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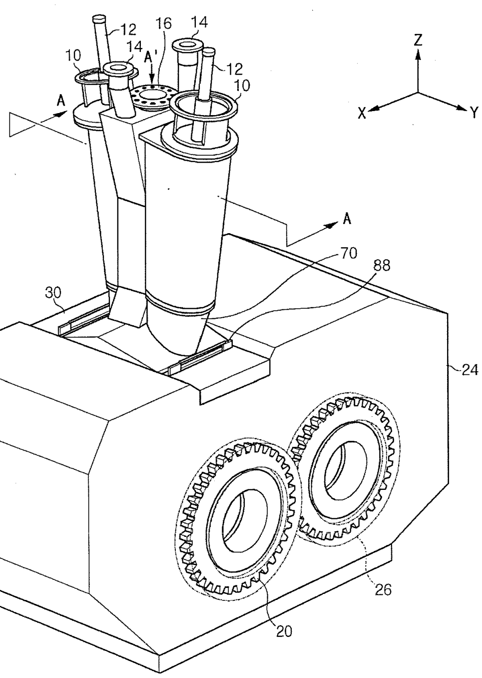
(54) Apparatus for manufacturing compacted irons of reduced materials comprising fine direct reduced irons and apparatus for manufacturing molten irons using the same

(57) The present invention relates to an apparatus for manufacturing compacted irons and an apparatus for manufacturing molten irons using the same. The apparatus for manufacturing compacted irons according to the present invention includes a charging hopper into which reduced materials containing fine reduced irons are charged; a couple of rolls separated from each other to form a gap between the rolls; a feeding box for transferring the reduced materials comprising fine reduced irons to the couple of the rolls and a couple of cheek plates installed on the sides of the couple of rolls. The charging hopper includes guide tubes extending downward. The couple of rolls compact the reduced materials containing fine reduced irons discharged from the charging hopper and manufacture compacted irons. The couple of cheek plates prevent leakage of the reduced materials containing fine reduce irons charged into the gap and are overlapped with the guide tubes in the axis direction of the rolls.

Fig. 1



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Description

BACKGROUND OF THE INVENTION

(a) Field of the Invention

[0001] The present invention relates to an apparatus for manufacturing compacted irons and an apparatus for manufacturing molten irons using the same, and more particularly, to an apparatus for manufacturing compacted irons by compacting reduced materials comprising fine direct reduced irons and manufacturing compacted irons and an apparatus for manufacturing molten irons using the same.

(b) Description of the Related Art

[0002] The iron and steel industry is a core industry that supplies the basic materials needed in construction and in the manufacture of automobiles, ships, home appliances, etc. Further, it is an industry which has the longest history having advanced since the dawn of human history. Iron works, which play a pivotal roll in the iron and steel industry, produce steel from molten iron, and then supply it to customers, after producing the molten iron (Le., pig iron in a molten state) using iron ores and coals as raw materials.

[0003] Nowadays, approximately 60% of the world's iron production is produced using a blast furnace method that has been developed since the 14th century. According to the blast furnace method, irons ores, which have gone through a sintering process, and cokes, which are produced using bituminous coals as raw materials, are charged into a blast furnace together and oxygen is supplied to the blast furnace to reduce the iron ores to irons, thereby manufacturing molten irons. The blast furnace method, which is the most popular in plants for manufacturing molten irons, requires that raw materials have strength of at least a predetermined level and have grain sizes that can ensure permeability in the furnace, taking into account reaction characteristics. For that reason, cokes that are obtained by processing specific raw coals are needed as carbon sources to be used as a fuel and as a reducing agent. Also, sintered ores that have gone through a successive agglomerating process are needed as iron sources.

[0004] Accordingly, the modern blast furnace method requires raw material preliminary processing equipment, such as coke manufacturing equipment and sintering equipment. Namely, it is necessary to be equipped with subsidiary facilities in addition to the blast furnace, and also equipment for preventing and minimizing pollution generated by the subsidiary facilities. Therefore, the heavy investment in the additional facilities and equipment leads to increased manufacturing costs.

[0005] In order to solve these problems with the blast furnace method, significant effort is made in iron works all over the world to develop a smelting reduction process that produces molten irons by directly using fine coals as a fuel and a reducing agent and by directly using fine ores, which account for more than 80% of the world's ore production.

[0006] An installation for manufacturing molten irons directly using raw coals and fine iron ores is disclosed in US Patent No. 5,534,046. The apparatus for manufacturing molten irons disclosed in US Patent No. 5,534,046 includes three-stage fluidized-bed reactors forming a bubbling fluidized bed therein and a melter-gasifier connected thereto. The fine iron ores and additives at room temperature are charged into the first fluidized-bed reactor and successively go through three-stage fluidized-bed reactors. Since hot reducing gas produced from the melter-gasifier is supplied to the three-stage fluidized-bed reactors, the temperature of the iron ores and additives is raised by contact with the hot reducing gas. Simultaneously, 90% or more of the iron ores and additives are reduced and 30% or more of them are sintered, and they are charged into the melter-gasifier.

[0007] A coal-packed bed is formed in the melter-gasifier by supplying coals thereto. Therefore, iron ores and additives are melted and slagged in the coal packed bed and then are discharged as molten irons and slags. The oxygen supplied from a plurality of tuyeres installed on the outer wall of the melter-gasifier burns a coal packed bed and is converted to a hot reducing gas. Then, the hot reducing gas is supplied to the fluidized-bed reactors in order to reduce iron ores and additives and is exhausted outside.

[0008] However, since a high-speed gas flow is formed in the upper portion of the melter-gasifier included in the above-mentioned apparatus for manufacturing molten irons, there is a problem in that the fine reduced irons and sintered additives charged into the melter-gasifier are elutriated and loosened. Furthermore, when fine reduced irons and sintered additives are charged into the melter-gasifier, there is a problem in that permeability of gas and liquid in the coal packed bed of the melter-gasifier cannot be ensured.

[0009] For solving these problems, the method for briquetting fine reduced irons and additives and charging them into the melter-gasifier has been developed. Relating to the above development, US Patent No. 5,666,638 discloses a method for-manufacturing oval-shaped briquettes made of sponge irons and an apparatus using the same. In addition, US Patent Nos. 4,093,455, 4,076,520 and 4,033,559 disclose a method for manufacturing plate-shaped or corrugation-shaped briquettes made of sponge irons and an apparatus using the same. Here, fine reduced irons are hot briquetted and then cooled, and thereby they are manufactured into briquettes made of sponge irons in order to suitably transport them a long distance.

[0010] According to the above general apparatus for manufacturing briquettes, cheek plates are installed at both sides of the rolls in order to prevent the fine reduced irons from elutriating outside during manufacturing the briquettes. Since the apparatus for manufacturing briquettes is small-sized, using normal cheek plates can sufficiently prevent fine reduced irons from elutriating.

[0011] However, in the case of a large-sized apparatus for manufacturing briquettes, even though it is equipped with cheek plates, there is a problem in that fine reduced irons are elutriated outside as a large amount of reduced materials containing reduced irons are charged into the rolls. Especially, since the hot reduced materials containing reduced irons can be in the upper side of the rolls, when there is a large amount charged into the rolls, the amount of the hot reduced materials containing reduced irons that are stagnated in the upper side of the rolls is largely increased, and there is a problem in that a large amount of fine reduced irons are elutriated outside through the gap formed between the upper side of the apparatus for manufacturing briquettes and the cheek plates.

SUMMARY OF THE INVENTION

[0012] The present invention has been made to solve the above-mentioned problems, and provides an apparatus for manufacturing compacted irons that is suitable for manufacturing a large amount of compacted irons.

[0013] In addition, the present invention provides an apparatus for manufacturing molten irons provided with the apparatus for manufacturing compacted irons.

[0014] The apparatus for manufacturing compacted irons according to the present invention includes a charging hopper into which reduced materials containing fine reduced irons are charged; a couple of rolls separated from each other to form a gap between the rolls; and a couple of cheek plates installed on the sides of the couple of rolls. The charging hopper includes guide tubes extending downward. The couple of rolls compact the reduced materials containing fine reduced irons discharged from the charging hopper and manufacture compacted irons. The couple of cheek plates prevent leakage of the reduced materials containing fine reduce irons charged into the gap and are overlapped with the guide tubes in the axis direction of the rolls. Moreover, the apparatus for manufacturing compacted irons according to the present invention further includes a feeding box for transferring the reduced materials containing fine reduced irons to the couple of rolls.

[0015] The following features are to be understood as features which alone and/or in combination with each other further develop the apparatus of claim 1 in a manner which is an invention in itself. Therefore, any such feature combination is hereby claimed as defining an invention.

[0016] It is preferable that grooves are formed on an upper portion of the cheek plates and that the grooves closely adhere to the feeding box.

[0017] It is preferable that the cheek plates include a sealing member for sealing the reduced materials containing fine reduced irons, and the sealing member is installed in the grooves along the grooves.

[0018] A side of the sealing member may be attached to the grooves and the sealing member is slanted relative to the grooves.

[0019] It is preferable that the slanted surface of the sealing member directs to the outer side of the gap.

[0020] The apparatus for manufacturing compacted irons according to the present invention may further include a feeding box for transferring the reduced materials containing fine reduced irons to the couple of rolls and in this case, the sealing member may support the feeding box.

[0021] The sealing member may be made of a heat-resistant steel plate.

[0022] The grooves may include a first groove formed along the arranging direction of the couple of rolls and second grooves connected to both ends of the first groove. The second grooves may be formed along the axis direction of the couple of rolls.

[0023] It is preferable that the lengths of the guide tubes become longer as the guide tubes go away from the center of the gap.

[0024] An end portion and the area around the end portion of each guide tube, corresponding to the longest length of the guide tube, may be overlapped with a surface of the cheek plate.

[0025] It is preferable that a slanted concave portion is formed on a surface of the cheek plate facing the couple of rolls and that the concave portion is overlapped with the guide tube. A stepped portion may be formed on the center of the concave portion of the cheek plate along the arranging direction of the rolls.

[0026] The stepped portion is preferably formed on the guide tube.

[0027] The stepped portion of the cheek plate and the stepped portion of the guide tube preferably face each other.

[0028] The apparatus for manufacturing compacted irons according to the present invention may further include a supporter for supporting the cheek plate. The supporter may be attached to the cheek plate at the opposite side of the gap so that the cheek plate is located between the supporter and the gap. An internal space may be formed on the surface of the supporter which is adjacent to the cheek plate.

[0029] The apparatus for manufacturing compacted irons according to the present invention may further include a device for pressing the cheek plate to the gap. The device for pressing the cheek plate may be bendable.

[0030] The device for pressing the cheek plate includes a bar, of which one end is adjacent to the cheek plate, for pressing and supporting the cheek plate, and a concave portion is formed at the other end; a tension spindle combined with the concave portion of the bar, the outer surface of which has grooves shaped as a screw formed thereon; a supporting member having an opening through which the bar penetrates; a block having an opening through which the tension spindle is screwed and combined with the opening; a spring inserted into the tension spindle; and a guiding member through which the tension spindle penetrates. The guiding member may be combined with both sides of the supporting member.

[0031] The device for pressing the cheek plate is preferably shaped as a bar.

[0032] It is preferable that at least three devices for pressing the cheek plate are installed.

[0033] The device for pressing the cheek plate according to the present invention may further include a frame installed in the outer side of the couple of rolls. The device for pressing the cheek plate may penetrate into the frame and may support the cheek plate.

[0034] The supporting member, the block, the spring, and the guiding member may be combined with each other in order from the bar to the tension spindle.

[0035] It is preferable that both ends of the guiding member are bent toward the pressing direction and that the guiding member is combined with both sides of the supporting member.

[0036] A stepping portion may be formed on the inner surfaces of both bent ends of the guiding member in order for the block to be limited in movement.

[0037] The center portion of the supporting member may be inserted between the bent portions of the guiding member and may be combined with the guiding member with pins.

[0038] The guiding member may be capable of being rotated at approximately 90 degrees using the pins as an axis.

[0039] It is preferable that the guiding member surrounds the block and the sides of the spring.

[0040] The block is preferably shaped as a rectangular parallelepiped and both sides of the block preferably face an inner surface of the guiding member.

[0041] The end portion of the supporting member may protrude toward both sides of the supporting member and may be adjacent to the guiding member.

[0042] An independent invention is to be seen in incorporating the above described apparatus into a plant or an apparatus for manufacturing molten irons. Such apparatus for manufacturing molten irons according to the present invention includes the above apparatus for manufacturing compacted irons; a breaker for breaking compacted irons discharged from the apparatus for manufacturing compacted irons; and a melter-gasifier into which the compacted irons, which are broken by the breaker, are charged and are melted.

[0043] In such a manufacturing plant for producing molten irons it may be advantageous to supply in addition at least one of the coals selected from the group of lumped coals and coal briquettes to the melter-gasifier into which compacted irons produced by the above described apparatus for manufacturing compacted irons are charged.

BRIEF DESCRIPTION OF THE DRAWINGS

[0044] The above and other features and advantages of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

Fig. 1 is a schematic perspective view of the apparatus for manufacturing compacted irons according to a first embodiment of the present invention.

Fig. 2 is a schematic sectional view along the line AA of Fig. 1.

Fig. 3 is a schematic perspective view of the cheek plates of Fig. 2.

Fig. 4 is a sectional view of an apparatus for manufacturing compacted irons according to a second embodiment of the present invention.

Fig. 5 is a schematic exploded view of the device for pressing a cheek plate shown in Fig. 4.

Fig. 6 is an assembled view of the device for pressing a cheek plate shown in Fig. 5.

Fig. 7 is a diagram showing a disassembling method of the device for pressing a cheek plate shown in Fig. 4.

Fig. 8 is a schematic diagram showing an apparatus for manufacturing molten irons provided with the apparatus for manufacturing compacted irons according to the first embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0045] Now, exemplary embodiments of the present invention will be described with reference to the attached drawings in order for those skilled in the art to work out the present invention. However, the present invention can be embodied in various modifications and thus is not limited to the embodiments described below.

[0046] Embodiments of the present invention will be explained below with reference to Figs. 1 to 8. The embodiments of the present invention are merely to illustrate the present invention and the present invention is not limited thereto.

[0047] Fig. 1 schematically shows an apparatus for manufacturing compacted irons 100 including a charging hopper 10 and a couple of rolls 20. Gears are attached to the ends of the rolls, and thereby the couple of rolls are interlocked and rotated together. The structure of the apparatus for manufacturing compacted irons shown in Fig. 1 is merely to illustrate the present invention and the present invention is not limited thereto. Therefore, the apparatus for manufacturing compacted irons can be modified in other forms.

[0048] The reduced materials containing fine reduced irons are charged into the charging hopper 10 through the opening 16 located in the center thereof along the direction indicated by the arrow f:\. The reduced materials containing fine reduced irons are manufactured from iron ores. The reduced materials containing fine reduced irons further comprise sintered additives and are reduced while going through multi-stage fluidized-bed reactors. The reduced materials containing fine reduced irons manufactured by using other methods can be charged into the charging hopper 10. Ventilation openings 14 are formed on the upper side of the charging hopper 10, thereby eliminating gas produced from the hot reduced materials containing fine reduced irons.

[0049] The charging hopper 10 includes guide tubes 70 extending downward. The guide tubes 70 are inserted into the feeding box 30 located below and are combined therewith. The feeding box 30 closely adheres to the cheek plates 80 (shown in Fig. 2) which are overlapped with the guide tubes 70 along the axis direction of the rolls 20 (Y-axis direction).

[0050] Screw feeders 12 are installed in the charging hopper 10. The screw feeders 12 discharge the reduced materials containing fine reduced irons charged into the charging hopper 10 to the gap between the couple of rolls 20. Here, the gap means a space formed between the rolls along the longitudinal direction of the couple of rolls. Screws 122 (shown in Fig. 2) installed at a lower end of the screw feeders 12 discharge the reduced materials containing fine reduced irons collected in their lower portions due to gravity downward by rotating by a motor (not shown). The motor is installed in the upper end of the screw feeders 12. Scrapers 124 (shown in Fig. 2) installed on the screw feeders 12 eliminate fine reduced irons adhered to the inner walls of the charging hopper 10.

[0051] The couple of rolls 20 are located in the roll casing 24. The couple of rolls 20 are separated from each other and so form a gap therebetween. The couple of rolls 20 compress the reduced materials containing fine reduced irons discharged by the screw feeders 12 and thereby manufacture compacted irons. The roll cover 26 is attached on the external side of the roll 20.

[0052] Fig. 2 shows an internal section of the apparatus for manufacturing compacted irons shown in Fig. 1. The enlarged circle of Fig. 2 shows a magnified cheek plate 80 supporting both sides of the couple of rolls 20.

[0053] The reduced materials containing fine reduced irons are charged into the feeding box 30 by the screw feeders 12 through the guide tubes 70. The feeding box 30 is installed below the charging hopper 10 and transfers the reduced materials containing fine reduced irons to the couple of rolls 20. The feeding box 30 forms a lower space bulged to the charging hopper 10. The feeding box 30 has such a structure to be capable of ensuring a stagnated bed of a large amount of charged reduced materials containing fine reduced irons. Therefore, it is possible to suitably supply the reduced materials containing fine reduced irons to the center of the gap of the couple of rolls 20.

[0054] In addition, the lengths of the guide tubes 70 become longer as the guide tubes 70 go away from the center of the gap. Therefore, it is possible to effectively distribute reduced materials containing fine reduced irons into the inner space of the feeding box 30, thereby smoothly manufacturing compacted irons in the center of the rolls. End portions 701 and the area around the end portions 701 of the guide tubes 70 corresponding to the longest lengths of the guide tubes 70 are overlapped with surfaces of the cheek plates 80. Therefore, the reduced materials containing fine reduced irons, which are discharged from the guide tubes 70, are not elutriated outside and are smoothly supplied to the gap formed between the rolls 20.

[0055] The cheek plates 80 are installed at both sides of the gap formed between the rolls 20. The cheek plates 80 prevent the reduced materials containing fine reduce irons entering the gap from leaking outside.

[0056] A large amount of the reduced materials containing fine reduced irons gets into the lower side of the feeding box 30 and stagnates therein, and thereby there is much possibility that the fine reduced irons are elutriated outside. In order to prevent the fine reduced irons from being elutriated, a closely adhered portion formed between the feeding box 30 and the cheek plates 80 should be suitably sealed. Therefore, grooves 82, which are closely adhered to the feeding box 30, are formed on an upper portion of the couple of cheek plates 80, and thereby the feeding box 30 is supported by a sealing member 84 in the grooves 82. By using this method, the fine reduced irons are prevented from being elutriated outside. Since the sealing member 84 is slanted, elutriated fine reduced irons are entrapped in the lower side of the sealing member 84 and are not elutriated outside. Therefore, the reduced materials containing fine reduced irons, which enter the feeding box 30, are not elutriated, and so it is possible to realize a stable manufacturing process.

[0057] As shown in the enlarged circle of Fig. 2, a stepped portion 703 is formed on each guide tube 70. In addition, a stepped portion 861 is formed in the center of a concave portion 86 of each cheek plate 80 along the arranging direction of the rolls 20. Since the stepped portion 703 of the guide tube 70 and the stepped portion 861 of the cheek plate 80 face each other, the fine reduced irons are prevented from elutriating through the overlapped space formed between the guide tube 70 and the cheek plate 80. Namely, obstacles made of the stepped portions, which face each other, are formed in the passageway formed between the guide tube 70 and the cheek plate 80, and thereby the fine reduced irons are prevented from elutriating outside.

[0058] Meanwhile, the apparatus for manufacturing compacted irons further includes a supporter 88 for supporting the cheek plates 80. The supporter 88 is attached to the cheek plates 80 at the opposite side of the gap, locating the cheek plate 80 therebetween. The supporter 88 supports the cheek plates 80. The upper portion of the supporter 88 is protruded toward the upper portion of the feeding box 30. The cheek plates 80 can be assembled through the upper opening of the feeding box 30. An internal space 89 is formed in the surface of the supporter 88 which is adjacent to the cheek plates 80. Therefore, the areas in which the supporter 88 is adjacent to the cheek plates 80 is minimized, thereby keeping uniform heat distribution and preventing staggering by heat transfer.

[0059] Fig. 3 shows an exploded state of the cheek plates shown in Fig. 2. The enlarged circle of Fig. 3 shows the grooves 82 formed on the upper side of the cheek plates 80 in detail.

[0060] Although not shown in Fig. 3, the couple of rolls are arranged in the X-axis direction between the couple of cheek plates 80 located in Y-axis direction. The supporter 88 installed outside of the cheek plates 80 presses the cheek plates 80 to the rolls 20. An opening 87 is formed in the outer side of the supporter 88 in order to assemble it with bolts. The opening 87 is manufactured as a long hole, thereby absorbing the expansion and contraction amount of the cheek plates 80 when the cheek plates 80 are thermally expanded.

[0061] The grooves 82 are formed on an upper portion of the cheek plates 80 and the grooves closely adhere to the feeding box 30 (shown in Fig. 2). Sealing members 84 are attached along the grooves 82. The sealing members 84 can be attached by welding and also by other methods.

[0062] As shown in the enlarged circle of Fig. 3, each of the grooves 82 includes a first groove 822 and a couple of second grooves 824. The first groove 822 is formed along the arranging direction of the couple of rolls (not shown). The second grooves 824 are connected to both ends of the first groove 822 and are arranged along the axis direction of the couple of rolls (not shown). Since the first groove 822 and the second grooves 824 are formed surrounding the rolls and the grooves 82 are closely adhered to the feeding box 3D, the fine reduced irons are essentially prevented from elutriating outside.

[0063] The slanted sealing members 84 are installed in the grooves 82 and sides 841 thereof are attached to the grooves 82. Attachment can be accomplished by using welding and by other various methods. Especially, it is preferable that the slanted surfaces of the sealing members 84 direct to the outer sides of the gap. Therefore, the sealing members 84 support the feeding box 30 whilst closely adhering to the cheek plates 80, and thereby guiding any fine reduced irons passed outside to the lower portions of the slanted surfaces of the sealing members 84 and entrapping them therein. By using this method, an amount of the fine reduced irons that are elutriated outside is minimized.

[0064] Since the sealing members 84 are located in the closely adhering surface between the cheek plates 80 and the feeding box 30 and prevent the fine reduced irons from elutriating outside, they are disposed in a hot environment. Therefore, the sealing members 84 are preferably made of a heat-resistant steel plate in order to resist the hot temperature. A stainless steel can be used as a heat-resistant steel plate. For example, STS310S can be used.

[0065] A stepped portion 861 and a slanted concave portion 86 are formed on a surface of each cheek plate 80 facing the couple of rolls along the arranging direction of the rolls, and are overlapped with the guide tube 70 (shown in Fig. 2). Therefore, it is possible to prevent the fine reduced irons charged from the guide tubes from elutriating, thereby realizing a stable manufacturing process.

[0066] In the apparatus for manufacturing compacted irons having such a structure, the cheek plates minimize the amount of the fine reduced irons that is elutriated outside. Therefore, it is possible that not only the cost for manufacturing reduced materials containing fine reduced irons is prevented from being raised, but also that the compacted irons are stably manufactured.

[0067] Fig. 4 shows an internal structure of an apparatus for manufacturing compacted irons 150 according to a second embodiment of the present invention. The structure of the apparatus for manufacturing the compacted irons 150 according to the second embodiment of the present invention is the same as that of the apparatus for manufacturing the compacted irons 100 according to the first embodiment of the present invention, except for a device for pressing the cheek plates 90. Therefore, the same reference numerals are used to refer to the same elements.

[0068] The device for pressing the cheek plates 90 presses the cheek plates 80 to the gap, thereby more stably fixing the cheek plates 80. Therefore, it is possible to effectively prevent the fine reduced irons from elutriating. Since the device for pressing the cheek plates 90 is bendable, it is possible to disassemble and assemble it whenever the cheek plates 80 are overhauled.

[0069] Since the device for pressing the cheek plate 90 is shaped as a bar, it is possible to support a plurality of points of the cheek plates 80. At least three of the devices for pressing the cheek plates 90 are installed in order to press the cheek plates 80. Therefore, the fine reduce irons are prevented from elutriating outside. Especially, since the cheek plates 80 are shaped almost as a triangle, it is preferable that three devices for pressing the cheek plates 90 are installed in a triangle shape.

[0070] A frame 29 protects the elements included in the apparatus for manufacturing the compacted irons 150 from outside. The device for pressing the cheek plates 90 penetrates the frame 29 and supports the cheek plates 80. Accordingly, even though pressure acts on the cheek plates 80, it is possible to resist the pressure by the device for pressing the cheek plates 90 supported by the frame 29.

[0071] The structure of the device for pressing the cheek plates according to the embodiment of the present invention will be explained in detail below with reference to Fig. 5.

[0072] Fig. 5 shows an exploded view of the device for pressing the cheek plates 90 shown in Fig. 4. The structure of the device for pressing the cheek plates 90 shown in Fig. 5 is merely to illustrate the present invention and the present invention is not limited thereto. Therefore, the device for pressing the cheek plates 90 can be modified in other forms.

[0073] Each device for pressing the cheek plates 90 includes a bar 92, a supporting member 94, a block 96, a spring 98, a guiding member 91, and a tension spindle 93. The supporting member 94, the block 96, the spring 98, and the guiding member 91 are combined with each other in order from the bar 92 to the tension spindle 93.

[0074] The bar 92 is shaped as a rod. The left end of the bar 92 (in Fig.5) is adjacent to the cheek plate and puts a pressure on it. A concave portion 921, which is manufactured by using a drill, is formed on the right end of the bar 92. The tension spindle 93 is inserted into the concave portion 921. A dividing pin (not shown) is inserted into the opening 901 formed in the center of the bar 92. The dividing pin prevents the device for pressing the cheek plates 90 from being separated when disassembling the device for pressing the cheek plates 90 from the apparatus for manufacturing compacted irons 150.

[0075] The bar 92 penetrates the opening formed in the supporting member 94. The end portion 941 of the supporting member 94 protrudes outwards of both sides thereof, and thereby the supporting member 94 is shaped as a T character. The supporting member 94 is adjacent to the guiding member 91. In addition, an opening 943 is formed in the center of the supporting member 94, and is assembled with the guiding member 91 using pins 905. Furthermore, a couple of openings 945 are formed in the end portion 941 of the supporting member 94. The supporting member 94 is assembled with the frame 29 (shown in Fig. 4) by using screws 903 through the openings 945. Therefore, the device for pressing the cheek plates 90 can be stably fixed.

[0076] The block 96 is shaped as a rectangular parallelepiped. The tension spindle 93 is combined with the opening formed in the block 96 and moves forwards and backwards by the elasticity of the spring 98 along the pressing direction.

[0077] The spring 98 is shaped as a plurality of overlapped dishes. The spring 98 is inserted into the tension spindle 93 and is located between the block 96 and the guiding member 91. The bar 92 is pressed against the cheek plate by moving the block 96 in accordance with a pressing force.

[0078] Both ends of the guiding member 91, through which the tension spindle 93 penetrates, are bent toward a pressing direction (left direction in Fig. 5). Therefore, the guiding member 91 is shaped as a "Π" character. The center portion of the supporting member 94 is inserted between the bent portions of the guiding member 91 and is combined with the guiding member 91 with pins 905. A stepped portion 911 is formed on the inner surface of both bent ends of the guiding member 91. The stepped portions 911 are combined with the block 96 and limit the movement of the block 96.

[0079] The tension spindle 93 is shaped as a cylinder. The tension spindle 93 is combined with the concave portion 921 of the bar 92 and then presses the bar 92. A protruding portion 931 is formed on the front end of the tension spindle 93 and is combined with the concave portion 921 of the bar 92, and thereby it is possible to prevent the tension spindle 93 from being sunken. Since a bolt head portion 933 shaped as a hexagonal column is formed on the rear end of the tension spindle 93, the tension spindle 93 can be smoothly rotated. In addition, grooves shaped as a screw thread are formed on an outer surface of the tension spindle 93, and thereby the tension spindle 93 can be combined with the opening of the block 96 by screwing. Therefore, the tension spindle 93 can press the spring 98 by moving the block 96 forward and backward.

[0080] Fig. 6 shows the device for pressing the cheek plates 90 of Fig. 5 in which all the elements are combined together.

[0081] As shown in Fig. 6, the bar 92, at one end of which the tension spindle 93 is connected, is moved forward by rotating the bolt head portion 933 of the tension spindle 93. By using this method, the cheek plate 80, which is adjacent to the other end of the bar 92, can be pressed. The cheek plate 80 is pushed by the inner pressure of the apparatus for manufacturing compacted irons 150, and then presses the device for pressing the cheek plates 90. However, the pressure can be buffed since the block 96 and the spring 98 provided in the device for pressing the cheek plates 90 act as a repulsive force.

[0082] The guiding member 91 surrounds the sides of the block 96 and the spring 98 while being combined with the bar 92. Therefore, the block 96 and the spring 98 located between the supporting member 94 and the guiding member 91 cannot become separated. In addition, since the block 96, shaped as a rectangular parallelepiped, faces the inner surface of the guiding member 91, the block 96 cannot be rotated. Therefore, the device for pressing the cheek plates 90 can constantly maintain a uniform pressing force acting on the cheek plates 80.

[0083] Especially, since the guiding member 91 is assembled with the supporting member 94 using pins 905, it can be rotated at an approximate right angle using the pins 905 as an axis. Therefore, since the bar 92 can freely move forwards and backwards, the device for pressing the cheek plates 90 can be separated from the apparatus for manufacturing compacted irons 150 during overhauling of the cheek plates 80.

[0084] Fig. 5 shows a process for disassembling a device for pressing the cheek plates 90 which is combined in the apparatus for manufacturing compacted irons 150. As shown in Fig. 5, by rotating the guiding member 91, the bar 92 can be disassembled from the apparatus for manufacturing compacted irons 150 in the direction indicated by an arrow.

[0085] First, the tension spindle 93 is rotated and then is separated from the bar 92. Next, the guiding member 91 is rotated downward. Therefore, since the end portion of the bar 92 protrudes outside, the bar 92 can be pulled out. By using this method, the device for pressing the cheek plates 90 can be easily disassembled. Since the device for pressing the cheek plates 90 can be easily removed when the cheek plates 80 are overhauled, replacement and maintenance of the cheek plates 80 is simplified.

[0086] Fig. 7 shows an apparatus for manufacturing molten irons 200 provided with an apparatus for manufacturing compacted irons 100 according to the first embodiment of the present invention. Although the apparatus for manufacturing molten irons 200 provided with an apparatus for manufacturing compacted irons 100 according to the first embodiment of the present invention is shown in Fig. 8, this is merely to illustrate the present invention and the present invention is not limited thereto. Therefore, the apparatus for manufacturing molten irons 200 can be provided with an apparatus for manufacturing compacted irons 150 according to the second embodiment of the present invention.

[0087] The apparatus for manufacturing molten irons 200 shown in Fig. 7 includes the apparatus for manufacturing compacted irons 100, a breaker 40, and a melter-gasifier 60. The breaker 40 crushes the compacted irons discharged from the apparatus for manufacturing compacted irons 100. The compacted irons, which were crushed in the breaker 40, are charged into the melter-gasifier 60 and are melted therein. Besides, a storage bin 50 for temporarily storing the compacted irons that are crushed in the breaker 40 can be also included. Since the structure of the breaker 40 and the melter-gasifier 60 can be understood by those skilled in the art, a detailed explanation is omitted.

[0088] At least one of the coals selected from the group of lumped coals and coal briquettes are charged into the melter-gasifier 60. Generally, for example, the lumped coals are coals having grain size of 8mm or more which are gathered from the producing district. In addition, for example, the coal briquettes are coals which are made by gathering coals having grain size of 8mm or less from the producing district, pulverizing them, and molding them by a press.

[0089] The coal packed bed is formed in the melter-gasifier 60 by charging lumped coals or coal briquettes therein. Oxygen is supplied to the melter-gasifier 60 and then the compacted irons are melted. Molten irons are discharged through a tap. Therefore, it is possible to manufacture molten irons having good quality.

[0090] Since the apparatus for manufacturing compacted irons according to the present invention includes cheek plates combined with guide tubes, elutriation of the fine reduced irons can be effectively prevented.

[0091] Since concave portions formed on a surface of the cheek plates are slanted and overlapped with the guide tubes, the guide tubes are conveniently assembled.

[0092] In addition, since a stepped portion is formed in the center of each concave portion of each cheek plate along the arranging direction of the rolls, there is an advantage that the concave portions are conveniently manufactured.

[0093] An internal space is formed in the supporter, thereby keeping thermal distribution uniform and so the cheek plates are prevented from staggering due to thermal shock.

[0094] Since the apparatus for manufacturing compacted irons according to the present invention includes a device for pressing the cheek plates, the cheek plates are effectively pressed.

[0095] Since the device for pressing the cheek plates is shaped as a bar, the pressing position can be freely adjusted and a plurality of them can be used.

[0096] Since the device for pressing the cheek plates is supported while penetrating through the frame, the cheek plates can be firmly supported.

[0097] Since the guiding member can be rotated at an approximate right angle, the device for pressing the cheek plates can be easily disassembled.

[0098] The apparatus for manufacturing molten irons according to the present invention includes the above-identified apparatus for manufacturing compacted irons, thereby manufacturing molten irons having good quality.

[0099] While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the sprit and scope of the invention as defined by the appended claims.

Claims

1. An apparatus for manufacturing compacted irons comprising:

    a charging hopper (10) into which reduced materials comprising fine reduced irons are charged, the charging hopper comprising guide tubes (70) extending downward;
    a couple of rolls (20) separated from each other to form a gap between the rolls; and
    a feeding box (30) for transferring the reduced materials comprising fine reduced irons to the couple of the rolls, **characterized by**:
    a couple of cheek plates (80) installed at the sides of the couple of rolls (20), the couple of cheek plates (80) being configured for preventing leakage of the reduced materials comprising fine reduced irons entering into the gap and being overlapped with the guide tubes (70) in the axis direction of the rolls, i.e. when seen in a cross-section parallel to the axis direction of the rolls.

2. The apparatus according to claim 1, wherein grooves (82) are formed on an upper portion of the cheek plates (80) and the grooves closely adhere to the feeding box (30).

3. The apparatus of claim 1 or 2, wherein said cheek

plates (80) comprise sealing members (84) for sealing the reduced materials comprising fine reduced irons, said sealing members (84) being installed in the grooves (82) along the grooves, wherein preferably sides of the sealing members (84) are attached to the grooves (82) and the sealing members are slanted relative to the grooves.

4. The apparatus of claim 3, wherein the slanted surfaces of the sealing members (84) direct to the outer sides of the gap.

5. The apparatus of one of the claims 1 to 4, wherein the sealing members (84) which are preferably made of heat-resistant steel plates, support the feeding box (30).

6. The apparatus of one of the claims 2 to 5, wherein the grooves (82) comprise a first groove (822) formed along the arranging direction of the couple of rolls (20) and second grooves (824) connected to both ends of the first groove (822) and formed along the axis direction of the couple of rolls (20).

7. The apparatus of one of the claims 1 to 6, wherein the length of the guide tubes (70) becomes longer as the guide tubes go away from the center of the gap, i.e. with an increasing distance of the guide tubes from the center of the gap.

8. The apparatus of claim 7, wherein an end portion (701) and the area around the end portion of the guide tubes (70) corresponding to the longest length of the guide tubes (70) are overlapped with a surface of the cheek plates (80).

9. The apparatus of claim 7 or 8, wherein slanted concave portions (86) are formed on a surface of the cheek plates (80) facing the couple of rolls (20) and the concave portions (86) are overlapped with the guide tubes (70).

10. The apparatus of claim 9, wherein
stepped portions (861) are formed in the center of the concave portions (86) of the cheek plates (80) along the arranging direction of the rolls (20), and/or stepped portions (703) are formed on the guide tubes (70).

11. The apparatus of claim 10, wherein stepped portions (861) of the cheek plates (80) and stepped portions (703) of the guide tubes (70) face each other.

12. The apparatus of one of the claims 1 to 11, wherein the apparatus for manufacturing compacted irons further comprises a supporter (88) for supporting the cheek plates (80), the supporter being attached to the cheek plates at the opposite side of the gap so that the cheek plates (80) are located between the supporter (88) and the gap, and
wherein internal spaces (89) are formed on the surface of the supporters (88) which are adjacent to the cheek plates (80).

13. The apparatus of one of the claims 1 to 12, comprising a device (90) for pressing the cheek plates (80) to the gap, with the device for pressing the cheek plates being bendable, wherein preferably
said device (90) for pressing the cheek plates (80) comprises:

a bar (92) of which one end is adjacent to the cheek plates (80) for pressing and supporting the cheek plates, and a concave portion (921) is formed at the other end;
a tension spindle (93) combined with the concave portion (921) of the bar, the outer surface of which has grooves shaped as a screw thread formed thereon;
a supporting member (94) having an opening through which the bar (92) penetrates;
a block (96) having an opening through which the tension spindle (93) is screwed and combined with the opening;
a spring (98) inserted into the tension spindle (93); and
a guiding member (91) through which the tension spindle (93) penetrates, the guiding member being combined with both sides of the supporting member.

14. The apparatus of claim 13, wherein the device for pressing the cheek plates is shaped as a bar (92), and/or preferably at least three of the devices for pressing the cheek plates are installed.

15. The apparatus of claim 13 or 14, wherein the device for pressing the cheek plates further comprises a frame (29) installed at the outer side of the couple of rolls (20), and
wherein the device for pressing the cheek plates penetrates into the frame (29) and supports the cheek plates (80).

16. The apparatus of one of the claims 13 to 15, wherein the supporting member (94), the block (96), the spring (98), and the guiding member (91) are combined with each other in order from the bar (92) to the tension spindle (93).

17. The apparatus of one of the claims 13 to 16, wherein both ends of the guiding member (91) are bent toward the pressing direction and the guiding member is combined with both sides of the supporting member (94), and/or wherein preferably
stepped portions (911) are formed on the inner sur-

face of both bent ends of the guiding member (91) in order for the block (96) to be limited in movement, wherein further preferably
the center portion of the supporting member (94) is inserted between the bent portions of the guiding member (91) and is combined with the guiding member with pins (905), wherein preferably the guiding member (91) is capable of being rotated at approximately 90 degrees using the pins (905) as an axis.

18. The apparatus of one of the claims 13 to 17, wherein the guiding member (91) surrounds the block (96) and the sides of the spring (98), wherein preferably the block (96) is shaped as a rectangular parallelepiped and both sides of the block face an inner surface of the guiding member (91) and/or
wherein the end portion (941) of the supporting member (94) protrudes outward of both sides of the supporting member and is adjacent to the guiding member (91).

19. An apparatus for manufacturing molten irons comprising:

said apparatus for manufacturing compacted irons (100) of one of the claims 1 to 18;
a breaker (40) for breaking compacted irons discharged from the apparatus for manufacturing compacted irons (100); and
a melter-gasifier (60) into which the compacted irons, which are broken by the breaker (40), are charged and are melted, wherein preferably

in addition to the compacted irons at least one of the coals selected from the group of lumped coals and coal briquettes are supplied to the melter-gasifier.

Fig. 1

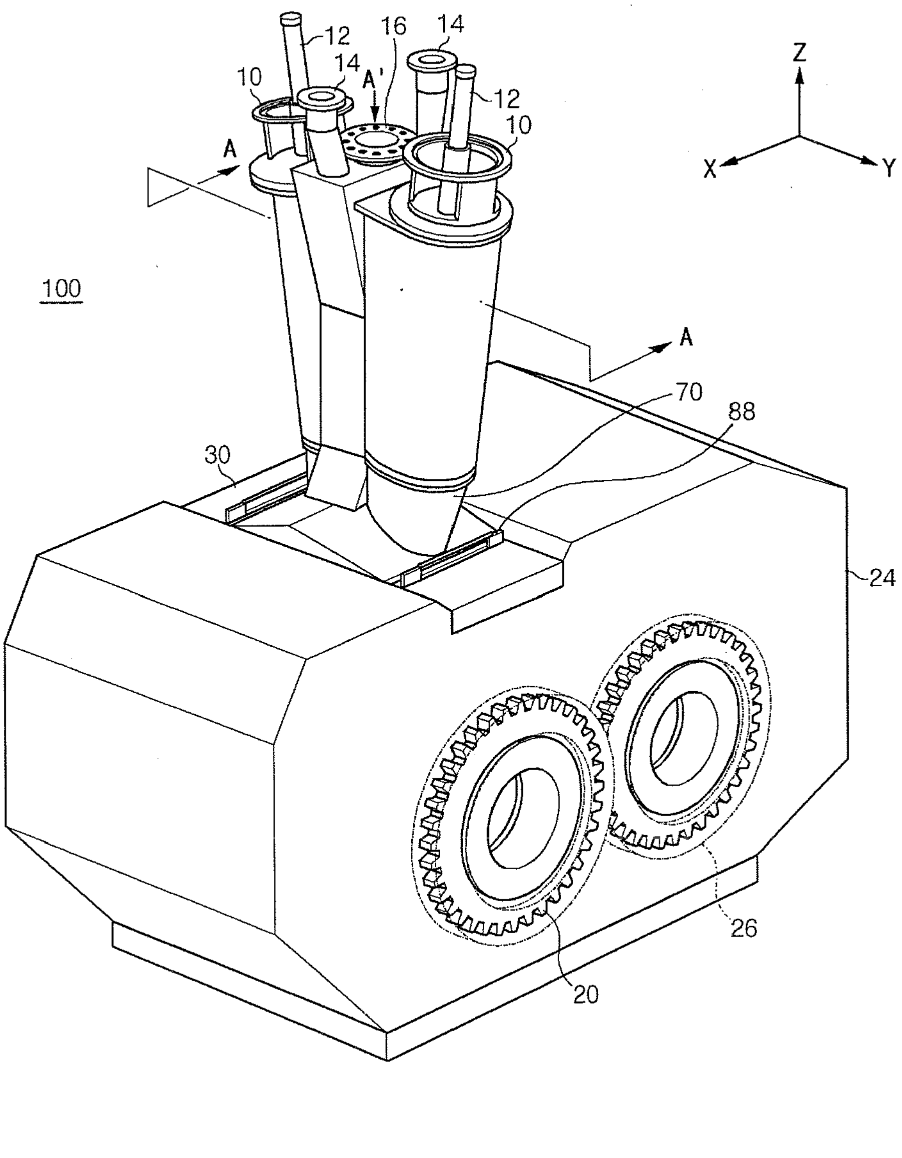

Fig. 2

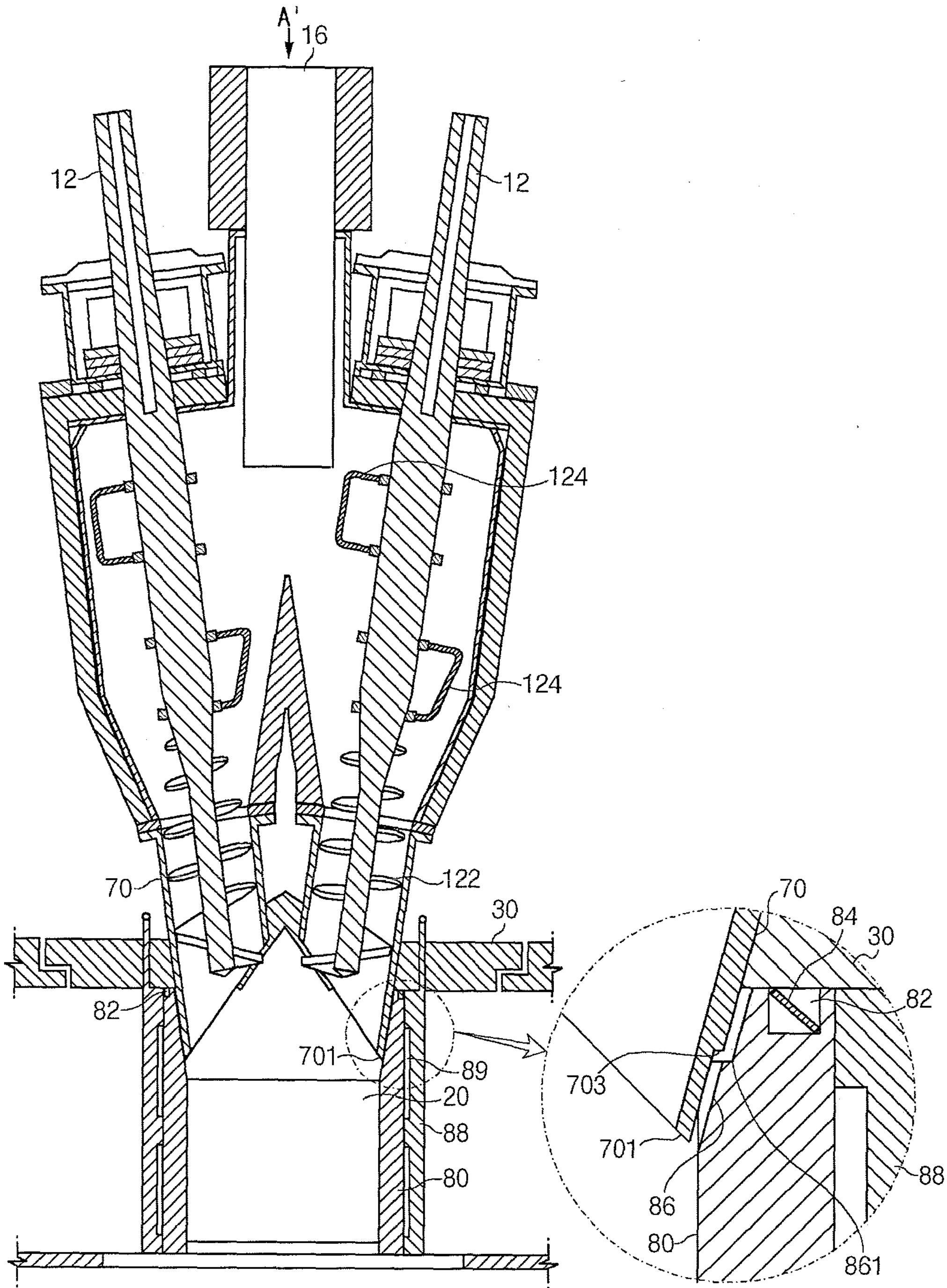
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Fig. 3

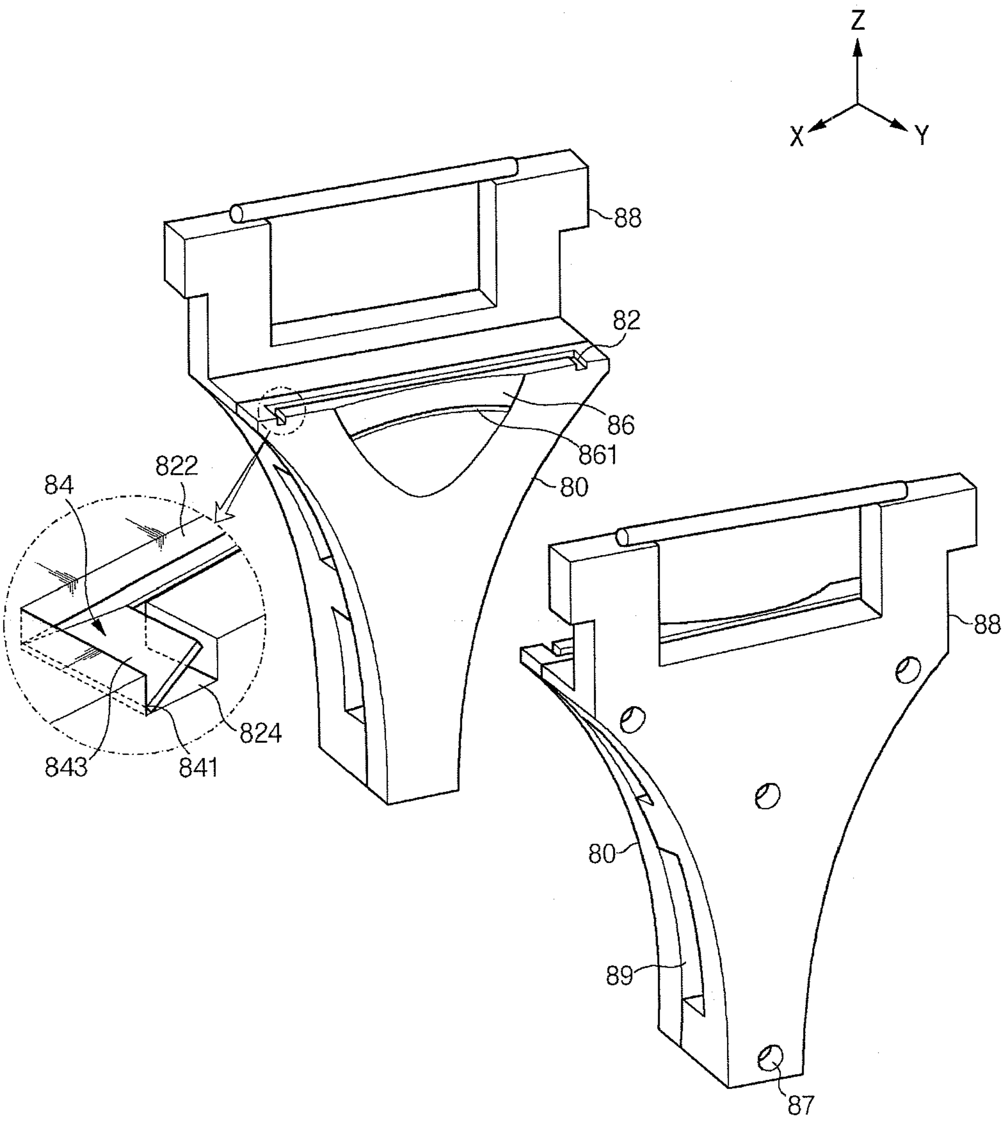

Fig. 4

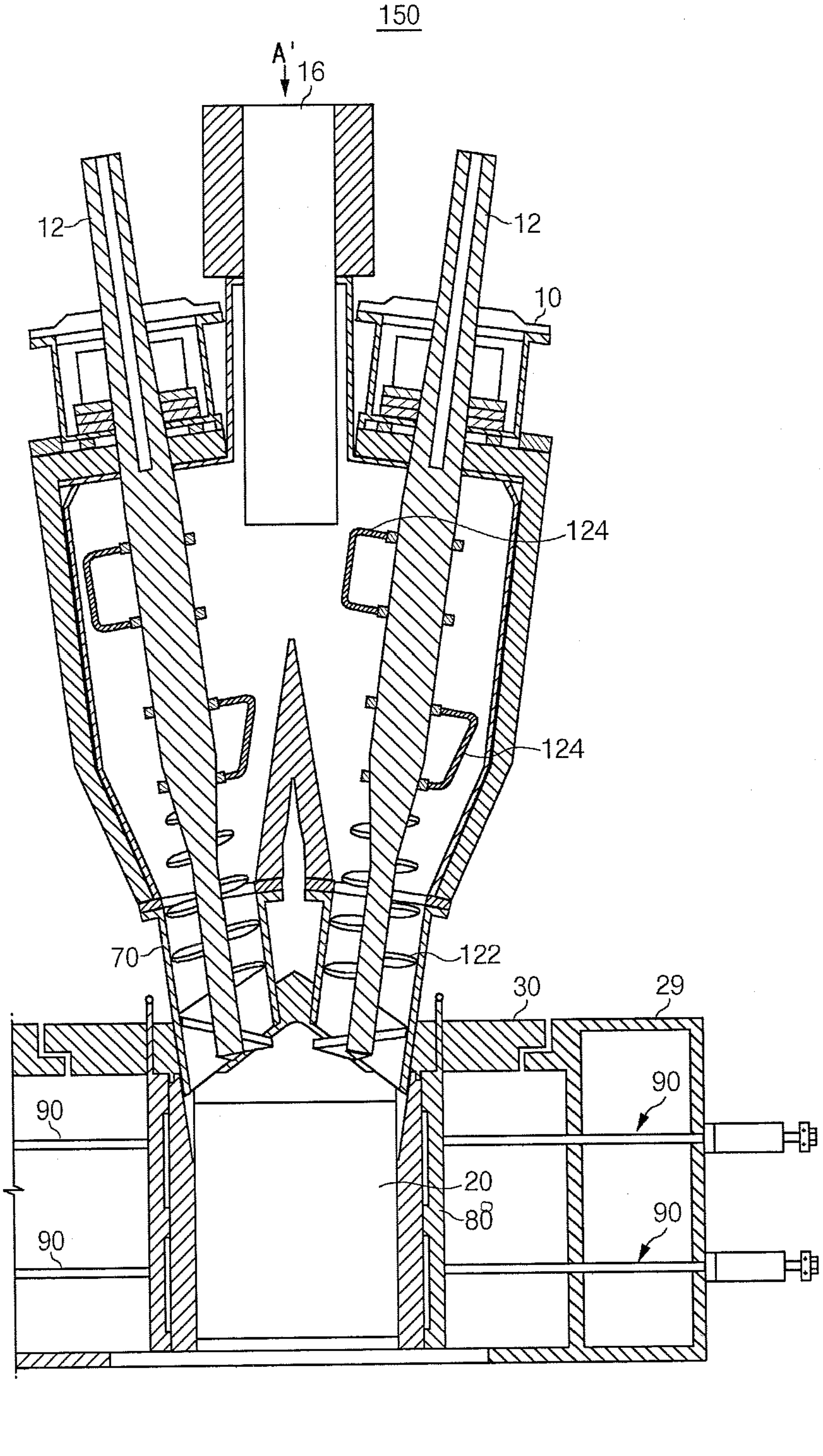

Fig. 5

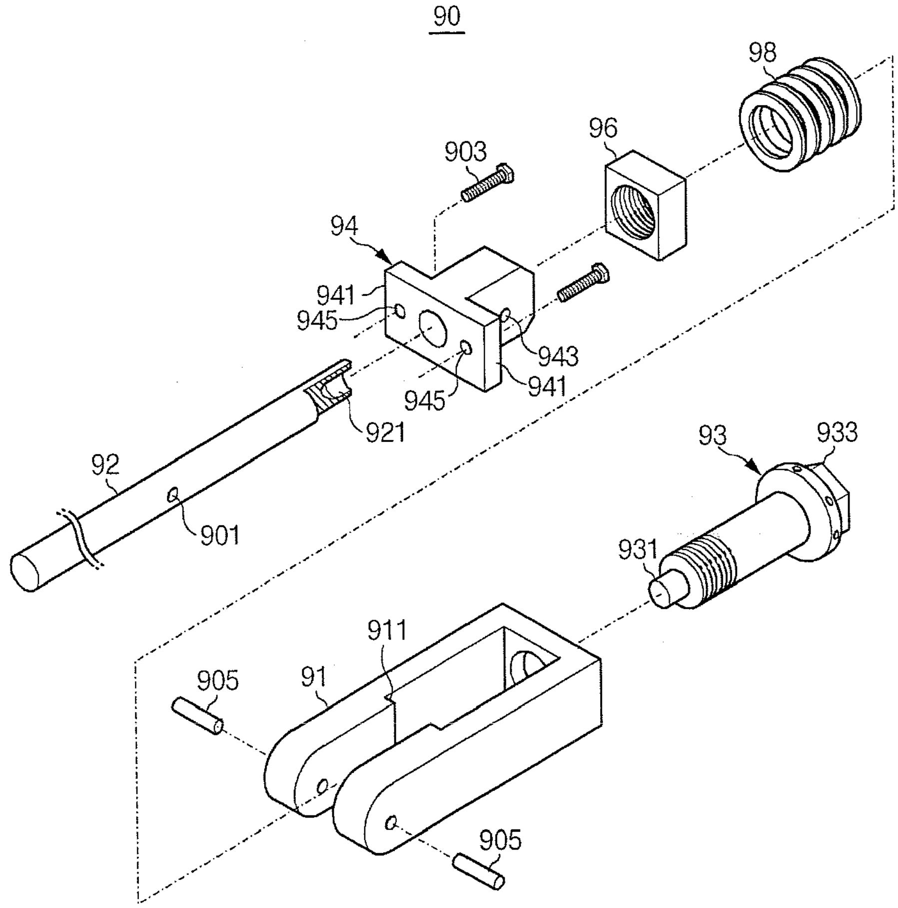
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Fig. 6

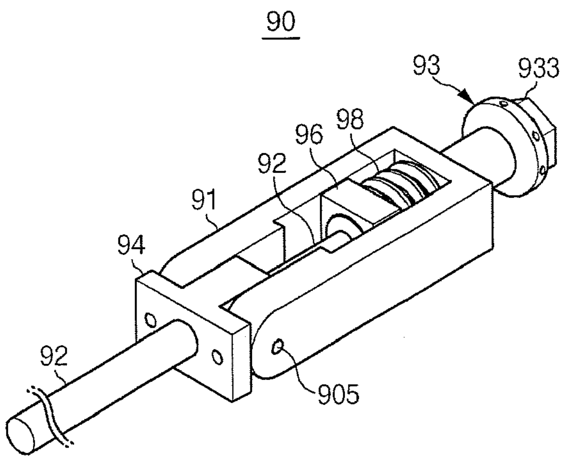


Fig. 7

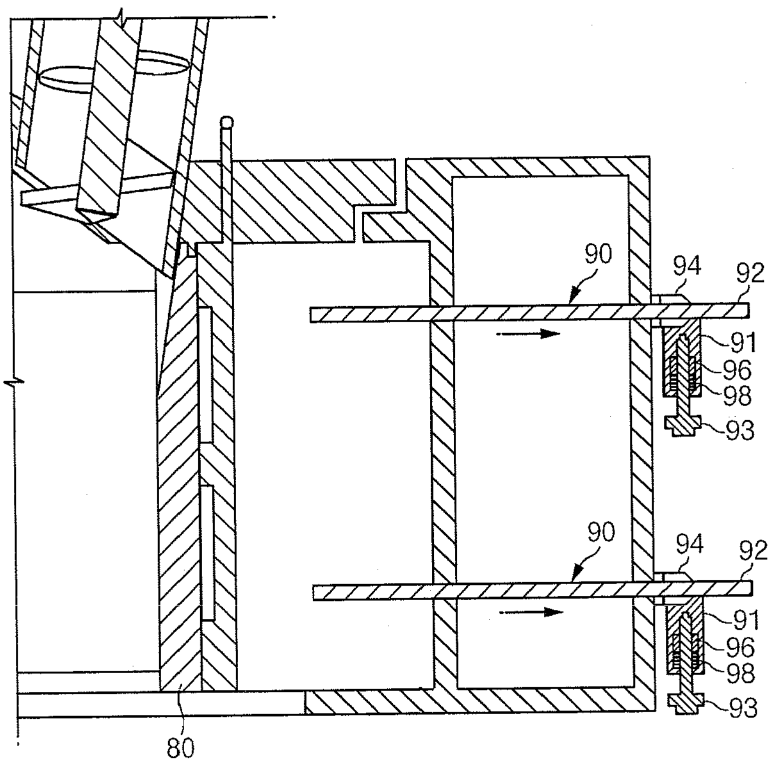
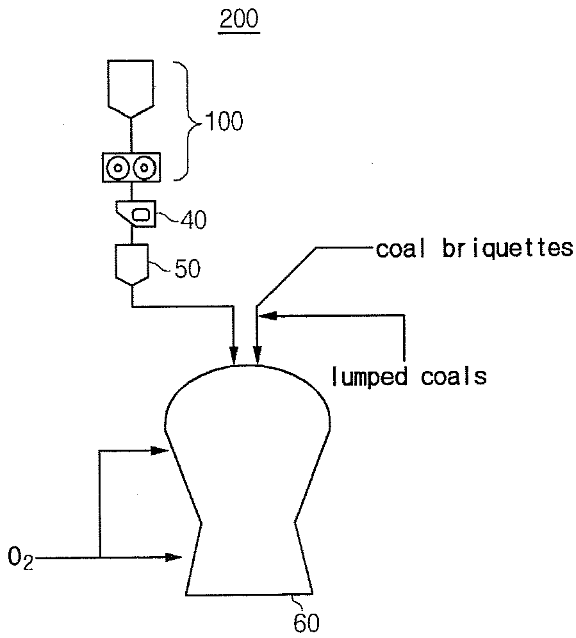


Fig. 8



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EUROPEAN SEARCH REPORT

Application Number
EP 10 19 4663

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The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
Munich	18 February 2011	Gavriliu, Alexandru

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