(No Model.)

F. G. WATERHOUSE.

ELECTRIC LAMP.

No. 334,317. Patented Jan. 12, 1886.

Fig 1.

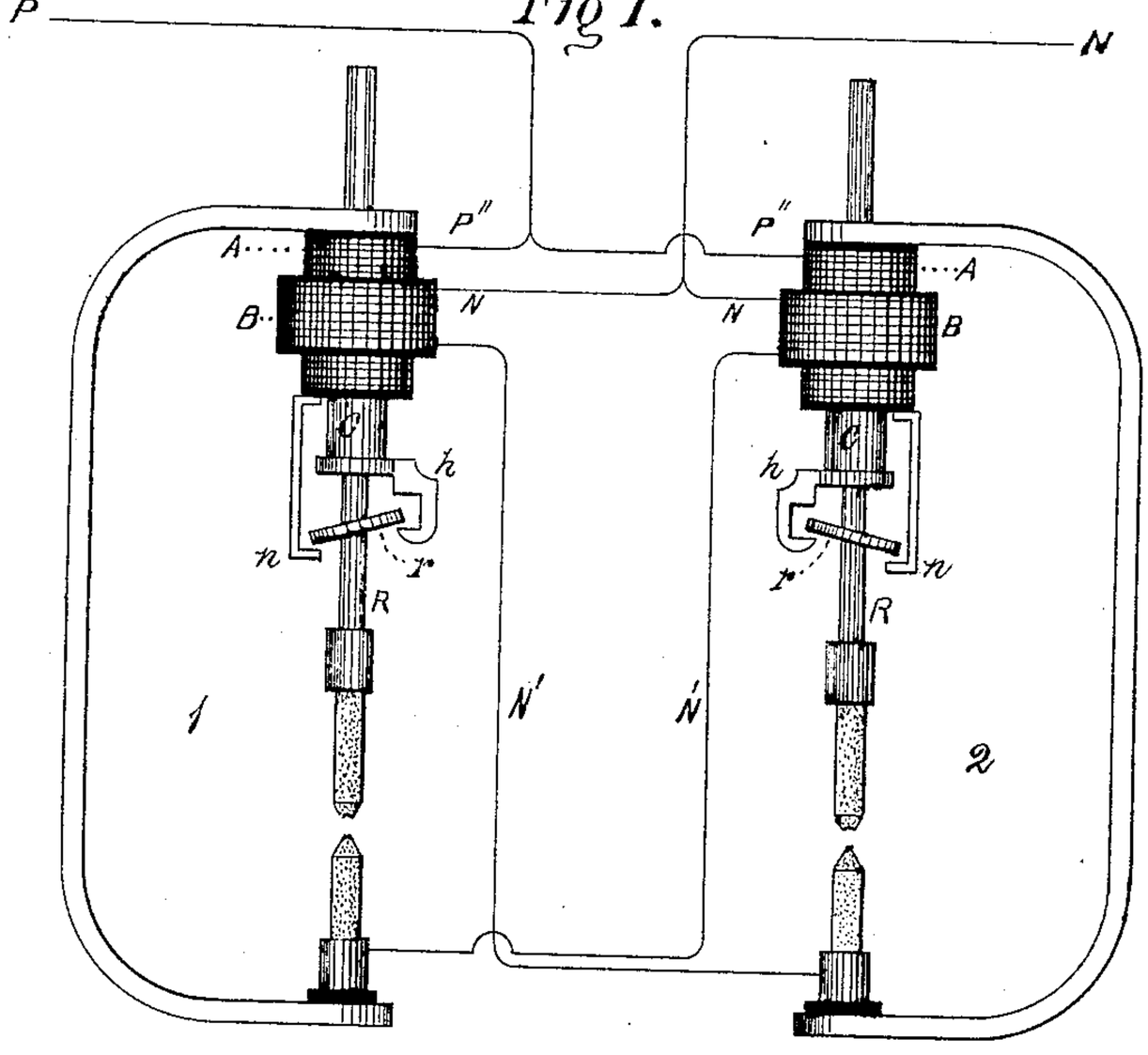
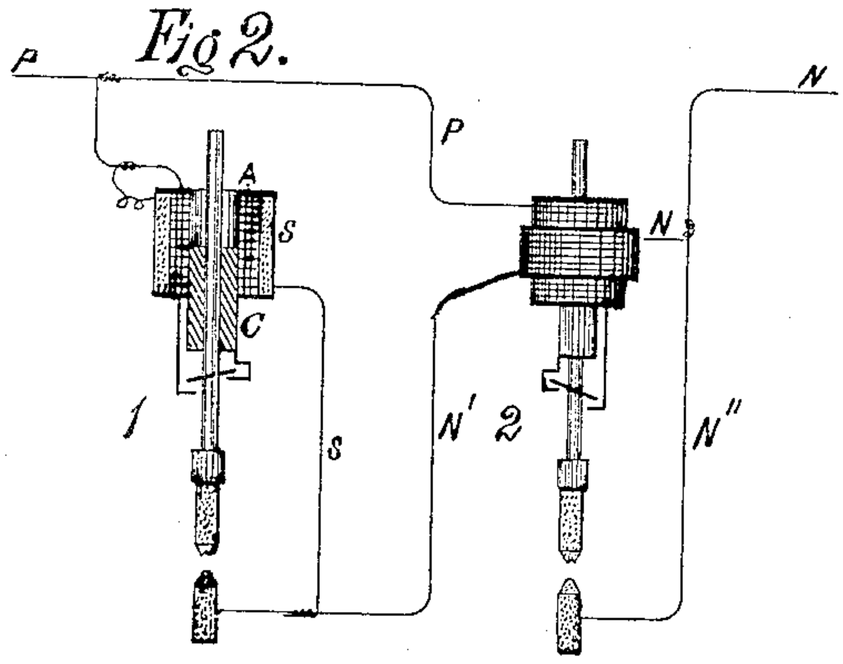


Fig 2.



WITNESSES.
James F. Henderson
John F. H. Forbes

INVENTOR.
Frank G. Waterhouse

UNITED STATES PATENT OFFICE.

FRANK G. WATERHOUSE, OF SACRAMENTO, CALIFORNIA.

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 334,317, dated January 12, 1886.

Application filed May 23, 1884. Serial No. 132,524. (No model.)

To all whom it may concern:

Be it known that I, FRANK G. WATERHOUSE, of the city of Sacramento, county of Sacramento, and State of California, have invented a new and useful Improvement in Electric Lamps, of which the following is a description.

This invention relates to that class of electric lighting known as "arc-lighting," and more particularly relates to regulating the distance between the carbons by means of the magnetic effect of the current employed.

My invention consists in the manner of employing the magnetic effect of the current after it has passed through the arc, in combination with the magnetic effect of the current before it passes into the arc, for the purpose of regulating the adjustment of the carbons, and is adapted for regulating lamps when placed either in series or multiple arc.

In order to explain my invention more fully, I will refer to the following drawings, in which—

Figure 1 shows two lamps, forming a single set, which are placed in two branches of the main current and regulate each other by means of my invention. Fig. 2 is a set of lamps adapted to being worked in series with other sets of lamps of the same kind, or with series lamps which are run with the whole current.

In giving a general description of my invention I will first refer to Fig. 1, in which is shown two lamps marked, respectively, 1 and 2. These lamps are connected to the positive electrical wire P in two branch circuits, or in other words, the current divides, one half going through branch P and forming the magnet A of lamp 1 and then terminating in its carbon rod R, the other half of the current going into lamp 2, forming its magnet A and ending in its carbon rod R, the object of the magnets A being to raise the cores C, to which are attached the hooks *h*, which carry the clutch-rings *r* and raise the carbon rods R and form the arc. As the cores C move down, the rings *r* strike the foot or step *n*, which tilts the rings and allows the rods R to slide through and bring the carbons nearer together as they are burned away. This form of mechanism is preferred, as it is one of the common forms in use in arc-lamps, and not because my invention is confined to it or any other form of feeding mechanism; but where my invention comes in is in the use I make of the current as it passes out of the lamp in acting upon a magnet which acts in combination with another magnet that is excited by the current which passes into a lamp, so that one magnet or current will be used to separate the carbons, while the other current will be used to feed the carbons together.

In Fig. 1 I have shown how the current enters the lamp and separates the carbons which form the arc, after which it passes to the lower carbon and then becomes what we will call the "negative current" from lamp 1, passes out through wire N', and then around magnet B of lamp 2, which magnet or helix is outside of the positive helix A. As the current in B runs in an opposite direction to the current in A, one, therefore, tends to counteract the effect of the other. After the current has passed around B, it passes out on the line N. The negative current from lamp 2 is connected in the same way in relation to the lamp 1. As the magnets A have to do work in separating the carbons, they are made so as to act stronger than magnets B, so that when the current in each magnet is alike the greater strength of A will be sufficient to separate the carbons, but when the current in B becomes stronger than that in A the strength of A will be overcome, which allows the cores C to move down and the carbons to feed together.

The effect of using the two magnets A and B with the current of the two lamps combined, as shown, will be as follows: I will suppose it necessary that the current which passes through each lamp should be equal. In order to maintain this equal division the resistance of each lamp must be equal. This equality is created as follows: When the current passes through lamps 1 and 2, a part of it tends to pass through each lamp. If more than half passes through lamp 1 it will be because the resistance of lamp 2 is the greatest, and, as the length of the arc represents the resistance, I will call it the "length of the arc," so if more than half the current passes through lamp 1 it is because the arc of lamp 2 is the longest. To correct this inequality there are two forces at work. One is the weakened effect of the magnet A in lamp 2, which is caused by a decrease in the amount of current that is passing through it, and the other and more posi-

tive cause is the greater amount of current which is passing through lamp 1, is also passing around the magnet B of lamp 2, which so overcomes the strength of its magnet A as to instantly cause the core C to fall and the carbons to feed together. At the same time that these causes are at work on lamp 2, in order to adjust or reduce its too-great resistance, the work is being carried on with lamp 1, as more current is passing through this lamp on account of its arc being shorter than that of lamp 2. The increase of current in magnet A of lamp 1 tends to lengthen its arc, while the opposing force in magnet B of lamp 1 is weakened by the decrease of current in lamp 2, which gives greater power to magnet A of lamp 1 to separate its carbons, and as the action of one lamp upon the other is reciprocal both ways, so I have a quadruple force at work, regulating both lamps in opposite directions, so as to approach an exact balance in the resistance of each lamp.

In Fig. 2 is shown my invention, in which two kinds of lamps are burned in branches of the main circuit, which enters at the wire P. Lamp 1 is what is known as a "series lamp" having a short wire, *s*, which forms the shunt-magnet S. The main current enters in and passes around magnet A to the upper carbon, which raises the core C and forms the arc, as above described, while the shunt-magnet S receives its current in an opposite direction to the main magnet A, and as the shunt-wire passes around the arc the current which passes around S is in proportion to the length of the arc, and as the arc gets too long the current in S increases, which overcomes the magnetic effect of A and causes the lamp to feed according to the common method of regulating what are known as "series lamps." This lamp 1 is used in combination with one or more of the kind of lamps marked 2, which is the same as those described in Fig. 1.

The result of combining these two kinds of lamps and running them both in branch circuits is as follows: First, the length of the arc in lamp 1 is regulated by the shunt-magnet, as described, so its resistance is what we may call "fixed," subject, of course, to the variations of the main current. When one or more of the lamps marked 2 are run with lamp 1, the current tends to go through both kinds of lamps. If it separates the carbons of lamp 2 too far, more current passes through lamp 1, so that the increased negative current from 1 passes around magnet B of lamp 2, which causes it to feed as described in Fig. 1. If too much current passes through lamp 2, the decreased current which flows through lamp 1 and around the magnet B of lamp 2 being weakened, allows the strength of magnet A to be proportionately stronger, which separates the carbons of lamp 2, so as to make its resistance even with lamp 1. When more than one of the kind of lamps marked 2 are used with one of the kind marked 1, the negative wire of lamp 1 is wound around each one of the magnets B of the kind marked 2 in series, so that one of the kind marked 1 can be used to regulate several of the kind marked 2.

I have shown only such forms of magnets as would enable me to explain the nature of my invention; but the same may be used in all forms of magnets, the same as in use in series lamps where the shunt-wire is used on the armature and the main wire on the magnet, and in all the various ways that the shunt and main current are combined, so the magnetic effect of the positive and negative wire can be combined, as set forth in my invention.

While I have described, broadly, the system of regulating two lamps in branch circuits, with the currents arranged so that they pass from both branches through the arc of the respective lamps and assist in regulating the feeding mechanism of the other lamp, I do not broadly claim the same, as I know it to be old.

What I claim as my invention, and desire to secure by Letters Patent, is--

1. In a system of electric lighting, two lamps arranged in branches of the main circuit, one lamp being of the class known as "series lamps," provided with a main and a shunt magnet which act in combination to maintain the proper separation of the carbons, and the other lamp provided with a main-circuit magnet for causing a separation of the carbons, and a magnet for causing the feed of the carbons included in the combined main and shunt circuit of the series lamp, substantially as described.

2. The combination of two lamps arranged in branch circuits, one of which is provided with two superposed magnet-coils, one in the main branch and another in a shunt circuit, the other being also provided with two superposed coils, one in the main branch circuit, and the other in the combined main and shunt circuits of the first lamp, substantially as described.

FRANK G. WATERHOUSE.

Witnesses:
GEORGE W. JACKSON,
JOHN T. H. FORBES.