*, wire *f*, resistance *w*, to the main line —. This would then cut out lamp No. 1, whose carbons falling together would again be ready to begin burning as soon as the carbons of lamp No. 2 were together and ready.

I have stated above that armature *q* in dropping would short-circuit magnet *d* and cause its armature to drop, and I will explain how it is done. When armature *q* drops on contact-point *r*, a short route is made for the current from lamp No. 1 which went around cut-out magnet *d* and lamp-magnet *y*. This short route is from wire *b* to wire *c′*, to contact *c* on armature *q*, then along the armature *q* to the contact *r*, then out on *r′*, as above stated, to junction *r″* to the main line —.

In some forms of lamps it is only necessary to cause the armature to short-circuit the cut-out magnet *d* and leave the magnet *y* constantly in circuit. This way produces the same effect described. I have shown that in case either of the lamps should break their arc the carbons of the other lamp would come together until the lamp that broke is ready to resume burning, when they will both start again even, and in case either one of the lamps should become disabled the other lamp will remain permanently cut out, or until the disability of the other lamp is removed.

Fig. 2 shows a form of one of the cut-out magnets, consisting of the coil of conductor D, the armature C, and the permanent iron core C′, which holds the armature in place after it has been drawn up by the joint action of the coil D and the core C. When the current ceases in coil D, the armature C drops on the spring-connection S and forces it on the contact-piece X, which forms a circuit from the wire B through the screw to S, then across to X, then up through the screw to wire B′. The parts S and X are connected to an insulated strip, as shown, which also answers as a head for the coil D.

In describing this invention I have shown the operating parts of a lamp; but I do not confine myself to any particular form of mech-

anism or form of lamp, as the same will apply to the various kinds now in use.

I have shown in the above a combination of two forms of lamps, No. 1 being what I call a "pilot-lamp," in which a certain length of arc is produced and maintained by means of the shunt *s* acting in unison with the main-current magnet, or by means of the shunt alone, as in some forms of lamps, No. 2 being what I call the "annex-lamp," which may be constructed as above described, and claimed in said patent to F. G. Waterhouse, or may be of any other form, and instead of one of these annex-lamps being used, as described, and hereinafter claimed, several can be used with each pilot-lamp and the current divided between them.

What I claim as my invention is—

1. The combination, with two electric-arc lamps in parallel branches of the main circuit, as described, of a cut-out magnet in the branch of one lamp behind the arc of the same and in series with the regulating-coil of the other lamp, a cut-out magnet in the branch of the second lamp and in series with the arc and arc-establishing coil of the same, and a short circuit around each cut-out magnet and its connections, each magnet controlling the short circuit around the other, substantially as described.

2. In an electric lamp adapted to burn in multiple arc with a second arc lamp, the magnet *d*, actuated by the negative current from the other lamp, and provided with armature *p* and contact-point *k*, which prevents a short circuit around the lamps while a current is passing through said magnet and creates a short circuit around the lamps as soon as a current ceases from passing around said magnets; also the magnet *h*, provided with armature *q* and contact-point *r*, which, while a current is passing around it, allows a current to also pass around magnet *d*, but which prevents a current from passing around magnet *d* as soon as a current ceases to pass around said magnet *h*, substantially as and for the purposes set forth.

3. In combination with two electric-arc lamps in parallel branches of the main circuit, as described, a cut-out magnet in each branch, and a short circuit around each lamp controlled by the magnet in the other branch, whereby the breaking of the circuit of either lamp causes a short circuit around the other lamp to be established, substantially as described.

4. In an electric lamp adapted to burn on a branch of the main current, the cutting-out magnet *d* in the same branch of the main circuit as the feeding-magnet *y* of the lamp, and the cutting-out magnet *h* in another branch with the arc-producing magnet *i* of the lamp, substantially as and for the purposes set forth.

ADDISON G. WATERHOUSE.

Witnesses:
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