PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:
F16D 65/12	A1	WO 92/11474
		(43) International Publication Date: 9 July 1992 (09.07.92)

(21) International Application Number: PCT/SE91/00861

(22) International Filing Date: 13 December 1991 (13.12.91)

(30) Priority data:
9004021-3 17 December 1990 (17.12.90) SE

(71) Applicant *(for all designated States except US)*: AB VOLVO [SE/SE]; S-405 08 Göteborg (SE).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)* : BODIN, Jan-Olof [SE/SE]; Hultebackavägen 94, S-441 65 Alingsås (SE). DAGH, Ingemar [SE/SE]; Halmgatan 9, S-422 47 Hisingsbacka (SE).

(74) Agents: KIERKEGAARD, Lars-Olov et al.; H. Albihns Patentbyrå AB, Box 3137, S-103 62 Stockholm (SE).

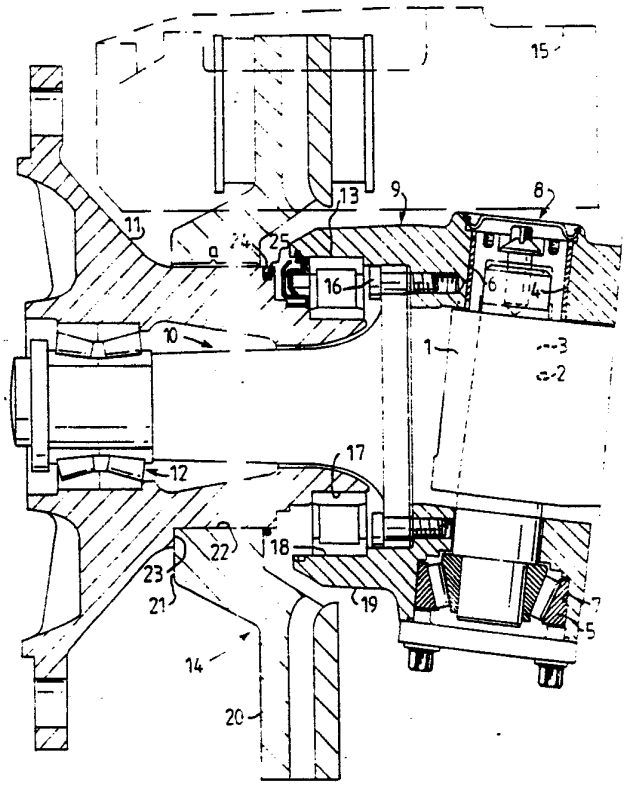
(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), MC (European patent), NL (European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

Published
With international search report.
In English translation (filed in Swedish).

(54) Title: NON-CIRCULAR OUTWARDLY CROSS-SECTION OF A WHEEL HUB WITH DISK BRAKE

(57) Abstract

Wheel hub (11) and disk brake (14, 15) device for a vehicle wheel. The wheel hub has a portion (a) with a polygonal exterior cross-sectional profile and the disk brake (14) has a central aperture (22) with a corresponding shape for non-rotational locking of the disk brake onto the hub.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	**ES**	Spain	**MG**	Madagascar
AU	Australia	**FI**	Finland	**ML**	Mali
BB	Barbados	**FR**	France	**MN**	Mongolia
BE	Belgium	**GA**	Gabon	**MR**	Mauritania
BF	Burkina Faso	**GB**	United Kingdom	**MW**	Malawi
BG	Bulgaria	**GN**	Guinea	**NL**	Netherlands
BJ	Benin	**GR**	Greece	**NO**	Norway
BR	Brazil	**HU**	Hungary	**PL**	Poland
CA	Canada	**IT**	Italy	**RO**	Romania
CF	Central African Republic	**JP**	Japan	**SD**	Sudan
CG	Congo	**KP**	Democratic People's Republic of Korea	**SE**	Sweden
CH	Switzerland			**SN**	Senegal
CI	Côte d'Ivoire	**KR**	Republic of Korea	**SU+**	Soviet Union
CM	Cameroon	**LI**	Liechtenstein	**TD**	Chad
CS	Czechoslovakia	**LK**	Sri Lanka	**TG**	Togo
DE*	Germany	**LU**	Luxembourg	**US**	United States of America
DK	Denmark	**MC**	Monaco		

+ Any designation of "SU" has effect in the Russian Federation. It is not yet known whether any such designation has effect in other States of the former Soviet Union.

NON-CIRCULAR OUTWARDLY CROSS-SECTION OF A WHEEL HUB WITH DISK BRAKE

The present invention relates to a wheel hub and disk brake device for a vehicle wheel, comprising a carrier with means supporting the brake yoke, an axel portion joined to the carrier, on which axel portion a wheel hub is rotatably mounted and a brake disk non-rotatably joined to the wheel hub.

Brake disks for disk brakes have up to now been fixed to the hub in essentially two ways, namely either by being made in one piece with the hub or by being screwed securely to a circular flange on the hub. The former method is in principle limited to brakes in lighter vehicles while the latter method is used in vehicles of intermediate weight as well, e.g. trucks up to about 16 tons. In the heaviest truck class, drum brakes have been used almost exclusively in part because the very high maximum brake torques about (20,000 Nm) in combination with the application of the braking force by the brake pads creates problems. Firstly, the extreme heating of the brake disk to the extreme braking force causes the disk, due to its rigid connection to the hub, to have a tendancy to ware or tilt and this affects its orientation relative to the brake yoke and secondly the force on the disk results in deformation of the steering knuckle, which also affects the orientation of the brake disk relative to the brake yoke. Both of these factors contribute to stresses on the disk and uneven wear on the disk and pads. With conventional attachment of the brake disk to the steering knuckle, the deformation of the steering knuckle in heavy vehicles which can occur when taking a curve can result in such misalignment between the disk and the brake yoke that wear occurs. The purpose of the present invention is to provide a wheel hub and disk brake device where the brake disk is fixed to the hub in such a way that tilting due to heating and misalignment relative to the brake yoke when

taking curves for example can be eliminated.

This is achieved according to the invention by virtue of the fact that the wheel hub has a portion with an external, non-circular cross-sectional profile and that the brake disk carried by the wheel hub at the portion has a central aperture with a form adapted to said non-circular cross-section for non-rotating locking of the brake disk unto the hub.

Such shape locking of the brake disk permits, on the one hand, the disk to expand radially without tilting or "warping" and, on the other hand, to adapt its alignment to the brake yoke upon deformation of the knuckle with accompanying misalignment of the brake yoke.

The arrangement according to the invention makes it possible to use disk brakes in the heaviest class of vehicles.

Form locking according to the invention can, however, due to the braking force and the shape of the non-circular cross-section, result in subjecting the disk hub to extreme bursting forces. There must therefore be sufficient material mass in the disk hub to absorb the bursting forces arising. Normally wheel hubs of the type in question are mounted on their axel shafts in distal and proximal bearings which are arranged between the axel shaft and the inner surface of the hub. The outer diameter of the proximal bearing determines the smallest inner diameter of the hub and thus the inner diameter of the disk hub as well.

In a preferred embodiment of the device according to the invention, the proximal bearing is disposed between an external bearing support surface on the hub and an internal bearing support surface on an angular flange

joined to the knuckle unit. Such a solution means that it is the inner diameter of the proximal bearing instead of its outer diameter which determines the minimum inner diameter of the hub and this means that the amount of material in the disk hub will increase substantially in relation to conventional hub mountings. This also permits cross-sectional profiles which eliminate the risk of the disk hub jamming onto the wheel hub at the same time as sufficient strength is achieved as regards radial forces.

The invention will be described in more detail with reference to the accompanying drawings which show examples. Fig. 1 shows a schematic prospective view of one embodiment of a steering knuckle arrangement according to the invention, Fig. 2 shows a longitudinal section through a steering knuckle arrangement corresponding to that in Fig. 1 and Figs. 3a-e show different cross-sectional shapes of a part of the hub portion and a central aperture in a brake disk.

In Figs. 1 and 2, 1 designates a distal end of a fixed front axel of a truck. The end of the axel has a conical bore 2 in which a king pin 3 is fixed. The king pin 3 has at its upper lower ends bearings 4 and 5 which are housed in upper and lower bores 6 and 7 respectively in a steering knuckle with a general designation 8, the steering knuckle shown comprises a knuckle unit 9 and an axel shaft unit 10, on which a wheel hub 11 is mounted in distal and proximal bearings 12 and 13 respectively. The hub supports a brake disk 14 and the knuckle unit 9 supports a brake yoke 15 which straddles the disk.

As can be seen in Fig. 2, the knuckle unit 9 and the axel shaft unit 10 are two separate components which are screwed together with screws 16. The knuckle unit 9 is preferably cast, while the axial shaft is forged to

provide the required strength characteristics of the two units with optimum manufacturing methods.

The hub 11 is mounted on the axel shaft unit 10 in a distal bearing 12 comprising two taper roller bearings and in an proximal bearing 13 consisting of a cylindrical roller bearing. This bearing 13 is disposed between an exterior bearing surface 17 on the hub 11 and an interior bearing surface 18 which is machined in a flange 19 cover which is cast in one piece with the knuckle unit 9. As can be seen in the figure, it is possible to dimension the hub 11 with a smaller external diameter in this type of mounting than in the conventional type described by way of introduction.

Instead of fixing a brake disk in the conventional manner to a wheel hub by screwing the disk to a flange on the hub, the disk in the embodiment according to the invention is joined to the hub by form locking. For this purpose the hub has a central portion "a" which has a non-circular cross-section. Figs. 3a-e show a number of possible cross-sectional shapes for the portion "a", which can be characterized as polygons with "rounded corners". The brake disk 14, which consists of a disk portion 20 with friction surfaces and an inner hub portion 21, which has a central aperture 22 with the same shape as the cross-section of the portion "a" and is adapted thereto so that there is a slide fit between the disk hub and the wheel hub. The movement of the disk 14 axially is limited on one side by an abutment surface 23 and on the other side by a lock ring 24 in a groove 25.

The bearing arrangement shown in Fig. 2 permits, with such a form lock of the disk, a greater amount of material in the radial dimension of the wheel hub and the disk and thus greater strength in the connection

than in a conventional bearing arrangement. This also permits a greater difference between the maximum and minimum radii r_1 and r_2 respectively, reducing the risk of the disk jamming fast onto the hub when the disk cools off after braking. Figs. 3a-c show embodiments of the polygon cross-section with a relatively large difference between the maximum and minimum radii. The shapes thereof are such that there is no risk for freezing or jamming but they presuppose the proximal bearing arrangement shown in Fig. 2.

Figs. 3d-e show polygon shapes with a smaller radius difference, which could be used in a conventional proximal bearing of the wheel hub, but with greater risk for jamming under exceptional braking torque and heating.

In Fig. 2, the disk 14 is mounted without any axial play, in an embodiment not shown in more detail here, the disk can be disposed with a certain amount of play between it and the abutment surface 23 and/or the lock ring 24. By mounting a thrust spring in the gap, there is provided greater freedom for axial adjustment at the same time as the risk of knocking is eliminated.

Claims

1. Wheel hub and disk brake device for a vehicle wheel, comprising a carrier with means supporting a brake yoke, an axel portion joined to the carrier, on which axel portion a wheel hub is rotatably mounted and a brake disk non-rotatably joined to the wheel hub, c h a r a c t e r i z e d in that the wheel hub (11) has a portion (a) with a non-circular exterior cross-sectional profile and that a brake disk (14) carried by the wheel hub at that portion has a central aperture (22) with a form adapted to said non-circular cross-section for non-rotational locking of the brake disk unto the hub.

2. Device according to claim 1, c h a r a c - t e r i z e d in that the central aperture (22) has the same shape as said hub cross-section and is so adapted thereto that there is a slide fit between the disk (14) and the hub (11).

3. Device according to claim 1 or 2, c h a r a c - t e r i z e d in that the axial movement of the disk (14) is limited on one side of the disk by an abutment surface (23) on the hub (11) and, on the other side of the disk, by a lock-ring (25) held in a groove (24) in the hub.

4. Device according to claim 3, c h a r a c - t e r i z e d in that there is play between at least the abutment surface (23) and said one-side of the disk (14) and that a thrust spring element is place between the abutment surface and the disk.

5. Device according to one of claims 1-4, c h a r a c - t e r i z e d in that the wheel hub (11) is mounted in axially distal (12) and proximal (13) anti-friction

bearings of which the proximal bearing (13) is disposed between an external bearing support surface (17) on the hub and an internal bearing support surface (18) on an annular flange (19) joined to carrier (9).

6. Steering knuckle device according to one of claims 1-5, c h a r a c t e r i z e d in that said non-circular cross-section (a) has the shape of a polygon with rounded corners (Fig. 5).

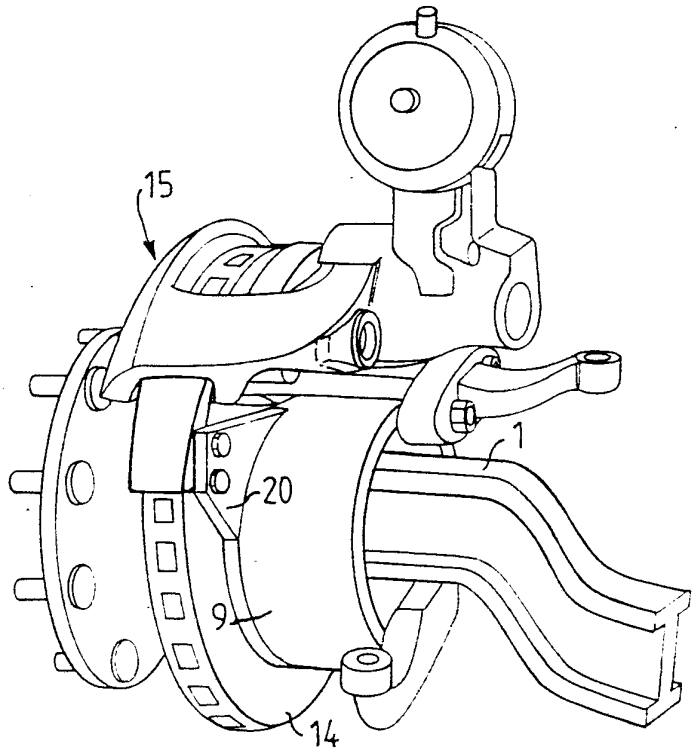


FIG.1

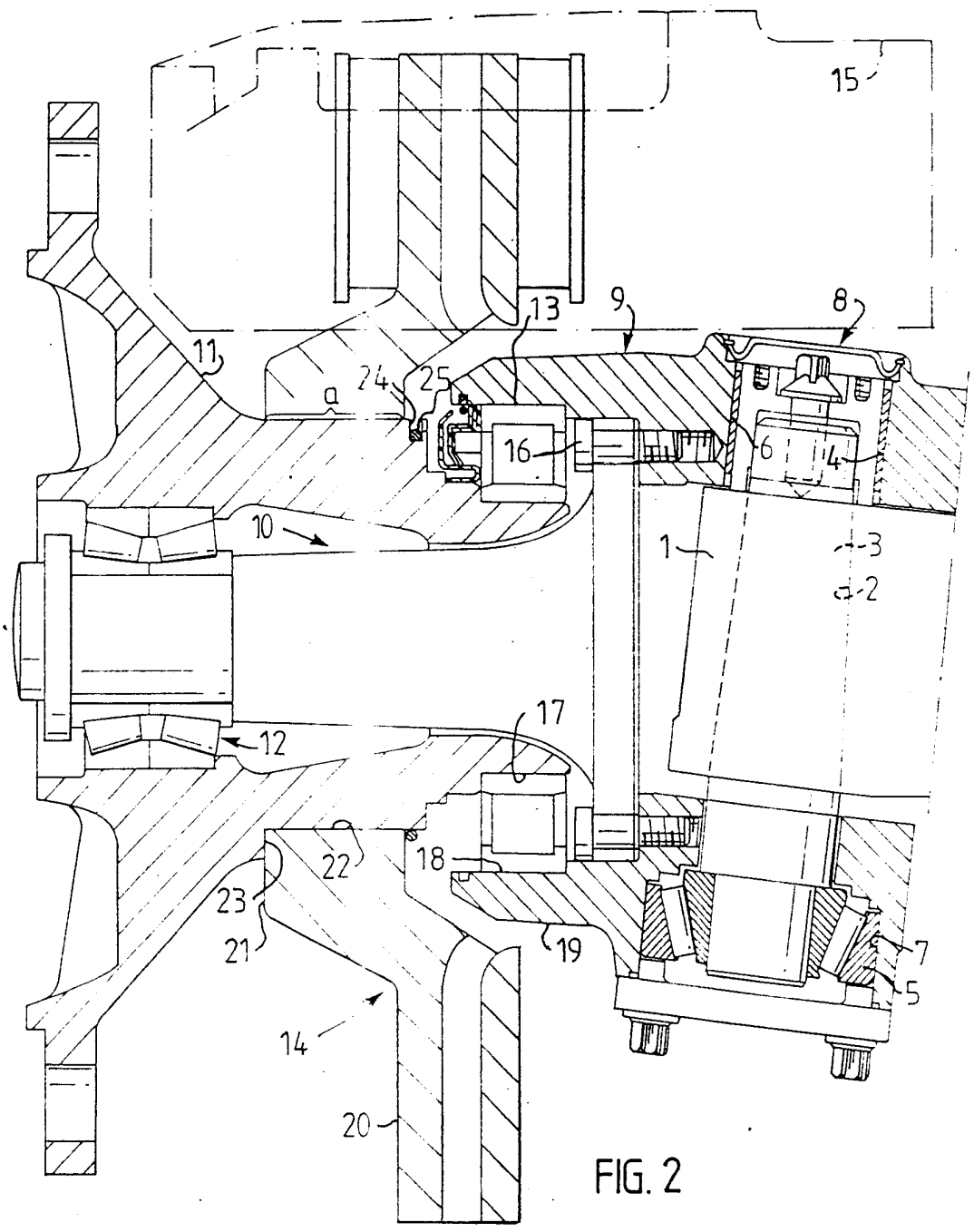

15
13
9
8
11
a
24
25
16
6
4
10
1
3
2
17
12
22
18
23
21
19
7
5
14
20

FIG. 2

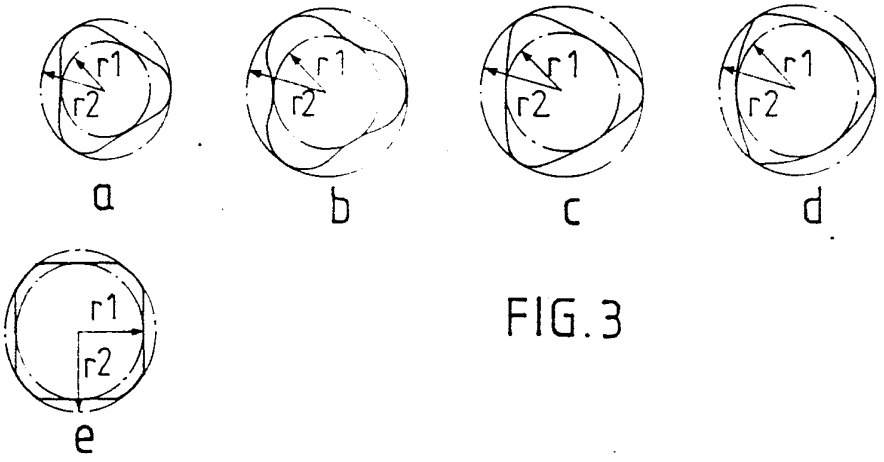

r1
r2
a
b
c
d
e

FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 91/00861

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: F 16 D 65/12

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	F 16 D

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	SE, B, 182186 (THE BENDIX CORP.) 8 January 1963, see page 2, line 15 - line 19; figures 1,2,7	1-2
Y		3
A		4-6
	--	
X	DE, A1, 1800161 (ALFRED TEVES GMBH) 9 April 1970, see page 4, line 24 - page 5, line 33; figures 1,4,5	1,6
A		3
	--	
X	SE, B, 305814 (THE GOODYEAR TIRE & RUBBER COMPANY) 4 November 1968, see page 2, line 28 - line 31; figure 1	1,2
A		6
	--	

* Special categories of cited documents:[10]

"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

"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

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
28th February 1992	1992 -03- 05
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Anders Brinkman Anders Brinkman

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
Y	Patent Abstracts of Japan, Vol 9, No 316, M438, abstract of JP 60-151438, publ 1985-08-09 (HITACHI SEISAKUSHO K.K.) --	3
X	DE, B2, 2154933 (SKF INDUSTRIAL TRADING AND DEVELOPMENT CO) 30 November 1978, see figure 1; claim 1 --	1,2
X	SE, B, 436787 (ALFRED TEVES GMBH) 21 January 1965, see page 4, line 22 - page 6, line 15; figure 2; claim 1	1
A	--	6
A	DE, C2, 2520767 (THE BENDIX CORP.) 22 April 1982, see figure 1 --	1-5

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/SE 91/00861

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the Swedish Patent Office EDP file on 30/12/91
The Swedish 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	Publication date	Patent family member(s)		Publication date
SE-B- 182186	63-01-08	NONE		
DE-A1- 1800161	70-04-09	NONE		
SE-B- 305814	68-11-04	NONE		
DE-B2- 2154933	78-11-30	NL-A-	7016447	72-05-15
SE-B- 436787	65-01-21	DE-A-C-	2807485	79-08-23
		FR-A-B-	2418385	79-09-21
		GB-A-B-	2015122	79-09-05
		JP-C-	1291984	85-11-29
		JP-A-	54123662	79-09-26
		JP-B-	60014939	85-04-16
		SE-A-	7901530	79-08-23
		US-A-	4256209	81-03-17
DE-C2- 2520767	82-04-22	AU-B-	498306	79-03-01
		AU-D-	1898776	77-01-20
		CA-A-	1018908	77-10-11
		FR-A-B-	2272298	75-12-19
		GB-A-	1494795	77-12-14
		GB-A-	1494796	77-12-14
		JP-A-	50160661	75-12-26
		JP-A-	58005543	83-01-12
		US-A-	3942611	76-03-09