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APPARATUS FOR OPERATING DEVICES HAVING A NEGATIVE TEMPERATURE CHARACTERISTIC FROM AN ALTERNATING CURRENT SUPPLY CIRCUIT

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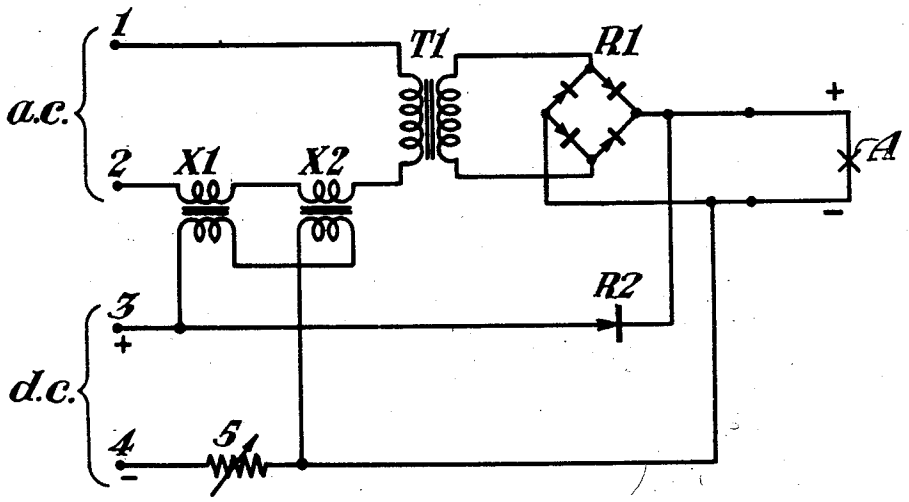


Fig. 1.

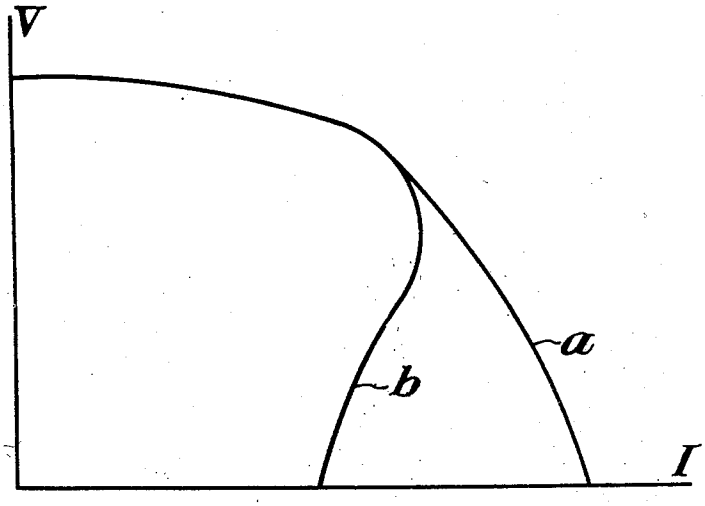


Fig. 2.

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APPARATUS FOR OPERATING DEVICES HAVING A NEGATIVE TEMPERATURE CHARACTERISTIC FROM AN ALTERNATING CURRENT SUPPLY CIRCUIT

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5 Claims. (Cl. 321—25)

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This invention relates to apparatus for operating devices having a negative resistance characteristic, such as a cinema arc, from an alternating current supply circuit and has for its object to provide improved arrangements whereby the current taken by the load is limited and is prevented from attaining an excessive value under conditions when the resistance of the load becomes small.

In equipment designed to supply current to a load having a negative resistance characteristic, it is normal practice to provide some form of ballast impedance in order to stabilize the load current, this ballast impedance usually being variable in order to provide means for varying the load current.

For some purposes, and in particular where remote control of the equipment is desired, a ballast impedance comprising direct current saturable reactors has many advantages and the present invention relates to apparatus embodying ballast impedance of this kind.

In order to provide the stability required, it would clearly be desirable to include a feed-back from the load circuit itself, in this case an arc, in such a way as to stabilize either the current or the voltage of the load, but in practice it is found that when one attempts to do this with an unstable type of load such as an arc, low frequency oscillations or "hunting" tends to occur. The most desirable point at which feed-back could be introduced, apart from the hunting problem, would be when the arc tends to become very short, i. e. towards the short-circuit of the carbons. Under these conditions the current, using a normal D. C. saturated reactor, tends to become very large, if the control current on the existing windings of the reactor is of any appreciable magnitude, that is to say, if the control knob which is used to set the output current has been turned up to the normal running condition, for example.

According to the principal feature of the invention, a feed back circuit is provided for the saturable reactors which is rendered ineffective at the normal voltage applied to the load by a blocking rectifier, and the undesirable hunting which otherwise occurs is avoided, but when the voltage applied to the load is below a predetermined value, the control current fed to the control windings of the saturable reactors is automatically reduced below its set value thus limiting the current fed to the load circuit.

One form of apparatus embodying the invention will now be described, and the novel features thereof will then be pointed out in claims.

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Referring to the accompanying drawing, Fig. 1 illustrates one form of regulating apparatus embodying the invention, and Fig. 2 is a graph illustrating the control exercised by the apparatus upon the load voltage and current.

In the embodiment shown in Fig. 1, the invention is applied to the control of a direct current arc A fed through a rectifier R1 and a transformer T1 from a source of alternating current having the supply terminals 1 and 2, and two direct current saturable reactors X1 and X2 are connected in series in the primary circuit of the transformer T1 from the secondary of which is supplied the rectifier which feeds the arc. The control windings of the reactors X1 and X2 are supplied with direct current from the terminals 3 and 4 of a suitable control source through a variable resistance 5 by means of which the control current, and thus the output can be varied. To this control circuit is added a "feed-back" feature which consists of connecting together the arc and the control windings, like terminals to like terminals, with a blocking rectifier R2 inserted in the circuit in such a manner that the control windings are prevented from being fed with current from the arc rectifier. Under normal operating conditions the voltage across the arc exceeds that applied to the control windings of the reactors and the blocking rectifier is under reverse stress, thus preventing the flow of current in the feed-back circuit. If, however, the arc shortens, the arc voltage will fall below that applied to the control windings through resistor 5 and the blocking rectifier R2 then permits the flow of current from the D. C. control source through the low resistance of the arc, thus reducing the flow of current in the control windings of reactors X1 and X2 and limiting accordingly the current taken from the alternating current supply. In the extreme case when the carbons are short-circuited, the direct current flowing in the control windings becomes practically nil and the reactors have their most restrictive effect.

By suitable choice of the resistance of the control windings and of the operating voltage and current therein, the point at which the by-passing or shunting of the current from the control winding of the saturable reactor by the arc circuit commences as well as the amount of regulation for a given arc resistance may be varied so that any desirable shape of output voltage current characteristic may be obtained. For example, the shape of this characteristic as set by

adjustment of resistor 5 may be as indicated by curve *a* in Fig. 2, in which case this may be changed automatically by the regulating apparatus to the form indicated by curve *b*. Above the point at which this operation starts, the arc voltage is in excess of the control winding voltage, so that the rectifier is under reverse stress, and therefore it effectively switches off the feedback arrangement, and the circuit operates in the normal way without undesirable hunting. It will be appreciated that this provides a valuable and automatic method of limiting the starting current taken by the arc.

The invention may be applied to single or multiphase arcs fed either from a multiphase supply or from a single phase supply through a phase-converter, and a multiphase rectifier, such for example as shown in my application for Letters Patent of the United States, Serial No. 746,903, filed on May 9, 1947, now Patent No. 2,497,522, issued February 14, 1950.

It will be understood that the invention is not limited to the particular construction above described, but that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. Apparatus for energizing a load device having a negative resistance characteristic by direct current derived from an alternating current supply circuit comprising a saturable reactor, a rectifier supplied with alternating current from said circuit through said reactor and supplying direct current to said load device, a manually adjustable resistor, a control winding on said reactor supplied with direct current through said resistor for regulating the alternating current voltage supplied to said rectifier in accordance with the current supplied to said control winding, and circuit connections between said control winding and load device including a blocking rectifier through which current flows only when the voltage across the terminals of said load device is less than the voltage across the terminals of said control winding for automatically varying the current supplied to said control winding in accordance with variations in the resistance of said load device.

2. Apparatus for energizing a load device having a negative resistance characteristic by direct current derived from an alternating current supply circuit comprising a saturable reactor, a rectifier supplied with current from said circuit through said reactor and supplying direct current to said load device, a manually adjustable resistor, a control winding on said reactor supplied with direct current through said resistor for regulating the alternating current voltage supplied to said rectifier in accordance with the current supplied to said control winding, and a circuit shunting said control winding comprising a blocking rectifier in series with said load device through which current flows only upon a predetermined reduction in the resistance of said load device, said shunting circuit being effective to decrease the current supplied to said control winding in response to a further reduction in the resistance of said load device.

3. Apparatus for energizing a load device having a negative resistance characteristic by direct current derived from an alternating current supply circuit comprising a saturable reactor, a rectifier supplied with current from said circuit through said reactor and supplying rectified current to said load device, a manually adjustable resistor, a control winding on said reactor supplied with direct current through said resistor for regulating the alternating current voltage supplied to said rectifier, in accordance with the current supplied to said control winding, and a circuit including a blocking rectifier connecting said control winding across the terminals of said load to permit a portion at least of the direct current supplied through said adjustable resistor to pass through said load device while preventing the flow of said rectified current through said control winding.

4. Apparatus for regulating the current supplied to a variable resistance load device from an alternating current source through a full wave rectifier comprising a saturable reactor having an alternating current winding interposed in the supply circuit for said rectifier and having a control winding effective when supplied with direct current to decrease the impedance of said alternating current winding, means for supplying direct current to said control winding through an adjustable resistor, and a circuit including said load device and a blocking rectifier in series for diverting a portion at least of said direct current from said control winding when the resistance of said load device is less than a predetermined value.

5. Apparatus for regulating the current supplied to a variable resistance load device from an alternating current source through a full wave rectifier comprising a saturable reactor having an alternating current winding interposed in the supply circuit for said rectifier and having a control winding effective when supplied with direct current to decrease the impedance of said alternating current winding, means for supplying direct current to said control winding through an adjustable resistor, and means for automatically varying the impedance of said saturable reactor comprising a circuit shunting said control winding which includes said load device and a blocking rectifier in series and is supplied with direct current through said adjustable resistor only when the voltage across said load device is less than the voltage across said control winding.

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