

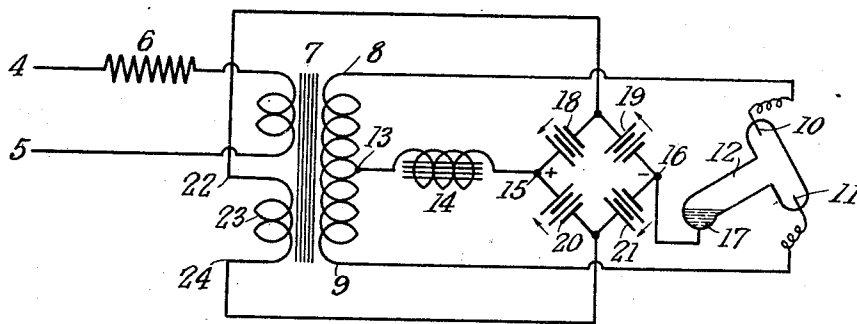
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ALTERNATING CURRENT VAPOR ELECTRICAL DEVICE

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ALTERNATING CURRENT VAPOR ELECTRICAL DEVICE

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This invention refers particularly to operating means for multiple electrode gas or vapor filled electric devices that are normally designed for alternating current operation.

Alternating current vapor or gas filled electric current devices, commonly known as arcs, are ordinarily rectifiers, these arcs usually having one cathode and two anodes. Current from the alternating current source flows into the anodes of the arc and out of the cathode terminal. The nature of the arc is such that there is no electrical path from the cathode thru the arc stream back to the anodes.

For this reason current will flow thru the arc only when an anode is at a positive potential with respect to the cathode.

The nature of the electrical circuit is such that each anode in succession is positive with respect to the cathode once during each cycle of the alternating current. The anodes are therefore active intermittently, one or the other being operative at all times. Since current can flow thru the arc in only one direction the current flowing from the cathode terminal is unidirectional. It is well known that unidirectional current flowing thru a resistance produces potential drops which may be measured with a direct current voltmeter.

Consequently a direct current voltmeter placed across any part of the electrical circuit carrying currents from such an arc will register unidirectional potentials. If the electrical resistance of an arc circuit could be reduced to zero the unidirectional potentials produced by the current flow would be zero also. However, since it is impossible to reduce resistances to so low a value there are always some unidirectional potentials associated with these circuits.

I have found that these unidirectional potentials caused by the current flow thru the circuit resistances consume energy that should be properly utilized in the arc tube to produce useful light. Since there is only a given quantity of energy present in a burner circuit as much as possible of this energy should be consumed where it will do useful

work. All of the energy that is consumed in the resistance of the circuit is lost and this energy can be reduced to a very low percentage of the circuit energy by efficient design and in itself is of no importance.

It is of enormous importance when the light output of the arc is considered, however. A circuit resistance loss that represents less than ten percent of the total energy causes a reduction of 50 percent of the useful light output of the arc. It is apparent that it is of the utmost importance that the circuit losses be reduced to a low value.

There is a limit to the circuit resistance below which it is uneconomical to go, this limit being reached when the bulk and cost of the transformer and other units of the electrical circuit become prohibitive.

I have found that although it is not practicable to reduce the resistance of the circuit all that could be desired by direct reduction of the circuit resistance, it is practicable to secure the same result by the insertion in the circuit from a direct current source sufficient direct current voltage to substantially neutralize or even reverse the resistance potential drops.

When such voltages were introduced in the circuit, the light output was increased in proportion as the effective resistance of the circuit was reduced. In fact I have found that even better results could be obtained if sufficient potential was added to the circuit from a direct current source to completely overcome and reverse the usual direct current potential in the circuit. The insertion of a direct current potential in the circuit was the equivalent of reducing the circuit resistance to a small value or even to zero and if more potential than this was added the direct current source actually supplied energy to the arc lamp.

I have found that the source of the direct current potential is not important, but there are many reasons for the choice of a rectifier for this supply. A particular type of rectifier provides a very simple, inexpensive and convenient source of direct current potential. All types of rectifiers were not equally desirable. The rectifier had to be of the full wave

type, that is, it had to rectify both halves of the alternating current cycle. It also is required to furnish fairly constant potential currents; in other words the output voltage should not suffer from large fluctuations, and the cost of the rectifier should not be more than would be justified by the gain in the light output.

All of these requirements are met by a rectifier of the copper-copper oxide type employing a bridge circuit assembly. Such a rectifier provides full wave rectification with good wave shape which is easily reduced to a constant potential with a simple filter. Usually such a rectifier must be provided with a smoothing reactor to remove the fluctuations of voltage in the output, but when it is combined in an arc lamp circuit this is found to be unnecessary since the reactor already present in the circuit serves in both capacities, that is, as a reactor to maintain the arc in the alternating current circuit, and as a smoothing reactor for the output of the rectifier.

Referring to the drawing, the circuit is shown to include a source 4, 5 of alternating current, and a resistance 6 in series with the primary winding of a transformer 7.

The terminals 8, 9 of the secondary winding of the transformer are connected to the anodes 10, 11, respectively, of a mercury vapor arc lamp 12, and a mid-tap 13 on the secondary winding is connected to a reactor 14, which is connected to the positive terminal 15 of a bridge rectifier assembly, the negative terminal 16 of the rectifier assembly being connected to the cathode 17 of the arc lamp.

The rectifier assembly comprises four sets of rectifier plates 18, 19, 20 and 21, the junction of sets 18, 19 being connected to one terminal 22 of a separate winding 23 on the transformer, while the junction of sets 20, 21 are connected to the terminal 24 of the winding 23.

During operation current flows from the secondary terminals of the transformer 8 and 9 to the anodes 10, 11 of the vapor electric device. After flowing through the arc tube the current flows out of the cathode terminal to the negative terminal 16 of the rectifier assembly. It then flows thru the rectifier assembly and out of the positive terminal 15. From there it flows thru the reactor 14 and then back to the mid-tap of the transformer secondary.

The rectifier is called upon to supply to the circuit an amount of energy equal to the product of the voltage across its terminals multiplied by the current flowing thru it. All of the energy supplied is not available for the lamp because part of it is consumed in supplying the circuit losses.

The value and polarity of the direct current potential across the lamp is a measure

of the amount of energy supplied by the rectifier to the circuit.

Without the rectifier in the circuit the direct current potential indicator will always show the cathode of the lamp to have a positive potential with respect to the anodes. With a rectifier in the circuit the indicated potential will depend upon the energy supplied by the rectifier. If the rectifier potential is less than the voltage consumed in the circuit resistance the direct current indicator will still show that cathode to be positive with respect to the anodes but at a reduced value compared to the potential without the rectifier.

If the rectifier supplies a voltage just equal to the potential lost in the circuit resistance the indicated voltage across the lamp will be reduced to zero. If the rectifier supplies a potential greater than that lost in the resistance of the circuit the indicator across the lamp will show a reversal of the polarity of the indicated voltage and the anodes will become positive with respect to the cathode. When the rectifier is supplying sufficient voltage to cause a reversal of the indicated lamp potential the rectifier is supplying a part of the energy consumed in the lamp.

While my invention has been described in connection with a mercury vapor arc lamp, its application is not limited to such lamps, as it is adapted for use on all types of vapor or gas arc devices operating on alternating current.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

In combination with a vapor or gas filled electric device operating on alternating current, a circuit containing a transformer having the terminals of its secondary winding connected to the anodes of the device, a reactor connected to a mid-point of the secondary winding, and a rectifying device connected in series with said reactor and the cathode of the gas filled electric device, the negative terminal of the rectifying device being connected to the cathode and the positive terminal connected to the reactor, said rectifying device comprising a bridge formation of four dry contact rectifiers, the junctions of the rectifying device intermediate the positive and negative terminals being connected to an independent winding on the transformer.

This specification signed this 19th day of October, 1929.

LESTER F. BIRD.