



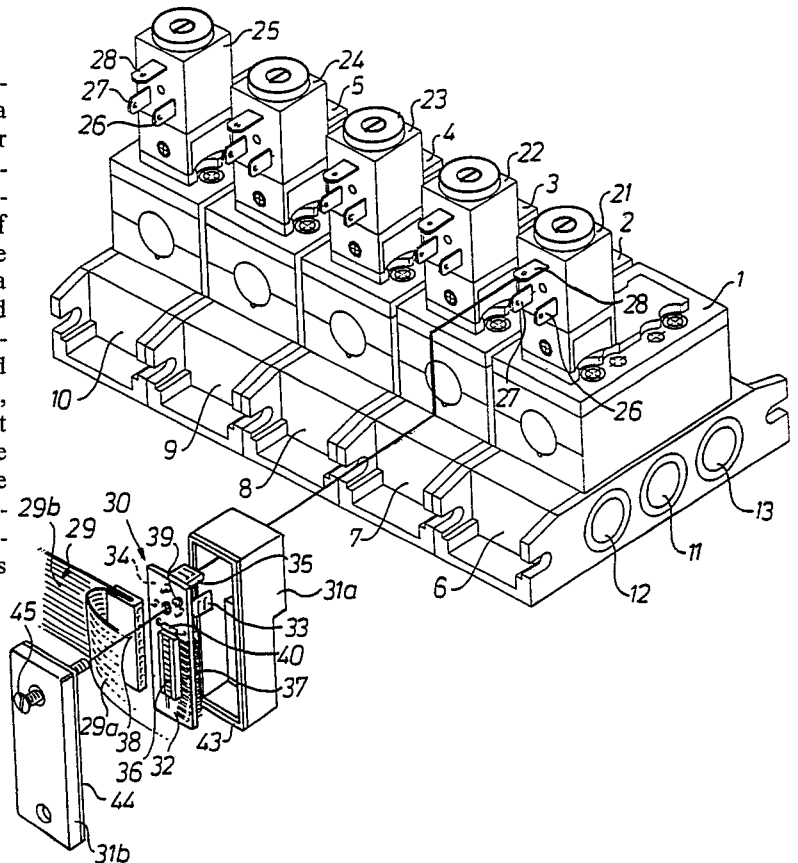
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<p>(21) International Application Number: PCT/SE91/00176 (22) International Filing Date: 6 March 1991 (06.03.91) (30) Priority data: 9001157-8 29 March 1990 (29.03.90) SE (71) Applicant (for all designated States except US): AB MEC-MAN [SE/SE]; S-125 81 Stockholm (SE). (72) Inventors; and (75) Inventors/Applicants (for US only) : LILJENBERG, Anders [SE/SE]; Sollerövägen 22, S-161 40 Bromma (SE). PETERSSON, Hans [SE/SE]; Mantalsvägen 4, S-141 39 Huddinge (SE). (74) Agents: MODIN, Jan et al.; Axel Ehnrners Patentbyrå AB, Box 10316, S-100 55 Stockholm (SE).</p>		<p>(81) Designated States: AT (European patent), 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), HU, IT (European patent), JP, LU (European patent), NL (European patent), NO, SE (European patent), SU, US.  <b>Published</b> <i>With international search report.</i></p>

(54) Title: ELECTRIC CONNECTING DEVICE FOR PILOT VALVES IN A VALVE ARRAY

(57) Abstract

Electric connecting device for electrically controlled, so called pilot valves (21-25) connected to a corresponding number of valves (1-5) in a modular valve array. Each pilot valve has equally placed contact pins (26, 27, 28), which are connected to a common, flexible connecting cable (29) with a plurality of conductors (29) over an electric connecting module (30). Each connecting module (30) is constituted by a coupling plate (32) provided with on the one hand contact sockets (33, 34, 35) for connection to said contact pins (26, 27, 28) of the respective pilot valve, and on the other hand a multipolar contact means (37), which is connectable to a corresponding cable contact means (38), which is connected to conductors of the common connecting cable (29). The coupling plate (32) is provided with an array of preferably controllable electrical connections (36) for the desired connection between said multipolar cable contact means (37) and said contact sockets (33, 34, 35).



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ELECTRIC CONNECTING DEVICE FOR PILOT VALVES IN A VALVE ARRAY

The invention concerns an electric connecting device for electrically controlled, so called pilot valves connected to a corresponding number of valves in a modular valve array, wherein each pilot valve has equally placed contact pins, normally three contact pins, which are connected to a common connecting cable with a plurality of conductors over an electric connecting module. By "a corresponding number" is meant either that each main valve (in particular a pneumatic, directional valve) has a single pilot valve or that at least two pilot valves are mounted on each main valve for controlling the function thereof.

In a known connecting device of a similar kind, the connecting modules are contained in a special plug-in-unit, which is mechanically fixed to the main valves and contains electrical connections, which are connected to the contact pins of the pilot valves in a predetermined manner. Thus, a plug-in-unit of this kind must be adapted to the dimensions of a particular valve array and the number of valves therein.

The aim of this invention is to achieve a flexible connecting device, which can be adjusted to different valve arrays in a simple manner, whereby the electrical as well as the mechanical connection can be varied by simple means as desired.

This aim is achieved according to the invention with a connecting device according to claim 1. Thus, every connecting module is constituted essentially by a coupling plate with contact sockets for electrical and mechanical connection with the contact pins of the pilot valve, so that the coupling plate, in particular in the form of a circuit card (c.f. claim 5), is connected to the contact pins of the pilot valve. The coupling plate or the circuit card further has a multipolar contact means, which is connectable to a cable contact means being

connected to the conductors of the common, flexible connecting cable, and an array of controllable electric connections, in particular contact bridges, for the desired connection between the multipolar contact means and the contact sockets which are connectable to the contact pins of the pilot valve. Hereby, the respective connecting module may easily be mounted on the contact pins of the associated pilot valve, and may further be adjusted to a desired electric connection between the contact pins of the pilot valve and the conductors of the common, flexible connecting cable. The latter is preferably constituted by a flat cable, as stated in claim 2, and facilitates a desired electric series connection of the pilot valves irrespective of their relative order and distance. Thus, the connecting device according to the invention may be adjusted in a very simple way to the valve array in question, i.e. to different mechanical constructional details (type, number, relative distance, etc.), as well as to different electric coupling arrangements (by exchanging the coupling plate or selectively controlling the contact bridges of the respective coupling plate).

Further advantageous features are stated in the dependent claims 3, 4, 6, 7, 8, 9 and 10 and will be apparent from the following detailed description of a preferred embodiment, reference being made to the annexed drawing.

Fig. 1 shows in a perspective view a valve array and (in an exploded view) the different parts of an electric connecting device according to the invention; and

Fig. 2 shows, likewise in a perspective view, the valve array according to Fig. 1 with the electric connecting device being completely mounted.

The valve array shown in Fig. 1 comprises a number (in this case

five) of serially connected, pneumatic main valves 1-5 being part of a compact control system. The valves 1-5 are mounted on supporting, mutually fastened (by screw fasteners, not shown) mounting plates 6-10, with a common inlet 11 for pressurized air and likewise common outlet ports 12, 13 (connected to a connecting portion 14 which is only shown in Fig. 2). The mounting plates 6-10 are at the underside (not shown), provided with inlet and outlet ports connected e.g. to pneumatic control cylinders.

The main valves 1-5, which in the embodiment are constructed as directional valves, are in turn controlled by so called pilot valves 21-25, which at the bottom are connected to the respective valve 1-5 through inlet and outlet ports (not visible) and at the top are provided with a solenoid part which is electrically connected to three flat contact pins 26, 27, 28, namely for the connection to signal, zero and earth conductors of a common connecting cable 29 by way of an electric connecting module 30.

In Fig. 1, only the connecting module 30 belonging to the pilot valve 21 is shown (the others are built up in a similar manner), said module 30 essentially comprising a coupling plate in the form of a rectangular circuit card 32 contained in a protective housing 31a, 31b and being provided with three contact sockets 33, 34, 35 (the socket 34 is not shown), an array of electric connections in the form of contact bridges 36, a multipolar contact means 37 (only partly visible) for the connection to a cable contact means 38, which is connected to the connecting cable 29, as well as other electrical components, i.a. a light emitting diode for operational indication and a varistor 40 for the protection against transients in the current supply of the magnet coil of the pilot valve.

The contact sockets 33, 34, 35 fit onto the respective flat contact pins 26, 27, 28 and serve as combined contact and

suspension means for the connecting module 30. The contact sockets 33, 34, 35 are connected to the contact bridges 36 through conductors on the circuit card, said contact bridges being connected to the multipolar contact means 37 through conductors on the circuit card (on the rear side not visible in the Figure of the circuit card 32). The contact bridges 36 consist of sheet metal contact elements, which before, during or after the installation can be broken away, for example by means of a screw driver or the like, so that only one or some of the signal conductors of the connecting cable 29 are connected to the signal contact pin of the pilot valve.

The multipolar contact means 37, which is located on the rear side of the circuit card 32 and the pins of which are not shown, is angled in such a way that the cable contact means 38, which is formed as a socket contact, lies flat and parallel to the rear side of the circuit card 32 when connected.

Thus, the contact pins 26, 27, 28 of the pilot valve 21 will be connected to the earth and zero conductors of the common connecting cable 29 after mounting of the connecting module 30 (and breaking of the desired sheet metal contact elements of the contact bridges 36) and to one or more of the signal conductors for the desired control of the pilot valve 21 (and the other pilot valves in a corresponding manner) from a number of signal generators or a central control unit (not shown), possibly through a decoder (not shown).

As shown in Figs. 1 and 2, the connecting cable 29 is of flat cable type, i.e. in the form of a plastic ribbon with a plurality of parallel conductors placed between surrounding strips of a synthetic material. The flexible flat cable 29 is divided into a number of portions 29a, 29b, 29c etc connected in series (see Fig. 2), over the respective flat socket contact means 28, which portions preferably form curved loops between

the connecting modules 30. The loop or flat cable portion 29a is connected to an ordinary multi-wire cable 42 through a connector 41.

5 It is obvious that the described arrangement facilitates a very simple electric connection of the pilot valves without any separate conductors having to be connected, e.g. by soldering, to the respective contact pin 26, 27, 28 or to any other contact means. The only thing that has to be done is to press the  
10 contact sockets 33, 34, 35 onto the contact pins 26, 27, 28 and to break some of the sheet metal contact elements. If an altered function is desired, the particular circuit card may be exchanged, whereby the connection to the pilot valve and the cable contact means can be made fast and easy. The cable 21 is  
15 thereby intact.

When mounted, the circuit card with its conductors, components and contact means is protected by the two-part protective housing, the inside part 31a of which is tightly attached to the  
20 outside of the pilot valve housing (around the contact pins 26, 27, 28) and the outer part or cap 31b of which is tightly attached to the inner part 31a by means of elastic seals 43 and 44, respectively. The circuit card 32 lies approximately flush with the partition line of the protective housing 31a, 31b, and  
25 the flat cable portions 29a, 29b lie flat between the seals 43, 44, so that no special lead-through arrangements are needed.

The protective housing, at least its cap 31b, is transparent, whereby it is possible to check whether the light emitting diode  
30 39 is lit up when the pilot valve in question is activated.

The whole connecting module 30 with its protective housing 31a, 31b is fastened by means of through fastening screws 45.

35 The described connecting device may be modified within the scope

of the following claims. In principle conventional cables may be used instead of the flat or ribbon cable portions 29a, 29b etc. Further, the electric connection may be made in any other way, for instance as switches, so that the contact function may be altered without exchanging the circuit card in the respective connecting module. Alternatively, the electric connections may be fixed, whereby the adjustment takes place by exchanging the circuit card. The protective housing 31a, 31b may be omitted if there is no demand for protection against dust, flushing or the like.

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## C L A I M S

1. Electric connecting device for electrically controlled, so called pilot valves (21-25) connected to a corresponding number of valves (1-5) in a modular valve array, wherein each pilot valve has equally placed contact pins (26,27,28), which are connected to a common connecting cable (29) with a plurality of conductors over an electric connecting module (30), characterized in

- that each connecting module (30) essentially consists of a coupling plate (32) provided with on the one hand contact sockets (33,34,35) dimensioned and arranged for connection to said contact pins (26,27,28) of the respective pilot valve (21), and on the other hand a multipolar contact means (37) being connectable to a corresponding cable contact means (38) which is connected to the conductors of the common connecting cable (29);

- that said connecting cable (29) comprises series-connected flexible portions (29a,29b,29c, etc) between the connecting modules (30);

- that said coupling plate (32) is provided with an array of controllable electric connections (36), in particular contact bridges, for the desired connection between said multipolar cable contact means (37) and said contact sockets (33,34,35), whereby the respective connecting module (30) is programmable for achieving electric connection between the contact pins (26,27,28) of the associated pilot valve and desired conductors of the common, flexible connecting cable (29).

2. Connecting device according to claim 1, characterized in that said flexible connecting cable is constituted of a flat cable (29).

5 3. Connecting device according to claim 2, characterized in that the ends of two adjoining flat cable portions are jointly connected into said cable contact means (38).

10 4. Connecting device according to claim 3, characterized in that said cable contact means is constituted by a longitudinal, relatively flat socket contact means (38) extending along the width of the flat cable, whereas said multipolar contact means is constituted by a corresponding pin contact means (37) attached to said coupling plate (32).

15 5. Connecting device according to any of the claims 1-4, characterized in that said coupling plate is constituted by a circuit card (32) with components, including said contact sockets (33,34,35), multipolar contact means (37)  
20 and electric connections (36) attached thereto.

6. Connecting device according to claims 4 and 5, characterized in that said pin contact means (37) is angled in such a way that the associated socket contact means  
25 (38) and the ends of the flat cable portions (29a,29b) connected thereto lie parallel to the circuit card (32).

7. Connecting device according to claim 5 or 6, characterized in that said components of the  
30 circuit card include means for operational indication, e.g. a light emitting diode (39), and/or protective means, e.g. transient protective means, e.g. a varistor (40), a zener diode or the like.

8. Connecting device according to any of the preceding claims, characterized in that said controllable electric connections (36) are constituted by mechanically breakable short-circuit sheet metal elements.

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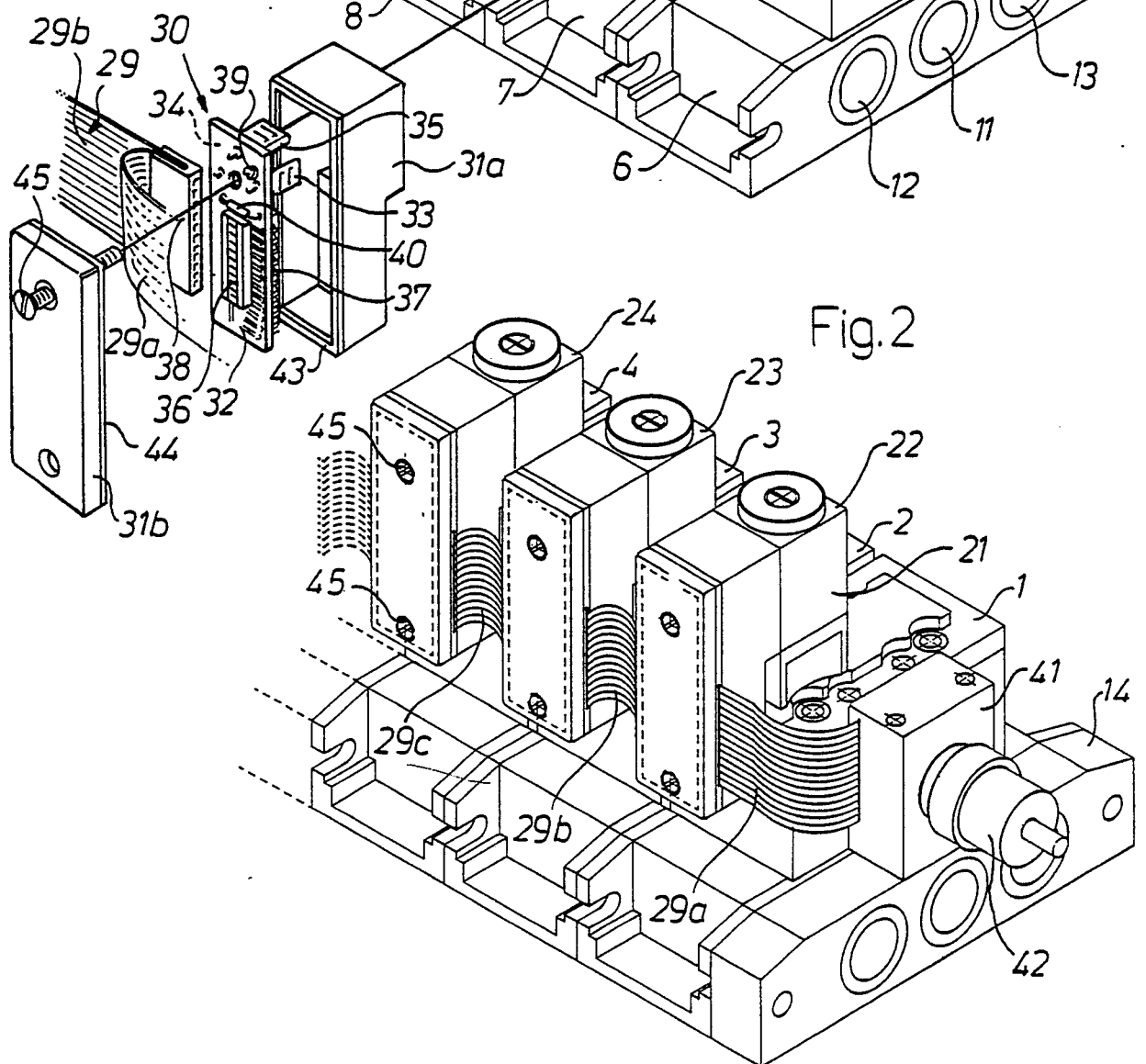
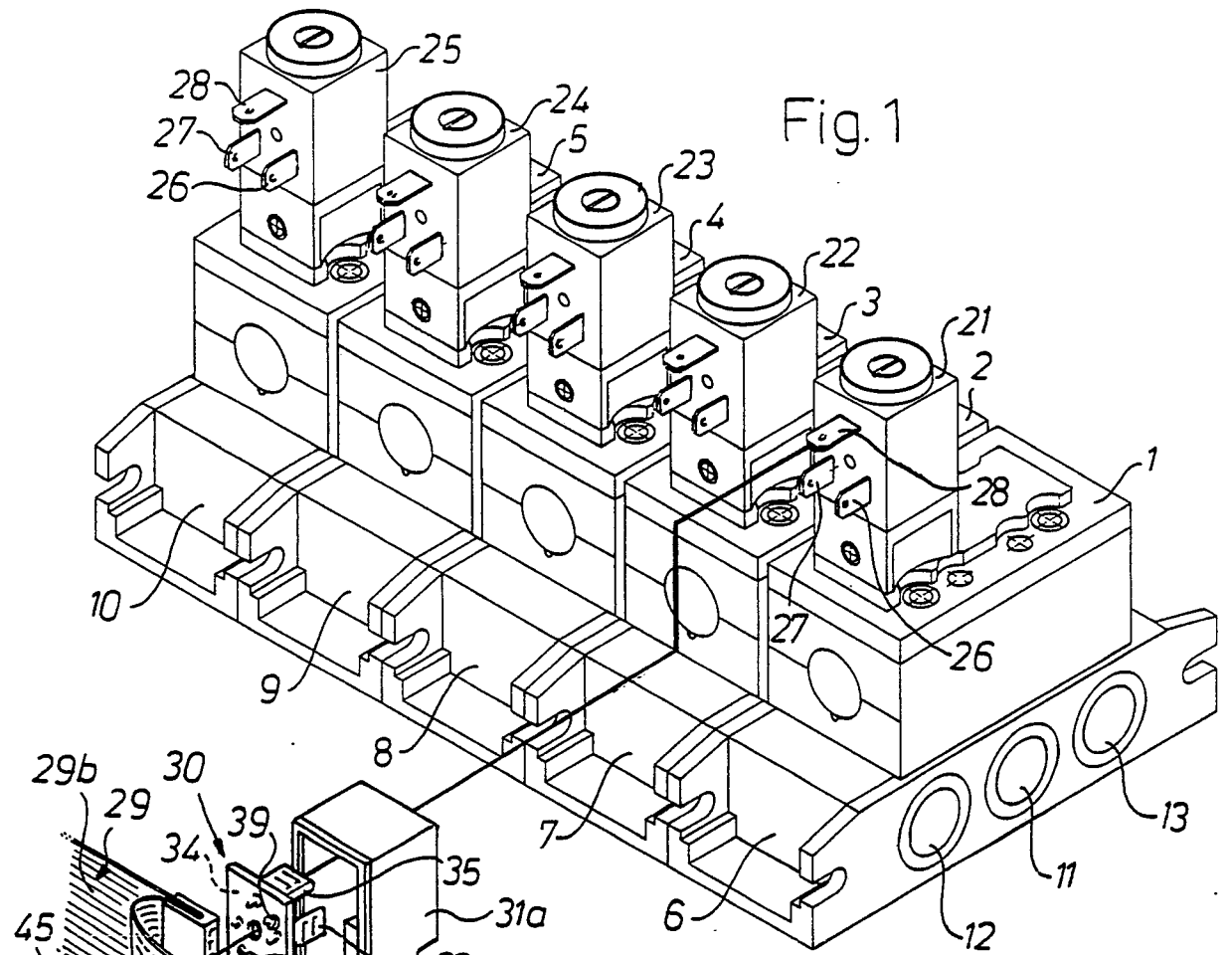
9. Connecting device according to any of the preceding claims, characterized in that said contact pins (26,27,28) of the respective pilot valve (21) together with the associated coupling plate (32) and contact means are contained in an openable, preferably two-part protective housing (31a,31b) with lead-through arrangements for said connecting cable (29).

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10. Connecting device according to claims 6 and 9, characterized in that the protective housing (31a,31b) is divided into two parts and that the circuit card (32) lies essentially in the partition plane of the protective housing, whereby both of the flat cable portions (29a,29b), which are connected to said socket contact means (38), are brought through the wall of the protective housing in the partition plane, preferably between elastic seals (43,44).

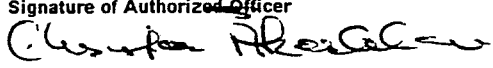
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# INTERNATIONAL SEARCH REPORT

International Application No **PCT/SE 91/00176**

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC <b>IPC5: H 01 R 9/22</b>		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
IPC5	H 01 R	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched <sup>8</sup>		
SE,DK,FI,NO classes as above		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b>		
Category *	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	DE, C2, 3637008 (NIXDORF COMPUTER AG) 11 May 1988, see the whole document --	1-10
A	EP, A2, 0278430 (OMRON TATEISI ELECTRONICS CO.) 17 August 1988, see the whole document --	1-10
A	CH, A, 560470 (PHÖNIX ELEKTRIZITÄTSGESELLSCHAFT H. KNÜMANN & CO) 27 March 1975, see the whole document --	1-10
A	CH, A, 469373 (OSKAR WOERTZ, INH. H. & O. WOERTZ) 15 April 1969, see the whole document -- -----	1-10
<p>* Special categories of cited documents:<sup>10</sup></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>"&amp;" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
26th June 1991	<b>1991-07-03</b>	
International Searching Authority	Signature of Authorized Officer	
<b>SWEDISH PATENT OFFICE</b>	 <b>CHRISTER ÅKERBLOM</b>	

**ANNEX TO THE INTERNATIONAL SEARCH REPORT  
ON INTERNATIONAL PATENT APPLICATION NO. PCT/SE 91/00176**

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 **91-05-29**. 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
DE-C2- 3637008	88-05-11	NONE	
EF-A2- 0278430	88-08-17	JP-A- 63264884 US-A- 4878860	88-11-01 89-11-07
CH-A- 560470	75-03-27	DE-A-B-C 2219131	73-10-31
CH-A- 469373	69-04-15	GB-A- 1254304 US-A- 3594709	71-11-17 71-07-20