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ELECTRODE SUPPORTING ARM FOR ARC FURNACES

The invention relates to an electrode supporting arm for use with arc furnaces.

Electrodes for arc furnaces for steel production are usually attached by means of electrode terminals to supporting arms, which themselves are held on vertically movable supporting columns. Current is supplied either in current tubes which pass above the supporting arms or via the supporting arms themselves. With supporting arms made of steel, the current is carried by copper or aluminium plating on the arm exterior. However, the supporting arm can alternatively consist entirely of a material which conducts current.

For instance, a supporting arm made wholly from aluminium so as to be conductive of current is known from French Patent 1336823. Due to the low current load, the supporting arm, which is designed as a hollow profile, is itself not cooled. The cooling water required for the electrode terminal is supplied via pipes which pass through the interior of the hollow profile.

A supporting arm made of light metal is known from European Patent 0340726, through the cavity of which cooling liquid flows. Piping is provided for supplying the electrode clamping stirrup with cooling water, the piping being connected by hoses.

In both the aforementioned electrode arms, cooling of the electrode holding means is made in a costly manner. Furthermore, in the cooled supporting arm design, the cooling potential of the cooling medium is not sufficiently utilised.

It is therefore an object of the invention to avoid the aforementioned drawbacks.

An electrode supporting arm for use with arc furnaces, in accordance with the invention, is in the form of a hollow profile, the walls of which are formed at least partly of material of high conductivity, the arm including a coolant guidance system comprising multiple channels formed in the walls, the channels being provided in such a number and with such dimensions that sufficient cooling is

produced without a reduction in the strength of the supporting arm.

The supporting arm is of simple construction, low weight but of rigid design, and allows high electric power to be transmitted with low maintenance.

In a preferred embodiment, the channels are parallel to each other and to the centre line of the supporting arm. Adjacent channels are connected alternately at the top and bottom thereof to form a coolant flow path. Other forms of cooling flow paths can be constructed as desired.

The thickness of the walls is selected such that the supporting arm is sufficiently rigid and at the same time all the walls are cooled without danger.

The supporting arm is considerably lighter than supporting arms of comparable size which have been known hitherto. This is due firstly to the use of the walls provided with channels, so that the dead weight of the arm is lower whilst still having comparative rigidity. Secondly, however, overall less water is used, since a considerably smaller quantity of water is deliberately passed through the channels through the supporting arm which are designed as a closed coolant circuit.

The hollow profile may have a circular, oval or a box-shaped form. The box-shaped form is preferred, with the walls consisting of two L-profiles of identical size or of four flat profiles welded to one another at the corners.

Preferably the walls' profiles comprise flat extruded aluminium. These profiles not only have a high dimensional accuracy, but they also have an excellent surface quality right at the outer wall of the cooling channel, so that no finishing work is necessary in order to achieve the desired coolant flow rate.

The supporting arm in the preferred form thereof has a simple external shape in which no structural members project outwards and are thus exposed to possible damage. The simple shape permits simple attachment of the electrode holding means to the front part of the supporting arm.

This ensures simple replacement.

The ratio of the diameter d of the channels to the thickness D of the walls, $d:D$, is preferably between 1:1.5 and 1:2.5. The channels may be spaced apart from one another by a distance $a = 1-1.5 D$.

Selected channels are, in a preferred embodiment, connected with supply means and removal means of a coolant guidance system for cooling electrode holding means of an arc furnace.

In order to reduce induction losses in an arc furnace where three electrodes are used, the middle supporting arm preferably has a bent central section and is passed above the other electrode arms. The central section may have a length l , the ratio of which to the electrode arm length L is between 1:3 and 1:4. The central section may point away from the furnace vessel at an angle of between 50° and 70° to the horizontal.

The invention will now be described with reference to the accompanying drawings:-

Figure 1 shows a furnace installation including electrode supporting arms in accordance with the invention;

Figure 2 is a section through an electrode supporting arm; and

Figure 3 is a diagram of the guidance of coolant in the furnace of Figure 1.

Figure 1 shows an arc furnace 10, with a furnace vessel 11 which is closed by a cover 12. In the furnace vessel 11 there is a molten mass 13 and slag 14.

Electrodes 21-23 protrude through the cover 12 and into the furnace vessel 11, which electrodes are attached to a single electrode arm 24 or to individual electrode arms 24-26 of an electrode supporting device 20.

When three electrode supporting arms 24-26 are used, the middle electrode supporting arm has a central angled section 28 which is integrally connected to horizontal outer sections 29. The length of the middle electrode supporting arm 25 is L . The middle angled region has a

length l and is located at an angle α to the horizontal electrode supporting part 29. The ratio $l:L$ may be between 1:3 and 1:4, whilst α may be 50° and 70° .

Figure 2 shows various hollow profiles 30 for the electrode supporting arm formed by structural members 31. These structural members 31 are extruded and have channels 36 in the longitudinal direction. The channels are designed in number and dimension such that sufficient cooling can be achieved without reducing the strength of the supporting arm.

Advantageously, the hollow profile 30 is composed of at least two extruded structural members 31 welded together. These structural members may be designed, for example, as a half oval profile 34, Figure 2.3, or as an L-profile 33, Figure 2.2. Alternatively, flat profiles 32 of identical construction may be employed which are welded together, for example, at 4 seams, as shown in Figure 2.1.

Channels 36 are made in the walls 35 during the extrusion process. The channels 36 have a diameter d whilst the walls have a thickness D . The ratio of $d:D = 1:1.5-2.5$. The individual channels are spaced a distance a from each other of $a = 1-1.5 D$.

Flanges or covers (not shown) are attached to the ends of the hollow profiles 30, by means of which the parallel channels 36 are connected together, and thus permit a defined through flow of coolant.

Figure 3 shows individual flow paths of coolant of a coolant guidance system 40. The individual channels 36 form the path of coolant 46, which flows through the major part of the supporting arms 24 to 26. The electrode holding means 27 has coolant paths 47 and 48 which are supplied by coolant paths 49. Owing to the large number of channels, widely varying guidance of coolant can be produced. In Figure 3, in the lower part of the drawing, there is illustrated the possibility of cooling a spraying ring 41 out of which coolant, which is supplied thereto via the coolant path 42, can flow freely.



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CLAIMS

1. An electrode supporting arm for use in an arc furnace, the arm being in the form of a hollow profile, the walls of which are formed at least partly of material of high conductivity, the arm including a coolant guidance system comprising multiple channels formed in the walls, the channels being provided in such a number and with such dimensions that sufficient cooling is produced without a reduction in the strength of the supporting arm.
2. An electrode supporting arm as claimed in Claim 1, wherein the channels are parallel to each other and to the axis of the arm.
3. An electrode supporting arm as claimed in Claim 1, wherein the ratio of the diameter d of the channels to the thickness D of the walls, $d:D$, is between 1:1.5 and 1:2.5 and wherein the channels are spaced apart from one another by a distance $a = 1-1.5 D$ and are connected together in pairs at the top and bottom ends to form a closed circuit coolant flow path.
4. An electrode supporting arm as claimed in any preceding Claim, wherein the hollow profile is circular, oval or shaped, the walls comprising at least two structural members.
5. An electrode supporting arm as claimed in Claim 4, wherein the structural members comprise identical aluminium profiles which are welded together.
6. An electrode supporting arm as claimed in Claim 5, wherein the structural members have an L shape.
7. An electrode supporting arm as claimed in any preceding Claim, wherein selected channels are connected with supply means and removal means of a coolant guidance system for cooling electrode holding means.





8. An arc furnace comprising a furnace vessel, three electrodes and electrode supporting arms therefor as claimed in any preceding Claim wherein the electrode supporting arm of the middle electrode has a central section angled to the remainder thereof, the central section having a length l , the ratio of which to the electrode arm length L is between 1:3-4, and pointing away from the furnace vessel at an angle α of between 50° to 70° to the horizontal.

9. An electrode supporting arm substantially as hereinbefore described and illustrated in the accompanying drawings.

10. An arc furnace substantially as hereinbefore described and illustrated in the accompanying drawings.





A B S T R A C T

An electrode supporting arm (24, 25, 26) for an arc furnace (10) is described. The arm (24, 25, 26) is a hollow profile (30) and has walls (35) formed at least partially of current-conducting material of high conductivity. The walls (35) of the hollow profile (30) have a coolant guidance system (40), comprising channels (36) arranged parallel to one another and concentrically to the centre line of the supporting arm in the wall (35) in such a number and with such dimensions that sufficient cooling is permitted without a reduction in the strength of the supporting arm (24, 25, 26).

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Fig. 1

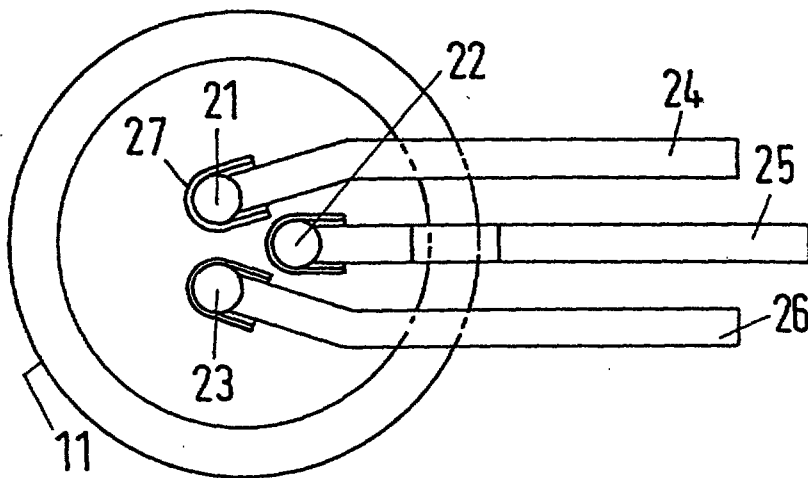
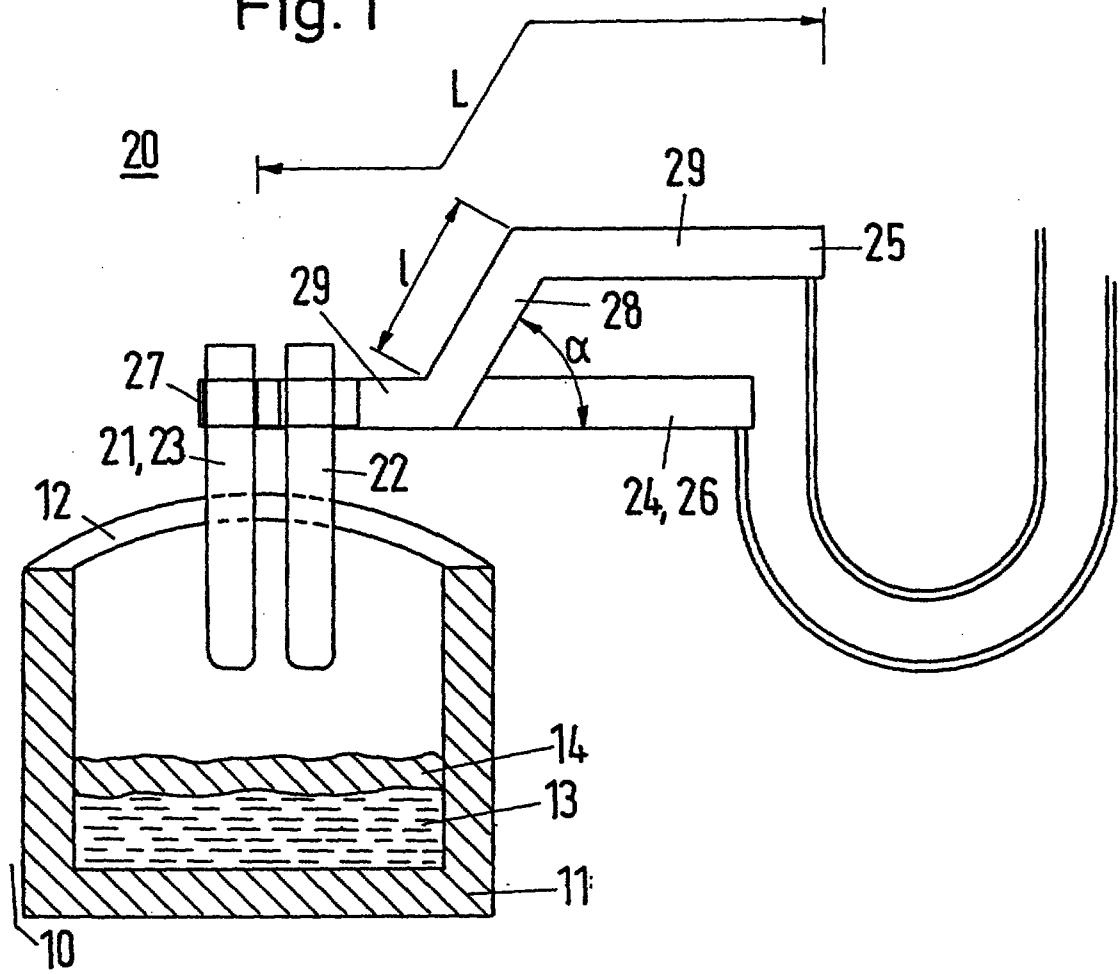




Fig. 2

Fig. 2.1

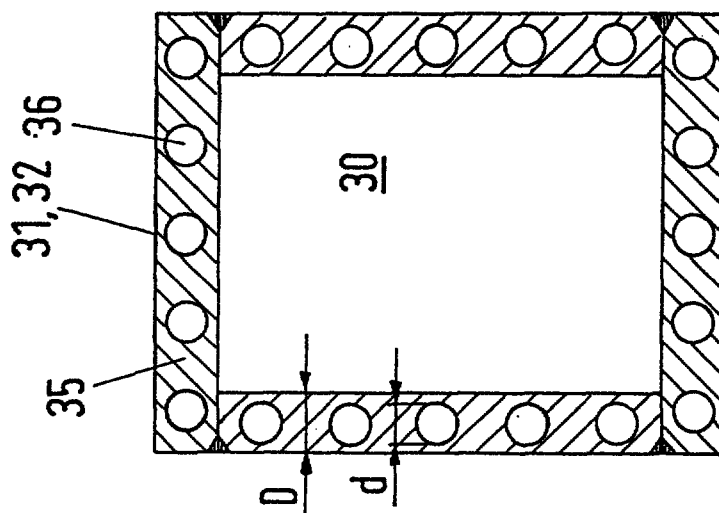


Fig. 2.2

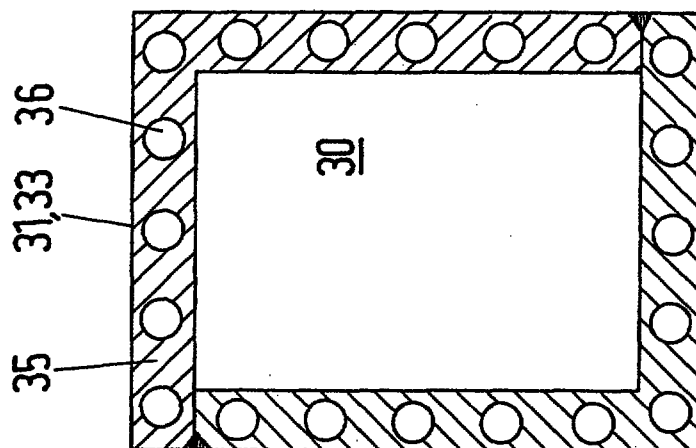


Fig. 2.3

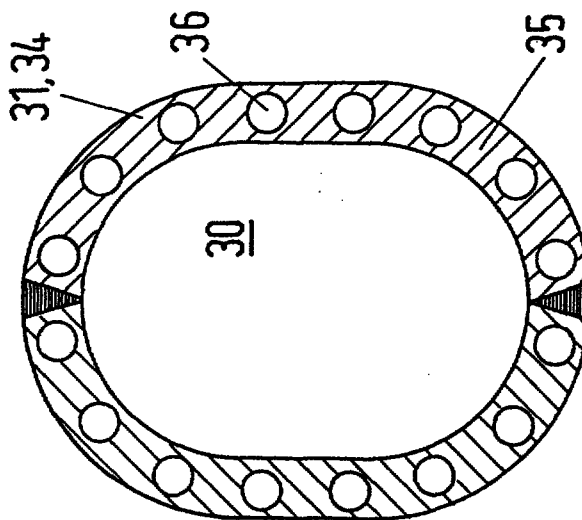
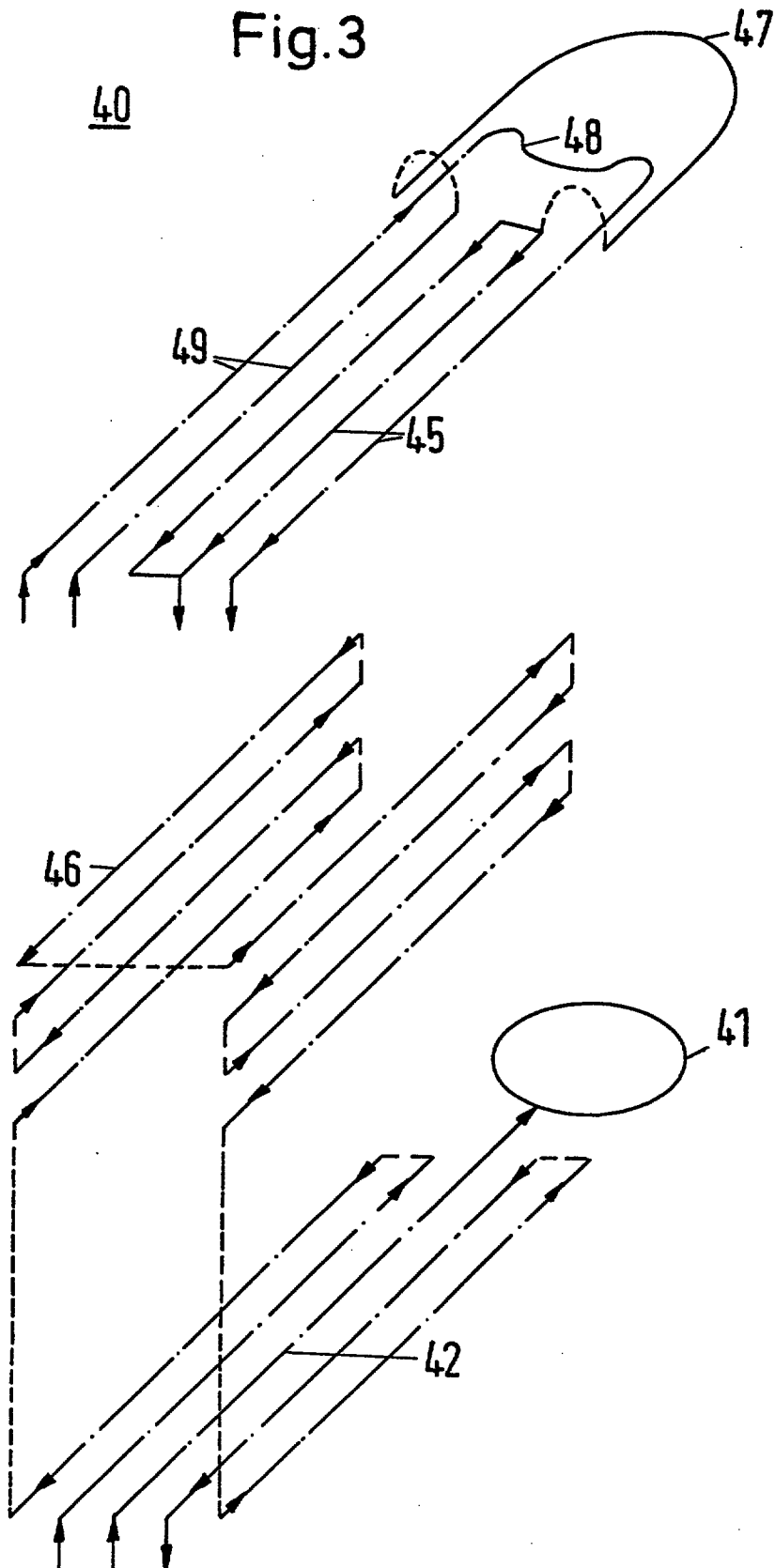




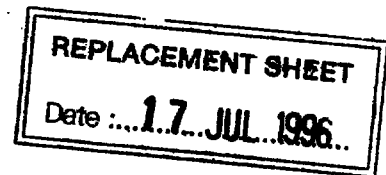
Fig.3





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CLAIMS

1. An electrode supporting arm for use in an arc furnace, the arm being in the form of a hollow profile, the walls of which are formed at least partly of material of high conductivity, the arm including a coolant guidance system comprising multiple channels formed in the walls, the channels being provided in such a number and with such dimensions that sufficient cooling is produced without a reduction in the strength of the supporting arm.
2. An electrode supporting arm as claimed in Claim 1, wherein the channels are parallel to each other and to the axis of the arm.
3. An electrode supporting arm as claimed in Claim 1, wherein the ratio of the diameter d of the channels to the thickness D of the walls, $d:D$, is between 1:1.5 and 1:2.5 and wherein the channels are spaced apart from one another by a distance $a = 1-1.5 D$ and are connected together in pairs at the top and bottom ends to form a closed circuit coolant flow path.
4. An electrode supporting arm as claimed in any preceding Claim, wherein the hollow profile is circular, oval or shaped, the walls comprising at least two structural members.
5. An electrode supporting arm as claimed in Claim 4, wherein the structural members comprise identical aluminium profiles which are welded together.
6. An electrode supporting arm as claimed in Claim 5, wherein the structural members have an L shape.
7. An electrode supporting arm as claimed in any preceding Claim, wherein selected channels are connected with supply means and removal means of a coolant guidance system for cooling electrode holding means.

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Date : **17 JUL 1996**

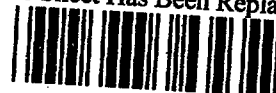
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8. An arc furnace comprising a furnace vessel, three electrodes and electrode supporting arms therefor as claimed in any preceding Claim wherein the electrode supporting arm of the middle electrode has a central section angled to the remainder thereof, the central section having a length l , the ratio of which to the electrode arm length L is between 1:3-4, and pointing away from the furnace vessel at an angle α of between 50° to 70° to the horizontal.

9. An electrode supporting arm substantially as hereinbefore described and illustrated in the accompanying drawings.

10. An arc furnace substantially as hereinbefore described and illustrated in the accompanying drawings.

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Fig. 1

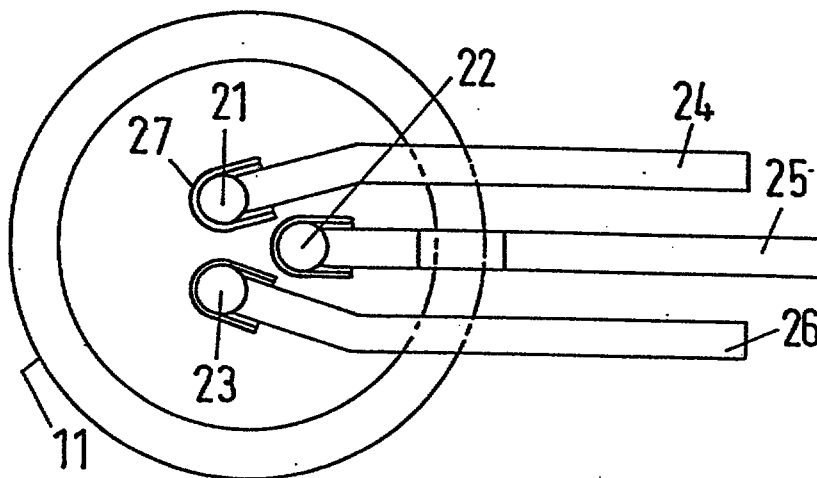


Fig. 2

Fig. 2.1

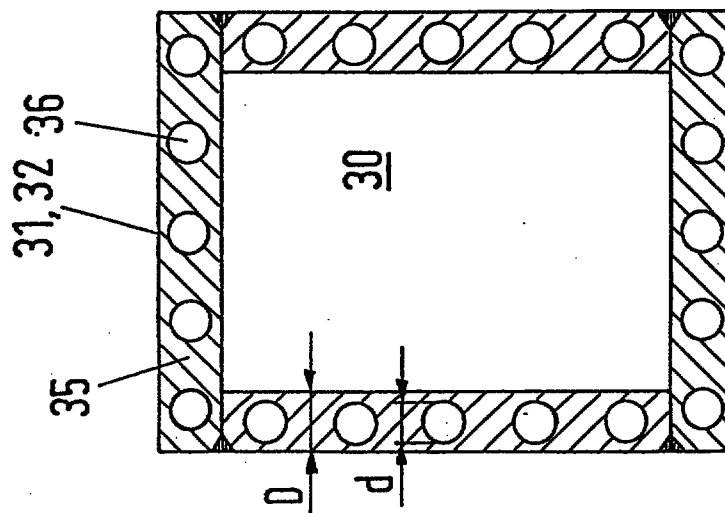


Fig. 2.2

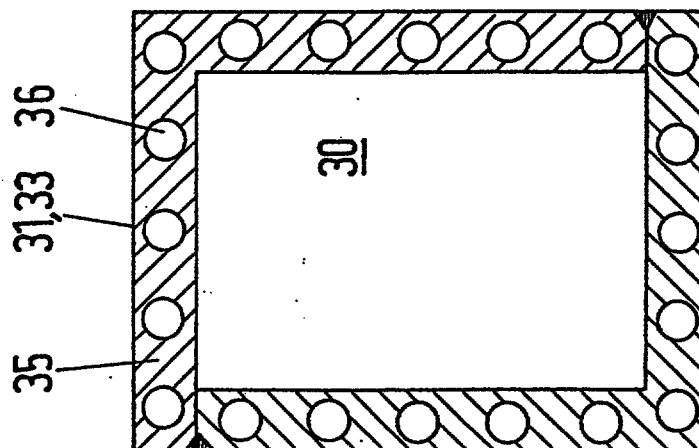
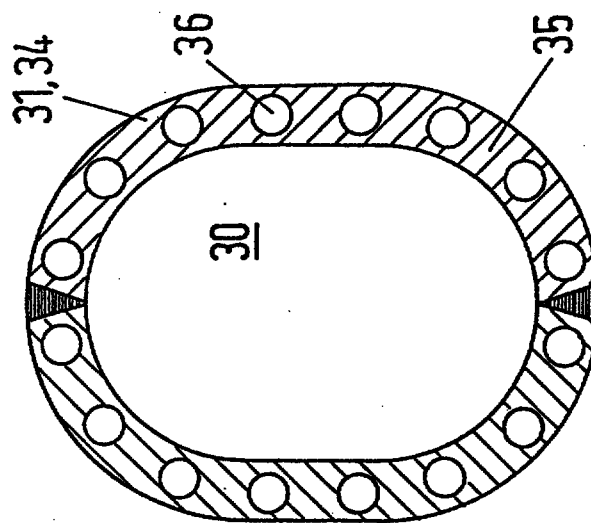
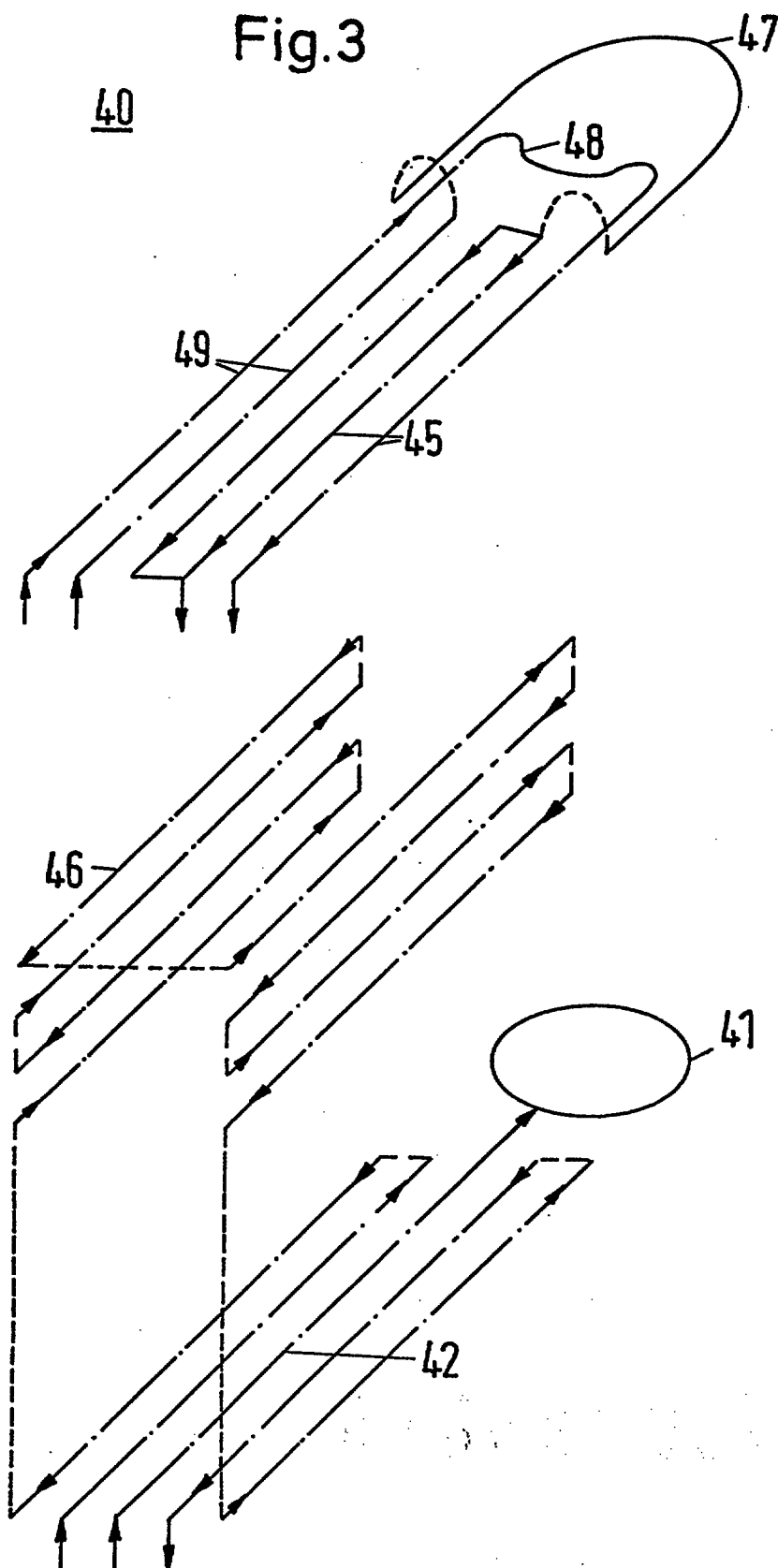


Fig. 2.3



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Fig.3



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ELECTRODE SUPPORTING ARM FOR ARC FURNACES

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For instance, a supporting arm made wholly from aluminium so as to be conductive of current is known from French Patent 1336823. Due to the low current load, the supporting arm, which is designed as a hollow profile, is itself not cooled. The cooling water required for the electrode terminal is supplied via pipes which pass through the interior of the hollow profile.

A supporting arm made of light metal is known from European Patent 0340726, through the cavity of which cooling liquid flows. Piping is provided for supplying the electrode clamping stirrup with cooling water, the piping being connected by hoses.

In both the aforementioned electrode arms, cooling of the electrode holding means is made in a costly manner. Furthermore, in the cooled supporting arm design, the cooling potential of the cooling medium is not sufficiently utilised.

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An electrode supporting arm for use with arc furnaces, in accordance with the invention, is in the form of a hollow profile, the walls of which are formed at least partly of electrically conductive material, the arm including a coolant guidance system comprising multiple channels formed in the walls, the channels being provided in such a number and with such dimensions that sufficient cooling is _____

CLAIMS

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2. An electrode supporting arm as claimed in Claim 1, wherein the channels are parallel to each other and to the axis of the arm.
3. An electrode supporting arm as claimed in either Claim 1 or Claim 2, wherein the channels are circular, the ratio of the diameter d of the channels to the thickness D of the walls, $d:D$, is between 1:1.5 and 1:2.5 and wherein the channels are spaced apart from one another by a distance $a = 1-1.5 D$.
4. An electrode supporting arm as claimed in any preceding Claim, wherein the channels are connected together in pairs at alternate ends to form a closed circuit coolant flow path.
5. An electrode supporting arm as claimed in any preceding Claim, wherein the hollow profile is circular, oval or box-shaped, the walls comprising at least two structural members.
6. An electrode supporting arm as claimed in Claim 5, wherein the structural members comprise identical aluminium profiles which are welded together.
7. An electrode supporting arm as claimed in Claim 6, wherein the structural members have an L shape.



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8. An electrode supporting arm as claimed in any preceding Claim, wherein selected channels are connected with supply means and removal means of a coolant guidance system for cooling electrode holding means.

9. An arc furnace comprising a furnace vessel, three electrodes and electrode supporting arms therefor as claimed in any preceding Claim wherein the electrode supporting arm of the middle electrode has a central section angled to the remainder thereof, the central section having a length l , the ratio of which to the electrode arm length L is between 1:3-4, and pointing away from the furnace vessel at an angle α of between 50° to 70° to the horizontal.

10. An electrode supporting arm substantially as hereinbefore described and illustrated in the accompanying drawings.

11. An arc furnace substantially as hereinbefore described and illustrated in the accompanying drawings.