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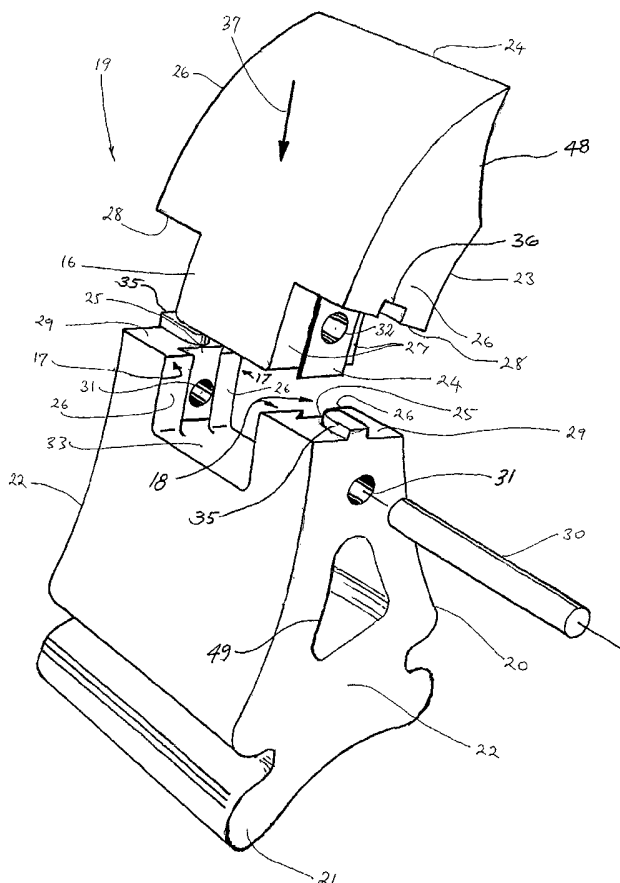
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(54) Title: CONVEYOR BELT SCRAPER BLADE ASSEMBLY



(57) Abstract: A scraper blade assembly for cleaning a conveyor belt surface, including first and second sections secured together end to end by a location pin, said first section including means for securing said scraper blade to a scraper blade support structure, said second section being adapted to be maintained in contact with the surface of a conveyor belt for cleaning thereof, said first and second sections having adjacent surfaces including at least one dovetailed tenon and a dovetailed mortise which are arranged to be in interlocking mechanical engagement after movement of said adjacent surfaces towards each other, the location pin extending through said sections to prevent withdrawal of said tenon from said mortise.

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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.

TITLE

CONVEYOR BELT SCRAPER BLADE ASSEMBLY

5 FIELD OF THE INVENTION

This invention concerns the cleaning of conveyor belts, and in particular a scraper blade assembly for use in belt scraper installations.

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BACKGROUND

In a widely used arrangement for cleaning adhering material from a conveyor belt, one or more scraper blades, mounted on a support structure, are maintained in contact with the belt's conveying surface so that the adhering material is scraped off. The support structure includes means whereby the or each blade is constantly pushed against the belt surface so that adequate scraping action is obtained and so that there is substantially continuous blade/belt contact despite belt and blade wear, passage past the blades of splices, damaged sections, etc.

"Primary" scraper installations of this type normally apply the scraper blades to the belt surface where the belt passes over a head pulley, and "secondary" scraper installations of this type normally apply the scraper blades to the conveying surface after the head pulley, i.e. on the belt's return run. The scraper blade of the present invention is applicable to both primary and secondary belt scraper installations, although primarily intended for the primary type.

A much used type of scraper blade is moulded in one piece from a resilient plastics material such as polyurethane and has an integrally moulded foot formation which is retained by a co-operating formation on the support structure. When such a blade wears to a certain degree, it

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must be replaced by a new one, but the removed blade is a substantial piece of material and discarding it is wasteful and costly.

5 In one approach to this problem, a two-part blade is used. A first part includes the foot formation and is not normally intended to wear in use of the blade. The second part has an edge which is held against the belt to scrape off adhering material and is intended to wear to a certain
10 wear limit. The first part, instead of being discarded when the blade reaches its wear limit, is placed in a blade mould and new material added to build up a complete new blade, the new material bonding to the existing material. The unworn remnant of the first part may or may
15 not be removed before this remoulding process takes place, as required.

This two-piece blade has a further advantage. It is possible to arrange for the first and second parts to have
20 different properties. In particular, it is known and desirable to provide a first part with a higher Shore Hardness than that of the second part. This allows a blade with adequate stiffness to be designed with less material.

25 A problem which can arise with blades of this type is deterioration of the properties of the material of the first part due to the heat involved in the remoulding process. This can limit the number of times a first part can be recycled. Moreover, a user must either have
30 moulding facilities or seek outside supply of rebuilt blade assemblies.

Mechanical connection of the first and second parts can eliminate this problem, but it is vitally important to
35 provide a connection that is reliable and strong, yet easy to make.

SUMMARY OF THE INVENTION

In accordance with a first aspect of the present invention there is provided a scraper blade assembly ***claim 1***.

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Preferably, the adjacent surfaces have secondary male projections and female recesses which interfit when the sections are in interlocking engagement. The secondary male projections may extend on either side of the mortise and the secondary female are provided on either side of the tenon.

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In a preferred embodiment, the second section terminates in an end scraper surface that includes a tip, said end scraper surface being concave. Preferably, the location pin is an interference fit in said first and second sections.

15

In a preferred embodiment, the tenon is formed on said second section and said mortise is formed on the first section. Preferably, a dovetailed projection is formed along each side of said tenon and a dovetail slot is formed along the edges of said mortise.

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In accordance with a further aspect of the present invention, there is provided a conveyor belt scraping apparatus including an elongate blade support, at least two scraper blade assemblies as described above mounted to said blade support, and means for supporting said blade support adjacent to a conveyor belt surface to urge the scraper blade assembly against said belt surface.

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In accordance with a still further aspect of the present invention, there is provided a method of replacing a worn or damaged scraper blade assembly, as described above, comprising progressively removing blade assemblies from the blade support to expose the worn or damage scraper

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blade, removing the worn or damages scraper blade, pushing
out the location pin and inserting a replacement second
section into interlocking engagement with the first
section, refitting the location pin and reassembling the
5 scraper blade assemblies to the blade support.

DESCRIPTION OF THE DRAWINGS

The preferred embodiments of the invention will now be
10 described in detail by reference to the attached Figures,
of which:

Figure 1 is a side view of a head end of a
conveyor fitted with a prior art belt scraper
installation;

15 Figure 2 is a perspective exploded view of a
scraper blade assembly according to the invention;

Figure 3 is an end view of the scraper blade
assembly shown in Figure 2 assembled on a mounting;

20 Figure 4 is a perspective exploded view of an
upper section of a further scraper blade assembly
according to the invention; and

Figure 5 is an end view of the upper section
shown in Figure 4, partially sectioned.

25 DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 shows one end of a belt conveyor 1, with much
mechanical detail omitted. The belt conveyor is for use
in the mining industry to convey mining quarry. The belts
30 vary in width from 600mm to 2400mm. Belt 2 passes over a
head pulley 3, which is rotated by suitable drive means
(not shown) so that the belt moves in the direction shown
by arrow 4. Material 5 is conveyed on the belt 2, leaving
conveyor 1 at the head pulley 3 in known manner as shown.
35 A primary belt scraper installation 6 is provided to
remove from the belt 2 at least a portion of any material
5 that remains adhering to the belt 2, rather than being

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thrown from it. This can occur if the belt 2 and/or the material 5 are wet, for example.

Scraper installation 6 includes a support bar assembly 7.
5 Support bar assembly 7 includes a tube 8 which is supported (by a support structure not shown) near the belt 2 and extends substantially parallel to the axis of rotation 9 of head pulley 3. Also included in support bar assembly 7 is a mounting rail 10, which is secured to, and
10 extends along, tube 8. Scraper blades 11 are mounted on mounting rail 10 in known manner. Specifically, each blade 11 has an integral foot formation 12 which co-operates with rail 10 so that blade 11 is able to be moved
15 lengthwise along rail 10 for mounting and dismounting, but otherwise is retained by rail 10. Means (not shown) are provided for holding each blade 11 in a fixed position along rail 10.

Blades 11 are arrayed across the width of belt 2 and
20 contact belt 2 at tips 13. Assembly 7 is able to rotate about an axis 14 that is parallel to the axis of rotation 9 of head pulley 3 and means (not shown) are provided in installation 6 for applying a torque in the direction of arrow 15 about axis 14 so that tips 13 of blades 11 are
25 pushed against belt 2 with a pressure suitable to provide a satisfactory combination of belt cleaning effectiveness and scraper wear rate.

Blades 11 are of a type (known in the art as a "doctor
30 blade") that has proven very satisfactory in service. Typically a doctor blade is a single polyurethane moulding. The invention is applicable to doctor blades, although other possibilities exist (for example secondary cleaners for the return runs of conveyor belts) and the
35 invention may be applicable to some of these. Blades 11 have a cross-sectional shape that is constant along their length in the direction of axis 14, and are seen in end

view in Figure 1.

In the present invention, a blade assembly, having two main parts, is used instead of blade 11. One of these main parts is intended to wear in use; the other is not. The two main parts are mechanically connected rather than being bonded and able to be separated so that a worn main part can be replaced without having to throw away the other main part. It is important that in a blade assembly having two mechanically connected parts, the parts will remain reliably connected. It is also desirable to minimize the number of components involved, and the difficulty of connecting the two parts.

Figures 2 and 3 show a scraper blade assembly 19 according to the invention and which can be used as a direct substitute for blade 11. A lower section 20 includes a foot formation 21 similar to foot 12 of blade 11 and which extend between end faces 22. An upper section 23 has an elongate tip 24 (scraping edge) and a formation 16. Section 23 has a constant cross-section between end faces 26 except for formation 16. The lower section 20 is moulded to have a throughway 49 that extends through a central position to increase the flexibility and reduce the weight of the section.

The formation 16 is in the form of a rectangular protrusion that is arranged to be a close fit within a similarly profiled recess 33 in the lower section 20. The lateral edges of the formation 16 have centrally positioned dovetailed lands 24 that are arranged to inter-engage with dovetailed slots 25 in opposite walls 17, 18 of the recess 33.

The upper section 23 and lower section 20 are able to be brought into mechanical engagement by a user aligning them as shown in Figure 2 and moving formation 16 onto the

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recess 33 in lower section 20, in the direction of arrow 37 (see also Figure 3). As this is done, the dovetailed lands 24 on formation 16 enter dovetailed slots 25 in walls 17 and 18 of the recess 33 (only one of the two lands 24 is visible in Figure 2). Planar surfaces 27 on formation 16 slide over planar surfaces 26 on the walls 17 and 18 of the recess 33 during this engagement process.

The formation 16 and its inter-engagement with the recess 33 act in the manner of a tenon and mortise respectively. The use of the dovetailed lands 24 and slots 25 resist splaying apart of walls 17 and 18 of recess 33 if there is relative twisting of sections 20 and 23 about an axis parallel to arrow 37.

As a further means of resisting relative twisting movement faces 29 of lower section 20 have transversely extending centrally positioned rectangular lands 35 and faces 28 of the upper section 23 have co-operating recesses 36. Lands 35 and recesses 36 extend lengthwise between the end faces 22 and 26 except where faces 28 and 29 are interrupted by formation 16. This arrangement provides an enhanced degree of resistance to relative twisting movement between sections 20 and 23 about an axis extending in the same direction as arrow 37. Such twisting may occur if a piece of debris passes assembly 34. Of course, the particular shape of formations 35 and recesses 36 are not critical. Other possible forms will readily suggest themselves to a person skilled in the art and are within the scope of the invention, the requirement being to limit or prevent relative movement in their plane of abutment of faces 28 and 29.

Engagement is complete when faces 28 of upper section 23 abut corresponding faces 29 of lower section 20.

To complete the connection between upper and lower

sections 23 and 20, a location pin 30 is then pushed through holes 31 and 32 in lower section 20 and upper section 23 respectively. Location pin 30 is an interference fit at holes 31 and 32 to ensure no free play between sections 20 and 23. It is also preferred that when pin 30 is in place, there is a degree of preloading of faces 28 against faces 29, this being achievable by the hole 32 and holes 31 being made slightly out of alignment.

Location pin 30 has a length equal to (or slightly less than) the distance between end faces 22 of lower section 20 and does not protrude from either of end faces 22. End faces 26 of upper section 23 are substantially the same distance apart as end faces 22. Thus, a number of assemblies 19 may be placed end to end on mounting rail such as rail 10 with their scraping edges 24 effectively forming a single scraping edge across the width of the belt to be cleaned. Pin 30 is for preference parallel to the direction of sliding of foot 12 in mounting rail 10.

Figure 3 shows in end view the assembly 19 with sections 20 and 23 fully engaged with each other and pin 30 in position. The facts that formation 16 extends from one side of assembly 19 to the other (i.e. in a direction normal to that of pin 30) between walls 17 and 18 and that lands 24 are engaged in recesses 25 provide for a substantial resistance to bending of assembly 19 in a plane normal to scraping edge 24. This is important because assembly 19 may be subject to a degree of bending in this way in normal operation, and in abnormal conditions, for example when a damaged belt splice or piece of debris impaled in the belt passes assembly 19, this bending may be extreme for a short period. It is necessary that assembly 19 act essentially as a single item. This resistance to bending is further enhanced by the abutting of faces 28 and 29 fully from one side to the other of assembly 19 and over a substantial part of the

length of sections 20 and 23.

Location pin 30 may be made of any suitable material that is found suitable for the conditions that are to be encountered. For example, it may be of metal or of an elastomer. In the latter case, it may be of the same class of elastomer that is used for one or both of sections 20 and 23, although the Shore A (or other) hardness of pin 30 must be enough to allow it to be satisfactorily driven (by a mallet) or pushed (by a press) into engagement with sections 20 and 23. Surprisingly, it has been found that a pin made of a plastics material reinforced by glass or Kevlar® fibres, carbon fibres or any other material suitable for reinforcing plastics may be found. These and other non-metallic substances may be advantageous in underground mining applications (for example) where metallic debris could impact the scraper blade assembly and with a metallic pin, perhaps cause a spark. Another suitable option is Teflon® coated stainless steel.

In use of assemblies 19, it is of course intended that before the scraper assembly is worn far enough for section 20 to contact the belt being cleaned, the worn section 23 will be replaced. An unworn section 20 may thus be used a number of times.

The use of two main sections 20 and 23 also permits different materials to be used for them to achieve desired performance objectives. In the preferred arrangement, each of sections 20 and 23 in a single moulding in a suitable elastomer, such as polyurethane. However, different hardnesses may be used for the sections 20 and 23 to adjust the stiffness distribution of the assembly 19 or to secure improved wear performance. To ensure even wear of the second section as the tip 24 is urged into contact with the conveyor belt, the front surface 48 of the section that includes the tip 24 is concave as shown in

Figure 3. The concavity of the surface ensures that the section wears evenly along its length and thus extends the effective operative life of the section.

5 A wear-resistant insert may be provided for actual contact with the belt to be cleaned, if required. This may be bonded (for example by adhesive or by being suitably shaped to achieve mechanical retention and then being positioned in the mould when a section 23 is being moulded
10 with elastomeric material).

In the preferred embodiment shown in Figure 2 each blade assembly is about 160mm in width, that is the tip 24 extends about 160mm across the conveyor. The thickness of
15 the furthest part of the bare section 20 is about 185mm and the thickness of the upper section 23 is about 45mm. The aperture 31 for the location pin 30 is 12.3mm in diameter. Each blade assembly is about 300mm high.

20 However, another arrangement may be used where conditions make it desirable. Figures 4 and 5 show an upper section 70 usable in a scraper blade assembly otherwise similar to assemblies 19, and which corresponds to upper section 23 of those assemblies. Upper section 70 has a formation 71
25 the same as and corresponding to formation 16.

Upper section 70 has a wear resistant tip 74 (for example of tungsten carbide) mounted thereto. Tip 74 is secured (for example by brazing) to an anchor plate 75, which has
30 studs 76 moulded into an elastomeric part 78 of section 70 to retain plate 75 in position. Between plate 75 and part 78 a layer 77 of a suitable thermally insulating material is provided to reduce heat transfer to part 78 during operation and during replacement of tip 74. Many materials
35 can be used for layer 77, for example "Haysite", available from Associated Gaskets Pty Ltd.

It is within the scope of the invention to provide a belt cleaning apparatus (not shown) having one or more scraper blade assemblies such as those disclosed above. The assemblies are mounted end to end on a support bar
5 assembly such as assembly 7 of Figure 1, which includes mounting rail 10. As known in the art, means (not shown) are provided for urging assembly 7 in direction 15 (in Figure 1) to load the scraper blades against the belt, in the same manner shown in Figure 1 for a prior art
10 apparatus. Using assembly 19 as an example, pins 30 are generally retained in position in holes 31 and 32 of their respective assemblies 19 by friction. However, where possible movement of pins 30 is a concern, it is only necessary to provide retaining means (not shown) to hold
15 them in place in the end members of the group of assemblies 19, for the pins 30 of intermediate members of the group are prevented from movement by contact with adjacent assemblies 19. The retaining means may simply be scraper blade assemblies that are single-piece mouldings,
20 without pins. Alternatively, plates may be mounted on the assembly 7 so as to abut the outer end faces 22 of the endmost assemblies 19. Other retaining means will suggest themselves to persons skilled in the art.

25 Many variations may be made without departing from the spirit and scope of the invention.

THE CLAIMS:

1. A scraper blade assembly for cleaning a conveyor belt surface, including first and second sections secured together end to end by a location pin, said first section including means for securing said scraper blade to a scraper blade support structure, said second section being adapted to be maintained in contact with the surface of a conveyor belt for cleaning thereof,
said first and second sections having adjacent surfaces including at least one dovetailed tenon and a dovetailed mortise which are arranged to be in interlocking mechanical engagement after movement of said adjacent surfaces towards each other, the location pin extending through said sections to prevent withdrawal of said tenon from said mortise.
2. The scraper blade assembly according to claim 1 wherein the adjacent surfaces have secondary male projections and female recesses which interfit when the sections are in interlocking engagement.
3. The scraper blade assembly according to claim 2 wherein the secondary male projections extend on either side of the mortise and the secondary female recesses are provided on either side of the tenon.
4. The scraper blade assembly according to any one of the preceding claims wherein said second section terminates in an end scraper surface that includes a tip, said end scraper surface being concave.
5. The scraper blade assembly according to any one of the preceding claims wherein said first section is hollow in cross said section.
6. The scraper blade assembly according to any one

of the preceding claims wherein said location pin is an interference fit in said first and second sections.

5 7. The scraper blade assembly according to any one of the preceding claims wherein the widths of the first and second sections at the interlocking engagement is the same and the length of the location pin is the same, or slightly less, than the width of the sections.

10 8. The scraper blade assembly according to any one of the preceding claims wherein said tenon is formed on said second section and said mortise is formed in the first section.

15 9. A scraper blade assembly according to claim 8 wherein a dovetailed projection is formed along each side of said tenon and a dovetailed slot is formed along the edges of said mortise.

20 10. The scraper blade assembly according to any one of claims 1 to 9 wherein at least one of said first or second sections is integrally formed of an elastomeric material.

25 11. The scraper blade assembly according to any one of claims 1 to 9 wherein said first and second sections are integrally formed of elastomeric materials, and the Shore A hardness of said first section differs from the Shore A hardness of said second section.

30 12. The scraper blade assembly according to any one of claims 1 to 11 wherein said second section includes a wear resistant tip.

35 13. The scraper blade assembly according to claim 12 wherein said wear resistant tip is replaceably secured to a mounting member and said mounting member is molded into

and/or bonded to a further part of said second section, said further part being formed of elastomeric material.

14. The scraper blade assembly according to claim 13
5 wherein thermally insulating material is provided within said elastomeric material of said second section and an adjoining part of said mounting member.

15. The scraper blade assembly according to any one
10 of claims 1 to 14 wherein said location pin is formed of a plastics material reinforced by a reinforcing material.

16. The scraper blade assembly according to claim 15
15 wherein said reinforcing material is in the form of fibres extending axially within said location pin.

17. The scraper blade assembly according to either
claim 15 or 16 wherein said reinforcing material is one of
glass, carbon and Kevlar®.

20

18. The scraper blade assembly according to any one
of claims 1 to 14 wherein the location pin is stainless
steel coated in Teflon®.

19. A conveyor belt scraping apparatus including an
25 elongate blade support, at least two scraper blade
assemblies according to any one of claims 1 to 18 mounted
to said blade support, and means for supporting said
blades support adjacent to a conveyor belt's surface to
30 urge the scraper blade assembly against said belt surface.

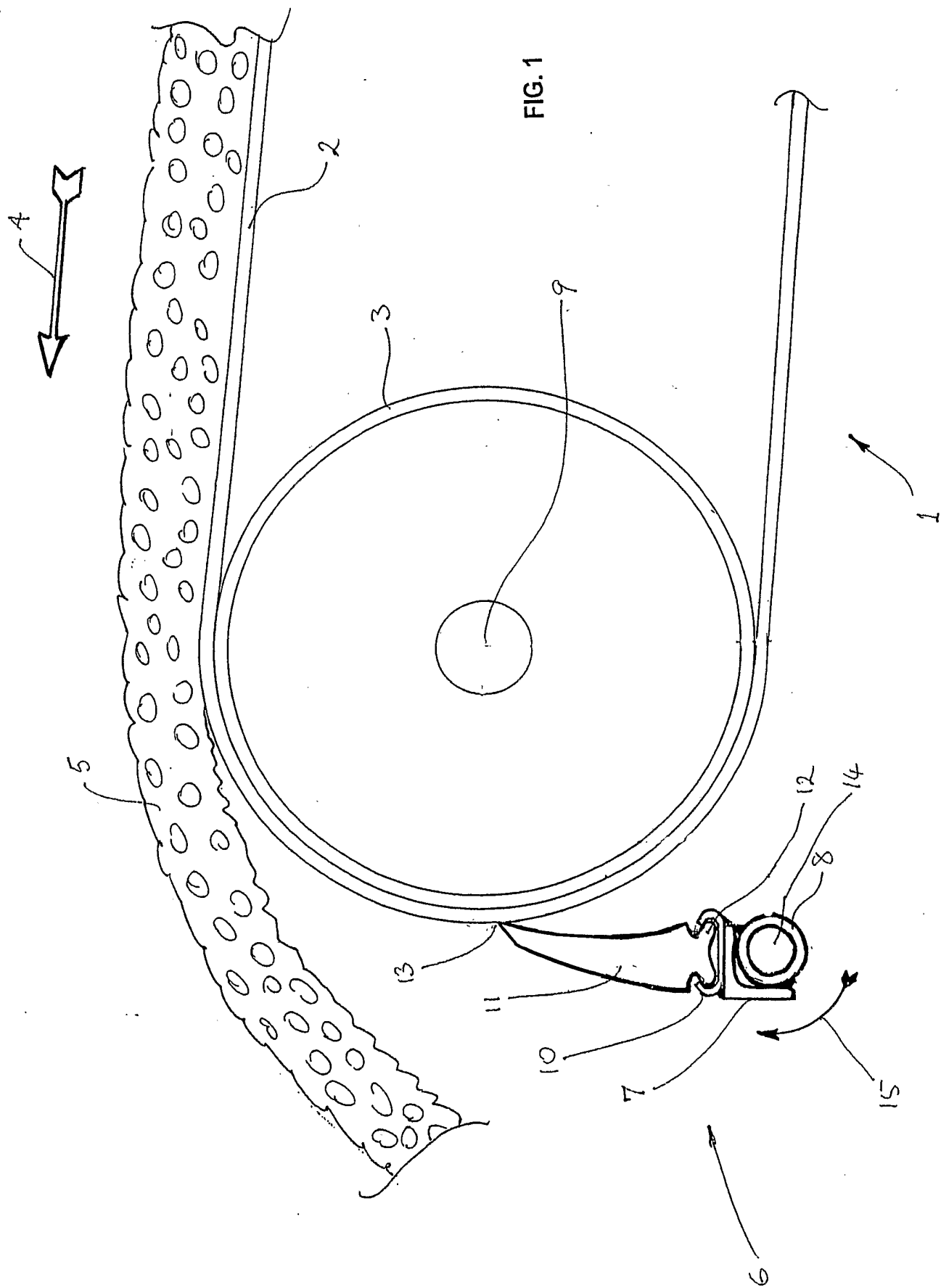
20. An apparatus according to claim 19, including a
plurality of said scraper blade assemblies in abutting
side by side contact.

35

21. A method of replacing a worn or damaged scraper
blade assembly of any one of claims 1 to 20 comprising

progressively removing blade assemblies from the blade support to expose the worn or damaged scraper blade, removing the worn or damaged scraper blade, pushing out the location pin and inserting a replacement second
5 section into interlocking engagement with the first section, refitting the location pin and reassembling the scraper blade assemblies to the blade support.

FIG. 1



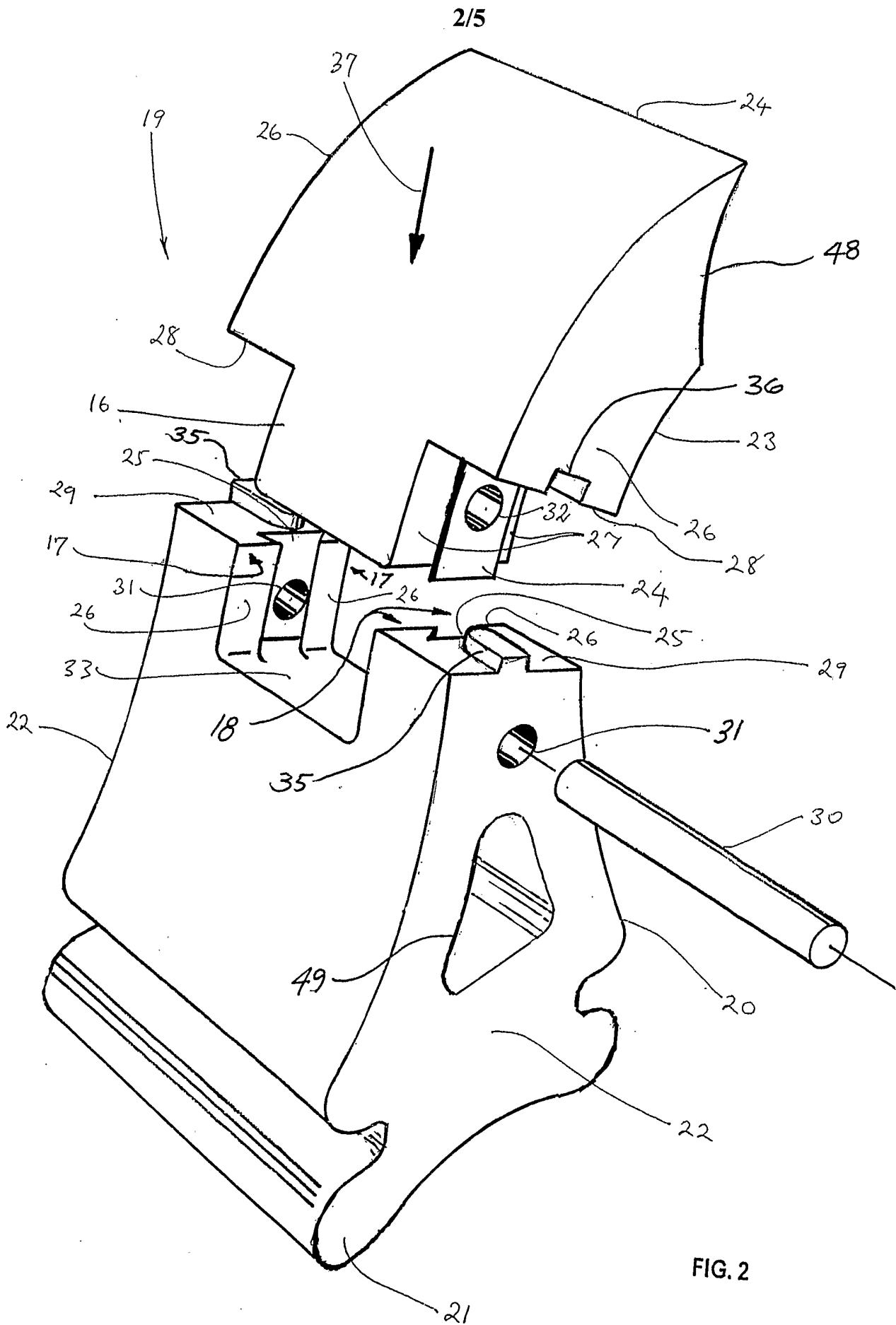


FIG. 2

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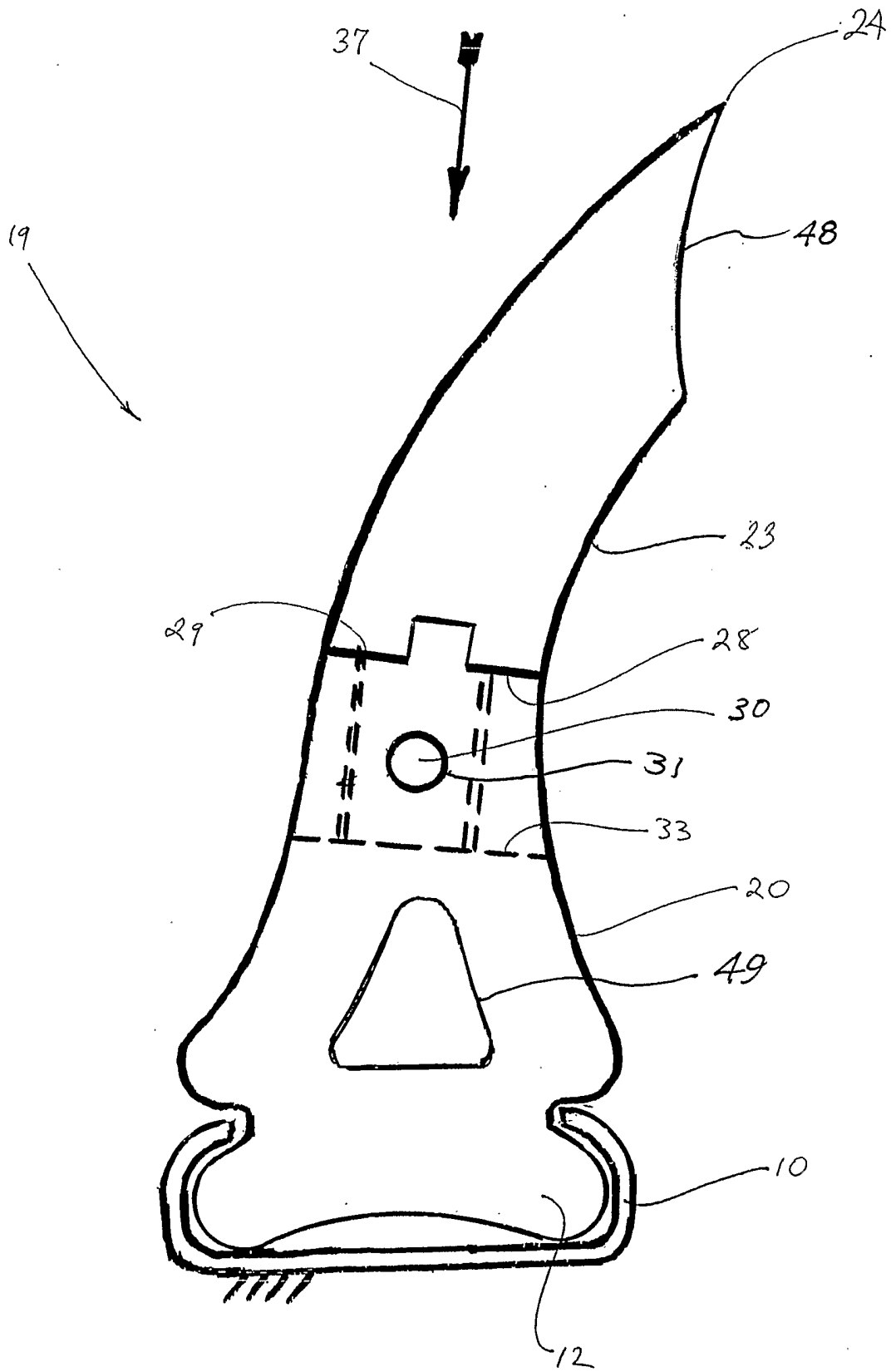


FIG. 3

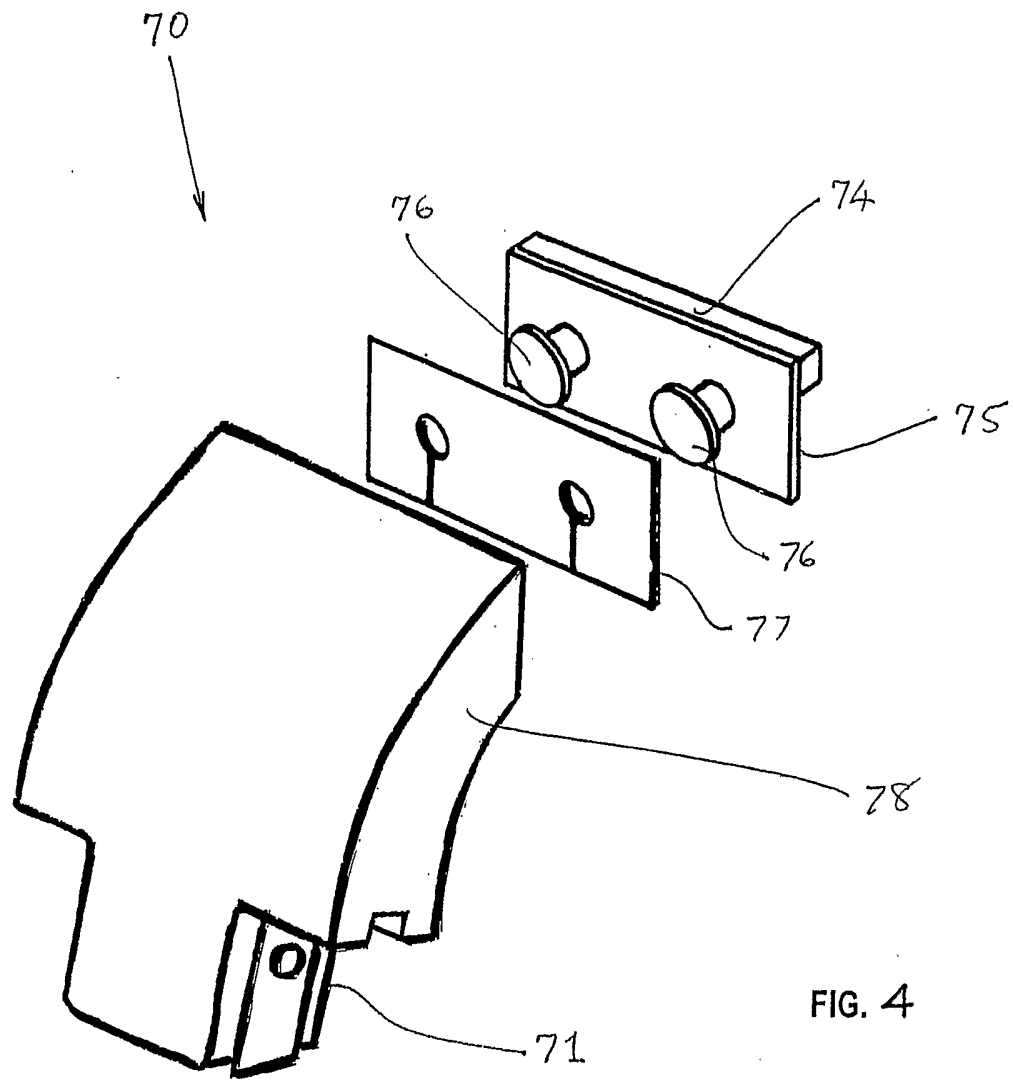


FIG. 4

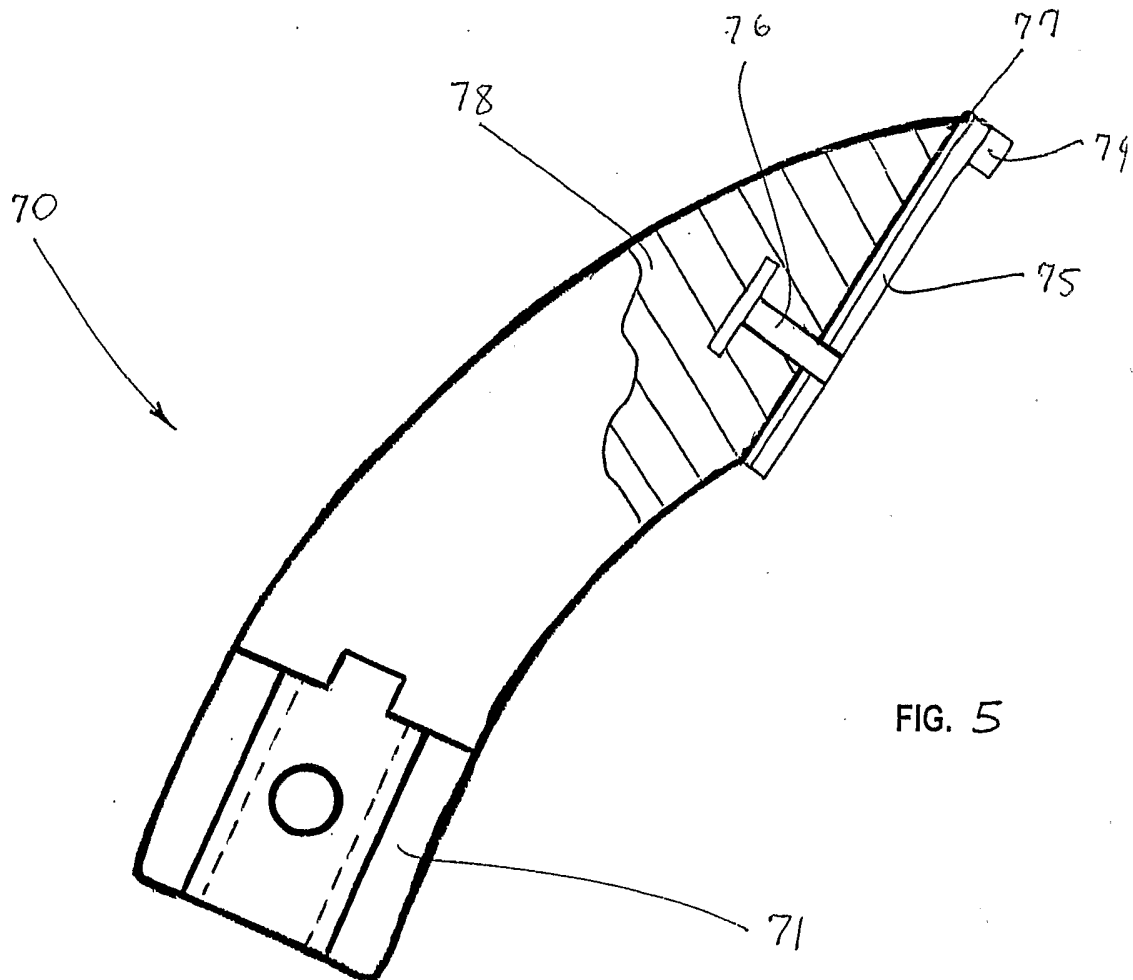


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER		
Int. Cl. ⁷ : B65G 45/12		
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) IPC: B65G 45/12		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU: IPC As above		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPAT		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 573688 A (ANTTONEN) 15 December 1993 Figures 3 and 4.	1 - 21
A	US 2001/0054539 A (SWINDERMAN) 27 December 2001 Figure 8	1 - 21
A	GB 2338944 A (SLIC TRADING COMPANY LIMITED) 12 January 2000 Abstract	1 - 21
<input type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> 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 4 April 2003		Date of mailing of the international search report 14 APR 2003
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustrialia.gov.au Facsimile No. (02) 6285 3929		Authorized officer JASON PREMNATH Telephone No : (02) 6283 2127

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU03/00270

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
EP	573688	NONE					
US	2001/0054539	AU	200152001	BR	200102575	EP	1167249
GB	2338944	AU	29080/99	US	6082524	ZA	9902822
END OF ANNEX							