

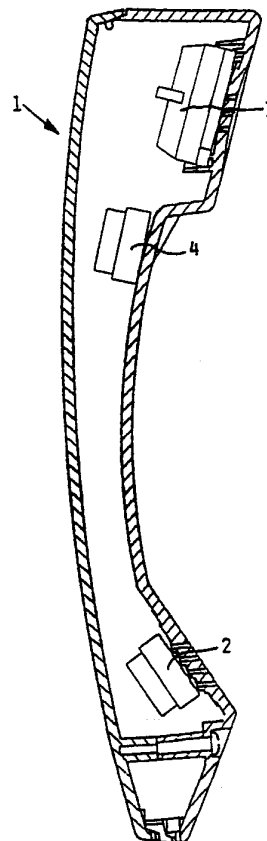


INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁵ : H04M 1/19	A1	(11) International Publication Number: WO 92/17019 (43) International Publication Date: 1 October 1992 (01.10.92)
(21) International Application Number: PCT/DK92/00091 (22) International Filing Date: 20 March 1992 (20.03.92) (30) Priority data: 0509/91 21 March 1991 (21.03.91) DK (71) Applicant (for all designated States except US): KIRK ACOUSTICS A/S [DK/DK]; Fuglevangsvej 45, DK-8700 Horsens (DK). (72) Inventor; and (75) Inventor/Applicant (for US only) : HANSEN, Kaj, Børge [DK/DK]; Kirkebakken 17, DK-8700 Horsens (DK). (74) Agent: HOFMAN-BANG & BOUTARD A/S; Adelgade 15, DK-1304 Copenhagen K (DK).		(81) Designated States: AT (European patent), BE (European patent), CA, 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 <i>With international search report.</i>

(54) Title: A NOISE SUPPRESSING TELEPHONE HANDSET**(57) Abstract**

The handset (1) of a telephone instrument, which contains a microphone (2) and a receiver (3) arranged in ordinary manner, is additionally provided with a second microphone (4) which is negatively fed back to the first microphone (2). The second microphone (4) is electrically negatively fed back to the first, ordinary microphone (2) and is arranged in the vicinity of the receiver (3), and, like the first microphone (2), it is directed toward the user's face. These two microphones thereby substantially outbalance the remote field and reduce noise, while they affect the speech sensitivity only to an insignificant degree such that improved signal/noise ratios are obtained.



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	RU	Russian Federation
CG	Congo	KP	Democratic People's Republic of Korea	SD	Sudan
CH	Switzerland	KR	Republic of Korea	SE	Sweden
CI	Côte d'Ivoire	LI	Liechtenstein	SN	Senegal
CM	Cameroon	LK	Sri Lanka	SU	Soviet Union
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
DE	Germany	MC	Monaco	TG	Togo
DK	Denmark			US	United States of America

- 1 -

A noise suppressing telephone handset

5 The invention concerns a telephone instrument of the type stated in the introductory portion of claim 1.

10 In contrast to older telephone instruments with carbon microphones, modern telephone instruments with electronic speech transmission circuit and with electromagnetic, electrodynamic, piezoelectric or electret microphones are highly sensitive to the acoustic remote noise field.

15 To remedy this long-known problem numerous variants of said microphone types have been manufactured in the course of time, constructed as a pressure gradient microphone with acoustic passage to both sides of the diaphragm. The advantage of this is that the remote noise field affects the two sides of the diaphragm in the same manner and is thus outbalanced, while the near field, i.e. the direct
20 speech against the front side of the diaphragm affects the rear side of the diaphragm only to a very limited degree. An acceptable total speech sensitivity can therefore be achieved.

25 However, this applies only in case of direct speech into the microphone. On the other hand, the slightest displacement of the microphone end from the optimum position close to the mouth will cause a drastic reduction in speech sensitivity, because the impedances from the mouth to the
30 front side and the rear side, respectively, of the diaphragm approach each other so that also the near field will be outbalanced.

35 The remote field sensitivity is in both cases approximately the same for frequencies below 1 kHz, but only with an optimally positioned handset is the signal/noise ratio

- 2 -

acceptable.

Furthermore, all these previously known solutions have been based on special transducers which are relatively complicated because suitable acoustic impedances are to be
5 obtained at both sides of the diaphragm. These transducers are more expensive to manufacture than standard microphones, and since they are moreover just produced in a relatively small number, it is clearly a costly solution.

10

The Patent Abstracts of Japan, JP 1-42966 discloses a telephone instrument of the type stated in the opening paragraph. In this, the two microphones are of different types, and precisely because different microphones are
15 used with different direction and frequency characteristics, it is necessary to adjust the subtraction means of the microphones, i.e. an additional circuit for the connection of the microphones.

20

The object of the invention is to produce a telephone with a handset of the type stated in the opening paragraph, which is better and cheaper than the known noise-reducing handset.

25

This object is achieved according to the invention in that the second microphone is identical with the first microphone, that the second microphone is negatively fed back to the first microphone, and that it is arranged at a distance from the first microphone.

30

Preferably, the second microphone is arranged near the receiver and is directed towards the face in the position of use like the first microphone.

35

The two microphones are preferably two uniform standard microphones which are mass-produced and are therefore in-

- 3 -

expensive.

The distance a from the mouth opening to the openings in the handset to the first microphone is about 18 mm. The
5 distance b from the mouth opening to the openings of the handset to the second microphone is about 120 mm.

In the near field the pressure decreases more than proportionally to the increase in distance, i.e. when inserting
10 the second microphone the sensitivity deterioration is less than:

$$20 \log \frac{1}{1 - \frac{18}{120}} = 1.4 \text{ dB}$$

15

If the microphone end of the handset is no longer kept optimally, but is lowered e.g. 50 mm, whereby the distance a from the mouth to the first microphone increases to 53
20 mm, the distance to the second microphone will still be considerably greater than the distance to the first microphone, so that the microphones will still have speech sensitivity.

25 In all cases, the acoustic impedance of the remote field or the noise signal will be approximately the same for the two microphones since both of them are directed toward the face with the same distance to the skin. The noise signal will therefore be well outbalanced to a degree depending
30 upon the type and position of the noise sources.

Since the distance between the microphones corresponds to the halfwave of the acoustic oscillation of 1.5 kHz, the second microphone will be in phase with the first microphone
35 at this frequency and will therefore cause a slight increase in sensitivity. This is not desirable, and the

input holes to the acoustic volume in front of the second microphone are therefore constructed as an acoustic low-pass filter with a cut-off frequency of about 1.5 kHz. The outbalancing of the remote field will therefore be limited to frequencies below 1.5 kHz, and it is also in this low frequency range that the most speech recognition disturbing noise generators occur. According to the invention it is possible to outbalance the remote field entirely without using subtraction means, solely because both microphones are serially connected in opposition. In this series coupling, the reduction of the near field sensitivity of the original microphone can easily be kept below 2 dB with a number of alternative positions of the second microphone. It should be mentioned that the smaller the distance between the microphones, the greater the frequency range covered. The input openings and the volume in front of the second microphone are arranged such that the cut-off frequency of the acoustic low-pass filter formed thereby reduces the sensitivity of this microphone outside the desired frequency range.

An additional advantage of the microphone of the invention over the microphone in JP 1-42966 is that because of the two identical microphones there is no need for a connection and disconnection facility like in JP 1-42966, just as the subtraction means in JP 1-42966 adds to the costs. Finally, the two microphones in JP 1-42966 cannot be serially connected because they are different.

Finally, it is an advantage that the handset of the invention does not require additional power supply wires like the Japanese publication. Accordingly, telephone instruments can freely be supplied with one or two microphones without there being any other differences.

- 5 -

Preferred microphone types are electromagnetic or in particular electrodynamic ones rather than electret microphones, because it is then possible to manufacture handsets according to the invention which can readily replace
5 existing handsets without noise reducing properties, without having to change the actual telephone instrument.

It should be mentioned that also noise produced by scratching on the handset is outbalanced by the two micro-
10 phones.

The invention will be described more fully below with reference to the drawing, in which

15 fig. 1 shows a handset according to the invention seen from the side facing the user's head,

fig. 2 is a longitudinal section through the handset of fig. 1, and

20 fig. 3 shows a measured comparison between noise transfer via a handset according to the invention, curve A, and a known handset, curve B.

25 The drawing shows a handset 1 which contains a first, ordinary microphone 2 and a receiver 3. Also a second microphone 4 is mounted near the receiver 3, as shown in fig. 2. The microphones are uniform standard moving coil microphones which are directed toward the user's face, the
30 handset being formed with openings 5 and 6 for the first microphone and the second microphone, respectively, and openings 7 for the receiver 3. These openings are shaped so as to form suitable acoustic impedances for the subject three transducers 2, 3 and 4. The openings 6 moreover form
35 an acoustic low-pass filter which cuts off frequencies above 1.5 kHz.

- 6 -

Fig. 3 shows a measurement result obtained by letting the handset transfer a random, but constant noise field from its surroundings, i.e. a remote field through a telephone link, the noise being measured in dB at the receiver end,
5 distributed over the actual frequency range.

The curve A shows the measurement for the handset of the invention, and the curve B shows the measurement for the same handset, but with the openings 6 closed, so that the
10 noise compensating effect of the microphone 4 is cancelled.

As appears from fig. 3, there is an improvement of about 5
15 to 10 dB over the entire essential frequency range from about 300 Hz to 1.5 kHz.

20

25

30

35

- 7 -

P a t e n t C l a i m s :

1. A telephone instrument with a handset containing in
5 ordinary manner a first microphone and a receiver as well
as a second microphone for suppressing room noise, c h a -
r a c t e r i z e d in that the second microphone is
identical with the first microphone, that the second
10 microphone is negatively feed back in series with the
first microphone, and that it is arranged at a distance
from the first microphone.
2. A telephone instrument with a handset according to
claim 1, c h a r a c t e r i z e d in that the second
15 microphone is arranged near the receiver and is directed
toward the face in the position of use like the first
microphone.

20

25

30

35

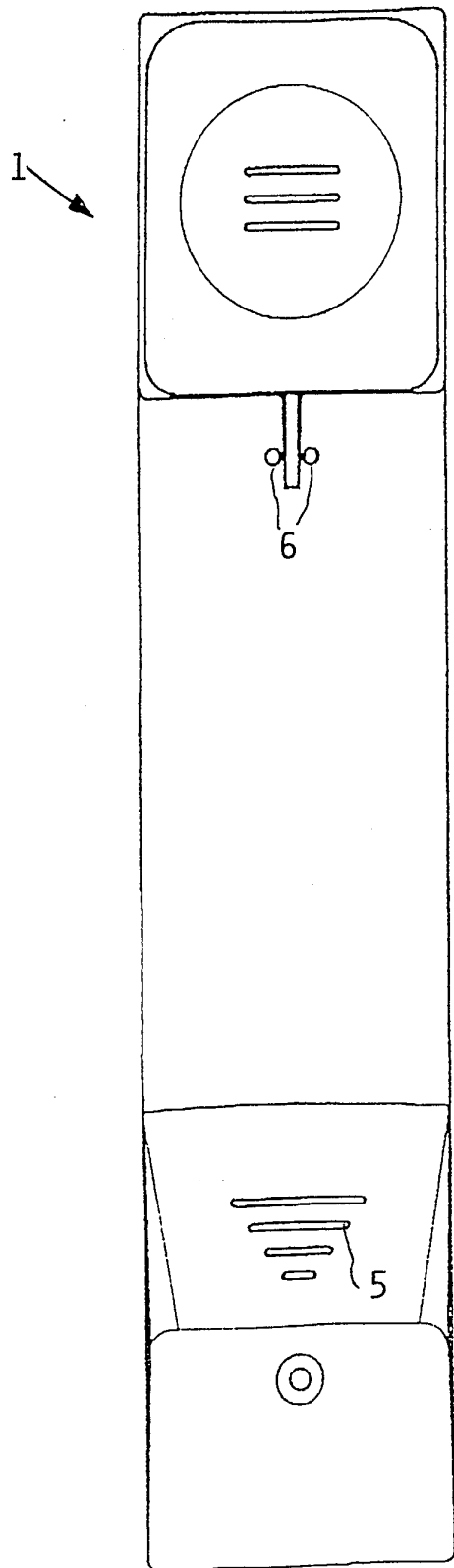


FIG. 1

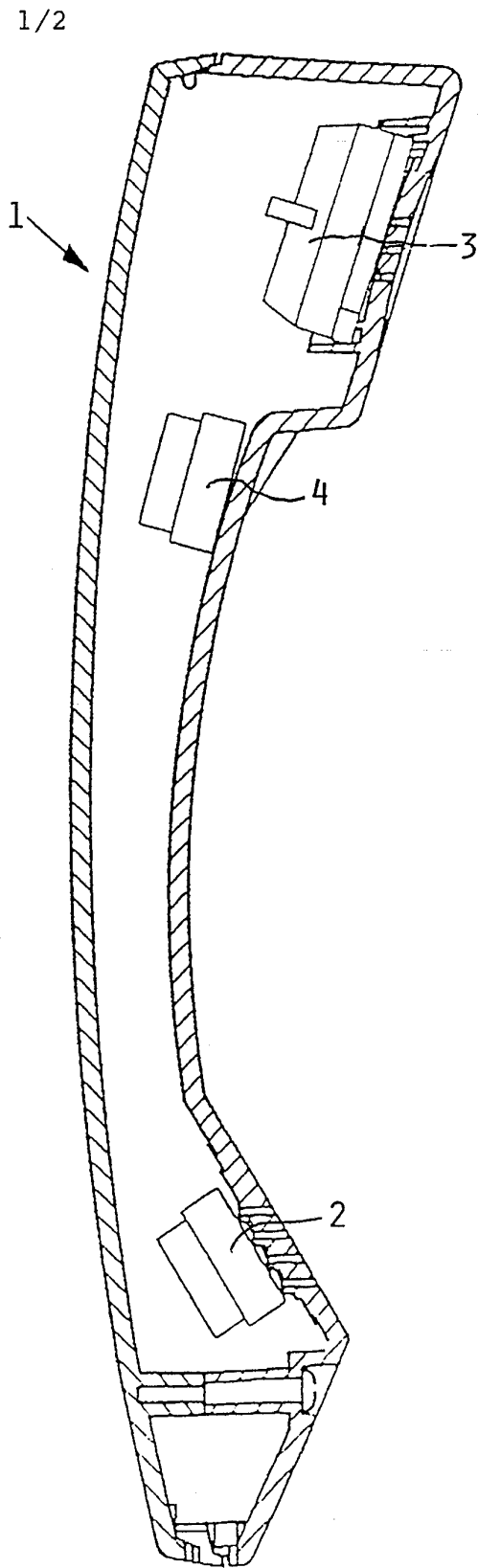
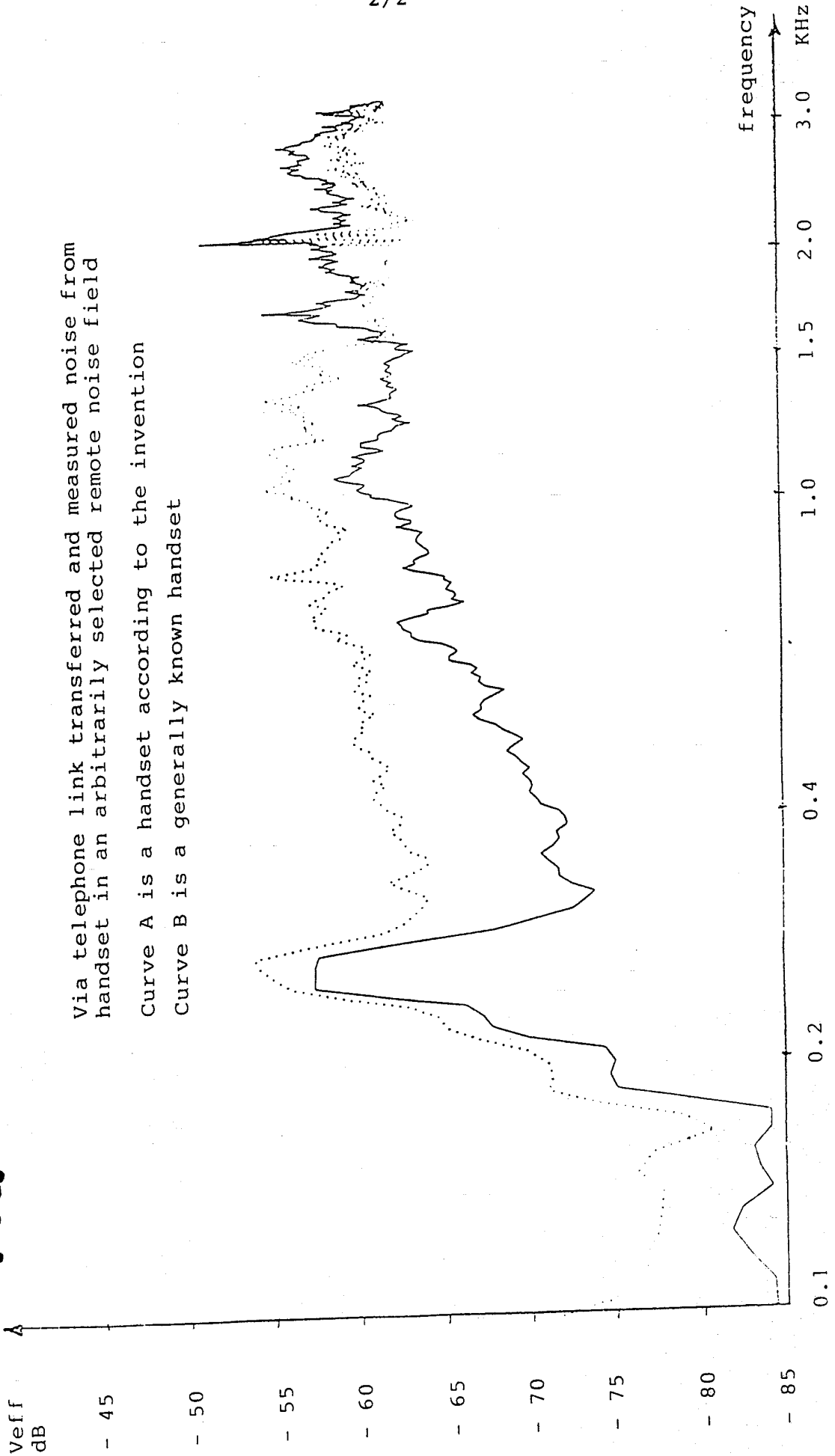


FIG. 2

FIG 3




Via telephone link transferred and measured noise from handset in an arbitrarily selected remote noise field

Curve A is a handset according to the invention

Curve B is a generally known handset

INTERNATIONAL SEARCH REPORT

International Application No. PCT/DK 92/00091

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: H 04 M 1/19				
II. FIELDS SEARCHED				
Minimum Documentation Searched ⁷				
Classification System	Classification Symbols			
IPC5	H 04 M			
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 RELEVANT⁹				
Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³		
A	Patent Abstracts of Japan, Vol 13, No 86, E720, abstract of JP 63-263865, publ 1988-10-31 NEC CORP. --	1-2		
A	US, A, 4773091 (ALAN C. BUSCHE ET AL.) 20 September 1988, see abstract; figure 1 -- -----	1-2		
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; vertical-align: top;"> <p>* Special categories of cited documents:¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </td> <td style="width: 50%; border: none; vertical-align: top;"> <p>"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</p> <p>"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"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.</p> <p>"&" document member of the same patent family</p> </td> </tr> </table>			<p>* Special categories of cited documents:¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"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</p> <p>"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"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.</p> <p>"&" document member of the same patent family</p>
<p>* Special categories of cited documents:¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"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</p> <p>"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"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.</p> <p>"&" document member of the same patent family</p>			
IV. CERTIFICATION				
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report			
15th June 1992	1992 -06- 2 9			
International Searching Authority	Signature of Authorized Officer			
SWEDISH PATENT OFFICE	 MICHAEL FELHENDLER			

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.PCT/DK 92/00091**

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 **29/05/92**
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
US-A- 4773091	88-09-20	NONE	