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(71) Applicant: **DA GAMA INDUSTRIES PTY LTD** [AU/AU]; 4 Railway Parade, Kurri Kurri, New South Wales 2327 (AU).

(72) Inventor: **CLIMACO, Francelino**; 4 Railway Parade, Kurri Kurri, New South Wales 2327 (AU).

(74) Agent: **ACROGON GROUP PTY LTD**; Level 3, 478 George Street, Sydney, New South Wales 2000 (AU).

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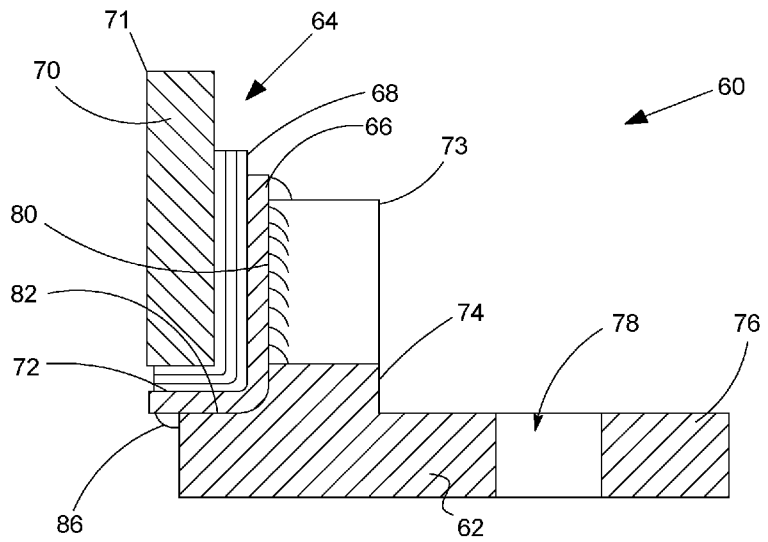


Fig. 15

(57) Abstract: A scraper (60) or cleaner tip for a belt (11) of a conveyor belt machine (10) has a holding body (62) made of a first metal or alloy material. The holding body is configured or adapted for connecting to a mounting assembly (20) of the conveyor belt machine. The scraper also has a scraper element (64) joined to the holding body. The scraper element is configured or adapted for scraping from the belt any conveyed material (12) which has adhered to the belt. The scraper element has a single tungsten carbide blade (70) joined by brazing to a backing strip (66). The backing strip is made of a second metal or alloy material which is the same or similar in its thermal properties to the first metal or alloy material of the holding body. The backing strip of the so assembled scraper element (64) is then joined to the holding body. The scraper provided hereby is such that the single tungsten carbide blade extends substantially the length of the holding body.

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CONVEYOR BELT SCRAPER

TECHNICAL FIELD

The present disclosure relates to conveyor belt scrapers, also known as conveyor belt cleaner tip, used to remove residual material which clings or adheres to the surface of a belt of a conveyor belt machine.

This invention has particular application to conveyor belts for conveying bulk materials, such as coal, coke and iron ore, but is not limited thereto, and may have broader application, say, in conveying any material which has adherent properties.

The present invention may have even broader application in machines, chutes or other assemblies where a single tungsten carbide blade needs to be joined reliably and efficiently to a main body made of stainless steel or mild steel.

BACKGROUND OF THE INVENTION

Numerous conveyor belt cleaning systems have been developed over many years which incorporate belt scrapers having a main body that holds specialized teeth or blades against a conveyor belt surface to scrape off material adhering to the return side of the belt, whilst maintaining the strength and integrity of the belt to ensure its prolonged use.

In, for example, the Australian coal industry, conveyor belts conveying coal and coke have utilised belt scrapers made of a stainless steel or mild steel main body, also known as a holding body, which holds a scraper element having of a plurality (usually three or four) of tungsten carbide blades (also known as inserts) arranged as end-to-end, closely separated, segments brazed to, but projecting from, a common edge of the main body at a desired common angle.

A plurality of such belt scrapers, arranged end-to-end, is required to extend across (and provide enough scraper elements to scrape against) the full (or effective) width of the conveyor belt. The angle at which the scraper element projects from the steel main body varies for different types of belt scrapers, and this is particularly the case for scrapers known as H-type, P-type and R-type scrapers, with each type being uniquely suited to cleaning the belt at different locations therealong.

The adoption and widespread use in the prior art of the aforementioned belt scrapers which utilize a plurality of end-to-end arranged, but closely separated, segments of tungsten carbide blades as the scraper element, rather than any adoption of a belt scraper utilizing a single tungsten carbide blade extending substantially the length of the steel main body, has had its limitations, particularly in the manufacturing stage. This is primarily because, during manufacturing, brazing is used to melt a silver-based filler material so that it flows to form a joint between the plurality of the tungsten carbide blades and the steel main body, but under the high temperature reached by brazing, the steel expands (and then contracts during cooling) significantly more than does the tungsten carbide, due to their very different thermal properties, and especially their very different thermal expansion rates.

During the subsequent cooling stage, as the joint is solidifying, the contraction of the steel main body far exceeds that of the tungsten carbide blades, such that the steel main body continues to contract after the tungsten carbide blades have stopped contracting, causing the facing end surfaces of any two adjacent tungsten carbide blades to be moved closer together, and thus reducing the gap between them, due to the still contracting steel main body to which the two adjacent blades are joined.

While this process, including the presence of the gaps, reduces the likelihood of the manufactured belt scraper becoming significantly bent or otherwise distorted, or even cracking, the process is not without its limitations, as it is still possible (and not uncommon) for belt scrapers to be produced which have a slight bend that then requires manual labour to physically straighten them if they are to be used.

This problem is particularly acute when attempting to braze a single tungsten carbide blade substantially along the length of the steel main body of the belt scraper, and so has prevented the adoption and widespread use of any such single blade belt scrapers, but is less acute, although still of concern, when brazing a plurality of tungsten carbide blades along the length of the steel main body of the belt scraper.

Aside from these manufacturing problems, there have also been problems associated with the performance and long term use of such prior art belt scrapers. It is not uncommon for parts of the facing end surfaces across the gaps between any two adjacent tungsten carbide blades (and especially the corner edges of the blades nearest to the belt) to crack or suddenly break off under a strong impact by conveyed bulk material, and cause damage to the belt. Moreover, with

prolonged use, the gaps between adjacent blades gradually become enlarged as the large amount of material being conveyed on the belt causes the corner edges and other scraping surfaces of the blades to wear, and this reduces the scraping efficiency of such belt scrapers over time.

It is an object of the present invention to provide a conveyor belt scraper which overcomes, or at least substantially ameliorates, the aforementioned problems and shortcomings of the prior art, or at least provides a useful alternative.

It is another object of the present invention to provide a conveyor belt scraper that has a single tungsten carbide blade extending substantially the length of the holding body and which is easier to manufacture and does not suffer from the manufacturing problems associated with belt scrapers or belt cleaner tips which have a plurality of tungsten carbide blades, and which has a prolonged useful life over that of prior art belt scrapers.

SUMMARY OF INVENTION

According to one aspect of the present invention, there is provided a scraper for a belt of a conveyor belt machine, the scraper comprising:

(a) a holding body made of a first metal or alloy material and having a length, the holding body being adapted for connecting to a mounting assembly of the conveyor belt machine, and

(b) a scraper element joined to the holding body and adapted for scraping from the belt any conveyed material which has adhered to the belt, the scraper element comprising a single tungsten carbide blade having a length which extends substantially the length of the holding body, the single tungsten carbide blade being joined by brazing to a backing strip made of a second metal or alloy material which is the same or similar in its thermal properties to the first metal or alloy material of the holding body, whereupon the backing strip of the so assembled scraper element is then joined to the holding body, such that the single tungsten carbide blade extends substantially the length of the holding body.

In a preferred form, the holding body comprises a variably projecting wall portion to which the backing strip of the scraper element is joined, wherein the variably projecting wall

portion extends to varying extents of height along its length from a mounting wall portion, and a welded joint is formed along a variable path which follows an outer line of the variably projecting wall portion.

The backing strip is preferably an L-section backing strip.

Alternatively, the backing strip may be a flat-section backing strip.

The variably projecting wall portion is preferably a saw tooth arrangement.

In this preferred form, the welded joint is a zig zag shaped welded joint.

Alternatively, the variably projecting wall portion may be a wave surface arrangement.

In this preferred form, the welded joint is a wave surface shaped welded joint.

It is preferred that the first metal or alloy material is selected from stainless steel or mild steel.

It is preferred that the second metal or alloy material is selected from stainless steel or mild steel.

The backing strip of the scraper element may be joined to the holding body by welding.

The single tungsten carbide blade may be joined to the backing strip by induction brazing.

It is preferred that a metal filler material is utilized for the induction brazing.

The metal filler material is preferably a silver-based filler material.

Preferably, the silver-based filler material is in the form of a trilay structure.

According to another aspect of the present invention, there is provided a method of assembling a scraper for a belt of a conveyor belt machine, the method comprising the steps of:

(a) providing a holding body made of a first metal or alloy material and having a length,

(b) providing a single tungsten carbide blade having a length which extends substantially the length of the holding body,

(c) providing a backing strip made of a second metal or alloy material which is the same or similar in its thermal properties to the first metal or alloy material of the holding body,

(d) brazing the single tungsten carbide blade to the backing strip to form an assembled scraper element, and

(e) joining the assembled scraper element to the holding body, such that the single tungsten carbide blade extends substantially the length of the holding body.

Preferably, the step of brazing of the single tungsten carbide blade to the backing strip is by induction brazing.

Preferably, the step of joining of the assembled scraper element to the holding body is by welding.

There has been thus outlined, rather broadly, the more important features of the invention in order that the detailed description thereof that follows may be better understood and put into practical effect, and in order that the present contribution to the art may be better appreciated.

There are additional features of the invention that will be described hereinafter. As such, those skilled in the art will appreciate that the concept, upon which the disclosure is based, may be readily utilized as the basis for designing other structures, assemblies, method steps and system configurations for carrying out the objects of the present invention. It is important, therefore, that the broad outline of the invention described above be regarded as including such equivalent features insofar as they do not depart from the spirit and scope of the present invention.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is an isometric view of one end of a conventional conveyor belt machine to which conveyor belt scrapers or belt cleaner tips of the prior art are engaged for cleaning the surface on the return side of the belt from adhered particulate material.

Fig. 2 is a side view of the conveyor belt machine shown in Fig. 1.

Fig. 3 is an isometric view of a H-type belt scraper of the prior art.

Fig. 4 is an isometric view of a R-type belt scraper of the prior art.

Fig. 5 is an isometric view of a P-type belt scraper of the prior art.

Fig. 6 is an isometric exploded view of the prior art H-type belt scraper of Fig. 3.

Fig. 7 is a side sectional view of the prior art H-type belt scraper of Fig. 3.

Fig. 8 is a side sectional view of the prior art P-type belt scraper of Fig. 5.

Fig. 9 is a side sectional view of the prior art R-type belt scraper of Fig. 4.

Fig. 10 is an isometric view, from above, of a conveyor belt scraper or belt cleaner tip (of the H-type) according to a first embodiment of the present invention.

Fig. 11 is an isometric view, from below, of the conveyor belt scraper of Fig. 10.

Fig. 12 is an isometric exploded view of a scraper element of the conveyor belt scraper of Figs. 10 and 11, the scraper element being securable to a holding body for connecting to a mounting assembly of a conveyor belt machine.

Fig. 13 is a side sectional view of the scraper element of Fig. 12 when assembled.

Fig. 14 is an isometric view of the assembled scraper element of Fig. 13 adjacent to a holding body to which it is about to be secured.

Fig. 15 is a side sectional view of the conveyor belt scraper of Figs. 10 and 11 in which the scraper element and the holding body of Fig. 14 are secured together.

Fig. 16 is an isometric view of the conveyor belt scraper of Fig. 15, and which is identical to that of Fig. 10.

Fig. 17 is an isometric view of a conveyor belt scraper or belt cleaner tip (of the P-type) according to a second embodiment of the present invention.

Fig. 18 is an isometric view of a conveyor belt scraper or belt cleaner tip (of the R-type) according to a third embodiment of the present invention.

Fig. 19 is a side sectional view of the R-type belt scraper of Fig. 18.

Fig. 20 is a side sectional view of the P-type belt scraper of Fig. 17.

Fig. 21 is a side view of an end portion of a conventional conveyor belt machine to which a HT-type belt scraper or belt cleaner tip of the prior art is engaged for initially cleaning the surface on the return side of the belt from adhered particulate material.

Fig. 22 is an isometric view, from above, of the HT-type belt scraper of the prior art shown in Fig. 21.

Fig. 23 is an isometric view, from below, of the HT-type belt scraper of Fig. 22.

Fig. 24 is a side view of the HT-type belt scraper of Figs. 22 and 23.

Fig. 25 is an isometric view, from above, of a conveyor belt scraper or belt cleaner tip (of the HT-type) according to a fourth embodiment of the present invention.

Fig. 26 is an isometric view, from below, of the HT-type belt scraper of Fig. 25.

Fig. 27 is a side view of the HT-type belt scraper of Figs. 25 and 26.

BEST MODE OF CARRYING OUT THE INVENTION

The conventional conveyor belt machine 10 shown in Figs. 1 and 2 conveys particulate or bulk materials 12, such as coal, coke and iron ore, on its belt 11 in the direction shown by the arrows A, and any residual "carryback" matter of those materials 12 which does not fall off the end of the belt 11, but clings or adheres to the surface on the return side 13 of the belt 11, is substantially removed by the sequential actions of the H-type scraper 14, the P-type scraper 16, and the R-type scraper 18 of the prior art, each of which is connected to a dedicated suspension arm and mounting assembly 20, 22, 24, respectively, of the conveyor belt machine 10.

The prior art H-type scraper 14 shown in Figs. 3 and 7 has a H-type holding body 26 to which is secured a scraper element 28.

As more clearly shown in Figs. 6 and 7, the scraper element 28 includes a conventional trilay structure 30 used in brazing processes, and made of conventional metal filler material, such as filler material known as “trimetal brazing alloys” in the form of laminated foils or a three-layered structure, which is sandwiched between a stepped portion 32 of the holding body 26 and four pieces or blades 34 of tungsten carbide. As is known to persons skilled in this art, the trilay structure 30 is a three-layered structure having two outer strips of silver-based brazing filler material clad onto a copper middle layer (or carrier filler material) in a suitable size ratio of, say, 1 to 2 to 1 (1:2:1). In this example of the prior art, an induction brazing process is used to melt the metal filler material of the trilay structure 30 so that it flows and effectively joins the four blades 34 of tungsten carbide to the holding body 26. Although induction brazing has been used in this example of the prior art, other suitable techniques of brazing may alternatively be used, such as silver brazing, which is sometimes known as hard soldering.

The presence of expansion joints 36 or gaps between any two adjacent blades 34 of tungsten carbide can generally accommodate the expansion and contraction effects of different metals when the assembled components of the scraper 14 are subjected to heating and cooling during the manufacture of the H-type scraper 14. It is well known that tungsten carbide cools down from high temperatures at a very different rate to steel, as these two materials have very different thermal properties.

The prior art P-type scraper 16 shown in Figs. 5 and 8 has a P-type holding body 38 to which is secured a scraper element 40.

The scraper element 40 includes a conventional trilay structure 30 sandwiched between a stepped portion 42 of the holding body 38 and three pieces or blades 44 of tungsten carbide separated end-to-end by expansion joints 46 for reasons stated above, and the three blades 44 of tungsten carbide are joined to the holding body 38 by a process of brazing as described above.

The prior art R-type scraper 18 shown in Figs. 4 and 9 has an R-type holding body 48 to which is secured a scraper element 50.

The scraper element 50 includes a conventional trilay structure 30 sandwiched between a stepped portion 52 of the holding body 48 and three pieces or blades 54 of tungsten carbide separated end-to-end by expansion joints 56 for reasons stated above, and the three blades 54 of tungsten carbide are joined to the holding body 48 by a process of brazing as described above.

In a broad form of the present invention, and as shown in those of the accompanying drawings which depict various specific embodiments of the invention, there is provided a scraper 60, 90, 110, 160 or cleaner tip for a belt 11 of a conveyor belt machine 10. The scraper has a holding body 62, 92, 112, 162 made of a first metal or alloy material and having a length. The holding body is configured or adapted for connecting to a mounting assembly 20, 132 of the conveyor belt machine. The scraper also has a scraper element 64, 164 joined to the holding body. The scraper element is configured or adapted for scraping from the belt any conveyed material 12 which has adhered to the belt. The scraper element has a single tungsten carbide blade 70, 170 having a length which extends substantially the length of the holding body, the single tungsten carbide blade being joined by brazing to a backing strip 66, 168. The backing strip is made of a second metal or alloy material which is the same or similar in its thermal properties to the first metal or alloy material of the holding body. The backing strip of the so assembled scraper element is then joined to the holding body. The scraper provided hereby is such that the single tungsten carbide blade extends substantially the length of the holding body.

More particularly, a conveyor belt scraper or belt cleaner tip 60 according to a more specific first embodiment of the present invention is shown in Figs. 10 to 16. The scraper 60 is of the H-type, but has a modified H-type holding body 62, preferably made of stainless steel, but which may alternatively be made of mild steel or other suitable metal or alloy material, to which is secured a modified scraper element 64.

The scraper element 64, as more clearly shown in Figs. 12 to 15, includes a central L-section trilay structure 68 used in brazing processes, and preferably made of conventional filler material, a thin L-section backing strip 66 or plate, preferably made of stainless steel, but which may alternatively be made of mild steel or other suitable metal or alloy material, on one side of the trilay structure 68, and a single piece or blade 70 of tungsten carbide which provides a scraping edge 71 on the other side of the trilay structure 68.

The L-section backing strip 66 is joined along at least one first surface thereof to the holding body 62.

The L-section backing strip 66 is also joined along at least one opposite second surface thereof to the single blade 70 of tungsten carbide via the trilay structure 68.

A suitable brazing process is used to braze the L-section trilay structure 68 securely between the L-section backing strip 66 and the single blade 70 of tungsten carbide to form or assemble the scraper element 64 in a first step of assembling the belt scraper 60. In this embodiment, an induction brazing process is used to melt the filler material of the trilay structure 68 so that it flows and effectively joins the single blade 70 of tungsten carbide to the holding body 62. Although induction brazing has been used in this embodiment of the invention, other suitable techniques of brazing may alternatively be used, such as silver brazing, which is sometimes known as hard soldering.

As is well known to persons skilled in this art, for the L-section trilay structure 68 to form a brazed joint between two metal or metal alloy surfaces, the trilay structure must comprise a filler material having a lower melting point than the two surfaces being joined. For example, a metal filler material having two outer strips (or layers) comprising predominantly of silver with lower concentrations of other common filler metals, such as zinc, nickel, manganese and optionally cadmium, clad onto a core strip of copper, can be used. The filler material will become molten when sufficiently heated by electromagnetic induction and then flow by capillary action to bond together the two surfaces to form the joint when cooled.

The L-section backing strip 66 of the assembled scraper element 64 is then secured to an L-shaped stepped portion 72 of the holding body 62, in a second step of assembling the belt scraper 60, by a suitable welding process, such as laser welding, or possibly by plasma welding, or by traditional TIG welding or MIG welding, or by a suitable fastening process which utilizes mechanical fasteners or other connecting devices.

The use, in this embodiment, of an induction brazing process as a first step to assemble the scraper element 64 before the assembled scraper element 64 is secured to the holding body 62 in a second step, coupled with the use of the backing strip 66 in the induction brazing process,

results in the scraper element 64, and particularly the single blade 70 of tungsten carbide included in the scraper element 64, experiencing significantly less distortional forces during contraction from the high temperatures applied in the aforementioned induction brazing process than are experienced by the scraper elements of the prior art scrapers. Without wishing to be bound by theory, this may be primarily attributable to the use of the backing strip 66 to which the single blade 70 of tungsten carbide is brazed, and which is made of the same, or similar, material (especially in its thermal properties) as that of the holding body 62. Those features enable the facing surfaces of the backing strip 66 and the holding body 62 to be joined in the second step by heating, such as by welding, at a lower temperature than that which is used in the prior art, where there is no use of a backing strip, and where the higher temperature process of brazing is used to join the plurality of tungsten carbide blades to the holding body via the trilay structure to form or assemble the prior art belt scraper in a single step.

The H-type holding body 62 has a saw tooth arrangement 73 which forms a variably projecting wall portion 74 that extends perpendicularly to varying extents of height along its length from a larger mounting wall portion 76 (as specifically shown in Figs. 10, 14 and 16).

Bolts or studs are adapted to pass through holes 78 in the mounting wall portion 76 to connect the scraper 60 to the suspension arm and mounting assembly 20 (see Figs. 1 and 2) of the conveyor belt machine 10.

As shown in Fig. 15, a surface 80 of the projecting wall portion 74 facing away from the bolt holes 78 and an adjoining surface 82 of the mounting wall portion 76 (located at the side of the projecting wall portion 74 opposite to the side which faces the bolt holes 78) form the L-shaped stepped portion 72 of the holding body 62 to which the L-section backing strip 66 of the assembled scraper element 64 is welded.

In this embodiment of the present invention, a zig zag shaped welded joint 84, as shown in Figs. 10 and 16, is formed along a variable path which follows an outer line (or the outline) of the saw tooth arrangement 73 of the variably projecting wall portion 74. As the path of the zig zag shaped welded joint 84 between the holding body 62 and the scraper element 64 is not linear, the non-linear or variable path of the zig zag shaped welded joint 84 significantly

prolongs the useful life of the scraper 60 compared to the much shorter useful life of the prior art scrapers.

The scraper 60 can remain operational for as long as there is sufficiently strong bonding by at least some parts of the zig zag shaped welded joint 84 between the scraper element 64 and the variably projecting wall portion 74, even though prolonged use may cause progressive and gradual wearing away of parts of both the scraper element 64 and the variably projecting wall portion 74, and of parts of the zig zag shaped welded joint 84 which are closer to the scraping edge 71 of the scraper element 64 than to the mounting wall portion 76.

As well as the zig zag shaped welded joint 84, there is also a linear welded joint 86 formed along the exposed junction of the L-section backing strip 66 and the mounting wall portion 76, as shown in Figs. 11 and 15.

Another conveyor belt scraper or belt cleaner tip 90 according to a more specific second embodiment of the present invention is shown in Figs. 17 and 20. The scraper 90 is of the P-type, but has a modified P-type holding body 92, preferably made of stainless steel, but which may alternatively be made of mild steel or other suitable metal or alloy material, to which is secured the same modified scraper element 64 as used in the H-type scraper 60.

Like features of the identical scraper elements 64 of the P-type scraper 90 and the H-type scraper 60 are identified in the drawings and in the following description by like numerals. Because of the identical structure of the scraper elements 64, and because a suitable brazing process is used to braze the trilay structure securely between the backing strip and the single blade of tungsten carbide to form or assemble the scraper element 64 in a first step of assembling the belt scraper 90, and because the backing strip of the assembled scraper element 64 is then secured to the holding body 92 in a second step of assembling the belt scraper 90 by heating, such as by welding, at a lower temperature, the P-type scraper 90 also experiences (in its manufacture) significantly less distortional forces during contraction from the high temperatures applied in the aforementioned brazing process than are experienced by the prior art scrapers, for the reasons mentioned above with reference to scraper 60.

The P-type holding body 92 also has a saw tooth arrangement 93 which forms a variably projecting wall portion 94 that, in this embodiment, extends longitudinally, or in the same direction, to varying extents of height along its length from a mounting wall portion 96 (as specifically shown in Fig. 17).

Bolts or studs 98 passing through holes in the mounting wall portion 96 connect the scraper 90 to the suspension arm and mounting assembly 22 (see Fig. 2) of the conveyor belt machine 10.

An L-shaped stepped portion 102 is formed on the holding body 92, and an L-section backing strip 66 of the assembled scraper element 64 is welded to the holding body 92 along a variable path which follows an outer line (or the outline) of the saw tooth arrangement 93 to form the aforementioned zig zag shaped welded joint 84. There is also a linear welded joint 86 formed along the exposed junction of the L-section backing strip 66 and the mounting wall portion 96.

The zig zag shaped welded joint 84 of the scraper 90 significantly prolongs the useful life of the scraper 90 compared to the much shorter useful life of the prior art scrapers, for the reasons mentioned above with reference to scraper 60.

Another conveyor belt scraper or belt cleaner tip 110 according to a more specific third embodiment of the present invention is shown in Figs. 18 and 19. The scraper 110 is of the R-type, but has a modified R-type holding body 112, preferably made of stainless steel, but which may alternatively be made of mild steel or other suitable metal or alloy material, to which is secured the same modified scraper element 64 as used in the H-type scraper 60 and the P-type scraper 90.

Like features of the identical scraper elements 64 of the R-type scraper 110 and of the H-type and P-type scrapers 60, 90 are identified in the drawings and in the following description by like numerals. Because of the identical structure of the scraper elements 64, and because a suitable brazing process is used to braze the trilay structure securely between the backing strip and the single blade of tungsten carbide to form or assemble the scraper element 64 in a first step of assembling the belt scraper 110, and because the backing strip of the assembled scraper element 64 is then secured to the holding body 112 in a second step of assembling the belt scraper 110 by heating, such as by welding, at a lower temperature, the R-type scraper 110

also experiences (in its manufacture) significantly less distortional forces during contraction from the high temperatures applied in the aforementioned brazing process than are experienced by the prior art scrapers, for the reasons mentioned above with reference to scrapers 60 and 90.

The R-type holding body 112 also has a saw tooth arrangement 113 which forms a variably projecting wall portion 114 that, in this embodiment, extends longitudinally, or in the same direction, to varying extents of height along its length from a mounting wall portion 116 (as specifically shown in Fig. 18).

Bolts or studs 118 passing through holes in the mounting wall portion 116 connect the scraper 110 to the suspension arm and mounting assembly 24 (see Fig. 2) of the conveyor belt machine 10.

An L-shaped stepped portion 122 is formed on the holding body 112, and an L-section backing strip 66 of the assembled scraper element 64 is welded to the holding body 112 along a variable path which follows an outer line (or the outline) of the saw tooth arrangement 113 to form the aforementioned zig zag shaped welded joint 84. There is also a linear welded joint 86 formed along the exposed junction of the L-section backing strip 66 and the mounting wall portion 116.

The zig zag shaped welded joint 84 of the scraper 110 significantly prolongs the useful life of the scraper 110 compared to the much shorter useful life of the prior art scrapers, for the reasons mentioned above with reference to scrapers 60 and 90.

The prior art HT-type scraper 130 shown in Figs. 21 to 24 is connected to a dedicated suspension arm and mounting assembly 132 (see Fig. 21) of the conveyor belt machine 10.

Like features of the identical conveyor belt machines 10 shown in Fig. 21 and Fig. 2 are identified in the drawings and in the following description by like numerals.

The prior art HT-type scraper 130 has a HT-type holding body 134 to which are secured two scraper elements 136, 138 on opposite sides of the holding body 134.

As more clearly shown in Figs. 22 to 24, the first scraper element 136, which utilizes four pieces or blades 140 of tungsten carbide, initially cleans conveyed material which adheres to the surface on the return side 13 of the belt 11, whereas the second scraper element 138, which also utilizes four pieces or blades 144 of tungsten carbide but is located on the holding body 134 remotely of the belt 11, physically protects the stud 141 and its nut from being damaged by collision with conveyed bulk material falling from the top of the belt 11. Rather than colliding with, and damaging, the stud 141 and its nut, the falling conveyed bulk material collides with the four blades 144 of tungsten carbide of the second scraper element 138. This protection of the stud 141 and its nut prolongs the operational life of the prior art HT-type scraper 130.

The prior art HT-type scraper 130 includes two conventional trilay structures 30 sandwiched between respective stepped portions 146, 148 of the holding body 134 and respective blades 140, 144 of tungsten carbide separated end-to-end by expansion joints 150, 152 for reasons described earlier, and the blades 140, 144 of tungsten carbide are joined to the holding body 134 on opposite sides thereof by a brazing process.

However, such a configuration of the prior art scraper 130 requires that the two opposed scraper elements 136, 138 be separated from each other by an upper extension of the holding body 134, which increases the amount of steel required to construct such a holding body, and therefore significantly increases the cost to manufacture such a scraper 130. The configuration of the prior art scraper 130 also requires brazing to occur on opposite sides of the holding body 134, which increases the complexity and difficulty of the brazing process and further increases the manufacturing cost of such a scraper 130.

Another conveyor belt scraper or belt cleaner tip 160 according to a more specific fourth embodiment of the present invention is shown in Figs. 25 to 27. The scraper 160 is of the HT-type, but has a modified HT-type holding body 162, preferably made of stainless steel, but which may alternatively be made of mild steel or other suitable metal or alloy material, to which is secured a modified scraper element 164 of a different structure to that used in the H-type scraper 60, the P-type scraper 90 and the R-type scraper 110.

The scraper element 164, as more clearly shown in Fig. 27, includes a central planar or flat-section trilay structure 166 used in brazing processes, and preferably made of conventional filler material, a thin planar or flat-section backing strip 168 or plate, preferably made of stainless steel, but which may alternatively be made of mild steel or other suitable metal or alloy material, on one side of the trilay structure 166, and a single piece or blade 170 of tungsten carbide which provides both a scraping edge 171 on one side of the trilay structure 166 and a physical protection edge 172 for the stud 174 and its nut on the other side of the trilay structure 166.

The flat-section backing strip 168 is joined along at least one first surface thereof to the holding body 162. The flat-section backing strip 168 is also joined along at least one opposite second surface thereof to the single piece 170 of tungsten carbide via the trilay structure 166.

A suitable brazing process is used to braze the flat-section trilay structure 166 securely between the flat-section backing strip 168 and the single piece 170 of tungsten carbide to form or assemble the scraper element 164 in a first step of assembling the belt scraper 160. In this embodiment, an induction brazing process is used to melt the filler material of the trilay structure 166 so that it flows and effectively joins the single blade 170 of tungsten carbide to the holding body 162. Although induction brazing has been used in this embodiment of the invention, other suitable techniques of brazing may alternatively be used, such as silver brazing, which is sometimes known as hard soldering.

As is well known to persons skilled in this art, for the flat-section trilay structure 166 to form a brazed joint between two metal or metal alloy surfaces, the trilay structure must comprise a filler material having a lower melting point than the two surfaces being joined. For example, a metal filler material having two outer strips (or layers) comprising predominantly of silver with lower concentrations of other common filler metals, such as zinc, nickel, manganese and optionally cadmium, clad onto a core strip of copper, can be used. The filler material will become molten when sufficiently heated by electromagnetic induction and then flow by capillary action to bond together the two surfaces to form the joint when cooled.

The flat-section backing strip 168 of the assembled scraper element 164 is then secured to a flat top surface of the holding body 162, in a second step of assembling the belt scraper 160,

by a suitable welding process, such as laser welding, or possibly by plasma welding, or by traditional TIG welding or MIG welding, or by a suitable fastening process which utilizes mechanical fasteners or other connecting devices.

The use, in this embodiment, of an induction brazing process as a first step to assemble the scraper element 164 before the assembled scraper element 164 is secured to the holding body 162 in a second step, coupled with the use of the backing strip 168 in the induction brazing process, results in the scraper element 164, and particularly the single blade 170 of tungsten carbide included in the scraper element 164, experiencing significantly less distortional forces during contraction from the high temperatures applied in the aforementioned induction brazing process than are experienced by the scraper elements of the prior art scrapers. Without wishing to be bound by theory, this may be primarily attributable to the use of the backing strip 168 to which the single blade 170 of tungsten carbide is brazed, and which is made of the same, or similar, material (especially in its thermal properties) as that of the holding body 162. Those features enable the facing surfaces of the backing strip 168 and the holding body 162 to be joined in the second step by heating, such as by welding, at a lower temperature than that which is used in the prior art, where there is no use of a backing strip, and where the higher temperature process of brazing is used to join the plurality of tungsten carbide blades to the holding body via the trilay structure to form or assemble the prior art belt scraper in a single step.

The HT-type holding body 162 has a wave surface arrangement 180 which forms a variably projecting wall portion 182 that, in this embodiment, extends perpendicularly to varying extents of height along its length from a larger mounting wall portion 184 (as specifically shown in Fig. 26).

Bolts or studs 174 passing through holes in the mounting wall portion 184 connect the scraper 160 to the suspension arm and mounting assembly 132 (see Fig. 21) of the conveyor belt machine 10.

In this embodiment of the present invention, and unlike the holding bodies 62, 92, 112 of the scrapers 60, 90, 110, respectively, the holding body 162 of scraper 160 does not have an L-shaped stepped portion. The flat-section backing strip 168 of the assembled scraper element

164 is positioned flat on the adjoining top surfaces of the variably projecting wall portion 182 and mounting wall portion 184 of the holding body 162, and is welded thereto along a variable path which follows an outer line (or the outline) of the wave surface arrangement 180 of the variably projecting wall portion 182 to form a wave surface shaped welded joint 186. As the path of the wave surface shaped welded joint 186 between the holding body 162 and the scraper element 164 is not linear, the non-linear or variable path of the wave surface shaped welded joint 186 significantly prolongs the useful life of the scraper 160 compared to the much shorter useful life of the prior art scrapers.

As well as the wave surface shaped welded joint 186, there is also a linear welded joint 188 formed along the exposed junction of the flat-section backing strip 168 and the top of the mounting wall portion 184 of the holding body 162, as shown in Fig. 27.

The scraper 160 can remain operational for as long as there is sufficiently strong bonding by at least some parts of the wave surface shaped welded joint 186 between the scraper element 164 and the variably projecting wall portion 182, even though prolonged use may cause progressive and gradual wearing away of parts of both the scraper element 164 and the variably projecting wall portion 182, and of parts of the wave surface shaped welded joint 186 which are closer to the scraping edge 171 of the scraper element 164 than to the mounting wall portion 184.

The holding bodies 62, 92, 112, 162 of the preferred belt scrapers of the present invention may be made, as alternatives to stainless steel or mild steel, of any suitable metal or alloy material, so long as this material is compatible and at least substantially similar in its thermal properties, for reasons apparent from the above description, with the material from which the backing strip is made, which may also be alternatively made of any suitable metal or alloy material.

The welded joints 84, 186 may, in other suitable embodiments of the present invention, take different shapes, forms and configurations, depending on the structure or shape of the projecting wall portion. For example, the projecting wall portion may include one or more holes (of any suitable shape), and along the or each inner edge of such holes may be formed a welded joint between the backing strip of the assembled scraper element and the projecting wall portion of the holding body. Also, the outer profile structure (or projecting edge shape) of

the projecting wall portion, rather than being a saw tooth arrangement 113 or a wave surface arrangement 180, may be a castellated arrangement, or any other suitable outer profile structure or shape.

The present invention may be applicable to many types of conveyor belt scraper, not only to the H, R, P and HT-types described above, but also to Y, HEL and HMLL-types of scrapers, or any other suitable scraper types.

When it is desired to use an L-section backing strip, rather than a flat-section backing strip or other configuration of backing strip, the scrapers of the present invention do not always require an L-shaped stepped portion to be formed in the holding body thereof. This is because the L-section backing strip itself provides an L-shaped stepped portion when one of the two outer flat sides of the L-section backing strip is secured to a flat surface region of a mounting wall portion, or to a flat surface region of a projecting wall portion positioned at an end of a mounting wall portion. For scrapers of this type, it is still necessary that there is sufficiently strong bonding by at least some parts of the welded joint between the scraper element and the selected flat surface region of the wall portion to ensure the scraper remains operational during prolonged use.

In addition to the advantages mentioned above which stem from the present invention, a significant further advantage is that only a single piece or blade of tungsten carbide is necessary to create an assembled scraper element which extends substantially the length of the holding body of the scraper, and that this contributes to a significant saving of time, labour and cost in the manufacture of such scrapers.

It will also be readily appreciated by persons skilled in this art, upon reading this description of embodiments of the invention, that there may be alternative embodiments of conveyor belt scrapers which fall within the scope of the present invention. The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgement or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates before the filing date of this patent application.

CLAIMS:

1. A scraper for a belt of a conveyor belt machine, the scraper comprising:

(a) a holding body made of a first metal or alloy material and having a length, the holding body being adapted for connecting to a mounting assembly of the conveyor belt machine, and

(b) a scraper element joined to the holding body and adapted for scraping from the belt any conveyed material which has adhered to the belt, the scraper element comprising a single tungsten carbide blade having a length which extends substantially the length of the holding body, the single tungsten carbide blade being joined by brazing to a backing strip made of a second metal or alloy material which is the same or similar in its thermal properties to the first metal or alloy material of the holding body, whereupon the backing strip of the so assembled scraper element is then joined to the holding body, such that the single tungsten carbide blade extends substantially the length of the holding body.

2. The scraper of claim 1, wherein the holding body comprises a variably projecting wall portion to which the backing strip of the scraper element is joined, wherein the variably projecting wall portion extends to varying extents of height along its length from a mounting wall portion, and a welded joint is formed along a variable path which follows an outer line of the variably projecting wall portion.

3. The scraper of claim 1, wherein the backing strip is an L-section backing strip.

4. The scraper of claim 1, wherein the backing strip is a flat-section backing strip.

5. The scraper of claim 2, wherein the variably projecting wall portion is a saw tooth arrangement.

6. The scraper of claim 5, wherein the welded joint is a zig zag shaped welded joint.

7. The scraper of claim 2, wherein the variably projecting wall portion is a wave surface arrangement.

8. The scraper of claim 7, wherein the welded joint is a wave surface shaped welded joint.

9. The scraper of claim 1, wherein the first metal or alloy material is selected from stainless steel or mild steel.

10. The scraper of claim 1, wherein the second metal or alloy material is selected from stainless steel or mild steel.

11. The scraper of claim 1, wherein the backing strip is joined to the holding body by welding.

12. The scraper of claim 1, wherein the single tungsten carbide blade is joined to the backing strip by induction brazing.

13. The scraper of claim 1, wherein a metal filler material is utilized for the brazing.

14. The scraper of claim 13, wherein the metal filler material is a silver-based filler material.

15. The scraper of claim 14, wherein the silver-based filler material is in the form of a trilay structure.

16. A method of assembling a scraper for a belt of a conveyor belt machine, the method comprising the steps of:

(a) providing a holding body made of a first metal or alloy material and having a length,

(b) providing a single tungsten carbide blade having a length which extends substantially the length of the holding body,

(c) providing a backing strip made of a second metal or alloy material which is the same or similar in its thermal properties to the first metal or alloy material of the holding body,

(d) brazing the single tungsten carbide blade to the backing strip to form an assembled scraper element, and

(e) joining the assembled scraper element to the holding body, such that the single tungsten carbide blade extends substantially the length of the holding body.

17. The method of claim 16, wherein the brazing of the single tungsten carbide blade to the backing strip is by induction brazing.

18. The method of claim 16, wherein the joining of the assembled scraper element to the holding body is by welding.

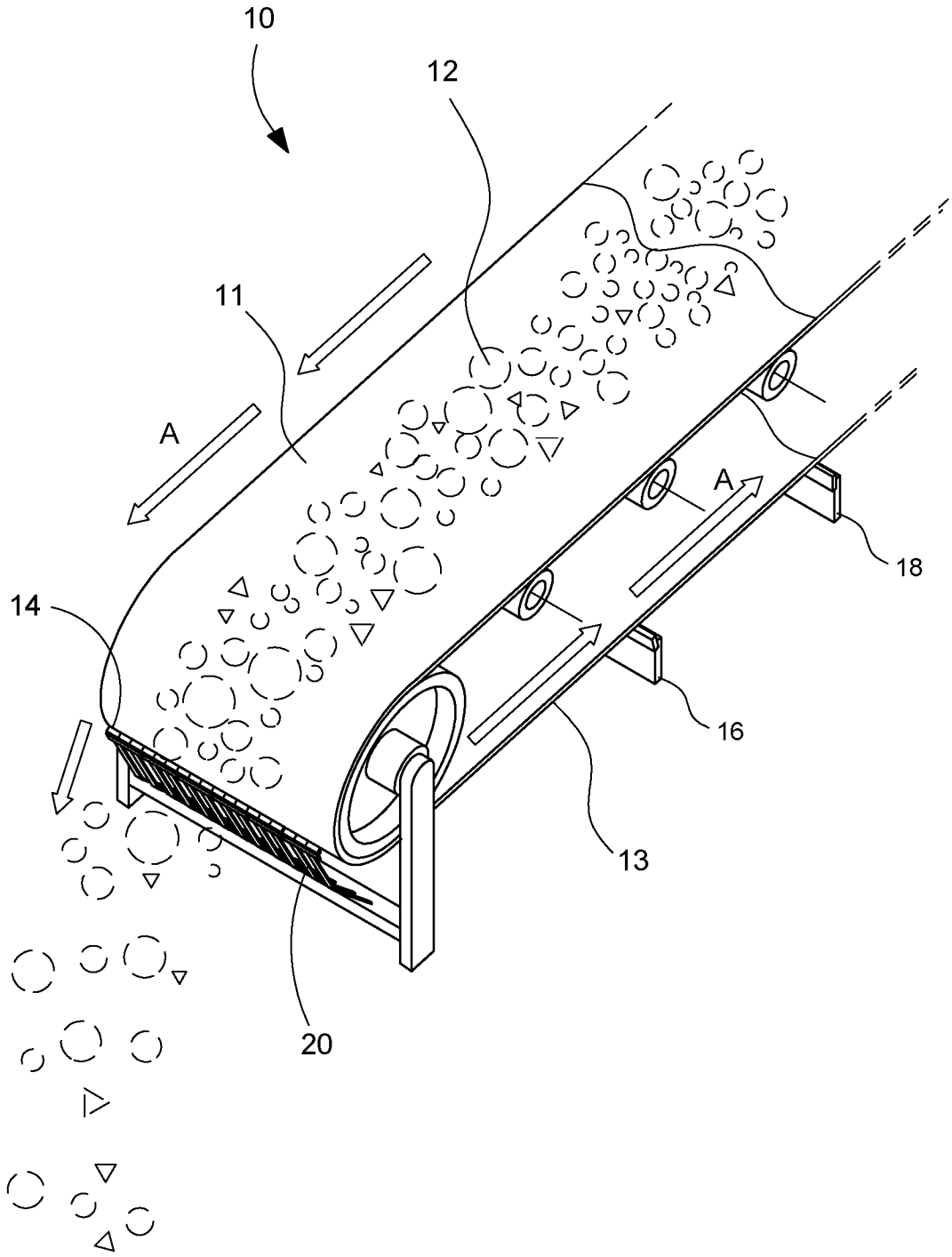


Fig. 1

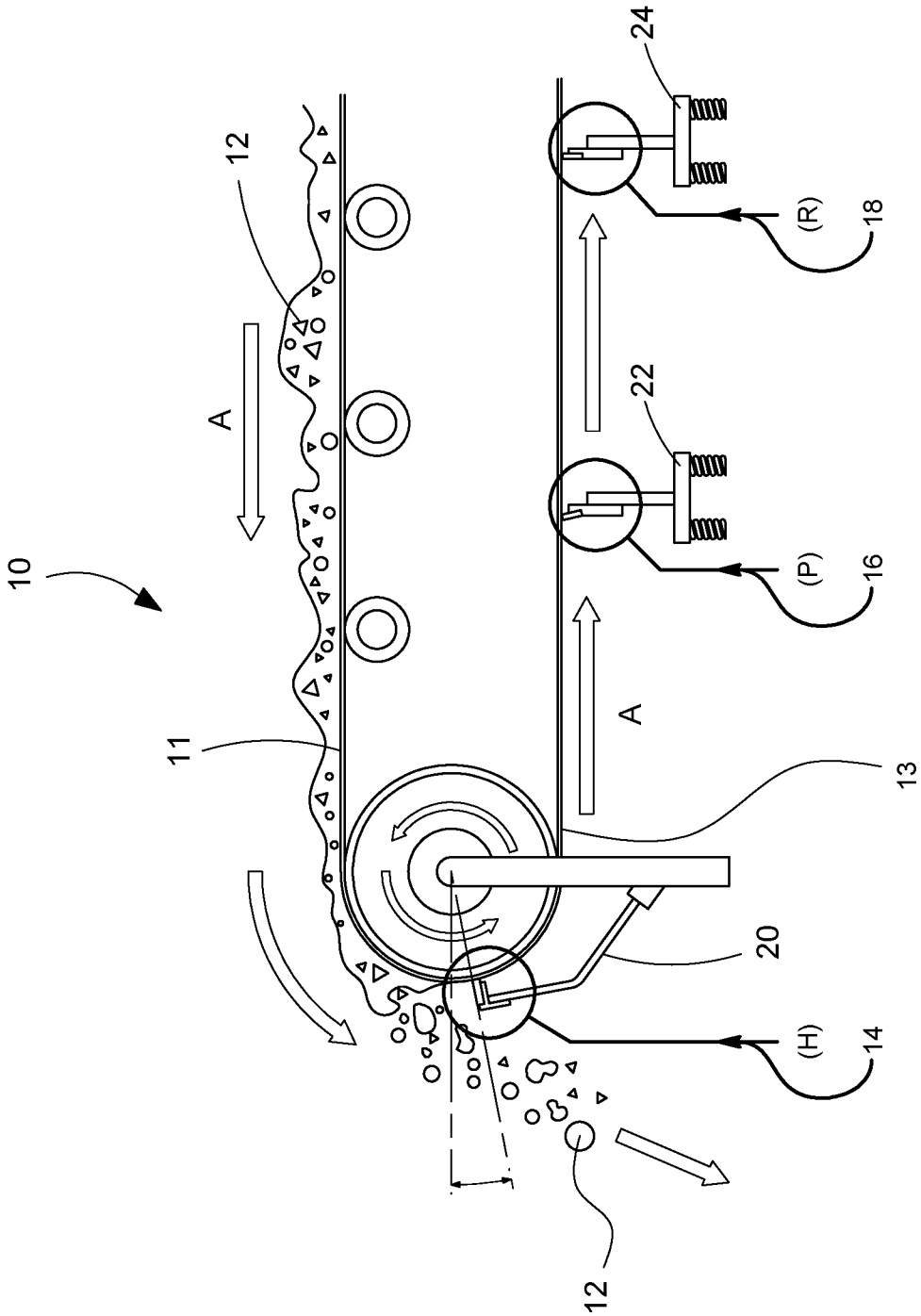


Fig. 2

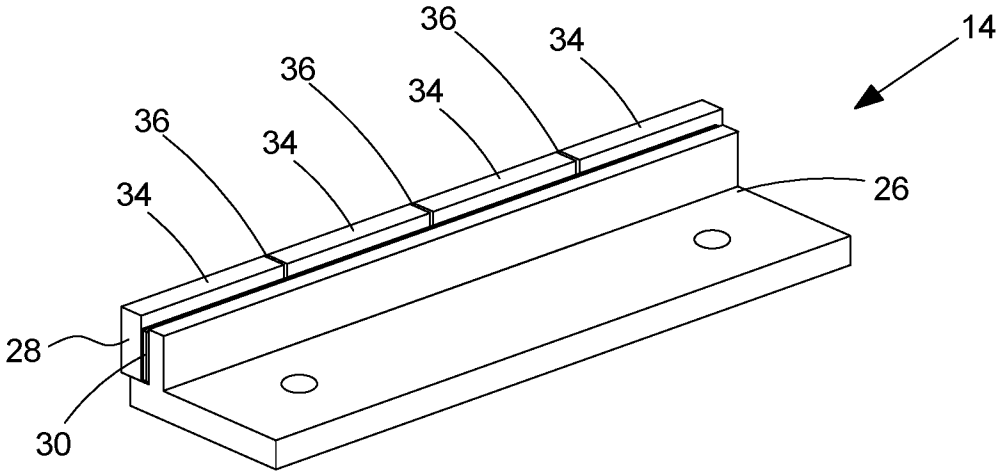


Fig. 3

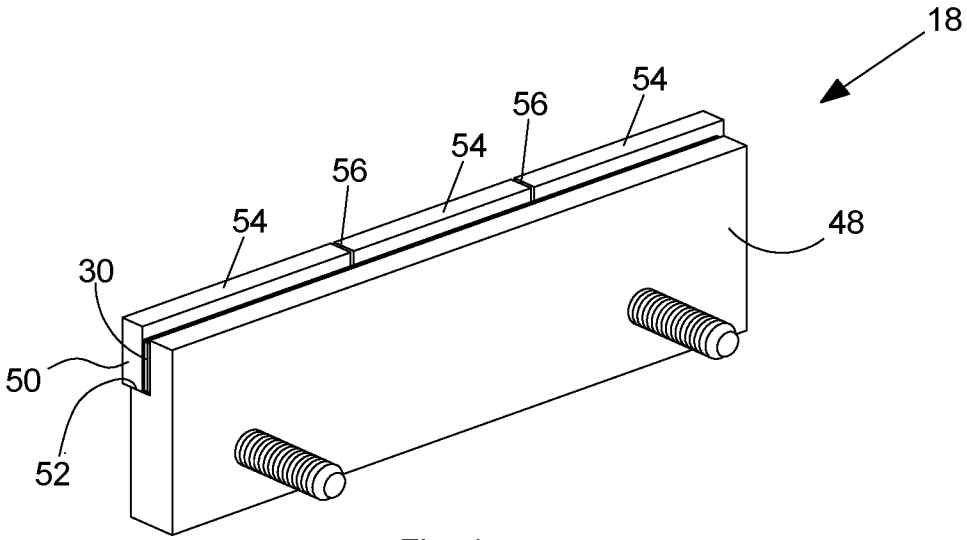


Fig. 4

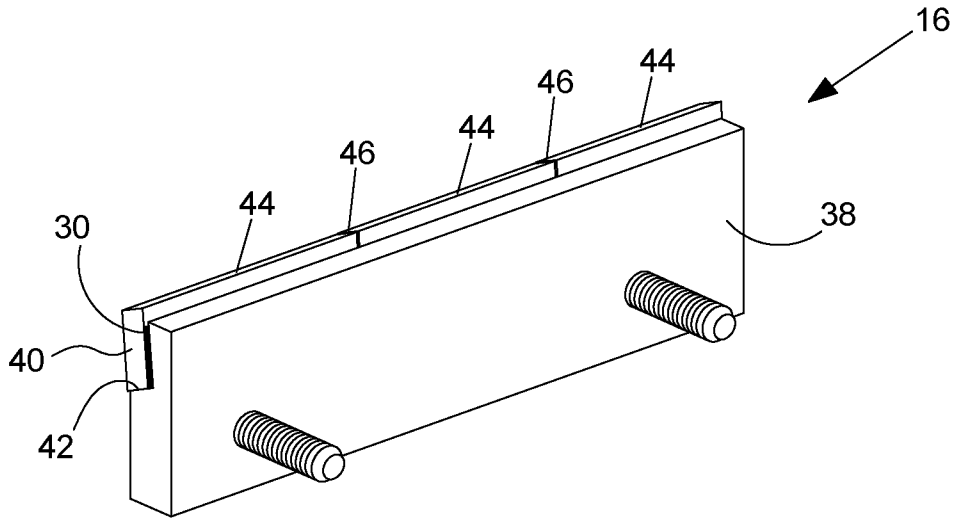


Fig. 5

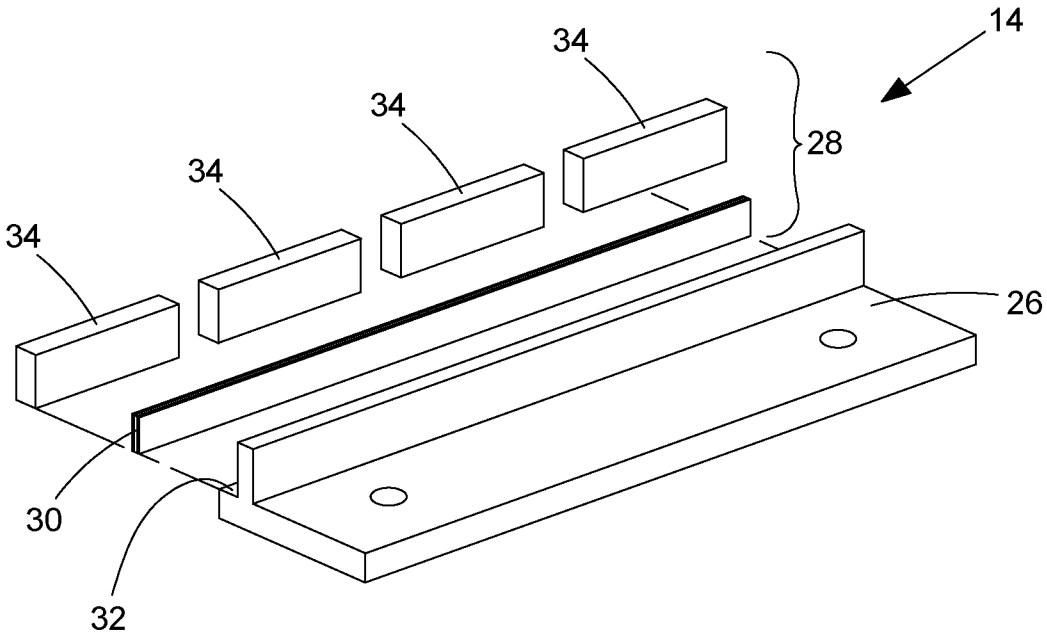


Fig. 6

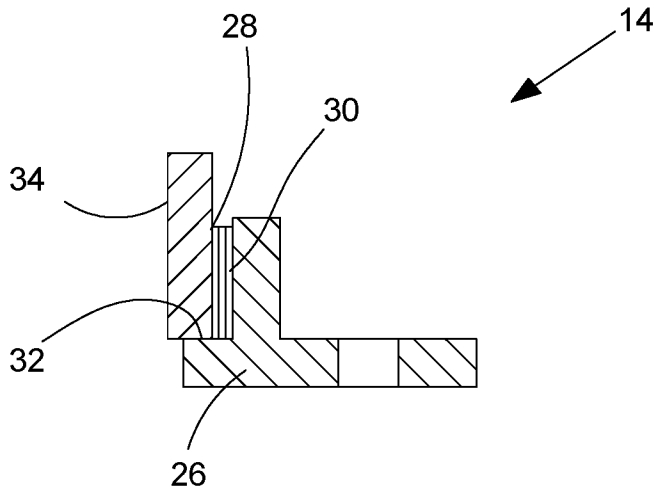


Fig. 7

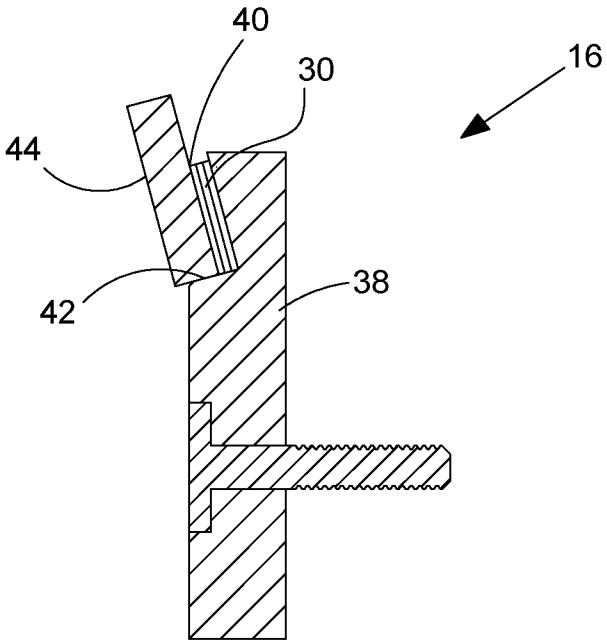


Fig. 8

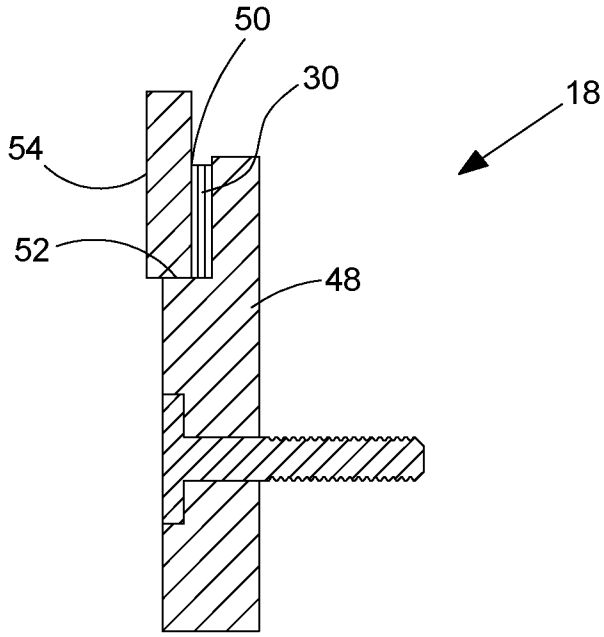


Fig. 9

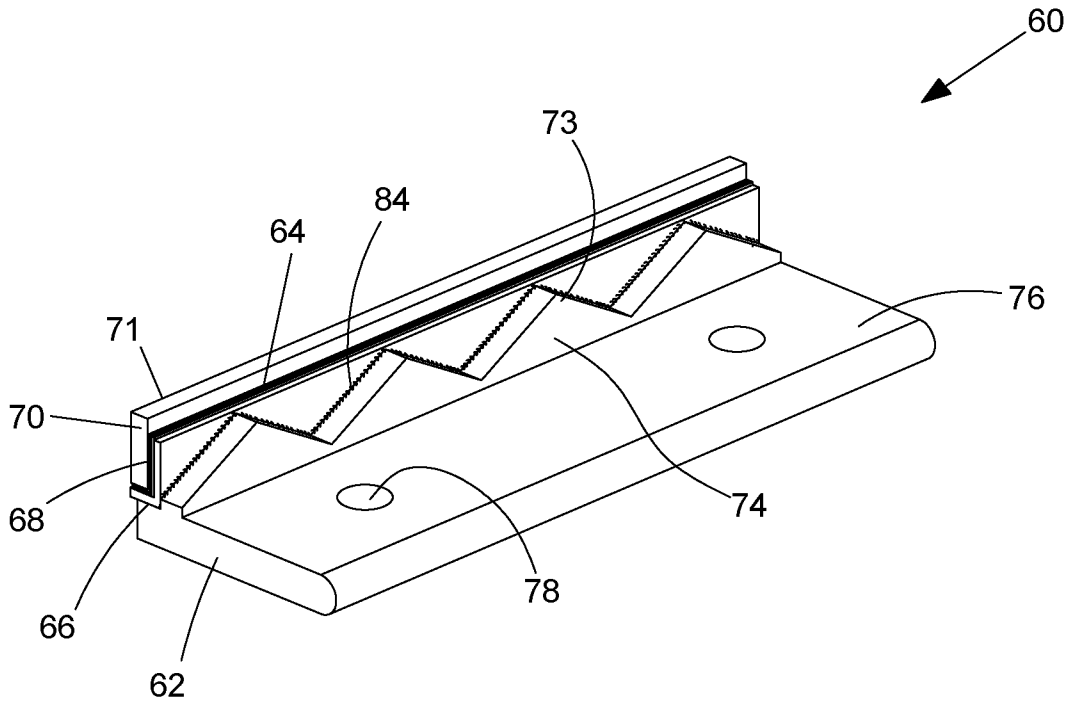


Fig. 10

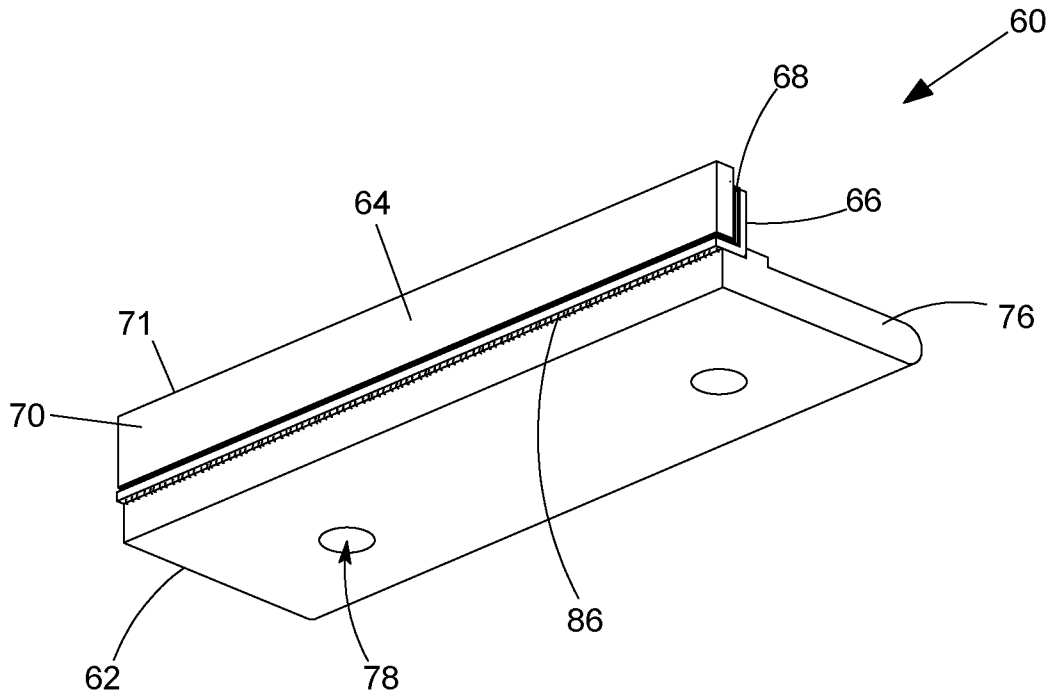


Fig. 11

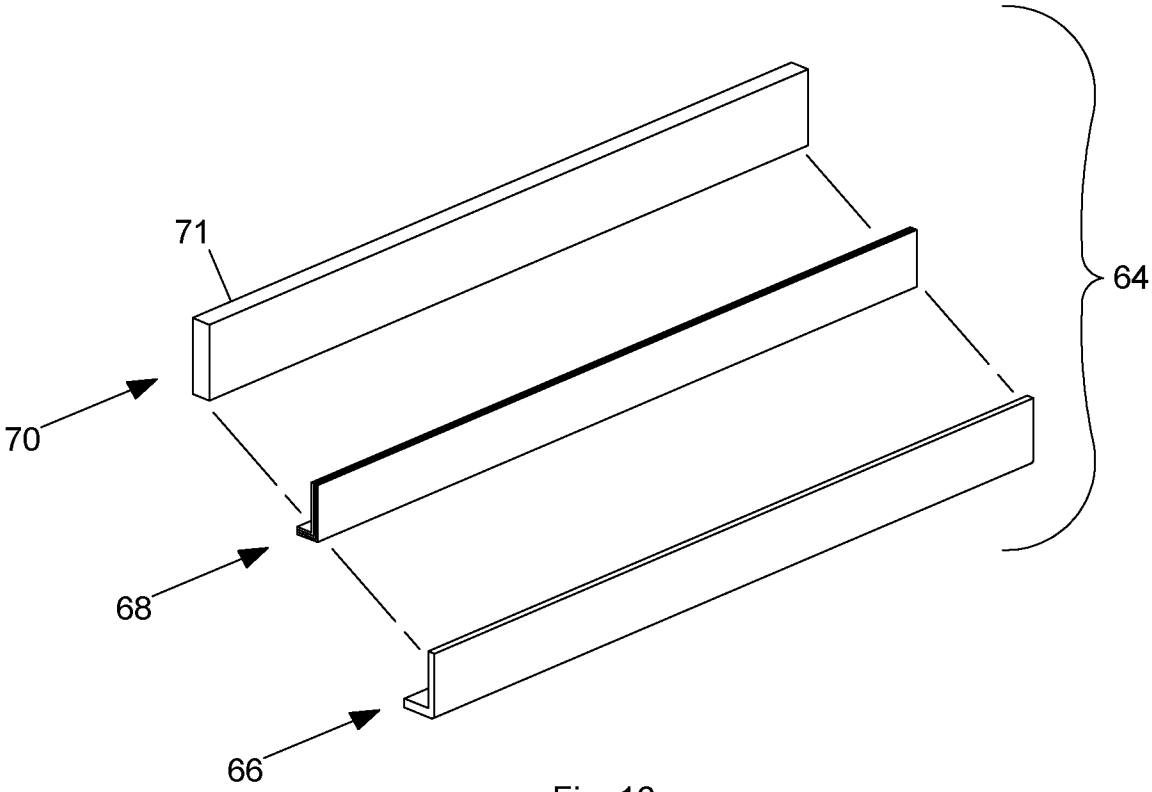


Fig. 12

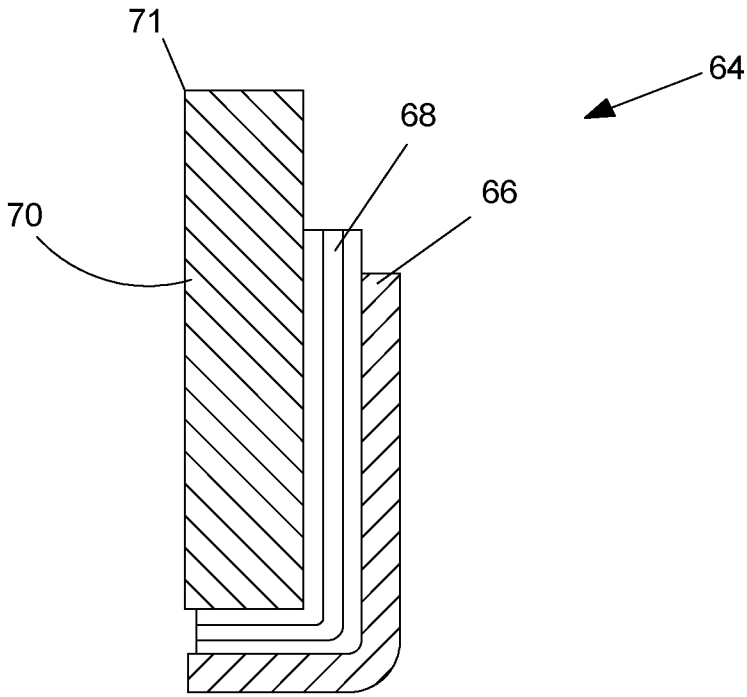


Fig. 13

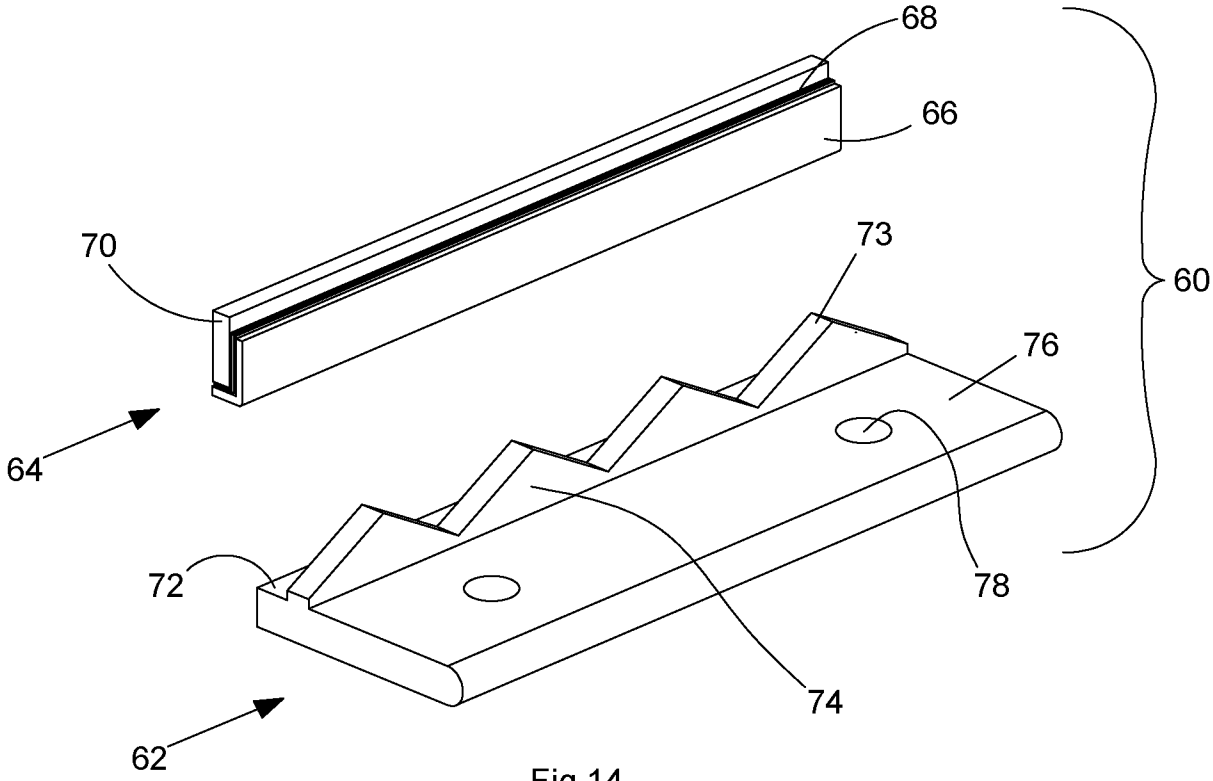

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Fig.14

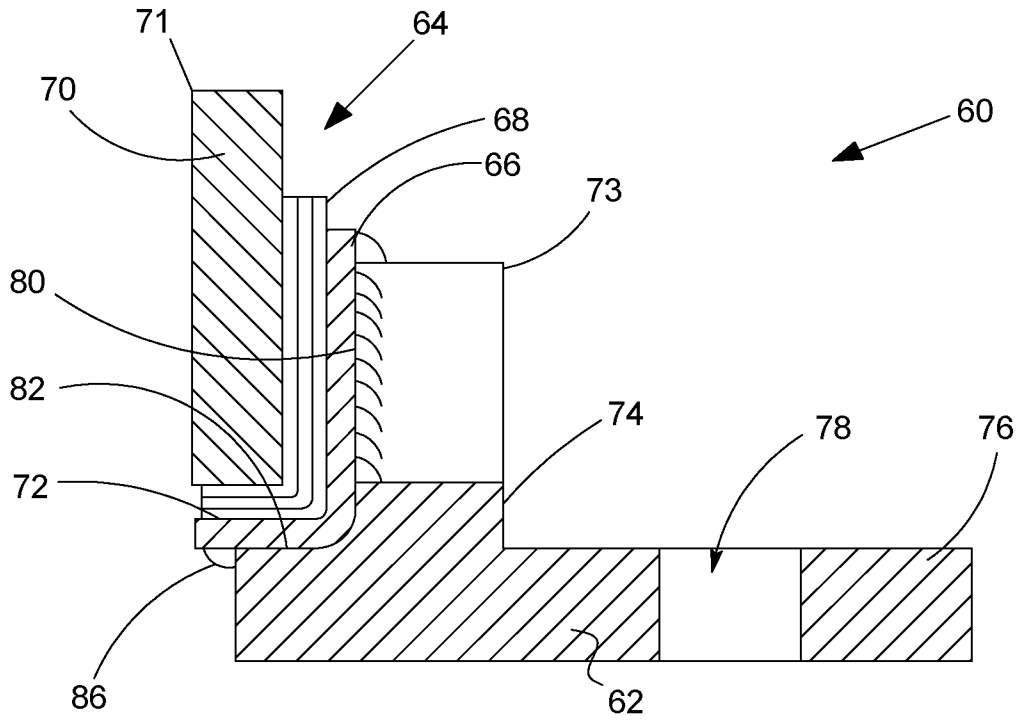

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Fig. 15

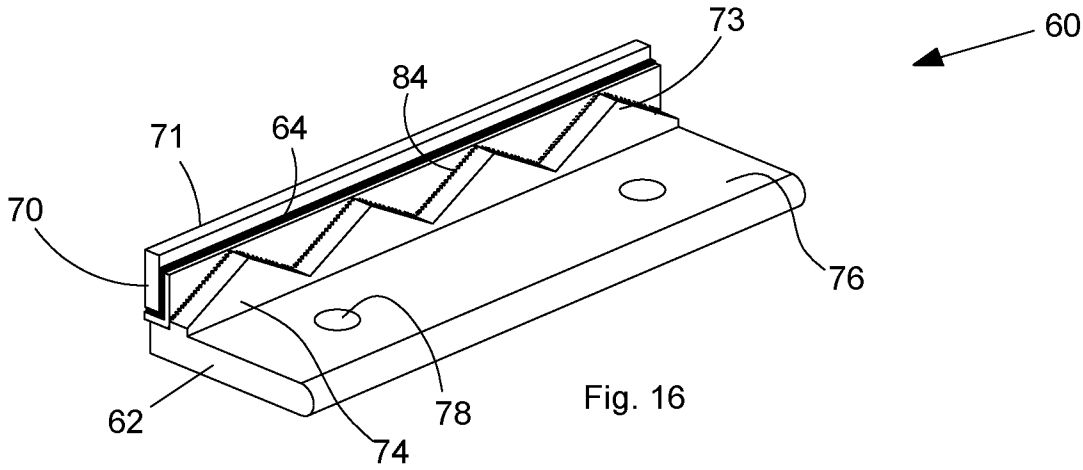


Fig. 16

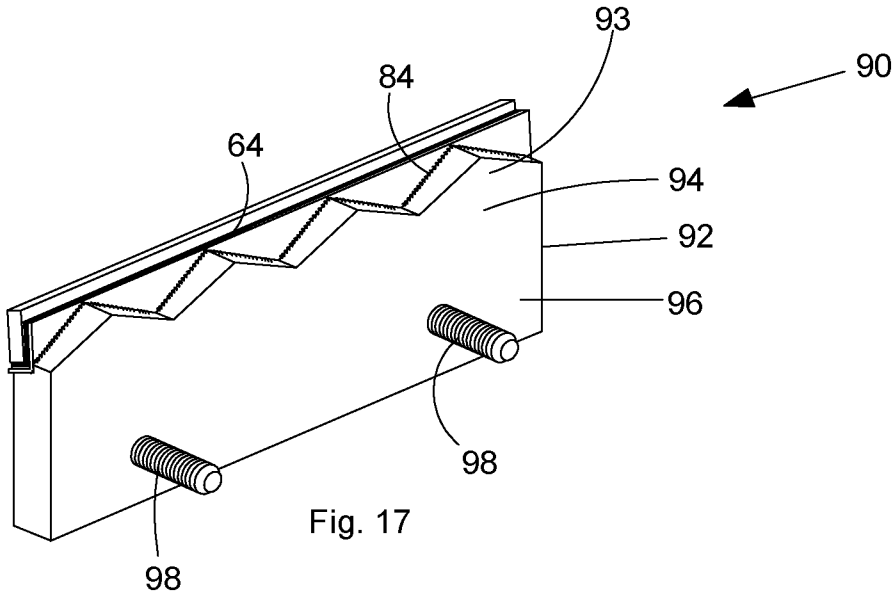


Fig. 17

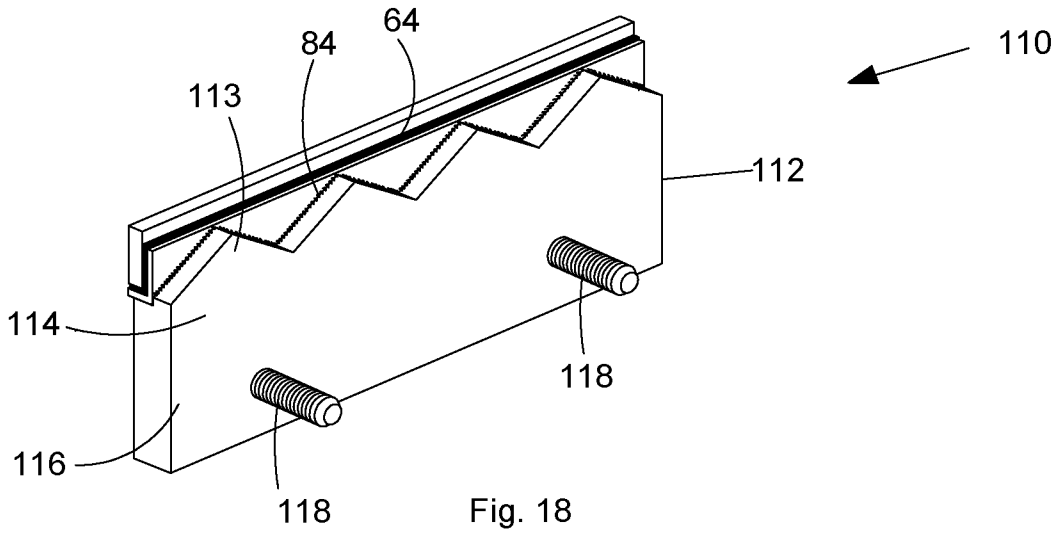


Fig. 18

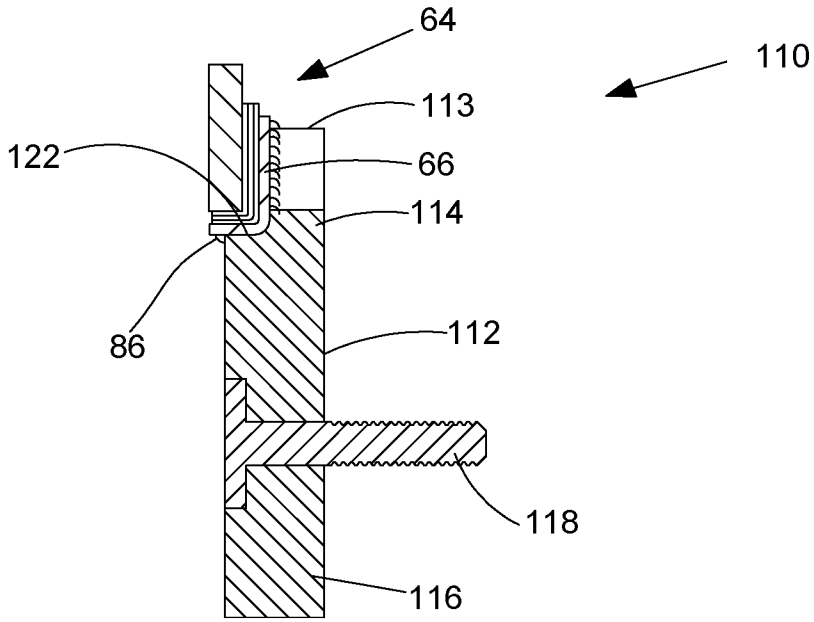


Fig. 19

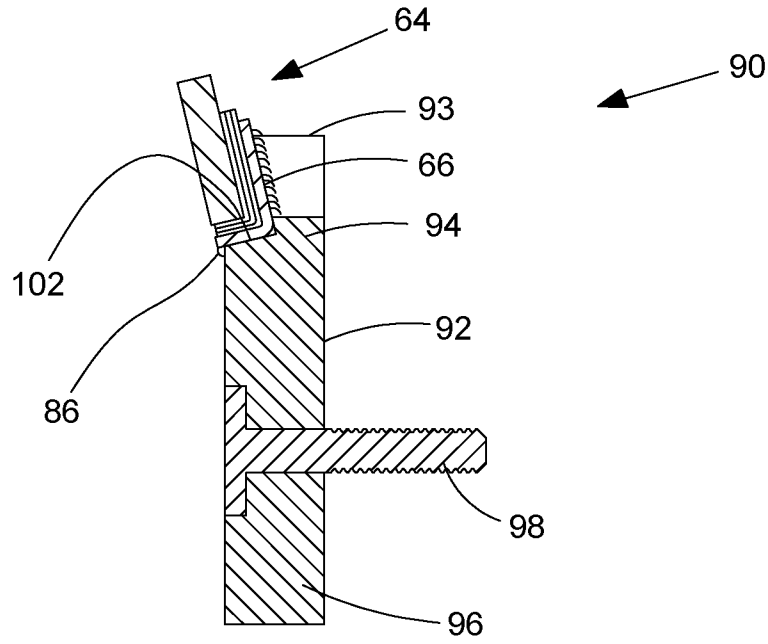


Fig. 20

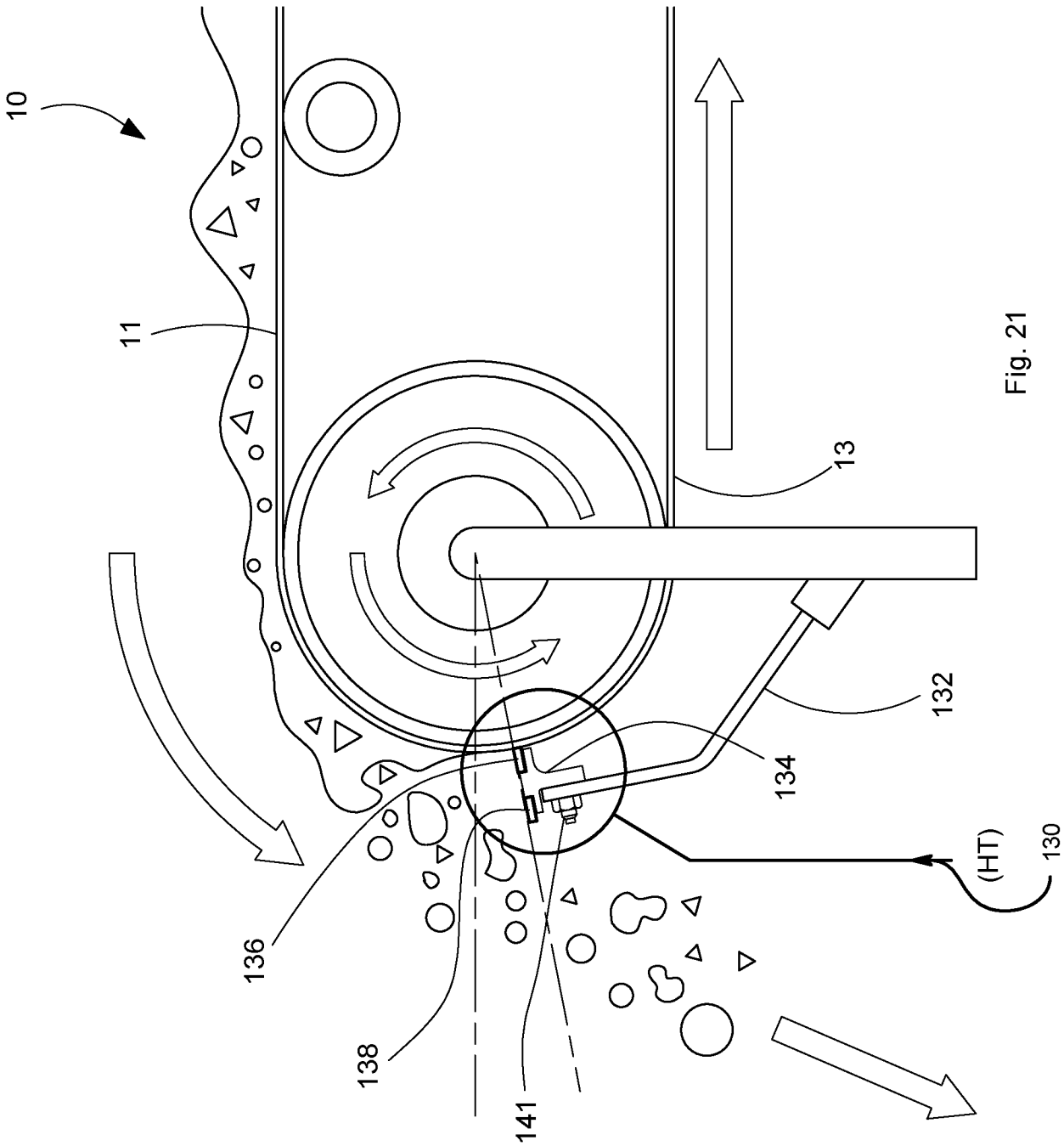


Fig. 21

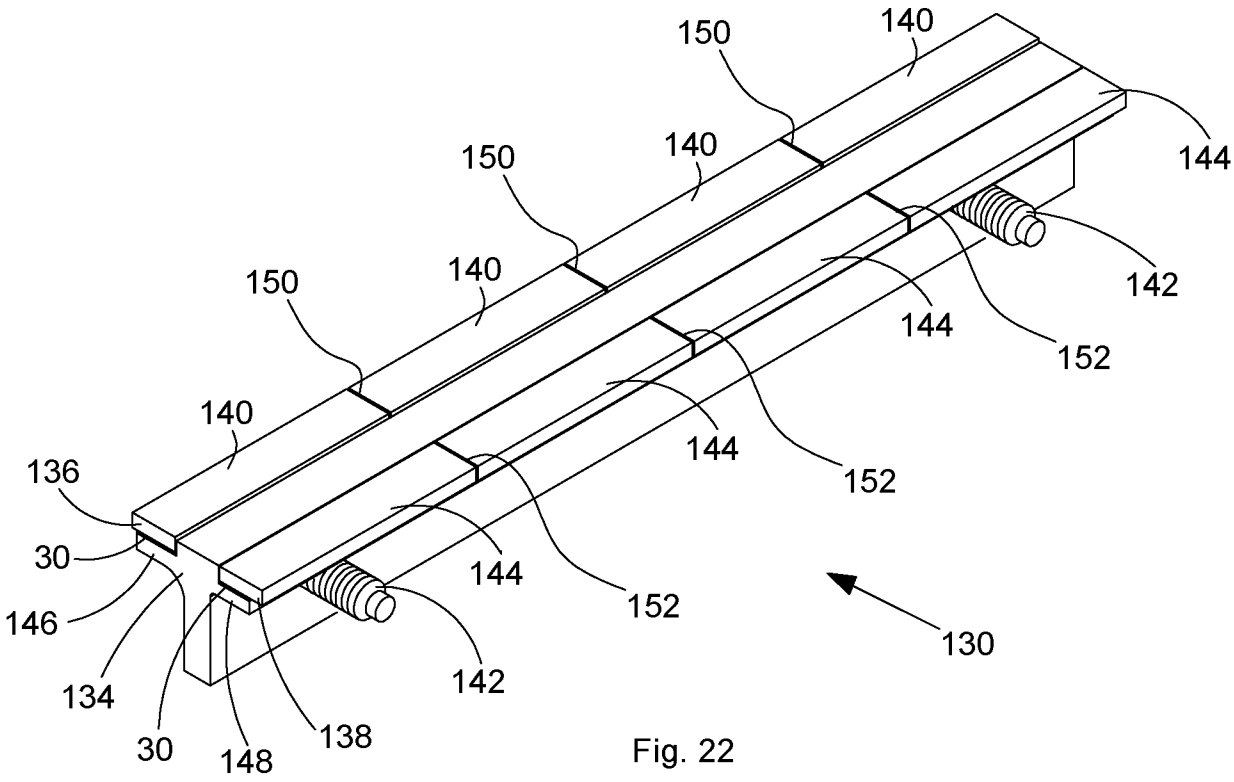

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Fig. 22

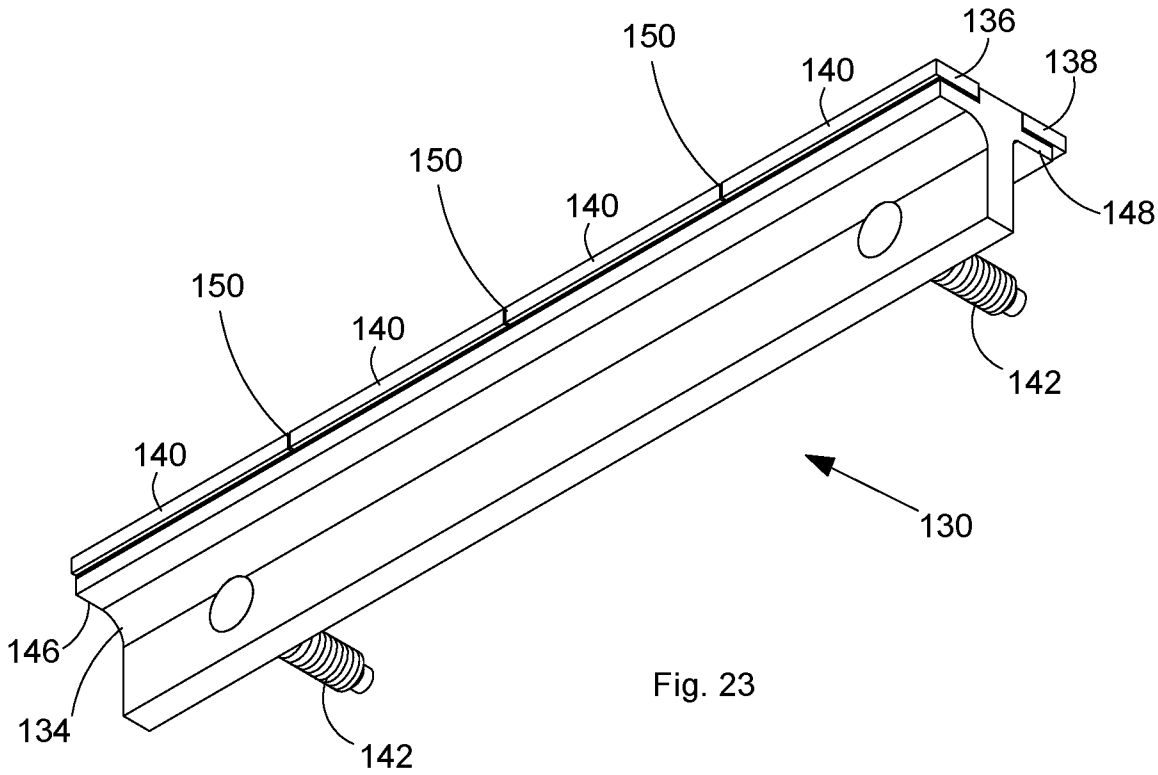

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Fig. 23

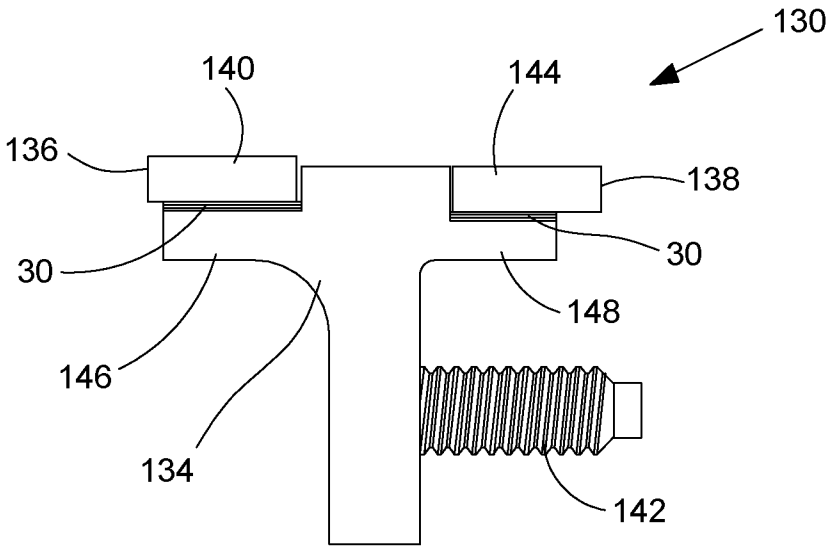

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Fig. 24

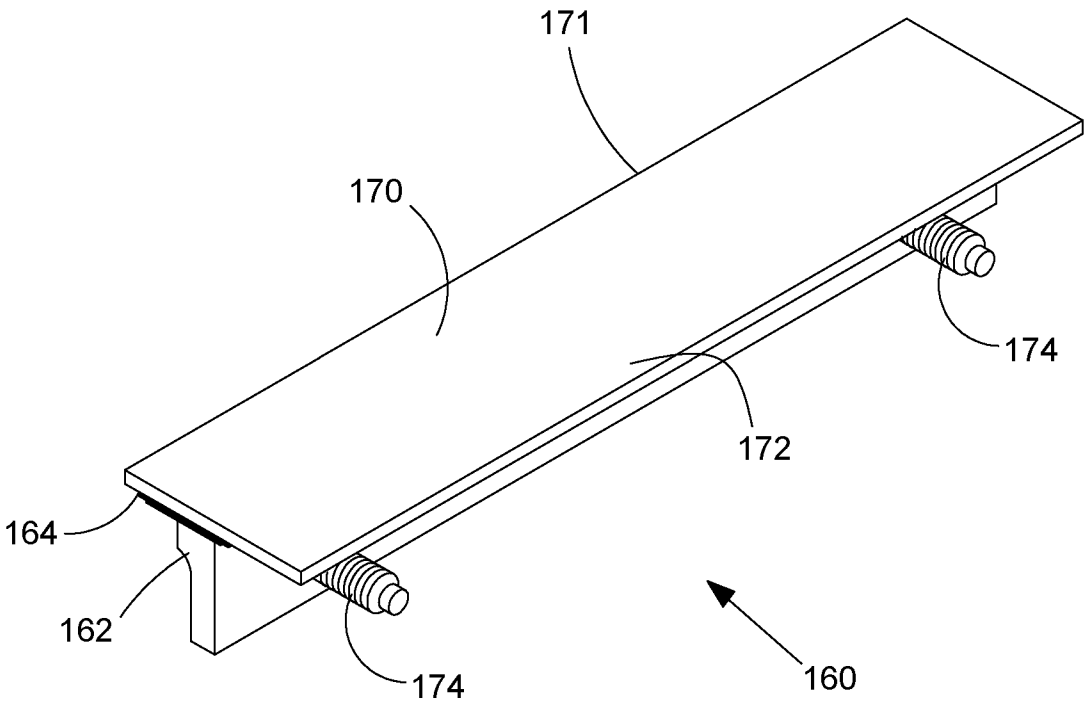

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Fig. 25

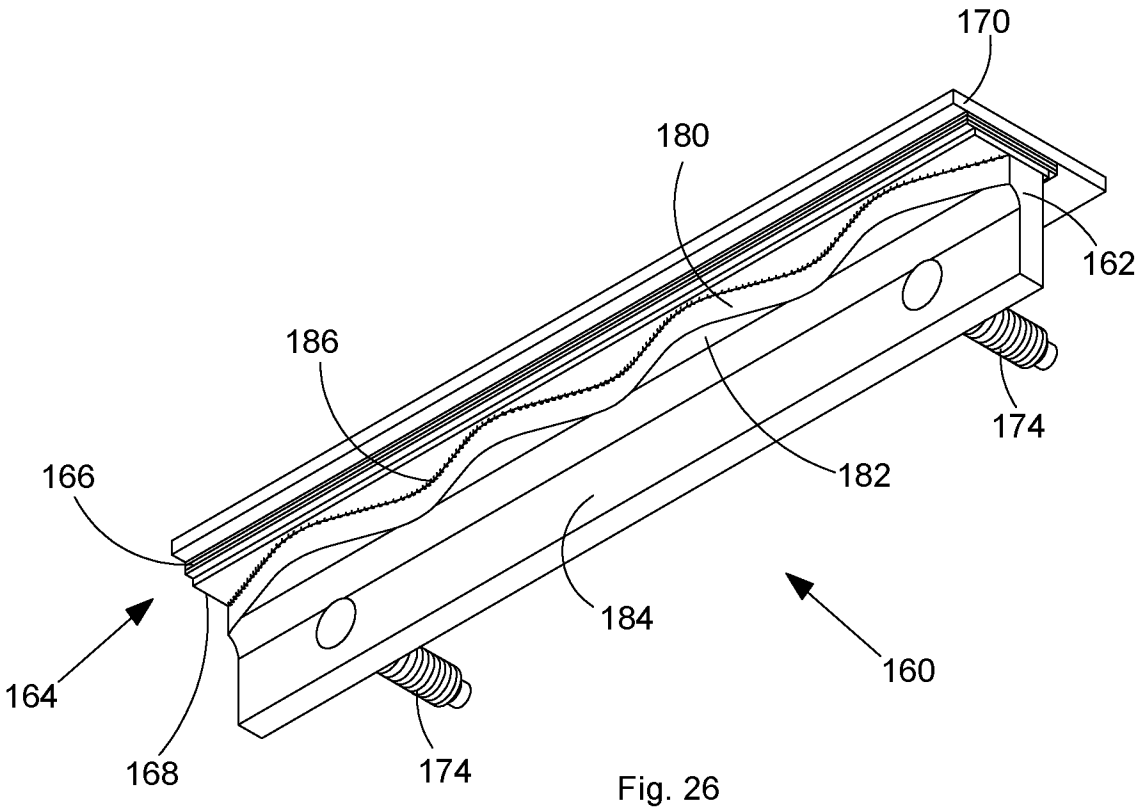

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Fig. 26

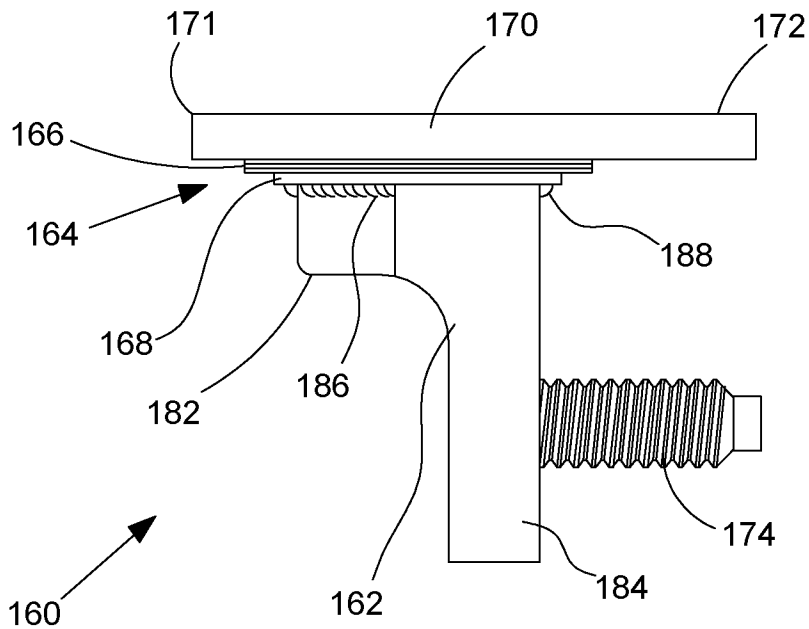

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Fig. 27

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2024/050755

A. CLASSIFICATION OF SUBJECT MATTER

B65G 45/12 (2006.01) B23K 31/02 (2006.01) B23K 33/00 (2006.01) B23K 101/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PATENW, CPC/IPC: B65G45/12, B23K2103/18, B23K31/025 and keywords: different, dissimilar, metal, thermal, expand, coefficient, weld, brazing, tungsten, avoid, prevent, minimise, distort, stress, strain, scraper, blade, cleaner, transition, tri-metal, tri-layer, assembly, silver based, filler, strip, backing, layer, holder, support, frame, property, character, same, similar, zig-zag, wave, saw, tooth, teeth, undulate, infuse, join, conveyor, carbide. Google patents searched, keywords: conveyor, belt, tungsten, weld. Espacenet, keywords: conveyor, belt, scraper, carbide. Applicant/inventor names searched in Google patents and Espacenet. Citing/cited documents of relevant prior art viewed in Epoque.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 September 2024	25 September 2024

Name and mailing address of the ISA/AU

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PO BOX 200, WODEN ACT 2606, AUSTRALIA
Email address: pct@ipaustralia.gov.au

Authorised officer

Damir Budinski
AUSTRALIAN PATENT OFFICE
(ISO 9001 Quality Certified Service)
Telephone No. +61 2 6283 2948

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation).	DOCUMENTS CONSIDERED TO BE RELEVANT	**PCT/AU2024/050755**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	AU 2019100239 A4 (DA GAMA INDUSTRIES PTY LTD) 18 April 2019 abstract, fig. 1-3	1-18
A	AU 2019101370 A4 (PILBARA CONVEYOR SUPPLIES PTY LTD) 12 December 2019 abstract, fig. 3, 8	1-18
A	CN 115108277 A (ANHUI GEBADI INTELLIGENT EQUIPMENT CO LTD) 27 September 2022 abstract, fig. 4	1-18

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2024/050755**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
AU 2019100239 A4	18 April 2019		
AU 2019101370 A4	12 December 2019	AU 2020257161 A1	13 May 2021
CN 115108277 A	27 September 2022	CN 115108277 A	27 Sep 2022

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.