18. Implantat nach Anspruch 17, dadurch gekennzeichnet, dass der Radius der einseitigen Abrundung (31) derart bemessen ist, dass

a) die Differenz zwischen der grösseren Seite des rechteckigen Querschnittes und der Diagonalen über die abgerundete Kante kleiner als 3 mm, vorzugsweise 1 - 2 mm beträgt;

und

b) die Kontaktfläche zum Knochen durch die Abrundung (31) um weniger als die Hälfte, vorzugsweise weniger als ein Drittel reduziert ist.

19. Implantat nach einem der Ansprüche 1 bis 18, dadurch gekennzeichnet, dass es einen rechteckigem Querschnitt mit einer doppelseitigen Abrundung (32) über die Diagonale aufweist.

20. Implantat nach Anspruch 19, dadurch gekennzeichnet, dass die Radien der doppelseitigen Abrundungen (32) derart bemessen sind, dass

a) die Differenz zwischen der grösseren Seite des Querschnittes und der Diagonalen über die abgerundeten Kanten kleiner als 3 mm, vorzugsweise 0,5 - 1,0 mm beträgt und

b) die kleinere Fläche des Implantates um weniger als die Hälfte, vorzugsweise weniger als ein Viertel reduziert ist.

21. Implantat nach Anspruch 19 oder 20, dadurch gekennzeichnet, dass es derart ausgebildet ist, dass bei paariger Anordnung solcher Implantate deren gerundete Kanten symmetrisch zueinander zu liegen kommen.

22. Implantat nach einem der Ansprüche 19 bis 21, dadurch gekennzeichnet, dass es einen rechteckigen Querschnitt aufweist, welcher derart beschaffen ist, dass nach der Rotation des Implantates in die Konkavität der Deckplatten der angrenzenden Wirbelkörper eine Distraktion des Zwischenwirbelraumes (25) zwischen 1 und 4 mm, vorzugsweise zwischen 2 - 3 mm, verbleibt.

23. Implantat nach einem der Ansprüche 19 bis 21, dadurch gekennzeichnet, dass es einen Querschnitt aufweist, der zu einem Quadrat reduziert ist und dass nach der Rotation des Implantates in die Konkavität der Endplatten der angrenzenden Wirbelkörper keine Distraktion des Zwischenwirbelraumes (25) verbleibt.

24. Implantat nach einem der Ansprüche 19 bis 22, dadurch gekennzeichnet, dass das posteriore Ende des Implantats (6) derart beschaffen ist, dass ein linkes und ein rechtes Implantat anterior derart mit einem Konnektor (34) verbindbar sind, dass
(a) der Abstand zwischen dem linken und rechten Implantat (6) und deren Ausrichtung aufrechterhalten wird;
(b) die Implantate (6) um ihre Längsachse (35) drehbar sind; und
(c) die zwei Implantate (6) vor deren Implantation und/oder in situ mit dem Konnektor (34) koppelbar sind.

25. Implantat nach einem der Ansprüche 19 bis 22, dadurch gekennzeichnet, dass es derart beschaffen ist, dass es vor dessen Implantation oder in situ mit einem zweiten Implantat (6) verhakbar ist, wobei die Verbindung

(a) den Abstand und den Winkel zwischen den Implantaten (6) aufrecht erhält; und

(b) eine Rotation der Implantate (6) um ihre Längsachse (35) in die Konkavität der Deckplatten der angrenzenden Wirbelkörper (1,2) zulässt.

26. Implantat nach einem der Ansprüche 19 bis 22, dadurch gekennzeichnet, dass es derart beschaffen ist, dass es nach der Rotation um seine Längsachse (35) in die Konkavität der Deckplatten medial über ein weiteres Implantat winkelstabil verbindbar ist.

27. Implantat nach einem der Ansprüche 19 bis 26, dadurch gekennzeichnet, dass es an seiner Oberfläche beschichtet ist, vorzugsweise mit Hydroxylapatit oder Titanplasma.

28. Implantat nach einem der Ansprüche 13, 14 und einem der Ansprüche 19 - 27, dadurch gekennzeichnet, dass es perforierte Wände aufweist, wobei die Perforationen (37) vorzugsweise lochartig sind und der Durchmesser der Löcher derart konzipiert ist, dass

(a) in die Längsöffnung gepresste Spongiosa nicht seitlich austritt, und

(b) die in der Spongiosa enthaltene Flüssigkeit beim Stopfen der Implantate seitlich austreten und nach der Implantation wieder zurückdiffundieren kann, um ein postoperatives Schwellen der Spongiosa zu bewirken; und
(c) Knochen durch die Perforation in das Implantat hineinwachsen kann.

29. Implantat nach einem der Ansprüche 19 - 28, dadurch gekennzeichnet, dass die eine Kontaktfläche zwischen Implantat und Knochen eine Rasterung in der Längsrichtung des Implantates aufweist.

30. Implantat nach einem der Ansprüche 19 - 28, dadurch gekennzeichnet, dass beide Kontaktflächen zwischen Implantat und Knochen eine Rasterung in der Längsrichtung des Implantates aufweisen.

31. Implantat nach einem der Ansprüche 29 oder 30, dadurch gekennzeichnet, dass die Geometrie der Rasterung ein Rotieren des Implantates in eine Richtung zulässt und in die andere Richtung verhindert.

32. Implantat nach einem der Ansprüche 19 - 28, dadurch gekennzeichnet, dass die eine Kontaktfläche zwischen Implantat und Knochen eine Querrasterung aufweist.

33. Implantat nach einem der Ansprüche 19 - 28, dadurch gekennzeichnet, dass beide Kontaktflächen zwischen Implantat und Knochen eine Querrasterung aufweisen.

34. Implantat nach einem der Ansprüche 32 oder 33, dadurch gekennzeichnet, dass die Geometrie der Rasterung ein Verschieben des Implantates in anteriorer Richtung verhindert.

35. Implantat nach einem der Ansprüche 32 oder 33, dadurch gekennzeichnet, dass die Geometrie der Rasterung ein Verschieben des Implantates in posteriorer Richtung verhindert.

36. Implantat nach Anspruch 32, dadurch gekennzeichnet, dass die Geometrie der Rasterung der beiden Kontaktflächen zwischen Implantat und Knochen derart gestaltet ist, dass die eine Rasterung ein Verschieben des Implantates in anteriorer Richtung und die andere ein Verschieben in posteriorer Richtung verhindert.

37. Implantat nach einem der Ansprüche 29 oder 32, dadurch gekennzeichnet, dass es eine Längsrasterung der einen und eine Querrasterung der anderen Kontaktfläche aufweist.

38. Implantat nach einem der Ansprüche 32 - 35 oder 37, dadurch gekennzeichnet, dass die Querrasterung der einzelnen Kontaktflächen derart ausgelegt ist, dass ein Verschieben in posteriorer und anteriorer Richtung verhindert wird.

39. Implantat nach einem der Ansprüche 13,14 und einem der Ansprüche 19-17 und 29-38, dadurch gekennzeichnet, dass die Wände (19) und (20) Querschlitze aufweisen.

40. Implantat nach Anspruch 39, dadurch gekennzeichnet, dass die Hohlräume und Schlitze mit einem osteokonduktiven oder osteoinduktiven Material, vorzugsweise Hydroxylapatit, gefüllt sind, so dass der Knochen von den Deckplatten der angrenzenden Wirbelkörper und von der Seite her einwachsen kann.

41. Implantat für den Zwischenwirbelraum (25) mit

a) einer im wesentlichen quaderförmigen Gestalt mit den Kantenlängen a,b,c;

b) einer vorderen axialen Endfläche (12) und einer hinteren axialen Endfläche (10), welche von der Längsachse (35) durchstossen werden;

c) zwei Seitenflächen (14,15) welche von einer Querachse (44) durchstossen werden; und

d) einer Oberfläche (16) und einer Unterfläche (17)) welche von einer Querachse (45) durchstossen werden;

dadurch gekennzeichnet, dass

e) das Implantat (6) eine Vorrichtung (8) zur Ergreifung durch ein Werkzeug (9) aufweist; und

f) die vordere axialen Endfläche (12) und/oder die hinteren axialen Endfläche (10) rechteckig ausgebildet sind.

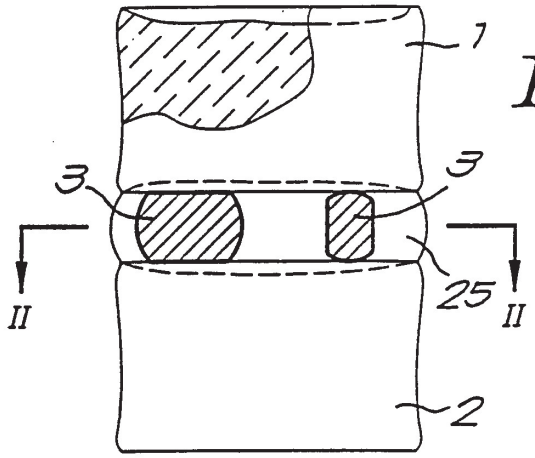


Fig.1

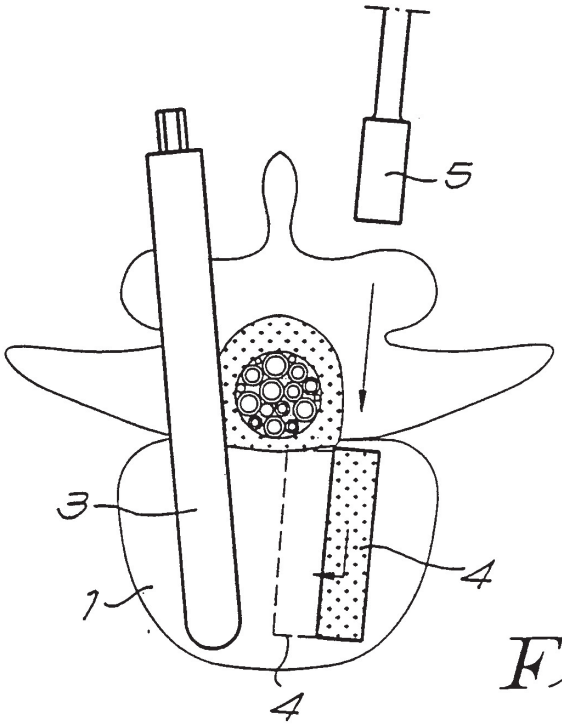


Fig.2

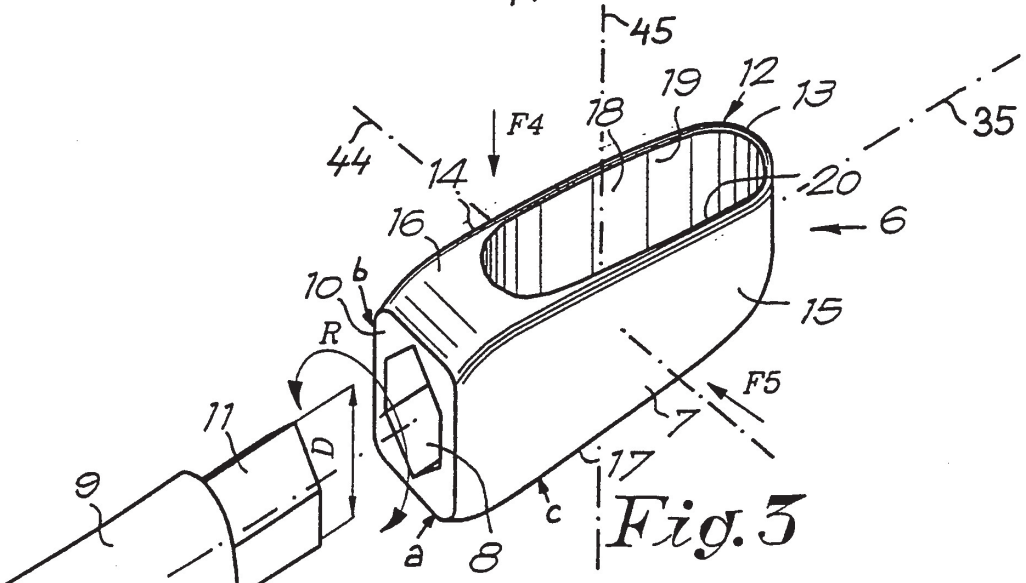


Fig. 3

Fig. 4

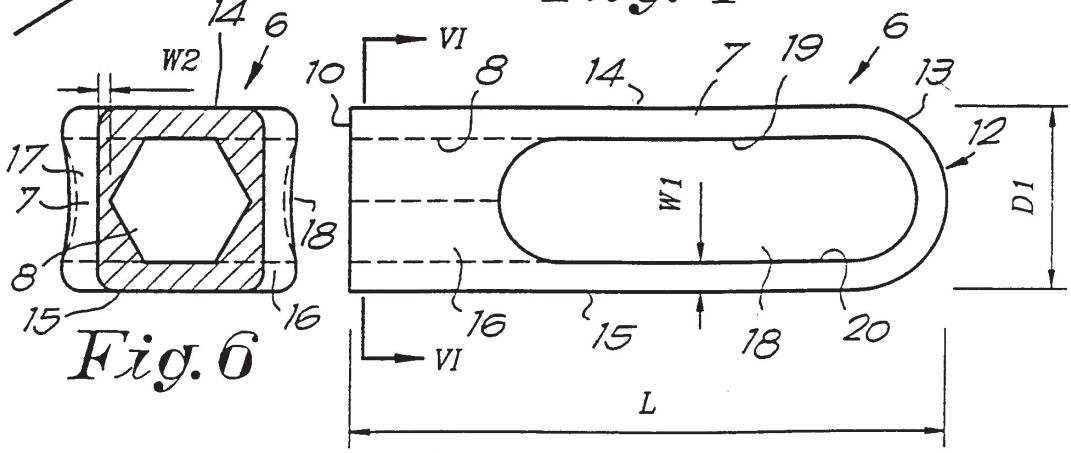


Fig. 6

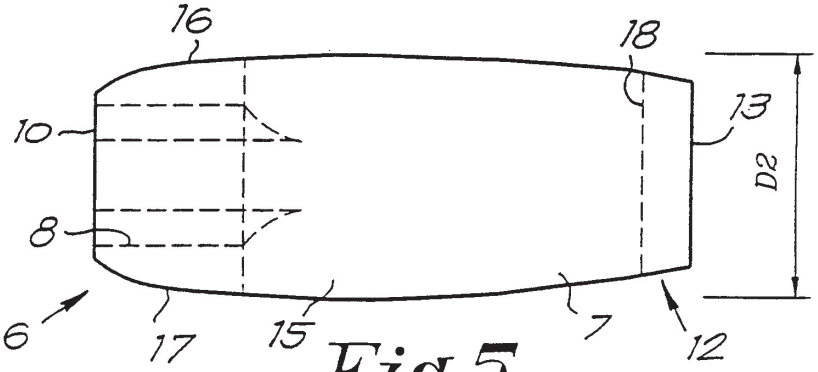


Fig. 5

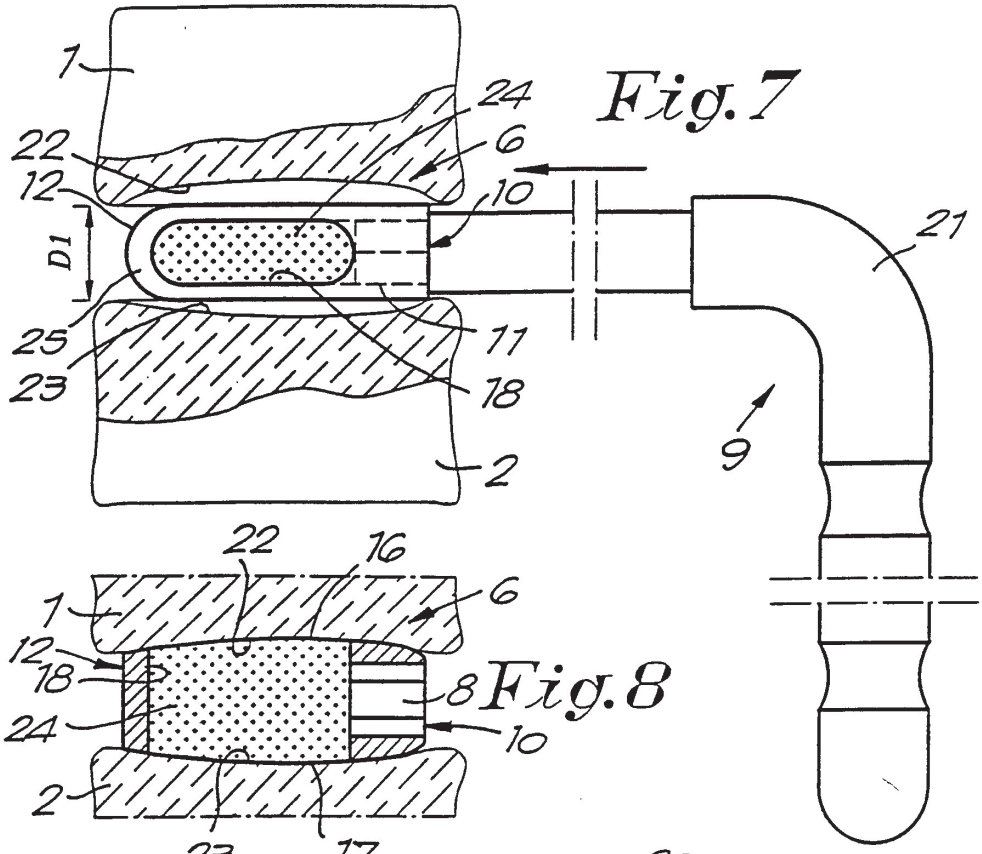


Fig.7

Fig.8

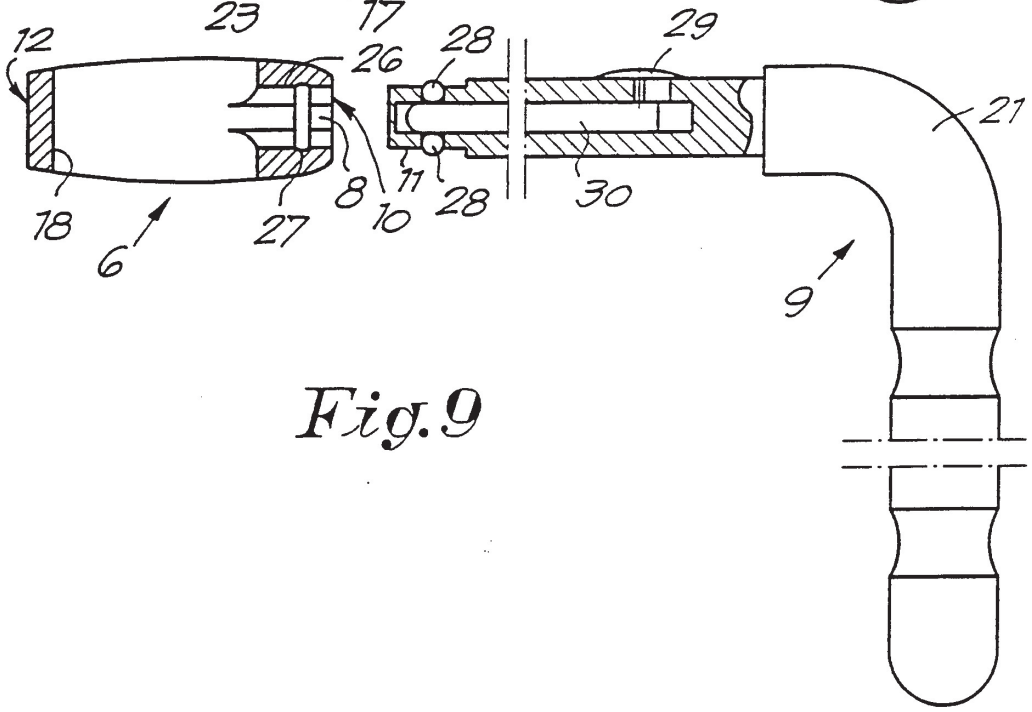


Fig.9

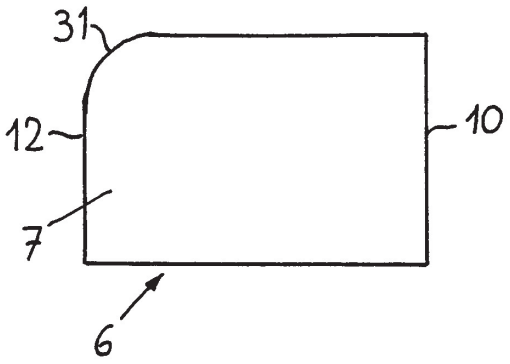


Fig. 10

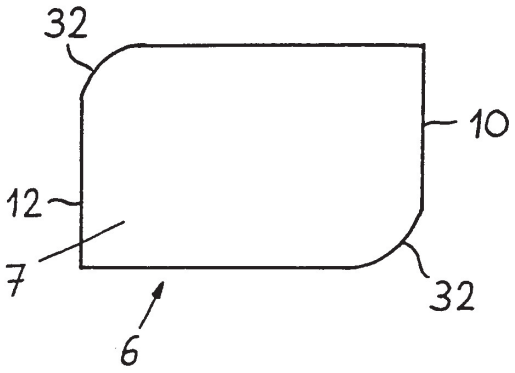


Fig. 11

5/7

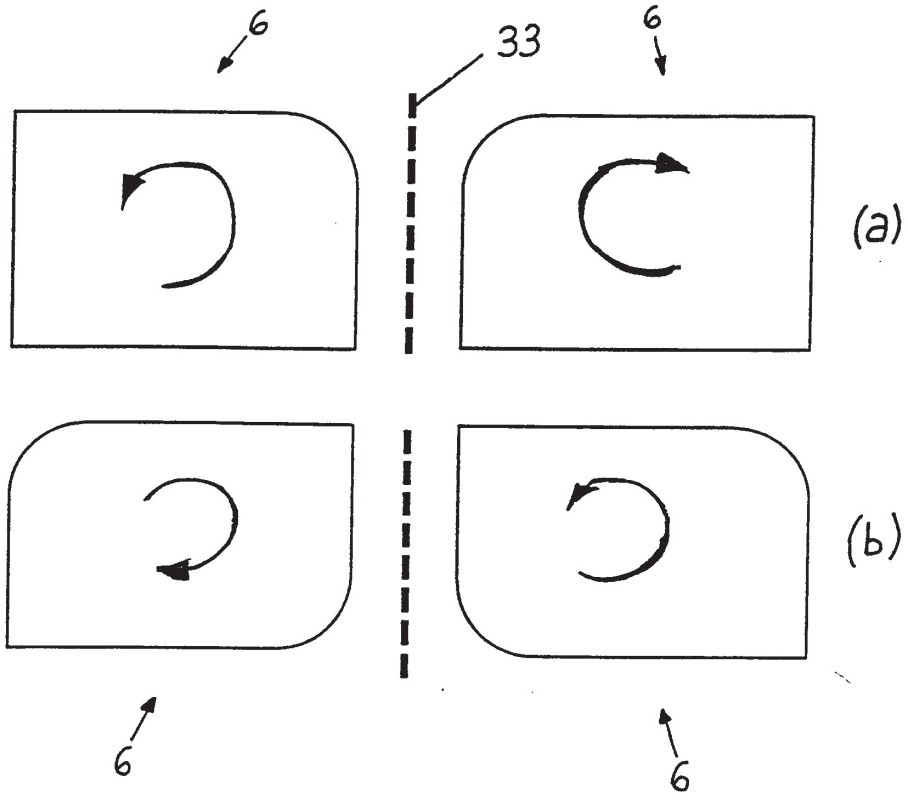


Fig. 12

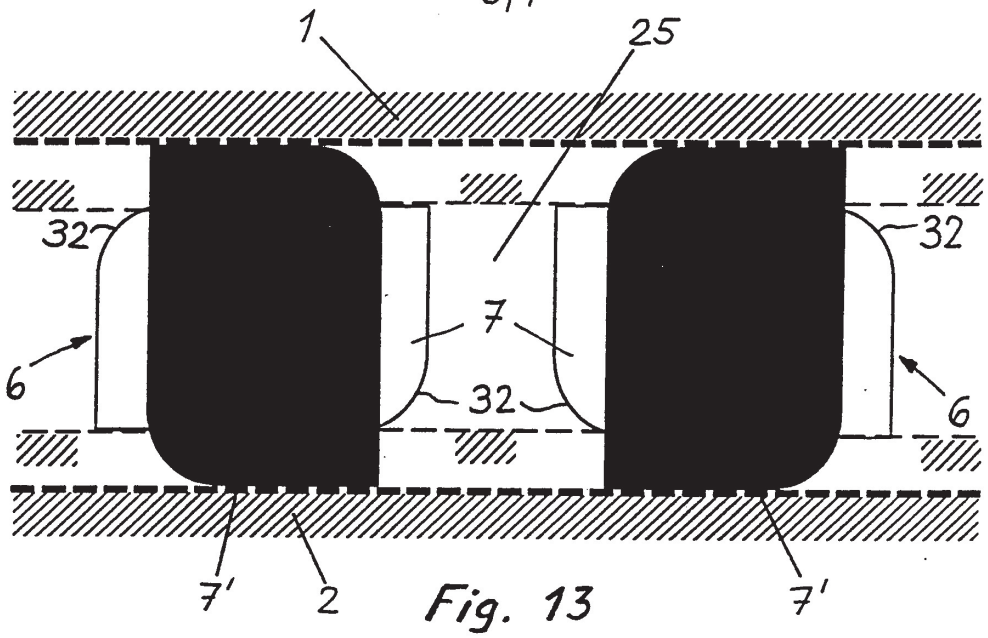


Fig. 13

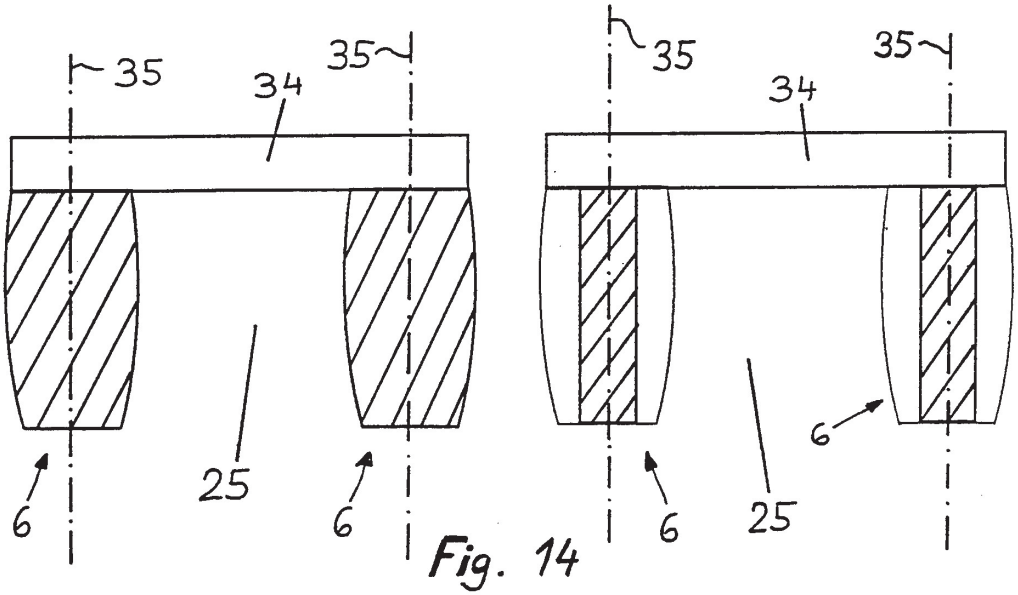


Fig. 14

Fig. 15

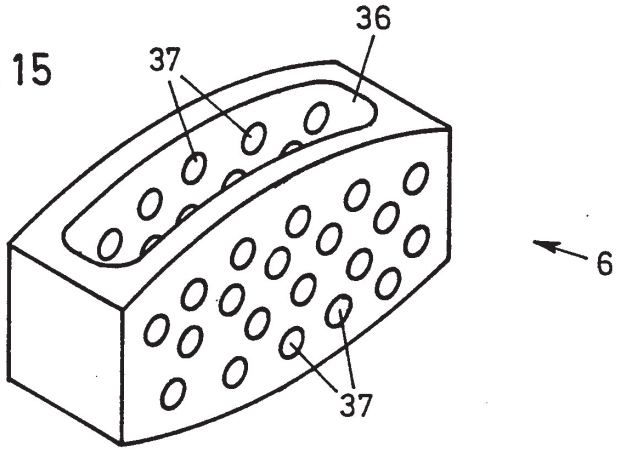


Fig. 16

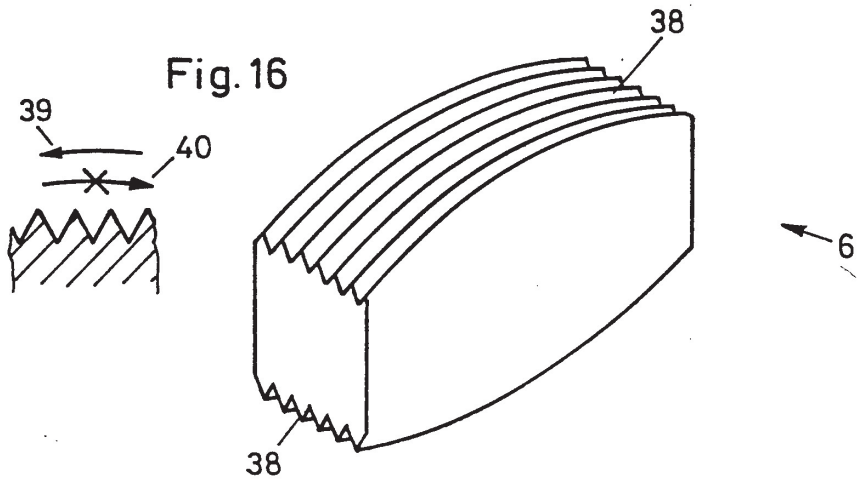
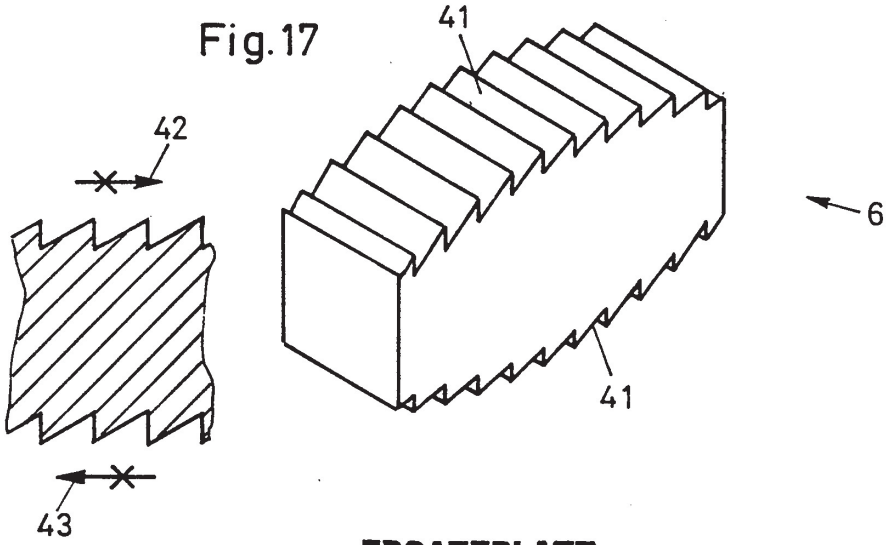


Fig. 17



INTERNATIONAL SEARCH REPORT

Inter. nal Application No
PCT/CH 94/00184

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A61F2/44 A61F2/46

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 6 A61F

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO,A,90 00037 (MICHELSON) 11 January 1990	1-3,8,9, 12,13, 17,41
Y	see the whole document	5,10
A		4,28,40

Y	US,A,3 486 505 (MORRISON) 30 December 1969	5
A	see column 2, line 21 - line 68; claims 2-4	1,13,40

Y	US,A,4 349 921 (KUNTZ) 21 September 1982 see column 6, line 19 - line 24; figures 2-4	10

	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in 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 document 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	Date of mailing of the international search report
19 December 1994	09. 01. 95

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	Klein, C

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inter. nal Application No
PCT/CH 94/00184

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 307 241 (BRANTIGAN) 15 March 1989	1-3,8,9, 13,14,16
A	see the whole document	28-33, 35,40
X	WO,A,89 12431 (MICHELSON) 28 December 1989	1-3,13
A	see page 13, line 11 - page 16, line 37; figures 4-5	4,15,28, 40
A	EP,A,0 260 044 (SHEPPERD) 16 March 1988 see column 7, line 28 - column 8, line 21; claim 15	16,27,39
A	US,A,5 092 893 (SMITH) 3 March 1992 see column 5, line 7 - line 23; figures 1,5	24
A	WO,A,93 01771 (CALCITEK) 4 February 1993 see abstract; figure 4	37
A	WO,A,92 14423 (MADHAVAN) 3 September 1992 see page 8, line 11; figures 5,6	39
A	EP,A,0 493 698 (HÄRLE) 8 July 1992	
A	US,A,4 772 287 (RAY) 20 September 1988	

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/CH 94/00184

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO-A-9000037	11-01-90	AU-A-	3965489	23-01-90
		EP-A-	0425542	08-05-91
		JP-T-	3505416	28-11-91
US-A-3486505	30-12-69	NONE		
US-A-4349921	21-09-82	NONE		
EP-A-0307241	15-03-89	US-A-	4834757	30-05-89
		CA-A-	1292596	03-12-91
		DE-A-	3876909	04-02-93
		US-A-	4878915	07-11-89
		AU-B-	614609	05-09-91
		AU-A-	3436389	16-10-89
		JP-T-	3503133	18-07-91
		WO-A-	8909035	05-10-89
WO-A-8912431	28-12-89	US-A-	5015247	14-05-91
		AU-A-	3838789	12-01-90
		CA-A-	1332999	15-11-94
		EP-A-	0419564	03-04-91
EP-A-0260044	16-03-88	JP-A-	63145650	17-06-88
		US-A-	4863476	05-09-89
US-A-5092893	03-03-92	NONE		
WO-A-9301771	04-02-93	US-A-	5306307	26-04-94
		EP-A-	0612230	31-08-94
WO-A-9214423	03-09-92	US-A-	5171278	15-12-92
		AU-A-	1454192	15-09-92
		EP-A-	0571555	01-12-93
		JP-T-	6504704	02-06-94
EP-A-0493698	08-07-92	DE-A-	4101526	02-07-92
		EP-A-	0623323	09-11-94
US-A-4772287	20-09-88	DE-A-	3871460	02-07-92
		EP-A,B	0304305	22-02-89

INTERNATIONAL SEARCH REPORT

Inter. nal Application No
PCT/CH 94/00184

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4772287		JP-A- 1070041	15-03-89
		US-A- 4904260	27-02-90

INTERNATIONALER RECHERCHENBERICHT

Interna ies Aktenzeichen
PCT/CH 94/00184

A. KLASSIFIZIERUNG DES ANMELDUNGSGEGENSTANDES
IPK 6 A61F2/44 A61F2/46

Nach der Internationalen Patentklassifikation (IPK) oder nach der nationalen Klassifikation und der IPK

B. RECHERCHIERTE GEBIETE

Recherchierter Mindestprüfstoff (Klassifikationssystem und Klassifikationssymbole)
IPK 6 A61F

Recherchierte aber nicht zum Mindestprüfstoff gehörende Veröffentlichungen, soweit diese unter die recherchierten Gebiete fallen

Während der internationalen Recherche konsultierte elektronische Datenbank (Name der Datenbank und evtl. verwendete Suchbegriffe)

C. ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie°	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
X	WO,A,90 00037 (MICHELSON) 11. Januar 1990	1-3,8,9, 12,13, 17,41
Y	siehe das ganze Dokument	5,10
A		4,28,40

Y	US,A,3 486 505 (MORRISON) 30. Dezember 1969	5
A	siehe Spalte 2, Zeile 21 - Zeile 68; Ansprüche 2-4	1,13,40

Y	US,A,4 349 921 (KUNTZ) 21. September 1982 siehe Spalte 6, Zeile 19 - Zeile 24; Abbildungen 2-4	10

	-/--	

[X] Weitere Veröffentlichungen sind der Fortsetzung von Feld C zu entnehmen

[X] Siehe Anhang Patentfamilie

° Besondere Kategorien von angegebenen Veröffentlichungen :

"A" Veröffentlichung, die den allgemeinen Stand der Technik definiert, aber nicht als besonders bedeutsam anzusehen ist

"E" älteres Dokument, das jedoch erst am oder nach dem internationalen Anmeldedatum veröffentlicht worden ist

"L" Veröffentlichung, die geeignet ist, einen Prioritätsanspruch zweifelhaft erscheinen zu lassen, oder durch die das Veröffentlichungsdatum einer anderen im Recherchenbericht genannten Veröffentlichung belegt werden soll oder die aus einem anderen besonderen Grund angegeben ist (wie ausgeführt)

"O" Veröffentlichung, die sich auf eine mündliche Offenbarung, eine Benutzung, eine Ausstellung oder andere Maßnahmen bezieht

"P" Veröffentlichung, die vor dem internationalen Anmeldedatum, aber nach dem beanspruchten Prioritätsdatum veröffentlicht worden ist

"T" Spätere Veröffentlichung, die nach dem internationalen Anmeldedatum oder dem Prioritätsdatum veröffentlicht worden ist und mit der Anmeldung nicht kollidiert, sondern nur zumVerständnis des der Erfindung zugrundeliegenden Prinzips oder der ihr zugrundeliegenden Theorie angegeben ist

"X" Veröffentlichung von besonderer Bedeutung; die beanspruchte Erfindung kann allein aufgrund dieser Veröffentlichung nicht als neu oder auf erfinderischer Tätigkeit beruhend betrachtet werden

"Y" Veröffentlichung von besonderer Bedeutung; die beanspruchte Erfindung kann nicht als auf erfinderischer Tätigkeit beruhend betrachtet werden, wenn die Veröffentlichung mit einer oder mehreren anderen Veröffentlichungen dieser Kategorie in Verbindung gebracht wird und diese Verbindung für einen Fachmann naheliegend ist

"&" Veröffentlichung, die Mitglied derselben Patentfamilie ist

Datum des Abschlusses der internationalen Recherche	Absendedatum des internationalen Recherchenberichts
19. Dezember 1994	09. 01. 95

Name und Postanschrift der Internationale Recherchenbehörde	Bevollmächtigter Bediensteter
Europäisches Patentamt, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Klein, C

Formblatt PCT/ISA/210 (Blatt 2) (Juli 1992)

C.(Fortsetzung) ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie°	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
X	EP,A,0 307 241 (BRANTIGAN) 15. März 1989	1-3,8,9, 13,14,16
A	siehe das ganze Dokument	28-33, 35,40
X	WO,A,89 12431 (MICHELSON) 28. Dezember 1989	1-3,13
A	siehe Seite 13, Zeile 11 - Seite 16, Zeile 37; Abbildungen 4-5	4,15,28, 40
A	EP,A,0 260 044 (SHEPPERD) 16. März 1988 siehe Spalte 7, Zeile 28 - Spalte 8, Zeile 21; Anspruch 15	16,27,39
A	US,A,5 092 893 (SMITH) 3. März 1992 siehe Spalte 5, Zeile 7 - Zeile 23; Abbildungen 1,5	24
A	WO,A,93 01771 (CALCITEK) 4. Februar 1993 siehe Zusammenfassung; Abbildung 4	37
A	WO,A,92 14423 (MADHAVAN) 3. September 1992 siehe Seite 8, Zeile 11; Abbildungen 5,6	39
A	EP,A,0 493 698 (HÄRLE) 8. Juli 1992	
A	US,A,4 772 287 (RAY) 20. September 1988	

INTERNATIONALER RECHERCHENBERICHT

Inten. nales Aktenzeichen
PCT/CH 94/00184

Im Recherchenbericht angeführtes Patentdokument	Datum der Veröffentlichung	Mitglied(er) der Patentfamilie		Datum der Veröffentlichung
WO-A-9000037	11-01-90	AU-A-	3965489	23-01-90
		EP-A-	0425542	08-05-91
		JP-T-	3505416	28-11-91
US-A-3486505	30-12-69	KEINE		
US-A-4349921	21-09-82	KEINE		
EP-A-0307241	15-03-89	US-A-	4834757	30-05-89
		CA-A-	1292596	03-12-91
		DE-A-	3876909	04-02-93
		US-A-	4878915	07-11-89
		AU-B-	614609	05-09-91
		AU-A-	3436389	16-10-89
		JP-T-	3503133	18-07-91
		WO-A-	8909035	05-10-89
WO-A-8912431	28-12-89	US-A-	5015247	14-05-91
		AU-A-	3838789	12-01-90
		CA-A-	1332999	15-11-94
		EP-A-	0419564	03-04-91
EP-A-0260044	16-03-88	JP-A-	63145650	17-06-88
		US-A-	4863476	05-09-89
US-A-5092893	03-03-92	KEINE		
WO-A-9301771	04-02-93	US-A-	5306307	26-04-94
		EP-A-	0612230	31-08-94
WO-A-9214423	03-09-92	US-A-	5171278	15-12-92
		AU-A-	1454192	15-09-92
		EP-A-	0571555	01-12-93
		JP-T-	6504704	02-06-94
EP-A-0493698	08-07-92	DE-A-	4101526	02-07-92
		EP-A-	0623323	09-11-94
US-A-4772287	20-09-88	DE-A-	3871460	02-07-92
		EP-A,B	0304305	22-02-89

INTERNATIONALER RECHERCHENBERICHT

Internales Aktenzeichen
PCT/CH 94/00184

Im Recherchenbericht angeführtes Patentdokument	Datum der Veröffentlichung	Mitglied(er) der Patentfamilie		Datum der Veröffentlichung
US-A-4772287		JP-A-	1070041	15-03-89
		US-A-	4904260	27-02-90

Morningside Translations

450 7th Ave
6th Floor
New York, NY 10123
Tel 212.643.8800
Fax 212.643.0005
www.morningtrans.com

TRANSLATOR CERTIFICATION

County of New York
State of New York

Date: June 3, 2013

To whom it may concern:

This is to certify that the attached translation from German into English is an accurate representation of the documents received by this office.

The documents are designated as:

- WO 95/08306 – "Implant for the intervertebral space"

Roxanne Le, Project Manager in this company, certifies that Christian Scrogum, who translated these documents, is fluent in German and standard North American English and qualified to translate. Roxanne Le attests to the following:

"To the best of my knowledge, the aforementioned documents are a true, full and accurate translation of the specified documents."

Signature of Roxanne Le

PCT WORLD ORGANIZATION FOR INTELLECTUAL PROPERTY
International Bureau
INTERNATIONAL APPLICATION PUBLISHED IN ACCORDANCE WITH THE PATENT COOPERATION TREATY (PCT)

(51) International patent classification[6]: **A61F 2/44, 2/46**

A1

(11) International publication number: WO 95/08306

(43) International publication date: 30 March 1995 (03/30/1995)

(21) International file number: PCT/CH94/00184

(22) International application date: 20 September 1994 (09/20/94)

(30) Priority information:
9300982 21 September 1993 (09/21/93) BE

(71) Applicant *(for all designated countries except US)*: SYNTHES AG, CHUR [CH/CH]; Grabenstrasse 15, CH-7002 Chur (CH).

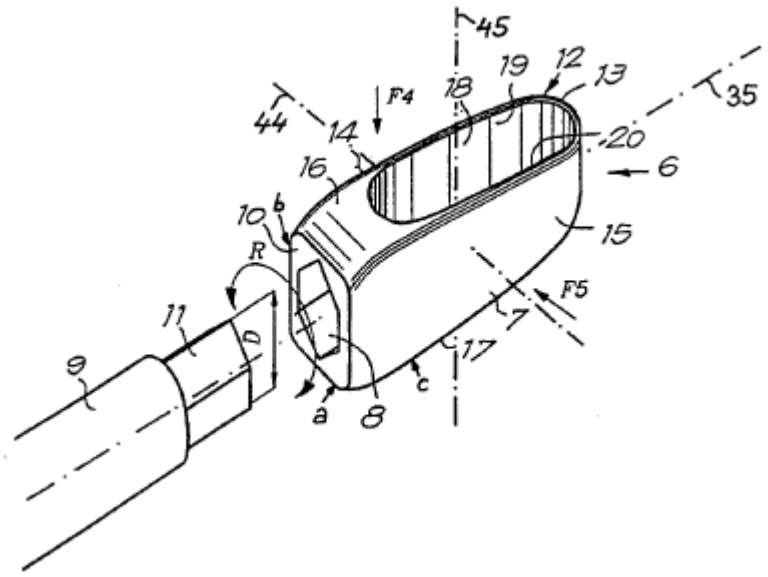
(72) Inventor; and
(75) Inventor/applicant *(only for US)*: BECKERS, Louis, François, Charles [BE/BE]; Peulisbaan 22, B-2820 Rijmenam (BE). SCHLÄPFER, Johannes, Fridolin [CH/CH]; Leimen, CH-8750 Glarus (CH).

(74) Attorney: LUSUARDI, Werther, G.; Dr. Lusuardi AG, Kreuzbühlstrasse 8, CH-8008 Zurich (CH).

(81) Designated states: CA, JP, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: IMPLANT FOR INTERVERTEBRAL SPACE



(57) Abstract

The implant for the intervertebral space consists of an essentially cuboid body with a device for gripping by a tool.

FOR INFORMATION ONLY

Codes for the identification of PCT designated states in the headers of documents in which international applications are published in accordance with PCT.

AT	Austria	GA	Gabon	MR	Mauritania
AU	Australia	GB	United Kingdom	MW	Malawi
BB	Barbados	GE	Georgia	NE	Niger
BE	Belgium	GN	Guinea	NL	Netherlands
BF	Burkina Faso	GR	Greece	NO	Norway
BG	Bulgaria	HU	Hungary	NZ	New Zealand
BJ	Benin	IE	Ireland	PL	Poland
BR	Brazil	IT	Italy	PT	Portugal
BY	Belarus	JP	Japan	RO	Romania
CA	Canada	KE	Kenya	RU	Russian Federation
CF	Central African Republic	KG	Kyrgyzstan	SD	Sudan
CG	Congo	KP	Democratic People's Republic of Korea	SE	Sweden
CH	Switzerland	KR	Republic of Korea	SI	Slovenia1
CI	Côte d'Ivoire	KZ	Kazakhstan	SK	Slovakia
CM	Cameroon	LI	Liechtenstein	SN	Senegal
CN	China	LK	Sri Lanka	TD	Chad
CS	Czechoslovakia	LU	Luxembourg	TG	Togo
CZ	Czech Republic	LV	Latvia	TJ	Tajikistan
DE	Germany	MC	Monaco	TT	Trinidad and Tobago
DK	Denmark	MD	Republic of Moldova	UA	Ukraine
ES	Spain	MG	Madagascar	US	United States of America
FI	Finland	ML	Mali	UZ	Uzbekistan
FR	France	MN	Mongolia	VN	Viet Nam

Implant for intervertebral space

The invention concerns an implant for the intervertebral space according to the preamble of patent claim 1. Such implants are principally intended to promote bone bridges on vertebral bodies and are put in place following resection of disks or intervertebral disks between the vertebral body and the spinal column.

It is known that if an intervertebral disk is damaged, it can be removed and the space thereby produced can be filled with cortico-spongiose bone.

With this method, the vertebral bodies are first spread as far apart from each other as possible using a spreader. One special technique consists of placing wedge-shaped pieces – so-called dilators – between the two vertebral bodies, to spread them in stepped fashion apart from each other. In turn, dilators with diameters that increase in each case by 1 mm are alternately inserted from the left and right from the posterior. After the greatest possible spreading has been achieved, the dilators are replaced by the above-mentioned cortico-spongiose bone.

This known technique has the disadvantage that the bone is difficult to manipulate and bring into the correct position, with corrections being nearly impossible. An additional disadvantage of this technique is that, in the intervertebral space, a rectangular or cylinder-shaped recess must be cut away or milled out in order to insert the bone implants between the initially concave sides of the adjoining vertebral bodies, which is complicated and also causes damage to the vertebral body.

It is the intention of invention to provide a remedy for this. The object of the invention is to provide an implant for the intervertebral space which, due to its specific shape and the method of

insertion, enables extremely stable locking between the vertebral bodies without damaging the surface of the bony cover plate of the vertebral body.

An additional object of the invention is to create an implant for the intervertebral space which can be put in without using dilators.

The invention achieves the object with an implant for the intervertebral space which exhibits the features of claim 1.

Additional advantageous embodiments of the invention are characterized in the dependent claims.

Since the implant according to the invention is equipped with a device for grasping using a tool, an external force can be exerted on it with relatively little effort, which makes it possible to move the implant after insertion or take it out again if necessary.

The device for grasping using a tool can be configured as attachment points, so that a rotational force and/or an axial force and/or a lateral force can be exerted on the implant.

In an advantageous embodiment, these attachment points are shaped at least in such as way as to allow for the exertion of rotational force on the implant, the implant in this case needing to have different cross-sectional lengths so that it can be squeezed to a greater or lesser extent as a result of the rotation of the implant or can even be placed absolutely loosely in its position, so that it can be inserted with no effort between the vertebral bodies, and have the required positional locking in another position.

In another embodiment, the body of the implant in one plane has a lens-shaped, cut-to-size profile which for the most part corresponds to the dual concave shape of the sagittal section surface of the intervertebral space. In this case, the same body in the other plane has principally parallel, flat or only slightly curved sides and a rounded end, so that it can be pressed into the intervertebral space without having to cut away an insert in the vertebral body, and without damaging the edge of the vertebral body.

The implant is preferably hollow, so that it can be filled with bone material.

To better explain the invention, several examples of advantageous embodiments (to which, however, the invention is not limited) are described in the following, with references to the appropriate drawings.

In the drawings:

Fig. 1 is a schematic representation of two vertebral bodies which have been spread out away from each other using two dilators;

Fig. 2 is a cross section along line II-II of Fig. 1, with a dilator being replaced by a small bone cuboid;

Fig. 3 is a perspective view of an implant according to the invention with a tool that can be used with it;

Fig. 4 is a view in the direction of arrow F4 of Fig. 3;

Fig. 5 is a view in the direction of arrow F5 of Fig. 3;

Fig. 6 is a cross section along line VI-VI in Fig. 4;

Fig. 7 is a schematic representation of the implant of Fig. 3 following insertion between two vertebral bodies;

Fig. 8 is a schematic representation of the implant of Fig. 3 following insertion between two vertebral bodies and rotation by 90°;

Fig. 9 is a schematic representation of an alternative embodiment of the invention with a tool that can be used with it;

Fig. 10 is a cross section through an implant according to the invention with one rounding;

Fig. 11 is a cross section through an implant according to the invention with two sides rounded across the diagonal;

Fig. 12 is a cross section through a pairwise arrangement of two mirror-symmetric implants according to the invention;

Fig. 13 is a schematic representation of pairwise arranged mirror-symmetric implants according to the invention with the aid of which the intervertebral disk space can be widened;

Fig. 14 is a schematic representation of two implants lying flat in the intervertebral disk space which are connected anteriorly by a third implant, before and after rotation into the concave area of the cover plates of the adjoining vertebral bodies;

Fig. 15 is a perspective view of an implant according to the invention with a longitudinal cut to admit spongy bone material or osteoconductive or osteoinductive material, and transverse perforation of the walls for bone growth;

Fig. 16 is a perspective view of an implant according to the invention with longitudinally toothed contact surfaces between implant and bone, the longitudinal toothing being configured such that rotation of the implant into the concave space of the cover plates is possible only in one direction;

Fig. 17 is a perspective view of an implant according to the invention with transversely toothed contact surfaces between implant and bone, the transverse toothing being configured such that one toothing prevents translational motion in the anterior direction, while the other toothing prevents translational motion in the posterior direction. The prevention of translational motion in the anterior direction results in the removal of pressure from the remaining annulus, which, according to the latest research, is innervated and may therefore react with pain signals to anterior pressure.

The invention and additional embodiments of the invention are described in the following in even greater detail using the partially schematic diagrams of numerous configurational examples.

Using Figs. 1 and 2, the known technique will first be described.

When an intervertebral disk is removed, as Fig. 1 shows, the two adjoining vertebral bodies 1 and 2 are spread as far away from each other as possible, so that dilators 3 can be inserted. After vertebral bodies 1 and 2 are at the desired distance, dilators 3, as shown in Fig. 2, are replaced by

the bone grafts 4. Following the cutting away of a recess in vertebral bodies 1and 2, these bone grafts 4 must be grafted between the vertebral bodies using a pressure element 5. It is evident that this technique has the disadvantages identified in the introduction to the description.

The implant according to the invention depicted in Figs. 3-6 overcomes these disadvantages, permitting it to be inserted quickly and, in addition, if necessary, enabling it to be locked between two vertebral bodies by applying force. The implant 6 essentially consists of a body 7 with a device 8 to allow grasping using a tool 9. The devices 8 for grasping using a tool 9 is so configured that rotational, axial and/or lateral force can be exerted on the implant 6, preferably in all directions.

Preferably, as depicted in Figs. 3-6, the devices 8 are configured such that at least a rotational force R can be exerted on it and, in connection with that, the implant is so configured that it has differing diameters or cross-sectional lengths, so that by turning at the cited devices 8, the body 7 of the implant 6 can be inserted between the vertebral bodies 1 and 2 at greater or lesser distances.

In the configuration in Figs. 3-6, the devices 8 consist of a recess made on the rear axial end 10 of implant 6, in the inner side of body 7. This recess enables a tool 9 to be inserted. As shown, the recess may consist of an axially many-sided (such as hexagonal) opening, it being necessary here to use a tool 9 that is equipped with a hexagonal end 11 in the form of a socket wrench.

The use of an opening made in the inner side for inserting a tool 9, i.e., the above-mentioned recess, offers the advantage that the implant 6 has no protruding disturbing parts.

Preferably, the body 7 has a particular shape with one or more of the following characteristics:

– the front axial end 12 of the body 7 should be configured to be rounded or wedge-shaped, since this facilitates insertion into the intervertebral space 25;

– the rounding 13 on the front axial end 12 of the body 7 preferably runs only along a cross section parallel to the smaller diameter D1 – see Fig. 4 – and not along the cross section that is at a right angle to it, as depicted in Fig. 5;

– the sides 14 and 15 through which the smaller diameter runs are preferably parallel and flat, except for the rounding 13;

– when viewed from the side, the body 7, as depicted in Fig. 5, has a rounded-off, lens-shaped profile, and thus a profile that matches the natural dual concave form possessed by an intervertebral space in the sagittal section. The transitions between the sides 14 and 15 and the sides 16 and 17 are rounded off;

– the sides 16 and 17 are preferably at least partially flat, and better if completely flat, along a cross section; the fact that the sides 17 and 18 are at least partially flat in a transverse direction offers the advantage that they offer stability against tilt in their locked-in state;

– the body 7 has one or more openings or recesses for filling with graft material; as per Figs. 3 to 6, a straight-through opening 18, extending from side 16 to side 17, is preferred; the opening 18 preferably consists of an elongated slit with parallel walls 19 and 20. The abovementioned recess 8 can extend to opening 18 if desired;

– the implant consists of titanium or a titanium alloy suitable for implants;

– the opening 18 or the slit in the body 7 of the implant of Fig. 3 can be made by drilling several vertical boreholes into the body 7 and milling away the intermediate walls;

– preferably, the implant 6, and more precisely the body 7, has a length L of about 22 mm and is hollowed out to an approximate wall thickness W1 of 1.5 mm. The rear axial end 10 with the device 8 preferably has a minimum diameter of 6 mm; to ensure that the minimum wall thickness W2 at the site of the device 8 and the thickness D of the tool is as large as possible, the abovementioned recess is made such that the alignment of its greater diameter coincides with the larger diameter of the body 7.

Figs. 7 and 8 will now be used in the following to describe the use and insertion of the implant 6 between vertebral bodies 1 and 2.

Fig. 7 shows how the implant 6, on the end of a corresponding tool 9 which resembles a wrench, can be inserted between the two vertebral bodies 1 and 2. The implant 6 is inserted with the smaller diameter D1 between the sides 22 and 23 of vertebral bodies 1 and 2 turned toward each other. Here it is already filled with bone graft material 24. In order to then insert the implant 6 between the vertebral bodies 1 and 2 so as to fit or lock, the wrench 21 of the tool 9 is rotated by 90°, so that after removal of the tool 9, a situation as depicted in Fig. 8 will result. Since the bone graft material 24 adjoins the vertebral bodies 1 and 2, the implant 6 can achieve a firm hold through growth of the bone graft 24.

The implant 6 can be inserted with no particular auxiliary aids. However, the procedure can be simplified if the vertebrae are previously spread apart by oval dilators on the left and right side and kept in this position until an implant 6 can be locked in place on the other side. Since the

presence of the implant 6 in turn prevents the vertebral surfaces from pressing together again, the last dilator can be removed and, if necessary, be replaced by a second implant 6. Normally, two implants 6 must be inserted.

Figs. 7 and 8 show clearly that, with the use of a rotatable implant 6 with different dimensions D1 and D2, it can be inserted between vertebral bodies 1and 2 freely and without difficulty. In addition, it can be brought to a perfect stopping position between the two vertebral bodies by being turned. Therefore, it is not necessary to cut out or mill out the intervertebral space 25 in order to obtain a rectangular or cylinder-shaped recess.

Since the body 7 of the implant 6 has different diameters D1 and D2, it is easy to remove from the intervertebral space 25. It is clear that, following locking in, the implant 6 can be loosened by turning it in the opposite direction, until the smaller diameter D1 is between the vertebral bodies 1 and 2.

If an implant 6 is used that has a body 7 possessing a shape that matches the natural dual concave shape of intervertebral space 25, a perfect fit is automatically achieved between the sides 22 and 23 of the vertebral bodies 1 and 2 and the sides 16 and 17 of the implant 6, which is grafted with bone grafts 24.

The technique of turning implant 6 has the following advantages:

– if the cover plates are concave-arched, then rotation allows for the possibility of configuring the implant 6 such that it is flat in one dimension and matches the geometry of the cover plates in

the other dimension. The flat dimension facilitates insertion from the posterior direction; the arched surface affords optimal contact with the cover plates;

– if the cover plates are flat, then rotation can be used to widen the intervertebral disk space;

– transverse toothing of the surface of the implant is possible, since the implant is turned only after insertion.

Naturally, the implant 6 can be designed in various shapes. In place of a recess for a hex socket wrench, other recess shapes can be used, which may, for example, have rectangular, square or oval openings.

Although the devices 8 for grasping using a tool 9 are preferably mounted in the inner side of the implant 4, this is not absolutely required. They can also consist of a projecting piece or of a particular configuration of the rear axial end 10, so that the projecting piece or the rear axial end 10 can be attached to a suitable tool, so that the required force can be exerted.

According to another embodiment of the invention, the devices 8 are not exclusively designed to allow rotational force to be applied, but rather also axial force. Indeed, both a compressive and a tensile force can be exerted, so that, if necessary, the implant 6, when being inserted between the vertebral bodies 1 and 2, can be pressed in. If the need arises to withdraw it again, tensile force can be exerted. Thus, it is possible to remove the implant 6 again during the operation at any time.

Such an embodiment is depicted by Fig. 9. The devices 8 combine a first attachment element 26, which permits exertion of rotational force, with a second attachment element 27, which allows

for the exertion of axial compression and tensile force on the implant 8, and for this purpose it is equipped with an axial stop.

The first attachment element 26 consists of a recess as in the embodiment shown in Fig. 3. The second attachment element 27 consists of an additional recess, such as in the form of a slit in the wall of the above-mentioned hexagonal 50 opening, into which the locking element 28 of the tool 9 in question can grip. As shown in Fig. 9, the locking elements 28 consist of balls or the like which, after the hexagonal end 11 of the respective tool 9 has been inserted into the hexagonal recess, press radially outwards and engage into the above-mentioned slit.

The tool 9 can have various shapes and be operated in various ways. According to Fig. 9, it is controlled by means of a shifter grip 29 combined with a wedge 30, which in turn presses the locking elements away from each other or loosens them.
In another variation, the wrench end is split. The exterior diameter can be increased by applying pressure or screwing an interior pin, so that the wrench can be locked into the opening of the implant 6 into which it is inserted.

According to another variation, attachment possibilities can also be provided for a tool 9 on the front axial end 12 with the rounding 13 of the implant 6. These attachment possibilities can be of different types and are preferably configured such that, just as with the devices 8, they allow for the application of rotational force, axial force and/or lateral force onto the implant 6. The attachment options consist of a many-sided (hexagonal, for example) opening, allowing insertion of a wrench with an appropriate end piece, so that torsional force can be exerted on the implant 6 if it has not grown sufficiently into place and must be removed in the abdominal direction. This

invention naturally also concerns to implants 6, that are equipped at one end with an attachment device that enables attachment of the implants in the abdominal direction.

Figs. 10 and 11 show implants according to the invention having a partially rounded cross section.

Fig. 10 shows the body 7 of an implant 6, with a rounding 31 on the upper edge of the front axial end 12. The radius of the rounding 31 on one side is measured in such a way that a) the difference between the larger side of the rectangular cross section and the diagonal via the rounded edge is less than 3 mm, preferably 1-2 mm; and b) the smaller surface is reduced by less than half, and preferably by less than a third, i.e., the supporting surface should correspond to at least 2/3 of the overall width of the implant.

Fig. 11 shows the body 7 of the implant 6 in cross section, with the implant having roundings 23 across the diagonal on each side in cross section. The radii of the opposite roundings 32 are measured in such a way that a) the difference between the longer side of the cross section and the diagonal across the rounded edges is less than 3 mm, preferably 0.5-1.0 mm; and b) the shorter side of the implant is reduced by less than half, and preferably by less than a third.

Fig. 12 shows two pairs of implants 6, symmetrically placed along the axis of symmetry 33. The upper pair of implants 6 in section (a) is depicted as per Fig. 10, while the lower pair of implants 6 in section (b) is depicted as per Fig. 11.

When erecting (rotating) an implant 6 as shown in Fig. 6, the intervertebral space 25 is overstretched by about 3-4 mm, which can cause the cover plates to break and can lead to

permanent overstretching of the connective tissue. If the edges are rounded (31, 32), overstretching is greatly reduced, but this reduces the stability of the straightened implants. Or, the paired implants are arranged to be mirror-symmetric in order to mutually stabilize each other (see Fig. 13).

Erection using two implants 6 which have roundings 31 and 32 results, with suitably selected radii, in overstretching of the intervertebral space by only 1 mm. However, the individually set up implants 6 are not all that stable; they can tilt back as easily as they were erected. In Fig. 13, the two implants 6 are mutually protected from tilting by their mirror-symmetric geometry, since the implants 6 can tip only as a pair and not individually.

Fig. 13 shows two mirror-symmetrically arranged implants 6 in accordance with Fig. 11. The roundings 32 of the bodies 7 lie symmetrically against each other. Following insertion, the bodies 7 of the implants 6 lie horizontally between the vertebral bodies 1 and 2. They can then be rotated using a suitable tool 9 by 90° into the position 7', drawn in black, in order to expand the intervertebral space 25. The rectangular cross section of the bodies 7 is created in such a way that, following rotation of the implant 6 by 90° into the concave space of the cover plates of the adjoining vertebral bodies 1 and 2, there is a residual widening of the intervertebral space 25 of between 1 and 4 mm, preferably between 2 and 3 mm.

Fig. 14 shows two implants 6 lying flat in the intervertebral space 25 (plane of the drawing). These are linked in anterior fashion with each other by a connector 34. The left side of Fig.14 depicts the position before rotation of the implants 6. The right side of Fig. 14 shows the

placement after rotation by 90° into the concave area of the cover plates of adjoining vertebral bodies.

The posterior end of the implants 6 remains free and is linked only by the connector 34 in anterior fashion, so that (a) the distance between the right and left implant 6 and the orientation thereof with respect to each other is kept in place, (b) the implants 6 are able to be turned about their longitudinal axis 35, and (c) the two implants 6 can be coupled prior to implantation and/or in situ using the connector 34.

Fig. 15 shows an implant 6 with a longitudinal cutout 35 to admit spongy bone material or osteoconductive or osteoinductive material. It also has transverse perforations 36 of its walls for bone growth. Preferably, the diameter of the perforations 36 is designed in such a way that (a) cancellous bone pressed into the longitudinal cutout 36 does not escape from the sides, and (b) upon filling implant 6, the fluid contained in the cancellous bone is able to escape out the sides and then diffuse back following implantation in order to effect a postoperative swelling of the cancellous bone; and (c), bone can grow into the implant (6) through the perforations 37.

Fig. 16 shows an implant 6 whose contact surfaces between the implant 6 and the bone are equipped with a longitudinal toothing 38. The longitudinal toothing 38 is preferably configured in such a way that rotating the implant 6 into the concave space of the cover plates is possible only in one direction, as indicated by the arrows 39, 40.

Fig. 17 shows an implant 6 whose contact surfaces between the implant 6 and the bone are equipped with a transverse toothing 41. Preferably, the transverse toothing 41 is configured in such a way that it prevents the one contact surface from making translational motion in the

anterior direction, while it prevents the other contact surface from making a translational motion in the posterior direction, as shown by the arrows 42, 43. Prevention of translation in the anterior direction causes a removal of pressure on the remaining annulus which, according to the latest research, is innervated, and therefore could react with pain signals to anterior pressure.

In no way is this invention limited to the examples given and the models depicted in the illustrations; such dilators and the accompanying tool can take various shapes and sizes without falling outside of the scope of the definitions that are given in the enclosed abstract.

Patent claims

1. Implant (6) for an intervertebral space (25), characterized in that it comprises a substantially cuboid-shaped body (7) with a device (8) for gripping by a tool (9).

2. Implant according to claim 1, characterized in that the device (8) is such that it enables the exertion of rotational force onto the implant (6).

3. Implant according to claim 1 or 2, characterized in that the device (8) comprises at least one recess provided in the inner side of the body (7) into which the preferably wrench-like tool can be inserted.

4. Implant according to claim 3, characterized in that the recess comprises an interior hexagon provided in the inner side of the body (7).

5. Implant according to one of claims 1 to 4, characterized in that the device (8) is embodied so as to enable application of an axial, compressive or tensile force on the implant (6).

6. Implant according to one of claims 1 to 5, characterized in that it has a device (8) in the form of an inner recess for admitting a tool (9) and that two attachment elements (27) are provided in the recess that provide axial locking for the tool (9).

7. Implant according to one of claims 1 to 6, characterized in that the device (8) is embodied such that at least the application of lateral force on the implant (6) is possible.

8. Implant according to one of claims 1 to 7, characterized in that it has different diameters (D1, D2).

9. Implant according to claim 8, characterized in that the sides (14 and 15) between which the smaller diameter extends (D1) are predominantly parallel and flat.

10. Implant according to claim 8 or 9, characterized in that the implant (6) has a rounded-off, lens-shaped profile on the longitudinal section of the larger diameter (D2).

11. Implant according to claim 10, characterized in that the sides (15, 16) that enclose the rounded-off, lens-shaped profile are at least partially flat in the direction transverse to the implant (6).

12. Implant according to one of claims 1 to 11, characterized in that at least one of its axial ends (10; 12) is rounded off.

13. Implant according to one of claims 1 to 12, characterized in that the body (7) has one or more openings (18) for filling with grafting material (24), the openings being applied such that the grafting material (24) touches the vertebral bodies (1, 2) in the final position of the implant (6).

14. Implant according to one of claims 1 to 13, characterized in that the implant (6) is provided with a through hole (18) having the shape of an elongated groove with parallel walls (19, 20).

15. Implant according to one of claims 1 to 14, characterized in that it is provided at two of its ends with devices (8, 26).

16. Implant according to one of claims 1 to 15, characterized in that it is composed of titanium or a titanium alloy.

17. Implant according to one of claims 1 to 16, characterized in that it has a rectangular cross section with a rounding (31) on one side.

18. Implant according to claim 17, characterized in that the radius of the rounding (31) on one side is dimensioned such that

a) the difference between the longer side of the rectangular cross section and the diagonal across the rounded edge is less than 3 mm, preferably 1-2 mm;

and

(b) the contact surface to the bone is reduced by less than half, preferably less than one-third by the rounding (31).

19. Implant according to one of claims 1 to 18, characterized in that it has a rectangular cross section with a double-sided rounding (32) over the diagonal.

20. Implant according to claim 19, characterized in that the radii of the double-sided roundings (32) are dimensioned such that

a) the difference between the larger side of the cross section and the diagonal over the rounded-off edges is less than 3 mm, preferably 0.5 - 1.0 mm, and

b) the smaller surface of the implant is reduced by half, preferably less than one-fourth.

21. Implant according to claim 19 or 20, characterized in that it is embodied such that, when such implants are arranged in pairs, their rounded-off edges lie symmetrically against each other.

22. Implant according to one of claims 19 to 21, characterized in that it has a rectangular cross section which is such that, after rotation of the implant into the concavity of the cover

plates of the adjacent vertebral bodies, a widening of the intervertebral space (25) remains between 1 and 4 mm, preferably between 2-3 mm.

23. Implant according to one of claims 19 to 21, characterized in that it has a rectangular cross section that is reduced to a square and that, after rotation of the implant into the concavity of the end plates of the adjacent vertebral bodies, no widening of the intervertebral space (25) remains.

24. Implant according to one of claims 19 to 22, characterized in that the posterior end of the implant (6) is such that a left and a right implant can be connected using a connector (34) in anterior fashion such that

(a) the distance between the left and right implant (6) and the orientation thereof is maintained;

(b) the implants (6) can be rotated about their longitudinal axis (35); and

(c) the two implants (6) can be coupled using the connector (34) before implantation and/or in situ.

25. Implant according to one of claims 19 to 22, characterized in that it is such that it can be interlocked with a second implant (6) before implantation thereof or in situ, wherein the connection

(a) maintains the distance and the angle between the implants (6); and

(b) permits a rotation of the implants (6) about their longitudinal axis (35) into the concavity of the cover plates of the adjacent vertebral bodies (1, 2).

26. Implant according to one of claims 19 to 22, characterized in that it is such that, after being rotated about its longitudinal axis (35) into the concavity of the cover plates, it can be connected medially via another implant in a locking manner.

27. Implant according to one of claims 19 to 26, characterized in that it is coated on its surface, preferably with hydroxylapatite or titanium plasma.

28. Implant according to one of claims 13, 14 and one of claims 19 to 27, characterized in that it has perforated walls, wherein the perforations (37) are preferably in the manner of holes and the diameter of the holes is such that

(a) cancellous bone pressed into the longitudinal opening does not emerge from the sides, and

(b) the liquid contained in the cancellous bone upon stuffing of the implants is able to emerge from the sides and diffuse back after implantation in order to effect postoperative swelling of the cancellous bone; and

(c) bone is able to grow through the perforation into the implant.

29. Implant according to one of claims 19 to 28, characterized in that one contact surface between implant and bone has toothing in the longitudinal direction of the implant.

30. Implant according to one of claims 19 to 28, characterized in that both contact surfaces between implant and bone have toothing in the longitudinal direction of the implant.

31. Implant according to one of claims 29 or 30, characterized in that the geometry of the toothing permits rotation of the implant in one direction and prevents rotation in the other direction.

32. Implant according to one of claims 19 to 28, characterized in that one contact surface between implant and bone has transverse toothing.

33. Implant according to one of claims 19 to 28, characterized in that both contact surfaces between implant and bone have transverse toothing.

34. Implant according to one of claims 32 or 33, characterized in that the geometry of the toothing prevents movement of the implant in the anterior direction.

35. Implant according to one of claims 32 or 33, characterized in that the geometry of the toothing prevents movement of the implant in the posterior direction.

36. Implant according to claim 32, characterized in that the geometry of the toothing of both contact surfaces between implant and bone is such that one toothing prevents movement of the implant in the anterior direction and the other prevents movement in the posterior direction.

37. Implant according to one of claims 29 or 32, characterized in that it has longitudinal toothing on one contact surface and on the other contact surface.

38. Implant according to one of claims 32 to 35 or 37, characterized in that the transverse toothing of the individual contact surfaces is such that movement in the posterior and anterior direction is prevented.

39. Implant according to one of claims 13, 14 and one of claims 17 to 19 and 29 to 38, characterized in that the walls (19) and (20) have transverse slits.

40. Implant according to claim 39, characterized in that the hollow spaces and slits are filled with an osteoconductive or osteoinductive material, preferably hydroxyapatite, so that the bone is able to grow in from the cover plates of the adjacent vertebral body and from the side.

41. Implant for the intervertebral space (25), with

a) a substantially cuboid structure with the edge lengths a, b, c;

b) a front axial end surface (12) and a rear axial end surface (10) through which the longitudinal axis (35) passes;

c) two side surfaces (14, 15) through which a transverse axis (44) passes; and

d) an upper surface (16) and a lower surface (17) through which a transverse axis (45) passes;

characterized in that

e) the implant (6) has a device (8) for gripping by a tool (9); and

f) the front axial end surface (12) and/or the rear axial end surface (10) are rectangular.

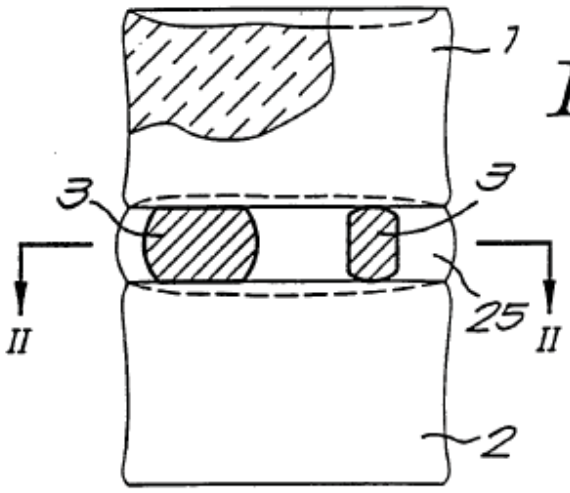


Fig.1

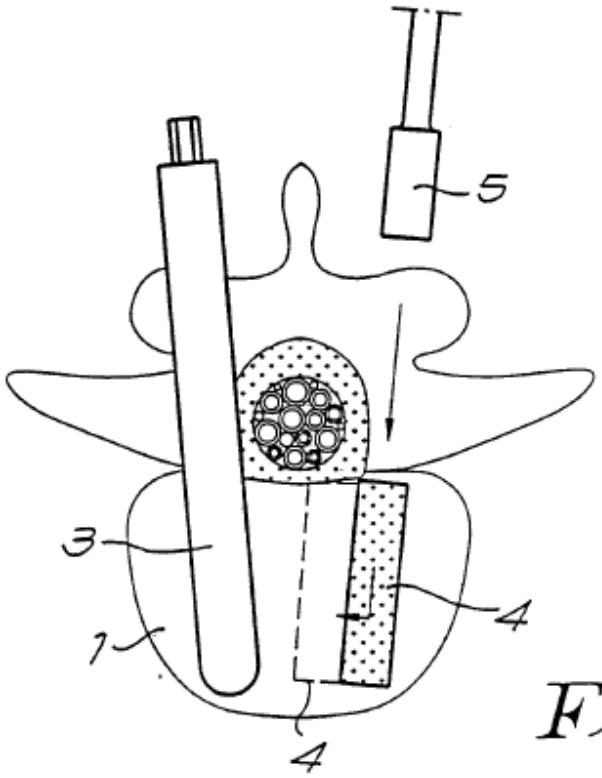


Fig. 2

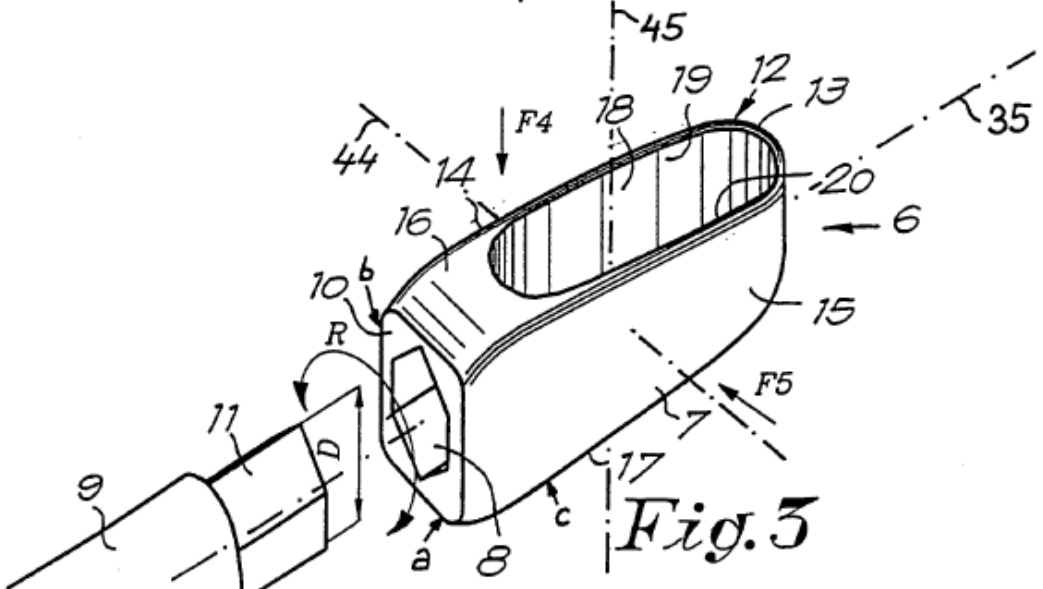


Fig. 3

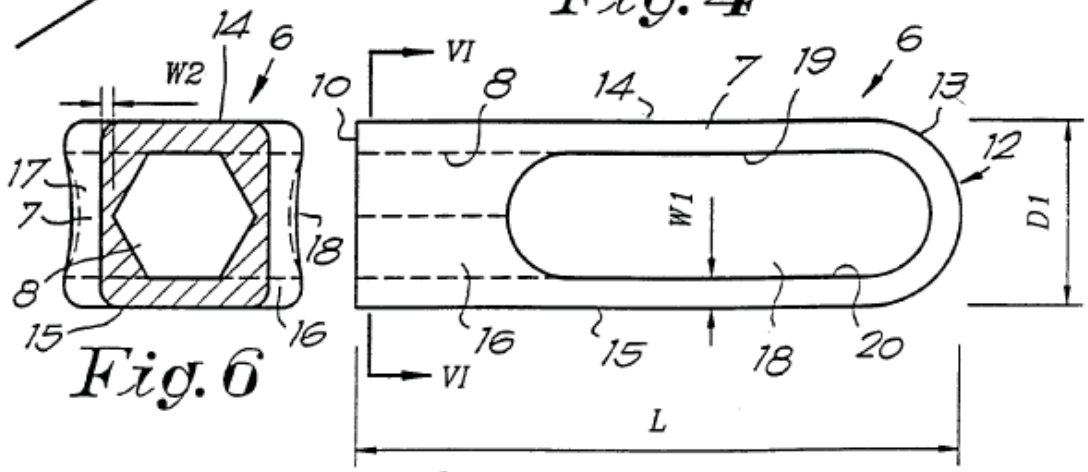


Fig. 6

Fig. 4

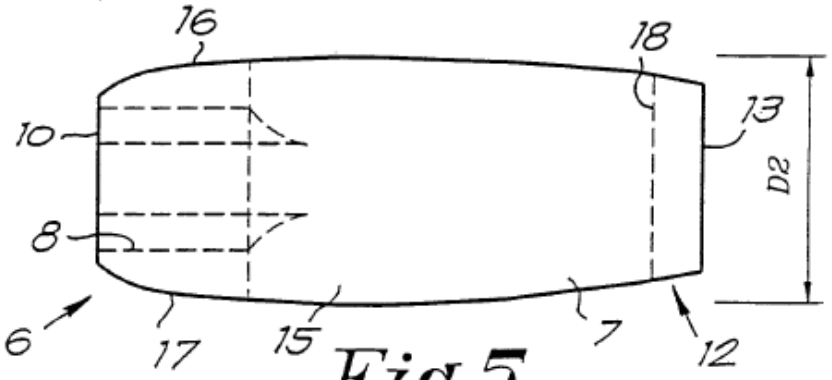


Fig. 5

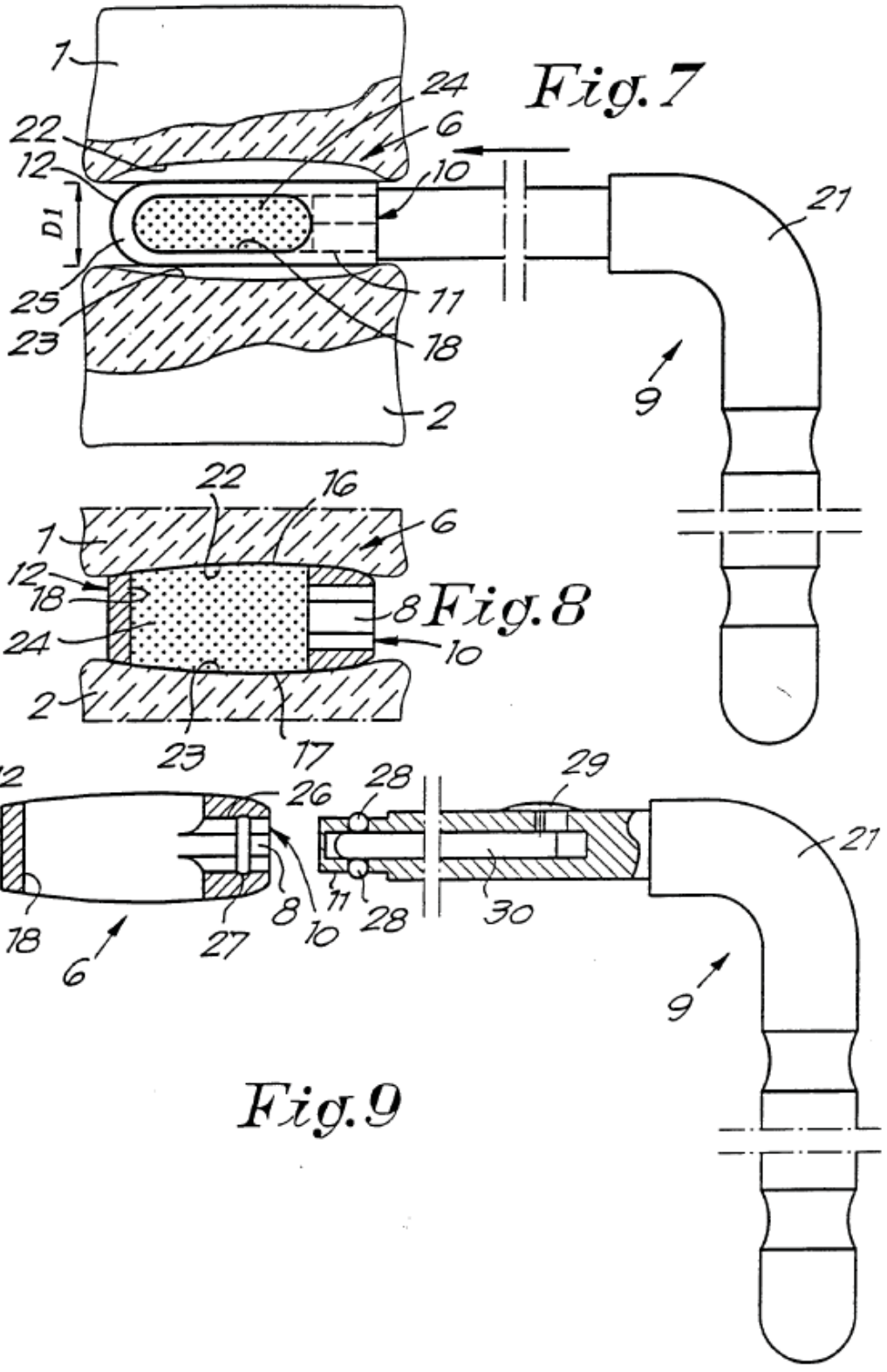


Fig.7

Fig.8

Fig.9

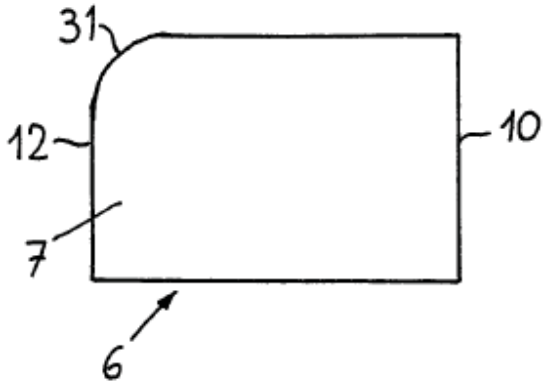


Fig. 10

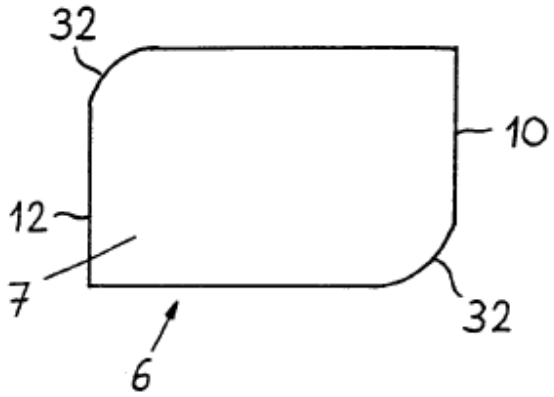


Fig. 11

5/7

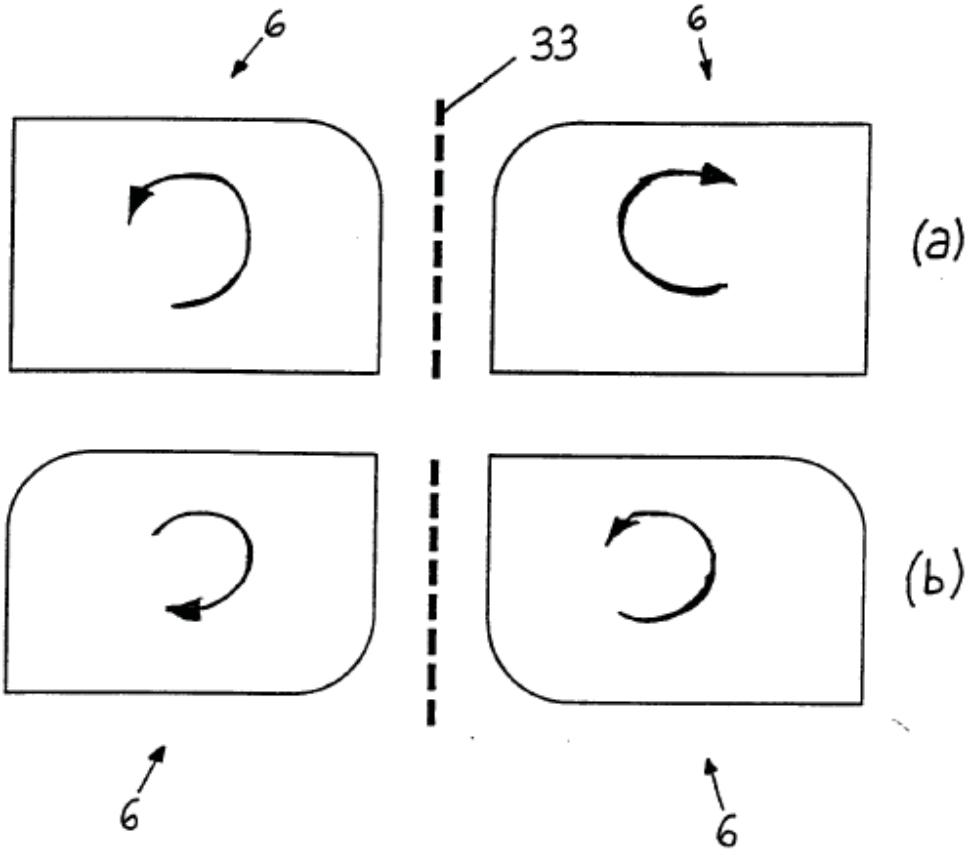


Fig. 12

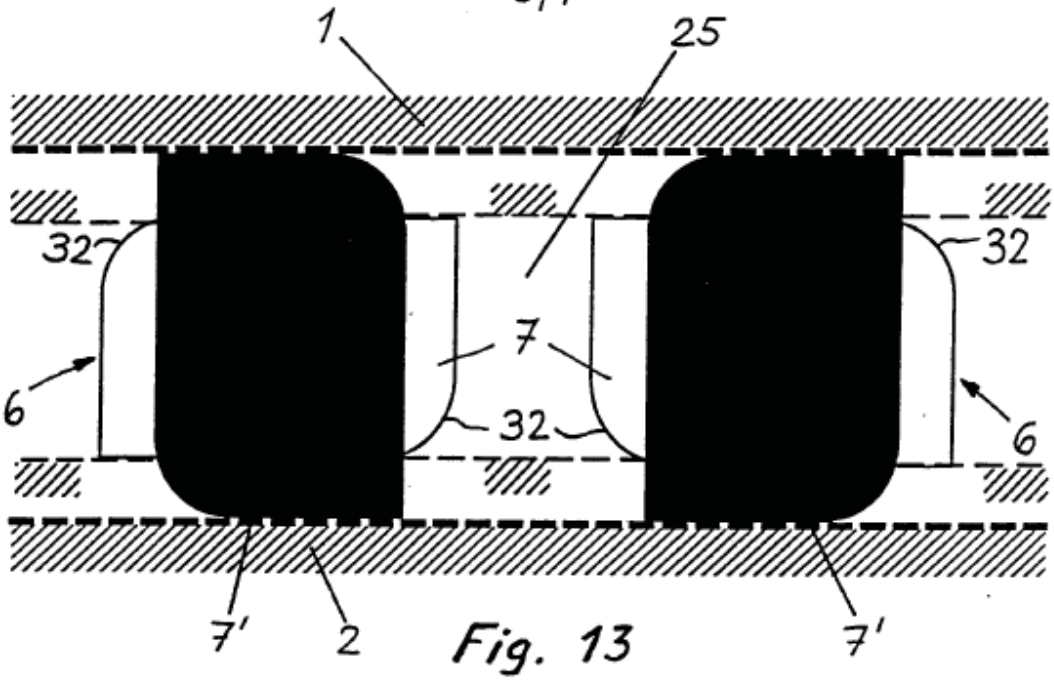


Fig. 13

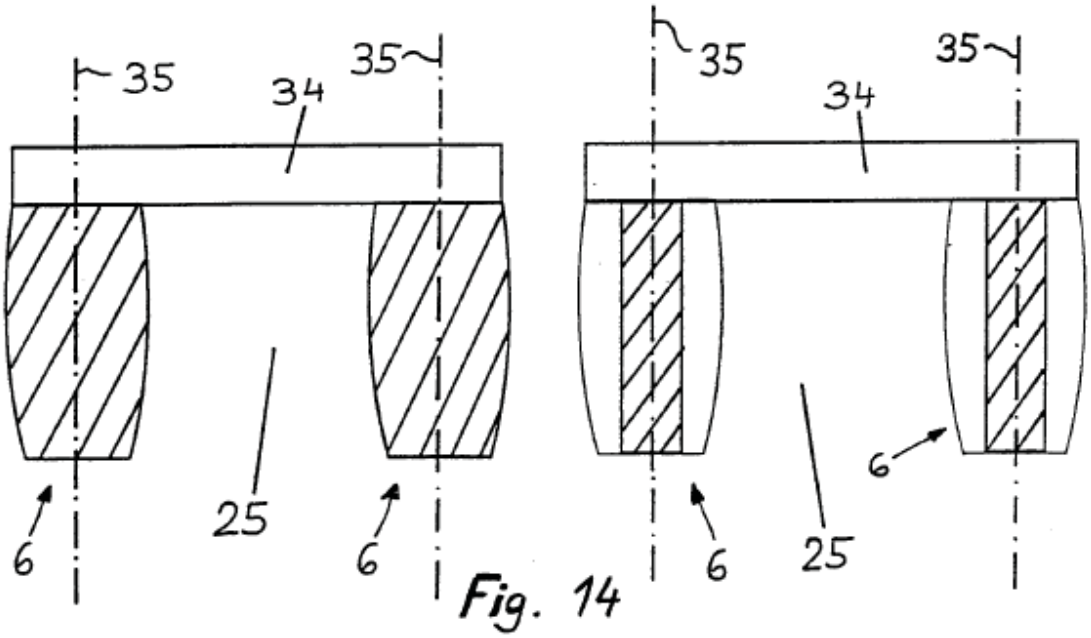


Fig. 14

7/7

Fig. 15

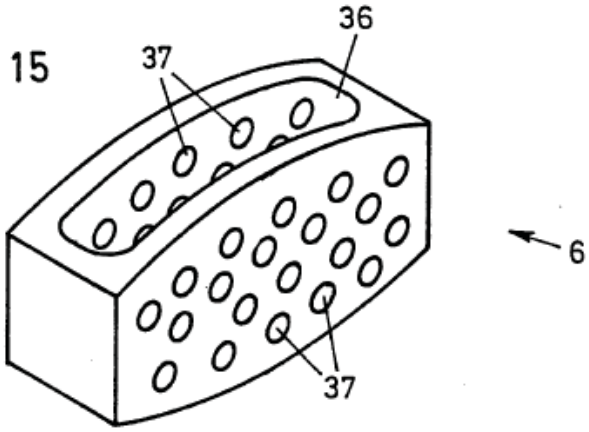


Fig. 16

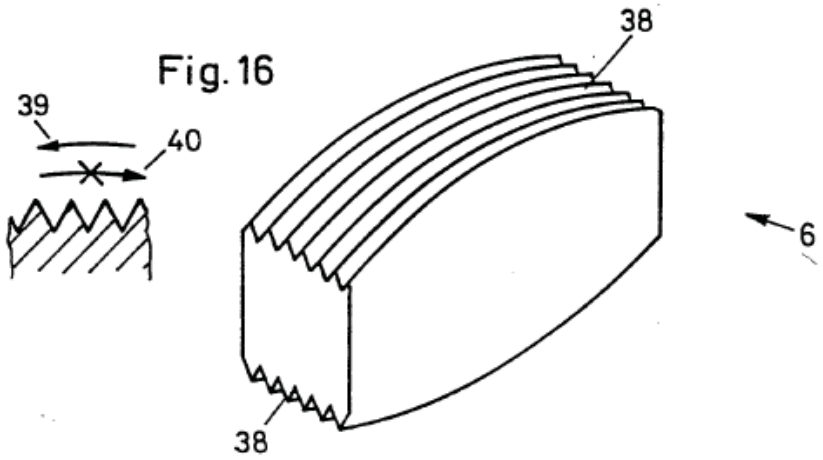
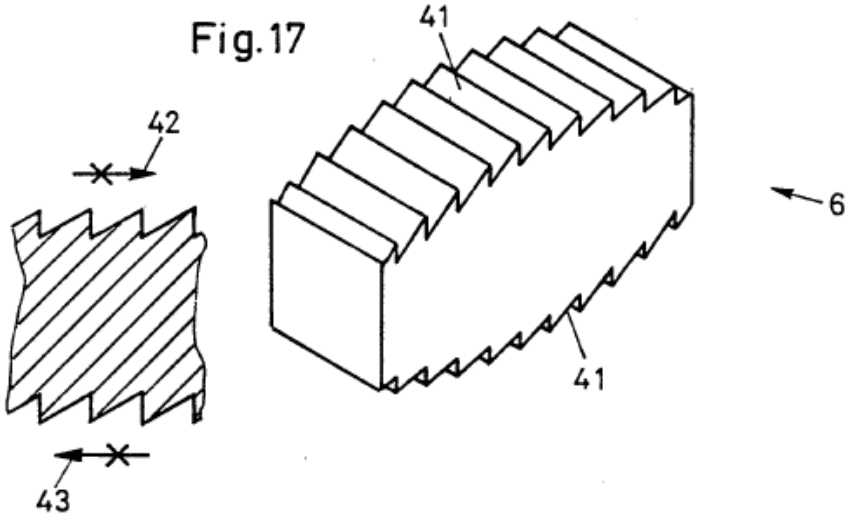


Fig. 17



REPLACEMENT SHEET