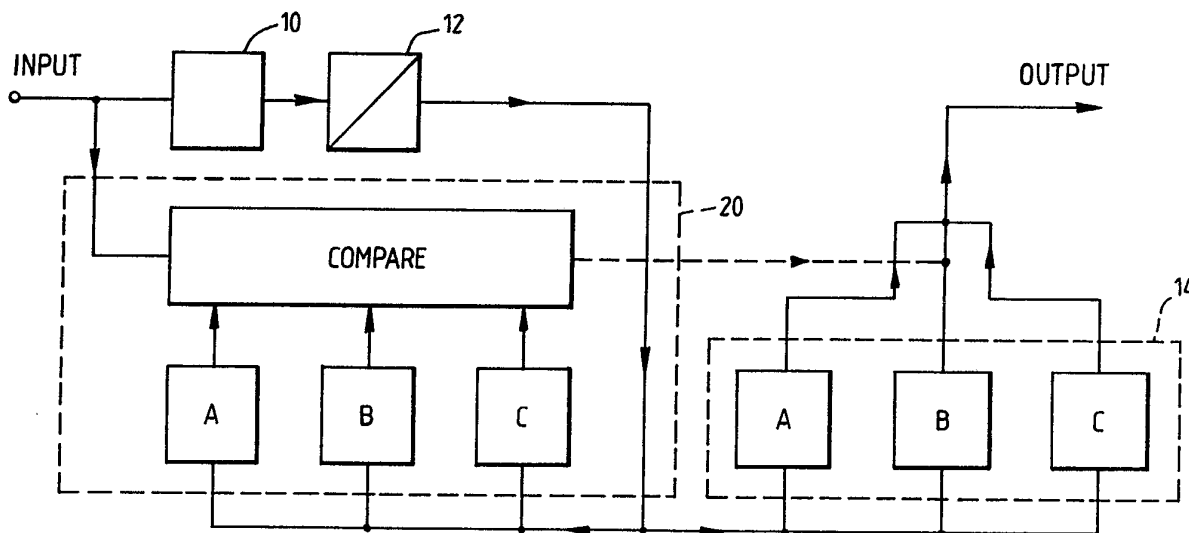




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/GB91/02023 <b>(22) International Filing Date:</b> 15 November 1991 (15.11.91)  <b>(30) Priority data:</b> 9025518.3 23 November 1990 (23.11.90) GB  <b>(71) Applicant (for all designated States except US):</b> BRITISH BROADCASTING CORPORATION [GB/GB]; Broadcasting House, London W1A 1AA (GB).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only) :</b> WESTON, Martin [GB/GB]; Cossington House, 7b Weston Road, Petersfield, Hampshire GU31 4JS (GB). EASTERBROOK, James, Edward [GB/GB]; BBC Research Department, Kingwood Warren, Tadworth, Surrey KT20 6NP (GB).		<b>(74) Agent:</b> HARLAND, Linda, Jane; Reddie & Grose, 16 Theobalds Road, London WC1X 8PL (GB).  <b>(81) Designated States:</b> AT (European patent), AU, BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FI, FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.  <b>Published</b> <i>With international search report.</i>

**(54) Title:** TELEVISION TRANSMISSION SYSTEM WITH BANDWIDTH REDUCTION**(57) Abstract**

In a television system in which a signal of given bandwidth is to be transmitted over a channel of narrower bandwidth, the signal is subject to pre-filtering and subsampling at the transmitter and supersampling and post-filtering at the receiver. The post-filtering means (14) comprises three filters A, B and C in parallel which are selectable in response to the characteristics of the signal to be transmitted. In order to avoid anomalies caused by switching at the transmitter, the pre-filter (10) is a single filter with a fixed pass band equivalent to the union of the pass bands of the filters A, B and C of the post-filtering means (14). The pre-filter (10) thus effectively rejects signals of frequency, such that they would not be passed by any of the filters A, B and C.

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## TELEVISION TRANSMISSION SYSTEM WITH BANDWIDTH REDUCTION

This invention relates to the transmission of a television signal of a given bandwidth within a channel of a lower bandwidth. This is commonly achieved by subsampling the signal before transmission, then supersampling the received signal before display. For a one-dimensional signal (such as an audio signal), the well known Nyquist sampling theory requires that the signal be pre-filtered before subsampling and post filtered after supersampling in order to prevent aliasing. The filters are required to have a pass bandwidth of less than half the subsampling frequency.

In accordance with the invention there is provided a television transmission system and means for transmitting a television signal (claim 2).

An embodiment of the invention will now be described in detail, by way of example, with reference to the drawings, in which:

Figure 1 shows diagrammatically pass band shaped for a two dimensional sampling frequency;

Figure 2 is a block diagram of a system using switched pre and post filtering means;

Figure 3 shows schematically a television transmission system in accordance with the invention; and

Figure 4 shows the system of Figure 3 in greater detail.

As television signals are three dimensional (horizontal, vertical and temporal), the subsampling frequency used when transmitting over a channel of lower bandwidth may also be two or three dimensional. In this case the pre and post filters have a multi-dimensional pass band shape. This shape is required to tessellate when repeated at each sampling frequency. There is usually a choice of pass bands that meet this requirement. For example, figure 1 shows the position of a two dimensional sampling frequency ( $F_s$ ), and three possible pre and post filter ideal pass band shapes (A, B & C).

The choice of a filter pass band shape to suit a given subsampling frequency depends on the spectrum of the signal. For example, if the television signal contains no high horizontal frequencies, filter A is a good choice, as it has no effect on the signal, but does remove aliases. On the other hand, for a signal with no high vertical frequencies, filter B is appropriate. For a general television signal, a filter can be chosen that offers the best compromise response. In the example shown in figure 1, this might be filter C.

Using a fixed filter pass band shape, as described has the disadvantage that some television signals will contain frequencies that the filter rejects. Systems have been proposed where the pre and post filter responses are varied as the signal is subsampled. The transmitter chooses a filter response to suit the signal, and sends this information to the receiver, which uses a matching post filter to recover the signal. An example of a system in which pre- and post-filters are both varied by switching is the Japanese MUSE system. This is described in some detail in European patent application 0146713. A block diagram of such a system is shown in figure 2. For clarity the process by which the switch control signal is generated has been omitted.

There are several difficulties inherent in the switched filter system shown in Figure 2. Firstly, switching from one pre filter to another may introduce high frequency components that give rise to low frequency aliases when the signal is subsampled. Secondly, because the post filters are filtering a switched signal, the choice of post filter for one area of picture may be influenced by which pre filter is used for a nearby area of picture. This in turn may be influenced by which post filter is used for this area, so no clear choice can be made.

In an effort to overcome these problems, we propose to use a single fixed pre filter whilst still selecting the output of one of several post filters. This system is shown in figure 3.

As shown in Figure 3, the transmission system of the invention includes a pre-filter 10 and subsampling means 12 which subsamples the pre-filtered signal at a frequency  $F_s$ . At the receiver, there is provided post-filtering means 14 which consists of three filters, A, B and C in parallel. The filters

A, B and C are selected in dependence on the characteristics of the television signal to be transmitted. The pre-filter 10 is chosen so that it effectively rejects all frequencies which would not be passed by any of the filters A, B and C of the post-filtering means 14. So, if, for example, the filters A, B and C have the pass band shapes A, B and C, respectively, shown in Figure 1, the pass band width of the pre-filter 10 is equivalent to the union 30 (outlined by a heavy line) of the three pass bands A, B and C of Figure 1.

The switch by means of which the filters A, B and C are selected at the post-filtering means 14 is controlled by the transmitter, which uses a "local decoder" 20 to compare the output of each post filter with the input signals, and so determine which post filter produces the best result. An example of a complete system is shown in figure 4.

Although three filters are shown in all the examples, the actual number of filters used in a system will depend on several factors such as the cost, complexity and benefit of each filter.

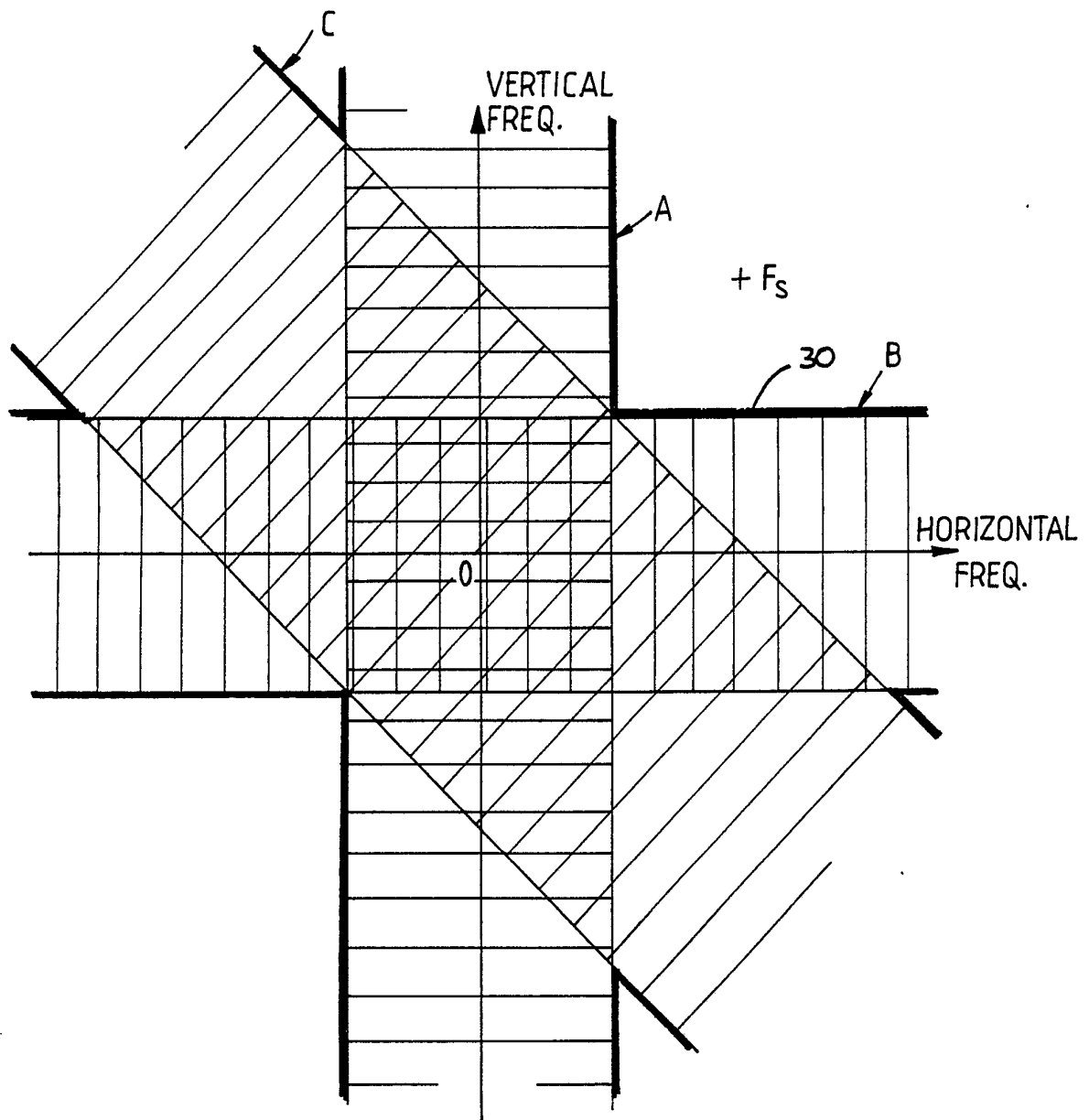
CLAIMS

1. A television transmission system for transmitting a television signal having a first bandwidth by means of a transmission channel having a second bandwidth lower than said first bandwidth; the system including pre-filtering means for filtering the signal prior to transmission, the pre-filtered signal being subsampled for transmission, and post-filtering means at the receiver for filtering a received signal after supersampling, the system being characterised in that the post-filtering means comprises a plurality of filters each having a different pass bandwidth to the other said filters and control means for switching selectively between the said filters and in that the pre-filtering means comprises a single filter means having a pass bandwidth such that the pre-filtering means rejects substantially all frequencies which cannot be passed by any of the filters of the post-filtering means.

2. Means for transmitting a television signal having a first bandwidth by means of a transmission channel having a second bandwidth lower than said first bandwidth, the means for transmitting including pre-filtering means for filtering the signal prior to transmission and means for subsampling the pre-filtered signal for transmission to a receiver including supersampling means and post-filtering means having a plurality of filters selectable by control means and each having a different pass bandwidth to the other said filters, the means for transmitting being characterised in that the pre-filtering means comprises a single filter means having a pass bandwidth such that the pre-filtering means rejects substantially all frequencies which could not be passed by any of the filters of the post-filtering means.

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Fig.1



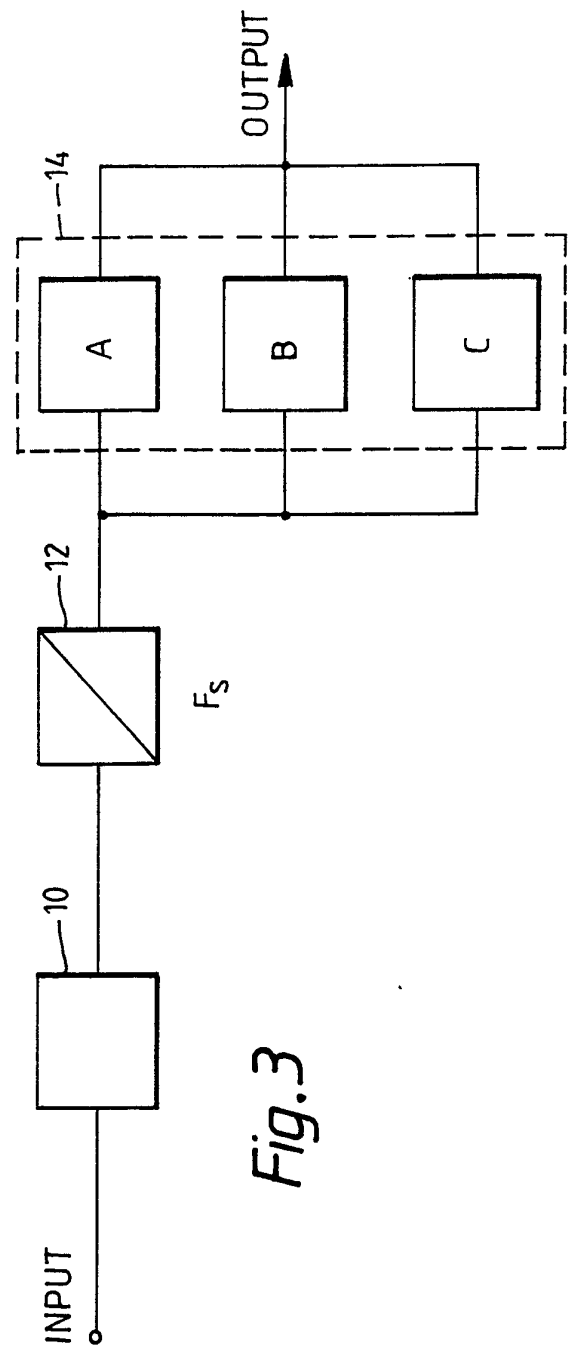
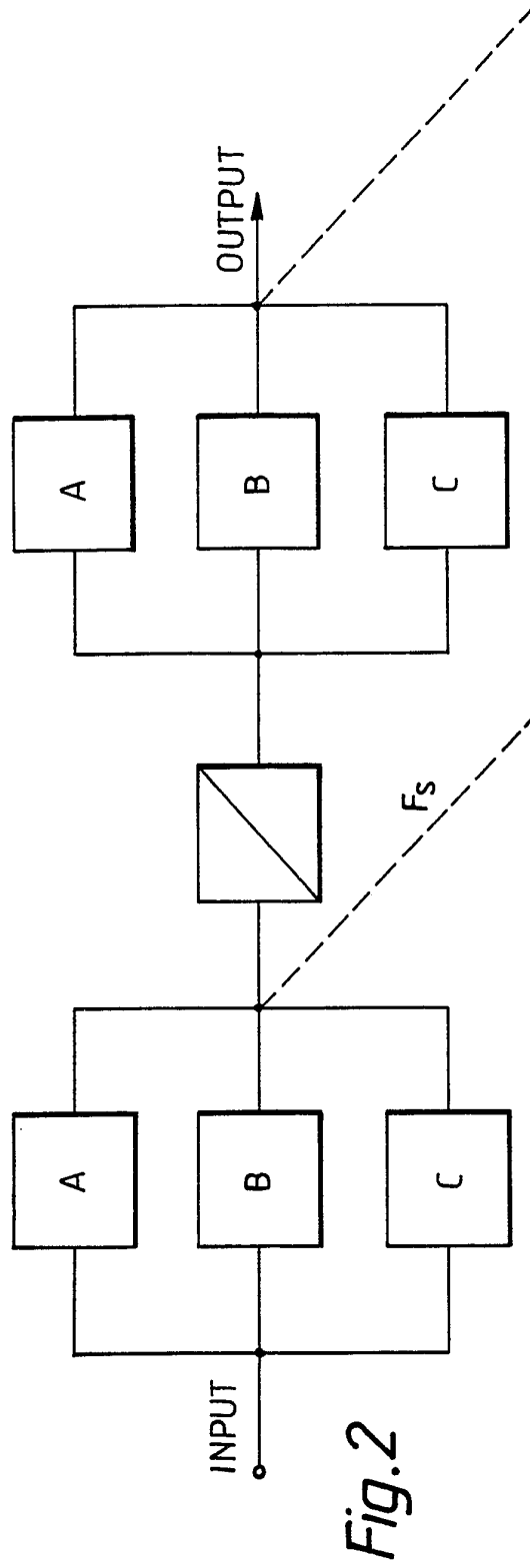
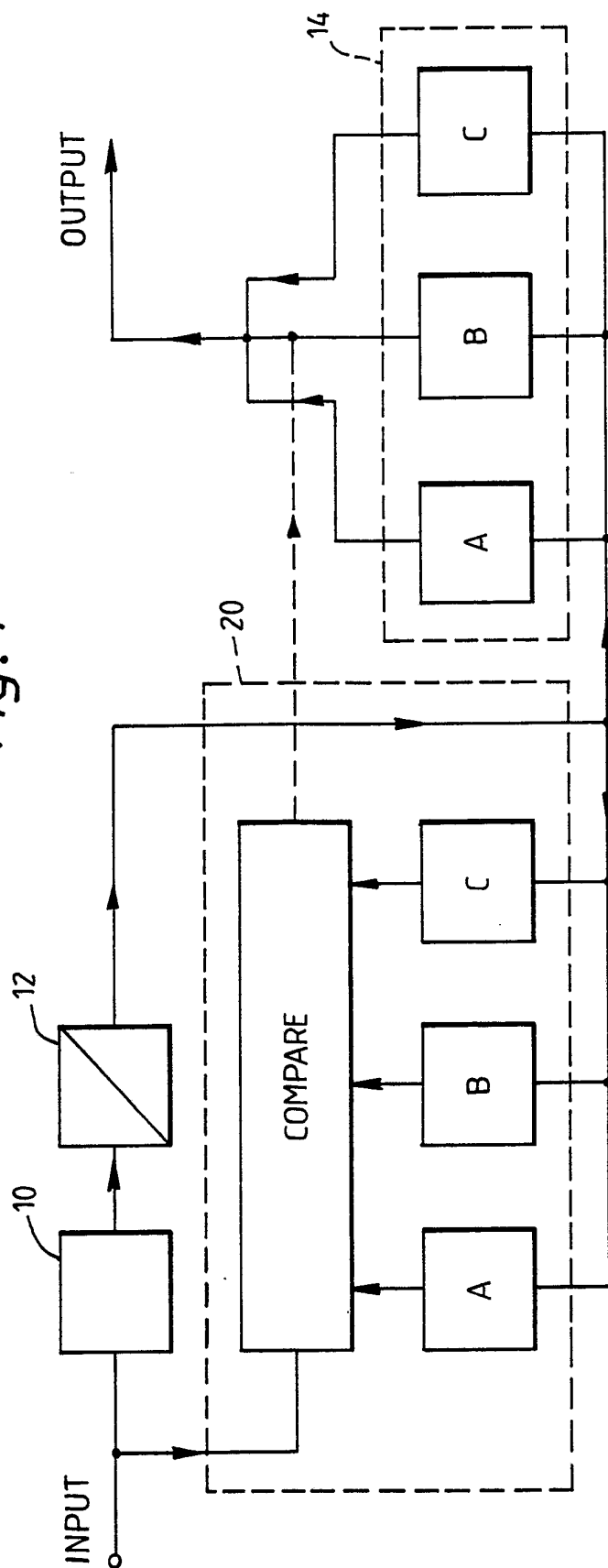


Fig. 4



## /INTERNATIONAL SEARCH REPORT

PCT/GB 91/02023

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)<sup>6</sup>

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

Int.Cl. 5 H04N7/12

## II. FIELDS SEARCHED

Minimum Documentation Searched<sup>7</sup>

Classification System	Classification Symbols
Int.Cl. 5	H04N

Documentation Searched other than Minimum Documentation  
to the Extent that such Documents are Included in the Fields Searched<sup>8</sup>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup>

Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
A	WO,A,8 704 034 (BRITISH BROADCASTING CORPORATION) ) 2 July 1987 see page 4, line 1 - page 7, line 30 ---	1,2
A	EP,A,0 352 964 (BRITISH BROADCASTING CORPORATION) ) 31 January 1990 see column 7, line 23 - column 10, line 29 ---	1,2
A	ELECTRONICS & WIRELESS WORLD. vol. 94, no. 1631, 30 September 1988, SUTTON GB pages 845 - 850; T.IVALL: 'Eureka 95 - a world standard?' see page 848, middle column, line 29 - page 849, left column, line 27 ---	1,2
A	EP,A,0 323 274 (BRITISH BROADCASTING CORPORATION) ) 5 July 1989 see column 3, line 10 - column 6, line 21 --- -/--	1,2

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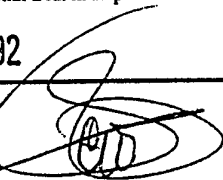
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## IV. CERTIFICATION

Date of the Actual Completion of the International Search  06 MARCH 1992	Date of Mailing of this International Search Report  12 MAR 1992
International Searching Authority  EUROPEAN PATENT OFFICE	Signature of Authorized Officer VERSCHELDEN J. 

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