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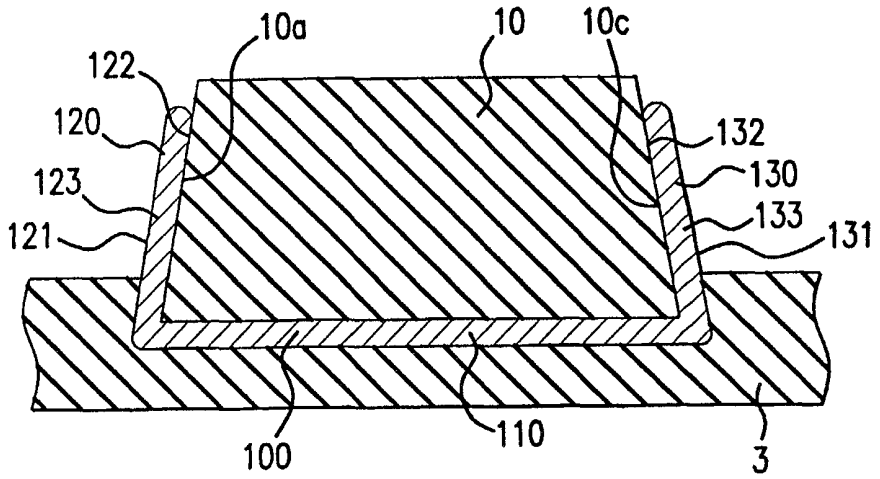

(57) Abstract

An endless drive track system for use with a tracked vehicle includes a planetary drive system having drive rollers, a plurality of roller wheels, an endless track (3) having an interior surface and a plurality of drive lugs attached to the interior surface. Each drive lug includes at least one drive face that is positively engaged by the drive rollers of the planetary drive system, and longitudinal faces (10a, 10c) that are engageable with the sides of the roller wheels. Each longitudinal face has an angled shape defined by upper and lower portions. The lower portion is substantially perpendicular to the interior surface while the upper portion is angled between about 5° and 60° with respect to the lower portion. This arrangement promotes lateral guidance of the endless track (3) and reduces the potential of damaging contact between the longitudinal faces (10a, 10c) and the roller wheels (5). The endless track (3) may include a reinforcing brace (100) having flanges that protect the longitudinal faces. The reinforcing brace (100) extends from the interior surface of the endless track and decreases the amount each of the drive lugs erodes from possible contact with the roller wheels. Each reinforcing brace (100) may include a horizontal section (110) having first and second ends.

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ENDLESS DRIVE TRACK WITH IMPROVED DRIVE LUG CONFIGURATION AND REINFORCING BRACE AND METHOD

BACKGROUND OF THE INVENTION

1. Field of Invention

The present invention relates to a track for an endless drive track system. More particularly, the present invention relates to an endless drive track having an improved drive lug configuration and reinforcing braces for use with a tracked vehicle such as a tractor, bulldozer or tank.

2. Description of Related Art

Conventional endless drive track systems are used with tracked vehicles such as tractors, bulldozers, tanks or the like, as shown in U.S. Patent No. Re. 33,324, incorporated herein by reference. As shown in Fig. 1 herein, a vehicle 1 includes an endless drive track system 2 with an endless track 3, a drive system, e.g., a planetary drive system 4, and a plurality of roller wheels 5, also commonly known as idler wheels that guide, laterally align and support the track 3. The planetary drive system 4 and the plurality of roller wheels 5 are located at separate positions within the endless drive track system 2. For example, when the drive rollers 6 (see Figs. 2 and 3) of the planetary drive system 4 rotate in a clockwise direction, the endless track 3 is driven in the clockwise direction. The roller wheels 5 also rotate in the clockwise direction due to the frictional engagement of the roller wheels 5 with the driven endless track 3. Alternatively, the roller wheels 5 can be positively driven. Consequently, the drive rollers 6, the roller wheels 5 and the endless track 3 rotate in a common direction.

The endless track 3 is comprised of a plurality of drive sections 7. Fig. 2 shows an exploded perspective view of an exemplary drive section 7 where the drive rollers 6 of the planetary drive system 4 engage the drive section 7 of the endless track. Each drive section 7 includes an interior surface 8 and an exterior surface 9. The exterior surface 9 of each drive section 7 faces away relative to the endless drive track system 2 and includes a tread that contacts the ground over which the tracked vehicle 1 travels. The interior surface 8 of each drive section 7 faces toward the endless drive track system 2 and includes a plurality of drive lugs 10 extending inwardly from the interior surface 8.

Typically, each drive lug 10 includes four faces 10a-10d. Faces 10b and 10d are drive faces that extend in a direction transverse to the traveling direction of the endless track 3 and are contacted and driven by the drive rollers 6. An arrow A indicates the traveling direction

of the endless track 3 as being from right to left, although the traveling direction of the endless track 3 can also be from left to right. The remaining faces 10a and 10c are longitudinal faces and extend in a direction substantially parallel to the traveling direction of the endless track 3. At least one purpose of the longitudinal faces 10a and 10c is to guide the endless track 3 as it travels past the roller wheels 5.

Fig. 3 shows a schematic diagram of the drive rollers 6 rotated in a clockwise direction by the planetary drive system 4 to engage and drive the drive lugs 10. When a drive section 7 of the endless track 3 reaches the planetary drive system 4, the rotated drive rollers 6 of the planetary drive system 4 contact drive face 10b of the drive lugs 10 to drive the endless track 3 in the clockwise direction. Similarly, when the drive rollers 6 are rotated in the counterclockwise direction, the drive rollers 6 contact drive face 10d of the drive lugs 10 to drive the endless track 3 in a counterclockwise direction. As such, upon contacting the drive face 10b or 10d of the drive lugs 10, the drive rollers 6 are able to drive the drive section 7 of the endless track 3 in the desired traveling direction. The drive rollers 6 repeat the above-described operation for every drive lug 10 passing through the planetary drive system 4.

As the drive rollers 6 of the planetary drive system 4 are typically constructed from wear-resistant materials, e.g., metals, and the endless track 3 is typically made of a polymeric material, the engagement of the drive rollers 6 with the drive lugs 10 of the endless track 3 may result in the wearing down or erosion of the drive lugs 10. Although the drive rollers 6 are illustrated as substantially filling the region between adjacent drive lugs 10, the size of the drive rollers 6 can be made smaller, as long as the drive rollers 6 are capable of engaging the drive faces 10b and 10d of the drive lugs 10.

Fig. 4 shows an exploded perspective view where the roller wheels 5 engage a drive 7 section of the endless track 3 driven in the clockwise, i.e., right to left, direction. In the illustration, three roller wheels 5 are provided on a common shaft, although more or less than three rollers can be provided, and independent shafts may be desirable, depending on need. As such, because of the frictional engagement of the endless track 3 with the roller wheels 5, each roller wheel 5 is rotated in the clockwise direction with the drive section 7 of the endless track 3. The rotation of the roller wheels 5 provides even support across the endless track 3 in an orthogonal direction relative to the direction the track 3 is driven.

Fig. 5 is cross-sectional view of the roller wheels 5 engaging the drive section 7 of the endless track 3 shown in Fig. 4, as taken along section line 5-5. The spacing of the roller wheels 5 relative to the drive lugs 10 is such that the roller wheels 5 should not contact the

longitudinal faces 10a and 10c of the drive lugs 10 while engaging the drive section 7. To this end, the total length of the combined distances X and Y is typically about 3/8" - 1/2".

As represented by the bi-directional arrows in Fig. 5, the endless track 3 has a tendency to move with respect to the roller wheels 5 in the direction parallel to the axes of the roller wheels 5. Consequently, the roller wheels 5 may contact the longitudinal faces 10a and 10c of the drive lugs 10. As the roller wheels 5 are typically constructed from wear-resistant materials and the endless track 3 is typically made of a polymeric material, the frictional engagement of the roller wheels 5 with the drive lugs 10 results in the wearing down or eroding of the longitudinal faces 10a and 10c of the drive lug 10.

For example, as shown in Fig. 6, which is an enlargement of the dashed box of Fig. 5, contact between the roller wheels 5 and the longitudinal faces 10a and 10c of the drive lug 10 results in the wearing away of the longitudinal faces 10a and 10c. The worn away portions of the drive lug 10 are represented by the shaded region R. The gradual decrease in the surface area weakens the drive lugs 10 and causes early failure of the drive belt. For example, the endless drive belt may need to be replaced after 300 working hours due to erosion of the drive lugs. Also, due to the reduced surface area, "slipping" can occur between the drive rollers 6 of the planetary drive system 4 and the endless track 3.

Furthermore, the wearing away of the longitudinal faces 10a and 10c weakens the structural integrity of the endless track 3 and permits an increase in lateral "play", i.e., the extent the endless track 3 moves in the direction parallel to the axes of the roller wheels 5. Also, the wearing away of the endless track 3 frequently requires that the endless track 3 be replaced, which requires a stoppage of work, increases the cost associated with using the tracked vehicle 1, and increases labor costs.

SUMMARY OF THE INVENTION

One aspect of the invention is to provide an endless track including drive lugs having a configuration that better resists erosion and/or abrasion. The drive lugs can also provide better lateral alignment of the drive track and help prevent unwanted lateral play of the track.

A further aspect of the invention is to provide an endless track that can be retrofitted into existing positive drive track systems using a conventional planetary drive system.

Another aspect of the invention is to provide an endless track having reinforcing braces made from wear-resistant material that are capable of better guiding roller wheels and/or preventing roller wheels from wearing away the longitudinal faces of drive lugs extending from the endless track.

It is another aspect of the invention to provide an endless track having reinforcing braces made from wear-resistant material that are capable of preventing the drive rollers of the planetary drive system from slipping when attempting to engage the drive lugs.

It is another aspect of the invention to provide an endless track having reinforcing braces made from wear-resistant material that decreases the frequency at which the endless track must be replaced because the track is worn away, the number of work stoppages to replace the track, as well as labor costs.

In order to achieve the above, and to overcome the shortcomings in the related art, an endless drive track system for use with a tracked vehicle according to a preferred embodiment of the invention includes a positively driven endless track having an interior surface and a plurality of drive lugs attached to the interior surface, each of the drive lugs including at least one drive face and first and second longitudinal faces, each of the first and second longitudinal faces having a first portion adjacent the interior surface and a second portion remote from the interior surface, each of the first and second portions forming an inside angle of less than 180° with respect to one another, and a drive system cooperteable with the at least one drive face of the drive lug.

The endless drive track system may further comprise a plurality of roller wheels that guide and support the endless track, the plurality of roller wheels being positionable to possibly contact the first and second longitudinal faces of the drive lug. The first portion of each of the first and second longitudinal faces may be substantially perpendicular to the interior surface, and an exterior angle between each first portion and each corresponding second portion may be about 5-60°, and preferably about 30-45°, as measured from the second portion to a line extending from the first portion.

A positively driven endless track according to a preferred embodiment of the invention includes an interior surface and a plurality of drive lugs attached to the interior surface, each of the drive lugs including at least one drive face and first and second longitudinal faces, each of the first and second longitudinal faces having a first portion adjacent the interior surface and a second portion remote from the interior surface, each of the first and second portions defining an inside angle of less than 180° with respect to one another.

A reinforcing brace for protecting a longitudinal face of a lug of an endless track according to a preferred embodiment of the invention includes at least one flange positioned adjacent the longitudinal face, wherein the longitudinal face comprises an angled longitudinal face and the at least one flange includes a first flange portion and a second flange portion

angled with respect to the first flange portion to protect the angled longitudinal face. The lug may be a drive lug of a positively driven endless track, the at least one flange may be attached to the longitudinal face with at least one of a fastener and an adhesive, and/or the at least one flange may be embedded within the endless track adjacent the longitudinal face.

It is yet another aspect of the invention to provide an endless track having reinforcing braces made from wear-resistant material that are capable of preventing roller wheels from wearing away the longitudinal faces of drive lugs extending from the endless track.

It is another aspect of the invention to provide an endless track having reinforcing braces made from wear-resistant material that are capable of preventing the drive rollers of the planetary drive system from slipping when attempting to engage the drive lugs.

It is also another aspect of the invention to provide an endless track having reinforcing braces made from wear-resistant material that decreases the frequency at which the endless track must be replaced because the track is worn away, the number of work stoppages to replace the track, as well as labor costs.

In order to achieve the above, and to overcome the shortcomings in the related art, an endless drive track system according to a preferred embodiment of the invention includes a drive system, a plurality of roller wheels, and an endless track with reinforcing braces embedded in the endless track. Each reinforcing brace is made of wear-resistant material. The drive lugs extend in a direction inwardly from an interior surface of the endless track and have first and second longitudinal faces that may contact the roller wheels and a pair of drive faces that are engaged by the drive rollers to drive the endless track in a driven direction.

The reinforcing brace may include a horizontal section (embedded in the endless track) having a first end and a second end. Additionally, the reinforcing brace also includes a first flange extending from the horizontal section near the first longitudinal face of each drive lug and a second flange extending from the horizontal section near the second longitudinal face of each drive lug. The first and second flanges each extend from the interior surface of the endless track and have a width that extends along the longitudinal direction of the endless track.

In another embodiment of the invention, the reinforcing braces can also include a support rod attached to an interior face of the first flange and an interior face of the second flange with the support rod that maintains a distance between the first and second flanges. If a horizontal section is provided, the support rod extends substantially parallel to the horizontal section.

In another embodiment of the invention, a horizontal section of the reinforcing brace, if one is provided, can also include at least one aperture that is configured to interact with a portion of the endless track and promote positive locking of the reinforcing brace within the endless track. The aperture can also receive a bolt or other suitable fastening devices for attachment to the endless track and/or removable tread element.

In another embodiment of the invention, the reinforcing brace can include both a support rod attached to the interior faces of the first and second flanges and at least one aperture in the horizontal section.

The horizontal section may include a rib that extends away from the horizontal section in a direction opposite to the first and second flanges. The rib is located on a bottom face of the horizontal section at a position spanning a region that is at least between adjacent drive lugs. The rib extending from the bottom face provides the reinforcing brace with additional strength to guard against the brace from cracking when the endless track drives over an obstruction, such as a rock.

Additionally, a section of the exterior surface of the endless track may be relieved from between adjacent treads having the drive lugs extending from the interior surface. The relieved section of the exterior surface of the endless track reduces the manufacturing and material costs of the endless track and provides the endless track with additional space to channel any fluids through treads in the track to provide better traction.

Furthermore, a cap may be placed on top of the extending flanges to protect a top portion of the drive lug in embodiments neither a horizontal section nor a support rod would necessarily be provided.

These and other aspects will be described in or apparent from the following detailed description of preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention will be described in conjunction with the following drawings in which like reference numerals designate like elements and wherein:

Fig. 1 is a schematic side view of a tracked vehicle having a conventional endless drive track system;

Fig. 2 is an exploded perspective view of an exemplary drive section where drive rollers of the planetary drive system engage a drive section of the endless track;

Fig. 3 is a schematic diagram of the drive rollers engaging drive faces of the drive lugs of the conventional drive track system;

Fig. 4 is an exploded perspective view where the roller wheels of the conventional endless drive track system engage a drive section of the endless track;

Fig. 5 is a cross-sectional view of the roller wheels engaging a drive section of the endless track, as taken along section line 5-5 of Fig. 4;

Fig. 6 is an enlarged view of the dashed box of Fig. 5 to illustrate the worn regions of the longitudinal faces of the drive lugs due to frictional contact with the roller wheels;

Fig. 7 is a cross-sectional view of an endless track according to a preferred embodiment of the present invention;

Fig. 8 is a cross-sectional view of an endless track according to another preferred embodiment of the present invention;

Fig. 9 is a perspective view of a reinforcing brace for protecting a drive lug of the endless track, according to an embodiment of the invention.

Fig. 9A is a perspective view of a reinforcing brace for protecting a drive lug of the endless track, according to an embodiment of the invention;

Fig. 10 is a side elevational view of the reinforcing brace embedded in he endless track.

Fig. 10A is a side elevational view of the reinforcing brace embedded in the endless track;

Fig. 11 is cross-sectional view of the reinforcing brace of Fig. 10 embedded in the endless track to protect a drive lug;

Fig. 11A is a cross-sectional view of an alternative embodiment of a reinforcing brace embedded an endless track;

Fig. 11B is cross-sectional view of the reinforcing brace of Fig. 10A embedded in the endless track to protect a drive lug;

Fig. 11C is a cross-sectional view of an alternative embodiment of a reinforcing brace embedded an endless track;

Fig 11D is a side elevation view of an alternative embodiment of a reinforcing brace attached to a longitudinal face of a drive lug;

Fig. 12 is a cross-sectional view of a reinforcing brace embedded in an endless track to protect a drive lug, according to another embodiment of the invention;

Fig. 12A is perspective view of the reinforcing brace of Fig. 12;

Fig. 13 is a cross-sectional view of a reinforcing brace embedded in an endless track to protect a drive lug, according to another embodiment of the invention;

Fig. 13A is a cross-sectional view of another alternative embodiment of a reinforcing brace embedded in an endless track to protect a drive lug;

Fig. 14 is a perspective view of a reinforcing brace for protecting a drive lug of the endless track, according to another embodiment of the invention;

Fig. 14A is a cross-sectional view of the reinforcing brace of Fig. 14 embedded in the endless track to protect a drive lug;

Fig. 15 is a perspective view of a reinforcing brace for protecting a drive lug of the endless track, according to another embodiment of the invention;

Fig. 15A is a cross-sectional view of the reinforcing brace of Fig. 15 embedded in the endless track to protect a drive lug;

Fig. 16 is a perspective view of a reinforcing brace for protecting a drive lug of the endless track, according to another embodiment of the invention;

Fig. 17 is a cross-section view of the reinforcing brace of Fig. 16 embedded in the endless track to protect a drive lug;

Fig. 18 is a perspective view of a unitary reinforcing brace capable of simultaneously protecting at least two drive lugs, according to another embodiment of the invention;

Fig. 19 is a cross-sectional view of the unitary reinforcing brace of Fig. 18 embedded in an endless track to simultaneously protect at least two drive lugs;

Fig. 20 is a perspective view of the exterior surface of the drive section;

Fig. 21 is a side elevational view along section 21-21 of Fig. 20 with a relieved section of the tread depicted with hidden lines;

Fig. 22 is a perspective view of a unitary reinforcing brace for protecting at least two drive lugs of the endless track, according to another embodiment of the invention;

Fig. 23 is a cross-sectional view of the unitary reinforcing brace of Fig. 22 embedded in an endless track to protect at least two drive lugs;

Fig. 24 is a perspective view of a unitary reinforcing brace for protecting at least two drive lugs of the endless track, according to another embodiment of the invention;

Fig. 25 is a cross-sectional view of the unitary reinforcing brace of Fig. 24 embedded in an endless track to protect the at least two drive lugs;

Fig. 26 is a perspective view of an unitary reinforcing brace for protecting at least two drive lugs of the endless track, according to another embodiment of the invention;

Fig. 27 is a cross-section view of the unitary reinforcing brace of Fig. 26 embedded in an endless track to protect the drive lugs;

Fig. 27A is a perspective view of a removable steel tread;

Fig. 27B is a perspective view of a removable polymeric tread;

Fig. 28 is a cross-sectional view of a unitary reinforcing brace embedded in an endless track with reinforcing belts, according to another embodiment of the invention; and

Fig. 28A is a cross-sectional view of a unitary reinforcing brace embedded in an endless track with reinforcing belts, according to another embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 7 is a cross-sectional view of an endless track 3A according to one preferred embodiment of the present invention. The endless track 3A includes a pair of drive lugs 10' that are integrally formed with or attached to an interior surface 8' of the endless track 3A. A plurality of roller wheels 5 are disposed between drive lugs 10'.

Each of the drive lugs 10' includes angled longitudinal faces defined by a lower portion 10L extending from the interior surface 8' and an upper portion 10U forming a non-zero angle with the lower portion 10L. The non-zero angle defines an inside angle θ between the upper and lower portions 10U, that is less than 180°. Each lower portion 10L forms an angle β that is 90° or less with respect to the horizontal, e.g., the lower portion 10L forms a substantially right angle with respect to the interior surface 8', and each upper portion 10U forms an exterior angle α with respect to the lower portion 10L as measured from the upper portion 10U to a line extending from the lower portion 10L. The angle α can be selected to promote guidance of the roller wheels 5 into rolling contact with the interior surface 8', while at the same time reducing the possibility of contact between the lower portion 10L and the roller wheels 5. The angle α can be from about 5°-60°, but is preferably between about 30°-45°. If the angle α is too large, then the contact area between the drive faces 10b and 10d (Fig. 4) and the drive rollers 6 may be too small. If the angle α is too small, then possible contact between the roller wheels 5 and the upper portion 10U may be undesirably increased. The upper portion 10U also forms an obtuse angle γ with respect to the top portion 10e. Thus, both the angle θ and the angle γ may be obtuse angles.

Moreover, the dimensions of the upper and lower portions 10U, 10L should be selected to achieve both reduced contact between the roller wheels 5 and the lower portions 10L and positive engagement between the drive faces 10b, 10d and the drive rollers 6 (Figs. 2 and 3). For example, the length L of the lower portion 10L can be larger than the length ℓ of the upper portion 10U. For example, the length L of the lower portion can be about 1"-1.5", while the length ℓ of the upper portion 10U can be about 0.5" - 1.5".

Furthermore, the width of the drive faces 10b, 10d should be from about 2 to about 4 times the width of the longitudinal faces 10a, 10c.

Also, Fig 7 shows that the left and right sides of the central one of the roller wheels 5 are separated from the corresponding adjacent lower portion 10L by distances X and Y, respectively. The total length of the combined distances X and Y should be no more than about 3/16" - 1/4", and preferably no more than 3/16". With this amount of spacing, the lateral play or shifting of the endless track 3A can be further prevented, i.e., the distance between adjacent longitudinal faces (as measured along the interior surface 8') is about 3/16" - 1/4" greater than a thickness of the central one of the roller wheels 5.

Fig. 8 shows a preferred second embodiment of the present invention. Fig. 8 is a cross-sectional view of an endless track 3B and the planetary drive system 4, as shown in Figs. 1 and 3. In Fig. 8, the drive rollers 6 have been removed from the planetary drive system 4 for clarity. (In Fig. 4, the drum D has been removed from the drive rollers 6 for clarity.) The planetary drive system 4 includes a drum D that rotates about an axis A. Further details of this conventional planetary drive 4 can be seen in ASV's brochure entitled "POSI-TRACK HD -- Performance Beyond the Ordinary" (incorporated herein by reference), which shows a tracked vehicle.

The drum D includes end flanges 4A and 4B, as well as a central flange 4C. The central flange 4C divides the drum D into first and second drive sections DS1 and DS2. The first drive section DS1 defines a first annular recess R1 while the second drive section DS2 defines a second annular recess R2. The first annular recess R1 defines a drive lug insertion depth D1, while the second annular recess R2 defines a second drive lug insertion depth D2 that is less than the first drive lug insertion depth D1.

The endless track 3B in Fig. 8 is structured to cooperate with the planetary drive system 4. The endless track 3B includes a first drive lug 10' that is substantially identical to the drive lug 10' shown in Fig. 7. However, the endless track 3B also includes a second drive lug 10" that is different from the first drive lug 10'. One difference between the first and second drive lugs 10' and 10" is that the second drive lug 10" has a height H1 that is greater than a height H2 of the first drive lug 10'. This feature allows the second drive lug 10" to penetrate to the maximum possible extent within the recess R1 of the drum D, which increases positive engagement with the drive rollers 6 and promotes better guidance. Thus, the height H1 and the drive lug insertion depth D1 are substantially equal. The positions of the drive lugs 10' and 10" are shown in phantom lines within the recesses R2 and R1, respectively.

Another difference between the first and second drive lugs 10' and 10" is that the second drive lug 10" includes an asymmetrical shape due to upper and lower portions 10U and 10L that are shaped differently than the upper and lower portions 10U' and 10L'. The asymmetrical shape can be achieved by forming the lengths of the upper and lower portions 10U' and 10L' differently from the lengths of the upper and lower portions 10U and 10L, and/or by increasing or decreasing the exterior angle α' in comparison to the exterior angle α. The upper and lower portions 10U' and 10L' (on the right hand side of the second drive lug 10") are dimensioned so as to avoid interference or contact between the second drive lug 10" and, for example, a bolt B found in the inside surface of the first drive section DS1.

Fig. 9 is a perspective view of a reinforcing brace 100 for protecting a drive lug 10 of an endless track 3, according to one embodiment of the invention. Preferably, the reinforcing brace 100 is to be made from a wear-resistant material, such as, for example, metal and/or plastic materials. However, any material that can resist degradation or erosion due to the engagement of the drive rollers 6 from the planetary drive system 4 and/or the frictional contact of the roller wheels 5 would be suitable.

The reinforcing brace 100 may have a uniform thickness t, e.g., about 1/8" to about ½", and may include a horizontal section 110 having two ends. The ends of the horizontal section 110 can be bent to form extending flanges 120 and 130. For example, the brace 100 can initially be flat and then bent to form the flanges 120 and 130. Alternatively, the flanges can be attached, for example, by welding to a separate horizontal section. The horizontal section 110 may have a length of about 3"-5", which is preferably slightly longer than a length of the drive lug 10. Each flange 120 and 130 extends away from the horizontal section 110.

As shown in Fig. 10, the width of the flanges 120 and 130 is about 2"-3" at each base, and is substantially similar to, but slightly smaller than, the width of the longitudinal faces 10a and 10c of the drive lug 10 such that the drive roller 6 contacts the drive face 10b of the drive lug 10. The contour of an exterior face 121 and 131 of each extending flange 120 and 130 is also substantially similar to, but slightly smaller than, the contour of the longitudinal faces 10a and 10c of the drive lug 10. Also, each flange 120 and 130 of the reinforcing brace 100 has a vertical height that is slightly smaller than the height of the drive lugs 10.

Fig. 11 is cross-sectional view of the reinforcing brace 100 of Fig. 10 embedded in an endless track 3 to protect a drive lug 10. The exterior faces 121 and 131 of the extending flanges 120 and 130 serve to protect the longitudinal faces 10a and 10c of the drive lug 10

from the roller wheels 5 when the endless track 3 moves. As a result, the endless track 3 is not weakened, does not have to be replaced as often, nor are costs associated with corresponding work stoppages, such as labor, incurred. For example, the reinforcing brace 100 can extend the life of a drive belt to last up to 3000 hours or more because the drive lugs are protected from damage.

Interior faces 122 and 132 of the flanges 120 and 130 of the reinforcing brace 100 are depicted as being flush with the longitudinal faces 10a and 10c of the drive lug 10 for illustrative purposes. However, the flanges 120 and 130 can be formed to provide a predetermined gap (not shown) between the flanges 120 and 130 and the longitudinal faces 10a and 10c.

Fig. 11A shows another embodiment of the invention, which is similar to the reinforcing brace 100 shown in Fig. 9, but does not include a horizontal section 110. In Fig. 11A, the longitudinal faces 10a and 10c are protected and covered with flanges 120 and 130, which are simply embedded within the interior surface of the endless track 3.

Returning to Fig. 10, it can be seen that the drive rollers 6 engage the drive face 10b or 10d of each drive lug 10 depending on the rotation direction of the drive rollers 6. However, assuming wearing away of the drive faces 10b or 10d, edges 122 and 133 of the extending flanges 120 and 130 may come into contact with the drive rollers 6. Because the extending flanges 120 and 130 are made of wear-resistant material, the flanges 120 and 130 will not wear away or erode from contact with the drive rollers 6. Even if the drive faces 10b and 10d of the protected drive lug 10 do wear away or erode with the contact of the drive rollers 6, the drive rollers 6 of the planetary drive system 4 will drive the drive lugs 10 of the endless track 3 by engaging the edges 123 and 133 of the extending flanges 120 and 130, thereby preventing the planetary drive system 4 from "slipping" while attempting to drive the endless track 3.

Fig. 9A is a perspective view of a reinforcing brace 100 for protecting a drive lug 10 of an endless track 3, according to a preferred embodiment of the invention. Preferably, the reinforcing brace 100 is to be made from a wear-resistant material, such as, for example, metal and/or plastic materials. However, any material that can resist degradation or erosion due to the engagement of the drive rollers 6 from the planetary drive system 4 and/or the contact of the roller wheels 5 would be suitable.

The reinforcing brace 100 may have a uniform thickness t, e.g., about 1/8" to about 1/2", and may include a horizontal section 110 having two ends. The ends of the horizontal section 110 can be bent to form extending flanges 120 and 130. For example, the

brace 100 can initially be flat and then bent to form the flanges 120 and 130. Alternatively, the flanges can be attached, for example, by welding to a separate horizontal section. The horizontal section 110 may have a length of about 3"-5", which is preferably slightly longer than a length of the drive lug 10'. Each flange 120 and 130 extends away from the horizontal section 110. The flange 120 includes an upper flange portion 120A and a lower flange portion 120B, while the flange 130 includes an upper flange portion 130A and a lower flange portion 130B. The upper and lower portions are angled with respect to one another so as to match the shape of the drive lug 10'.

As shown in Fig. 10A, the width of the flanges 120 and 130 is about 2"-3" at each base, and is substantially similar to, but may be slightly smaller than, the width of the longitudinal faces of the drive lug 10' such that the drive roller 6 contacts the drive face 10b of the drive lug 10'. The contours of exterior faces 121 and 131 of each extending flange 120 and 130 are also substantially similar to, but may be slightly smaller than, the contours of the longitudinal faces of the drive lug 10'. Also, each flange 120 and 130 of the reinforcing brace 100 has a vertical height that may be slightly smaller than the height of the drive lugs 10'.

Fig. 11B is cross-sectional view of the reinforcing brace 100 of Fig. 10A embedded in an endless track 3 to protect the drive lug 10'. The exterior faces 121 and 131 of the extending flanges 120 and 130 serve to protect the longitudinal faces of each drive lug 10' from the roller wheels 5 when the endless track 3 moves. As a result, the endless track 3 is not weakened and does not have to be replaced as often. Also, costs associated with corresponding work stoppages, such as labor, are reduced. For example, the reinforcing brace 100, especially in combination with the shape of the drive lug 10', can extend the life of a drive belt to last up to 3000 hours or more because the drive lugs 10' are protected from damage.

Interior faces 122 and 132 of the flanges 120 and 130 of the reinforcing brace 100 are depicted as being flush with the upper and lower portions 10U, 10L of the longitudinal faces of the drive lug 10' for illustrative purposes. However, the flanges 120 and 130, and/or the upper and/or lower portions 10U, 10L thereof, can be formed to provide a predetermined gap (not shown) between the flanges 120 and 130 and the upper and lower portions 10U, 10L of the longitudinal faces.

Fig. 11C shows another embodiment of a reinforcing brace 100' of the present invention, which is similar to the reinforcing brace 100 shown in Fig. 9A, but does not include a horizontal section 110. In Fig. 11C, the longitudinal faces are protected and

covered with flanges 120' and 130', which are simply embedded within the interior surface of the endless track 3. Alternatively, as shown in Fig. 11D, the flanges 120' and 130' can be mounted directly on the longitudinal faces without embedding, using an adhesive or a fastener such as a screw 132. As shown, the flanges 120' an 130' can have dimensions that are larger than the dimensions (height and width) of the drive lugs 10' to promote better guidance of the roller wheels 5 and/or to reduce erosion of the drive faces 10b, 10d due to contact with the drive rollers 6.

Returning to Fig. 10A, it can be seen that the drive rollers 6 positively engage the drive face 10b or 10d of each drive lug 10' depending on the rotation direction of the drive rollers 6. However, assuming wearing away of the drive faces 10b or 10d, edges 123 and 133 of the extending flanges 120 and 130 may come into contact with the drive rollers 6. Because the extending flanges 120 and 130 are made of wear-resistant material, the flanges 120 and 130 will not wear away or erode from contact with the drive rollers 6. Even if the drive faces 10b and 10d of the protected drive lug 10' do wear away or erode due to contact with the drive rollers 6, the drive rollers 6 of the planetary drive system 4 will drive the drive lugs 10' of the endless track 3A by engaging the edges 123 and 133 of the extending flanges 120 and 130, thereby preventing the planetary drive system 4 from "slipping" while attempting to drive the endless track 3A.

Also, assuming the drive faces 10b or 10d do wear away, a top portion 10e of the protected drive lug 10 may wear away from the frictional engagement with the drive rollers 6. As such, Fig. 12 is a cross-sectional view of another embodiment of the reinforcing brace 150 for protecting a drive lug 10 of the endless track 3 from such an occurrence. The reinforcing brace 150 is substantially similar to the brace 100 depicted in Figs. 9-11, but includes a cap 151.

The cap 151 is made of a wear-resistant material, such as metal and/or plastic materials. However, any material that can resist degradation or erosion due to the engagement of the drive rollers 6 and/or the frictional contact from the rollers 5 would be suitable. The cap 151 is attached, for example, by welding to the top portion of each flange 120 and 130. As shown in Fig. 12A, which is a perspective view of the reinforcing brace 150, the cap 151 extends from the flange 120 to the other flange 130 to prevent the drive rollers 6 from wearing away the top portion 10e of the drive lug 10. Thus, even if the drive faces 10b and 10d of the protected drive lug 10 do wear away or erode with contact of the drive rollers 6, the drive rollers 6 of the planetary drive system 4 will drive the drive lugs 10 of the endless track 3 by engaging the edges 123 and 133 of the extending flanges 120

and 130 as well as the drive surfaces 152 or 153 of the cap 151, depending on the rotation direction of the drive rollers, thereby preventing the planetary drive system 4 from "slipping" while attempting to drive the endless track 3, as well as to prevent erosion of the top portion 10e of the drive lug 10, thereby extending the useful life of the lug 10.

Also, assuming the drive faces 10b or 10d do wear away, the top portion 10e of the protected drive lug 10' may wear away from the frictional engagement with the drive rollers 6. Fig. 13 is a cross-sectional view of another embodiment of a reinforcing brace 150 for protecting a drive lug 10' of the endless track 3 from such an occurrence. The reinforcing brace 150 is substantially similar to the reinforcing brace 100 depicted in Figs. 9A, 10A and 11B, but includes a cap 151. Alternatively, the reinforcing brace 100' in Fig. 11C can be used to avoid abrasion damage to the top portion of the drive lug 10'.

The cap 151 is made of a wear-resistant material, such as metal and/or plastic materials. However, any material that can resist degradation or erosion due to the engagement of the drive rollers 6 and/or the frictional contact from the rollers 5 would be suitable. The cap 151 is attached, for example, by welding to the top portion of each flange 120 and 130. The cap 151 extends from the flange 120 to the other flange 130 to prevent the drive rollers 6 from wearing away the top portion 10e of the drive lug 10'. Thus, even if the drive faces 10b and 10d of the protected drive lug 10' do wear away or erode with contact of the drive rollers 6, the drive rollers 6 of the planetary drive system 4 will drive the drive lugs 10' of the endless track 3A by engaging the edges 123 and 133 of the extending flanges 120 and 130 as well as the drive surfaces 152 or 153 of the cap 151, depending on the rotation direction of the drive rollers, thereby preventing the planetary drive system 4 from "slipping" while attempting to drive the endless track 3A, as well as to prevent erosion of the top portion 10e of the drive lug 10', thereby extending the useful life of the lug 10'.

Fig. 13A is a cross-sectional view of another reinforcing brace 200 embedded in an endless track 3 to protect a drive lug 10'. The exterior faces 221 and 231 of the extending flanges 220 and 230 serve to protect the upper and lower portions 10U, 10L of the longitudinal faces of the drive lug 10' from the roller wheels 5 when the endless track 3 moves in a direction parallel to the axes of the roller wheels 5. A support rod 250 maintains a distance between the flanges 220, 230.

Furthermore, the drive rollers 6 frictionally engage the drive faces 10b or 10d of each drive lug 10', depending on the rotation direction of the drive rollers 6. However, assuming wearing away of one of the drive faces 10b and 10d, edges 223 and 233 of the extending flanges 220 and 230 may come into contact with the drive rollers 6 in a manner substantially

similar to the reinforcing brace 100 of Figs. 9A, 10A and 11B discussed above. Also, if the top portion 10e of the protected drive lug 10' does wear away, the drive rollers 6 of the planetary drive system 4 will still be able to drive the drive lugs 10' of the endless track 3 by engaging the support rod 250, in addition to the edges 223 and 233 of the extending flanges 220 and 230, thereby preventing the planetary drive system 4 from "slipping" while attempting to drive the endless track 3A.

Fig. 13B also shows that a horizontal section 210 of the reinforcing base 200 may connect the first and second flanges 220 and 230. The horizontal section 210 may include one or more apertures 202 that are configured to interact with a portion of the endless track 3A to improve structural integrity and rigidity.

Fig. 14 is a perspective view of a reinforcing brace 200 for protecting a drive lug 10 of the endless track 3, according to another embodiment of the invention. The reinforcing brace 200 is substantially similar to the brace 100 depicted in Figs. 9-11, but includes a support rod 250. Preferably, the support rod 250 is a uniform piece of a wear-resistant material having a first end and a second end. The first end of the support rod 250 is attached, for example only, by welding, to an interior face 222 of one extending flange 222 and the second end is attached to the interior face 232 of the other extending flange 232 in a similar manner.

Fig. 14A is a cross-sectional view of the reinforcing brace 200 of Fig. 14 embedded in an endless track 3 to protect a drive lug 10. The exterior faces 221 and 231 of the extending flanges 220 and 230 serve to protect the longitudinal faces 10a and 10c of the drive lug 10 from the roller wheels 5 when the endless track 3 moves in a direction parallel to the axes of the roller wheels 5. The support rod 250 maintains a distance between the flanges 220, 230.

Furthermore, the drive rollers 6 frictionally engage the drive faces 10b or 10d of each drive lug 10, depending on the rotation direction of the drive rollers 6. However, assuming wearing away of one drive faces 10b and 10d, edges 223 and 233 of the extending flanges 220 and 230 may come into contact with the drive rollers 6 in a manner substantially similar to the reinforcing braces as discussed above. Also, if a top portion 10e of the protected drive lug 10 does wear away, the drive rollers 6 of the planetary drive system 4 will still be able to drive the drive lugs 10 of the endless track 3 by engaging the support rod 250, in addition to the edges 223 and 233 of the extending flanges 220 and 230, thereby preventing the planetary drive system 4 from "slipping" while attempting to drive the endless track 3.

Figs. 15-28 show additional preferred embodiments of the present invention. Although these embodiments show reinforcing braces that have flanges that are planar, the reinforcing braces could also include flanges that are double-angled as well, as shown in Fig. 28A.

Fig. 15 is a perspective view of a reinforcing brace 300 for protecting a drive lug 10 of the endless track 3, according to another embodiment of the invention. The reinforcing brace 300 is substantially similar to the brace 100 depicted in Figs. 9-11, but includes two apertures 360 in the horizontal section 310. The apertures 360 are configured to interact with a portion of the endless track and promote locking of the reinforcing brace 300 within the endless track 3.

Fig. 15A is a cross-sectional view of the reinforcing brace 300 of Fig. 15 embedded in an endless track 3 to protect a drive lug 10. The exterior faces 321 and 331 of the extending flanges 320 and 330 protect the longitudinal faces 10a and 10c of the drive lug 10 from the roller wheels 5 when the endless track 3 moves in a direction parallel to the axes the roller wheels 5. Additionally, the drive rollers 6 frictionally engage the drive face 10b or 10d of each drive lug 10, depending on the rotation direction of the drive rollers 6. However, assuming wearing away of one of the drive faces 10b and 10d, edges 323 and 333 of the extending flanges 320 and 330 may come into contact with the drive rollers 6 in a manner substantially similar to the reinforcing braces discussed above.

Fig. 16 is a perspective view of a reinforcing brace 400 for protecting a drive lug 10 of the endless track 3, according to another embodiment of the invention. The reinforcing brace 400 is substantially similar to the reinforcing brace 300 depicted in Figs. 14 and 14A, but includes a support rod 450. The support rod 450 is substantially similar to the rod 250 depicted in Figs. 14-14A and is attached to the interior faces 422 and 432 of the extending flanges 420 and 430 in a similar manner.

Fig. 17 is a cross-section view of the reinforcing brace 400 of Fig. 16 embedded in an endless track 3 to protect a drive lug 10. The exterior faces 421 and 431 of the extending flanges 420 and 430 serve to protect the longitudinal faces 10a and 10c of the drive lug 10 from the roller wheels 5 when the endless track 3 moves in a direction parallel to the axes of the roller wheels 5. The support rod 450 maintains a distance and prevents separation between the flanges 420 and 430. Furthermore, the drive rollers 6 frictionally engage the drive faces 10b or 10d of each drive lug 10, depending on the rotation direction of the drive rollers 6. However, assuming wearing away of the drive faces 10b or 10d, edges 423 and 433

of the extending flanges 420 and 430 may come into contact with the drive rollers 6 in a manner substantially similar to the reinforcing braces discussed above.

Also, if a top portion 10e of the protected drive lug 10 does wear away, the drive rollers 6 of the planetary drive system 4 will still be able to drive the drive lugs 10 of the endless track 3 by engaging the support rod 450, in addition to the edges 423 and 433 of the extending flanges 420 and 430, thereby preventing the planetary drive system 4 from "slipping" while attempting to drive the endless track 3.

Fig. 18 is a perspective view of a unitary reinforcing brace 500 capable of simultaneously protecting at least two drive lugs 10, 10. The unitary reinforcing brace 500 is made from a wear-resistant material and may have a uniform thickness t. The unitary reinforcing brace 500 includes a solid horizontal 510 section having two ends. At least one pair of flanges 520 and 530 extend from the horizontal section at a position corresponding to the location of the drive lugs 10,10. The flanges 520 and 530 may be attached to the horizontal section by, for example, welding, thereby improving the structural integrity of the endless track as well as the rigidity of the reinforcing brace 500.

Each flange 520 and 530 extends away from the horizontal section 510. The number of pair of flanges can equal the number of drive lugs. Additionally, the width and contour of the flanges 520 and 530 are substantially similar to, but slightly smaller than, the width and contour of the longitudinal faces 10a and 10c of the drive lug 10 in a manner similar to the embodiment shown in Fig. 10.

Fig. 19 is a cross-sectional view of the unitary reinforcing brace 500 of Fig. 18 embedded in an endless track 3 to simultaneously protect at least two drive lugs 10,10. The exterior faces 521 and 531 of the extending flanges 520 and 530 serve to protect the longitudinal faces 10a and 10c of the drive lug 10 from the roller wheels 5 when the endless track 3 moves in a direction parallel to the axes of the roller wheels 5. Although the flanges 520 and 530 of the unitary reinforcing brace 500 are depicted as being flush with the longitudinal faces 10a and 10c of the drive lugs 10,10, the flanges 520 and 530 can be formed to provide a predetermined gap (not shown) between the flanges 520 and 530 and the longitudinal faces 10a and 10c. Additionally, each flange 520 and 530 has a vertical height slightly smaller than the vertical height of the drive lugs 10,10.

The drive rollers 6 frictionally engage the drive face 10b or 10d of each drive lug 10,10, depending on the rotation direction of the drive rollers 6. However, assuming wearing away of the drive faces 10b or 10d, edges 523 and 533 of the extending flanges 520 and 530 may come into contact with the drive rollers 6. Because the extending flanges 520

and 530 are made of a wear-resistant material, the flanges 520 and 530 will not wear away from the frictional contact with the drive rollers 6. As such, the drive faces 10b and 10d will not erode as quickly as the unprotected drive lugs in the conventional endless track. Thus, even if the drive faces 10b and 10d of the protected drive lugs 10,10 do wear away with the frictional contact of the drive rollers 6, the drive rollers 6 of the planetary drive system 4 will drive the drive lugs 10 of the endless track 3 by engaging the edges 523 and 533 of the extending flanges 520 and 530, thereby preventing the planetary drive system 4 from "slipping" while attempting to drive the endless track 3.

Additionally, Fig. 19 shows the unitary reinforcing brace having a rib 580 protruding from the horizontal section 510 in a direction toward the exterior surface 9 of the drive section 7. The rib 580 is located at a position spanning at least the region of the horizontal section 510 between adjacent drive lugs 10,10. The rib 580 provides the unitary reinforcing brace 500 with additional strength, for example, when the tracked vehicle 1 is driven over an impediment, such as, for example, a rock or the like.

Furthermore, a section 570 of the exterior surface 9 of the drive section 7 may be relieved from the tread T2 between the treads T1 and T3 having the drive lugs 10 formed on a reverse surface thereof, as shown in Fig. 20. The relieved section 570 of the exterior surface 9 not only reduces the amount of material needed to form the track 3, but also provides the endless track 3 with additional space to channel any materials, such as rain, ground, dirt and the like through tread T2 in the exterior surface 9 of the track 3 to provide better traction. The dash-lined boxes represent the drive lugs 10, which extend from the interior surface (not shown) of the endless track. The side-elevational view of Fig. 21 shows the additional channeling provided by the relieved section 570 in the tread T2. This feature can be used with any of the embodiments described in this application.

Fig. 22 is a perspective view of a unitary reinforcing brace 600 for protecting at least two drive lugs 10,10 of the endless track 3, according to another embodiment of the invention. The unitary reinforcing brace 600 is substantially similar to the brace 500 depicted in Figs. 18-19, but includes a support rod 650 for each pair of extending flanges 620 and 630. Preferably, the support rod 650 is a uniform piece of a wear-resistant material having a first end and a second end where the first end of the support rod 650 is attached, for example, by welding, to an interior face 622 of one extending flange 620 of each pair of flanges and the second end is attached to the interior face 632 of the other extending flange 630 in a similar manner. The support rod 650 maintains a distance and prevents separation between the flanges 620 and 630.

Fig. 23 is a cross-sectional view of the unitary reinforcing brace 600 of Fig. 22 embedded in an endless track 3 to protect at least two drive lugs 10,10. The exterior faces 621 and 631 of the extending flanges 620 and 630 serve to protect the longitudinal faces 10a and 10c of the drive lugs 10,10 from the roller wheels 5 when the endless track 3 moves in a direction parallel to the axes of the roller wheels 5. Furthermore, the drive rollers 6 frictionally engage the drive faces 10b or 10d of each drive lug 10,10 depending on the rotation direction of the drive rollers 6. However, assuming wearing away of the drive faces 10b or 10d, edges 623 and 633 of the extending flanges 620 and 630 may come into contact with the drive rollers 6 in a manner substantially similar to the unitary reinforcing brace 500 as discussed above. Additionally, if the top portion 10e of the protected drive lugs 10,10 does wear away, the drive rollers 6 of the planetary drive system 4 will drive the drive lugs 10,10 of the endless track 3 by engaging the edges 623 and 633 of the extending flanges 620 and 630, thereby preventing the planetary drive system 4 from "slipping" while attempting to drive the endless track 3.

Fig. 24 is a perspective view of a unitary reinforcing brace 700 for protecting at least two drive lugs 10,10 of the endless track 3, according to another embodiment of the invention. The unitary reinforcing brace 700 is substantially similar to the brace 600 depicted in Figs. 18-19, but includes at least one aperture 760 in the horizontal section 710 between each pair of extending flanges 720 and 730. The apertures 760 are configured to interact with a portion of the endless track 3 and promote locking of the reinforcing brace 700 embedded in the endless track 3.

Fig. 25 is a cross-sectional view of the unitary reinforcing brace 700 of Fig. 24 embedded in an endless track 3 to protect the at least two drive lugs 10,10. The exterior faces 721 and 731 of each extending flange 720 and 730 protects the longitudinal faces 10a and 10c of each drive lug 10 from the roller wheels 5 when the endless track 3 moves in a direction parallel to the axes of the roller wheels 5. Additionally, the drive rollers 6 frictionally engage the drive face 10b or 10d of each drive lug 10 depending on the rotation direction of the drive rollers 6. However, assuming wearing away of the drive faces 10b or 10d, edges 723 and 733 of the extending flanges 720 and 730 may come into contact with the drive rollers 6 in a manner substantially similar to the unitary reinforcing braces 500 and 600 discussed above.

Fig. 26 is a perspective view of a unitary reinforcing brace 800 for protecting at least two drive lugs 10,10 of the endless track 3, according to another embodiment of the invention. The unitary reinforcing brace 800 is substantially similar to the brace 700 depicted

in Figs. 22-23, but includes a support rod 850 between each pair of extending flanges 820 and 830. The support rod 850 is substantially similar to the rod 650 depicted in Figs. 20-21 and is attached to the interior faces 822 and 832 of the extending flanges 820 and 830 in a similar manner, e.g., by welding. The support rod 850 maintains a distance and prevents separation between the flanges 820 and 830.

Fig. 27 is a cross-sectional view of the unitary reinforcing brace 800 of Fig. 26 embedded in an endless track 3 to protect the drive lugs 10,10. The exterior faces 821 and 831 of the extending flanges 820 and 830 serve to protect the longitudinal faces 10a and 10c of the drive lugs 10,10 from the roller wheels 5 when the endless track 3 moves in a direction parallel to the axes of the roller wheels 5. Furthermore, the drive rollers 6 frictionally engage the drive faces 10b or 10d of each drive lug 10,10 depending on the rotation direction of the drive rollers 6. However, assuming wearing away of the drive faces 10b or 10d, edges 823 and 833 of the extending flanges 820 and 830 may come into contact with the drive rollers 6 in a manner substantially similar to the unitary reinforcing brace 600 of the seventh embodiment as discussed above. Also, if the top portion 10e of the protected drive lugs 10,10 does wear away, the drive rollers 6 of the planetary drive system 4 will drive the drive lugs 10,10 of the endless track 3 by engaging the edges 823 and 833 of the extending flanges 820 and 830, thereby preventing the planetary drive system 4 from "slipping" while attempting to drive the endless track 3.

Furthermore, as discussed above, the apertures 360, 460, 760 and 860 in the reinforcing braces 300, 400, 700 and 800, respectively, are configured to interact with a portion of the endless track 3 and promote locking of the braces 300, 400, 700 and 800 embedded in the track 3. However, each of the apertures 360, 460, 760 and 860 may be used with a drive section 7 that preferably includes removable tread elements 875 or 885 having suitable bolts or other fastening means that can be received in the apertures 360, 460, 760 and 860 of the horizontal section 310, 410, 710 and 810, respectively. For example, if the treads T1, T2 and T3 can be removable, such as steel treads 875 in Fig. 27A and polymeric treads 885 in Fig. 27B. The polymeric treads 885 may have a tapered cross-section 886, while the steel treads 875 may have a U-shaped contour or channel 876. The polymeric tread 885 may include a metal or reinforcing plate 888 for attachment with the reinforcing brace. Removable tread elements are disclosed, for example, in U.S. Patent No. 5,005,921 to Edwards et al. entitled "Endless Track Drive System," e.g., see Fig. 7, which is incorporated herein in its entirety.

The reinforcing brace according to the invention is used to protect at least one drive lug of the endless track by embedding the reinforcing brace in the endless track a predetermined depth such that each flange extends away from the horizontal member and exterior surface of the endless track toward the endless drive system. To embed the reinforcing brace in the endless track, the pre-formed reinforcing brace is immersed in, e.g., a molten polymeric solution in a mold from which the endless track is formed. The reinforcing brace is positioned within the mold at a location in which a drive lug is formed such that each reinforcing brace encompasses a drive lug.

The polymeric solution with the reinforcing brace is then permitted to cool. Once the polymeric solution has cooled and solidified, the endless track with the reinforcing brace embedded therein is then removed from the mold. The endless track is then placed on a vehicle intended to travel across the ground.

Fig. 28 shows a cross-sectional view of a unitary brace 900 embedded in a reinforced endless track 903 according to another embodiment of the invention. The endless track 903 is reinforced with belts 905,906 extending within the track 903 in the longitudinal direction of the track 903. The belts can be made from a polymeric material different than the polymeric material from which the track body 904 is made. Furthermore, the belts 905 positioned within the drive lugs 10 can be larger than the belts 906 between and outside the drive lugs 10 in the longitudinal direction of the endless track 3.

Fig. 28A shows a cross-sectional view of a unitary reinforcing brace 900 embedded in a reinforced endless track 903 according to another preferred embodiment of the invention. The reinforcing brace 900 includes two sets of flanges 920, 930 mounted on a common element embedded within the endless track 903. The endless track 903 is reinforced with belts 905, 906 extending within the track 903 in the longitudinal direction of the track 903. The belts can be made from a polymeric material, e.g., kevlar, that is different than the polymeric material from which the track body 904 is made. Moreover, the belts can also be cables and/or the track 903 can be made of a strength enhanced material. Furthermore, the belts 905 positioned within the drive lugs 10' can be larger than the belts 906 between and outside the drive lugs 10' in the longitudinal direction of the endless track 3A.

Additionally, although preferred embodiments of the invention as set forth herein describe an endless track as a closed-loop integral assembly, the endless track 3, 3A, 3B can be one or more sections interconnected by one or more master link joint assemblies, such as disclosed in U.S. Patent Nos. 4,844,560 entitled "Endless Drive Track Joint Assembly"; 5,020,865 also entitled "Endless Drive Track Joint Assembly"; and 5,040,282

entitled "Method of Making A Modular Endless Track Drive System", all issued to Edwards et al. and all incorporated herein by reference in their entireties. For example, the reinforcing cables or belts 905 and 906 of Fig. 14 can be arranged for this purpose around a grooved rod sandwiched between connected portions of a master link joint assembly as shown in Fig. 12 of U.S. Patent No. 4,844,560.

Furthermore, while positively driven endless tracks have been described, at least the reinforcing braces described herein can be used in friction driven tracks as well to protect each of a series of guide lugs, such as those used in Caterpillar's Challenger 85E and 95E tracks. Depending on the shape of the guide lugs, the flange of the reinforcing brace (such as shown in Figs. 11A or 11B) need not have an angled shape.

While the invention has been described in conjunction with the specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, preferred embodiments of the invention as set forth herein are intended to be illustrative, not limiting. Various changes may be made without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. An endless drive track system for use with a tracked vehicle, comprising:

a positively driven endless track having an interior surface and a plurality of drive lugs attached to the interior surface, each of the drive lugs including at least one drive face and first and second longitudinal faces, each of the first and second longitudinal faces having a first portion adjacent the interior surface and a second portion remote from the interior surface, said first and second portions defining an inside angle of less than 180° with respect to one another; and

a drive system cooperateable with each said at least one drive face of the drive lug.

2. The endless drive track system according to claim 1, further comprising a plurality of roller wheels that guide and support the endless track, the plurality of roller wheels being positionable for possible contact with the first and second longitudinal faces of the drive lug.

3. The endless drive track system according to claim 2, wherein the roller wheels may possibly contact primarily the first portion of each of the first and second longitudinal faces.

4. The endless drive track system according to claim 2, wherein a distance between longitudinal faces of adjacent drive lugs is no more than about 3/16" -1/4" greater than a thickness of one of the roller wheels.

5. The endless drive track system according to claim 1, wherein the first portion of each of the first and second longitudinal faces is substantially perpendicular to the interior surface, and an exterior angle between each first portion and each corresponding second portion is about 30-45° as measured from the second portion to a line extending from the first portion.

6. The endless drive track system according to claim 5, wherein the first portion of the first longitudinal face is larger than the first portion of the second longitudinal face.

7. The endless drive track system according to claim 5, wherein the exterior angle between the first and second portions of the first longitudinal face is different than the exterior angle between the first and second portions of the second longitudinal face.

8. The endless drive track system according to claim 1, wherein the drive system includes a rotatable drum including a plurality of drive rollers circumferentially spaced around the drum, the drum including a central flange positioned to separate the drum into first and second drive sections, the first drive section of the drum having a first drive lug insertion

depth larger than a second drive lug insertion depth of the second drive section of the drum, wherein a first one of the drive lugs accommodated in the first drive section of the drum has a height that is greater than a height of a second one of the drive lugs, adjacent the first one of the drive lugs, accommodated in the second drive section of the drum.

9. The endless drive track system according to claim 8, wherein the second portion of the first longitudinal face of the first one of the drive lugs that faces the central flange is dimensioned differently from the second portion of the second longitudinal face of the first one of the drive lugs.

10. The endless drive track system according to claim 1, further comprising a reinforcing brace including a first flange adjacent the first longitudinal face and a second flange adjacent the second longitudinal face.

11. The endless drive track system according to claim 10, wherein the reinforcing brace further comprises a support rod attached to an interior face of the first flange and an interior face of the second flange.

12. The endless drive track system according to claim 10, wherein the reinforcing brace includes a horizontal section embedded within the interior surface and connecting the first and second flanges.

13. The endless drive track system according to claim 12, wherein the reinforcing brace further comprises:

a support rod attached to an interior face of the first flange and an interior face of the second flange and extending substantially parallel to the horizontal section; and

at least one aperture in the horizontal section, the at least one aperture being configured to interact with a portion of the endless track.

14. The endless drive track system according to claim 13, wherein the horizontal section spans across at least two drive lugs and includes first and second sets of the first and second flanges.

15. The endless drive track system according to claim 10, wherein each of the first and second flanges includes a first flange portion and a second flange portion corresponding to said first and second portions of each of said first and second longitudinal faces.

16. The endless drive track system according to claim 10, further comprising a horizontal section spanning across at least two drive lugs and including first and second sets of the first and second flanges.

17. The endless drive track system according to claim 1, wherein the endless track is reinforced with a plurality of at least one of cables and belts extending within the endless track in a longitudinal direction of the endless track.

18. A positively driven endless track comprising:

an interior surface; and

a plurality of drive lugs attached to the interior surface, each of the drive lugs including at least one drive face and first and second longitudinal faces, each of the first and second longitudinal faces having a first portion adjacent the interior surface and a second portion remote from the interior surface, said first and second portions defining an inside angle of less than 180° with respect to one another.

19. The positively driven endless track according to claim 18, wherein the first portion of each of the first and second longitudinal faces is substantially perpendicular to the interior surface, and an exterior angle between each first portion and each corresponding second portion is about 30-45° as measured from the second portion to a line extending from the first portion.

20. The positively driven endless drive track according to claim 19, wherein the first portion of the first longitudinal face is larger than the first portion of the second longitudinal face.

21. The positively driven endless drive track according to claim 19, wherein the exterior angle between the first and second portions of the first longitudinal face is different than the exterior angle between the first and second portions of the second longitudinal face.

22. The positively driven endless drive track according to claim 18, wherein a first one of the drive lugs has a height that is greater than a height of a second one of the drive lugs adjacent the first one of the drive lugs.

23. The positively driven endless drive track according to claim 22, wherein the second portion of the first longitudinal face of the first one of the drive lugs is dimensioned differently from the second portion of the second longitudinal face of the first one of the drive lugs.

24. The positively driven endless track according to claim 18, further comprising a reinforcing brace having a first flange and a second flange, the first flange being adjacent the first longitudinal face and the second flange being adjacent the second longitudinal face.

25. The positively driven endless track according to claim 24, wherein the reinforcing brace further comprises a support rod attached to an interior face of the first flange and an interior face of the second flange.

26. The positively driven endless drive track according to claim 24, further comprising a horizontal section connecting the first and second flanges and including at least one aperture.

27. The positively driven endless drive track according to claim 24, wherein the reinforcing brace further comprises:

a support rod attached to an interior face of the first flange and an interior face of the second flange; and

a horizontal section connecting the first and second flanges.

28. The positively driven endless drive track according to claim 27, wherein the horizontal section spans across at least two drive lugs and includes first and second sets of the first and second flanges.

29. The positively driven endless track according to claim 24, further comprising a cap attached to a top portion of the first and second flanges, the cap being positioned adjacent a top portion of each of the drive lugs.

30. The positively driven endless track according to claim 24, wherein each of the first and second flanges includes a first flange portion and a second flange portion corresponding to said first and second portions of said first and second longitudinal faces.

31. The positively driven endless track according to claim 18, wherein the endless track is reinforced with a plurality of at least one of cables and belts extending within the endless track in a longitudinal direction of the endless track.

32. A reinforcing brace for protecting a longitudinal face of a lug of an endless track and comprising at least one flange positioned adjacent the longitudinal face, wherein the longitudinal face is an angled longitudinal face and the at least one flange includes a first flange portion and a second flange portion angled with respect to the first portion to protect the angled longitudinal face.

33. The reinforcing brace according to claim 32, wherein the lug is a drive lug of a positively driven endless track.

34. The reinforcing brace according to claim 32, wherein the at least one flange is attached to the longitudinal face with at least one of a fastener and an adhesive.

35. The reinforcing brace according to claim 32, wherein the at least one flange is embedded within the endless track adjacent the longitudinal face.

36. An endless drive track system for use with a tracked vehicle, comprising:

a drive system;

an endless track having a plurality of drive lugs, each drive lug including at least one drive face and first and second longitudinal faces, the drive face cooperating with the drive system;

a plurality of roller wheels that guide and support the endless track, the roller wheels being positionable to possibly contact the first and second longitudinal faces of the drive lug; and

a reinforcing brace including a first flange adjacent the first longitudinal face and a second flange adjacent the second longitudinal face.

37. The endless drive track system according to claim 36, wherein the reinforcing brace further comprises a support rod attached to an interior face of the first flange and an interior face of the second flange, the support rod maintaining a distance between the interior faces of the first and second flanges.

38. The endless drive track system according to claim 36, wherein the reinforcing brace includes a horizontal section connecting the first and second flanges.

39. The endless drive track system according to claim 38, wherein the reinforcing brace further comprises:

a support rod attached to an interior face of the first flange and an interior face of the second flange and extending substantially parallel to the horizontal section and maintaining a distance between the interior faces of the first and second flanges; and

at least one aperture in the horizontal section, the at least one aperture being configured to interact with a portion of the endless track.

40. The endless drive track system according to claim 39, wherein the horizontal section spans across at least two drive lugs and includes first and second sets of the first and second flanges.

41. The endless drive track system according to claim 40, wherein the horizontal section further comprises a rib extending away from the horizontal section in a direction opposite to the first and second flanges.

42. The endless drive track system according to claim 40, wherein the endless track includes an exterior surface having a portion of a tread being relieved.

43. The endless drive track system according to claim 38, wherein the horizontal section spans across at least two drive lugs and includes first and second sets of the first and second flanges.

44. The endless drive track system according to claim 43, wherein the horizontal section further comprises a rib extending away from the horizontal section in a direction opposite to the first and second flanges.

45. The endless drive track system according to claim 43, wherein the endless track includes an exterior surface having a portion or a tread being relieved.

46. The endless drive track system according to claim 37, further comprising a horizontal section spanning across at least two drive lugs, said horizontal section including first and second sets of the first and second flanges.

47. The endless drive track system according to claim 46, wherein the horizontal section further comprises a rib extending away from the horizontal section in a direction opposite to the first and second flanges.

48. The endless drive track system according to claim 46, wherein the endless track includes an exterior surface having a portion of a tread being relieved.

49. The endless drive track system according to claim 36, further comprising a horizontal section spanning across at least two drive lugs and including first and second sets of the first and second flanges.

50. The endless drive track system according to claim 49, wherein the horizontal section further comprises a rib extending away from the horizontal section in a direction opposite to the first and second flanges.

51. The endless drive track system according to claim 36, wherein the endless track includes an exterior surface having a portion of a tread being relieved.

52. The endless drive track system according to claim 36, wherein the first flange extends from a first end of a horizontal section and the second flange extends from a second end of the horizontal section.

53. The endless drive track system according to claim 52, wherein the reinforcing brace further comprises a support rod attached to an interior face of the first flange and an interior face of the second flange, the support rod extending substantially parallel to the horizontal section and maintaining a distance between the interior faces of the first and second flanges.

54. The endless drive track system according to claim 52, wherein the horizontal section of the reinforcing brace further includes at least one aperture configured to interact with a portion of the endless track.

55. The endless drive track system according to claim 52, wherein the reinforcing brace further comprises:

a support rod attached to an interior face of the first flange and an interior face of the second flange and extending substantially parallel to the horizontal section and maintaining a distance between the interior faces of the first and second flanges; and

at least one aperture in the horizontal section, the at least one aperture being configured to interact with a portion of the endless track.

56. The endless drive track system according to claim 36, wherein the endless track is reinforced with a plurality of belts extending within the endless track in a longitudinal direction of the endless track.

57. An endless track comprising:

an interior surface having at least one drive lug, the at least one drive lug including first and second longitudinal faces;

an exterior surface facing a direction opposite to the interior surface; and

a reinforcing brace embedded in the endless track between the interior and exterior surfaces, the reinforcing brace being made of wear-resistant material and comprising a first flange and a second flange, the first flange being adjacent the first longitudinal face and the second flange being adjacent the second longitudinal face.

58. The endless track according to claim 57, wherein the reinforcing brace further comprises a support rod attached to an interior face of the first flange and an interior face of the second flange, the support rod maintaining a distance between the interior faces of the first and second flanges.

59. The endless drive track system according to claim 57, further comprising a horizontal section connecting the first and second flanges and including at least one aperture.

60. The endless drive track system according to claim 57, wherein the reinforcing brace further comprises:

a support rod attached to an interior face of the first flange and an interior face of the second flange and maintaining a distance between the interior faces of the first and second flanges; and

a horizontal section connecting the first and second flanges.

61. The endless drive track system according to claim 60, wherein the horizontal section spans across at least two drive lugs and includes first and second sets of the first and second flanges.

62. The endless drive track system according to claim 61, wherein the horizontal section further comprises a rib extending away from the horizontal section in a direction opposite to the first and second flanges.

63. The endless drive track system according to claim 61, wherein the endless track includes an exterior surface defining a tread, a portion of which is relieved.

64. The endless drive track system according to claim 57, wherein the first flange extends from a first end of a horizontal section and the second flange extends from a second end of the horizontal section.

65. The endless drive track system according to claim 64, wherein the reinforcing brace further comprises a support rod attached to an interior face of the first flange and an interior face of the second flange, the support rod extending substantially parallel to the horizontal section and maintaining a distance between the interior faces of the first and second flanges.

66. The endless drive track system according to claim 64, wherein the horizontal section of the reinforcing brace further includes at least one aperture configured to interact with a portion of the endless track.

67. The endless drive track system according to claim 64, wherein the reinforcing brace further comprises:

a support rod attached to an interior face of the first flange and an interior face of the second flange and extending substantially parallel to the horizontal section and maintaining a distance between the interior faces of the first and second flanges; and

at least one aperture in the horizontal section, the at least one aperture being configured to interact with a portion of the endless track.

68. The endless track according to claim 57, wherein the endless track is reinforced with a plurality of belts extending within the endless track in a longitudinal direction of the endless track.

69. The endless track according to claim 57, further comprising a cap attached to a top portion of the first and second flanges, the cap shielding a top portion of the drive lug.

70. The endless track according to claim 57, comprising at least one section interconnected by at least one master link joint assembly.

71. A method for forming an endless drive track having a plurality of drive lugs, each drive lug having first and second longitudinal faces, the endless drive track including an interior surface from which each drive lug of the plurality of drive lugs extends and an exterior surface facing a direction opposite to the interior surface, the method comprising:

forming an endless track; and

embedding a reinforcement brace within the endless track between the interior and exterior surfaces of the endless track, wherein first and second flanges of the reinforcing

brace extend inwardly from the interior surface to substantially cover the first and second longitudinal faces of each drive lug.

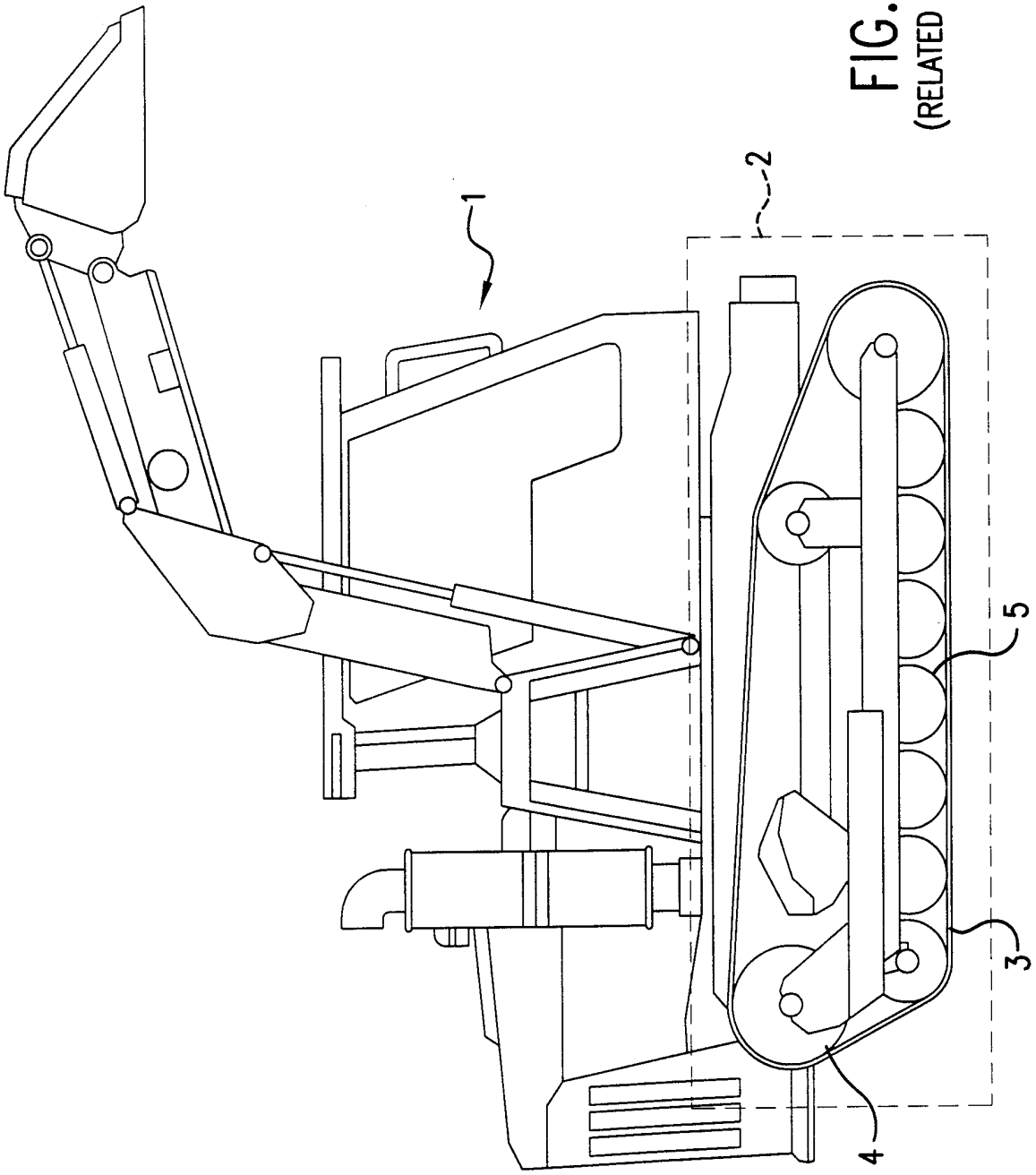


FIG. 1
(RELATED ART)

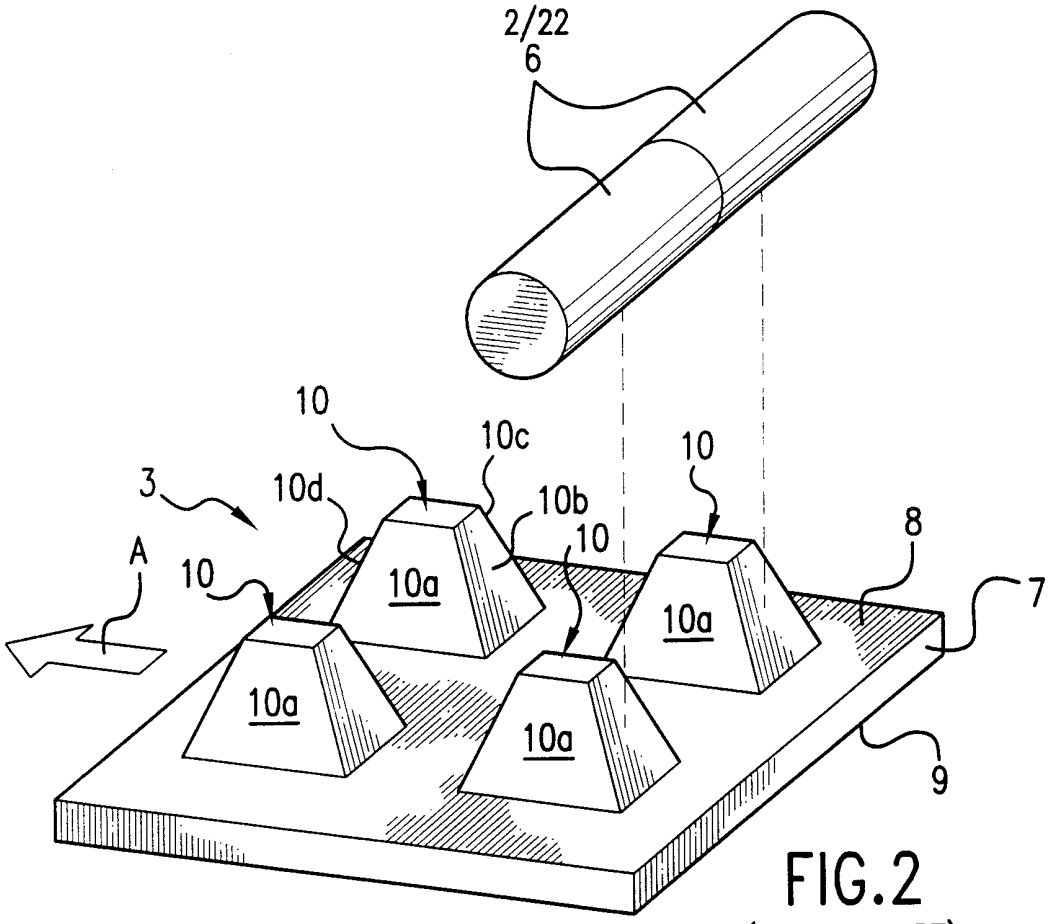


FIG.2
(RELATED ART)

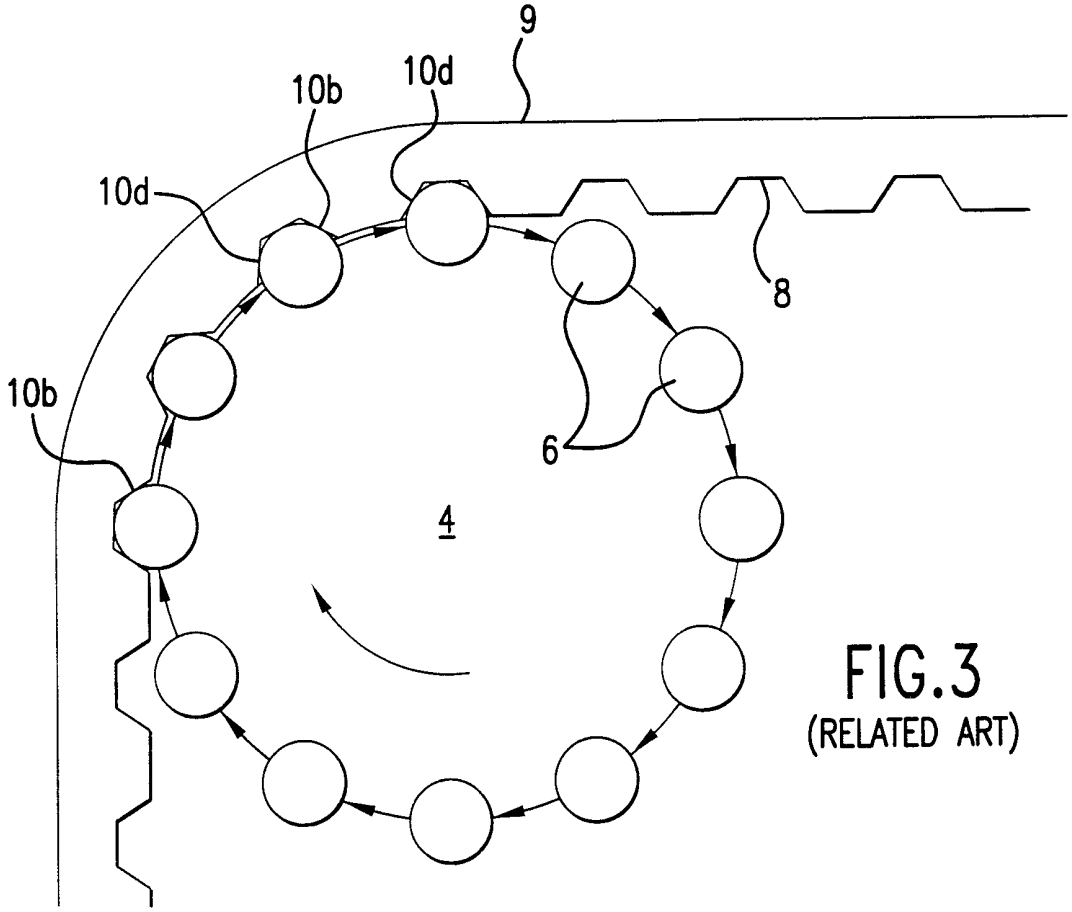


FIG.3
(RELATED ART)

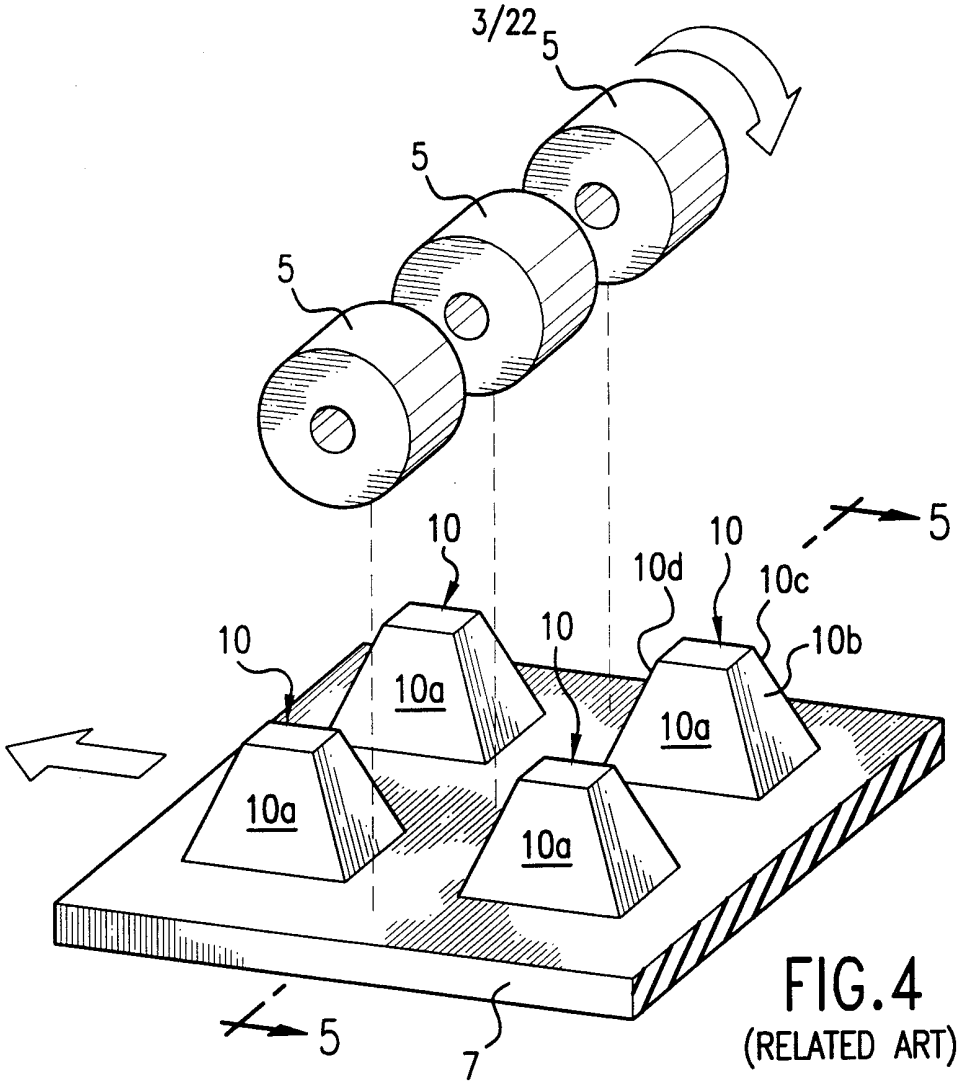


FIG.4
(RELATED ART)

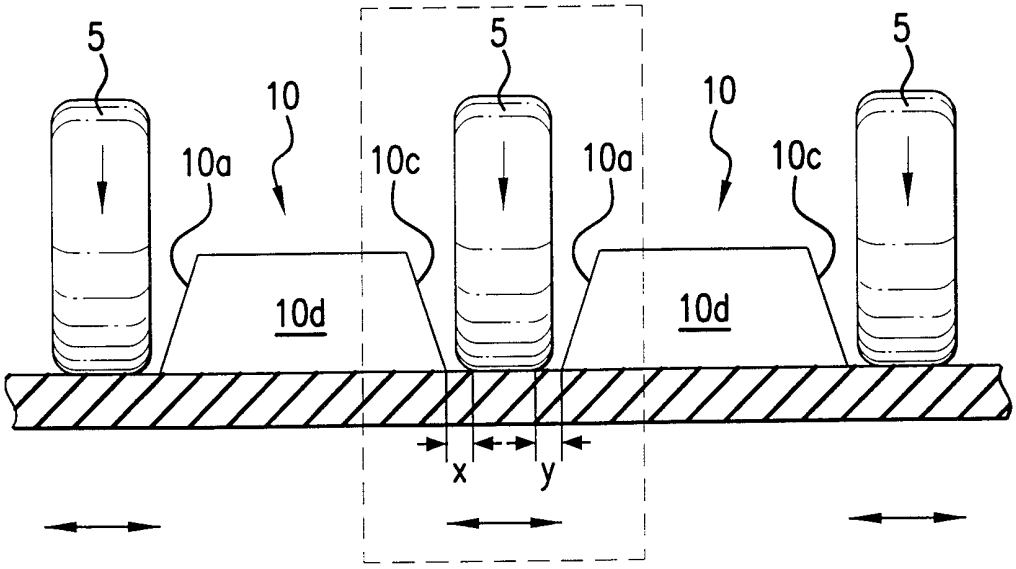


FIG.5
(RELATED ART)

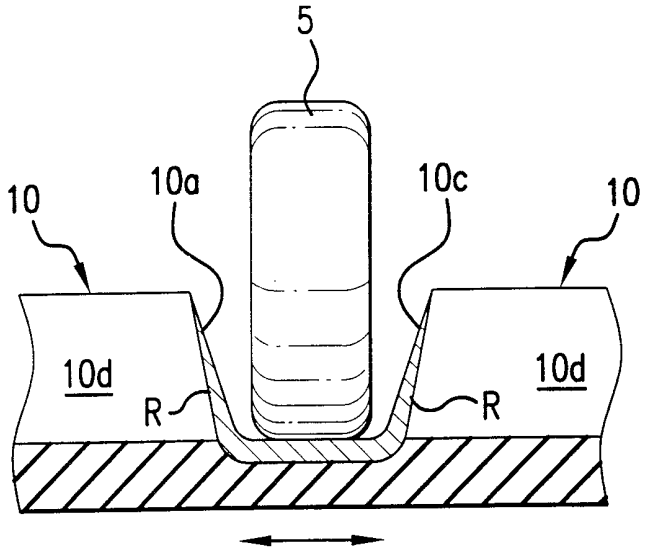


FIG.6
(RELATED ART)

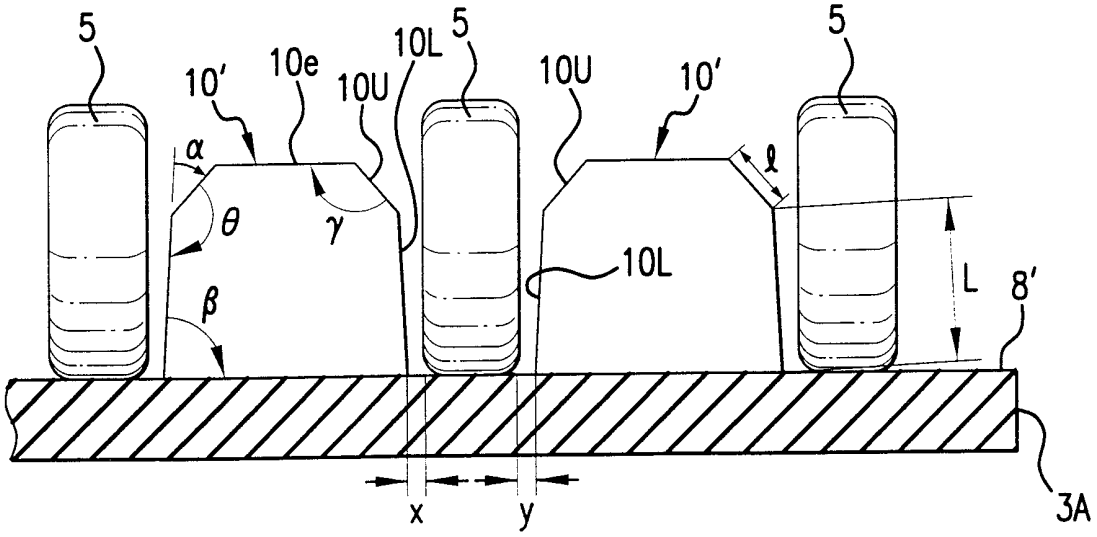
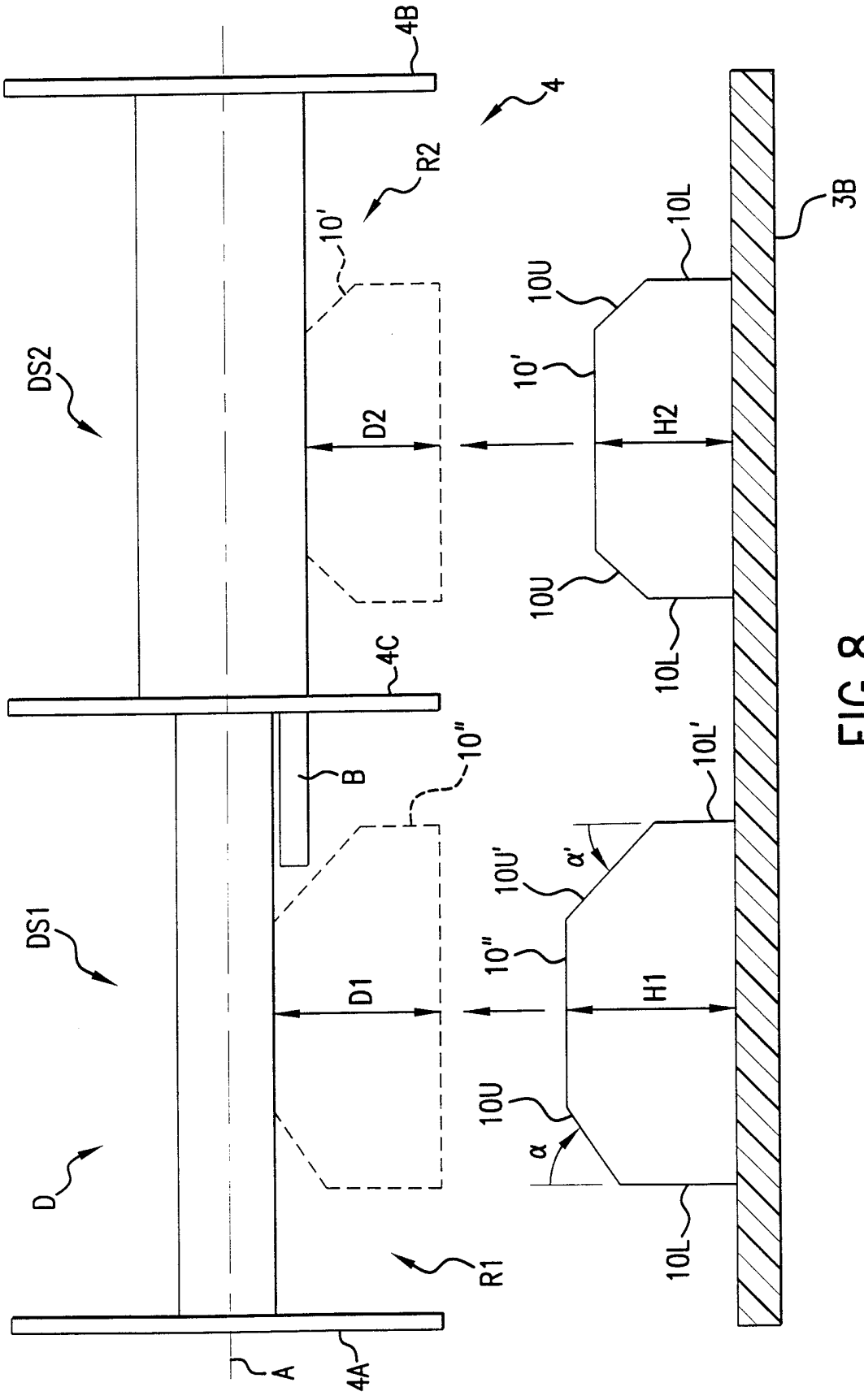


FIG.7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10'
DS2
D2
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10'
10L
3B
H2
10U
10L
4C
B
10"
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α'
10"
H1
D
10U
α
R1
10L
A
4A

FIG.8

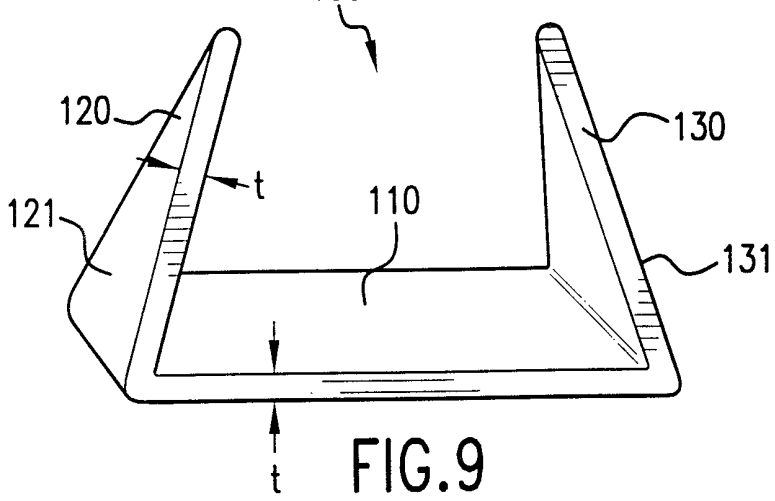

FIG.9

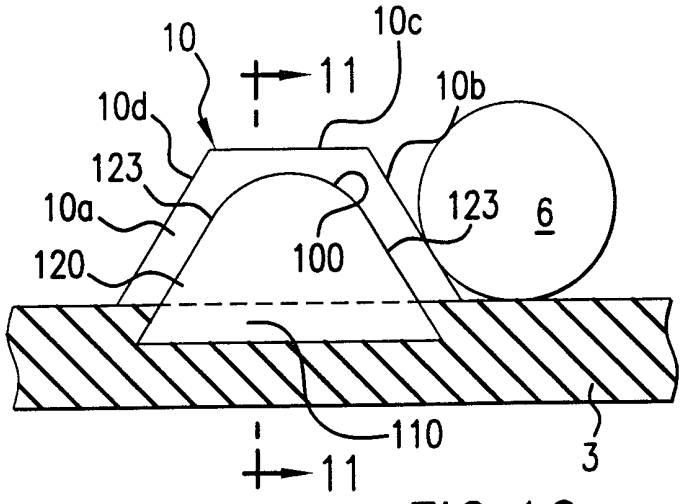

FIG.10

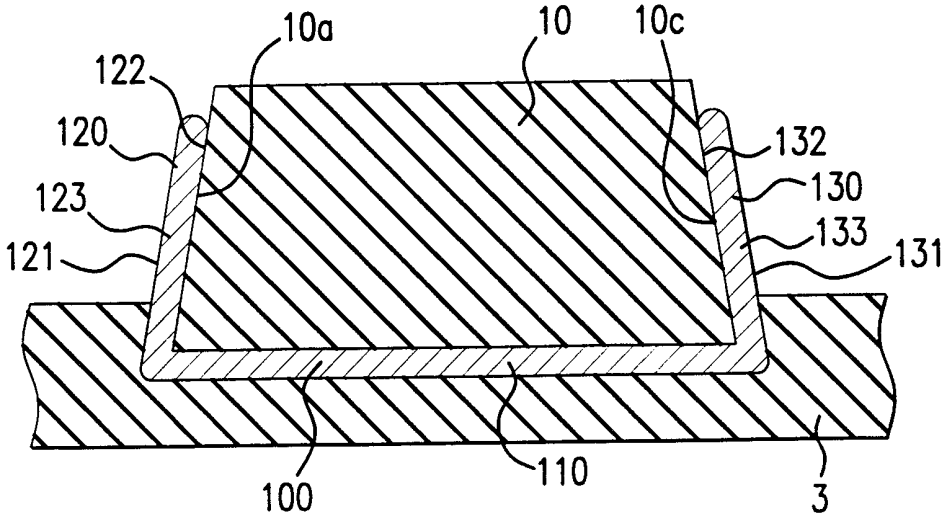

FIG. 11

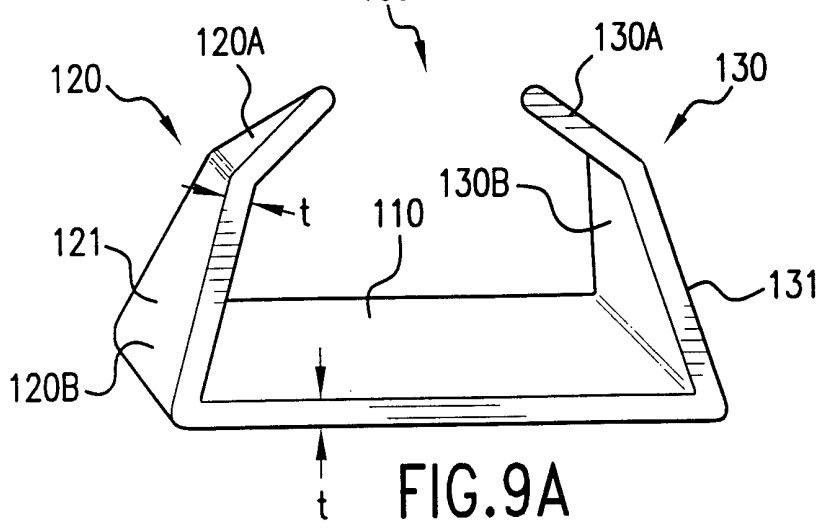

FIG.9A

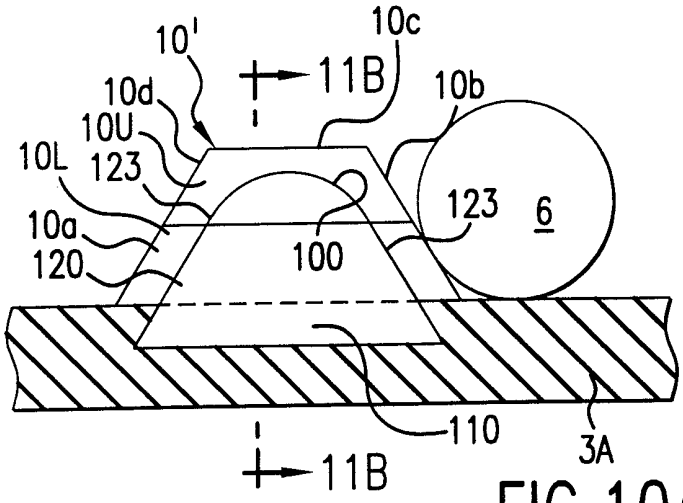

FIG.10A

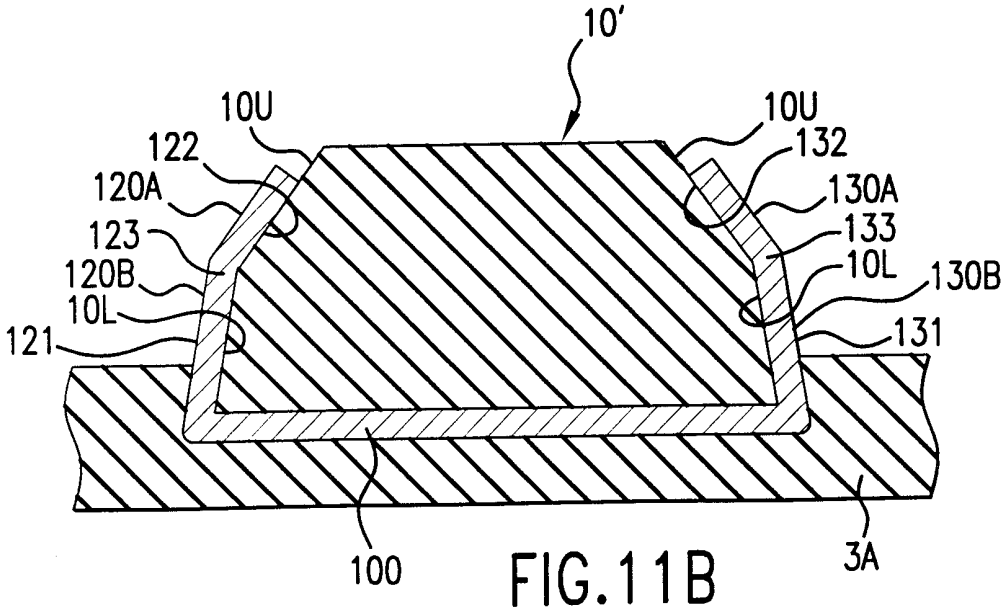

FIG.11B

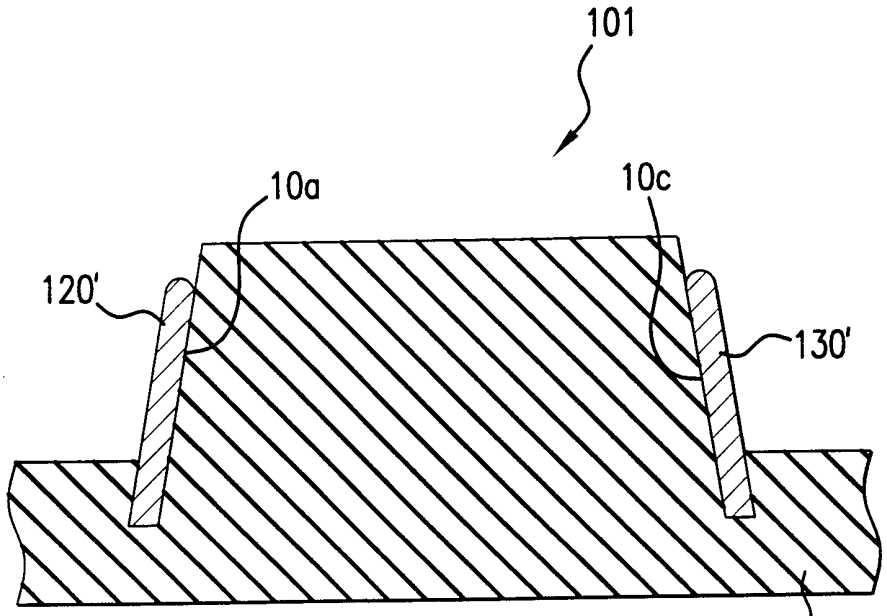

FIG.11A

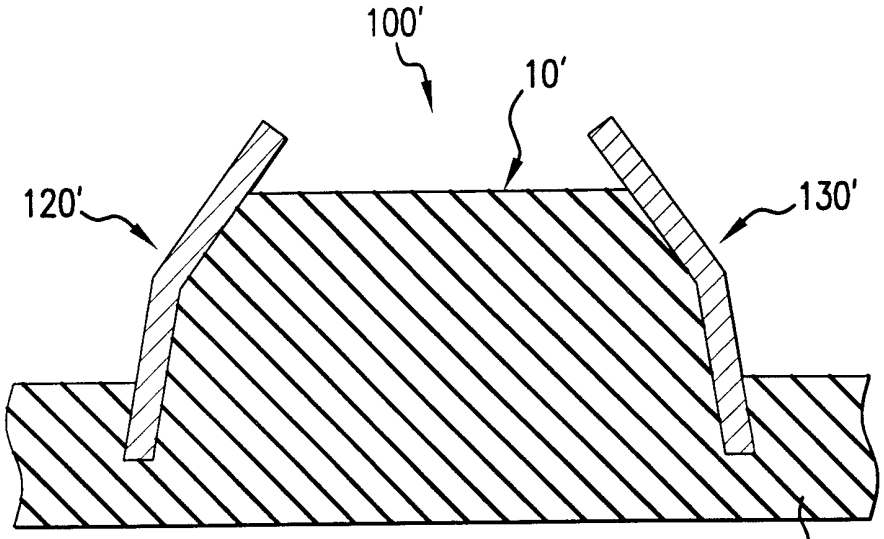

FIG.11C

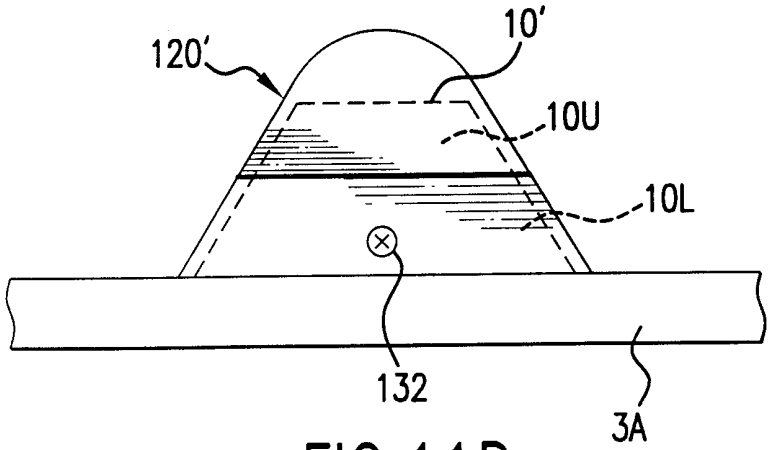

FIG.11D

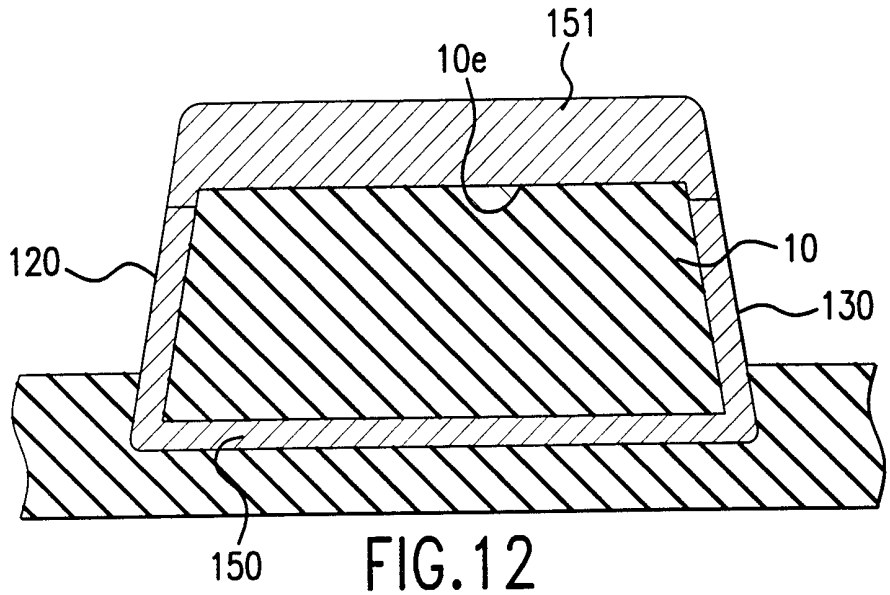

FIG.12

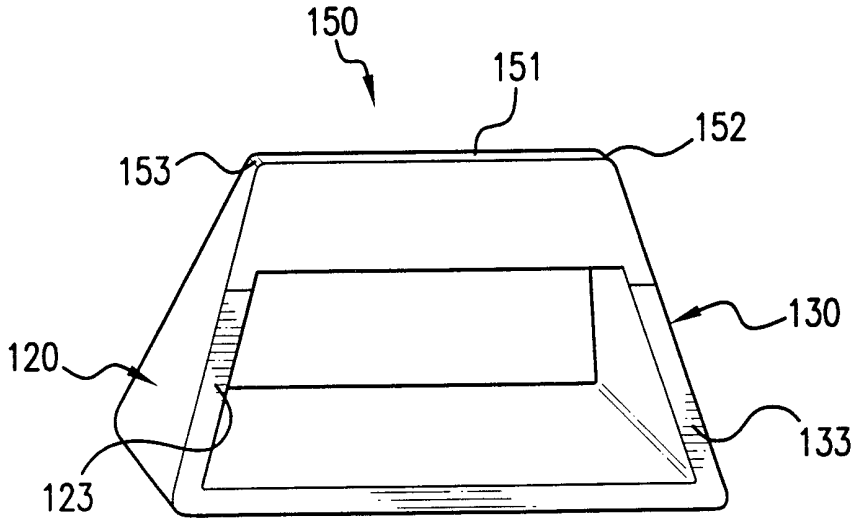

FIG.12A

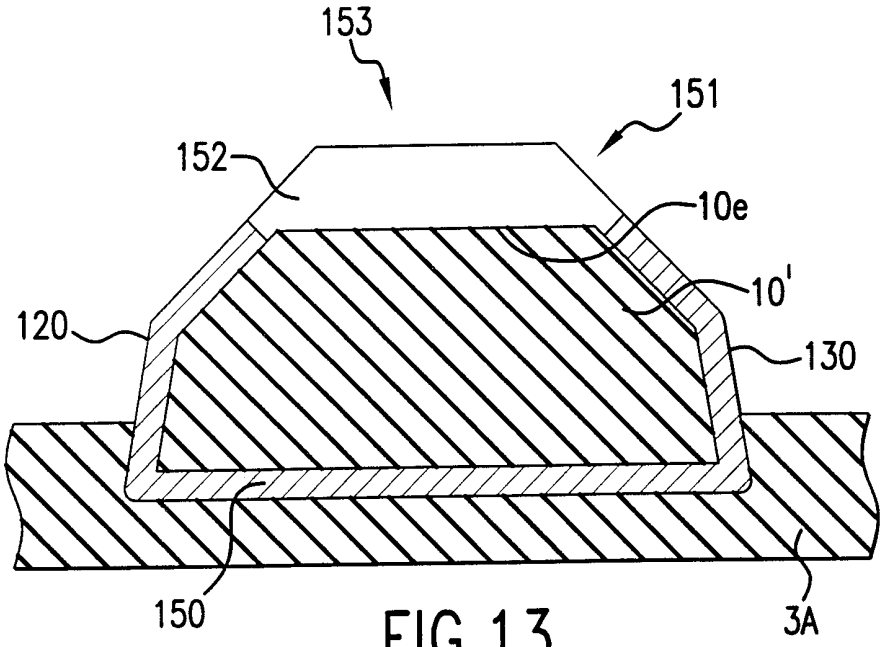

FIG.13

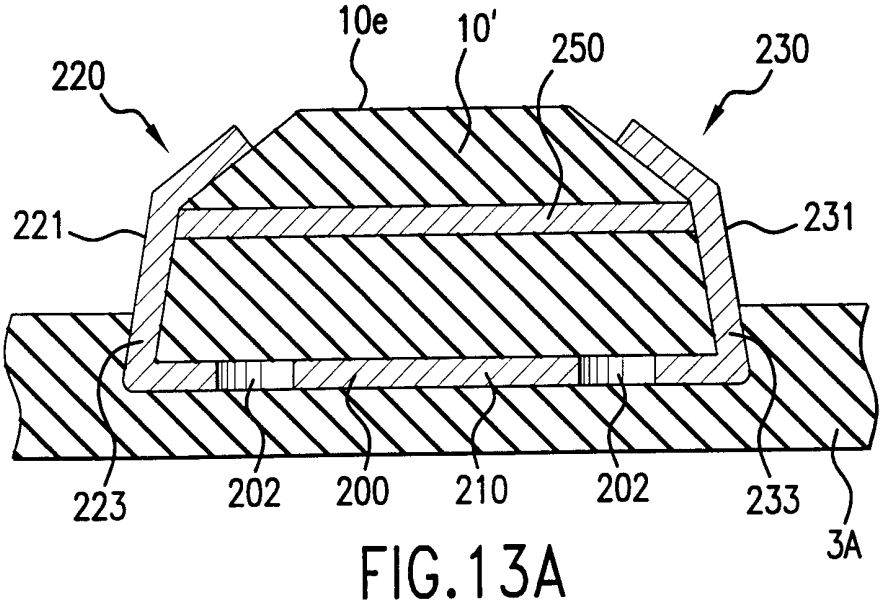

FIG.13A

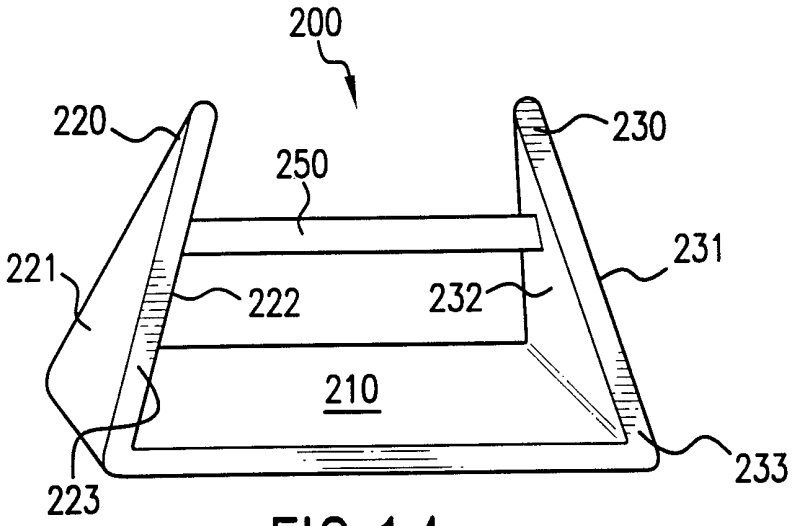

FIG.14

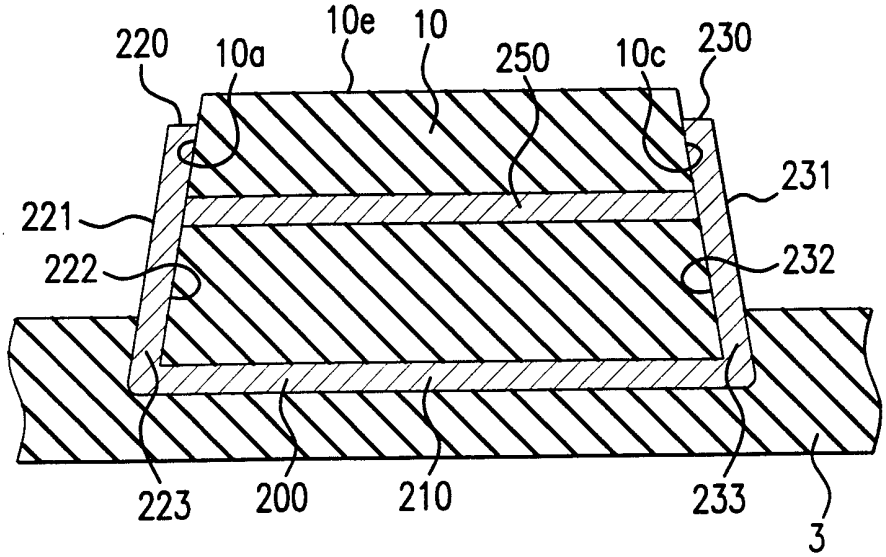

FIG.14A

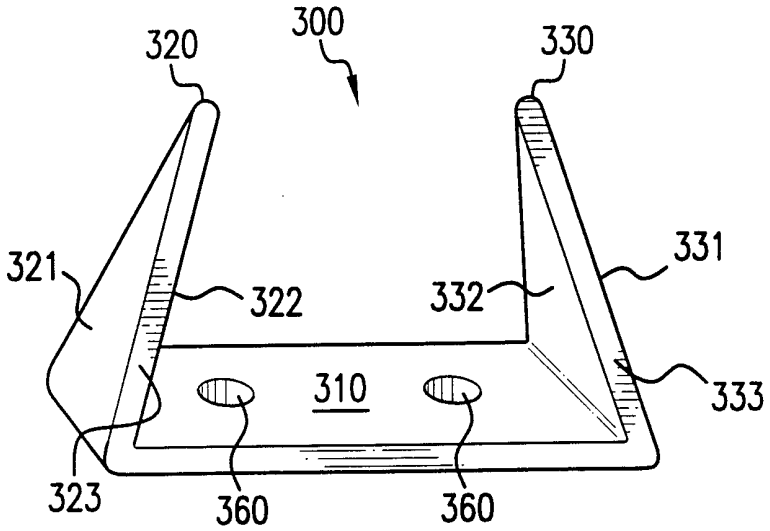

FIG.15

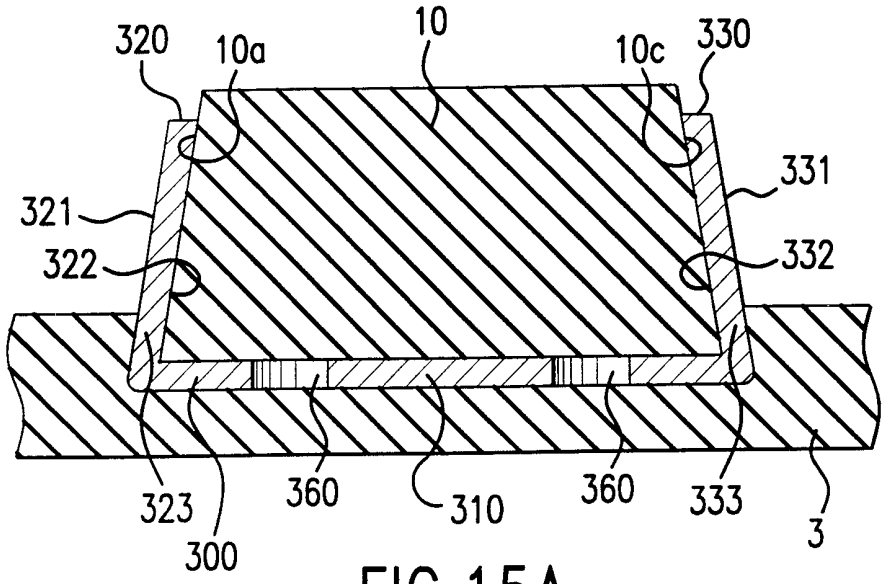

FIG.15A

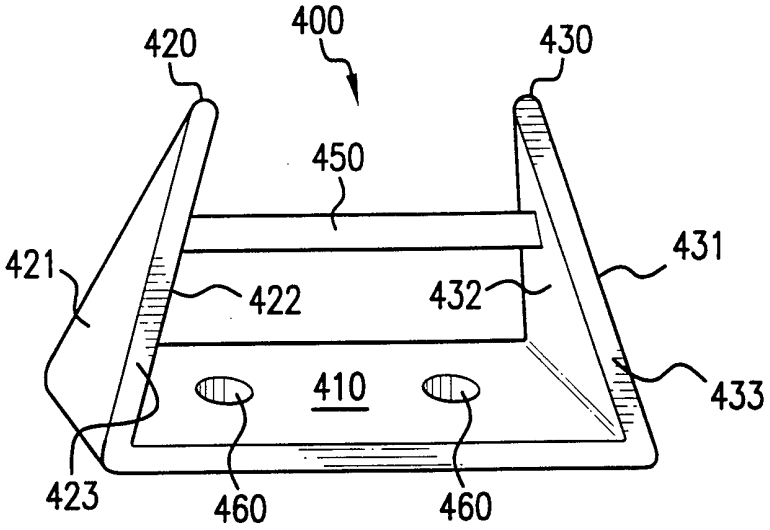
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FIG.16

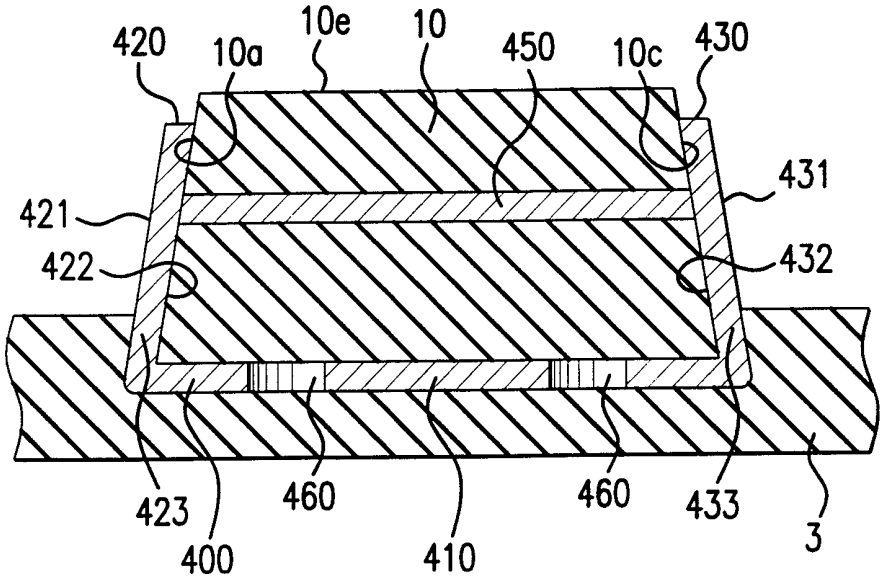
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FIG.17

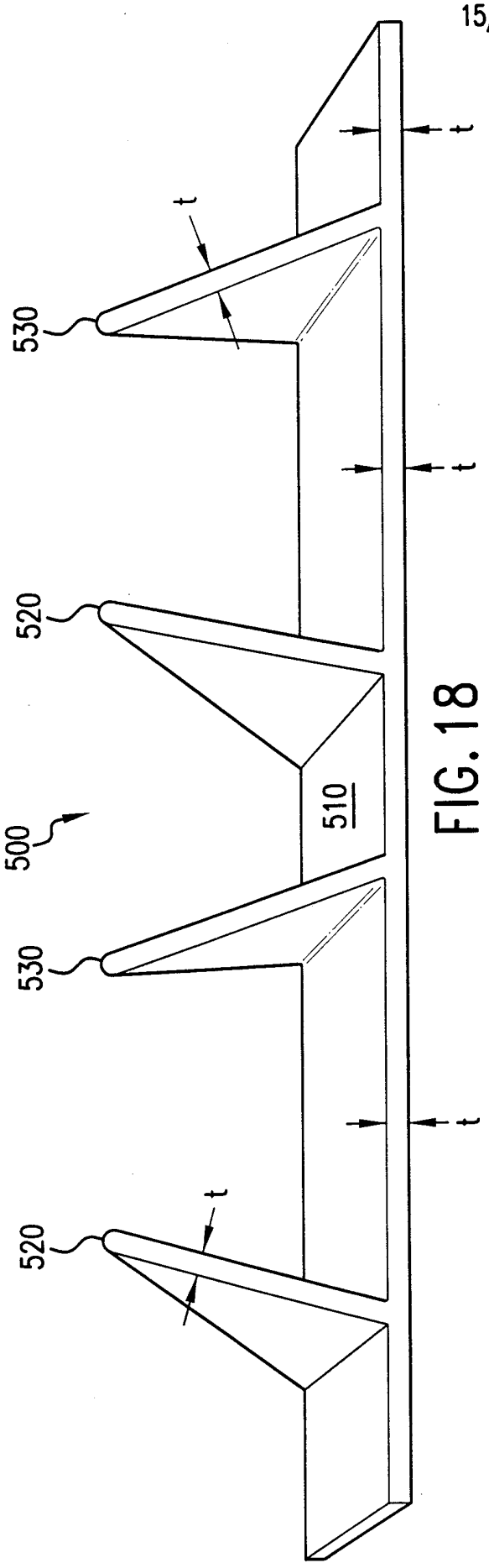
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FIG. 18

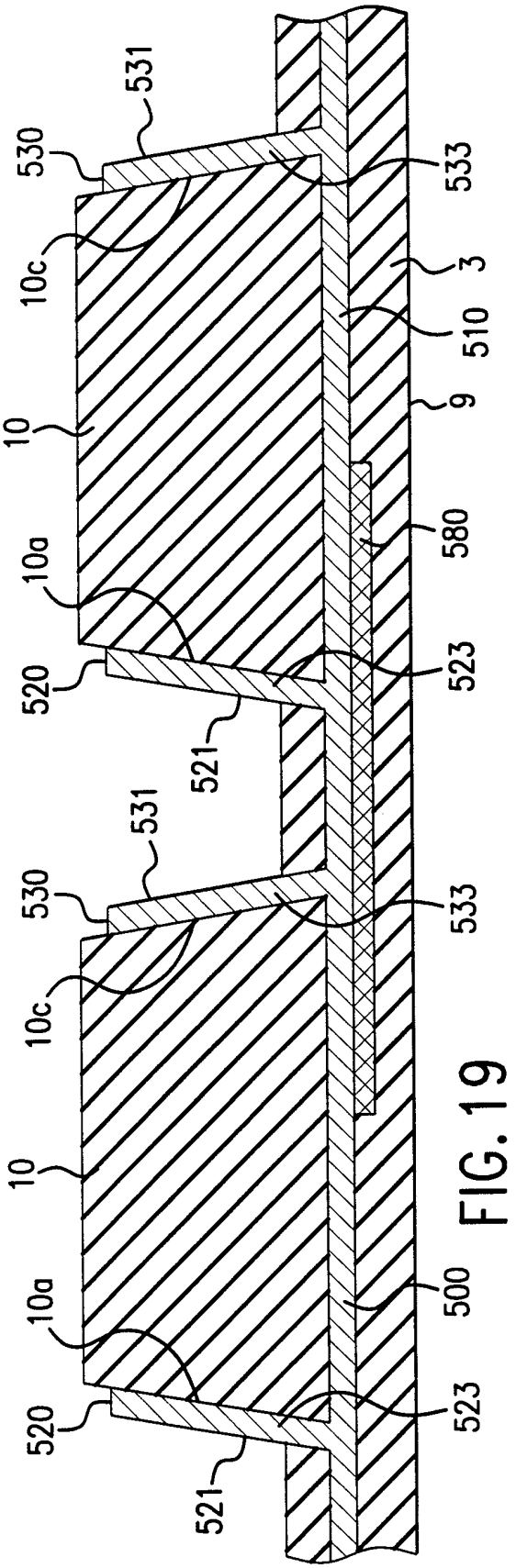
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FIG. 19

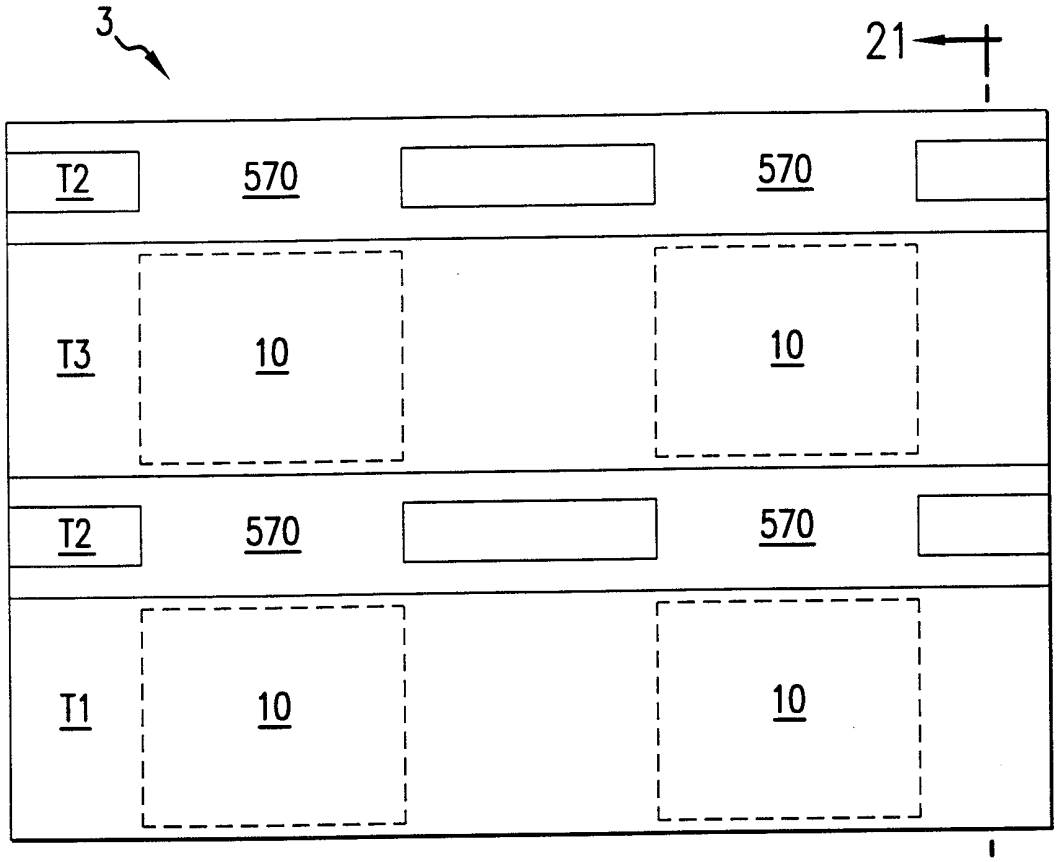

FIG. 20

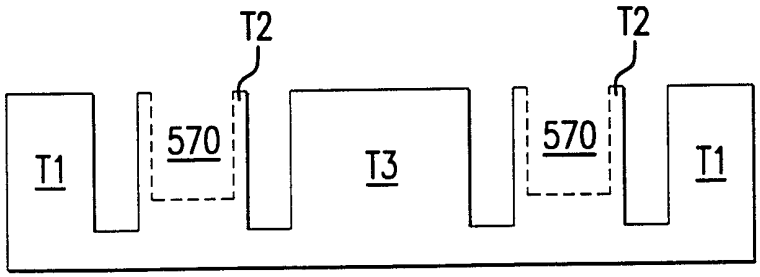

FIG. 21

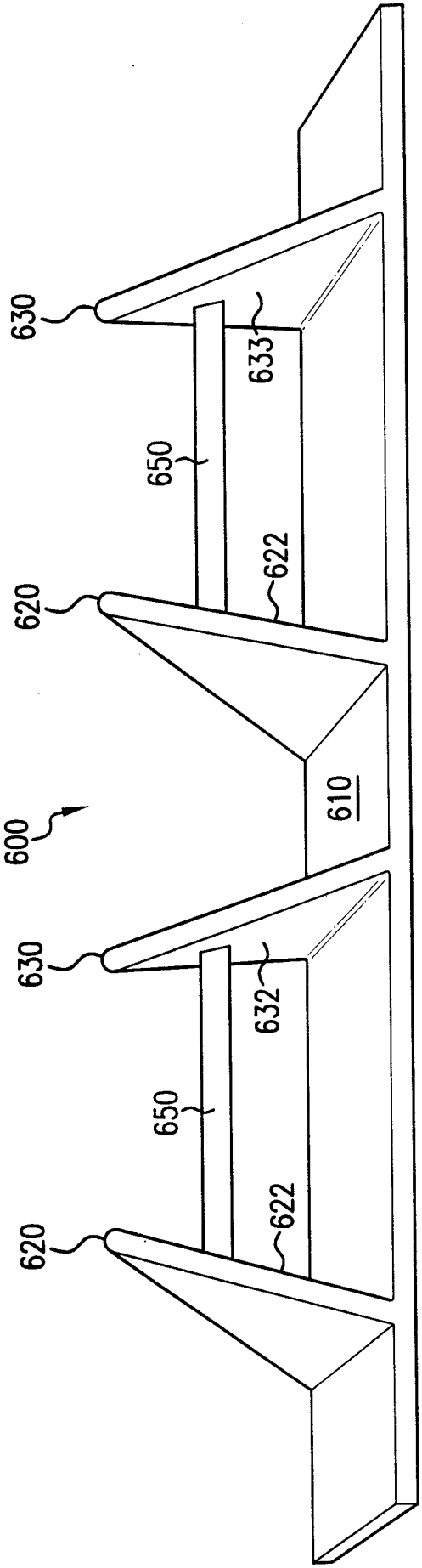
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FIG. 22

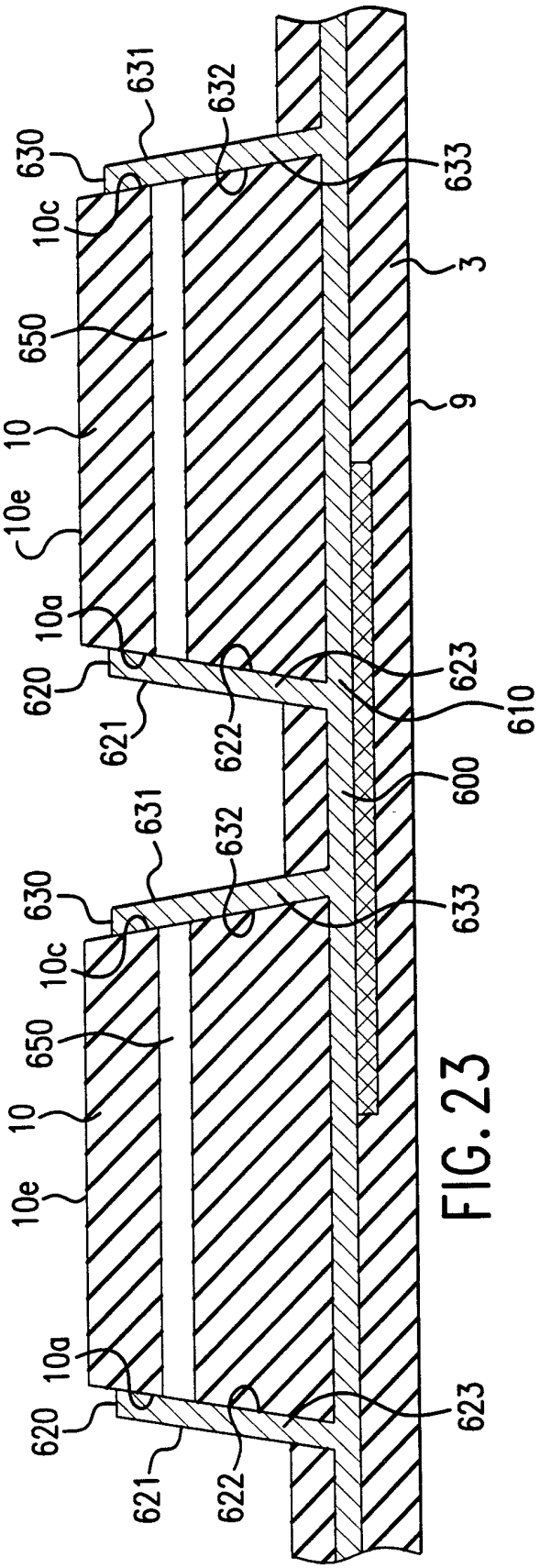
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FIG. 23

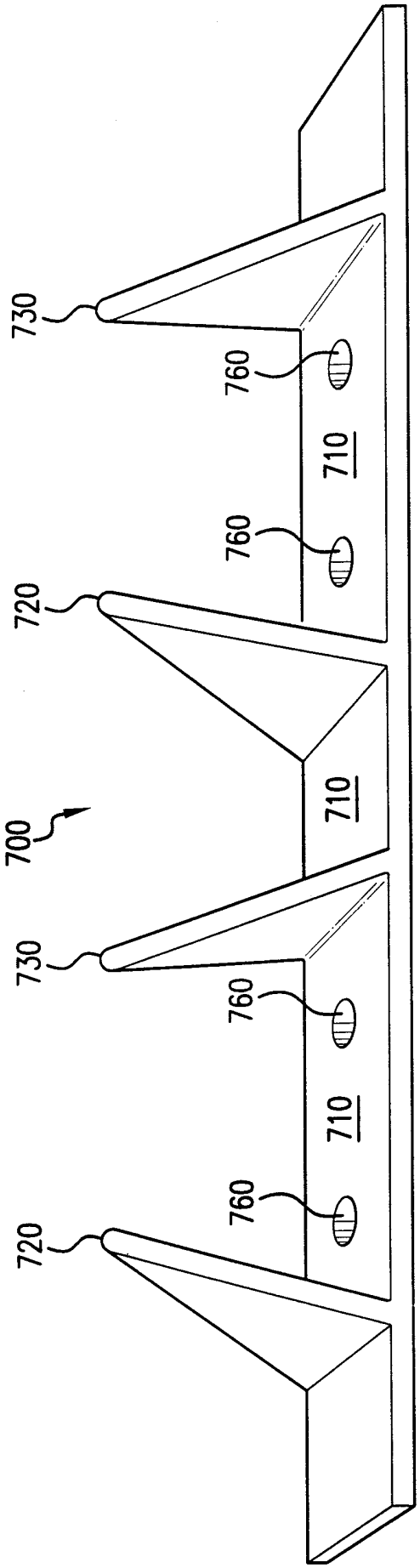
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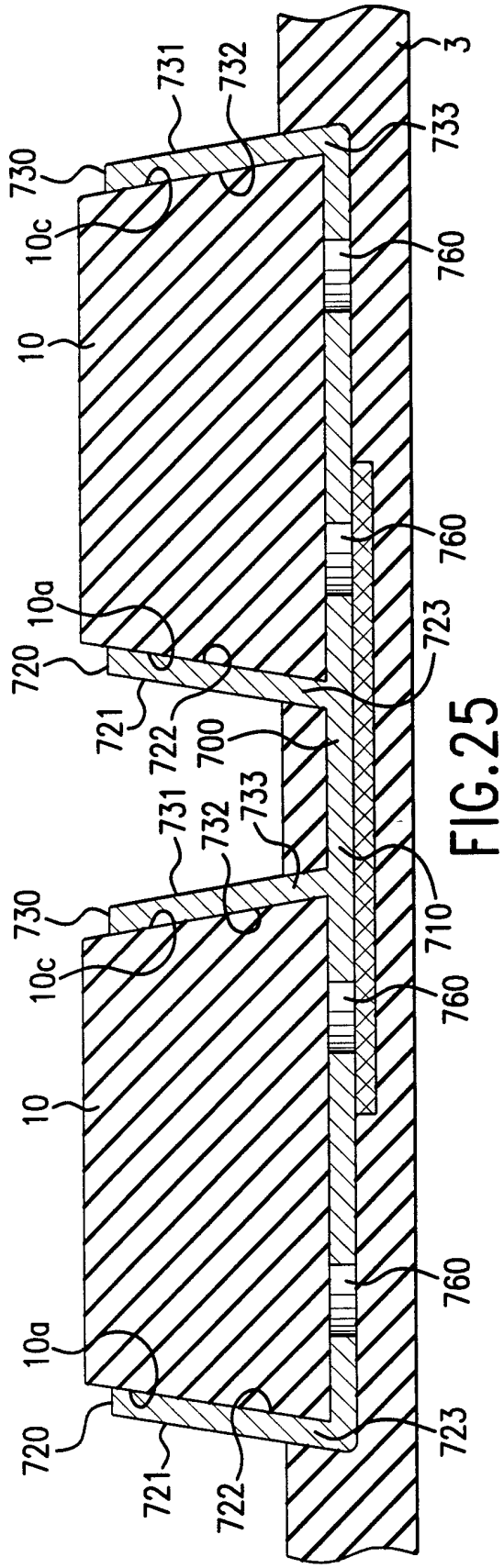
FIG. 24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720
723
721
722

FIG. 25

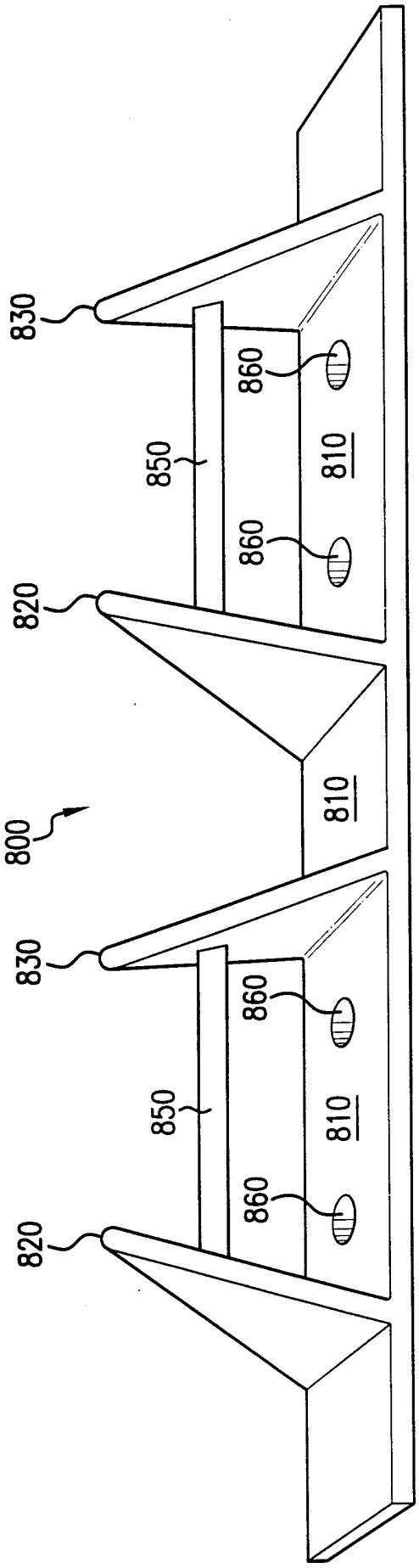
830
860
850
810
860
820
810
800
830
860
850
810
860
820

FIG.26

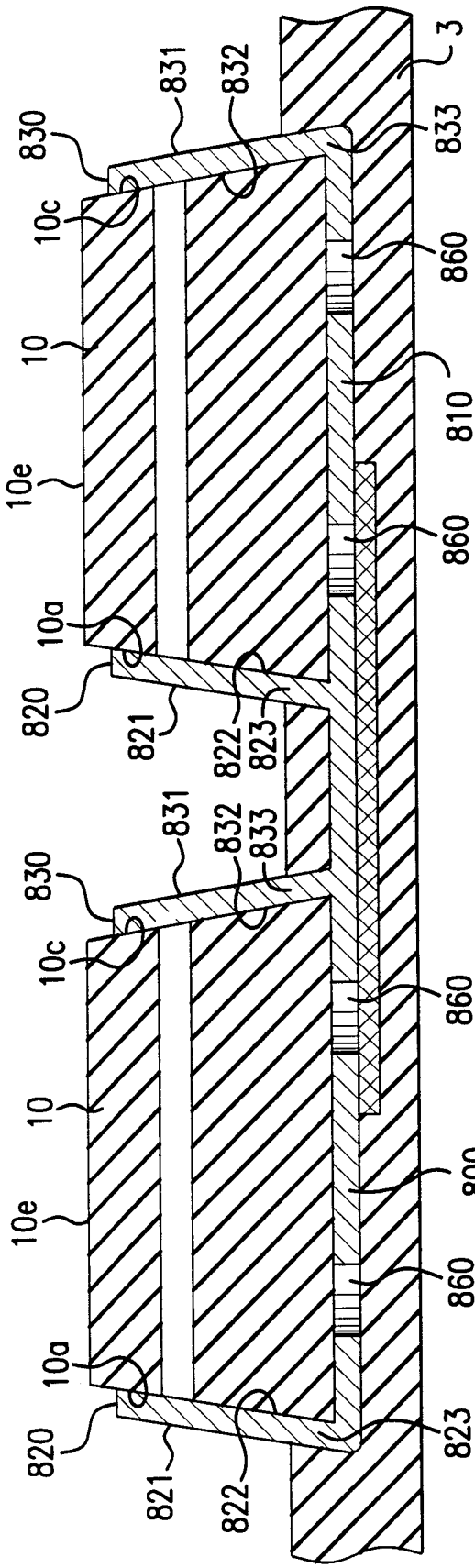
831
832
3
830
833
10c
860
10
810
10e
860
10a
820
821
822
823
831
832
833
830
10c
860
10
800
10e
860
10a
820
823
821
822

FIG.27

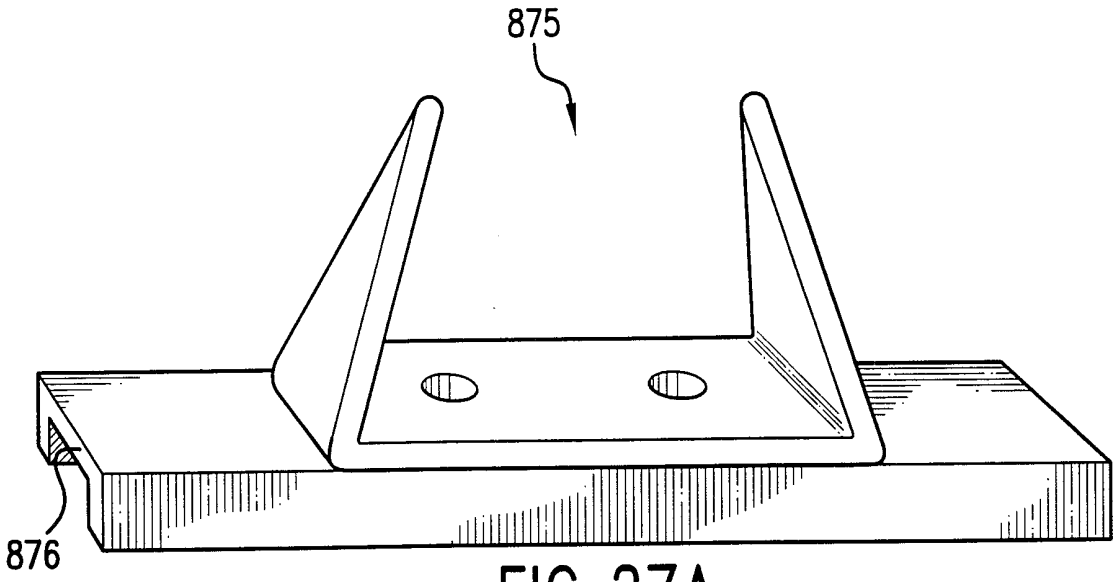

FIG. 27A

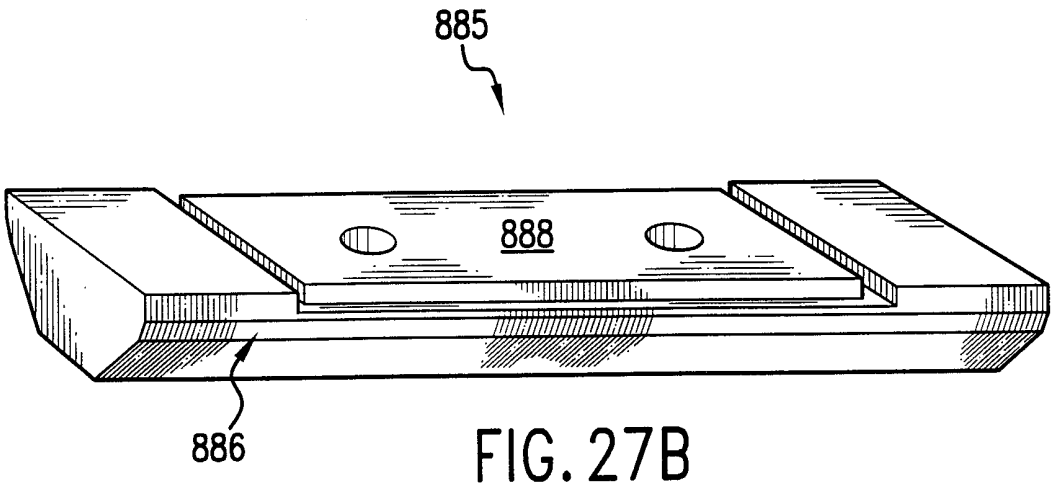

FIG. 27B

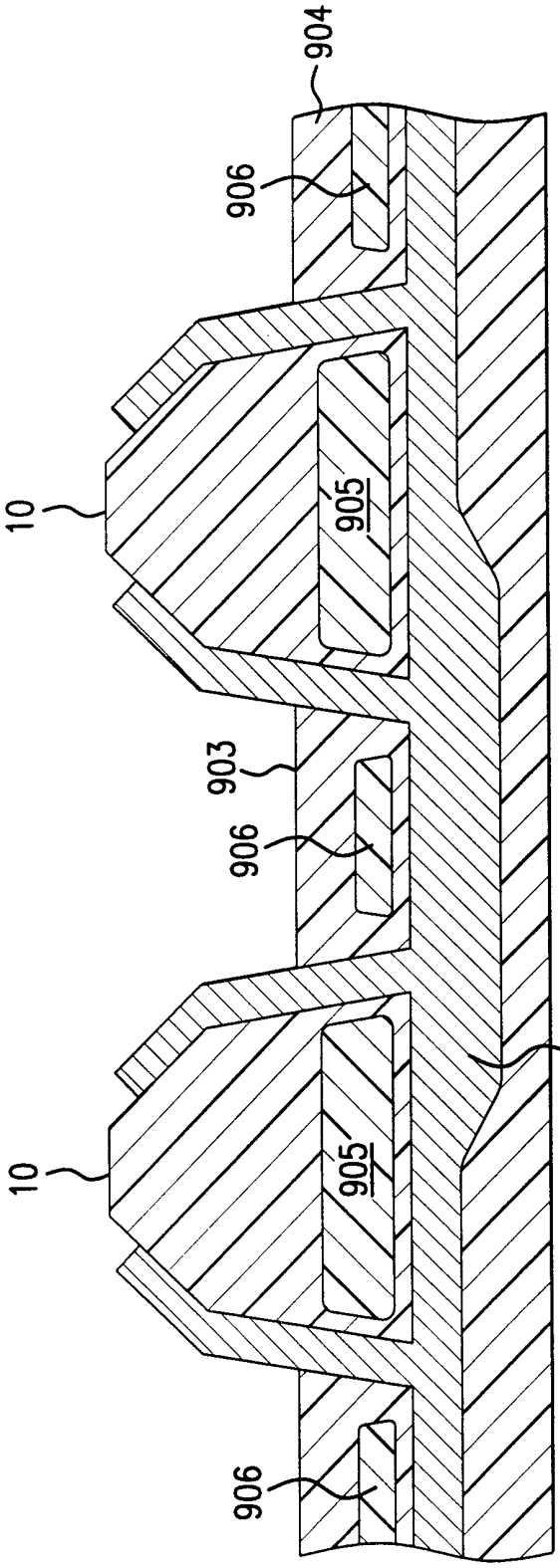

FIG.28

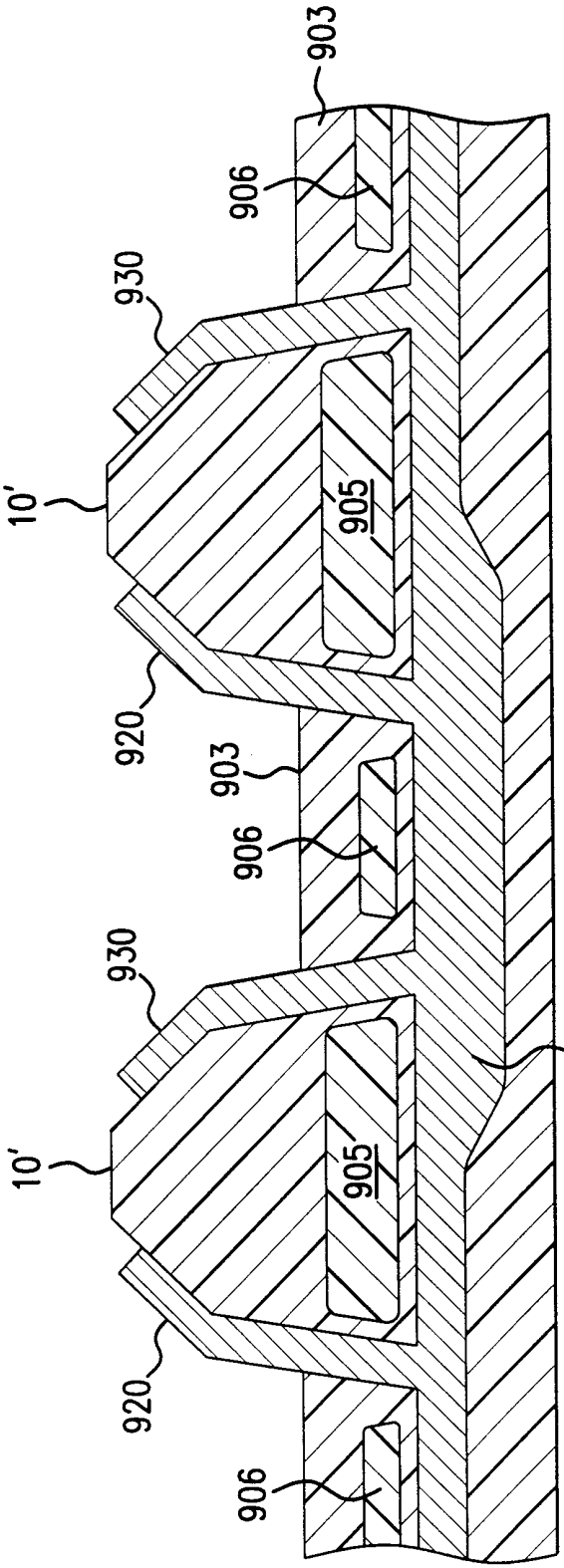

FIG.28A

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/06927

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : B62D 55/28; B65G 15/44
US CL : 305/180
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)

U.S. : 305/180, 165, 167, 169, 178, 179, 171, 177, 195, 199, 193, 160

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -----, P Y	US 5,984,438 A (TSUNODA ET AL) 16 NOVEMBER 1999, SEE ENTIRE DOCUMENT.	1-4,10,12, 15,17-18, 24,30-33, 35 ---------- 5-7,8,9,19-22
X ---- Y	US 5,447,365 A (MURAMATSU ET AL) 05 SEPTEMBER 1995, SEE ENTIRE DOCUMENT.	36,38,51, 52,56,57, 64,68,71 --------- 70
A, P	US 6,000,766 A (TAKEUCHI ET AL) 14 DECEMBER 1999.	
A	US 3,721,477 A (COOPER et al) 20 MARCH 1973.	

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"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
"A"	document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier document published on or after the international filing date	"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
"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)	"&"	document member of the same patent family
"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		

Date of the actual completion of the international search
31 MAY 2000

Date of mailing of the international search report
10 JUL 2000

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231
Facsimile No. (703) 305-3230

Authorized officer
J. Morano Diane Smith for
Telephone No. (703) 308-1113

Form PCT/ISA/210 (second sheet) (July 1998)★

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/06927

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING
This ISA found multiple inventions as follows:

This application contains claims directed to more than one species of the generic invention. These species are deemed to lack Unity of Invention because they are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for more than one species to be searched, the appropriate additional search fees must be paid. The species are as follows:

I. DRAWN TO FIG. 9-11a, 18-21
II. DRAWN TO FIG. 9a, 10a, 11b, 11c
III. DRAWN TO FIG. 11d
IV. DRAWN TO FIG. 12, 12a
V. DRAWN TO FIG. 13
VI. DRAWN TO FIG. 13a
VII. DRAWN TO FIG. 14, 14a, 22, 23
VIII. DRAWN TO FIG. 15, 15a, 24, 25
IX. DRAWN TO FIG. 16, 17, 26, 27
X. DRAWN TO FIG. 27a, 27b
XI. DRAWN TO FIG. 28

The claims are deemed to correspond to the species listed above in the following manner:

SPECIES I & II: CLAIMS 1-10, 12, 15-24, 30-33, 35, 36, 38, 43-45, 49-52, 56, 57, 64, 68, 70, 71

The following claims are generic: 17, 31, 36, 38, 52, 56, 64, 68, 70-71

The species listed above do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, the species lack the same or corresponding special technical features for the following reasons: Each species contains distinct configurations that each have different manners in which the invention can be used to reinforce a drive lug.