(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 108 335 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.12.2022 Bulletin 2022/52

(21) Application number: **21181343.1**

(22) Date of filing: **24.06.2021**

(51) International Patent Classification (IPC):
B02C 2/00 *(2006.01)* ***B02C 2/04*** *(2006.01)*
B02C 2/02 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B02C 2/005; B02C 2/02; B02C 2/04

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(54) **A WEAR RESISTANT LINER FOR A CONE CRUSHER**

(57) A cone crusher wear plate (160) to protect a bottom shell wall (30) of a cone crusher bottom shell (10) from impacts from processed materials in which the wear plate (160) comprises a main body (163), and an outer-wear resistant surface (190) on the main body wherein the wear plate (160) comprises a demountable hanging mounting (170) on an inner surface (451) of the main body (163) for removably supporting the wear plate (160) at the bottom shell wall (3) to form a wear resistant liner (20) in the bottom shell (10) of the cone crusher. The invention also relates to a wear resistant liner (20) for a cone crusher bottom shell (10) comprising the wear plate (160) and a carrier plate (140) for carrying the wear plate (160) via a demountable hanging mounting (170) attachable to an inside surface (40) of the bottom shell wall (30). The invention also relates to a crusher comprising the wear resistant liner (20).

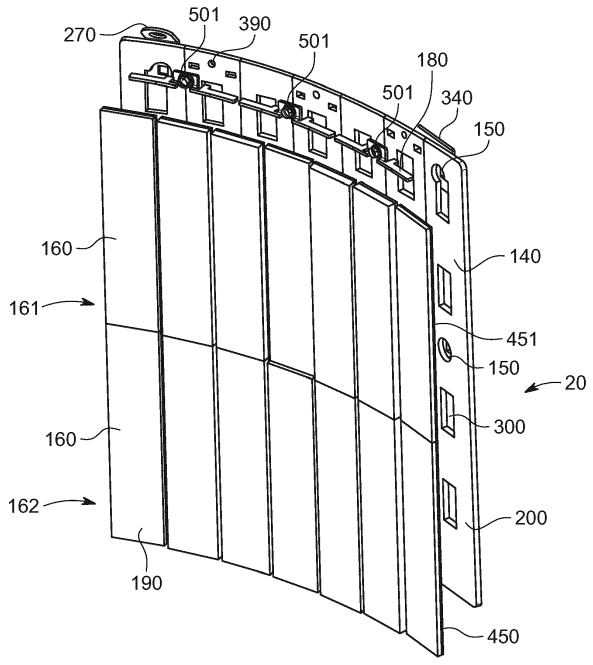

FIG. 2

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Description

Field of the Invention

[0001] This invention relates to a cone crusher wear plate for protecting a bottom shell wall of a cone crusher bottom shell from impacts from processed materials and to a wear resistant liner for a cone crusher bottom shell. The invention also relates to a crusher comprising the wear resistant liner.

Background to the Invention

[0002] Cone or gyratory crushers, hereinafter referred to collectively as cone crushers, are used for crushing and size reducing hard materials such as ore, mineral and rock. The crusher generally includes a top shell, a central crusher shaft for operation of the top shell, a bottom shell and a frame. The top shell comprises a crushing head mounted to an upper end of the central crusher shaft, an inner crushing shell (referred to as an inner shell or mantle) mounted to the crushing head, and a second crushing shell (referred to as an outer shell or concave) mounted to a frame so that a crushing chamber is defined between the inner shell and outer shell. A drive mechanism is operatively connected to the central crusher shaft for rotation of the inner shell within the outer shell about an eccentric (gyratory) axis to crush material passed into the crushing chamber. Examples of cone crushers and inner shells for cone crushers are described in EP2818246, EP2774680 and EP1868726.

[0003] The main purpose of the bottom shell is to support the drive shaft and provide a material discharge chamber disposed underneath the crushing chamber through which material crushed in the crushing chamber falls before being ejected from the cone crusher. To this end, the bottom shell comprises a bottom shell wall, a central hub positioned radially within the bottom shell wall having a central cavity to support a central crusher shaft in a mounting boss, a material discharge chamber defined between the bottom shell wall and central hub through which crushed material falls, and a plurality of support arms extending radially between the bottom shell wall and the central hub.

[0004] The bottom shell wall is generally provided with a wear resistant liner on its inside surface to protect the bottom shell wall from impacts from processed materials.

[0005] Known wear resistant liners are generally modular being made up of large heavy wear plates fixed directly, e.g. by welding or other non-demountable permanent fixings, to the inside surface of the bottom shell wall. For example, EP 3718636, CN 212092429, WO 2014146703 and EP 2730337 all describe modular wear resistant liners in which wear plates are fixed to the bottom shell wall of the crusher bottom shell with non-demountable mountings such as welds, bonds, bolts and the like requiring the use of tooling.

[0006] In use, the wear plates are subjected to significant loading forces resulting in wear to the plates which ultimately necessitates replacement of the wear plates. However, replacement of the heavy wear plates must be performed manually by personnel from inside the crusher which is a time consuming operation due to the need to manually detach the wear plates from the bottom shell wall at the permanent fixings and install new wear plates at new permanent fixings e.g. using time consuming welding, bonding or bolting techniques requiring the use of tooling and the like. This is costly both due to crusher downtime and the high cost of replacement wear plates. The procedure is also potentially dangerous due the weight of the wear plates and significant time personnel must spend inside the crusher to remove the permanently fixed wear plates resulting in an increased risk that personnel could fall through the crusher.

[0007] Accordingly, a need exists for a cone crusher wear plate and a wear resistant liner that can be more easily and quickly replaced when worn.

It is an object of the invention to overcome at least one of the above-referenced problems.

Summary of the Invention

[0008] According to the invention there is provided a cone crusher wear plate to protect a bottom shell wall of a cone crusher bottom shell from impacts from processed materials, the wear plate comprising:

a main body, and

an outer wear resistant surface on the main body wherein the wear plate comprises a demountable hanging mounting on an inner surface of the main body for removably supporting the wear plate at the bottom shell wall to form a wear resistant liner in the bottom shell. By having a demountable hanging mounting the wear plate of the invention can be quickly and easily mounted within the bottom shell and replaced as required without the need to use tooling or welding techniques thus minimising crusher downtime and the time operatives must spend within the crusher replacing the wear plates.

[0009] In any embodiment, the main body below the demountable hanging mounting defines a ballast to stabilise the wear plate at the bottom shell wall. The ballast therefore ensures that the wear plate remains in place at the bottom shell wall during use.

[0010] Suitably, the hanging mounting comprises at least two hanging mountings arranged along a vertical axis of the wear plate. The use of two hanging mountings enhances the stability of longer wear plates at the bottom shell wall.

[0011] Advantageously, the hanging mounting comprises a hook. A hanging mounting in the form of a hook further enhances the speed and ease of mounting and removal of the wear plate.

[0012] The invention also extends to a wear resistant

liner for a cone crusher bottom shell comprising at least one cone crusher wear plate as hereinbefore defined. A wear resistant liner incorporating the wear plate effectively protects the bottom shell wall whilst also allowing for rapid and easy replacement of the wear plates when worn.

[0013] In one embodiment, the wear resistant liner comprises:

a carrier plate attachable to an inside surface of the bottom shell wall at a carrier plate fixing, and
the at least one wear plate is removably supportable on the carrier plate via the demountable hanging mounting to protect the carrier plate and the inside surface of the bottom shell wall. The use of a carrier plate allows for the retrofitting of the wear resistant liner to existing crushers whilst also allowing for the wear plates to be secured to the carrier plate at openings in the carrier plate instead of directly to the bottom shell wall. The use of a carrier plate allows for the wear plates to be relatively light for ease of handling and safety purposes.

[0014] Preferably, the carrier plate is configured to support a plurality of wear plates. The use of multiple wear plates on a single carrier plate allows for wear plates having different wear resistant surfaces to be positioned according to the wear to which different areas of the bottom shell wall are exposed.

[0015] In any embodiment, the wear resistant liner comprises a plurality of carrier plates circumferentially attachable to the inside surface of the bottom shell wall at carrier plate fixings. The use of multiple carrier plates allows the wear resistant liner to be more easily conformed with the curvature of the bottom shell wall.

[0016] Optionally, the wear plate comprises an inner backing plate abuttable against the carrier plate and an outer wear resistant layer on the backing plate defining the outer wear resistant surface. An outer wear resistant layer on the backing plate allows for different materials to be employed for the wear resistant surface and the backing plate e.g. a ceramic material for the wear resistant layer and steel for the backing plate.

[0017] In any embodiment, the wear resistant surface on each wear plate can be the same or different. This also allows for the targeted use of different wear resistant surfaces according to the wear to which different areas of the bottom shell wall are exposed.

[0018] Suitably, the carrier plate comprises a complementary wear plate opening for receiving the hanging mounting. The wear plate mounting can therefore be easily positioned on the carrier plate.

[0019] Optionally, the wear resistant liner further comprises a wear plate lock to lock the wear plate in position on the carrier plate. The use of a lock ensures that demountable hanging mounting such as the hook does not detach or unhook from the carrier plate in use.

[0020] Preferably, the wear plate lock comprises a lock fastener for demountably attaching the wear plate lock to the carrier plate to prevent detachment of the wear plate from the carrier plate. The lock fastener securely fastens the lock to the carrier plate.

[0021] In any embodiment, the carrier plate fixing comprises a permanent carrier plate fixing. The carrier plate is therefore permanently fixed to the bottom shell wall so that only the wear plates require removal and replacement.

[0022] In another embodiment, the invention also extends to a cone crusher comprising a wear plate or a wear resistant liner as hereinbefore defined. Such a cone crusher can be maintained more easily due to the ease and speed with which the wear plates can be replaced.

[0023] The wear resistant liner of the invention can be formed in a bottom shell of a crusher by attaching a carrier plate to an inside surface of a bottom shell wall of the bottom shell, and removably supporting on the carrier plate at least one wear plate having an outer wear resistant surface for protecting the carrier plate and the inside of the bottom shell wall.

Brief Description of the Drawings

[0024] The invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a perspective view from above and one side of a cone crusher bottom shell fitted with a modular wear resistant liner of the invention;

Figure 2 is an enlarged exploded perspective view from above and one side of a single carrier plate, associated wear plates and locks of the wear resistant liner of Figure 1;

Figure 3 is a front non-exploded view of the carrier plate, wear plate and associated locks of the wear resistant liner of Figure 3;

Figure 4 is a front view of the wear resistant liner of Figure 3 with an inner wear plate omitted to reveal a pair of complementary wear plate openings on the carrier plate for the removed wear plate;

Figure 5 is a rear non-exploded view of the carrier plate, wear plate and associated locks of the wear resistant liner of Figure 3;

Figure 6 is a front view of the wear resistant liner of Figure 3 with a corner wear plate omitted to reveal a pair of complementary wear plate openings on the carrier plate for the removed wear plate and an outwardly projecting notch in one of the complementary openings for receiving a carrier plate fixing for securing the carrier plate to the inside surface of the bottom shell wall;

Figure 7 is a perspective view from above and front wear plate receiving side of the carrier plate of Figures 1 to 6 with the wear plates and locks omitted showing the pairs of complementary wear plate openings for removably supporting wear plates on the carrier plate;

Figure 8 is a front view of the carrier plate of Figure 7;

Figure 9 is a rear view of the carrier plate of Figure 8 showing the eyelet band of the carrier plate lifting eyelet and a carrier plate fixing opening in the eyelet band;

Figure 10 is a side view of the carrier plate of Figure 7;

Figure 11 is an enlarged perspective view from above and the wear side of a wear plate of the wear resistant liner showing the outer wear resistant layer on the inner backing plate;

Figure 12 is a perspective view from above and the backing plate side of the wear plate of Figure 11;

Figure 13 is an enlarged perspective view from above and the rear carrier plate side of the lock of the wear resistant liner of Figures 1 to 6 configured and sized to simultaneously lock three wear plates in place on the carrier plate;

Figure 14 is a front view (from the wear plate side) of the lock of Figure 13;

Figure 15 is a rear view (from the carrier plate side) of the lock of Figure 13;

Figure 16 is a side view of the lock of Figure 13;

Figure 17 is an enlarged perspective view from above and the rear carrier plate side of an alternate lock for the wear resistant liner of Figures 1 to 6 configured and sized to lock a single wear plate in place on the carrier plate;

Figure 18 is a front view (from the wear plate side) of the lock of Figure 17;

Figure 19 is a rear view (from the carrier plate side) of the lock of Figure 17;

Figure 20 is a side view of the lock of Figure 19;

Figure 21 is a perspective view from above and the wear plate side of an alternate single carrier plate, associated wear plates and locks of the wear resistant liner configured and sized for positioning over the support arm and arm liner of the cone crusher bottom shell;

Figure 22 is an exploded view of the wear resistant liner;

Figure 23 is a front view from the wear plate side of the wear resistant liner;

Figure 24 is a rear view from the carrier plate side of the wear resistant liner;

Figure 25 is a perspective view from above and front wear plate receiving side of the carrier plate of Figure 21 with the wear plates and locks omitted showing the complementary wear plate openings for removably supporting wear plates on the carrier plate;

Figure 26 is a front view of the carrier plate of Figure 25;

Figure 27 is a rear view of the carrier plate of Figure 25 showing the eyelet band of the carrier plate lifting eyelet and a carrier plate fixing opening in the eyelet band;

Figure 28 is a side view of the carrier plate of Figure 25;

Figure 29 is an enlarged perspective view from above and the wear side of a wear plate of the wear resistant liner of Figure 21 showing the outer wear resistant layer on the inner backing plate;

Figure 30 is a perspective view from above and the carrier plate side of the wear plate of Figure 29;

Figure 31 is a front plan view of the wear plate;

Figure 32 is a rear plan view of the wear plate, and

Figure 33 is a rear plan view of the wear plate.

Detailed Description of the Invention

[0025] Figure 1 shows a bottom shell 10 of a cone crusher fitted with a wear resistant liner 20 of the invention. As shown in the drawing, the bottom shell 10 is made up of a bottom shell wall 30 arranged about a central axis having a radially inward facing inside surface 40 on which the wear resistant liner 20 is mounted and a radially outward facing outside surface 50. The bottom shell wall 30 terminates at its axial upper end at an annular upper rim 60 provided with an annular upward facing planar surface 70, while at its axial lower end, the bottom shell wall 30 terminates at a lower rim 80 for mounting against a base or lower support structure (not shown).

[0026] The bottom shell 10 includes an annular central mounting boss 90 positioned radially within the bottom shell wall 30 for supporting a central crusher shaft in a hub (not shown). The hub is supported radially within the

bottom shell wall 30 by support arms 100 that extend radially between the inside surface 40 of the bottom shell wall 30 and a radially outward facing face 120 of the central mounting boss 90. In the present embodiment, the bottom shell 10 has four support arms 100 (only two of which are shown) that are equally spaced around the circumference of the inside surface 40 of the bottom shell wall 30. However, as will be appreciated by those skilled in the art, the bottom shell 10 can have fewer or more support arms 100. The bottom shell 10 also includes an arm liner 110 for covering and protecting each of the support arms 100.

[0027] A material discharge chamber 130 is defined between the bottom shell wall 30 and mounting boss 90. When the bottom shell 10 is coupled to a top shell, the material discharge chamber 130 is aligned with the crushing chamber of the top shell so that it receives crushed material which falls through the material discharge chamber 130 before being discharged from the cone crusher.

[0028] The wear resistant liner 20 of the invention serves to protect the bottom shell wall 30 from impacts from processed materials. As shown particularly in Figures 2 to 6, in the present embodiment, the wear resistant liner 20 comprises a carrier plate 140 attachable to the inside surface 40 of the bottom shell wall 30 at carrier plate fixings 150 (typically four per carrier plate 140) and a plurality of detachable wear plates 160 (in the present embodiment fourteen wear plates 160 arranged in an upper row 161 of seven wear plates 160 and a lower row 162 of seven wear plates 160 to cover the carrier plate 140) removably supported on the carrier plate 140 at demountable hanging mountings 170 provided on the wear plates 160. The wear resistant liner 20 can also include optional wear plate locks 180 to lock the wear plates 160 in position on the carrier plate 140. In the present embodiment, the wear plate locks 180 are positioned at the upper row 161 of wear plates 160.

[0029] The wear plates 160 are provided with an outer wear resistant surface 190 which protects the carrier plate 140 beneath the wear plates 160 and the inside surface 40 of the bottom shell wall 30 from damage from processed materials. As shall be explained more fully below, the wear plates 160 are easily attachable to and detachable from the carrier plate 140 at the demountable hanging mountings 170 so that the wear plates can be easily and quickly replaced within the bottom shell 10 without the use of tooling, welders and the like as required while the carrier plate 140 remains in situ.

[0030] Accordingly, the wear plates 160 can be formed as relatively lightweight modular units for ease of handling while the relatively heavy and cumbersome carrier plate 140 can remain in place and does not require moving or manipulation when replacing the wear plates 160. As a result, crusher downtime and the cost of replacement wear plates 160 is reduced. In addition, as the time personnel must spend inside the crusher is reduced, the risk of injury to personnel is also reduced.

[0031] In general, the wear resistant liner 20 of the invention is a modular wear resistant liner 20 made up of a plurality of carrier plates 140 attached to the inside surface 40 of the bottom shell wall 30 and associated wear plates 160 removably supportable on the carrier plates 140 i.e. a plurality of carrier plates 140 with demountable wear plates 160 is circumferentially attachable to the inside surface 40 of the bottom shell wall 30 at carrier plate fixings 150 to form a complete wear resistant liner 20. As will be appreciated by those skilled in the art, the number of carrier plates 140 and wear plates 160 employed in the wear resistant liner 20 of the invention can be varied as required in accordance with the size and configuration of the crusher bottom shell 10.

[0032] In general, in a typical bottom shell 10 of crusher, each carrier plate 140 can be configured to carry any desired number of wear plates 160. In the present embodiment, each carrier plate 140 can be configured to carry either seven or fourteen wear plates 160 with each wear plate being 100mm in width for example.. However, the dimensions of the wear plates can be varied as required e.g. a wear plate having a width of 200mm or more and the carrier plate 140 can carry wear plates 160 of varying dimensions combined to cover the carrier plate 140.

[0033] Figures 7 to 10 show the carrier plate 140 of Figures 1 to 6 in more detail with the wear plates 160 omitted for clarity. As shown in the drawings, the carrier plate 140 is made up of a generally curved rectangular carrier plate panel 200 having a wear plate receiving front face 280 and a rear face 290 disposable towards the bottom shell wall 30 and configured to conform with the arcuate inside surface 40 of the bottom shell wall 30. The panel 200 is subdivided into elongate axial wear plate receiving segments 210 radially oriented to mimic the curvature of the inside surface 40 of the bottom shell wall 30. In the present embodiment, the elongate segments 210 are defined by elongate bends or creases 220 formed in the panel 200 and are sized and shaped to receive the wear plates 160 on the front face 280 arranged in the upper and lower rows 161,162 shown in Figures 2 to 6.

[0034] The panel 200 has a top edge 230, an opposite bottom edge 240, a first side edge 250 and an oppositely disposed second side edge 260.

[0035] Each elongate segment 210 is provided with complementary wear plate openings 300 for receiving the demountable hanging mountings 170 on the wear plates 160. In the present embodiment, the wear plate openings 300 are generally rectangular in shape and are made up of an upper pair 310 of wear plate openings 300 arranged along a vertical axis for receiving a complementary pair of hanging mountings 170 on each wear plate 160 of the upper row 161 of wear plates 160 and a lower pair 320 of wear plate openings 300 arranged along a vertical axis for receiving a complementary pair of hanging mountings 170 on each wear plate 160 of the lower row 162 of wear plates 160.

[0036] At its top edge 230, the panel 200 is provided

with a pair of spaced apart lifting eyelets 270 for lifting carrier plates 140 into position in the bottom shell 10. Each eyelet 270 is made up of an elongate eyelet band 330 which projects above the top edge 230 of the panel 200 and is welded or secured to the panel rear face 290 and an upper eyelet opening 340 defined in the eyelet band 330 for receiving a lifting device. The eyelet band 330 is further provided with a lower carrier plate fixing opening 350 for receiving a carrier plate fixing (not shown) such as a carriage bolt for fixing the carrier plate 140 to the bottom shell wall 30. The lifting eyelets 270 can be positioned towards the corners defined between the top edge 230 and side edges 250, 260 of the panel 200 and can overlap with wear plate openings 300 so that the carrier plate fixings can pass through the wear plate openings 300 and the carrier plate fixing openings 350 (see for example Figures 6 and 8). In this arrangement, the wear plate opening 300 can be provided with a notch 360 which also serves as a carrier plate fixing opening.

[0037] The carrier plate 140 is also provided with centrally located carrier plate fixing openings 370 for fixing the carrier plate to the bottom shell wall 30. As shown particularly in Figures 8 and 9, the centrally located carrier plate fixing openings 370 are centrally positioned on the outer elongate segments 210 of the panel 200.

[0038] The lower carrier plate fixing opening 350 and the centrally located carrier plate fixing openings 370 are positioned on the panel 200 of the carrier plate 140 so that the wear plates 160 cover and protect the carrier plate fixings when the hanging mountings 170 are inserted in the wear plate openings 300.

[0039] The carrier plates 140 of the wear resistant liner 20 can be dimensioned as required in accordance with the size of the crusher. Similarly, the number of carrier plate fixings employed can be varied in accordance with the size of the carrier plate 140. The thickness of the carrier plate 140 and wear plate 160 can also be varied as required although, typically, the carrier plate 140 has a thickness of about 10mm while the wear plate 160 has a thickness of about 20 mm giving a total thickness of about 30mm which can result in longer wear periods compared with known wear plates which only have a thickness of about 20mm.

[0040] As indicated above, in the present embodiment, the wear resistant liner 20 of the invention is provided with an optional lock 180 for locking the wear plates 160 in place on the carrier plate 140. Accordingly, the carrier plate 140 is provided with a lock mounting 380 for receiving the lock 180. A lock mounting 380 is provided at the top edge 230 of alternate elongate segments 210 for receiving a single lock 180 which can extend laterally to simultaneously lock three wear plates 160 from the upper row 161 of wear plates 160 in place. Each lock mounting 380 is made up of a central mounting hole 390 in the elongate segment 210 with a lug hole 400 either side of the central mounting hole 390 for receiving the lock 180. Operation of the lock 180 and the lock mounting 380 shall be explained more fully below.

[0041] Figures 11 and 12 show enlarged views of a wear plate 160 of the invention. As shown in the drawings, the wear plate 160 has a plate-like main body 163 which is generally rectangular in shape and is sized to be received in the elongate segments 210 of the carrier pate 140. The main body 163 has an outerwear resistant layer 460 and an inner surface 451, a bottom edge 410, first and second side edges 420,430 upstanding from the bottom edge 410 and a top edge 440. In the present embodiment, the main body 163 is formed from an inner backing plate 450 defining the inner surface 451 which is abuttable against the carrier plate 140 and an outer wear resistant layer 460 on the backing plate 450 defining the outer wear resistant surface 190.

[0042] As shown in the drawings, the hanging mountings 170 are located on the inner face 451 of the backing plate 450 and each backing plate 450 is provided with two hanging mountings 170 arranged along a vertical axis of the wear plate 160 which are spaced and configured to be complementary with the wear plate openings 300 in the carrier plate 140. In the present embodiment, the hanging mountings 170 are in the form of hooks 171 made up of an upper hook mounting plate 172 attached to the backing plate 450 and a lower hook portion 173 contiguous with the hook mounting plate 172 but spaced apart from the backing plate 450 to define a downwardly oriented carrier plate receiving slot 174 between the hook portion 173 and the backing plate 450.

[0043] As will be appreciated by those skilled in the art, the number of hanging mountings 170 on the wear plate 160 (and corresponding complementary openings 300) can be varied as required e.g. in accordance with the size of the wear plate 160 with from one to four hanging mountings 170 and complementary openings 300 being typical. The number of hanging mountings 170 can also be dictated by the level of wear to which the wear plate 160 is exposed e.g. as the wear plates 160 in the upper row 161 endure less wear, fewer hanging mountings 170 can be employed in some applications.

[0044] The hanging mountings 170 can be located on the backing plate 450 so that an area or weight of the main body 163 below the demountable hanging mountings 170 defines a ballast to stabilise the wear plate 160 on the bottom shell wall 30 in use. More particularly, in the present embodiment, the demountable hanging mountings 170 are attached to the main body 163 within the upper two thirds portion by area/weight of the main body 163 so that the lower third portion functions as a ballast to stabilise the wear plate 160 at the bottom shell wall 30 in use.

[0045] As will be appreciated by those skilled in the art, the wear resistant surface 190/wear resistant layer 460 on each wear plate 160 can be the same or different within and between carrier plates 140 - i.e. the wear resistant surfaces 190/wear resistant layers 460 for each wear plate 160 can be selected according to the materials to be processed and/or the wear experienced by each

wear plate 160 in a specific location within the bottom shell 10. For example, the wear resistant surfaces 190/wear resistant layers 460 employed in the upper row 161 (which endures less wear) can differ to those employed in the lower row 162.

[0046] Examples of suitable wear resistant surfaces 190/wear resistant layers 460 include elastomers such as polyurethane, ceramics, steel (e.g. Hardox (Trade Mark)), composites such as HX900 (Trade Mark), rubber and the like. The backing plate 450 can be typically formed of steel. The wear plates 160 of the invention are relatively light and therefore easily handled typically weighing up to about 10kg each.

[0047] Figures 13 to 16 show the optional lock 180 of the wear resistant liner 20 configured and sized to attach to the carrier plate at the lock mounting 380 to simultaneously lock three wear plates 160 in place on the carrier plate 140. As shown in the drawings, the lock 180 is made up of a central boss plate 470 having a boss front face 480, a boss rear face 490 abuttable against the carrier plate 140 and a lock through hole 500 in the boss 470 for receiving a lock fastener 501 (see also Figure 2) to attach the lock 180 to the carrier plate 140 via the central mounting hole 390 defined in the carrier plate 140.

[0048] The lock 180 is provided with arcuate wings 510,520 which, as indicated above, extend sufficiently laterally outwards from the boss plate 470 to simultaneously lock three wear plates 160 in place. The arcuate wings 510,520 are curved to follow the curvature of the carrier plate 140 and are provided with rearwardly extending lugs 530 insertable in the lug holes 400 in the carrier plate 140 to lock the lock 180 in place towards the top edge 230 of the carrier plate 140 thus preventing the upper row 161 of wear plates 160 from lifting/moving on the carrier plate 140. The wear plates 160 of the upper row 161 therefore prevent wear plates 160 in the lower row 162 from lifting/moving in turn.

[0049] Figures 17 to 20 show an alternate lock 180 for the wear resistant liner 20 of Figures 1 to 6 configured and sized to lock a single wear plate 160 in place on the carrier plate 140. The lock 180 of Figures 17 to functionally and structurally similar to the lock 180 of Figures 13 to 16 and like numerals indicate like parts. However, in the present embodiment, the arcuate wings 510,520 are shortened so that the wings 510,520 lock the single wear plate 160 only in place on the carrier plate 140. As a result, in this embodiment, the carrier plate 140 is provided with a lock mounting 380 for each wear plate 160 in the upper row 161 of wear plates 160.

[0050] Figures 21 to 24 show another embodiment of a wear resistant liner 20 of the invention in which the wear resistant liner 20 is sized, shaped and configured for positioning over the support arm 100 and arm liner 110 of the cone crusher bottom shell 10 (see also Figure 1). The wear resistant liner 20 is similar to the wear resistant liner of Figures 2 to 6 but smaller in scale and like numerals indicate like parts. More particularly, the wear resistant liner 20 is made up of carrier plates 140, a plurality of wear plates 160 (in a single row) mountable on each carrier plate 140 via hook-like demountable hanging mountings 170 and optional locks 180 for locking the wear plates 160 on place on the carrier plates 140. However, due to the smaller size of the carrier plate 140 and the wear plates 160, each wear plate only requires a single demountable hanging mounting 170 on its inner backing plate 450. In the present embodiment, each lock 180 is sized to simultaneously lock three wear plates 160 in place on the carrier plate 140 in an identical manner to the locks described in Figures 13 to 16.

[0051] As the wear resistant liner 20 is shaped to be mounted over the arm liner 110 on the inside surface 40 of the bottom shell wall 30, the carrier plate 140 is shaped to define an inwardly curved or arcuate bottom edge 240 to conform with the arm liner 110 with the result that the wear plates 160 on the carrier plate 140 are of various sizes to cover the carrier plate 140. More particularly, as shown in the drawings, due to the arcuate bottom edge 240, the elongate segments 210 of the carrier plate increase in length towards each side edge 250,260 of the carrier plate 140. As a result, the wear plates 160 mounted at the side edges 250,260 of the carrier plate 140 are longer than the more centrally positioned wear plates 160 while the bottom edge 410 of these wear plates 160 are also inwardly arcuately curved to conform with the curvature of the carrier plate bottom edge 240.

[0052] Figures 25 to 28 show the carrier plate 140 of Figures 21 to 24 with the wear plates 160 and locks 180 omitted to more clearly illustrate the shape and size of the carrier plate 140. As shown in the drawings, the carrier plate 140 is made up of a panel 200 which is curved to conform to the inside surface 40 of the bottom shell wall 30 by being subdivided into elongate segments 210 at bends or creases 220 defined in panel 200. As indicated above, the panel 200 has a top edge 230 and side edges 250,260 as previously described while the bottom edge 240 is inwardly curved to complement the curvature of the arm liner 110 with the result that the elongate segments 210 disposed towards the side edges 250,260 have an increased length. In addition, each elongate segment 210 of the carrier plate 140 is provided with a single complementary wear plate opening 300 for receiving the single hanging 170 on the wear plates - a single hanging mounting 170 on the wear plate 160 and a single complementary mounting on each elongate segment 210 being adequate due to the reduced size of the wear plates 160. The carrier plate 140 is typically secured with three carrier plate fixings 150.

[0053] Figures 29 to 33 show a wear plate 160 of the wear resistant liner of Figures 21 to 24. The wear plate 160 is one of the centrally positioned wear plates 160 mounted on the carrier plate 140 between the wear plates 160 having curved bottom edges 240. The wear plate 160 is similar to the wear plates 160 described in Figures 11 and 12 but is of a reduced size and like numerals indicate like parts. Accordingly, the wear plate 160 is generally rectangular in shape having a main body 163 de-

fining bottom edge 410, two side edges 420,430 and a top edge 440. The main body 163 is made up of an inner backing plate 450 and an outer wear resistant layer 460. As indicated above, due its reduced size, a single hanging mounting 170 only is required on the backing plate 450. As with the hanging mountings 170 shown in Figure 12, the single hanging mounting 170 is also attached to the inner backing plate 450 within the upper two thirds portion by area/weight of the main body 163 so that the lower third portion functions as a ballast to stabilise the wear plate 160 at the bottom shell wall 3 in use.

[0054] In use, carrier plates 140 are first fixed to the inside surface 40 of the bottom shell wall 30 via carrier plate fixings (e.g. carriage bolts) inserted through the carrier plate fixing openings 350,360,370 defined in the carrier plate 140 and/or the eyelet band 330. The carrier plates 140 are generally permanently fixed to the bottom shell wall 30 with the carrier plate fixings and can be fitted to new crushers or retrofitted to existing crushers if desired.

[0055] To complete the wear resistant liner 20, the wear plates 160 are then manually hung on the permanently fixed carrier plates 140 via the demountable hanging mountings 170 on the wear plates 160 and the complementary wear plate openings 300 on the carrier plates 140 so that the wear plates 160 effectively hang from the carrier plates 140 in a stable manner under the ballast weight provided by the wear plates 160. The wear plates 160 can then be manually locked into place with the locks 180 if present. As indicated above, wear plates 160 with differing wear resistant surfaces 190 can be positioned as required on the carrier plates 140 in accordance with the wear experienced at different locations on the bottom shell wall 30. The wear plates 160 therefore protect both the carrier plate 140, the carrier plate fixings 150 and the bottom shell wall 30 from impacts from processed materials.

[0056] Where the wear resistant surface 190 reaches the end of its life or where the wear plates 160 require replacement due to a change in the materials being processed, the wear plates 160 can be simply and quickly manually lifted from the carrier plates 140 and replaced without requiring the use of tools.

Claims

1. A cone crusher wear plate (160) to protect a bottom shell wall (30) of a cone crusher bottom shell (10) from impacts from processed materials, the wear plate (160) comprising:

   a main body (163), and
   an outer wear resistant surface (190) on the main body wherein the wear plate (160) comprises a demountable hanging mounting (170) on an inner surface (451) of the main body (163) for removably supporting the wear plate (160) at the bottom shell wall (3) to form a wear resistant liner (20) in the bottom shell (10).

2. A cone crusher wear plate (160) as claimed in Claim 1 wherein the main body (163) below the demountable hanging mounting (170) defines a ballast to stabilise the wear plate (160) at the bottom shell wall (3).

3. A cone crusher wear plate (160) as claimed in Claim 1 or Claim 2 wherein the hanging mounting (170) comprises at least two hanging mountings (170) arranged along a vertical axis of the wear plate (160).

4. A cone crusher wear plate (160) as claimed in any of Claim 1 to 3 wherein the hanging mounting (170) comprises a hook (171).

5. A wear resistant liner (20) for a cone crusher bottom shell (10) comprising at least one cone crusher wear plate (160) as claimed in any of Claims 1 to 4.

6. A wear resistant liner (20) as claimed in Claim 5 wherein the wear resistant liner (20) comprises:

   a carrier plate (140) attachable to an inside surface (40) of the bottom shell wall (30) at a carrier plate fixing (150), and
   the at least one wear plate (160) is removably supportable on the carrier plate (140) via the demountable hanging mounting (170) to protect the carrier plate (140) and the inside surface (40) of the bottom shell wall (30).

7. A wear resistant liner (20) as claimed in Claim 6 wherein the carrier plate (140) is configured to support a plurality of wear plates (160).

8. A wear resistant liner (20) as claimed in Claim 6 or Claim 7 wherein the wear resistant liner (20) comprises a plurality of carrier plates (140) circumferentially attachable to the inside surface (40) of the bottom shell wall (30) at carrier plate fixings (150).

9. A wear resistant liner (20) as claimed in any of Claims 6 to 8 wherein the wear plate (160) comprises an inner backing plate (200) abuttable against the carrier plate (140) and an outer wear resistant layer (210) on the backing plate (200) defining the outer wear resistant surface (190).

10. A wear resistant liner (20) as claimed in any of Claims 6 to 9 wherein the wear resistant surface (190) on each wear plate (160) can be the same or different.

11. A wear resistant liner (20) as claimed in any of Claim 6 to 10 wherein the carrier plate (140) comprises a complementary wear plate opening (300) for receiving the hanging mounting (170).

12. A wear resistant liner (20) as claimed in any of Claims 6 to 11 further comprising a wear plate lock (180) to lock the wear plate (160) in position on the carrier plate (140).

13. A wear resistant liner (20) as claimed in Claim 12 wherein the wear plate lock (180) comprises a lock fastener (501) for demountably attaching the wear plate lock (180) to the carrier plate (140) to prevent detachment of the wear plate (160) from the carrier plate (140).

14. A wear resistant liner (120) as claimed in any of Claims 6 to 13 wherein the carrier plate fixing (150) comprises a permanent carrier plate fixing (150).

15. A cone crusher comprising a wear plate (160) as claimed in any of Claims 1 to 4.

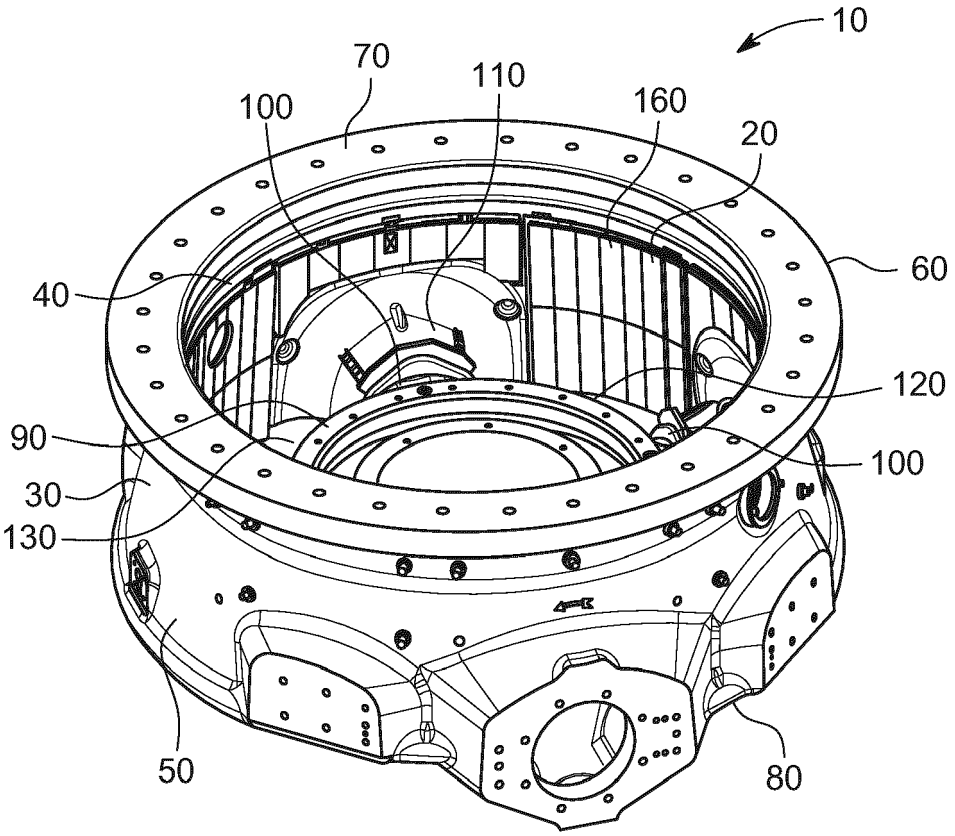

FIG. 1

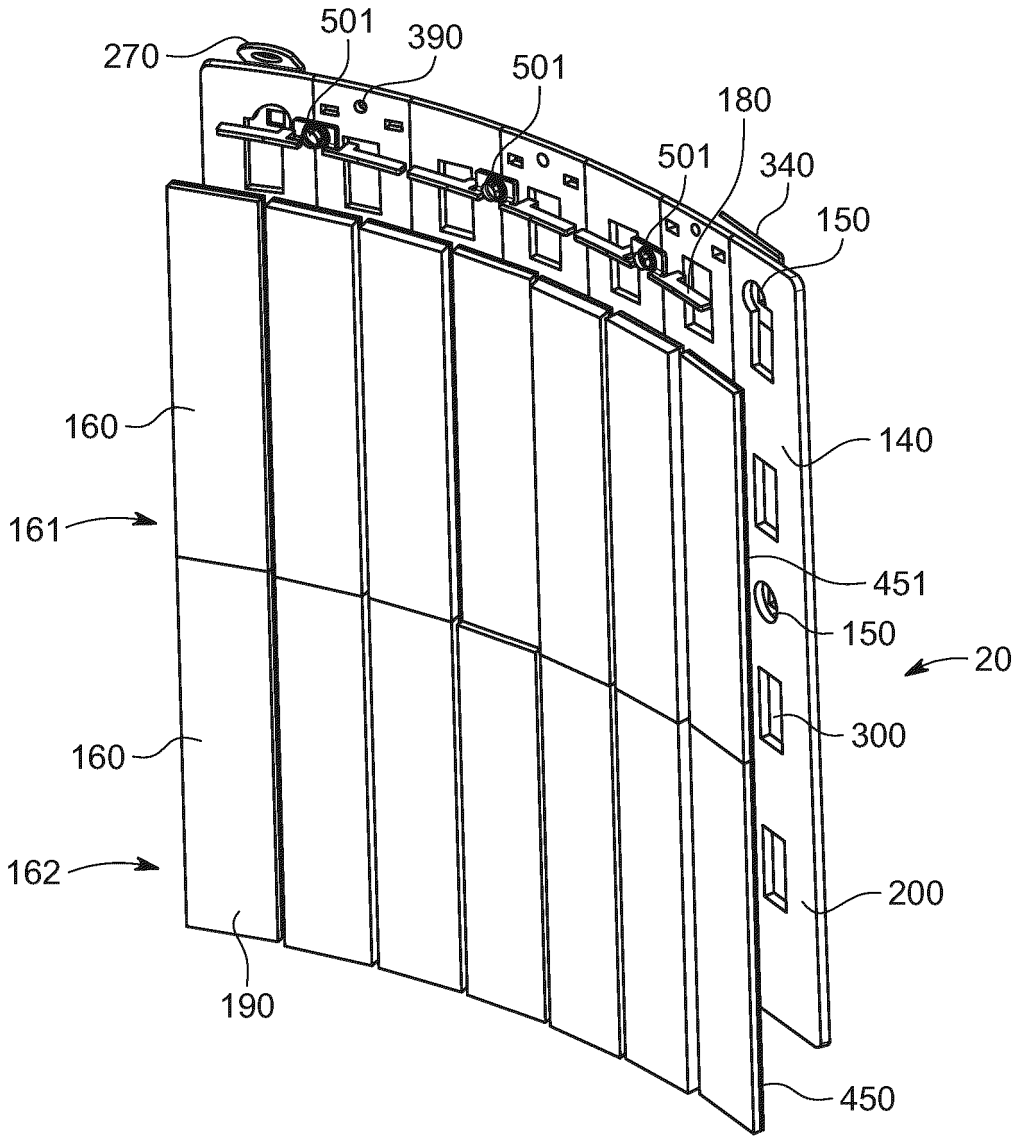
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FIG. 2

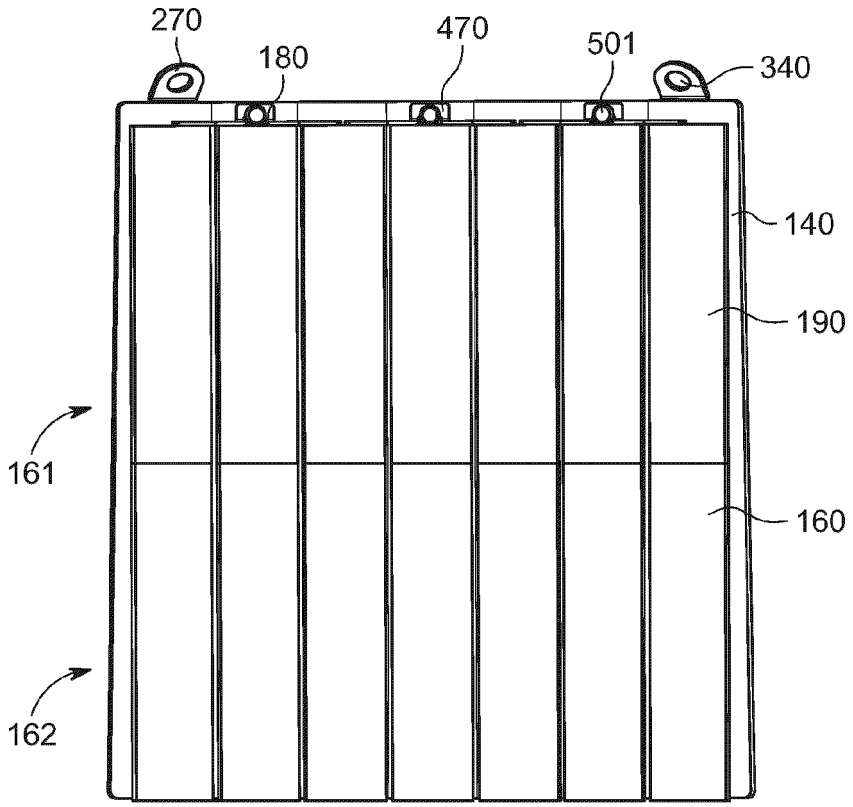
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FIG. 3

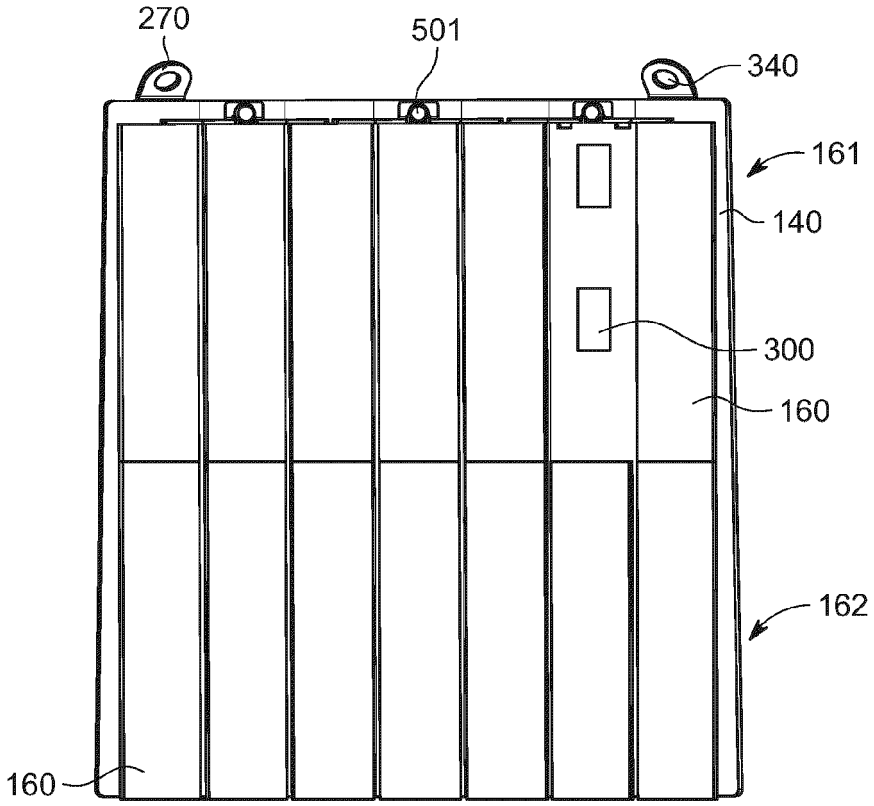
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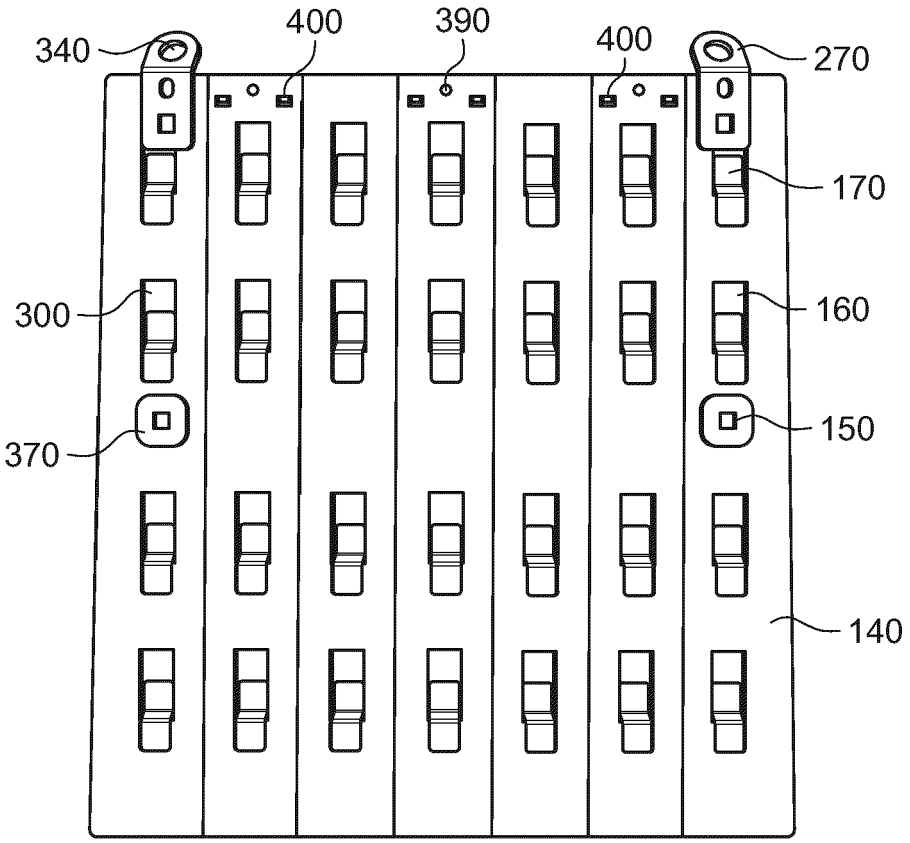
FIG. 4



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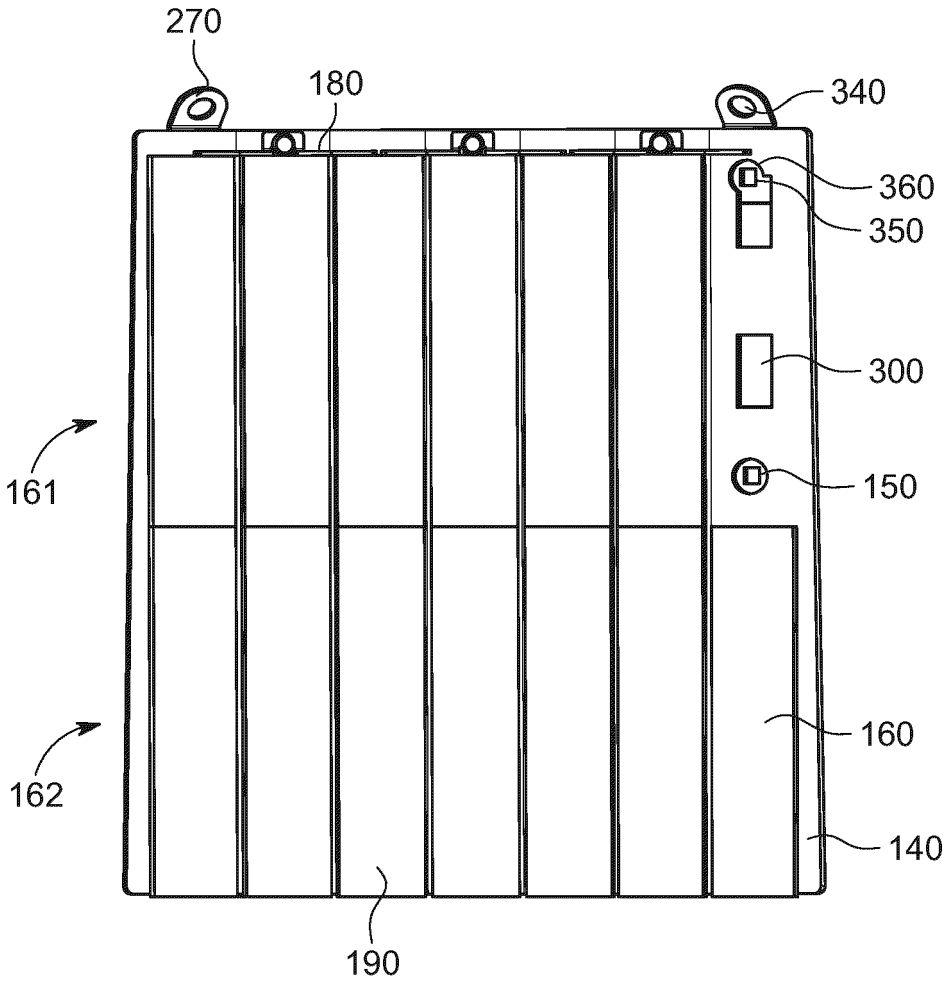

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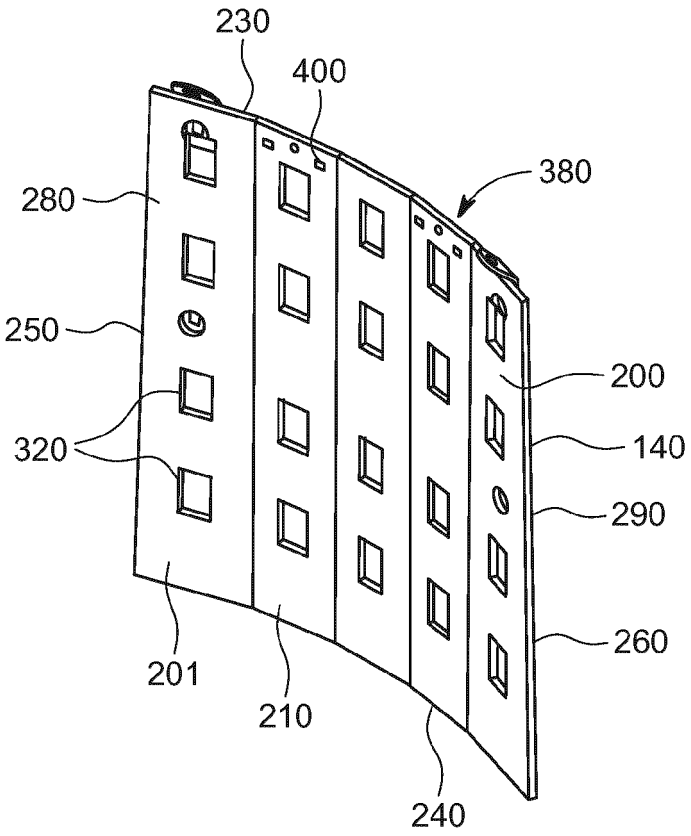
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FIG. 7

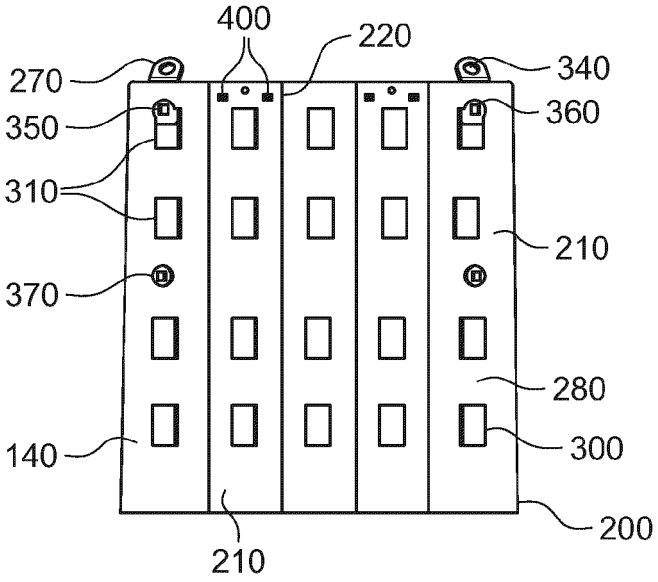
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FIG. 8

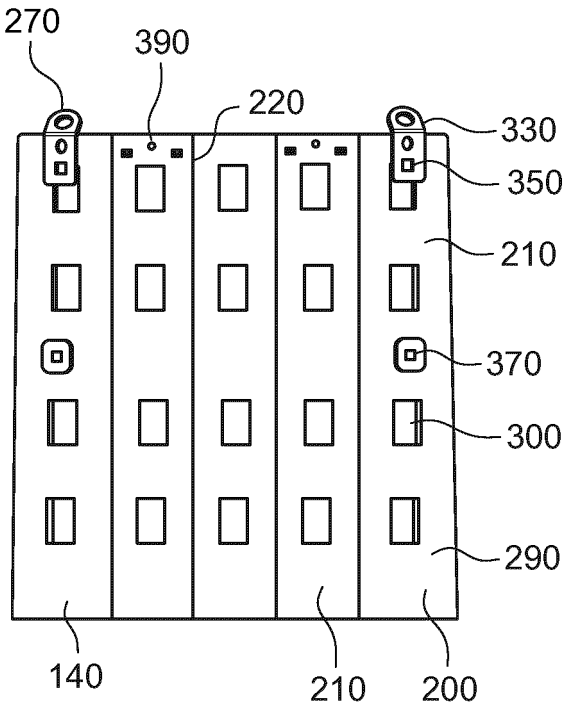
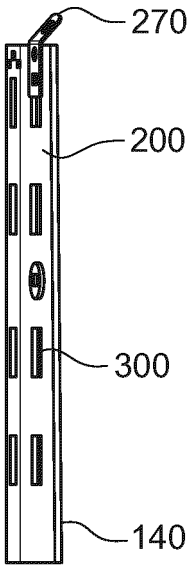


FIG. 9



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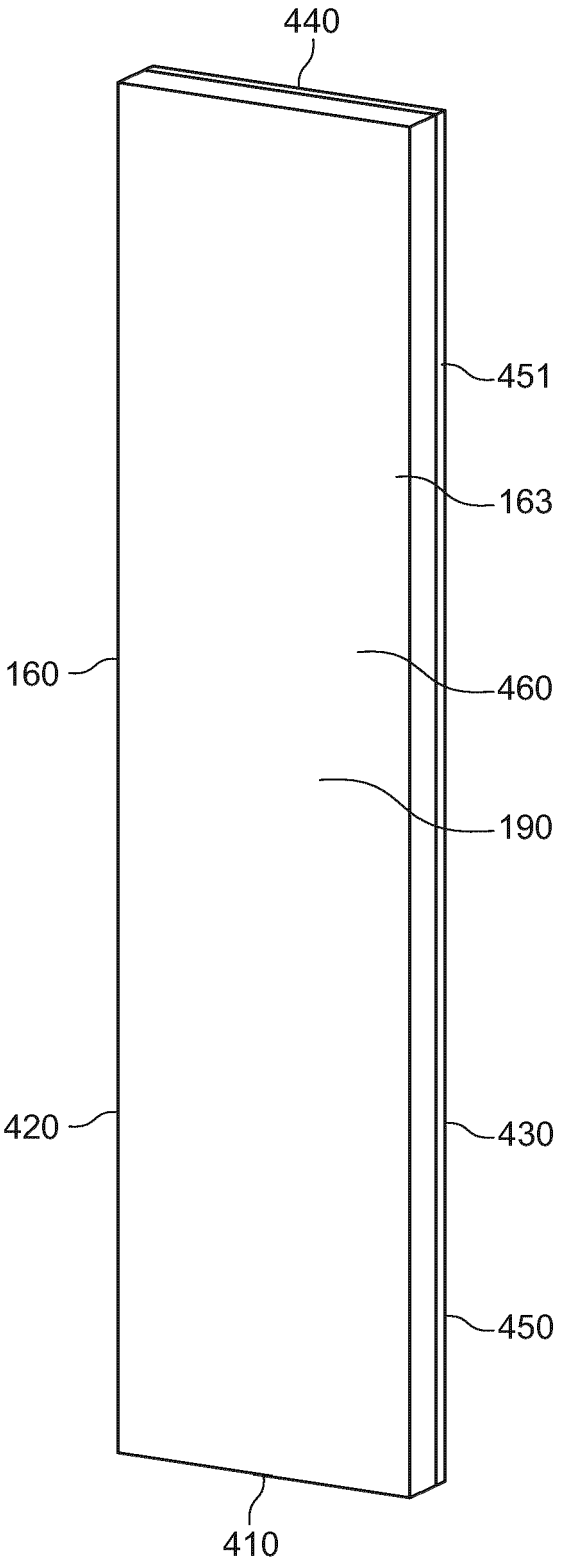

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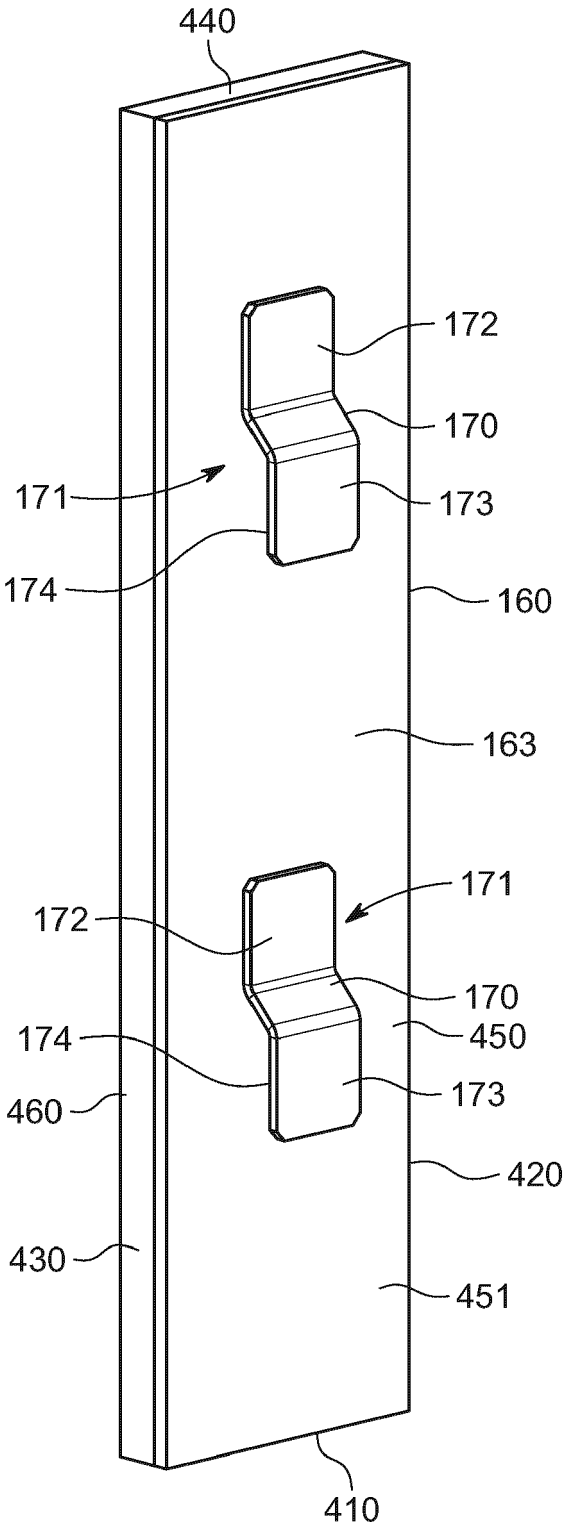
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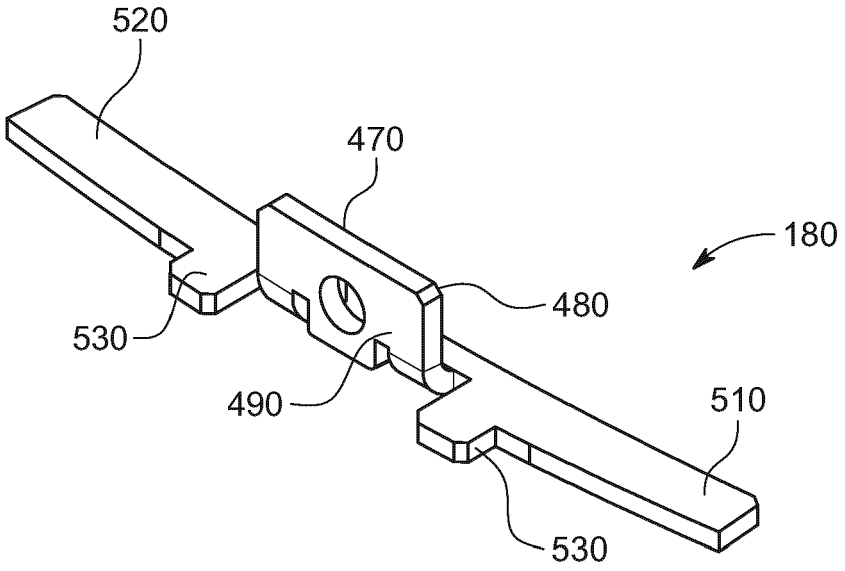
FIG. 12



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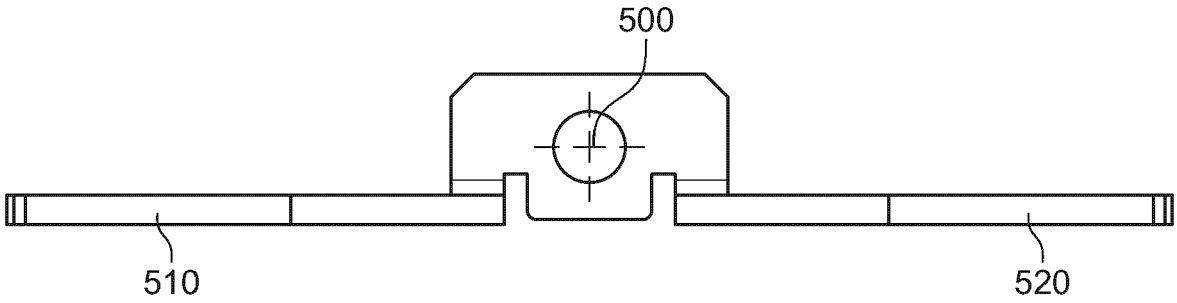

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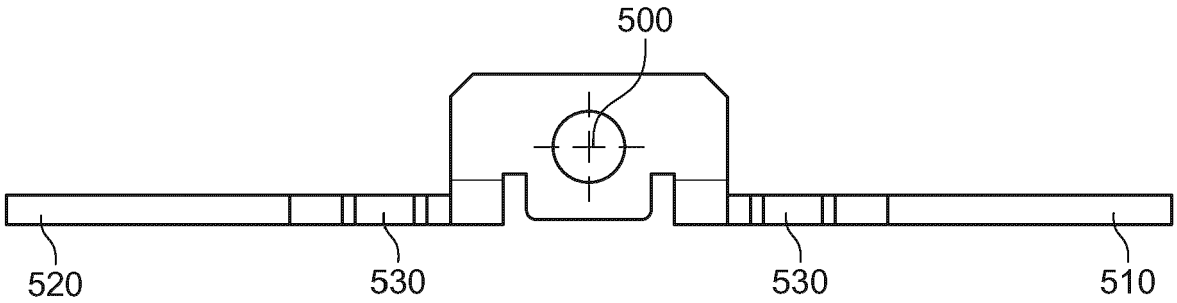

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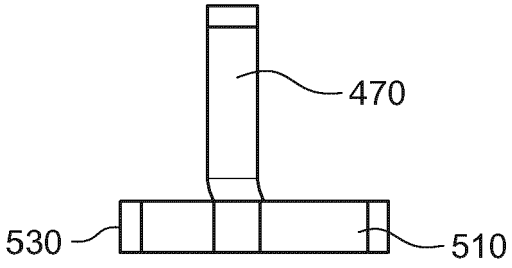

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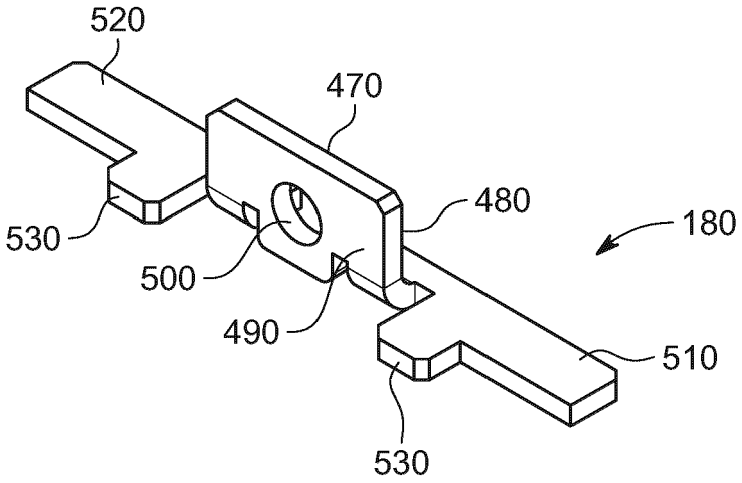

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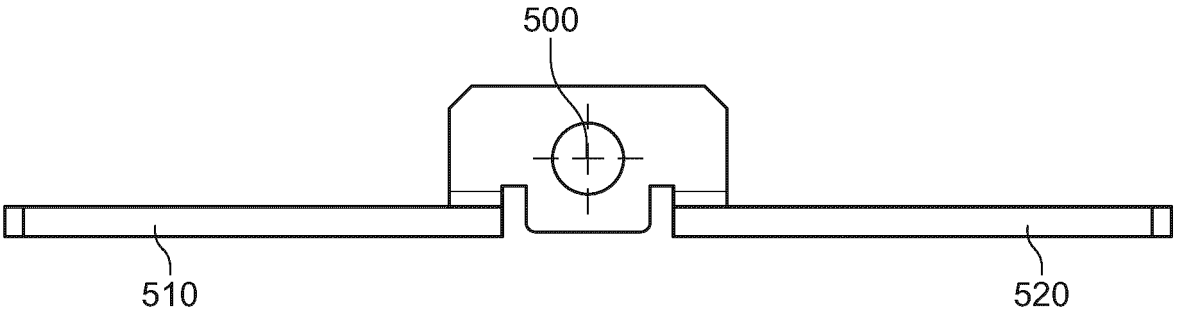

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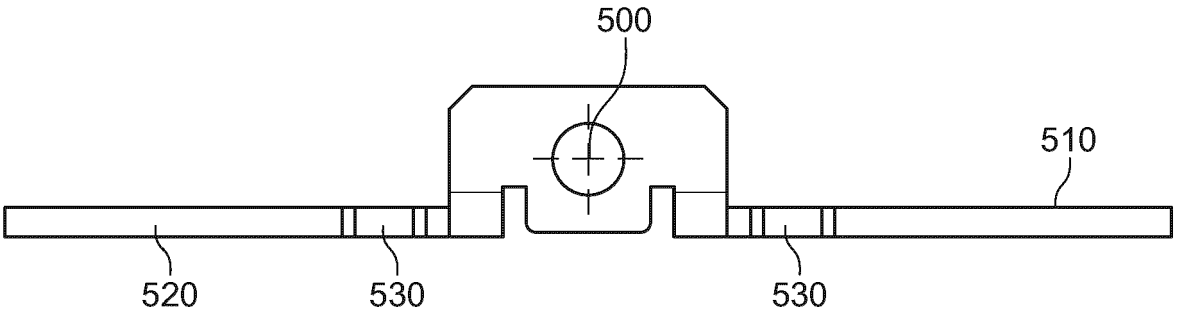

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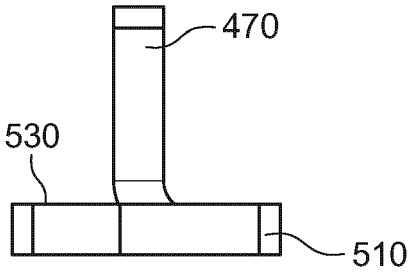
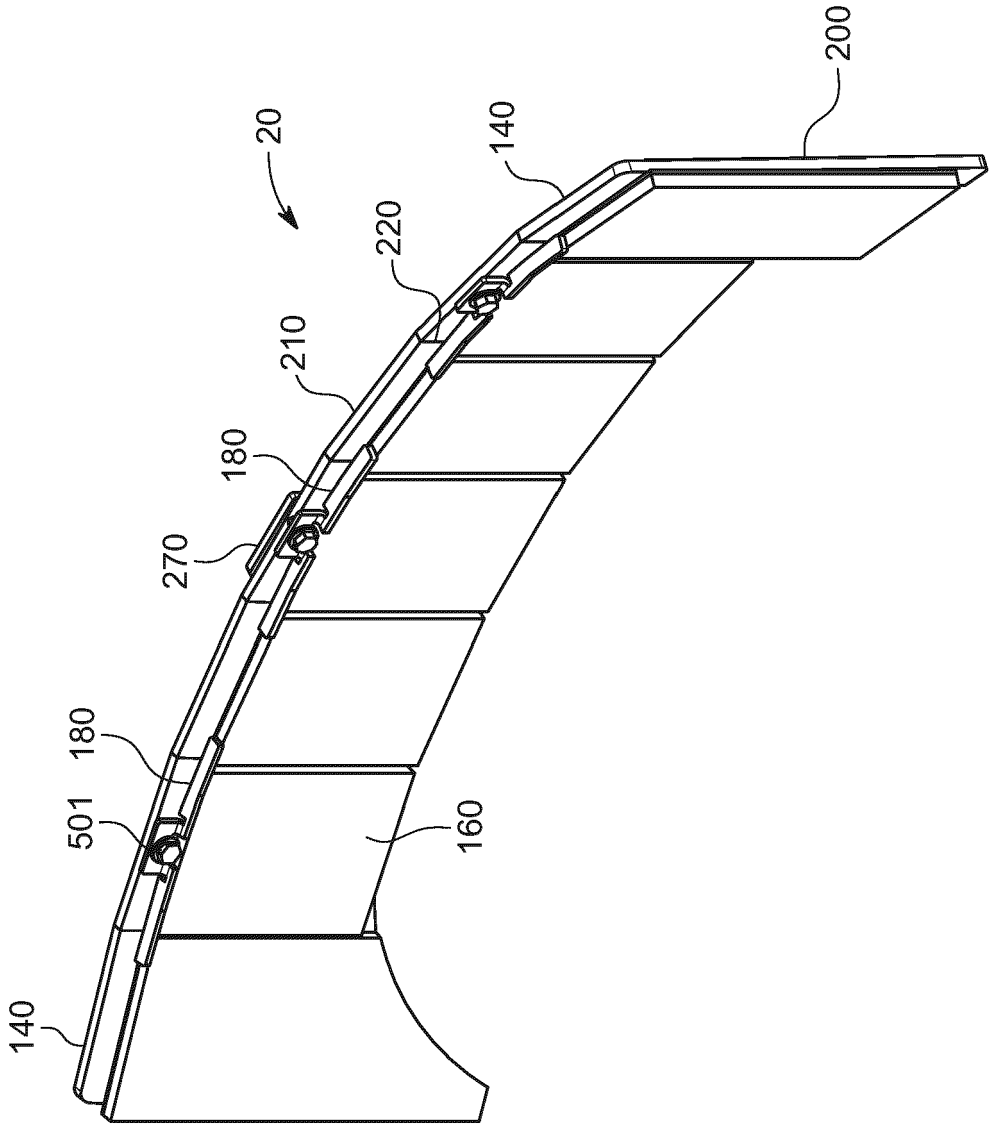


FIG. 20



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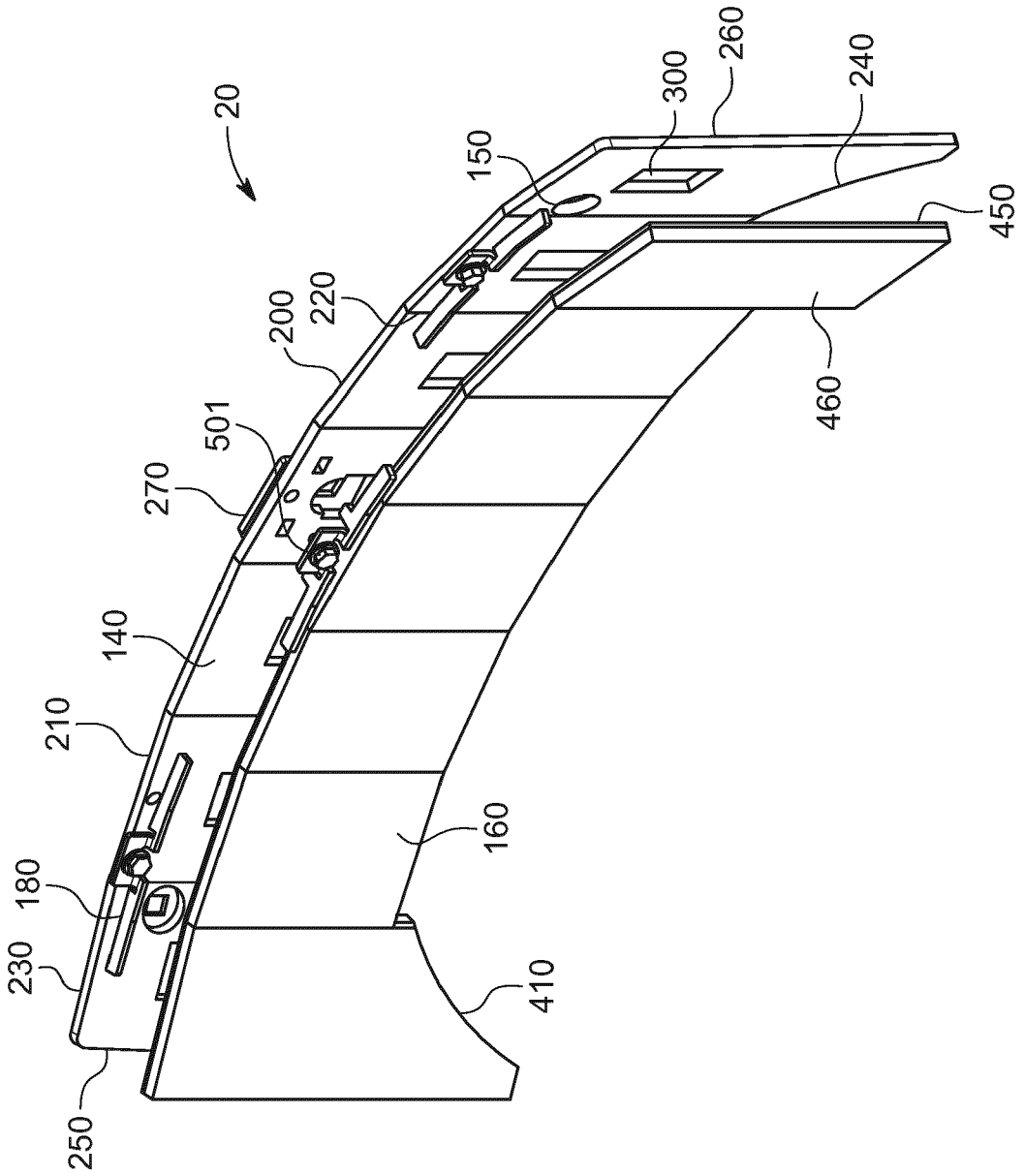
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FIG. 22

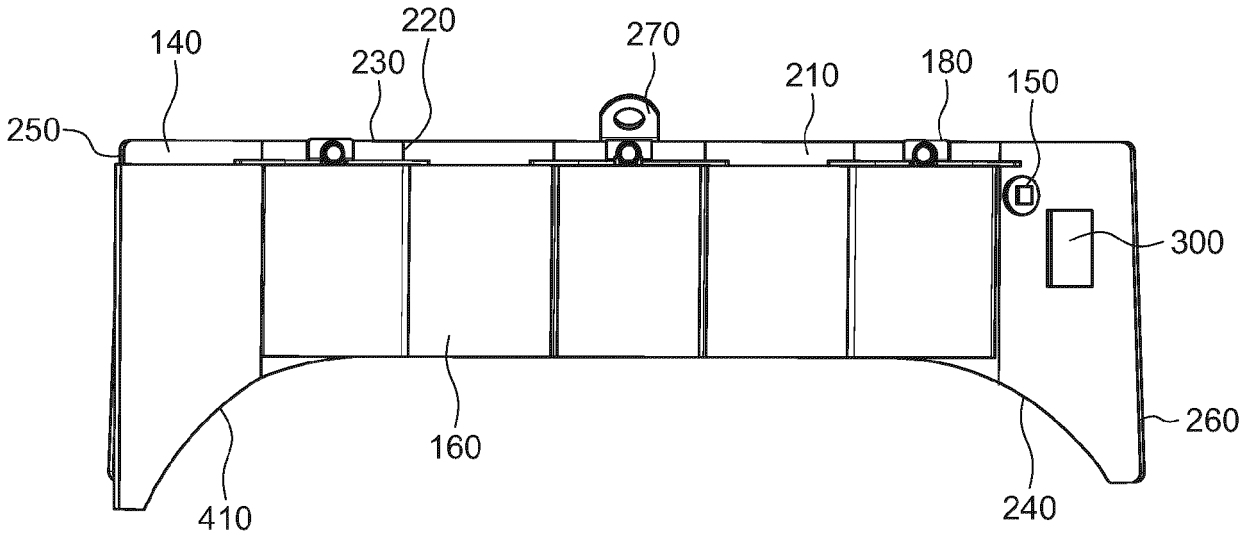
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FIG. 23

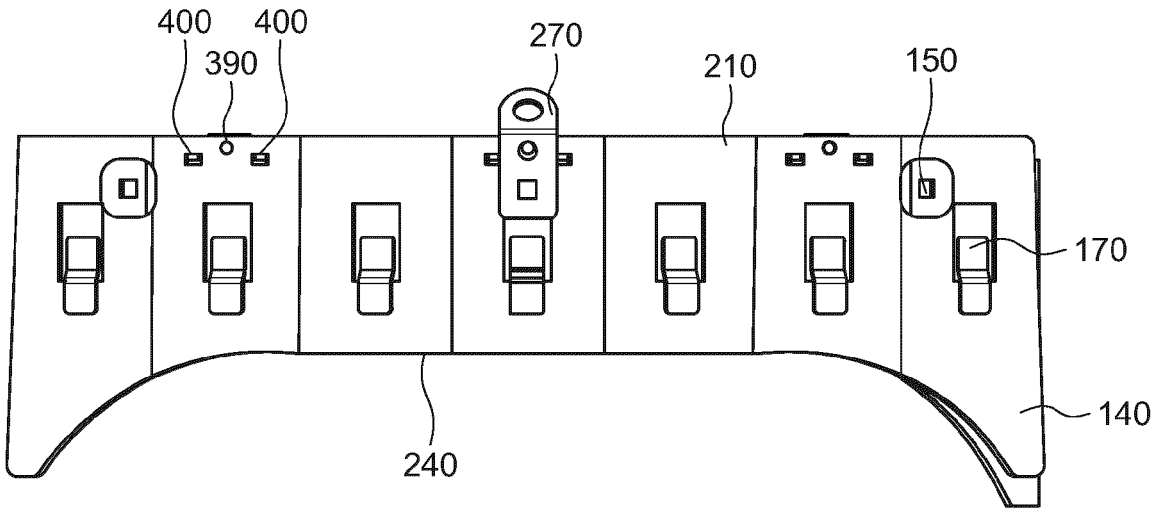
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FIG. 24

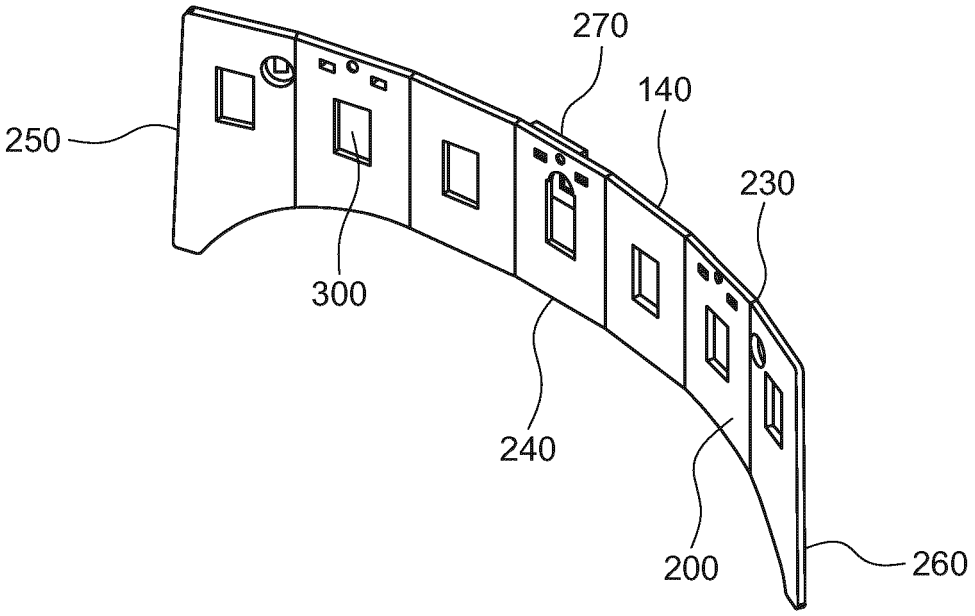
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FIG. 25

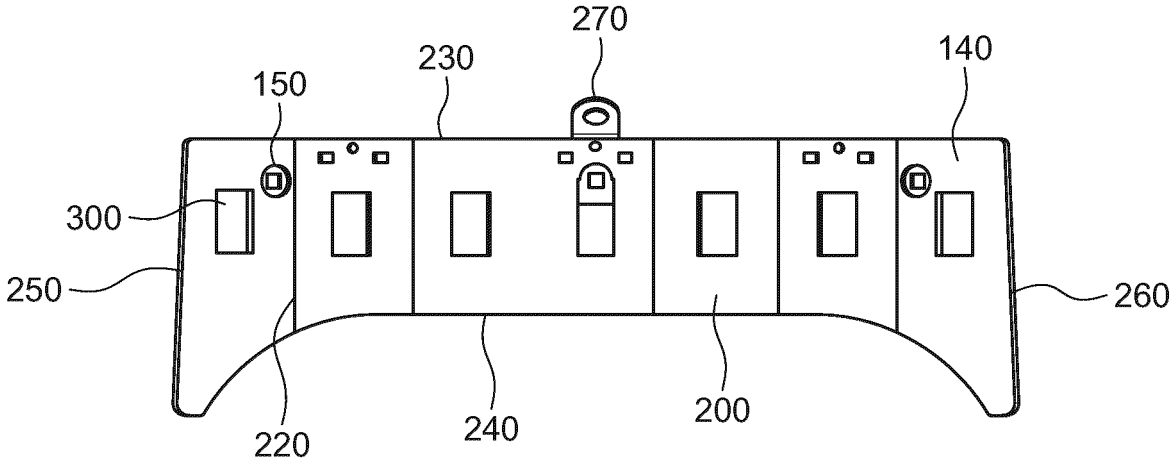
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FIG. 26

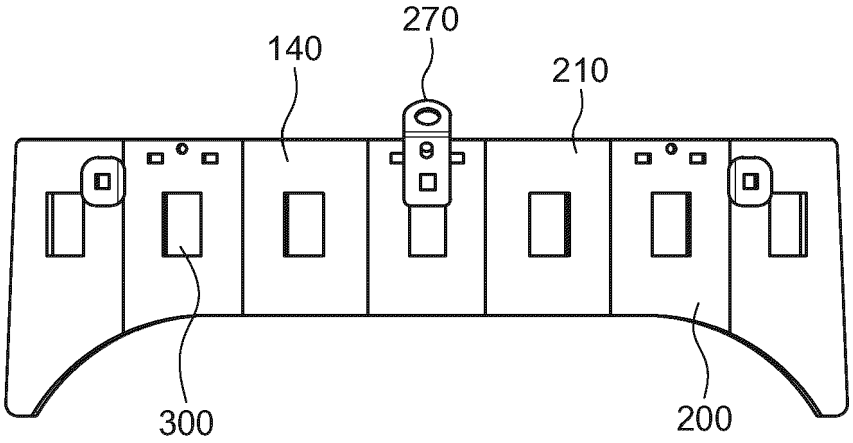

FIG. 27

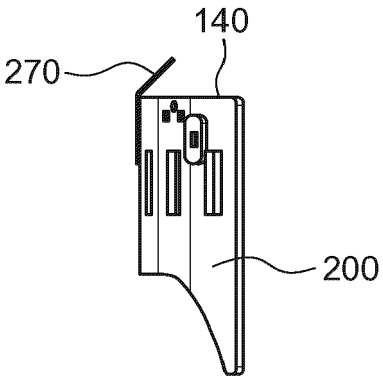

FIG. 28

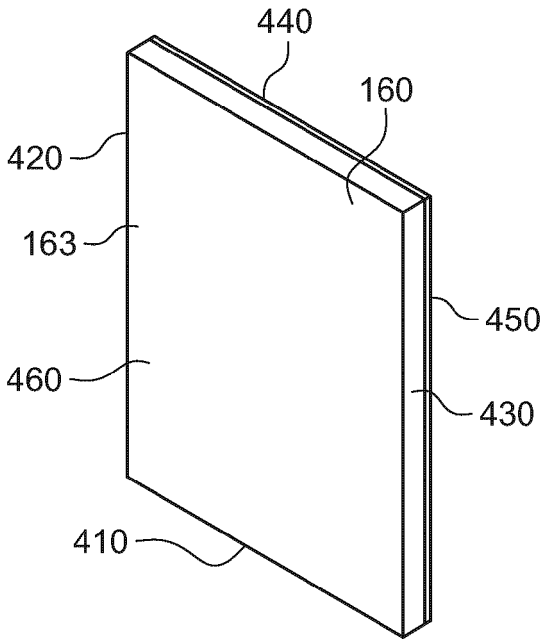
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FIG. 29

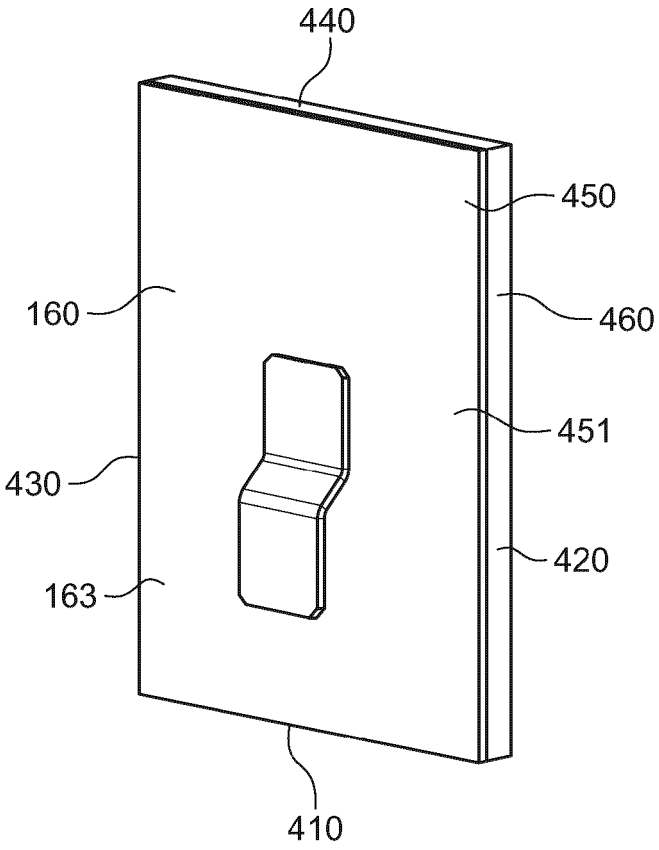
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FIG. 30

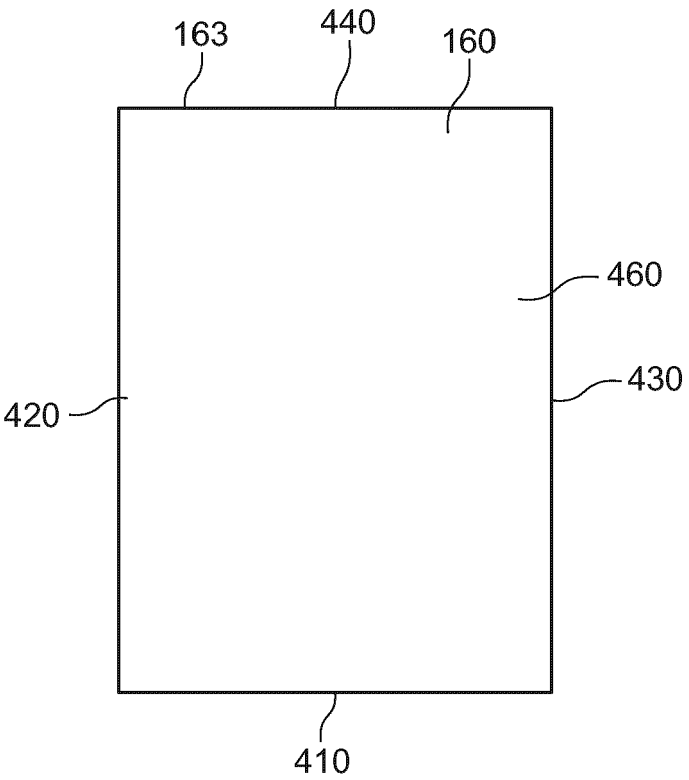

FIG. 31

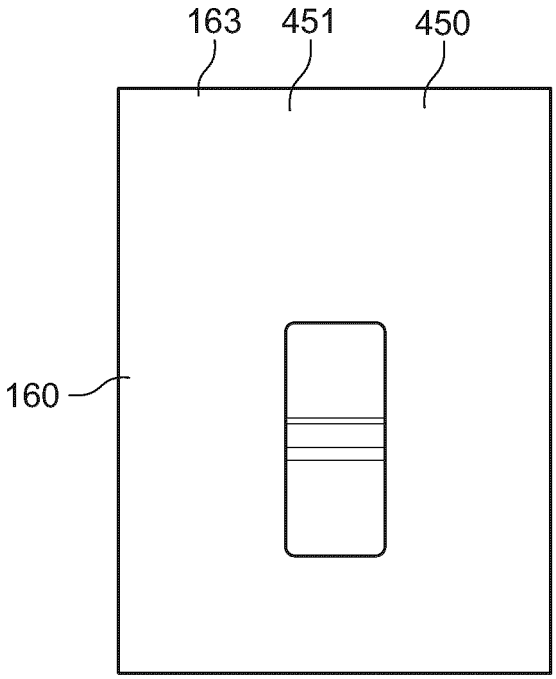

FIG. 32

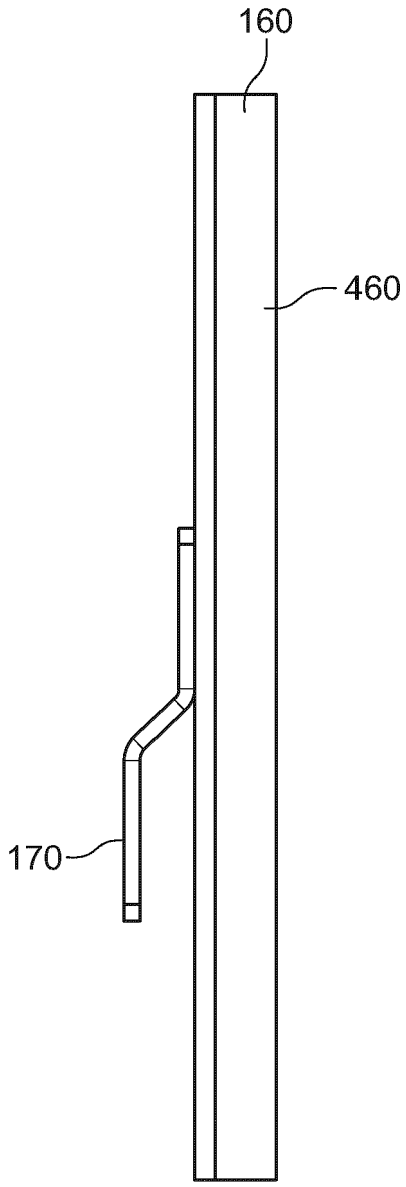

FIG. 33

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EUROPEAN SEARCH REPORT

Application Number
EP 21 18 1343

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 3 659 706 A1 (METSO SWEDEN AB [SE]) 3 June 2020 (2020-06-03) * paragraphs [0051] - [0068]; figures 1-5 *	1-15	INV. B02C2/00 B02C2/04 B02C2/02
A	WO 2020/223757 A1 (FORTESCUE METALS GROUP LTD [AU]) 12 November 2020 (2020-11-12) * paragraphs [0007] - [0025]; figures 1,2,6-8 *	1-15	
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TECHNICAL FIELDS SEARCHED (IPC)
B02C

1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	10 December 2021	Iuliano, Emanuela

CATEGORY OF CITED DOCUMENTS

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10-12-2021

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