Dec. 6, 1966 J. MAATSCH ETAL 3,290,031

SMELTING-FURNACE, PARTICULARLY FOR THE PRODUCTION OF STEEL

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Fig. 1

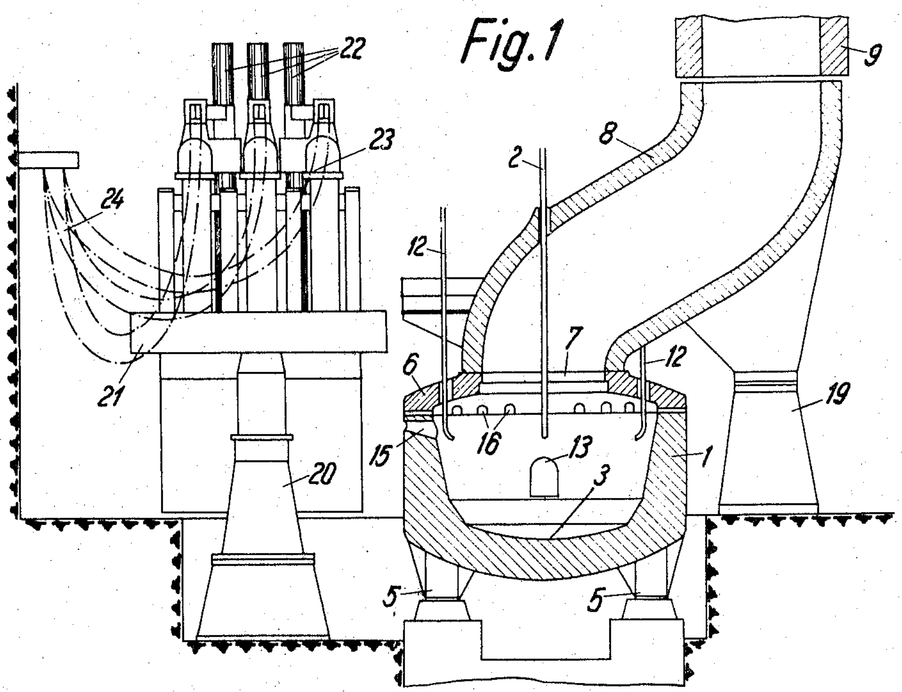

Fig. 2

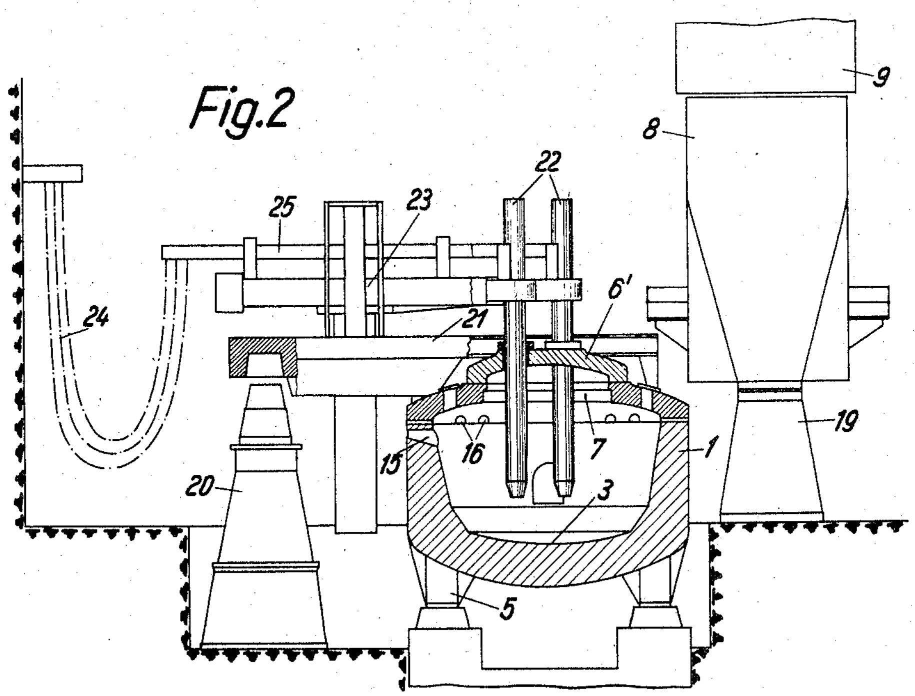

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Fig.3

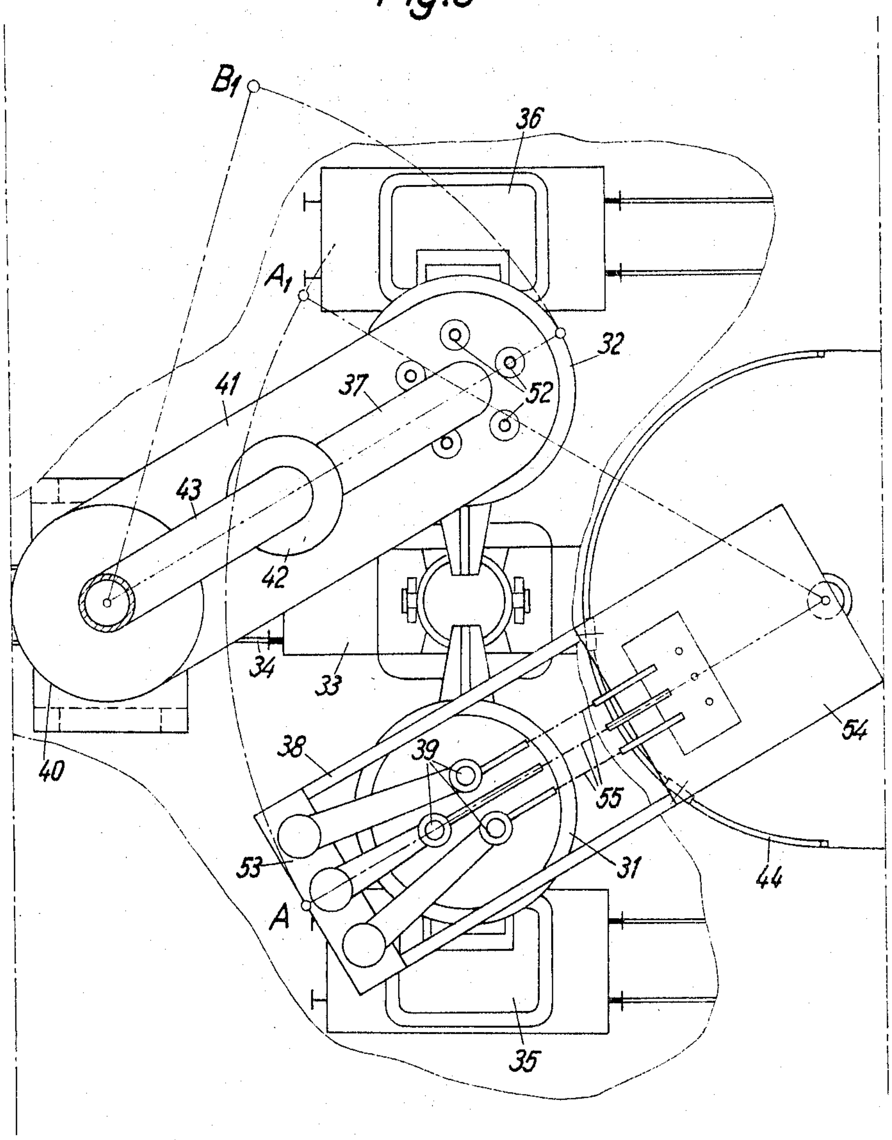

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Fig.4

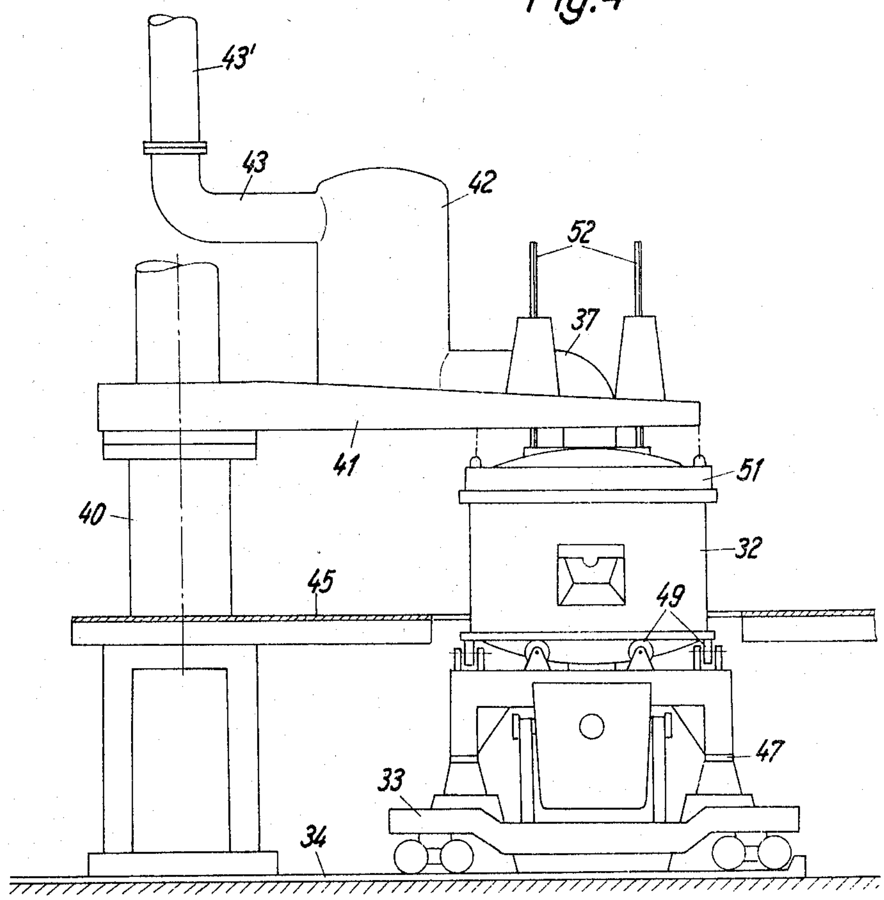

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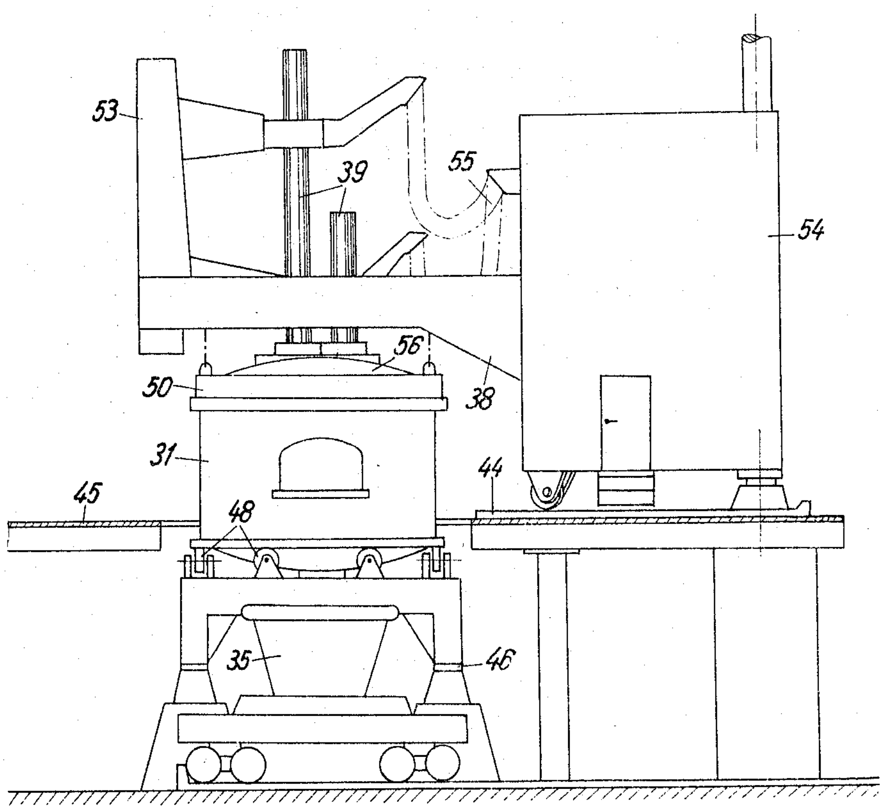
Fig.5



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United States Patent Office

3,290,031

Patented Dec. 6, 1966

3,290,031

SMELTING-FURNACE, PARTICULARLY FOR THE PRODUCTION OF STEEL

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Filed July 16, 1963, Ser. No. 295,491
Claims priority, application Germany, Nov. 29, 1962, B 69,790
10 Claims. (Cl. 266—11)

The present invention relates to a smelting-furnace, particularly for the production of steel from scrap iron and carburization material, which is heated by means of burners for gaseous, liquid or powdery fuel and oxygen or air enriched with oxygen and in which the discharge of the gases takes place through an opening of the furnace arch over which a movable, for instance, rollable or swingable flue is disposed.

Such smelting furnace for the production of steel from scrap iron and carburization material adapted for heating with gaseous, liquid for pulverized fuel with oxygen or oxygen enriched air has been disclosed in the co-pending patent application, Serial No. 264,635, filed March 12, 1963 now Patent No. 3,188,065.

The present invention is based on the discovery that the furnace described in said copending patent application, Serial No. 264,635, is particularly suitable for all steel production methods combined with a fining process and in particular also for such methods, in which the fining takes place by blowing of oxygen and/or in which the reduction is performed with a slag poor in FeO, in such manner, as it is conventional in an arc furnace.

It is, therefore, one object of the present invention to provide a smelting furnace, particularly for the production of steel, wherein this general applicability of the furnace designed in accordance with the structure disclosed in said copending patent application Serial No. 264,635 is brought about in such manner, that the furnace is heated selectively by means of burners or by means of electrodes.

It is another object of the present invention to provide a smelting-furnace, particularly for the production of steel, wherein the smelting and fining is performed by means of burner heating and the reduction by means of heating with electrodes. During the fining, oxygen can be blown onto the bath, and in particular, either the burner or predetermined burners can be used for the blowing of the oxygen or particular nozzles are provided for this purpose. Practically all specialties of steel can be produced in this furnace and also such specialties, in which particularly high requirements are put on the quality, as for electric steel, since the reduction of the steel takes place by means of heating the melt with electrodes. The reduction can be performed in the same manner as in an electro furnace with slag poor in FeO.

It is still another object of the present invention to provide a smelting-furnace, particularly for the production of steel, wherein the melts are produced in the furnace such, that the furnace is fed in a manner conventional with an open hearth furnace method with scrap iron and pig iron serving as carburization material and the charge is molten by means of burners operated with fuel and oxygen. The decarburization and the dephosphorizing can take place, as it is conventional, in connection with open hearth furnaces, by means of the oxydizing flame over the slag. It is also possible, however, to perform the fining step with oxygen, which is blown onto the bath and which reacts directly with the melt.

It is still another object of the present invention to provide a smelting furnace, particularly for the production of steel, wherein the furnace is fed with liquid pig iron and the latter is subjected to a fining step with oxygen, as in an LD-converter, whereby more scrap iron is added, as it would be done in the normal LD-process, because the heating of the furnace makes possible the feeding of heat for the melting of the scrap iron in larger quantities. After the fining step, and under circumstances upon tapping the dephosphorizing slag, the reduction can then be performed with new slag and with heating of the melt by means of electrodes.

With these and other objects in view, which will become apparent in the following detailed description, the present invention will be clearly understood in connection with the accompanying drawings, in which:

FIGURE 1 is a elevation, partly in section, of a melting furnace with swung out electrodes, in case of burner heating;

FIG. 2 is an elevation, partly in section, of the furnace shown in FIG. 1, indicating the position in case of electrode heating;

FIG. 3 is a top plan view of two melting furnaces designed in accordance with the present invention;

FIG. 4 is an elevation of one of the furnaces shown in FIG. 3, seen from the tapping side in case of operation with burners; and

FIG. 5 is an elevation of one of the furnaces shown in FIG. 3 seen from slag-out side in case of operation with electrodes.

Referring now to the drawings, and in particular to FIGS. 1 and 2, the furnace comprises a circular furnace vessel **1** which is equipped with a central head burner **2** and which includes a hearth **3** receiving the charge, which is molten by means of the central head burner **2**. The furnace vessel **1** is tippingly mounted on the rocker **5**. A furnace arch **6** is exchangeably mounted on top of the furnace vessel **1** and has a central opening **7** (FIG. 1), through which the furnace gases are discharged into the gas flue **8** and are fed into a waste heat vessel **9**. In addition to the central burner **2**, tiltingly disposed lateral burners **12** are provided, which can be lifted and lowered, respectively, in the same manner as the central burner **2**, which lateral burners **12** can be adjusted in their position during the melting period to the prevailing surface of the melting charge. The burners **2** and **12** can be used selectively also for blowing-on of oxygen onto the melt, whereby the fuel feed is closed completely or partly, so that free oxygen can be fed to the bath with a quantity of 1–5 $Nm.^3/t.u.min.$ preferably about 3 $Nm.^3/t.u.min.$ One or a plurality of doors **13** and an inspection hole **15** for the observation of the melt are provided in the furnace vessel **1**. False air is sucked into the furnace by means of channels **16** which are equally distributed about the periphery of the furnace, which false air cools the arch **6**. The flue **8** is swingable by means of a swingable column **19**. A swingable lifting cylinder **20** is disposed adjacent the furnace, which lifting cylinder **20** serves the purpose of swinging in and out, respectively, the arch lid **6'** (FIG. 2) and the electrodes **22**, including their carrying device **23** by means of a swinging arm **21**. The feed of electric current to the electrodes **22** takes place by means of the current rails **25** and flexible conduits **24**.

If a shifting takes place from the burner heating to the electrode heating, at first the burners **2** and **12** are lifted into an upper position by any conventional means and the flue **8** swings out into the position shown in FIG. 2 of the drawings. Then the swinging arm **21** together with the electrodes **22** and the arch lid **6'** swing over the furnace and the arch lid **6'** is set over the opening **7** of the arch **6** and the electrodes **22** are rolled in. Upon

shifting to burner heating, the same movements take place in reversed succession.

Referring now again to the drawings, and in particular to FIG. 3, two furnaces are disclosed designed in accordance with the present invention, which are coupled together such that the burners and the electrodes can be exchangeably used for both furnaces. This has the advantage, that the voluminous device for the electrode operation is better exploited and that the rest and cooling occurring during the burner heating, which reduces the wear on the electrodes, is avoided and shortened, respectively.

The two furnaces **31** and **32** are arranged in such manner, that they can be tapped into a ladel car **33** which is rollable on the tracks **34**. Slag buckets **35** and **36** are arranged on the opposite sides on the furnaces **31** and **32**. In accordance with the present invention, a single gas flue **37** is provided for both furnaces and only one swinging frame **38** is arranged for the electrodes **39**. A saturation device and a dust separator **42** are disposed on the swinging arm **41** arranged on the swinging column **40** for the gas flue **37**, from which saturation device and dust separator **43** are fed off the gases through the conduit **43**, which is rotatable relative to the conduit **43'** (FIG. 4). The electrodes **39** are swingable from one furnace to the other by means of the swinging frame **38**, which is rollable on a track **44**.

Referring now again to the drawings, and in particular to FIGS. 4 and 5, a working platform **45** is provided. Both furnace vessels **31** and **32** are not only tiltable on the rockers **46** and **47**, but are mounted also rotatably on the rotary devices **48** and **49**. The rotation of the furnace vessels should accelerate the melting of the charge. Since the furnace arches **50** and **51** do not join the rotation, it is possible to reach the entire hearth with the burner flames by a corresponding arrangement of the burners **52** (FIG. 4) on the swinging arm **41** at different distances from the rotating axis of the furnace vessel.

As can be ascertained from FIG. 5, the electrode carrying frame **53** is disposed on the swinging frame **38**. A transformer **54**, which is likewise operative for both furnaces, swings with the swinging frame **38**, whereby the latter is supported by the rolling track **44**. The dimensioning of the transformer can take into consideration, that it is designed not for the high current requirement for the melting, but for the appreciably lesser current requirement in the fining period. The current is fed to the electrodes **39** by flexible electrical conduits **55**. The furnace arch **50**, as well as the lid **56** closing the discharge opening, are suspended from the swinging frame **38** for a lifting and lowering movement.

While in the positions of the swinging frames **38** and **40** shown in FIG. 3 of the drawings, the furnace **31** performs a fining operation, the charge is either molten in the furnace **32** by means of the burners **52**, or the melt is subjected to fining with oxygen, which is blown thereon through the burners **52** or by means of particular oxygen nozzles. If the devices are to be exchanged after tapping of the fined melt of the furnace **31** into the container **33**, the swinging arm **41** is shifted from the position shown in full lines into the position indicated in dash-pointed lines as B_1 in FIG. 3 of the drawings, whereby the path for the swinging frame **38** is freed, so that now the swinging frame **38** swings from the position indicated by A as far over the position A_1 indicated in dash-pointed lines, that upon filling the furnace vessel **31** with scrap iron and with liquid pig iron, respectively, the swinging arm **41** together with the burners **52** can be brought into the position B_2 above the furnace vessel **31**. Thereafter, the swinging arm **38** is brought into the swinging position A_1.

While we have disclosed several embodiments of the

present invention, it is to be understood that these embodiments are given by example only and not in a limiting sense, the scope of the present invention being determined by the objects and the claims.

We claim:

1. A smelting furnace, particularly for the production of steel, comprising

a furnace vessel,

an arch having an opening supported by said furnace vessel,

said opening in said arch being adapted to discharge gases from said furnace vessel,

burner means disposed in the upper portion of said furnace vessel for heating the latter,

a flue movably disposed on top of said arch,

said burner comprising fuel burners and electrode burners, the latter including a transformer, to be used selectively and exchangeably, and said electrode burners extending through said opening in said arch.

2. The smelting furnace, as set forth in claim **1**, which includes

means for rolling said flue from its operative, arch covering position into its lateral inoperative position.

3. The smelting furnace, as set forth in claim **1**, which includes

means for swinging said flue from its operative, arch covering position into its lateral inoperative position.

4. The smelting furnace, as set forth in claim **1**, which includes

means for fining melt formed in said furnace vessel including means for feeding oxygen to said melt.

5. The smelting furnace, as set forth in claim **1**, which includes

a first swinging device carrying said electrode burners, and

a second swinging device carrying said movable flue.

6. The smelting furnace, as set forth in claim **5**, wherein

said first swinging device carries said electrode burners and said transformer.

7. The smelting furnace, as set forth in claim **5**, which includes

a lid covering said opening of said arch and being suspended from said first swinging device for a lifting and lowering movement, respectively.

8. The smelting furnace, as set forth in claim **5**, wherein

said second swinging device carrying said movable flue supports simultaneously said fuel burners.

9. The smelting furnace, as set forth in claim **1**, which includes

means for coupling said furnace with an equal second furnace, and

said electrode burners and said transformer selectively heating one of said furnaces.

10. The smelting furnace, as set forth in claim **9**, wherein

said flue and said fuel burners are operatively connected selectively with one of said furnaces.

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