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(54) Method of removing ash in a furnace, a furnace, and use of ash in a furnace

(57) A method in a furnace (2), which comprises two or several successive spaces (5, 2, 23) with different pressures and at least one passage (11, 21, 30) between them. In the method ash is conveyed by means of a conveyor (34) to said passage and the ash is compressed to the passage by means of said conveyor, wherein the compressed ash prevents the flow of gases between the spaces through said passage. The furnace (2) comprises: a fire chamber; a grate (3); at least two successive spaces (2, 5, 23, 29) with different pressures, comprising at least a first space and a second space; at least one conveyor (34) arranged to move ash from the first space to the second space; and at least one passage (11, 30) through which dry ash can be pushed by said conveyor from the first space to the second space. The ash conveyed by the conveyor plugs and seals said passage.

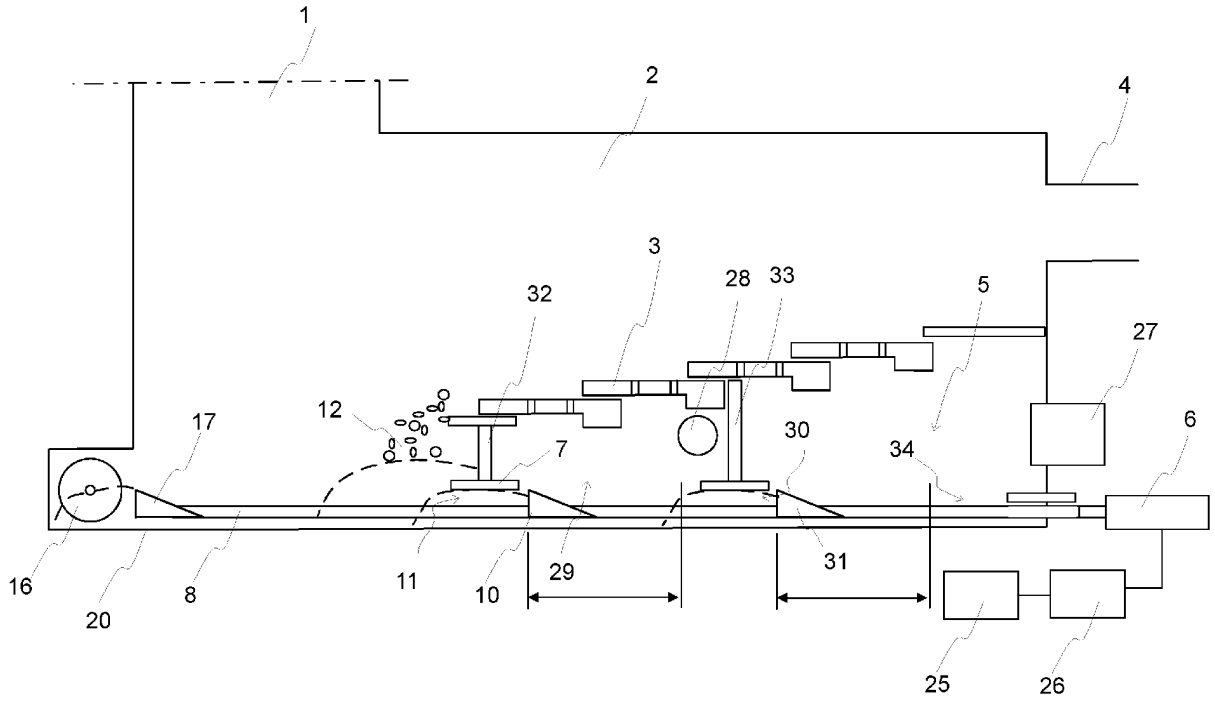

Fig. 2

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Description

Field of the invention

[0001] The invention relates to a method in a furnace, containing two or several spaces with different pressures and at least one passage between the spaces. The invention relates to a furnace. The invention relates to the use of ash in a furnace.

Background of the invention

[0002] When solid fuel such as wood, wood chips, peat or the like is used for heating, the combustion of said fuels produces ash as a result. During combustion ash falls under the grate of the burner head and the ash accumulated on top of the grate is removed to the ash space as a result of the movement of the grate, part of the ash being so-called fly ash that flies along with the flame and adheres on the convection surfaces of the boiler. The ash must be removed one way or another, because otherwise the boiler will be filled with ash and its function will be prevented.

[0003] The conventional way to remove ash from the boiler is to do it manually, the ash removal hatches of the boiler are opened and the ash is shovelled or scraped manually out of the boiler. Mechanically this can be carried out for example in such a manner that the object producing ash contains a so-called ash pit from which an ash screw conveyor pushes the ashes to an ash bin. Ash pits often have malfunctions; the ash forms a vault by itself and does not travel to the ash screw conveyor, and there is also the problem that the ash screw conveyors leak air, which, if uncontrolled, weakens the efficiency of the boiler.

[0004] For the removal of ash from boilers a system is also used where the ash falls in successive pits containing water, and the pits are connected with an underwater tunnel comprising a chain scraper conveyor. The problem of wet ash is that it is difficult to handle and in winter wet ash will freeze outdoors. Peat ash contains sulphur, which turns into sulphurous acid during the combustion and when the sulphurous acid becomes wet, it turns into sulphuric acid. Sulphuric acid is a very complicated substance for which neutralization is absolutely necessary.

[0005] One moving and stepped grate is disclosed in publications FI-B-94284 or FIB-108258. One scraper conveyor i.e. chain scraper conveyor or push rod discharger or screw conveyor, conveying wet ash and operating in wet conditions is disclosed in publication FI-B-85420. One reciprocating scraper conveyor, i.e. a push rod discharger is disclosed in publication FI-B-100731.

Summary of the invention

[0006] A simple and functional way to remove ash from below the grate of the burner head and from the space for ash of the boiler is to remove the ashes by means of a so-called push rod discharger, which begins from below the grate and extends along the bottom of the fire chamber of the boiler to the screw conveyor removing ash from the boiler. In our first experiments, problems were caused by the sealing of the grate and the fire chamber. Sealing is important in view of effective combustion, because there must be small primary air overpressure under the burner head. The fire chamber, in turn, must have slight negative pressure to prevent the access of smoke outside the boiler.

[0007] The solution was found in the idea to use ash as a sealing agent.

[0008] The method according to the invention is presented in claim 1. The furnace according to the invention is presented in claim 6. The use of ash according to the invention is presented in claim 9.

[0009] The solution has a simple structure. The solution operates in dry conditions, and the use of for example water is not required. By means of the solution, it is possible to make the different spaces, i.e. chambers leakproof and to prevent the leaks between them. One single conveyor can be utilized in connection with a number of different spaces and for sealing of several openings, i.e. passages. A reciprocating conveyor is suitable for the solution, especially a so-called scraper conveyor operating as a push rod discharger, which is positioned in the passage between the spaces and conveys and compresses the ash which at the same time seals the passage. The ash forms a sort of a plug that closes and seals the passage. The sealing functions both when the conveyor is stationary and when it is moving.

Brief description of the drawings

[0010]

Fig. 1 shows a furnace applied in the invention and a push rod discharger for ash from the side.

Fig. 2 shows a principle view of a furnace having a grate and a conveyor in a cross-sectional view from the side.

Fig. 3 shows in a principle view from the top different scraper conveyors, which can be applied in the furnace of Fig. 1 or Fig. 2.

Detailed description of the invention

[0011] With reference to Fig. 1, fuel is supplied into a furnace 2 by feeding members, for example along a feeding pipe 4. The fuel is made of combustible solid fuels, such as wood, straw and peat, for example by cutting, compressing or crushing. The fuel is in the form of wood chips, briquets or pellets. The moving grate 3 is made of grate elements of cast iron, on top of which the actual combustion takes place. The combustion produces ash, part of which falls into a space 5 under the grate. Most

of the produced ash is pushed by the moving grates 3 to an ash pile 12.

[0012] Fig. 1 shows one example of the operating devices intended for removing the generated ash from the bottom of the space 5 and from the bottom of the furnace 2. For example a hydraulic cylinder 6 alternately pulls and pushes back and forth the rod 8 of the push rod discharger to which scrapers 10 and 14 conveying the ash are attached.

[0013] The scraper 10 moves back and forth a distance 9 between point 24 and point 15, thus removing the ash fallen under the grate 5, and pushing the ash to a suitably narrow passage 11, thereby forming a plug in the passage 11 which operates as a seal preventing the flow of gas between the pressurized space 5 and the furnace 12 having negative pressure. The passage 11 is formed by a plate 7 and the bottom 20 shared by the space 5 and the furnace 2. The pushing movement of the scraper 10 must end at the point 15 so that a suitable ash plug is generated in the passage 10 and also in such a manner that the force of the scraper 10 is capable of squeezing the ash from the space 5 to the ash pile 12. From the ash pile 12 the scraper 14 moves the ash, both the ash squeezed from the space 5 and the ash coming from the grate 3 from the bottom of the furnace 2 towards the ash screw conveyor 16. The scraper 14 attached to the rod 8 conducts a movement of equal length simultaneously with the scraper 10. The scraper 14 moves a distance 13 back and forth from point 18, leaving a suitable amount of ash in the ash pile 12. When the scraper 14 stops, a plug of ash preventing the flow of gas is generated in point 18 under a plate 19 in the passage 21. It is necessary to prevent the flow of gas in the passage 21 because there is a pressure difference between the fire chamber of the furnace 2 and the bottom part 23 of the convection 22 of the furnace 2.

[0014] In Fig 1 double-headed arrows 9 and 13 illustrate the distance to-and-fro travelled by the scrapers 10 and 14. The scraper 17 pushes the ashes to an ash screw conveyor 16 that conveys the ashes out of the furnace. Smoke exits along a channel 1.

[0015] Figure 2 shows another example of the solution in which the same reference numerals indicate the parts corresponding to those of Fig. 1. Combustion air is supplied to the space 5 for example by means of blast members 27. There may be separate blast members 28 for the space 29. The heat generated in the combustion can be collected by means of the walls of the fire chamber and the flue gas channel 1, or as shown in Fig. 1, by means of heat exchangers located in the channel 1, through so-called convection 22. In the example of Fig. 1 the smoke is conveyed through the convection 22 to its bottom part 23 which contains a push rod discharger, and then up through the convection 22.

[0016] In the example of Fig. 2 there are two separate spaces 5 and 29 underneath the grate, from which combustion air is fed zonally to the fuel. The spaces are separated from each other and/or from the fire chamber with one or several partition walls 32 and 33. Ash also falls into the spaces 5 and 29. The solution comprises a conveyor 34 travelling through two or several spaces. The conveyor 34 moving the ash is in this example a scraper conveyor moving back and forth, in which the scraper 10, 17 or 31 is preferably wedge-shaped or for example triangular. When moving in one direction (to the left in Fig. 1 and 2) the scrapers push the ash in front of them and when moving to the opposite direction the scrapers dig underneath the ash.

[0017] In Fig 1, the spaces include the space 5, the fire chamber of the furnace 2 and the bottom part 23 of the convection. In Fig. 2 the spaces include the space 5, the space 29 next to it and the fire chamber of the furnace 2. Different pressures prevail in different spaces. The pressure of the (pressurized) spaces underneath the grate is greater than the pressure of the (negative pressure) fire chamber and the pressure of the fire chamber is smaller than the pressure of the channel 1 or the bottom part of the convection 23.

[0018] The pile or wall of ash accumulated in front of the scraper can now be used for sealing the passage 11 or 30, or passage 14 in Fig. 1. Via the passage the scraper conveyor travels through or passes by the partition wall 32, 33. The distances between the scrapers and their travelling distances are adopted in accordance with the passages. The conveyor, especially the scrapers therein are arranged in such a manner that the conveyed ash wall is positioned at the passage, thus blocking the passage, also when the conveyor 4 is stationary. It is not always necessary for one single scraper to enter into the passage in order to perform the sealing, as shown in Fig. 1. In one example it is sufficient that the scraper proceeds close to the passage and pushes a sufficient amount of ash to the passage, as shown in Fig. 2. Thus, the sealing also functions when the scraper is moving back and forth outside the passage. In the reciprocating movement the scraper may move into the passage. Preferably, in order to make sure that the sealing is constantly effective, the scraper does not travel through the passage during the reciprocating movement.

[0019] The conveyor 34 is moved by at least one actuator which is, for example, a cylinder 6 operating by means of pressurized medium. The movement of the actuator is controlled by means of control members 26, such as valves. The control members, in turn, are controlled by a control device 25, such as a programmable logic controller or other microprocessor-based device.

[0020] Fig. 3 show some examples of conveyors to be applied, in other words chain scraper conveyors or scraper conveyors, or especially push rod dischargers, containing one or several rods 8 connecting the scrapers, for example the scraper 10. The conveyor is preferably made of steel. Instead of a rigid rod 8 it is also possible to use one or several flexible chains, wires or corresponding members 35, to which the scrapers are attached. Thus, two actuators are in use, which alternately pull the conveyor 34 to opposite directions. In some special struc-

tures the member 35 and at the same time the conveyor 34 form an endless loop that is rotated for example only to one direction and which moves the ash for example to the screw conveyor 16. Thus, a return path for the conveyor 4 must be arranged at the bottom 20 or underneath the same.

[0021] In one alternative the conveyor does not travel via the passages, but there are separate conveyors on different sides of the passage. Thus, for example the space 5 contains a separate conveyor and the chamber and/or the bottom part 23 has a separate conveyor. The conveyor 34 of Fig. 2 can thus be composed of several different successive parts. The parts either share a control unit or they have separate control units. There may also be more scrapers in Figs 1 and 2 than shown in the Figures.

[0022] The present invention is not limited to the above-presented examples and embodiments, but it can be modified within the scope of the appended claims.

Claims

1. A method in a furnace (2), which comprises two or several successive spaces (5, 2, 23) with different pressures and at least one passage (11, 21, 30) between them, **characterized in that** ash is conveyed by means of a conveyor (34) to said passage and the ash is compressed by means of said conveyor to the passage, wherein the compressed ash prevents the flow of gas between the spaces through said passage.

2. The method according to claim 1, **characterized in that** the conveyor (34) comprises a reciprocating scraper (10, 14, 31), which is arranged to push ash.

3. The method according to claim 1 or 2, **characterized in that** said space is positioned underneath the grate (3) or in the fire chamber of the furnace (2), or in the bottom part (23) of a convection (22) positioned in a flue gas channel (1).

4. The method according to any of the claims 1 to 3, **characterized in that** the ash forms a plug in said passage (11), wherein ash is squeezed out from one side of the passage when the conveyor (34) pushes more ash to the passage from the other side of the passage (11).

5. The method according to any of the claims 1 to 4, **characterized in that** the conveyor (34) is arranged to travel through the passage.

6. A furnace (2) comprising:

   - a fire chamber for combustion of fuel,
   - a grate (3) located in the chamber,
   - at least two successive spaces (2, 5, 23, 29) with different pressures, comprising at least a first space and a second space,

   characterized in that the furnace also comprises:

   - at least one conveyor (34) arranged to move ash from the first space to the second space,
   - at least one passage (11, 30) through which dry ash can be pushed by said conveyor from the first space to the second space,
   - wherein said conveyor is also arranged to convey dry ash to said passage in the form of a pile or wall, which at the same time blocks and seals said passage.

7. The furnace according to claim 6, **characterized in that** the conveyor (34) comprises a reciprocating scraper (10, 14, 31), which is arranged to push ash.

8. The method (7) according to claim 6 or 7, **characterized in that** the conveyor (34) is a scraper conveyor, chain scraper conveyor or a push rod discharger.

9. Use of ash in a furnace (2), which comprises two or several successive spaces (5, 2, 23) with different pressures and at least one passage (11, 21, 30) between them, **characterized in that** ash conveyed and compressed by means of a conveyor (34) to the passage is used for preventing the flow of gas between the spaces through said passage.

10. The use according to claim 9, **characterized in that** ash is used as a plug in the passage, said ash being pushed to said passage by a reciprocating scraper (10, 14, 31).

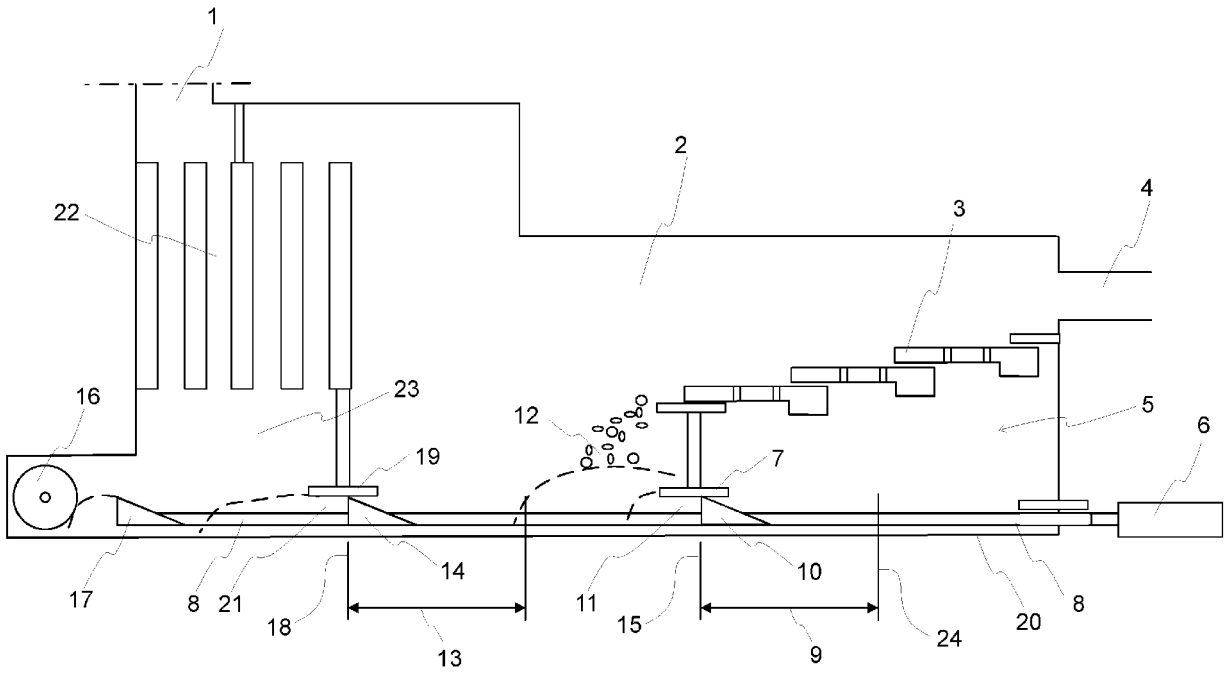

Fig. 1

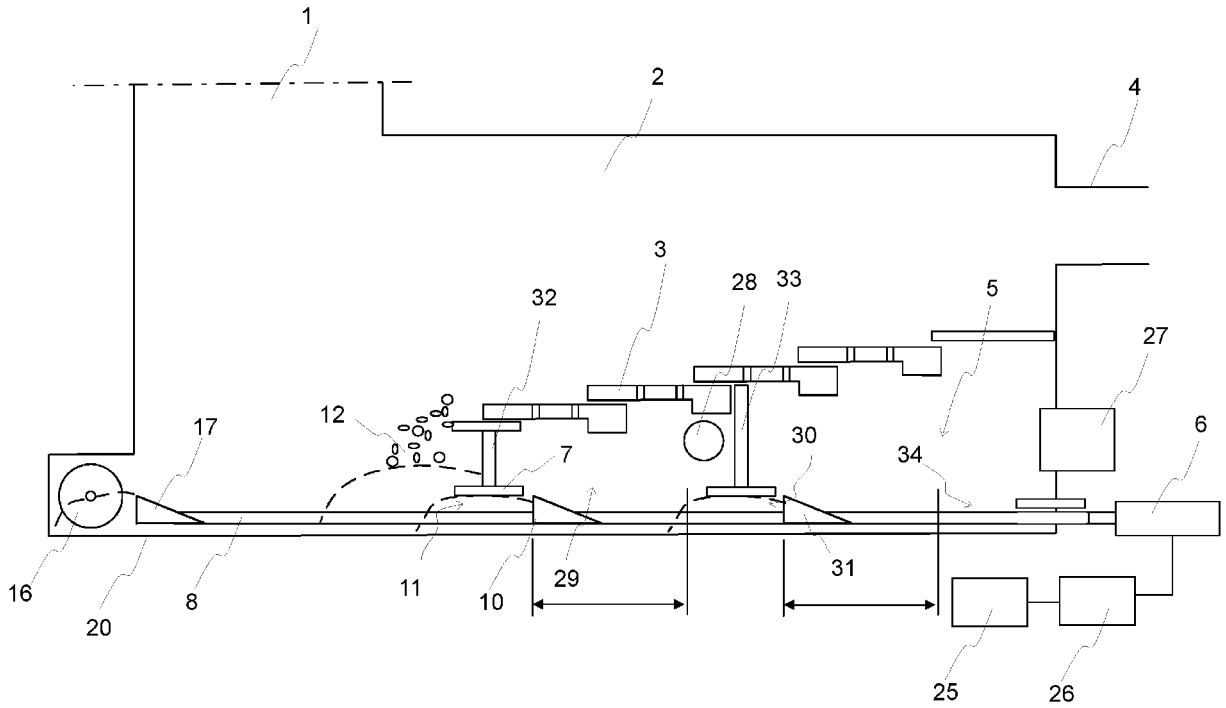

Fig. 2

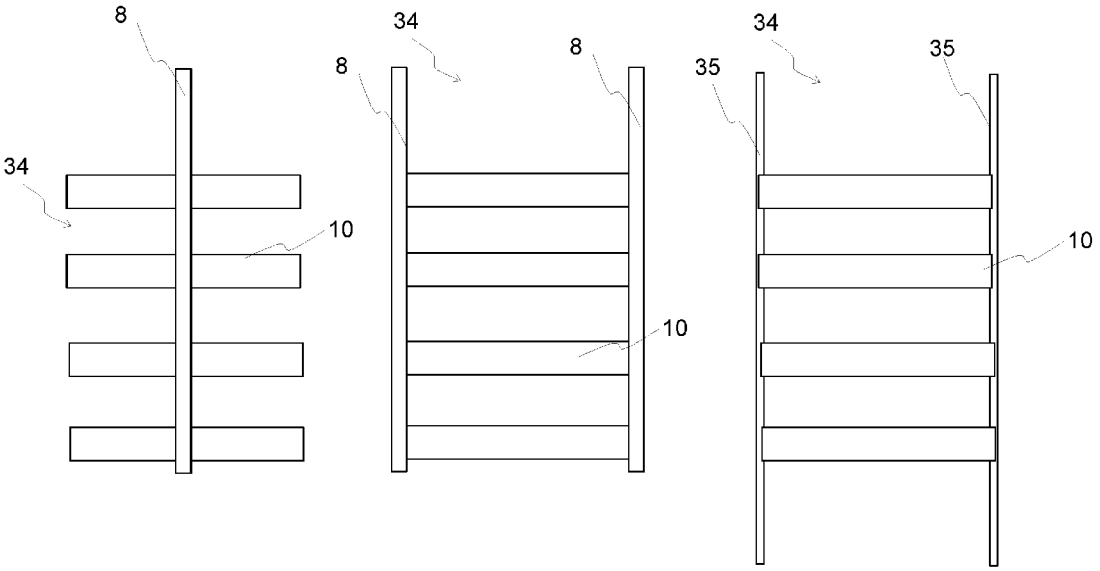

Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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- FI 108258 B **[0005]**
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