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<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top; padding: 5px;"> (21) International Application Number: PCT/SE83/00457 (22) International Filing Date: 15 December 1983 (15.12.83) (31) Priority Application Number: 8207184-6 (32) Priority Date: 16 December 1982 (16.12.82) (33) Priority Country: SE (71) Applicant (for all designated States except US): INNOC- AP AKTIEBOLAG [SE/SE]; Box 81550, S-104 82 Stockholm (SE). (72) Inventor; and (75) Inventor/Applicant (for US only) : JÖNSSON, Nils [SE/ SE]; Högstigen 10, S-182 74 Stocksund (SE). (74) Agent: INGER, Ulf; L+U Inger Patentbyrå HB, Gar- varegatan 12, S-262 00 Ängelholm (SE). </td> <td style="width: 50%; vertical-align: top; padding: 5px;"> (81) Designated States: AT (European patent), BE (Euro- pean patent), CH (European patent), DE (European patent), DK, FI, FR (European patent), GB (Euro- pean patent), JP, LU (European patent), NL (Euro- pean patent), NO, SE (European patent), US. Published <i>With international search report.</i> <i>In English translation (filed in Swedish).</i> </td> </tr> </table>			(21) International Application Number: PCT/SE83/00457 (22) International Filing Date: 15 December 1983 (15.12.83) (31) Priority Application Number: 8207184-6 (32) Priority Date: 16 December 1982 (16.12.82) (33) Priority Country: SE (71) Applicant (for all designated States except US): INNOC- AP AKTIEBOLAG [SE/SE]; Box 81550, S-104 82 Stockholm (SE). (72) Inventor; and (75) Inventor/Applicant (for US only) : JÖNSSON, Nils [SE/ SE]; Högstigen 10, S-182 74 Stocksund (SE). (74) Agent: INGER, Ulf; L+U Inger Patentbyrå HB, Gar- varegatan 12, S-262 00 Ängelholm (SE).	(81) Designated States: AT (European patent), BE (Euro- pean patent), CH (European patent), DE (European patent), DK, FI, FR (European patent), GB (Euro- pean patent), JP, LU (European patent), NL (Euro- pean patent), NO, SE (European patent), US. Published <i>With international search report.</i> <i>In English translation (filed in Swedish).</i>
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(54) Title: A MICROPROCESSOR-CONTROLLED LIGHT SCREEN				
(57) Abstract A microprocessor-controlled light screen comprises a plurality of light transmitters and light receivers arranged in a holder on one side of the screen opening, and a corresponding number of light receivers and light transmitters arranged in a holder on the opposite side of the screen opening. Mutually opposite light transmitters and light receivers are sequentially actuable in pairs from a data processor over a given period of time. The light screen is characterized in that the data processor for each light transmitter and light receiver respectively is programmed to transmit a train of light pulses (codes) and to receive and change the received codes and to re-transmit the changed code to a receiver on the opposite side. The data unit on one side functions as a Master, and on the other side as a Slave. The data units are programmed to change (invert) received codes, and to transmit the changed codes to the opposite side.				

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A MICROPROCESSOR-CONTROLLED LIGHT SCREEN

The present invention relates to a microprocessor-controlled light screen intended to guard
5 against accidents when working with dangerous machines, for example presses, should an object be passed unintentionally into the screen opening. Such light
10 screens, or barriers, must be highly reliable. The light screen comprises a series of electrical light transmitters which are placed in a holder on one side of the curtain screen and which are arranged to send out a train of light pulses (codes), while a corresponding number of light pulse detectors are arranged in a holder on the opposite side of the opening, for
15 detecting the presence of an object in the screen opening, as a result of one or more of the beams transmitted being blocked by said object. The transmitters used may be light diodes which transmit invisible IR-light. The light screen is coupled to separate
20 sensing devices, which stop the machine should an object be passed into said opening, or should a fault occur in the monitoring system.

The characterizing features of the invention are set forth in the following claims.

25 The invention will now be described in more detail with reference to the accompanying drawings, in which Figure 1 illustrates schematically how the light screen system is constructed; Figure 2 is a block schematic of one of two identical processor
30 units having four transmitter and four receiver units, and a mains unit; Figure 3 is a circuit diagram for one of the two identical units; Figure 4 illustrates the pulse-train communication between the two processor units Master and Slave, and also illustrates



the change in the pulse train after each step; Figure 5 shows the shape of the pulses; and Figure 6 is a flow diagram of the programmes of the two microprocessors.

5 The light screen comprises two totally separate micro processors which are separated galvanically and which communicate with one another via the light curtain, i.e. the one data processor sends information with invisible IR-light to the other processor, and vice versa. With respect to hardware, the two
10 processor systems are identical, while their software (data cards) are mutually different. When programmed, the one data processor assumes the character of a so-called Master, and the other the character of a so-called Slave. This merely means that the one data
15 processor has predominance when starting-up and the like. Connected to the data processors in the drawings are four identical transmitter units and four identical receiver units, e.g. light diodes for invisible
20 light and photodiodes or phototransistors. In addition, there is provided a mains unit for the various data systems.

 The light diode is driven by a so-called driver (a current amplifier), Figure 2. The current amplifier on the receiver side is sensitive to a given
25 frequency, e.g. 42kHz, and consequently the transmitter must also be pulsed with the same frequency. This is effected by means of an oscillator, the frequency of which is set to 42kHz. The oscillator pulses are
30 added logically to the information-carrying pulses of the data processor by means of a so-called gate. Arranged on the receiver side is a photodiode incorporating an associated amplifier in an aluminium casing. The signal then passes to a tone decoder,
35 which may be a phase-locked circuit having a frequency



of 42kHz, Figure 3.

The Operational Mode of the Data Processors

The basic principle of the present invention is to cause two completely separate data processors to communicate with one another in an interactive manner, i.e. one data processor controls the operational mode of the other data processor and vice versa. This means that the total function is twice as safe. The principle of communication is one in which the transmitter S1 of the Master transmits a code communication to the receiver M, in accordance with Figure 4. This code can contain two ones (11). The Slave re-sends through the transmitter S1 a new code to the receiver M1 of the Master, namely two zeros (00) for example, i.e. it inverts both data bits. If this code (00) reaches the receiver M1 of the Master, the transmitter S2 of the Master sends a new code, in this case a one and a zero (10). If the light screen remains undisturbed, i.e. no object is present in the screen opening, all code words are sent, in accordance with Figure 4, whereupon the Master begins again from the beginning. Should a light beam be broken, e.g. the light beam transmitted from the transmitter S2 of the Master to the receiver M2 of the Slave, the Slave will wait, in vain, for a pulse for five ms, and when receiving no pulse within this period of time will initiate an alarm signal or will activate a relay or like device, to stop the machine. After a further few micro seconds have lapsed, the receiver M2 of the Master will become aware that the chain has been broken, i.e. the receiver receives no signal and also passes immediately into an alarm state. At the same time as the Master switches to an alarm state, it begins to transmit a signal to the transmitter M1 etc., so as to be able to check whether the fault is temporary



or permanent. If the fault still exists when the signal reaches receiver M2, the alarm state of the Master will continue. This means that each data processor is not only monitored by the light screen and the
5 second data processor, but also by all components in the two systems. This doubles the functional safety of the systems.

The shape or appearance of the pulses is shown in Figure 5. Each pulse begins with a so-called
10 start bit having a duration of one ms, the start bit being followed by two data bits. Each data bit has a length of one ms. When a data bit has a length of one ms, the transmitter transmits pulsating infrared light having a frequency of 42kHz. Figure 6
15 illustrates a flow sheet for the programmes of the two data processors. The programmes of the two data processors are written in their entirety in Figure 2.

In order to avoid optical activity in the paths
20 travelled by the light beams, each of the transmitters S and the receivers M are mounted approximately 40mm in their respective holes in the aforesaid holders. This provides a certain degree of collimation of the beams. Despite these holes, the beams spread or
25 widen quite considerably, which means that the light diode or transmitter 1 can be sensed by both the receivers 1 and 2, and possibly also by the receiver 3. This makes no difference, however, since each data processor itself chooses, in an intelligent manner,
30 which receiver shall be active at each moment.



C L A I M S

1. A microprocessor-controlled light screen comprising a plurality of light transmitters and light receivers arranged in a holder on one side of the screen opening, and a corresponding number of light receivers and light transmitters arranged in a holder on the opposite side of said screen opening, where-
10 with mutually opposite light transmitters and light receivers are sequentially actuatable in pairs from a data processor over a given period of time, characterized in that the data processor for each light transmitter and light receiver respectively is pro-
15 grammed to transmit light-pulse trains (codes) and to receive and to change the received code and transmit said changed code to a receiver on the opposite side.
- 20 2. A light screen according to Claim 1, characterized in that the light transmitters and light receivers on respective sides are connected to identical data units (microprocessors).
- 25 3. A light screen according to Claim 2, characterized in that with respect to hardware the data units (microprocessors) on both sides of the curtain opening are identical, but contain mutually different software.
- 30 4. A light screen according to Claim 3, characterized in that the data unit on one side of the opening functions as a Master, and the data unit on the other side functions as a Slave.



5. A light screen according to any one of the preceding Claims, characterized in that the data units are programmed to change received codes, and to transmit the changed codes to the opposite side.

5

6. A light screen according to Claim 5, characterized in that the data units are programmed to invert received codes, and to send said inverted codes to the receiver on the opposite side.

10

7. A light screen according to any one of the preceding Claims, characterized in that the data units have a plurality of light transmitters and light receivers respectively, and also a mains unit.

15



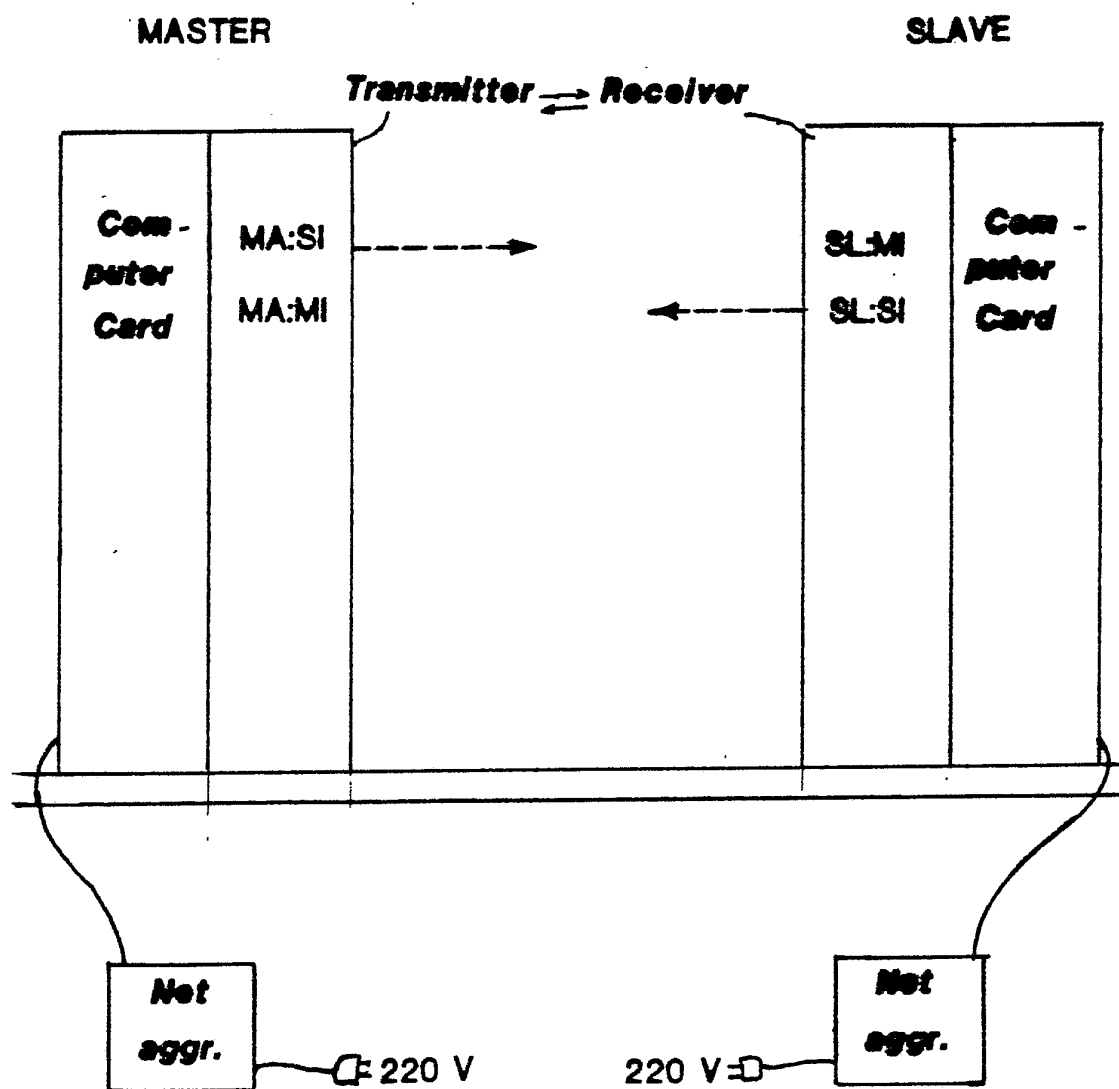


FIG 1

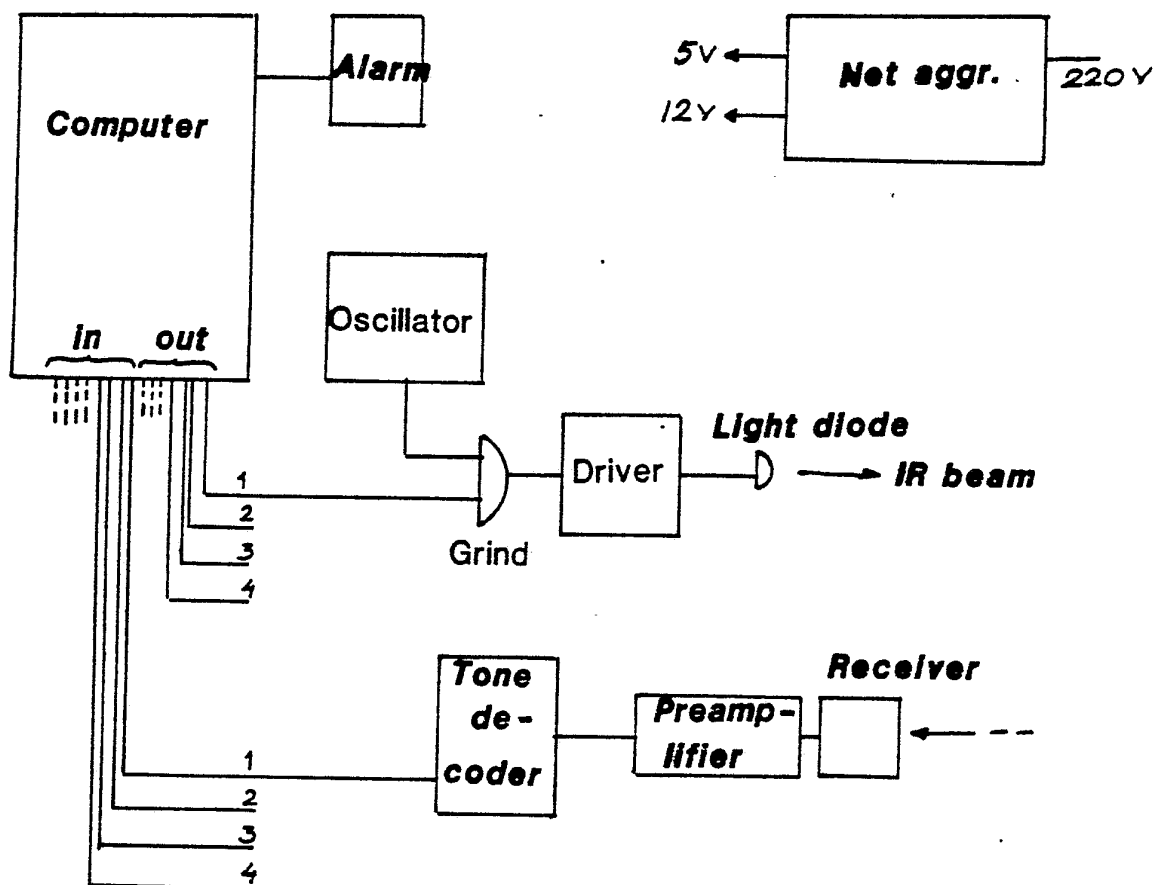
Block scheme

FIG 2

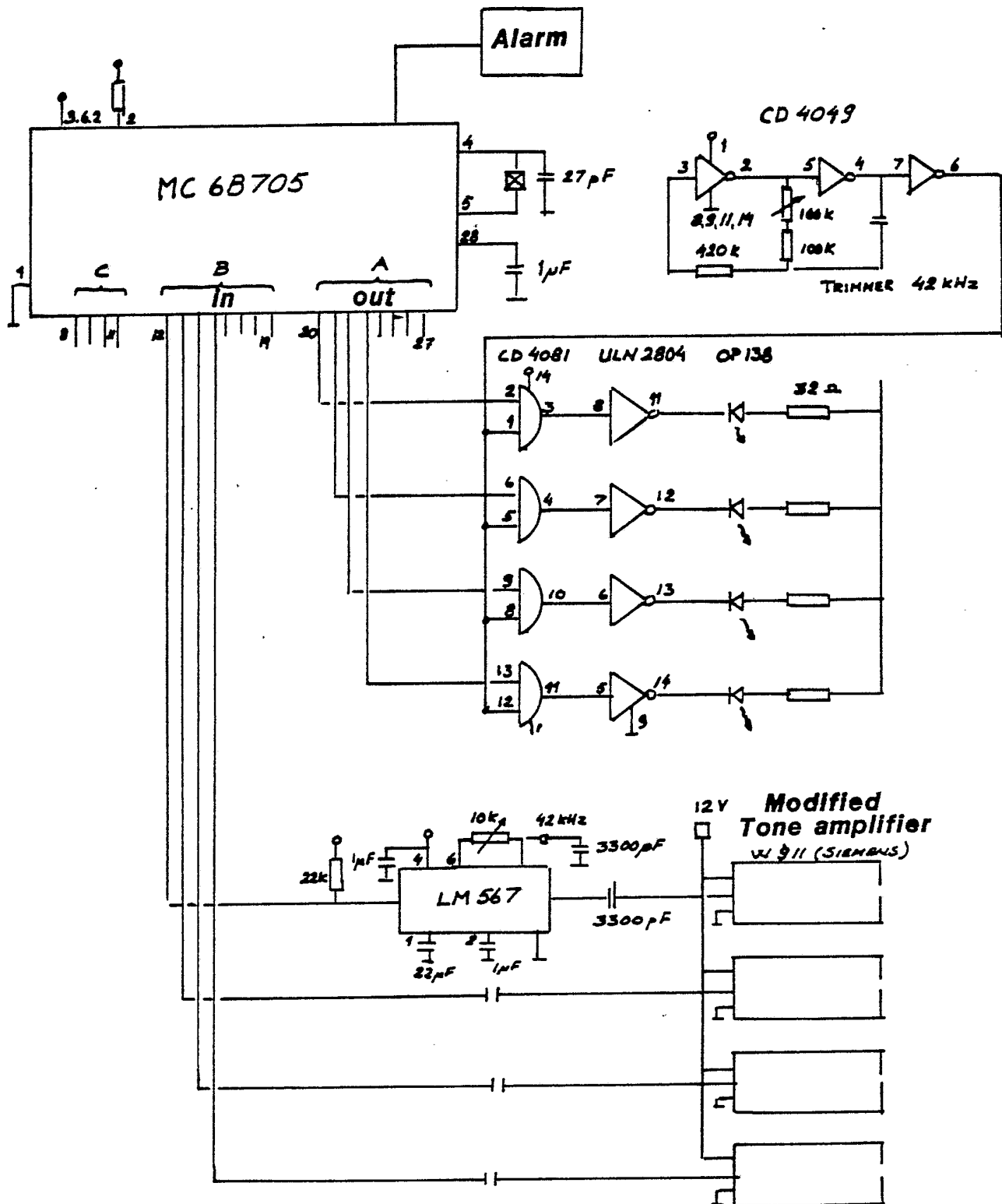


FIG 3

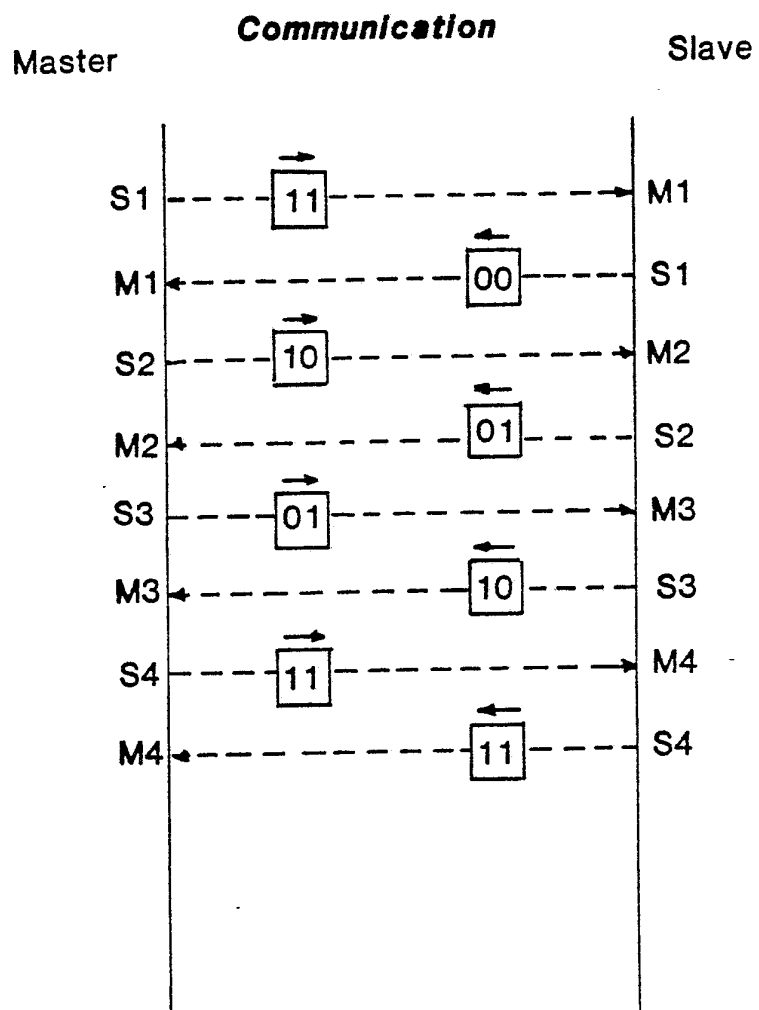


FIG 4

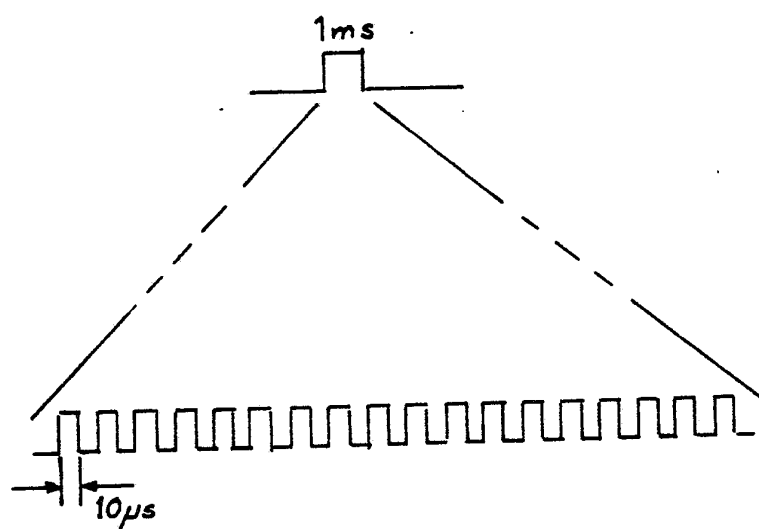
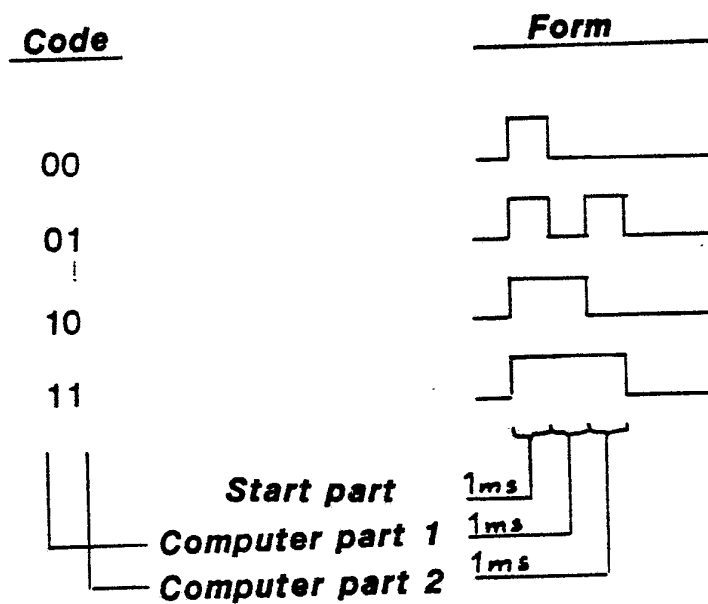
Pulse forms

FIG 5

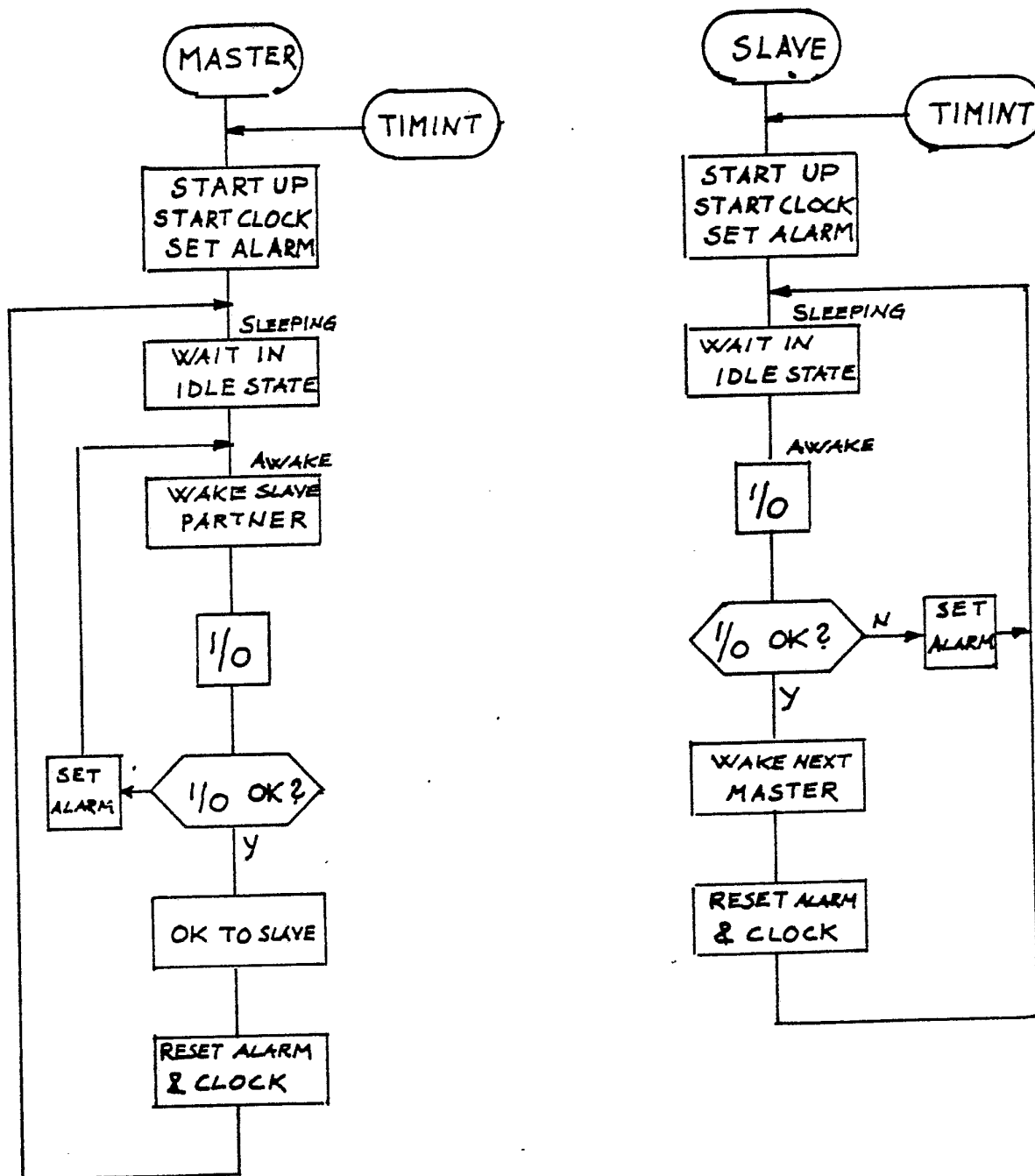
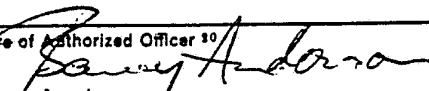
Programming

FIG 6

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE83/00457

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC 3		
G 08 B 13/18 // F 16 P 13/14		
II. FIELDS SEARCHED		
Minimum Documentation Searched 4		
Classification System	Classification Symbols	
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Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 5		
SE, NO, DK, FI classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT 14		
Category *	Citation of Document, 16 with indication, where appropriate, of the relevant passages 17	Relevant to Claim No. 18
X	US, A 3 742 222 (ALFONS ENDL) 26 June 1973 & DE 2007840 CH 523463	1
A	GB, A, 2 023 282 (TELUB AB) 11 Oktober 1979	
A	SE, A, 324 726 (SERVODAN AS) 1 July 1968	
A	SE, A, 385 746 (TELUB AB) 21 Mars 1976	
A	SE, A, 417 462 (L E SVENSSON) 22 December 1980	
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IV. CERTIFICATION		
Date of the Actual Completion of the International Search 1	Date of Mailing of this International Search Report 2	
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