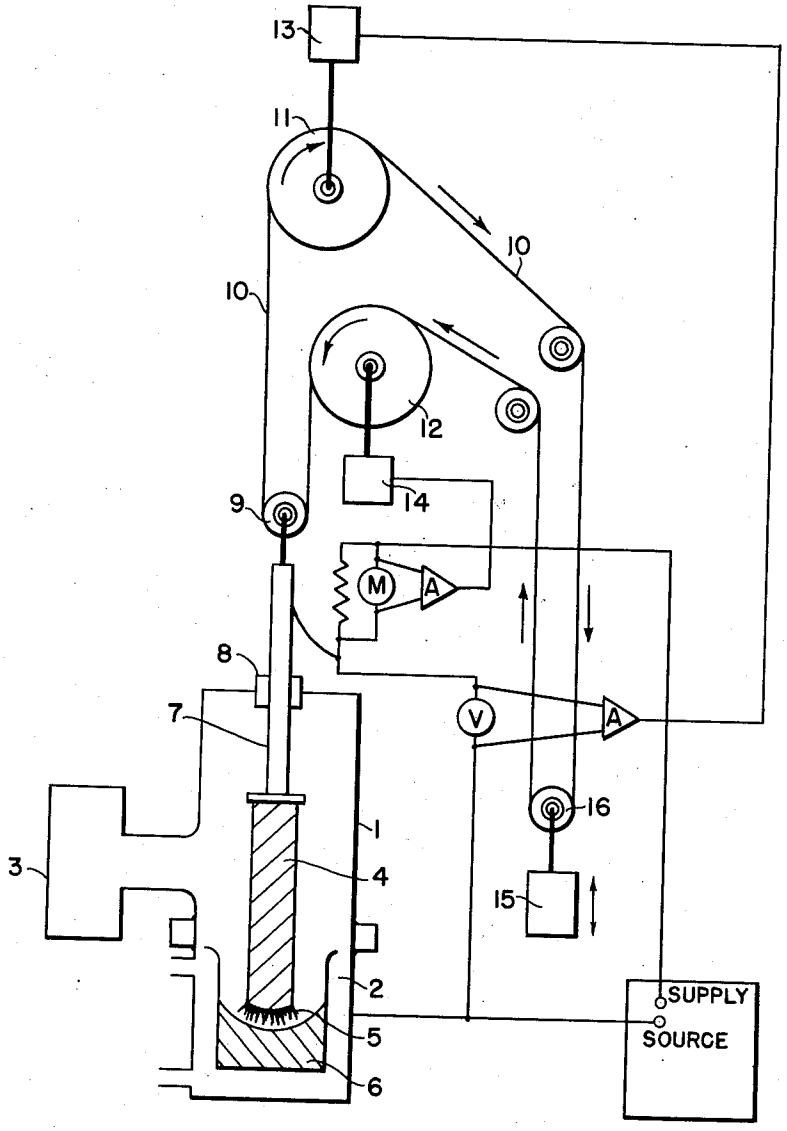
July 3, 1962 H. GRUBER ET AL 3,042,731

MOVEMENT MECHANISM FOR ELECTRODE CONTROL IN VACUUM ARC FURNACES

Filed July 27, 1959



United States Patent Office 3,042,731 Patented July 3, 1962

3,042,731

MOVEMENT MECHANISM FOR ELECTRODE CONTROL IN VACUUM ARC FURNACES

Helmut Gruber and Helmut Scheidig, Hanau (Main), Germany, assignors to W. C. Heraeus G.m.b.H., Hanau (Main), Germany, a German body corporate

Filed July 27, 1959, Ser. No. 829,592
Claims priority, application Germany Aug. 5, 1958
1 Claim. (Cl. 13—13)

The present invention relates to improvements in movement mechanism for electrodes in vacuum electric arc furnaces which operate with two continuously running motors.

One of the most important problems in electric arc furnaces is the adjustment of the length of the arc, the arce voltage and/or the arc current providing the necessary control means for this adjustment as is well known in the art. This problem is particularly important in vacuum arc furnaces in which consumable electrodes are melted. The adjustment must be effected as far as possible in an inertialess manner in order to prevent arcs towards the water-cooled crucible and in order to yield an ingot of good quality. The use of electrical motors as driving means effecting the electrode movement has proved very efficient. However, the acceleration or relatively large masses which takes place has hitherto precluded complete safety of operation. Previously it was necessary in most cases to accelerate the rotors of the motors from the standstill to high speed within a short space of time, whereby the electrode, which may have a relatively large mass up to a weight of a few tons, was also made to move. Therefore it has already become known to use for this purpose two continuously-running motors, the difference in speed between them causing the electrode to be moved. For this purpose it is only necessary to increase or reduce to some extent the speed of one or of both motors in order to have only relatively small accelerations, but coupling of the two motors and the transmission of the difference in speed to the electrode represents a difficult technical problem. Hitherto mechanical differential arrangements employing gear wheels have been used. These are quite good, but their construction is necessarily very expensive when the electrodes have a large mass and moreover they must be differently dimensioned for each type of furnace. Therefore, such arrangements are not appicable in all cases or, after a certain period of operation, they cause disturbances of the melting operation which are usually of longer duration. The fact that such furnaces are not suited for the production of large quantities presupposes that a relatively large capital outlay is necessary for equipping electric arc furnaces with these gears.

The present invention overcomes these drawbacks. The invention provides in a surprisingly simple manner for the replacement of the gear wheel differential gear by a movement mechanism of means of which the two motors drive an endless conveyor member, for example an endless chain, an endless cable rope or the like so that is performs a constant circulatory motion passing in loops about an electrode carrier pulley and a counterweight carrier pulley.

Both the electrode and the counterweight exert, owing to their weight, opposite forces which tension the endless chain in such a manner as to ensure that the two motors may be safely applied to this chain for the purpose of adjustment.

The accompanying drawing shows schematically a motor mechanism according to the invention. In the drawing, the vacuum electric arc furnace **1** has a water-cooled melting crucible **2** and is evacuated by a pump unit **3** known per se. Inside the furnace, an electrode **4** melts

in an arc **5** to form a molten mass **6**. The electrode **4** is supported by a rod **7** which is passed through a vacuum-tight seal **8** into the furnace. The basic problem is therefore to readjust the electrode with sufficient speed, as a function of the electrical arc parameters, in order to compensate for melting-off and, if necessary, also to withdraw the electrode very rapidly if the arc length becomes too short and the electrode is brought very near to the molten mass **6** up to a point where the arc is short-circuited.

This is obtained by providing an electrode carrier pulley **9** at the end of the rod **7** outside the furnace about which pulley **9** moves the first loops of an endless conveyor member **10** such as a chain which is driven by two driving pulleys **11** and **12**. The pulley **11** rotates in a direction which corresponds to the withdrawal of the electrode **4** and is driven by a motor **13**: the driving pulley **12** rotates in the direction to advance the electrode **4** and is driven by a second motor **14** which rotates in a direction opposite to that of that motor **13**. The endless conveyor member **10** carries a counterweight **15** for the electrode **4** by means of guide pulleys and by way of a second loop about a counterweight carrier pulley **16**.

The two motors **13** and **14** run continuously at average speed so that the endless conveyor member **10** also has a continuous circulatory movement. The control circuit for this operation of the motors **13** and **14** is the same as the circuit disclosed in the copending application of the same inventors as the present invention, filed May 13, 1957, Serial No. 658,667. As described in said copending application, the control circuit functions to increase the speed of a first motor when the arc voltage in an arc furnace increases due to an increase in the length of the arc from a predetermined standard, and to increase the speed of a second motor when the arc current increases due to a decrease in the length of the arc. If the arc becomes excessively extended whereby the arc voltage becomes too large, then the speed of the motor **14** is increased and the electrode is thereby very rapidly fed forwards. If on the other hand the arc is too short, so that the arc current increases considerably, then the motor **13** is accelerated as a function of this increase and the electrode is thereby rapidly withdrawn for a corresponding distance.

Such a movement mechanism has the advantage that the continuously moving conveyor member **10** takes up all the forces which are necessary for accelerating the electrode in either direction and the conveyor member is sufficiently flexible to be able to balance large transient forces. This constant movement of the conveyor member offers therefore substantial advantages as compared to a mechanical differential gear and among these advantages may be cited:

(1) Very much smaller cost;
(2) Easier adaptability to particular conditions;
(3) The possibility of using constructional parts and replacement parts which are readily obtainable in the trade;
(4) The withstanding of sudden loads because the chain (or like conveyor member) is flexible.

The movement mechanism according to the invention ensures a very high degree of operational safety.

We claim:

An apparatus for adjustably moving a consumable electrode of an arc furnace to maintain the length of an arc at a predetermined length during melting of the same, said apparatus comprising a pair of electric motors adapted to rotate continuously in opposite directions to each other, a first pulley associated with one of said motors for rotation in the direction of said first motor, a second pulley associated with the other of said motors for rotation in the direction of said second motor, a third pulley con-

nected to the electrode for movement therewith, a counterweight carrier pulley, and an endless flexible conveyor member passing around said pulleys, said pulleys being arranged so that an increase in speed of said first motor will advance the electrode and an increase in the speed of said second motor will retract the electrode.

References Cited in the file of this patent

UNITED STATES PATENTS

723,504	Titus	Mar. 24, 1903
2,956,098	Gruber et al.	Oct. 11, 1960