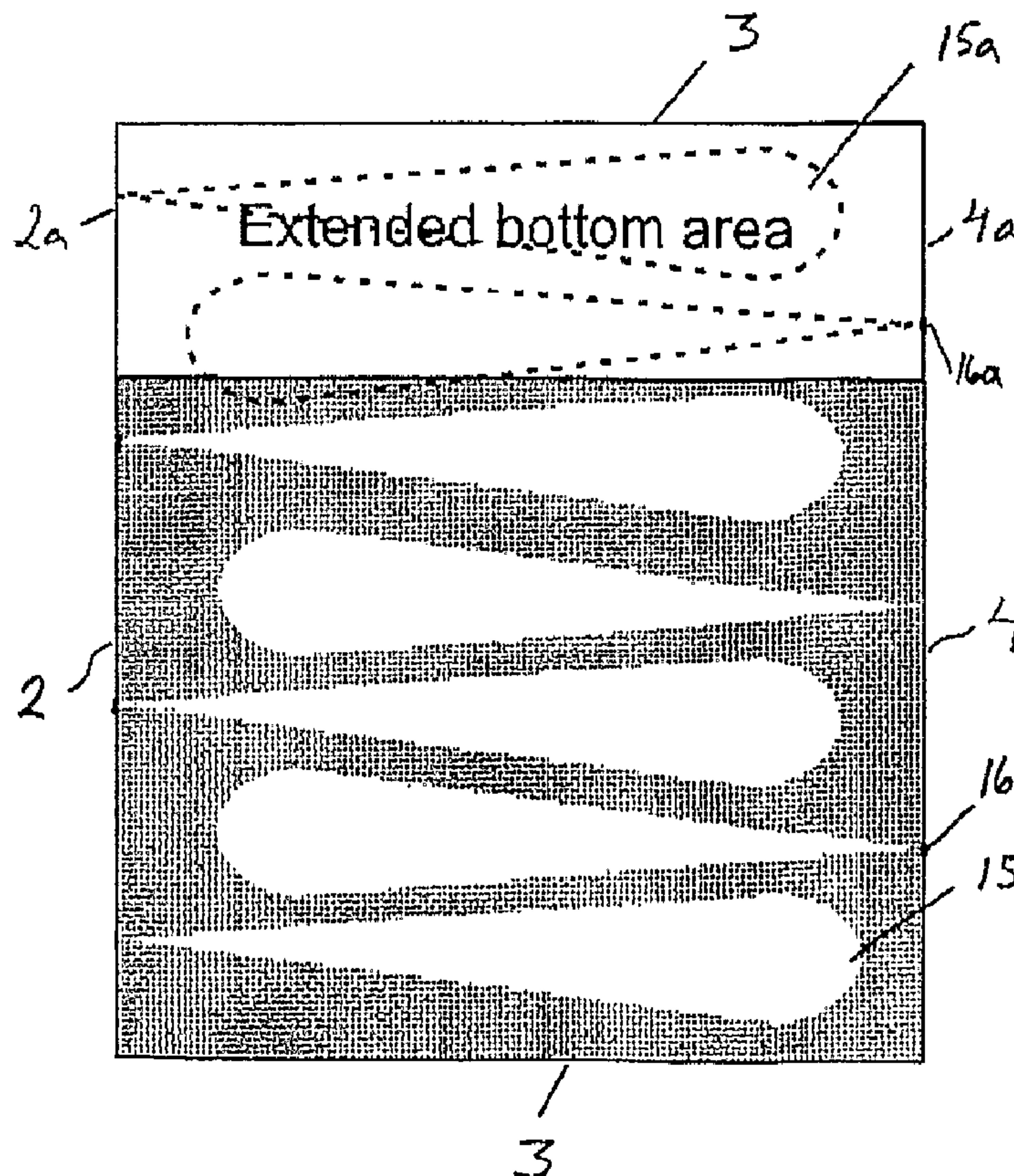




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(57) Abrégé/Abstract:

The present invention relates to an arrangement and a method for enlarging a boiler, especially a chemical recovery boiler, and in that way for optimizing and simplifying a capacity increase. An object of the present invention is to provide for a boiler plant, which is



(57) **Abrégé(suite)/Abstract(continued):**

easily adaptable to increasing boiler loading without decreasing the efficiency of the combustion process, but facilitating its optimal control. In accordance with the invention, the option of enlarging the boiler is taken into account by reserving space in connection with the boiler so that a side wall (3) may be moved, thus increasing the length of the front wall (2) and the rear wall (4). After the enlargement, the distance between the front and rear walls is essentially the same as before the enlargement.

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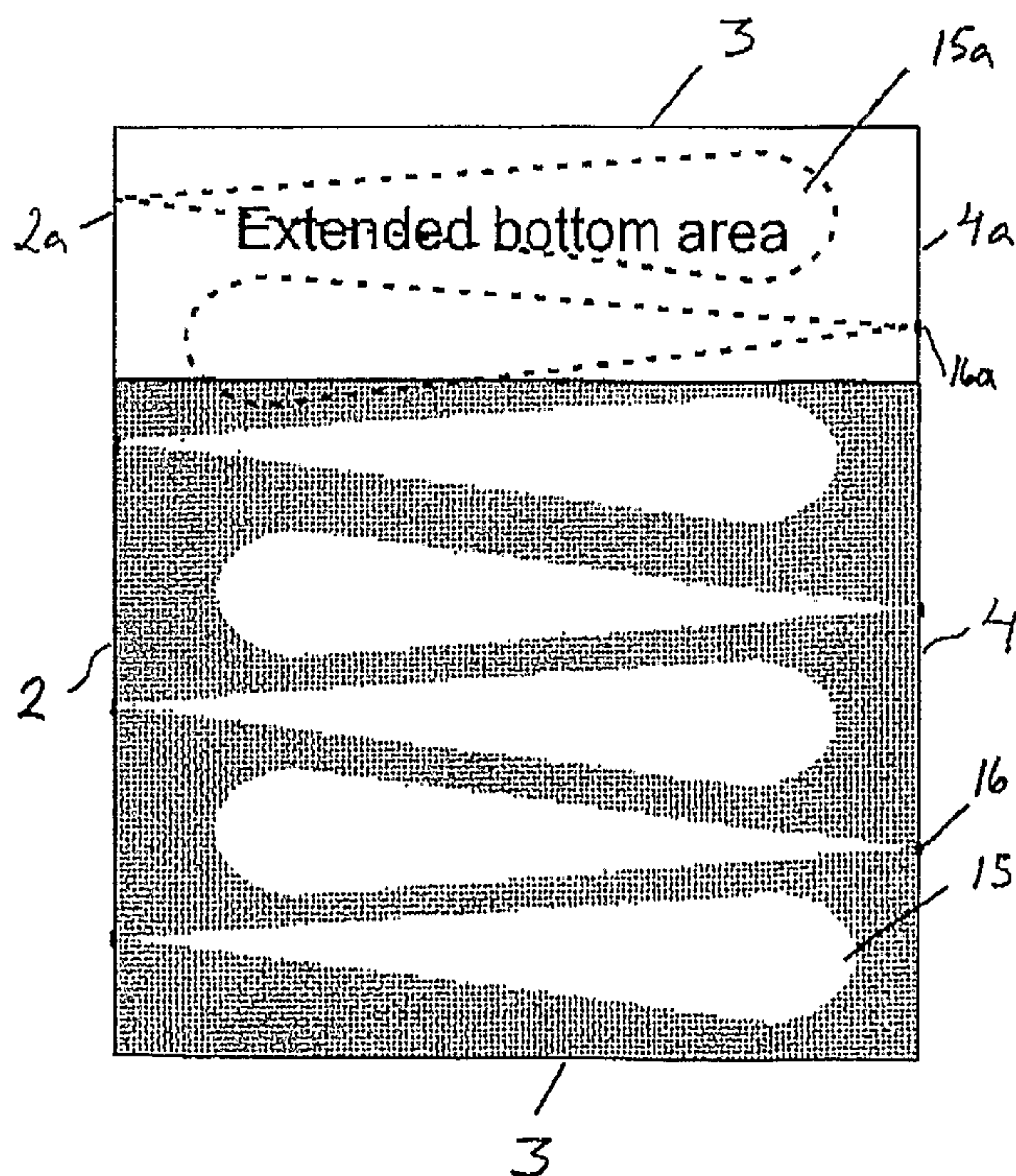
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(54) Title: BOILER ARRANGEMENT



(57) Abstract: The present invention relates to an arrangement and a method for enlarging a boiler, especially a chemical recovery boiler, and in that way for optimizing and simplifying a capacity increase. An object of the present invention is to provide for a boiler plant, which is easily adaptable to increasing boiler loading without decreasing the efficiency of the combustion process, but facilitating its optimal control. In accordance with the invention, the option of enlarging the boiler is taken into account by reserving space in connection with the boiler so that a side wall (3) may be moved, thus increasing the length of the front wall (2) and the rear wall (4). After the enlargement, the distance between the front and rear walls is essentially the same as before the enlargement.

BOILER ARRANGEMENT

The present invention relates to an arrangement and a method for enlarging a boiler, especially a chemical recovery boiler of a pulp mill, and specifically a furnace of the boiler, and thus for optimizing and simplifying the increase of the capacity thereof.

5 The furnace of a chemical recovery boiler for burning black liquor has a front wall, a rear wall and sidewalls. Black liquor spraying devices are disposed on said walls on one or several levels. A plurality of air ports are arranged on several horizontal levels on said walls for introducing air into the furnace from an air supply. Flue gas generated in black liquor combustion is led into contact with various heat transfer devices, super-
10 heaters, the boiler bank and water preheaters (economizers) of the boiler, whereby the heat present in the gas is recovered in water, steam or mixture thereof flowing in the heat transfer devices. A nose construction is disposed in the upper part of the furnace for directing the gas flow. Superheater elements suspended through the roof super-heat the steam.

15 Air is introduced into the boiler usually at three different levels: primary air into the bottom part of the furnace, secondary air above the primary air level, but below the liquor nozzles, and tertiary air above the liquor nozzles for ensuring complete combustion. Air is usually fed in via several air ports either from all four walls of the boiler or from two opposites walls only. More than three air levels for introducing air into the furnace may
20 be arranged in the boiler.

A feature common to new boiler plants delivered during the last years is that a new boiler with auxiliary equipment is predesigned in view of possible future capacity increase, if necessary. Typically this is accomplished by reserving space in the boiler building and structural steel constructions and oversizing the piping and auxiliary
25 equipment with enough capacity for future loading of the boiler.

A wide capacity range creates problems in operation of the boiler. As to a chemical recovery boiler, too large a furnace complicates the maintaining of a high enough smelt bed temperature and appropriate superheating at low loads, whereas too small a furnace leads to plugging risks of the heat surfaces at high boiler loads. This could be
30 avoided by enlarging the furnace when the loading of the boiler changes.

So far, the enlargement inside the chemical recovery boiler has been accomplished by reserving space for a relocation of the front (and rear) wall of the furnace, whereby the sidewalls are extended. This results in an increase in the distance between the front wall and the rear wall, which may cause problems in the combustion process itself.

5 This involves problems especially when combustion air in the air arrangement is fed in mainly from the front and rear walls. Air penetration and air jet velocities on the secondary and tertiary air levels are key factors in the combustion process in the recovery boiler furnace. These parameters are optimized by selecting the right air port size. The right size depends on boiler loading in that an adequate amount of air must be fed via
10 the air port to a proper penetration distance towards the opposite wall. If the number of the air ports is kept essentially unchanged when the distance to the opposite wall increases in the enlargement of the furnace, the size of the air port is bound to be a compromise for different boiler loads. In such a case, the best result in view of the combustion process in the boiler is not achieved. A typical air arrangement, wherein e.g. secondary
15 air is fed in preferably from the front and rear walls only has been presented in WO-publication WO 02/081971.

An object of the present invention is to eliminate the above-mentioned disadvantages and provide for a boiler plant, which is easily adaptable for increasing the boiler load so that the efficiency of the combustion process does not suffer, and may still be controlled
20 in an optimal way. An object of the invention is also a technically simpler and quicker way of accomplishing the enlargement compared to prior art. An object of the invention is an arrangement for optimizing certain air levels, especially the secondary and tertiary air flows of a chemical recovery boiler, before and after the enlargement of the furnace.

25 The present invention relates to a boiler, especially a chemical recovery boiler defined by a front wall, a rear wall and sidewalls. The invention is characterized in that space has been reserved in connection with the boiler for enlarging the boiler in such a way that a sidewall is moved, whereby the length of the front and rear wall extends.

Thus, a vital idea of the invention is to prepare for relocating one sidewall by extending
30 the front and rear walls when modifying or building a boiler plant.

Also, the invention relates to a method in a boiler, especially in a chemical recovery boiler defined by a front wall, a rear wall and side walls, an essential characteristic be-

ing that the boiler is first operated in a first capacity range, whereafter the boiler is modified for operation in a second capacity range higher than the first range, by enlarging the boiler moving one side wall and providing the boiler accordingly with other devices/equipment and modifications required by the capacity increase.

- 5 The present invention provides an improved way of preparing for capacity increase of new boilers. Especially the method according to the invention allows for maintaining an optimized air feed and a constant penetration into the furnace with widely changing load levels, when a remarkable portion of or essentially all air at certain levels, specifically at secondary and tertiary levels, is introduced via the front and rear wall.
- 10 The distance between the front and rear wall does not change in the enlargement. Additional air required with the enlargement is introduced via additional air ports arranged in elongations of the front and rear wall. This means that the size of the air ports may be optimized for a boiler loading before the enlargement as well as a loading after that. In the WO-publication mentioned above, the air jets of a certain air level or certain air
- 15 levels form vertical rows. The increase in the amount of combustion air required by the enlargement may be obtained by increasing the number of vertical air port rows in the elongations of the front and rear wall in a way required by the air feed system in question.

In accordance with the invention, during the layout design stage for the boiler plant,

20 provisions are made for enabling the relocation of one sidewall of the boiler. Easily removable maintenance platforms are first installed along this removable sidewall. Other equipment is preferably located elsewhere inside the building. A steam drum is elongated and equipped with the necessary nozzles during the enlargement. A dissolving tank is built big enough in the first place for the enlargement, or space is reserved

25 for future enlargement of the dissolving tank. Main headers are equipped with the necessary nozzles for the enlargement.

The furnace of the boiler has a width and a depth. The width of the furnace refers to the horizontal length of the furnace front wall and the depth refers to the horizontal length of the furnace sidewall. The so-called nose depth, which plays an important part

30 in directing the flue gas streams into the upper part of the furnace and which typically comprises 40 – 45% of the total depth of the furnace, may be kept unchanged, because the length of the furnace sidewalls, and thus the total depth of the furnace do not

change. The nose/sidewall proportion is desired to be the same before and after the enlargement.

Optimal steam velocity in the superheating elements suspended through the roof is important for ensuring adequate cooling of the superheater tubes, and on the other hand
5 for avoiding an excessive pressure decrease. This is achieved in the present invention by increasing the number of superheating elements while maintaining an adequate transversal distance between the elements.

For minor loading, the use of excessively large and thus ineffective heat surfaces on the boiler bank and in the economizer part is avoided, as according to the invention
10 additional tube panels are installed only in connection with the enlargement. The same applies to the superheater as well.

A further advantage of the invention is that before the enlargement soot blowers are used on one wall only with a smaller boiler capacity, because this solution does not affect the size of the boiler plant. Thus, initial investments and maintenance work are
15 significantly reduced.

In a prior art enlargement method (transfer of a front/rear wall), at least four complete transversal tube weld lines are required on the front (rear) wall, which results in hundreds of tube/tube field welds forming potential leak risks in the most hazardous zones. The arrangement according to the invention reduces these critical welds to only two in
20 the upper furnace headers.

In the arrangement according to the invention, the shut-down time for the boiler during the enlargement may be shortened compared to prior art methods, because the superheater, boiler bank and economizer elements can be preassembled in a dedicated space before effecting the enlargement. The furnace enlargement according to the invention is faster also due to easier site welding.
25

The present invention is described in more detail with reference to the appended figures, of which

Figure 1 illustrates schematically a typical chemical recovery boiler in side view, in connection with which boiler the present invention may be applied, and

Figure 2 illustrates a schematical cross-section of the bottom of the furnace according to the invention from an air level.

Figure 1 illustrates a chemical recovery boiler construction with a furnace 1 defined by water tube walls: front wall 2, sidewalls 3 and rear wall 4, and a bottom 5 also formed
5 of water tubes. Combustion air is fed into the furnace from several different levels as primary, secondary and tertiary airs. There may be other air levels as well. Spent liquor, such as black liquor, is introduced via nozzles 6 between the secondary and tertiary air zones. In the combustion process, a melt bed from the effluent is formed on the bottom 5 of the furnace, wherefrom the melt is discharged via a melt spout 7 fitted
10 in the bottom of the furnace.

Heat recovery surfaces of the boiler, i.e. superheaters 8, are located above the furnace, and the rear wall 4 side of the furnace accommodates the heat surfaces following the superheaters above the furnace, the boiler bank 9 and the economizers 10, wherein the heat of the flue gas generated in the furnace is recovered in form of steam. In the super-
15 heaters the saturated steam is converted to a higher-temperature steam. On the boiler banks 9 of the boiler the water in a saturated temperature is boiled partly into steam and in the feed water preheaters 10 the water is heated by means of flue gas prior to leading the water into the vaporizing part 9 of the boiler and into the superheating parts 8. The so-called nose is shown with reference numeral 14.

20 The water/steam circulation of the boiler is effected by means of natural circulation, whereby the water/steam mixture generated in the water tubes of the boiler walls and bottom flows upwards via collection tubes into a steam drum 11 arranged crosswise in relation to the boiler, i.e. in the direction of the front wall 2. Hot water flows from the steam drum via drain tubes 12 into the bottom manifold 13, wherefrom the water is distributed into the bottom water tubes and further into the water tube walls.
25

Figure 2 illustrates the enlargement zone reserved in the boiler for the relocation of one sidewall 3 when an enlargement of the boiler is desired. The sidewall is moved to the extent of the length of the elongation 2a, 4a of the front/rear wall. Figure 2 further shows schematically air jets 15 via air ports 16, the number of air jets in this arrangement comprising with a lower boiler capacity two jets on the rear wall 4 and three jets
30 on the front wall 2. The required additional air is received into the enlargement by arranging more air ports 16a and via them air jets 15a in the elongation 2a, 4a of the front

and rear wall. During the enlargement, there is no need to change the operation of the existing air ports and the air jets flowing therethrough.

The measures connected to the boiler enlargement are as such known to a person skilled in the art, and thus have not been more widely described in this connection.

- 5 Though the present invention has been described in the connection, which at present is considered the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the presented embodiment, but in the opposite it is intended to cover various modifications and corresponding arrangements in the spirit and scope of the appended claims. For example, the application of the invention is not limited to a certain air arrangement, although the advantages of the invention become especially obvious when the main portion of the air on certain levels is fed in via the front and rear wall.
- 10

CLAIMS:

1. A boiler defined by a front wall, a rear wall and side walls, which boiler is provided with devices for feeding secondary air and devices for feeding tertiary air
5 in such a way that an essential portion of the secondary air and tertiary air is fed in from the front and rear walls,

characterized in that an enlargement zone is reserved in connection with the boiler for enlarging the boiler in such a way that a side wall is moved, whereby the length
10 of the front and the rear wall extends and after the enlargement the distance between the front and the rear wall is essentially the same as before the enlargement, and after the enlargement the elongations of the front and rear wall are provided with additional air ports for feeding additional air required by the enlargement.

15

2. A boiler according to claim 1, **characterized** in that it is provided with devices for feeding tertiary air in such a way that an essential portion of the tertiary air is fed in from the front and rear walls.

20 3. A boiler according to any one of claims 1 or 2, **characterized** in that the proportion of the depth of the so-called nose to the total depth of the boiler is essentially the same before and after the enlargement.

4. A method of altering a boiler arrangement defined by a front wall, a rear wall
25 and side walls, characterized in that the boiler is first operated in a first capacity range, whereby remarkable portion of or essentially all air at secondary and tertiary levels is introduced via the front and rear wall, after which the boiler is modified to be operated in a second capacity range higher than the first range, by enlarging the boiler by means of moving one side wall of the boiler so that the length of the front
30 and rear wall increases and providing the boiler accordingly with other devices and modifications required by the capacity increase and the additional air required in the second capacity range is fed in via additional air ports arranged in the elongations of the front and rear wall.

35 5. The boiler of any one of claims 1 to 3 or the method of claim 4, wherein the boiler is a chemical recovery boiler.

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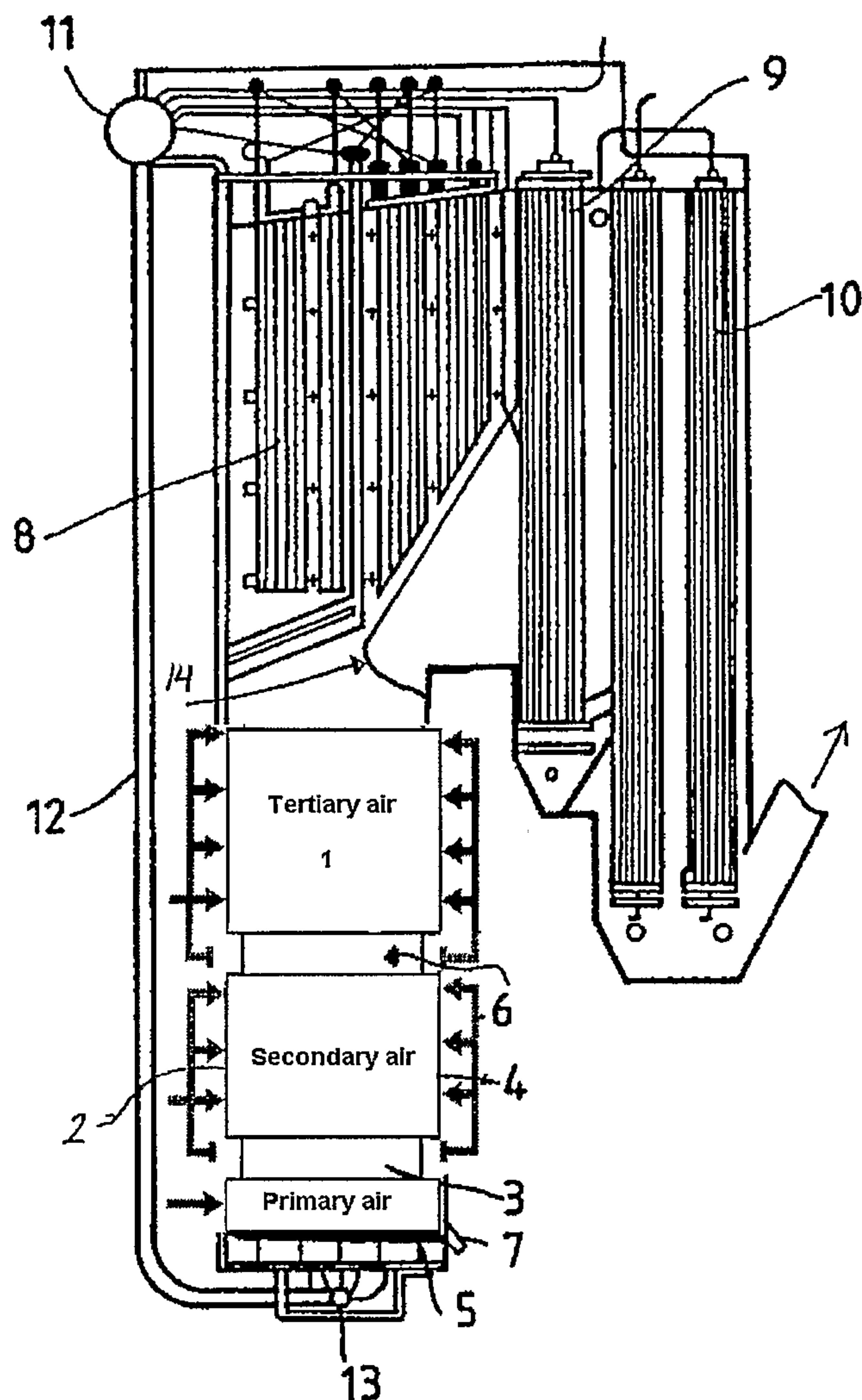


FIG. 1

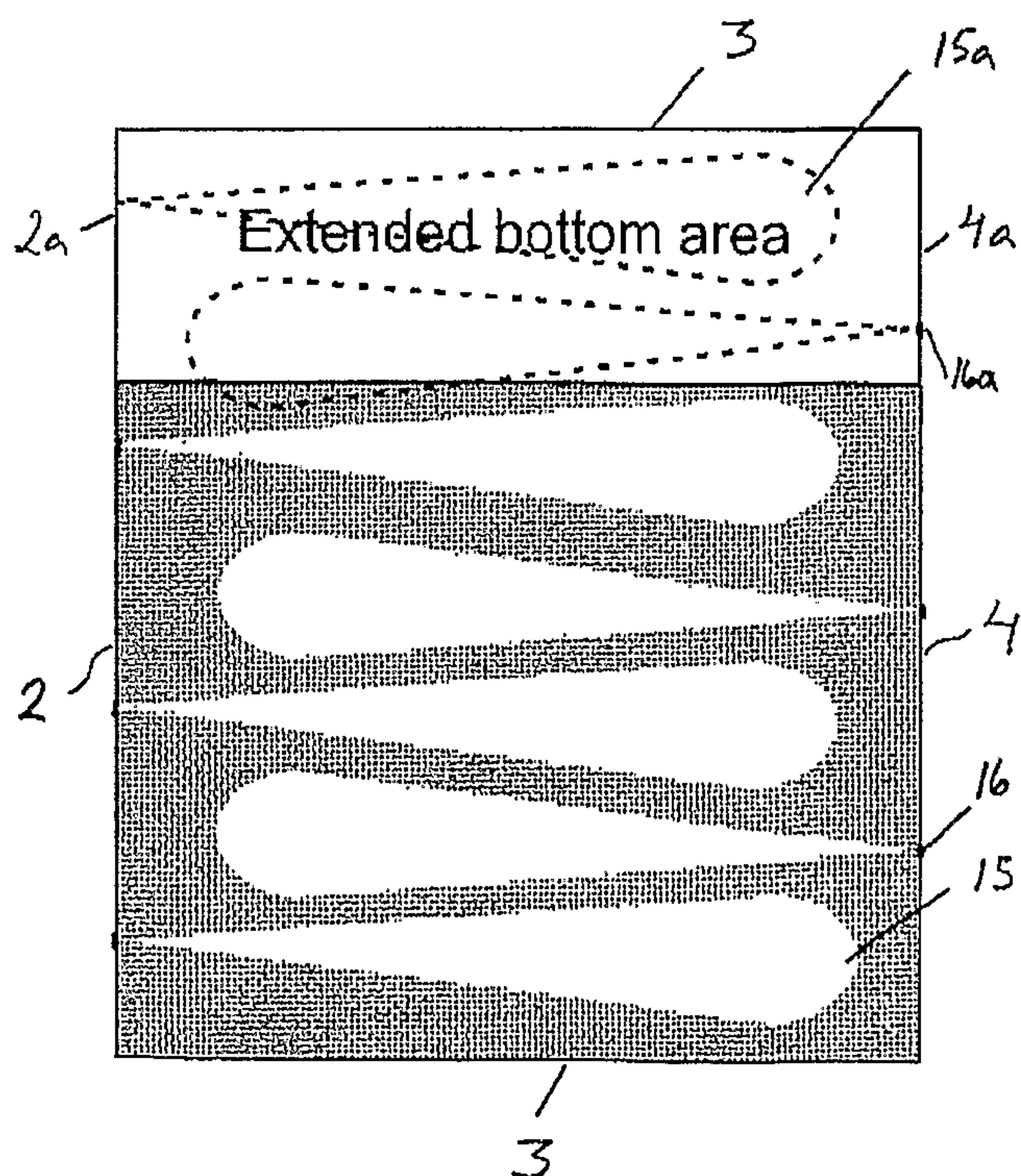


FIG. 2

