(No Model.)

R. H. JAHR.

ELECTRIC ARC LAMP.

No. 545,694. Patented Sept. 3, 1895.

Fig. 2.

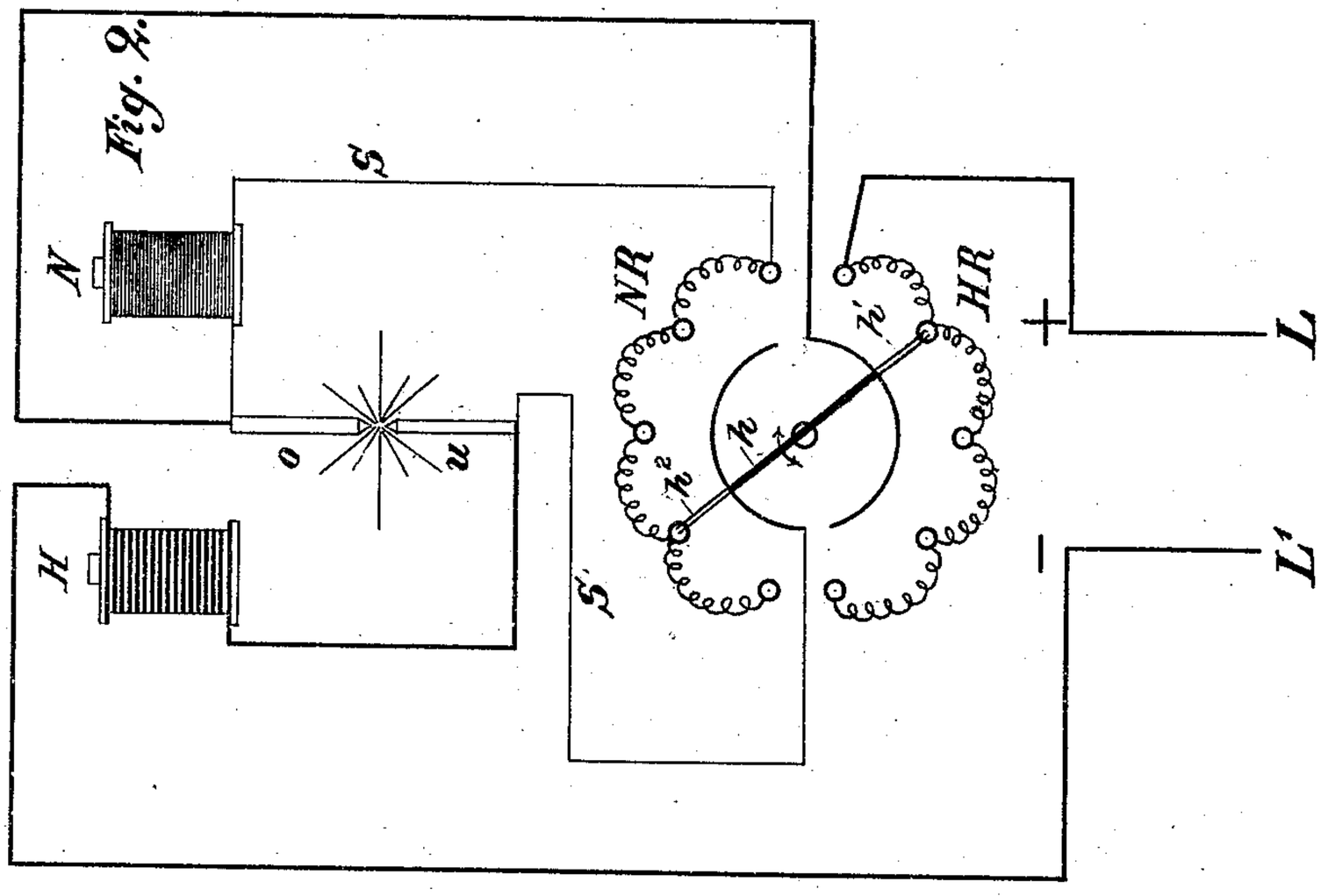
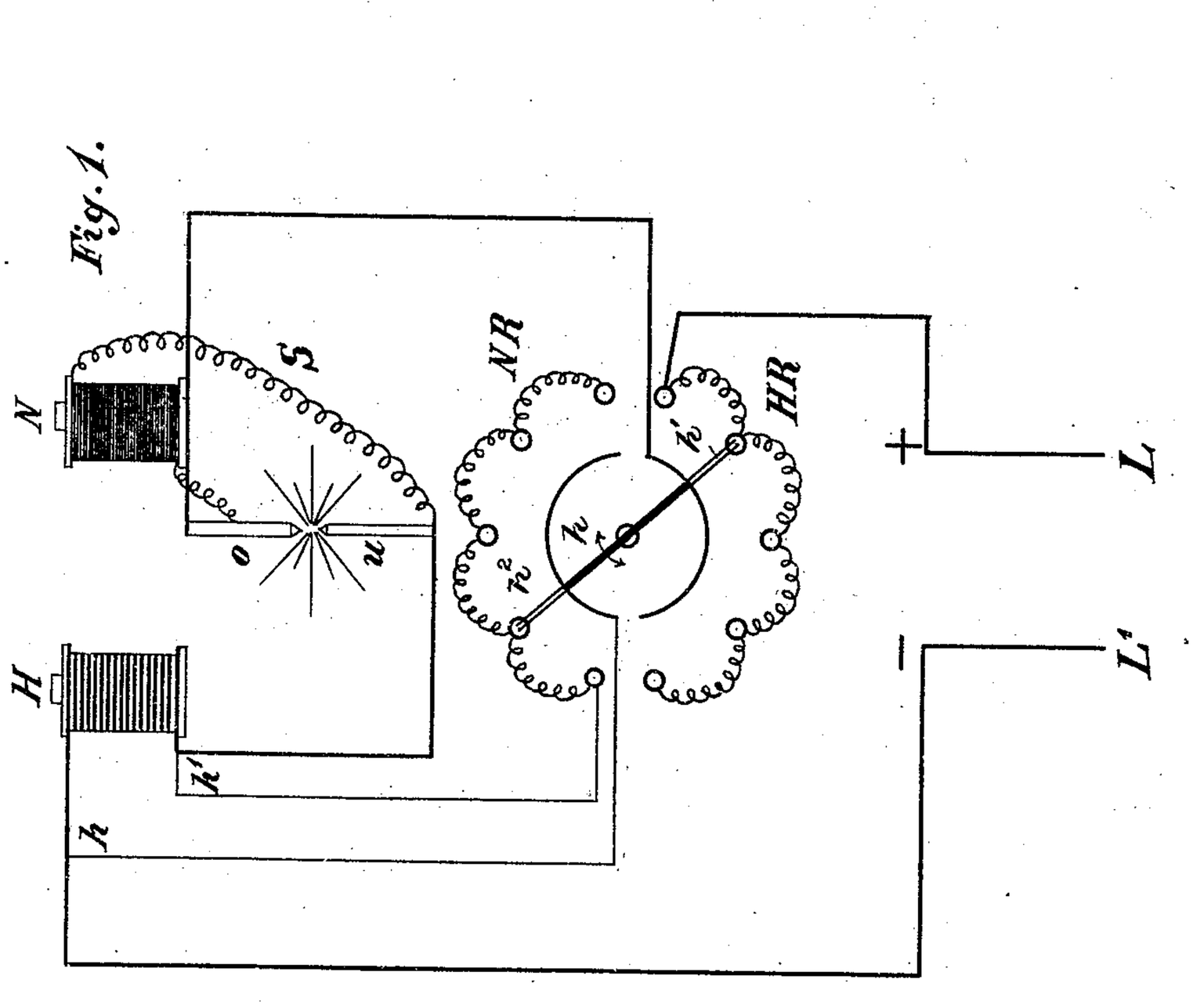


Fig. 1.



Witnesses;

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UNITED STATES PATENT OFFICE.

RUDOLF H. JAHR, OF OPLADEN, GERMANY.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 545,694, dated September 3, 1895.

Application filed November 26, 1894. Serial No. 529,953. (No model.) Patented in Belgium September 10, 1894, No. 111,772.

To all whom it may concern:

Be it known that I, RUDOLF HERMANN JAHR, a subject of the King of Prussia, German Emperor, residing at Opladen, in the Kingdom of Prussia, German Empire, have invented a new and useful Electric-Arc Lamp, (for which I have obtained a patent in Belgium, No. 111,772, bearing date September 10, 1894,) of which the following is a specification.

This invention relates to electric-arc lamps, and has for its object to allow the brilliancy of the lamp or its current intensity to be varied according to special requirement and to cause the lamp to work with such length of arc or current tension as is most favorable for the special degree of brilliancy it is desired to burn with.

To this end the present invention consists in combining the regulating-helix of the lamp with means adapted to vary the action of said helix according to requirement and to simultaneously adjust the main regulating resistance of the lamp in accordance with said variation. The said means substantially consist in an auxiliary resistance determining the current flow through the regulating-helix and a connection between this auxiliary resistance and the main regulating resistance of the lamp, whereby both these resistances are caused to move in conformity with the current intensity and current tension necessary for the degree of brilliancy desired.

The present invention is applicable whether the regulating-helix is in the main or light circuit of the lamp or in a derivation of, or shunt to this circuit. In the first case the said auxiliary resistance or "graduator," as it may be called, is so arranged as to form a shunt to the main-current helix, while in the second case it is placed in or forms part of the regulating-shunt. The first-named arrangement is that for main-current lamps proper or lamps regulated by means of a helix traversed by the main or light current, and the second-named one that for shunt-lamps proper or lamps the regulation of which is effected by a helix placed in a derivation branched off from the terminals of the lamp, while both the said arrangements are serviceable for differential lamps or lamps regulated by means of any difference taking place between the action of two helices, one placed in the main or light circuit of the lamp (main or prime helix) and the other in a shunt to the arc (shunt or differential helix.)

As my invention will best be understood by contemplating its combination with a differential lamp and the latter simultaneously permits both forms of application to be made use of, I proceed to more particularly describe it on the base of a differential lamp.

(*a.*) *Varying the current intensity by varying the action of the main helix or that through which circulates the main or light current.*— The lamp is in equilibrium—that is to say, it will burn when the number of ampère-windings of the main helix is equal to that of the differential helix (differential lamps) or when the magnetic force created by a main helix having a given number of ampère-windings is equal to the given force of a spring (main-current lamps and shunt-lamps). In a differential lamp the number of ampère-windings maintaining the equilibrium may easily be determined on the prime helix, as is well known. For instance, when the said helix comprises eighty-six windings and the lamp burns quietly on being fed with a current of ten ampères, then the number of ampère-windings on either helix will be eight hundred and sixty, the thickness of the wire composing the prime helix being one millimeter, or, in other terms, the prime helix opposing a resistance of 0.937. Supposing such a lamp, and supposing, further, the same be fed with a current intensity of two ampères, then the number of windings of its prime helix will be reduced to $\frac{860}{2}=430$, and it will burn provided its co-operating counter-force be caused to be balanced by the said reduced number of ampère-windings. Moreover, this lamp will also burn with a current intensity of ten ampères when a shunt is arranged to the main or prime helix and provided with such a resistance as to allow eight ampères to be diverted from the said helix, so that the number of ampères received by the latter is but two ampères. As long as the current flowing through the arc has an intensity of ten ampères, the lamp will continue to burn quietly. When the said intensity is caused to fall below ten ampères—for instance, to nine ampères—the shunt will

not be altered, but continue to divert eight ampères from the main helix. Consequently the latter will be fed with one ampère only instead of with two ampères, and its number of ampère-windings proportionally reduced, so that it discontinues to balance its counter-force. This state of the lamp will be maintained until by the action of the said counter-force two ampères are again permitted to flow through the main helix. From this it results that, when the lamp is desired to burn with a two-ampères brilliancy, the said resistance must be raised to an infinitely great amount or the second shunt cut out totally.

From the foregoing it is readily to be conceived how the lamp can be enabled to burn with any number of ampères between two and ten ampères as the minimum and maximum intensities of current or the minimum and maximum degrees of brilliancy, it being only necessary to arrange a shunt to the main helix and to provide this shunt with a resistance capable of being so adjusted as to allow but two ampères to pass through the main helix, whatever number of ampères is admitted to the lamp, provided this number be within the limits of two and ten ampères. For instance, when the lamp is desired to develop a brilliancy corresponding to five ampères, then the auxiliary resistance or graduator has to be so adjusted as to cause three ampères to be diverted from the prime helix.

The principle disclosed by the foregoing may be expressed as follows: In order to reduce the brilliancy of the lamp or its current intensity, the action of its main helix must be increased by increasing the resistance of the shunt to said helix. Moreover, in order that in all instances the lamp may burn with a current tension best adapted for the degree of brilliancy desired, the main regulating resistance of the lamp has to be varied simultaneously with the variation of the auxiliary resistance, so that the current intensity acts with such tension as experience has proved to be best.

The variations of the auxiliary and main regulating resistances are found by methods of calculation known to electricians.

The following is a table indicating several amounts of auxiliary resistance and current tension for lamps intended to burn with any intensity within the limits of two and ten ampères:

Intended brilliancy of lamp.	Main helix receiving.	Difference for shunt.	Resistance of the shunt.	Tension, volts.
10.....	2	8	0.0234	40
8.....	2	6	0 0342	39
6.....	2	4	0.0467	38
4.....	2	2	0.0907	37
3.....	2	1	1 87	36
2.....	2	0	∞	33

It is well understood that instead of arranging one shunt provided with an adjustable resistance it is but an equivalent means to provide for as many shunts as variations of brilliancy are desired and to provide each individual shunt with the special resistance required for the degree of brilliancy to be obtained by the respective shunt.

(*b.*) *Varying the current intensity by varying the action of the differential helix.*—From case *a*, where the action of the main helix has to be increased by increasing the resistance of the shunt to the main helix, in order to permit the current intensity to be reduced, and from the contemplation that a maximum of current intensity is caused to flow through the arc when the differential shunt—*i. e.*, the shunt to the arc—exerts its maximum of action, it results that the current intensity can also be reduced by increasing the resistance in the differential shunt. Thus to enable the lamp to burn at different times with different degrees of brilliancy the differential shunt of same has to be provided with an adjustable auxiliary resistance or graduator and the latter adjusted to allow such a number of ampères to pass as corresponds with the degree of brilliancy desired, it being well understood that the main regulating resistance must simultaneously be varied, as already stated.

The amount of variation of both the auxiliary and the main regulating resistance is found by methods of calculation known to electricians.

On the annexed sheet of drawings, Figure 1 is a diagram of a differential lamp with the auxiliary resistance or graduator placed in a shunt to the prime helix, and Fig. 2 a diagram of a differential lamp with the graduator placed in the circuit of the differential helix.

In both figures similar letters of reference are employed for indicating identical parts.

In Fig. 1, *o* is the upper carbon, *u* the lower carbon, L L′ the main circuit of the lamp, and H the helix placed in the same, or the prime helix. S is the shunt to the arc, and N the helix arranged in the same, or the differential helix. H R is the usual regulating resistance of the lamp. The light current flows from the positive pole of the source of electricity, through the main L and the regulating resistance H R, to the upper carbon, from this to the lower carbon, whence it passes back to the negative pole of the source of electricity through the prime helix H and the main L′. As seen, a shunt *h h′* is arranged to the prime helix H, and in this shunt is placed a resistance N R, which is adjustable. This auxiliary resistance N R is what I call the "graduator." If this shunt is switched out the whole light current will be caused to pass through the windings of the prime helix; but when it is switched in but such fraction of the current will be allowed to pass through the prime helix as corresponds to the amount of resistance opposed by the graduator N R. The two resistances N R and H R are so connected by appropriate means—for instance, by a hand pivoted

in its center and the middle portion of which is made of non-conducting material, while its end portions h' and h^2 are conductors—that any variation of one of them causes such variation of the other as is best suited for the degree of brilliancy obtained by that variation.

In Fig. 2 the adjustable auxiliary resistance or graduator is placed in the circuit S of the differential helix N, while there is no shunt to the prime helix H. As long as the graduator is switched out the full amount of differential current will pass through helix N and the lamp will burn with its maximum degree of brilliancy; but when it is switched in only such an amount of current will be allowed to circulate through the differential helix as corresponds to the amount of active resistance of the graduator and the lamp will burn with a correspondingly lower degree of brilliancy. In this case, also, a connection has to be established between the two resistances H R and N R, as described with reference to Fig. 1, this connection being omitted from the drawings. It is obvious that the graduator may also be placed in the circuit of the prime helix or in a shunt to the differential helix, and that in such case the effect will be the reversal of that described with reference to cases *a* and *b*, respectively.

What I claim is—

1. In electric arc lamps the combination, with the upper and lower carbons, the regulating helix, and the main regulating resistance of the lamp, of an auxiliary resistance for changing the action of the said helix, and a connection between the said auxiliary resistance and the main regulating resistance, substantially as and for the purpose described.

2. In electric arc lamps the combination, with the upper and lower carbons, the regulating helix, and the main regulating resistance of the lamp, of an adjustable auxiliary resistance for changing the action of the said helix, and a connection between the said auxiliary resistance and the main regulating resistance, substantially as and for the purpose described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

RUDOLF H. JAHR.

Witnesses:
FRITZ SCHRÖDER,
MARIA NAGEL.