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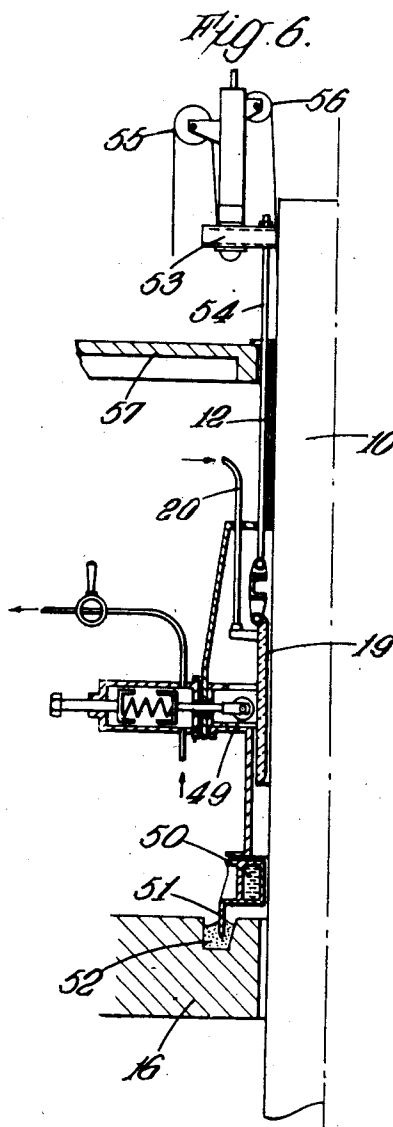
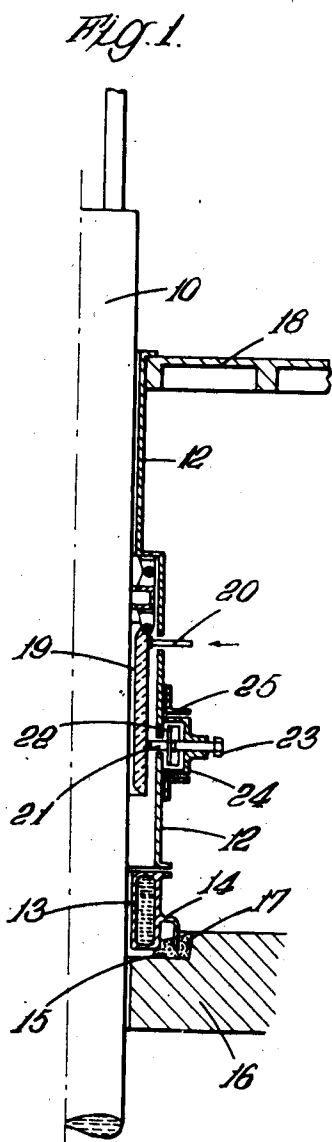
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2,363,078

ELECTRIC ARC FURNACE

Filed April 30, 1943

3 Sheets-Sheet 1



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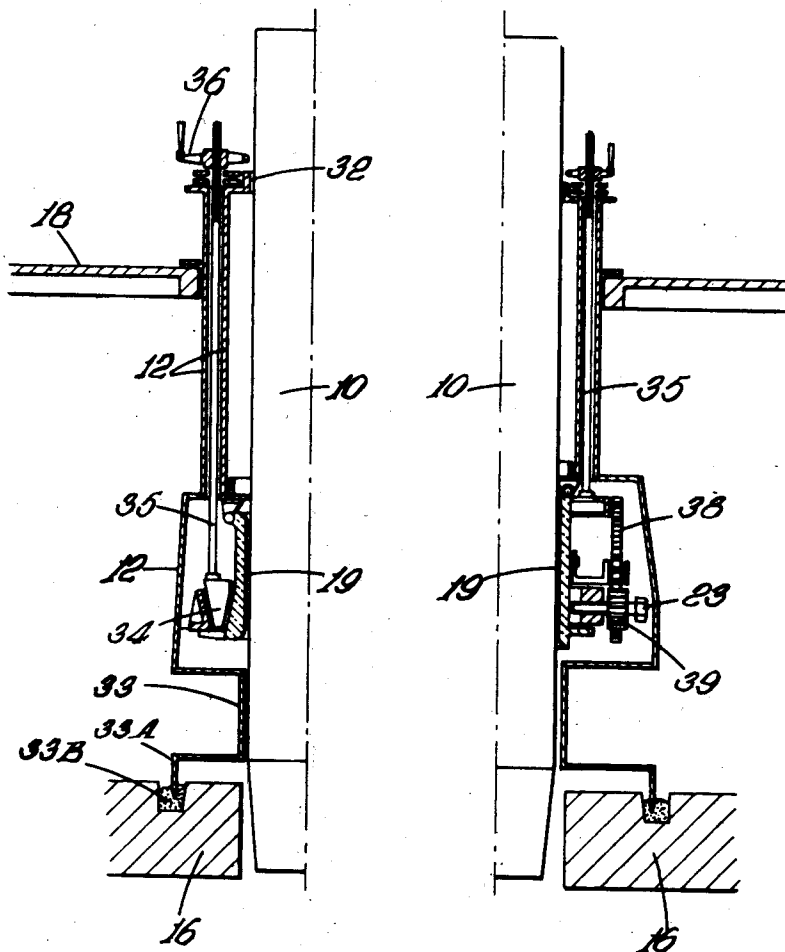
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FIG. 2

FIG. 3



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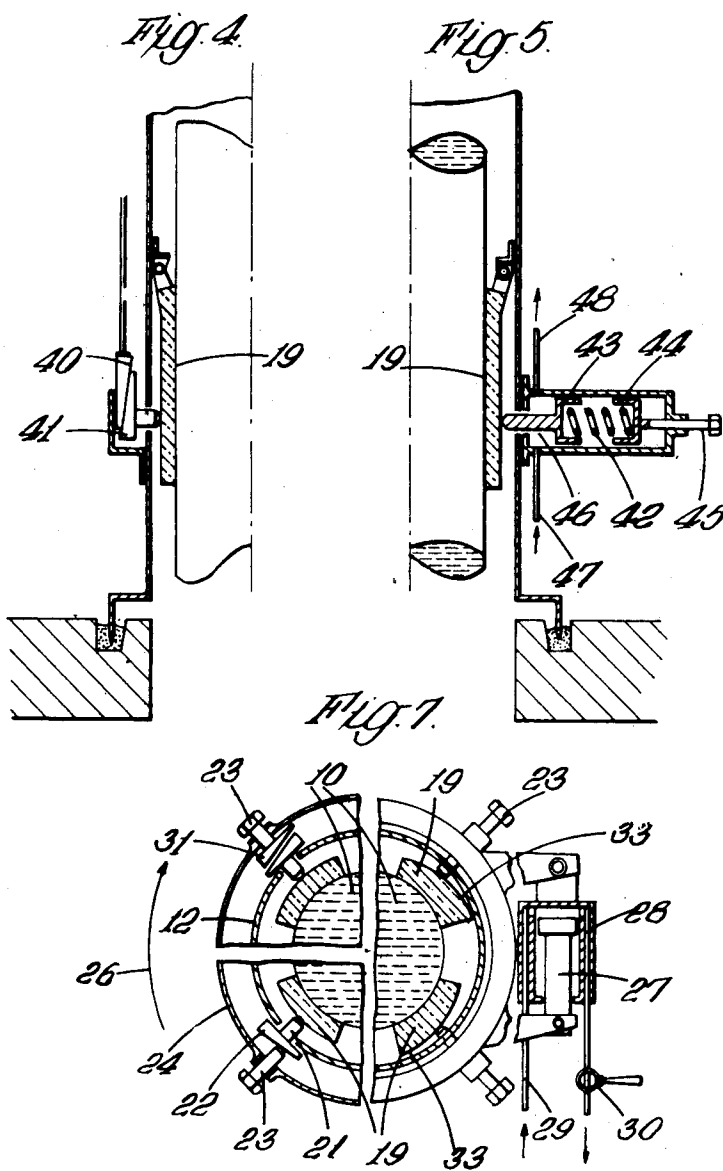
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ELECTRIC ARC FURNACE

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ELECTRIC ARC FURNACE

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7 Claims. (Cl. 13—16)

The present invention relates to an electric arc furnace, and is particularly concerned with apparatus for ensuring that good electric contact is made between each electrode and the leads carrying the current thereto.

In present day electric arc furnaces each electrode is normally cased within a sheath. The sheath is sealed to the electrode over its upper part whilst the lower part encloses one or more clamps constituting electric connectors to the electrode. Electric current leads to the clamps are taken through the sheath, the bottom end of which passes into the furnace in a gas-tight manner through cooling rings disposed around the aperture in the furnace roof. One form of known clamping device comprises a screw-driven wedge operated between the sheath and the clamp.

Such an arrangement suffers from the disadvantages that owing to deformation of the furnace roof with the changes of temperature it is difficult to preserve the gas tight seal at the point where the sheath passes through the cooling rings. Furthermore, since the lower part of the sheath and the clamps within it lie within the furnace, if the clamps are operated by springs or screws the heat of the furnace damages these members and as they are close to the furnace, hand operation of these members is difficult and entails an interruption of the current with a consequent loss of production.

In another arrangement the electric current leads are connected to the sheath itself, the lower end of which may dip into a sand seal formed on the furnace roof. In this arrangement it is difficult to ensure adequate contact between the sheath and the electrode in the absence of means for pressing the sheath upon the electrode.

It is known to form self-baking electrodes in a sheet steel mould of a plurality of part-cylindrical sections which adapt themselves well both to the shape of the electrode and to the sheath. It frequently occurs, however, that the baked paste extrudes between the sections of the mould and tends to stick against the external casing which again gives rise to considerable trouble.

It is an object of the present invention to provide means whereby the above mentioned difficulties may be avoided.

According to the present invention there is provided an electric hearth furnace comprising a hearth; a roof; an electrode extending into the hearth through an aperture in the roof; an electrode-sheath located wholly above the roof sealed loosely to the top of the roof and sealed to the

electrode at a point well above the roof but being spaced from the electrode for a portion of its length intermediate said two seals; a clamp; and, extending through the sheath to the clamp, an electric current lead to the clamp and means for operating said clamp.

Preferably pressure is exerted upon each clamp by way of a roller so that the electrode may be moved without releasing the pressure upon the clamp.

Preferred forms of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a sectional elevation showing a portion of a fixed electrode where it passes through the furnace roof, the construction being in accordance with the present invention,

Figures 2, 3, 4, 5 and 6 are sectional elevations of alternative embodiments of the present invention, whilst

Figure 7 is a composite transverse section illustrating further embodiments of the invention.

In the arrangement illustrated in Figure 1 it is assumed that the electrode is stationary and that changes of the arc current are effected by changing the supply voltage. In this arrangement the electrode and its sheath are mounted upon a common fixed support which is independent of the furnace roof, whilst clamps and their cooperating means are supported by the sheath.

Referring to this figure, a fixed electrode 10 is partly encased by a sheath 12 which at its upper end is sealed to the electrode with tar or pitch so as to make a gas-tight seal at a position well above the furnace roof and thus well away from great heat. The lower end of the sheath 12 is formed with a water-cooled ring 13 and with a flange 14 dipping into a trough 15 formed on the furnace roof 16 and filled with sand 17 or the like. The electrode 10 and its sheath 12 are suspended as at 18 by means independent of the furnace roof so that deformations of the latter, due to changes of temperature, do not break the seal 17 between the electrode and the roof.

Between the upper and lower seals are disposed a plurality of clamps one of which is shown at 19. Each clamp is located within the sheath 12 and electric current leads 20 to each clamp are passed in a gas-tight manner through the sheath.

The clamp operating means which are shown also in the bottom left hand quarter of Figure 7 comprise a rod 21 passing freely through the sheath to which is secured a wedge 22 against which bears an adjustable screw 23. Pressure can be brought to bear upon the clamp by man-

ual adjustment of the screw 23 but normally the pressure on the clamp is adjusted by rotation of an auxiliary ring 24 secured within a ring 25 on the sheath. It will be seen that rotation of the ring 24 in the direction of the arrow 26 (Figure 7) is effective to increase the pressure on the clamp whilst rotation of the ring 24 in the opposite angular sense reduces the pressure on the clamp.

As shown at the right hand side of Figure 7 rotation of the ring 24 is controlled hydraulically by means of a differential piston 27 working within the cylinder 28. By means of the pipe 29 fluid at constant pressure is supplied to both sides of the differential piston 27 whilst the escape of fluid from the upper side of the piston is controlled by means of a valve 30. The auxiliary ring 24 is linked with the piston 27 as illustrated so that, by controlling the valve 30, the ring 24 can be rotated in their direction in order to adjust the pressure applied to each clamp associated with each electrode.

The resultant pressure above and below the piston 27 is such that if the exhaust pipe breaks the piston 27 moves downwardly thus tending to rotate the ring 25 in the direction which increases pressure upon the clamps so that the system is automatically self-locking.

Normally there would be a plurality of clamps associated with each electrode, each clamp being provided with similar operating means and all the operating means being controlled by way of the auxiliary ring from control means, such as the hydraulic means illustrated in Figure 7, located at a distance from the electrode.

The screw 23 may be provided at its lower end with a wedge 31 as illustrated at the top left hand side of Figure 7. Alternatively, both wedges may be omitted in which case the screw 23 bears directly against the clamp 19 as shown at the right hand side of Figure 7, the clamp having an eccentric rib 33, as shown.

Figure 2 illustrates another embodiment of the invention suitable for a fixed electrode. As before, the electrode 10 is partly enclosed within a sheath 12 which at its upper and lower ends 32 and 33 respectively is sealed to the electrode 10, whilst the lower end 33 is formed with a flange 33A dipping into a sand seal 33B formed in the furnace roof 16. Pressure upon each clamp 19 is exerted by means of a wedge member 34 which may be screwed up or down upon a rod 35 by rotation of the latter by means of a handwheel 36. The electrode 10, together with its sheath 12, are mounted upon a common fixed support 18.

In Figure 3 is illustrated a similar arrangement except that pressure is exerted upon the clamp 19 by rotation of the rod 35 to move the rack 38 co-operating with a pinion 39 to rotate the screw 23.

As illustrated in Figure 4, pressure upon the clamp 19 is exerted by means of a pair of wedges 40 and 41, whilst, as illustrated in Figure 5, pressure upon the clamp 19 is exerted by means of a spring 42 located between a pair of pistons 43 and 44, the latter of which is adjustable in position by means of a screw 45 pressing the former piston 43 against the clamp 19. Fluid is supplied to the chamber 46 by a pipe 47 and exhausted therefrom by pipe 48. When it is desired to alter the pressure on the clamp or to release it the supply or exhaust of fluid is varied appropriately, fluid control being used for the normal clamping and unclamping, whilst adjustment of the screw 45 is used to adjust the final clamping pressure.

As illustrated in Figures 1 to 5 inclusive, each clamp is suspended from the sheath and the sheath is suspended independently of the furnace roof.

In the arrangement illustrated in Figure 6 it is assumed that the strength of the arc current is varied by varying the position of the electrode axially with respect to the molten metal. For this purpose the electrode is made movable with respect to its sheath whilst the clamp must of course move with the electrode. Thus, the sheath and the operating means for the clamp are stationary whilst the electrode and the clamp move axially. The clamp operating means are supported upon the sheath. The sheath is suspended independently of the room and each clamp is suspended independently of both the roof and sheath. Furthermore, pressure is exerted upon each clamp 19 by way of a roller 49 so that both the clamp and the electrode may be moved without releasing the pressure upon the clamp, this arrangement being of special advantage where the height of the electrode above the bath is controlled automatically in accordance with changes of arc current. Pressure is applied to the clamp in a manner similar to that illustrated in Figure 5. The upper part of the sheath 12 is sealed to the electrode 10, whilst the lower end of the sheath is formed with a cooling ring 50 and a flange 51 dipping into a sand seal 52 formed either in the furnace roof 16 or on an auxiliary ring resting upon the furnace roof. The seal 52, being of annular shape, has the advantage over the seal 17 illustrated in Figure 1, that sand does not tend to drop into the furnace. Referring again to Figure 6, it will be seen that the clamp 19 is suspended from a beam 53 by way of a rod 54, the beam being adjustable in height by apparatus illustrated at 55. The height of the electrode 10 is adjustable by apparatus illustrated at 56, whilst the sheath 12 is fixedly suspended from a platform 57.

In all forms of the invention illustrated sufficient space must be left between the sheath and the electrode for lateral adjustment of the clamps.

If desired the sheath may be naturally or artificially cooled over the whole of its length.

I claim:

1. An electric furnace comprising a hearth; a roof; an electrode extending into the hearth through an aperture in the roof; an electrode-sheath located wholly above the roof sealed loosely to the top of the roof and sealed to the electrode at a point well above the roof but being spaced from the electrode for a portion of its length intermediate said two seals; a clamp; and, extending through the sheath to the clamp, an electric current lead to the clamp and means for operating said clamp.

2. A furnace as claimed in claim 1, comprising a trough-like seal on the furnace roof into which dips the sheath.

3. A furnace as claimed in claim 1, comprising an axially movable electrode, a movable support for the electrode and its clamp, and a fixed support independent of the roof for the sheath and the clamp-operating means.

4. A furnace as claimed in claim 1, wherein each electrode is provided with a plurality of clamps and each clamp is provided with separate clamp-operating means comprising a wedge, there being also provided a rotatable auxiliary ring surrounding the clamps and carrying clamp-operating means, one of which is adapted to en-

gage each clamp wedge, the arrangement being such that upon rotation of the auxiliary ring in one angular direction pressure upon the clamps is increased, and upon rotation of the ring in the other angular direction pressure upon the clamps is reduced.

5. A furnace as claimed in claim 1, wherein each electrode is provided with a plurality of clamps and each clamp is provided with separate clamp-operating means comprising a wedge, there being also provided a rotatable auxiliary ring surrounding the clamps and carrying clamp-operating means one of which is adapted to engage each clamp wedge, and fluid operated mechanism for rotating said auxiliary ring, the arrangement being such that upon rotation of the auxiliary ring in one angular direction pressure upon the clamps is increased, and upon rotation of the ring in the other angular direction pressure upon the clamps is reduced.

6. A furnace as claimed in claim 1, wherein each electrode is provided with a plurality of clamps and each clamp is provided with sep-

arate clamp-operating means comprising a wedge, there being provided also a rotatable auxiliary ring surrounding the clamps and carrying clamp-operating means one of which is adapted to engage each clamp wedge, and fluid operated mechanism for rotating said auxiliary ring including a differential piston and cylinder to the opposite sides of which fluid is supplied at constant pressure, and from one side of which fluid is exhausted at a rate which is varied when it is desired to change the pressure applied to the clamp, the piston being connected with the auxiliary ring, the arrangement being such that upon rotation of the auxiliary ring in one angular direction pressure upon the clamps is increased, and upon rotation of the ring in the other angular direction pressure upon the clamps is reduced.

7. A furnace as claimed in claim 1, wherein said clamp operating means comprises a roller, and means for urging the roller against the clamp so that pressure may be applied to the clamp whilst the electrode is moved.

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