P/00/008
Section 29(1)
Regulation 3.1(2)

AUSTRALIA
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NOTICE OF ENTITLEMENT

I/We ABB FLAKT AB

of S-120 86 STOCKHOLM
SWEDEN

being the applicant(s) and nominated person(s) in respect of an application for a patent for an invention entitled INLET BELL FOR CENTRIFUGAL FANS (Application No. 51227/93), state the following:

1. The nominated person(s) has/have, for the following reasons, gained entitlement from the actual inventor(s):

   THE NOMINATED PERSON WOULD BE ENTITLED TO HAVE ASSIGNED TO IT A PATENT GRANTED TO THE INVENTOR IN RESPECT OF THE SAID INVENTION.

2. The nominated person(s) has/have, for the following reasons, gained entitlement from the applicant(s) listed in the declaration under Article 8 of the PCT:

   THE APPLICANT AND NOMINATED PERSON IS THE BASIC APPLICANT.

3. The basic application(s) listed in the declaration under Article 8 of the PCT is/are the first application(s) made in a Convention country in respect of the invention.

DATED: 8 March 1995

ABB FLAKT AB

GRIFFITH HACK & CO.

Patent Attorney for and
on behalf of the applicant

AU9351227

(12) PATENT ABRIDGMENT (11) Document No. AU-B-51227/93
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 671157

(54) Title
INLET BELL FOR CENTRIFUGAL FANS

International Patent Classification(s)
(51)[5] F04D 029/42
(51)[6] F04D 029/44

(21) Application No. : 51227/93 (22) Application Date : 24.09.93

(87) PCT Publication Number : WO94/08144

(30) Priority Data

(31) Number	(32) Date	(33) Country
9202850	01.10.92	SE SWEDEN

(43) Publication Date : 26.04.94

(44) Publication Date of Accepted Application : 15.08.96

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(56) Prior Art Documents
WO 91/1450
US 4255080
US 1612568

(57) Claim

1. An inlet bell for centrifugal fans having an impeller with a cover plate, the inlet bell opening into the cover plate with an intervening gap for recirculation air, the inlet bell being provided with a conical inlet part, tapering towards the impeller, and a mouthpiece connected to the inlet part, wherein a circular lip is formed inside the mouthpiece by the tapered end of the inlet part, which is partly inserted into the mouthpiece, acting as a flow guide means, designed to bring about separation of the flow from the inlet part of the bell with a minimal disturbance of the flow, the lip being arranged at the intersection between the inlet part and the mouthpiece of the inlet bell.

7. An inlet bell for centrifugal fans having an impeller with a cover plate, the inlet bell opening into the cover plate with an intervening gap for recirculation air, the inlet bell being provided with a conical inlet part, tapering towards the impeller, and a mouthpiece

.../2

connected to the inlet part, wherein the mouthpiece has a conical form opening up towards its outlet end, and wherein the inlet bell comprises a flow guide means being the edge formed between the mouthpiece and the inlet part secured to each other at their respective narrow ends, the angle between the walls of said mouthpiece and said inlet part being at least 230°, the edge bringing about separation of the flow from the inlet part of the bell with a minimal disturbance of the flow.

REVISED VERSION*

51227/93

WORLD INTELLECTUAL PROPERTY ORGANIZATION
ANNOUNCEMENT OF THE LATER PUBLICATION OF REVISED VERSIONS OF INTERNATIONAL SEARCH REPORT

INTERNATIONAL TREATY (PCT)

(51) International Patent Classification 5 : **F04D 29/42**	**A1**	**(11) International Publication Number:** **WO 94/08144** **(43) International Publication Date:** 14 April 1994 (14.04.94)

(21) International Application Number: PCT/SE93/00772

(22) International Filing Date: 24 September 1993 (24.09.93)

(30) Priority data:
9202850-5 1 October 1992 (01.10.92) SE

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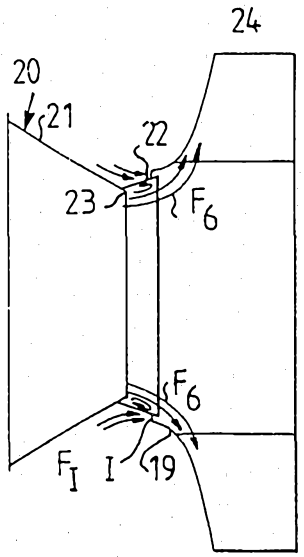
(81) Designated States: AT, AU, BB, BG, BR, BY, CA, CH, CZ, DE, DK, ES, FI, GB, HU, JP, KP, KR, KZ, LK, LU, LV, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SK, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With a revised version of the international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(88) Date of publication of the revised version of the international search report: 13 October 1994 (13.10.94)

671157

(54) Title: INLET BELL FOR CENTRIFUGAL FANS



(57) Abstract

Inlet bell for centrifugal fans having an impeller (15, 24) with a cover plate (14, 23), the inlet bell opening into the cover plate with an intervening gap (I) for recirculation air, wherein the inlet bell (11, 20) is provided with a conical inlet part (12, 21), tapering towards the impeller (15, 24), and a mouthpiece (13, 22) connected to the inlet part, and in that a circular flow guide means (16, 23) is arranged at the intersection between the inlet part and the mouthpiece of the inlet bell.

* (Referred to in PCT Gazette No. 23/1994, Section II)

Inlet bell for centrifugal fans

The present invention refers to a novel inlet bell for centrifugal fans having an impeller with a cover plate with a circular inlet opening, the inlet bell opening into the cover plate with an intervening gap for recirculated air.

Prior art

Many shapes have already been designed and used for inlet bells of centrifugal fans. Those shapes are designed either for good performances of the fan or for minimum cost.

For obtaining a good performance prior art inlet bells have been made very smooth by manufacturing the pieces using spinning technique. This makes the inlet bells very expensive. In Fig. 1 an inlet bell of this kind is shown, with an outlet end manufactured using spinning technique, opening into the impeller of a centrifugal fan.

Where these high costs are not accepted, simple constructions with an inlet bell in the form of a cylinder, as in Fig. 2, or as a cone, as in Fig. 3, have been used with a resulting poor performance. This is due to undesirable eddies formed in the recirculation area adjacent the inlet of the impeller coverplate.

Brief description of the invention

The object of the invention is to provide an inlet bell with a good performance and at the same time a low manufacturing cost.

According to a first broad aspect of the present invention there is provided an inlet bell for centrifugal fans having an impeller with a cover plate, the inlet bell opening into the cover plate with an intervening gap for recirculation air, the inlet bell being provided with a conical inlet part, tapering towards the impeller, and a mouthpiece connected to the inlet part, wherein a circular lip is formed inside the mouthpiece by the tapered end of the inlet part, which is partly inserted into the

mouthpiece, acting as a flow guide means, designed to bring about separation of the flow from the inlet part of the bell with a minimal disturbance of the flow, the lip being arranged at the intersection between the inlet part and the mouthpiece of the inlet bell.

With this arrangement according to the invention a fairly good performance is achieved at a very reasonable manufacturing cost for the inlet bell. The object of the flow guide means is to obtain a separation of the flow from the inlet part of the bell with as small a disturbance of the flow as possible.

Preferably the lip is chamfered or rounded on one side in order to enhance the separation of the flow from the lip.

The performance may be further enhanced by providing a chamfered or rounded edge of the protruding lip, and/or forming the lip with a small curvature at the edge. With this arrangement the point where the flow separates from the surface is fixed. The costs for the chamfering or rounding the edge and the forming of a small curvature on the edge of a cylinder or cone is very low and easily done.

Preferably the mouthpiece has a conical form opening up towards its outlet end, the lip being formed inside the mouthpiece by the tapered end of the inlet part, which is partly inserted into the mouthpiece.

According to a second broad aspect of the present invention there is provided an inlet bell for centrifugal fans having an impeller with a cover plate, the inlet bell opening into the cover plate with an intervening gap for recirculation air, the inlet bell being provided with a conical inlet part, tapering towards the impeller, and a mouthpiece connected to the inlet part, wherein the mouthpiece has a conical form opening up towards its outlet end, and wherein the inlet bell comprises a flow guide means being the edge formed between the mouthpiece and the

inlet part secured to each other at their respective narrow ends, the angle between the walls of said mouthpiece and said inlet part being at least 230°, the edge bringing about separation of the flow from the inlet part of the bell with a minimal disturbance of the flow.

One advantage of the conical mouthpiece is that it provides a low resistance to the recirculating flow entering through the gap between the inlet mouthpiece and the impeller coverplate. This recirculating flow maintains pressure stability of the fan and can increase the pressure.

As in the case of the protruding lip, the outlet edge of the mouthpiece can be chamfered or rounded and/or might have a small curvature in order to further enhance the flow

characteristics and to fix the point where the flow separates from the surface.

Brief description of the drawings.

The invention will be explained more in detail in the following description of embodiments of the invention illustrated in the accompanying drawings, in which

Figs. 1 - 3 are schematic cross sectional views of prior art inlet bells, discussed in the introductory part of the description,

Fig. 4 is a schematic cross sectional view of one embodiment of the inlet bell according to the invention, also showing part of the inlet bell in an enlarged scale,

Fig. 5 is a view corresponding to Fig. 4 showing important characteristic dimensions of the inlet bell,

Fig. 6 is a schematic cross sectional view of a second embodiment of the inlet bell according to the invention,

Figs. 6a and 6b showing part of the inlet bell in two different configurations in an enlarged scale,

Figs. 7a and 7b are fragmentary views showing two different embodiments of the flow guide means, and

Figs. 8a, 8b and 8c are fragmentary views showing different configurations of the flow guide means and the outlet end of the mouthpiece.

Description of preferred embodiments of the invention

In Fig. 1 a prior art type inlet bell 1 is shown with a smooth rounded outlet part 2 opening into a coverplate 3 of the impeller 4. This results in a very good performance with undisturbed flow indicated with arrows F_1, but, as discussed above, this part will be quite expensive.

In Fig. 2 the inlet bell 5 is cylindrical, which is a very inexpensive solution, but the performance is poor, as illustrated with eddies F_2 formed along the inside wall of the coverplate 6 of the impeller 7. The same result is obtained with a conical inlet bell 8 opening into the coverplate 9 of the impeller 10 as illustrated with arrows F_3 in Fig. 3.

In fig. 4, a first embodiment of the invention is shown. The inlet bell 11 has a conical inlet 12 and a cylindrical mouthpiece 13, which opens into a coverplate 14 of the

impeller 15. The conical inlet 12 protrudes into the mouthpiece 13 and the two parts are welded together or combined in any other suitable way. The part of the inlet cone 12 protruding into the mouthpiece forms a lip 16 acting as a flow guide means. According to the enlarged view in fig. 4 of the lip and the adjacent parts of the inlet cone and the mouthpiece, the edge 17 of the lip is chamfered as is also the edge 18 of the mouthpiece. With this arrangement the point where the flow separates from the surface is fixed. The flow is illustrated with arrows F_4, showing that eddies will form downstream the flow separation point. The main flow will pass over these eddies substantially undisturbed, resulting in a good performance. The length of the lip is a function of flow velocity and may be determined during model tests for optimum performance. Critical dimensions will be discussed more in detail in connection with the description of fig. 5.

In Fig. 5, the important geometrical dimensions are inserted. The cone angle α of the conical inlet should be kept within the interval $25° < \alpha < 50°$. The diameter of the flow guide means, i.e. the lip 16, which is the diameter of the smaller opening of the conical inlet "d" should be less or equal to the diameter "D" of the cylinder acting as the mouthpiece of the inlet bell, and preferably the ratio d/D should be kept within the interval 0,8 - 1. Finally, the length "l" of the cylinder should stand in a relation to the diameter "D" of the cylinder such that $0,1 < l/D < 0,28$.

In Fig. 6 another embodiment of the invention is shown. The inlet bell 20 comprises a conical inlet 21 getting narrower in the direction of the flow and a conical mouthpiece 22 getting wider in said direction, which parts are welded or otherwise connected to each other with a lip 23 formed as according to the Fig. 4 embodiment, or an edge 23b, see Fig. 6b. With a cone angle between 25° and 50° for each of said two conical parts, the angle β between the walls of the two conical parts, see Fig. 6a, will be at least 230° which is sufficient for the separation of the flow from the surface at the connection point between the two parts, and the edge 23b formed will act as the flow guide means. Hence there need not be a protruding lip. The angle β is

illustrated in fig. 6a and the embodiment without a protruding lip is illustrated in fig. 6b.

In the embodiment according to fig. 6 the conical mouthpiece 22 gives the advantage of a low resistance to the recirculating flow F_I in the recirculation area "I" between the inlet mouthpiece 22 and the inner part of the coverplate 19 of the impeller 24. This recirculating flow maintains pressure stability of the fan and can increase the pressure. This embodiment also results in a good performance, as discussed above, and which is shown with arrows F_6 illustrating the flow.

As is discussed above, the configuration of the different parts of the inlet bell according to the invention can be varied for obtaining the best possible performance at a low manufacturing cost.

As an example, in fig. 7a wherein part of a protruding lip 25 is shown, the outer edge 26 is chamfered on one side and according to fig. 7b the edge 27 is rounded. These two alternatives will give substantially the same effect.

In fig. 8a, a protruding lip 28 is shown, having a small curvature, which is realized easily and cheaply by widening the narrow part of the inlet cone. In fig. 8b a protruding lip 29 is shown being straight while the outer edge 30 of the cylindrical mouthpiece 31 has a small curvature. This will amplify the pressure stabilising effect in the recirculation area "I" by improving the flow characteristics for the recirculation air as well as the air coming through the inlet bell according to the invention. In fig. 8c an embodiment, in which the protruding lip 28 having a small curvature and the edge of the mouthpiece 30 having a small curvature, is illustrated. These embodiments can also be used in connection with a conical mouthpiece.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An inlet bell for centrifugal fans having an impeller with a cover plate, the inlet bell opening into the cover plate with an intervening gap for recirculation air, the inlet bell being provided with a conical inlet part, tapering towards the impeller, and a mouthpiece connected to the inlet part, wherein a circular lip is formed inside the mouthpiece by the tapered end of the inlet part, which is partly inserted into the mouthpiece, acting as a flow guide means, designed to bring about separation of the flow from the inlet part of the bell with a minimal disturbance of the flow, the lip being arranged at the intersection between the inlet part and the mouthpiece of the inlet bell.

2. An inlet bell according to claim 1, wherein the lip is chamfered or rounded on one side in order to enhance the separation of the flow from the lip.

3. An inlet bell according to claim 1 or 2, wherein the lip terminates with a small curvature in the direction of the flow.

4. An inlet bell according to any one of claims 1 to 3, wherein the mouthpiece has a conical form opening up towards its outlet end, the lip being formed inside the mouthpiece by the tapered end of the inlet part, which is partly inserted into the mouthpiece.

5. An inlet bell according to any one of claims 1 to 4, wherein the edge of the mouthpiece is chamfered or rounded on one side.

6. An inlet bell according to any one of claims 1 to 5, wherein the edge of the mouthpiece terminates with a small curvature.

7. An inlet bell for centrifugal fans having an impeller with a cover plate, the inlet bell opening into the cover plate with an intervening gap for recirculation air, the inlet bell being provided with a conical inlet part, tapering towards the impeller, and a mouthpiece

connected to the inlet part, wherein the mouthpiece has a conical form opening up towards its outlet end, and wherein the inlet bell comprises a flow guide means being the edge formed between the mouthpiece and the inlet part secured to each other at their respective narrow ends, the angle between the walls of said mouthpiece and said inlet part being at least 230°, the edge bringing about separation of the flow from the inlet part of the bell with a minimal disturbance of the flow.

8. An inlet bell according to claim 7, wherein the edge of the mouthpiece is chamfered or rounded on one side.

9. An inlet bell according to claim 7 or 8, wherein the edge of the mouthpiece terminates with a small curvature.

10. An inlet bell substantially as hereinbefore described with reference to any one of figures 4 to 8 of the accompanying drawings.

DATED this 18th day of June, 1996.

ABB FLÄKT AB
By Its Patent Attorneys

GRIFFITH HACK & CO
Fellows Institute of Patent
Attorneys of Australia

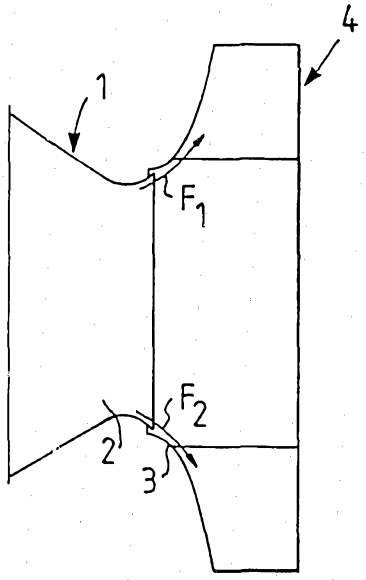


FIG. 1

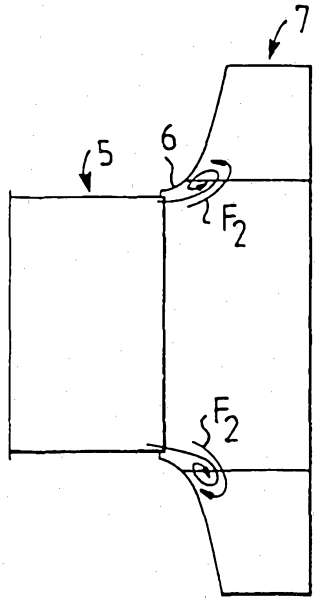


FIG. 2

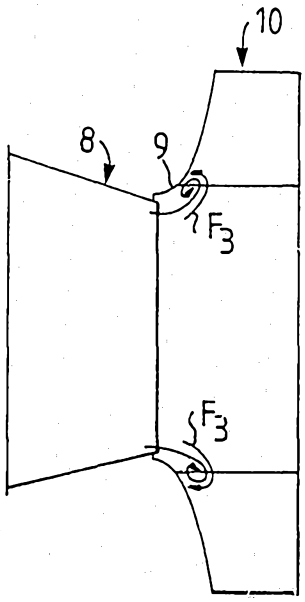


FIG. 3

51227/93

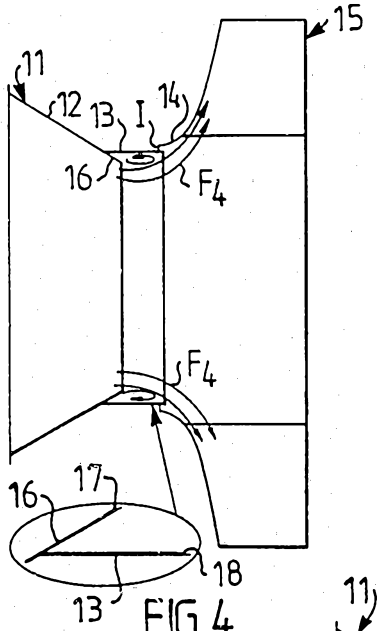


FIG.4

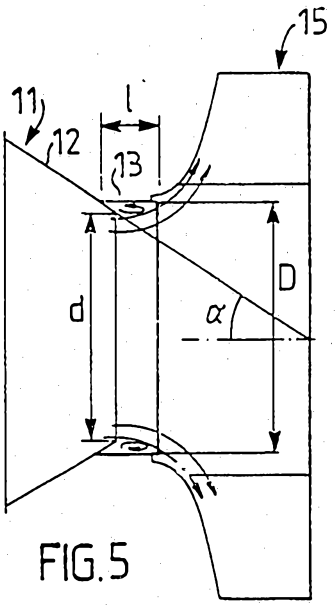


FIG.5

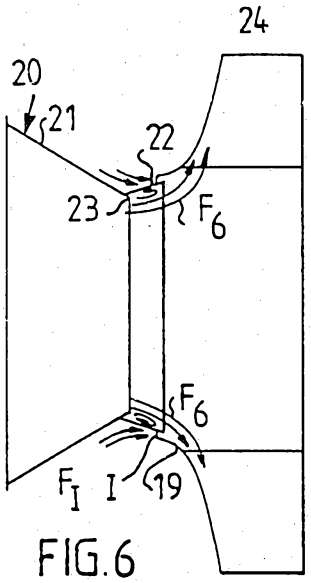


FIG.6

FIG.6A

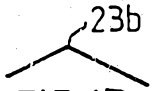


FIG.6B

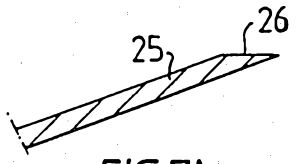


FIG.7A

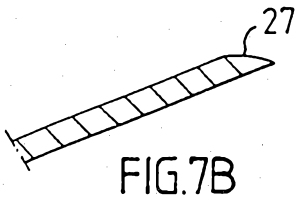


FIG.7B

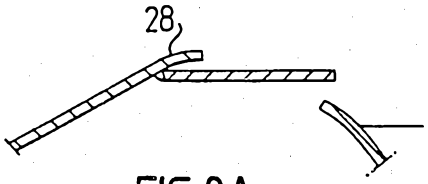


FIG.8A

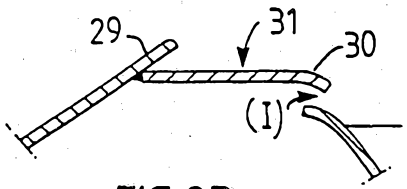


FIG.8B

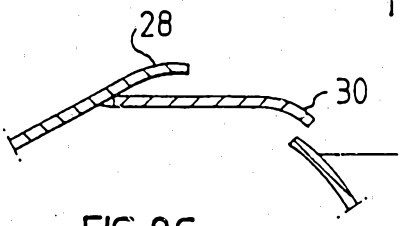


FIG.8C

REVISED VERSION

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 93/00772

A. CLASSIFICATION OF SUBJECT MATTER

IPC[5]: F04D 29/42
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[5]: F04D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, 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	DE, A1, 4020236 (KELLER LUFTTECHNIK GMBH + CO KG), 2 January 1992 (02.01.92), figure 6	1,5,6,7,8
X	US, A, 1612568 (CHARLES G. BUDER), 28 December 1926 (28.12.26), figure 4	1,5,6,7,8
A	GB, A, 2017823 (JAMES HOWDEN & COMPANY LIMITED), 10 October 1979 (10.10.79)	1
A	DE, A1, 4023724 (TURBOWERKE MEISSEN - VENTILATOREN GMBH), 25 April 1991 (25.04.91)	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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"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
31 August 1994	01-09-1994
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Sune Söderling Telephone No. +46 8 782 25 00

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

INTERNATIONAL SEARCH REPORT

Information on patent family members

16/10/93

International application No.
PCT/SE 93/00772

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
DE-A1- 402036	02/01/92	NONE		
US-A- 1612568	28/12/26	NONE		
GB-A- 2017823	10/10/79	AU-B-	526362	06/01/83
		AU-A-	4540079	04/10/79
		CA-A-	1104103	30/06/81
		DE-A-	2912581	04/10/79
		FR-A,B-	2421291	26/10/79
		JP-A-	54164009	27/12/79
		NL-A-	7902346	02/10/79
		US-A-	4255080	10/03/81
DE-A1- 4023724	25/04/91	NONE		