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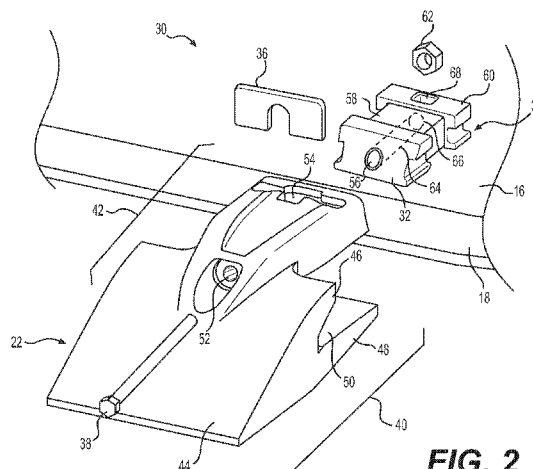


FIG. 2

(57) **Abstract:** A shroud (22) for a work tool (10) is disclosed. The shroud may have a tip portion (40). The tip portion may have a tip (44) extending from a shroud proximal end (70) to a tip end (74) disposed between the shroud proximal end and a shroud distal end (72). The tip portion may further have an upper leg (46) extending from the tip end to an upper leg distal end (76). The tip portion may also have a lower leg (48) extending from the tip end to a lower leg distal end (78). The lower leg may be spaced apart from the upper leg to form an opening (50) between the upper leg and the lower leg. The shroud may have an attachment portion (42) attached to the upper leg. The attachment portion may extend from adjacent the tip end to the shroud distal end.

Description

SHROUD RETENTION SYSTEM FOR A WORK TOOL

Technical Field

5 The present disclosure relates generally to a shroud retention system and, more particularly, to a shroud retention system for a work tool.

Background

Earth-working machines, such as excavators, shovels, and wheel loaders, include ground engaging work tools that engage with and/or move a variety of earthen materials. These work tools often have one or more cutting
10 tools or tooth assemblies mounted to an edge of the work tool, for example, to a lip of a bucket. The exposed portions of the work tool edge between adjacent tooth assemblies come into contact with the ground or the earthen materials and are subjected to extreme abrasion and impacts that cause them to wear. To prolong the useful life of the work tools, wear members or shrouds are attached
15 to the work tools between adjacent tooth assemblies to protect the exposed portions of the work tool edge.

Although the wear members protect the edge of the work tool, the wear members are still subject to severe abrasion and may need periodic repair or replacement. Removal and/or replacement of a wear member may require
20 disassembly of the wear members from the edge of the work tool, and assembly of a repaired or a new wear member on the work tool. The machine must be taken out of service to perform such replacement or repair. The time required to disassemble and reassemble a wear member may be dictated by the mechanism used to retain the wear member on the work tool. It is desirable to have a
25 retention system that allows for quick assembly and disassembly at a worksite to allow the machine to be returned to service as quickly as possible.

U.S. Patent No. 6,240,663 of Robinson, issued on June 5, 2001 (“the ’663 patent”), discloses a resilient connection system for attaching a wear member to an excavating lip structure. In particular, the ’663 patent discloses a
30 wear member that has a front portion with two rearwardly extending legs including an upper leg which is disposed on top of a lip of a bucket and a lower leg, which is disposed below the lip. The ’663 patent further discloses that a

connection member is welded to the bucket. The connection member includes an upstanding boss that includes a circular opening. Likewise, the upper leg of the wear member of the '663 patent includes a projection. A fastener passing through the circular opening in the boss engages with the projection in the upper
5 leg to attach the wear member to the connection member. The connection member of the '663 patent also includes two spring assemblies disposed on either side of the fastener. Each spring assembly includes a rod attached at one end to the connection member and a spring circumscribed around the rod. The spring is retained at the other end of the rod by a snap ring. The rods in each
10 spring assembly of the '663 patent engage with openings in downwardly projecting bosses of the upper leg of the wear member so that the springs are retained between the bosses and the connection member. As the fastener is tightened, the spring assemblies of the '663 patent are compressed providing a biasing force to urge the wear member onto the lip. The '663 patent also
15 discloses that a protective shroud is installed to protect the components of the retention system.

Although the '663 patent discloses a resilient wear member retention system, the disclosed retention system may not be optimal. For example, assembly of the wear member using the system of the '663 patent
20 requires multiple features of the wear member to engage with corresponding features of the connection member, making the assembly cumbersome. In particular, the system of the '663 patent requires a projection in the wear member leg to engage with a fastener attached to the connection member, while simultaneously requiring two bosses in the leg to engage with spring assemblies
25 in the connection member. Disassembly of the wear member may also be cumbersome because of the need to loosen the fastener and disengage the wear member from the fastener and the two spring assemblies for removal. Further, the retention system of the '663 member requires a fastener, two separate spring assemblies, and a protective shroud. The large number of parts required for
30 assembly may increase the cost of manufacturing and maintaining the retention system of the '663 patent.

The shroud retention system of the present disclosure solves one or more of the problems set forth above and/or other problems of the prior art.

Summary

In one aspect, the present disclosure is directed to a shroud for a work tool. The shroud may include a tip portion. The tip portion may include a tip extending from a shroud proximal end to a tip end disposed between the shroud proximal end and a shroud distal end. The tip portion may further include an upper leg extending from the tip end to an upper leg distal end. The tip portion may also include a lower leg extending from the tip end to a lower leg distal end. The lower leg may be spaced apart from the upper leg to form an opening between the upper leg and the lower leg. The shroud may include an attachment portion attached to the upper leg. The attachment portion may extend from adjacent the tip end to the shroud distal end.

In another aspect, the present disclosure is directed to a slide compressor for attaching a work tool. The slide compressor may include a central block. The central block may include a compressor front face and a compressor rear face disposed opposite the front face. The compressor rear face may be inclined relative to the compressor front face. The central block may further include a compressor bottom face extending between the compressor front face and the compressor rear face. The central block may also include a compressor top face disposed opposite the compressor bottom face and extending between the compressor front face and the compressor rear face. The central block may include a hole extending between the compressor front face and the compressor rear face. In addition, the central block may include a slot extending from the compressor top face towards the compressor bottom face. The slot may intersect with the hole.

In yet another aspect, the present disclosure is direct to a retainer plate. The retainer may include a retainer front face and a retainer rear face disposed opposite the retainer front face. The retainer may include a retainer portion and a pull out portion. The retainer portion may include a retainer bottom face extending between the retainer front face and the retainer rear face. The retainer portion may further include a retainer top face extending between the retainer front face and the retainer rear face. The retainer portion may also include retainer side faces extending between the retainer front face and the retainer rear face. The pull out portion may extend from the retainer portion. The pull out portion may include a top wall disposed generally parallel to the

retainer top face. The pull out portion may further include a first side wall connecting the top wall to the retainer top face. The pull out portion may also include a second side wall connecting the top wall to the retainer top face. The retainer plate may include a first slot extending from the retainer bottom face towards the retainer top face. The retainer plate may also include a second slot disposed between the first slot and the top wall of the pullout portion.

Brief Description of the Drawings

Fig. 1 is an illustration of an exemplary work tool;
Fig. 2 is an illustration of an exemplary shroud retention system
10 for the work tool of Fig. 1;
Fig. 3 is a perspective view of an exemplary shroud for the
shroud retention system of Fig. 2;
Fig. 4 is rear view of the exemplary shroud of Fig. 3;
Fig. 5 is a perspective view of an exemplary adapter for the
15 shroud retention system of Fig. 2;
Fig. 6 is a cross-sectional view of the exemplary adapter of Fig. 5;
Fig. 7 is a perspective view of an exemplary slide compressor for
the shroud retention system of Fig. 2;
Fig. 8 is a cross-sectional view of the exemplary slide compressor
20 of Fig. 7;
Fig. 9 is a perspective view of an exemplary retainer plate for the
shroud retention system of Fig. 2;
Fig. 10 is a perspective view of an exemplary spring damper for
the shroud retention system of Fig. 2;
25 Fig. 11 is a cross-sectional view of the exemplary shroud
retention system of Fig. 2;
Fig. 12 is a bottom view of the exemplary shroud retention
system of Fig. 2;
Fig. 13 is a perspective view of another exemplary shroud for the
30 shroud retention system of Fig. 2;
Fig. 14 is a perspective bottom view of an exemplary adapter,
spring damper, and slide compressor for the shroud retention system of Fig. 2;
and

Fig. 15 is a flow-chart of an exemplary method of retaining the shroud of Fig. 3 using the shroud retention system of Fig. 2.

Detailed Description

Fig. 1 illustrates an exemplary work tool 10 for a machine (not shown). Work tool 10 may embody any device used to perform a task assigned to the machine. For example, work tool 10 may be a bucket (shown in Fig. 1), a blade, a shovel, a crusher, a grapple, a ripper, or any other material moving device known in the art. Work tool 10 may include side walls 12, 14, and primary wall 16, which may form a bottom of work tool 10. Primary wall 16 may extend from side wall 12 to side wall 14. Primary wall 16 of work tool 10 may also include edge 18 (see Fig. 2), extending between side walls 12, 14. Edge 18 may be detachable from work tool 10 or it may be a fixed component of work tool 10.

Work tool 10 may include a plurality of shrouds 22 (or wear members) attached to edge 18. Each shroud 22 may be configured to protect edge 18 from abrasion and wear by reducing or preventing contact of an exposed portion of edge 18 with earthen materials. In some exemplary embodiments, shrouds 22 may be disposed between adjacent tool assemblies (not shown) attached to edge 18 to protect a portion of edge 18 between the adjacent tool assemblies from abrasion and wear.

For the purposes of this disclosure, attention will be focused on attachment of shrouds 22 to work tool 10. It is contemplated, however, that the attachment methods and structures presented in this disclosure may be equally utilized with tool assemblies, other wear components, and/or with any other wear components known in the art.

Fig. 2 illustrates an exemplary shroud retention system 30 for attaching shroud 22 to work tool 10. Shroud retention system 30 may include adapter 32, spring assembly 34, retainer plate 36, and bolt 38. Shroud 22 may include tip portion 40 and attachment portion 42. Tip portion 40 may be generally U-shaped and may include tip 44, upper leg 46, and lower leg 48. Upper and lower legs 46, 48 may extend in a direction away from tip 44. Upper and lower legs 46, 48 may be spaced apart from each other to form opening 50 that may be large enough to receive edge 18 of work tool 10. Attachment

portion 42 may be attached to upper leg 46 of tip portion 40. Like upper and lower legs 46, 48, attachment portion 42 may extend in a direction away from tip 44. Attachment portion 42 may include hole 52 configured to receive bolt 38. Attachment portion 42 may also include opening 54 configured to slidably receive retainer plate 36.

Adapter 32 may be attached to primary wall 16 of work tool 10. Adapter 32 may be configured to be slidably received in attachment portion 42. Adapter 32 may include hole 56 configured to receive bolt 38. Spring assembly 34 may be disposed adjacent adapter 32. Spring assembly 34 may be attached to adapter 32 and may include spring damper 58, slide compressor 60, and nut 62. As illustrated in Fig. 2, spring damper 58 may be disposed between adapter 32 and slide compressor 60. Spring damper 58 may include hole 64 configured to receive bolt 38. Slide compressor 60 may be configured to be slidably received in attachment portion 42. Slide compressor 60 may include hole 66 configured to receive bolt 38. Slide compressor 60 may also include slot 68, which may be configured to receive nut 62. Bolt 38 may pass through hole 52 in attachment portion 42 of shroud 22, hole 56 in adapter 32, hole 64 in spring damper 58, and hole 66 in slide compressor 60 to threadingly engage with nut 62 disposed within slot 68. Slide compressor 60 may be configured to slidably movable relative to adapter 32. For example, slide compressor 60 may be configured to slidably move towards adapter 32 when bolt 38 is turned to engage with nut 62, compressing spring damper 58 disposed between adapter 32 and slide compressor 60.

Fig. 3 illustrates a perspective view of shroud 22, which may extend from adjacent shroud proximal end 70 to adjacent shroud distal end 72. Tip 44 of shroud 22 may extend from adjacent shroud proximal end 70 to adjacent tip end 74. Tip 44 may be generally wedge shaped with a thickness adjacent shroud proximal end 70, which may be smaller than a thickness of tip 44 adjacent tip end 74. Upper leg 46 of tip portion 40 may extend from tip end 74 to upper leg distal end 76, which may be disposed between tip end 74 and shroud distal end 72. Lower leg 48 of tip portion 40 may extend from tip end 74 to lower leg distal end 78, which may be disposed between tip end 74 and shroud distal end 72. Upper leg 46 may be spaced apart from lower leg 48, forming opening 50 between upper and lower legs 46, 48. Upper and lower legs 46, 48

may be wedge shaped. For example, a thickness of upper leg 46 adjacent tip end 74 may be larger than a thickness of upper leg 46 adjacent upper leg distal end 76. Likewise, a thickness of lower leg 48 adjacent tip end 74 may be larger than a thickness of lower leg 48 adjacent lower leg distal end 78. Tip 44, upper leg 46, and lower leg 48 may each have a width " W_1 ."

Attachment portion 42 may be attached to tip portion 40. In one exemplary embodiment as illustrated in Fig. 3, attachment portion 42 may be attached to upper leg 46 and may extend from adjacent tip end 74 to shroud distal end 72. Attachment portion 42 may have a width " W_2 " adjacent shroud distal end 72. In one exemplary embodiment as illustrated in Fig. 3, width W_2 may be smaller than width W_1 . Attachment portion 42 may include a channel 80 (see dashed lines), which may extend from adjacent tip end 74 to shroud distal end 72. Channel 80 may have a generally inverted C-shape and may be configured to slidably engage with adapter 32 and slide compressor 60.

Attachment portion 42 may also include channel front wall 82 adjacent tip end 74. Channel front wall 82 may include hole 52, which may be a through hole. Hole 52 may be sized to receive bolt 38, which may pass through hole 52 and extend into channel 80. As also illustrated in Fig. 3, attachment portion 42 may include opening 54, which may be configured to receive retainer plate 36.

Opening 54 may be disposed adjacent shroud distal end 72 across a width of attachment portion 42. In one exemplary embodiment as illustrated in Fig. 3, opening 54 may be disposed nearer to shroud distal end 72 compared to tip end 74. Opening 54 may have a width " W_3 ," which may be smaller than a width W_2 of attachment portion 42. Width W_3 of opening 54 may be selected to allow retainer plate 36 to pass through opening 54 into channel 80.

Fig. 4 illustrates a rear view of shroud 22. As illustrated in Fig. 4, channel 80 of attachment portion 42 may have a generally inverted C-shape having top wall 84, first leg 86, and second leg 88. First leg 86 may extend from top wall 84 towards edge 18 of work tool 10. First leg 86 may be disposed on first side 90 of channel 80 and may extend from top wall 84 to adjacent upper surface 92 of edge 18. Second leg 88 may extend from top wall 84 towards edge 18 of work tool 10. Second leg 88 may be disposed opposite first leg 86 on second side 94. Second leg 88 may extend from top wall 84 to adjacent upper surface 92 of edge 18. Channel 80 may have a height " H_1 " and may include

lower recess 96 and upper recess 98, both of which together may form channel 80. Lower recess 96 may extend from adjacent upper surface 92 to first lower recess end 100 on first side 90 and second lower recess end 102 on second side 94. Lower recess 96 may have a height "HL₁" adjacent first leg 86 and height "HL₂" adjacent second leg 88. Heights HL₁ and HL₂ may be equal or unequal and may be smaller than height H₁ of channel 80. Lower recess 96 may have a width "W₄" adjacent upper surface 92 and a width "W₅" adjacent first and second lower recess ends 100, 102. In one exemplary embodiment as illustrated in Fig. 4, width W₅ may be smaller than width W₄ giving lower recess 96 a generally inverted trapezoidal or dovetail shape.

Upper recess 98 may extend from first and second lower recess ends 100, 102 to channel inner wall 104. Upper recess 98 may have a height "HU₁" adjacent first leg 86 and a height "HU₂" adjacent second leg 88. Heights HU₁ and HU₂ may be smaller than height H₁ of channel 80. Further, heights HU₁, HU₂, HL₁, and HL₂ may be equal or unequal. Upper recess 98 may have a width W₆ adjacent top wall 84. In one exemplary embodiment as illustrated in Fig. 4, width W₆ may be larger than width W₅ giving upper recess 98 a generally inverted trapezoidal or dovetail shape. Lower and upper recesses 96, 98 of channel 80 may be configured to slidably receive adapter 32 and slide compressor 60.

Fig. 5 illustrates a perspective view of an exemplary disclosed adapter 32. Adapter 32 may include central block 106, first projection 108, and second projection 110. Central block 106 may include adapter front face 112 and adapter rear face 114 disposed opposite adapter front face 112. Adapter rear face 114 may be spaced apart from adapter front face 112. Central block 106 may include adapter bottom face 116 that may extend between adapter front face 112 and adapter rear face 114. Adapter bottom face 116 may be configured to abut against upper surface 92 of work tool 10. Central block 106 may include adapter top face 118 that may extend between adapter front face 112 and adapter rear face 114. Adapter top face 118 may be disposed opposite adapter bottom face 116. Adapter rear face 114 may be disposed generally orthogonal to adapter bottom face 116 and adapter top face 118.

Adapter 32 may include first adapter side wall 120 and second adapter side wall 122. First adapter side wall 120 may be disposed on first side

124 of adapter 32 and may extend between adapter front face 112 and adapter rear face 114. Second adapter side wall 122 may be disposed on second side 126 of adapter 32 opposite first side 124. Second adapter side wall 122 may also extend between adapter front face 112 and adapter rear face 114. First and
5 second adapter side walls 120, 122 may be disposed generally orthogonal to adapter front face 112, adapter rear face 114, adapter bottom face 116, and adapter top face 118. Adapter 32 may have a height " H_2 ," which may be smaller than height H_1 of channel 80 to allow channel 80 to slidably engage with adapter 32.

10 First projection 108 may extend outward from central block 106. First projection 108 may be disposed generally orthogonal to first adapter side wall 120. First projection may have a height " h_1 ," between adapter bottom face 116 and first projection end 128. Height h_1 may be smaller than height H_2 of adapter 32. Second projection 110 may be disposed opposite first projection 108
15 and may extend outward from central block 106. Second projection 110 may be disposed generally orthogonal to second adapter side wall 122. Second projection may have a height " h_2 ," between adapter bottom face 116 and second projection end 130. Height h_2 may be smaller than height H_2 of adapter 32. It is also contemplated that height h_2 may be the same as or different from height h_1 .

20 First projection 108 may have a first lower side face 132, which may extend from adapter bottom face 116 to first projection end 128. First adapter side wall 120 may include a first upper side face 134, which may extend from first projection end 128 to adapter top face 118. Second projection 110 may have a second lower side face 136, which may extend from adapter bottom
25 face 116 to second projection end 130. Second adapter side wall 122 may include second upper side face 138, which may extend from second projection end 130 to adapter top face 118. First and second lower side faces 132, 136 may be inclined relative to each other and relative to adapter bottom face 116 and adapter top face 118. Likewise, first and second upper side faces 134, 138 may
30 be inclined relative to each other and relative to adapter bottom face 116 and adapter top face 118. Adapter bottom face 116, first lower side face 132, and second lower side face 136 may be arranged so that first and second projections 108, 110 may form a dovetail mortice shape, which may be slidably received in lower recess 96 of channel 80. Likewise, first and second upper side faces 134,

138 may be arranged so that central block 106 may form a dovetail mortice shape, which may be slidably received in upper recess 98 of channel 80.

Adapter 32 may have a width “ W_7 ” adjacent adapter top face 118 and a width “ W_8 ” between first and second projection ends 128, 130. Widths W_7 and W_8 may be less than widths W_6 and W_5 , respectively, to allow adapter 32 to be slidably received within channel 80 of shroud 22.

Adapter 32 may include recess 140, which may extend from adapter rear face 114 into adapter 32 towards adapter front face 112. Recess 140 may have a recess base 142, which may be disposed generally parallel to adapter rear face 114. Recess 140 may have a depth “ D_1 ,” between adapter rear face 114 and recess base 142. Depth D_1 may be smaller than a thickness “ D_2 ” of adapter 32. Recess 140 may have a height “ H_3 ” and a width “ W_9 .” Height H_3 and width W_9 may be selected such that one end of spring damper 58 may be slidably retained within recess 140. Adapter 32 may include hole 56, which may extend from recess base 142 to adapter front face 112. In one exemplary embodiment as illustrated in Fig. 4, hole 56 may be a through hole and may have a generally circular cross-section. It is contemplated, however, that hole 56 may be tapped to threadingly receive bolt 38.

Fig. 6 illustrates a vertical cross-sectional view of adapter 32. As illustrated in Fig. 6, adapter front face 112 may be generally inclined relative to adapter bottom face 116, adapter top face 118, adapter rear face 114, and recess base 142. In one exemplary embodiment, adapter front face 112 may be inclined towards adapter rear face 114 so that thickness D_2 of adapter 32 adjacent adapter top face 118 may be smaller than thickness “ D_3 ” of adapter 32 adjacent adapter bottom face 116. Angle of inclination θ of adapter front face 112 relative to a vertical plane disposed generally parallel to adapter rear face 114 may range between about 15° to 30° . As used in this disclosure, the terms “about” and “generally” indicate typical manufacturing tolerances and dimensional rounding.

Fig. 7 illustrates a perspective view of an exemplary disclosed slide compressor 60. Slide compressor 60 may include central block 144, first projection 146, and second projection 148. Central block 144 may include compressor front face 150 and compressor rear face 152 disposed opposite compressor front face 150. Compressor rear face 152 may be spaced apart from compressor front face 150. Central block 144 may include compressor bottom

face 154 that may extend between compressor front face 150 and compressor rear face 152. Compressor bottom face 154 may be configured to slidably engage with upper surface 92 of work tool 10. Central block 144 may include compressor top face 156 that may extend between compressor front face 150 and compressor rear face 152. Compressor top face 156 may be disposed opposite compressor bottom face 154. Compressor front face 150 may be disposed generally orthogonal to compressor bottom face 154 and compressor top face 156.

Slide compressor 60 may include first compressor side wall 158 and second compressor side wall 160 disposed opposite first compressor side wall 158. First compressor side wall 158 may be disposed on first side 162 of slide compressor 60 and may extend between compressor front face 150 and compressor rear face 152. Second compressor side wall 160 may be disposed on second side 164 of slide compressor 60 opposite first side 162. Second compressor side wall 160 may extend between compressor front face 150 and compressor rear face 152. First and second compressor side walls 158, 160 may be disposed generally orthogonal to compressor front face 150, compressor rear face 152, compressor bottom face 154, and compressor top face 156. Slide compressor 60 may have a height " H_4 ," which may be smaller than height H_1 of channel 80 to allow channel 80 to slidably engage with slide compressor 60.

First projection 146 may extend outward from central block 144. First projection 146 may be disposed generally orthogonal to first compressor side wall 158. First projection may have a height " h_3 ," between compressor bottom face 154 and first projection end 166. Height h_3 may be smaller than height H_4 of slide compressor 60. Second projection 148 may be disposed opposite first projection 146 and may extend outward from central block 144. Second projection 148 may be disposed generally orthogonal to second compressor side wall 160. Second projection may have a height " h_4 ," between compressor bottom face 154 and second projection end 168. Height h_4 may be smaller than height H_2 . It is also contemplated that height h_4 may be the same as or different from height h_3 .

First projection 146 may include first lower side face 170, which may extend from compressor bottom face 154 to first projection end 166. First compressor side wall 158 may include first upper side face 172, which may

- extend from first projection end 166 to compressor top face 156. Second projection 148 may have a second lower side face 174, which may extend from compressor bottom face 154 to second projection end 168. Second compressor side wall 160 may include second upper side face 176, which may extend from second projection end 168 to compressor top face 156. First and second lower side faces 170, 174 may be inclined relative to each other and relative to compressor bottom face 154 and compressor top face 156. Likewise, first and second upper side faces 172, 176 may be inclined relative to each other and relative to compressor bottom face 154 and compressor top face 156.
- Compressor bottom face 154, first lower side face 170, and second lower side face 174 may be arranged so that first and second projections 146, 148 may form a dovetail mortice shape, which may be slidably received in lower recess 96 of channel 80. Likewise, first and second upper side faces 172, 176 may be arranged so that central block 144 may form a dovetail mortice shape, which may be slidably received in upper recess 98 of channel 80. Slide compressor 60 may have a width " W_{10} " adjacent compressor top face 156 and a width " W_{11} " between first and second projection ends 166, 168. Widths W_{10} and W_{11} may be less than widths W_6 and W_5 , respectively, to allow slide compressor 60 to be slidably received within channel 80 of shroud 22.
- Slide compressor 60 may include recess 178, which may extend from compressor front face 150 into slide compressor 60 towards compressor rear face 152. Recess 178 may have a recess base 180, which may be disposed generally parallel to compressor front face 150. Recess 178 may have a depth " D_4 ," between compressor front face 150 and recess base 180. Depth D_4 may be smaller than a thickness " D_5 " of slide compressor 60. Recess 178 may have a height " H_5 " and a width " W_{12} ." Height H_5 and width W_{12} may be selected such that one end of spring damper 58 may be slidably retained within recess 178. It is contemplated that height H_5 of recess 178 may be the same as or different from height H_3 of recess 140. Likewise, it is contemplated that width W_{12} of recess 178 may be the same as or different from width W_9 of recess 140.
- Slide compressor 60 may include hole 66, which may extend between compressor front face 150 and compressor rear face 152. In one exemplary embodiment as illustrated in Fig. 7, hole 66 may extend from recess base 180 to compressor rear face 152. Hole 66 may have a first hole portion

182, a second hole portion 184, and a third hole portion 186. First hole portion 182 and third hole portion 186 may be through holes and may have a generally circular cross-section. It is contemplated that first and third hole portions 182, 186 may be tapped to threadingly receive nut 62. Second hole portion 184 may have a generally non-circular cross-section. Slide compressor 60 may include slot 68 on compressor top face 156. Slot 68 may extend from compressor top face 156 towards compressor bottom face 154 and may intersect with hole 66. Slot 68 may intersect with second hole portion 184, which may be configured to slidably receive nut 62 through slot 68. The non-circular cross-section of second hole portion 184 may help prevent rotation of nut 62 within second hole portion 184. Slot 68 may be disposed nearer compressor rear face 152 relative to compressor front face 150. In one exemplary embodiment as illustrated in Fig. 7, slot 68 may have a generally rectangular cross-section. Slot 68 may have a width "W₁₃," which may be selected such that nut 62 may be receivable within slot 68.

Fig. 8 illustrates a vertical cross-sectional view of slide compressor 60. As illustrated in Fig. 6, compressor rear face 152 of slide compressor 60 may be generally inclined relative to compressor bottom face 154, compressor top face 156, compressor front face 150, and recess base 180. In one exemplary embodiment, compressor rear face 152 may be inclined towards compressor front face 150 so that thickness D₅ of slide compressor 60 adjacent compressor top face 156 may be smaller than thickness "D₆" of slide compressor 60 adjacent compressor bottom face 154. Angle of inclination ϕ of compressor rear face 152 relative to a vertical plane disposed generally parallel to compressor rear face 152 may range between about 15° to 30°.

As also illustrated in Fig. 8, first hole portion 182 may be disposed between recess base 180 and slot 68. First hole portion 182 may extend from recess base 180 to first hole portion end 188 disposed adjacent slot 68. First hole portion end 188 may be disposed between recess base 180 and compressor rear face 152. Second hole portion 184 may extend within slot 68 from first hole portion end 188 to second hole portion end 190, which may be disposed between first hole portion end 188 and compressor rear face 152. Third hole portion 186 may be disposed between slot 68 and compressor rear face 152. For example, third hole portion 186 may extend from second hole portion end

190 to compressor rear face 152. As discussed above, first and third hole portions 182, 186 may have a generally circular cross-sections while second hole portion 184 may have a generally non-circular cross-section. Second hole portion 184 may have a width “D₇,” which may be selected to ensure that nut 62
5 may be slidably received in second hole portion 184. The non-circular cross-section of second hole portion 184 may help ensure that nut 62 does not rotate when placed within second hole portion 184.

Fig. 9 illustrates a perspective view of an exemplary disclosed retainer plate 36. Retainer plate 36 may have a retainer front face 192 disposed
10 opposite retainer rear face 194. Retainer front and rear faces 192, 194 may be disposed generally parallel to each other and may be separated by a thickness T of retainer plate 36. In one exemplary embodiment as illustrated in Fig. 9, thickness T may be generally uniform over an area of retainer front and rear faces 192, 194.

15 Retainer plate 36 may include retainer portion 196 and pull out portion 198. Retainer portion 196 may have a generally rectangular shape and may include retainer bottom face 200, retainer top face 202, first retainer side face 204, and second retainer side face 206. Retainer bottom face 200 may extend from retainer front face 192 to retainer rear face 194. Retainer bottom
20 face 200 may be disposed generally orthogonal to retainer front and rear faces 192, 194. Retainer top face 202 may extend from retainer front face 192 to retainer rear face 194. Retainer top face 202 may be disposed generally orthogonal to retainer front and rear faces 192, 194. First retainer side face 204 may extend from retainer front face 192 to retainer rear face 194 and between
25 retainer bottom face 200 and retainer top face 202. First retainer side face 204 may be disposed generally orthogonal to retainer front and retainer rear faces 192, 194 and retainer top and bottom faces 200, 202. Likewise, second retainer side face 206 may extend from retainer front face 192 to retainer rear face 194 and extend between retainer bottom face 200 and retainer top face 202. Second
30 retainer side face 206 may be disposed generally orthogonal to retainer front and retainer rear faces 192, 194 and retainer top and bottom faces 200, 202. It is contemplated, however, that retainer front face 192, retainer rear face 194, retainer bottom face 200, retainer top face 202, first retainer side face 204, and second retainer side face 206 may be disposed generally inclined relative to one

or more of each other. Retainer portion 196 may have a width " W_{14} " between first and second retainer side faces 204, 206 and a height " H_6 " between retainer bottom face 200 and retainer top face 202.

Retainer portion 196 may include slot 208, which may extend
5 through thickness T from retainer front face 192 to retainer rear face 194. In one exemplary embodiment as illustrated in Fig. 9, slot 208 may be disposed generally midway between first and second retainer side faces 204, 206. Slot 208 may extend from retainer bottom face 200 toward retainer top face 202 to slot end 210, which may be disposed between retainer bottom face 200 and
10 retainer top face 202. Slot 208 may include first slot portion 212 and second slot portion 214. First slot portion 212 may extend from retainer bottom face 200 to first slot portion end 216, which may be disposed between retainer bottom face 200 and slot end 210. First slot portion 212 may be a generally rectangular slot having a width " W_{15} " and a height " H_7 ." It is contemplated, however, that first
15 slot portion 212 may have a square shape or any other suitable shape known in the art. Width W_{15} of first slot portion 212 may be smaller than width W_{14} and may be selected so that width W_{15} may be larger than a diameter of bolt 38. Second slot portion 214 may extend from first slot portion end 216 to slot end 210. Second slot portion 214 may have a generally semi-circular shape. In one
20 exemplary embodiment as illustrated in Fig. 9, a radius R of second slot portion 214 may be about half of width W_{15} of first slot portion 212.

Pull out portion 198 may have a generally trapezoidal shape and may extend outward from retainer top face 202 of retainer portion 196. Pull out portion 198 may have a width " W_{16} ," which may be smaller than width W_{14} of
25 retainer portion 196. Pull out portion 198 may be disposed generally midway between first and second retainer side faces 204, 206 of retainer portion 196. Pull out portion 198 may have a top wall 218, which may extend between retainer front face 192 and retainer rear face 194 of retainer plate 36. Top wall 218 may be disposed generally parallel to retainer top face 202 of retainer
30 portion 196. Top wall 218 may be disposed at a height " H_7 " above retainer top face 202.

Pull out portion 198 may have first side wall 220 and second side wall 222 disposed opposite first side wall 220. First and second side walls 220, 222 may extend from retainer front face 192 to retainer rear face 194 of retainer

plate 36. First and second side walls 220, 222 may be disposed generally orthogonal to retainer front face 192 and retainer rear face 194 of retainer plate 36. First and second side walls 220, 222 may connect top wall 218 of pull out portion 198 with retainer top face 202 of retainer portion 196. First and second
5 side walls 220, 222 may be inclined relative to top wall 218 and retainer top face 202 so that pull out portion 198 may have a generally trapezoidal shape. For example top wall 218 may have a width “W₁₇,” which may be smaller than width W₁₆ of pull out portion 198.

Retainer plate 36 may include slot 224, which may be disposed
10 between slot end 210 and top wall 218. Slot 224 may extend from retainer front face 192 to retainer rear face 194. Slot 224 may have a generally rectangular shape with generally semi-circular shaped slot ends 226. It is contemplated, however, that slot 224 may have an oblong, elliptical, circular, or any other type of shape known in the art. In one exemplary embodiment as illustrated in Fig. 9,
15 slot 224 may be disposed generally orthogonal to slot 208. Slot 224 may have a width “W₁₈,” which may be equal to, smaller than, or larger than widths W₁₅, W₁₆, and W₁₇. In one exemplary embodiment as illustrated in Fig. 9, slot 224 may be disposed partially in retainer portion 196 and partially in pull out portion 198. It is contemplated, however, that slot 224 may be disposed wholly in one
20 of retainer portion 196 and pull out portion 198.

Fig. 10 illustrates a perspective view of an exemplary disclosed spring damper 58. In one exemplary embodiment as illustrated in Fig. 10, spring damper 58 may have a generally cuboidal shape having width “W₁₉,” thickness “D₈,” and height “H₈.” It is contemplated, however, that spring damper 58 may
25 have a cylindrical, conical, ellipsoidal, frusto-conical, or any other shape known in the art. Spring damper 58 may be configured to be disposed between adapter 32 and slide compressor 60. Spring damper 58 may extend from damper proximal end 228 to damper distal end 230. Spring damper 58 may be configured to be slidably attached to adapter 32 adjacent damper proximal end
30 228. Likewise, spring damper 58 may be configured to be slidably attached to slide compressor 60 adjacent damper distal end 230.

Spring damper 58 may include damper front face 232, damper rear face 234, and damper sides 236. Damper front face 232 may be disposed adjacent damper proximal end 228. Damper rear face 234 may be disposed

opposite and spaced apart from damper front face 232. Damper rear face 234 may be disposed adjacent damper distal end 230. Damper sides 236 may extend from damper front face 232 to damper rear face 234. Damper front face 232 may be disposed generally parallel to damper rear face 234. Damper sides 236
5 may be disposed generally orthogonal to damper front face 232 and damper rear face 234.

Damper front face 232 may have a generally rectangular shape, although other shapes are also contemplated. A size of damper front face 232 may be selected so that damper front face 232 may be receivable in recess 140 of
10 adapter 32. Damper front face 232 may be configured to abut against recess base 142 of recess 140. Damper rear face 234 may have a generally rectangular shape, although other shapes are also contemplated. A size of damper rear face 234 may be selected so that damper rear face 234 may be receivable in recess 178 of slide compressor 60. Damper rear face 234 may be configured to abut
15 against recess base 180 of recess 178.

Spring damper 58 may include hole 64, which may extend from damper front face 232 to damper rear face 234. Hole 64 may be a through hole. It is contemplated that hole 64 may be tapped to threadingly receive bolt 38. Spring damper 58 may be made of elastomeric material, which may be
20 configured to be compressed between adapter 32 and slide compressor 60. Additionally, or alternatively, spring damper 58 may include one or more spring members (not shown) disposed between damper front face 232 and damper rear face 234.

Fig. 11 illustrates a cross-sectional view of an exemplary
25 disclosed shroud retention system 30. As illustrated in Fig. 11, in an assembled configuration, lower leg 48 of shroud 22 may be disposed adjacent lower surface 238 of edge 18 of work tool 10. Upper leg 46 may be disposed adjacent upper surface 92 of edge 18, which may be disposed in opening 50 between upper leg 46 and lower leg 48. Further, adapter 32 may be disposed on upper surface 92 of
30 edge 18. In some exemplary embodiments, adapter 32 may be fixedly attached to edge 18 via welded joints, fasteners, or using any other means of attachment known in the art. Adapter 32 may be disposed within channel 80, which may slidably engage with adapter 32. Channel front wall 82 of channel 80 may have an outer surface 240 and an inner surface 242. Hole 52 in attachment portion 42

of shroud 22 may extend from outer surface 240 to inner surface 242 of channel front wall 82. Adapter front face 112 of adapter 32 may be disposed opposite inner surface 242 of channel 80.

Slide compressor 60 may also be disposed within channel 80, which may slidably engage with slide compressor 60. As illustrated in Fig. 11, spring damper 58 may be disposed between adapter 32 and slide compressor 60 within channel 80. Damper front face 232 of spring damper 58 may be disposed opposite recess base 142 of recess 140 of adapter 32. Damper front face 232 may abut against recess base 142. Damper rear face 234 of spring damper 58 may be disposed opposite recess base 180 of recess 178 of slide compressor 60. Damper rear face 234 may abut against recess base 180. Holes 52, 56, 64, and 66 in shroud 22, adapter 32, spring damper 58, and slide compressor 60, respectively, may be axially aligned with nut 62 disposed in slot 68 of slide compressor 60, and may be configured to receive bolt 38.

Nut 62 may be disposed within second hole portion 184 of hole 66. As also illustrated in Fig. 11, retainer plate 36 may be disposed within channel 80 in a locked position. For example, retainer plate 36 may be disposed in channel 80 such that retainer front face 192 may abut against compressor rear face 152 of slide compressor 60. Top wall 84 of channel 80 may include channel inner surface 244, which may include notch 246. Notch 246 may be disposed adjacent opening 54 between opening 54 and hole 52. Notch 246 may include notch upper wall 248 and notch base wall 250. Pull out portion 198 of retainer plate 36 may slidably engage with notch 246 adjacent retainer top face 202. Top wall 218 of pull out portion 198 of retainer plate 36 may abut against notch upper wall 248, and retainer front face 192 of retainer plate 36 may abut against notch base wall 250.

Fig. 12 illustrates a bottom view of an exemplary disclosed shroud retention system 30. As illustrated in Fig. 12, retainer plate 36 may be slidably attached to first and second legs 86, 88 of channel 80 and may be configured to retain spring assembly 34 between adapter 32 and retainer plate 36. Front face 196 of retainer plate 36 may abut compressor rear face 152 of slide compressor 60. As further illustrated in Fig. 12, first leg 86 of channel 80 may include first retainer slot 252 and second leg 88 of channel 80 may include second retainer slot 254. First retainer slot 252 may extend from opening 54 in

top wall 84 of channel 80 to adjacent upper surface 92 (see dashed line in Fig. 4). Likewise, second retainer slot 254 may extend from opening 54 in top wall 84 of channel 80 adjacent upper surface 92 of edge 18 to top wall 84 of channel 80 (see dashed line in Fig. 4). First and second retainer slots 252, 254 and opening 54 may allow retainer plate 36 to be inserted through opening 54 and be disposed in first and second retainer slots 252, 254.

Returning to Fig. 11, in a locked position, pull out portion 198 of retainer plate 36 may slidably engage with notch 246 in top wall 84 of channel 80 and retainer portion 196 of retainer plate 36 may abut against retainer slot walls 256 adjacent retainer bottom face 200. In one exemplary embodiment as illustrated in Fig. 11, when retainer plate 36 is in its locked position, retainer rear face 194 may abut against retainer slot walls 256 of first and second retainer slots 252, 254 adjacent retainer bottom face 200. Thus in the locked position, pull out portion 198 of retainer plate 36 may slidably engage with notch 246. Simultaneously, retainer rear face 194 may engage with retainer slot walls 256 of first and second retainer slots 252, 254. In particular, the biasing force of spring damper 58 may help compressor rear face 152 move retainer plate 36 into its inclined and locked position within channel 80 as illustrated in Fig. 11.

Fig. 13 illustrates a perspective view of another exemplary embodiment of shroud 22. In addition to the features of shroud 22 discussed above with respect to Fig. 3, shroud 22 may also include one or more grooves 258 disposed on lower surface 260 of tip 44. Lower surface 260 may extend from tip edge 262, which may be disposed adjacent shroud proximal end 70, to adjacent lower leg distal end 78. Grooves 258 may be disposed adjacent tip edge 262 and may extend between first side face 264 of shroud 22 and second side face 266, which may be disposed opposite first side face 264. In one exemplary embodiment as illustrated in Fig. 13, grooves 258 may have a width equal to width W_1 of tip 44. Although Fig. 13 illustrates shroud 22 with three grooves 258, it is contemplated that shroud 22 may include any number of grooves 258, which may be spaced from each other at equal or unequal distances. It is also contemplated that grooves 258 may be disposed parallel to or inclined relative to tip edge 262. Each groove 258 may have a generally rectangular shaped cross-section. Grooves 258 may be configured to slidably or interferingly receive abrasion resistant materials, which may be attached to shroud 22 via fasteners,

rivets, welded or brazed joints, or by any other method of attachment known in the art.

Fig. 14 illustrates a perspective bottom view of exemplary embodiments of adapter 32, spring damper 58, and slide compressor 60. As illustrated in Fig. 14, in addition to the features of adapter 32 described above with respect to Figs. 2, 5, and 6, adapter 32 may include a dovetail shaped recess 140 between adapter rear face 114 and recess base 142. For example, adapter 32 may include first adapter lip 268 disposed on first side 124 of adapter 32 and second adapter lip 270 disposed on second side 126 of adapter 32. First adapter lip 268 may extend into recess 140 from first adapter side wall 120 towards second adapter side wall 122. Likewise, second adapter lip 270 may extend into recess 140 from second adapter side wall 122 towards first adapter side wall 120. First and second adapter lips 268, 270 may extend from adapter bottom face 116 and may have a height H_3 (see Fig. 3). As also illustrated in Fig. 14, recess 140 may include first side wall 272 disposed on first side 124 and second side wall 274 disposed on second side 126. First side wall 272 may extend between recess base 142 and first adapter lip 268. Likewise second side wall 274 may extend between recess base 142 and second adapter lip 270. First and second side walls 272, 274 may be disposed generally orthogonal to adapter bottom face 116. First and second side walls 272, 274 may be inclined relative to recess base 142 and relative to each other. First and second adapter lips 268, 270, first and second side walls 272, 274, and recess base 142 may form a generally dovetail shaped recess 140 in adapter 32.

As also illustrated in Fig. 14, in addition to the features of slide compressor 60 described above with respect to Figs. 2, 7, and 8, slide compressor 60 may include a dovetail shaped recess 178 between compressor front face 150 and recess base 180. For example, slide compressor 60 may include first compressor lip 276 disposed on first side 162 of slide compressor 60 and second compressor lip 278 disposed on second side 164 of slide compressor 60. First compressor lip 276 may extend into recess 178 from first compressor side wall 158 towards second compressor side wall 160. Likewise, second compressor lip 278 may extend into recess 178 from second compressor side wall 160 towards first compressor side wall 158. First and second compressor lips 276, 278 may extend from compressor bottom face 154 and may

have a height H_5 (see Fig. 6 and second side wall 282 disposed on second side 164. First side wall 280 may extend between recess base 180 and first compressor lip 276. Likewise second side wall 282 may extend between recess base 180 and second compressor lip 278. First and second side walls 280, 282 may be disposed generally orthogonal to compressor bottom face 154. First and second side walls 280, 282 may be inclined relative to recess base 180 and relative to each other. First and second compressor lips 276, 278, first and second side walls 280, 282, and recess base 180 may form a generally dovetail shaped recess 178 in slide compressor 60.

As further illustrated in Fig. 14, in addition to the features of spring damper 58 described above with respect to Figs. 2 and 10, spring damper 58 may include first damper channel 290 and second damper channel 292. First damper channel 290 may be disposed on first side 294 of spring damper 58 and second damper channel may be disposed on second side 296 opposite first side 294. First side 294 of spring damper 58 may be disposed adjacent first side 124 of adapter 32 and first side 162 of slide compressor 60. Likewise, second side 296 of spring damper 58 may be disposed adjacent second side 126 of adapter 32 and second side 164 of slide compressor 60.

First damper channel 290 may extend from spring damper base 298 to spring damper top face 300. As illustrated in Fig. 14, spring damper base 298 may be disposed generally coplanar with adapter bottom face 116 and compressor bottom face 154. First damper channel 290 may have side walls 302 and first channel base 304. Side walls 302 and first channel base 304 may be disposed generally orthogonal to spring damper base 298 and spring damper top face 300. Side walls 302 may be disposed generally parallel to each other and generally orthogonal to first channel base 304. Second damper channel 292 may extend from spring damper base 298 to spring damper top face 300. Second damper channel 292 may have side walls 306 and second channel base 308. Side walls 306 and second channel base 308 may be disposed generally orthogonal to spring damper base 298 and spring damper top face 300. Side walls 306 may be disposed generally parallel to each other and generally orthogonal to second channel base 308.

As also illustrated in Fig. 14, adapter 32 may include first dovetail mortice 310 and second dovetail mortice 312. First dovetail mortice

310 may extend from damper front face 232 to side walls 302, 306 of first and second damper channels 290, 292, respectively. First dovetail mortice 310 may include mortice side walls 314, 316, which may extend from spring damper base 298 to spring damper top face 300. Mortice side wall 314 may be disposed on
5 first side 294 and may extend from damper front face 232 to side wall 302 of first damper channel 290. Mortice side wall 316 may be disposed on second side 296 and may extend from damper front face 232 to side wall 306 of second damper channel 292. Mortice side walls 314, 316 may be disposed generally orthogonal to spring damper base 298 and spring damper top face 300. Mortice
10 side walls 314, 316 may be generally inclined to each other. Damper front face 232, side walls 302, 306, and mortice side walls 314, 316 may give first dovetail mortice 310 a dovetail mortice shape. First dovetail mortice 310 may be configured to engage with dovetail shaped recess 140 in adapter 32 such that side wall 302 of first dovetail mortice 310 may engage with first adapter lip 268
15 and side wall 306 may engage with second adapter lip 270.

Second dovetail mortice 312 may extend from damper front face 232 to side walls 302, 306 of first and second damper channels 290, 292, respectively. Second dovetail mortice 312 may include mortice side walls 318, 320, which may extend from spring damper base 298 to spring damper top face
20 300. Mortice side wall 318 may be disposed on first side 294 and may extend from damper rear face 234 to side wall 302 of first damper channel 290. Mortice side wall 320 may be disposed on second side 296 and may extend from damper rear face 234 to side wall 306 of second damper channel 292. Mortice side walls 318, 320 may be disposed generally orthogonal to spring damper base 298 and
25 spring damper top face 300. Mortice side walls 318, 320 may be generally inclined to each other. Damper rear face 232, side walls 302, 306, and mortice side walls 318, 320 may give second dovetail mortice 312 a dovetail mortice shape. Second dovetail mortice 312 may be configured to engage with dovetail shaped recess 178 in slide compressor 60 such that side wall 302 of second
30 dovetail mortice 312 may engage with first compressor lip 276, and side wall 306 may engage with second compressor lip 278.

Industrial Applicability

The disclosed shroud retention system may be used with various earth-working machines, such as hydraulic excavators, cable shovels, wheel loaders, front shovels, draglines, and bulldozers. Specifically, the shroud retention system may be used to connect shrouds to work tools of these machines to help protect the work tool edges against wear. A method of retaining shroud 22 on work tool 10 will be described next.

Fig. 15 illustrates a method 1500 of retaining shroud 22 on work tool 10. Method 1500 may include a step of attaching spring assembly 34 to adapter 32 (Step 1502). To attach spring assembly 34 to adapter 32, spring damper 58 may be slidably inserted in recess 140 of adapter 32 adjacent damper proximal end 228 such that damper front face 232 abuts against recess base 142 of adapter 32. For example, spring damper 58 may be placed adjacent adapter rear face 114 and may be pushed towards adapter 32 so that first dovetail mortice 310 may engage with first and second adapter lips 268, 270. Further, slide compressor 60 may slidably attached to spring damper 58 adjacent damper distal end 230 such that damper rear face 234 abuts against recess base 180 of slide compressor 60. In one exemplary embodiment, recess 178 of slide compressor 60 may be slidably engaged with second dovetail mortice 312 of spring damper 58 by engaging second dovetail mortice 312 and recess 178 adjacent spring damper top face 300. Slide compressor 60 may be slidably pushed downward toward spring damper base 298 so that second dovetail mortice 312 of spring damper 58 engages with first and second compressor lips 276, 278. Nut 62 may be inserted into slot 68 of slide compressor 60 so that nut 62 is disposed in second hole portion 184 of hole 66 in slide compressor 60.

Method 1500 may include a step of attaching shroud 22 (Step 1504). Attachment portion 42 of shroud 22 may be positioned and pushed rearward toward edge 18 so that adapter 32 and spring assembly 34 may be slidably received in channel 80 of attachment portion 42 of shroud 22. Thus, for example, shroud 22 may be attached such that first and second projections 108, 110 of adapter 32 and first and second projections 146, 148 of slide compressor 60 may be slidably received in lower recess 96 of channel 80. Likewise, first and second upper side faces 134, 138 of adapter 32 and first and second upper

side faces 172, 176 of slide compressor 60 may be slidably received within upper recess 98 of channel 80.

Method 1500 may include a step of compressing spring assembly 34 (Step 1506). To compress spring assembly 34, bolt 38 may be inserted through holes 52, 56, 64, 66 of shroud 22, adapter 32, spring damper 58, and slide compressor 60, respectively, so that bolt 38 threadingly engages with nut 62 in slide compressor 60. Turning bolt 38 may cause slide compressor 60 to slidably move towards adapter 32, compressing spring damper 58. Bolt 38 may be turned until opening 54 in attachment portion 42 of shroud 22 is located rearward of compressor rear face 152 of slide compressor 60. In this condition, opening 54 may be disposed between compressor rear face 152 of slide compressor 60 and shroud distal end 72.

Method 1500 may include a step of inserting retainer plate 36 into opening 54 (Step 1508). Retainer plate 36 may be pushed into opening 54 so that first and second retainer side faces 204, 206 slidably engage with first and second retainer slots 252, 254. Retainer plate 36 may be pushed in through opening 54 until retainer bottom face 200 abuts against upper surface 92 of edge 18. Retainer plate 36 may in an unlocked position when inserted in this manner through opening 54 because it may be possible to pull retainer plate 36 out of opening 54.

Method 1500 may include a step of partially uncompressing spring assembly 34 (Step 1510). To partially uncompress spring assembly 34, bolt 38 may be turned to loosen bolt 38 from nut 62. Turning bolt 38 in this manner may allow slide compressor 60 to move away from adapter 32, uncompressing spring damper 58. As bolt 38 is turned to uncompress spring assembly 34, spring damper 58 may exert a biasing force on slide compressor 60 pushing slide compressor 60 away from adapter 32. The biasing force of spring damper 58 may cause compressor rear face 152 of slide compressor 60 to push retainer front face 192 of retainer plate 36 so that retainer plate 36 may be tilted into its locked position. Tilting retainer plate 36 may cause retainer plate 36 to slidably engage with notch 246 in channel 80 of shroud 22. Thus, retainer front face 192 of retainer plate 36 may abut against notch base wall 250 and top wall 218 of pull out portion 198 of retainer plate 36 may abut against notch upper wall 248. The biasing force of spring damper 58 and the angle of inclination of

compressor rear face 152 of slide compressor 60 may help push retainer plate 36 against notch 246, preventing retainer plate 36 from being ejected out of opening 54. Likewise, the biasing force of spring damper 58 and the angle of inclination of compressor rear face 152 may help retainer rear face 194 abut against retainer slot walls 256 adjacent retainer bottom face 200. Thus, by partially
5 uncompressing spring damper 58 to push retainer plate 36 into a locked position, retention system 30 may allow shroud 22 to be attached to work tool 10 without the use of any fasteners.

In one exemplary embodiment, bolt 38 may be completely
10 removed from retention system 30. Bolt 38 may be reusable for assembly and/or disassembly of one or more shroud 22 on the same work tool 10. Further, by using a single spring damper 58 as the compressible element, retention system 30 may help reduce the number of components in the assembly, which may help reduce the cost of operating work tool 10. In addition, because assembly of
15 shroud 22 using the disclosed shroud retention system 30 requires only a linear movement of channel 80 to slidably receive adapter 32 and slide compressor 60, shroud retention system 30 may help simplify the assembly process for shrouds 22 at a work site.

To remove shroud 22 from work tool 10, a pry bar may be
20 inserted through opening 54 to push retainer front face 192 of retainer plate 36 rearward so that retainer front face 192 and retainer top face 202 of retainer plate 36 may disengage from notch base wall 250 and notch upper wall 248, respectively. The pry bar may then be inserted into slot 224 in retainer plate 36 to pull retainer plate 36 out of opening 54. In one exemplary embodiment, by
25 engaging with dovetail shaped recesses 140 and 178, first and second dovetail mortises 310, 312, respectively, of spring damper 58 may prevent slide compressor 60 from being ejected rearward due to the biasing force of spring damper 58 when retainer plate 36 is removed from slot 224. Once retainer plate 36 has been removed, shroud 22 may be slidably disengaged from slide
30 compressor 60 and adapter 32 by pulling shroud 22 towards shroud proximal end 70 and away from edge 18 of work tool 10.

It will be apparent to those skilled in the art that various modifications and variations can be made to the disclosed shroud retention system. Other embodiments will be apparent to those skilled in the art from

consideration of the specification and practice of the disclosed shroud retention system. It is intended that the specification and examples be considered as exemplary only, with a true scope being indicated by the following claims and their equivalents.

Claims

1. A shroud (22) for a work tool (10), comprising:
a tip portion (40), including:
a tip (44) extending from a shroud proximal end (70) to a tip end
5 (74) disposed between the shroud proximal end and a shroud distal end (72);
an upper leg (46) extending from the tip end to an upper leg distal
end (76);
a lower leg (48) extending from the tip end to a lower leg distal
end (78), the lower leg being spaced apart from the upper leg; and
10 an attachment portion (42) attached to the upper leg, the
attachment portion extending from adjacent the tip end to the shroud distal end,
the attachment portion including a channel (80).
2. The shroud of claim 1, wherein the channel includes:
15 a top wall (84);
a first leg (86) extending from the top wall on a first side (90) of
the channel; and
a second leg (88) extending from the top wall, the second leg
being disposed on a second side (94) of the channel opposite the first side.
20
3. The shroud of claim 2, wherein the channel further
includes:
an opening (50) disposed adjacent the shroud distal end;
a first retainer slot (252) disposed in the first leg, the first retainer
25 slot extending from the opening; and
a second retainer slot (254) disposed in the second leg, the second
retainer slot extending from the opening, wherein the opening, the first retainer
slot, and the second retainer slot are configured to receive a retainer plate (36).
4. The shroud of claim 3, wherein the channel includes a
30 notch (246) disposed in an inner surface (244) of the top wall, the notch being
disposed adjacent the opening.

5. The shroud of claim 3, wherein the channel further includes:

a lower recess (96) having a first width between the first leg and the second leg; and

5 an upper recess (98) having a second width between the first leg and the second leg, the second width being smaller than the first width.

6. The shroud of claim 1, wherein the tip includes:

a tip edge (262) disposed adjacent the shroud proximal end;

10 a lower surface (260) extending from the tip edge to adjacent the lower leg distal end; and

at least one groove (258) disposed along a width of the tip.

7. A slide compressor (60) for attaching a work tool, the slide compressor comprising:

a central block (106), including:

a compressor front face (150);

15 a compressor rear face (152) disposed opposite the compressor front face, the compressor rear face being inclined relative to the compressor front face;

20 a compressor bottom face (154) extending between the compressor front face and the compressor rear face;

25 a compressor top face (156) disposed opposite the compressor bottom face and extending between the compressor front face and the compressor rear face;

a hole (66) extending between the compressor front face and the compressor rear face; and

a slot (68) extending from the compressor top face towards the compressor bottom face and intersecting with the hole.

30

8. The slide compressor of claim 7, further including a recess (178) extending from the compressor front face towards the compressor rear face, the recess including a recess base (180), the hole extending from the recess base to the compressor rear face.

9. A retainer plate (36), comprising:
- a retainer front face (192);
 - a retainer rear face (194) disposed opposite the retainer front face;
 - a retainer portion (196), including:
 - 5 a retainer bottom face (200) extending between the retainer front face and the retainer rear face;
 - a retainer top face (202) extending between the retainer front face and the retainer rear face; and
 - retainer side faces (204, 206) extending between the retainer front
 - 10 face and the retainer rear face;
 - a pullout portion (198) extending from the retainer portion, the pullout portion including:
 - a top wall (218) disposed generally parallel to the retainer top face; and
 - 15 a first side wall (220) connecting the top wall to the retainer top face; and
 - a second side wall (222) connecting the top wall to the retainer top face;
 - a first slot (208) extending from the retainer bottom face towards
 - 20 the retainer top face; and
 - a second slot (224) disposed between the first slot and the top wall of the pullout portion.

10. The retainer plate of claim 9, wherein the first slot
- 25 includes:
- a first slot portion (212) extending from the retainer bottom face to a first slot portion end (216) disposed between the retainer bottom face and the retainer top face; and
 - a second slot portion (214) extending between the first slot
 - 30 portion end and a slot end (210) disposed between the retainer bottom face and the retainer top face.

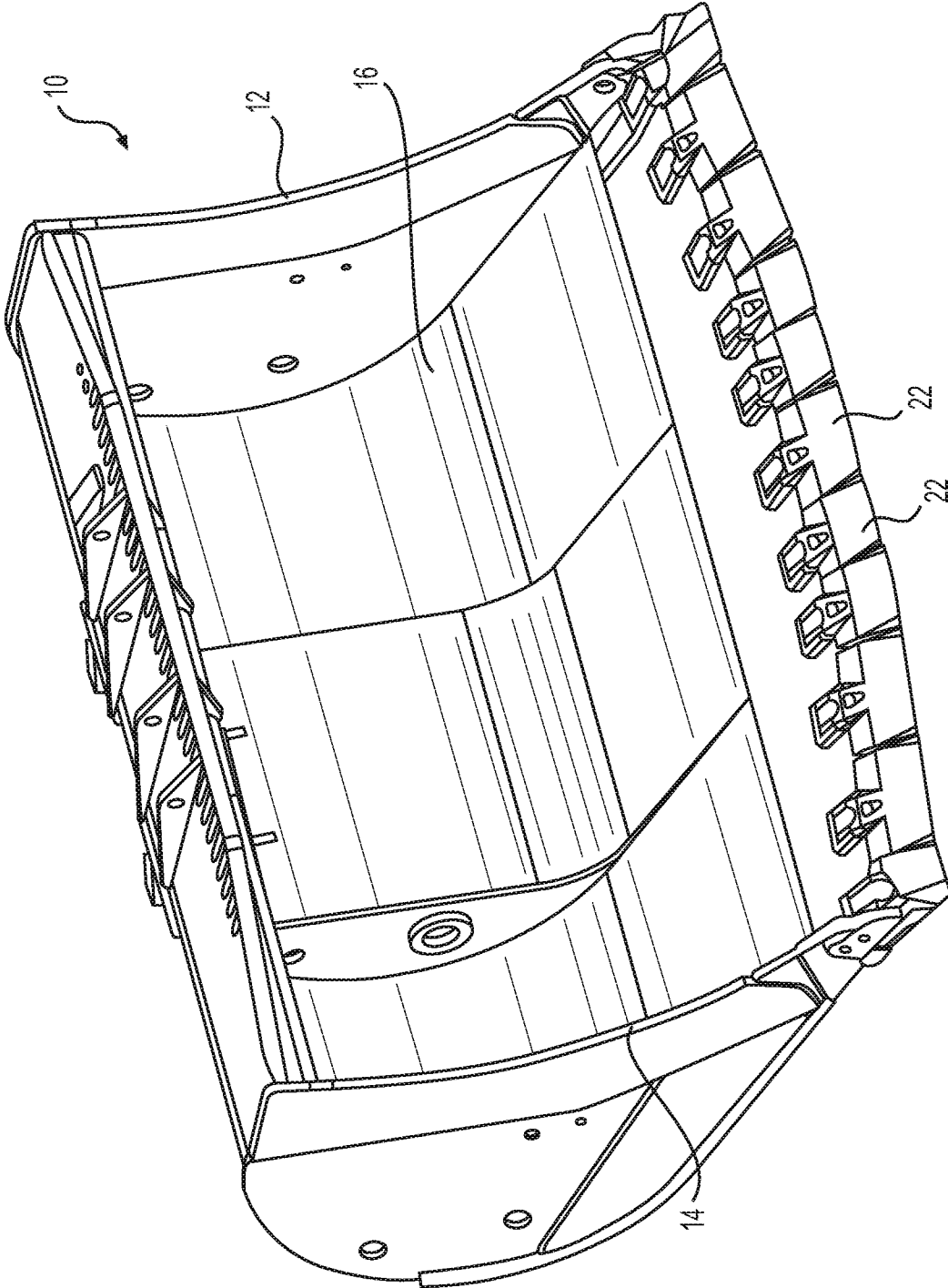


FIG. 1

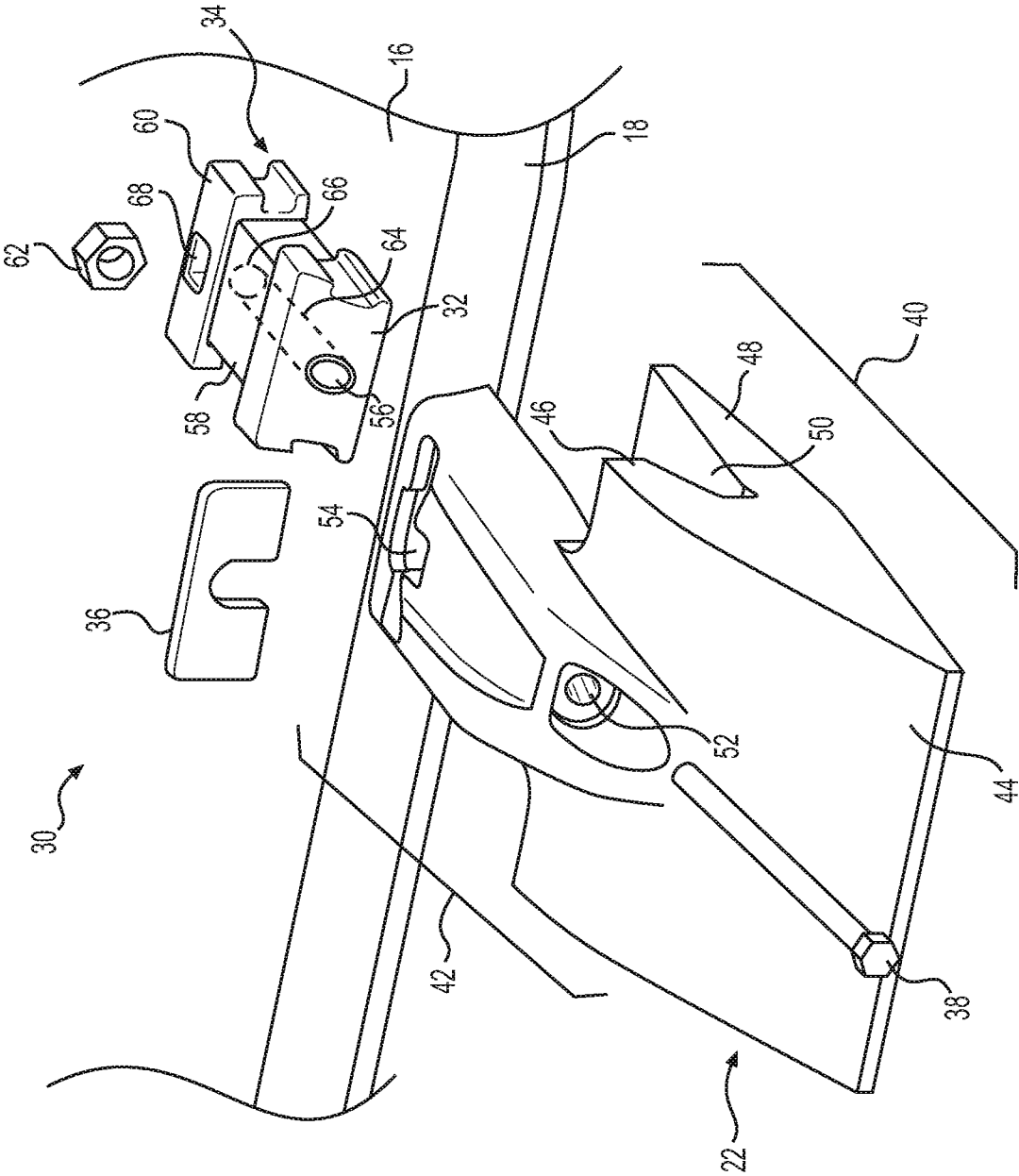
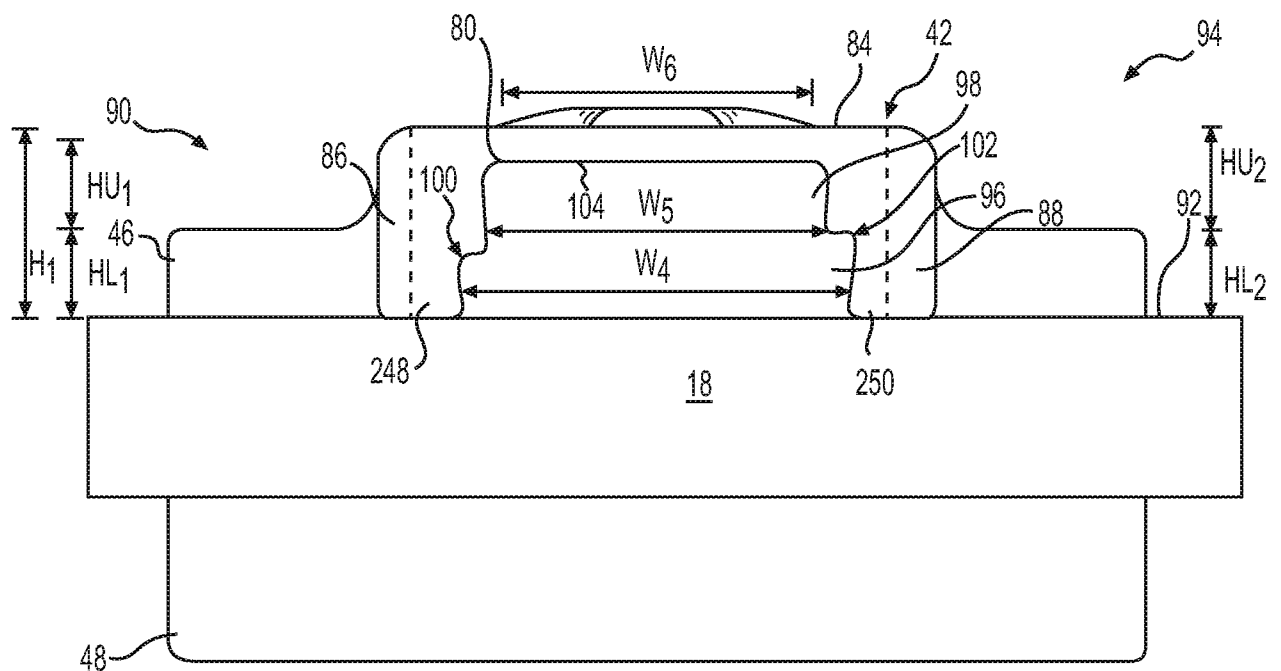
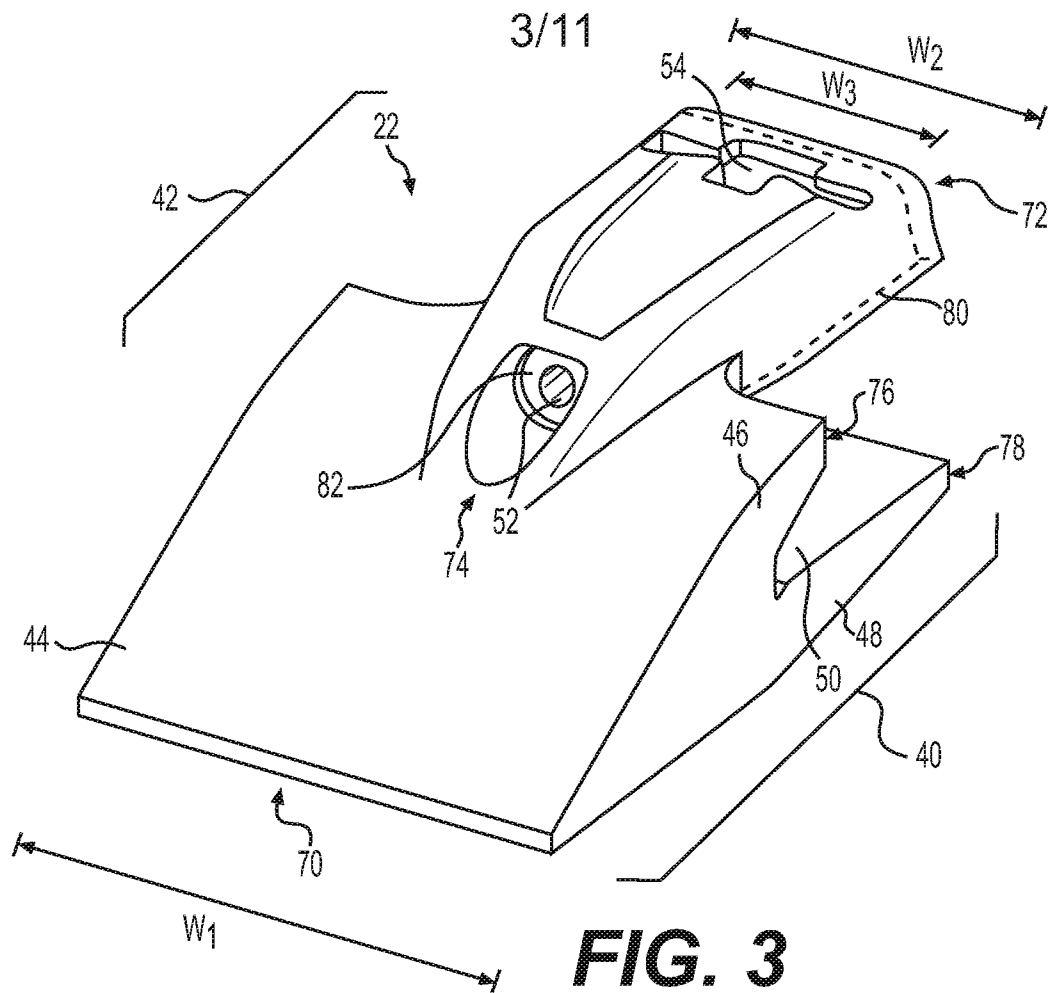


FIG. 2

**FIG. 4**

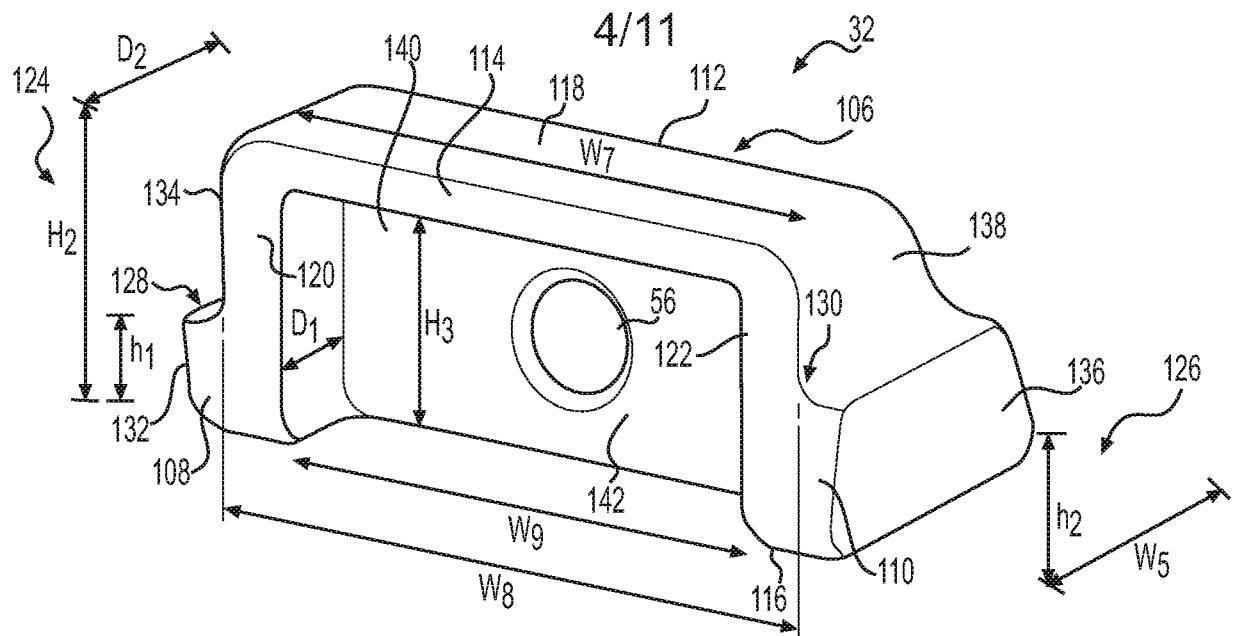


FIG. 5

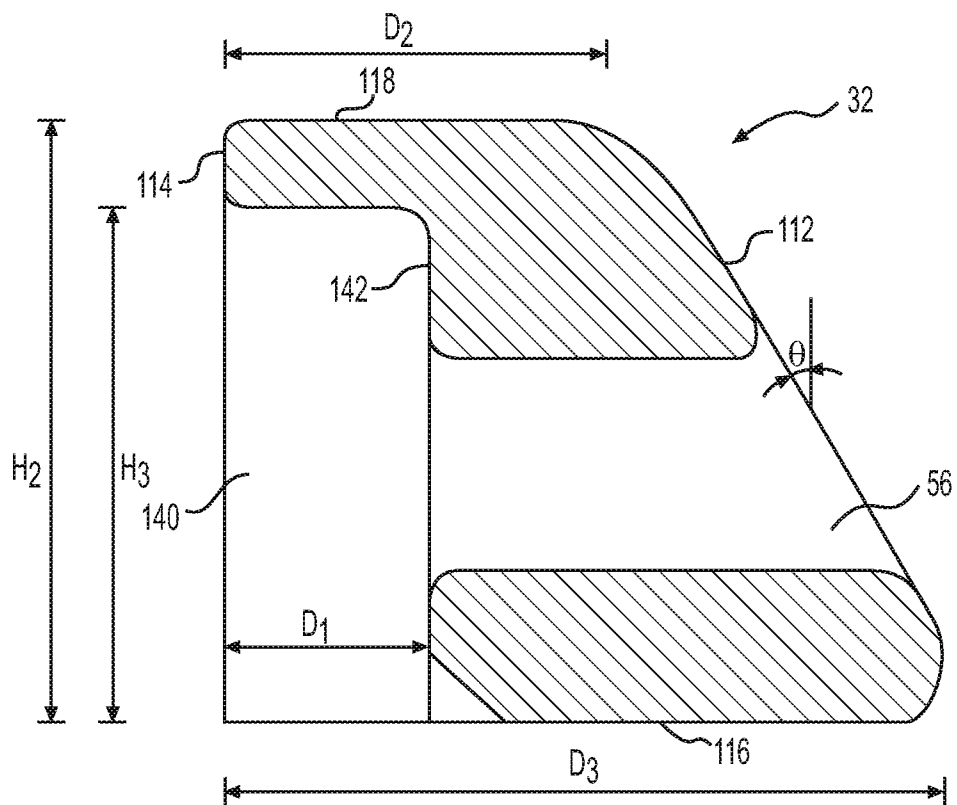
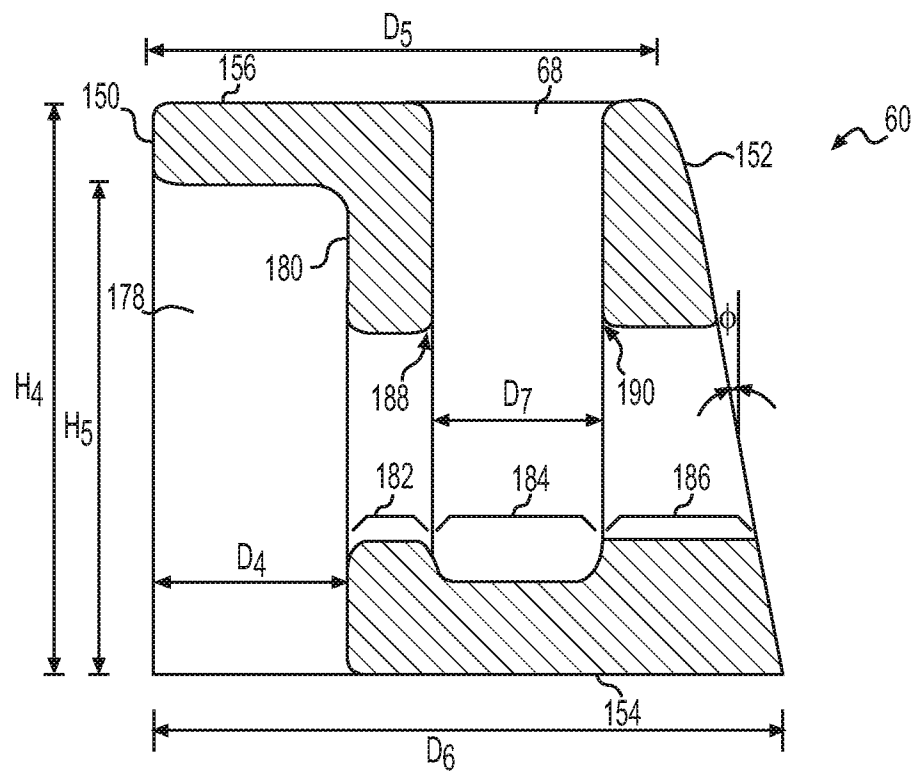
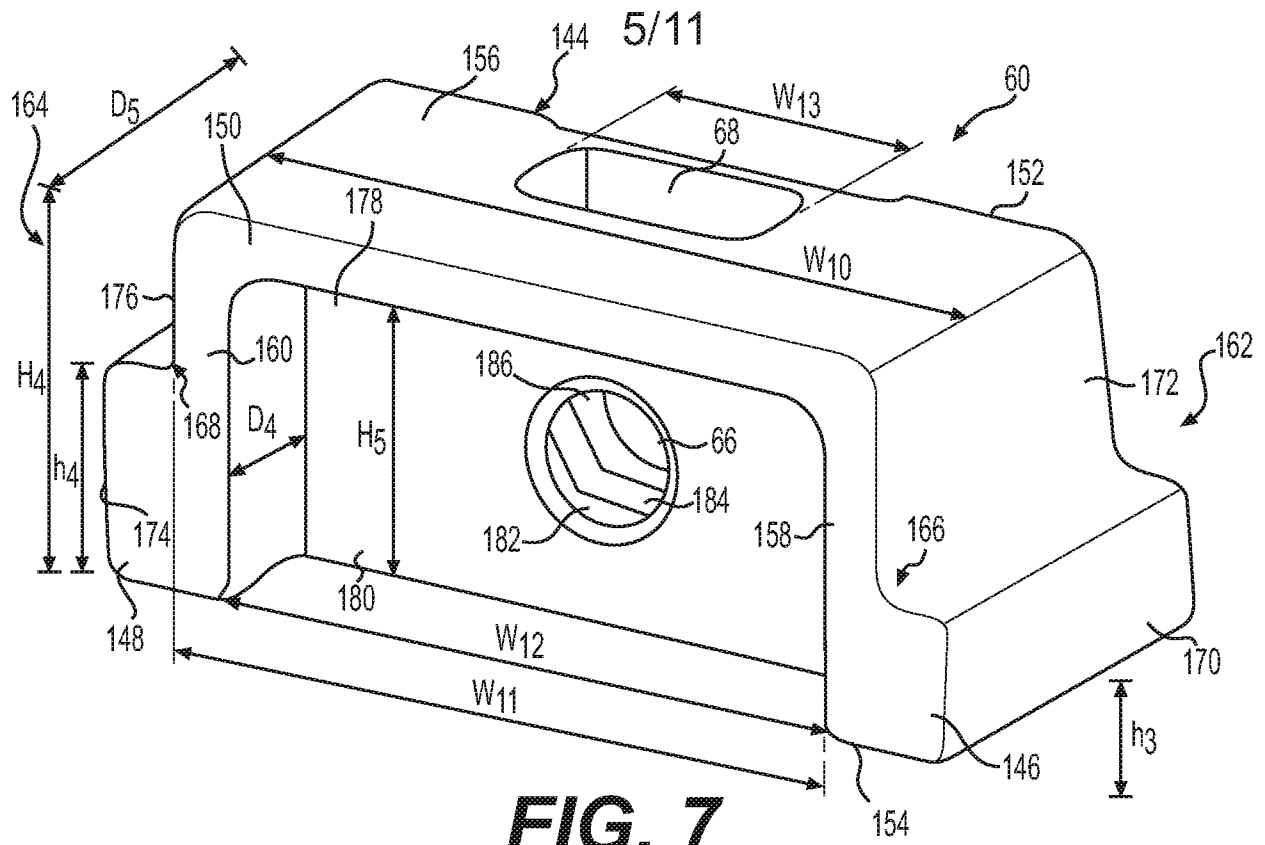


FIG. 6



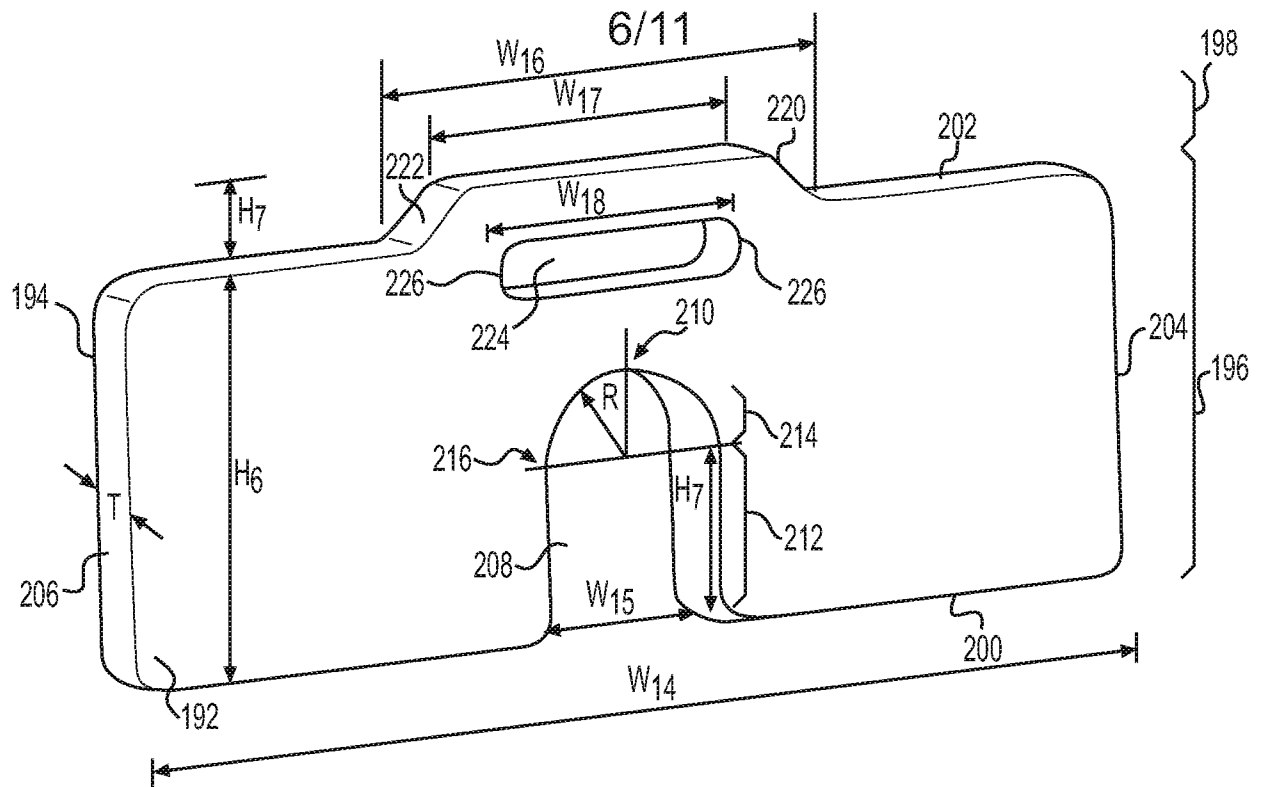
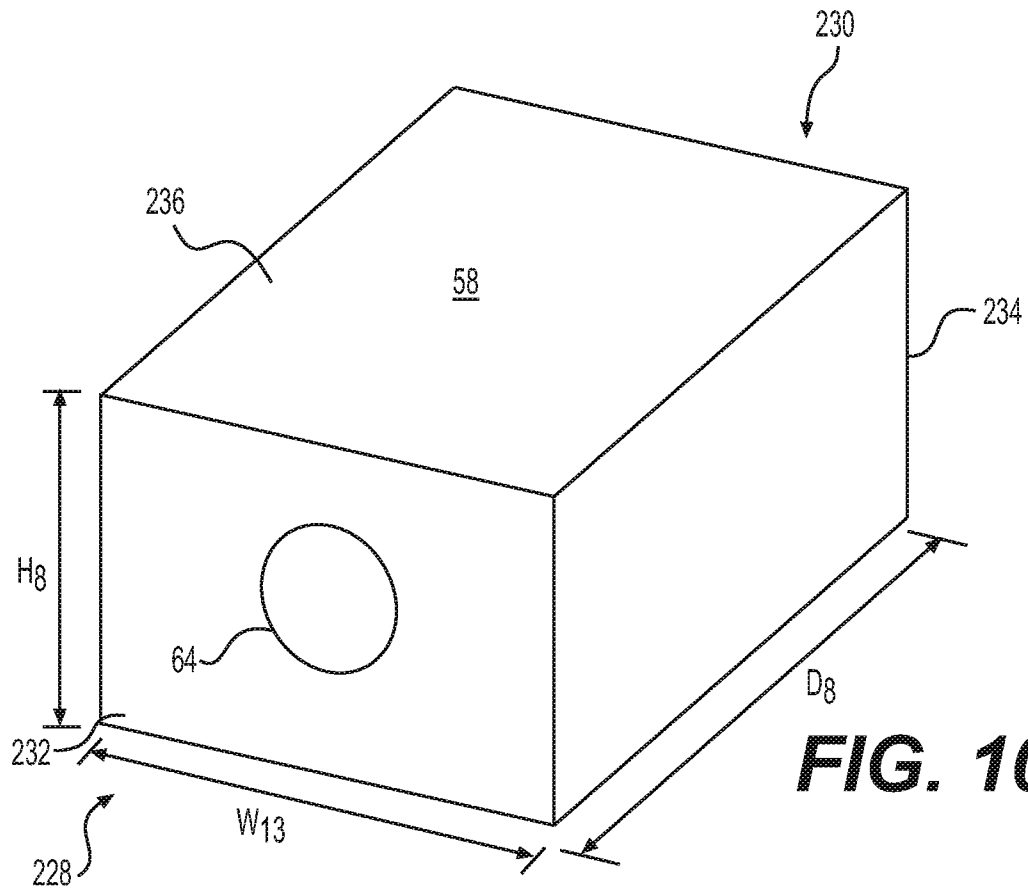
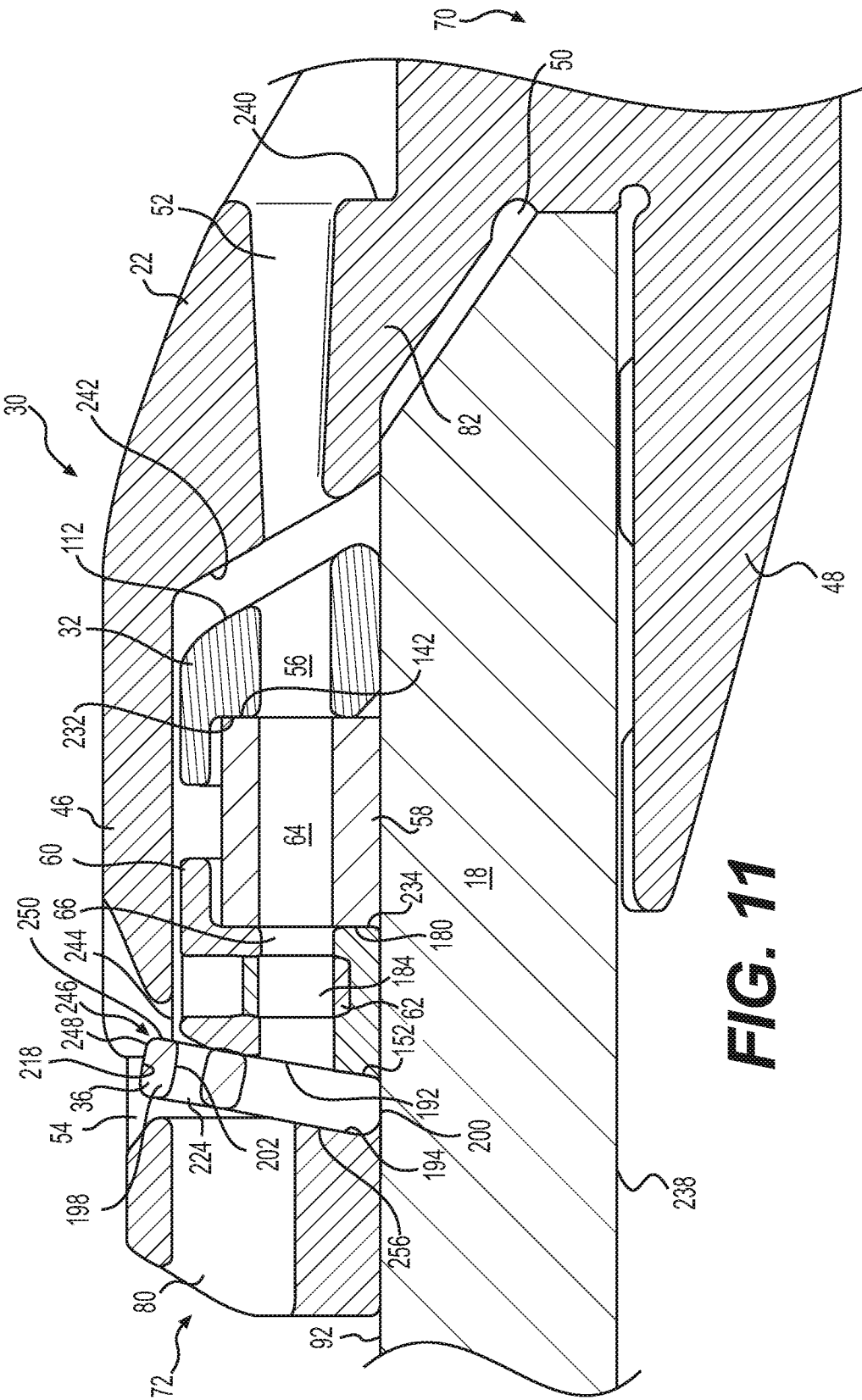
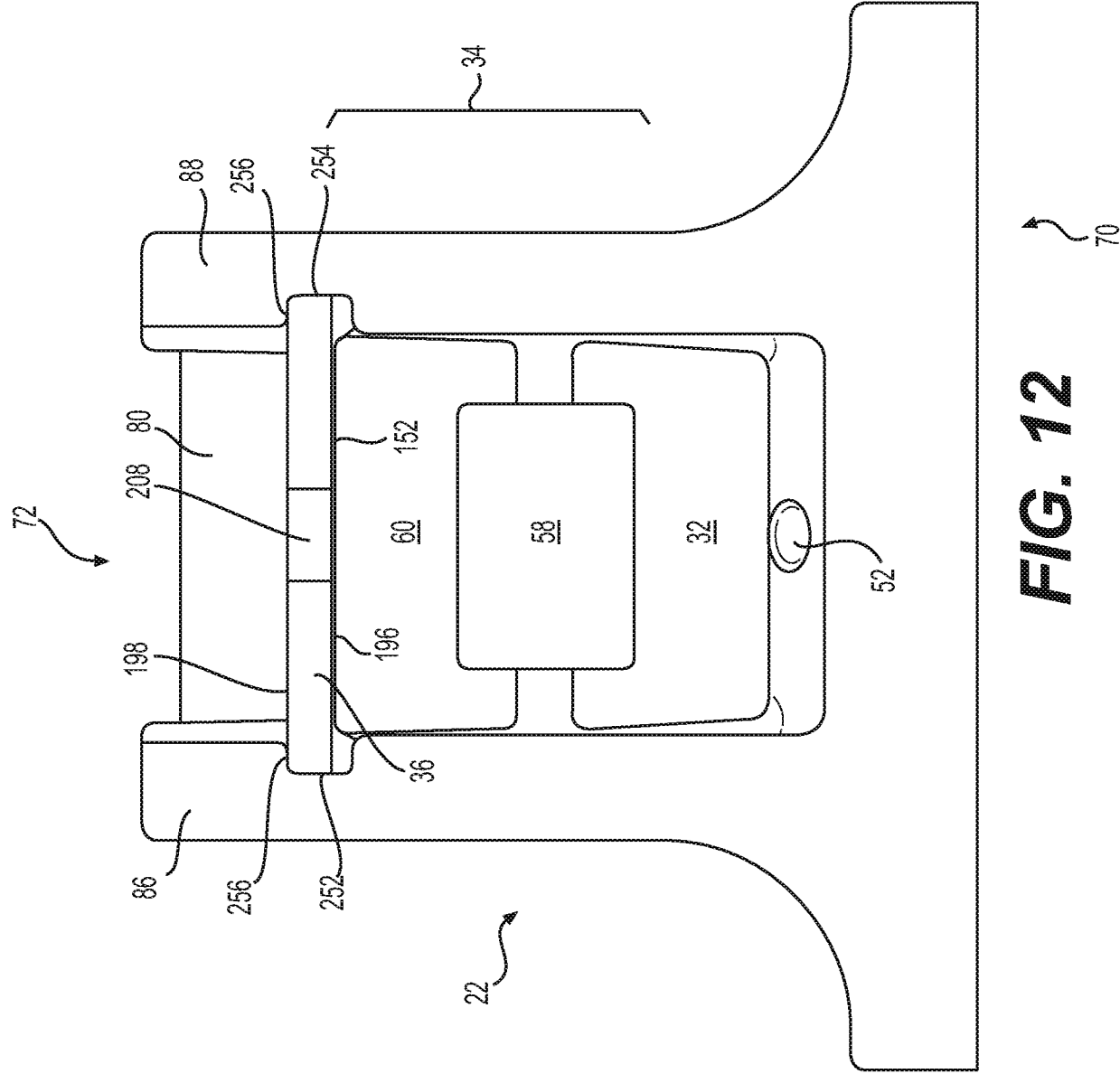
**FIG. 9**

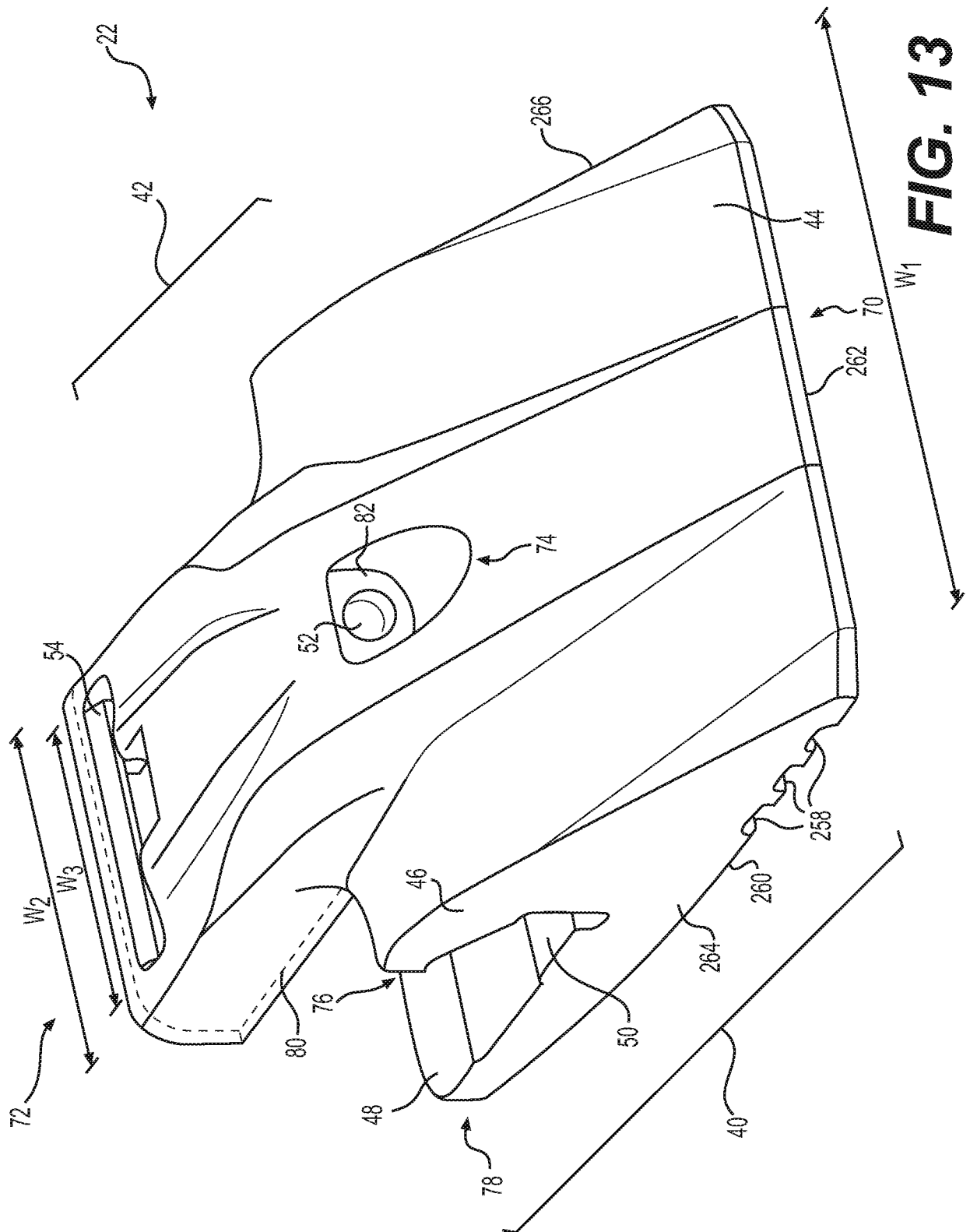
FIG. 10

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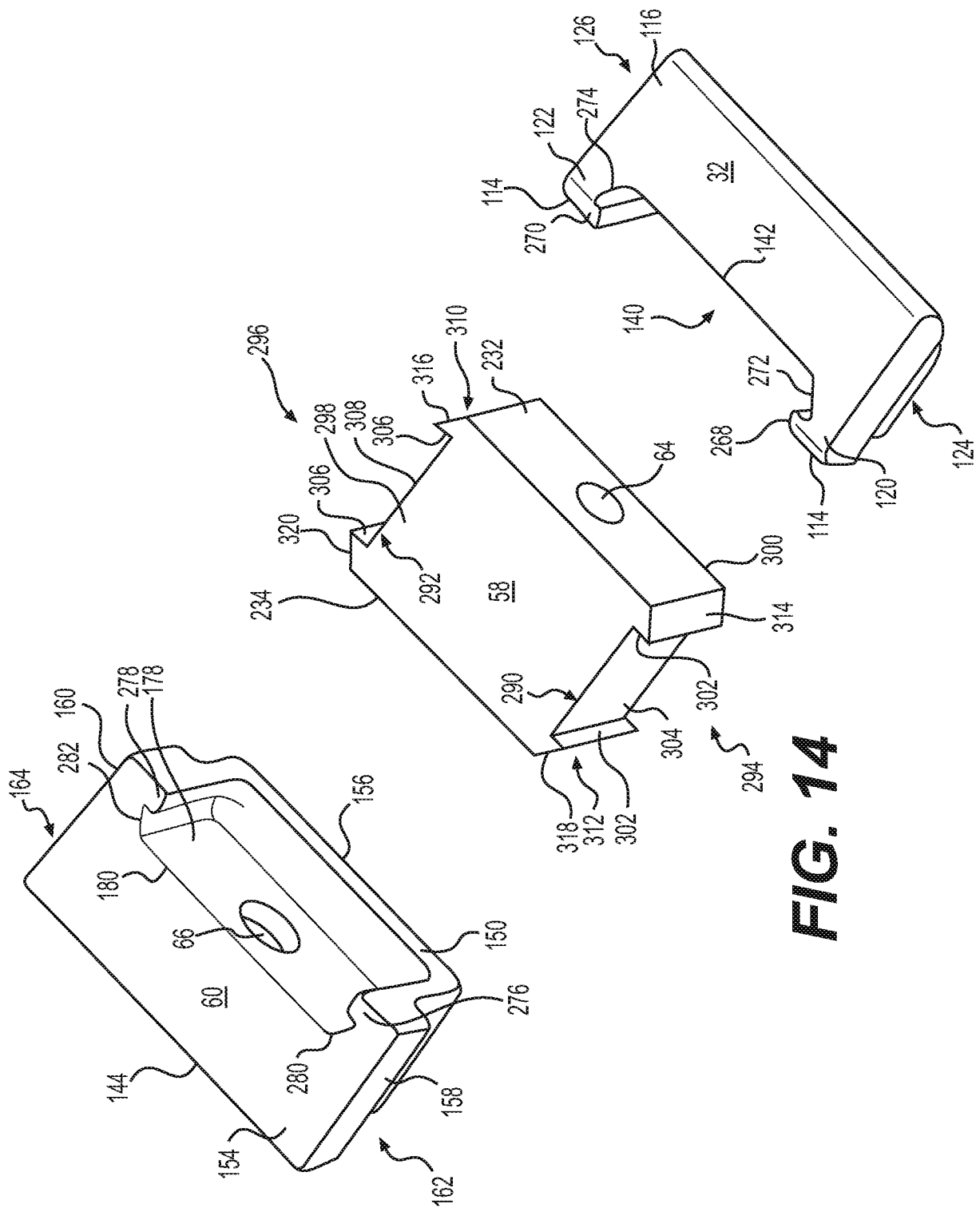
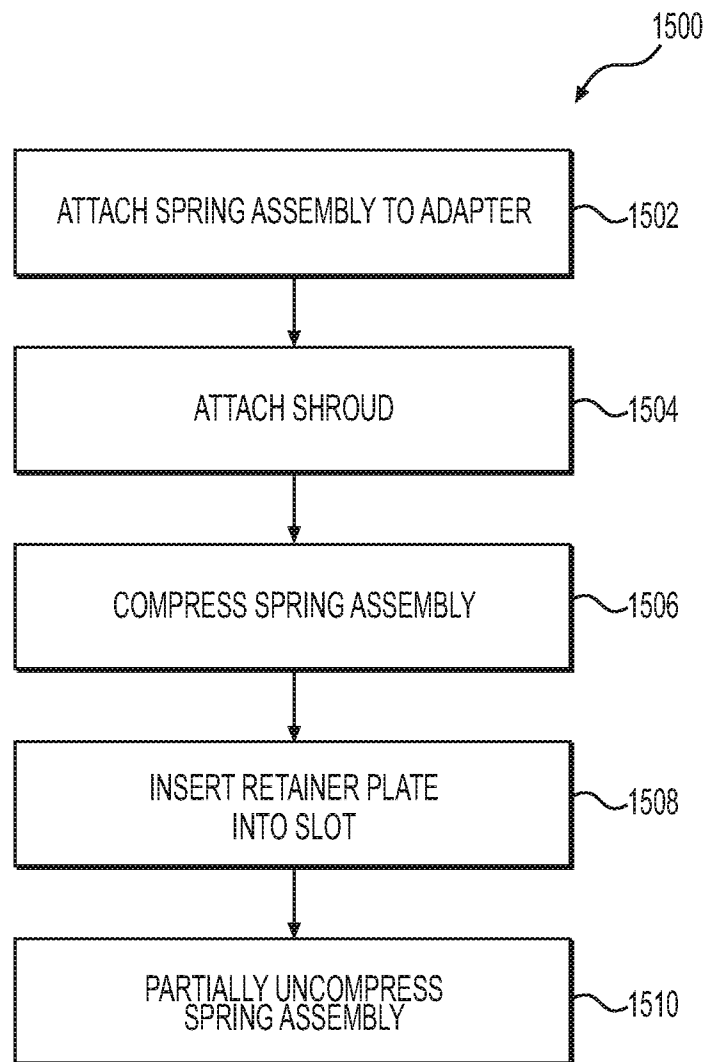


FIG. 14

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**FIG. 15**

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2016/049275

A. CLASSIFICATION OF SUBJECT MATTER

INV. E02F9/28

ADD.

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)

E02F

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)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013/185964 A1 (ANISY MARK [AU] ET AL) 25 July 2013 (2013-07-25) figures 1-4,6,9	1-5
X	----- WO 2013/122561 A1 (BLACK CAT BLADES LTD [CA]; RUVANG JOHN A [US]) 22 August 2013 (2013-08-22) figures 2-9	1-3,5
X	----- US 2005/229441 A1 (MAHER PATRICK G [AU]) 20 October 2005 (2005-10-20) figures 1,2	1-3



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

25 October 2016

Date of mailing of the international search report

03/01/2017

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Authorized officer

Laurer, Michael

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/049275

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search 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 No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

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

see additional 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 fees, this Authority did not invite payment of additional fees.
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.:

1-5

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-5

directed to the known shroud of claim 1 wherein the attachment portion is further specified. The objective technical problem to solve may be formulated as: Improve load transfer from a shroud into a work-tool.

2. claim: 6

directed to the known shroud of claim 1 wherein the tip is further specified. The objective technical problem to solve may be formulated as: Improve wear resistance of a shroud of a work-tool.

3. claims: 7, 8

directed to slide compressor wherein portions of the slide compressor may interact with a spring damper and an adaptor of a spring assembly. The objective technical problem to solve may be formulated as: Provide an adapted part of a spring assembly for use in securing a shroud to a work tool.

4. claims: 9, 10

directed to a retainer plate wherein portions of the retainer plate for better fitting, such as the diverse faces, and for handling, such as a "pullout portion", of the retainer are specified. The objective technical problem to solve may be formulated as: Improve a retainer for such an assembly.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2016/049275

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013185964 A1	25-07-2013	AU 2011214909 A1 CA 2789773 A1 CL 2012002252 A1 EA 201290802 A1 PE 05062013 A1 US 2013185964 A1 WO 2011097689 A1	13-09-2012 18-08-2011 22-02-2013 28-02-2013 22-04-2013 25-07-2013 18-08-2011
-----	-----	-----	-----
WO 2013122561 A1	22-08-2013	AU 2012370301 A1 CA 2860777 A1 CN 104114780 A EP 2815034 A1 JP 5764267 B2 JP 2015507112 A KR 20140116499 A WO 2013122561 A1 ZA 201405375 B	18-09-2014 22-08-2013 22-10-2014 24-12-2014 19-08-2015 05-03-2015 02-10-2014 22-08-2013 29-04-2015
-----	-----	-----	-----
US 2005229441 A1	20-10-2005	AU 2003212111 A1 AU 2009210367 A1 CA 2480095 A1 MX PA04009371 A US 2005229441 A1 WO 03080946 A1 ZA 200407582 B	08-10-2003 15-10-2009 02-10-2003 25-01-2005 20-10-2005 02-10-2003 30-05-2005
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