

The invention relates to a smelting plant as set forth in the classifying portion of claim 1.

A smelting plant of that kind is disclosed in German utility
5 model No 84 12 739.

In the known smelting plant the charging material is charged through a shaft-like charging material preheater into a metal sump present in the furnace vessel. In that situation the problem arises that, after the tapping operation and re-igniting the electric arc, the
10 electrical energy input is restricted by the bath temperature which is high at that time. The residual sump which remains in the furnace vessel after the tapping operation cools down so little in that brief period of time that only a low level of electrical energy can be inputted in order to prevent the bath from overheating. Therefore the power available for
15 the smelting operation cannot be utilised in the initial phase so that the smelting time is correspondingly increased.

For the purposes of reducing the period of time involved in the smelting procedure and for the purposes of protecting the furnace walls, it is desirable after each tapping operation to introduce the charging
20 material not just at the side of the furnace vessel at which the charging material preheater is disposed, but in such a way as to be distributed over the entire cross-section of the furnace, or specifically and deliberately on the side of the furnace vessel which is in opposite relationship to the charging material preheater.

Problems of space arise when the content of a scrap metal basket is charged directly into the furnace vessel, due to the shaft of the charging material preheater which is disposed on one side of the furnace vessel, and the electrode lifting and pivoting apparatus which is disposed on the other side of the furnace vessel. Furthermore such a
25 charging operation involves environmental pollution.
30

The object of the present invention is to provide a smelting plant of the kind set forth in the classifying portion of claim 1, wherein, without being impeded by the shaft, the charging material can be introduced by means of a scrap metal basket into the entire cross-
35 section of the furnace, or specifically on the side of the furnace vessel which is in opposite relationship to the charging material preheater. The invention further seeks to provide that the charging operation involves the minimum level of environmental pollution.

That object is attained by the features set forth in claim 1. Advantageous configurations in accordance with the invention are set forth in the subsidiary claims.

Accordingly the walls of the charging preheater, in the lower region
5 of the preheater, up to the level of the upper edge of the furnace vessel, are formed by a part of the vessel wall against which the column of charging material can laterally bear, and in the region thereabove, by the walls of a shaft fixed in a holding structure. The holding structure carrying the shaft, and the furnace vessel, are movable
10 relative to each other. The furnace vessel cover is preferably releasably fixed to the holding structure. It then forms a structural unit with the shaft. In that way, the shaft of the charging material preheater can be removed simultaneously with the furnace cover when it is removed, and sufficient space is provided for charging material
15 directly into the furnace vessel.

Subdividing the preheater into an upper shaft fixed in a holding structure and lower portion formed by a part of the vessel wall affords further options which are advantageous in regard to the charging and
smelting procedure, particularly when the shaft is structurally combined
20 with the cover. The shaft itself can be utilised for specifically charging material into the furnace vessel, by virtue of a horizontal relative movement as between the furnace cover and the furnace vessel, while environmental pollution can be minimised in the charging operation, by virtue of the furnace vessel being substantially covered
25 over by the cover. The horizontal relative movement can be a pivotal or a linear movement of the furnace vessel cover and/or a linear movement of the furnace vessel. The spacing between the upper edge of the vessel and the lower edge of the vessel cover, which is required for the horizontal relative movement to take place, can be provided either by
30 raising the cover or by lowering the vessel.

In a particularly advantageous configuration of the invention, the furnace vessel is fixed in an upper frame which is supported by way

of a frame lifting means on a lower support structure which is adapted to be mobile. In that way the furnace vessel cover and the shaft can be stationary. The frame lifting means may be formed for example by hydraulic lifting cylinders which are arranged at the four corners of a rectangular frame and which are controlled in pairs and which, besides a slight lifting and lowering movement of the furnace vessel, permit tilting thereof in one direction for carrying out the tapping operation and tilting thereof in the other direction for the removal of slag from the furnace vessel. The mobile design configuration of the support structure permits the desired horizontal displacement as between the furnace vessel cover and the shaft, either for charging of the furnace vessel with a scrap metal basket outside the region of the cover, or for specifically charging material into the furnace vessel through the shaft of the furnace vessel cover. In that connection the relative horizontal displacement takes place parallel to the connecting line between the middle of the furnace vessel cover and the centre line of the shaft, and the tilting movement for tapping and for slag removal purposes takes place perpendicularly thereto.

Preferably in plan view the furnace vessel is in the form of an oval which is delimited on one side by a straight line, wherein the straight wall portion together with adjoining portions of the oval forms the walls of the charging material preheater in the lower region thereof.

The wall, which is adjacent to the electrodes, of the shaft may be extended a distance under the underside of the cover in order to define the connecting zone between the interior of the charging material preheater and the interior of the furnace vessel. With an enlarged connecting zone however retention of the material which is charged into the shaft of the charging material preheater may also be promoted by virtue of the fact that the floor of the charging material preheater is designed to drop away towards the furnace hearth at an angle of inclination of $> 30^\circ$ and $< 60^\circ$.

In order to keep down the weight of the shaft the shaft walls are preferably formed by water-cooled wall elements.

Usually the electrode lifting apparatus is arranged beside the furnace vessel on the side thereof which is opposite to the charging material preheater so that the shaft does not impede the pivotal movement of the electrodes. Normally the cover lifting and pivoting apparatus is also disposed on the same side as the electrode lifting apparatus. As in the smelting plant according to the invention however the centre of gravity is close to the shaft, the lifting and pivoting apparatus for the holding structure of the shaft, which preferably also carries the vessel cover, is preferably arranged in the vicinity of the charging material preheater, on the side of the furnace vessel which is opposite to the electrode lifting apparatus. The arrangement may also include a movable portal assembly which is supported on rails on both sides of the smelting plant and the support beams of which carry the holding structure of the shaft and possibly the vessel cover.

The lifting and pivoting apparatus for the furnace vessel cover can in principle be of the design configuration described in EP-A-203 339. In accordance therewith, fixed on a laterally pivotable rotary portal assembly which is arranged beside the charging material preheater is a lifting apparatus which includes at least one support member which can be raised and lowered and which engages the cover. If that arrangement is so designed that the support member is released from the cover in the lowered position, then, in the case of a tiltable furnace vessel, the lifting and pivoting apparatus does not need also to be tilted, but can be in the form of a unit which is disposed on stationary foundations. It will be appreciated however that, with suitable dimensioning of the furnace rocking cradle, the lifting and pivoting apparatus can be fitted on to a furnace platform which also performs a tilting movement.

When using a tiltable construction, the furnace vessel is to be tiltable perpendicularly to a line connecting the middle of the

charging material preheater to the middle of the furnace hearth.

When the apparatus for removing the ^{structure of the shaft} holding is in the form of a lifting and pivoting apparatus, it is to be adapted to be pivoted away to the same side with respect to the furnace vessel as the electrode lifting and pivoting apparatus, that is to say one apparatus is to be adapted to pivot out of the operative position in a mathematically positive sense and the other apparatus is adapted to be pivoted out of the operative position in the mathematically negative direction. That provides space for the charging operation on the other side.

In regard to a reduction in the length of time involved in the smelting procedure, and savings of energy, it is desirable for the charging material which is introduced after the tapping operation either by means of a scrap basket or specifically by way of the shaft of the cover, to be preheated with waste gases from the smelting vessel. For that purpose, beside the charging material preheater, there may be provided an additional preheating chamber for receiving a container which is filled with charging material, the preheating chamber being connected to the gas outlet of the shaft-like charging material preheater and making it possible for the hot waste gases also to be utilised during the refining phase when the shaft-like charging material preheater is empty. An additional preheating chamber is unnecessary if, in accordance with a further development of this invention, disposed in the shaft is at least one movable blocking or barrier member which in a closed position retains charging material in the shaft, while gas is permitted to pass through, and which in an open or release position releases the preheated charging material and permits the material to be unimpededly charged into the furnace through the shaft. That construction is particularly environment-friendly in that respect because the charging material which is preheated during the refining phase can be charged into the furnace vessel without removal of the entire furnace vessel cover.

The invention will be described in greater detail by means of embodiments with reference to Figures of drawings. In the diagrammatic

drawings:

Figure 1 is a partly sectional side view of a smelting plant,

Figure 2 is a plan view of the smelting plant with the cover disposed on the furnace vessel and the electrodes in the inserted position,

Figure 3 is a view corresponding to that shown in Figure 2 with the electrodes and the cover in the positions of being pivoted away,

Figure 4 is a side view of a second embodiment,

Figure 5 is a partly sectional side view of a third embodiment with a mobile furnace vessel and blocking members in the shaft,

Figures 6 through 12 are different views of a third embodiment, more specifically:

Figure 6 is a side view in the basic position,

Figure 7 is a side view with the vessel in a displaced position,

Figure 8 is a view partly in section taken along line VIII-VIII in Figure 7,

Figure 9 is a plan view of the smelting plant,

Figure 10 is a plan view of the support structure of the furnace vessel,

Figure 11 shows the furnace vessel in the tapping position, and

Figure 12 shows the smelting plant with the furnace vessel cover removed from the shaft.

The smelting plant shown in Figures 1 through 3 includes an electric arc furnace 1 and a shaft-like charging material preheater 2. The arc furnace includes a furnace vessel 3 comprising a furnace hearth 4 and a vessel wall 5. The furnace vessel 3 is closed with a cover 6 which can be pivoted away and through which three electrodes 9 can be introduced into the furnace vessel. The electrodes 9 are carried by support arms 7 and can be raised and pivoted laterally by means of a lifting and pivoting apparatus 8. Only one electrode is shown in Figure 1, for the sake of clarity of the drawing.

The charging material preheater 2 is arranged laterally on the furnace vessel 3. In the lower region of the charging material

preheater, which extends as far as the upper edge of the furnace wall 5, the outside walls of the charging material preheater are formed by the vessel wall 5. In the region thereabove the walls of the charging material preheater are formed by a shaft 10 which like the cover 6 is fixed in a holding structure 27 and by way of the latter forms a structural unit with the vessel cover 6. As Figure 3 in particular shows, in plan view the furnace vessel 3 is in the form of an oval which is delimited on one side by a straight line. The straight wall portion 11, together with adjoining portions 12 of the oval, forms the outer shaft walls in the lower region of the charging material preheater. The brick-lined floor 13 of the charging material preheater falls away towards the floor of the brick-lined furnace hearth 4, at an angle of inclination as indicated at 14 of about 45°.

The walls of the shaft 10 are formed by water-cooled wall elements for reasons of weight.

The cross-section of the interior 15 of the shaft 10 increases in a downward direction in order to ensure a trouble-free flow of the charging material 16 in the shaft 10.

In the present case the shaft 10 is of approximately rectangular shape in plan and extends upwardly the cross-section of the charging material preheater 2, which is defined by the wall portions 11 and 12 of the furnace vessel 3. In this case formed between the charging material preheater 2 and the arc furnace 1 is a connecting zone 17 which extends over the internal height and the internal width of the furnace vessel in the notional common plane between the charging material preheater and the arc furnace. It will be appreciated that the cross-sectional shape selected for the shaft may differ from a rectangular shape, and it also does not need to extend over the entire width of the furnace vessel or cover. In addition the wall of the shaft 10 which faces towards the arc furnace 1 may be extended downwardly from the edge of the cover within the furnace vessel in order to reduce the internal height of the connecting zone 17. When the cover is removed, it must then be lifted higher by the appropriate distance

before it can be displaced laterally.

In the upper region the charging material preheater 2 has a closable loading opening 18 and a gas outlet 19. The gas outlet 19 is communicated by way of a gas pipe 20 with the chimney or a preheating chamber which is suitable for accommodating a scrap basket or container which is filled with charging material.

As can be seen from Figure 2, in the first embodiment the electrodes 9 are displaced in the direction of the charging material preheater 2. In that way the radiant heat produced by the arcs can act to an enhanced degree on the charging material which is supplied by way of the charging material preheater 2 and at the same time the radiant heat loading on the free wall regions of the arc furnace can be reduced.

As Figure 3 shows, the furnace hearth 4 has an eccentrically arranged tap hole 21. The furnace vessel 3 is designed to be tiltable for the tapping operation in known manner, with the tilting movement taking place perpendicularly to a line 22 (see Figure 2) which connects the middle of the charging material preheater with the middle of the furnace hearth.

In the illustrated smelting plant, the electrode lifting and pivoting apparatus 8 is arranged beside the furnace vessel 3 on the side of the cover 6 which is in opposite relationship to the shaft 10, and a lifting and pivoting apparatus 23 for the holding structure 27 and therewith also for the vessel cover 6 is arranged beside the charging material preheater 2. The lifting and pivoting apparatus 23 can be designed in accordance with the principle described in EP-A-203 939. In the illustrated case fixed on a rotary portal assembly 24 is a lifting cylinder 25 with a support member 26 which can be raised and lowered and which in the lowered position is released from a holding structure 27 fixedly connected to the vessel cover 6, and in the raised position engages into a lifting eye 28 of the holding structure 27, which lifting eye is adapted to the support member. The lifting and pivoting apparatus 23 can lift the shaft 10 together with the cover 6

and pivot same to the side. Figure 3 shows the cover and also the electrodes in the position of being pivoted to the side. It will be seen that the vessel cover and the electrodes can be pivoted away to the same side in relation to the furnace vessel 3, that is to say in the illustrated case towards the tap hole side, so that a scrap basket can be unimpededly moved into position over the open furnace vessel 3 from the other side in the direction indicated by an arrow 29, and emptied into the furnace vessel.

Instead of the rotary portal assembly 24, the mobile portal assembly may also be a linearly movable portal assembly with a lifting apparatus. In that case it is advantageous for the portal assembly carrying the lifting apparatus to be movable in the direction indicated by a double-headed arrow 32 in Figure 2.

In the illustrated construction the electrode lifting and pivoting apparatus 8 is fixed on a furnace platform 30 which also performs a tilting movement and which for that purpose must be of suitably stable dimensioning while the lifting and pivoting apparatus 23 for the holding structure 27 is in the form of a unit which is supported directly on the foundations. The latter construction is possible for the reason that, in the lowered position of the support member 26, the lifting and pivoting apparatus 23 is uncoupled from the holding structure 27 of the vessel cover 6, so that the furnace vessel together with the vessel cover can be tilted without being impeded by the lifting and pivoting apparatus 23.

In the embodiment illustrated in Figure 4, upon removal of the vessel cover, it is not pivoted towards the side but is moved towards the side after having been lifted. For that purpose the arrangement has a portal assembly 42 which is movable on two rails 41. The rails 41 are mounted on the foundation structure on both sides of the smelting plant. The movable portal assembly 42 has two support beams 43 which extend over the smelting plant. In the view shown in Figure 4 one of the support beams 43 is arranged in front of the shaft 10 and one

support beam is arranged behind the shaft 10. In the present case the movable portal assembly also carries the electrode lifting and pivoting apparatus 8. The support beams 43 are connected to the vessel cover 6 or a holding structure for the shaft 10 at suitable locations, by way of uncouplable lifting devices (not shown), so that when required the ^{the shaft and} vessel cover can be lifted and moved to the side. On the other hand the arrangement used is not to impede the tilting movement when removing slag from and tapping the furnace vessel 3.

The arc furnace can be in the form of an alternating current arc furnace or a direct current arc furnace with one or more electrode or electrodes which can be introduced through the vessel cover.

The arc furnace 1 shown in Figure 5 has a furnace vessel 3 which is displaceable horizontally by way of wheels 57 on two parallel rails 58 of which only the front rail is visible in the drawing.

Arranged in the shaft 10 of the preheater 2 is a barrier or blocking member which is generally identified by reference numeral 51. The blocking member 51 comprises two for example water-cooled rollers 52 which are arranged in mutually opposite relationship substantially in a common horizontal plane, while cantilever carriers 53 extend from the rollers 52 in respective rows which are disposed in a common plane. The carriers 53 are each of the same configuration and, like the rollers 52, may be water-cooled.

The rollers 52 are each rotatably mounted in respective receiving means 54. The mounting means (not shown) may be of a flexible configuration, for example, using mechanical spring elements or hydraulic damping elements. The rollers can be driven by way of drive means (not shown) and can be stopped in predeterminable angular positions. The receiving means 54 are each formed by an enlarged region of the charging material preheater 2, wherein the respective corresponding wall region of the shaft 10 is displaced outwardly in the direction of a respective receiving means 54 so that the rollers 52 with the associated carriers 53 are arranged gas-tightly within the

shaft 10.

The two rollers 52 can be driven substantially simultaneously in such a way that the carriers can occupy the positions shown in solid lines in Figure 5 as well as the positions shown in dashed and dash-dotted lines. The solid lines show a release or open position in respect of the respective carriers 53, in which the rows of carriers are disposed within the respective receiving means 54. When the blocking member 51 or the carriers 53 is or are in that position, the carriers 53 are entirely withdrawn and a column of charging material can be charged through the shaft. The column of charging material is supported on the floor and wall region of the furnace vessel 3, which is beneath same.

At an end region which is in opposite relationship to the charging material preheater 2, the holding structure for the shaft 10 and cover 6 is pivotably mounted to the electrode lifting and pivoting apparatus 8 by way of a rotary mounting 55. In opposite relationship to the rotary mounting 55, the holding structure is engaged by a lifting apparatus 56 comprising one or more and preferably two piston-cylinder units in order to pivot the cover 6 with the shaft 10 upwardly about the rotary mounting 55 and therewith relative to the furnace vessel 3. By actuation of the lifting apparatus 56, the shaft 10 and cover 6 can thus be pivoted out of a position in which they lie on the upper edge of the furnace vessel 3 and close the vessel. In the lifted position of the holding structure 6 the furnace vessel 3 can be displaced on the rails 58 by way of the wheels 57 in different directions. The furnace vessel 3 can thus be moved from the basic position I shown in solid lines in Figure 5, for example into the position II which is to the left thereof, as shown in broken lines, or into the position III which is to the right of the basic position and which is shown in dash-dotted lines. The association of the furnace vessel with respect to the shaft 10 alters in accordance with the respective position of the furnace vessel. In that way different regions of the furnace vessel 3 can be specifically and deliberately associated with the shaft 10. With the association therebetween, which occurs when the furnace vessel 3 is in

the basic position, the shaft 10 of the charging material preheater 2 is arranged above a first region of the furnace vessel 3, for introducing a column of charging material into same. The furnace vessel 3 can be moved out of that association in such a way that the shaft 10 is associated with a second region of the furnace vessel 3, which is disposed at a spacing as indicated at b; in that position the furnace vessel 3 is disposed in position II. Therefore, the positional association as between the shaft 10 and the furnace vessel 3, which can be predetermined by displacement of the furnace vessel 3, means that it is possible for the batch material to be used in the arc furnace to be specifically introduced into the furnace vessel 3, in dependence on the respective operating condition or the state of the procedure.

Displacement in the opposite direction into position III may be effected in order to move a column of charging material, which is introduced at the left-hand side of the furnace vessel, closer to the electrodes 9, in order to provide a faster melting effect.

A typical operating procedure will now be described. With the carriers 53 in their open position and with the shaft 10 being in a position of being associated with the furnace vessel 3 above the first region thereof, a column of charging material can be charged into the furnace vessel by way of the shaft 10 during a smelting phase. Basic position I of the furnace vessel 3 as illustrated in Figure 5 corresponds to that association. After the termination of the smelting phase, the column of charging material has been melted and the charging material preheater 2 is substantially empty. Any portions of the column of charging material which are still remaining in the shaft 10, for example due to the material forming bridges therein, can be easily conveyed into the furnace vessel 1 by a rotary movement of the carriers 53, and by virtue of the pressure which is applied to the charging material when that happens. In order to expedite the smelting process, the furnace vessel 3 may be moved during or after the operation of introducing the column of charging material, in such a way that the distance of the column of charging material from the electrodes 9 is

reduced. For that purpose for example the furnace vessel 3 can be moved into position III. The energy of the arcs can thus be used specifically to cause smelting of the column of charging material.

In the course of the refining phase which follows the operation of melting the column of charging material, no charging material is added to the molten metal bath, in order to produce a molten metal bath having the required properties. With the smelting plant shown in Figure 5, it is possible for charging material to be introduced into the shaft 10 when the carriers 53 are in their closed position. That charging material is preheated by hot gas which rises from the furnace vessel 3 and passes into the shaft 10, during the refining phase. The charging material is available for charging the furnace vessel 3 after tapping thereof. So that the wall region of the furnace vessel 3 which is shown at the right in Figure 5 is protected from the excessive effects of heat from the electrodes 9, the charging material in the shaft 10 is charged into the furnace vessel 3 when, by virtue of displacement of the furnace vessel 3 relative to the substantially stationary shaft 10, the shaft 10 has been associated with the right-hand region of the furnace vessel 3. The position II shown in Figure 5 corresponds to that condition of association. In that position the heated charging material can be delivered to the right-hand region of the furnace vessel 3.

Then, for charging material into the left-hand region of the furnace vessel 3, the furnace vessel 3 is moved back into basic position I as shown in solid lines in Figure 5. In that condition the carriers 53 can be moved into their release or open position in which they do not impede the continuous charging of charging material through the shaft 10.

Thus, preheating of the charging material within the shaft 10 can also be effected during the refining phase. As the cover 6 only has to be lifted to a slight extent for movement of the furnace vessel 3, that arrangement ensures that no environmental pollution occurs during the preheating phase and also during the charging phase.

In the embodiment of the invention which is shown in various views and operating conditions in Figures 6 through 12, the holding structure 27 for the shaft 10 in which the cover is releasably fixed is mounted in a stationary position by means of cantilever arms 59 on foundation columns or pillars 60 and the electrode lifting and pivoting apparatus 8 (see Figures 8 and 9). The furnace vessel 3 is fixed in an upper frame 61 which is supported on a support structure 63 by way of a frame lifting apparatus 62. The support structure 63 is movable parallel to the connecting line between the centre line of the shaft and the centre of the furnace hearth, that is to say parallel to the line 22 (see Figure 9). For that purpose, in the view shown in Figure 6, the support structure is provided with wheels 57 running on rails 58, on the left-hand and on the right-hand sides.

As in the above-described embodiments, the furnace vessel can be tilted in a direction transverse with respect to the line 22 connecting the centre line of the charging material preheater 2 to the centre of the furnace hearth 4, more specifically it can be tilted towards one side in which a tap hole 21 is disposed adjacent the edge of the furnace hearth 4, for the tapping operation, and it can be tilted for the slag removal operation towards the other side at which there is provided a working opening 64, which can be closed by a liftable door, with an operating plate 65. In order to provide space for a ladle 66 (see Figure 11) when tapping the furnace vessel, the upper frame 61 is offset upwardly on that side (see the broken line in Figure 6). On the opposite side, because of the space required for the opening 64, the upper frame 61 is displaced or offset downwardly (see the dash-dotted line in Figure 6).

For reasons of space for the ladle 66 and a slag truck (not shown) which is to be disposed beneath the plate 65, the support structure 63 is also of a particular configuration. As Figure 10 shows in plan view, the support structure 63 comprises two parallel transverse bearers 67 and 68 and a longitudinal bearer 69 which connects the transverse bearers 67 and 68 approximately at the middle. The runner wheels 57 are respectively mounted in the end regions of the transverse bearer 67 and in the middle region of the transverse bearer 68, while two spaced-apart wheels 57 are also provided in the middle

region of the transverse bearer 68. In that way the rails for the wheels of the transverse bearer 68 can also be moved into the middle so that they do not impede either the ladle on one side or the slag truck on the other side. In the illustrated construction the frame lifting apparatus 62 is formed by four lifting elements 70 and 71 which are arranged at the periphery of the frame 61, more specifically in the region of the corners of the frame which is approximately rectangular in plan view. The lifting elements 70 and 71 comprise hydraulically actuatable piston-cylinder units, but they could also comprise other components such as a toothed pinion and a rack co-operating therewith, or a screw spindle drive. Lifting elements are provided on both sides of the line 22 which connects the centre line of the charging material preheater to the middle of the furnace hearth, while in the illustrated embodiment the lifting elements 71 are pivotable about axes of rotation which are parallel to the line 22, on the tapping side, both in the frame 61 and also in the support structure 63, while on the slag side (left-hand side in Figure 8) the lifting elements have a vertical guide action and are mounted pivotably about an axis of rotation which is parallel to the line 22, only in the upper frame 61. The lifting elements 71 and the lifting elements 70 are respectively controllable synchronously. By synchronous downward movement of the lifting elements 71, the furnace vessel can be tilted towards one side for the tapping operation while by synchronous downward movement of the lifting elements 70 the furnace vessel can be tilted towards the other side for the slag-removal operation. If all the lifting elements are lowered synchronously, the furnace vessel 3 can be lowered without tilting.

In the illustrated construction the vertical guide action in respect of the lift elements 70 is provided by the hydraulic cylinders being held in tubes 72 which are fixedly connected to the support structure 63.

The following process steps can be carried out with the above-described smelting plant:

After tapping of a molten bath (see Figure 11), for which purpose the lifting elements 71 are lowered, and the furnace vessel 3 tilts about the upper axes of rotation of the lifting elements 70 which are held fast in position, the lifting elements 71 are lifted again until they reach a position in which there is still a sufficient spacing relative to the lower edge of the furnace vessel cover 6 for the furnace vessel 3 to be displaced horizontally. In that position the support structure is moved towards the left from the position shown in Figure 6 until either the entire vessel is disposed outside the region of the shaft 10 in order for charging material to be introduced directly into the vessel from a scrap basaket, or only into a position as shown in Figure 7 in order for charging material to be passed from a charging material container 73 by way of the shaft 10 into the right-hand half of the furnace vessel, that is to say the half thereof which is on the side of the electrode lifting apparatus. That position is shown in dash-dotted lines in Figure 9. In order to prevent environmental pollution due to furnace gases escaping from the left half of the vessel in that position, a cover means (not shown) may be provided here as a horizontal extension of the vessel cover (towards the left in Figure 7), for example a cover plate which is aligned with the lower edge of the cover and which is fixed to same or in some other fashion. The furnace vessel is then moved back into the starting position shown in Figure 6 and lifted to such an extent as to ensure the desired closure effect as between the furnace vessel and the vessel cover. In that position further charging material is supplied through the shaft 10 and a column of scrap is thus built up in the shaft, the column of scrap being supported on the floor of the vessel and in the left-hand region of the vessel wall. After closure of the cover 74 which is of the cross-sectional configuration shown in Figure 6, being in the form of an inverted U, and which is movable horizontally on rails 75, the next furnace charge is smelted down and, as that occurs, the furnace gases produced preheat the column of scrap material. If blocking members as described with reference to Figure 5 are provided

in the shaft 10, then charging material which has been retained in the shaft 10 and also heated up during the refining phase may be charged into the furnace vessel at the desired location after the operation of tapping the furnace vessel.

5 It will be appreciated that the horizontal mobility of the furnace vessel also makes it possible for the arc electrodes to be moved closer to the column of charging material, during the smelting procedure, in order to expedite the smelting procedure at that location. Partial opening of the furnace vessel, which occurs as a result of that mode of
10 operation, can be avoided by the provision here too of a cover means disposed horizontally in line with the edge of the vessel cover (towards the right in Figure 7). The discharge of furnace gases can be retarded in the tapping operation (see Figure 11), for example by a chain apron or skirt 74. However the gases which issue in the tilting
15 operation can also be sucked away by a stationary collecting hood.

The structural association of the shaft 10 with the furnace vessel cover 6 does not mean that the shaft must be non-releasably connected to the vessel cover. On the contrary it is desirable for the cover to be replaceable in the event of damage. For that reason, in the
20 embodiment illustrated in Figures 6 through 12, the vessel cover 6 is releasably fixed in the holding structure 27 of the shaft 10, which is supported on the foundation columns or pillars 60 so that, after that fixing arrangement has been released, as shown in Figure 12, the vessel cover can be lowered in such a way as to lie on the upper edge of the
25 furnace vessel, by simultaneous downward movement of the lifting elements, and can be moved with the furnace vessel out of the region of the shaft 10 (towards the left in the view shown in Figure 6) and can then be removed and replaced, by means of a crane.

In the embodiment shown in Figures 1 to 3 there is also no need
30 for the vessel cover 6 to be pivoted to the side together with the shaft 10. It is sufficient if the shaft 10 is fixed in the holding structure 27 and the cover 6 is carried by its own arrangement, for

example by the lifting and pivoting apparatus 8, and pivoted therewith to the side.

There is also no need for the left-hand wall of the shaft 10 to be aligned with the vessel wall disposed beneath same, as shown in Figure 5 6. It may also be displaced somewhat towards the middle of the cover. The important consideration is that a column of material which is charged through the shaft 10 can be supported against the wall 5 of the furnace vessel.

CLAIMS

1. A smelting plant comprising
an electric arc furnace (1) which includes a furnace vessel (3) comprising a furnace hearth (4) and a vessel wall (5), and a vessel cover (6),
a shaft-like charging material preheater (2) which is arranged laterally on the furnace vessel (3) and
whose interior (15) is connected in a region adjoining its floor (13) by a connecting zone (17) to the interior (31) of the electric arc furnace (1) and
which in addition in its upper region has a closable loading opening (18) for charging material and a gas outlet (19),
characterised in that
the walls of the charging material preheater (2) are formed in the lower region thereof as far as the height of the upper edge of the furnace vessel (3) by a part of the vessel wall (5) and in the region above same by the walls of a shaft (10) which is fixed in a holding structure (27), and that the holding structure (27) and the furnace vessel (3) are movable relative to each other.
2. A smelting plant according to claim 1 characterised in that the vessel cover (6) is releasably fixed to the holding structure (27).
3. A smelting plant according to claim 1 or claim 2 characterised in that the holding structure (27) can be lifted relative to the furnace vessel by a lifting apparatus (23, 56).
4. A smelting plant according to claim 1 or claim 2 characterised in that the furnace vessel (3) can be lowered relative to the holding structure (27).



5. A smelting plant according to one of claims 1 to 4 characterised in that the holding structure (27) and the furnace vessel (3) are horizontally displaceable relative to each other.

6. A smelting plant according to claim 5 characterised in that the direction of the horizontal displacement relative to each other is parallel to the connecting line between the middle of the vessel cover (6) and the centre line of the shaft (10).

7. A smelting plant according to one of claims 1 to 6 characterised in that at least one movable blocking member (51) is so arranged in the shaft (10) that it is movable from a closed position in which it forms a support means for charging material into an open or release position for charging of charging material into the furnace vessel (3), in which release position it releases the passage of charging material through the shaft (10).

8. A smelting plant according to claim 7 characterised in that the blocking member (51) is formed by at least one water-cooled, rotatably mounted roller (52) which is drivable in at least one direction of rotation and which can be arrested in a predeterminable angular position and from which there extends at least one row of cantilever carriers (53) which are disposed substantially in one plane, that the carriers (53) are arranged in the closed position in a predeterminable angular position in which their free ends (53') project into the interior of the shaft (10), and that the carriers (53) are arranged in the open position substantially in an angular position beneath the closed position, in such a way that charging material can pass through.

9. A smelting plant according to claim 8 characterised in that the carriers (53) are water-cooled.



10. A smelting plant according to one of claims 7 to 9 characterised in that arranged at oppositely disposed walls of the shaft (10) at substantially the same level are respective rollers (52) with carriers (53), the free ends (53') of which are disposed adjacent to each other at a spacing from each other in the closed position.

11. A smelting plant according to one of claims 1 to 10 characterised in that in plan view the furnace vessel (3) is in the form of an oval which is delimited on one side by a straight line and the straight wall portion (11) together with adjoining portions (12) of the oval forms the outside walls of the charging material preheater (2) in the lower region thereof.

12. A smelting plant according to claim 11 characterised in that the straight line delimits the oval between three quarters and nine tenths of its length.

13. A smelting plant according to one of claims 1 to 12 characterised in that the walls of the shaft (10) are formed by water-cooled wall elements.

14. A smelting plant according to one of claims 1 to 13 characterised in that the cross-section of the interior (15) of the shaft (10) is enlarged downwardly.

15. A smelting plant according to one of claims 1 to 14 characterised in that an electrode lifting and pivoting apparatus (8) is arranged beside the furnace vessel (3) on the side of the vessel cover (6), which is in opposite relationship to the charging material preheater (2).

16. A smelting plant according to one of claims 1 to 15



characterised in that a means (23) for removal of the holding structure (27) for the shaft (10) is arranged on the side of the charging material preheater (2) beside the furnace vessel (3).

17. A smelting plant according to claim 15 and claim 16 characterised in that the means for removal of the holding structure (27) is in the form of a lifting and pivoting apparatus (23) and said apparatus and the electrode lifting and pivoting apparatus can be pivoted out to the same side with respect to the furnace vessel (3).

18. A smelting plant according to one of claims 1 to 17 characterised in that fixed on a mobile portal assembly (24) arranged beside the charging material preheater (2) is a lifting apparatus (25) which includes at least one support member (26) which can be raised and lowered and which engages the holding structure (27) or, in the case of a vessel cover (6) which is fixed to the holding structure (27), the edge of the cover.

19. A smelting plant according to claim 18 characterised in that in the lowered position the support member (26) is released from the edge of the cover (6) or from the holding structure (27) and when it is lifted it engages into a lifting eye (28) at the edge of the cover or the holding structure (27), the lifting eye being adapted to the shape of the support member.

20. A smelting plant according to claim 18 or claim 19 characterised in that the mobile portal assembly is in the form of a rotary portal assembly (24).

21. A smelting plant according to one of claims 1 to 20 characterised in that the furnace vessel (3) is tiltable perpendicularly to a line (22) connecting the centre line of the



charging material preheater (2) to the centre of the furnace hearth (4).

22. A smelting plant according to one of claims 18 to 21 characterised in that the mobile portal assembly (24) is arranged on a stationary foundation.

23. A smelting plant according to one of claims 1 to 16 characterised by a mobile portal assembly (42) with at least one support beam (43) which extends over the vessel cover (6), and lifting devices which are releasably connectable to the holding structure (27) or to the vessel cover (6).

24. A smelting plant according to claim 23 characterised in that the mobile portal assembly (42) carries the electrode lifting and pivoting apparatus (8).

25. A smelting plant according to one of claims 1 to 24 characterised in that the furnace vessel (3) is fixed in an upper frame (61) which is supported on a support structure (63) by way of a frame lifting apparatus (62).

26. A smelting plant according to claim 25 characterised in that the support structure (63) is adapted to be movable.

27. A smelting plant according to claim 25 or claim 26 characterised in that the frame lifting apparatus (62) is formed by at least three lifting elements (70, 71) which are arranged in a distributed array at the periphery of the frame (61).

28. A smelting plant according to claim 27 characterised in that the lifting elements (70, 71) are formed by hydraulically or



pneumatically actuable piston-cylinder units.

29. A smelting plant according to one of claims 25 to 28 in conjunction with claim 21 characterised in that the lifting elements (70, 71) are disposed on both sides of the line (22) connecting the centre line of the charging material preheater (2) to the centre of the furnace hearth (4), and the lifting element or elements (71) at one side are mounted pivotably about axes of rotation which are parallel to the line (22), both in the frame (61) and also in the support structure (63), while the lifting element or elements on the other side have a vertical guide means (72).

30. A smelting plant according to one of claims 25 to 29 characterised in that the support structure (63) has two parallel transverse bearers (67, 68) and a longitudinal bearer (69) which connects same approximately at the middle.

31. A smelting plant according to claim 30 in conjunction with claim 21 characterised in that the longitudinal bearer (69) extends parallel to the line (22).

32. A smelting plant according to one of claims 27 to 31 characterised in that in plan view the frame (61) is of substantially rectangular configuration and the lifting elements (70, 71) are respectively arranged in the regions of the corners of said frame.

33. A smelting plant according to one of claims 30 to 32 characterised in that the support structure (63) has respective wheels (57) in the end regions of the one transverse bearer (67) and in the middle region of the other transverse bearer (68).

34. A smelting plant according to one of claims 30 to 33



characterised in that the frame (61) is displaced upwardly on the tapping side of the furnace vessel and downwardly on the side of the slag opening.

35. A smelting plant according to one of claims 25 to 34 characterised in that the holding structure (27) is stationary.



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