



⑪ Publication number : **0 437 407 A1**

⑫

EUROPEAN PATENT APPLICATION

⑳ Application number : **91400055.9**

⑤① Int. Cl.⁵ : **C22B 1/20**

㉔ Date of filing : **11.01.91**

③① Priority : **11.01.90 JP 4049/90**
09.10.90 JP 270983/90

④③ Date of publication of application :
17.07.91 Bulletin 91/29

⑧④ Designated Contracting States :
BE DE FR

⑦① Applicant : **SUMITOMO METAL INDUSTRIES,**
LTD.
5-33, Kitahama 4-chome Chuo-ku
Osaka-Shi Osaka 541 (JP)

⑦② Inventor : **Kawaguchi, Takazo**
5-33 Kitahama 4-chome, Chuo-ku
Osaka-shi, Osaka (JP)
Inventor : **Matsumura, Masaru**
5-33 Kitahama 4-chome, Chuo-ku
Osaka-shi, Osaka (JP)

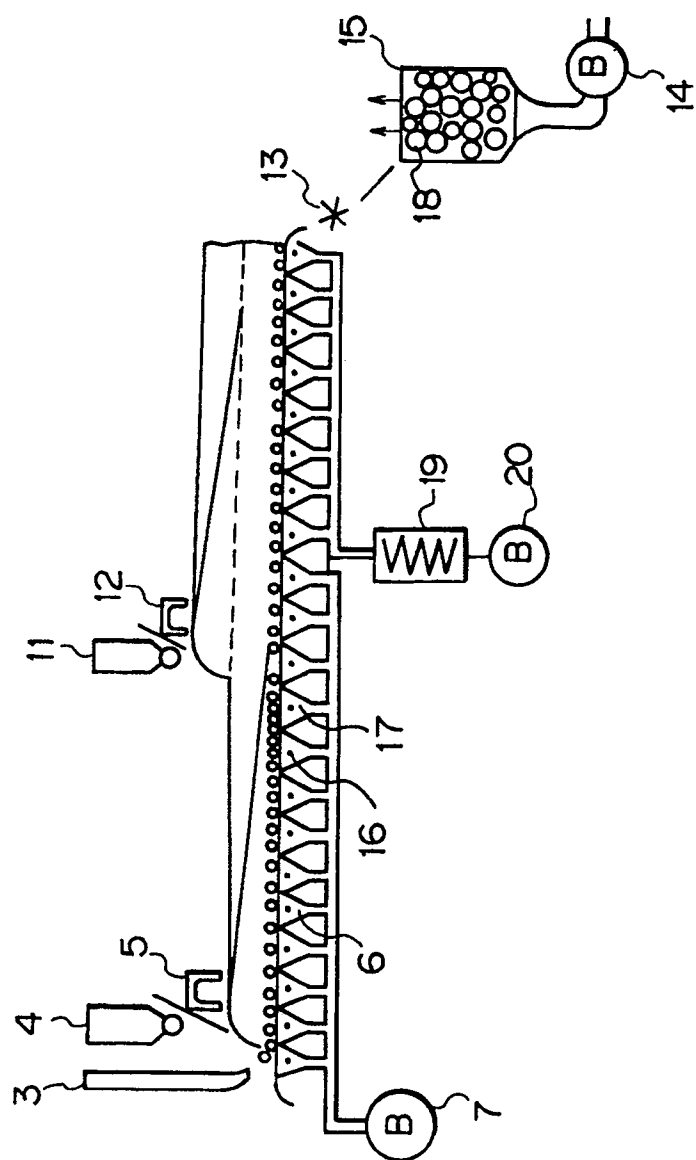
⑦④ Representative : **Schrimpf, Robert et al**
Cabinet Regimbeau 26, Avenue Kléber
F-75116 Paris (FR)

⑤④ **Method for sintering fine iron ore using dual ignition system.**

⑤⑦ A method for sintering fine iron ore using a dual layer system is disclosed. Two layers of sintering charge are placed on a train of pallets and each of the layers is set on fire at given intervals of time to perform sintering of the charge. The upper layer of the charge is set on fire when the front flame point of the lower layer reaches grates of the pallet. The upper layer may contain, as a solid fuel, coal containing 10 wt% of higher of volatile matter.

EP 0 437 407 A1

Fig. 5



METHOD FOR SINTERING FINE IRON ORE USING DUAL IGNITION SYSTEM

The present invention relates to a method for sintering fine iron ore using a dual layer system, i. e., a dual ignition system.

Fine iron ore is sintered into the form of lumps prior to being charged into a blast furnace for producing pig iron.

Generally, fine iron ore is combined with coke and lime to prepare a charge for sintering (hereunder referred to as "charge" or "sintering charge"), which is sintered into lumps with a DL (Dwight-Lloyd) sintering apparatus.

Figure 1 schematically shows a DL sintering apparatus, in which a train of pallets are provided around a sintering strand and bed ore and a charge for sintering are successively supplied onto the pallets through hoppers 3 and 4, respectively. When the charge on the pallets passes through an ignition furnace 5, the charge is set fire on its surface. Since air is drawn downwardly via a wind box 6 with a blower 7, sintering is performed through the charge from the top to the bottom of the layer while the pallet moves toward an outlet end of the sintering apparatus.

The progress of sintering is illustrated in Figure 2, in which a layer of charge, i.e., a sintering charge zone 8 is placed on the pallet. The hatched zone indicates a sintering reaction zone 9 where a charge is being progressively sintered. A zone placed on the sintering reaction zone 9 is a sintering-finished zone 10 in which the sintering process has been finished.

A charge for sintering which contains fine coke as a solid fuel is set fire with an ignition furnace 5. While it travels along the sintering strand, air containing about 21 vol% of oxygen is blown through the layer to carry out combustion of the fine coke. The heat generated by the combustion of coke partly melts and sinters fine iron ore. Usually it takes about 30 minutes for the sintering front to reach the bottom of the layer after ignition. A combustion gas is removed through a wind box 6 and the oxygen content thereof is about 11 vol% at a temperature of about 100 °C. Combustion gas having an oxygen content of this level has the ability to combust coke. So, recycling of such a combustion gas is desirable.

The journal "Tetsu-to-Hagane", Vol.69, No.4, p.72 in Japanese discloses a method of reutilizing the combustion gas in a sintering process, in which a combustion gas recovered from the latter half of a sintering process is recycled and blown as a firing gas onto the surface of the charge in an area near the ignition furnace. This method is effective for reducing the amount of gas which is exhausted to the air, and is also effective for suppressing formation of nitrogen oxides (NOx) and increasing heat recovery. However, the combustion of coke and sintering reactions which occur within a layer of the charge are the same as those taking place in the conventional process shown in Figure 2, i.e., a single layer system. Therefore, it is impossible to increase the rate of sintering and improve productivity.

In order to increase the rate of sintering by reutilizing a combustion gas, it is necessary to set the charge on fire in many locations on the layer of the charge to start a sintering reaction in many places simultaneously. Japanese Published Unexamined Patent Application No. 26304/1972 discloses a sintering method, as shown in Figure 1 by a long and short dashed line, in which an additional hopper 11 for supplying an additional layer of the charge and an additional ignition furnace 12 are provided in addition to the hoppers 3 and 4 and the ignition furnace 5 with a given space being provided between the ignition furnaces along the direction of movement of the pallets. Each of the layers is set on fire successively. Thus, according to this method it is possible to successfully reutilize combustion gas and to increase productivity of the sintering apparatus.

The progress of sintering for this double layer system is illustrated in Figure 3. The combustion gas discharged from the upper layer is reused in the lower layer as a firing gas.

However, according to this double layer system, the oxygen content of the combustion gas passing from the upper layer to the lower layer is so small that coke in the lower layer of the charge cannot be combusted completely, resulting in a decrease in the amount of heat of combustion. Thus, the temperature of the lower layer is not high enough to carry out a sufficient degree of sintering. The resultant sintered lump has poor strength.

Therefore, although the double layer system is superior to the single layer system in respect to productivity, the strength of the resultant product is small, so this process is impractical.

For the purpose of overcoming such disadvantages the present applicant has proposed various methods. These include a method of adjusting the depth of the layer to 700 mm or more (see Japanese Published Unexamined Patent Application No. 109932/1987), a method of restricting the water content of the charge (see Japanese Published Unexamined Patent Application No. 107033/1987), and a method of restricting the coke loading (see Japanese Published Unexamined Patent Application No. 107032/1987).

Furthermore, a method of adding quicklime and a method of adding oxygen to a blowing air have also been proposed (see Japanese Published Unexamined Patent Application No.60828/1987).

On the other hand, as a solid fuel, usually fine coke with a diameter of 5 mm or less and anthracite with a diameter of 5 mm or less are used. Coal having a high content of volatile matter is not used. This is because volatile matter is easily expelled from such a low grade coal before it is set on fire at a temperature around 500 °C, and such expelled volatile matter is easily deposited as a tar pitch on many parts of a combustion gas apparatus, causing numerous problems.

The above-described methods, proposed in the past are partly effective, but are not thoroughly satisfactory from various standpoints. One of their disadvantages is that the operation of a sintering apparatus is rather complicated since there are numerous restrictions with respect to operation procedures. Those methods are also disadvantageous in that quicklime and oxygen gas are expensive.

One of the objects of the present invention is to provide a method for sintering fine iron ore using a dual layer system, in which problems regarding a lack of oxygen in the lower layer and a decrease in the strength of sintered lumps can be eliminated.

Another object of the present invention is to provide a method for sintering fine iron ore using a dual layer system, in which the use of fine coke and anthracite as solid fuel can be avoided and instead cheap coal can be used without causing problems due to the evolution of volatile matters.

In one aspect, the present invention resides in a method for sintering fine iron ore using a dual layer system, in which two layers of sintering charge are placed on a train of pallets and each of the layers is set on fire at given intervals of time to perform sintering of the charge, characterized in that a lower layer of the charge is set on fire to start sintering, and an upper layer of the charge is set on fire to start sintering of the upper layer when the front flame point reaches gates of the pallet and the sintered lump of the charge of the lower layer starts being cooled while the charge of the upper layer is sintered.

It is possible to determine when the front flame point reaches the gates by measuring the temperature of the exhaust gas from the bottom of the pallets, by analyzing the chemical composition of the exhaust gas, or by doing both. The time period in which the front flame point reaches the gates can be adjusted by varying the travelling rate of the pallets and the depth of the lower layer.

In another aspect, the present invention resides in a method for sintering fine iron ore using a dual layer system, in which two layers of sintering charge are placed on a train of pallets and each of the layers is set on fire at given intervals of time to perform sintering of the charge, characterized in that at least part of solid fuel which is contained in the charge of the upper layer is coal containing at least 10 wt% of volatile matter.

In a preferred embodiment, the lower layer of the charge may contain as a solid fuel coal containing the volatile matter in an amount of 10 wt% or lower.

In a further preferred embodiment, the lower layer of the charge is set on fire to start sintering, and the upper layer of the charge is set on fire to start sintering of the upper layer when the front flame point reaches gates of the pallet and the sintered lumps of the charge of the lower layer start being cooled while the charge of the upper layer is sintered.

The volatile matter can be analyzed by conventional analyzing methods such as those specified in JIS (Japanese Industrial Standards).

Figure 1 shows a conventional sintering apparatus of the DL type ;

Figure 2 and Figure 3 are graphs schematically illustrating the progress of sintering ;

Figure 4 is a graph showing the variation of the temperature and composition of exhaust gas in the travelling direction of the pallets ;

Figure 5 shows an example of a sintering apparatus which can perform the method of the present invention; and

Figure 6 shows graphs of the temperature and composition of exhaust gas of the working example of the present invention, which vary depending on the position of the strand.

Figure 4 schematically illustrates the progress of sintering together with the composition and temperature of exhaust gas, which vary in the travelling direction of the pallets. As is apparent from this figure, the temperature of exhaust gas is kept at about 65°C for a while after ignition, then it starts increasing to reach a peak of around 500°C, and gradually decreases.

On the other hand, the oxygen content of the exhaust gas decreases and the content of CO and CO₂ increases while the temperature of the exhaust gas is kept around 65°C. When the temperature of the exhaust gas increases, the content of CO and CO₂ decreases to the same level as that found just after ignition.

A change in the composition of the exhaust gas depends on the progress of sintering reactions within the layer. As long as a sintering charge zone 8 exists, exhaust gas is cooled in this zone 8 so that the temperature of the exhaust gas is kept at the dew point of the exhaust gas, i.e., about 65°C. The hatched area in Figure 4 is a sintering reaction zone 9 where a sintering reaction occurs. Before a front flame point (hereunder abbreviated as "FFP") between the sintering charge zone 8 and the sintering reaction zone reaches the bottom of the layer, coke combusts to promote sintering at a temperature of 1100°C or higher. Therefore, exhaust gas

passing through this area is heated and then cooled to a temperature of around 65°C in the sintering charge zone 8 which exists under the sintering reaction zone 9.

In the sintering reaction zone 9, the coke contained in the charge combusts with oxygen, and the oxygen content of the exhaust gas decreases to as low as about 10 vol% and the content of CO and CO₂ increases. After the FFP reaches the bottom of the layer, since a sintering reaction zone 9 but not a sintering charge zone 8 exists beneath the bottom, the temperature of the exhaust gas rapidly increases to a peak temperature and the coke contained therein is completely combusted, resulting in an increase in the oxygen content and a decrease in the content of CO and CO₂.

In a reaction completion zone 10, there exists only sintered lumps or cakes and the sintered lumps are cooled. Accordingly the temperature of the exhaust gas decreases along the travelling direction of the pallets. Thus, before the FFP reaches the bottom of the layer, oxygen is being consumed due to combustion of coke, and after the FFP point reaches the bottom, oxygen is not consumed any more.

In a conventional double layer system, the upper layer is set on fire and coke contained therein combusts while the combustion of coke takes place in the lower layer before the FFP reaches the bottom of the layer. Thus, a shortage of oxygen in the lower layer is unavoidable.

For this reason, according to the present invention, the lower layer is set on fire when the FFP of the first layer, i.e., the lower layer reaches the bottom of the first layer. Namely, after confirming the completion of sintering in the first layer, the ignition of the upper layer is carried out in order to ensure the presence of a sufficient amount of oxygen in air to be blown through the lower layer.

At the outlet end of the sintering strand the cooling state is different for each of the layers, but the sintering is completed for both layers. Therefore, the upper and lower layers can be simultaneously discharged and crushed and the crushed products can be efficiently cooled with a conventional cooler.

Furthermore, when the depth of the upper layer is adjusted to be smaller than that of the lower layer, both layers can be cooled to substantially the same temperature level at the discharge end of the sintering strand. Needless to say, even if the difference in the depth of the layers is small, the discharge point for each of the layers, i. e., the timing for discharging can be delayed for the lower layer, and the difference in the temperature of the layers can also be minimized.

Figure 5 illustrates the arrangement of the sintering apparatus for carrying out the present invention. The same reference numerals indicate the same members as in Figure 2.

In Figure 5, flooring ore and a sintering charge are continuously supplied through hoppers 3 and 4 onto the pallets to form an ore bed and a lower layer of the sintering charge, respectively. The top surface of the lower layer is set on fire when it travels under the ignition furnace 5. Air passes from the top to the bottom of the lower layer since air suction is carried out by means of a blower 7 through a series of wind boxes 6 which are provided under the travelling pallets.

Another set of a hopper 11 and an ignition furnace 12 is provided above a central area of the strand in the travelling direction. An additional charge is supplied through the hopper 11 onto the surface of the lower layer of the charge so as to form an additional layer of the charge. At this point the lower layer has been sintered, i.e., the FFP has reached the bottom of the lower layer. This additional layer is also set on fire when it travels under the ignition furnace 12. Since suction of air through a series of wind boxes 6 is continued, air passes from the top of this additional layer to the bottom of the lower layer, the sintering of which has been finished.

At the end of the strand, sintered lumps of fine iron ore are discharged from the sintering machine at the outlet end of the sintering strand and then crushed and mixed with each other in a crusher 13. The crushed lumps are supplied to an air-blowing cooler 15 provided with a blower 14 and are cooled within this cooler. In the apparatus illustrated in Figure 5 an exhaust gas boiler 19 and a blower 20 are provided in order to recover heat from the exhaust gas from the last half of the sintering strand.

A temperature sensor 16 and/or a gas sampler 17 are provided in each of the boxes 6 to determine the FFP by measuring the starting point of an increase in temperature, or an increase in the oxygen content, or a decrease in the CO and CO₂ content of the exhaust gas.

In operating the sintering apparatus, the travelling rate of the pallets is controlled so that the temperature sensor 18 provided in the cooler 15 indicates a given temperature. In place of sensor 18, sensor 16 provided in the boxes 6 may be used. When the content of fuel coke in the charge is increased or the total depth of the charge including upper and lower layers is increased, the travelling rate of the pallets must be decreased. On the other hand, when the air flow rate through the sintered charge increases, the travelling rate can be increased.

After the travelling rate is determined, while keeping the total depth of the charge at a given level, the ratio of the depth of the lower layer to that of the upper layer is adjusted so that the FFP is located on the sintering strand at a point just below or a little upstream of the ignition furnace 12. If the depth of the upper layer is increased, the FFP moves toward the ignition furnace 5. When the depth of the lower layer is increased, the

FFP shifts toward the discharge end of the sintering strand.

On the other hand, when the temperature increases to around 500°C, the carbon of the solid fuel contained in the layer is caught on fire and the temperature in the neighborhood increases to as high as around 1300°C, and iron ore is partly welded and sintered. After the carbon of the fuel combusts out, a sintered portion starts
5 being cooled and goes into a cooling stage.

According to one aspect of the present invention, coal having a high content of volatile matter is used as at least part of the solid fuel in an upper layer. Therefore, before it is heated to the point of catching fire, i.e., around 500°C, the volatile matter in the coal is vaporized. Vaporized volatile matter is entrained in combustion gas drawn downwardly through a sintering charge zone 8 in the upper layer and then goes into a lower layer.
10 When the volatile matter reaches a sintering finishing zone 10 and a sintering reaction zone 9 in the lower layer, it combusts. In contrast, since in the lower layer coke having substantially no volatile matter or anthracite having a low content of volatile matter is used as a solid fuel, there is substantially no volatile matter evaporated from the lower layer and there is no release of the volatile matter from the bottom of the lower layer into the air or deposition of the volatile matter on the exhaust gas treating apparatus as tar pitch.

Thus, the volatile matter evaporated in the upper layer is combusted in a high temperature zone of the lower layer and is never released from the layer.
15

Needless to say, a solid fuel which can be combined in the lower layer comprises a coke substantially free of volatile matter or anthracite with a small content of volatile matter. However, even if coal having 10 % by weight or less of volatile matter is employed, the amount of tar which is carried in an exhaust gas is very small.
20 Therefore, as long as the coal contains 10 wt% or less of volatile matter, steam coal may be used as a solid fuel even in the lower layer.

In a preferred embodiment of the present invention the content of volatile matter of coal which is combined in the upper layer is restricted to not lower than 10 wt%, because coal having volatile matter in an amount of smaller than 10 wt% may be used in a single layer system, so there is no need to employ the dual layer system.
25 In contrast, if coal having volatile matter in an amount of 10 wt% or more is combined with a charge in a single layer system, the volatile matter evaporated from the coal is carried in an exhaust gas and deposit as tar pitch on the inner wall within the exhaust gas piping. Such coal cannot be used in a single layer system. However, according to the present invention such coal having a high content of volatile matter can be used in the upper layer. This is advantageous from a practical viewpoint.

The present invention will be described in conjunction with working examples which are presented merely for illustrative purposes and do not restrict the present invention in any way.
30

Example 1

A DL-sintering apparatus of the strand cooling type, as illustrated in Figure 5, was used to carry out sintering of fine iron ore in accordance with the double layer system. The length of a sintering strand was 100 meters.
35

Table 1 shows the composition of the charge employed in this example. Table 2 shows the operating conditions.

Comparative Example 1 employed the double layer system, and the arrangement of the hopper 11 and the ignition furnace 12 was that shown in Figure 1. The hopper 11 and the ignition furnace 12 were placed at a position rather close to the ignition furnace 5 for the lower layer.
40

Comparative Examples 2 and 3 employed a single layer system. In Comparative Example 2, the FFP was positioned 54 meters away from the ignition point, i.e., near the central area of the strand in the travelling direction of the pallets. In Comparative Example 3, the FFP was positioned 74 meters away from the ignition point, i.e., about midway between the central area and the discharge end of the strand. The charge used was the same as in the working examples of the present invention.
45

Test results are shown in Figure 6 and Table 3. The abscissa of Figure 6 indicates the distance (meters) from the ignition furnace 5 for the lower layer. A distance of 100 meters represents the discharge end of the strand, i.e., the outlet end of the sintering strand.

As is apparent from Figure 6, according to the present invention, the temperature of the combustion gas started increasing at a point 43 meters away from the ignition furnace 5. This point corresponds to the FFP. The oxygen content which once decreased to around 10 vol% due to the ignition of the lower layer again increased after passing the FFP. However, the content of CO and CO₂ decreased after passing the FFP.
50

The ignition of the upper layer was carried out at a distance of 47 m away on the sintering strand. After this point, there was no difference in the temperature of the exhaust gas for a single layer system such as shown in Figure 4, but the oxygen content decreased and the content of CO and CO₂ increased after the ignition of the upper layer.
55

However, according to Comparative Example 1, the upper layer was set on fire at a point 8 m away from

the ignition point for the lower layer, and after ignition the O₂ content of the exhaust gas decreased from 10 vol% to nearly 0 vol%, but the content of CO and CO₂ increased to 5 vol% and 25 vol%, respectively. This is because the ignition furnace 12 for the upper layer was located closer to the ignition furnace 5 for the lower layer and coke combusted in both the upper and lower layers simultaneously. The starting point of an increase in temperature of the exhaust gas was the FFP, i.e., 68 m away from the ignition point for the lower layer.

Comparative Examples 2 and 3 employed a single sintering layer system, in which the temperature increased, the content of O₂ decreased, and the content of CO and CO₂ increased for the exhaust gas after the point corresponding to the FFP.

Furthermore, as is apparent from Table 3, compared with Comparative-1, it is noted that in accordance with the present invention the yield rate which had a correlation with cold strength and the production of steam by an exhaust gas boiler 19 increased markedly, although the production of sintered lumps did not increase greatly.

Comparing with Comparative-2, it is also noted that the production of sintered lumps was improved markedly in accordance with the present invention, although the yield rate and the production of steam were equal to those of Comparative-2.

In Comparative-3 the production of steam decreased drastically.

Example 2

In this example, Example 1 was repeated using the sintering apparatus of the DL type to sinter fine iron ore, but various solid fuels were employed and the content of tar contained in an exhaust gas was determined. The sintering charge used was the same as in Example 1.

Test conditions are summarized in Table 4, in which Case-1 shows the case of the single ignition system and Cases-3 and -4 are the case of a dual ignition system.

Test results are shown in Table 5 for Case-1, Table 6 for Case-2, and Table 7 for Case-3.

In Table 5 for Case-1, i.e., the case of the single layer system the amount of tar of the exhaust gas rapidly increased when coal containing more than 10 wt% of volatile matter was used. In contrast, in Case-2 and -3, although coal having more than 10 wt% of volatile matter was used, the amount of tar in the exhaust gas was very small and was on the same level as for coal having a small amount of volatile matter.

Table 1

	Amount (wt%)
Iron Ore	64.0
Lime stone	13.0
Fine Coke	3.0
Return Fines	20.0
Total	100.0
Water Content	6.0

Table 2

	Present Invention	Comparative - 1	Comparative - 2	Comparative - 3
Upper Layer Depth (mm)	400	400	0	0
Lower Layer Depth (mm)	450	450	450	450
Number of the Layers	2	2	1	1
Distance between the Ignition furnaces (m)	47	8	—	—
FFP (m)	43	68	54	74
Temp. of Cooler (°C)	200	450	200	450
Pallet Travelling Rate (m/min)	2.5	3.1	2.9	4.4
Strand Area (m ²)	360	360	360	360

Table 3

	Present Invention	Comparative - 1	Comparative - 2	Comparative - 3
Production (T/D · m ²)	45.7	44.8	28.6	41.0
Yield (%)	76.1	58.3	76.0	71.8
Steam Recovery (kg/T)	130	40	130	30

Table 4

	Case - 1	Case - 2	Case - 3
Number of the Layers	1	2	2
Upper Layer depth (mm)	480	480	480
Lower Layer depth (mm)	—	480	480
Distance between the Ignition Furnaces (m)	—	8	47
F F P (m)	74	68	43
Pallet Travelling Rate (m/min)	2.5	2.5	2.5
Strand Area (m ²)	360	360	360

Table 5

Solid Fuel	Volatiles (%)	Tar in Exhaust Gas (mg/Nm ³)
Coke	1.0	1
Oil Coke	6.3	5
Coal (Anthracite)	7.2	9
Coal (Steam Coal)	10.3	55
"	14.8	91
"	17.3	102
"	21.7	134
"	27.4	187
"	35.4	225
"	42.5	321

Table 6

	Lower Layer		Upper Layer		Tar in Exhaust Gas (mg/Nm ³)
	Solid Fuel	Volatiles(%)	Solid Fuel	Volatiles(%)	
Comparative	Coke	1.0	Coke	1.0	1
"	"	1.0	Oil Coke	6.3	3
"	"	1.0	Coal (Anthracite)	7.2	2
Present Invention	"	1.0	Coal (Steam Coal)	10.3	4
"	"	1.0	"	14.8	3
"	"	1.0	"	17.3	6
"	"	1.0	"	21.7	7
"	"	1.0	"	35.4	10
"	"	1.0	"	42.5	8
"	Coal (Anthracite)	7.2	"	35.4	16
Comparative	Coal (Steam Coal)	35.4	"	35.4	252

Table 7

	Lower Layer		Upper Layer		Tar in Exhaust Gas (mg/Nm ³)
	Solid Fuel	Volatiles(%)	Solid Fuel	Volatiles(%)	
Comparative	Coke	1.0	Coke	1.0	2
"	"	1.0	Oil Coke	6.3	4
"	"	1.0	Coal (Anthracite)	7.2	2
Present Invention	"	1.0	Coal (Steam Coal)	10.3	8
"	"	1.0	"	14.8	4
"	"	1.0	"	21.7	6
"	"	1.0	"	35.4	11
"	Coal (Anthracite)	7.2	"	35.4	17

Claims

- 5 1. A method for sintering fine iron ore using a dual layer system, in which two layers of sintering charge are placed on a train of pallets and each of the layers is set on fire at given intervals of time to perform sintering of the charge, characterized in that the lower layer of the charge is set on fire to start sintering, and the upper layer of the charge is set on fire to start sintering of the upper layer when the front flame point reaches
10 grates of the pallet and the sintered lumps of the lower layer starts being cooled while the charge of the upper layer is sintered.
2. A method as set forth in Claim 1 wherein the time when the front flame point reaches the gates is determined by measuring the temperature of the exhaust gas from the bottom of the pallets, by analyzing chemical
15 composition of the exhaust gas or, by doing both.
3. A method as set forth in Claim 1 or 2 wherein the time period in which the front flame point reaches the grates is adjusted by varying the travelling rate of the pallets and the depth of the lower layer.
4. A method for sintering fine iron ore using a dual layer system, in which two layers of sintering charge are placed on a train of pallets and each of the layers is set on fire at given intervals of time to perform sintering
20 of the charge, characterized in that at least part of solid fuel which is contained in the charge of the upper layer is coal having volatile matter in an amount of 10 wt% or higher.
5. A method as set forth in Claim 4 wherein the lower layer of the charge contains as a solid fuel coal having
25 volatile matter in an amount of 10% in weight or lower.
6. A method as set forth in Claim 4 or 5 wherein the lower layer of the charge is set on fire to start sintering, and the upper layer of the charge is set on fire to start sintering of the upper layer when the front flame point reaches grates of the pallet and the sintered lumps of the lower layer start being cooled while the
30 charge of the upper layer is sintered.

35

40

45

50

55

Fig. 1

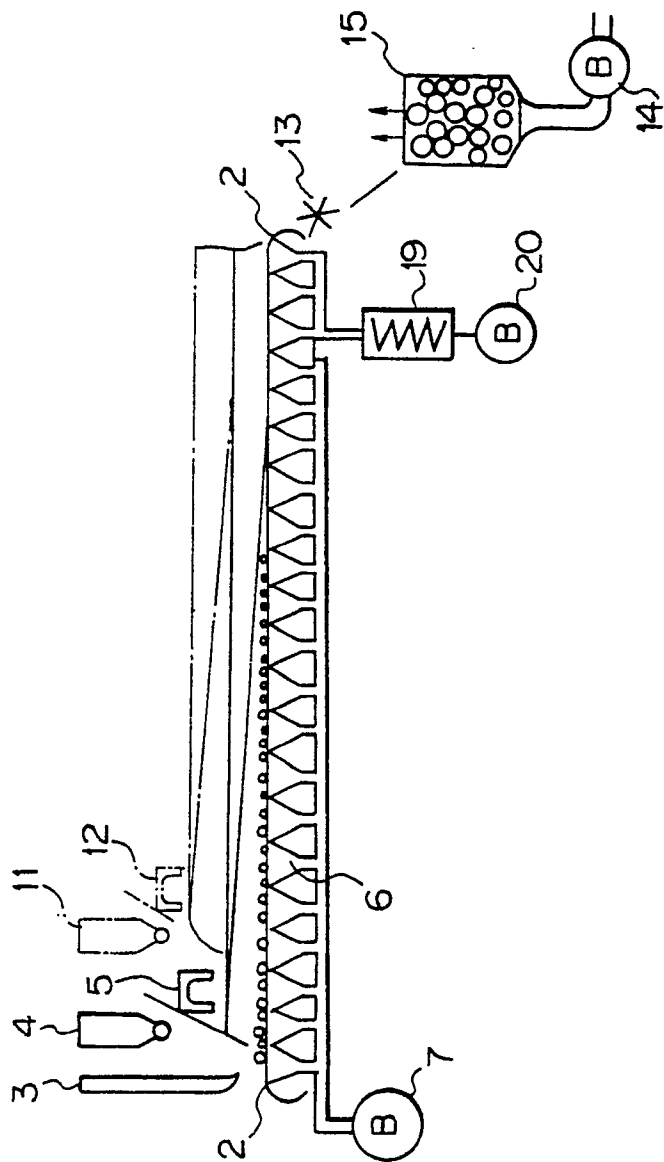


Fig. 2

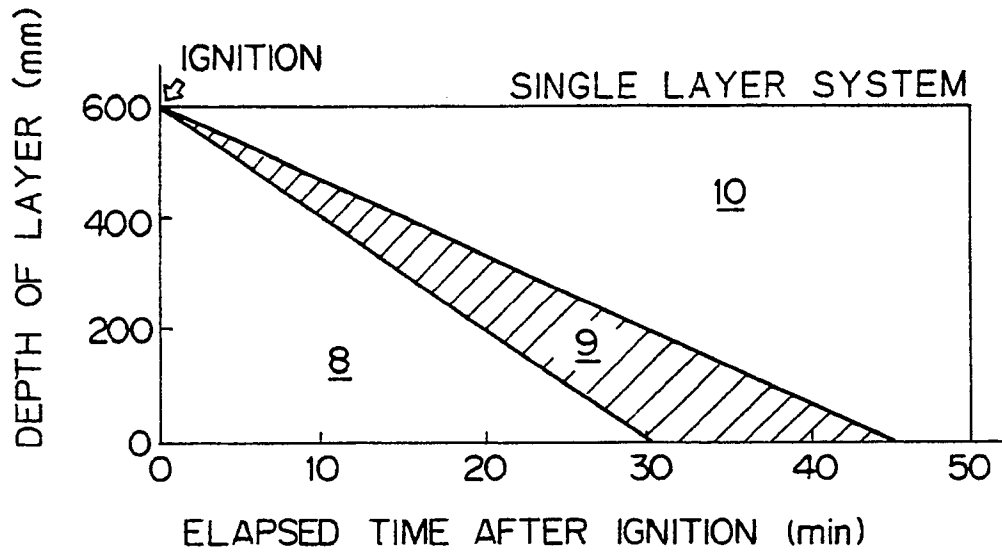


Fig. 3

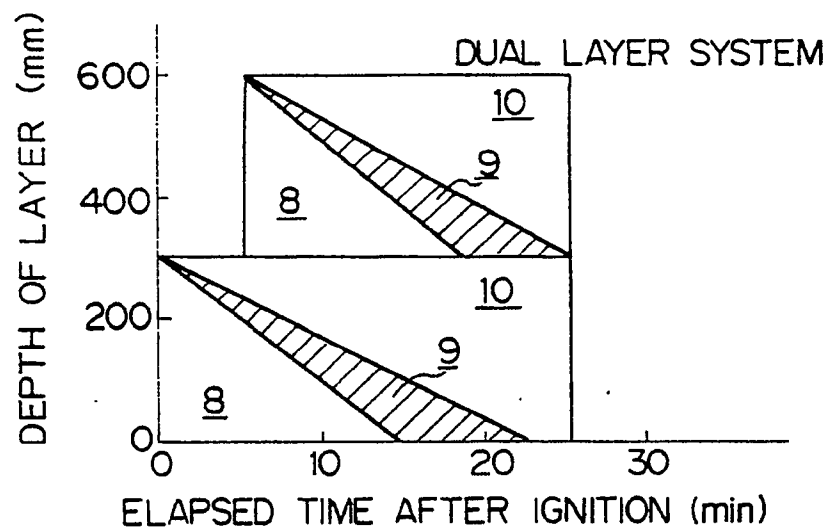


Fig. 4

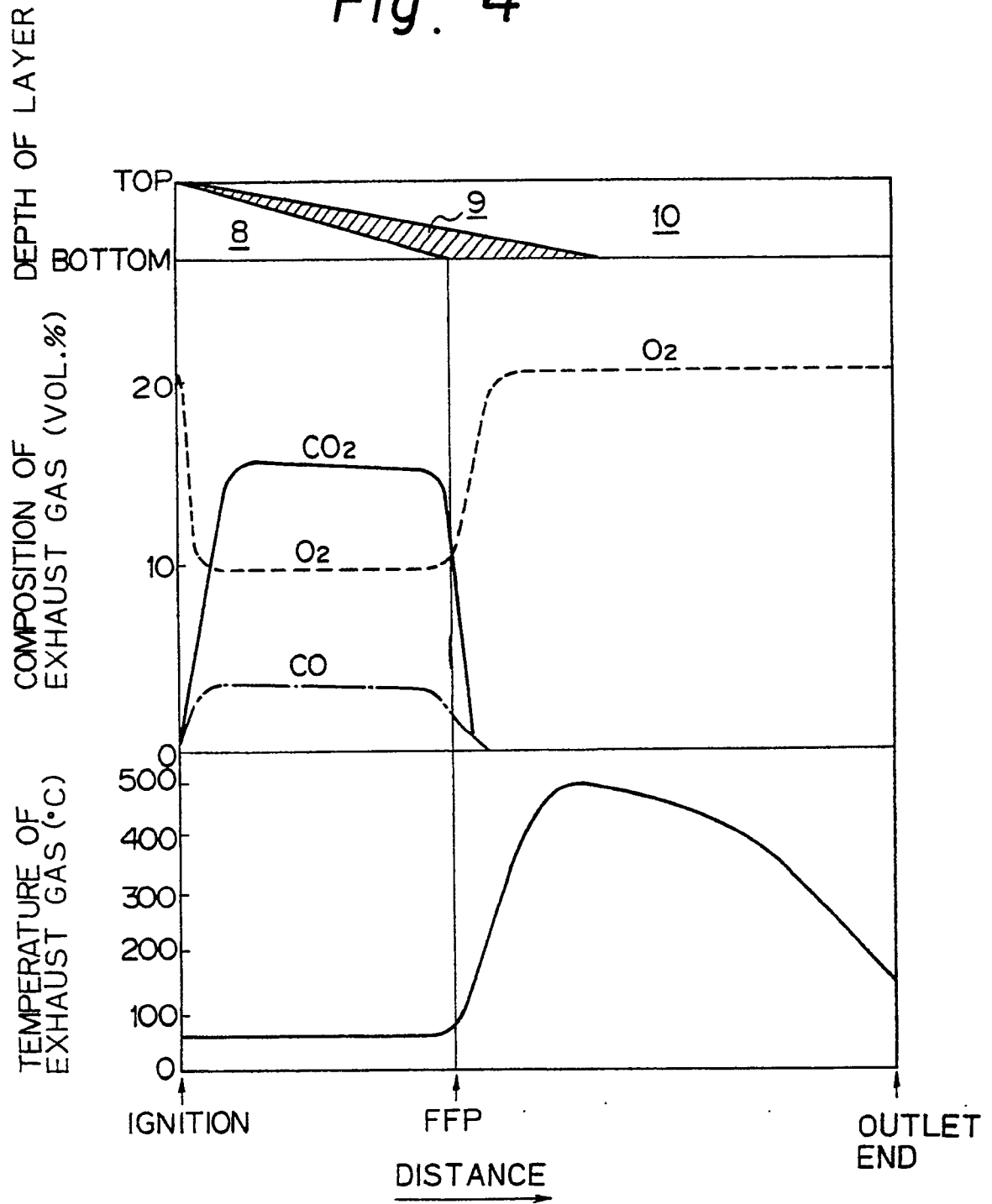


Fig. 5

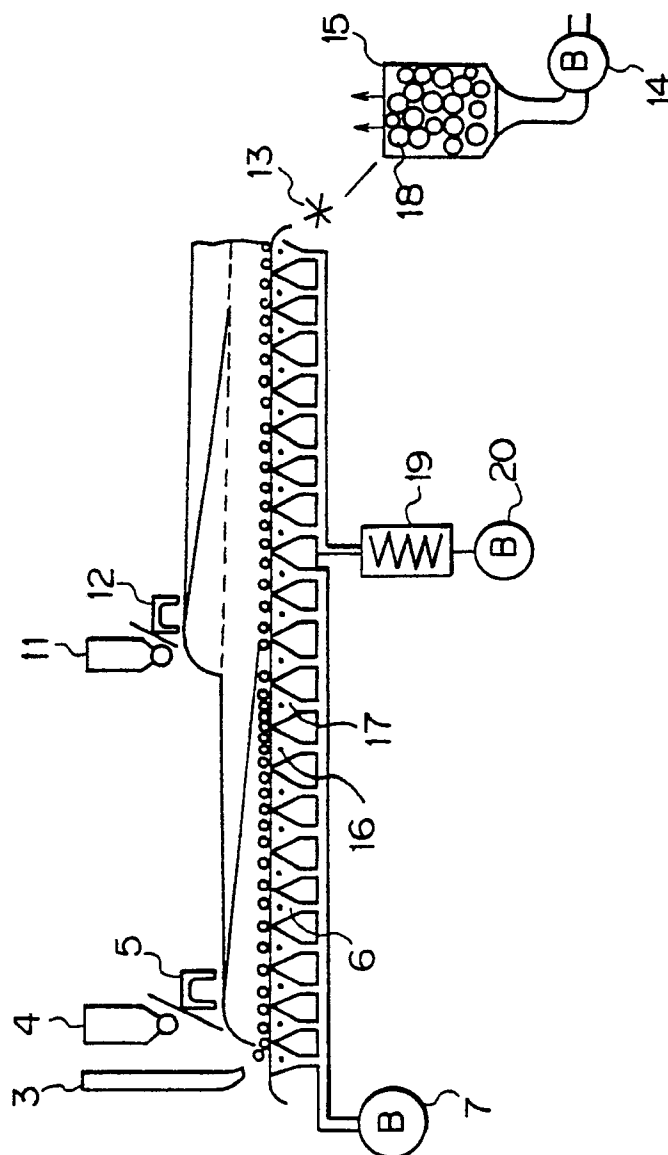
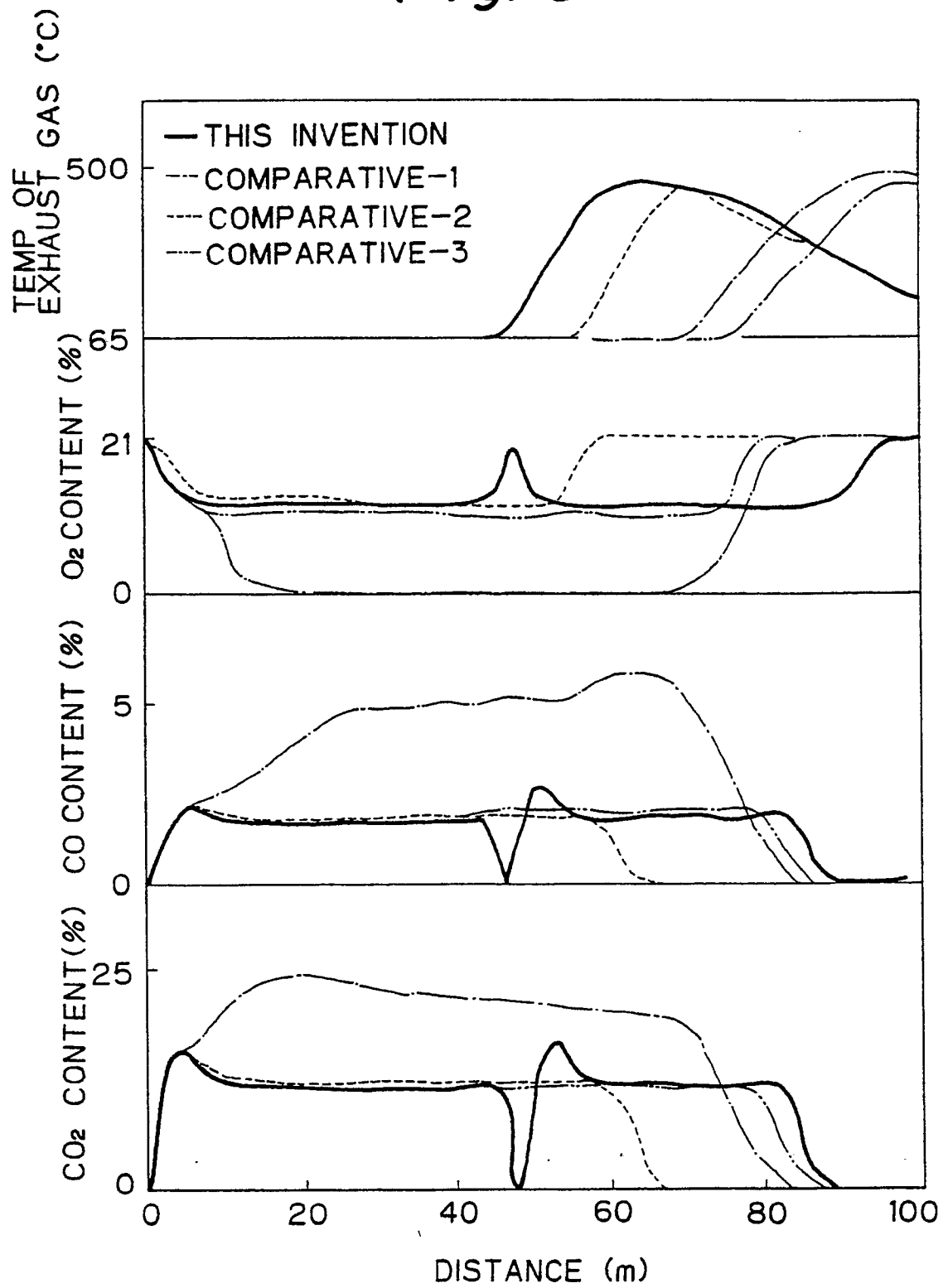


Fig. 6





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 40 0055

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	FR-A-2 468 653 (CREUSOT-LOIRE) * Claims 1-3 *	1,4-6	C 22 B 1/20
A	SOVIET INVENTIONS ILLUSTRATED, section Ch, week B14, 16th May 1979, class M25; & SU-A-606 886 (KONSTANTINOVSK UKRT) 17-04-1978 * Whole abstract *	1,4	
A,D	PATENT ABSTRACTS OF JAPAN, vol. 11, no. 322 (C-453), 20th October 1987; & JP-A-62 107 032 (SUMITOMO METAL IND.) 18-05-1987 * Whole abstract *	1,4	
A	LU-A- 65 649 (CRM) * Claims 1,4 *	1,4	
A	US-A-3 949 974 (SHIOKAWA et al.) * Claim 1 *	1,2	
A	FR-A-2 068 683 (ARBED) * Claim 1 *	4,5	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A,D	PATENT ABSTRACTS OF JAPAN, vol. 11, no. 322 (C-453), 20th October 1987; & JP-A-62 109 932 (SUMITOMO METAL IND.) 21-05-1987 * Whole abstract *	1,4	C 22 B
A,D	PATENT ABSTRACTS OF JAPAN, vol. 11, no. 322 (C-453), 20th October 1987; & JP-A-62 107 033 (SUMITOMO METAL IND.) 18-05-1987 * Whole abstract *	1,4	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 18-04-1991	Examiner WITTLAD U.A.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.92 (P0401)