

Aug. 24, 1965

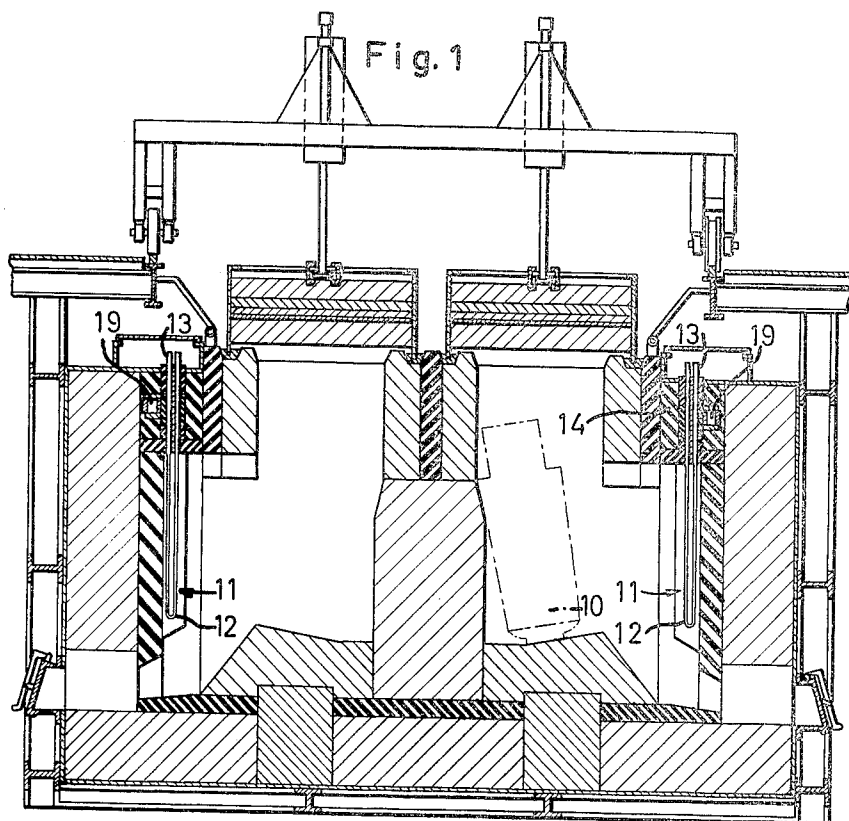
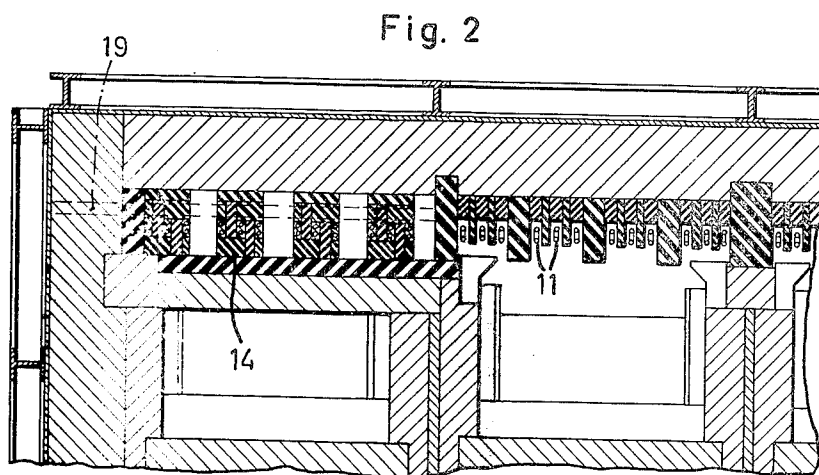
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ELECTRIC RESISTANCE FURNACES

Filed May 6, 1963

4 Sheets-Sheet 1



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ELECTRIC RESISTANCE FURNACES

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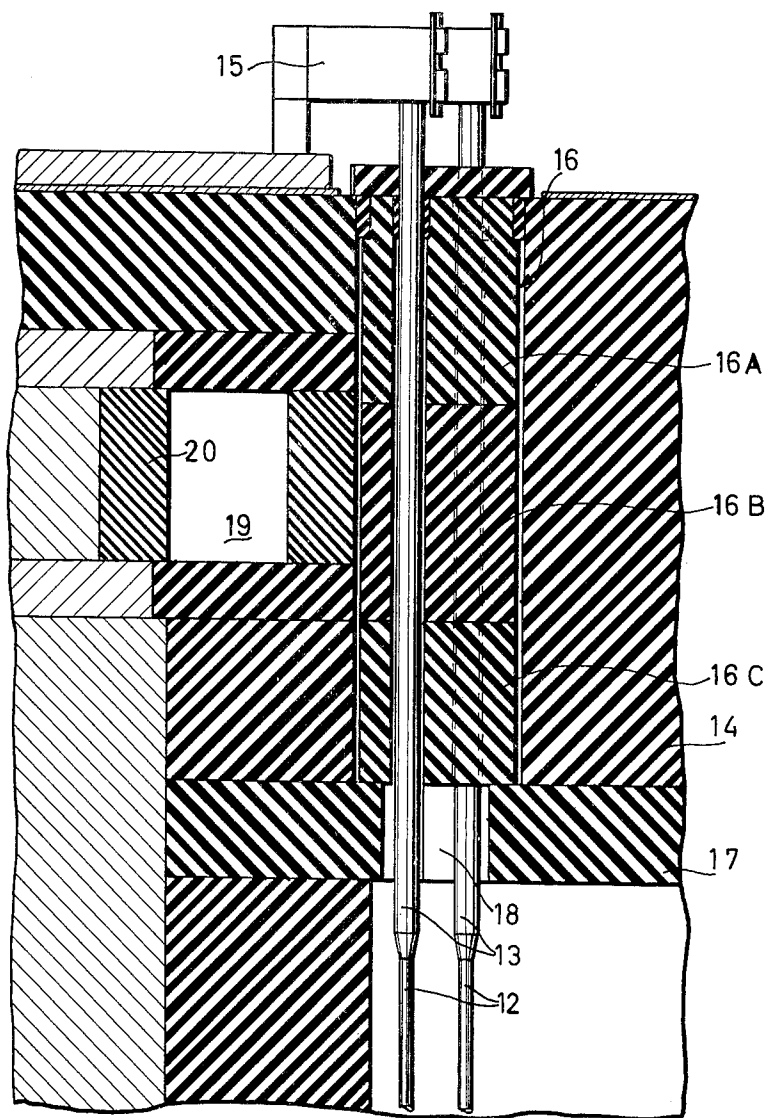


Fig.3

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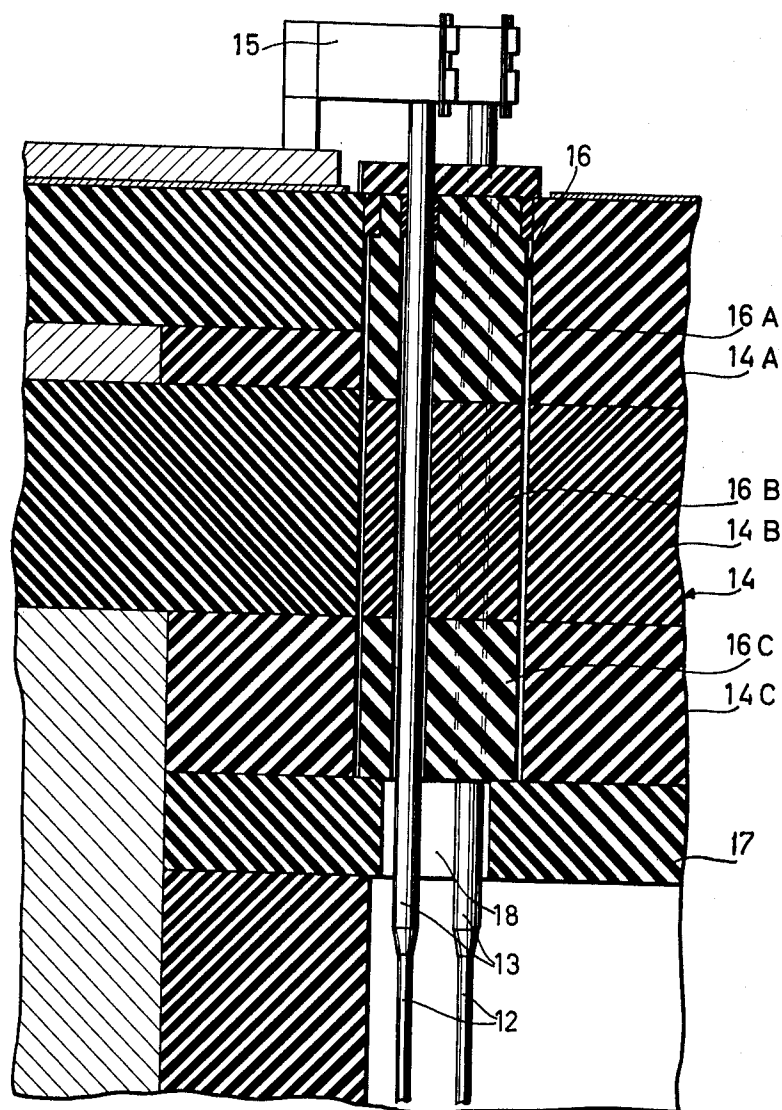
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Fig. 4



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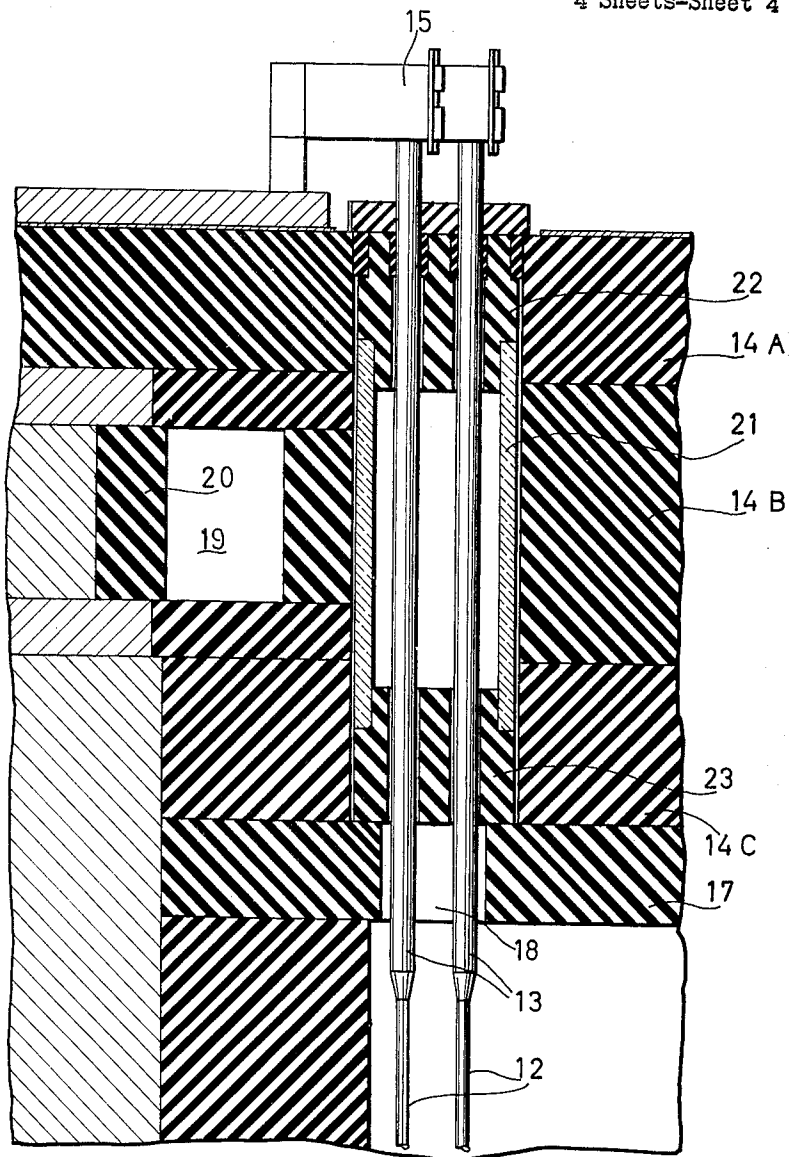


Fig. 5

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ELECTRIC RESISTANCE FURNACES

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2 Claims. (Cl. 13—25)

The present invention relates to electric resistance furnaces, particularly furnaces of the kind intended for industrial purposes and designed to operate at very elevated temperatures.

Advantageously, furnaces of this kind are equipped with resistance elements, which essentially consist of molybdenum disilicide, MoSi_2 . The elements may be essentially hairpin-shaped or U-shaped, in which case the glowzone portion thereof is adapted to depend freely, normally near the inner most surface of the furnace wall, whereas the lead-in ends of the element are disposed in a special inlet insulation and are passed through the furnace vault slightly spaced from each other. It has also been proposed to use similar elements that are bent between the glow zone portion and the lead-in ends, in which case the lead-in ends are passed out through the furnace wall, similarly slightly spaced from each other.

Elements of the just mentioned kind are able to withstand very elevated temperatures and permit very high surface loads. Therefore, they may be used in cases where very high load concentrations are required, such as in soaking pit furnaces, and for convenience the invention will be disclosed below with particular reference to soaking pit furnaces, although the invention is by no means limited to such use, in as much as it is applicable to other electric resistance furnaces, where such problems arise that may now be avoided according to the present invention.

When a soaking pit furnace is brought up to its normal operation temperature from a cold or an essentially cooled-off state, it is necessary to provide for a certain ventilation of the furnace room. To this end the covers over the inlet openings for the ingots are normally lifted, and it is furthermore possible to open the slag doors, which are normally disposed near the bottom of the furnace. The purpose of ventilating is to secure a smooth and even heating of the furnace walls as is possible, so that the walls are not injured by a chocklike application of heat and mechanical stresses inherent therewith. Here, the problem is that the development of heat at the lead-in ends of the elements is often much greater when the furnace is started up than during the continuous operation state following therewith, for which reason an overheating of the lead-in insulation may arise.

The temperature rise is dependent on that the electric resistance of the MoSi_2 -material is highly temperature dependent, and increases considerably with increasing temperature. During the start up period the heat transmission from the element to the furnace room is very good, due to the very great difference in temperature at that time. Therefore, the temperature of the glow zone portion initially will be lower than normal, for which reason the element resistance and heating effect attain comparatively low values, whereas the starting current may increase considerably over the normal operation current. In the lead-in ends, which are passed through the normally very thick insulation, the temperature and therewith the electric resistance, increase at a faster rate than in the glow zone portion in the furnace room, and the increased start up current results in a highly increased development of heat with a resulting increase of the temperature in the lead-in insulation. Due to very varying starting conditions the above discussed parameters may

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be very difficult to predict, which involves the above mentioned overheating hazards. In other words, it may also be said that the danger of overheating of the lead-in ends puts the limit for the permissible element temperature lower than would be theoretically possible with respect only to the properties of the glow zone portion.

The present invention has for its objects to remedy the above mentioned problems, to which end the invention is essentially characterized in that the middle portion of the lead-in insulation is designed for transport of the heat developed in the lead-in ends to a certain layer of the furnace vault or furnace walls, situated around said middle portion, and in that said layer of the furnace vault or furnace walls situated around said lead-in ends consists of an electrically insulating material of a good heat conductivity, whereas the insulating layers above and below said middle portion and said central layer consist of an electrically insulating material of a lower heat conductivity.

According to the present invention, it is further preferable that the middle portion of the inlet insulation consists of a tube-shaped sleeve preferably of a ceramic material, which sleeve surrounds the lead-in ends with an air space and in the uppermost and lowermost ends of which are inserted insulating plugs, through which the lead-in ends are passed to be fixedly secured by means of said plugs.

Furthermore, according to the present invention, it is preferred that there in the furnace vault or furnace wall, near the inlet positions of the lead-in ends, is disposed at least one cooling channel, which passes perpendicularly to the inlet direction and is adapted for cooling the lead-in ends of a plurality of resistance elements in a row.

Furthermore, according to the present invention, it is preferable that the walls of the cooling channel consist of a material which has a greater heat conductivity than the material in the remaining part of the furnace vault or furnace walls.

As a result of the invention a better utilization than previously of the good properties of the resistance elements in question with respect to high permissible operating temperature etc. is enabled, and particularly is should be noted that this improvement according to the invention is attained in a considerable cheaper way than if a forced cooling of each lead-in end separately was provided for, and at the same time as it is ensured that the very desirable possibility to change the elements separately also in operation is by no means limited.

The invention will be set forth in more details below with reference had to the enclosed drawings.

FIG. 1 is a vertical cross-section through a soaking pit furnace designed according to one embodiment of the present invention;

FIG. 2 illustrates a portion of the soaking pit furnace of FIG. 1 in horizontal section;

FIG. 3 similarly shows a portion of FIG. 1 to an enlarged scale, and similarly in vertical section;

FIG. 4 illustrates in a manner like FIG. 3 another embodiment according to the invention;

FIG. 5 illustrates a third embodiment according to the invention in a vertical section similar to FIG. 3.

The soaking pit furnace shown as an example is intended for heating ingots 10 of a size of the order of several tons up to forging temperature. Along the sidewalls the furnace is equipped with a plurality of essentially U-shaped resistance elements 11, which mainly consist of molybdenum disilicide MoSi_2 . The glow zone portion 12 of the elements 11 depends freely along the inner surface of the furnace wall, whereas the slightly spaced lead-in ends 13 of the elements are passed through the furnace vault 14 and are connected to current supply means 15 on the upper side of the furnace vault, FIG. 3. The both lead in ends 13 of each element are disposed in an insulat-

ing lead-in body or plug 16, which rests on a ledge, formed by the furnace lining 17 around the opening 13 for the introduction of the glow zone portion 12. This far, the soaking pit furnace is of a known and already previously described design, for which reason no complete description appears to be necessary. This also applies with respect to the arrangement of the resistance elements 11 in such a manner that they are separately interchangeable in operation.

According to the present invention the body 16 is composed of uppermost and lowermost portions 16A and 16C, respectively, which consist of a material of a low heat conductivity, and a middle portion 16B of a material of a good heat conductivity. Furthermore, according to FIGS. 1-3, a cooling channel 19 is disposed near the lead-in ends of the elements disposed in a row along each long-side of the furnace. In FIG. 3 it is illustrated that the walls 20 of the cooling channel 19 consist of another material than the remaining portion of the furnace vault, and more particularly, the material of the walls has to have a rather good heat conductivity, whereas the material of the remaining portion of the furnace wall naturally should have as high a heat insulating ability as possible.

In the embodiment according to FIG. 4 the body 16 similarly consists of three different portions. However, in this embodiment the cooling channel has been omitted and instead the furnace vault 14 comprises three layers of different heat conductivity, viz. uppermost and lowermost layers 14A and 14C, respectively, of a low heat conductivity, and a central layer 14B of a good heat conductivity adjacent the middle portion 16B of the body 16.

Although not shown in the drawings the cooling channels 19 as disclosed in FIGS. 1-3 also may be formed in shorter sections, each provided for cooling of the lead-in ends of a lower number of elements. In this case, the inlets to the separate channel sections may be connected to a common headbox for supplying cooling air. It is also possible to dispose tubings for e.g. cooling water in the cooling channels 19.

The embodiment according to FIG. 5 differs from the one as disclosed in FIG. 4 essentially in that the separate layers 16A, 16B and 16C have been replaced by a ceramic tubing 21, which has in the uppermost and lowermost ends thereof two brick-plugs 22 and 23, respectively, through which the lead-in ends of the element are passed so that said ends are fixedly secured in said brick-plugs 22 and 23. This embodiment permits a heat transport from the lead-in ends to the surrounding material essentially by radiation, which is of special importance with elements of the above mentioned kind in as much as the heat transport by radiation takes place with a considerably increased intensity in the temperature range where

the overheating hazard would otherwise be greatest, at the same time as an unnecessary and uneconomical cooling within the lower temperature ranges is almost entirely avoided.

Naturally, several modifications and alterations as to details may be made within the scope of the inventive idea.

What we claim is:

1. An electric resistance furnace of the kind intended for industrial purposes, said furnace having an insulated furnace room and being equipped with resistance elements which consist of molybdenum disilicide, MoSi_2 , said elements being of hairpin shape and each having a glow portion depending freely into said furnace room, each resistance element having two slightly spaced electrodes provided with lead-in parts extending through the furnace insulation, the insulation having a central part through which the lead-in parts of the electrodes extend, said central part consisting of a tube-shaped sleeve preferably composed of a ceramic material, said sleeve surrounding and spaced from the parts of the electrodes which pass through it, insulating plugs located respectively in the uppermost and lowermost ends of the tube and through which parts of the electrodes extend to fixedly secure the electrodes, said tubular central insulation part transmitting heat developed in the lead-in parts of the electrodes to a central layer of the furnace insulation located around the first-mentioned central part of the insulation, the layer being provided near the lead-in ends of the electrodes with at least one cooling channel, said channel extending perpendicularly to the direction in which the lead-in ends pass through the furnace insulation, said cooling channel being of a length to cool the lead-in ends of a plurality of the resistance elements arranged in a row, the insulation of the furnace room including layers located above and below the central layer, said upper and lower layers being composed of an electrically insulating material of low conductivity.

2. An electric resistance furnace according to claim 1, wherein the cooling channel has walls which consist of a material having greater heat conductivity than the material in the remaining parts of the furnace insulation, and also greater than that of the middle layer.

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