

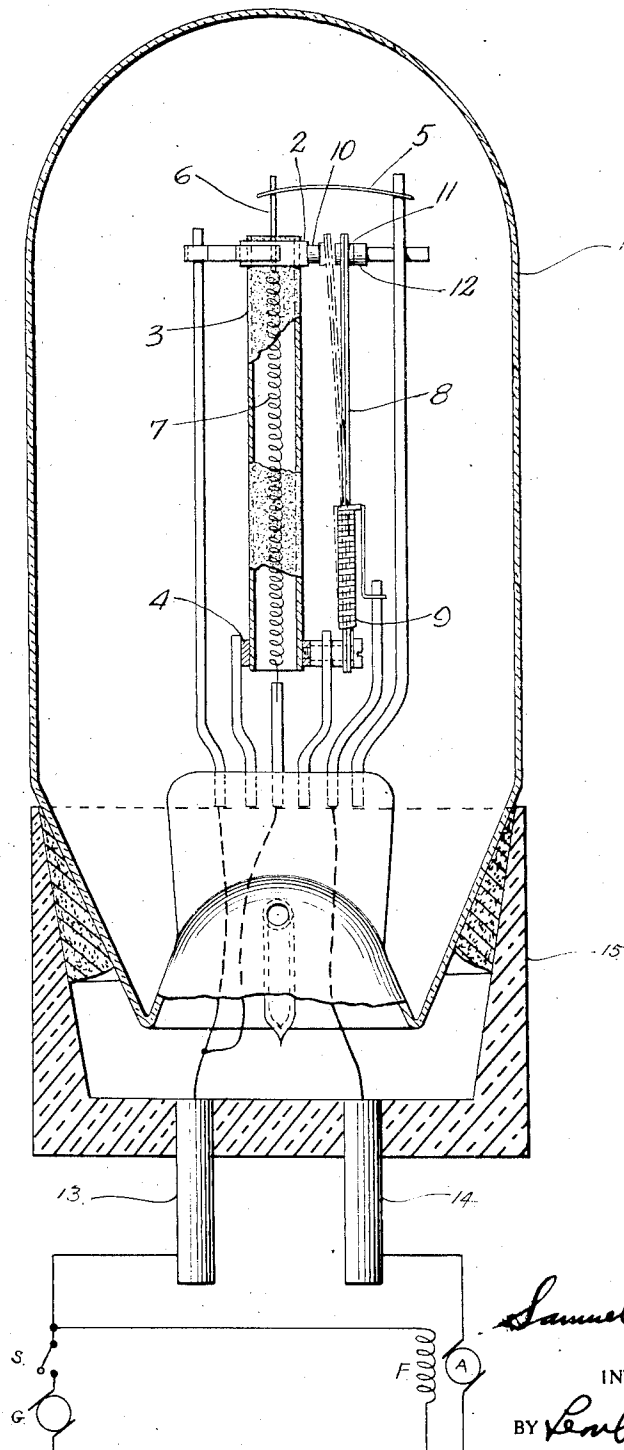
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S. RUBEN

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AUTOMATIC STARTER

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AUTOMATIC STARTER

Samuel Ruben, New Rochelle, N. Y., assignor to
Vega Manufacturing Corporation, Wilmington,
Del., a corporation of Delaware

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10 Claims. (Cl. 201-63)

This invention relates to a device for use in starting apparatus requiring the introduction of resistance when connected to a line so as to prevent excess current flow. Specifically, it relates to a device for automatically controlling the current flow without manual operation of a control device such as the commonly used starting box or rheostat.

This device utilizes the electrical resistance properties of silver sulphide (or other compounds of the oxygen series of the sixth periodic group) when that material is produced in a certain manner and used in an inert atmosphere.

I have found that if silver metal be heated under pressure in a sulphur atmosphere to a temperature of 600° C., that a black and dense crystalline material is obtained having a very large negative resistance temperature coefficient. Silver sulphide made by a wet reaction as by reaction with an alkaline sulphide or with hydrogen sulphide does not have the property described.

In order to indicate this negative resistance coefficient, the following relation of resistance to temperature has been observed with a rod of silver sulphide 1 millimeter thick and 2 cm. long:

Temperature ° cent.	Resistance (ohms)
20	5,000,000
40	2,000,000
60	1,000,000
80	500,000
100	100,000
120	20,000
140	5,500
160	2,000
170	500
175	25
180	5
190	5.5
200	6.0

From the foregoing observed data, it is noted that the resistance drop with temperature is very large and it is also subject to other variables such as the voltage applied to the element in measuring the resistance.

I have found that if the resistance element be operated under pressure in an inert gas such as helium that a device utilizing this effect can be made that will maintain its characteristics.

If operated in air, oxidation of the sulphur takes place which by substitution produces metallic silver and sulphur dioxide which permanently alters the resistance of the sulphide element.

In a device for use in starting motors which application has been commercially found to be of advantage, the silver sulphide element is con-

nected in series with the armature and is heated by a refractory heater element such as a coiled tungsten filament which also is heated by being connected in series with the load. The variable resistance element is preferably short circuited after the motor is at operating speed and it is maintained in a shunt connection as long as the load is on. This allows it to cool so as to be at a high resistance when starting is again desired. The heater element is also automatically disconnected when the starting has been accomplished.

The short circuiting is preferably accomplished by use of an independently heated thermostatic element.

In order to more completely describe this invention, reference is made to the accompanying drawing in which is shown a glass bulb (1) which after having the parts therein assembled, has been completely exhausted and filled under pressure with helium. The silver sulphide element (3) requires ageing which is accomplished by heating in an inert atmosphere to a temperature in excess of that to be used in practice or operation of the device. Nickel rings (4) and (2) positioned respectively at the top and bottom of the silver sulphide element (3) are adapted to establish the electrical circuit through the sulphide element and related connection. The nickel rings, as are all supporting parts, are electrically welded to the support wires in the glass press or stem in a manner common to the lamp and vacuum tube art. Tungsten spring (5) is used to take up the expansion of the heater filament (7) which is coiled and made of tungsten. Supporting and welded to this filament is straight support wire (6). The thermostatic or bimetal strip (8) is made by rolling and brazing a brass sheet on an invar steel base and when heated bends toward the contact on ring (2). Around the thermostatic element (8) is wound insulated resistance wire (9) so that when the current becomes high enough, it heats the thermostatic strip causing it to move toward the sulphide tube, short circuiting it and opening the heater contact. As long as the load current flows, it keeps the heater circuit open and the sulphide resistance short circuited. Tungsten contact (10) is mounted on upper ring (2). The contacts (11) mounted on thermostatic element (8) are initially in contact with contact (12) which connects the heater element in circuit with the load. Other designations shown in the drawing are generator (G); armature of a motor (A); field (F) and switch for connecting motor (S).

In operation, when the switch (S) completes the circuit, the supply current flows through the tungsten coil heater circuit, which due to radiation and excellent thermal conductivity of the helium, rapidly heats the silver sulphide tube. This sulphide tube is in shunt with the heater. When the sulphide tube becomes heated, its resistance drops from an open circuit value to a very low resistance and when the current in the resistance (9) is great enough it heats the thermostat element (8) which bends over toward the sulphide tube, breaking the heater circuit between contacts (11) and (12) and short circuits the silver sulphide resistor element by making contact with contact (10) on upper ring (2). This allows the silver sulphide to cool and return to its normal high resistance. The heat from the element (9) is insufficient to adequately raise the temperature of the silver sulphide to an effective value.

The tube can be mounted as shown in a molded base (15) with prong connections (13) and (14).

While silver sulphide is deemed preferable, I have also been able to accomplish the operating characteristics described, though with less efficiency, with other compounds of the oxygen series of the sixth periodic group, such as cuprous oxide, antimony sulphide, cupric oxide and mixtures of cupric and antimony sulphide.

A thermostatic means for short circuiting the silver sulphide is considered preferable, but it is obvious that other means, such as electromagnetic means could also be used in a similar manner. It is also obvious that the shunting means could be external if desired.

What is claimed is:

1. In a sealed atmosphere of helium, the combination of a silver sulphide tube, a refractory heater coil with which it is in shunt, and a bimetallic thermostat element adapted to short circuit said silver sulphide tube at a predetermined temperature.

2. In combination, a sealed envelope having an atmosphere of helium and containing a variable resistance device employing as its variable resistance element a crystalline sulphur compound, associated thermal means within said envelope to effect the desired variations in resistance, and means to short circuit said variable resistance element when a predetermined resistance value is obtained.

3. In combination, a variable resistance element consisting of a crystalline compound having an abnormal negative temperature coefficient, associated thermal means to effect the desired resistance variation, with means to simultaneously short circuit said variable resistance element and disconnect the thermal means.

4. In a sealed envelope having an atmosphere having a heat conductivity greater than air, the combination of a variable resistance element consisting of a crystalline compound having an abnormal negative temperature coefficient, associated thermal means within said envelope to effect the desired resistance variation, with means to short circuit said variable resistance element and disconnect the thermal means.

5. In combination in a sealed envelope containing helium, a variable resistance element consisting of silver sulphide, associated thermal means within said envelope to effect the desired resistance variation, with means to short circuit said variable resistance element and disconnect the thermal means.

6. A resistance device comprising the combination of a tube of a material having a negative temperature coefficient, a heater element axially suspended within said tube, with means of simultaneously short circuiting said tube and disconnecting said axially arranged heater element.

7. A resistance device comprising the combination of a tube of silver sulphide, a heater element axially suspended within said tube, with means of simultaneously short circuiting said tube and disconnecting said axially arranged heater element.

8. A resistance device comprising the combination of a tube of a material having a negative temperature coefficient a heater element axially suspended within said tube, with means of simultaneously short circuiting said tube and disconnecting said heater element, said combination arranged in an envelope containing an inert gas of high thermal conductivity.

9. A resistance device employing a resistance element having a negative temperature coefficient of resistance, temperature responsive means positioned in close proximity to said element to short circuit said element when a predetermined resistance value is reached, and means to maintain the temperature of said temperature responsive means when said resistance element is short circuited.

10. A resistance device employing a resistance element having a negative temperature coefficient of resistance, temperature responsive means positioned in close proximity to said element to short circuit said element when a predetermined resistance value is reached, and auxiliary means to initially raise the temperature of said temperature responsive means and to maintain the temperature thereof when said element is short circuited.

SAMUEL RUBEN.