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(54) Apparatus for charging raw sinter mix to sintering machine

(57) An apparatus for charging raw sinter mix to a sintering machine comprises:

supply mechanism for supplying raw sinter mix onto a pallet;

a screen-shaped chute for charging the raw sinter mix supplied from the supply means onto the pallet;

the screen-shaped chute comprising:

a plurality of screen constituting member groups; and

a plurality of guide members to guide the screen constituting members,

transfer mechanism to move the two adjacent screen constituting member groups in a lengthwise direction of the screen constituting member, wherein the transfer mechanism comprises a connecting member at least a portion of which is constituted by a chain member.

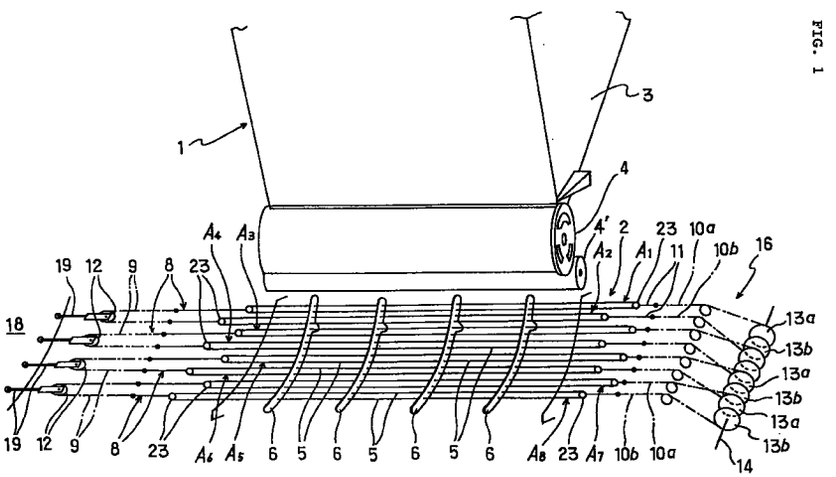

Fig. 1

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an apparatus for charging raw sinter mix on a traveling pallet of a sintering machine for manufacturing sintered ore to be used as a blast furnace material.

2. Description of the Related Arts

A sintering machine manufactures the sintered ore in such a manner that a raw sinter mix produced by mixing iron ore fines with coke fines, lime stone fines and the like is charged to a pallet to form a bed and the iron ore fines are sintered by burning the coke fines in the bed while the pallet is moved. The raw sinter mix must be charged onto the pallet in the state that the grain size of the raw sinter mix is properly segregated in the thickness direction of the bed, that is, in the state that a finer material is deposited toward an upper layer of the bed in order to secure the gas permeability of the bed and burning property of the coke fines when the raw mix is sintered.

There is known a charging apparatus disclosed in Japanese Unexamined Patent Publication No. 5-1335 as an apparatus permitting the grain-size-segregated-charge of the raw sinter mix. The apparatus is provided with a screen-shaped chute disposed below a supply mechanism such as a roll feeder in the state that it is inclined downward in the direction opposite to a pallet moving direction. The screen-shaped chute has such a structure that a multiplicity of rods are disposed at intervals in parallel with the width direction of the pallet with the intervals between the rods made narrower toward the upper portion of the chute.

FIG. 18 shows how a raw sinter mix is charged by the above charging apparatus, in which the raw sinter mix which is supplied from a supply mechanism 40 and falls down while sliding on a screen-shaped chute 41 is sieved according to the grain size thereof when it drops onto a pallet 43 through the intervals between rods 42 because the intervals between the rods 42 constituting the screen-shaped chute 41 are made narrower toward the upper side of the chute, so that a material having a larger grain size is charged to the starting side of the pallet 43. As a result, the bed formed after the material is charged has such a grain size segregation that a material of finer grain size is distributed to an upper layer of the bed.

However, the charging apparatus having the screen-shaped chute 41 as described above has a problem that the spaces between the rods 42 are clogged in a short time with the lime stone fines and coke fines which are adhered to the rods 42 of the screen-shaped chute 41 and the intrinsic function of the screen-shaped chute 41 cannot be achieved.

As a charging apparatus for solving the above problem, Japanese Unexamined Patent Publication No. 7-229684 proposes an apparatus arranged such that wire ropes are employed in place of the rods of the screen-shaped chute, the directions of one set or a plurality of sets of endless wire ropes are sequentially changed through pulleys to form a multiplicity of wire rope portions parallel with the width direction of a pallet as well as guide members for supporting the wires and also scraping off adhered materials are disposed to at intermediate positions of the wire rope portions disposed parallel with each other at several positions and the wire rope portions are inserted through the guide holes of the guide members. Each of the endless wire ropes is restricted between a pair of driving pulleys as a driving unit or wound around a driving drum about several times and the endless wire ropes are moved in circulation or reciprocation by the driving force thereof.

When a raw sinter mix is adhered to the wire rope portions constituting a chute surface in the above material charging apparatus, the respective endless wire ropes are driven by the driving units and the adhered raw sinter mix is scraped off when the wire ropes pass through the guide holes of the guide members.

However, the above conventional apparatus has problems to be described below.

(1) Since the endless wire ropes are liable to slip on the driving pulleys or the driving drums, the wire ropes may not smoothly and correctly move. In particular, when the endless wire ropes are reciprocatingly moved at a predetermined stroke (a stroke longer than the intervals between the guide members), they are liable to be slipped, thus an error is liable to be made to the moving distance of the wire ropes. Thus, the adhered material removing function may not be sufficiently achieved because the moving distance of the wire ropes is made shorter than the preset stroke and some of the wire rope portions cannot reach the guide holes of the guide members.

(2) Further, the wire rope portions constituting the chute surface are loosened and the intervals between the wire ropes are made greatly irregular due to the slip of the wire ropes as mentioned above, so that the grain-size-segregated-charging function intrinsic to the apparatus is liable to be damaged.

(3) Since the wire ropes are slid on the driving pulleys or the driving drum, they are worn in a short time and liable to be broken.

(4) In the system, since the long endless wire ropes are moved in such a manner that they are forcibly stretched in one direction by being restricted by the friction force between them and the driving pulleys or the driving drums, the wire ropes are elongated while they are used for a long time, thus the wire rope portions constituting the chute surface are loosened and the intervals between the wire ropes

are made greatly irregular likewise the above item (2), thus the grain-size-segregated-charging function intrinsic to the apparatus is liable to be damaged likewise the case of the above item (2).

In addition, since a large load is imposed on the stretched sides of the wire ropes and moreover the twist of the wire ropes is liable to be loosened due to the long use of them, the wire ropes themselves are liable to be broken.

(5) In the system that the wire ropes are moved by being wound around the driving drums, an error is liable to be caused to the moving distances of the wire ropes because the wire ropes are dislocated or twisted on the driving drums when they are wound therearound due to the elongation and the twist thereof. Thus, when the endless wire ropes are reciprocatingly moved at the predetermined stroke, the adhered material removing function may not be sufficiently achieved because some of the wire rope portions cannot reach the guide holes of the guide members likewise the above item (1).

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an apparatus for charging raw sinter mix wherein the raw sinter mix adhered to the outside surfaces of screen constituting members can be securely removed and the screen constituting members are difficult to be broken.

To attain the object, the present invention provides an apparatus for charging raw sinter mix to a sintering machine comprising:

supply means for supplying raw sinter mix onto a pallet;

a screen-shaped chute for charging the raw sinter mix supplied from the supply means onto the pallet, the screen-shaped chute being arranged below the supply means and being inclined downward in the direction opposite to a pallet moving direction;

and

transfer means for moving the two adjacent screen constituting member groups in a lengthwise direction of the screen constituting member.

The screen-shaped chute comprises a plurality of screen constituting member groups and a plurality of guide members for guiding the screen constituting members. The plurality of screen constituting member groups are disposed in parallel with each other at intervals in the lengthwise direction of the pallet. The plurality of guide members are disposed at intervals in the widthdirection of the pallet. The screen constituting member group comprises at least one screen constituting member. The outside surface of the screen constituting member is preferably coated with a resin. The screen constituting member is a wire or a rod. The guide member has guide holes to permit the screen constituting members to pass therethrough. A plastic bush is preferably arranged to inside of the guide hole.

The transfer means comprises: a connecting menber for connecting the respective one ends of two adjacent screen constituting member groups; a rotatable follower sprocket wheel for changing moving directions of the two adjacent screen constituting member groups each other; and drive means for move the two adjacent screen constituting member groups in an opposite direction each other. At least a portion of the connecting menber is composed of a chain in the lengthwise direction thereof. The chain is engaged around the rotatable follower sprocket wheel.

The drive means for move the two adjacent screen constituting member groups is preferably a chain-sprocket wheel system, a rack-pinion system, or a cylinder system.

In the chain-sprocket wheel system, said drive means includes connecting means for connecting the other ends of two adjacent screen constituting member groups; and said connecting means includes chain means which is engaged with the driving sprocket wheel.

The drive means can comprise: a pair of driving sprocket wheels which are disposed coaxially; and a pair of chains which are engaged around the pair of driving sprocket wheels in an opposite direction each other. The ends of the pair of chains are connected to the other ends of two adjacent screen constituting member groups.

The drive means can comprise: a driving sprocket wheel; and a chain which is engaged around the driving sprocket wheel. The ends of the chain are connected to the other ends of two adjacent screen constituting member groups.

It is preferable that the drive means further comprises: a timer for driving the driving sprocket wheel at arbitrary time intervals; and means for changing a direction of rotation of the driving sprocket wheel.

In the charging apparatus of the present invention, the screen constituting member group is a screen constituting member or at least two screen constituting members. The two adjacent screen constituting member groups move in an opposite direction each other. The two adjacent screen constituting member groups can be a screen constituting member group composed of a screen constituting member and a screen constituting member group composed of at least two screen constituting members.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing an embodiment of an apparatus for charging raw sinter mix according to the present invention.

FIG. 2 is a perspective view showing a pair of screen constituting member groups constituting a unit and a driving mechanism thereof in the embodiment shown in FIG. 1.

FIG. 3 is a front elevational view showing a chain

locking mechanism to a driving sprocket wheel which is applied to the embodiments shown in FIG. 1 and FIG. 2.

FIG. 4 is a front elevational view showing another chain locking mechanism to the driving sprocket wheel which is applied to the embodiments shown in FIG. 1 and FIG. 2.

FIG. 5 is a partial perspective view showing a guide member in the apparatus for charging raw sinter mix according to the present invention.

FIG. 6 is a front elevational view showing a breakage sensing mechanism provided with the apparatus for charging raw sinter mix according to the present invention.

FIG. 7 is a perspective view showing a pair of screen constituting members constituting a unit and a driving mechanism thereof according to the present invention.

FIG. 8 is a perspective view showing a screen constituting member group and a screen constituting member constituting a unit and a driving mechanism thereof according to the present invention.

FIG. 9 is a perspective view showing a pair of screen constituting member groups constituting a unit and a driving mechanism thereof according to the present invention.

FIG. 10 is a perspective view partially showing a pair of screen constituting member groups constituting a unit and the driving mechanism thereof according to the present invention.

FIG. 11 is a perspective view partially showing a pair of screen constituting member groups constituting a unit and the driving mechanism thereof according to the present invention.

FIG. 12 are graphs showing the transitions of productivity of sinter, unit consumption of coke fines, unit consumption of return fines, TI and percentage of -4 mm sinter.

FIG. 13 is a graph showing the distribution of grain size in the thickness direction of the bed when a raw sinter mix is charged using an apparatus of the present invention in Example 2.

FIG. 14 is a graph showing the distribution of grain size in the thickness direction of the bed when the raw sinter mix is charged using the conventional apparatus in Example 2.

FIG. 15 is a graph showing the distribution of coke content in the thickness direction of the bed when the raw sinter mix is charged using the apparatus of the present invention in Example 2.

FIG. 16 is a graph showing the distribution of coke content in the thickness direction of the bed when the raw sinter mix is charged using the conventional apparatus in Example 2.

FIG. 17A and FIG. 17B are graphs showing the temperature distribution in the width direction of a pallet under the grate of the sintering machine in the sintering operation of Example 3.

FIG. 18 is a view explaining the principle of a grain-size-segregated-charge executed by a apparatus for charging raw sinter mix provided with a screen-shaped chute.

DESCRIPTION OF THE EMBODIMENT

FIG. 1 and FIG. 2 show an embodiment of an apparatus for charging raw sinter mix of the present invention.

The apparatus for charging raw sinter mix includes a supply mechanism 1 for supplying a raw sinter mix onto a pallet and a screen-shaped chute 2 disposed below the material supply mechanism 1.

The supply mechanism 1 includes a raw sinter mix hopper 3, and a roll feeder and a drum chute 4' for feeding the raw sinter mix from the opening at the lower end of the hopper. However, the arrangement of the supply mechanism 1 is not limited to the above embodiment but may be arranged such that, for example, a belt conveyer is provided in place of the hopper 3, the roll feeder 4 and the drum chute 4' so that the raw sinter mix is directly supplied onto the screen-shaped chute 2 from an end of the belt conveyer.

The screen-shaped chute 2, which is used to charge the raw sinter mix supplied from the supply mechanism 1 onto the pallet (not shown) in the state that the grain size of the material is segregated in a thickness direction of the bed, is disposed such that it is inclined downward in the direction opposite to a pallet moving direction as well as the upper end thereof is located approximately just below the feed unit (the roll feeder 4 in the embodiment) of the supply mechanism 1.

The screen-shaped chute 2 includes a plurality of screen constituting members 5 which are composed of wire-shaped members (for example, wire ropes or the like) or bar-shaped members (for example, solid or hollow rods or the like) and disposed approximately in parallel with the width direction of the pallet and guide members 6 which support the screen constituting members 5 at the intermediate portions thereof as well as perform a function for scraping off the raw sinter mix adhered to the outside surfaces of the screen constituting members.

The plurality of screen constituting members 5 are movable in the width direction of the pallet with respect to the guide members 6 and disposed in the lengthwise direction (moving direction) of the pallet at suitable intervals in parallel with each other. These screen constituting members 5 constitute the chute surface of the screen-shaped chute 2 and are disposed so that the interval between adjacent screen constituting members 5 is made narrower toward the upper portions thereof to permit the raw sinter mix to be charged in a grain-size-segregated state. When it is assumed that the intervals between the screen constituting members 5 is W_1 on the uppermost side of the chute and w_n on the lowermost side thereof, the magnitude of the intervals may be, for example, continuously varied from the interval w_1 to the interval w_n for every intervals or varied stepwise

such as intervals w_1 -w_4, w_5 - w_8 ... for every several intervals, thus magnitude of the intervals may be arbitrarily set. Consequently, the structure of the present invention for making the interval of adjacent screen constituting members narrower toward the upper portion of the chute includes the above various fashions.

Although the screen constituting members 5 may be disposed to any one of a linear-shape, a concavely-curved-shape and the like in the lengthwise direction the pallet, it is particularly preferable to dispose them entirely to the concavely-curved-shape or to the linear-shape only at the upper portion of the chute and to the concavely-curved-shape in the portion following the above portion as shown in FIG. 18 to securely sieve the raw sinter mix by a screen by reducing the slidingly falling velocity of the material.

Further, although the screen constituting members 5 may be composed of the wire ropes, the rods (including the hollow rods) or the like as described above, the wire ropes are particularly preferable from the view point of a cost, strength, handling and the like, thus the screen constituting members 5 of the embodiment are also composed of the wire ropes. Note, the cross sectional shape of the screen constituting members 5 may be arbitrarily formed.

The plurality of guide members 6 are disposed at suitable intervals in the width direction of the pallet and supported and fixed by not shown support members such as frames or the like. Each of the guide members 6 has a plurality of guide holes 7 formed in the lengthwise direction thereof at intervals to permit the screen constituting members 5 to pass therethrough and the screen constituting members 5 slidingly pass through these guide holes 7. These guide members 6 support the long screen constituting members 5 at the intermediate portions thereof so as to keep the intervals between the screen constituting members as well as perform the function for scraping off the raw sinter mix adhered to the outside surfaces of the screen constituting members 5 when they move and pass through the guide holes 7. Thus, although the interval between adjacent guide members 6 is selected taking the above functions into consideration, they are usually disposed at the interval of about 800 - 1300 mm.

In the structure example, a set of a screen constituting member group A is composed of each two adjacent screen constituting members 5, 5 of the plurality of screen constituting members 5 constituting the chute surface by connecting both the ends of the screen constituting members 5, 5 by a coupling member 23, thus the structure example includes a total of 8 sets of screen constituting member groups A_1 - A_8. Then, each two sets of adjacent screen constituting member groups A, A (that is, A_1 - A_2, A_3 - A_4, A_5 - A_6, A_7 - A_8) of these screen constituting member groups A are arranged as one unit through which the screen constituting members 5 carry out a synchronous moving operation. For this purpose, the respective one ends of the two sets of adjacent screen constituting member groups A, A constituting one unit are connected by a connecting member 8 having a chain 9 at the intermediate portion thereof as well as the other ends thereof are connected to the driving portion (chains 10a, 10b) of a driving unit 16 to be described below.

The screen-shaped chute 2 includes a plurality of follower sprocket wheels 12 around which the chains 9 of the connecting members 8 corresponding to the above respective units disposed at an end thereof in the width direction of the pallet and the driving unit 16 composed of a plurality of pairs of driving sprocket wheels 13a, 13b corresponding to the respective units and the chains 10a, 10b to be wound around them disposed at the other end thereof. Each one pair of the driving sprocket wheels 13a, 13b constituting the driving unit 16 are disposed coaxially with to a driving shaft 14 which is driven in rotation by a not shown motor or the like. Further, the chains 10a, 10b are wound around the driving sprocket wheels 13a, 13b in an opposite direction each other.

Then, in each of the units, the chain 9 of the connecting member 8 for connecting the one ends of the screen constituting member groups A, A is wound around the follower sprocket wheel 12, whereas the chains 10a, 10b of the driving unit 16 are connected to the other ends of the screen constituting member groups A, A through a connecting member 11.

Therefore, in the apparatus of FIG. 1 and FIG. 2 arranged as described above, when the driving sprocket wheels 13a, 13b are rotated in an arbitrary direction, any one of the two sets of the screen constituting member groups A, A makes a going-motion and the other of them makes a returning-motion.

The chains 10a, 10b constituting the driving unit 16 are wound around the driving sprocket wheels 13a, 13b with a suitable winding surplus and locked by suitable means so that they do not fall away from the sprocket wheels. FIG. 3 and FIG. 4 show structure examples for the purpose. FIG. 3 shows an structure example in which the end 100 of a chain 10 is secured to a driving sprocket wheel 13 and FIG. 4 shows an structure example in which a guide member 15 is disposed to restrict the chain 10 around a portion of the outside periphery of the driving sprocket wheel 13. Note, the driving sprocket wheels 13a, 13b must have an outside diameter which is sufficient to permit the portion of a chain having the length of "the winding surplus of the chain" + "the moving amount of the screen constituting member" to be wound around the outside periphery thereof.

In the embodiment shown in FIG. 1 and FIG. 2, since the screen constituting members 5 are composed of the wire ropes, tension must be applied thereto. For this purpose, the positions of the follower sprocket wheels 12 is made adjustable in the width direction of the pallet with respect to the driving sprocket wheels 13a, 13b on the fixed side so that tension is applied to the screen constituting members 5 constituting the screen constituting member groups A as well as the tension is made arbitrarily adjustable. More specifically,

brackets 17 for rotatably holding the follower sprocket wheels 12 are supported by a fixed base portion 18 through support members 19 each of which is provided with a length adjustment mechanism 20 (for example, a turnbuckle or known means making use of a long hole), so that the positions of the follower sprocket wheels 12 can be adjusted in the width direction of the pallet by adjusting the length of the support members 19.

In the other drawings, numeral 27 denotes guide sprocket wheels for guiding the chains 10a, 10b.

It is preferable to apply resin coating of an urethane resin or the like to the outside surfaces of the wire ropes constituting the screen constituting members 5 to enhance an effect for restricting the adhesion of the raw sinter mix and scraping off the raw sinter mix adhered to the outside surfaces

Further, it is preferable to mount a bush 34 composed of a resin (for example, an urethane resin) to the inside of each of the guide holes 7 of the guide members 6 to thereby prevent the wear of the screen constituting members 5 which slide in the guide holes as shown in FIG. 5.

Further, FIG. 6 shows an embodiment in which a breakage sensor 21 is disposed to sense the breakage of the screen constituting member 5 at once if it should be broken. In the embodiment, an end of the support member 19 of the follower sprocket wheel 12 is mounted so as to be able to be inclined in a lower direction with respect to the fixed base portion 18 and the switch lever 22 of a limit switch constituting the breakage sensor 21 is disposed below the support member 19, so that the switch lever 22 is actuated by the support member 19 which is inclined downward when the screen constituting members 5 is broken (cut off) to thereby instantly sense the breakage of the screen constituting member 5.

Note, the structure of the breakage sensor 21 is not limited to the one shown in FIG. 6 but any appropriate arrangement may be employed such as, for example, a tension sensor disposed to the intermediate portion of the support member 19 or the portion where the support member 19 is mounted to the fixed base portion 18, or the like.

Note, in the embodiment shown in FIG. 1 and FIG. 2, each of the screen constituting member groups A may be composed of the arbitrary number of at least two of the screen constituting members 5 and further the two sets of the screen constituting member groups constituting one unit may have the different number of the screen constituting members 5 constituting the group.

Although the embodiment shown in FIG. 1 and FIG. 2 is arranged such that the two sets of the screen constituting member groups A, A are moved as the one unit, for example, each two adjacent screen constituting members 5 may be moved as one unit as shown in FIG. 7. That is, in this case, the respective one ends of the two adjacent screen constituting members 5, 5 are connected by the connecting member 8 having the chain 9 as well as the respective other ends thereof are connected to the chains 10a, 10b constituting the driving unit 16 directly or through a suitable connecting member.

In the apparatus shown in FIG. 7, when the driving sprocket wheels 13a, 13b are rotated in an arbitrary direction, any one of the two screen constituting members 5, 5 constituting the one unit makes a going-motion and the other of them makes a returning-motion.

Note, since the other arrangements are the same as those shown in FIG. 1 and FIG. 2, the same numerals are used to denote them and the detailed description of them is omitted.

Further, as shown in FIG. 8, one set of the screen constituting member group A and one screen constituting member 5 adjacent to it may be moved as one unit. That is, in this case, the screen constituting member group A is arranged by connecting both the ends of at least two adjacent screen constituting members 5 by the coupling member 23 and the respective one ends of the screen constituting member group A and the screen constituting member 5 adjacent to it are connected by the connecting member 8 having the chain 9 as well as the respective other ends of the screen constituting member group A and the screen constituting member 5 are connected to the chains 10a, 10b constituting the driving unit 16 directly or through the connecting member 11. The screen constituting member group A may be composed of the arbitrary number of at least two of the screen constituting members 5 also in this case.

In the apparatus of FIG. 8, when the driving sprocket wheels 13a, 13b are rotated in an arbitrary direction, any one of the screen constituting member group A and the screen constituting member 5 constituting the one unit makes a going-motion and the other of them makes a returning-motion.

Note, since the other arrangements are the same as those shown in FIG. 1 and FIG. 2, the same numerals are used to denote them and the detailed description of them is omitted.

FIG. 9 shows another embodiment using the driving unit 16a of the chain/sprocket wheel system. In the embodiment, the other ends (driving sides) of the two sets of the screen constituting member groups A, A constituting one unit are also connected by a connecting member 24 having a chain 25 at the intermediate portion thereof likewise the one ends (the follower sides) and the chain 25 is wound around a horizontal type driving sprocket wheel 26. In the embodiment arranged as described above, it suffices only to provide the one driving sprocket wheel 26 to the two sets of screen constituting member groups A, A constituting the one unit. The driving unit 16 shown in FIG. 9 is also applicable to the embodiments of FIG. 7, FIG. 8 and the like.

In the apparatus of FIG. 9, when the driving sprocket wheel 26 is rotated in an arbitrary direction, any one of the two sets of screen constituting member groups A, A constituting the one unit makes a going-motion and the other of them makes a returning-motion.

Note, numeral 33 in the drawing denotes guide sprocket wheels for guiding the chain 25. Since the other arrangements are the same as those shown in FIG. 1 and FIG. 2, the same numerals are used to denote them and the detailed description of them is omitted.

FIG. 10 and FIG. 11 show another embodiment using a driving unit other than the chain sprocket wheel system. FIG. 10 shows an embodiment using a driving unit 16 of a rack/pinion system and FIG. 11 shows an embodiment using a driving unit 16 of a cylinder system employing an air cylinder or the like.

The structure shown in FIG. 10 is arranged such that a pair of parallel rack members 28a, 28b is disposed to the other ends of two sets of screen constituting member groups A, A constituting one unit so as to be movable in the width direction of the pallet along guides 29 with the rack portions thereof confronting each other as well as a pinion 30 to be meshed with both the rack portions 280 is interposed between both the rack members 28a, 28b and the respective rack members 28a, 28b are connected to the respective other ends of the screen constituting member groups A, A through connecting members 31.

In the apparatus of FIG. 10, when the pinion 30 is rotated in an arbitrary direction, any one of the rack members 28a, 28b makes a going-motion and the other of them makes a returning-motion and as the rack members 28a, 28b move, the screen constituting member groups A, A also make a going- and returning-motions.

Further, the structure shown in FIG. 11 is arranged such that a pair of cylinder units 32a, 32b (air cylinders, hydraulic cylinders etc.) is disposed to the other ends of two sets of screen constituting member groups A, A constituting one unit and the respective actuating rods 320 of the pair of cylinder units 32a, 32b are connected to the respective other ends of the screen constituting member groups A, A through the connecting members 31.

In the apparatus shown in FIG. 11, when any one of the actuating rods 320 of the pair of cylinder units 32a, 32b is advanced and the other thereof is retracted at the same time, the screen constituting member groups A, A also make going- and retracting-operation as the actuating rods 320 are advanced and retracted.

The driving units 16 shown in FIG. 10 and FIG. 11 are also applicable as the driving units of any one of the embodiments shown in FIG. 1, FIG. 2 and FIG. 7 -FIG. 9.

Note, the apparatus of the present invention may dispose a sheet-shaped chute above the screen-shaped chute 2 in place of the drum chute 4, that is, the sheet-shaped chute may be disposed approximately just below the material discharge portion and the screen-shaped chute 2 may be disposed on a line extending from the sheet-shaped chute downward. Further, the apparatus may employs a structure in which no drum chute 4' and sheet-shaped chute are provided.

Next, a using example and operation of the apparatus for charging raw sinter mix of the present invention will be described as to the embodiment shown in FIG. 1 and FIG. 2.

The basic grain-size-segregated charging function achieved by the screen-shaped chute 2 constituting the apparatus of the present invention is similar to that of the conventional apparatus shown in FIG. 18.

On the other hand, in the apparatus of the present invention, the driving unit 16 is driven at predetermined time intervals while the apparatus is run as well as the driving sprocket wheels 13a, 13b are alternately rotated in an opposite direction each time the driving unit 16 is driven to thereby cause the pair of screen constituting member groups A, A constituting each unit to make going-and returning-motions in the width direction of the pallet. The moving stroke of the going- and returning-motions of the screen constituting members 5 is set longer than the interval between adjacent guide members 6.

For example, when the adjacent guide members 6 have the interval of 900 mm, the driving sprocket wheels 13a, 13b are rotated in the directions of the arrows of the solid lines in FIG. 2 to thereby move the screen constituting member groups A, A in the directions of the arrows of the solid lines and stop them after they are moved, for example, 1100 mm. Then, after a predetermined period of time (for example, about 15 minutes) elapses, the driving sprocket wheels 13a, 13b are rotated in the directions of the arrows of the broken lines which are opposite to the above rotational directions to thereby move the screen constituting member groups A, A in the directions of the arrows of the broken lines and stop them when they return to original positions. Thereafter, the respective screen constituting member groups A, A are caused to make the going- and returning-motions by repeating the above driving and stopping operations.

Although the raw sinter mix adhered to the outside surfaces of the screen constituting members 5 is scraped off when they pass through the guide holes 7 of the guide members 6, since the moving distance (stroke) of the screen constituting members 5 is larger than the intervals between the guide members 6, the entire length of the screen constituting members 5 pass through the guide holes 7 of the guide members 6 each time the screen constituting members 5 move (going- or returning-motion), so that the raw sinter mix adhered to the outside surfaces thereof is properly removed. Then, since the screen constituting members 5 are moved at suitable time intervals, the adhesion and deposition of the raw sinter mix to the outside surfaces of the screen constituting members 5 can be effectively suppressed.

The above operation can be also obtained by the embodiments shown in FIG. 7 - FIG. 9, FIG. 10 and FIG. 11 likewise. The screen constituting member groups A, A can be caused to make going- and returning-motions at a predetermined stroke, respectively, by for example, forwardly and reversely rotating the driving sprocket wheel 26 at a predetermined time interval likewise the

above embodiment in the case of the embodiment of FIG. 9, forwardly and reversely rotating the pinion 30 at a predetermined time interval in the case of the embodiment of FIG. 10 and further advancing and retracting the actuating rods 320 of the pair of cylinder units 32a, 32b in an opposite direction each other at a predetermined time interval in the case of the structure example of FIG. 11.

Note, the driving conditions and using fashion of the screen constituting members may be arbitrarily selected in the apparatus of the present invention and they are not limited to the above fashions.

Since the apparatus of the present invention is arranged such that the pair of screen constituting members 5, 5 or the screen constituting member groups A, A are arranged as one unit, the one ends thereof are coupled by the chain 9 and the chain 9 is wound around the follower sprocket wheel 12, the driving unit 16 of the chain/sprocket wheel system, the rack-pinion system or the cylinder system is provided and the driving portion thereof is connected to the other ends of the screen constituting members 5 or the screen constituting member groups A, problems caused in the conventional apparatus by using the driving drum or the driving pulley are entirely eliminated, thus the screen constituting members 5 are accurately moved by the amount of a set stroke as well as the grain-size segregated-charging function intrinsic to the apparatus can be stably maintained for a long time. That is, even if the wire ropes are used as the screen constituting members, the mechanical means such as the chain/sprocket wheels, racks/pinions and the like constituting the follower side and driving side mechanisms does not intrinsically cause the problem of slip, extension and the like and further since there is no room for making winding displacement, twist, friction and the like which wound be caused when a wire rope is wound around the driving drum, there is no possibility for causing the aforesaid problems (1) - (5) in the conventional apparatus.

Example 1

A apparatus for charging raw sinter mix of the present invention shown in FIG. 1 and FIG 2 was disposed to a sintering machine and a sintering operation was carried out using the apparatus for charging raw sinter mix. In the operation, the amount of raw sinter mix (iron ore fines, lime stone fines , coke fines and return fines) to be supplied was set to 980 tons/hour.

The apparatus for charging raw sinter mix of the present invention was arranged such that screen constituting members 5 constituting a screen-shaped chute 2 was composed of wire ropes and the number of them was set to 22 pieces. The interval between adjacent screen constituting members 5 was set to 20 mm at the uppermost side thereof and to 24 mm at the lowermost side thereof so that the interval was made narrower toward the upper side of the chute. As to the disposition of the screen constituting members in the lengthwise direction of a pallet, the eight screen constituting members 5 on the upper side of the chute were disposed to a linear-shape (angle to a horizontal plane: 58 degrees) and the screen constituting members 5 below them were disposed to a concavely-curved-shape.

An 11 mm outside diameter wire rope composed of a rope main body (iron core wire) with an outside diameter of 4 mm and having an outside surface covered with an urethane resin was used as the wire ropes constituting the screen constituting members 5. Further, a bush 34 of a polyurethane resin having an inside diameter of 12 mm was mounted to each of the guide holes 7 of guide members 6 for supporting the screen constituting members 5 and inserted through the screen constituting member 5.

As the driving conditions of the screen constituting members 5, a moving distance: 1100 mm/once and a moving velocity: 2 m/minute were set. Driving sprocket wheels 13a, 13b were driven at the interval of every 15 minutes and rotated in an opposite direction each time so that the screen constituting members 5 made going- and returning-motions in the width direction of the pallet.

As a result of observation how the material was adhered to the screen-shaped chute 2 during the operation of 24 hours, it was admitted that a very slight amount of the raw sinter mix was adhered to the screen-shaped chute 2 and the material adhered to the side portion of the guide members 6 was exfoliated as the screen constituting members 5 were moved. In the conventional apparatus which was not provided with a mechanism for moving screen constituting members, although an operator manually removed a raw sinter mix adhered to screen constituting members and brackets every two hours such a removing job was not required at all in the apparatus for charging raw sinter mix of the present invention during the above entire operation period. In addition, no wire rope was broken in the operation.

FIG. 12 are graphs showing the transitions of the sintering operation using the apparatus for charging raw sinter mix of the present invention in comparison with those of the conventional apparatus without the mechanism for moving the screen constituting members. Since a proper grain-size-segregated charge was carried out in the sintering operation using the charging apparatus of the present invention, the uniformity of a sintered state was greatly improved in the width direction of the pallet as compared with the case that the conventional apparatus was used. As a result, the unit consumption of return fines was reduced by about 14 kg/ton of sinter as compared with that of the conventional apparatus and a yield of sinter was greatly enhanced. Consequently, the unit consumption of coke fines was also reduced by about 1.0 kg/ ton of sinter, thus the reduction of a fuel cost was realized. In addition, since the proper grain-size-segregated charge was stably realized and a sintering bed had a good gas permeability, the strength of sinter at ordinary temperature (TI) was improved.

Example 2

A sintering operation was carried out using an apparatus similar to that of Example 1 under the same operation conditions as Example 1, a material was sampled from a total of five positions in the thickness direction of the bed (bed height: about 580 mm) in the vicinity of a charging portion during the operation and the average grain size of the material at the respective sampling positions and the coke (carbon) content in the material were examined. FIG. 13 - FIG. 16 show the result of the examination in comparison with the case that the conventional apparatus without the mechanism for moving the screen constituting members was used.

FIG. 13 (the apparatus of the present invention) and FIG. 14 (the conventional apparatus) show the average grain size in the thickness direction of the bed and FIG. 15 (the apparatus of the present invention) and FIG. 16 (the conventional apparatus) show the coke (carbon) content in the material in the layer thickness direction.

In the case of the apparatus of the present invention shown in FIG. 13 and FIG. 15, since the screen constituting members 5 were moved at intervals of about 15 minutes, there are shown the result of samplings which were carried out at a timing in 5 minutes after the screen constituting members 5 were moved once (the average grain size and the coke content shown by (A) in the figure) and at a timing in a little shorter than 15 minutes which was just before the screen constituting members 5 were moved next time (the average grain size and the coke content shown by (B) in the figure). On the other hand, in the case of the conventional apparatus shown by FIG. 14 and FIG. 16, there are shown the result of samplings which were carried out at timings in 5 minutes and 120 minutes after the screen-shaped chute was manually cleaned (cleaning and removing of the adhered sintering material).

First, as to the distribution of grain size in the thickness direction of the bed, there was almost no change in the distribution in 5 minutes and in a little shorter than 15 minutes after the movement of the screen constituting members 5 in the case of the apparatus of the present invention shown in FIG. 13, thus a properly-segregated-charging-state was obtained in which the grain size was made smaller toward the upper layer. Since the screen constituting members 5 were moved at the intervals of every 15 minutes in the apparatus, the segregated charging state was not substantially made worse than the state of (B) shown in FIG. 13. On the other hand, in the case of the conventional apparatus without the mechanism for moving the screen constituting members shown in FIG. 14, since the raw sinter mixwas gradually adhered to and deposited on the outside surfaces of the screen constituting members and the spaces therebetween were clogged, the distribution of grain size was averaged in the thickness direction of the bed when 120 minutes elapsed after cleaning, thus a properly-grain-size-segregated-charging-state could not be obtained.

Further, as to the distribution of coke content in the thickness direction of the bed, there was almost no large change in the distribution in 5 minutes and in a little shorter than 15 minutes after the movement of the screen constituting members 5 in the case of the apparatus of the present invention shown in FIG. 15, thus a properly-segregated-charging-state in which the coke content was higher toward the upper layer was obtained. Since the screen constituting members 5 were moved at the intervals of every 15 minutes in the apparatus as described above, the segregated-charging-state was not substantially made worse than the state after a little less than 15 minutes were elapsed shown in FIG. 15. On the other hand, in the case of the conventional apparatus without the mechanism for moving the screen constituting members shown in FIG. 16, since the raw sinter mix was gradually adhered to and deposited on the outside surfaces of the screen constituting members and the spaces therebetween were clogged, the coke content in the thickness direction was averaged when 120 minutes elapsed after cleaning, thus a properly-grain-size segregated-charging-state that the coke content was higher toward the upper layer could not be obtained.

Example 3

A sintering operation was carried out using an apparatus similar to that of Example 1 under the same operation conditions as Example 1 and a temperature distribution was examined in the width direction of a pallet below the grate of a sintering machine between No. 18 WB (wind box) - No. 23 WB (wind box) during the operation. FIG. 17 shows the result of examination in comparison with the case that the conventional apparatus without the mechanism for moving the screen constituting members was used. In the case of the conventional apparatus shown in FIG. 17A, there is shown a temperature distribution when a material layer, which was charged in about 100 - 110 minutes after a screen-shaped chute was cleaned, passed, whereas in the case of the apparatus of the present invention shown in FIG. 17B, there is shown a temperature distribution when a material layer, which was charged in about 5 minutes - a little shorter than 15 minutes after the screen constituting members were moved once, passed, respectively.

In the case of the conventional apparatus shown in FIG. 17A, since there is a large difference of temperature in the width direction of the pallet, it is apparent that a sintered state was greatly dispersed in the width direction of the pallet, by which it is shown that the material was adhered to and deposited on the screen-shaped chute of the apparatus for charging raw sinter mix to thereby damage a grain-size-segregated-charging function so that a segregated charge was not properly carried out. Whereas, in the case of the apparatus of the present invention shown in FIG. 17B, the temperature

difference in the width direction of the pallet is remarkably removed, thus it is shown that the segregated-charge of the material could be stably maintained by using the apparatus of the present invention.

According to the raw sinter mixcharging apparatus of the present invention as described above, since the screen constituting members such as the wire ropes and the like constituting the screen-shaped chute can be moved smoothly and accurately for a long period of time without causing the problem of the extension, twist, wear, breakage and the like of the wire ropes and the like, the function for removing a raw sinter mixadhered to the outside surfaces of the screen constituting members and the grain-size-segregated-charging function which is intrinsic to the apparatus can be stably maintained for a long period of time.

Claims

1. An apparatus for charging raw sinter mix to a sintering machine comprising:

supply means for supplying raw sinter mix onto a pallet;
a screen-shaped chute for charging the raw sinter mix supplied from the supply means onto the pallet, the screen-shaped chute being arranged below the supply means and being inclined downward in the direction opposite to a pallet moving direction;
the screen-shaped chute comprising:

a plurality of screen constituting member groups which are disposed in parallel with each other at intervals in the lengthwise direction of the pallet, the screen constituting member group including at least one screen constituting member; and
a plurality of guide members for guiding the screen constituting members, the guide member having guide holes to permit the screen constituting members to pass therethrough and being disposed at intervals in the width direction of the pallet,

transfer means for moving the two adjacent screen constituting member groups in a lengthwise direction of the screen constituting member;
the transfer means comprising:

a connecting menber for connecting the respective one ends of two adjacent screen constituting member groups, at least a portion of the connecting menber being composed of a chain in the lengthwise direction thereof;
a rotatable follower sprocket wheel, around which the chain is engaged, for changing moving directions of the two adjacent screen constituting member groups each other; and
drive means for moving the two adjacent screen constituting member groups in an opposite direction each other.

2. The apparatus of claim 1, wherein said screen constituting member is a wire.

3. The apparatus of claim 1, wherein said screen constituting member is a rod.

4. The apparatus of claim 1, wherein said drive means includes a driving sprocket wheel.

5. The apparatus of claim 4, wherein
said drive means includes connecting means for connecting the other ends of two adjacent screen constituting member groups; and
said connecting means includes chain means which is engaged with the driving sprocket wheel.

6. The apparatus of claim 4, wherein said drive means comprises:

a pair of driving sprocket wheels which are disposed coaxially;
and
a pair of chains which are engaged around the pair of driving sprocket wheels in an opposite direction each other, the ends of the pair of chains being connected to the other ends of two adjacent screen constituting member groups.

7. The apparatus of claim 4, wherein said drive means comprises:

a driving sprocket wheel; and
a chain which is engaged around the driving sprocket wheel, the ends of the chain being connected to the other ends of two adjacent screen constituting member groups.

8. The apparatus of claim 4, wherein said drive means further comprises:

a timer for driving the driving sprocket wheel at arbitrary time intervals; and
means for changing a direction of rotation of the driving sprocket wheel.

9. The apparatus of claim 1, wherein said drive means comprises a rack and pinion system.

10. The apparatus of claim 1, wherein said drive means comprises a cylinder system.

11. The apparatus of claim 1, wherein said screen constituting member group is a screen constituting member and the two adjacent screen constituting members move in an opposite direction each other.

12. The apparatus of claim 1, wherein said screen constituting member group is at least two screen constituting members and the two adjacent screen constituting member groups move in an opposite direction each other.

13. The apparatus of claim 1, wherein said two adjacent screen constituting member groups are a screen constituting member group composed of a screen constituting member and a screen constituting member group composed of at least two screen constituting members, and the two adjacent screen constituting member groups move in an opposite direction each other.

14. The apparatus of claim 1, wherein said screen constituting member has a resin coating on the outside surface thereof.

15. The apparatus of claim 1, wherein the guide hole of the guide member has a plastic bush inside of the guide hole.

16. The apparatus of claim 1, further comprising a breakage sensor on a mechanism for supporting the follower sprocket wheel to sense a breakage of the screen constituting member.

FIG. 1

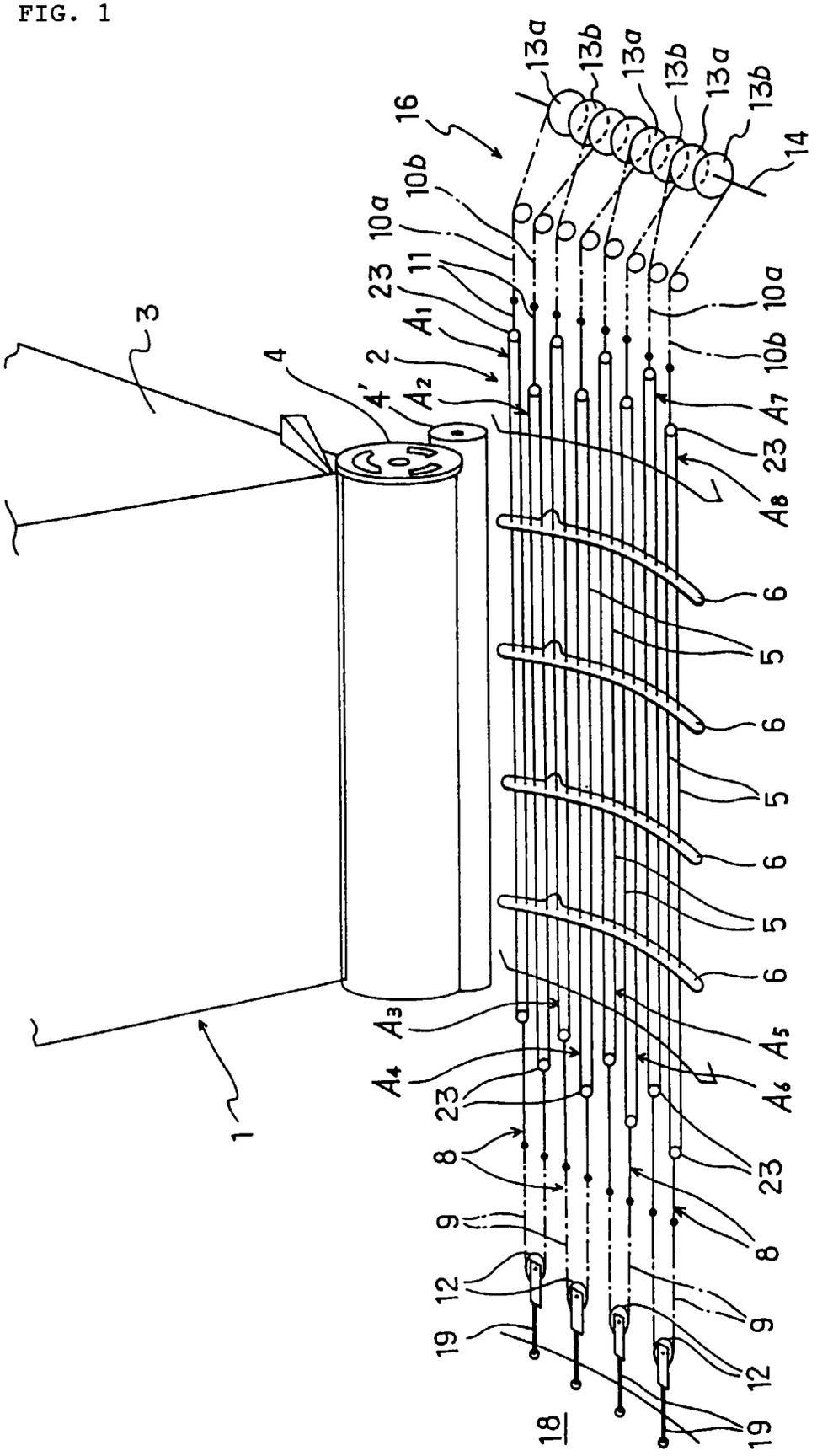

13a
13b
13a
13b
13a
13b
14
16
10b
10a
23
11
A1
2
A2
4'
4
3
10a
10b
A7
23
A8
6
5
6
5
6
5
6
A3
A4
A5
A6
23
8
9
12
19
18
1

FIG. 2

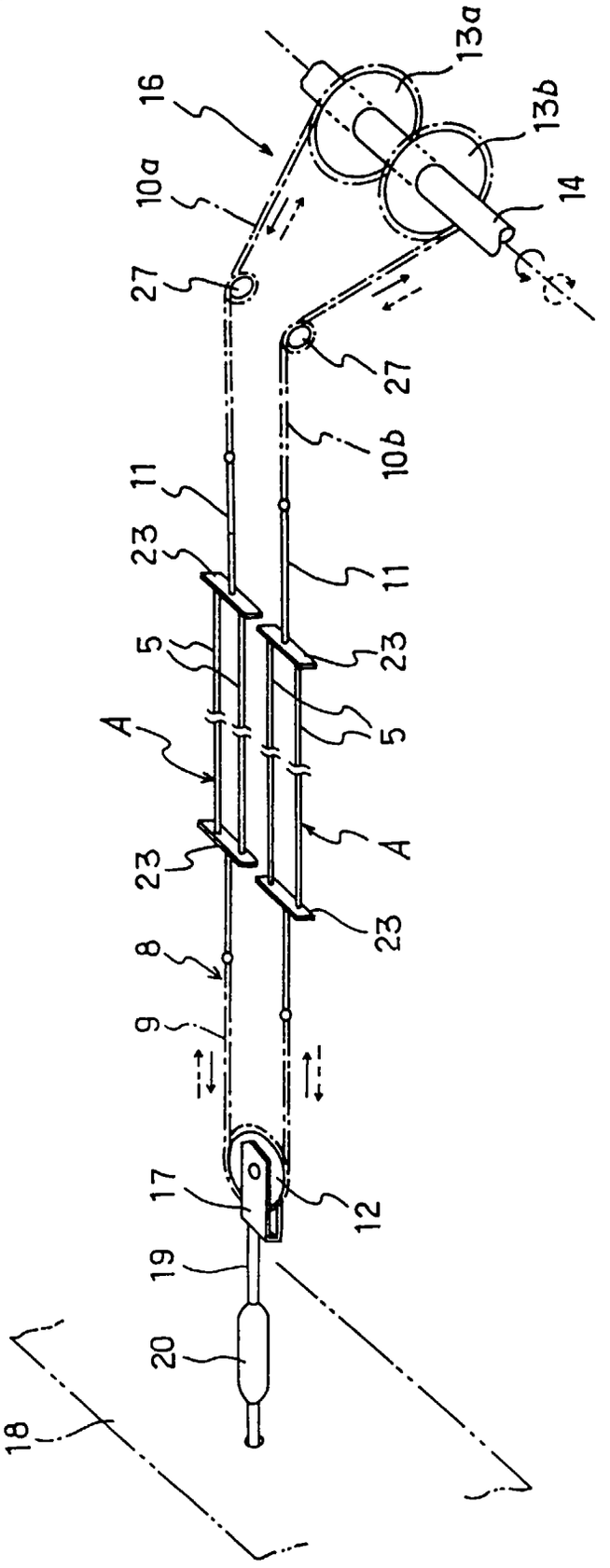


FIG. 3

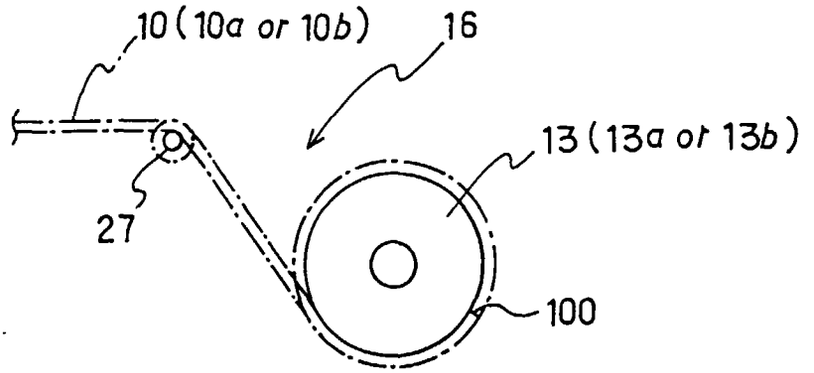

10 (10a or 10b)
16
13 (13a or 13b)
27
100

FIG. 4

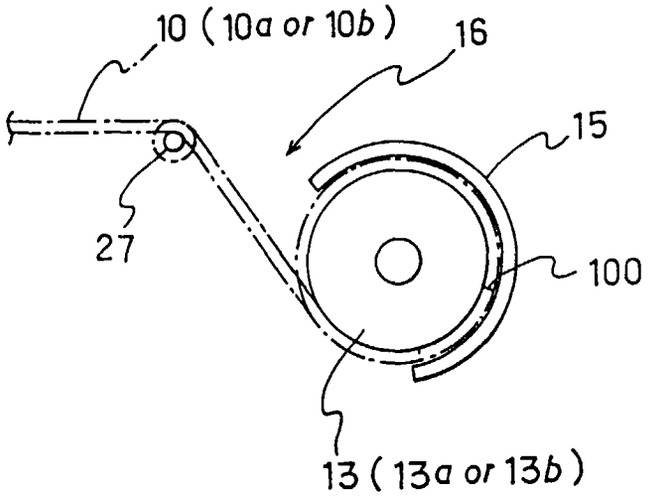

10 (10a or 10b)
16
15
27
100
13 (13a or 13b)

FIG. 5

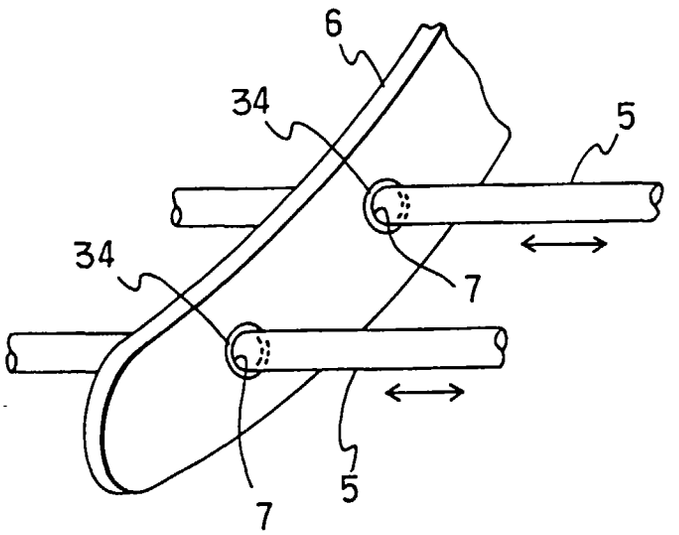


FIG. 6

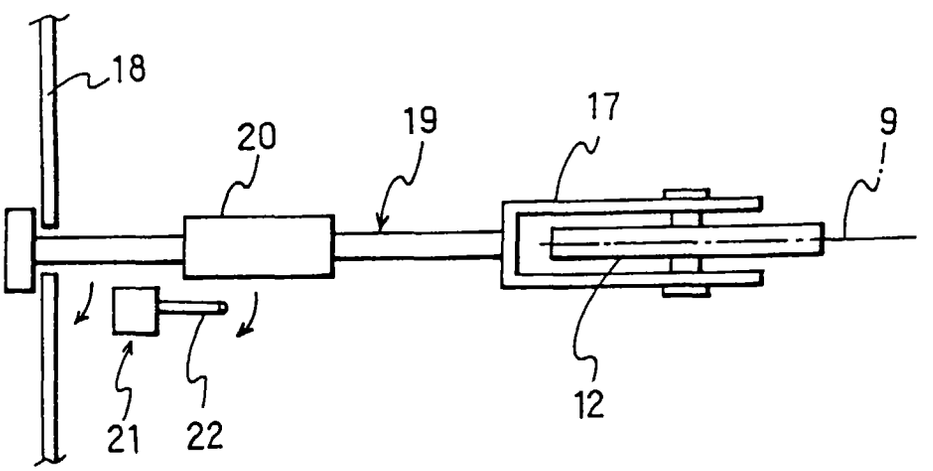


FIG. 7

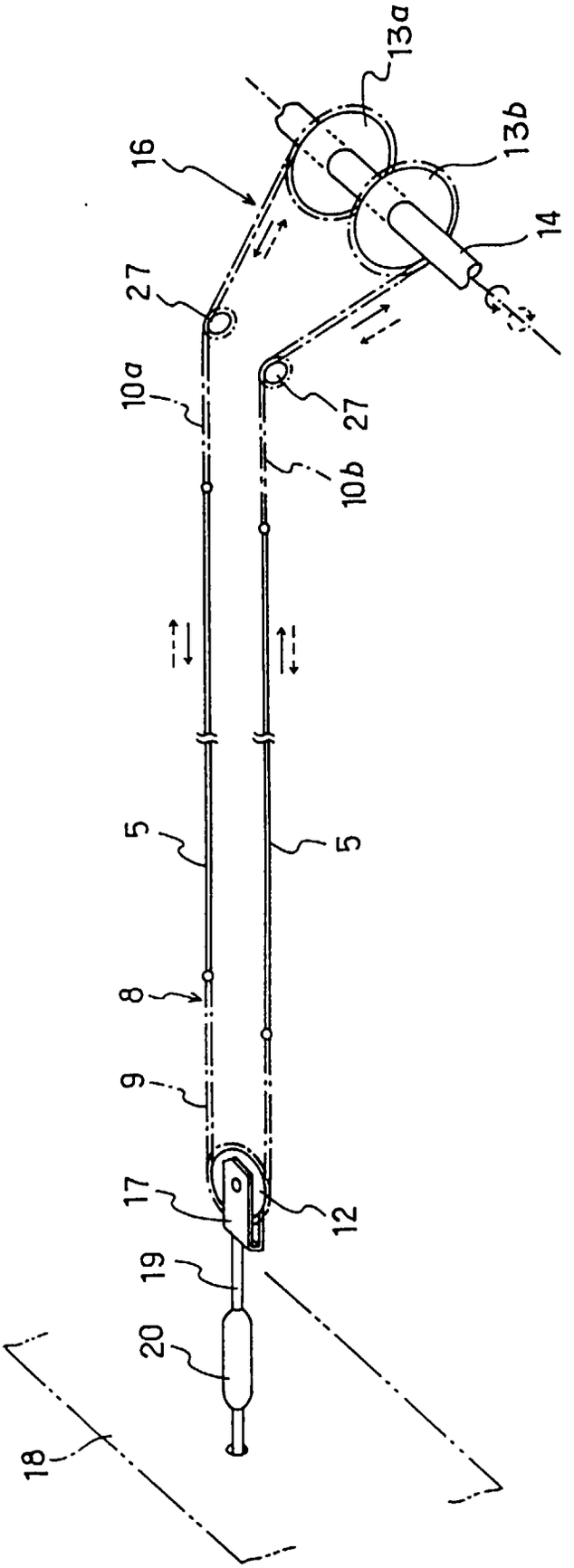


FIG. 8

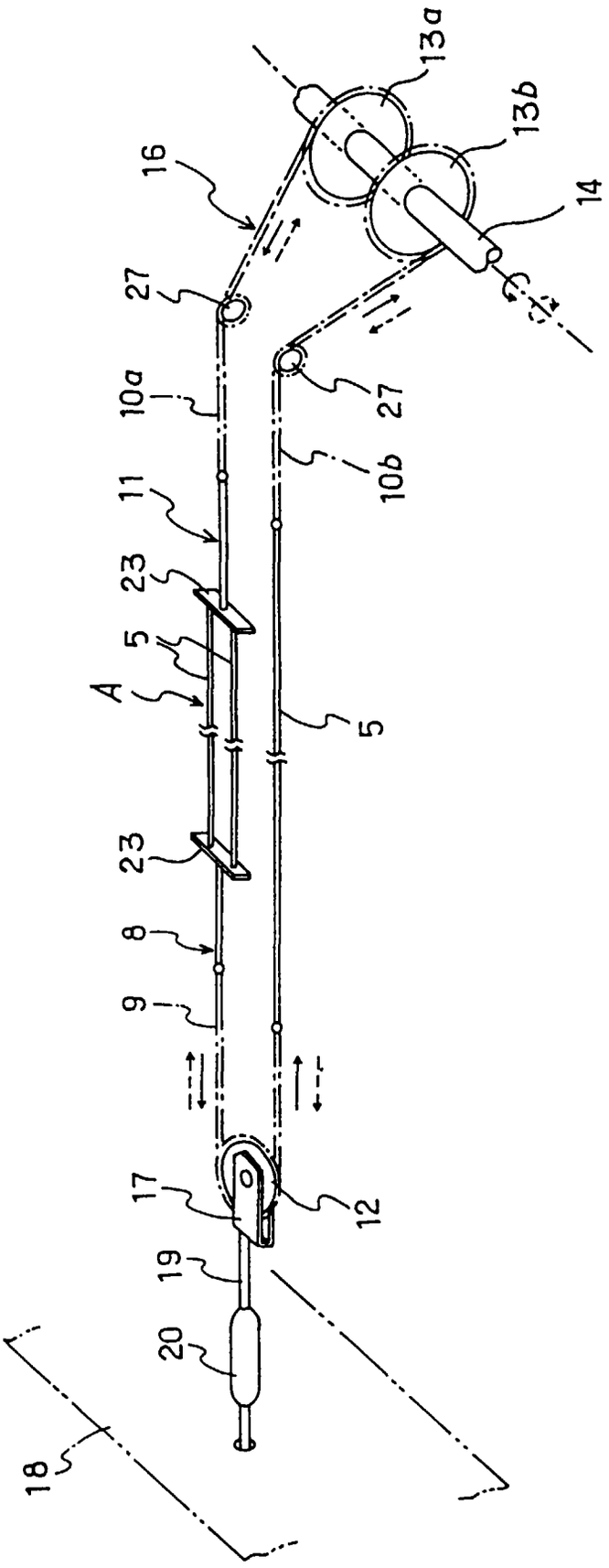


FIG. 9

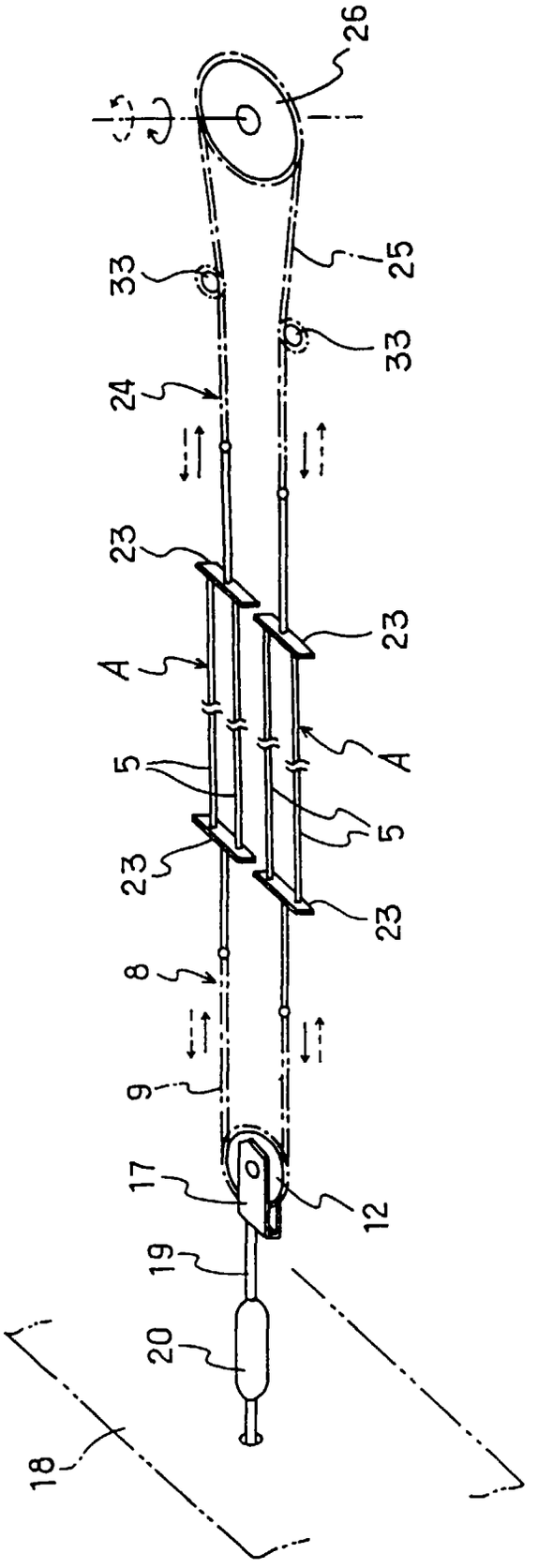


FIG. 10

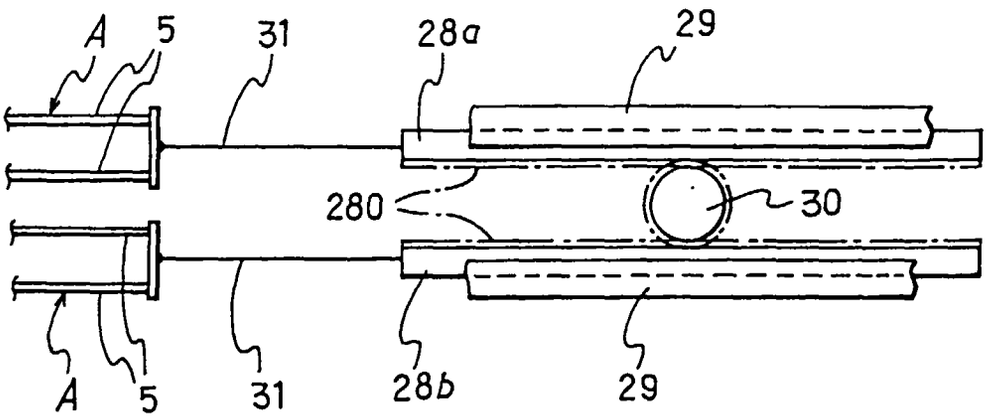


FIG. 11

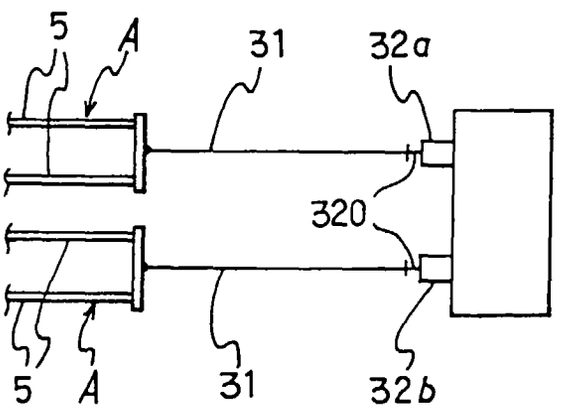


FIG. 12

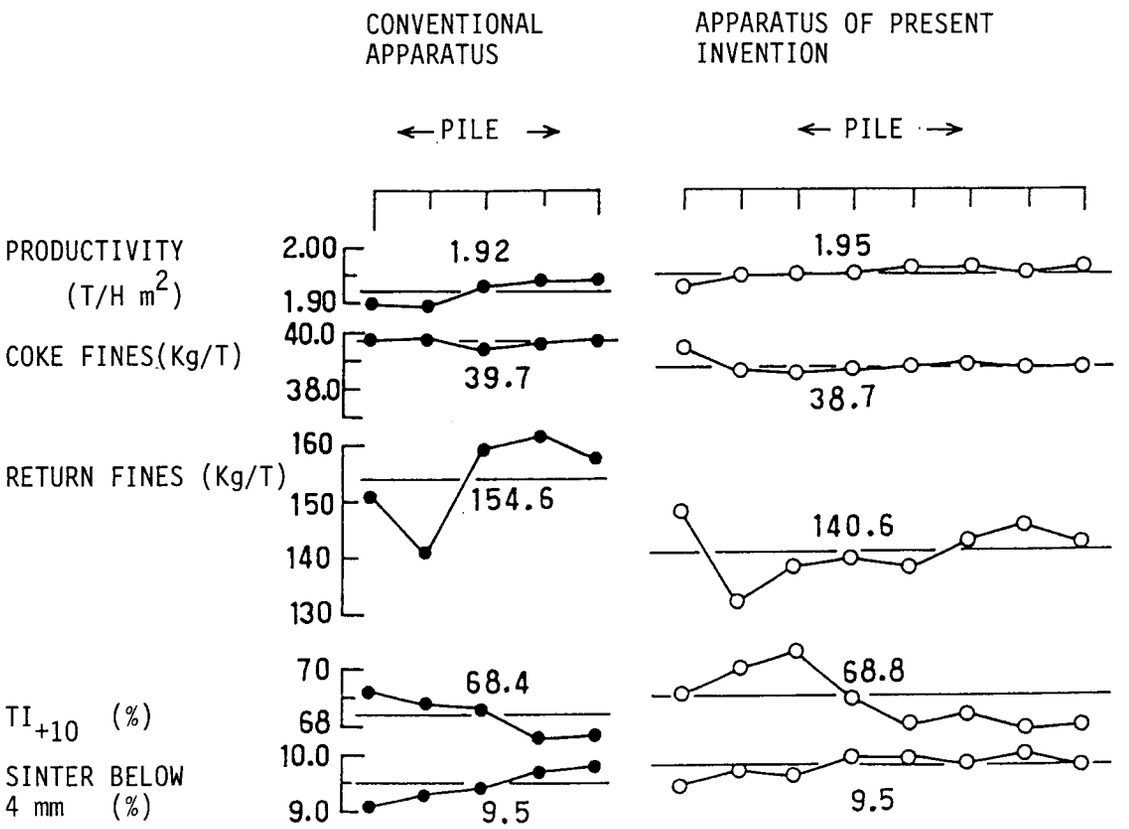

CONVENTIONAL APPARATUS
APPARATUS OF PRESENT INVENTION
← PILE →
← PILE →
PRODUCTIVITY (T/H m²)
2.00
1.90
1.92
1.95
COKE FINES(Kg/T)
40.0
38.0
39.7
38.7
RETURN FINES (Kg/T)
160
150
140
130
154.6
140.6
TI+10 (%)
70
68
68.4
68.8
SINTER BELOW 4 mm (%)
10.0
9.0
9.5
9.5

FIG. 13 APPARATUS OF PRESENT INVENTION

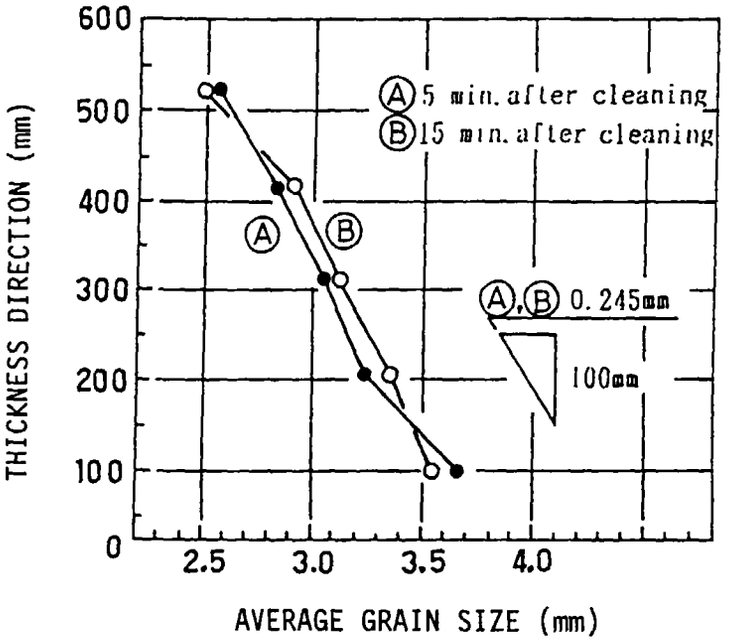


FIG. 14 CONVENTIONAL APPARATUS

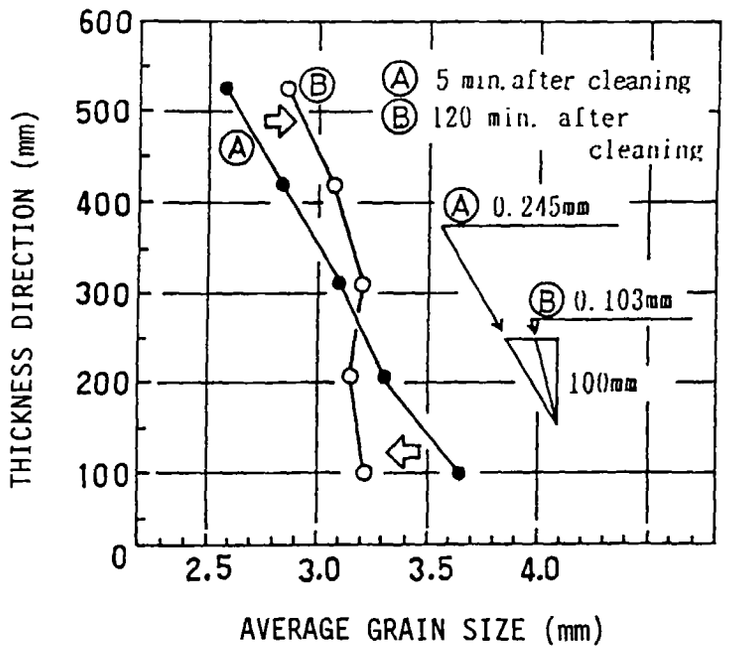


FIG. 15 APPARATUS OF PRESENT INVENTION

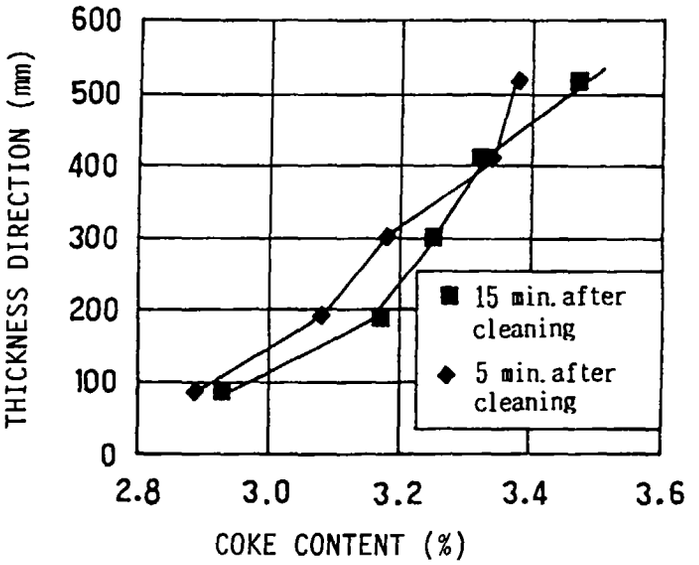


FIG. 16 CONVENTIONAL APPARATUS

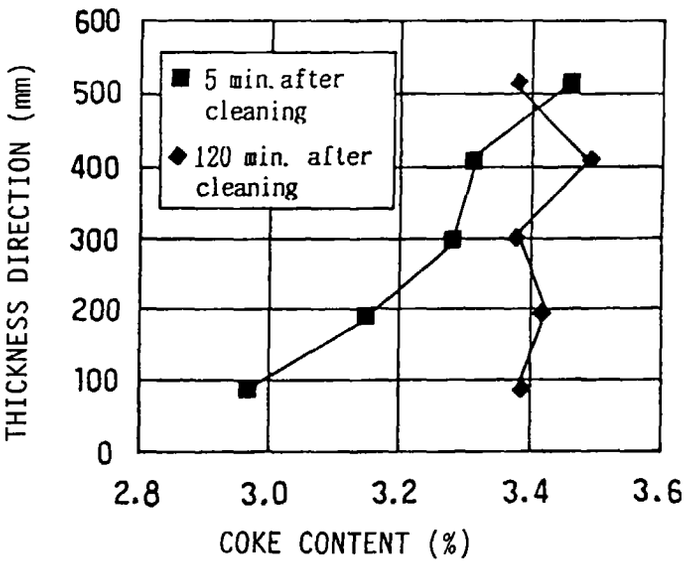


FIG. 17A CONVENTIONAL APPARATUS

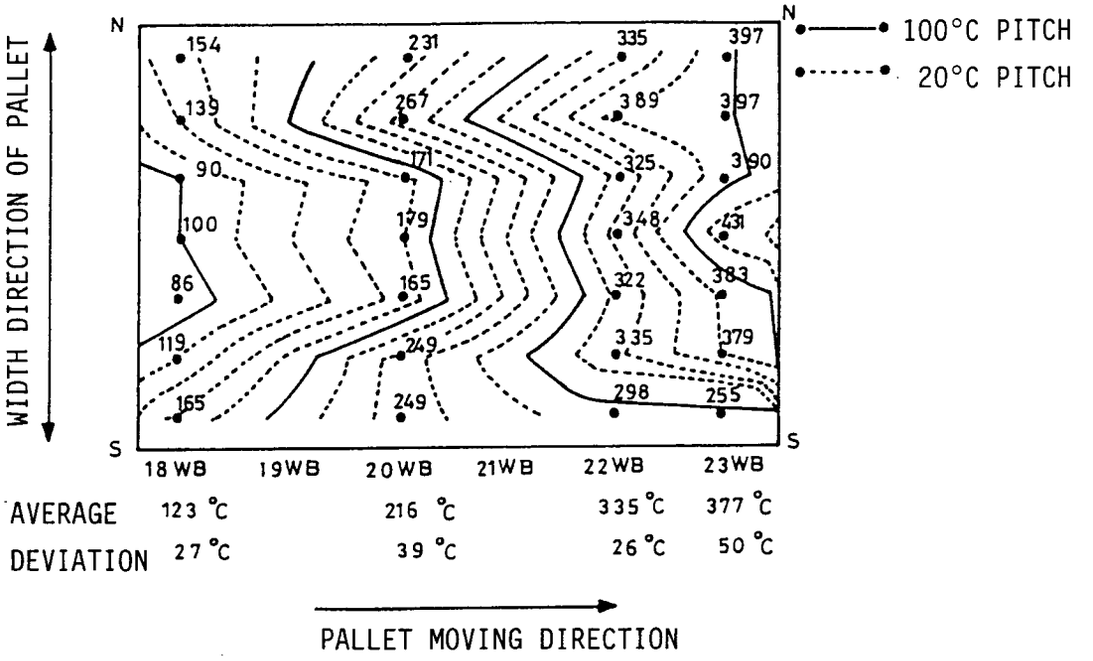


FIG. 17B APPARATUS OF PRESENT INVENTION

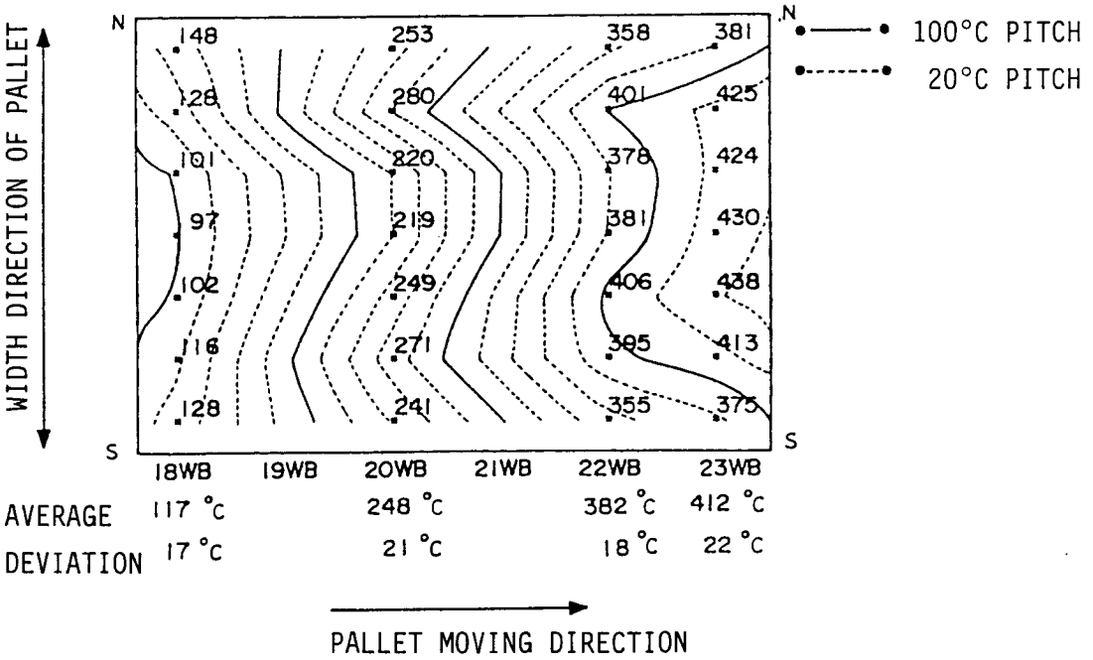
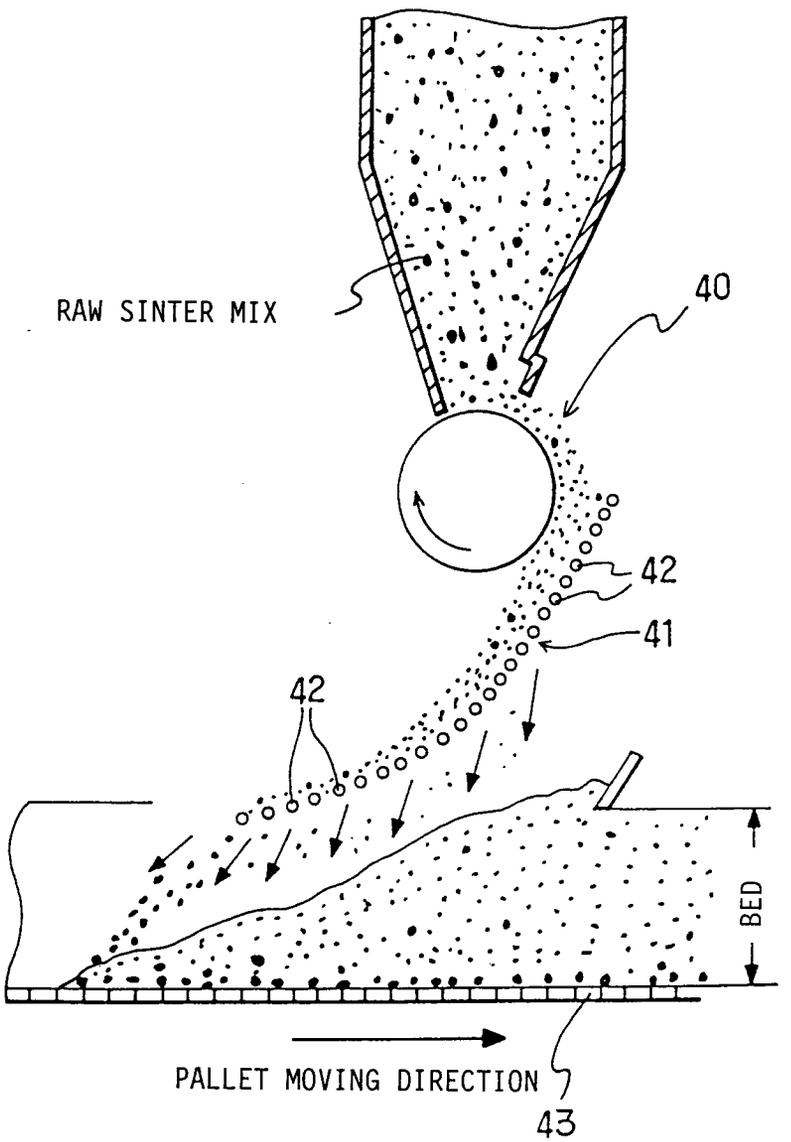


FIG. 18



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 10 1346

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.6)
A,D	PATENT ABSTRACTS OF JAPAN vol. 095, no. 011, 26 December 1995 & JP 07 229684 A (NKK CORP), 29 August 1995, * abstract * ---	1,2,10, 11	C22B1/20 F27B21/10 F27D3/00 B65G65/42
A	PATENT ABSTRACTS OF JAPAN vol. 003, no. 050 (C-044), 27 April 1979 & JP 54 026905 A (SUMITOMO METAL IND LTD), 28 February 1979, * abstract * ---	1,3	
A	EP 0 286 381 A (NIPPON STEEL CORPORATION) 12 October 1988 * claims 1-7; figures 1,10 * ---	1,3	
A	US 4 457 840 A (NAGI MARTIN) 3 July 1984 * claim 1; figure 2 * ---	3	
A	DE 35 21 781 C (ELINO INDUSTRIE-OFENBAU) 19 June 1986 ---		TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	DE 259 282 C (FRIEDRICH C.W. TIMM) 30 April 1913 -----		C22B F27D B65G F27B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24 April 1997	Bombeke, M

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
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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

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