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(54) FIREBRICK AND STOVE

(57) A firebrick (1) for a stove having a combustion chamber (11). The firebrick (1) comprises an air supply path (6) for delivering a tertiary airflow to the combustion chamber (11). The air supply path (6) comprises an air mixing formation (4) for inducing swirling in the delivered tertiary airflow for promoting burning of smoke particles in the combustion chamber (11).

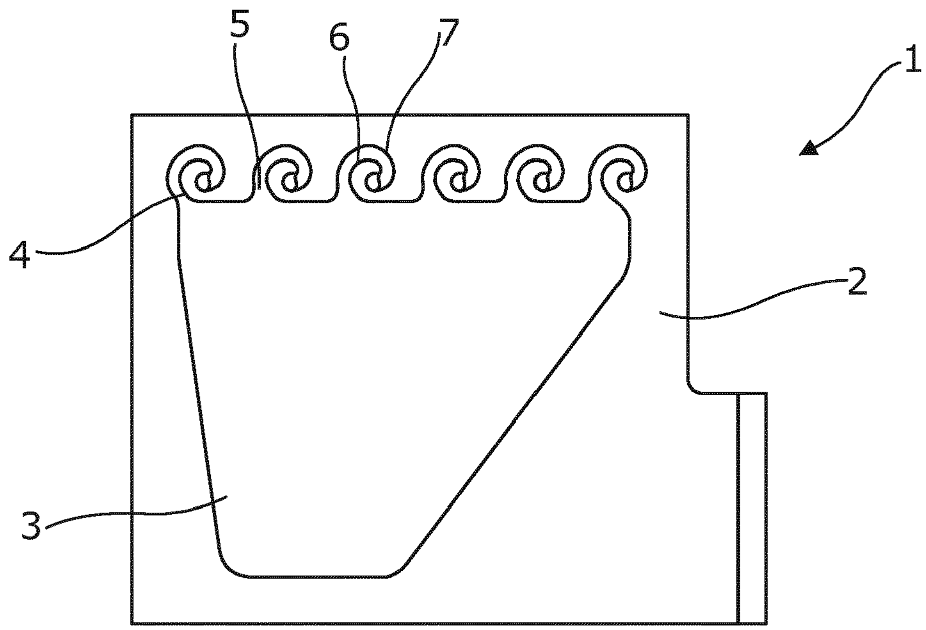

Fig. 1

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Description

[0001] The present invention concerns a firebrick for a stove and a stove. In particular, the present invention concerns wood burning or multi-fuel domestic stoves, having an enhanced tertiary air delivery system.

[0002] Wood burning and multi-fuel stoves have remained a popular method of heating homes. However, combustion of wood results in the production of several unwanted by-products, such as carbon monoxide and smoke. This has lead to stove designs being refined over the years to try to maximise combustion efficiency and reduce the production of such unwanted by-products. In particular, designs have focussed on increasing efficiency by delivering oxygen to different regions of the stove's combustion chamber using diverted airflows for promoting more complete combustion.

[0003] In this connection, a stove's primary airflow is delivered through inlets located at the base of the combustion chamber. This thereby feeds air up through the firebed, allowing for an intense main combustion stage. Nevertheless, a proportion of unburnt particles will remain suspended in the heated combustion gasses as smoke. One method for addressing this is to deliver a secondary airflow as a warmed stream of air for igniting any unburnt particles prior to their exhaustion from the stove. This secondary airflow may also be directed over the inner face of the stove's door as an air wash for keeping a stove's glass window clean.

[0004] In some stove designs, a further air supply is provided to deliver a tertiary airflow from the rear of the combustion chamber to its upper region above the firebed. This is commonly achieved by forming apertures in a firebrick at the back of the combustion chamber, with the additional delivered oxygen enhancing combustion of smoke particles in the heated combustion gases collected at the top of the chamber.

[0005] Despite the above designs, however, there remains a need for further improvements to enhance combustion efficiency and reduce the quantity of carbon monoxide and smoke particles generated. The present invention therefore seeks to offer solutions to this problem.

[0006] According to a first aspect of the present invention there is provided a firebrick for a stove having a combustion chamber, the firebrick comprising: an air supply path for delivering a tertiary airflow to the combustion chamber, and wherein the air supply path comprises an air mixing formation for inducing swirling in the delivered tertiary airflow.

[0007] In this way, the air mixing formation modifies the airflow through the tertiary air path by imparting a rotational momentum such that the air ejected into the combustion chamber generates a swirling turbulence in the combustion gases. This leads to better mixing of the air and smoke particles as they rise from the firebed, advantageously promoting their combustion and thereby reducing the levels of carbon monoxide and smoke produced. The air supply path thereby provides a duct or ducts through the firebrick for both delivering and mixing the oxygenated air with the combustion gasses to enhance combustion efficiency.

[0008] The above arrangement contrasts with conventional tertiary air supplies that simply deliver a generally lamina airflow directed linearly away from the face of the firebrick. Whilst this provides additional oxygen for combustion, it does not enhance the mixing of gasses and particulates, and therefore does not achieve the improved combustion efficiency associated with the present invention.

[0009] Preferably, the air mixing formation is formed integrally into the firebrick. In this way, the improved combustion effects may be achieved by simply modifying the shape of the firebrick itself, either as part of its casting process or in a subsequent machining operation. As such, expensive modifications to the configuration of air ducts formed in the metal structure of the stove are not required.

[0010] Preferably, the air mixing formation is provided by a channel formed in the firebrick.

[0011] Preferably, the channel is a spiral channel for guiding the tertiary airflow. In this way, the tertiary airflow is guided around the spiral as it travels through the air supply path thereby inducing the swirling rotational momentum in the airflow.

[0012] Preferably, the material defining the walls between the spiral channel is equal to or greater than the width of the spiral channel. In this way, a robust design is achieved. That is, the firebrick material is relatively brittle and overly thin sections may otherwise be prone to breakage; the above arrangement ensures the middle section of the spiral is sufficiently tough to minimise manufacturing defects and avoid damage during handling, installation and use.

[0013] Preferably, the air mixing formation extends across a plane defined by a face of the firebrick. In this way, the tertiary airflow is directed laterally as it passes through the air supply path. This imparts a lateral component to the movement vector of the airflow, thereby increasing the footprint in the vertical plane occupied by the swirling tertiary air.

[0014] Preferably, the air mixing formation comprises a graduated channel depth for guiding the tertiary airflow through the firebrick. In this way, air is funnelled through the airflow channel formed by the mixing formation into the combustion chamber.

[0015] Preferably, there is a plurality of air mixing formations. In this way, the delivery of the tertiary airflow may be distributed across the width of the combustion chamber for more uniform combustion. For instance, the plurality of air mixing formations may be provided in an array.

[0016] Preferably, the plurality of air mixing formations are fed by a manifold formed by a recess in a rear face of the firebrick for supplying air to each air mixing formation. In this way, the plurality of air mixing formations may be fed by a simple cavity formed by a recess in the firebrick body.

[0017] Preferably, the firebrick further comprises a front face for facing a firebed in the combustion chamber, and wherein the air supply path delivers the tertiary airflow from the front face of the firebrick.

[0018] Preferably, the air mixing formation is provided on a back face of the firebrick.

[0019] Preferably, the air mixing formation funnels air to an outlet provided on a front face of the firebrick for delivery to the combustion chamber. In this way, the outlet of the air supply path forms an aperture through the firebrick for allowing fluid communication from the back face to the front face.

[0020] Preferably, the air supply path comprises an air inlet for receiving the tertiary airflow from a stove manifold.

[0021] Preferably, the air supply path comprises an air outlet for delivering a tertiary airflow to the combustion chamber. In this way, the outlet forms an aperture through the firebrick for allowing fluid communication from the back to the front.

[0022] Preferably, the air supply path is configured for delivering the tertiary airflow to above a firebed in the combustion chamber. In this way, the air supply path is configured to outlet air from an upper portion of the firebrick, such that when the firebrick is installed in a stove, the tertiary airflow is fed in above the firebed.

[0023] According to a second aspect of the present invention, there is provided a stove having a combustion chamber, comprising: an air supply path for delivering a tertiary airflow through a face of the interior of the combustion chamber, wherein the air supply path comprises an air mixing formation for inducing swirling in the delivered tertiary airflow for promoting burning of smoke particles in the combustion chamber.

[0024] In this way, a stove is provided in which the tertiary air path is modified by the mixing formation to impart a rotational momentum to the flow. As such, the air ejected into the combustion chamber generates a swirling turbulence in the combustion gases, leading to better mixing of the air and smoke particles, promoting their combustion. This reduces the levels of carbon monoxide and smoke produced, and hence enhances combustion efficiency.

[0025] Preferably, the face of the interior of the combustion chamber comprises a firebrick according to any one of the above statements.

[0026] Preferably, the stove further comprises a tertiary airflow duct for delivering air to the air supply path.

[0027] Preferably, the tertiary airflow duct receives air from an air intake manifold.

[0028] According to a third aspect of the present invention, there is provided a combustion enclosure part for a stove, comprising: one or more tertiary air supply outlets for delivering a tertiary airflow to the combustion enclosure; and one or more feeding channels for feeding air to the one or more tertiary air supply outlets, wherein the one or more feeding channels are curved for inducing rotational momentum in the tertiary airflow when it exits the one or more tertiary air supply outlets.

[0029] Illustrative embodiments of the present invention will now be described with reference to the accompanying drawings in which:

Figure 1 shows a view of the back of a firebrick according to an embodiment of the invention;
Figure 2 shows an enlarged view of a mixing formation shown in Figure 1;
Figure 3 shows a cross-sectional isometric view of a stove incorporating the firebrick shown in Figure 1; and
Figure 4 shows a cross-sectional side view of the stove shown in Figure 3.

[0030] Figure 1 shows the back face of a firebrick 1 according to an illustrative embodiment of the invention. The firebrick 1 is designed for use as the rear panel of the combustion chamber in a wood burning or multi-fuel stove. As such, together with side, floor and roof panels, the firebrick 1 defines an enclosure, with its front face for facing the firebed within the stove and its back face 2 for backing onto an air duct within the stove.

[0031] As shown in Figure 1, the back face 2 of the firebrick 1 comprises a recess 3 which forms an air delivery manifold for feeding air to a plurality of air feed channels 6 defined by mixing formations 4 provided in an array at the upper boundary of the recess 3.

[0032] Figure 2 shows an enlarged view of one of the mixing formations 4. The mixing formation 4 is formed integrally into the back face 2 of the firebrick 1, with the air feed channel 6 having a spiral shape that extends laterally across a portion of a plane defined by the back face 2 of the firebrick 1.

[0033] The spiral shape of the air feed channel 6 is defined by the channel's curved walls 8. A portion of firebrick material forming the inner side wall 8 is thereby provided in the middle of the spiral, partially surrounded by the air feed channel 6. In this embodiment, the width of the air feed channel 6 is 5mm, with the width of the firebrick material in the middle of the spiral having an equal width or greater for enhanced toughness.

[0034] The air feed channel 6 has a graduated base 9 that gets deeper along its length, terminating in an aperture 7 formed at the centre of the spiral. The aperture 7 forms an outlet to the front face of the fire brick. As such, the air feed channel 6 passes through the body of the firebrick 1, and defines an air supply path for funnelling an airflow from its inlet 5 at the top of the recess 3 through to the outlet 7. As air flows along the air supply path, the spiral configuration induces a rotational momentum for swirling the air delivered from the outlet 7.

[0035] In connection with the design of the mixing formation 4, the applicant has identified that one of the challenges with forming the mixing formation is to ensure that the design is robust enough to minimise manufacturing defects and avoid damage during subsequent handling.

In particular, overly thin sections of firebrick may be prone to breakage because the firebrick material is relatively brittle. However, the above described spiral design allows the diameter of formation to be made sufficiently large to maintain the integrity of the material in any protruding sections. Furthermore, the curved shape helps to minimise stress concentrations in the regions where different formations link together, allowing for smooth transitions between the recess 3, the air feed channels 6, and the outlets 7.

[0036] Figure 3 shows a cross-sectional isometric view of a stove 10 incorporating the firebrick shown in Figure 1. Figure 4 shows a cross-sectional side view of the same stove 10.

[0037] As shown in Figure 3, in use, the firebrick 1 forms a panel located at the rear of the combustion chamber 11 of the stove 10. The front of the firebrick 1 faces the combustion chamber 11, with the outlets 7 providing a linear array across the width of the firebrick 1 towards the top of the combustion chamber 11. The back face 2 of the firebrick 1 backs onto the rear structure of the stove body, with the recess 3 forming a cavity aligned with the stove's tertiary airflow duct 12. The tertiary airflow duct 12 is connected to the stove's manifold 13 provided at the base of the stove. The manifold 13 is fed by an air inlet 14 provided at the rear of the stove 10. Consequently, an airflow path is established from the stove's manifold 13 through to the outlets 7.

[0038] In use, an air feed enters the stove manifold 13 and is divided for providing the primary, secondary and tertiary airflows. The tertiary airflow is directed up through tertiary airflow duct 12 to the back face of the firebrick 1, where it rises through the cavity formed by the recess 3 and into the airflow channels 6 defined by the mixing formations 4. As the airflow travels through the body of the firebrick 1, the spiral shape of the mixing formation 4 imparts a rotational momentum to the flow, prior to its release through the outlets 7. As such, the tertiary airflow delivered from the outlets 7 into the combustion chamber 11 has a swirling current. This acts to mix the gasses and suspended particulates at the top of the combustion chamber for promoting their more complete combustion. That is, the tertiary airflow is delivered to the combustion chamber 11 above the firebed. Smoke particles produced from the combustion of the fuel, such as burning wood, are thereby further mixed by the swirling turbulence created by the airflow delivered from outlets 7. This promotes the subsequent combustion of these particles with the oxygen provided by the tertiary airflow, and consequently a reduction in the amount of carbon monoxide and smoke produced by the stove.

[0039] The present invention therefore promotes more efficient combustion by inducing swirling in the tertiary airflow to further improve the mixing of gasses and particulates within the combustion chamber.

[0040] It will be understood that the embodiment illustrated above shows applications of the invention only for the purposes of illustration. In practice the invention may be applied to many different configurations, the detailed embodiments being straightforward for those skilled in the art to implement.

[0041] For example, the air mixing formations 4 could be disposed on the front face of the firebrick, with the formation guiding the airflow for inducing swirling after it exits an outlet aperture in the firebrick.

[0042] Furthermore, it is also envisaged that embodiments of the inventions may be provided as a stove, with the air mixing formations being formed as part of the stove body, rather than an integral part of a firebrick. For example, the outlets 7 may be provided as an additional component adjacent to the firebrick.

[0043] It will also be understood that whilst embodiments of the present invention may be provided as a stove incorporating a firebrick with the described mixing formation, embodiments of the present invention may also be provided as a firebrick for fitting to an existing stove. For instance, a firebrick according to an embodiment of the present invention may be retrofitted since it may utilise the existing air inlet from a conventional stove body's rear air ducts.

Claims

1. A firebrick for a stove having a combustion chamber, the firebrick comprising:

   an air supply path for delivering a tertiary airflow to the combustion chamber, and
   wherein the air supply path comprises an air mixing formation for inducing swirling in the delivered tertiary airflow for promoting burning of smoke particles in the combustion chamber.

2. A firebrick according to claim 1, wherein the air mixing formation is formed integrally into the firebrick.

3. A firebrick according to claim 2, wherein the air mixing formation is provided by a channel formed in the firebrick.

4. A firebrick according to claim 3, wherein the channel is a spiral channel for guiding the tertiary airflow.

5. A firebrick according to claim 4, wherein material defining the walls between the spiral channel is equal to or greater than the width of the spiral channel.

6. A firebrick according to any preceding claim, wherein the air mixing formation extends across a plane defined by a face of the firebrick.

7. A firebrick according to any preceding claim, wherein the air mixing formation comprises a graduated channel depth for guiding the tertiary airflow through the firebrick.

8. A firebrick according to any preceding claim, wherein there is a plurality of air mixing formations.

9. A firebrick according to claim 8, wherein the plurality of air mixing formations are fed by a manifold formed by a recess in a rear face of the firebrick for supplying air to each air mixing formation.

10. A firebrick according to any preceding claim, wherein the firebrick comprises a front face for facing a firebed in the combustion chamber, and
wherein the air supply path delivers the tertiary airflow from the front face of the firebrick.

11. A firebrick according to any preceding claim, wherein the air mixing formation is provided on a back face of the firebrick.

12. A firebrick according to claim 11, wherein the air mixing formation funnels air to an outlet provided on a front face of the firebrick for delivery to the combustion chamber.

13. A firebrick according to any preceding claim, wherein the air supply path comprises an air inlet for receiving the tertiary airflow from a stove manifold.

14. A firebrick according to any preceding claim, wherein the air supply path comprises an air outlet for delivering a tertiary airflow to the combustion chamber.

15. A firebrick according to any preceding claim, wherein the air supply path is configured for delivering the tertiary airflow to above a firebed in the combustion chamber.

16. A stove having a combustion chamber, comprising:

an air supply path for delivering a tertiary airflow through a face of the interior of the combustion chamber,
wherein the air supply path comprises an air mixing formation for inducing swirling in the delivered tertiary airflow for promoting burning of smoke particles in the combustion chamber.

17. A stove according to claim 16, wherein the face of the interior of the combustion chamber comprises a firebrick according to any one of claims 1 to 15.

18. A stove according to claim 16 or 17, further comprising a tertiary airflow duct for delivering air to the air supply path.

19. A stove according to claim 18, wherein the tertiary airflow duct receives air from an air intake manifold.

20. A combustion enclosure part for a stove, comprising:

one or more tertiary air supply outlets for delivering a tertiary airflow to the combustion enclosure; and
one or more feeding channels for feeding air to the one or more tertiary air supply outlets, wherein the one or more feeding channels are curved for inducing rotational momentum in the tertiary airflow when it exits the one or more tertiary air supply outlets.

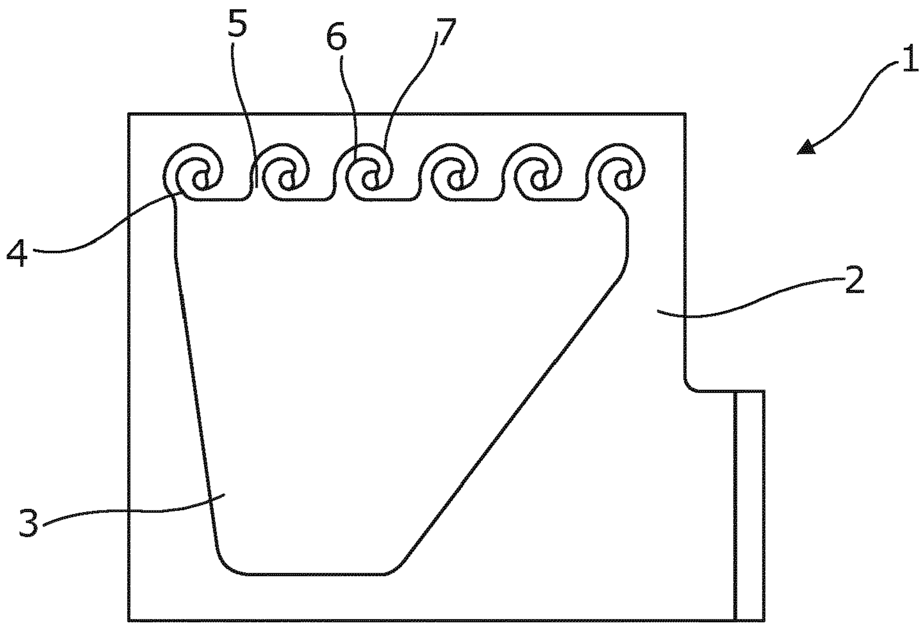

Fig. 1

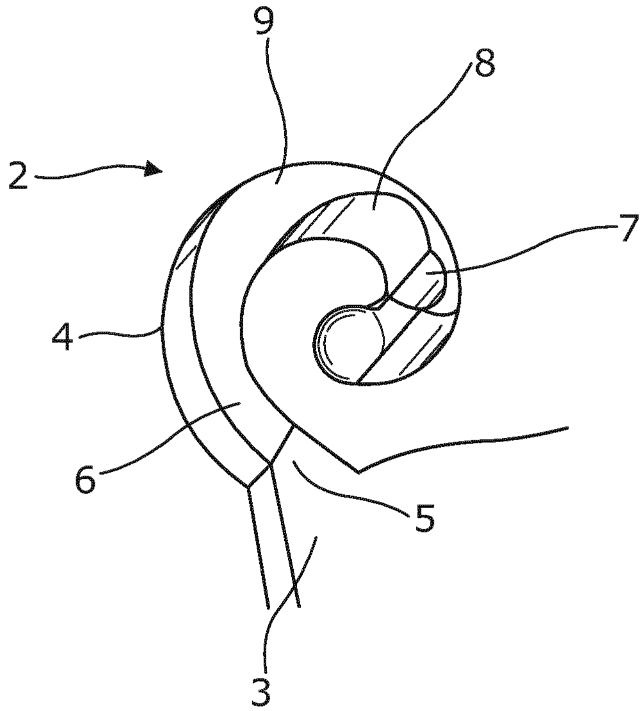

Fig. 2

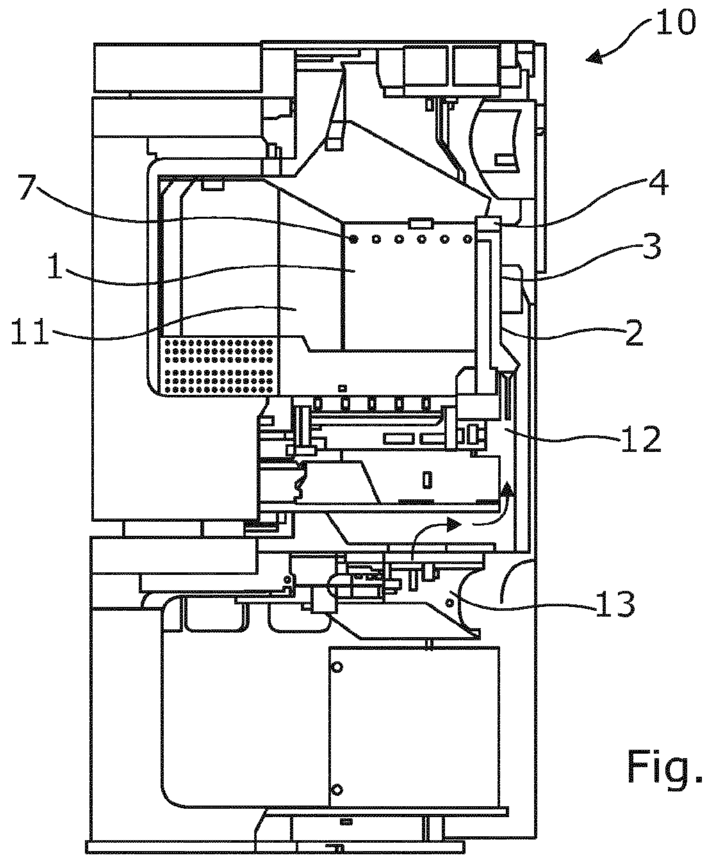

Fig. 3

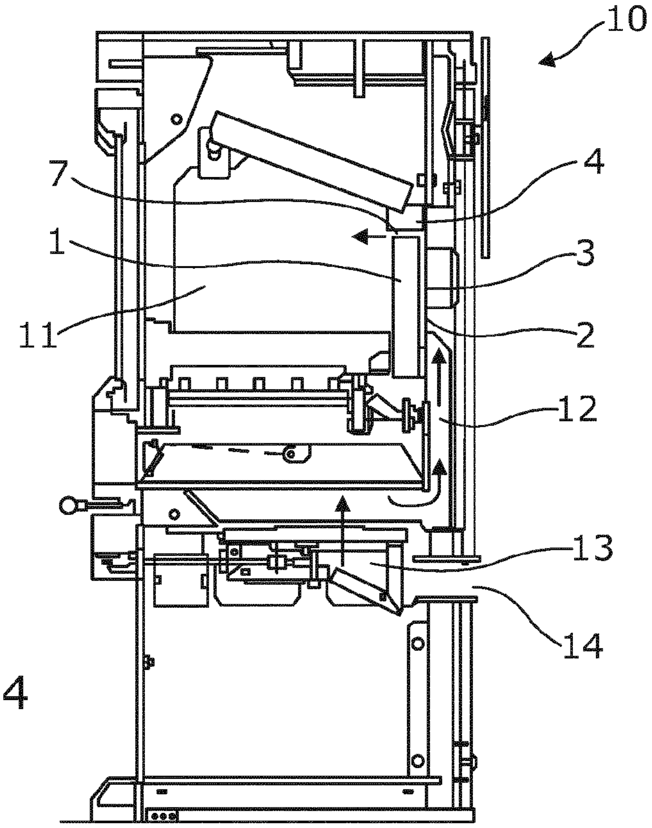

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 18 19 0428

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TECHNICAL FIELDS SEARCHED (IPC)

F23M
F27D
F24C
F24B
F23C
F23L

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	13 March 2019	Vogl, Paul

CATEGORY OF CITED DOCUMENTS

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