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(56) Documents cited
GB 1203792

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G3U
H2F

(54) Electrical heating arrangement

(57) An electrical heating arrangement particularly suitable for melting glass and similar material uses an electric current having a frequency lower than 50 Hz. This solves the problem of connecting the power source and of the automatic regulation of the melting process by using a cycloconvertor (5) comprising thyristors (6), which is connected to feeding and regulating circuits of a melting furnace (9). The arrangement includes a pulse timing circuit (14) responsive to a frequency selector (12), synchroniser (17) and DC power component sensor (20). Power and temperature regulating control loops may also be provided.

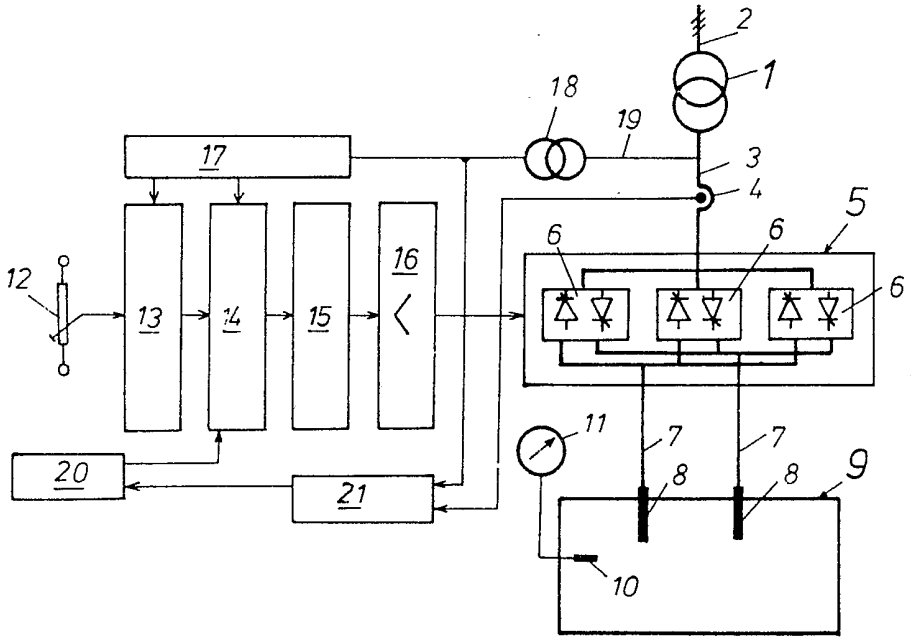

Fig. 1

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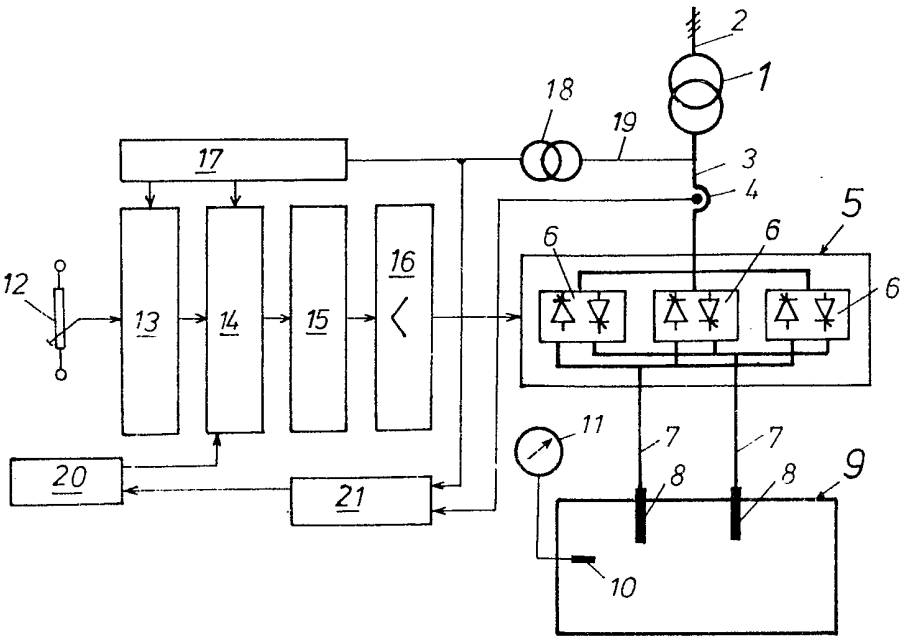
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Fig. 1

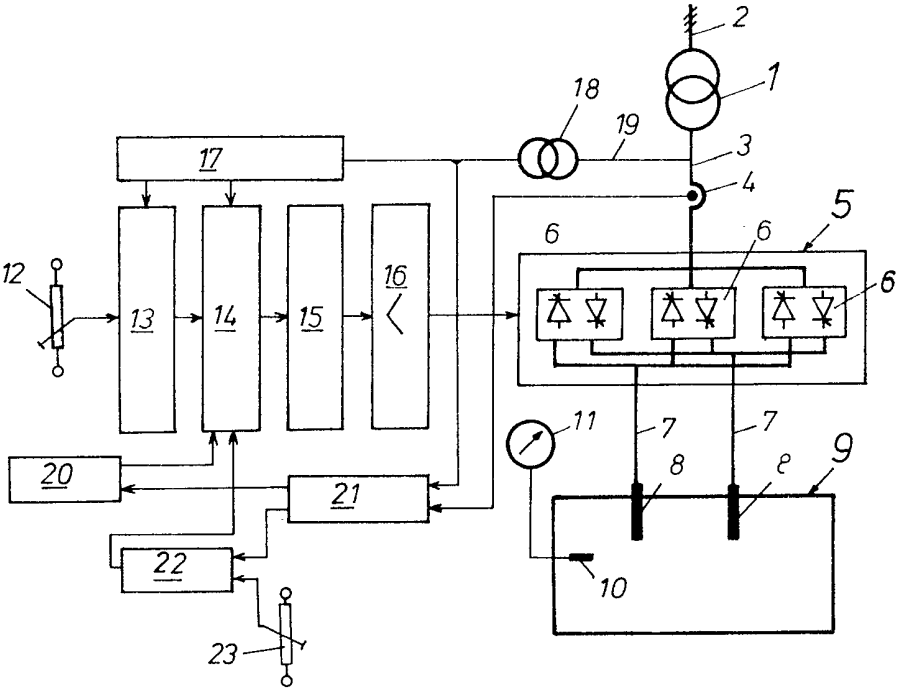
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Fig. 2

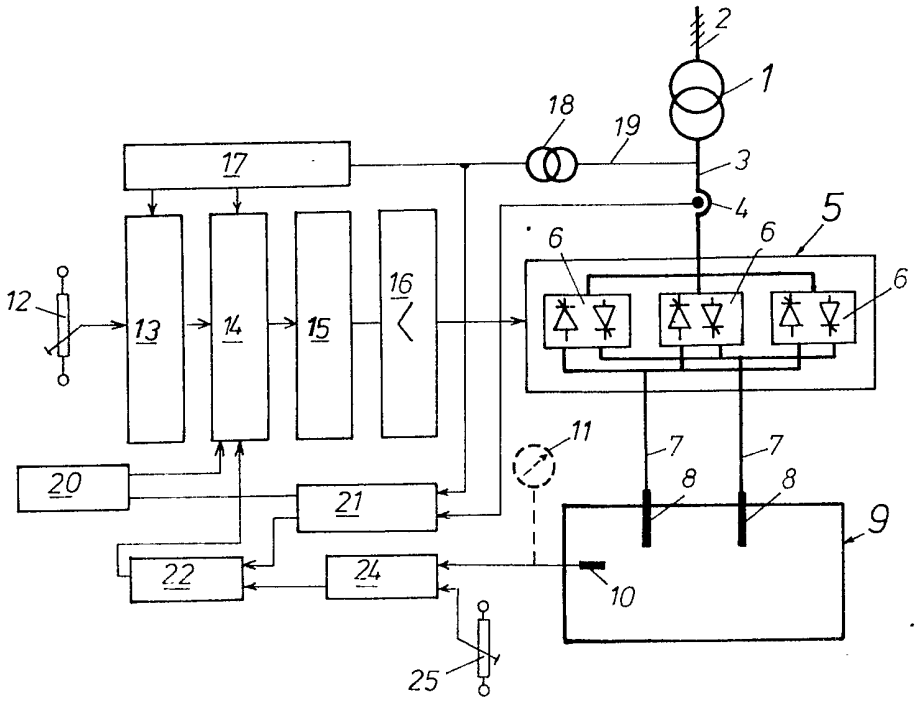

Fig. 3

SPECIFICATION

Electrical Heating Arrangement

The present invention relates to electrical heating arrangements for example for directly heating an ion melt, particularly of glass by passing an alternating electric current having a frequency lower than 50 Hz through the melt.

A method of heating melts conductive to ions, particularly of glass by passage of electric alternating current of a frequency lower than 50 Hz is known. Using this method the corrosion of metal electrodes is reduced. The circuit arrangement for carrying out this method comprises means capable of changing the frequency of the feeding current. The publications of M. Kubat: "Semiconductor power technics" (SNTL, ALFA, Prague 1978) on pages 538 to 539 and of V. Hrbek: "Problems of electric power systems" (SNTL, Prague 1980) on page 25 disclose converters securing changes of parameters of alternating voltage of a given frequency. Cycloconverters, usually provided with thyristors, generally used for controlling rotational frequency and output of drives for slow moving synchronous motors for cement mills, furnaces and the like, are referred to as direct frequency converters. Their application for controlling the heating of electric glass melting furnaces is not known and known circuit arrangements of cycloconverters are not suitable for this purpose as it is necessary to maintain certain required values constant.

A circuit arrangement will be described which is suitable for melting glass and of similar materials using an electric alternating current having a frequency below 50 Hz.

The problem of interconnection of the respective power source and of the automatic regulation of the melting process is solved by using cycloconverters with thyristors connected to the feeding and regulating circuits of a melting furnace.

According to the present invention there is provided an electrical heating arrangement comprising an alternating current feeding source, means leading from said source to melting electrodes of a furnace, a current transformer and a cycloconverter comprising thyristors associated with said means leading to said melting electrodes, a selector for selecting a required constant alternating frequency value, the output of said selector being connected through a main frequency generator a power control timing circuit, an ignition pulse distributor and an amplifier to said cycloconverter, a synchronizer connected to outputs of both said main frequency generator and said power control timing circuit, the output of said synchronizer or being connected by way of a regulating conduit and a synchronizing transformer to said source, a DC power component measuring device having an output connected to one input of said timing circuit, a power measuring device having a voltage input connected to said regulating conduit and a current input connected to said current transformer, and a temperature sensor measuring the temperature within the furnace, the output of the sensor being connected to a temperature indicator.

The output from a power regulator is advantageously connected to the power control timing circuit. One input of said power regulator is connected to a second output of the power measuring device, and a second input thereof is connected to a selector of the required power value. The second input of the power regulator is advantageously connected to the output of a temperature regulator, one input of which is connected to the temperature sensor, a second input thereof is connected to a required temperature value selector.

By using a cycloconverter connected to corresponding suitable circuits, it is not only possible to control and regulate the frequency determined according to the kind of glass to be melted, but it is also possible to regulate the source of power according to the required power consumption, preferably in dependence upon the temperature within the furnace.

Electrical heating arrangements embodying the invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:

Fig. 1 shows a block diagram of a first embodiment of an electrical heating arrangement;

Fig. 2 is a block diagram of a second embodiment of an electric heating arrangement; and

Fig. 3 a block diagram of a third embodiment of an electric heating arrangement.

In the arrangement shown in Fig. 1 an AC source 1 coupled to a three phase network 2 is connected by a main conduit 3 to a cycloconverter 5 provided with thyristors 6. A current transformer 4 measures the current flowing through the conduit 4. Single phase outputs 7 from the converter 5 are connected to melting electrodes 8 immersed in a melt in the melting furnace 9, where a temperature sensor 10 is situated which sensor 10 is connected to a temperature indicator 11 beyond the furnace 9. A frequency selector 12 is connected to a main frequency generator 13 which in turn is connected to a timing circuit 14 for controlling power. A distributor 15 supplies ignition pulses through an amplifier 16 to the cycloconverter 5. A synchronizer 17, is connected via a synchronizing transformer 18 and a regulating conduit 19 to the main conduit 3. The synchronizer 17 is connected to the main frequency generator 13 and to the timing circuit 14. The output of a measuring device 20 for measuring the DC component of power (the input of which is connected to the output of a measuring device 21) is connected to the power control timing circuit 14. The voltage input of the measuring device 21 is connected via said synchronizing transformer 18 to the regulating conduit 19 and its current input is connected to the current transformer 4.

In Fig. 2, a power regulator 22 has one input connected to the second output of the measuring device 21 and its other input is connected to a selector 23 of the required power value. The output of the regulator 22 is connected to the timing circuit 14 for power control.

In Fig. 3, the second input of the power regulator 22 is connected to the output of the temperature regulator 24, one input of which is connected to the temperature sensor 10, and the other input of which is connected to the selector 25 of the required temperature value.

This circuit arrangement operates as follows: The required frequency which is lower than 50 Hz, determined according to the kind of the glass to be melted, is set by the selector 12. The frequency from the selector 12 and from the generator 13 of the main frequency is synchronized with the network frequency by the synchronizing transformer 17. The carrier frequency generated by the generator 13 of the main frequency and by the timing circuit 14 is modulated and distributed to individual thyristors 6 of the cycloconverter 5 by the distributor 15 of ignition pulses, after being amplified by the amplifier 16 of ignition pulses. The thyristors 6 allow passage of alternating electric current of a frequency selected by the selector 1 to electrodes 8. Transmitted power is measured by the power measuring device 21 from information derived from the synchronizing transformer 18 and the current transformer 4. Simultaneously the DC power component is measured by the measuring device 20 from information derived from the power measuring device and from the timing circuit 14. The temperature of the melt is indicated by the indicator 11 connected to the temperature sensor 10.

According to Fig. 2 it is also possible to regulate the consumed power of the furnace 9 by comparing the required power set on the selector 23 by means of the regulator 22 with information obtained from the power measuring device 21. The signals for adjustment of the power are transmitted by the regulator 22 to the timing circuit 14.

According to Fig. 3 it is also possible to regulate the temperature within the furnace 9 when the temperature set on the selector 25 of the required temperature is compared with readings of the temperature sensor 10 by the temperature regulator 24 and the signals for changing the temperature are transmitted to the power regulator 22.

CLAIMS

1. An electrical heating arrangement comprising an alternating current feeding source, means leading from said source to melting electrodes of a furnace, a current transformer and a cycloconverter comprising thyristors associated with said means leading to said melting electrodes, a selector for selecting a required constant alternating frequency value, the output of said selector being connected through a main frequency generator a power control timing circuit, an ignition pulse distributor and an amplifier to said cycloconverter, a synchronizer connected to outputs of both said main frequency generator and said power control timing circuit, the output of said synchronizer or being connected by way of a regulating conduit and a synchronizing transformer to said source, a DC power component measuring device having an output connected to one input of said timing circuit, a power measuring device having a voltage input connected to said regulating conduit and a current input connected to said current transformer, and a temperature sensor measuring the temperature within the furnace, the output of the sensor being connected to a temperature indicator.

2. An arrangement according to Claim 1, comprising a power regulator, having an output connected to said power control timing circuit, a required power selector having a first input connected to the output of said power measuring device and a second input connected to the output of said required power selector.

3. An arrangement according to Claim 2, comprising a required temperature selector and a temperature regulator, a second input of said power regulator being connected to the output of said temperature regulator, which in turn is connected both to the required temperature selector and to the temperature sensor.

4. An electrical heating arrangement substantially as hereinbefore described with reference to Figure 1 of the accompanying drawings.

5. An electrical heating arrangement substantially as hereinbefore described with reference to Figure 2 of the accompanying drawings.

6. An electrical heating arrangement substantially as hereinbefore described with reference to Figure 3 of the accompanying drawings.

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