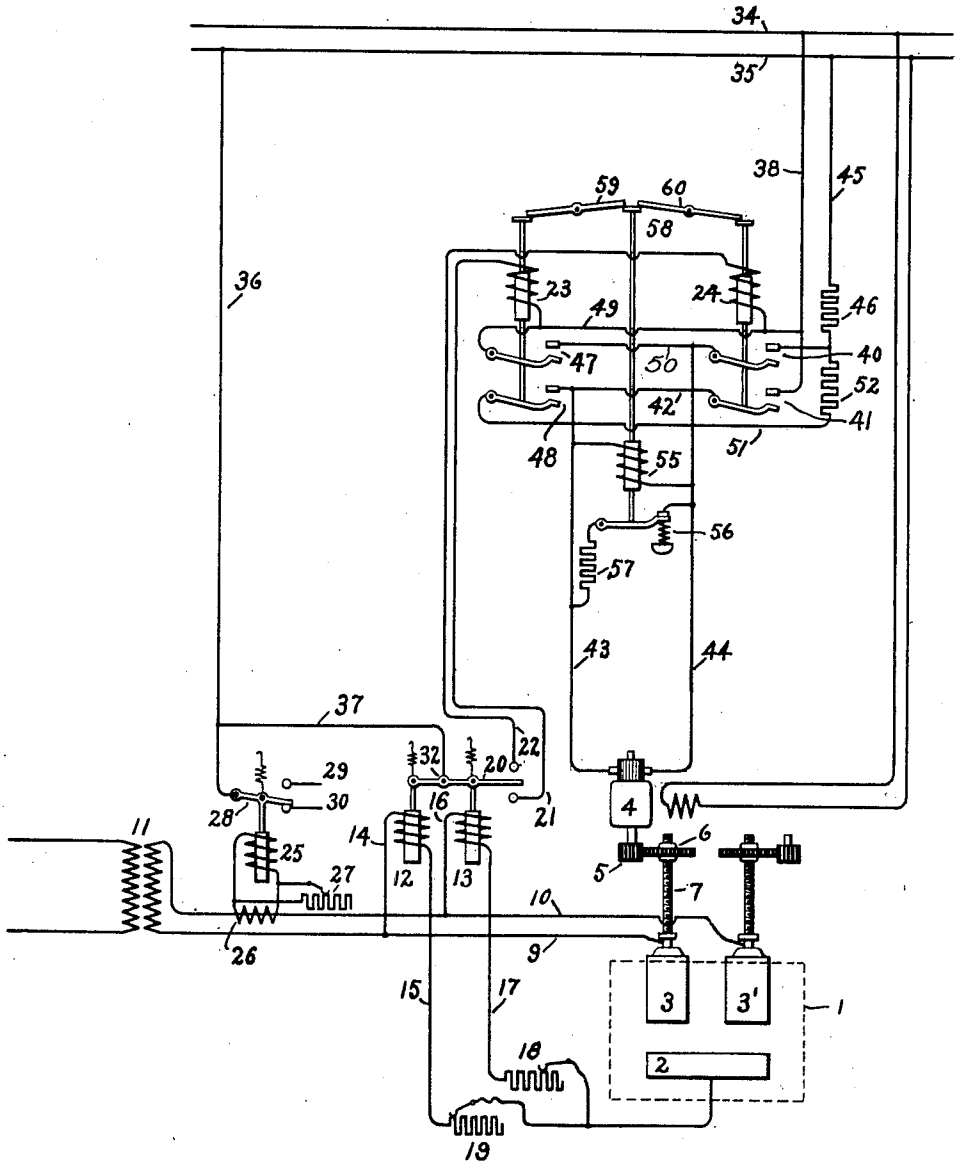
H. A. WINNE.

ELECTRIC FURNACE CONTROL APPARATUS.

APPLICATION FILED JAN. 2, 1919.

1,310,109. Patented July 15, 1919.



Inventor:
Harry A. Winne,
by Albert G. Davis
His Attorney.

UNITED STATES PATENT OFFICE.

HARRY A. WINNE, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC-FURNACE-CONTROL APPARATUS.

1,310,109. Specification of Letters Patent. Patented July 15, 1919.

Application filed January 2, 1919. Serial No. 269,309.

To all whom it may concern:

Be it known that I, HARRY A. WINNE, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Electric-Furnace-Control Apparatus, of which the following is a specification.

The present invention relates to control apparatus for electric arc furnaces, and the object of my invention is to maintain the lengths of a plurality of arcs at a predetermined relation.

In Patent #1,253,732, issued to John A. Seede, January 15, 1918, is described a control apparatus which regulates the length of one arc in an electric furnace in response to variations of current in the arc circuit, and regulates a second arc in the furnace in response to variations of voltage across the second arc.

When the supply voltage remains unchanged the maintenance of a predetermined voltage across one arc must necessarily maintain at a fixed relation the voltage across another arc, connected in series with the voltage regulated arc. However, when the voltage of the furnace supply system changes, this will not be the case as the voltage variations will not affect the voltage regulated arc but will all occur in the arc regulated by current only.

In accordance with my invention I have provided a control apparatus whereby the voltage drop across a voltage regulated arc may be maintained at a predetermined relation to the voltage drop of a current regulated arc even though variations of furnace supply voltage occur. The novel features of my invention are pointed out with particularity in the appended claims.

The accompanying drawing illustrates diagrammatically an embodiment of my invention.

Referring to the drawing, an electric furnace is diagrammatically indicated by dotted rectangle 1. It contains a stationary conductor, or an electrode 2, located at its base, which may consist either of a charge of conductive material in the furnace, for example, a charge of metal, or consist of a conductor such as a block of carbon or graphite. The movable electrodes 3, 3′ ordinarily consist of carbonaceous material, but their constitution is not material to my invention. An electric motor 4 is mechanically connected to the electrode 3 by any form of suitable gearing, the drawing showing a speed reducing gear 5 on the motor shaft acting on a nut 6 on the screw threaded rod 7 to raise and lower the electrode. The motor connected to the electrode 3′ has not been shown, but it is to be understood that the motor and control apparatus connected to the electrode 3′ is similar to the motor and control apparatus shown in connection with the electrode 3.

The electrodes 3, 3′ are connected respectively to electric conductors 9 and 10, receiving energy from the secondary of a transformer 11 or other suitable source.

The magnets 12 and 13 are connected respectively across the gaps between electrodes 3 and 3′ and the coöperating stationary electrode 2. The magnet 12 is connected by conductor 14 to the current supply conductor 9 leading to the electrode 3 and by the conductor 15 to the electrode 2, it being understood that the connection to the electrode 2 is not necessarily metallic throughout. For example, in a steel making furnace the conductor 15 may be merely connected to the framework of the furnace or to an electrode (not shown) embedded in the lining of the furnace. The connection from this external conductor to the charge of steel within the furnace is obtained through the furnace lining which at elevated temperatures will conduct a sufficient current to energize a relay magnet. The magnet 13 is connected by conductor 16 to the current main 10 and by conductor 17 in series with a resistance 18 to the electrode 2. The resistance 18 is adjustable to permit of an adjustment of the relation of the voltages across the two arcs. In some cases the resistance 18 may be omitted, if desired. The armatures of the magnets 12 and 13 are connected to a switch lever 20 which is adapted to contact with either of the conductors 21, 22 connected respectively to the contactor magnets 23, 24.

A current controlled magnet 25 is connected in series with a secondary of a current transformer 26, the primary of which is so connected that the current in the secondary is proportional to the current in the furnace circuit, for example, the primary is constructed of a turn of the furnace main 10. The magnet 25 is shunted by an adjust-

able resistance 27 so that the magnet 25 may be made responsive at will to any desired current flow in the furnace circuit. Connected to the armature of the magnet 25 is the switch lever 28 making contact with conductors 29, 30 which in turn lead to a set of contactor magnets connected similar to the magnets 23, 24 to control a motor (not shown) for raising and lowering the electrode 3'.

The switch lever 20 connected to the armatures of the voltage-controlled magnets 12, 13 will be in a neutral position or out of contact with both the conductors 21, 22 when the pull of the magnets 12 and 13 is equal, assuming the armatures to be connected to the lever 20 at equal distances than the point of support 32. If the magnets 12, 13 are similar, this neutral position will be assumed by the lever 20 when the voltage across the magnet 12 is equal to the voltage across the magnet 13 and hence, assuming the resistance 18 out of circuit, when the voltage across the two arcs in the furnace is equal. By connecting the resistance 18 into circuit, the lever 20 may be in a neutral position when the arc from the electrode 3' is longer than the arc from the electrode 3. Similarly by proper proportioning, the magnets 12, 13 or by suspending them at unequal distances from the support 32, the lever 20 may be made to assume a neutral position with a certain value of resistance 18 in circuit and with equal arc voltages. By varying the resistance 18 above or below this value, the lever 20 may be made to assume a neutral position when the voltage across one arc is either greater or less than the voltage across the other arc. In some cases an adjustable resistance may be inserted in circuit with the conductor 15 as indicated in dotted lines at 19. In that case the magnets 12, 13 may be made identical and mounted to exert an equal pull on the lever 20. By varying the resistance in circuit with either of the magnets 12, 13 desired arc relations may be maintained in accordance with the explanation given above.

When the voltage in either of the arc departs from this predetermined setting, the switch lever 20 will be moved into contact with either conductor 21 or 22. For example, should the voltage across the arc terminating in electrode 3' become greater than the arc terminating in electrode 3, the armature of magnet 13 will be pulled up completing a circuit through the contactor magnet 24 from a separate source of current such as conductors 34, 35 through the conductors 36, 37, switch lever 20, the conductor 22, the winding of the magnet 24 and the conductor 38. This closes the contacts 40, 41 connected to the armature of the magnet 24 and completes a circuit through the motor 4 from the conductors 34, 35, the circuit being by conductor 38, the contact 41, the conductors 42, 43, the motor armature, the conductor 44, the contact 40 and the conductor 45 in series with which is connected a resistance 46. The polarity of the motor is so arranged that this connection will turn in a direction to raise the electrode 3 to cause the arc from electrode 3 to bear a predetermined direction in length to the electrode 3'.

Should this increase in the length of the arc from electrode 3 result in an undue lowering of the current, the current controlled magnet 25 will energize the motor connected to the electrode 3' through a similar set of contactor magnets to lower the electrode 3' thereby decreasing the resistance of the furnace circuit and increasing the current. This may be followed by lowering of the electrode 3, the switch lever 20 being pulled into contact with the conductor 21 by the magnet 12 energizing the contactor magnet 23 and closing the contacts 47, 48. This will result in the motor 4 being energized to rotate in the opposite direction, its circuit being completed as follows: through the conductors 38, 49, the contact 47, conductors 50, 44, and 43, the contact 48, the conductors 51, 45 in series with the resistance 52 and 46.

In the preferred embodiment of my invention herein illustrated, the motor is brought to a stop by dynamic braking. When a desired change in the position of the electrode has been brought about and the contactor magnet which has closed, the motor circuit releases its armature, the magnet 55 connects across the motor circuit 43, 44 will pull up its armature assisted by spring 56 and insert a resistance 57 across the armature circuit to quickly bring the motor to rest as will be understood. When the motor circuit is closed through the resistance 57, a mechanical interlock 58 prevents the functioning either of magnets 23, 24, the armatures of which act upon interlocks 59, 60.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A regulator for a plurality of arcing electrodes, comprising means for regulating the arcing relation of one of said electrodes and means for regulating the arcing relation of a second electrode in response to predetermined relation between the voltage drop across the respective arcs terminating in said electrodes.

2. A regulator for an electric arc furnace having a plurality of electrodes comprising means for regulating the arcing relation of one of said electrodes in response to variations from a predetermined value of current in the circuit of said electrode and

means for maintaining the voltage drop across another arc at a predetermined relation to the voltage drop across the current regulated arc.

3. The combination of a plurality of electrodes adapted to support a plurality of arcs, electrical supply circuits connected thereto, means for regulating the length of one of said arcs in response to variations from a predetermined value of current in the circuit of said arc, and means for regulating the length of another arc in response to a predetermined difference between the voltage drop across said current-regulated arc and the voltage drop across the arc to be regulated.

4. A regulator for an electric arc furnace having a plurality of electrodes comprising means for adjusting the arcing relation of one of said electrodes in response to variations from a predetermined current value in said electrode, a plurality of magnets, one of which is connected across an arc to said current-controlled electrode, a second being connected across an arc in series therewith, a switch lever connected to said magnets to rest in a balanced state when the voltages impressed on said magnets have a predetermined relation, a motor connected to move said second electrode, and contacts coöperating with switch lever to energize said motor when said voltage relation is disturbed.

In witness whereof, I have hereunto set my hand this 31st day of December, 1918.

HARRY A. WINNE.