(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 August 2007 (09.08.2007)

PCT

(10) International Publication Number
WO 2007/090045 A1

(51) International Patent Classification:
B05C 11/04 (2006.01)

(21) International Application Number:
PCT/US2007/061102

(22) International Filing Date: 26 January 2007 (26.01.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/763,518 31 January 2006 (31.01.2006) US

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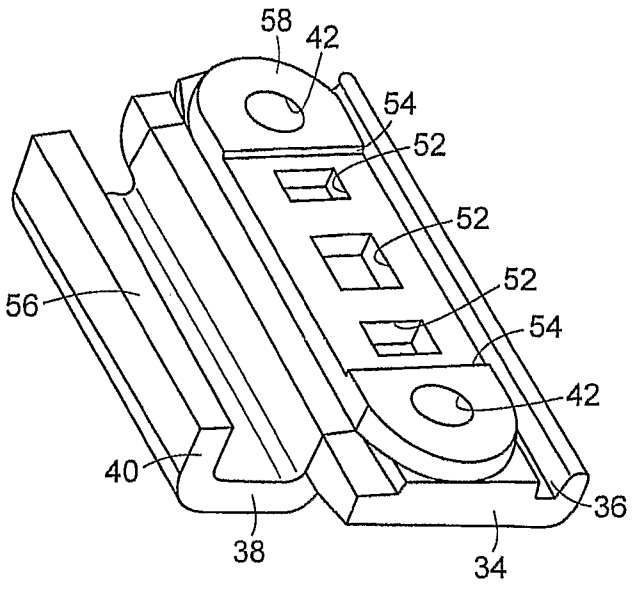
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** KEEP FOR DOCTOR BLADE HOLDER



(57) **Abstract:** An injection molded keep (22) is disclosed that includes a thermoplastic material and a reinforcement material. The keep is positioned adjacent a top plate (20) in a doctor blade (24) holding apparatus and provides a slot opening between the keep and the top plate for receiving an end of a doctor blade in the slot opening.

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KEEP FOR DOCTOR BLADE HOLDER

PRIORITY

This application claims priority to U.S. Provisional Patent Application Ser. No. 60/763,518 filed on January 31, 2006.

BACKGROUND OF THE INVENTION

This invention relates generally to doctor blade holders, and is concerned in particular with improved mounting structures (or keeps) for such holders.

A doctor blade holder generally holds a doctor blade in a desired position with respect to a rotating roll in a manufacturing process. For example, doctor blades in papermaking machines are generally employed to remove accumulated debris from a roll in the papermaking machine. In certain systems, the doctor blade may further be employed to shed a portion of a sheet of paper. Many such roll cleaning and sheet shedding applications in paper machines and other web handling applications involve blade support devices that are commonly referred to as doctor blade holders. Typically, a doctor blade holder is mounted on a heavy-duty beam, and includes a top plate with a mounting structure called a keep along its underside. Each keep coacts with the top plate to define a slot, and the rear edge of a doctor blade is received in the slot of each keep. The doctor blade then becomes captured between the top plate and the keeps.

The doctoring process often involves exposing the blade holder to high steady-state loads in combination with impact loads. It is imperative that holder components, including the keeps, be of robust design so as to safely accommodate such conditions.

In addition to the mechanical loading, the blade holder may be exposed to a wide range of caustic chemicals and high operating temperatures. For this reason, the selection of appropriate materials is of the utmost importance and often involves the use of very expensive corrosion resistant metals such as type 316 Stainless Steel.

The metal keeps are conventionally produced by a process known as investment casting whereby molten stainless steel is poured into a ceramic mold. After solidification of the stainless steel, the ceramic mold is broken apart to remove the keep. The mold is not reusable.

The casting process is labor intensive and therefore quite expensive. Since a typical blade holder requires many keeps (often several hundred), the total cost of the keeps amounts to a very significant percentage of the holder cost. Stainless steel is also difficult and costly to machine. Each keep requires the machining of two tapped holes that receives screws used to mount the keep to the top plate. This operation further adds cost to the already expensive part.

An objective of the present invention is to provide an improved keep design that addresses the major issues of structural integrity, chemical resistance, and hi-temperature endurance.

SUMMARY

In accordance with an embodiment, the invention provides an injection molded keep that includes a thermoplastic material and a reinforcement material. The keep is positioned adjacent a top plate in a doctor blade holding apparatus and provides a slot

opening between the keep and the top plate for receiving an end of a doctor blade in the slot opening.

In accordance with another embodiment, the invention provides an injection molded thermoplastic keep that is positioned adjacent a top plate in a doctor blade holding apparatus and provides a slot opening between the keep and the top plate for receiving an end of a doctor blade in the slot opening. The keep includes a thermoplastic material and relief features in the thermoplastic keep. The relief features include at least one gusset that provides additional structural rigidity, at least one cavity that is positioned to provide a more uniform cross-sectional area that would exist on the keep without the cavity, and a relieve in a surface for providing that a portion of the keep adjacent a fastening screw hole maintains contact with the top plate when the keep is secured to the top plate.

In accordance with a further embodiment, the invention provides an injection molded thermoplastic keep that is positioned adjacent a top plate in a doctor blade holding apparatus and provides a slot opening between the keep and the top plate for receiving an end of a doctor blade in the slot opening. The keep includes a nut retaining and anti-rotation cavity for receiving a nut that may be fastened to a screw that passes through the top plate.

BRIEF DESCRIPTION OF THE DRAWINGS

The following description may be further understood with reference to the accompanying drawings in which:

Figure 1 is a side view of a doctoring apparatus, with a keep in accordance with the present invention included in the doctor blade holder;

Figure 2 is a top perspective view of the keep;

Figure 3 is a bottom perspective view of the keep;

Figures 4, 5, 6, and 7 are top, front, bottom, and side views respectively of the keep; and

Figure 8 is an enlarged partially sectioned view of the keep attached to the top plate.

The drawings are shown for illustrative purposes only and are not to scale.

DETAILED DESCRIPTION

Applicants have discovered that a thermoplastic material may be formed by an injection molding process that is suitable for use in securing a doctor blade to a top plate in accordance with various embodiments of the invention.

With reference initially to Figure 1, a doctoring apparatus 10 is shown adjacent to the surface of a roll 12. The roll rotates about an axis A_1, and the doctoring apparatus includes a doctor back 14 that is rotatable about an axis A_2 that is parallel to the axis A_1. A doctor blade holder 16 is shown supported on a beam 18 forming part of the doctor back. The holder is formed of a generally conventional design, having a top plate 20 mounted for pivotal movement about an axis A_3. A plurality of keeps 22 in accordance with the present invention are spaced along the underside of the top plate 20. The keeps 22 coact with the top plate 20 to define slots receiving the rear edge of a doctor blade 24. The rear edge of the doctor blade is captured between the top plate and the keeps, and its

forward edge is applied to the surface of the roll 12 to effect doctoring. The top plate 20 is pivoted about axis A_3 by means of inflatable loading and unloading tubes 26, 28 in a manner that is well known to those skilled in the art. A piston/cylinder unit 30 acts via a crank arm 32 to rotate the doctor back 14 about axis A_2 in order to load the blade 24 against the roll surface.

The keep 22 is a one piece component that is molded from a variety of thermoplastics including engineered thermoplastic materials. Such engineered plastics include, but are not limited to polyetheretherketone (PEEK), polyphenylene sulfide (PPS), polyphthalamide (PPA), polyvinyl chloride (PVC), polyethylene (PE) and polypropylene (PP).

PPA, as a base resin, combines excellent chemical and thermal resistance. When used in combination with fiber reinforcement, the mechanical properties are greatly enhanced in a variety of environments. A preferred reinforcement is discontinuous carbon fiber wherein the term discontinuous refers to the size of fibers relative to the keep. The small fibers may be injection molded resulting in random orientation. This random orientation leads to isotropic properties. The fibers may be formed of glass, carbon, aramid, ceramic and thermoplastic material. The fibers may be between about 0.25 mm and about 15 mm, and may preferably be between about 0.5 mm and about 3 mm in length. Other potential reinforcement materials may include non-fiber elements formed of glass, ceramic, or plastic as well in continuous or discontinuous size distributions. In further embodiments the reinforcement material may include a plurality of particles that are formed of glass, silicon carbide and calcium carbide, and may have a

diameter of between about 1 nm to about 1 mm, and preferably may have a diameter of between about 10 nm and about 100 nm.

With reference additionally to Figures 2-7, it will be seen that the keep 22 comprises a base 34 grooved along its rear edge at 36, with a forwardly projecting ledge 38 having an upturned lip 40. The top surface of the base forms an elongated boss having through holes 42 at the opposite ends thereof. Each hole 42 leads to a hexagonal recess 44 in the bottom surface of the base 34. The hexagonal recess 44 provides a nut-retaining recess for receiving a nut that engages a screw that passes through the top plate. The nut may be adhered to the keep within the recess or may be received within the recess in a snap-fit arrangement in various embodiments. The hexagonal recess 44 also provides an anti-rotation recess that prevents the nut from rotating when screw is rotated.

The keep also includes a plurality of engineered relief features. For example, mutually spaced parallel strengthening gussets or ribs 46 are located between the recesses 44 and extend rearwardly from the ledge 38 along the underside of the base 34. The gussets provide additional structural rigidity. The relief features also include at least one cavity 52 that is positioned to provide a more uniform cross-sectional area that would exist on the keep without the cavity, and a relieve 54 (as also shown in Figure 5) in a surface for providing that a portion of the keep adjacent a fastening screw hole maintains contact with the top plate when the keep is secured to the top plate.

The keep also provides that the slot opening is partially defined by a slot flat portion 56 that has a flatness tolerance of at least 0.250 inches per inch. The keep further provides a top plate flat portion 58 that contacts the tope plate, and the top plate flat portion has a flatness tolerance of at least 0.250 inches per inch.

As shown in Figure 8, the keep 22 is attached to the underside of the top plate 24 by means of a pair of screws 48 (only one being shown) and coacting hexagonal nuts 50. The screws 48 project downwardly through holes in the top plate and the holes 42 in the keep for threaded engagement with the nuts, the latter being received in and rotatably fixed in the hexagonal recesses 44.

With this arrangement, there is no need to drill and tap holes in the keep. The use of mass produced threaded nuts as an alternate to a machining operation further reduces cost.

The nuts 50 are prevented from rotating by the matching molded recesses 44 in the keep. Thus, when the two screws are tightened, there is no need to use a wrench to hold the nuts at the underside of the keep. This simplifies the assembly operation further reducing the overall cost of the blade holder.

Those skilled in the art will appreciate that numerous modifications and variations may be made to the above disclosed embodiments without departing from the spirit and scope of the invention.

What is claimed is:

1. An injection molded keep comprising a thermoplastic material and a reinforcement material, said keep being positioned adjacent a top plate in a doctor blade holding apparatus and providing a slot opening between said keep and said top plate for receiving an end of a doctor blade in said slot opening.

2. The keep as claimed in claim 1, wherein said thermoplastic material includes at least one of a polyetheretherketone, polyphenylene sulfide, polyphthalamide polyvinyl chloride, polyethylene and polypropylene.

3. The keep as claimed in claim 1, wherein said reinforcement material includes a plurality of fibers.

4. The keep as claimed in claim 3, wherein each of said fibers is formed of at least one of glass, carbon, aramid, ceramic and a thermoplastic material.

5. The keep as claimed in claim 3, wherein each of said fibers has a largest dimension of between about 0.25 mm and about 15 mm.

6. The keep as claimed in claim 3, wherein each of said fibers has a largest dimension of between about 0.5 mm and about 3 mm.

7. The keep as claimed in claim 1, wherein said reinforcement material includes a plurality of particles.

8. The keep as claimed in claim 7, wherein each of said particles is formed of at least one of glass, silicon, carbide and calcium carbide.

9. The keep as claimed in claim 7, wherein each of said particles has a diameter of between about 1 nm to about 1 mm.

10. The keep as claimed in claim 7, wherein each of said particles has a diameter of between about 10 nm to about 100 nm.

11. The keep as claimed in claim 1, wherein said keep includes at least one gusset for providing additional structural rigidity.

12. The keep as claimed in claim 1, wherein said keep includes cavities that are positioned to provide a more uniform cross-sectional area that would exist on the keep without the cavities.

13. The keep as claimed in claim 1, wherein said keep includes a relieve in a surface for providing that a portion of the keep adjacent a fastening screw hole maintains contact with the top plate when the keep is secured to the top plate.

14. An injection molded thermoplastic keep that is positioned adjacent a top plate in a doctor blade holding apparatus and provides a slot opening between said keep and said top plate for receiving an end of a doctor blade in the slot opening, said keep comprising a thermoplastic material and relief features in said thermoplastic keep, said relief features including at least one gusset that provides additional structural rigidity, at least one cavity that is positioned to provide a more uniform cross-sectional area that would exist on the keep without the cavity, and a relieve in a surface for providing that a portion of the keep adjacent a fastening screw hole maintains contact with the top plate when the keep is secured to the top plate.

15. The keep as claimed in claim 14, wherein said keep provides a flat portion of a surface that contacts the top plate, wherein said flat portion has a flatness tolerance of at least 0.250 inches per inch.

16. The keep as claimed in claim 14, wherein said keep provides the slot opening with a flat portion having a flatness tolerance of at least 0.250 inches per inch.

17. The keep as claimed in claim 14, wherein said thermoplastic material includes at least one of a polyetheretherketone, polyphenylene sulfide, polyphthalamide polyvinyl chloride, polyethylene and polypropylene.

18. The keep as claimed in claim 14, wherein said keep further includes a plurality of reinforcement fibers formed of at least one of glass, carbon, aramid, ceramic and a thermoplastic material.

19. The keep as claimed in claim 14, wherein said keep further includes a plurality of reinforcement particles formed of at least one of glass, silicon, carbide and calcium carbide.

20. An injection molded thermoplastic keep that is positioned adjacent a top plate in a doctor blade holding apparatus and provides a slot opening between said keep and said top plate for receiving an end of a doctor blade in the slot opening, said keep comprising a nut retaining and anti-rotation cavity for receiving a nut that may be fastened to a screw that passes through the top plate.

21. The keep as claimed in claim 20, wherein nut is received with said cavity in a snap-fit arrangement.

22. The keep as claimed in claim 20, wherein said nut is adhered to the keep within the cavity.

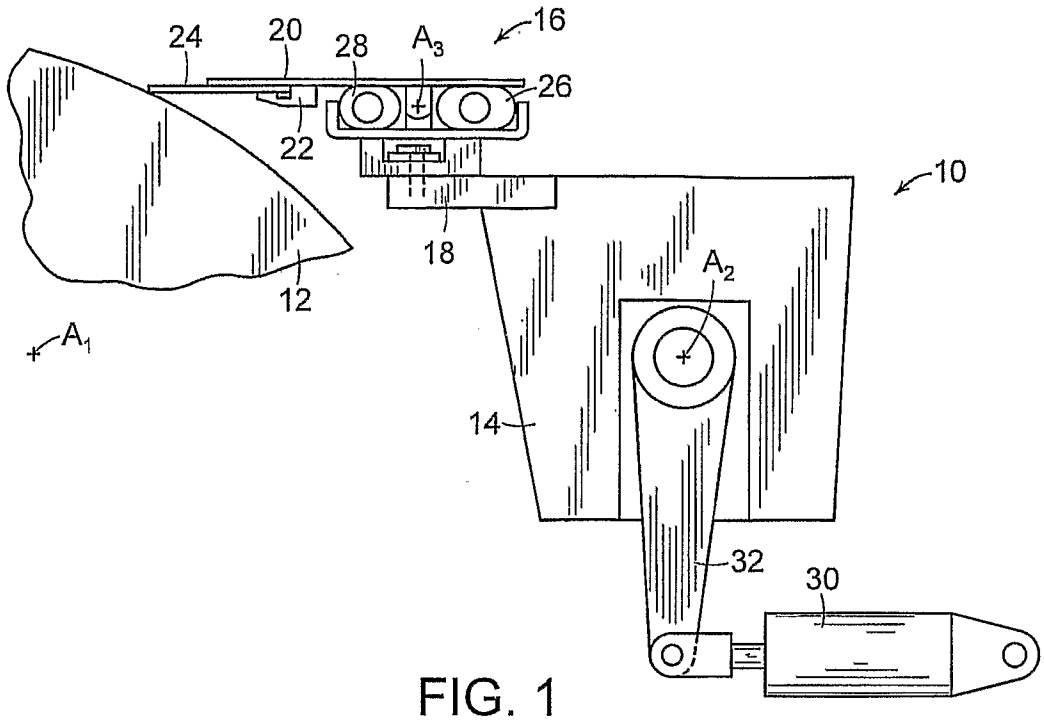

FIG. 1

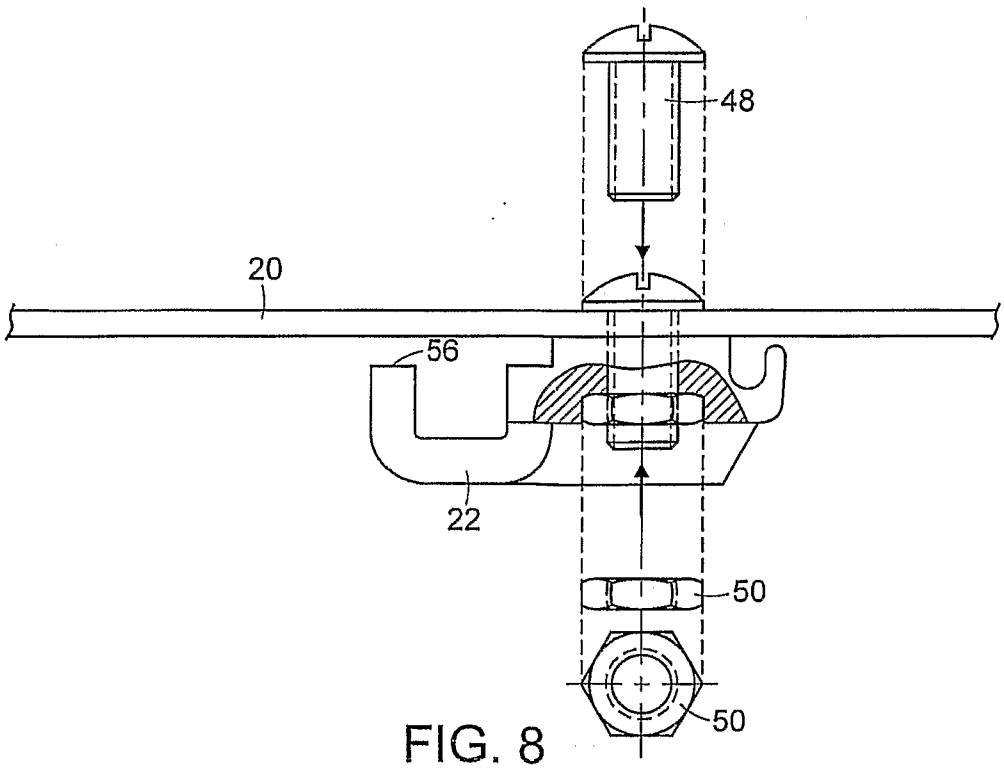

FIG. 8

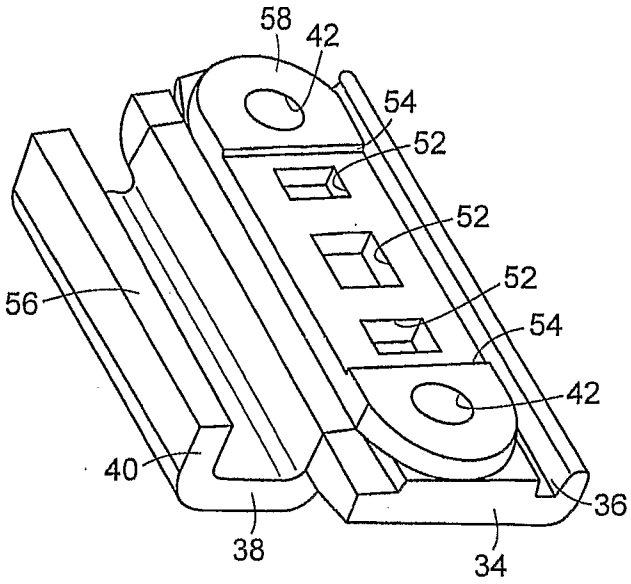

FIG. 2

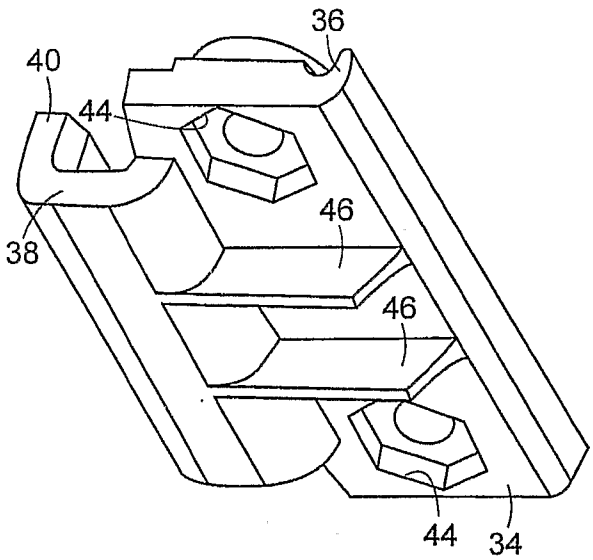

FIG. 3

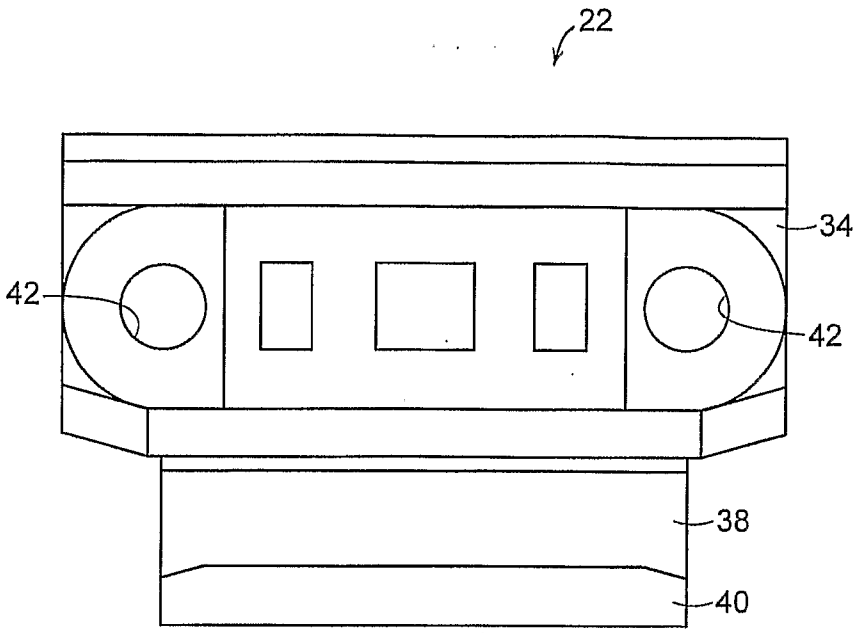

FIG. 4

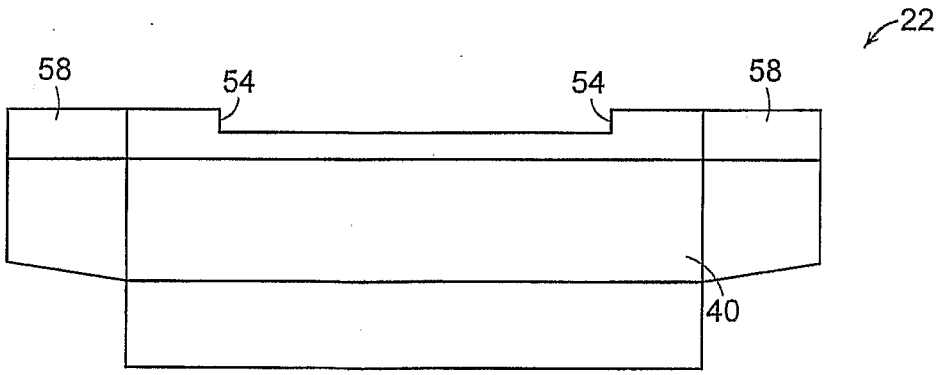

FIG. 5

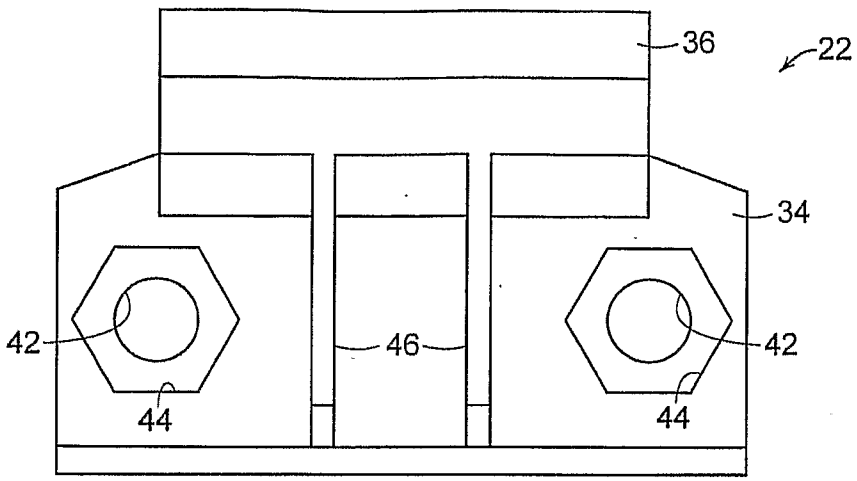

FIG. 6

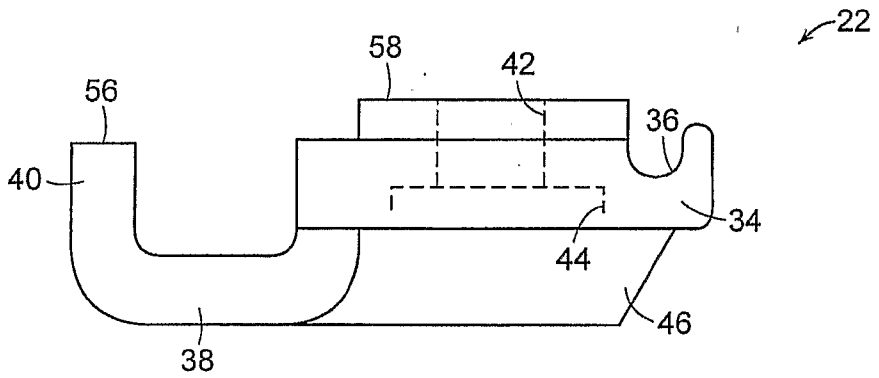

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2007/061102

A. CLASSIFICATION OF SUBJECT MATTER
INV. B05C11/04

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)
B05C D21G

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 practical, search terms used)
EPO-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.
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
4 May 2007	14/05/2007

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Pöll, Andreas

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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