F. GIRARD.

METHOD OF CONNECTIONS FOR STARTING METALLIC VAPOR LAMPS.

APPLICATION FILED OCT. 9, 1911.

1,091,648.

Patented Mar. 31, 1914.

2 SHEETS—SHEET 1.

Fig. 1

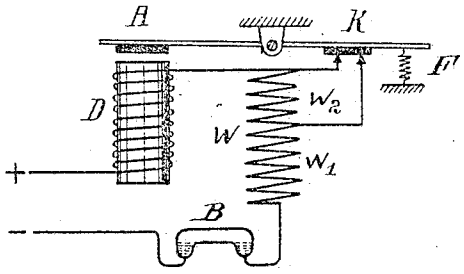


Fig. 2

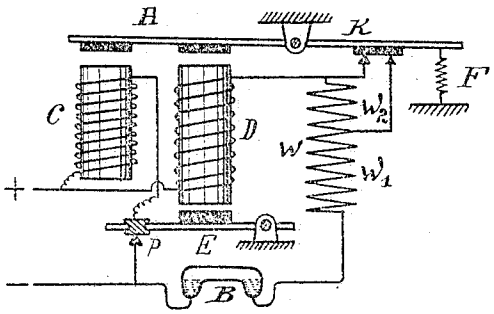
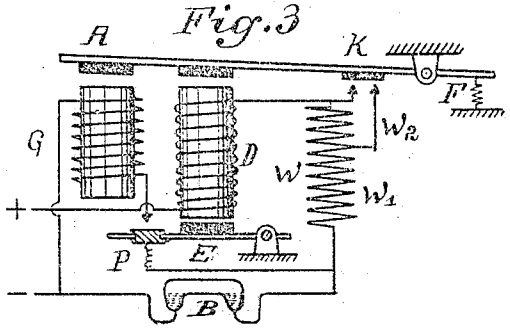


Fig. 3



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2 SHEETS—SHEET 2.

Fig. 4

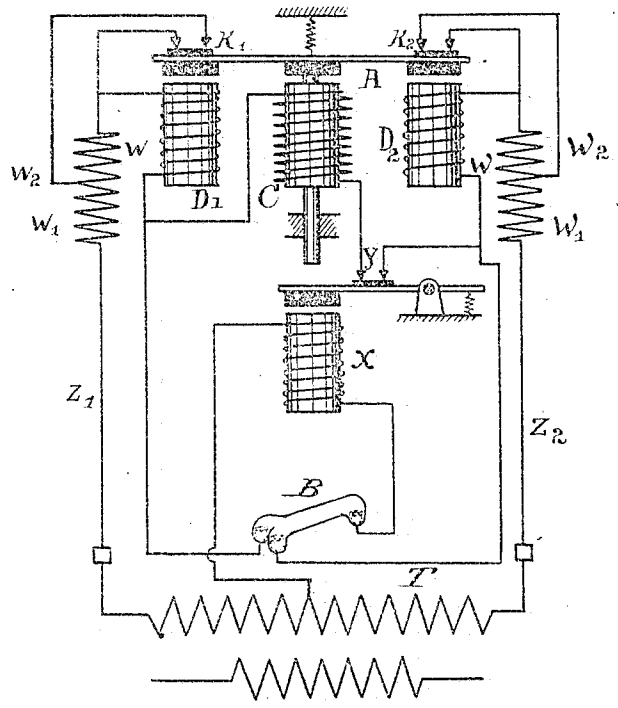
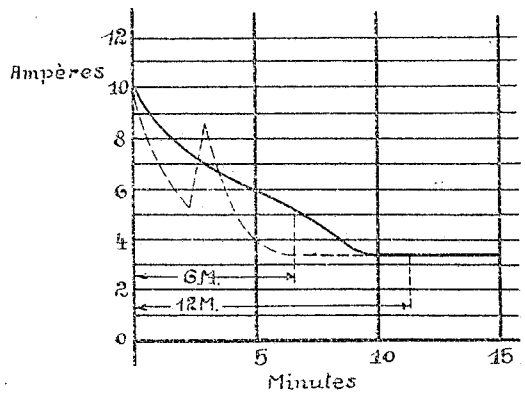


Fig. 5



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UNITED STATES PATENT OFFICE.

FRITZ GIRARD, OF HANAU, GERMANY, ASSIGNOR TO THE FIRM OF W. C. HERAEUS GESELLSCHAFT MIT BESCHRANKTER HAFTUNG, OF HANAU, GERMANY.

METHOD OF CONNECTIONS FOR STARTING METALLIC-VAPOR LAMPS.

1,091,648. Specification of Letters Patent. Patented Mar. 31, 1914.

Application filed October 9, 1911. Serial No. 653,644.

To all whom it may concern:

Be it known that I, FRITZ GIRARD, a subject of the German Emperor, and resident of Hanau-on-the-Main, Germany, have invented certain new and useful Improvements in the Method of Connections for Starting Metallic-Vapor Lamps, of which the following is a specification.

The current strength and voltage of metallic vapor lamps are, as is well known, dependent upon the vapor pressure in the lamp, and moreover, the higher the vapor pressure is, the lower the current strength and the higher the voltage of the lamp. For this reason peculiar conditions obtain during the lighting up period in mercury vapor lamps which, when lighted up, work at a high vapor pressure, as in the case of quartz lamps for example. (See O. Bussmann, "Neues uber die quarz-lampe", *Elektrotechnischer Anzeiger*, 1908, Nos. 73 and 74). If a lamp of this kind be constructed for a current consumption of 3.5 amperes and 180 volts burner voltage, it will require with a current off the mains of 220 volts and when lighted up a reducing resistance of

$$\frac{220-180}{3.5}=11.4 \text{ ohms.}$$

With a reducing resistance of this magnitude the current strength will amount at the instant of lighting up and with the burner short circuited by the flowing of the mercury from one pole over to the other, to

$$\frac{220}{11.4}=19.3 \text{ amperes,}$$

but immediately after lighting up, when the burner voltage amounts to about 30 volts, it will drop to

$$\frac{220-30}{11.4}=16.7 \text{ amperes.}$$

Such high initial currents must however be avoided on economical grounds for a lamp which, under normal working conditions, only requires 3.5 amperes, and 10 amperes ought to be regarded as quite the highest permissible current strength when commencing to light up. At the commencement therefore a reducing resistance of at least

$$\frac{220-30}{10}=19 \text{ ohms}$$

is necessary which must be reduced to 11.4 ohms during lighting up. In the quartz lamp this regulation has hitherto been accomplished by the use of reducing resistances of iron wire.

As is well known, iron possesses a high positive temperature coefficient and its resistance becomes quadrupled when it is heated to a low red heat by the current. If its dimensions be suitably proportioned for quartz lamps, it is possible to make the iron resistance glow feebly at the high initial current strength at which temperature it takes up about 130 volts corresponding to 17 ohms resistance, while at the final current strength of 3.5 amperes it becomes only inappreciably heated up and then does not absorb more than 13 volts corresponding to 4 ohms resistance. The resistance must naturally have a very small thermal capacity so that when switched into circuit it shall be raised to a red heat as rapidly as possible. For this reason very fine iron wires are employed and in order to protect them from oxidation and for the better conducting away of the heat, they are inclosed in glass cylinders which are filled with hydrogen gas. The use of these glass globes with the iron resistances inclosed therein leads to all sorts of inconveniences on account of their fragility.

In the specification of German Patent No. 178,064 there is described a method whereby a main current magnet placed in the lamp circuit short circuits the reducing resistance or a portion thereof when the current strength declines. This method may be made use of with advantage in order to replace the iron resistances of the quartz lamps. At first when lighting up the lamp has a large resistance switched in in front of it which restricts the current strength to the permissible amount and the drop in the current strength which takes place as the vapor pressure rises or the corresponding rise in the burner voltage is utilized to elec-

tromagnetically short circuit or cut out of circuit a portion of the reducing resistance. This causes the current strength to rise again transitorily to drop however gradually to its final value as the vapor pressure continues to rise.

The simplest possible way of obtaining the end aimed at would be by means of an arrangement illustrated by Fig. 1. W denotes the reducing resistance, of which the part W_1 remains permanently in circuit, the part W_2 on the other hand is only switched into circuit during the lighting up time of the burner. The contact K which short circuits the resistance W_2, is normally closed. When lighting up the burner the main current magnet D is excited; it attracts its armature A and opens the contact K, whereby the entire resistance W is switched into circuit.

When the current strength has dropped to a certain amount, the magnetism of D will have decreased to such an extent that the tractive force of the spring F will pull off the armature A. By this means the contact K will be closed. A rise in the current strength now again takes place. The adjustment of the armature A and of the spring F must be such that the armature is only attracted by the first current impulse when short circuiting takes place in the burner and not by the lesser impulse when W_2 is short circuited.

The repeated raising of the current strength effects a more rapid heating up of the burner and the lighting up period can in consequence be curtailed to the half of that requisite with iron resistances.

The arrangement shown in Fig. 1 of German Patent No. 178,064 has the disadvantage that the moment the mercury runs together in the burner the part W_2 of the resistance is still short circuited whereby a momentary very strong current impulse is produced which is injurious firstly to the adjacent lamps in the circuit and secondly to the contact K *per se*.

The object of the present invention is therefore to avoid the strong current impulse which is effected by the arrangement shown in Fig. 1. The invention consists in the use of a shunt magnet in addition to the main current magnet provided in Patent No. 178,064. This shunt magnet may be used in a twofold way for the prevention of the strong current impulse when the lamps are switched on. Figs. 2 and 3 explain this.

In Fig. 2 immediately the lamp is switched on and before the burner is tilted and the mercury runs together in it, the shunt magnet C attracts the armature A and opens the contact K in consequence. Immediately the main current is established and magnetizes the main current coil D, this takes over the keeping open of the contact K while it simultaneously attracts the small armature E and thereby breaks the shunt circuit at P. The shunt magnet C may conveniently be the same as that which operates the tilting mechanism required for lighting up.

In the arrangement shown in Fig. 3 the contact K is normally open. When lighting up the main current magnet D switches the shunt magnet G in at P by attracting the armature E. The shunt magnet G at first receives the small initial voltage of the burner of about 30 volts, and its magnetism is therefore not strong enough to attract the armature A. With the increase in the burner voltage the magentism in G becomes finally so strong that the armature A becomes attracted, the contact thereby closed at K and the resistance W_2 short circuited.

In alternating current lamps one of the arrangements shown in Figs. 2 and 3 may likewise be used. A suitable method of connections is shown in Fig. 4 for example. In this case W W are two nickelin resistances each of which is placed in the leads Z_1 and Z_2 leading from the secondary terminals of the transformer T to the anodes of the burner. There are also two contacts K_1 and K_2 for the short circuiting of the parts W_2 of two resistances, and the two main current magnets D_1 and D_2, but only one shunt coil C, which performs the same function as that shown in example Fig. 2, and is thrown out of operation after lighting up by the interrupter Y worked by a magnet X. In this case the two main current magnets have also to keep the armature A attracted and the contacts K_1 and K_2 open when transitory short circuiting is produced between the two anodes on the tilting of the burner and the shunt magnet thereby thrown out of operation. Instead of short circuiting only one portion of the resistance, the whole resistance W may be short circuited through the contact K or K_1 and K_2 should occasion require it.

Fig. 5 shows the course of the current strength when the lamp is lighted up. The drawn curve shows the lighting up when iron resistances are employed. The dotted curve shows the lighting up when the new arrangement is employed. In the first case the final current strength of 3.5 amperes is attained after about 12 minutes and in the latter in as soon as 6 minutes.

What I claim is:—

1. The combination of a high pressure vapor electric device, taking a high starting current, a resistance therefor, automatic means for including said resistance in series therewith before starting, and coöperating means responsive to a predetermined value of operating current to remove said resistance.

2. The combination of a high pressure mercury vapor lamp, starting at a voltage lower and a current higher than the normal

operating voltage and current, a resistance therefor, means responsive to the application of potential across the lamp for including said resistance in series therewith, and means responsive to an operating current in said lamp for short-circuiting said resistance when the operating current falls below a predetermined limit due to a rise of potential in the lamp.

3. The combination of a vapor electric device starting at a lower voltage than the normal operating voltage, a source of current, a resistance, means for including said resistance in series with said device before an arc has been started therein, and means responsive to a drop of operating current in said device below a predetermined value to short-circuit said resistance.

4. The combination of a vapor electric device, a resistance therefor, magnetic means in shunt with said device for including said resistance in series with said device, and cooperating magnetic means in series with said device for shunting at least part of said resistance when the operating current has decreased to a predetermined value.

5. The combination of a vapor electric device, a resistance in series therewith, a circuit shunting at least part of said resistance, means for opening and closing said circuit, a magnetic device in shunt with said vapor device for opening said circuit, and magnetic means in series with said vapor device for deënergizing the shunt device and maintaining the shunt circuit open until the load current has reached a predetermined value.

6. The combination of a high pressure alternating current vapor electric device, a source of current therefor, series resistance for the alternating current supply circuits of said device, magnetic means operable by an application of voltage across the electrodes of said device for including said resistance in series with the supply circuits, means operable by a flow of load current for deënergizing said means, and means operable by a decrease of load current below a predetermined value to short-circuit at least a portion of said resistances.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FRITZ GIRARD.

Witnesses:

FRANZ HASSLACHER,

ERWIN DIPPEL.