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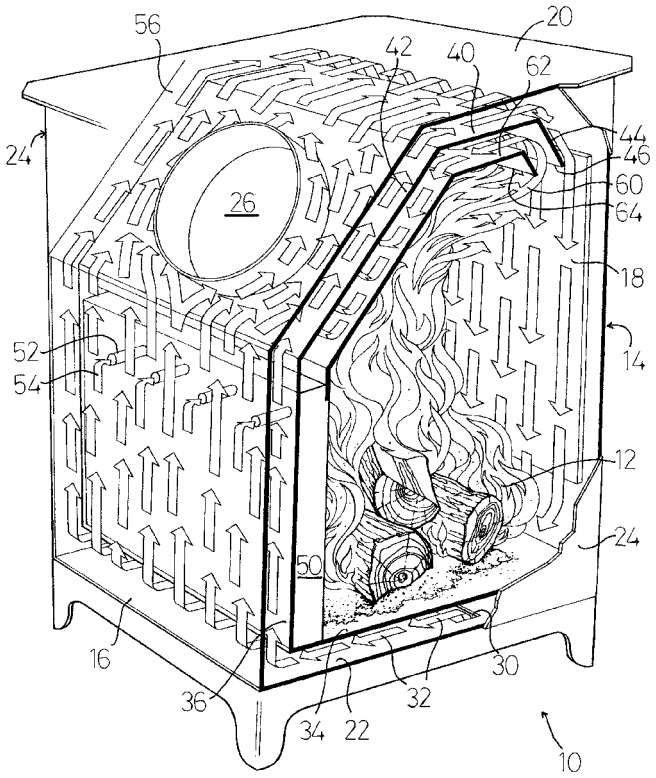
(54) Solid fuel stove

(57) This invention relates to a solid fuel stove (10) having a fire box (12) located within a substantially closed chamber. The stove has a primary controllable opening permitting air to enter the fire box, and a secondary opening (30) (which may also be controllable) permitting additional air to enter the fire box. The secondary opening (30) is located in the bottom wall of the stove. The stove has a first partition (34) between the fire box (12) and its bottom wall (22), a second partition (36) between the fire box (12) and its rear wall (16) and a third partition (40) between the fire box (12) and its top wall (20), the partitions (34, 36, 40) separating the secondary air from the fire box (12), the secondary air entering the fire box (12) above the fire box. The secondary air is therefore heated as it passes across the partitions so that the efficiency of the stove is increased.



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Description

FIELD OF THE INVENTION

[0001] This invention relates to a solid fuel stove.

BACKGROUND TO THE INVENTION

[0002] In the following description, directional and orientational terms such as "top", "bottom" etc. will be used to describe the stove in its normal orientation of use.

[0003] Solid fuel stoves having a fire box where wood and other solid fuels can be burned have been available for many years. The fire box is located within a substantially closed chamber, permitting the stove to be located within a room or other area to be heated, the fire box being connected to a flue through which combustion and exhaust products can pass into a chimney or the like.

[0004] Most solid fuel stoves are controllable, in that the rate of burning of the fuel within the fire box can be controlled to some extent. Control can be effected by a choke flap within the flue, the position of the choke flap, and in particular the proportion of the flue which is blocked thereby, determining the rate at which smoke can pass out of the fire box and into the chimney. If less smoke can pass out of the fire box more is retained within the fire box so that the proportion of oxygen within the fire box is reduced and the rate of burning decreases.

[0005] Control is also effected by varying the rate at which fresh air can enter the fire box. Specifically, the user can move an adjustable valve to vary the amount of fresh air entering the fire box. This adjustable valve is usually called the primary air control, and the air which has passed through the primary air control will be referred to herein as the primary air. If the user closes the primary air control the rate of burning decreases to match the reduced amount of oxygen within the fire box.

[0006] It is known that the efficiency of a solid fuel stove will increase with the temperature of the air within the fire box. The manufacturers of solid fuel stoves have sought to increase the efficiency of their stoves by adding baffles or deflectors which prevent the smoke from passing directly to the flue, the baffles being intended to cause the smoke to recirculate within the fire box increasing the likelihood that combustible particles within the smoke will be burned.

[0007] The primary air usually passes underneath the fire box and enters the fire box from below, typically though a grate upon which the fuel rests, the grate also typically allowing ash to fall from the fire box into a tray beneath the grate.

[0008] The primary air is usually drawn from the room or area within which the stove is located, and so will be at the ambient temperature of the room or area. It has been recognised that the primary air does not have much opportunity to heat up further before it engages the fuel, and in order to increase the efficiency of a solid fuel stove manufacturers have sought to provide more heated air to the fire box.

[0009] Specifically, manufacturers have developed secondary air systems through which additional air is admitted to the fire box. In GB patent application 2 274 162 for example secondary air enters the back of the stove, passes through a channel above the fire box, and enters the fire box above the fuel. The secondary air is heated as it passes along the channel, so that the average temperature of the air entering the fire box (comprising the primary and secondary air) is hotter than in stoves with only a primary air supply, so reducing the proportion of unburned combustible particles in the smoke and increasing the efficiency of the stove.

[0010] Many stoves include one or more transparent viewing windows at the front of the stove so that the burning fuel within the fire box can be seen. It is known for soot and other waste products to become deposited onto the window over time, so reducing the aesthetic appeal of the stove. To reduce the likelihood of such deposits manufacturers have developed systems in which secondary air enters the stove above the window and passes down across the inside of the window. Such systems are often referred to as providing an "air curtain" for the window, and the secondary air flow across the window reduces the likelihood that soot or other solid materials will engage the window and become deposited thereupon.

SUMMARY OF THE INVENTION

[0011] The present invention seeks to provide a solid fuel stove with improved efficiency. In some embodiments the improved stove also provides an air curtain for the window of the stove.

[0012] According to the invention there is provided a solid fuel stove having a fire box located within a substantially closed chamber, the stove having a primary opening permitting air to enter the fire box, a secondary opening permitting additional air to enter the fire box, and a flue through which smoke may pass out of the fire box, the stove having a bottom wall, a rear wall, a top wall and a front wall, the secondary opening being located in the bottom wall, the stove having a first partition between the fire box and the bottom wall, a second partition between the fire box and the rear wall and a third partition between the fire box and the top wall, the partitions separating the secondary air from the fire box, the secondary air entering the fire box above the fire box.

[0013] Accordingly, secondary air enters the stove through the bottom wall, passes along the bottom wall, up the rear wall and along the top wall, before entering the fire box adjacent to the front wall. Such a flow path increases the time during which the secondary air can absorb heat from the walls and partitions of the stove so that the air is very hot when it enters the fire box, increasing the efficiency of the stove.

[0014] Preferably the third partition terminates adjacent to the front wall, so that the secondary air enters the fire box adjacent to the front wall, and ideally immediately

above a window in the front wall. It has also been found that the hotter the air within the air curtain the more effectively will the air curtain keep the window free of deposited soot and other solid particles, so that the particularly hot secondary air provided by the present invention is especially useful in this respect.

[0015] It will be understood that when the stove has been alight for some time all of the walls become hot, including the bottom wall. This is despite the introduction of primary air beneath the fire box, and the presence of the ash tray and the first partition between the fire box and the bottom wall. It is advantageous for the secondary air to enter the stove in the bottom wall, as close to the front wall as possible, so as to maximise the length of the (hot) path along which the secondary air must travel to enter the fire box.

[0016] In less advantageous arrangements, the secondary opening may be provided through the rear wall, but in such cases it is preferable that the secondary opening be located near to the bottom wall so that the secondary air must pass most of the rear wall and most of the top wall (in such embodiments there is no requirement for a first partition). Even in such less advantageous embodiments the secondary air must pass across part or all of at least two of the walls of the stove, rather than a part of a single wall as in GB 2 274 162.

[0017] Since the top and bottom walls of the stove are typically substantially parallel, and the rear wall is typically substantially perpendicular to the top and bottom walls, the first and third partitions are preferably similarly substantially parallel to each other, and substantially perpendicular to the second partition. In other words, the first, second and third partitions provide a substantially parallel-sided channel for the secondary air with their respective wall.

[0018] Preferably the first, second and third partitions are contiguous, perhaps being formed from a single sheet of metal bent into the desired shape.

[0019] In common with prior art stoves the flue is preferably located at the rear of the stove, and ideally passes through one of the partitions and one or both of the top wall and the rear wall.

[0020] Desirably, the stove includes a baffle or deflector plate between the fire box and the flue. Preferably at least part of the deflector plate is parallel to at least part of the third partition. Preferably also the deflector plate terminates close to the front wall, and ideally close to the terminal edge of the third partition. Such an arrangement can increase the heat exchange between the secondary air and the smoke and hot combustion products.

BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] The invention will now be described in more detail, by way of example, with reference to the accompanying drawing, which shows a perspective view of a stove according to the invention, with some of the walls removed, and shows the typical path of the secondary air and smoke within the stove.

DETAILED DESCRIPTION

[0022] The stove 10 has a fire box 12 located within a substantially closed chamber provided by the front wall 14, rear wall 16, top wall 20, bottom wall 22, and side walls 24. In common with prior art solid fuel stoves the stove 10 has one or more doors (not shown) in the front wall 14, though which solid fuel may be introduced to the fire box, the door(s) having a window 18 in known fashion.

[0023] Though not shown in this drawing, it will be understood that the stove also has a grate at the bottom of the fire box, and an ash tray beneath the grate.

[0024] Also, in common with prior art stoves, the stove 10 has a primary opening (not seen) in the front wall (below the door(s)) permitting primary air to enter the fire box through the grate.

[0025] Smoke passes from the fire box through a flue 26 and into a chimney which can be connected to the flue outlet in known fashion.

[0026] According to the present invention the stove also has a secondary opening 30 permitting secondary air to enter the fire box 12, the path of the secondary air being shown by the arrows 32. The secondary air is guided along a channel defined by respective partitions, each of which is substantially planar in this embodiment. A first partition 34 is substantially parallel with the bottom wall 22, a second partition 36 is substantially parallel with the rear wall 16 and a third partition 40 is substantially parallel with the top wall 20.

[0027] Whilst in some embodiments the first, second and third partitions could be joined to their neighbours at respective right-angled junctions, in this embodiment there is a fourth intermediate partition 42 between the second and third partitions 36, 40, the fourth intermediate partition lying at an angle of approximately 45° to the second and third partitions. In addition, a fifth partition 44 is connected to the third partition, angled downwardly at approximately 45°. The fifth partition in particular acts to reduce the turbulence in the secondary air flow as it enters the fire box 12 adjacent to the front wall 14 and above the window 18. The reduction in turbulence is intended to increase the effect of the air curtain, and to increase the likelihood that the secondary air will flow across the full length of the window 18 as represented.

[0028] The gap between the terminal edge 46 of the fifth partition and the back of the window 18 is around 18-20 mm, which is a dimension which has been found to promote a beneficial air curtain across much or all of the window 18.

[0029] Though not shown in the drawing, it will be understood that the first partition 34 lies below the ash tray, whereas the primary air passes above the ash tray and through the grate. Accordingly, the primary and secondary air do not mix. Also, the secondary opening 30 is not controllable, i.e. the user can control the rate of air entry

into the fire box, and thereby control the rate of burning of the solid fuel, only by controlling the rate of entry of primary air. If desired, however, in other embodiments the secondary opening 30 may also be manually controllable, at least to some extent.

[0030] The relative number and sizes of the primary and secondary openings can be determined by the manufacturer so as to provide the desired air flow into the fire box 12.

[0031] In common with prior art solid fuel stoves the back of the fire box is lined with fire bricks 50 or the like. In this embodiment several holes 52 are provided through the fire bricks, whereby some of the secondary air 54 can enter the fire box without passing fully up the rear wall 16, or along the top wall 20. The size and number of the holes 52 can be determined by the manufacturer in relation to the other design features so as to provide the desired air flow into the fire box.

[0032] The flue 26 is located in an aperture in the fourth partition 42, the flue being welded or the like to the fourth partition so as to provide an air tight seal therebetween. Whilst it would be possible to provide an enlarged volume for the secondary air between the rear wall 16, top wall 20 and the angled fourth partition 42, in this embodiment the channel for the secondary air is maintained at a substantially constant cross-section by an additional wall 56 which lies substantially parallel to the fourth partition 42. It will be understood that the flue 26 also passes (in an air tight manner) through an aperture in the additional wall 56.

[0033] Though not shown in the drawing, in common with prior art stoves the flue 26 finally passes through the rear 16 and/or top wall 20 and exits the stove 10.

[0034] It will be observed that the smoke and other combustion products represented by the arrows 60 do not pass directly from the fire box 12 into the flue 26, but are obstructed by a baffle or deflector plate 62. In this embodiment the deflector plate 62 is shaped to match the fifth, third, fourth and part of the second partitions, and terminates adjacent to the top of the fire bricks 50. The deflector plate 62, together with the partitions, therefore provides a defined channel for the smoke and combustion products, increasing the heat exchange from the smoke and combustion products to the secondary air primarily by way of the intervening partitions.

[0035] In addition, the terminal end 64 of the deflector 62 lies adjacent to (and in this embodiment at substantially the same height as) the terminal edge 46 of the fifth partition, so that only a relatively small opening is available for the smoke and combustion products to leave the fire box 12. This increases the time for which the smoke and combustion products remain within the fire box and increases the likelihood that combustible particles within the smoke become burned.

[0036] The actual size of the gap between the terminal ends 64 and 46 can be chosen by the manufacturer to provide the air flow required, but will typically be less than 50 mm, and ideally less than 30 mm. The size of the gap between the terminal ends 64 and 46 is preferably substantially consistent along the full length of the terminal ends.

[0037] It will be understood that in this embodiment the path which the secondary air must take to enter the fire box 12 is long and circuitous, so that the secondary air has a significant period of time in which to absorb heat from the partitions and walls before it enters the fire box 12. In other embodiments the secondary opening could be in the rear wall 16, and provided the secondary opening was close to the bottom wall the path of the secondary air would be almost as long and circuitous as the embodiment shown. In any event, it is necessary that the secondary air passes along all (or almost all) of at least two walls of the stove, and preferably along all (or almost all) of three walls of the stove, so as to increase the temperature of the air entering the fire box.

[0038] It will also be understood that in the embodiment shown the channel for the secondary air is maintained at a substantially constant width, i.e. the gap between the (substantially planar) partition 34 and the (planar) bottom wall 22 is substantially identical to the gap between the partition 36 and the rear wall 16, and similarly for the partition 42 and wall 56, and partition 40 and top wall 20. That need not be the case, however, and in an alternative embodiment one or more expansion chambers are provided in the channel for the secondary air. One suitable expansion chamber could be provided at the bottom of the rear wall, usefully by angling at least the lowermost of the fire bricks 50 and part of the partition 36 so that the bottom of the firebricks is spaced further from the rear wall 16. This would provide a triangular-shaped chamber between the rear wall 16 and part of the partition 36.

[0039] The secondary air can circulate within the expansion chamber. The length of time before the secondary air enters the fire box 12 would therefore be increased by the presence of an expansion chamber, resulting in the secondary air being hotter when it enters the fire box 12. In addition, the presence of an expansion chamber will affect the pressure of the secondary air and can increase the rate of secondary air flow into the fire box 12. This in turn can make the stove easier to ignite, and can also help in ensuring more complete combustion, particularly of poor fuel such as damp wood. The shape, volume and position of the expansion chamber, and also whether there is one or more expansion chambers, can be determined by the stove manufacturer to achieve the desired secondary air flow.

[0040] Some solid fuel stoves act as water heaters or boilers. The embodiment shown could readily be modified for such use by replacing some or all of the fire bricks 50 by a heat exchanger or water tank. Typically, a water tank for a solid fuel stove will be made from 6 mm folded boiler plate, and a similar tank could be used in the modified embodiment, with the tank being welded or otherwise secured into the back of the fire box. An advantage of such an arrangement would be that the boiler tank would be heated by air flow across the bottom, back, top

and front of the tank and not merely across the front as in conventional solid fuel boiler stoves. Another advantage is that none of the heat from the tank would be lost directly to the room as can occur with conventional solid fuel boiler stoves.

[0041] It is also noted that the channel for secondary air around the fire box provides a suitable location for a heat exchanger or water tank. The purchaser or supplier of a stove according to the present invention might for example take advantage of the channel and occupy part of the channel with a heat exchanger or water tank. It is expected to be easier to fit a water tank into the channel for secondary air than to make and fit a water tank in place of one or more of the fire bricks for example. The water tank could block off some (or if it was intended to avoid the advantages of the present invention, all) of the air channel.

[0042] If a water tank or heat exchanger is fitted into the channel for secondary air, the advantages of the present invention can be maintained if the water tank or jacket does not block the channel, and embodiments having an expansion chamber would be particularly suitable in this respect, the heat exchanger or water tank ideally being sized to fit within the expansion chamber so as to minimise the restriction of the flow of secondary air.

[0043] In preferred embodiments the partitions are manufactured from steel plate, ideally 5mm thick. Such a material will heat up relatively quickly, but will also maintain its heat for a significant time after the fire in the fire box has been shut down.

Claims

1. A solid fuel stove (10) having a fire box (12) located within a substantially closed chamber, the stove having a primary opening permitting air to enter the fire box, a secondary opening (30) permitting additional air to enter the fire box, and a flue (26) through which smoke may pass out of the fire box, the stove having a bottom wall (22), a rear wall (16), a top wall (20) and a front wall (14), the secondary opening (30) being located in the bottom wall, the stove having a first partition (34) between the fire box (12) and the bottom wall (22), a second partition (36) between the fire box (12) and the rear wall (16) and a third partition (40) between the fire box (12) and the top wall (20), the partitions (34, 36, 40) separating the secondary air from the fire box (12), the secondary air entering the fire box (12) above the fire box.

2. A solid fuel stove according to claim 1 in which the partitions (34, 36, 40) terminate adjacent to the front wall (14).

3. A solid fuel stove according to claim 2 having a window (18) in the front wall (14), and in which a terminal end (46) of the partitions (34, 36, 40) lies adjacent to the top of the window.

4. A solid fuel stove according to any one of claims 1-3 in which the first partition (34) is substantially parallel with the first wall (22), the second partition (36) is substantially parallel with the rear wall (16) and the third partition (40) is substantially planar and parallel with the top wall (20).

5. A solid fuel stove according to claim 4 in which the first and third partitions (34, 40) are substantially parallel, and in which the first and third partitions (34, 40) are substantially perpendicular to the second partition (36).

6. A solid fuel stove according to any one of claims 1-5 in which a fourth partition (42) interconnects the second partition (36) and the third partition (40), the fourth partition being angled relative to the second and third partitions.

7. A solid fuel stove according to any one of claims 1-6 in which a fifth partition (44) is connected to the third partition (40) and is angled relative to the third partition.

8. A solid fuel stove according to any one of claims 1-7 in which the partitions (34, 36, 42, 40, 44) are contiguous.

9. A solid fuel stove according to any one of claims 1-8 in which the flue (26) passes through one or more of the partitions (42).

10. A solid fuel stove according to any one of claims 1-9 including a deflector plate (62) between the fire box (12) and the flue (26).

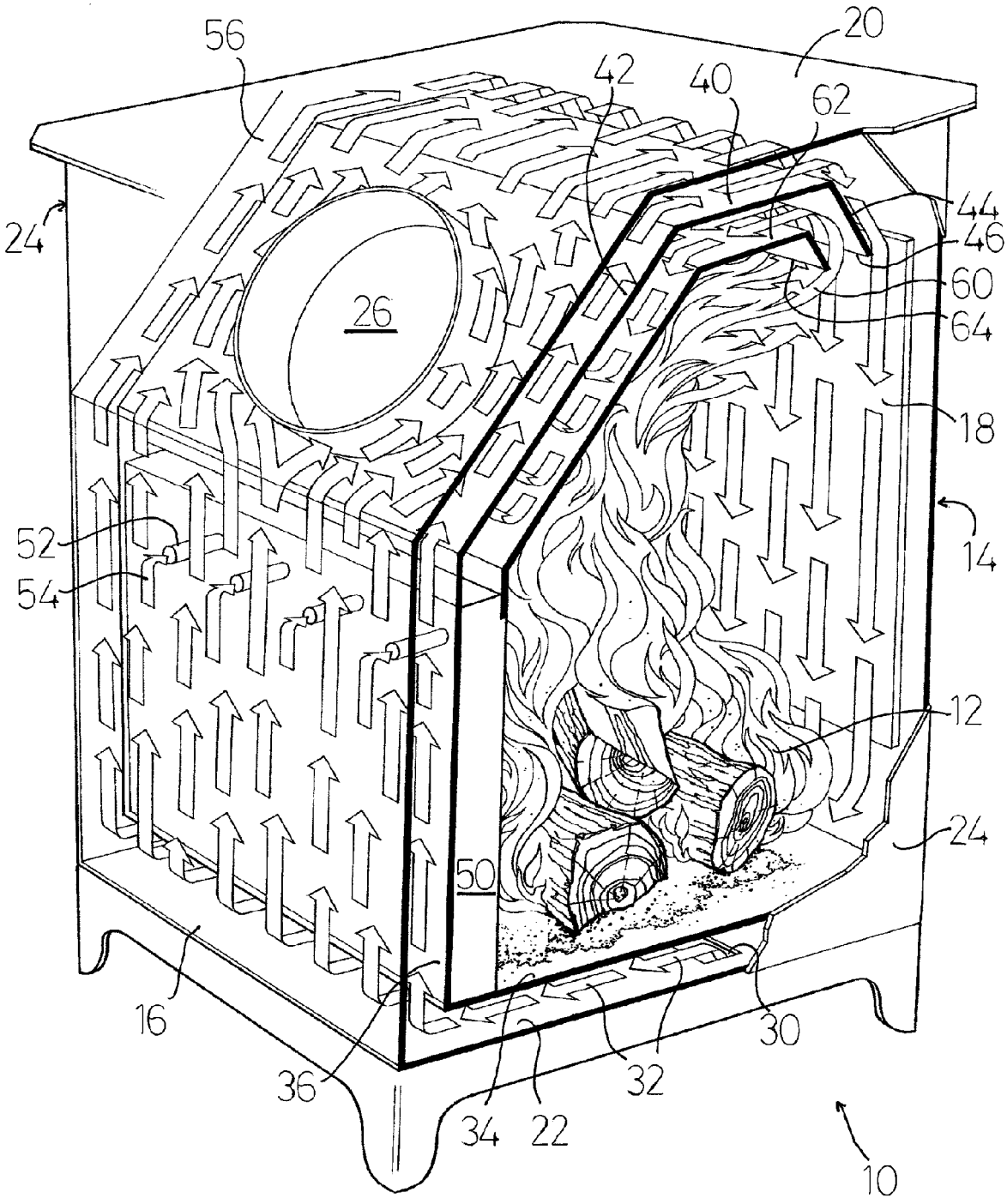
11. A solid fuel stove according to claim 10 in which at least part of the deflector plate (62) is substantially parallel with at least part of the third partition (40).

12. A solid fuel stove according to claim 10 or claim 11 in which a first part of the deflector plate (62) is substantially parallel with the third partition (40) and another part of the deflector plate is substantially parallel with the fourth partition (42).

13. A solid fuel stove according to any one of claims 10-12 in which the deflector plate (62) has a terminal edge (64) which lies close to the front wall (14), adjacent to the terminal edge (46) of the partitions (34, 36, 42, 40, 44).

14. A solid fuel stove according to any one of claims 1-13 in which the second partition (36) has openings to permit the passage of air into the firebox (12)

15. A solid fuel stove according to any one of claims 1-14 in which the secondary opening (30) is adjustable whereby the rate at which the additional air enters the fire box is controllable.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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
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CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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