



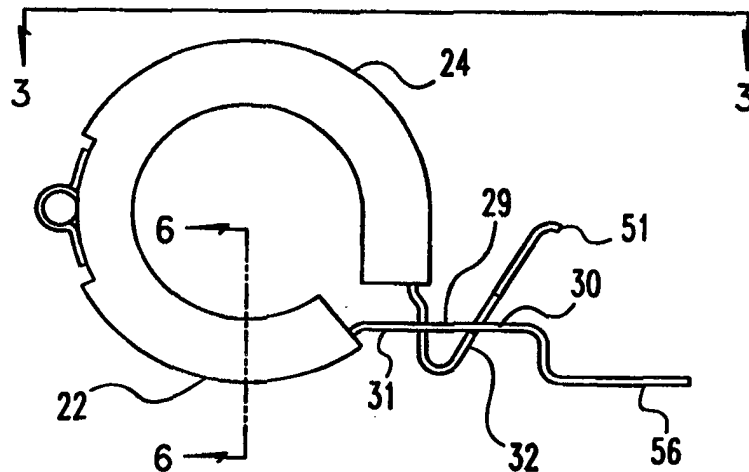
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<p>(21) International Application Number: PCT/US98/09609</p> <p>(22) International Filing Date: 13 May 1998 (13.05.98)</p> <p>(30) Priority Data: 08/855,670 14 May 1997 (14.05.97) US</p> <p>(71) Applicant (for all designated States except US): ALLISON ENGINE COMPANY, INC. [US/US]; P.O. Box 420, Indianapolis, IN 46206 (US).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): HANNAH, Mark, A. [US/US]; 7765 Eyeford Lane, Indianapolis, IN 46236 (US). PEREZ, Lucas, R. [US/US]; 7848 Cimarion Trail #607, Indianapolis, IN 46214 (US).</p> <p>(74) Agents: ALLIE, John, H. et al.; Woodard, Emhardt, Naughton, Moriarty & McNett, Bank One Center/Tower, Suite 3700, 111 Monument Circle, Indianapolis, IN 46204 (US).</p>		<p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p>Published With international search report. With amended claims.</p>

(54) Title: QUICK-RELEASE CLAMP

(57) Abstract

An apparatus (20) for clamping an object to a surface. The apparatus includes a first clamping portion (22, 82, 102), a second clamping portion (24, 84, 104) and an articulated hinge (26) that joins the two portions together. The first clamping portion (22, 82, 102) defines a through slot (34, 46) to which the second clamping portion (24, 84, 104) can be releasably connected by a spring (32) that cooperates with the slot to form the releasable connection. The spring (32) is generally in the shape of a V (33). A thumb tab (51) on the spring can release the spring from the slot (34, 46) without the need to remove the clamp (20) from the surface.



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QUICK-RELEASE CLAMP**BACKGROUND OF THE INVENTION**

The present invention relates generally to a clamp for affixing items to another surface, and more particularly a
5 clamp for affixing electrical harnesses, fuel tubes, and other components to engines, including gas turbine engines. Although the present invention was developed for use in a gas turbine engine certain applications may be outside of this field.

10 There is a continuing need to improve the manner in which a clamp can be made to securely fasten a harness, tube, or other component to a surface, and to easily release that component when necessary without having to remove the clamp itself. There are many patents related to the
15 clamping of components, including U.S. Patent No. 5,377,940 to Cabe et al; U.S. Patent No. 5,511,288 to McAndrews et al; U.S. Patent No. 4,609,171 to Matsui; U.S. Patent No. 4,460,139 to Bochen et al; U.S. Patent No. 2,641,808 to Tinnerman; U.S. Patent No. 5,129,608 to Goldman; and U.S.
20 Patent No. 5,390,876 to Hatano et al.

Even with the variety of earlier designs, there remains a need for a clamp with a quick release. The present invention satisfies this need in a novel and unobvious way.

-2-

SUMMARY OF THE INVENTION

One aspect of the present invention is to provide an apparatus for clamping an object associated with a gas turbine engine to a surface. The apparatus includes a first clamping portion, a second clamping portion, an articulated hinge that joins the two portions together, and a spring that releasably connects the two portions. In another aspect of the present invention, the spring is generally in the shape of the letter "V" and cooperates with a through slot defined in the first clamping portion to provide a releasable connection.

It is an object of the present invention to provide an improved releaseable clamp.

These and other objects of the present invention will be apparent from the specification to follow.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of the first embodiment of the present invention in the opened state.

FIG. 2 is a side view of FIG. 1 in the connected state.

5 FIG. 3 is a view of FIG. 2 taken along line 3-3.

FIG. 4 is a view taken along the line 4-4 in FIG. 1.

FIG. 5 is a view taken along line 5-5 of FIG. 1.

FIG. 6 is a view along line 6-6 of FIG. 2.

10 FIG. 7 shows an alternate arrangement of the through slot shown in FIG. 5.

FIG. 8 is a side view of a second embodiment of the present invention in the opened state.

FIG. 9 is a side view of FIG. 8 in the connected state.

FIG. 10 is a view taken along line 10-10 of FIG. 9.

15 FIG. 11 is a view taken along FIG. 11-11 of FIG. 9.

FIG. 12 is a side view of a third embodiment of the present invention in the closed state.

FIG. 13 is a view of FIG. 12 taken along line 13-13.

20 FIG. 14 is a view of a portion of a gas turbine engine with embodiments of the present invention attached to it.

-4-

DESCRIPTION OF THE PREFERRED EMBODIMENT

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiments illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

FIGS. 1-7 show clamping apparatus 20, the first embodiment of the present invention. Apparatus 20 includes first clamping portion 22 and second clamping portion 24 which are hingedly attached by hinge assembly 26. First curved portion 22 includes base portion 28 and elevated portion 30. Elevated portion 30 transitions to a section that is semi-circular in shape, although semi-oval and semi-oblong shapes are also useful for clamping objects. Second clamping portion 24 continues in the curvilinear shape of first clamping portion 22, although it is also possible that the curvilinear shape of second clamping portion 24 be different than that of portion 22. The present invention can be adapted to fit around a variety of sizes and shapes of objects, such adaptations being common in the art of clamping of objects.

Located at one end of portion 24 is V-spring 32, which is integral with portion 24, although spring 32 can be fabricated separately and then attached to portion 24. Spring 32 can be inserted through slots 34 or 46. The "V" feature 33 of spring 32 has an opened free state width that is compressed when it is inserted in slots 34 or 46 and remains compressed while installed in the slots. Feature 33

-5-

remains compressed when installed in slots 34 or 46. Although a V feature has been described, there are other spring types known to those of ordinary skill in the art that would also work. Removal of spring 32 from the slot is accomplished by pressing against thumb tab 51 located at the end of spring 32. Tab 51 is approximately as wide as portion 28. The end of tab 51 is curled so as to not present a sharp edge to a finger or thumb pressing spring 32 downward into a through slot. Also, the curled edge of tab 51 aids opening of the clamp by providing an improved grip to a finger or thumb compressing spring 32.

FIG. 5 shows features defined by base portion 28 and elevated portion 30. Portion 30 includes underside 31 and top side 29. Elevated portion 30 defines through slot 34 which creates an opening of particular size and shape in elevated portion 30. Slot 34 includes a first section 36 of a first width which transitions at edge 37 to a tapered width section 38 which tapers to edge 39.

Through slot 34 cooperates with spring 32 to releasably connect first clamping portion 22 to second clamping portion 24. Spring 32 includes a section 40 of a greater width and a section 42 of a lesser width. Second clamping portion 24 is rotated about hinge assembly 26 and V feature 33 of spring 32 is inserted into through slot 34. Section 40 must be slightly narrower than first width 36, thus permitting spring 32 to pass through slot 34. Section 51 is of a width approximately equal to portion 30, but may be of any width greater than that of section 42. Section 42 is of a width greater than the length of edge 39, and fits within tapered section 38.

When spring 32 is inserted in a through slot, edge 44 is located against underside 31 of portion 30, between edge 37 and edge 39. Since spring 32 is compressed when inserted in the through slot, spring 32 exerts a spring force which attempts to push spring 32 out of the through slot. This

-6-

spring force is resisted in part by a force exerted by edge 44 against underside 31. This force exerted by edge 44, in combination with the geometry of spring 32 and slots 34 or 46, positively retains the clamped portions connected.

5 FIG. 7 depicts through slot 46 which is an alternative to through slot 34. Slot 46 includes first section 36 of a first width and second section 48 of a second, lesser width. Edge 37 is created between sections 36 and 48, and edge 49 closes section 48. Spring 32 is inserted in slot 46
10 in a manner similar to insertion in slot 34. In both slots the portion of spring 32 with width 40 passes through section 36.

 Slots 34 and 46 differ in the manner of restraining spring 32. In slot 34, edge 39 is slightly narrower than
15 width 42. For that reason, insertion of spring 32 into slot 34 results in a portion of spring 32 with width 42 being in contact with tapered width 38. This contact reduces or eliminates side to side movement of spring 32 within slot 34. In slot 46, second section 48 and edge 49 have widths
20 that are greater than the portion of spring 32 with width 42. This permits more side-to-side motion of spring 32 within slot 46. When spring 32 is inserted in through slot 46, edge 44 is located against underside 31 of portion 30, between edge 37 and edge 49. Spring 32 is positively
25 retained within slot 46 in a manner similar to the retention of spring 32 within slot 34.

 Apparatus 20 is attached to a surface by means of a fastener through hole 52 located in base portion 28. Hole 52 is preferably centered on axis 35, although centering is
30 not required. Axis 35 is approximately coincident with a longitudinal line of symmetry of the first curved portion. Underside 56 of base portion 28 is in contact with the attachment surface. Bottom surface 56 is a second planar surface in the embodiments described herein, and is parallel
35 to a first plane defined by top surface 29 of elevated

-7-

portion 30. However, it is not necessary for bottom surface 56 to be planar. Base portion 28 could also be curved to accommodate a curved attaching surface, or could include various positioning features that work in combination with a fastener to locate clamp 20 on a surface.

Articulating hinge assembly 26 includes split portions 62 of first clamping portion 22 which have been formed to define two approximately cylindrical volumes. Likewise, center portion 64 of second clamping portion 24 has been formed to define a cylindrical volume. Articulated hinge assembly 26 is formed by inserting center portion 64 between split portions 62, aligning their respective cylindrical volumes, and inserting hinge pin 58 through them. Hinge pin 58 is retained in assembly 26 by pin head 60 on one end and a swaged or flattened feature on the other end.

Other arrangements of articulated hinge are possible, including hinge components made separately from portions 22 or 24 and attached thereto by various methods. Hinge assembly 26 is shown in the drawings at a location approximately opposite spring 32. However, it is also possible to locate hinge 26 at other locations, for example at the top of the clamp depicted in FIG. 2, or generally opposite the surface to which the apparatus is attached. With hinge 26 located generally opposite the attachment surface, the second curved portion would define an arc of less than 180 degrees. It is also possible to remove the hinge assembly entirely, in which case first curved portion 22 and second curved portion 24 are made from a single piece.

FIG. 6 shows a section of first clamping portion 22 which includes a resilient liner or insert 50. Liner 50 is molded and then assembled about first clamping portion 22. Liner 50 includes inner surface 53 which has a "W" shape. Portions of liner 50 are removed in the area of hinge assembly 26. When first clamping portion 22 and second clamping portion 24 are releaseably connected, the inner

-8-

surfaces 53 of the resilient liners form a clamped volume. If an object retained within this clamped volume is larger than some portion of the clamped volume, then liner 50 becomes deformed and pushes against the clamped object. The deformed liner 50 imparts a force to spring 32 that adds to the forces of spring 32 against edges 44, 38, 31, and 42. The shape of the liner and its resilience permit objects of irregular shape to be clamped, as well as objects of different diameters. Use of resilient liners with a cross-section such as that shown in FIG. 6 is within the ordinary knowledge of one skilled in this art. Liners of different cross-section or formed by different methods fall within the scope of what is being described.

In the embodiments described herein, the resilient liner is molded from silicone rubber, such as AMS 3352 or EMS 22787. However, other elastomers, including other versions of silicone rubber as well as fluorosilicone, fluorocarbon, butyl, nitrile, or other elastomers may be acceptable. The first curved portion and second curved portion are formed from a corrosion-resistant stainless steel, such as 17-7PH, although other materials, including cast metals and composites, may be acceptable. In the embodiments described herein, spring 32 is integral with either the first curved portion or the second curved portion. Spring 32 is fabricated from a material that has acceptable spring characteristics. The hinge pin is fabricated from corrosion-resistant stainless steel of type 304, although other metals may be acceptable.

In the embodiments described herein, hole 52 is compatible with a #10 fastener. An internal diameter for hole 52 larger than 0.19 inches and smaller than 0.23 inches would be acceptable for use with a #10 fastener. The width of base portion 28 in the vicinity of hole 52 is approximately 0.5 inches, and preferably greater than 0.4 inches. The thickness of first clamping portion 22 is

-9-

generally 0.030 inches, and preferably greater generally than 0.024 inches. Hinge pin 58 has a generally constant outer diameter where it passes through the cylindrical volumes defined by portions 62 and 64 of approximately 1/8
5 inch. This outer diameter of hinge pin 58 should be greater than 0.11 inches and less than 0.14 inches. Although specific materials and dimensions have been provided for various aspects of the present invention, these have been presented as examples and have not been presented as
10 limitations on this invention.

FIGS. 8-11 depict a second embodiment of the present invention. Clamping apparatus 80 is similar to apparatus 20. The base portion, elevated portion, hinge assembly, fastener through hole, and V spring are similar to those
15 already described. Some of the differences between apparatus 80 and apparatus 20 will be described. Apparatus 80 includes first clamping portion 82 and second clamping portion 84 which are hingedly attached. First clamping portion 82, second clamping portion 84, and insert 86 are of
20 shapes intended to hold multiple clamped objects. Portions 82 and 84 are depicted with an oblong shape, although an oval shape or other clamping shape would also be acceptable. Two or more objects can be accommodated within the clamped volume of apparatus 80 in a side-by-side
25 manner.

FIG. 11, showing a cross-section of portion 82 and insert 86, depicts another difference between apparatus 20 and apparatus 80. Portions 82 and 84 include retaining tabs 88. Tabs 88 are approximately perpendicular to portions 82
30 and 84 and combine with portions 82 and 84 to hold resilient insert 86. Insert 86 is preferably a single piece and may be molded apart from portions 82 or 84. Splits 85 permit insertion of components into insert 86.

FIGS. 12 and 13 depict a third embodiment of the present
35 invention. Clamping apparatus 100 has features similar to

-10-

those of apparatus 20. For example, the base portion, elevated portion, hinge assembly, fastener through hole and V spring are similar to those already described. A first clamping portion 102 and second clamping portion 104 are hingedly attached and releaseably connectable. Resilient insert 106 is in two pieces that fit between portions 102 and 104 when connected together. Insert 106 includes protrusions 108 that form a pocket 110 around the circumference of insert 106 and retain the pieces of insert 106 on portions 102 and 104. Insert 106 includes splits 112 and 114 that provides a location at which the object to be clamped can be inserted within the clamped volume of insert 106. Apparatus 100 is particularly suited to clamping small objects or objects requiring additional resiliency.

Although FIGS. 6, 11, and 13 depict different cross-sections of resilient inserts or liners, each of the liners or inserts may be adapted for use with any of apparatus 20, 80, or 100.

FIG. 14 shows clamps 20, 80, and 100 being used to attached components to a gas turbine engine. The front portion of an engine is shown, including inlet housing 117, compressor assembly 118, and diffuser 119. For sake of clarity, many components usually attached to housing 117, assembly 118, and diffuser 119 have been omitted. Apparatus 20 are shown clamping electrical harnesses 120 to housing 117 and assembly 118. Electrical connectors 122 are shown at the ends of the harnesses 120. Apparatus 20 is also shown clamping fuel tube 124 to assembly 118. Apparatus 80 is shown clamping multiple harnesses 120 to housing 117. Apparatus 100 is shown clamping a harness 120 to assembly 118. The surfaces of housing 117, assembly 118, and diffuser 119 all tend to be at temperatures elevated from ambient when the engine is operating.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the

-11-

same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiments has been shown and described and that all changes and modifications that come within the spirit of the
5 invention are desired to be protected.

-12-

WHAT IS CLAIMED IS:

1. An apparatus for clamping an object associated with a gas turbine engine to a surface, comprising:
 - a first clamping portion;
 - 5 a second clamping portion;
 - a spring located on said second clamping portion; and
 - an articulated hinge joining said first clamping portion to said second clamping portion.
2. The apparatus of claim 1 wherein said spring is
10 generally in the shape of a V.
3. The apparatus of claim 1 which further comprises a thumb tab attached to said spring.
4. The apparatus of claim 1 wherein said first clamping portion defines a through slot, said spring
15 cooperating with said through slot to releaseably connect said first clamping portion to said second clamping portion.
5. The apparatus of claim 4 wherein said spring is generally in the shape of a V.
6. The apparatus of claim 5 wherein said through slot
20 has a first section of a first width and a second section of a second width different than the first width.
7. The apparatus of claim 5 wherein said through slot has a first section of a first width and a second section of a tapered width.

-13-

8. The apparatus of claim 1 wherein said first clamping portion is semicircular, oval, or oblong in shape.

9. The apparatus of claim 4 wherein said hinge is located generally opposite of the clamping surface.

5 10. An apparatus for clamping an object associated with a gas turbine engine to a surface, comprising:

a first clamping portion defining a through slot;

a second clamping portion rotatably attached to said first clamping portion; and

10 a spring attached to said second clamping portion, said spring cooperating with said through slot to releaseably connect said first clamping portion to said second clamping portion.

15 11. The apparatus of claim 10 wherein said spring is generally in the shape of a V.

12. The apparatus of claim 10 wherein said through slot has a first section of a first width and a second section of a second width different than the first width.

20 13. The apparatus of claim 10 wherein said through slot has a first section of a first width and a second section of a tapered width.

14. The apparatus of claim 10 which further comprises a thumb tab attached to said spring.

25 15. The apparatus of claim 10 wherein said first clamping portion includes a base portion for affixing said

-14-

apparatus to the surface, the connection of said first clamping portion to said second clamping portion defining a clamped volume, said through slot being located between the clamped volume and said base.

5 16. The apparatus of claim 10 wherein said second clamping portion includes a base portion for affixing said apparatus to the surface, the connection of said first clamping portion to said second clamping portion defining a
10 clamped volume, said through slot being located between the clamped volume and said base.

17. An apparatus for clamping an object associated with a gas turbine engine to a surface, comprising:

15 a first clamping portion including an integral base for attachment to the surface, said first clamping portion including an integral elevated portion, the elevated portion having a surface defining a first plane; and

 a second clamping portion rotatably coupled to said first clamping portion to define a clamped volume; and

20 a spring attached to said second clamping portion; wherein an extension of the first plane intersects the clamped volume.

18. The apparatus of claim 17 wherein said base has a surface defining a second plane, the second plane being generally parallel to the first plane.

25 19. The apparatus of claim 17 wherein said elevated portion defines a through slot, said spring cooperating with said through slot to releaseably connect said first clamping portion to said second clamping portion.

-15-

20. The apparatus of claim 17 wherein said spring is generally in the shape of a V.

21. The apparatus of claim 19 wherein said through slot has a first section of a first width and a second section of
5 second width different than the first width.

22. The apparatus of claim 19 wherein said through slot has a first section of a first width and a second section of a tapered width.

23. The apparatus of claim 17 which further comprises a
10 thumb tab attached to said spring.

24. The apparatus of claim 17 which further comprises an articulated hinge rotatably attaching said second clamping portion to said first clamping portion.

25. An apparatus for clamping an object associated with
15 a gas turbine engine to a surface, comprising:

a first clamping portion of a semicircular shape, said first clamping portion including an elevated portion defining a through slot, wherein said through slot has a first section of a first width and a second section of a
20 second width different than the first width, said first clamping portion including a base portion for affixing said apparatus to the surface;

a second clamping portion of a semicircular shape, said second clamping portion including a spring, said spring
25 cooperating with said through slot to releaseably connect said first clamping portion to said second clamping portion, wherein said spring is generally in the shape of a V; and

an articulated hinge joining said first clamping portion to said second clamping portion.

-16-

26. The apparatus of claim 25 which further comprises a resilient insert.

27. The apparatus of claim 26 wherein said resilient insert is an elastomer.

5 28. The apparatus of claim 26 wherein said first clamping portion includes a base portion defining a hole.

29. The apparatus of claim 28 wherein said hole has a diameter between 0.19 inches and 0.23 inches.

10 30. The apparatus of claim 28 wherein said elevated portion and said base portion each have surfaces defining a plane and said planes are approximately parallel.

31. The apparatus of claim 30 wherein said first clamping portion is fabricated from corrosion resistant stainless steel.

15 32. The apparatus of claim 31 wherein said first clamping portion is fabricated from type 17-7PH stainless steel.

20 33. The apparatus of claim 31 wherein said first clamping portion has a thickness generally greater than 0.024 inches.

34. The apparatus of claim 33 wherein said articulating hinge includes a hinge pin.

35. The apparatus of claim 34 wherein said hinge pin has an outer diameter between 0.11 inches and 0.14 inches.

-17-

36. The apparatus of claim 34 wherein said hinge pin is constructed from corrosion resistant stainless steel.

37. The apparatus of claim 36 wherein said hinge pin is constructed from type 304 stainless steel.

5 38. The apparatus of claim 36 wherein said base portion has a width greater than 0.4 inches.

39. An apparatus for clamping an object associated with a gas turbine engine to a surface, comprising:

10 a first clamping portion defining a single fastening hole;

a second clamping portion; and

an articulated hinge joining said first clamping portion to said second clamping portion.

40. The apparatus of claim 39 which further comprises
15 a spring attached to said second clamping portion, said spring being generally in the shape of a V.

41. The apparatus of claim 40 wherein said first clamping portion defines a through slot, said spring cooperating with said through slot to releaseably connect
20 said first clamping portion to said second clamping portion.

42. The apparatus of claim 41 wherein said through slot has a first section of a first width and a second section of a second width different than the first width.

43. The apparatus of claim 41 wherein said through slot
25 has a first section of a first width and a second section of a tapered width.

-18-

44. The apparatus of claim 39 wherein said first clamping portion is semicircular, oval, or oblong in shape.

45. The apparatus of claim 39 wherein said hinge is located generally opposite of the clamping surface.

5 46. The apparatus of claim 39 wherein said first clamping portion has a longitudinal line of symmetry, and the line bisects said fastening hole.

AMENDED CLAIMS

[received by the International Bureau on 25 September 1998 (25.09.98);
original claims 2, 4, 5, 15, 17-24, 40 and 41 cancelled;
original claims 1, 6, 7, 9, 10 and 39 amended;
remaining claims unchanged (5 pages)]

1. An apparatus for clamping an object associated with a gas turbine engine to a surface, comprising:
a first clamping portion;
5 a second clamping portion;
a generally V shaped spring located on said second clamping portion;
and
an articulated hinge joining said first clamping portion to said second clamping portion;
10 wherein said first clamping portion defines a through slot and said spring cooperates with said through slot to releaseably connect said first clamping portion to said second clamping portion.
3. The apparatus of claim 1 which further comprises a thumb tab attached to said spring.
- 15 6. The apparatus of claim 1 wherein said through slot has a first section of a first width and a second section of a second width different than the first width.
7. The apparatus of claim 1 wherein said through slot has a first section of a first width and a second section of a tapered width.
- 20 8. The apparatus of claim 1 wherein said first clamping portion is semicircular, oval, or oblong in shape.
9. The apparatus of claim 1 wherein said hinge is located generally opposite of the clamping surface.

10. An apparatus for clamping an object associated with a gas turbine engine to a surface, comprising:

a first clamping portion defining a through slot, said first clamping portion including a base for affixing the apparatus to the surface;

5 a second clamping portion rotatably attached to said first clamping portion; and

a spring attached to said second clamping portion, said spring cooperating with said through slot to releaseably connect said first clamping portion to said second clamping portion, and the connection of said first
10 clamping portion to said second clamping portion defines a clamped volume, and said through slot is located between said clamped volume and said base.

11. The apparatus of claim 10 wherein said spring is generally in the shape of a V.

15 12. The apparatus of claim 10 wherein said through slot has a first section of a first width and a second section of a second width different than the first width.

20 13. The apparatus of claim 10 wherein said through slot has a first section of a first width and a second section of a tapered width.

14. The apparatus of claim 10 which further comprises a thumb tab attached to said spring.

25 16. The apparatus of claim 10 wherein said second clamping portion includes a base portion for affixing said apparatus to the surface, the connection of said first clamping portion to said second clamping portion defining a clamped volume, said through slot being located between the clamped volume and said base.

30 25. An apparatus for clamping an object associated with a gas turbine engine to a surface, comprising:

a first clamping portion of a semicircular shape, said

first clamping portion including an elevated portion defining a through slot, wherein said through slot has a first section of a first width and a second section of a second width different than the first width, said first
5 clamping portion including a base portion for affixing said apparatus to the surface;

a second clamping portion of a semicircular shape, said second clamping portion including a spring, said spring cooperating with said through slot to releaseably connect
10 said first clamping portion to said second clamping portion, wherein said spring is generally in the shape of a V; and
an articulated hinge joining said first clamping portion to said second clamping portion.

26. The apparatus of claim 25 which further comprises a
15 resilient insert.

27. The apparatus of claim 26 wherein said resilient insert is an elastomer.

28. The apparatus of claim 26 wherein said first clamping portion includes a base portion defining a hole.

20 29. The apparatus of claim 28 wherein said hole has a diameter between 0.19 inches and 0.23 inches.

30. The apparatus of claim 28 wherein said elevated portion and said base portion each have surfaces defining a plane and said planes are approximately parallel.

25 31. The apparatus of claim 30 wherein said first clamping portion is fabricated from corrosion resistant stainless steel.

30 32. The apparatus of claim 31 wherein said first clamping portion is fabricated from type 17-7PH stainless steel.

33. The apparatus of claim 31 wherein said first clamping portion has a thickness generally greater than 0.024 inches.

34. The apparatus of claim 33 wherein said articulating hinge includes a hinge pin.

35. The apparatus of claim 34 wherein said hinge pin has an outer diameter between 0.11 inches and 0.14 inches.

36. The apparatus of claim 34 wherein said hinge pin is constructed from corrosion resistant stainless steel.

37. The apparatus of claim 36 wherein said hinge pin is constructed from type 304 stainless steel.

38. The apparatus of claim 36 wherein said base portion has a width greater than 0.4 inches.

39. An apparatus for clamping an object associated with a gas turbine engine to a surface, comprising:
a first clamping portion defining a single fastening hole and a through slot;
a second clamping portion;
a spring attached to said second clamping portion; and
an articulated hinge joining said first clamping portion to said second clamping portion;
said spring cooperating with said through slot to releaseably connect said first clamping portion to said second clamping portion.

42. The apparatus of claim 41 wherein said through slot has a first section of a first width and a second section of a second width different than the first width.

43. The apparatus of claim 41 wherein said through slot has a first section of a first width and a second section of a tapered width.

44. The apparatus of claim 39 wherein said first clamping portion is semicircular, oval, or oblong in shape.

45. The apparatus of claim 39 wherein said hinge is located generally opposite of the clamping surface.

5 46. The apparatus of claim 39 wherein said first clamping portion has a longitudinal line of symmetry, and the line bisects said fastening hole.

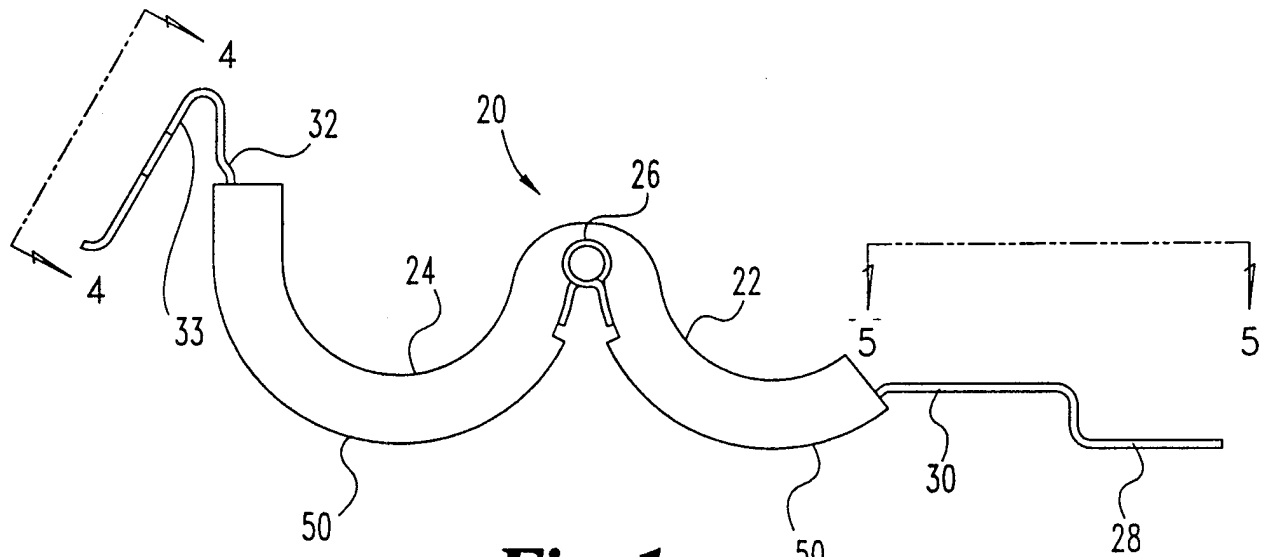


Fig. 1

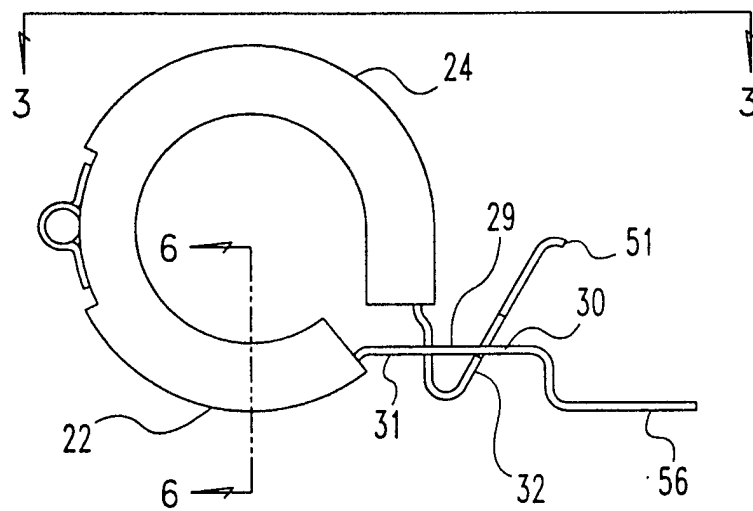


Fig. 2

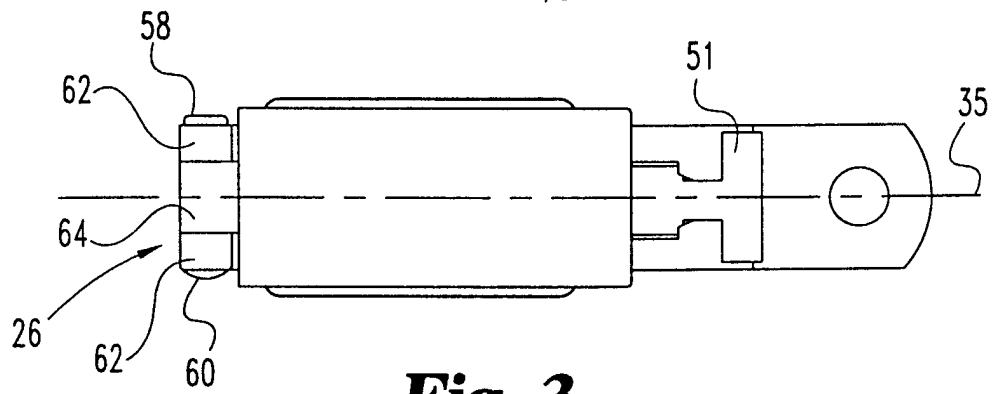


Fig. 3

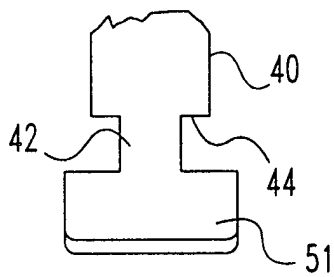


Fig. 4

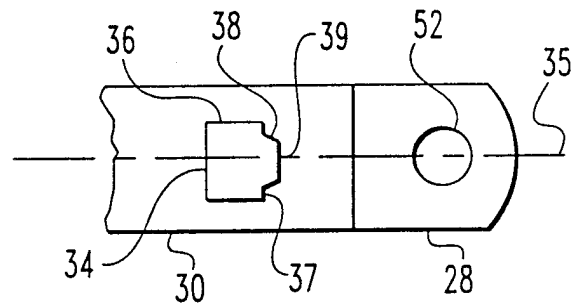


Fig. 5

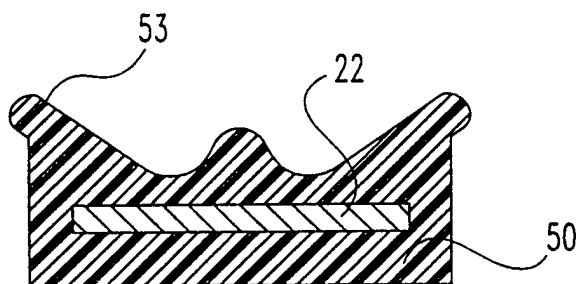


Fig. 6

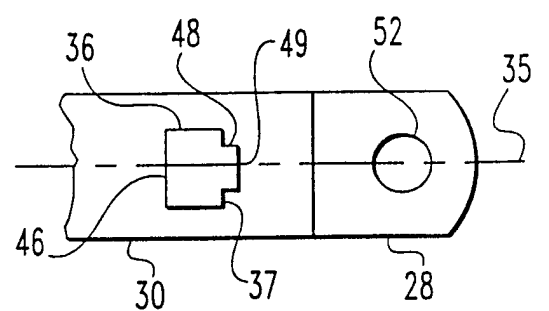


Fig. 7

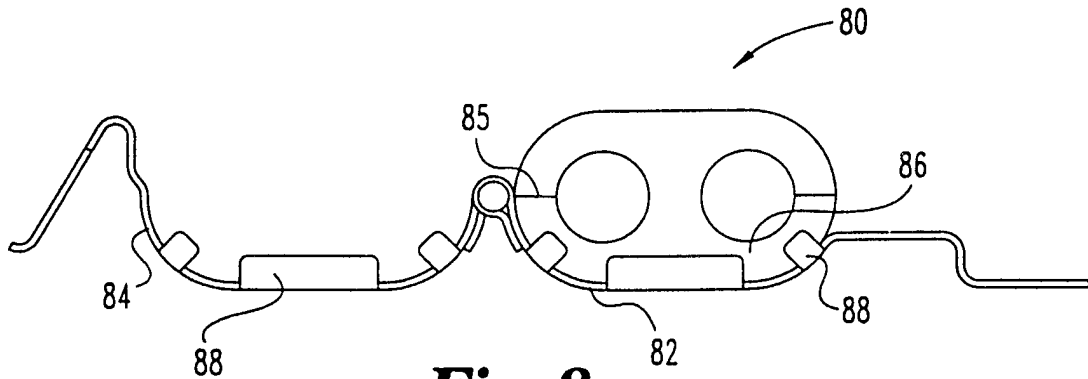


Fig. 8

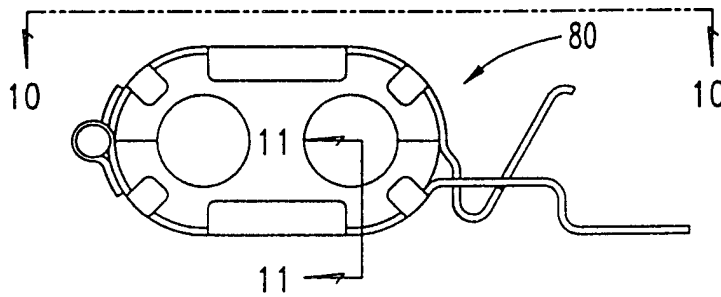


Fig. 9

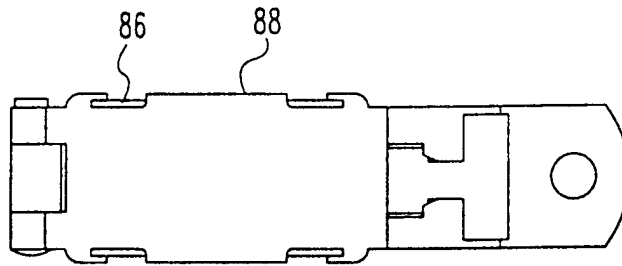


Fig. 10

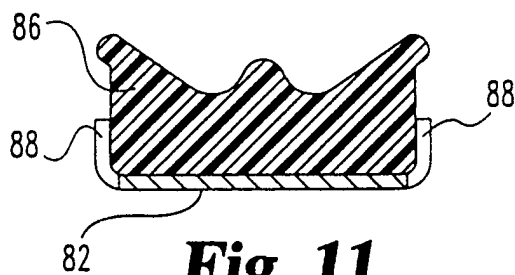


Fig. 11

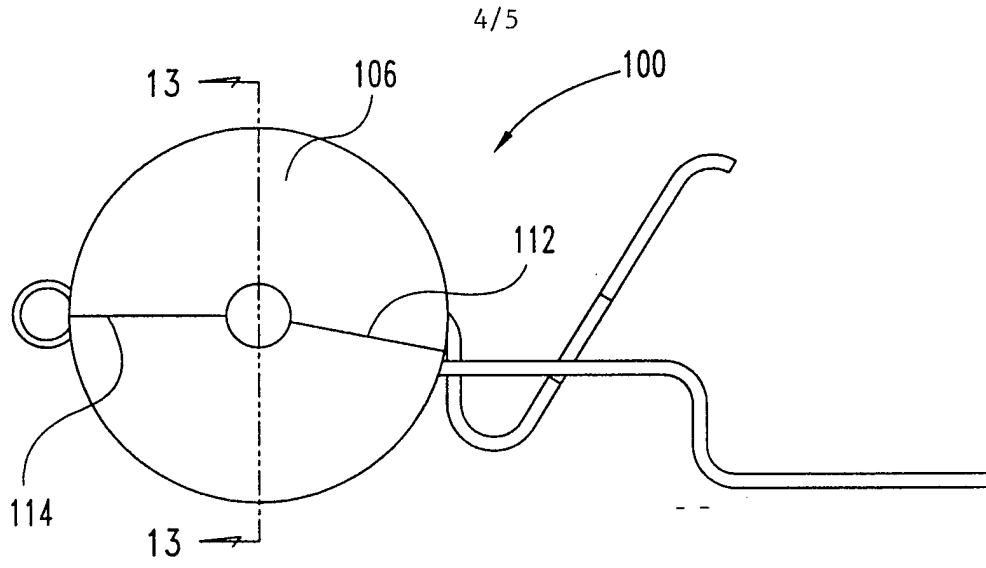


Fig. 12

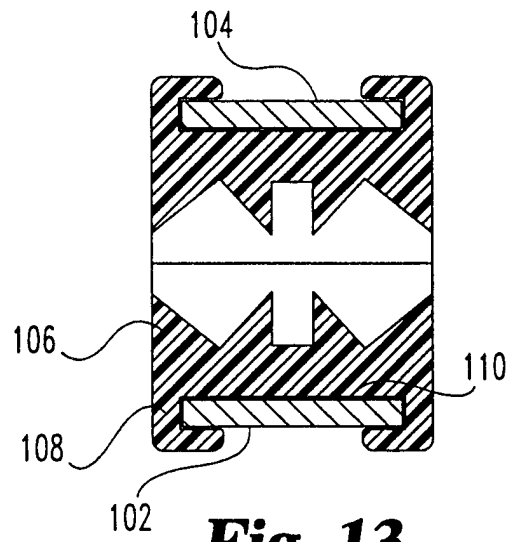


Fig. 13

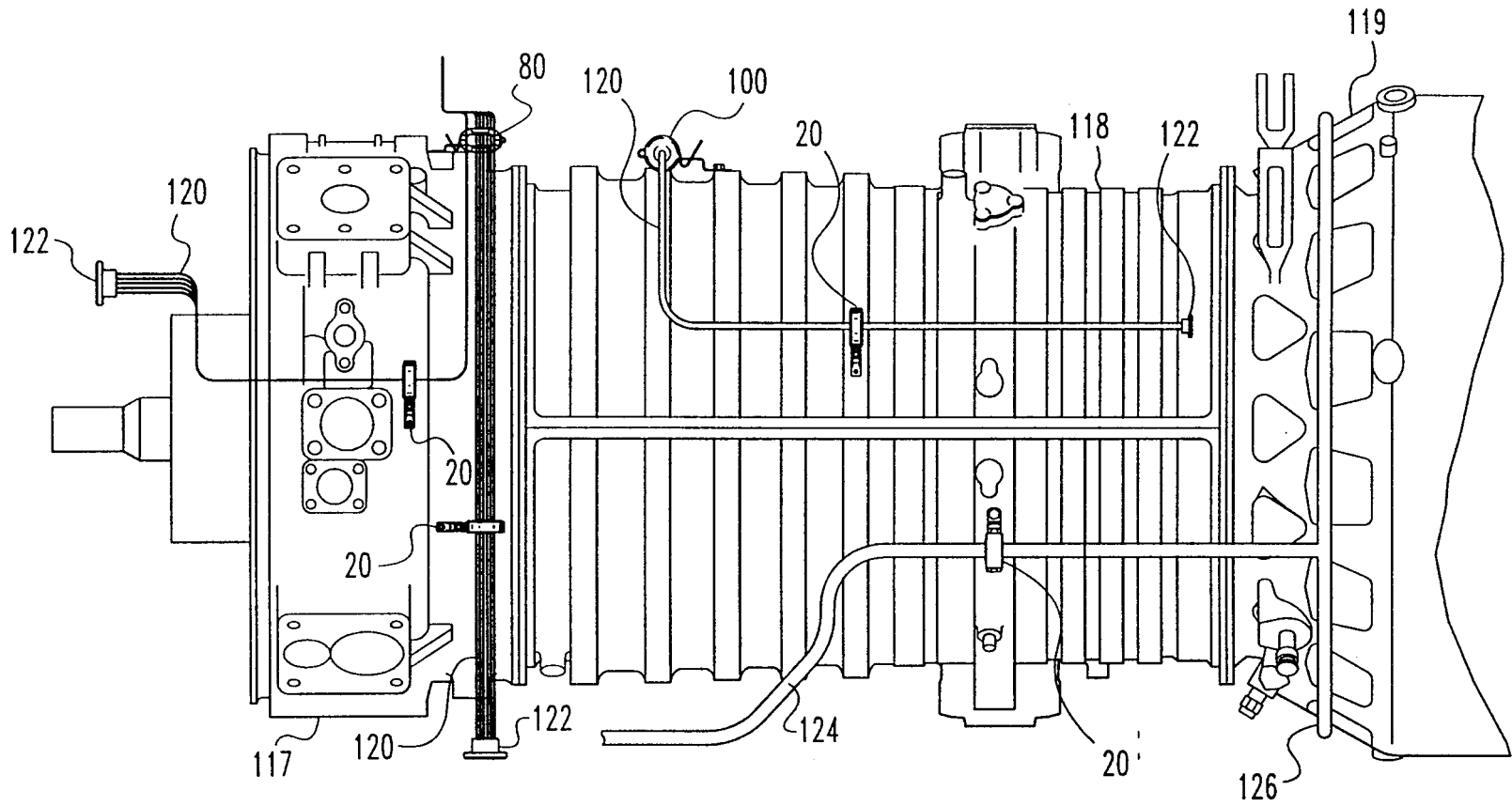


Fig. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/09609

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :F16L 3/08; A44B 1/04
US CL :248/74.1; 24/271

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. : 248/74.1, 74.3, 74.4, 73, 68.1, 74.2, 65, 67.7; 24/271, 279, 285, 274

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)

APS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y, P	IMO INDUSTRIES, INC., Adel Fasteners Division, product information. model no. Adel 10759. April 1990.	1-46
Y	FR 1124412 B (Tonna) 10 October 1956 (10-10-56), page 1.	1-38 and 40-46
Y	US 4,609,171 A (MATSUI) 02 September 1986 (02-09-86), see entire document.	3, 14, 23
Y	CA 508222 B (Flora) 14 December 1954 (14-12-54), see entire document.	6, 7,12, 13, 21, 22, 25-38, 42, and 43
Y	US 5,511,288 A (MC ANDREWS ET AL.) 30 April 1996 (30-04-96), see entire document.	39-46

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
20 JUNE 1998

Date of mailing of the international search report
27 JUL 1998

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US98/09609

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CA 651497 B (BROWN) 30 October 1962 (30-10-62), see entire document.	1-46
A	US 4,460,139 A (BOCHEN ET AL.) 17 JULY 1984 (17-07-84), see entire document.	1-46
A	US 4,338,707 A (Byerly) 13 July 1982 (13-07-82), see entire document.	1-46
A	US 2,417,245 A (EGGERT ET AL.) 11 March 1947 (11-03-47), see entire document.	1-46
A	US 5,305,978 A (CURRENT) 26 April 1994 (26-04-94), see entire document.	1-46