



(12) **EUROPEAN PATENT APPLICATION**  
published in accordance with Art. 158(3) EPC

(43) Date of publication:  
**10.04.2002 Bulletin 2002/15**

(51) Int Cl.7: **F27B 21/08**

(21) Application number: **01912290.2**

(86) International application number:  
**PCT/JP01/01937**

(22) Date of filing: **13.03.2001**

(87) International publication number:  
**WO 01/69153 (20.09.2001 Gazette 2001/38)**

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE TR**

- **IZUMIYAMA, Tadao, Nippon Steel Corporation Muroran-shi, Hokkaido 050-0087 (JP)**
- **SHIA, Yoshiaki, Nippon Steel Corporation Futtsu-shi, Chiba 293-0011 (JP)**
- **ITINOSE, Masaaki, Nippon Steel Corporation Futtsu-shi, Chiba 293-0011 (JP)**
- **HOSOTANI, Youzou, Nippon Steel Corporation Futtsu-shi, Chiba 293-0011 (JP)**

(30) Priority: **15.03.2000 JP 2000072606**  
**12.01.2001 JP 2001004454**

(71) Applicant: **NIPPON STEEL CORPORATION**  
**Tokyo 100-8071 (JP)**

(74) Representative: **VOSSIUS & PARTNER**  
**Siebertstrasse 4**  
**81675 München (DE)**

(72) Inventors:  
• **OKADA, Tsutomu, Nippon Steel Corporation Futtsu-shi, Chiba 293-0011 (JP)**

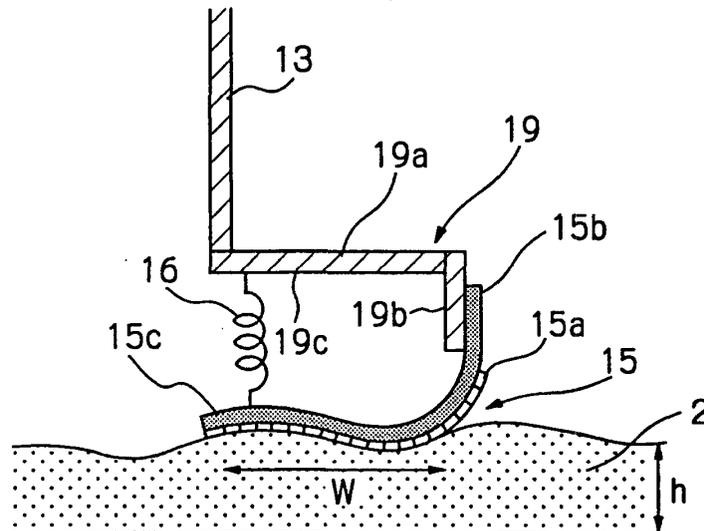
(54) **DEVICE AND METHOD FOR SEALING PRESSURE AIR BLOWING HOOD**

(57) An apparatus and a method for sealing a pressurized gas blow hood provided above the sintering raw mix bed charged in an under-suction type sintering machine, which can maintain good sealability and durability of the pressurized gas blow hood, are provided.

hood provided above sintering raw mix bed (2) charged in the under-suction type sintering machine, sealing piece (15) composed of a composite material comprising hard rigid body tips (15a) and an elastic body member (15b) is provided at skirt lower edge (13) of the pressurized gas blow hood so as to be in sliding contact with said sintering raw mix bed (2).

In the apparatus for sealing a pressurized gas blow

[Fig. 4]



**Description**

## Technical Field

5 **[0001]** The present invention relates to an apparatus and a method for sealing a pressurized gas blow hood in the sintering machine in connection to a process for producing sintered ores for blast furnaces.

## Background Art

10 (Prior Art)

**[0002]** Sintering process for use in the sintering machine includes, for example, a pressurized sintering process, which comprises, as shown in Fig. 1, charging a raw mix onto traveling endless palette belt 1 from raw mix hopper 5, igniting raw mix bed 2 at the top by ignition hood 6, introducing pressurized gas to said raw mix bed 2 at the top from pressurized gas blow hood 3 connected to pressurized gas blower 4 downwards, while discharging the gas downwards by suction by exhaust gas blower 11 through wind boxes 8, exhaust gas duct 9 and exhaust gas dust collector 10, and moving said palette belt 1, thereby roasting the raw mix bed from the top layer down to the bottom layer successively.

**[0003]** Such a pressurized sintering process can improve the product yield in the top layer of raw mix bed 2 and sintered ore quality, for example, by sucking the atmospheric air at the initial period of roasting, while setting the suction pressure in wind boxes 8 to - 9.8 kPa (-1,000 mmAq) relative to the atmospheric pressure, thereby lowering the migration speed of the combusting fused zone from the top layer down to the bottom layer of the raw mix bed, and making the residence time at high temperature longer than the conventional one. At the intermediate period of roasting or thereafter, the density of the gas flowing through raw mix bed 2 can be increased by forcing the air at a pressure of +19.6 kPa (+2,000 mmAq) relative to the atmospheric pressure into raw mix bed 2 at the top through pressurized gas blow hood 3 connected to pressurized gas blower 4, while withdrawing the exhaust gas from the bed at the bottom at a pressure of -9.8 kPa (-1,000 mmAq), thereby establishing a pressure difference of 29.4 kPa (3,000 mmAq) through raw mix bed 2. At the same time, a coke combustion rate and a heat transfer rate can be increased thereby, resulting in an increase in the migration speed of the combustion fused zone through the bed. Still furthermore, an increase in the gas flow rate means an increase in the cooling rate, and thus the thickness in the height direction of the combustion fused zone can be made smaller in the raw mix bed, thereby lowering the gas flow resistance through the combustion fused zone and increasing the migration speed of the combustion fused zone. As a result, productivity, product yield and sintered ore quality can be considerably improved in the pressurized sintering process.

**[0004]** However, the pressurized sintering process has been hardly practiced due to the serious difficulty in the sealing between said pressurized gas blow hood 3 and raw mix bed 2. Particularly in the case of covering the entire sintering palette belt or in the case of sealing part of the sintering pallet belt, influences of vertical and horizontal vibrations of the sintering palette belt, thermal expansion developed during the passage under the ignition hood or during the sintering, or others must be taken into design consideration. That is, no satisfactory sealing means has been established yet.

**[0005]** JP-U-A-61-177797 discloses that "sealing can be attained by providing a material having an appropriate elasticity at the skirts of a fixed type hood and bringing the material in sliding contact with the upper surface of sintering ores". However, no durable elastic materials capable of sealing by itself alone when brought into sliding contact with irregular surface of sintering ores charged on the traveling palettes have been available yet.

**[0006]** JP-U-A-61-141700 discloses that "sealing pieces move to follow the vertical movement of the upper surface of sintering ore bed, whereas sealing member vertically expands or contracts to follow the vertical movement of the sealing pieces, thereby ensuring satisfactory sealing of the outer periphery of the food". However, the disclosed method has a difficulty in sealing of corner parts of ore bed between the travelling direction of the palette belt and the lateral direction of the ore bed, requiring an apparatus of considerably large size.

## (Problem to be solved by the Invention)

50 **[0007]** The aforementioned prior arts are all based on a mechanism of sliding development between the sealing pieces and the sintering ore bed or between the sealing pieces themselves. That is, as shown in Fig. 2, without any provision of sealing piece 14 between skirt lower edge 13 of pressurized gas blow hood 3 and raw mix bed 2, a large volume of the pressurized gas is leaked from pressurized gas blow hood 3, resulting in a failure to obtain the necessary gas blowing pressure for the pressurized sintering process. The sintering machine is usually in continuous 24-hr operation and the sealing pieces are in constant sliding contact with hard sintered ore powders in the surface layer of raw mix bed, creating very hard conditions as to the wearing of sealing pieces 14. Thus, it is hard to obtain sealing pieces of satisfactory durability (wear resistance).

That is, it has been so far desired to develop an epock-making sealing technique capable of maintaining satisfactory sealing with good durability even if brought into sliding contact.

**[0008]** Thus, an object of the present invention is to provide an apparatus and a method for sealing a pressurized gas blow hood in a sintering machine with good sealability enabling a sufficient pressurized gas blowing from the pressurized gas blow hood provided over the sintering palette belt.

Disclosure of the Invention

(Means for Solving Problem)

**[0009]** The present invention is to solve the aforementioned technical problems, and the gist of the present invention will be summarized as follows:

(1) An apparatus for sealing a pressurized gas blow hood provided above the sintering raw mix bed charged in an under-suction type sintering machine, characterized in that a sealing piece composed of a composite material comprising hard rigid body tips and an elastic body member is provided at the skirt lower edge of the pressurized gas blow hood, while setting a ratio (w/h) of the width w in the lateral direction of the sealing piece in sliding contact with the surface of the sintering raw mix bed to the thickness h of the sintering raw mix bed to a range of 0.1 to 2.

(2) An apparatus for sealing a pressurized gas blow hood as described in the above item (1), characterized in that the sealing piece is composed of a composite material in which the hard rigid body tips are fixed to the surface layer of the elastic body member so that the hard rigid body tips exposed from the surface layer of the elastic body member each can have a maximum size of not more than 50 mm in the horizontal direction of the hard rigid body tip.

(3) An apparatus for sealing a pressurized gas blow hood as described in the above item (1), characterized in that the sealing piece is composed of a composite material in which the hard rigid body tips are fixed to the surface layer of the elastic body member so that the hard rigid body tips exposed from the surface layer of the elastic body member each can have a size of not less than 5 mm in the horizontal direction of the hard rigid body tip.

(4) An apparatus for sealing a pressurized gas blow hood as described in any one of the above items (1) to (3), characterized in that the sealing piece is composed of a composite material in which the hard rigid body tips are fixed to the surface layer of the elastic body member so that the hard rigid body tips exposed from the surface layer of the elastic body member each can have a thickness of not more than 5 mm.

(5) An apparatus for sealing a pressurized gas blow hood as described in any one of the above items (1) to (4), characterized in that the hard rigid body tips are composed of at least one of ceramics, a hard metal and a cermet.

(6) An apparatus for sealing a pressurized gas blow hood as described in any one of the above items (1) to (5), characterized in that the hard rigid body tips are in at least one of plate shape, spherical shape and cylindrical shape.

(7) An apparatus for sealing a pressurized gas blow hood as described in any one of the above items (1) to (6), characterized in that, in the case that the hard rigid body tips are in a plate shape, the hard rigid body tips each have a thickness of 1 mm to 10 mm.

(8) An apparatus for sealing a pressurized gas blow hood as described in any one of the above items (1) to (6), characterized in that, in the case that the hard rigid body tips are in a spherical or cylindrical shape, the layer of the hard rigid body tips composed of spherical or cylindrical hard rigid body tips has a thickness of 5 mm to 50 mm.

(9) An apparatus for sealing a pressurized gas blow hood as described in any one of the above items (1) to (8), characterized in that the elastic body member is composed of rubber.

(10) An apparatus for sealing a pressurized gas blow hood as described in any one of the above items (1) to (9), characterized in that the composite material is made up so that the hard rigid body tips can be fixed to the surface layer of the elastic body member so that the elastic body member can have a thickness of 2 mm to 20 mm.

(11) An apparatus for sealing a pressurized gas blow hood as described in any one of the above items (1) to (10), characterized in that a support member is provided at the skirt lower edge of the pressurized gas blow hood, the upper edge of the sealing piece is fixed to the side wall of the support member, and the lower edge of the sealing

piece is connected to the bottom of the upper wall of the support member through a spring.

5 (12)An apparatus for sealing a pressurized gas blow hood as described in the above item (11), characterized in that the hard rigid body tips are brought into sliding contact with the sintering raw mix bed, and one of the edges of the elastic body member is fixed to the outside of the side wall protruded downwards from the top wall of the support member.

10 (13)An apparatus for sealing a pressurized gas blow hood as described in any one of the above items (1) to (10), characterized in that a support member is provided at the skirt lower edge of the pressurized gas blow hood, and the sealing piece is fixed to the support member through a bulky elastic body member.

15 (14)An apparatus for sealing a pressurized gas blow hood as described in the above item (13), characterized in that the support member comprises a top wall provided at the skirt lower edge and a side wall protruded downwards from the top wall of the support member, the side wall being directed to fix the bulky elastic body member by holding the upper portion of the bulky elastic body member together with the top wall of the support member.

20 (15)An apparatus for sealing a pressurized gas blow hood as described in the above items (13) and (14), characterized in that the sealing piece is made up so that the hard rigid body tips can be brought into sliding contact with the sintering raw mix bed and the edge of the sealing piece-constituting elastic body member can be fixed to the side wall of the bulky elastic body member.

25 (16)An apparatus for sealing a pressurized gas blow hood as described in the above items (13) and (14), characterized in that the sealing piece is made up so that the hard rigid body tips can be brought into sliding contact with the sintering raw mix bed and the edge of the sealing piece-constituting elastic body member can be directly fixed to the support member.

30 (17)An apparatus for sealing a pressurized gas blow hood as described in any one of the above items (1) to (16), characterized in that the bulky elastic body member is composed of at least one of a sponge rubber, a tube and a flexible metal.

(18)An apparatus for sealing a pressurized gas blow hood as described in any one of the above items (1) to (10), characterized in that an inner pressure-adjustable air duct is provided at the skirt lower edge of the pressurized gas blow hood, and the sealing piece is provided at the bottom of the air duct.

35 (19)An apparatus for sealing a pressurized gas blow hood as described in the above item (18), characterized in that the air duct comprises an air duct upper wall provided at the skirt lower edge, an air duct side wall protruded downwards from the air duct upper wall, the side wall being directed to fix the upper edge of a bag-shaped sealing piece to which air is to be supplied, and an air supply port provided at the air duct upper wall, the air supply port being directed to supply air into the air duct.

40 (20)An apparatus for sealing a pressurized gas blow hood as described in the above item (18) or (19), characterized in that the air duct comprises an air duct upper wall provided at the skirt lower edge, an air duct side wall protruded downward from the air duct upper wall, the side wall being directed to fix the upper edge of a bag-shaped sealing piece to which air is to be supplied through an air tube, the air tube being provided in the air duct, and an air supply port provided at the air duct upper wall, the air supply port being directed to supply air into the air tube.

45 (21)A method for sealing a pressurized gas blow hood provided above a sintering raw mix bed charged into an under-suction type sintering machine, characterized by providing a sealing piece composed of a composite material comprising hard rigid body tips and an elastic body member at the skirt lower edge of the pressurized gas blow hood, while setting a ratio (w/h) of the width w in the lateral direction of the sealing piece in sliding contact with the surface of the sintering raw mix bed to the thickness h of the sintering raw mix bed to a range of 0.1 to 2.

50 (22)A method for sealing a pressurized gas blow hood as described in the above item (21), characterized in that the sealing piece is composed of a composite material in which the hard rigid body tips are fixed to the surface layer of the elastic body member so that the hard rigid body tips exposed from the surface layer of the elastic body member each can have a maximum size of not more than 50 mm in the horizontal direction of the hard rigid body tip.

55 (23)A method for sealing a pressurized gas blow hood as described in the above item (22), characterized in that

## EP 1 195 565 A1

the sealing piece is composed of a composite material in which the hard rigid body tips are fixed to the surface layer of the elastic body member so that the hard rigid body tips exposed from the surface layer of the elastic body member each can have a size of not less than 5 mm in the horizontal direction of the hard rigid body tip.

5 (24)A method for sealing a pressurized gas blow hood as described in any one of the above items (21) to (23), characterized in that the sealing piece is composed of a composite material in which the hard rigid body tips are fixed to the surface layer of the elastic body member so that the hard rigid body tips exposed from the surface layer of the elastic body member each can have a thickness of not more than 5 mm.

10 (25)A method for sealing a pressurized gas blow hood as described in any one of the above items (21) to (24), characterized in that the hard rigid body tips are composed of at least one of ceramics, a hard metal and a cermet.

(26)A method for sealing a pressurized gas blow hood as described in any one of the above items (21) to (25), characterized in that the hard rigid body tips are in at least one of plate shape, spherical shape and cylindrical shape.

15 (27)A method for sealing a pressurized gas blow hood as described in any one of the above items (21) to (26), characterized in that, in the case that the hard rigid body tips are in a plate shape, the hard rigid body tips each have a thickness of 1 mm to 10 mm.

20 (28)A method for sealing a pressurized gas blow hood as described in any one of the above items (21) to (26), characterized in that, in the case that the hard rigid body tips are in a spherical or cylindrical shape, the layer of the hard rigid body tips composed of spherical or cylindrical hard rigid body tips has a thickness of 5 mm to 50 mm.

(29)A method for sealing a pressurized gas blow hood as described in any one of the above items (21) to (28), characterized in that the elastic body member is composed of rubber.

25 (30)A method for sealing a pressurized gas blow hood as described in any one of the above items (21) to (29), characterized in that the composite material is made up so that the hard rigid body tips can be fixed to the surface layer of the elastic body member and the elastic body member can have a thickness of 2 mm to 20 mm.

30 (31)A method for sealing a pressurized gas blow hood as described in any one of the above items (21) to (30), characterized in that a support member is provided at the skirt lower edge of the pressurized gas blow hood, the upper edge of the sealing piece is fixed to the support member side wall, and the lower edge of the sealing piece is connected to the bottom of the upper wall of the support member through a spring.

35 (32)A method for sealing a pressurized gas blow hood as described in any one of the above items (21) to (30), characterized in that a support member is provided at the skirt lower edge of the pressurized gas blow hood and the sealing piece is fixed to the support member through a bulky elastic body member.

40 (33)A method for sealing a pressurized gas blow hood as described in any one of the above items (21) to (30), characterized in that a support member is provided at the skirt lower edge of the pressurized gas blow hood, the sealing piece is fixed to the support member through a bulky elastic body member, and the upper edge of the sealing piece is directly fixed to the support member side wall.

45 (34)A method for sealing a pressurized gas blow hood as described in the above item (32) or (33), characterized in that the bulky elastic body member is composed of at least one of a sponge rubber, a tube and a flexible metal.

(35) A method for sealing a pressurized gas blow hood as described in any one of the above items (21) to (30), characterized in that an inner pressure-adjustable air duct is provided at the skirt lower edge of the pressurized gas blow hood, and the sealing piece is provided at the bottom of the air duct, the pressure being adjustable by an air supply rate to the air duct.

50 (36)A method for sealing a pressurized gas blow hood as described in the above item (35), characterized in that the air is supplied to the air duct so that a percent gas leakage  $\eta$  can be maintained in a range of 0.1% to 10%.

55 (37)A method for sealing a pressurized gas blow hood as described in any one of the above items (21) to (30), characterized in that an inner pressure-adjustable air duct is provided at the skirt lower edge of the pressurized gas blow hood, the sealing piece is provided at the bottom of the air duct, and an air tube is provided in the air

duct, the air being supplied into the air tube and the pressure in the air duct being adjustable by an air supply rate to the air tube.

5 (38)A method for sealing a pressurized gas blow hood as described in the above item (37), characterized in that the air is supplied to the air tube so that a percent gas leakage  $\eta$  can be maintained in a range of 0.1% to 10%.

Brief Description of the Drawings

10 [0010]

Fig. 1 is a view showing one example of a pressurized sintering process.

Fig. 2 is a view showing one example of the conventional pressurized gas blow hood.

15 Fig. 3(a) is a view showing the state of a sealing piece according to one embodiment of the present invention.

Fig. 3(b) is an enlarged vertical cross-sectional view along the line I-I at the bottom part of Fig. 3(a).

20 Fig. 3(c) shows the ceramic part at the bottom part of Fig. 3(a) along the line II-II of Fig. 3(b).

Fig. 3(d) is a view showing the ceramic part of Fig. 3(c) according to another embodiment of the present invention.

25 Fig. 3(e) and Fig. 3(f) are views showing the states of sealing pieces, respectively, according to other embodiments of the present invention, where spherical and cylindrical ceramics 15a' are uniformly distributed in rubber 15b'.

Fig. 3(g) is a view showing the state of a sealing piece according to a further embodiment of the present invention, where spherical and cylindrical ceramics 15a' are distributed at random in rubber 15b'.

30 Fig. 4 is a view showing an apparatus for sealing a pressurized gas blow hood according to one mode for carrying out the present invention.

Fig. 5 is a view showing an apparatus for sealing a pressurized gas blow hood according to another mode for carrying out the present invention.

35 Fig. 6 is a view an apparatus for sealing a pressurized gas blow hood according to other mode for carrying out the present invention.

40 Fig. 7 is a conceptual view showing the gas flows in the proximity of the sliding contact region between the sealing piece and the sintering raw mix bed in the pressurized gas blow hood.

Fig. 8 is a diagram showing relations between a ratio (w/h) of sliding contact distance of a sealing piece to thickness of a raw mix bed and percent gas leakage  $\eta$  in the present invention.

45 Fig. 9 is a diagram showing relations between a ratio (w/h) of sliding contact distance of a sealing piece to thickness of a raw mix bed and productivity P of sintered ores in the present invention.

Best Modes for carrying out the Invention

50 [0011] The present invention will be described in detail below.

[0012] The present inventors have extensively studied an apparatus and a method for improving the durability (wear resistance) and the sealability of a sealing piece for sealing clearances between the skirt lower edge of a pressurized gas blow hood provided above the sintering raw mix bed in the pressurized sintering process and the sintering raw mix bed.

55 [0013] The primary function of a sealing piece provided at the skirt lower edge of a pressurized gas blow hood is to thoroughly follow the irregularities on the surface of traveling sintering raw mix bed during the traveling of the sintering raw mix charged in the palette belt in the sintering machine, thereby bringing the sealing piece always in sliding contact with the surface of the sintering raw mix bed and thereby sealing clearances between the pressurized gas blow hood and the surface of the sintering raw mix bed. The secondary function of the sealing piece is to maintain the durability

against the wearing, etc., while the sealing piece is in sliding contact with the surface of the sintering raw mix bed.

**[0014]** To satisfy the primary function, the conventional sealing pieces utilize elastic materials such as rubber, etc. as base materials in the most cases. However, the surface layer of the sintering raw mix bed in sliding contact with the sealing piece is composed sharp-edged, very hard powders, such as unroasted ore powders, etc. and thus the single use of elastic material such as rubber, etc as a base material for the sealing piece has such a problem as rapid wearing, resulting in a failure to maintain the desired sealing.

On the other hand, ceramics, etc. are known as materials having a higher hardness and a better wear resistance than those of at least the sintering ore powders in the surface layer of the sintering raw mix bed, but single use of such a hard material as a base material for the sealing piece has such problems as a failure to thoroughly follow the surface irregularities of the traveling sintering raw mix bed (difference in surface level: approximately 30-50 mm; intervals: approximately 500-2,000 mm), resulting in a failure to maintain the satisfactory sealability and also in a poor impact resistance.

**[0015]** As a result of extensive studies on material capable of satisfying both of these contradicting properties, i.e. sealability vs wear resistance, of the sealing piece, the present inventors have found that, when a composite material comprising a hard rigid body tips and an elastic body member made by bonding a large number of hard rigid body tips of, e.g. ceramics, etc. to an elastic body member of e.g. rubber, etc. by vulcanization, etc. is used as a base material for the sealing piece, the wearing resistance can be considerably improved, as compared with the conventional sliding piece, while maintaining the equivalent sealability to that of the conventional sealing piece.

**[0016]** Application modes of a large number of the hard rigid body tips to the present sealing piece will be described below.

**[0017]** As shown in Fig. 3(a), a sealing piece is provided so that tips (ceramic 15a') can be brought into sliding contact with the surface of sintering raw mix bed. A sheet (sealing piece) is made by bonding the hard rigid body tips to an elastic body member such as rubber 15b', etc. by vulcanization, etc. e.g. as shown in Fig. 3(b). The sheet may be bonded to a base rubber processed into the necessary structure by vulcanization, etc.

**[0018]** Tip arrangement may be in a lattice pattern as shown in Fig. 3(c) or in a staggered pattern as shown in Fig. 3(d), but cannot be limited thereto so long as the necessary elasticity for sliding can be obtained.

**[0019]** It is desirable that the hard rigid body tips exposed from the elastic body member each have a thickness of not more than 5 mm. Above 5 mm, the bonding strength will be lowered, resulting in easy peeling of the tips. It is rather preferable that the elastic body member is extended up to the joints between the ceramics, that is, throughout the surface layer of hard rigid body tips, as shown in Fig. 3(b).

**[0020]** Still furthermore, a plurality of combinations of tip shapes, materials, etc. can be made, and must be designed in view of surface irregularities of the sintering raw mix bed as well as desired sealability.

**[0021]** As a result of further studies, the present inventors have found that in the case that a sealing piece composed of said composite material comprising hard rigid body tips and an elastic body member is provided at the skirt lower edge of a pressurized gas blow hood, not only the sealability of the pressurized gas blow hood, but also the productivity of sintered ores can be improved without any adverse effect on the gas flow under the sliding contact region of the sealing piece by setting a ratio (w/h) of the width w in the lateral direction (sliding contact distance) of the sealing piece in sliding contact with the surface of the sintering raw mix bed to the thickness h of the sintering raw mix bed to a range of 0.1 to 2, as shown in Figs. 4 to 6.

**[0022]** The present invention has been established on the basis of the aforementioned finding, and is to provide an apparatus for sealing a pressurized gas blow hood provided above the sintering raw mix bed charged in an under-suction type sintering machine, characterized in that a sealing piece composed of a composite material comprising hard rigid body tips and an elastic body member is provided at the skirt lower edge of the pressurized gas blow hood, while setting a ratio (w/h) of the width w in the lateral direction of the sealing piece in sliding contact with the surface of the sintering raw mix bed to the thickness h of the sintering raw mix bed to a range of 0.1 to 2.

**[0023]** In the present invention, the wear resistance of the sealing piece can be remarkably improved, as compared with the conventional one, by providing a sealing piece composed of a composite material comprising hard rigid body tips and an elastic body member at the skirt lower edge of a pressurized gas blow hood. To maintain better sealability of the pressurized gas blow hood, it is necessary to provide sealing piece 15 so as to keep the relation of the width w in the lateral direction (sliding contact distance) of sealing piece 15 in sliding contact with the surface of sintering raw mix bed 2 to the thickness h of said sintering raw mix bed 2 within said specific range, as shown in Figs. 4 to 6.

**[0024]** Fig. 8 is a diagram showing relations between a ratio (w/h) of sliding contact distance of a sealing piece to thickness of a raw mix bed and a percent gas leakage, and Fig. 9 is a diagram showing relations between a ratio (w/h) of sliding contact distance of a sealing piece to thickness of a raw mix bed and a productivity P of sintered ores.

**[0025]** In Fig. 8, percent gas leakage  $\eta$  can be calculated from the following equation (1) by measuring a feed rate  $Q_0$  of gas from the overhead downwards through pressurized gas blow hood 3 (pressurized gas blow rate) and a suction rate  $Q_2$  of gas withdrawn from the bottom of the sintering raw mix bed by suction and obtaining a difference between the respective measurements  $Q_0 - Q_2$  (= gas leakage rate  $Q_1$ ):

$$\eta (\%) = Q_1/Q_0 \times 100 = (Q_0 - Q_2) / Q_0 \times 100 \quad (1)$$

where  $\eta$  : percent gas leakage,  $Q_1$ : gas leakage rate,  $Q_0$ : pressurized gas blow rate, and  $Q_2$ : suction gas rate.

**[0026]** In Fig. 9, productivity  $P(\%)$  is a ratio relative to the maximum sintered ore productivity when the sintering raw mix bed is subjected to pressurized gas blowing sintering operation under the same conditions except the sliding contact distance of a sealing piece.

**[0027]** Fig. 7 is a conceptual view showing gas flows (20 and 21) in the proximity of the sliding contact region between sealing piece 15 and sintering raw mix bed 2 in the pressurized gas blow hood. Generally, gas flows in the proximity of the sliding contact region of sealing piece 15 in the pressurized gas blow hood are dependent on a relation between a pressure drop  $\Delta P_1$  of downward gas flow 21 depending on the thickness  $h$  of sintering raw mix bed 2 and a pressure drop  $\Delta P_2$  of gas flow 20 in the lateral direction depending on the sliding contact distance  $w$ . Under a condition of  $\Delta P_1 \leq \Delta P_2$ , i.e. a thoroughly long sliding contact distance  $w$ , the gas flow in the proximity of the sliding contact region of sealing piece 15 becomes downward gas flow 21 (without any apparent gas leakage), whereas under a condition of  $\Delta P_1 > \Delta P_2$ , i.e. a shorter sliding contact distance  $w$ , gas flow 20 in the lateral direction of sliding contact distance  $w$  becomes predominant, resulting in an increased gas leakage from the pressurized gas blow hood to the outside.

**[0028]** As shown in Figs 8 and 9, when a ratio ( $w/h$ ) of the sliding contact distance  $w$  of the sealing piece to the thickness  $h$  of the sintering raw mix bed is less than 0.1, the sliding sealing piece will not be brought into good sliding contact with the surface irregularities of the sintering raw mix bed (resulting in occurrence of clearances between the sealing piece and the surface of the sintering raw mix bed), and thus the gas flow in the lateral direction of the sliding contact region of the sliding piece becomes predominant relative to the downward gas flow, whereby the sealability of the pressurized gas blow hood is considerably lowered (i.e. increased percent gas leakage  $\eta$ ) and the productivity  $P$  of the sintered ores are lowered to less than 95%. When a ratio ( $w/h$ ) of the sliding contact distance  $w$  of the sealing piece to the thickness  $h$  of the sintering raw mix bed exceeds 2 on the other hand, there will be no gas flow in the lateral direction of the sliding contact region of the sealing piece, resulting in better sealability, but the wider the sliding contact distance of sealing piece 15 with the surface of sintering raw mix bed 2 is, the more pronounced the adverse effect on roasting due to insufficiency of the gas flow to the sintering raw mix bed right under the sealing piece is, resulting in a decrease in the productivity  $P$  down to less than 95%.

**[0029]** For the aforementioned reasons, a ratio ( $w/h$ ) of the width  $w$  in the lateral direction of a sealing piece composed of said composite material comprising hard rigid body tips and an elastic body member in sliding contact with a sintering raw mix bed (sliding contact distance) to the thickness  $h$  of said sintering raw mix bed is set to a range of 0.1 to 2 in the present invention.

**[0030]** In the present invention, a sealing piece composite of a composite material comprising hard rigid body tips and an elastic body member can be obtained, for example, by bonding a large number of hard rigid body tips to an elastic body member by vulcanization, etc. Hard rigid body tips for use in the present invention are composed of a material having at least a higher hardness than that of sintered ore powders in the surface layer of a sintering raw mix bed, and a distinguished wear resistance, and, for example, ceramics, hard metals such as high Cr steel, Cr-Ni alloy, etc., cermets such as WC-Co alloy, WC-NiCr alloy, etc. or the like can be used as such materials. Elastic body member for use in the present invention is composed of a material having such a low hardness and a high flexibility as to thoroughly follow surface irregularities of traveling sintering raw mix bed (difference in surface level: approximately 30-50 mm; intervals: approximately 500-2,000 mm), and, for example, rubbers such as natural rubber, urethane rubber, NBR rubber, CR rubber, fabric-reinforced rubber, etc. or the like can be used as such materials.

Composite materials of ceramics and rubber such as commercially available Belcera-sheet (trademark of a product made by Nippon Tsusho K.K.), Gumcera-sheet (trademark of a product made by Santo Kakogyo K.K.), KR Cera-sheet (trademark of a product made by Kawamoto Kogyo K.K.), etc. are well known as composite materials comprising hard rigid body tips and an elastic body member.

**[0031]** In the sealing sheet for use in the present invention, the shape of hard rigid body tips bonded to the elastic body member is not particularly limited, and any shape such a plate shape, a spherical shape, a cylindrical shape, etc. can be used. However, when the maximum size each of hard rigid body tips exposed from the surface of the elastic body member exceeds 50 mm, the elasticity of the sealing piece will be lowered and also the sealability between the sealing piece and the sintering raw mix bed will be lowered. Thus, the maximum size each of the hard rigid body tips exposed from the surface of the elastic body member must be not more than 50 mm.

<Plate-shaped tips>

**[0032]** Among sizes, i.e. length, width, and height, of plate-shaped hard rigid body tips, it is preferable that the longest part, i.e. the longest size, is not less than 5mm. Below 5 mm, the bonding area between the ceramic tips and the rubber

member will be smaller and the ceramic tips will readily fall out, resulting in poor durability. [On the other side, with respect to sealability (elasticity), the smaller size is better.] Furthermore, the increased number of ceramic tips will complicate the fabrication of sealing pieces and will lead to a sharp cost increase.

5 **[0033]** Thickness each of plate-shaped hard rigid body tips is preferably 1 mm to 10 mm. Below 1 mm, the sealing piece will be cracked, because the sealing piece is used in a sliding state by pressing the hood down. When there are joints between the ceramic tips, no satisfactory bonding strength can be obtained owing to the smaller thickness. Above 10 mm, the elasticity of the composite material will be reduced, resulting in poor sealability between the sealing piece and the surface of the raw mix bed. When projections are formed on the tip surfaces to prevent the falling-out, the heights of the individual projections are not included in the thickness each of the hard rigid body tips.

10 **[0034]** Interspacing between one plate-shaped hard rigid body tip and another is preferably 0 mm to 3 mm. There is no lower limit to the interspacing. That is, the side of one ceramic tip can be in direct contact with the side of another without any presence of rubber joints therebetween. Above 3 mm, the exposed rubber will be soon worn out, resulting in a decrease in the bonding strength (in spite of good elasticity), and sintered ore powders are to enter the spacings between the ceramic tips to stay therein as starting points for falling out of the ceramic tips.

15 **[0035]** Thickness of a plate-shaped elastic body member is preferably 2 mm to 20 mm excluding the thickness of the ceramic tips (thickness at the joints). Below 2 mm, the strength of the elastic body member per se is so low that the elastic body member will be broken while the sealing piece is in sliding contact. Above 20 mm, the elastic body member will be so stiff that the sealing piece will not follow the surface irregularities of the sintering raw mix bed.

20 **[0036]** Particularly in the case of plate-shaped ceramic tips, it is preferable that the edges of tips to be in sliding contact with the surface of the sintering raw mix bed are rounded or filed smooth, because this can dampen the shock given to the ceramic tips by the sintered ore powders, while the sealing piece slides over the surface of the sintering raw mix bed, thereby preventing the edges of the ceramic tips from breakage or from falling-out.

25 **[0037]** It is further preferable that the plate-shaped ceramic tips are provided with falling out-preventing projections, whereby contact area between the ceramic tips and the rubber member can be increased to prevent the ceramic tips from falling out, thereby largely improving the durability. Shape of the projections is not particularly limited, and any shape, for example, a rail shape, a cylindrical shape, a trapezoidal shape, etc. can be used.

<Spherical and cylindrical tips>

30 **[0038]** Sizes (thickness) of hard rigid body tips, i.e. the longest diameter in the case of a spherical shape and the longest diameter at the bottom or top surface or the height in the case of a cylindrical shape, in other words, the longest diameter of spherical and cylindrical shapes, is preferably 5 mm to 50 mm, for the same reasons as for the plate-shaped tips.

35 **[0039]** Interspacing between one spherical or cylindrical hard rigid body tip and another is 0 mm to 3 mm, when the tips are arranged at equal interspacing, as shown in Figs. 3 (e) and 3 (f), for the same reasons as for the plate-shaped tips. The tips may be arranged at random, as shown in Fig. 3 (g), where  $t_1$  is the height of exposed tips (ceramic tip 15a'),  $t_2$  is the thickness of tip layer and  $t_3$  is the thickness of elastic body member.

**[0040]** Thickness of the elastic body member is preferably 2 mm to 20 mm excluding the thickness of ceramic tip layer at the joints, for the same reasons as for the plate-shaped tips.

40 **[0041]** Thickness of the hard rigid body tip layer is preferably 5 mm to 50 mm. In the case of tip layer having a thickness of less than 5mm, the composite material will be unpractical from the viewpoints of necessary bonding, fabrication, etc. due to the tip size, whereas in the case of tip layer having a thickness of more than 50mm, the composite material will be harder and poorer in the elasticity.

45 **[0042]** So long as the foregoing conditions are satisfied, extension of the elastic body member into the interspacings between ceramic tips is preferable from the viewpoint of bonding, though irrelevant particularly to the thickness of hard rigid body tip layer and thickness of the elastic body member.

**[0043]** The present apparatus and method for sealing with a sealing piece composed of said composite material comprising hard rigid body tips and an elastic body member will be described below, referring to embodiments.

50 **[0044]** Sealing piece composed of said composite material comprising hard rigid body tips and an elastic body member has satisfactory elasticity and wear resistance, and thus only replacement of sealing piece 14 in the conventional apparatus for sealing a pressurized gas blow hood with sealing piece 15 composed of a composite material comprising hard rigid body tips and an elastic body member according to the present invention can attain tight sealing of the sealing piece to the surface of sintering raw mix bed 2 by the positive inner pressure provided in pressurized gas blow hood 3. In that case, to prevent the sliding sealing piece from outward turning up, lower edge 15c of the sealing piece can be fixed by a wire or spring 16, as shown in Fig. 4.

55 **[0045]** In the present invention, a method of providing a sealing piece composed of a composite material comprising hard rigid body tips and an elastic body member at the skirt lower edge of a pressurized gas blow hood is not particularly limited, but to enhance the tight sealing between the sealing piece and the surface of the sintering raw mix bed, it is

very effective to use such apparatus for sealing a pressurized gas blow hood as shown in Figs. 4 to 6.

**[0046]** Fig. 4 shows an apparatus for sealing a pressurized gas blow hood, which comprises support member 19 provided at skirt lower edge 13 of a pressurized gas blow hood, and sealing piece 15 composed of a composite material comprising ceramic tips and a rubber member, the upper edge of said sealing piece 15 being fixed to the outside edge of support member 19 (side wall 19b provided at upper wall 19a of support member 19), and lower edge 15c of said sealing piece 15 being connected to the inside edge of support member (bottom 19c of support member 19) through spring 16 according to one embodiment of the present invention. The spring connection position is not limited to the inside edge of support member 19. That is, a plurality of springs 16 can be provided at positions in the lateral direction and within the region corresponding to the sliding contact distance  $w$  of sealing piece 15 with the surface of sintering raw mix bed 2.

**[0047]** By connecting sealing piece 15 to support member 19 provided at skirt lower edge 13 of the pressurized gas blow hood through spring 16, the followability and sliding contactability of sealing piece 15 with the surface of sintering raw mix bed 2 can be improved through the expanding or contracting action of spring 16, thereby maintaining more stable sealability.

**[0048]** Fig. 5 shows an apparatus for sealing a pressurized gas blow hood, which comprises support member 19 provided at skirt lower edge 13 of a pressurized gas blow hood and sealing piece 15 composed of a composite material comprising ceramic tips and a rubber member, said sealing piece 15 being fixed to support member 19 through bulky elastic body member 17 according to another embodiment of the present invention.

**[0049]** Bulky elastic body member 17 is not particularly limited, and sponge rubber, a gas or liquid-inflated tube, a flexible metal such as a metal in bellows structure, or the like can be used. By bonding sealing piece 15 composed of a composite material comprising hard rigid body tips and an elastic body member of the present invention to at least the surface at the lower part of bulky elastic body member 17, which faces the sliding contact surface of sintering raw mix bed 2, sealing piece 15 can be fixed to support member 19. Sealing piece 15 can be directly fixed to support member 19 without bonding sealing piece 15 to bulky elastic body member 17.

**[0050]** Among the sizes of bulky elastic body member, the width depends on a ratio  $w/h$  set forth by the sealability and the productivity. The length is large enough to absorb surface irregularities of sintering raw mix bed 2. Let the surface irregularities be  $l$  and then the length will be  $2l$  to  $10l$ . Below  $2l$ , no surface irregularities can be absorbed, above  $10l$  the sealing piece becomes unstable and will fall out from the support member at the fixing position.

**[0051]** By connecting sealing piece 15 to support member 19 provided at skirt lower edge 13 of the pressurized gas blow hood through bulky elastic member, the followability and sliding contactability of sealing piece 15 with the surface of sintering raw mix bed 2 can be improved through the elasticity of bulky elastic body member, thereby maintaining more stable sealability.

**[0052]** When sponge rubber is used for the bulky elastic body member, such well known rubber as chloroprene rubber, ethylene-propylene rubber, nitrile rubber, natural isoprene rubber, styrene-butadiene rubber, etc. can be used. Among them, soft rubber with a low hardness, such as those with ASKAR-C and a hardness of 8 can be preferably used.

**[0053]** Fig. 6 shows an apparatus for sealing a pressurized gas blow hood, which comprises inner pressure-adjustable air duct 18 provided at skirt lower edge 13 of a pressurized gas blow hood and sealing piece 15 composed of a composite material comprising ceramic tips and a rubber member of the present invention under bottom 18c of said air duct 18 according to other embodiment of the present invention.

**[0054]** When air is supplied into air duct 18 from the overhead in the apparatus for sealing the pressurized air blow hood to develop an inner pressure, sealing piece 15 will be expanded as a tire tube to further improve the tight sealing between sealing piece 15 and sintering raw mix bed 2. In the present invention, the inner pressure can be controlled by adjusting the air feed rate to air duct 18 in the apparatus for sealing the pressurized gas blow hood to uniformly press sealing piece 15 toward the entire sliding contact surface of sintering raw mix bed 2, thereby absorbing irregularities distributed unevenly and at random on the surface of sintering raw mix bed 2. Thus, the sliding contact, sealability and durability (wear resistance) of sealing piece 15 can be further improved.

**[0055]** Size of air duct 18 can be determined in the same manner as for the bulky elastic body member.

**[0056]** It is more preferable to provide a rubber tube in (air) duct 18 and supply air into the rubber tube without direct supply of air into air duct 18, thereby developing an inner pressure of, for example, 0.49 kPa to 19.6 kPa (0.005 kg/cm<sup>2</sup> to 0.2 kg/cm<sup>2</sup>) to prevent an inner pressure drop in air duct 18 when part of sealing piece 15 is damaged. Thus, stable inner pressure control can be carried out.

**[0057]** In Figs. 4 to 6, schematic views of providing sealing piece 15 of the present invention at skirt lower edge 13 at both sides of pressurized gas blow hood 3 are shown, but the sealing piece can be provided not only at the skirt lower edge at both sides of the pressurized gas blow hood, but also at the skirt lower edge at the inlet side, the outlet side or at the entire periphery, or can be provided continuously at the entire periphery or dividedly predetermined sizes.

**[0058]** In these apparatuses, a magnet can be provided above sealing piece 15 to magnetically attract sintered ore powders in the surface layer of sintering raw mix bed 2 toward the surface of sealing piece 15, thereby enhancing the tight sealability between sealing piece 15 and sintering raw mix bed 2 to further improve the sealability.

(Examples)

**[0059]** Examples of the present invention will be described below.

**[0060]** In examples 1 to 6 of the present invention and Comparative Examples 1 to 3, a sintering machine (sintering palette belt width: 4 m; sintering machine length: 100 m) was operated at a negative suction pressure of 12.74 kPa (1,300 mmAq), a raw mix bed thickness  $h$  of 550 mm and a constant palette belt speed of 3.5 m/s. A pressurized gas blow hood with such sizes as width: 3.5 m and length: 30 m was provided above the sinter strands at the sintered ore discharge side in a distance (height) between the skirt lower edge and the surface of the raw mix bed of 200 mm. Gas blow rate from the pressurized gas blow hood was set to constant  $8.5 \times 10^5$  Nm<sup>3</sup>/hr, and to evaluate the sealability, a gas leakage rate was calculated from a difference between a pressurized gas blow rate and a suction gas rate of  $3.4 \times 10^5$  Nm<sup>3</sup>/hr to obtain a percent gas leakage. Life of the composite material was the time required until the inner pressure of 7.84 kPa (800 mmAq) in the pressurized gas blow hood was lowered to 6.86 kPa (700 mmAq).

(Example 1)

**[0061]** In Example 1 of the present invention, apparatus 14 for sealing pressurized gas blow hood 3 in the structure as shown in Fig. 4 was used with a composite material sheet comprising ceramic tips and a rubber member and having a thickness of 5 mm on the whole, prepared by bonding a large number of 2 mm-thick ceramic tips in a square shape, 10 mm  $\times$  10 mm in the horizontal cross-section, to a natural rubber sheet by vulcanization, as sealing piece 15 composed of a composite material comprising ceramic tips and a rubber member, where the interspacing between the ceramic tips was 1 mm.

Bottom 19c of the upper wall of support member 19 was connected to lower edge 15c of sealing piece 15 through springs 16 at intervals of 300mm in the longitudinal direction of the pressurized gas blow hood. Sealing piece 15 was provided along the entire periphery of the hood so that the width  $w$  in the lateral direction of sealing piece 15 in sliding contact with the surface of sintering raw mix bed 2 (sliding contact distance) could be 200 mm [a ratio ( $w/h$ ) relative to the thickness  $h$  of sintering raw mix bed = 0.36].

(Example 2)

**[0062]** In Example 2 of the present invention, an apparatus for sealing pressurized gas blow hood 3 in the structure as shown in Fig. 5 was used, where side wall 19b of the support member with equal flanges at both edges was 50 mm high and upper wall 19a thereof was 200 mm wide, and sealing piece 15 was provided along the entire periphery of the hood. The same sealing piece as shown in Example 1 of the present invention was used as sealing piece 15 composed of a composite material comprising ceramic tips and a rubber member, and bonded to the surface of sponge rubber 17, followed by fixing to support member 19. The sponge rubber was fixed to the bottom of support member 19 along the entire periphery of the hood, while keeping the distance (height) of the skirt lower edge from the surface of the sintering raw mix bed at 200 mm. Width  $w$  in the lateral direction of said sealing piece 15 in sliding contact with the surface of sintering raw mix bed 2 (sliding contact distance) was set to 200 mm [a ratio ( $w/h$ ) relative to the thickness of the sintering raw mix bed = 0.36].

(Examples 3 to 6)

**[0063]** In Examples 3 to 6 of the present invention, and apparatus for sealing pressurized gas blow hood 3 in the structure as shown in Fig. 6 was used with a composite material sheet comprising ceramic tips and a rubber member and having a thickness of 5 mm on the whole, prepared by bonding a large number of 2mm-thick ceramic tips in a square shape, 5 mm  $\times$  5 mm, 10 mm  $\times$  10 mm or 60 mm  $\times$  60 mm in the horizontal cross-section, to a natural rubber sheet by vulcanization, as sealing piece 15 composed of a composite material comprising ceramic tips and a rubber member, where the interspacing between the ceramic tips was 1 mm. The sealing piece was provided along the entire periphery of the hood.

**[0064]** Edge of the sealing piece was fixed to bottom opening 18b of air duct 18. Inside of air duct 18 was tightly closed and air was supplied thereto from the top (air feed port 18d) to adjust the inner pressure in air duct 18 to 4.9 kPa (0.05 kg/cm<sup>2</sup>) while setting width  $w$  in the lateral direction of sealing piece 15 in sliding contact with the surface of sintering raw mix bed 2 (sliding contact distance) to 100 mm, 180 mm or 200 mm (a ratio  $w/h$  relative to the thickness of the sintering raw mix bed = 0.18, 0.33 or 0.36).

(Comparative Examples)

(Comparative Example 1)

5 **[0065]** In Comparative Example 1, an apparatus for sealing a pressurized gas blow hood in the structure as shown in Fig. 2 was used with fabric-reinforced urethane rubber, 3mm thick, as sealing piece 14, where the lower edge of sealing piece 14 was pulled inwardly by strings so that sealing piece 14 may not be turned up. Generally, urethane rubber is more distinguished in the wear resistance than NBR rubber used for sealing piece 15 of Examples 1 to 6 of the present invention. Width w in lateral direction of sealing piece 15 in sliding contact with the surface of sintering raw mix bed (sliding contact distance) was set to 200 mm [a ratio (w/h) relative to the thickness h of the sintering raw mix bed = 0.36].

(Comparative Example 2)

15 **[0066]** In comparative Example 2, conditions were all the same as in Example 3 of the present invention, except the sliding contact distance w of sealing piece 15. Sliding contact distance w of sealing piece 15 was set to 30 mm, which was shorter than the distances of the present invention [a ratio (w/h) relative to the thickness h of the sintering raw mix bed = 0.05].

20 (Comparative Example 3)

**[0067]** In Comparative Example 3, conditions were all the same as in Example 3 of the present invention, except the sliding contact distance w of sealing piece 15. Sliding contact distance w of sealing piece 15 was set to 1,400 mm, which was longer than the distances of the present invention [a ratio (w/h) relative to the thickness h of the sintering raw mix bed = 2.54].

25 **[0068]** Table 1 shows percent gas leakage from the pressurized gas blow hood and life of sealing piece apparatuses for sealing the pressurized gas blow hood of Examples 1 to 6 of the present invention and Comparative Examples 1 to 3.

Table 1

	Ceramic tip maximum size (mm)	Sliding contact distance w (mm)	Bed thickness h (mm)	w/h	Percent gas leakage (%)	Sintering productivity (%)	Sheet piece life (days)	
30								
35	Example 1	10	200	550	0.36	5	42.3	540
	Example 2	10	200	550	0.36	2	43.2	360
	Example 3	10	200	550	0.36	3	42.8	720
	Example 4	5	200	550	0.36	2	43.1	650
40	Example 5	10	100	550	0.18	5	42.2	740
	Example 6	60	180	550	0.33	9	41.2	1050
	Comp. Ex. 1	-	200	550	0.36	3	42.6	3
45	Comp. Ex. 2	10	30	550	0.05	20	36.3	750
	Comp. Ex. 3	10	1400	550	2.54	0	35.1	680
50								

**[0069]** As is apparent from Table 1, Examples 1 to 6 of the present invention show remarkable improvements of percent gas leakage from the pressurized gas blow hood and life of the sealing piece, as compared with Comparative Examples 1 to 3 showing departure from the scope of the present invention.

55

## Industrial Utility

(Effect of the Invention)

5 **[0070]** The present invention provides an apparatus and a method for sealing a pressurized gas blow hood provided above the sintering raw mix bed charged onto a sintering palette belt in the pressurized sintering process, which can maintain good sealability and durability of the pressurized gas blow hood, and remarkable effects on improved productivity of sintered ores, and product yield and quality in the pressurized sintering process can be obtained, as compared with the conventional art.

10

**Claims**

- 15 1. An apparatus for sealing a pressurized gas blow hood provided above the sintering raw mix bed charged in an under-suction type sintering machine, **characterized in that** a sealing piece composed of a composite material comprising hard rigid body tips and an elastic body member is provided at the skirt lower edge of the pressurized gas blow hood, while setting a ratio (w/h) of the width w in the lateral direction of the sealing piece in sliding contact with the surface of the sintering raw mix bed to the thickness h of the sintering raw mix bed to a range of 0.1 to 2.
- 20 2. An apparatus for sealing a pressurized gas blow hood according to Claim 1, **characterized in that** the sealing piece is composed of a composite material in which the hard rigid body tips are fixed to the surface layer of the elastic body member so that the hard rigid body tips exposed from the surface layer of the elastic body member each can have a maximum size of not more than 50mm in the horizontal direction of the hard rigid body tip.
- 25 3. An apparatus for sealing a pressurized gas blow hood according to Claim 1, **characterized in that** the sealing piece is composed of a composite material in which the hard rigid body tips are fixed to the surface layer of the elastic body member so that the hard rigid body tips exposed from the surface layer of the elastic body member each can have a size of not less than 5mm in horizontal direction of the hard rigid body tip.
- 30 4. An apparatus for sealing a pressurized gas blow hood according to any one of Claims 1 to 3, **characterized in that** the sealing piece is composed of a composite material in which the hard rigid body tips are fixed to the surface layer of the elastic body member so that the hard rigid body tips exposed from the surface layer of the elastic body member each can have a thickness of not more than 5 mm.
- 35 5. An apparatus for sealing a pressurized gas blow hood according to any one of Claims 1 to 4, **characterized in that** the hard rigid body tips are composed of at least one of ceramics, a hard metal and a cermet.
- 40 6. An apparatus for sealing a pressurized gas blow hood according to any one of Claims 1 to 5, **characterized in that** the hard rigid body tips are in at least one of plate shape, spherical shape and cylindrical shape.
- 45 7. An apparatus for sealing a pressurized gas blow hood according to any one of Claims 1 to 6, **characterized in that** in the case that the hard rigid body tips are in a plate shape, the hard rigid body tips each have a thickness of 1 mm to 10 mm.
- 50 8. An apparatus for sealing a pressurized gas blow hood according to any one of Claims 1 to 6, **characterized in that** in the case that the hard rigid body tips are in a spherical or cylindrical shape, the layer of the hard rigid body tips composed of spherical or cylindrical hard rigid body tips has a thickness of 5 mm to 50 mm.
- 55 9. An apparatus for sealing a pressurized gas blow hood according to any one of Claims 1 to 8, **characterized in that** the elastic body member is composed of rubber.
10. An apparatus for sealing a pressurized gas blow hood according to any one of Claims 1 to 9, **characterized in that** the composite material is made up so that the hard rigid body tips can be fixed to the surface layer of the elastic body member so that the elastic body member can have a thickness of 2 mm to 20 mm.
11. An apparatus for sealing a pressurized gas blow hood according to any one of Claims 1 to 10, **characterized in that** a support member is provided at the skirt lower edge of the pressurized gas blow hood, the upper edge of the sealing piece is fixed to the side wall of the support member, and the lower edge of the sealing piece is connected

to the bottom of the upper wall of the support member through a spring.

- 5
12. An apparatus for sealing a pressurized gas blow hood according to Claim 11, **characterized in that** the hard rigid body tips are brought into sliding contact with the sintering raw mix bed, and one of the edges of the elastic body member is fixed to the outside of the side wall protruded downwards from the top wall of the support member.
- 10
13. An apparatus for sealing a pressurized gas blow hood according to any one of Claims 1 to 10, **characterized in that** a support member is provided at the skirt lower edge of the pressurized gas blow hood, and the sealing piece is fixed to the support member through a bulky, elastic body member.
- 15
14. An apparatus for sealing a pressurized gas blow hood according to Claim 13, **characterized in that** the support member comprises a top wall provided at the skirt lower edge and a side wall protruded downwards from the top wall of the support member, the side wall being directed to fix the bulky elastic body member by holding the upper portion of the bulky elastic body member together with the top wall of the support member.
- 20
15. An apparatus for sealing a pressurized gas blow hood according to Claims 13 and 14, **characterized in that** the sealing piece is made up so that the hard rigid body tips can be brought into sliding contact with the sintering raw mix bed and the edge of the sealing piece-constituting elastic body member can be fixed to the side wall of the bulky elastic body member.
- 25
16. An apparatus for sealing a pressurized gas blow hood according to Claims 13 and 14, **characterized in that** the sealing piece is made up so that the hard rigid body tips can be brought into sliding contact with the sintering raw mix bed and the edge of the sealing piece-constituting elastic body member can be directly fixed to the support member.
- 30
17. An apparatus for sealing a pressurized gas blow hood according to any one of Claims 1 to 16, **characterized in that** the bulky elastic body member is composed of at least one of a sponge rubber, a tube and a flexible metal.
- 35
18. An apparatus for sealing a pressurized gas blow hood according to any one of Claims 1 to 10, **characterized in that** an inner pressure-adjustable air duct is provided at the skirt lower edge of the pressurized gas blow hood, and the sealing piece is provided at the bottom of the air duct.
- 40
19. An apparatus for sealing a pressurized gas blow hood according to Claim 18, **characterized in that** the air duct comprises an air duct upper wall provided at the skirt lower edge, an air duct side wall protruded downwards from the air duct upper wall, the side wall being directed to fix the upper edge of a bag-shaped sealing piece to which air is to be supplied, and an air supply port provided at the air duct upper wall, the air supply port being directed to supply air into the air duct.
- 45
20. An apparatus for sealing a pressurized gas blow hood according to Claim 18 or 19, **characterized in that** the air duct comprises an air duct upper wall provided at the skirt lower edge, an air duct side wall protruded downward from the air duct upper wall, the side wall being directed to fix the upper edge of a bag-shaped sealing piece to which air is to be supplied through an air tube, the air tube being provided in the air duct, and an air supply port provided at the air duct upper wall, the air supply port being directed to supply air into the air tube.
- 50
21. A method for sealing a pressurized gas blow hood provided above a sintering raw mix bed charged into an under-suction type sintering machine, **characterized by** providing a sealing piece composed of a composite material comprising hard rigid body tips and an elastic body member at the skirt lower edge of the pressurized gas blow hood, while setting a ratio (w/h) of the width w in the lateral direction of the sealing piece in sliding contact with the surface of the sintering raw mix bed to the thickness h of the sintering raw mix bed to a range of 0.1 to 2.
- 55
22. A method for sealing a pressurized gas blow hood according to Claim 21, **characterized in that** the sealing piece is composed of a composite material in which the hard rigid body tips are fixed to the surface layer of the elastic body member so that the hard rigid body tips exposed from the surface layer of the elastic body member each can have a maximum size of not more than 50 mm in the horizontal direction of the hard rigid body tip.
23. A method for sealing a pressurized gas blow hood according to Claim 22, **characterized in that** the sealing piece is composed of a composite material in which the hard rigid body tips are fixed to the surface layer of the elastic body member so that the hard rigid body tips exposed from the surface layer of the elastic body member each can

have a size of not less than 5 mm in the horizontal direction of the hard rigid body tip.

- 5
24. A method for sealing a pressurized gas blow hood according to any one of Claims 21 to 23, **characterized in that** the sealing piece is composed of a composite material in which the hard rigid body tips are fixed to the surface layer of the elastic body member so that the hard rigid body tips exposed from the surface layer of the elastic body member each can have a thickness of not more than 5 mm.
- 10
25. A method for sealing a pressurized gas blow hood according to any one of Claims 21 to 24, **characterized in that** the hard rigid body tips are composed of at least one of ceramics, a hard metal and a cermet.
- 15
26. A method for sealing a pressurized gas blow hood according to any one of Claims 21 to 25, **characterized in that** the hard rigid body tips are in at least one of plate shape, spherical shape and cylindrical shape.
- 20
27. A method for sealing a pressurized gas blow hood according to any one of Claims 21 to 26, **characterized in that**, in the case that the hard rigid body tips are in a plate shape, the hard rigid body tips each have a thickness of 1 mm to 10 mm.
- 25
28. A method for sealing a pressurized gas blow hood according to any one of Claims 21 to 26, **characterized in that**, in the case that the hard rigid body tips are in a spherical or cylindrical shape, the layer of the hard rigid body tips composed of spherical or cylindrical hard rigid body tips has a thickness of 5 mm to 50 mm.
- 30
29. A method for sealing a pressurized gas blow hood according to any one of Claims 21 to 28, **characterized in that** the elastic body member is composed of rubber.
- 35
30. A method for sealing a pressurized gas blow hood according to any one of Claims 21 to 29, **characterized in that** the composite material is made up so that the hard rigid body tips can be fixed to the surface layer of the elastic body member and the elastic body member can have a thickness of 2 mm to 20 mm.
- 40
31. A method for sealing a pressurized gas blow hood according to any one of Claims 21 to 30, **characterized in that** a support member is provided at the skirt lower edge of the pressurized gas blow hood, the upper edge of the sealing piece is fixed to the support member side wall, and the lower edge of the sealing piece is connected to the bottom of the upper wall of the support member through a spring.
- 45
32. A method for sealing a pressurized gas blow hood according to any one of Claims 21 to 30, **characterized in that** a support member is provided at the skirt lower edge of the pressurized gas blow hood and the sealing piece is fixed to the support member through a bulky elastic body member.
- 50
33. A method for sealing a pressurized gas blow hood according to any one of Claims 21 to 30, **characterized in that** a support member is provided at the skirt lower edge of the pressurized gas blow hood, the sealing piece is fixed to the support member through a bulky elastic body member, and the upper edge of the sealing piece is directly fixed to the support member side wall.
- 55
34. A method for sealing a pressurized gas blow hood according to Claim 32 or 33, **characterized in that** the bulky elastic body member is composed of at least one of a sponge rubber, a tube and a flexible metal.
35. A method for sealing a pressurized gas blow hood according to any one of Claims 21 to 30, **characterized in that** an inner pressure-adjustable air duct is provided at the skirt lower edge of the pressurized gas blow hood, and the sealing piece is provided at the bottom of the air duct, the pressure being adjustable by an air supply rate to the air duct.
36. A method for sealing a pressurized gas blow hood according to Claim 35, **characterized in that** the air is supplied to the air duct so that a percent gas leakage  $\eta$  can be maintained in a range of 0.1% to 10%.
37. A method for sealing a pressurized gas blow hood according to any one of Claims 21 to 30, **characterized in that** an inner pressure-adjustable air duct is provided at the skirt lower edge of the pressurized gas blow hood, the sealing piece is provided at the bottom of the air duct, and an air tube is provided in the air duct, the air being supplied into the air tube and the pressure in the air duct being adjustable by an air supply rate to the air duct.

**EP 1 195 565 A1**

**38.** A method for sealing a pressurized gas blow hood according to Claim 37, **characterized in that** the air is supplied to the air tube so that a percent gas leakage  $\eta$  can be maintained in a range of 0.1 % to 10%.

5

10

15

20

25

30

35

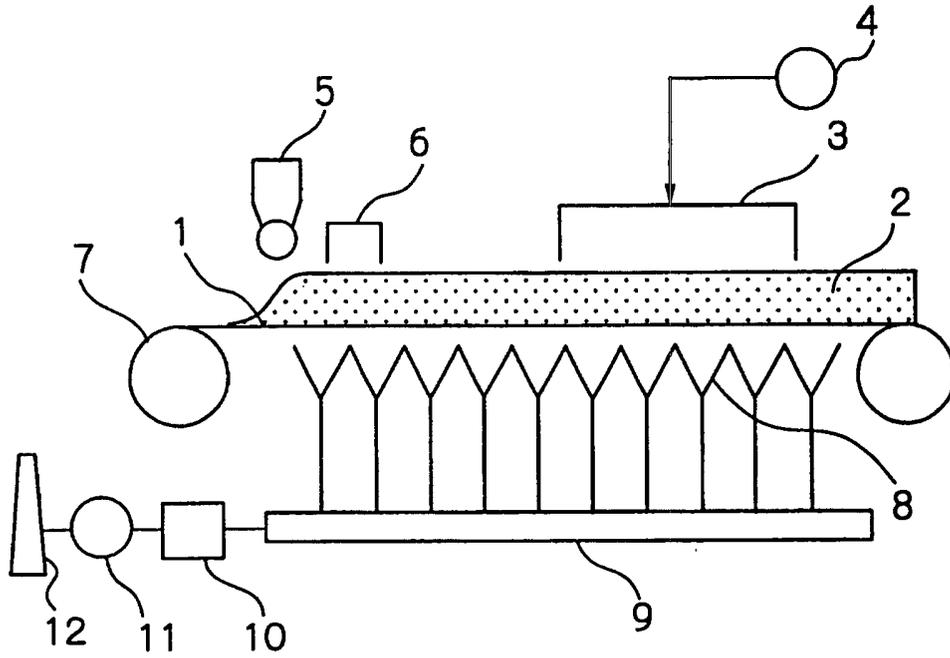
40

45

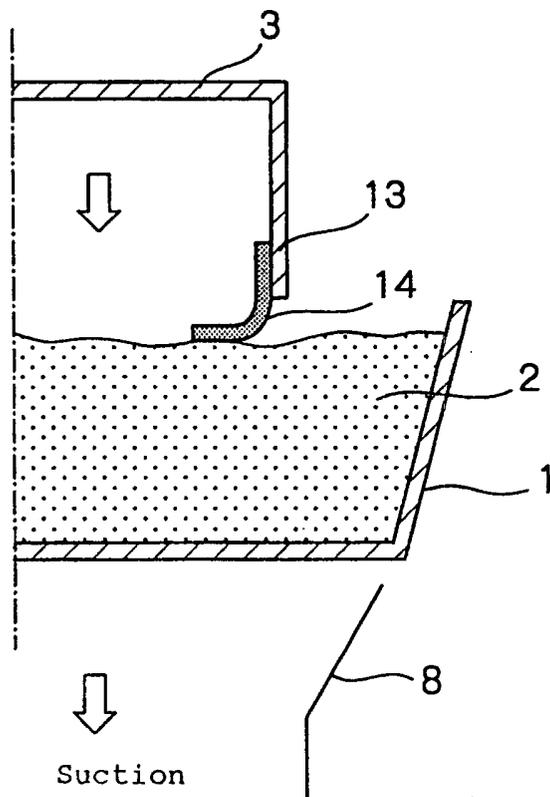
50

55

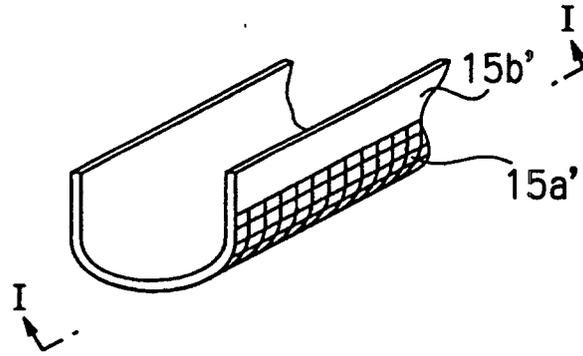
[Fig. 1]



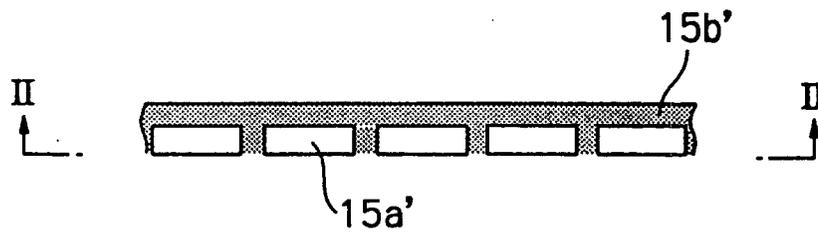
[Fig. 2]



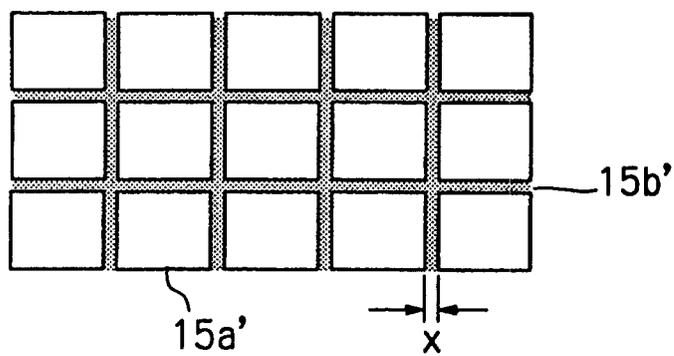
[Fig. 3a]



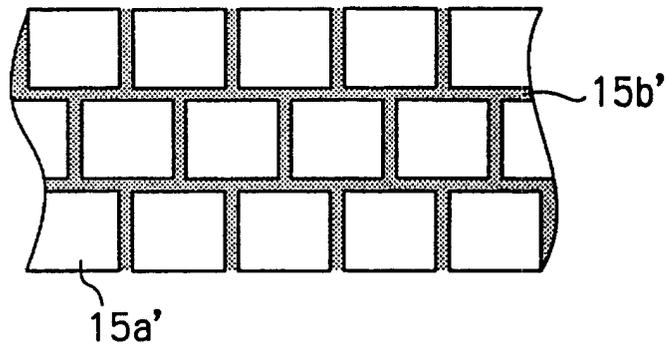
[Fig. 3b]



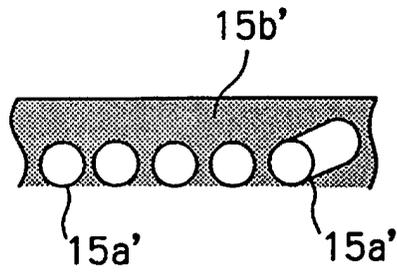
[Fig. 3c]



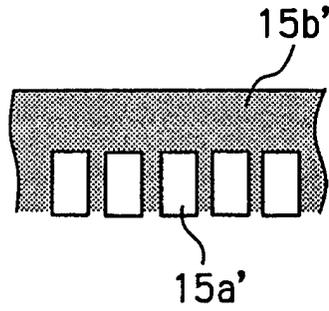
[Fig. 3d]



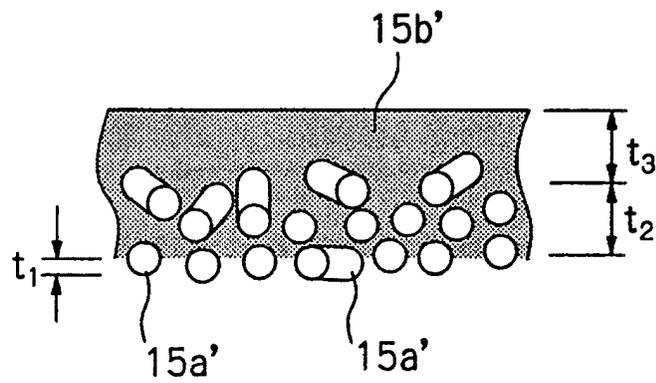
[Fig. 3e]



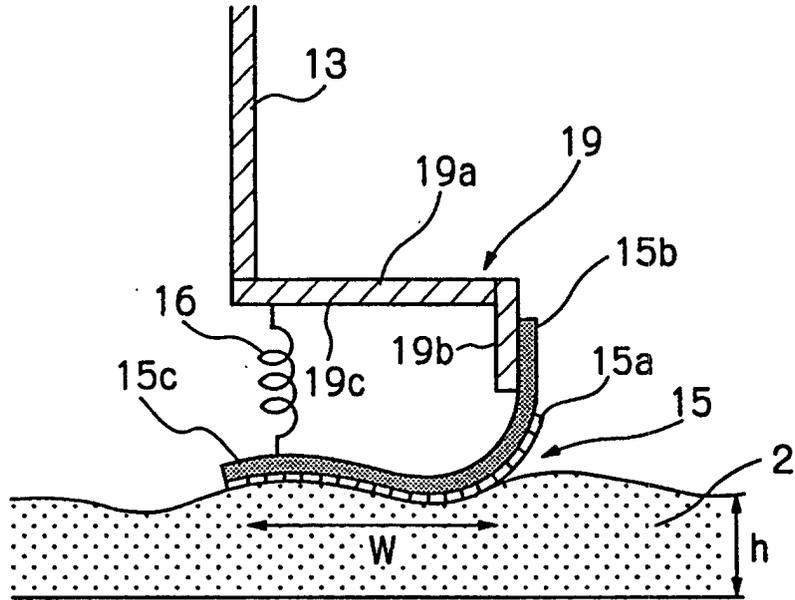
[Fig. 3f]



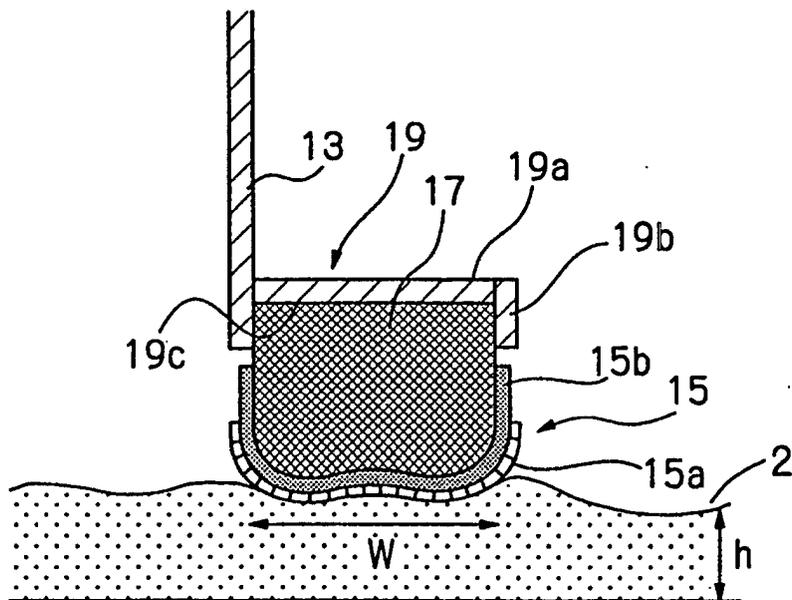
[Fig. 3g]



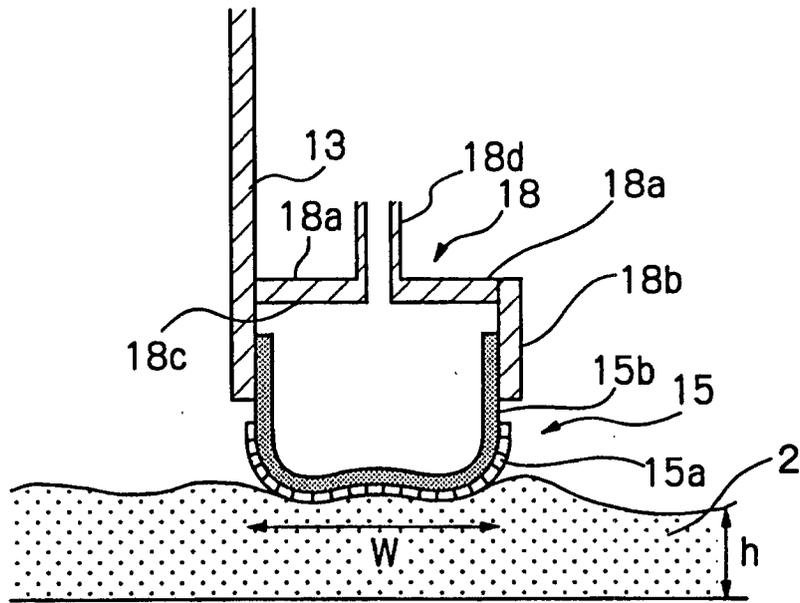
[Fig. 4]



[Fig. 5]

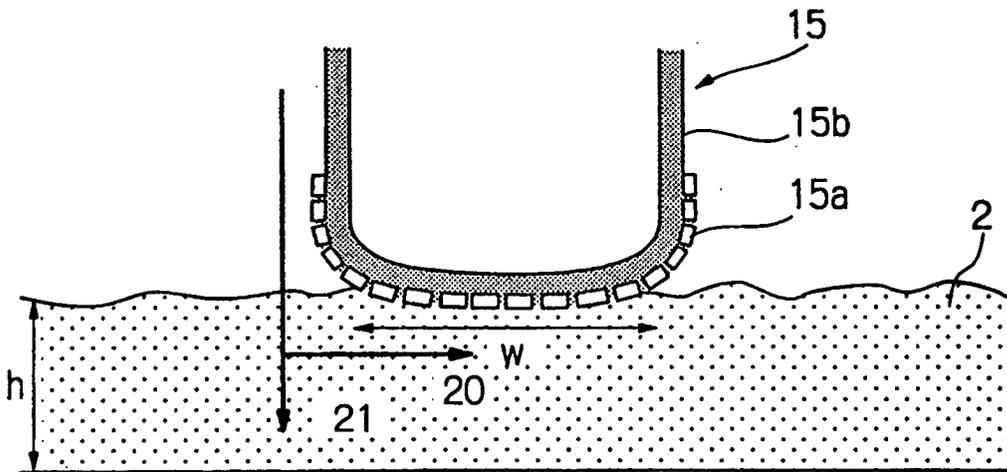


[Fig. 6]

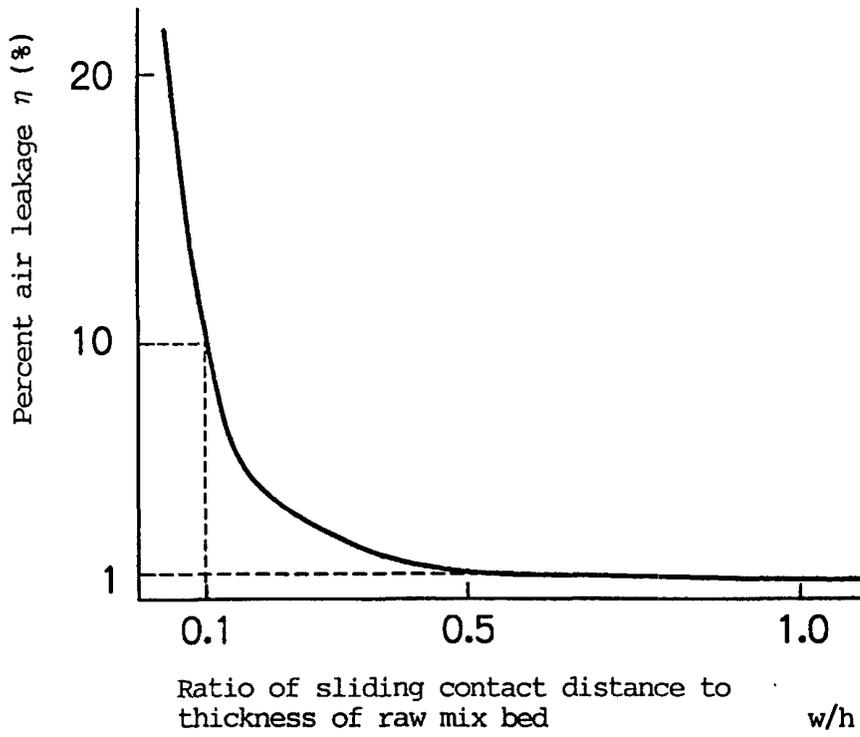


5

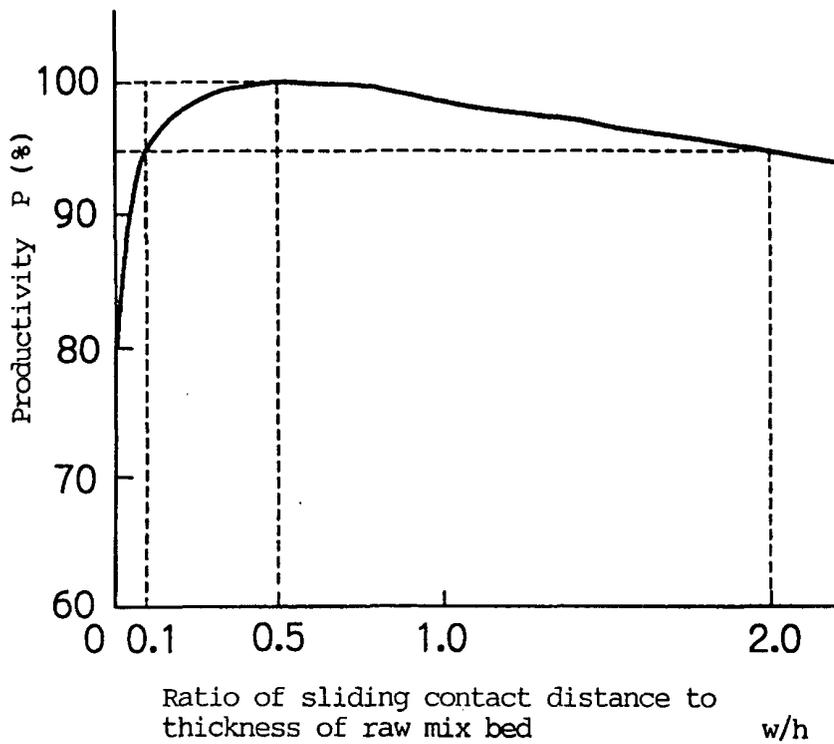
[Fig. 7]



[Fig. 8]



[Fig. 9]



(Description of Reference Numerals in the Drawings)

- 1 Sintering palette belt
- 2 Sintering raw mix bed
- 3 Pressurized gas blow hood
- 4 Pressurized gas blower
- 5 Raw mix hopper
- 6 Ignition hood
- 7 Sprockets
- 8 Wind boxes
- 9 Exhaust gas duct
- 10 Exhaust gas dust collector
- 11 Suction blower
- 12 Stack
- 13 Skirt lower edge
- 14 Sealing piece of conventional sealing apparatus
- 15 Sealing piece composed of a composite material comprising hard rigid body tips and an elastic body member in the sealing apparatus of the present invention
- 15a Hard rigid body tips
- 15a' Ceramic tip
- 15b Elastic body member
- 15b' Rubber member
- 15c Lower edge of sealing piece
- 16 Spring
- 17 Bulky elastic body member
- 18 Air duct
- 18a Upper wall of air duct
- 19 Support member
- 19a Upper wall of support member
- 19b Side wall provided at upper wall of support member
- 19c Bottom of upper (top) wall of support member
- 20 Gas flow in the lateral direction of sliding contact region of sealing piece in the pressurized gas blow hood
- 21 Gas flow in the perpendicular downward direction of sliding

contact region of sealing piece in the pressurized gas blow hood.

- w Width in the lateral direction in sliding contact with the surface of the sintering raw mix bed
- h Thickness of the sintering raw mix bed
- w/h ratio of width w in the lateral direction to the bed thickness h
- x Width of joints
- $t_1$  Thickness of exposed tips
- $t_2$  Thickness of tip layer
- $t_3$  Thickness of elastic body member

INTERNATIONAL SEARCH REPORT

International application No.  
PCT/JP01/01937

<p>A. CLASSIFICATION OF SUBJECT MATTER Int.Cl<sup>7</sup> F27B21/08</p> <p>According to International Patent Classification (IPC) or to both national classification and IPC</p>														
<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols) Int.Cl<sup>7</sup> F27B21/08</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2001 Kokai Jitsuyo Shinan Koho 1971-2001 Jitsuyo Shinan Toroku Koho 1996-2001</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)</p>														
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>P, A</td> <td>JP, 2000-249474, A (Nippon Steel Corpotation), 14 September, 2000 (14.09.00), Fig. 4 (Family: none)</td> <td>1-38</td> </tr> </tbody> </table> <p><input type="checkbox"/> Further documents are listed in the continuation of Box C.      <input type="checkbox"/> See patent family annex.</p> <p>* Special categories of cited documents:          "A" document defining the general state of the art which is not considered to be of particular relevance          "E" earlier document but published on or after the international filing date          "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)          "O" document referring to an oral disclosure, use, exhibition or other means          "P" document published prior to the international filing date but later than the priority date claimed          "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention          "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone          "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art          "&amp;" document member of the same patent family</p> <table border="1"> <tr> <td>Date of the actual completion of the international search 04 April, 2001 (04.04.01)</td> <td>Date of mailing of the international search report 17 April, 2001 (17.04.01)</td> </tr> <tr> <td>Name and mailing address of the ISA/ Japanese Patent Office</td> <td>Authorized officer</td> </tr> <tr> <td>Facsimile No.</td> <td>Telephone No.</td> </tr> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	P, A	JP, 2000-249474, A (Nippon Steel Corpotation), 14 September, 2000 (14.09.00), Fig. 4 (Family: none)	1-38	Date of the actual completion of the international search 04 April, 2001 (04.04.01)	Date of mailing of the international search report 17 April, 2001 (17.04.01)	Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer	Facsimile No.	Telephone No.
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.												
P, A	JP, 2000-249474, A (Nippon Steel Corpotation), 14 September, 2000 (14.09.00), Fig. 4 (Family: none)	1-38												
Date of the actual completion of the international search 04 April, 2001 (04.04.01)	Date of mailing of the international search report 17 April, 2001 (17.04.01)													
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer													
Facsimile No.	Telephone No.													