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(54) **APPARATUS FOR FORMING LEAK DETECTABLE GEOMEMBRANE LINERS**

VORRICHTUNG ZUR FORMUNG VON GEOMEMBRAN-EINSATZSTÜCKEN MIT
UNDICHTIGKEITSERKENNUNG

APPAREIL DE FORMATION DE REVÊTEMENTS DE GÉOMEMBRANE À DÉTECTION DE FUITES

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to geomembrane liners, and more specifically to geomembrane liners facilitating detection of leaks therein.

BACKGROUND OF THE INVENTION

[0002] Lining systems for containment systems (e.g., systems which contain bodies of water such as ponds) and the like are used to provide an "impermeable" barrier between contaminants and the underlying ground. Generally, these liners are made of insulating material (such as high density polyethylene) which, even if thoroughly tested to be defect free when shipped, can be damaged during shipping and/or installation by, for example, heavy equipment, cutting tools, welding equipment, animals, and vandalism, necessitating that a final leak check be conducted after the liner is installed to locate leaks caused by any such damage. The liner can also be damaged after it is covered by soil and/or liquid, including during its service life as a result, for example, of stones, rocks and/or settlement. Detecting such leaks is important, particularly where hazardous materials are involved, as holes as small as 1.0 millimeter in diameter may cause leaks on the order of a couple of gallons per day with one foot of water pressure.

[0003] Electrical leak location has heretofore been used which involves placing an electrical potential across a geomembrane and then locate the points of anomalous potential distribution where electrical current flows through leaks in the geomembrane. The electrical potential is typically applied utilizing a power supply with the positive electrode submerged in water or a soil layer above the geomembrane, and the negative electrode connected to the soil layer below. When there are leaks, electrical current flows through the leaks, which produces high current density and a localized anomaly in the potential distribution in the material above the geomembrane. Electrical measurements are made to locate those areas of anomalous signal at the leaks. ASTM D7002 and D7007, for example, include details pertaining to such tests. Such measurements have been made using a dipole or pole measurement configuration (though various types of data acquisition equipment can be used), with point by point measurements commonly made using either dipole or pole measurements along parallel lines on a grid pattern.

[0004] In one such method of electrically detecting liner leaks, for example, a potential is induced across the thickness of a liner. If a potential of one polarity is induced on one side of the sheet and a potential of the opposite polarity is induced on the opposite side of the sheet, the resulting electrical field will be affected if there is any conductivity from side to side across the sheet, with the effects on the conduction monitored to detect the pre-

sence of a leak. Such a detecting method requires an electrically conductive media both above and below the liner, which can be provided by liquid or soil above the liner and good electrical contact with a conductive underlying soil.

[0005] However, in some installations, electrically detecting leaks in the above described manner is unreliable. For example, if the liner is not maintained in good electrical contact with the earth (due to, e.g., use of double liners or other insulating materials, irregularities in the subgrade, and/or wrinkles in the liner) and/or the earth under the geomembrane is dry or not conductive or highly resistant (e.g., in a landfill or with a mining heap leach pad, secondary containment, or coal ash containment), reliable measurements of potential may not be obtained. Similarly, in some landfills, there is leak detection layer of either sand, gravel or geosynthetic product directly underneath the geomembrane for draining any leakage through the geomembrane to a detection site, which layer can inhibit or nullify the leak location survey due to the lack of conductivity of the material.

[0006] One solution to this unreliability arising from possibly insufficient electrical conductivity on the underside of the liner was suggested in U.S. Patent No. 3,252,155, which disclosed placing the liner over or even adhesively secured to a metal foil sheet, where the foil would provide the required underlying conductivity. That technique was not widely accepted in the industry, however, as such foil is expensive, securing the metal foil to the liner, whether adhesively or mechanically, is extremely difficult to achieve, and the exposed metal foil could severely degrade as a result of, for example, galvanic corrosion, at the construction site.

[0007] Spencer U.S. Patent No. 5,288,168 has significantly improved upon the foil sheet suggestion by disclosing a liner having an electrically conductive layer provided by embedding conductive particles in the bottom of the layer. The integrity of the sheet is then monitored by establishing an electric field across the sheet and monitoring for sparks between a probe and the bottom, conductive plastic layer. Such spark testing has been accomplished, for example, with a test device that includes a high voltage power source with the positive lead attached to a brass brush and the negative lead attached to a conductive neoprene grounding pad laid on top of the geomembrane. See, for example, ASTM 7240.

[0008] Spark testing of seams in particular has heretofore been done such as detailed in ASTM D6365, wherein conductive material is inserted into the seam just prior to or during fabrication of the seam, with the conductive material connected to a negative terminal of a test apparatus and a positive voltage applied across the seam edge such that a suspect area in the seam is indicated by a spark from the voltage source to the conductive material.

[0009] While the Spencer '168 invention significantly improved leak detection in testing panels, it should be appreciated that during construction of a lined pond,

leaks may be caused in a geomembrane panel which was found by testing to have no leaks immediately after liner installation (e.g., by puncturing a liner when it is covered in place by soil and/or water). Moreover, since such lined facilities are typically constructed using a plurality of geomembrane panels heat welded together along seams, testing of the individual panels will not detect leaks at the seams of the panels, where false and anomalous readings have been found. Still further, the conductivity of individual liner panels is often still insufficient for reliable testing, particularly where the liner panel is not maintained in good electrical contact with the earth (due to, e.g., use of double liners, irregularities in the sub-grade, and/or wrinkles in the liner) and/or the earth is dry or not conductive.

[0010] US5490626 discloses a device for the overlapping welding of foil edges.

SUMMARY OF THE INVENTION

[0011] A first aspect of the invention relates to a heat welder for securing edges of adjacent geomembrane liner panels together according to independent claim 1.

Brief description of the drawings

[0012]

Figure 1 is a partial perspective view of a heating element according to one aspect of the present invention;

Figure 2 is side view of the heating element of Fig. 1;

Figure 3 is a cross-sectional view showing a seam between adjacent panels of a prior art containment system liner;

Figure 4 is a side diagram view of a heat welder according to the present invention, having the heating element of Fig. 1;

Figure 5 is a top view of the heat welder of Fig. 4 shown welding adjacent geomembrane panels;

Figure 6 is a cross-sectional view showing a seam between adjacent panels of a containment system liner formed according to the present invention;

Figure 7 is a perspective view of the heating element of Fig. 1;

Figure 8 is a perspective view of the heat welder of Fig. 4 with the housing broken away for clarity;

Figure 9 is a perspective view like Fig. 8 but showing a bottom liner panel being fed into the heat welder;

Figure 10 is a perspective view like Fig. 8 but showing a both the top and bottom liner panels being fed into the heat welder;

Figure 11 is a perspective view like Fig. 8 but both liner panels continuing to be fed into the heat welder with a the panels passing out the rear of the welder having two seams formed therein according to the present invention;

Figure 12 is a cross-sectional view showing a seam between adjacent panels of a containment system liner formed according to another aspect of the present invention; and

Figures 13 and 14 are partial and full perspective views, respectively, of a heat welder which may be used in accordance with the present invention, with the heat welder being shown in an open configuration with the contour rollers illustrated in phantom in their operative position when the welder is closed.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0013] A heat welding apparatus 10 is disclosed in the Figures which may be used in accordance with the present invention to heat weld seams 14 between geomembrane panels 16, 18 (typically, rolls of plastic sheet) used to form a liner 20 for, for example, large containment areas, referred to herein generally as containment systems.

[0014] The panels 16, 18 are geomembranes formed of a suitable leak proof non-conductive material having a suitable integral conductive lower surface 25. The lower conductive surfaces of the individual panels 16, 18 may also be interconnected with a series of conductive geomembranes, wires, or other conductive media in a grid pattern, or other materials suitable for connecting individual panels. Moreover, in accordance with the present invention, the formed seams 14 between panels 16, 18 maybe be suitably tested for leaks even after covered with, for example, water and/or soil, allowing performance of a reliable leak location survey

[0015] In particular, in accordance with one aspect of the present invention, seams 14 may be easily formed so as to avoid the anomalies found in testing liner seams heretofore. Specifically, as illustrated in Fig. 3, the geomembrane panels 16', 18' have heretofore been connected in prior art liners 20' by overlapping two edges of the panels 16', 18' and then heat welding the overlapping edges together along a seam 14'. Even where two such seams 14' are formed as illustrated to help to guard against leaks between the overlapping edges, the conductive lower surface 25 of the seam flap 26' of the top panel 16' will carry current from above the liner 20' through the seams 14' to the bottom of the liner 20' (i.e., at the right side of Fig. 3) where it is in contact with

the underlying ground 27. Such conductivity through the seams 14' provides a false identification of a leak in the liner 20' along the seam 14'. Moreover, ignoring such current flow as being anomalous (or as indicating a leak through the seam(s) 14') could cause actual leaks through the bottom panel 18' near the flap 26' of the overlying edge of the top panel 16' to be overlooked.

[0016] In accordance with the present invention, the seam(s) 14 between adjacent panels may be advantageously heat welded continuously along the length of the overlapping edges of adjacent panels 16, 18 wherein the conductive layer 25 on the bottom of the top panel 16 is interrupted along the parallel lines of the seam(s) 14 during the heat welding process (see Fig. 6). As a result, the seam(s) 14 between adjacent panels 16, 18 will not allow electric current to flow between the top and bottom of the system through the liner seam(s), and thus reliable leak test readings may be obtained even at the seam(s) 14.

[0017] The heat welding apparatus 10 and formation of the seams 14 will now be described.

[0018] Specifically, a heat welding apparatus 10 which may be advantageously used in connection with the present invention includes a body 40 having front and rear ends 42, 44. As best seen in Fig. 4, the body 40 defines top and bottom slots 50, 52 extending between the front and rear ends 42, 44, each slot 50, 52 being generally horizontally oriented and arranged to accept the overlapping edges of adjacent panels 16, 18.

[0019] As best understood from Figs. 4, 5 and 14, the slots 50, 52 of the apparatus (heat welder) 10 are also open on opposite lateral sides of the body 40, so that the welder 10 may be oriented so that it too overlaps with the overlapping edges of the panels 16, 18. The apparatus is suitably supported by front and rear wheels 60, 62 so that it may move relative to the panels 16, 18 and may be suitably driven by nip rollers 64 (as indicated by the arrows 65) to pull the heat welder 10 along the panels 16, 18 in the direction of arrow 66.

[0020] It should be understood that while the apparatus slots 50, 52 may be described as extending horizontally, such horizontal orientation refers to the slots 50, 52 extending generally from the front to rear ends 42, 44, with the slots 50, 52 providing a non-planar path which merges together at the rear end 44 of the apparatus 10.

[0021] Moreover, it should be understood that while the slots 50, 52 may be described as having top and bottom walls for simplicity of description, such description encompasses guiding members 70 such as contour rollers and/or partial walls. As such, "slots" as described generally herein would encompass any structure in which the edges of the panels 16, 18 may be moved through the apparatus while maintaining their generally horizontal orientation without buckling or folding.

[0022] The welder 10 includes a heating unit 80 between the slots 50, 52 and forward of the merger of the slots 50, 52 at the apparatus rear end 44. Advantageously, the heating unit 80 defines a portion of a bottom

wall of the top slot 50 and a portion of the top wall of the bottom slot 52 and is wedge shaped so as to be tapered together at its rear end. The heating unit 80 is suitably heated so that the panels 16, 18 which pass over the heating unit 80 have their faces heated sufficiently so that when the panels 16, 18 are pressed together in the merged path at the apparatus rear end 44, they are heat welded.

[0023] As illustrated, the heating unit 80 includes two laterally spaced heating sections 82, 84, for forming a seal having two parallel seams 14, though it should be understood that it would be within the scope of the present invention to provide a single heat welded seam, or more than two seams if desired.

[0024] Moreover, in accordance with the present invention, at least one heating section 82, 84 of the heating unit 80 also includes at least one projection or fin 90 extending partially into the top slot 50 from below.

[0025] The fin 90 may advantageously be of any shape suitable to melt through the conductive thin layer on the bottom surface 25 of overlapping edge of the top panel 16 as it passes through the slot 50 and past the projection 90. Moreover, while the fin 90 may advantageously be shaped as illustrated, with a pointed leading (forward) edge, the shape and size could vary while still providing at least some of the advantages of the present invention.

[0026] Further, the fin 90 may be an integral part of the heating unit 80, or it may advantageously be provided on an insert 92 in a recessed pocket in the heating unit 80 and removably secured therein by, for example, a countersunk screw 94. Still further, for heating units 80 such as illustrated which have more than one heating section 82, 84, it should be appreciated that a projection 90 may be provided on both sections 82, 84 to provide redundancy, although at least some of the advantages of the present invention could be provided with a projection 90 provided on only one of the sections 82, 84.

[0027] It should thus be appreciated that as the two heated panels 16, 18 are pressed together behind the heating unit 80 by the nip rollers 64, each of which have two sections aligned with the two fins 90, respectively for forming the heat welded seams 14 along the length of the panels 16, 18. The welder 10 will thus form a pair of parallel seals 14 between the overlapping adjacent panels 16, 18 wherein, as shown in Fig. 6, there is no conductive layer passing through either of the seams 14 - that is, there will be no current flow through across the seams 14 such as has heretofore provided anomalous and erroneous readings when leak testing. (It should be appreciated also that it would be within the scope of the present invention to form only one such seam 14).

[0028] Yet another embodiment of the present invention allows for reliable leak testing of liners formed of a plurality of panels even when used in applications where the liner may not be not maintained in good electrical contact with the earth (due to, e.g., use of double liners, irregularities in the subgrade, and/or wrinkles in the liner) and/or the earth is dry or not sufficiently conductive.

[0029] Specifically, as illustrated in Fig. 12, in accordance with this aspect of the invention, a conductive member 100 may be provided beneath adjacent geomembrane liner panels 116, 118 having conductive bottom surfaces 125. As illustrated in Fig. 12, the conductive member 100 is an inverted section of a geomembrane liner panel with a conductive surface on one side - laid upside down with the conductive surface 130 on top so that it contacts the conductive bottom surfaces 125 of both of the liner panels 116, 118.

[0030] While the conductive member 100 may extend continuously underneath the adjacent liner panels 116, 118, spanning across the two so as to place them in electrical contact with each other, it should be appreciated that the member 100 may also consist of spaced short sections or strips of conductive geomembranes conductively connecting the adjacent panels 116, 118 at spaced locations along the seam(s). In fact, it should be appreciated that virtually any conductive member 100 could be used, including a grid of spaced wires or other conductive media laid beneath the liner, so long as it allows for the individual panels to effectively provide a single conductive bottom surface across the plurality of panels defining the liner 120.

[0031] It should be appreciated that while Fig. 12 illustrates this aspect of the invention with a seam incorporating the first aspect of the invention (*i.e.*, with the conductive bottom surface 25 of the top liner panel 16 broken), the advantages of this second aspect of the invention (*i.e.*, a conductive interconnection of the bottom surfaces of adjacent liner panels) could be provided with even prior art seams such as illustrated in Fig. 3. However, the full advantages of both aspects of the invention may be provided by the configuration illustrated in Fig. 12.

[0032] As previously noted, leak detection sensitivity depends on the conductivity of the materials above and below the geomembrane. As also previously noted, standard leak detection tests may use either water or moisture in the soil to transmit voltage above the geomembrane, and standard testing may utilize water or moisture in the soil below the liner for a grounding source. If there is a hole in the geomembrane then the voltage introduced in the above material will flow through the hole and to the grounding source underneath the geomembrane creating a current for leak detections. However, as also previously noted, where the material underneath the geomembrane does not have enough (or consistent) moisture to provide a suitable grounding source, such leak location testing could not heretofore be suitably performed.

[0033] With a liner 120 formed according to this aspect of the invention, leak surveys can be accomplished with direct connection to a minimum number of panels (*i.e.*, any one of interconnected panels). The bottom conductive surfaces 125 of the electrically interconnected geomembrane panels (*e.g.*, 116, 118) provide a single grounding source underneath the liner 120 to allow the leak location survey to be performed over entire geo-

membrane surface. Since the conductive layer (bottom surfaces 125 and conductive member 100) is always in intimate contact with the geomembrane panels 116, 118, and the conductivity is consistent regardless of the conductivity of the underlying layers, leak surveys can be more effectively performed when the conductive layer is utilized.

[0034] It should also be appreciated that leak detection of liners 20 formed of a plurality of panels 16, 18 according to the present invention may be performed using a variety of leak testing methods, including spark testing according to ASTM 7240. Moreover, leak detection of the seams of liners 20 formed according to the present invention could also be accomplished by spark testing according to ASTM 6365, with conductive material inserted into the seal (*e.g.*, between the seams 14) and spark testing performed in the area of the seams 14.

[0035] It should thus be appreciated that the present invention as disclosed herein allows for containment system liners to be more easily, economically and reliably inspected using an electrical inspection apparatus to detect leaks. Such inspections can be made without the need for maintaining good electrical contact with conductive natural surroundings outside the liner. Furthermore, other objects, features and advantages of the invention will become apparent from a review of the entire specification including any appended claims and drawings.

[0036] It should be appreciated that the invention may include any or all of the above-described features, include only one of the above features, more than one of the above features, and any combination of the above features. Moreover, it should be appreciated that such features may be achieved by use of fewer than all of the above-described structural elements, including combinations less than all of the above-described structural elements.

Claims

1. A heat welder (10) for securing edges of adjacent geomembrane liner panels (16,18) together, said geomembrane liner panels (16,18) having conductive bottom surfaces (25) and being overlapped along their edges with a first one of said panels on top of a second one of said panels, said welder comprising:

a welder body (40) having forward (42) and rear (44) ends and defining first and second slots (50,52) with top and bottom walls extending between the welder body (40) front and rear, wherein

the first slot (50) is open on one lateral side for receiving the first one of said panels and is substantially horizontally oriented at said lateral side,

- the second slot (52) is below said first slot (50) and open on the lateral side opposite the one side for receiving the overlapping edge of the second one of said panels and is substantially horizontally oriented at said lateral side, and said first and second slots (50,52) merge at the body rear end (44);
 a drive (64) for moving the welder body (40) forward;
 a heating unit (80) between said first and second slots (50,52) and forward of said merged first and second slots (50,52), said heating unit (80) defining a portion of a bottom wall of the first slot (50); and **characterised by**
 at least one projection (90) extending partially into said first slot (50) for engaging the conductive bottom surface (25) of the first one of said panels (16) to interrupt the conductive bottom surface (25) along a line as it passes the projection (90);
 wherein said merged first and second slots (50,52) press together first and second liner panels (16,18) to heat weld the first and second liner panels (16,18) together along the line of the interrupted conductive bottom surface (25).
2. The heat welder (10) of claim 1, wherein said at least one projection (90) is shaped to melt through the conductive bottom surface (25) of the first one of said panels (16) in use at an overlapping edge of said first one of said panels (16) as the overlapping edge passes through the first slot (50) past the projection (90), and wherein said at least one projection (90) interrupts the conductive bottom surface (25) of the first one of said panels (16) along said line by said melting..
3. The heat welder (10) of claim 1, wherein:
- said heating unit (80) is a wedge having first and second laterally spaced sections (82,84), with each section defining a portion of a bottom wall of the first slot (50) and a portion of a top wall of the second slot (52), having said wall defining portions tapered together at their rear ends adjacent the merged first and second slots (50,52), and
 including one of said projections (90); and
 said merged slots are adapted to heat weld first and second liner panels (16,18) together along substantially parallel lines corresponding to projection (90) interruptions in the conductive bottom surface (25) of the first one of said panels (16).
4. The heat welder (10) of either claim 1 or claim 2, wherein said projections (90) extend longitudinally toward the body rear from a pointed end.

5. The heat welder (10) of claim 1 wherein said heating unit (80) is a wedge between said first and second slots (50,52) whereby said wedge

defines part of an upper wall of the second slot and the second wall of the first slot (50), and said defined upper and lower walls taper together at a rear end of said heating unit (80); and said at least one projection (90) extends from the wedge defined lower wall of the first slot (50) sufficiently to interrupt a bottom portion of a liner panel as said line panel passes through the first slot (50) over the projection (90) during use, while still maintaining the overall structural integrity of the panel,
 wherein the heating unit (80) includes two laterally spaced sections (82,84), and wherein at least one of the sections (82,84) includes the at least one projection (90).

Patentansprüche

1. Wärmeschweißgerät (10) zum Verbinden der Ränder von benachbarten Geomembranauskleidungsplatten (16, 18), wobei die Geomembranauskleidungsplatten (16, 18) leitende untere Oberflächen (25) aufweisen und entlang ihrer Ränder überlappt werden, wobei eine erste der Platten auf einer zweiten der Platten liegt, das Schweißgerät umfassend:

einen Schweißkörper (40), der ein vorderes (42) und ein hinteres (44) Ende aufweist und einen ersten und einen zweiten Schlitz (50, 52) mit einer oberen und einer unteren Wand definiert, die sich zwischen dem vorderen und dem hinteren Schweißkörper (40) erstrecken, wobei der erste Schlitz (50) an einer Seite offen ist, um die erste der Platten zu empfangen, und im Wesentlichen horizontal an dieser Seite ausgerichtet ist,
 der zweite Schlitz (52) unterhalb des ersten Schlitzes (50) liegt und an der Seite offen ist, die der Seite gegenüberliegt, die den überlappenden Rand der zweiten der Platten empfängt, und im Wesentlichen horizontal an der Seite ausgerichtet ist, und
 die ersten und zweiten Schlitz (50, 52) am hinteren Ende des Körpers (44) ineinander übergehen;
 einen Antrieb (64) zum Vorwärtsbewegen des Schweißkörpers (40);
 eine Heizeinheit (80) zwischen dem ersten und zweiten Schlitz (50, 52) und vor dem zusammengeführten ersten und zweiten Schlitz (50, 52), wobei die Heizeinheit (80) einen Abschnitt einer Bodenwand des ersten Schlitzes (50) definiert; und **gekennzeichnet durch**

- mindestens einen Vorsprung (90), der sich teilweise in den ersten Schlitz (50) erstreckt, um mit der leitenden unteren Oberfläche (25) der ersten der Platten (16) in Eingriff zu kommen, um die leitende untere Oberfläche (25) entlang einer Linie zu unterbrechen, wenn sie den Vorsprung (90) passiert;
wobei die zusammengeführten ersten und zweiten Schlitze (50, 52) erste und zweite Auskleidungsplatten (16, 18) zusammenpressen, um die ersten und zweiten Auskleidungsplatten (16, 18) entlang der Linie der unterbrochenen leitfähigen unteren Oberfläche (25) miteinander zu verschweißen.
2. Wärmeschweißgerät (10) nach Anspruch 1, wobei der mindestens eine Vorsprung (90) geformt ist, um durch die leitende untere Oberfläche (25) der ersten der Platten (16) im Gebrauch an einem überlappenden Rand der ersten der Platten (16) zu schmelzen, wenn der überlappende Rand durch den ersten Schlitz (50) an dem Vorsprung (90) vorbei verläuft, und wobei der mindestens eine Vorsprung (90) die leitende untere Oberfläche (25) der ersten der Platten (16) entlang der Linie durch das Schmelzen unterbricht.
3. Wärmeschweißgerät (10) nach Anspruch 1, wobei:
- die Heizeinheit (80) ein Keil ist, der erste und zweite seitlich beabstandete Abschnitte (82, 84) aufweist, wobei jeder Abschnitt einen Abschnitt einer unteren Wand des ersten Schlitzes (50) und einen Abschnitt einer oberen Wand des zweiten Schlitzes (52) definiert, wobei die die Wand definierenden Abschnitte an ihren hinteren Enden angrenzend an die zusammengeführten ersten und zweiten Schlitze (50, 52) zusammenlaufen, und einschließlich eines der Vorsprünge (90); und die zusammengeführten Schlitze geeignet sind, erste und zweite Auskleidungsplatten (16, 18) entlang im Wesentlichen paralleler Linien, die Unterbrechungen von Vorsprüngen (90) in der leitenden unteren Oberfläche (25) der ersten der Platten (16) entsprechen, miteinander zu verschweißen.
4. Schweißgerät (10) nach Anspruch 1 oder 2, wobei sich die Vorsprünge (90) von einem spitzen Ende aus in Längsrichtung zum hinteren Teil des Körpers erstrecken.
5. Wärmeschweißgerät (10) nach Anspruch 1, wobei die Heizeinheit (80) ein Keil zwischen dem ersten und dem zweiten Schlitz (50, 52) ist, wobei der Keil
- einen Teil einer oberen Wand des zweiten

Schlitzes und die zweite Wand des ersten Schlitzes (50) definiert, und die definierten oberen und unteren Wände sich an einem hinteren Ende der Heizeinheit (80) verjüngen; und der mindestens eine Vorsprung (90) sich von der keilförmig definierten unteren Wand des ersten Schlitzes (50) ausreichend erstreckt, um einen unteren Abschnitt einer Auskleidungsplatte zu unterbrechen, wenn die Linienplatte während des Gebrauchs durch den ersten Schlitz (50) über den Vorsprung (90) läuft, während die gesamte strukturelle Integrität der Platte noch erhalten bleibt, wobei die Heizeinheit (80) zwei seitlich beabstandete Abschnitte (82, 84) einschließt, und wobei mindestens einer der Abschnitte (82, 84) den mindestens einen Vorsprung (90) einschließt.

Revendications

1. Soudeuse thermique (10) pour fixer ensemble des bords de panneaux de revêtement de géomembrane adjacents (16, 18), lesdits panneaux de revêtement de géomembrane (16, 18) ayant des surfaces inférieures conductrices (25) et se chevauchant le long de leurs bords avec un premier desdits panneaux sur un second desdits panneaux, ladite soudeuse comprenant :
- un corps de soudeuse (40) ayant des extrémités avant (42) et arrière (44) et définissant des première et seconde fentes (50, 52) avec des parois supérieure et inférieure s'étendant entre l'avant et l'arrière du corps de soudeuse (40), dans laquelle
- la première fente (50) est ouverte sur un côté latéral pour recevoir le premier desdits panneaux et est orientée sensiblement horizontalement sur ledit côté latéral,
- la seconde fente (52) est située en dessous de ladite première fente (50) et ouverte sur le côté latéral opposé au premier côté pour recevoir le bord de chevauchement du second desdits panneaux et est orientée sensiblement horizontalement sur ledit côté latéral, et
- lesdites première et seconde fentes (50, 52) fusionnent au niveau de l'extrémité arrière (44) du corps ;
- un entraînement (64) pour déplacer le corps de soudeuse (40) vers l'avant ;
- une unité de chauffage (80) entre lesdites première et seconde fentes (50, 52) et en avant desdites première et seconde fentes fusionnées (50, 52), ladite unité de chauffage (80) définissant une partie d'une paroi inférieure de la première fente (50) ; et **caractérisée**

- par** au moins une saillie (90) s'étendant partiellement dans ladite première fente (50) pour venir en contact avec la surface inférieure conductrice (25) du premier desdits panneaux (16) pour interrompre la surface inférieure conductrice (25) le long d'une ligne lorsqu'elle passe la saillie (90) ;
 dans laquelle lesdites première et seconde fentes fusionnées (50, 52) pressent ensemble les premier et second panneaux de revêtement (16, 18) pour thermosouder les premier et second panneaux de revêtement (16, 18) ensemble le long de la ligne de la surface inférieure conductrice interrompue (25).
2. Soudeuse thermique (10) selon la revendication 1, dans laquelle ladite au moins une saillie (90) est formée pour fondre à travers la surface inférieure conductrice (25) du premier desdits panneaux (16) lors de l'utilisation au niveau d'un bord de chevauchement dudit premier desdits panneaux (16) lorsque le bord de chevauchement passe à travers la première fente (50) au-delà de la saillie (90), et dans laquelle ladite au moins une saillie (90) interrompt la surface inférieure conductrice (25) du premier desdits panneaux (16) le long de ladite ligne par ladite fusion.
3. Soudeuse thermique (10) selon la revendication 1, dans laquelle :
- ladite unité de chauffage (80) est une cale ayant des première et seconde sections espacées latéralement (82, 84), chaque section définissant une partie d'une paroi inférieure de la première fente (50) et une partie d'une paroi supérieure de la seconde fente (52), ayant ladite paroi définissant des parties effilées ensemble au niveau de leurs extrémités arrière adjacentes aux première et seconde fentes fusionnées (50, 52), et
 comportant l'une desdites saillies (90) ; et
 lesdites fentes fusionnées sont conçues pour thermosouder les premier et second panneaux de revêtement (16, 18) ensemble le long de lignes sensiblement parallèles correspondant à des interruptions de la projection (90) dans la surface inférieure conductrice (25) du premier desdits panneaux (16).
4. Soudeuse thermique (10) selon la revendication 1 ou la revendication 2, dans laquelle lesdites saillies (90) s'étendent longitudinalement vers l'arrière du corps à partir d'une extrémité pointue.
5. Soudeuse thermique (10) selon la revendication 1, dans laquelle ladite unité de chauffage (80) est une cale entre lesdites première et seconde fentes (50,

52), moyennant quoi ladite cale définit une partie d'une paroi supérieure de la seconde fente et la seconde paroi de la première fente (50), et

lesdites parois supérieure et inférieure définies s'effilent ensemble au niveau d'une extrémité arrière de ladite unité de chauffage (80) ; et
 ladite au moins une saillie (90) s'étend à partir de la paroi inférieure définie par la cale de la première fente (50) suffisamment pour interrompre une partie inférieure d'un panneau de revêtement lorsque ledit panneau de revêtement passe à travers la première fente (50) sur la saillie (90) pendant l'utilisation, tout en maintenant l'intégrité structurelle globale du panneau, dans laquelle l'unité de chauffage (80) comporte deux sections espacées latéralement (82, 84), et dans laquelle au moins l'une des sections (82, 84) comporte au moins une saillie (90).

Fig. 1

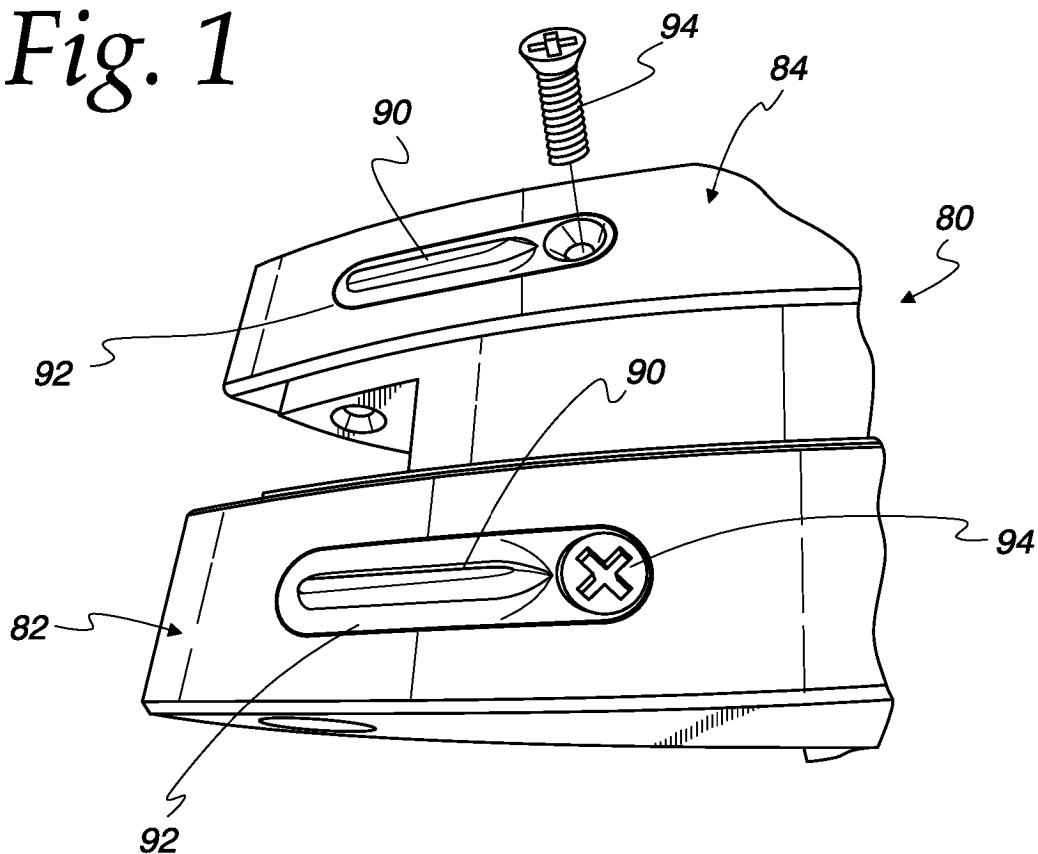


Fig. 2

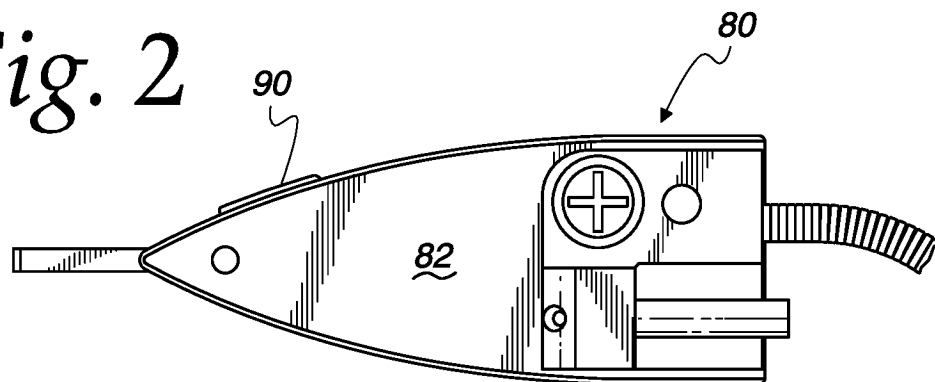


Fig. 3 (Prior Art)

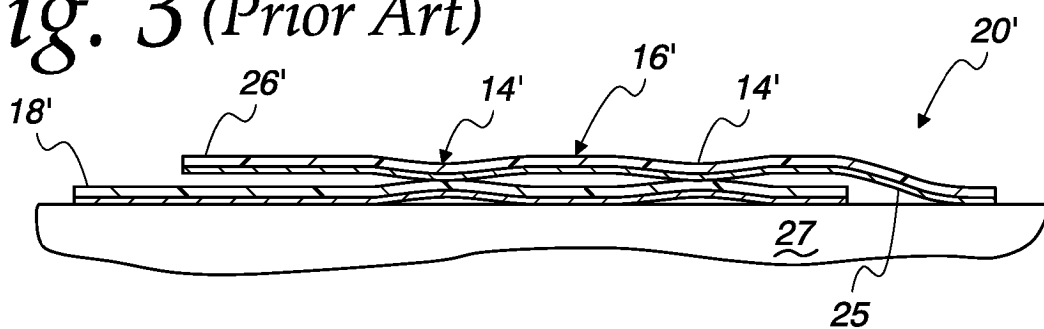


Fig. 4

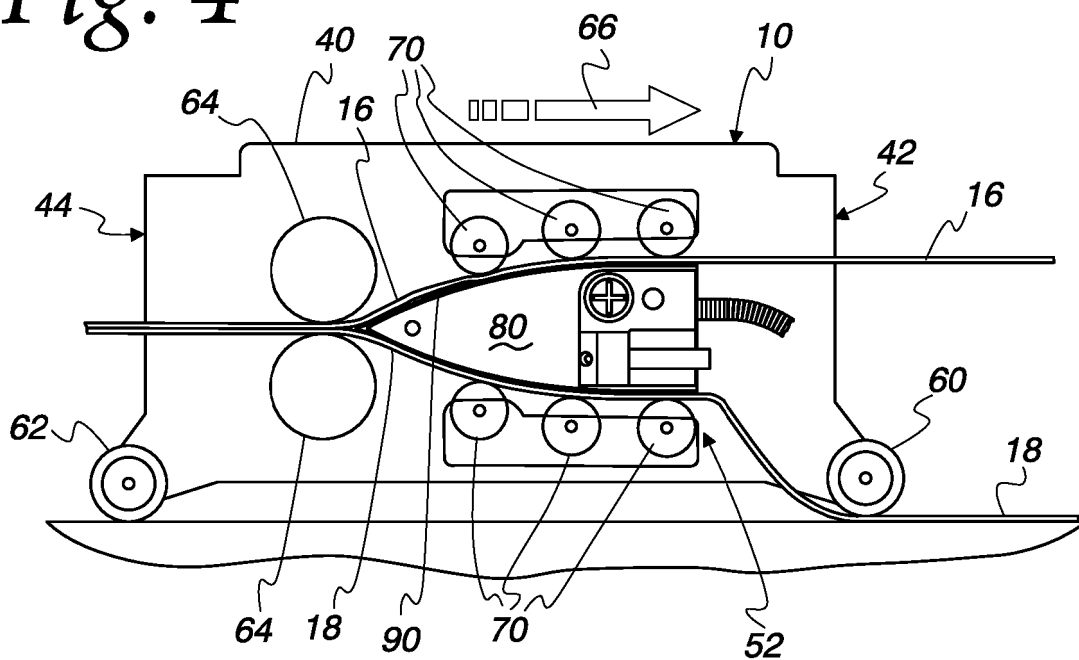


Fig. 5

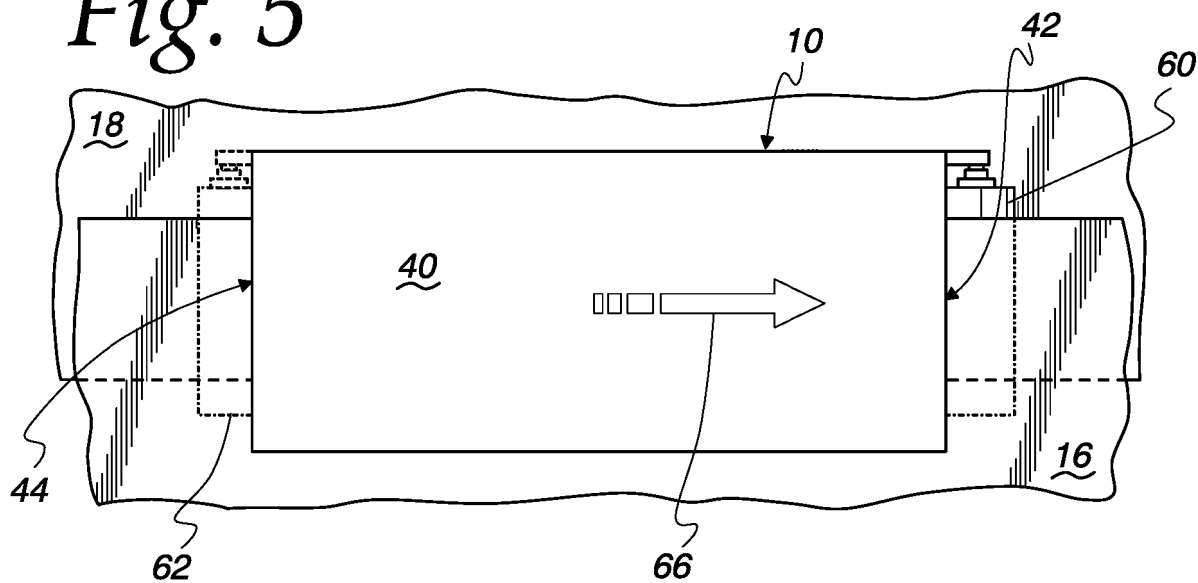


Fig. 6

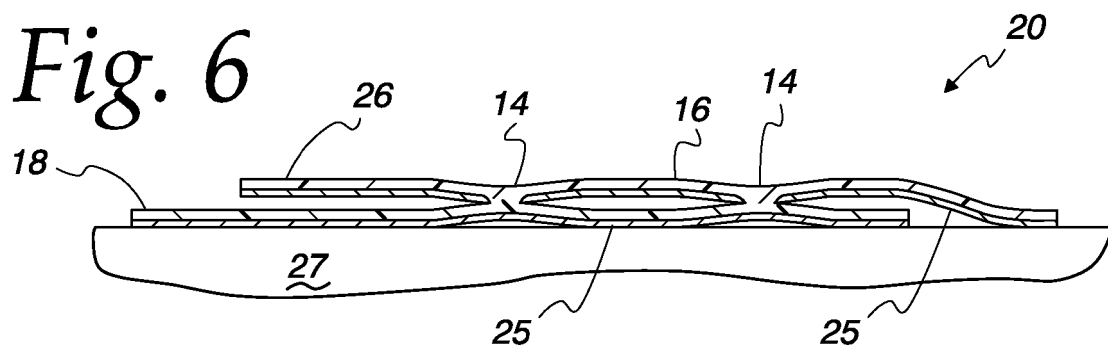


Fig. 7

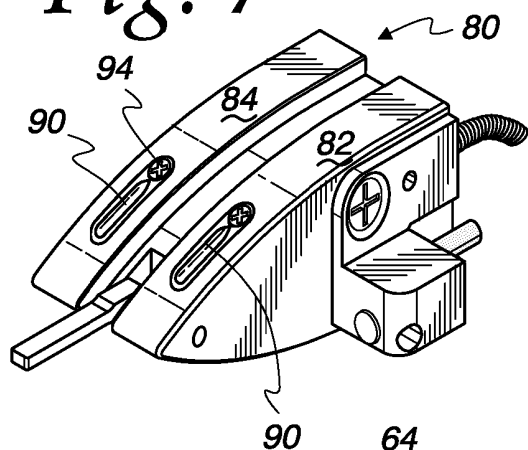


Fig. 8

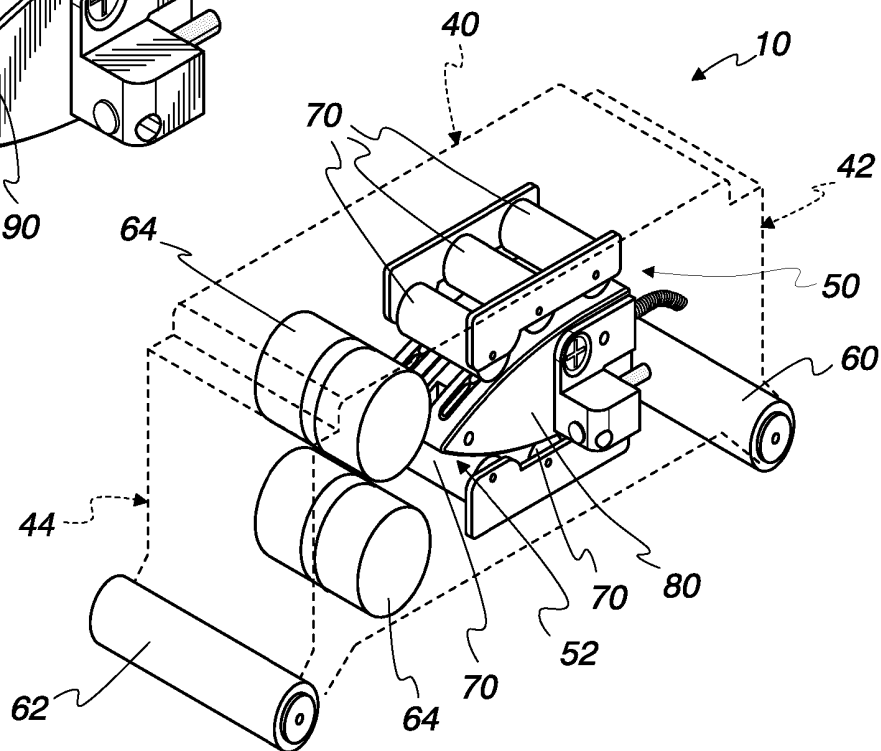


Fig. 9

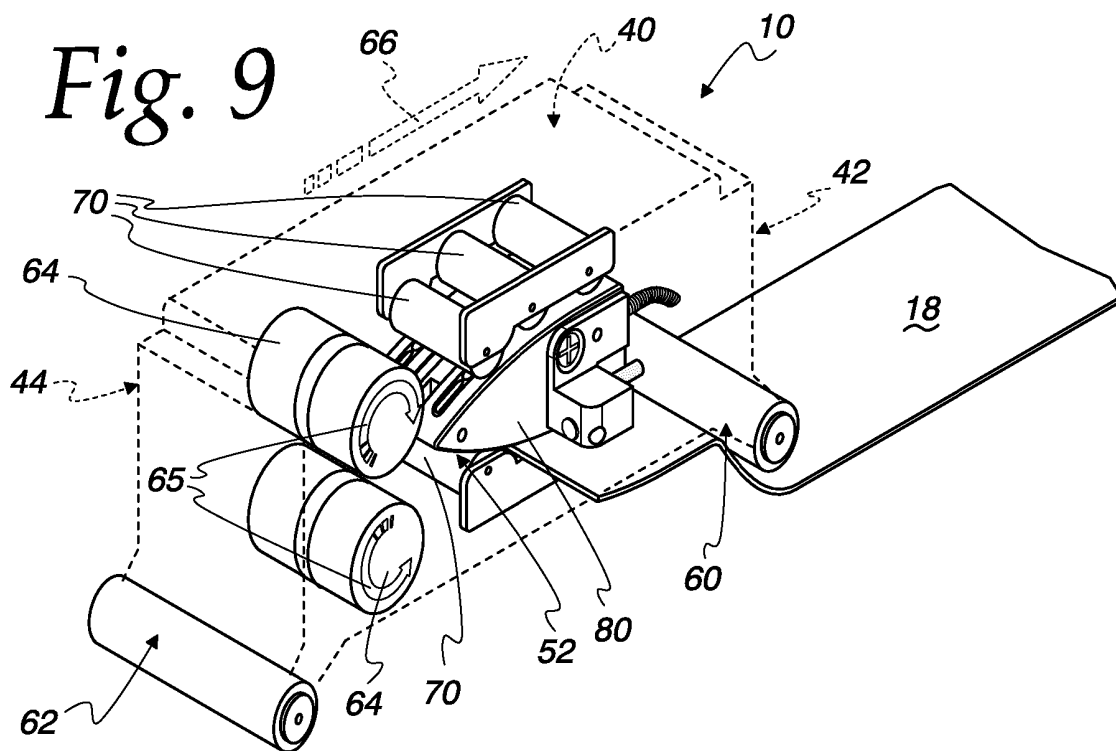


Fig. 10

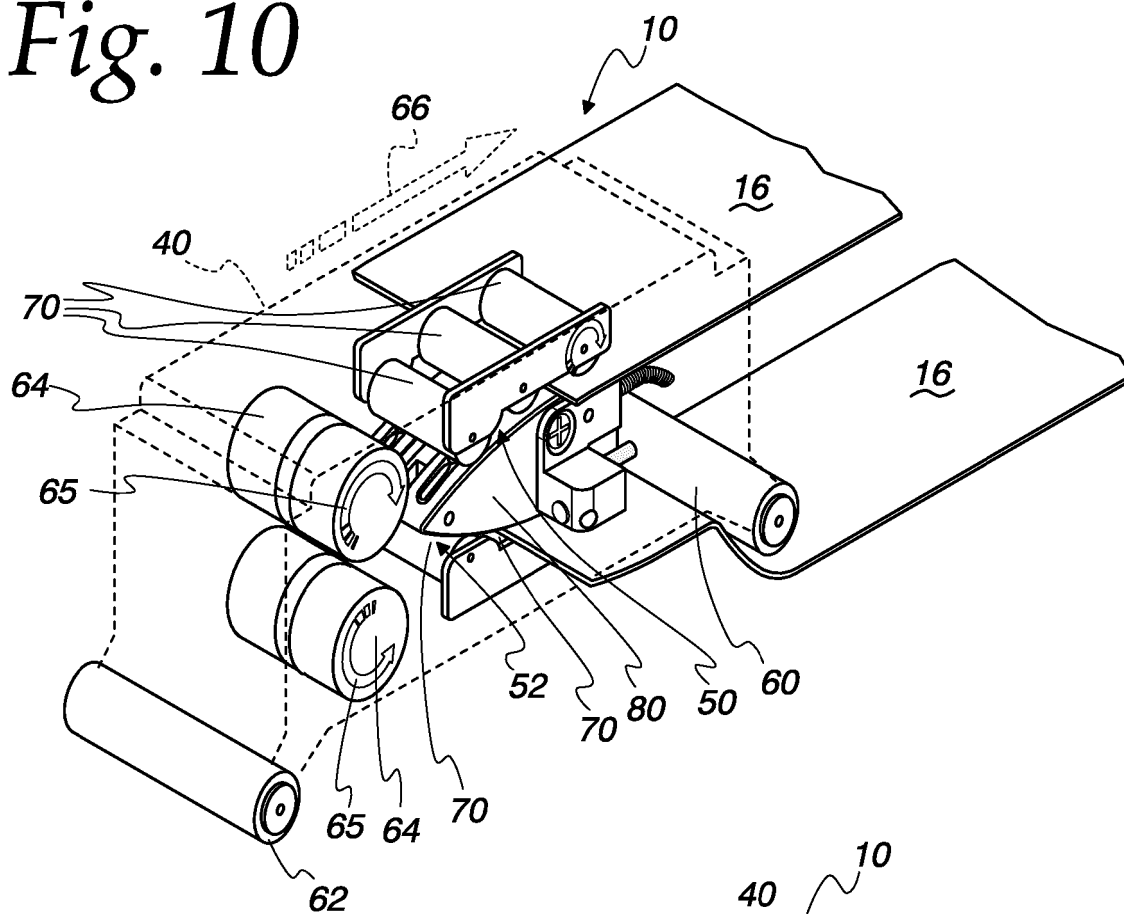


Fig. 11

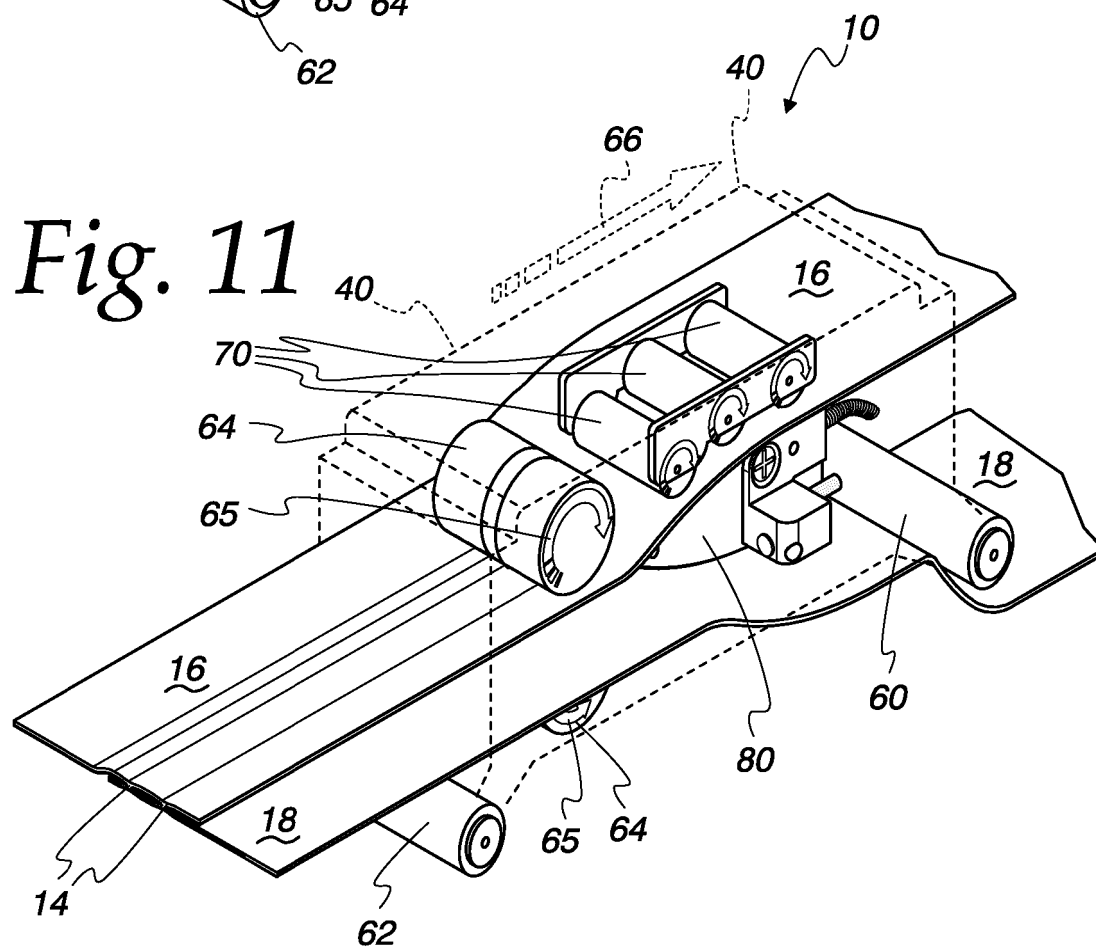


Fig. 12

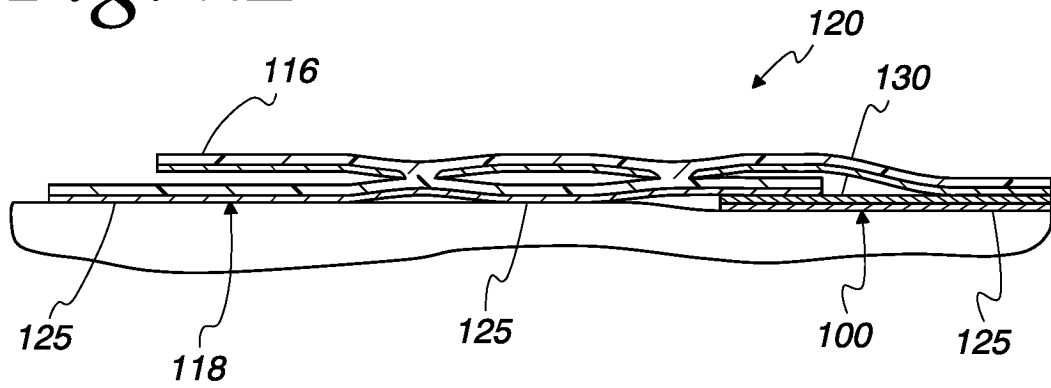


Fig. 13

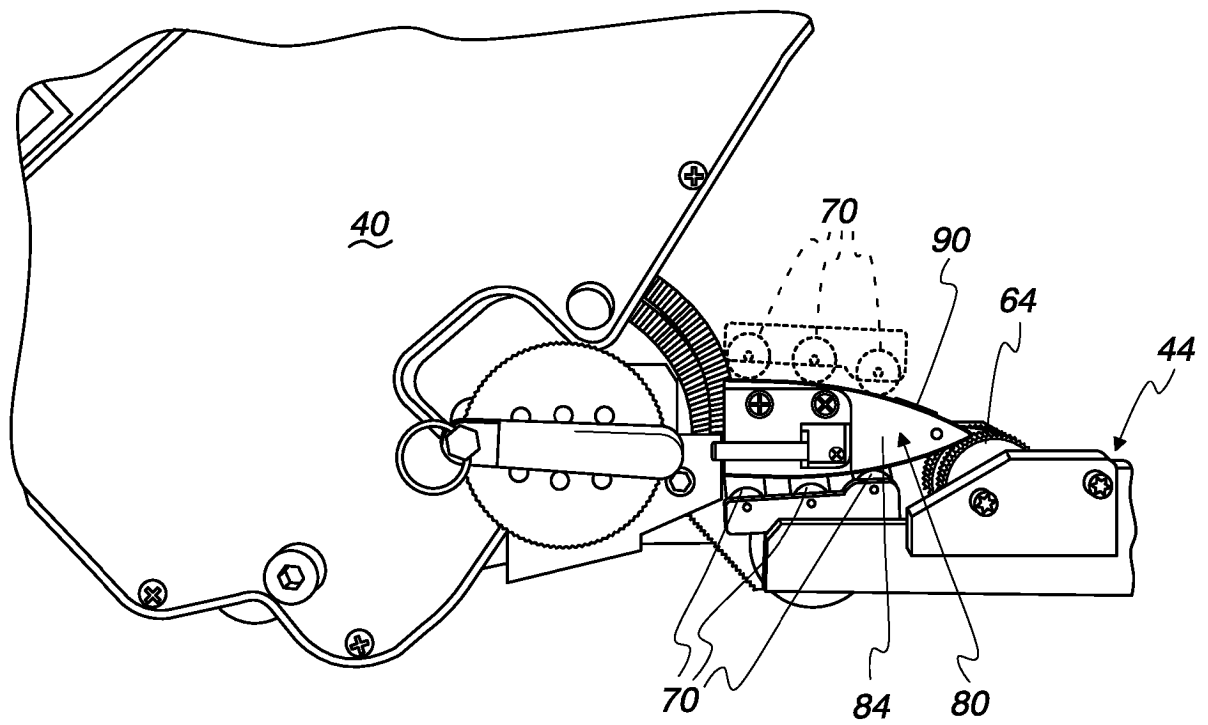
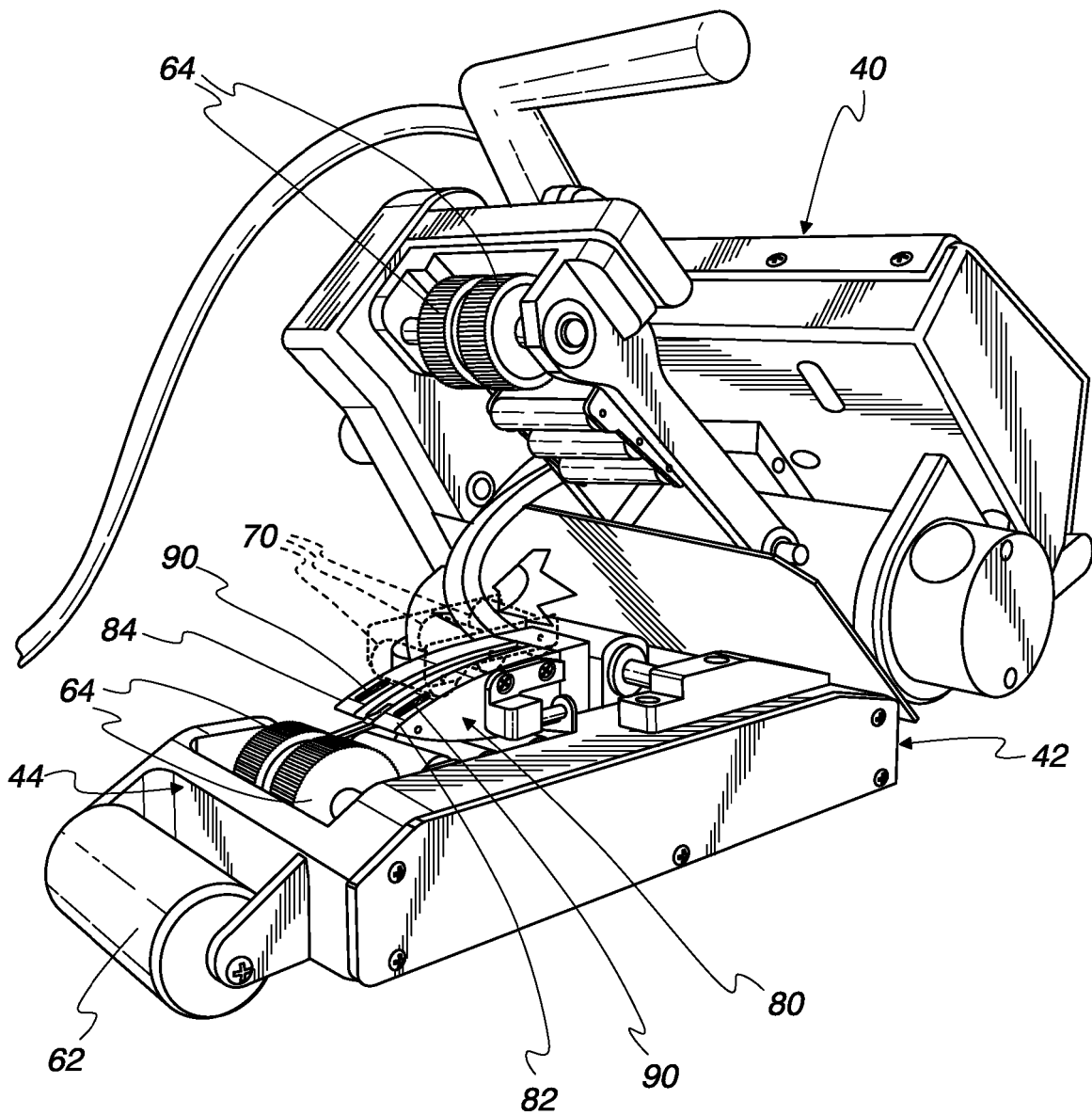


Fig. 14



REFERENCES CITED IN THE DESCRIPTION

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