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(54) **PLATES SET FOR COMPLETE COMBUSTION AND CENTRAL HEATING BOILER WITH THE PLATES SET**

(57) The afterburner plates set includes at least two fire-proof plates (1,2,3,4) made of concrete, providing a heat accumulator and carrier. The concrete plates (1,2,3,4) are placed horizontally. The top plates (2,3,4) are located above the bottom plate (1). The bottom plate (1) is provided with a through opening (5), whilst the top plate (2) is located above the top plate (1) and covers the aforementioned through window (5). The top plates (2,3,4) are shorter than the bottom plate (1) and have their bottom surface formed as parallel ridges (11) separated by grooves (12). The central heating boiler has a body with flow-connected water compartments (15), wherein the front wall (13) of the boiler is provided with an inspection door (16), whilst a retort (7) is provided in the bottom part of the both. Labyrinth-type partition elements (19) of the heat exchanger are located in the top part of the interior of the boiler, above the horizontal partition wall (18). A flue gas inlet duct leading to the heat exchanger is installed between the rear edge of the horizontal partition wall (18) and the rear wall (14) of the boiler. The concrete plates set (1,2,3,4) includes plates placed horizontally one above another.

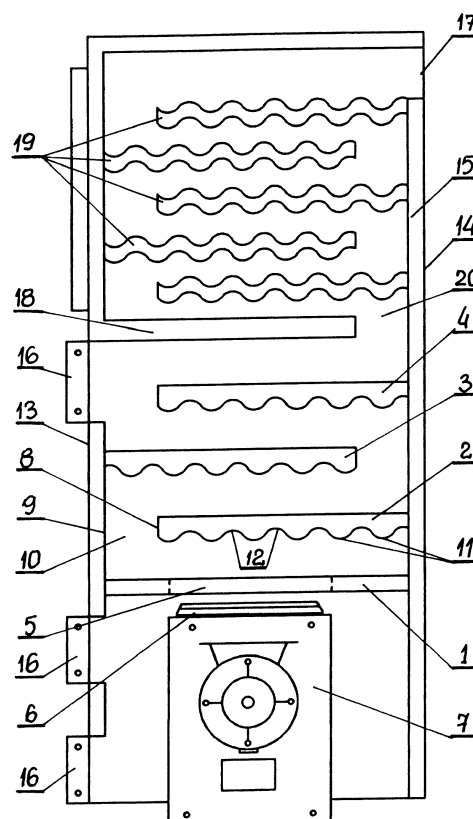


Fig. 1

Description

[0001] The object of the invention includes an afterburner plate set intended to be installed inside a central heating boiler and a central heating boiler, particularly a retort boiler with a fuel feeder, containing an afterburner plates set.

[0002] There are several known solutions of furnaces or central heating boilers with afterburner plates sets. A number of designs include central heating furnaces or boilers with solutions intended to optimise combustion processes, including maximum utilization of heating properties of gases obtained during combustion of solid or gaseous fuels. These solutions are focussed on afterburning of solid combustible residues present in flue gases. This facilitates the benefit of additional caloric value and higher purity of gases discharged through the chimney to the atmosphere.

[0003] An application of a Polish utility model no. W. 104735 presents a design of a gas burner. According to this known solution, the burner includes a cuboid housing with ellipse-shaped bases with rectangular, through openings provided in one semi-circular surface, parallel to each other and perpendicular to the longitudinal axis of the housing. A monolithic diffuser is fixed to the basis, which comprises a pipe section terminated with a cone, with its larger diameter directed outside. The internal part of the diffuser is provided as a cylindrical pipe section, an extension of which is formed as a cone with a narrow apical angle and a conical part with a broader conical angle, connected with it. The larger base of this section is provided with two flattened elements located on the sides of the base, parallel to each other.

[0004] According to the invention presented in the patent disclosure no. PL 220095, the afterburner used in afterburning of flue gases from solid fuel combustion is provided with a flat body with a rectangular cross-section. The body is provided with four vertical side walls and has gas inlet openings in the bottom and gas outlet openings at the top. According to this known solution, the bottom wall of the burner body is installed on side walls at an angle, on the hearth side, wherein this slanted bottom wall is provided with gas burning openings, whilst openings afterburning flue gases are provided in the top part of the front body wall, on the side of the hearth.

[0005] Another central heating water boiler is disclosed in another solution, known from the Polish patent application no. P.382992. According to this solution, the boiler is provided with a water mantle and with water tubes, it is also lined with a layer of fire-proof concrete on the inside and with mineral wool and a metal sheet housing on the outside. The boiler is provided with a biomass container placed loosely inside the boiler through the main door in one of the boiler walls.

[0006] Another solution known from the invention disclosure no P.416970 presents the structure of a top-fed furnace fired with solid fuel, including a body provided as a vertical front wall and a vertical rear wall, horizontal

bottom and horizontal top walls, as well as vertical side walls. This furnace is provided with flow-connected water compartments in said walls and with a draught regulator. The top horizontal wall of the furnace is provided with doors of the fuel feeding inlet and an opening with bottom door is located in the bottom part of the front wall, above the grate and an opening with the ash compartment door is provided below the grate. The top part of the furnace includes a chimney flue and water tubes of the heat exchanger are located inside the top part of the furnace. The top horizontal wall of the furnace also includes a flap dosing air to the hearth chamber. The interior of the furnace is divided with a vertical partition wall parallel to the rear wall of the furnace, into the hearth chamber with top fuel feeding and a flue gas discharge chamber with the water tubes of the heat exchanger and with the top chimney flue. According to this known solution, at least a section of the vertical partition wall is provided as a vertical partition wall made of a material providing a heat accumulator and carrier, wherein an aperture discharging flue gas to the flue gas chamber is located between the bottom horizontal edge of this vertical partition wall and the edge of the grate. A flue gas afterburning chamber is formed between the vertical partition wall and the rear wall of the furnace. The space between the edge of the grate and the rear vertical wall of the furnace is closed by a slanted partition wall made of a material providing a heat accumulator and carrier, directing flue gas from the hearth area on the grate to the flue gas discharging chamber. According to this solution, a flue gas inlet aperture leading to the afterburning chamber is located between the vertical partition wall and the slanted partition wall.

[0007] A disclosure of another solution, known from the patent application no. P.416680, presents another design of a furnace with an afterburning set. The furnace according to this solution includes a body with flow-connected water compartments. The front part of the furnace includes at least two inspection doors, whilst the bottom part of the body includes a biomass feeding and air inlet opening. A flue chimney is provided in the top part of the furnace. Inside the top part of the inside of the furnace, above the horizontal partition wall, labyrinth-type flue gas flow partition elements are provided, acting as a heat exchanger. An inlet duct leading flue gas to the heat exchanger is provided between the rear edge of the horizontal partition wall and the rear wall of the furnace. Panels made of a material providing a heat carrier and accumulator are located below the horizontal partition wall. This panels are attached to the rear wall and to the front wall of the furnace in an alternating pattern. A labyrinth-shaped flue gas outlet duct is located between free edges of this panel, the front wall and the rear wall of the furnace. A vertical flap is installed between the horizontal partition wall and the panel installed beneath the wall. This known solution is provided with a loose bed between the panels, in the form of irregularly shaped concrete elements made of a cement and aggregate mixture resistant to temper-

atures in the range between 1500°C and 2000°C.

[0008] Another known solution includes an afterburner set for a central heating furnace, provided in the form of concrete elements containing cement and aggregate, resistant to temperatures in the range between 1300°C and 2000°C, wherein the afterburner set is installed parallel to the rear wall of the furnace. The afterburner set includes an enclosed space between the concrete elements in the form of side walls, front wall and rear wall forming the flue gas afterburning duct. The space of the afterburning duct is open at the top and at the bottom, and the flue gas inlet of this duct is located near the bottom edge of the front panel of the afterburning duct. Once working temperature is reached inside the furnace, inside the afterburning duct where flue gas containing combustible fuel residues, such fuel residues are afterburned when the flue gas flows through this duct, thus removing harmful components of the flue gas. The flue gas afterburning duct according to this known solution may be provided as a pre-fabricated concrete or ceramic element placed inside the furnace.

[0009] A central heating furnace is known, with a body provided as walls with flow-connected water compartments, wherein fuel feeding doors are located in the front wall of the furnace and an opening with bottom door is provided in the bottom part of the front wall, above the grate, whilst an opening with an ash compartment door is provided below the grate, wherein a chimney flue is located in the top part of the furnace and a heat exchange chamber with labyrinth-type flue gas flow partition elements is located in the top part of the furnace. The aforementioned labyrinth-type partition elements form a heat exchanger. A horizontal partition wall connected to the front wall of the boiler is located inside the hearth chamber of the furnace, as well as at least one afterburner set described above. The afterburner set includes side walls, a front wall and a rear wall forming a flue gas afterburning duct. The flue gas afterburning duct is open at the top and at the bottom, thus allowing flue gas flow from the hearth chamber to the heat exchanger chamber. The described afterburning duct is made of concrete resistant to temperatures in the range between 1300°C and 2000°C. This known solution uses labyrinth-type partition elements in the heat exchange compartment, in the top part of the furnace.

[0010] These known solutions usually use fire-proof concrete elements accumulating heat, made of a cement mixture, for example of cement 70 with grain size 0-5 mm and of chamotte aggregate.

[0011] The known solutions of concrete plate sets, resistant to high temperatures and comprising heat accumulators and carriers, intended to afterburn flue gas inside the furnace or the central heating boiler include plates generally forming vertical flue gas ducts, whilst some of the plates are slanted. At higher flow rates, combustible components of flue gas may not undergo complete afterburning. The objective of this invention is to solve this particular problem.

[0012] According to the invention, the afterburner plates set for a central heating boiler, in particular for a retort boiler, includes at least two fire-proof plates made of concrete provided as a mix of cement and aggregate. These plates provide a heat accumulator and carrier.

[0013] The plates set according to the invention is characterised in that both concrete plates are located horizontally one above the other, wherein the bottom plate includes a central through opening and the top plate is located above the bottom plate and covers the central through opening. The top plate has at least one dimension smaller than the bottom plate and includes a bottom surface formed as parallel ridges separated by grooves.

[0014] The plates set preferably includes three top plates above the bottom plate, located one above another.

[0015] According to the invention, the central heating boiler, in particular a retort boiler with the afterburner plates set includes a body with flow-connected water compartments, wherein at least two inspection doors are provided in the front wall of the furnace and a retort with a fuel and air feeding mechanisms is provided in the bottom part of the body. The top part of the furnace includes a chimney flue, wherein labyrinth-shaped flue gas flow partition elements comprising a heat exchanger are located inside the top part of the interior of the furnace, above the horizontal partition wall. An inlet flue gas duct leading to the heat exchanger is located between the rear edge of the horizontal partition wall and the rear wall of the boiler, with concrete plates providing a heat carrier and accumulator are located inside the boiler.

[0016] According to the invention, the central heating boiler, in particular a retort boiler, is characterised in that the concrete plates are located horizontally, one above another, wherein the bottom plate is provided with a central through opening, whilst the first top plate is located above the bottom plate and covers the aforementioned central flue gas flow opening. The first top plate has at least one dimension smaller than the bottom panel, and its edge forms a flue gas flow aperture with the inner surface of the front side of the boiler. The first top plate has a bottom surface formed as parallel ridges separated with grooves, where in the ridges and the grooves run parallel to the inner surface of the front and of the rear wall of the boiler.

[0017] The flue gas afterburner plates set preferably includes at least one more to plate located above the first top plate, wherein this subsequent top plate forms a flue gas flow aperture with the inner surface of the rear wall of the boiler.

[0018] Subsequent plates located above the aforementioned, subsequent top plate form apertures with the surface of the rear wall and with the surface of the front wall of the boiler, in an alternating pattern.

[0019] The solution according to the invention proposes a plates set made of fire-proof concrete providing a heat carrier and accumulator inside the central heating boiler. The bottom plate covers the entire cross-section

of the combustion chamber of the furnace completely, however, it is provided with a central through opening located above the hearth. The bottom plate temporarily stops the flue gas flow at the edges, and its temperature results in combustion of a part of unburned, combustible components present in the flue gas. The flue gas is eventually discharged through the central opening in the bottom plate onto the bottom surface of the first top plate, also made of fire-proof concrete. This bottom surface is wavy, wherein the ridges and their separating grooves run parallel to the front wall and the rear wall of the boiler. Such shape of the bottom surface of the first top plate causes the flue gas flow towards the aperture between the edge of the first top plate and the inner surface of the front wall of the boiler to slow down. The first top plate and potential subsequent top plates have one dimension of their surface smaller than the respective dimension of the bottom plate, such that this one smaller dimension, for example smaller width of the top plate installed inside the boiler, leaves an aperture between the edge of the top plate and the front or the rear wall of the boiler. Flue gas from under the first top plate flow through this aperture at the front wall of the boiler under the next top plate, where the aperture is located near rear side of the boiler. This next top plate is also provided with a wavy bottom surface, which also slows down the flue gas flow and facilitates afterburning if residual flammable substances in contact with this plate. Any subsequent top plates are attached to the side walls of the boiler such that the flue gas flow apertures are located at the front wall of the boiler near one of the top plates and at the rear side of the boiler near the neighbouring top plate. The plate set located inside the boiler ensures labyrinthine flue gas flow, additionally decelerated thanks to the system of ridges and grooves on the bottom surfaces of the aforementioned top plates. This allowed additional removal of unburned, harmful combustible substances present in flue gas directed to the heat exchanger in the top part of the boiler, above the horizontal partition wall.

Embodiments

[0020] The object of the invention has been presented as embodiments in the attached drawings, in which individual figures of the drawing illustrate as follows:

- Fig. 1 - a cross-section through the retort furnace with the plates set.
- Fig. 2 - a view of the top plate.
- Fig. 3 - a side view of the top plate with its wavy bottom surface.
- Fig. 4 - a side view of the top plate with its bottom surface including ridges and triangular grooves.
- Fig. 5 - a side view of the top plate with its bottom

surface including ridges and trapezoidal cross-section grooves.

Fig. 6 - a view of the bottom plate.

[0021] Fig. 1 presents a cross-section through the inside of a retort boiler fired with solid fuel, depicting the plate set according to the invention. The boiler is fed with eco-pea or pellets in this particular embodiment. In this embodiment, the afterburner plates set includes four plates 1,2,3,4 made of the known fire-proof concrete provided as a mix of cement and aggregate. The plates provide a heat accumulator and carrier.

In this embodiment, the plates are made of a mix containing:

- clay and lime cement, 70%,
- silica, 25%
- iron oxide, 3%
- sodium oxide, 1%
- potassium oxide, 1%

[0022] In the plates set 1,2,3,4, as shown in Fig. 1, the plates are set horizontally, wherein the top plates 2,3,4 are located above the bottom plate 1. The aforementioned plates 1,2,3,4 are attached in the known manner to the side walls of the boiler in this embodiment.

[0023] Fig. 6 shows the bottom plate 1. The bottom plate 1 contains a central through opening 5. The through opening 5 is located above the hearth 6 of the retort 7. In this particular embodiment, three top plates 2,3,4 are located above the bottom plate, as shown in Fig. 1. The first top plate 2 covers the aforementioned central through opening 5 of the bottom plate 1. The top plate 2 has the same width as the bottom plate 1 in this embodiment, but is shorter than this bottom plate 1. This provides a flue gas aperture 10 between the edge 8 and the inner surface 9 of the front side of the wall 10. Each of the top plates 2,3,4 has a bottom surface formed as parallel ridges 11 with separating grooves 12. Ridges 11 and grooves 12 run parallel to the inner surface of the front wall 13 and the rear wall 14 of the boiler. In this embodiment, two more top plates 3,4 are located above the top plate 2, installed such that the flue gas flow aperture at the level of the top plate 3 is located at the rear side 14 of the boiler, whilst the flue gas flow aperture at the level of the top plate 4 is located at the front wall 13 of the boiler.

[0024] In other embodiments, the top plates 2,3,4 may have ridges 11 and grooves 12 on the bottom surface with different shapes, as shown in Fig. 3, Fig. 4 and Fig. 5.

[0025] Fig. 2 and the cross-section of Fig. 3 show the top plate 2 wherein the ridges 11 and the grooves 12 form a wavy surface. Fig. 4 shows a cross-section of another embodiment of the top plate 2, with triangular ridges 11 and grooves 12. On the other hand, ridges 11 and grooves 12 in the embodiment presented in Fig. 5 are of trapezoidal cross-section. The top plates 3,4 in this embodiment have their bottom surfaces shaped identi-

cally to the top plate 2. Other shapes of ridges 11 and grooves 12 of top plates 2,3,4, or other numbers of the top plates 2,3,4 can be provided in other embodiments.

Example II

[0026] Fig. 1 presents a schematic cross-section through a central heating retort boiler, including an afterburner plates set 1,2,3,4 according to the invention inside. The boiler in this embodiment has a body with flow-connected water compartments 15. The front side of the furnace is provided with three inspection doors, whilst the bottom part of the boiler body includes a retort 7 with a known fuel feeder and an air feeding unit. The top part of the boiler includes a chimney flue 17, wherein labyrinth-type flue gas flow partition elements 19 above the horizontal partition wall, comprising a heat exchanger. A flue gas inlet duct 20 is located between the rear edge of the horizontal partition wall 18 and the rear wall of the boiler. The concrete plates 1,2,3,4 are located inside the boiler one above another, as described in Example I.

List of figure references

[0027]

1. Bottom plate.
2. Top plate.
3. Top plate.
4. Top plate.
5. Through window.
6. Hearth.
7. Retort.
8. Top plate edge.
9. Inner surface of the front wall.
10. Flue gas flow aperture.
11. Ridge.
12. Groove.
13. Front wall of the boiler.
14. Rear wall of the boiler.
15. Water compartment.
16. Inspection door.
17. Chimney flue.
18. Horizontal partition wall.
19. Labyrinth-type partition element of the heat exchanger.
20. Flue gas inlet aperture leading to the heat exchanger.

Claims

1. An afterburner plates set for a central heating boiler including fire-proof plates made of concrete provided as a mix of cement and aggregate, providing a heat accumulator and carrier, **characterised in that** the concrete plates (1,2,3,4) are located horizontally, with at least one top plate (2,3,4) above the bottom

plate (1), wherein the bottom plate (1) is provided with a central through opening (5), whilst the first top plate (2) is located above the bottom plate (1) and covers the aforementioned through opening (5), wherein the top plate (2,3,4) has at least one dimension smaller than the bottom plate (1) and has a bottom surface formed as parallel ridges (11) separated by grooves (12).

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2. The afterburner plates set according to Claim 1, **characterised in that** it includes three top plates (2,3,5) placed one above another, above the bottom plate (1).

3. The central heating boiler with an afterburner plates set, including a body with water compartments, wherein the front wall of the boiler is provided with at least two inspection doors, whilst the bottom part of the body includes a fuel feeding mechanism and an air feeding mechanism and a chimney flue is provided in the top part of the boiler, wherein labyrinth-type flue gas flow partition elements are provided in the top part of the boiler, above the horizontal partition wall, a flue gas inlet duct leading to the heat exchanger is located between the free edge of the of the horizontal partition wall and the rear wall of the boiler, with concrete plates providing a heat carrier and accumulator are located inside the boiler, **characterised in that** concrete plates (1,2,3,4) are placed horizontally one above another, wherein the bottom plate (1) is provided with a central through window (5), whilst the first top plate (2) is located above this bottom plate (1) and covers the aforementioned through window (5) and this first top plate (2) has at least one dimension smaller than the bottom plate (1), while its edge forms a flue gas flow aperture (10) with the inner surface of the front wall (13) and includes a bottom surface formed as parallel ridges (11) separated by grooves (12), wherein the ridges (11) and the grooves (12) run parallel to the inner surface of the front wall (13) and of the rear wall (14) of the boiler.

4. A central heating boiler according to Claim 3, **characterised in that** the afterburner plates set includes at least one additional top plate (3) above the first top plate (2), wherein this additional top plate (3) forms the flue gas flow aperture (10) with the inner surface of the rear wall (14) of the boiler.

5. A central heating boiler according to Claim 3 or 4, **characterised in that** additional plates (3,4) above the first top plate (2) form apertures (10) with the surface of the rear wall (14) and with the surface of the front wall (13) of the boiler, in an alternating pattern.

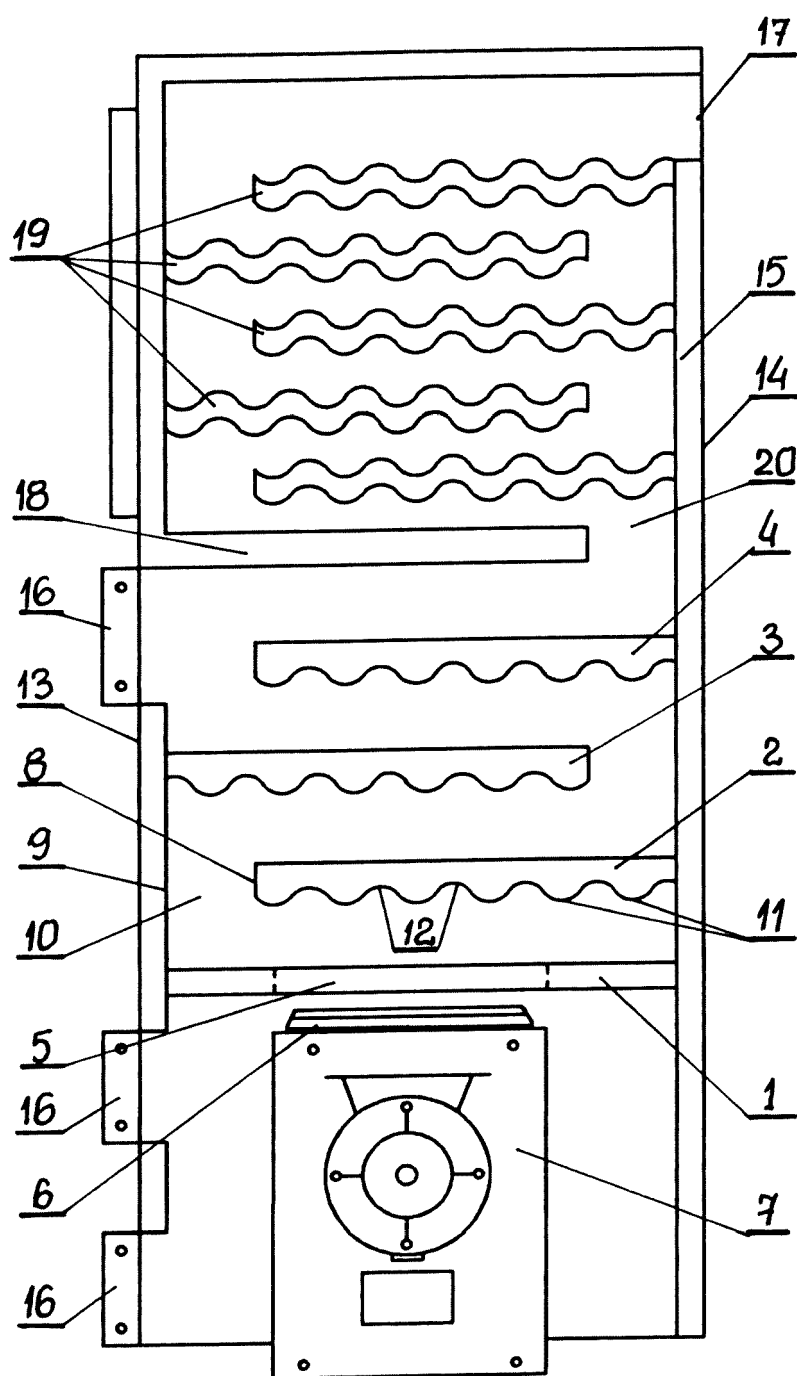


Fig. 1

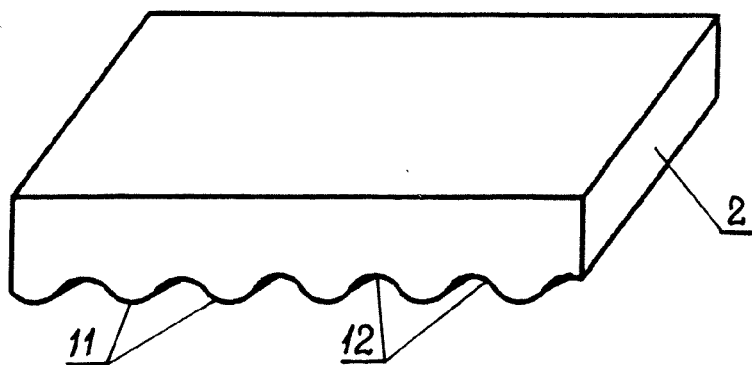


Fig. 2

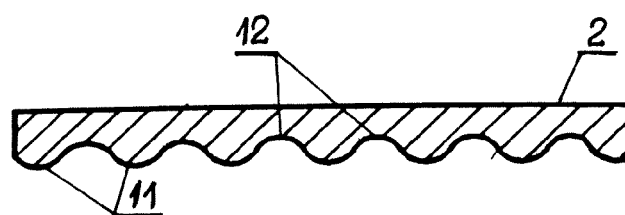


Fig. 3

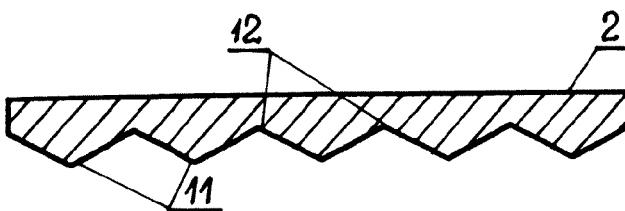


Fig. 4

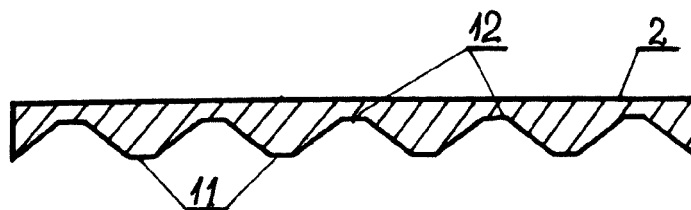


Fig. 5

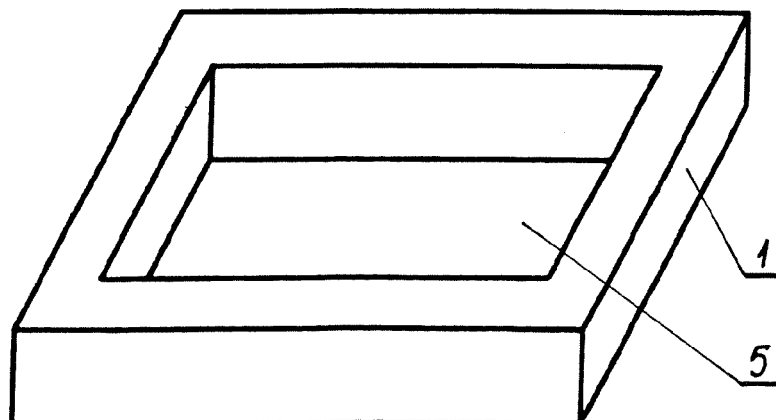


Fig. 6



EUROPEAN SEARCH REPORT

Application Number
EP 18 46 0072

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 8 March 2019	Examiner Hauck, Gunther
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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