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Jan. 18, 1927. 1,615,018

W. LANGDON-DAVIES ET AL

AUTOMATIC ELECTRIC CURRENT REGULATOR

Filed May 28, 1923 2 Sheets-Sheet 1

FIG. 1.

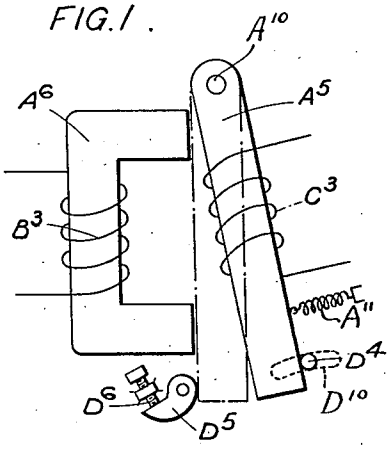
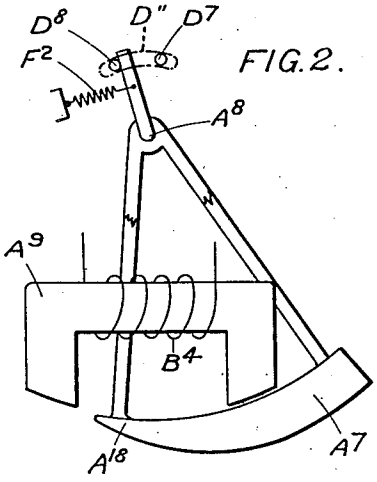


FIG. 2.



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By Watson, Coit, Moss & Grindle.

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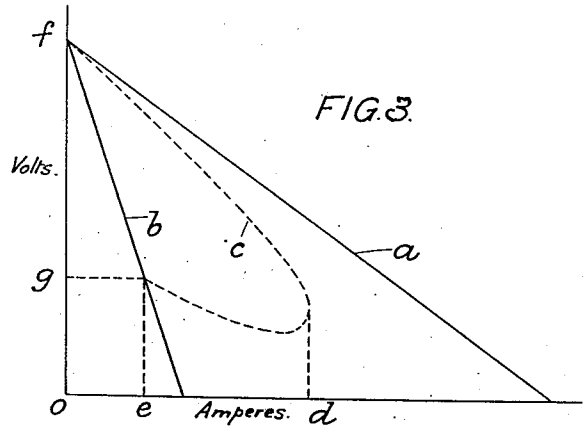


FIG. 3.

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UNITED STATES PATENT OFFICE.

WALTER LANGDON-DAVIES AND ALFRED SOAMES, OF LONDON, ENGLAND; CYRIL FREDERICK WRIGHT, EXECUTOR OF SAID WALTER LANGDON-DAVIES, DECEASED, ASSIGNOR TO SAID SOAMES.

AUTOMATIC ELECTRIC-CURRENT REGULATOR.

Application filed May 28, 1923, Serial No. 642,063, and in Great Britain June 19, 1922.

This invention relates to automatic electric current regulators for use as choke coils in alternating current arc welding.

In arc welding it is preferable that the circuit should have what is known as a drooping volt-ampere characteristic; i. e. that the volts should decrease as the current increases.

If however the volts drop too rapidly with respect to the current, it is difficult to strike, or set up, the arc. If however the volt drop is too slow, there is apt to be excessive current in the arc.

The object of this invention is to provide an improved regulator which will automatically give the circuit a slowly falling volt-ampere characteristic when the arc is being struck, and a more rapidly falling characteristic when the arc has been formed.

A drooping volt-ampere characteristic has hitherto been obtained by connecting an impedance, that is, either a resistance, a choke, or both, in series with some part of the welding circuit. When a transformer is used this may be connected either in the primary or the secondary circuit. When no transformer is used, or it is not convenient to alter its connections, the impedance is put in series with the arc. Such an impedance gives a fixed volt-ampere characteristic, which can only be altered by altering the value of the impedance so connected.

The same effect, namely a drooping volt-ampere characteristic, has also been obtained by giving a transformer a certain amount of magnetic leakage, that is providing that all the magnetic flux set up does not pass through all the windings, and thus the windings are not all mutually inductive. This magnetic leakage has been varied by varying the permeability of the magnetic leakage paths, such as filling them more or less with iron fixed in various positions. This has the same effect on the electrical circuits as varying the impedance referred to.

Again, the keeper or magnetic leakage member has in some cases been adjustable so as to vary the amount of leakage and in other cases has been arranged so that it has been moved automatically on guides by the magnetic flux, its movement being controlled say by a spring and a dash pot.

An automatic current regulator according to this invention for use as a choke coil in arc welding comprises a core of magnetic material, a keeper or flux regulator adapted to move relatively to said core, such movement of the keeper varying with and being responsive to the condition of the circuit whereby the impedance is automatically varied with the movement of the keeper, an inductive winding acting to produce a flux in the magnetic circuit formed by the core and its keeper, two stops to determine the initial and final relative positions of the core and the keeper so that the volt-ampere characteristic curve of the regulator lies between two definite volt-ampere characteristic curves corresponding to said initial and final positions, and means for varying the positions of said stops.

The keeper or flux regulator may be pivoted or hinged but this is not necessarily the case and its movement may be guided or constrained in any convenient way. Whatever the nature of its movement it is preferred that its construction shall be such that if desired the keeper or flux regulator may, in its final position, close the leakage path as far as possible leaving no appreciable air gap in that path.

In the accompanying drawings,

Figure 1 shows diagrammatically in side elevation one construction of automatic current regulator according to this invention,

Figure 2 is a diagram showing an alternative form, and

Figure 3 shows a volt-ampere characteristic curve such as may be obtained by the use of the improved regulator.

The regulator illustrated in Figure 1 comprises a U-shaped core A^6 having a keeper or flux regulator A^5 pivoted at A^{10} and provided with a controlling spring A^{11} which tends to hold it in the position shown in full lines where it rests against a stop D^4 whose position is adjustable in a slot D^{10}. The core A^6 has a winding B^3 and another winding C^3 surrounds the keeper A^5. The two windings act as parts of a choke coil and when they are energized the keeper A^5 will tend to move into the position shown in dot and dash lines. Its final position is determined by the stop D^5 which is capable of fine adjustment by means of the screw D^6. Some such arrangement is desirable in any construction where movement of the keeper when approaching the closed position makes

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a comparatively large difference in the reluctance of the magnetic circuit.

Figure 2 shows another form of regulator according to this invention. In this form the keeper A^7 is arc shaped and pivoted as at A^8 so that it swings in an arc across the curved poles of the core A^9. The leading end A^{10} of the keeper is made of gradually decreasing cross section so that the decrease in the magnetic reluctance of the circuit, as the end A^{10} approaches the adjacent pole, is less sudden than it would be were the keeper of uniform cross section throughout. The variable stops are indicated at D^7 and D^8 and the controlling spring at F^2. Each stop is adjustable in the slot D^{11}. Only one winding is shown as at B^4 but this winding may be on the keeper A^7 or that member may carry a second winding.

Figure 3 is merely intended to show how the improved regulator acts in giving a characteristic curve lying between two drooping volt-ampere characteristics corresponding to the initial and final positions determined by the stops. The curve *a* may be taken for instance as that which would be given if the leakage member, for instance A^5 (Figure 1), remained in its initial position against the stop D^4 whilst the curve *b* indicates that given when the arm rests against the stop D^5. Thus in working, the actual volt-ampere characteristic may, as indicated by the curve *c*, start on the curve *a* and pass on to the curve *b*.

By shifting the stop D^4 nearer to the stop D^5 the curve *a* would approach nearer to the curve *b* and vice versa.

In Figure 3 the horizontal ordinate *o d* represents the value of the striking current and *o e* the welding current, the vertical ordinate *o f* representing the open circuit volts and *o g* the welding volts.

It will be appreciated that the nature of the curves will vary according to the design of the magnetic circuit and the arrangement and disposition of the windings. For instance the regulator might be so constructed that after a given current was reached the voltage in the working circuit would fall suddenly.

What we claim as our invention and desire to secure by Letters Patent is:—

1. An automatic electric current regulator for use as a choke coil in arc welding, comprising a core of magnetic material, a keeper or flux regulator adapted to move relatively to said core, such movement of the keeper varying with and being responsive to the magnetization of said core whereby the impedance is automatically varied with the movement of the keeper, an inductive winding acting to produce a flux in the magnetic circuit formed by the core and its keeper, two stops to determine the initial and final relative positions of the core and the keeper so that the volt-ampere characteristic curve of the regulator lies between two definite volt-ampere characteristic curves corresponding to said initial and final positions, and means for varying the positions of said stops.

2. An automatic electric current regulator for use as a choke coil in arc welding, comprising a core of magnetic material, a keeper or flux regulator adapted to move relatively to said core, such movement of the keeper varying with and being responsive to the magnetization of said core whereby the impedance is automatically varied with the movement of the keeper, an inductive winding in series with the welding arc and acting to produce a flux in the magnetic circuit formed by the core and its keeper, two stops to determine the initial and final relative positions of the core and the keeper so that the volt-ampere characteristic curve of the regulator lies between two definite volt-ampr characteristic curves corresponding to said initial and final positions, means for varying the positions of said stops, and means for controlling the movement of the keeper.

3. An automatic electric current regulator for use as a choke coil in arc welding, comprising a core of magnetic material, a keeper or flux regulator adapted to move relatively to said core, such movement of the keeper varying with and being responsive to the magnetization of said core whereby the impedance is automatically varied with the movement of the keeper, an inductive winding in series with the welding arc and acting to produce a flux in the magnetic circuit formed by the core and the keeper, two stops to determine the initial and final relative positions of the core and the keeper so that the volt-ampere characteristic curve of the regulator lies between two definite volt-ampere characteristic curves corresponding to said initial and final positions, means for varying the positions of said stops the means for varying the final position being capable of fine adjustment, and means for controlling the movement of the keeper.

In testimony whereof we have signed our names to this specification.

WALTER LANGDON-DAVIES.
ALFRED SOAMES.