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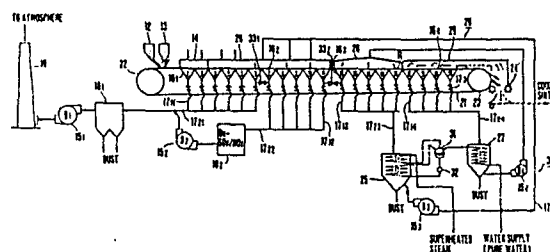
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54 **Waste gas circulation method and system for sintering apparatus.**

57 Herein disclosed are a waste gas circulation method and system for conducting the same. These method and system are appropriate for effectively recovering waste heat from an on-strand type sintering apparatus (20) which has its sintering and cooling zones extending continuously along a horizontal strand. The hottest waste gases coming from the final stage of the sintering zone and the front stage of the cooling zone (16₃) are subjected to heat recovery, and sulfur oxides in the hottest gases are prevented from condensing on the water pipe or pipes of a waste-heat boiler (25) by preheating the water with the still hot waste gases coming from the downstream half of the cooling zone (16₄). Thus, it is possible to conduct the ore sintering operation of regenerative type while assuring that the boiler components in those heat exchanging operations will not be corroded by the waste gases.



SPECIFICATION

TITLE OF THE INVENTION

Waste Gas Circulation Method and System for
Sintering Apparatus

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to an on-strand type sintering apparatus having a sintering zone and a cooling zone extending along a horizontal strand and, more particularly, to both a waste gas circulation method and a waste gas circulation system for heat recovery of the on-strand type sintering apparatus.

Description of the Prior Art

In the prior art, there have been proposed a variety of waste-heat recovering methods for a sintering apparatus, all of which have not succeeded in providing an efficient one. In other words, the methods thus far proposed have failed to reach the level of the so-called "energy generating process" in which such energy is generated as can sufficiently cover that to be consumed for driving the sintering apparatus itself.

The sintering apparatus existing in the art is generally divided into two types, namely, a separate type, in which a sintering machine and a cooling machine are so separately arranged that the sintered ore product discharged from the former is introduced

into and cooled by the latter after it has been crushed, and an on-strand type in which a sintering zone and a cooling zone immediately following the former zone are formed to extend along a horizontal strand.

In the separate type sintering apparatus, heat radiation takes place while the sintered ore product, which is still hot, is being crushed, and pallets of the sintering machine, which have conveyed both the charge mixture of ore, solid fuel and flux to be sintered and the sintered ore product, are returned back in a still hot state to receive a fresh charge mixture while allowing its heat to radiate to the surrounding atmosphere. This makes it rather difficult to effectively recover the heat which remains conserved in the cooling machine. Another heat loss is caused while the sintered ore product is being transferred from the sintering machine to the cooling machine. In the cooling machine, moreover, the sinter supplied has been so roughly crushed that it has a limited surface area to be effective for the cooling operation. As a result, the sintered ore product or sinter cannot be sufficiently cooled down unless the flow rate of cooling air is increased. This inevitably lowers the temperature of the waste gases coming from the downstream half of the cooling machine, thus making it difficult to recover the heat from the relatively cool waste gases. Therefore, no separate type sintering

apparatus of the prior art has endeavored to recover any heat from the downstream half of its cooling machine. Even if, on the other hand, it is intended to recover the heat from the waste gases coming from the upstream half of the cooling machine, it is unnecessary to preheat a heat transferring medium such as water because those waste gases contain no sulfur oxides SO_x . On the contrary, the water has to be preheated in case the waste gases coming from the intermediate and downstream portions of the sintering machine are to be subjected to a heat exchanging process. This is because those waste gases contain such a considerable amount of SO_x that condensation of sulfuric acid is undesirably invited.

In the latter type, i.e., on-strand type sintering apparatus having its sintering and cooling zones formed along the common strand, the heat recovery is conducted only from the waste gases coming from the cooling zone while allowing the sensible heat of the hot waste gases to uselessly dissipate into the atmosphere. In this respect, more specifically, the waste gases coming from the cooling zone is so sufficiently hot as to permit the heat recovery therefrom. This is because the sinter in the cooling zone shrinks to generate fine cracks all over the section of the cooling zone so that its effective surface area to be cooled can be so increased as to reduce the flow rate of the cooling air and to shorten the cooling time period.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide a waste gas circulation method for effectively recovering the heat which might otherwise be released from an on-strand type sintering apparatus having its sintering and cooling zones extending continuously along a horizontal strand.

Another object of the present invention is to provide a waste gas circulation system for putting the above-specified method into practice by repeatedly circulating the waste gases through a charge mixture of ore, solid fuel and flux being sintered and through the sintered ore product thereby to effectively recover the heat which might otherwise be carried away by the waste gases discharged.

The present invention is based upon the aforementioned differences between the separate type and on-strand type sintering apparatus and has been conceived in view of the facts that the waste gases discharged from the sintering apparatus take their maximum temperature at a point where the sintering reaction is completed in the actual run of the sintering apparatus, namely, where the cooling operation is started, and that the point and its neighborhood act as an important zone for recovering that sensible heat.

The gist of the present invention resides in that the hottest waste gases arising at the final stage of

the sintering zone and at the front stage of the cooling zone, in which the sintering reaction is completed, are subjected to heat recovery, and in that the problem, which naturally takes place in the case of the heat recovery, namely, the condensation of sulfur oxides SO_x of the waste gases in the form of droplets of sulfuric acid is prevented by preheating the water, which is supplied for the purpose of that heat recovery, with the waste gases coming from the downstream half of the cooling zone.

According to a feature of the present invention, there is provided a waste gas circulation method for heat recovery of on-strand type sintering apparatus which includes: a sintering zone having a plurality of wind boxes; and a cooling zone extending just downstream of said sintering zone and having a plurality of wind boxes, comprising: a first step of exchanging the heat of still hot waste gases coming from the wind boxes belonging to both the intermediate stage and at least a portion of the final stage of said cooling zone with cold water to recover said heat thereby to heat said cold water into hot water; and a second step of exchanging the heat of the hot waste gases coming directly from the wind boxes belonging to a mixed zone consisting of the final stage of said sintering zone and the front stage of said cooling zone with the hot water, which has been heated at the first-named heat exchanging step, to recover the second-named

heat thereby to heat said hot water into steam, whereby the heat generated by the sintering action of a charge mixture of ore, solid fuel and flux can be efficiently recovered as said steam from a sintered ore product, and whereby sulfur oxides, which are carried in the mixture of the hot waste gases having passed through both the wind boxes belonging to the final stage of said sintering zone and wind boxes belong to the front stage of said cooling zone, can be maintained at a relatively high temperature during the second-named heat exchanging step by the hot water, which has recovered the heat of said still hot waste gases, so that said sulfur oxides can be prevented from condensing in the form of droplets of sulfuric acid while ensuring substantially corrosion-free operation of the second-named heat exchanging step.

According to another feature of the present invention, the second heat exchanging step comprises; a first sub-step of exchanging the heat of the hottest waste gases coming directly from the wind boxes (163) belonging to a mixed zone consisting of the final stage of said sintering zone and the front stage of said cooling zone with steam to recover the second-named heat thereby to heat said steam into superheated steam, and a second sub-step of exchanging the heat of the waste gases, which have been subjected to the first heat exchanging sub-step, with the hot water, which has been heated at the first heat exchanging step, thereby

to heat said hot water into the steam which is to be heated at the first heat exchanging sub-step.

According to still another feature of the present invention, there is provided a waste gas circulation system for heat recovery of on-strand type sintering apparatus which includes: a sintering strand arranged generally in a horizontal direction; conveying means for conveying a charge mixture of ore, solid fuel and flux along said sintering strand; feeding means for feeding said conveying means with said charge mixture; ignition means for igniting the solid fuel in said charge mixture at the surface thereof so that the sintering of said charge mixture may be started; and a plurality of wind boxes arranged on line below and opened toward said charge mixture through the pallets of said sintering strand, said wind boxes being so grouped as to belong to an ignition zone, which underlies said ignition means, a sintering zone, in which the sintering reaction of said charge mixture proceeds until it is completed, and a cooling zone in which a sintered ore product resulting from said sintering reaction is cooled down, comprising: first heat exchanging means for exchanging the heat of still hot waste gases coming from the wind boxes belonging to both the intermediate stage and at least a portion of the final stage of said cooling zone with cold water to recover said heat thereby to heat said cold water into hot water: first waste gas circulating means for

sucking and supplying fresh air to the sintered ore product at both the intermediate stage and at least a portion of the final stage of said cooling zone, and for circulating the still hot waste gases, which have passed through said wind boxes of said intermediate and final stages of said cooling zone, through said first heat exchanging means to the charge mixture, which is being and has been sintered at a mixed zone consisting of the final stage of said sintering zone and the front stage of said cooling zone; second heat exchanging means for exchanging the heat of the waste gases coming directly from the wind boxes belonging to said mixed zone with steam to recover the second-named heat to heat said steam into superheated steam; third heat exchanging means disposed in tandem downstream of said second heat exchanging means for exchanging the heat of the hottest waste gases, which have passed through said second-named heat exchanging means, to recover the third-named heat thereby to heat said hot water into the steam which is to be heated by said second-named heat exchanging means; second waste gas circulating means for sucking and supplying said hottest waste gases to the second-named heat exchanging means and then to the third-named heat exchanging means and for circulating the waste gases, which have passed through said second and third-named heat exchanging means, to the charge mixture which is to be sintered at the front and intermediate stages of said sintering zone.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of the present invention will become more apparent from the following description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a schematic view showing the arrangement of an example of a separate type sintering apparatus according to the prior art;

Fig. 2 is also a schematic view but shows the arrangement of an on-strand type sintering apparatus which is equipped with a waste gas circulation system embodying the present invention;

Fig. 3 is an enlarged flow chart showing an essential portion of the waste gas circulation system of Fig. 2 for regeneratively cooling the sintered ore product so as to effectively recover its heat through heat exchanging operations;

Fig. 4 is similar to Fig. 3 but shows another embodiment of the waste gas circulation system according to the present invention; and

Fig. 5 is a graphical presentation illustrating the patterns of both temperatures and NO_x and SO_x concentrations in the sintering zone, which are plotted against the distance taken along the strand.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Before entering into detailed description of the present invention, cursory review will now be made upon

the separate type sintering apparatus of the prior art, which is indicated generally at reference numeral 10. Indicated at reference numeral 11 is a sintering strand which is arranged to extend in a horizontal direction.

The sintering strand 11 supports a plurality of not-shown pallets which are driven to travel in series therealong so that they are successively fed with a hearth layer and a charge mixture of ore, solid fuel and flux from a hearth layer hopper 12 and a mixture surge hopper 13, respectively. As the pallets on the sintering strand 11 travel, the charge mixture is ignited at its surface by the action of an ignition furnace 14 so that the sintering reaction of the charge mixture may be started. At the same time, fresh air is sucked by the action of a suction blower 15 through the charge mixture by way of a plurality of wind boxes 16, which are arranged on line below the sintering strand 11 and which are consecutively numbered at 1 to 14 and through a suction system 17 so that the resultant waste gases may be introduced into an electrostatic precipitator 18₁ and subsequently into a desulfurating and denitrating device 18₂. The suction system 17 is composed of a corresponding number of branch ducts or downcomers 17₁, which are respectively connected with the wind boxes 16 (i.e., Nos. 1 to 14), and a trunk duct or collector main 17₂ which is connected with the downcomers 17₁ in a merging manner and which has its downstream portion extending through the electrostatic

precipitator 18₁ , the suction blower 15 and the desulfurating and denitrating device 18₂. Moreover, the downcomers 17₁ are respectively equipped with valves 17₃ for controlling the respective flow rates of the waste gases therethrough. The waste gases thus cleared of the dust and the SO_x and NO_x are discharged from the collector main 17₂ to the atmosphere by way of a stack 19. Incidentally, the pallets are driven to travel on rails 21, which are mounted on the sintered strand 11, by the rotations of a charge side sprocket 22 and a discharge side sprocket 23.

As those pallets travel along the sintering strand 11, the charge mixture is ignited at its surface by the action of the ignition furnace 14. The solid fuel in the charge mixture thus ignited sinters the ore more deeply into the charge mixture as this mixture is conveyed from the feed end to the discharge end. The resultant sinter or the sintered ore product is crushed by means of a crusher 24. The crushed sinter is fed to a not-shown cooling machine in which it is cooled down. In this meanwhile, dust resulting from the crushing operation is so much that it has to be carried by suction to a not-shown dust collector (which may be of electrostatic type).

Turning now to Fig. 2, an on-strand type sintering apparatus, which is indicated generally at reference numeral 20 and which is equipped with a waste gas

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circulation system 30 according to the present invention, will be described. Incidentally, like reference numerals indicate like or corresponding parts of the sintering apparatus 10 of the prior art shown in Fig. 1. Below the strand 11 of the sintering apparatus 20, there are arranged on line a number of, e.g., twenty wind boxes. These wind boxes are divided into a first group of wind boxes 16₁ (which are numbered at 1 to 6), a second group of wind boxes 16₂ (which are numbered at 7 to 11), a third group of wind boxes 16₃ (which are numbered at 12 to 16), and a fourth group of wind boxes 16₄ (which are numbered at 17 to 20).

More specifically, the first group wind boxes 16₁ are further grouped into the wind boxes Nos. 1 and 2, which belong to the ignition zone underlying the ignition furnace 14, and into the wind boxes Nos. 3 to 6, which belong to the front stage of the sintering zone where the sintering reaction of the charge mixture proceeds. The second group wind boxes Nos. 7 to 11 belong to the intermediate stage of the sintering zone where that sintering reaction further proceeds. The third group wind boxes Nos. 12 to 16 belong to the final stage of the sintering zone, where that sintering reaction is completed, and to the front stage of a cooling zone where the sintered ore product is cooled down. The fourth group wind boxes Nos. 17 to 20 belong to the intermediate and final stages of the cooling

zone where the sinter or sintered ore product is sufficiently cooled down for the subsequent crushing operation resorting to a crusher 24'.

The first group wind boxes 16₁ , i.e., Nos. 1 to 6, are connected with the stack 19 through an electrostatic precipitator 18₁ and a blower 15₁ by way of the downcomers 17₁₁ and the collector main 17₂₁. On the other hand, the second group wind boxes 16₂ , i.e., Nos. 7 to 11, are made to merge into the collector main 17₂₁ through a desulfurating and denitrating device 18₂ and a blower 15₂ by way of the downcomers 17₁₂ and the collector main 17₂₂. On the contrary, the third group wind boxes 16₃, i.e., Nos. 12 to 16, are connected through the downcomers 17₁₃ and the collector main 17₂₃ with a waste-heat boiler 25 so that the waste gases may be circulated, after they have exchanged their heat with hot water or steam flowing through water pipes, to a sintering zone hood 26 by the action of a blower 15₃. Moreover, the fourth group wind boxes 16₄, i.e., Nos. 17 to 20, are connected through the downcomers 17₁₄ and the collector main 17₂₄ with a waste-heat boiler 27 so that the waste gases may be circulated, after they have exchanged their heat with the water flowing through a water pipe, to a mixed zone hood 28 by the action of a blower 15₄. Incidentally, reference numeral 29 indicates a fresh air guide hood which extends above the pallets travelling over the wind boxes Nos. 17 to 20 of the intermediate and final

stages of the cooling zone ¹⁴ and above the discharge end of the sintering apparatus 20 for guiding fresh air into the sinter. Since the fresh air guide hood 29 forms such a compartment as is opened toward the discharge end for allowing the dust, which might otherwise drop down to the outside, to be returned together with the fresh air to the particular sinter.

Pure water is supplied from the outside to flow through the water pipe of the waste-heat boiler 27 until the resultant hot water flows into a steam drum 31, as better seen from Fig. 3. On the other hand, the hot water reserved in the lower portion of the steam drum 31 is pumped out by the action of a pump 32 to the evaporator portion 25₂ of the waste-heat boiler 25 so that it is heated into steam, which is to be returned to the steam drum 31. The steam thus reserved in the upper portion of the steam drum 31 is guided through the superheater portion 25₁ of the waste-heat boiler 25, in which it is heated into superheated steam. This superheated steam is then discharged to the outside so that its energy may be recovered as an electric power by driving a steam turbine or the like.

Reverting to Fig. 2, incidentally, reference numerals 33₁ and 33₂ indicate dampers which are connected, respectively, between the downcomers 17₁₁ and 17₁₂ leading from the wind boxes 16₁ and 16₂ of the front and intermediate stages of the sintering zone and between the downcomers 17₁₂ and 17₁₃ leading from the

wind boxes 16₂ of the ¹⁵intermediate stage of the sintering zone and the wind boxes 16₃ of the mixed zone. The dampers 33₁ and 33₂ thus connected are adjusted so as to obtain a smooth sloping variation in the pressure difference at each boundary portion between the adjacent groups of wind boxes.

Turning now to Fig. 4, there is shown another embodiment of the present invention, in which the water pipe of the waste-heat boiler 27 is also divided into two portions, i.e., an evaporator portion 27₁ and an economizer portion 27₂ both connected with the steam drum 31. The remaining construction is absolutely the same as the first embodiment shown in Fig. 3, and the description to be made in the following is accordingly directed only to the different portion of the construction.

The pure water is supplied at a flow rate, which corresponds to the steam generation rate of the waste-heat boilers 25 and 27, first to the economizer portion 27₂ of the waste-heat boiler 27, in which it is preheated until it flows into the steam drum 31. On the other hand, the hot water reserved in the lower portion of the steam drum 31 is pumped out by the actions of the pumps 32 and 32', respectively, to the evaporator portions 25₂ and 27₁ of the waste-heat boilers 25 and 27, in which it is heated until it is returned to the steam drum 31. The steam thus separated by the steam drum 31 is then introduced into

the highest-temperature portion or the superheater portion 25₁ of the water pipe of the waste-heat boiler 25 until it is discharged as the superheated steam to the outside of the heat exchanging system under discussion.

Fig. 5 illustrates the sintering zone temperature distribution and the NO_x and SO_x concentration patterns along the strand in accordance with the present Example . With close reference to Fig. 5, it will be understood that the point at which the sintering reaction is completed is located at the wind box No. 14. More specifically, the instant when the temperatures A of the waste gases reach their maximum in an actual running operation is found to occur approximately three minutes after the temperature of the combustion zone of the lowermost layer has reached the maximum temperature. That instant is referred to as the "Burn Through Point" which is indicated at reference letters BTP. In the present Example, the mixed zone extending from the wind box No. 12 to the wind box No. 16, the latter of which belongs to the cooling zone downstream of the Burn Through Point, allows heat recovery of the waste gases at a high temperature of 400 to 500 °C. Furthermore, the waste gases in that mixed zone, which consists of the final stage of the sintering zone and the front state of the cooling zone, still has an oxygen concentration as high as 19 to 20 % and a moisture content as low as 1.0 to

1.5 % so that the particular waste gases can be advantageously reused as the burning air. Thus, this reuse is conducted for the wind boxes Nos. 3 to 11, which belong to the front and intermediate stages of the sintering zone, so that generation of NO_x can be restricted to 15 to 20 %. Incidentally, reference letter C appearing in Fig. 5 indicates the high-temperature zone at 1200 °C or higher, namely, the combustion zone where the charge mixture is being burned.

The high-temperature combustion zone C reaches the lowermost surface at the end of the second group wind boxes 16₂. Despite of this fact, the sintering reaction at this point is not completed yet, as has been touched in the above, so that the SO_x is still generated at such a considerable rate as will invite the mixing of the SO_x with the waste gases coming from the third group wind boxes 16₃ belonging to the mixed zone. Therefore, one might deduce that sulfuric acid would condense in the form of droplets on the water pipes of the waste-heat boiler 25 and would cause corrosion of the evaporator and superheating pipes. However, since the pure water has already been heated in the waste-heat boiler 27 so that at least the warm water will flow through those pipes of the waste-heat boiler 25, there is no danger of the pipe corrosion due to the condensation of sulfuric acid.

Next, the experimental conditions and the

resultant heat recovery rates in case the waste gas circulation system of the foregoing embodiments was run for actual applications are enumerated in the following:

Production rate of sintered ore: 12,000 tons/day

Supply of pure water: 90 tons/hour (at 20 °C)

Temp. of waste gases into boiler 25: 530 °C

Temp. of waste gases out of boiler 25: 155 °C

Temp. of waste gases into boiler 27: 380 °C

Temp. of waste gases out of boiler 27: 200 °C

Superheated steam: 90 tons/hour (at 370 °C, 30 atm.)

Turbine-generated power: 20,000 KW

(For reference, the sintering apparatus has a total power consumption of 10,000 KW.)

Thanks to the construction thus far described, according to the present invention, it is possible to achieve heat recovery of regenerative type while assuring that the boiler components will not be corroded by the waste gases.

WHAT IS CLAIMED IS:

1. A waste gas circulation method for heat recovery of on-strand type sintering apparatus (20) which includes: a sintering zone having a plurality of wind boxes (16); and a cooling zone extending just downstream of said sintering zone and having a plurality of wind boxes (16), comprising:

a first step of exchanging the heat of still hot waste gases coming from the wind boxes (16₄) belonging to both the intermediate stage and at least a portion of the final stage of said cooling zone with cold water to recover said heat thereby to heat said cold water into hot water; and

a second step of exchanging the heat of the hot waste gases coming directly from the wind boxes (16₃) belonging to a mixed zone consisting of the final stage of said sintering zone and the front stage of said cooling zone with the hot water, which has been heated at the first-named heat exchanging step, to recover the second-named heat thereby to heat said hot water into steam,

whereby the heat generated by the sintering action of a charge mixture of ore, solid fuel and flux can be efficiently recovered as said steam from a sintered ore

product, and whereby sulfur oxides, which are carried in the hot waste gases having passed through both the wind boxes (163) belonging to the final stage of said sintering zone and to the front stage of said cooling zone, can be maintained at a relatively high temperature during the second-named heat exchanging step by the hot water, which has recovered the heat of said still hot waste gases, so that said sulfur oxides can be prevented from condensing in the form of droplets of sulfuric acid while ensuring substantially corrosion-free operation of the second-named heat exchanging step.

2. A waste gas circulation method according to Claim 1, the second named heat exchanging step comprises:

a first sub-step of exchanging the heat of the hottest waste gases coming directly from the wind boxes (163) belonging to a mixed zone consisting of the final stage of said sintering zone and the front stage of said cooling zone with steam to recover the second-named heat thereby to heat said steam into superheated steam; and

a second sub-step of exchanging the heat of the waste gases, which have been subjected to the first heat exchanging sub-step, with the hot water, which has

been heated at the first heat exchanging step, thereby to heat said hot water into the steam which is to be heated at the first heat exchanging sub-step.

3. A waste gas circulation method according to claim 2, further comprising:

a first step of circulating the waste gases, which have been subjected to the second heat exchanging step, to the charge mixture carried on the pallets above the wind boxes (162) of the remaining or front and intermediate stages of said sintering zone thereby to preheat the same charge mixture, whereby reducing the content of nitrogen oxides and sulfuric oxides in the waste gases from the front and intermediate stage of the sintering zone; and

a second step of circulating the waste gases, which have been subjected to the first heat exchanging step, to the charge mixture which is being and has been sintered on the pallets above the wind boxes (163) belonging to the final stage of said sintering zone and to the front stage of said cooling zone, whereby recovering the sensible heat of said waste gases.

4. A waste gas circulation method according to Claim 2, further comprising:

a third step of exchanging the heat of said still hot waste gases with said hot water to recover said heat thereby to heat said hot water into steam.

5. A waste gas circulation method according to Claim 2, wherein said hottest waste gases come from that portion of said charge mixture, in which the sintering reaction is completed.

6. A waste gas circulation method according to Claim 5, wherein said portion is located to extend over the Burn Through Point of said sintering apparatus.

7. A waste gas circulation system for conducting the waste gas circulation method according to Claim 1, said system being characterized by comprising:

first heat exchanging means (27) for exchanging the heat of still hot waste gases coming from the wind boxes (164) belonging to both the intermediate stage and at least a portion of the final stage of said cooling zone with cold water to recover said heat thereby to heat said cold water into hot water:

first waste gas circulating means (154, 1714, 1724) for sucking and supplying fresh air to the sintered ore product at both the intermediate stage and

at least a portion of the final stage of said cooling zone, and for circulating the still hot waste gases, which have passed through said wind boxes (164) of said intermediate and final stages of said cooling zone, through said first heat exchanging means (27) to the charge mixture, which is being and has been sintered at a mixed zone consisting of the final stage of said sintering zone and the front stage of said cooling zone;

second heat exchanging means (25) for exchanging the heat of the waste gases coming from the wind boxes (163) belonging to said mixed zone with said hot water to heat said hot water into steam;

second waste gas circulating means (153, 1713, 1723) for sucking and supplying said waste gases to the second heat exchanging means and for circulating the waste gases, which have passed through said second heat exchanging means, to the charge mixture which is to be sintered at the front and intermediate stages of said sintering zone.

8. A waste gas circulation system for conducting the waste gas circulation method according to Claim 2, said system being characterized by comprising:

first heat exchanging means (27) for exchanging

the heat of still hot waste gases coming from the wind boxes (16₄) belonging to both the intermediate stage and at least a portion of the final stage of said cooling zone with cold water to recover said heat thereby to heat said cold water into hot water:

first waste gas circulating means (15₄, 17₁₄, 17₂₄) for sucking and supplying fresh air to the sintered ore product at both the intermediate stage and at least a portion of the final stage of said cooling zone, and for circulating the still hot waste gases, which have passed through said wind boxes (16₄) of said intermediate and final stages of said cooling zone, through said first heat exchanging means (27) to the charge mixture, which is being and has been sintered at a mixed zone consisting of the final stage of said sintering zone and the front stage of said cooling zone;

second heat exchanging means (25₁) for exchanging the heat of the waste gases coming directly from the wind boxes (16₃) belonging to said mixed zone with steam to heat said steam into superheated steam;

third heat exchanging means (25₂) disposed in tandem downstream of said second heat exchanging means (25₁) for exchanging the heat of the waste gases, which have passed through the second heat exchanging

means (25₁), thereby to heat said hot water into the steam which is to be heated by said second heat exchanging means (25₁);

second waste gas circulating means (15₃, 17₁₃, 17₂₃) for sucking and supplying said hottest waste gases to the second heat exchanging means (25₁) and then to the third heat exchanging means (25₂) and for circulating the waste gases, which have passed through the second and third heat exchanging means (25₁, 25₂), to the charge mixture which is to be sintered at the front and intermediate stages of said sintering zone.

9. A waste gas circulation system according to Claim 8, wherein the first heat exchanging means includes a waste-heat boiler (27) having its upstream portion communicating with the respective wind boxes (16₄) of both the intermediate and final stages of said cooling zone, wherein the first-named waste gas circulating means includes a blower (15₄) for sucking the waste gases, which have passed through the first-named heat exchanging means, and for supplying them to the charge mixture at said mixed zone, wherein the second and third heat exchanging means (25₁, 25₂) commonly include a waste-heat boiler (25) having its upstream portion communicating with the respective wind boxes (16₃) of

said mixed zone, and wherein the second circulating means includes a blower (15₃) for sucking the waste gases, which have passed through the second and third heat exchanging means (25₁, 25₂), and for supplying them to the charge mixture at both said ignition zone and the front and intermediate stages of said sintering zone.

10. A waste gas circulation system according to Claim 8, said system further including a steam drum (31) having its hot water reserving portion connected with both the first and third heat exchanging means (27, 25₂) and its steam reserving portion connected with the second and third heat exchanging means (25₁, 25₂).

11. A waste gas circulation system according to anyone of Claim 7 or 8, further comprising:

fourth heat exchanging means (27₁) disposed in tandem upstream of the first heat exchanging means (27₂) for exchanging the heat of said still hot waste gases, before the first heat exchanging means, with said hot water to heat said hot water into steam.

12. A waste gas circulation system according to Claim 11, wherein said fourth heat exchanging means (27₁)

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includes a waste-heat boiler (27) shared with the first
heat exchanging means (27₂).

FIG. 1

PRIOR ART

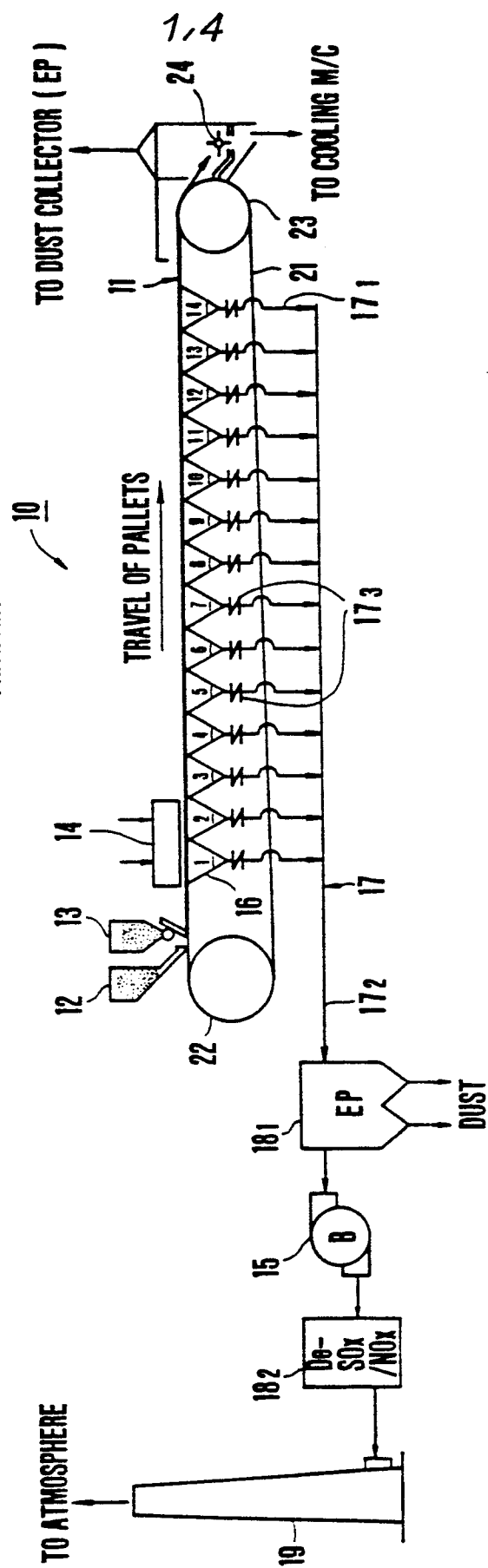


FIG.2

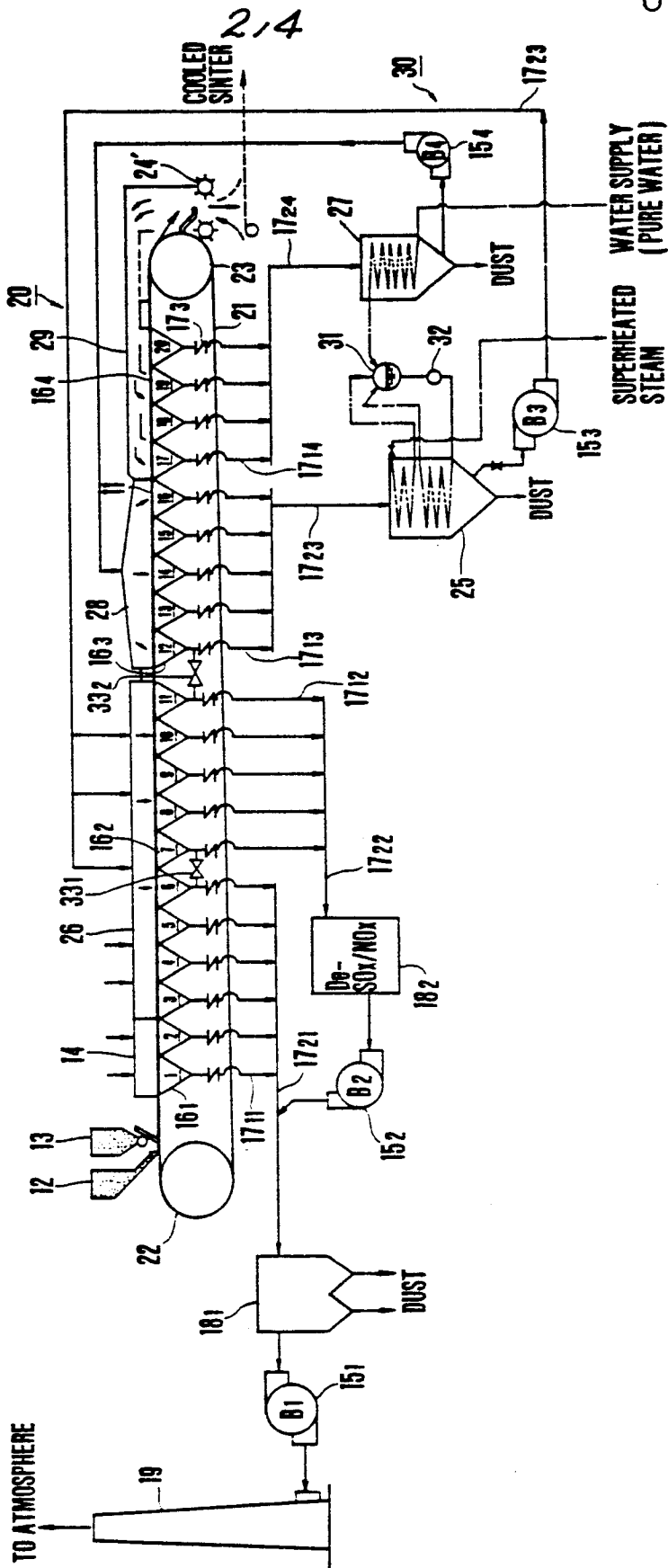


FIG. 3

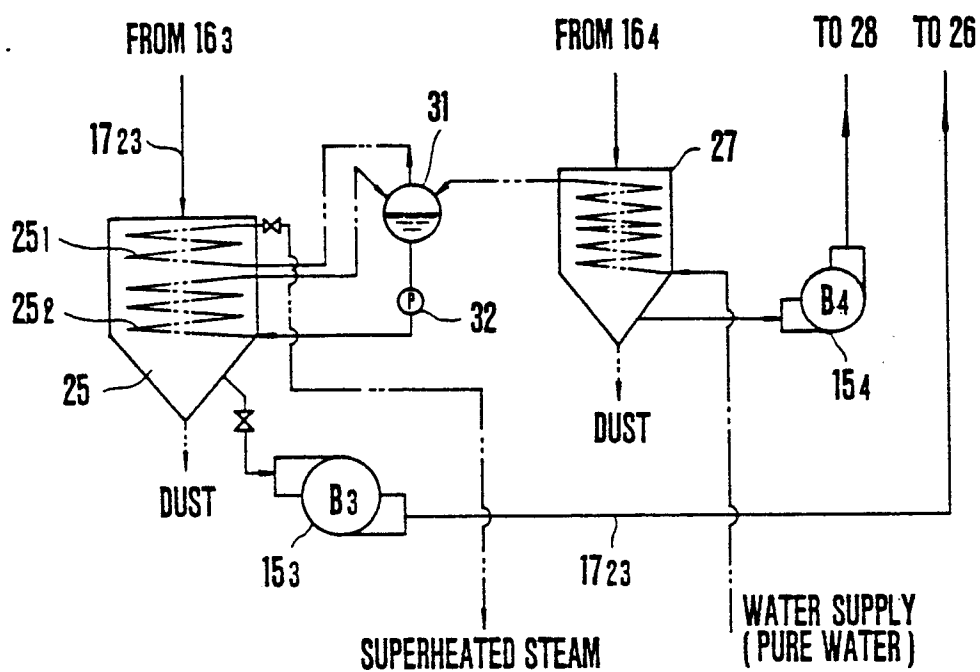


FIG. 4

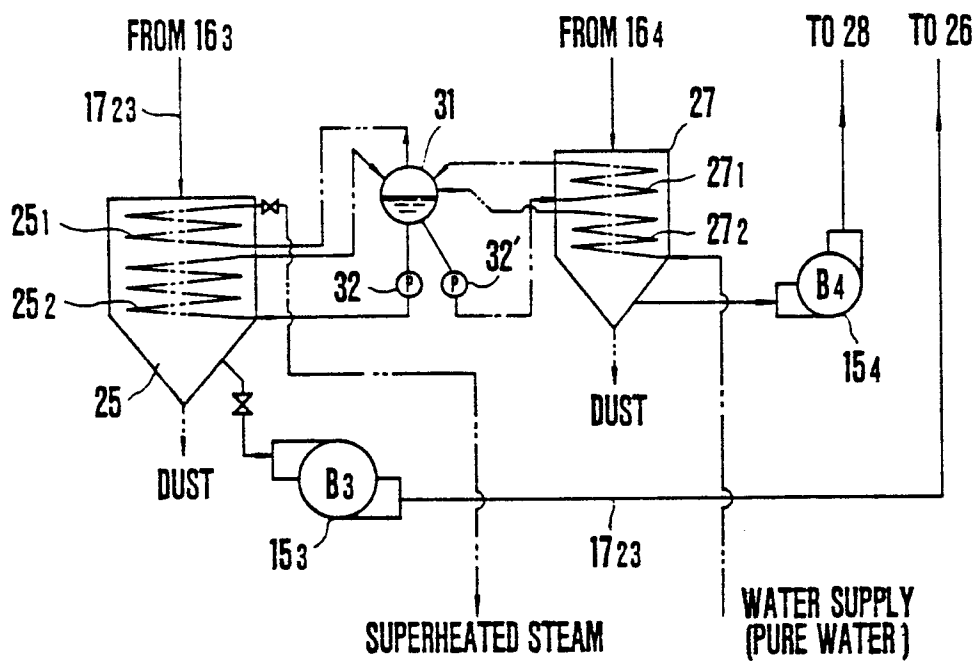
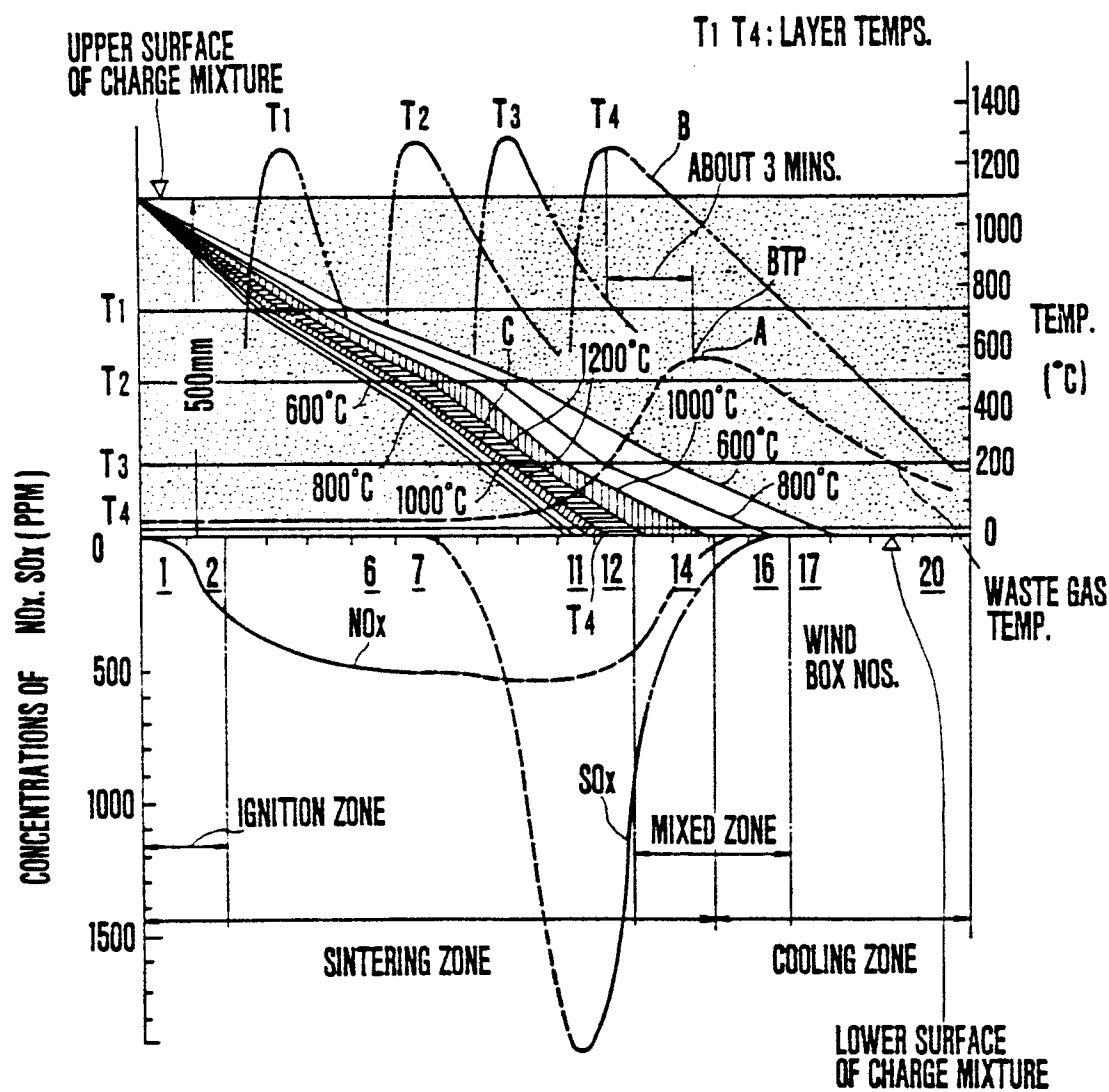


FIG. 5



0141890



European Patent
Office

EUROPEAN SEARCH REPORT

Application number

EP 83 40 2210

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. ³)
A	FR-A-2 297 922 (IRSID)		F 27 B 21/06 F 27 D 17/00 C 22 B 1/20
A	US-A-4 371 150 (TOSHIO TSUKUDA)		
A	AT-B- 352 408 (VEREINIGTE OSTERREICHISCHE EISEN- UND STAHLWERKE - ALPINE MONTAN AG.)		
A	FR-A-2 444 720 (DELATTRE-LEVIVIER)		
			TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
			F 27 B F 27 D C 22 B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 16-08-1984	Examiner COULOMB J.C.
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			