(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 635 115 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
15.03.2006 Bulletin 2006/11

(51) Int Cl.:
F23G 5/00 *(2006.01)* ***F23H 7/08*** *(2006.01)*

(21) Application number: **05108374.9**

(22) Date of filing: **13.09.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **14.09.2004 IT MI20041745**

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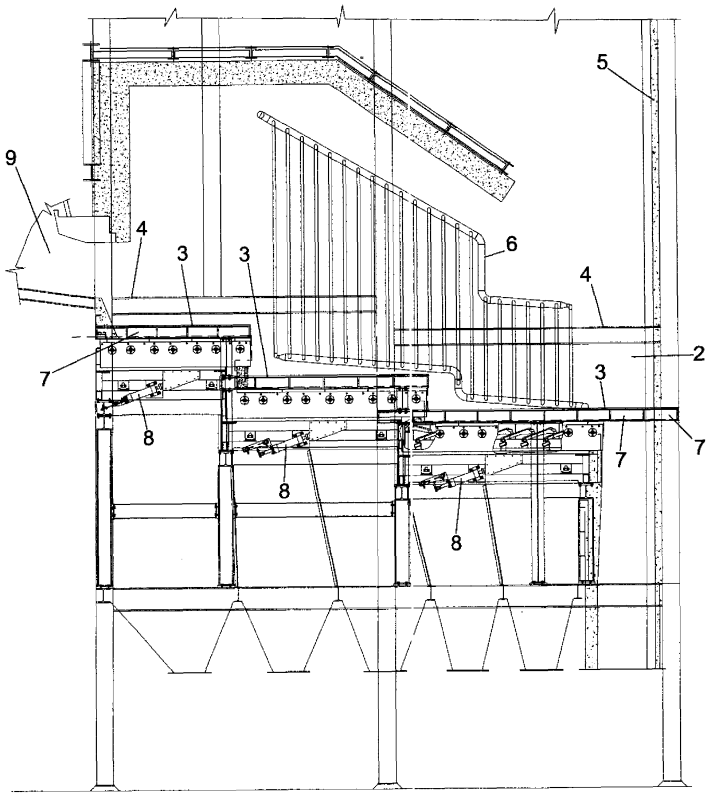
(54) Thermal waste disposal plant

(57) Waste disposal plant comprising a combustion chamber (2) inside which the waste is burned arranged on a combustion grid (3), which takes care of allowing the entry of a suitable amount of combustion air in the chamber through it. Said combustion grid comprises at least one moving group formed from a plurality of fire bars or plates (7), which move alternately with each other making the waste advance on said grid.

Fig. 1



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Description

[0001] The present invention concerns a combustion grid installed in the furnace of a waste disposal plant in which the aforementioned waste is burned and then disposed of in the form of ashes.

[0002] The disposal generally has an associated energy recovery system through the production of overheated steam and the exploitation of the steam in a turbine, in turn coupled with an electrical generator.

[0003] Such plants generally comprise a combustion chamber inside which the waste arranged on a combustion grid is burned, through which a suitable amount of air is blown.

[0004] The combustion grid is suitable for supporting and advancing the waste during its combustion at the same time allowing the forced blowing of combustion air below the waste bed.

[0005] The grid constitutes the lower part of the combustion chamber. The covering surface is roughly proportional to the potentiality and is typically between 10 and 1000 m^2. The combustion chamber physically begins immediately above the grid. In some cases the walls of the combustion chamber are cooled, completely or partially, by evaporating tube bundles protected by the refractory itself. The zone at the interface between grid and combustion chamber consists of the refractory-carrying girder. The flame produced by the combustion of waste develops inside the combustion chamber, a flame that reaches temperature of over 1400°C. The surface of the grid is struck only occasionally by the radiation of the flame since it is normally protected by the bed of waste in transit.

[0006] The surface of the grid consists of plates (typically known as "fire bars") usually consisting of molten steel with high chrome content to have high hot wear characteristics. The advance of the waste is obtained through the relative movement of the fire bars that can have different characteristics. The actuation system normally consists of oleodynamic pistons. The fire bars are provided with openings to allow the combustion air to flow from below the grid plane, through the waste. The combustion air actually has the double function of providing the oxygen for the oxidation of the waste and of cooling the fire bar keeping it at an acceptable temperature to maintain the mechanical characteristics. The grid comprises a plurality of moving groups, each formed from the quoted fire bars organised in a bundle, which move relative to each other by advancing the waste on the grid. In particular, the fire bars are divided into fixed fire bars and mobile fire bars that by means of slides carry out a to-and-fro movement, sliding one on top of the other and determining the advance of the waste in each moving group and thus on the grid in general.

[0007] The disposal of urban solid waste, since it is not characterised by a very high technology content, is an activity that is particularly sensitive from a point of view of reliability and of guaranteed operation. The integrated waste disposal system assembly (accumulation, collection, transportation, storage and disposal) requires that the technological components used in the last step of the production process allow continuous operation 24 hours a day and limit to the greatest possible degree the risks of stopping for damage (be they minor or catastrophic). The manager of the disposal plant requires that the "grid" component be reliable, strong and simple, both in operation and in maintenance.

[0008] The Applicant has made a waste disposal plant in which each fire bar is made with blowing holes in the high part of the front of the fire bar itself, whereas the fusions collect at the bottom, between fire bar and fire bar. The precision of the mechanical couplings with which the combustion bed is made, prevents the dripping of the fusions under the combustion surface and, through the positioning of said holes, also allows the passage of air to be obtained only where it has actually been foreseen, with advantages in terms of uniformity of combustion and reduction of the heat lance effect.

[0009] An aspect of the present invention concerns a waste disposal plant comprising a combustion chamber inside which waste is burned arranged on a combustion grid (3), which takes care of allowing the entry of a suitable amount of combustion air in the chamber through it, said combustion grid comprises at least one moving group formed from a plurality of fire bars or plates (7), which move alternately with each other making the waste advance on said grid, characterised in that each fire bar comprises a rectilinear upper portion, on the upper surface of which the waste rests, a fitting portion, arranged substantially perpendicular to said rectilinear portion, which has a through hole suitable for allowing the blowing air to pass from the lower portion of the combustion chamber to the upper portion and a base portion connected to said fitting portion, of a substantially smaller size than said rectilinear portion.

[0010] The characteristics and advantages of the plant according to the present invention shall become clearer from the following description, given as a non-limiting example, of an embodiment with reference to the attached figures, in which:

- Figure 1 is a schematic representation of a waste disposal plant, according to an embodiment of the present invention, which foresees a threee-level combustion grid;
- Figure 2 is a schematic representation of the combustion grid of the plant of figure 1;
- Figure 3 is a schematic representation of a moving group of the grid of figure 1;
- Figure 4 is a schematic representation of a fire bar of the moving group illustrated in figure 3.

[0011] With reference to the quoted figures, the waste disposal plant comprises a combustion chamber 2 inside which the waste is burned arranged on a combustion grid 3, through which a suitable amount of combustion air is

blown.

[0012] The grid constitutes the lower part of the combustion chamber, above which there is a beam 4 that also carries out the function of supporting refractory side walls 5.

[0013] Preferably, the walls of the combustion chamber are completely or partially cooled, through evaporating tube bundles 6 protected by the refractory itself.

[0014] The combustion grid comprises at least one moving group formed from a plurality of fire bars 7 or plates, which move alternately one after another making the waste advance on the grid.

[0015] In the example embodiment shown in the figures the moving group are three in number arranged staggered with respect to each other so as to obtain a discontinuous horizontal arrangement (in steps or jumps). Alternatively, still in the scope of the present invention, it is possible to obtain a slightly inclined arrangement (up to 15°), without substantial modifications.

[0016] According to the present invention each moving group is actuated by moving means 8 consisting for example of at least one oleodynamic piston. Such moving means allow the alternative movement of the fire bars 7.

[0017] In figure 3 a moving group is illustrated that comprises mobile fire bars 7a and fixed fire bars 7b, arranged alternating with each other, on transversal rows rested upon each other according to a longitudinal arrangement in alternating steps, one fixed and one mobile respectively.

[0018] The mobile fire bars are connected to mobile girders 9a bound to a mobile frame 10a, which is thrusted by a piston on each side of the frame.

[0019] The fixed fire bars 7b are in turn connected by means of fixed girders 9b to a fixed frame 10b common to all of the fixed fire bars.

[0020] The relative movement between the fixed frame and the mobile frame is of simple alternating translation. The relative movement of the fire bars is of alternating translation preferably according to a direction inclined by 20° to the horizontal.

[0021] In the forward stroke the mobile fire bar 7a thrusts the waste on the back of the fixed fire bar 7b until it is made to fall onto the subsequent mobile fire bar, and at the same time drags the waste on its own back. In the backward stroke the waste on the back of the mobile fire bar hits an obstacle in the front of the fixed fire bar and, instead of going back, is thrusted on the back of the fixed fire bar downstream and then thrusted forwards in the subsequent stroke, determining the advance of the waste in each moving group and thus on the grid in general.

[0022] The structure of the grid is preferably modular. For example, according to the requirements and the potentiality of the plant, the assembly with various combinations of moving groups of 8 rows (4 fixed fire bars plus 4 mobile fire bars) or 6 rows (3 fixed fire bars plus 3 mobile fire bars) is foreseen.

[0023] In the example of figure 1, a first step E, made by a first moving group comprising a module of six fire bars, in which the desiccation of the waste mainly takes place, is illustrated. Then follow a second step C comprising a moving group of eight fire bars, on which the combustion mainly takes place, and a third step F comprising a moving group of eight fire bars, on which the finishing is mainly carried out.

[0024] The aforementioned structure consists of a planar upper portion, rigidified in the lower part by perpendicular ribs also having the heat exchange function and defined as back 71, on the upper surface of which the waste rests, a fitting portion 72, arranged substantially perpendicular to said rectilinear portion (head of the fire bar) 71, which has a through hole 73 suitable for allowing the blown air to pass from the blown air collector under the grid to the combustion chamber. The fire bar also comprises a base portion 74 connected to said fitting portion, substantially smaller than said rectilinear portion, and a fastening portion 75 (hinge) that defines a seat for receiving said girders 9 of the mobile and fixed frames.

[0025] The configuration of the illustrated moving group of figure 2 foresees that the fire bars are positioned inclined and that the base portion of a fire bar rests upon the rectilinear upper portion of the subsequent fire bar of the group.

[0026] The movement thus determines the sliding between the lower surface of said base portion of a fire bar with the upper surface of said upper portion of the subsequent fire bar.

[0027] A characteristic of the present invention foresees that all of the fire bars are interchangeable; this is due to an identical design of both fixed and mobile fire bars and to mechanical processing that limits variations in size and irregularities.

[0028] According to a characteristic of the present invention the grid is designed to obtain a substantially horizontal and at least partially continuous combustion plane. The solution is in accordance with the product composition of waste that determines ever-increasing calorie values, with less need for mixing and greater requirements of controlling it advancement.

[0029] Alternatively, for particular requirements a discontinuous horizontal arrangement (in steps) or slightly inclined arrangement (up to 15°) can be obtained, without substantial modifications.

[0030] The support of the fire bars of the grid according to the present invention has characteristics of greater inertia in the advancing direction of the product, which is that in which the greatest stress peaks occur. This is due to the particular design of the fire bar-carrying girders and to the relative arrangement of the two frames.

[0031] To limit the peak load and therefore phenomena of instability on the mobile frame, the piston is fixedly connected at the end on the advancing side. This allows greater horizontal forces with the same use of material.

[0032] The balancing of the forces and of the displacements on the two parallel pistons (one on each side of the frame as described above) is carried out by a suitable hydraulic oil divider that ensures, within certain limits,

synchronous movements of the two pistons. Should there not be synchrony, an end of stroke rephasing system is foreseen. The arrangement in series of the pistons, which, with the same surfaces, involves the use of pressures double the operating pressure, is thus avoided, with all of the consequences of this in terms of sizing and reliability of the seals.

[0033] Moreover, the articulation of the piston to the mobile frame is kept outside the air chamber, and housed in a suitable box protected from the harmful actions of powders and fusions.

[0034] In order to find the best compromise between ease of disassembly of the fire bars from the grid and the efficiency of closing in the grid, a fastener with horizontal stainless steel plates is foreseen, rested with play on the fixed fire bar and locked with dovetailing. The aforementioned plates allow the frame, made from carbon steel, to be protected, and at the same time allow the support plate of the refractory to be arranged at a sufficient distance to make the disassembly of the first fire bar easy.

[0035] The fire bar according to the present invention foresees that the point of application of the forces due to the advance of the waste is below the axis of the hinge. This provision ensures that the fire bar, during the operation, is pushed downwards and thus pressed onto the next one, limiting to the greatest possible degree the possibilities of turning over. The solution that foresees fire bars rested upon each other, also avoids, through accurate scraping, the accumulation of material on the backs of the fire bars themselves, which is frequently the cause of turning over.

[0036] The moving system is with direct translation with a single articulation between the stem of the hydraulic piston and the frame. The moving is carried out by a pair of pistons, each on a side of the frame. This system allows the compactness and the rigidity of the system to be maximised with the same use of materials.

[0037] In order to contain the obstructions caused by the low-melting metals and the dirtying of the parts under the grid, the fire bar has been designed with the blowing holes 73 in the high part of the front, i.e. in the quoted fitting portion 72, whereas the fusions collect at the bottom, between fire bar and fire bar, in the zone where the head of one fire bar rests upon the back of the next one. The precision of the mechanical couplings with which the combustion bed is made, prevents the dripping of the fusions under the combustion surface and also allows the passage of air to be obtained only where it has actually been foreseen, with advantages in terms of uniformity of combustion and reduction of the heat lance effect.

[0038] Making the air seal involves an elastic compensation system of the dilations that is obtained by pressing the side plates of the frames against the fire bars through adjustable helical springs (not shown in the figures).

[0039] Moreover, said fire bars advantageously have vertical ribs having the double function of rigidifier and finning to maximise the heat exchange with the combustion air and thus contain the temperature of the fire bar.

Claims

1. Waste disposal plant comprising a combustion chamber (2) inside which the waste is burned arranged on a combustion grid (3), which takes care of allowing the entry of a suitable amount of combustion air in the chamber through it, said combustion grid comprises at least one moving group formed from a plurality of fire bars or plates (7), which move alternately with each other making the waste advance on said grid,
   characterised in that each fire bar comprises a planar upper portion (71), rigidified in the lower part by perpendicular ribs having a heat exchange function, on the upper surface of which the waste rests, a fitting portion (72), arranged substantially perpendicular to said rectilinear portion (71), which has a through hole (73) suitable for allowing the blowing air to pass from the air blowing collector to the combustion chamber and a base portion (74) connected to said fitting portion, of a substantially smaller size than said rectilinear portion.

2. Plant according to claim 1, wherein said moving group is configured so that the fire bars are positioned inclined and so that the base portion of a fire bar rests on the rectilinear upper portion of the next fire bar of the group.

3. Plant according to claim 1, wherein each moving group is actuated by moving means carried out by at least one oleodynamic piston (8) that allows the alternative movement of said fire bars (7).

4. Plant according to claim 2, wherein each moving group comprises mobile fire bars (7a) and fixed fire bars (7b), arranged alternating with each other, on transversal rows rested on top of one another according to a longitudinal arrangement with alternating steps, one fixed and one mobile respectively.

5. Plant according to claim 4, wherein said mobile fire bars are connected to mobile girders (9a) fixedly connected to a mobile frame (10a), which is pushed by a piston on each side of the frame and said fixed fire bars are connected by means of fixed girders (9b) to a fixed frame (10b) common to all of the fixed fire bars.

6. Plant according to claim 5, wherein each fire bar comprises an attachment portion (75) that defines a receiving seat for said girders (9) of said mobile and fixed frames (7).

7. Plant according to claim 1, wherein each fire bar comprises vertical ribs having the double function of rigidifier and finning to maximise the heat exchange with the combustion air and to contain the tempera-

ture of the fire bar.

8. Plant according to claim 1, wherein each fire bar has the thrusting centre of the head on the waste at a lower height than the centre of the hinge, so that the operating forces tend to press the fire bars against each other in the opposite direction to the one that causes turning over.

Fig. 1

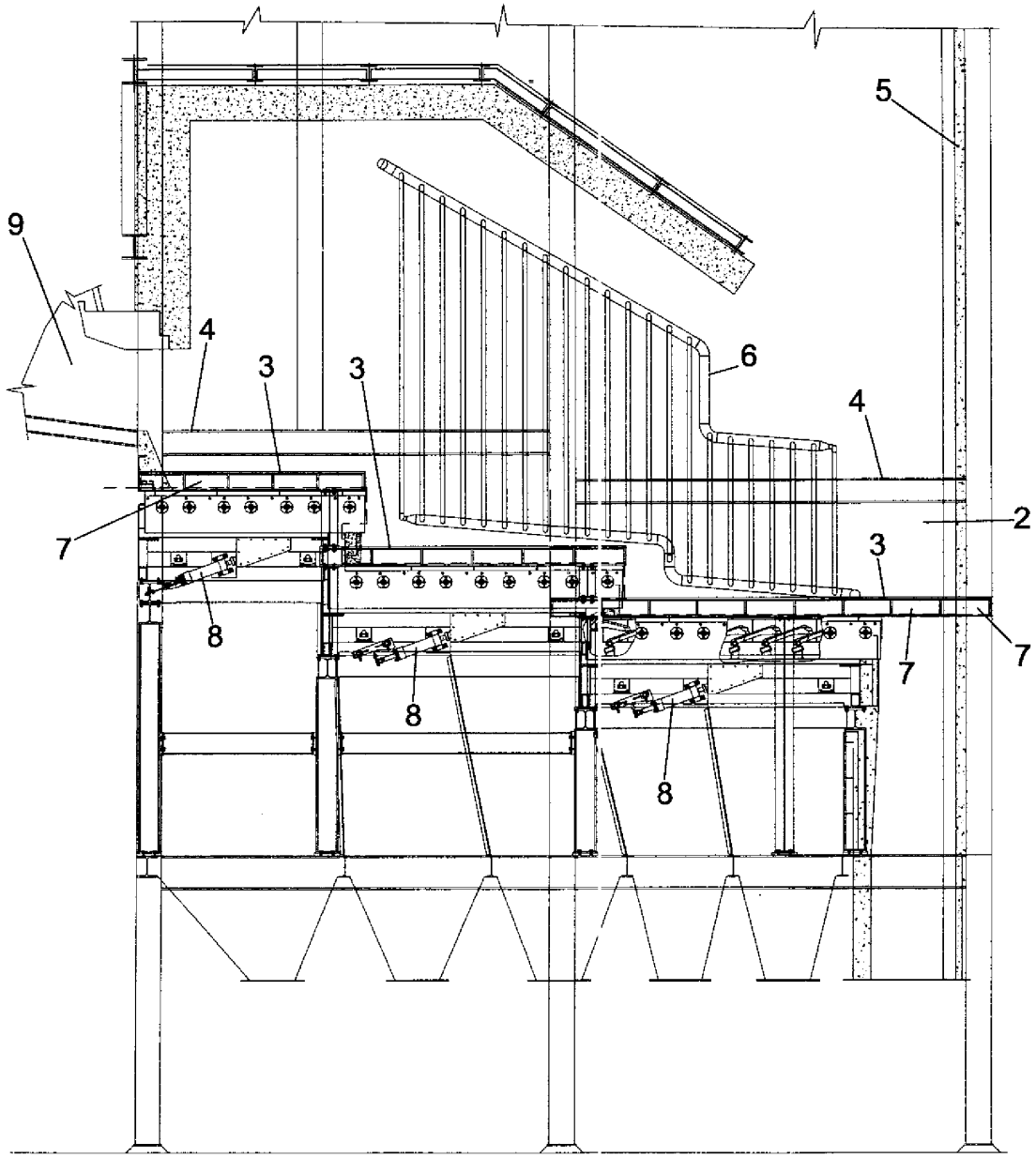

Fig. 2

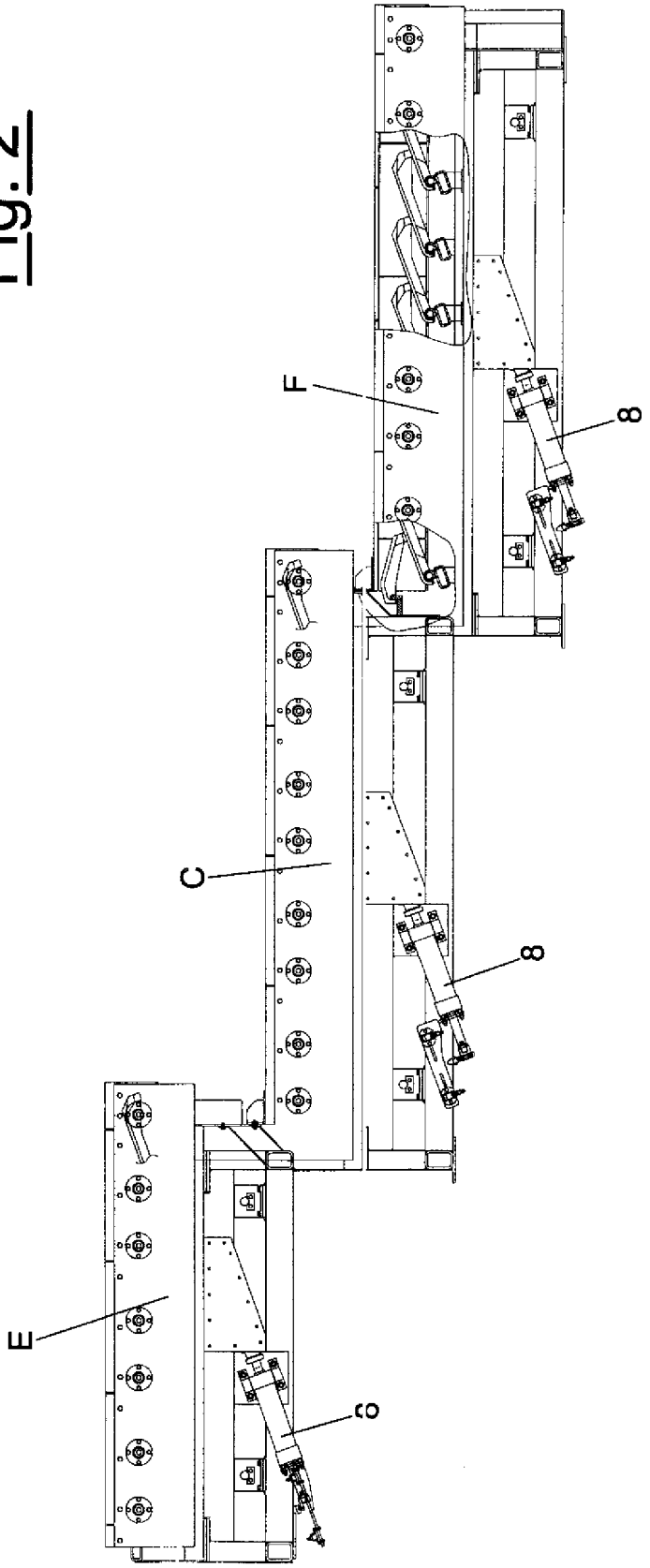

Fig. 3

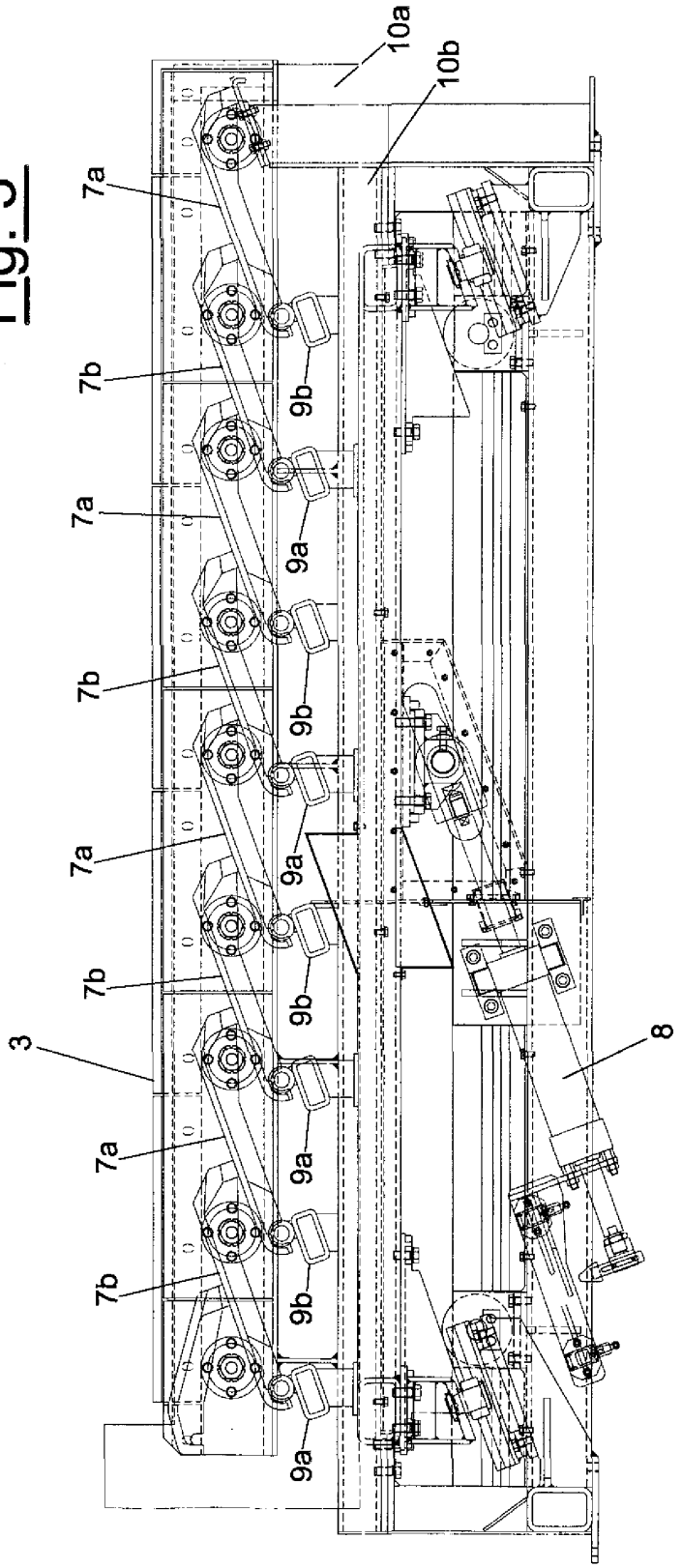

Fig. 4