May 14, 1935. W. MEYER ET AL 2,001,498

ELECTRIC TRANSLATING DEVICE

Filed Dec. 7, 1934

Fig. 4

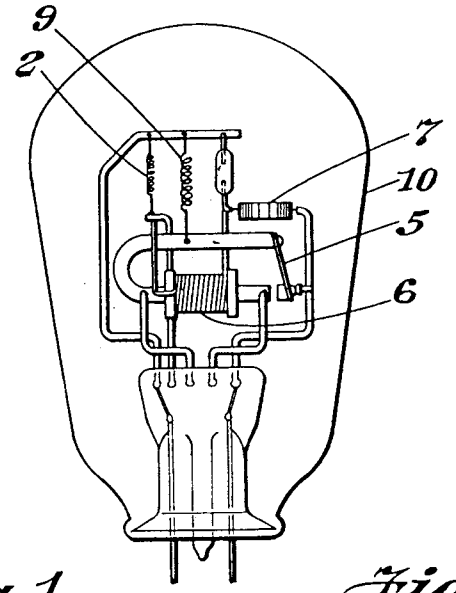


Fig. 1

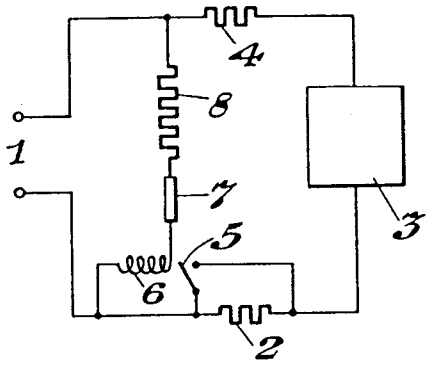


Fig. 2

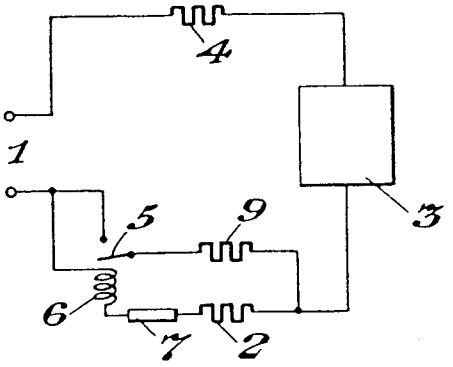


Fig. 3

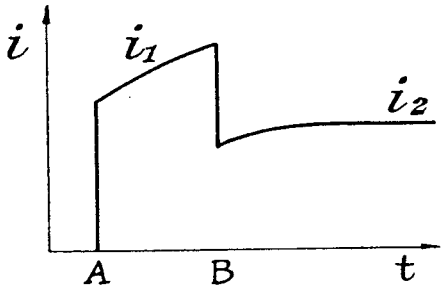
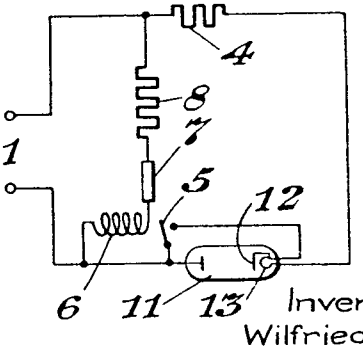


Fig. 5



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ELECTRIC TRANSLATING DEVICE

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6 Claims. (Cl. 176—124)

The present invention relates to electric translating devices, such as electric gaseous discharge devices, and more particularly to circuits and apparatus for starting and operating the same.

A particular object of the invention is to provide a novel apparatus for shortening the operating period before a gaseous discharge device reaches its normal operating condition. Another object of the invention is to provide a novel means to change the impedance in series with a gaseous discharge device during the starting period. A further object of the invention is to provide a novel means to prevent the initiation of a discharge to a cathode of the indirectly heated type until it has reached a desired electron emitting temperature. Another object of the invention is to provide means for preventing changes in the operating characteristics of the novel apparatus. Still other objects and advantages of the invention will appear from the following detailed specification or from an inspection of the accompanying drawing.

The invention consists in the novel combination of elements which is hereinafter set forth and claimed.

In various electric translating devices, and particularly in the operating circuits of gaseous electric discharge devices, it is desirable to provide for a relatively large initial current flow which is decreased after the device has been heated to a desired temperature. For example, where a vaporizable material such as sodium, mercury, cadmium, or the like is used as the principal source of the gaseous atmosphere in an electric discharge device it is desirable to heat the device as rapidly as possible in order to vaporize the material and bring the device to its equilibrium condition with a minimum of delay. Similarly where a thermionic cathode of the indirectly heated type is employed it is essential that this cathode should be at such a temperature that the free electron emission therefrom will support the discharge current before a discharge is initiated. This entails a delay which may be greatly reduced by passing an abnormally large current through the heater before the discharge is initiated. In either case a switching means, coupled with some sort of timing means, must be employed. The present invention relates to an improved mechanism for producing this result, which eliminates certain difficulties which are encountered with any of the switching mechanisms heretofore employed. According to this invention a resistance having a large negative temperature resistance coefficient is utilized to provide the desired timing of the abnormally large current flow, a suitable switch being actuated thereby after a predetermined time interval. This resistance may be connected either in series or in parallel with the device which is to be rapidly heated, and in order to maintain the electrical characteristics thereof constant it is preferably sealed within a vessel having a fixed gaseous content of a desired character.

For the purpose of illustrating the invention several embodiments thereof have been shown in the accompanying drawing, in which

Fig. 1 is a schematic diagram of a novel circuit for starting and operating an electric gaseous discharge device,

Fig. 2 is a modification of the circuit of Fig. 1,

Fig. 3 is a graph showing the current variations produced with the circuit of Fig. 2,

Fig. 4 is an elevational view showing the preferred arrangement of the elements of Fig. 2, and

Fig. 5 is a schematic diagram of still another modification of the invention.

As shown in Fig. 1 the operating device 3, such as an electric gaseous discharge device, is connected to the source 1 through a resistance 2 and a ballast resistance 4, the latter being just large enough to stabilize the discharge. A switch 5 is arranged to short circuit the resistance 2. Said switch, which is normally closed, is responsive to a coil 6 which is connected in series with a resistance 7 and a resistance 8 across the source 1. Said resistance 7 has a negative temperature coefficient, and is conveniently made of uranium dioxide, or any other similar material which has a marked decrease in resistance as the temperature thereof increases.

In the use of the apparatus shown in Fig. 1 as soon as potential is applied a relatively large current flows from the source 1 through the switch 5, operating device 3 and resistance 4, this current rapidly heating the device 3, so that it approaches the temperature at which it is in thermal equilibrium under normal conditions after an unusually short interval. During this time a small current also flows from the source 1 through the magnet 6, resistance 7 and resistance 8. As the resistance 7 is heated by this current its resistance decreases, so that the current flowing in this shunt circuit increases. As the device 3 approaches or just reaches its equilibrium temperature the current through the coil 6 becomes large enough to cause the switch 5 to open, inserting the resistance 2 in the operating circuit of the device 3, and thus reducing the current therethrough to the normal operating value. As a re-

sult the device 3 is brought to a stable operating condition without the relatively long delay which would be necessary without this novel circuit arrangement.

The foregoing arrangement is particularly intended for use where the current flowing through the device 3 is relatively large with respect to the current required by the coil 6 to maintain the switch 5 open, since under these conditions the energy used in the shunt circuit will not materially reduce the efficiency of the device. Where the current through the device 3 is relatively small, however, it is preferable to use the circuit illustrated in Fig. 2, wherein the magnet coil 6 and the resistance 7 are included in the operating circuit of the device 3. The switch 5 is here connected in series with a resistance 9 in parallel with the coil 6, resistance 7 and resistance 2. Said resistance 9 is small with respect to the resistance 2, being just large enough to cause the desired current to flow through the resistance 7.

As indicated in Fig. 3, where the current i is plotted as a function of time t for the embodiment shown in Fig. 2, a current i_1 flows as soon as the potential is applied at time A. This current divides between the two shunt circuits, by far the larger portion thereof flowing through the switch 5 and resistance 9 at time A. This current rapidly heats the device 3, and also the resistance 7. As a result of this heating of the resistance 7 the current therethrough, and likewise the total current i_1 increases, as shown in the graph until at time B, which corresponds to the time when the device 3 approaches its normal operating temperature, the current through the coil 6 is large enough to open the switch 5. The total current is thereupon greatly decreased to the value indicated by the curve i_2. As indicated in the graph this current is slightly increased as the resistance 7 is further heated until said resistance reaches its thermal equilibrium.

While the device 3 of Figs. 1 and 2 has been referred to as an electric gaseous discharge device it is to be understood that it could also be the heater of an indirectly heated cathode for such a device, or any similar device which it is essential or desirable to rapidly bring to thermal equilibrium.

The period during which the switch 5 is closed can be readily adjusted in various ways. For example, in Fig. 1 the resistance 8 may be varied, while in Fig. 2 a variation in the resistance 9 produces the same result. Where it is desirable to vary this time delay period to compensate for changes in ambient temperature, thermal shielding of the device 3, as by different reflectors and the like, these resistances are preferably made variable so that they can be adjusted to produce the best conditions under the particular operating conditions encountered.

In order to insure that the resistance 7 will have constant electrical properties it is preferably enclosed within a sealed envelope 10, as shown in Fig. 4. This envelope may be evacuated, or filled with a reducing gas, such as hydrogen, or with an inert gas such as nitrogen or one of the rare gases. As shown in Fig. 4 this envelope can conveniently also contain the other resistances, as well as the switch 5 and its operating coil 6. In this case the resistances 2 and 9 are made of tungsten or other metal with a high melting point and are arranged as filaments which may be availed of to give light, if desired, to add to and to modify that from the device 3. Likewise the switch contacts are maintained in a perfect condition due to the freedom from oxidation.

In some cases the resistance 8 is located in thermal relation to the resistance 7 in order to increase the heating of the latter. Under these conditions it is possible to obtain a greater independence from the ambient temperature by using a material such as chromium oxide, or one of the rare earth oxides, for the resistance 7. In this case the initial resistance is extremely high, but decreases as the temperature is raised by heat from the resistance 9, allowing an increased current to flow through the resistance 7 which then materially assists in still further raising the temperature of said resistance 7, said current thus continuing to increase until the switch 5 is opened as before.

When the novel switching arrangement of this invention is used to control the cathode heating current of an electric gaseous discharge device it can also be used in a novel manner to delay the initiation of a discharge until the cathode has reached a desired operating temperature. Thus as shown in Fig. 5 the discharge device 11 is itself short-circuited by the switch 5, allowing an abnormally large current to flow through the heater 13, whereby the cathode 12 is rapidly brought up to the operating temperature without any possibility of the discharge being initiated thereto during this interval. As soon as said cathode is properly heated, however, the resistance 7 passes sufficient current, by design, to permit the magnet coil 6 to open the switch 5. Operating potential is thereupon applied to the device 11 and the discharge is immediately initiated to the cathode 12, the discharge current thereupon flowing through the heater 13 and thus assisting to keep the cathode 12 at the desired temperature. In case the heating current is too large when the switch 5 is closed a resistance can obviously be included in series with the switch. Conversely, if the discharge current is inadequate to maintain the cathode at the proper temperature it is obvious that a resistance can be connected in parallel with the switch 5.

It is to be noted that the novel switching arrangement herein disclosed is adapted for use on either alternating or direct current without change. This feature, together with its simplicity and reliability, makes this arrangement especially useful.

While the invention has been illustrated by reference to certain specific embodiments thereof it is to be understood that it is applicable to various types of translating devices, and that various omissions, substitutions and changes, within the scope of the appended claims, may be made therein without departing from the spirit of the invention.

What we claim as new and desire to secure by Letters Patent of the United States:—

1. In combination, a device whose operating characteristics vary with temperature, means to pass a relatively large current through said device at starting to rapidly heat it to its normal operating temperature, and means to decrease said current when said device reaches a predetermined temperature, said last mentioned means comprising an impedance in series with said device, a resistance having a negative temperature-resistance characteristic, means to heat said resistance, and a switch which is responsive to temperature changes in said resistance to increase said impedance.

2. In combination, a device whose operating characteristics vary with temperature, means to pass a relatively large current through said device at starting to rapidly heat it to its normal operating temperature, and means to decrease said current when said device reaches a predetermined temperature, said last mentioned means comprising an impedance in series with said device, a resistance having a negative temperature-resistance characteristic, means to heat said resistance, and a switch which is responsive to temperature changes in said resistance to increase said impedance, said resistance being located within a sealed container.

3. In combination, a device whose operating characteristics vary with the temperature, means to pass a relatively large current through said device at starting to rapidly heat it to its normal operating temperature, and means to decrease said current when said device reaches a predetermined temperature, said last mentioned means comprising a filamentary resistance in series with said device, a resistance having a negative temperature-resistance characteristic, means to heat the latter resistance, and a switch which is responsive to temperature changes in the latter resistance to increase the portion of the current which traverses said filamentary resistance, both of said resistances being located within a sealed container.

4. In combination, a device whose operating characteristics vary with the temperature, a resistance having a negative temperature-resistance characteristic in series with said device, another resistance in parallel with said first mentioned resistance, and a switch responsive to increased current flow through said first mentioned resistance to open the circuit through the latter resistance.

5. In combination, a device whose operating characteristics vary with the temperature, a resistance having a negative temperature-resistance characteristic in series with said device, another resistance in parallel with said first mentioned resistance, and a switch responsive to increased current flow through said first mentioned resistance to open the circuit through the latter resistance, said resistances being in thermal relation to each other.

6. In combination, an electric gaseous discharge device having a thermionic cathode, a heater therefor, and another electrode, means to connect said device to a source of energy through said heater, a by-pass connection between said cathode and said other electrode whereby the potential is reduced to a value less than that necessary to initiate a discharge therebtween and a heating current is passed through said heater, and means to open said by-pass after said cathode has reached a temperature at which the free electron emission therefrom will support the normal discharge current.

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