

AUSTRALIA

Patents Act 1952

DECLARATION IN SUPPORT OF A CONVENTION OR NON-CONVENTION
APPLICATION FOR A PATENT OR PATENT OF ADDITION

No. 19361/88

Name(s) of Applicant(s)

In support of the application/made by BERTIN & CIE

Title

for a patent for an invention entitled A METHOD AND A DEVICE FOR DETERMINING THE NUMBER OF PEOPLE PRESENT IN A DETERMINED SPACE

Name(s) and address(es) of person(s) making declaration

I/We, Gilbert DAHAN, Vice General Manager of BERTIN & CIE, B.P. N° 3, 78373 PLAISIR CEDEX, FRANCE

do solemnly and sincerely declare as follows:-

1. I am/we are the applicant(s) for the patent, or am/are authorised by the abovementioned applicant to make this declaration on its behalf.
2. The basic application(s) as defined by Section 141 of the Act was/were made in the following country or countries on the following date(s) by the following applicant(s) namely:-

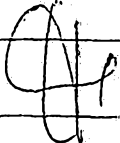
	in <u>FRANCE</u>	on <u>June 5,</u>	<u>19 87</u>
	by <u>BERTIN & CIE</u>		
	in _____	on _____	19 _____
	by _____		
3. The said basic application(s) was/were the first application(s) made in a Convention country in respect of the invention the subject of the application.
4. The actual inventor(s) of the said invention is/are
 - 1) Michel FARDEAU, 20 Domaine de Monclar, 13290 Les Milles FRANCE
 - 2) Yves GUERN, Chemin des Hermentaires, Quartier du Couvent, 83470 Pourrières, FRANCE
 - 3) Jean-Pierre DIGNAC, Quartier Le Parterre, 13880 Velaux, FRANCE
 - 4) Jean-Marc DREVON, 5 Rue de l'Estivale 13770 Venelles
5. The facts upon which the applicant(s) is/are entitled FRANCE to make this application are as follows:-
the applicant would be entitled to have assigned to it a patent granted to any of the actual inventors in respect of the said invention

Country, filing date and name of Applicant(s) for the or each basic application

Name(s) and address(es) of the or each actual inventor

See reverse side of this form for guidance in completing this part

DECLARED at PARIS, FRANCE this 12 day of January 1989



PCT

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ORGANISATION MONDIALE DE LA PROPRIÉTÉ INTELLECTUELLE
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DEMANDE INTERNATIONALE PUBLIÉE EN VERTU DU TRAITÉ DE COOPÉRATION EN MATIÈRE DE BREVETS (PCT)

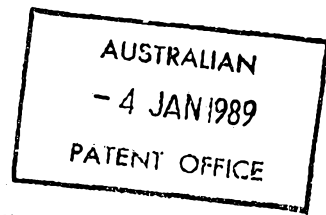
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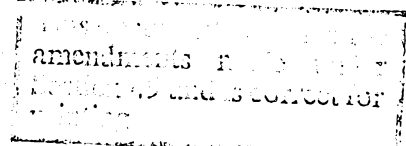
(74) Mandataire: RAMEY, Daniel; Cabinet Orès, 6, avenue de Messine, F-75008 Paris (FR).
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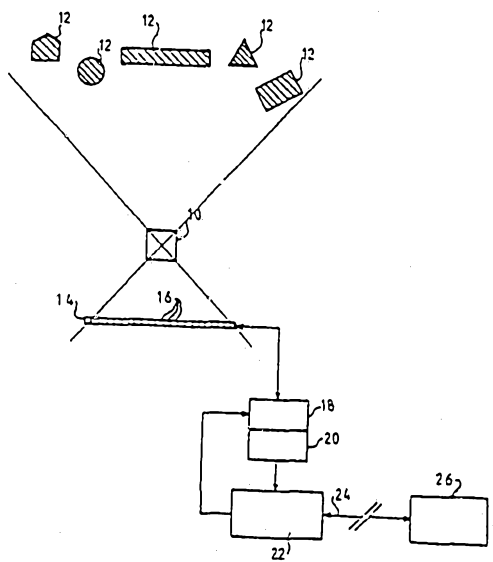
(54) Title: PROCESS AND DEVICE FOR DETERMINING THE NUMBER OF PERSONS PRESENT IN A GIVEN SPACE
 (54) Titre: PROCÉDE ET DISPOSITIF DE DETERMINATION DU NOMBRE DE PERSONNES PRESENTES DANS UN ESPACE DETERMINE

(57) Abstract

The invention concerns a process and a device for determining the number of persons present in a given space by means of a small bar (14) of photodetectors (16) on which a lens (10) produces a linear image of a space containing objects or persons (12). The signals produced successively by the photodetectors (16) are compared by a microcalculator (22) in order to detect the movements of persons and to deduce therefrom the number of persons present. The invention is applicable in particular to the carrying out of automatic surveys of television audiences and to the surveillance of buildings.

(57) Abrégé

L'invention concerne un procédé et un dispositif de détermination du nombre de personnes se trouvant dans un espace déterminé, au moyen d'une barre (14) de photodétecteurs (16) sur laquelle un objectif (10) forme une image linéaire d'un espace comprenant des objets ou des personnes (12). Les signaux produits successivement par les photodétecteurs (16) sont comparés par un microcalculateur (22) pour mettre en évidence les mouvements des personnes et en déduire le nombre de personnes présentes. L'invention s'applique notamment à la réalisation de sondages automatiques d'audience de télévision et à la surveillance de locaux.



A METHOD AND A DEVICE FOR DETERMINING THE NUMBER OF PEOPLE
PRESENT IN A DETERMINED SPACE

The invention relates to a method and to a device for
determining the number of people present in a determined space,
5 and it is equally applicable to performing television audience
surveys and to performing automatic surveillance of premises.

Apparatuses already exist for performing television
audience surveys, these apparatuses are associated with
respective television sets and they are capable of recording
10 the times at which the television set is switched on and off,
together with the channel that is selected, thereby making it
possible, in combination with the times given by a time base,
to accurately determine which programs are selected. A central
computer uses the telephone network to interrogate apparatuses
15 of this nature associated with television sets and thus to
automatically determine audience ratings and hence the success
of various broadcasts put out by different television channels.
However, these prior apparatuses do not provide information
concerning the number of people watching a program on a tele-
20 vision set, indeed they do not even specify whether there is
anybody actually watching a television set which happens to be
switched on.

Devices are also known, in general for use in premises
surveillance for security purposes, which make use of ultra-
25 sonic or Doppler effect detectors and which provide information
on the presence or absence of people in a determined premises.
Nevertheless, these prior devices do not specify how many
people are present. To obtain the number of people present it
is necessary to use means for counting people passing through
30 the entrance and through the exit of a room. However, this
requires the entrance to a room to be separated from its exit,
and it also requires counting to be initialized. Further, such
means would not be suitable for performing automatic television
audience surveys since merely verifying the presence of a
35 person in a room where a television set is present does not
ensure that the person is actually watching a broadcast.



According to the present invention there is provided a method of determining the number of people present in a given space, said method comprising forming an image of said space on a set of photodetectors, reading the output signals of said photodetectors at a determined read frequency, comparing the output signals of the same photodetectors in pairs of successive images, comparing the differences between the compared output signals of each photodetector with a threshold which is a function of the energy level of the photodetector and obtaining first result signals, comparing successive first result signals with each other to determine a second result signal over a given period, and deducing the number of people present in said space therefrom.

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According to the present invention there is further provided a device for determining the number of people in a given space, said device comprising an objective lens forming an image of said space on a strip or set of photodetectors, reading circuits connected to the photodetectors for reading their output signals at a determined read frequency, an analog-to-digital converter connecting the reading circuits to an information processing means such as a micro-computer, said information processing means being adapted for comparing the output signal signals of each photodetector in pairs of successive images of said space, comparing the differences of the output signals with a threshold and obtaining first result signals, comparing successive first result signals with each other for determining a second result signal over a given period, and deducing the number of people present in said space therefrom.

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The invention will be better understood, and other details, characteristics, and advantages thereof will appear on reading the following explanatory description which is made by way of example and with reference to the accompanying drawings, in which:

Figure 1 is a diagram of a device in accordance with the invention;

Figure 2 is a diagram showing a method of processing the signals from the photodetector; and

Figure 3 is a diagram showing the timing of essential stages in the method of the invention.

Reference is made initially to Figure 1 which shows the essential components of a device in accordance with the invention.

The device comprises an objective lens 10, such as the lens of a still camera or a video camera, said lens having a field of observation in which objects or persons 12 may be present.

The lens 10 is associated with a strip or row 14 of elementary photodetectors 16 such as charge-transfer photodetectors, and there may be 512 or 1,024 of them. The lens 10 forms an image of a plane in the space lying in its field of observation on the strip 14 of photodetectors 16, said plane corresponding to the plane of the drawing of Figure 1.

The photodetectors 16 of the strip 14 are associated with circuits given an overall reference 18, including circuits for reading the charges on the photodetectors 16 and at least one clock for determining the integration period or the frequency at which the photodetectors 16 are read. The read circuits are connected via an analog-to-digital converter 20 to a microprocessor 22 which processes the output signals from the photodetectors 16 and which controls the circuits 18. The microprocessor 22 may be interrogated, for example over the telephone network 24 by a remotely situated computer or else by a central unit 26.

When the invention is applied to performing automatic audience surveys, the device of the invention is associated



with a television set and is arranged to form an image on the strip 14 of photodetectors corresponding to a substantially horizontal flat zone situated at about 1 meter (m) above the ground, which height corresponds to the upper portion of the body of a person sitting in front of a television set.

When the invention is applied to performing the surveillance of premises, the device may include a matrix of photodetectors, thereby avoiding limiting its scan to a single dimension.

The main stages of the method of the invention, and the operation of the device, are now described with reference to Figures 2 and 3.

Curves a and b in Figure 2 represent the video signals obtained by reading the elementary photodetectors 16 of the strip 14 at two instants which are separated by a predetermined time interval.

Each of the curves a and b represents the gray levels which are observed by the various photodetectors.

When the scene under observation does not change between two observation instants, and providing the illumination thereof has not changed either, then the curves a and b are identical. However, when a person forming a part of the scene under observation moves, even by very little, that movement gives rise to a variation in the gray levels seen by the corresponding photodetectors. Detecting variations in the gray levels seen by the photodetectors thus serves to show that a person has moved, and as a result makes it possible to recognize the presence of a person and to distinguish that person from other people forming a part of the same scene under observation. As a corollary, it is possible to determine the number of people present in the scene. It is not possible, in practice, for a person to remain completely stationary, without even breathing, for more than a few seconds.

The processing of the video signals provided by the strip 14 of photodetectors is essentially as follows: two successive signals such as those represented by curves a and b are compared, and they are subtracted from each other in order to



obtain the signal shown by curve c. This signal is amplified (curve d), and is then rectified and converted into binary signals by comparison with a given threshold, which is set to eliminate the residual noise of the photodetectors 16. The
5 resulting signal, shown in curve e, comprises a first square-wave pulse or echo 28 of relatively large width and a second squarewave pulse or echo 30 of much smaller width. This signal is then applied to a filter which retains only the first echo 28 (curve f) which corresponds to a person, while eliminating
10 the second echo 30 whose width is much too small to correspond to a person, and which may be due, for example, to a local change in illumination (e.g. a lamp being switched on or off) or to the movement of a hand or an object held by a person.

In greater detail, the timing of the various operations of
15 the method of the invention may be as follows (Figure 3):

The photodetectors in the strip 14 are read at a frequency which is determined by the microprocessor 22 as a function of the intensity with which the observed scene is illuminated so as to avoid saturating the photodetectors and so as to ensure
20 that the mean gray levels seen by the photodetectors remain substantially constant and independent of lighting conditions. In practice, the rate at which the photodetectors are read may vary over the range one to ten (or even more) reads per second. The series of reads applied to the photodetectors for a given 5
25 second (s) to 6 s period of time is represented by portion A of Figure 3, from which it can be seen that reading takes place at a frequency of about four reads per second.

The signals read by the circuit 18 and digitized by the converter 20 are recorded by the microprocessor 22 at a
30 frequency which is no greater than the read frequency and which is more often a submultiple of said read frequency. Portion B of Figure 3 shows the stage of recording the digitized signals, and it can be seen in this example that a signal is recorded every half-second, which is equivalent to saying that only
35 every other digitized signal is recorded.

The next stage consists in comparing pairs of successive recorded signals which are separated from each other by a



predetermined time interval or by a predetermined number of recorded signals, and in taking the difference between the pair of signals being compared. This stage is represented by portion C of Figure 3 for the case where the recorded signals
5 being compared are separated from each other by an interval of 3 seconds. In other words, the first signal recorded at instant zero is compared 3 seconds later with the signal which has just been recorded, and the difference between them is processed as described with reference to Figure 2 (they are
10 amplified, rectified, transformed into binary signals, and then filtered) in order to obtain a result signal which is recorded at instant $t = 3$ s (portion C of Figure 3). The signal recorded at time $t = 0.5$ s is compared with the signal recorded at time $t = 3.5$ s, and so on.

15 The next stage consists in mutually comparing a predetermined number of results in order to eliminate spurious results which may be due to a person passing quickly in front of the television set, to the temporary superposition of the images of two people, etc. This stage is represented by portion D
20 of Figure 3 for the case where three successive results are mutually compared. The result of this comparison is recorded at instant $t = 4$ s.

It follows from the timing of these various stages, that the final result is obtained 4 s after the first event to be
25 recorded. This delay is known since it is determined by the frequency at which the photodetectors are read, the frequency at which the read and digitized signals are recorded, the selected time interval between the pairs of signals which are compared, and the number of successive results which are
30 mutually compared, and it can therefore be taken into account by the microprocessor which specifies the exact instant corresponding to each result.

The microprocessor also serves to adjust the frequency at which the digitized signals are recorded and the time interval
35 between two compared signals as a function of the detected speed of displacement of a person in the scene being observed. Naturally, when people are sitting down in front of a



television set, their movements are generally relatively slow, and the time interval between two recorded signals that are to be compared should be at least 2 s to 3 s in order to ensure that the difference between the two compared signals is not substantially zero, i.e. so as to make it possible to determine the number of people present. However, when people are moving rapidly in a premises, this time interval between compared signals should be smaller and the frequency at which signals are recorded may be increased.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of determining the number of people present in a given space, said method comprising forming an image of said space on a set of photodetectors, reading the output signals of said photodetectors at a determined read
5 frequency, comparing the output signals of the same photodetectors in pairs of successive images, comparing the differences between the compared output signals of each photodetector with a threshold which is a function of the energy level of the photodetector and obtaining first
10 result signals, comparing successive first result signals with each other to determine a second result signal over a given period, and deducing the number of people present in said space therefrom.

2. A method according to Claim 1, further comprising comparing the second results obtained over various periods with each other, and deducing the number of people from these comparisons.

3. A method according to Claim 1 or 2, wherein the said read frequency is varied as a function of the intensity with which the space is illuminated in order to obtain a mean output signal which is substantially independent of lighting conditions.

4. A method according to any one of the preceding claims, wherein the above-specified images are recorded at a frequency which is a submultiple of the read frequency, and wherein the output signals in pairs of successive images which are separated from each other by a determined number of recorded images are compared.

5. A method according to Claim 4, wherein the frequency at which images are recorded and/or the number of images separating two compared images is/are varied as a function of the speed of displacement of a person.

6. A method according to any one of the preceding claims, wherein the differences between the compared output signals are transformed into binary signals, by rectification and comparison with the said threshold.

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7. A method according to Claim 6, wherein the binary signals are filtered in order to eliminate the signals which are too small to correspond to a person.

8. A method according to any one of the preceding claims, applied to determining the number of people watching a television set, or to performing surveillance of premises.

9. A method of determining the number of people present in a determined space substantially as herein described with reference to the accompanying drawings.

10. A device for determining the number of people in a given space, said device comprising an objective lens forming an image of said space on a strip or set of photodetectors, reading circuits connected to the photodetectors for reading their output signals at a determined read frequency, an analog-to-digital converter connecting the reading circuits to an information processing means such as a micro-computer, said information processing means being adapted for comparing the output signal signals of each photodetector in pairs of successive images of said space, comparing the differences of the output signals with a threshold and obtaining first result signals, comparing successive first result signals with each other for determining a second result signal over a given period, and deducing the number of people present in said space therefrom.

11. A device according to Claim 10, wherein the information processing means are adapted for comparing the second results obtained over various periods with each other and for deducing the number of people from these comparisons.

12. A device according to Claim 10, wherein for each photodetector, the information processing means are adapted for determining the said threshold as a function of the energy level of the photodetector.



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13. A device according to any one of Claims 10 to 12, wherein the information processing means are adapted for determining the read frequency as a function of the intensity of illumination in said space.

14. A device according to any one of Claims 10 to 13 wherein the information processing means are adapted for recording the output signals of the photodetectors at a recording frequency which is a submultiple of the photodetector read frequency, and for comparing pairs of successively recorded signals which are separated from each other by a determined number of recorded signals.

15. A device according to Claim 14, wherein the information processing means are adapted for transforming the differences between the compared signals into binary signals, and comprise filter circuits for eliminating non-significant differences.

16. A device according to any one of Claims 10 to 15 associated with a system for performing surveillance of premises or with a television set for the purpose of determining the number of people watching the television set.

17. A device for determining the number of people in a given space substantially as described herein with reference to and as illustrated in the accompanying drawings.

DATED this 7th day of August, 1990.

BERTIN & CIE
By Its Patent Attorneys

GRIFFITH HACK & CO.
Fellows Institute of Patent
Attorneys of Australia.

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FIG.1

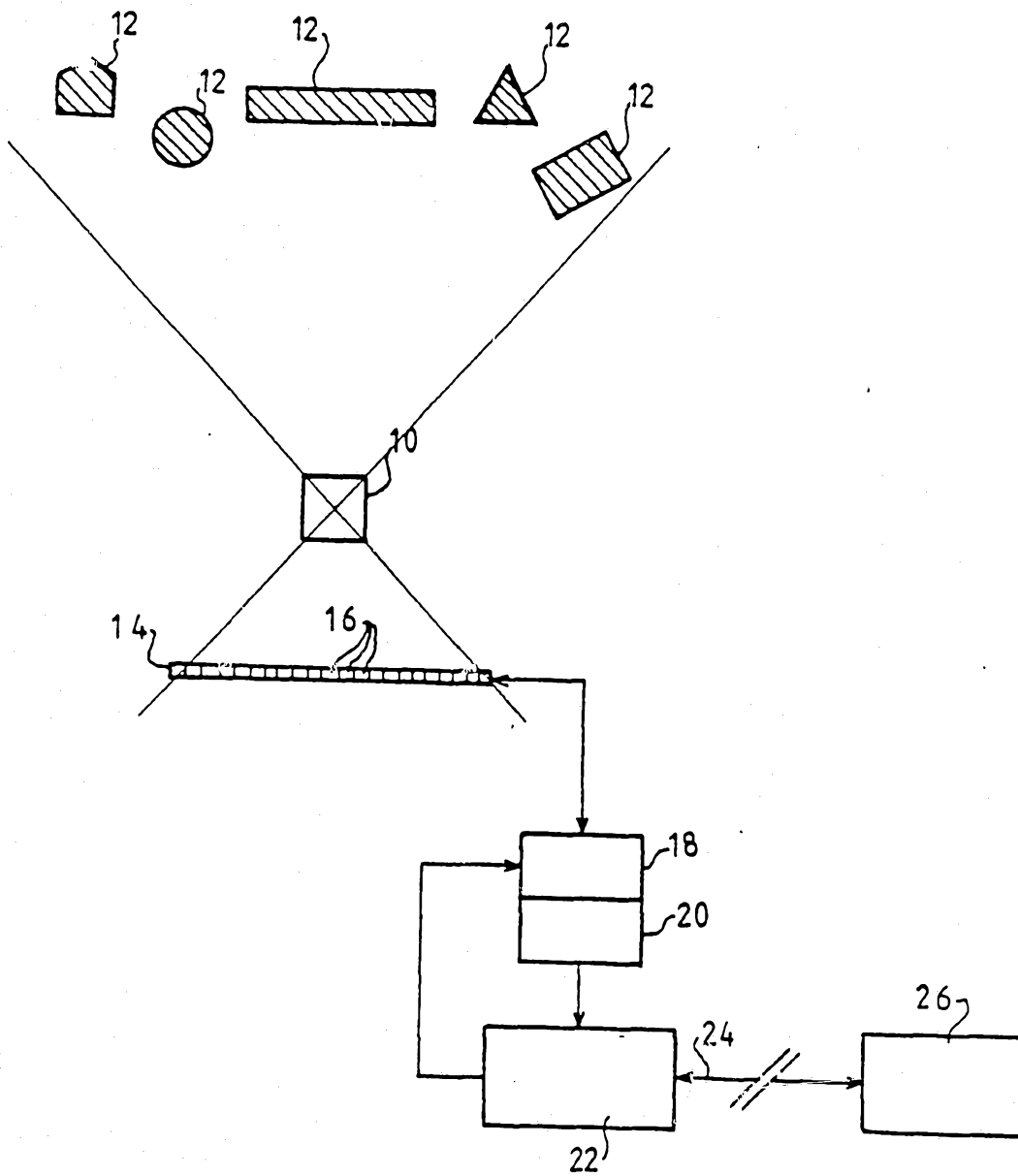


FIG. 2

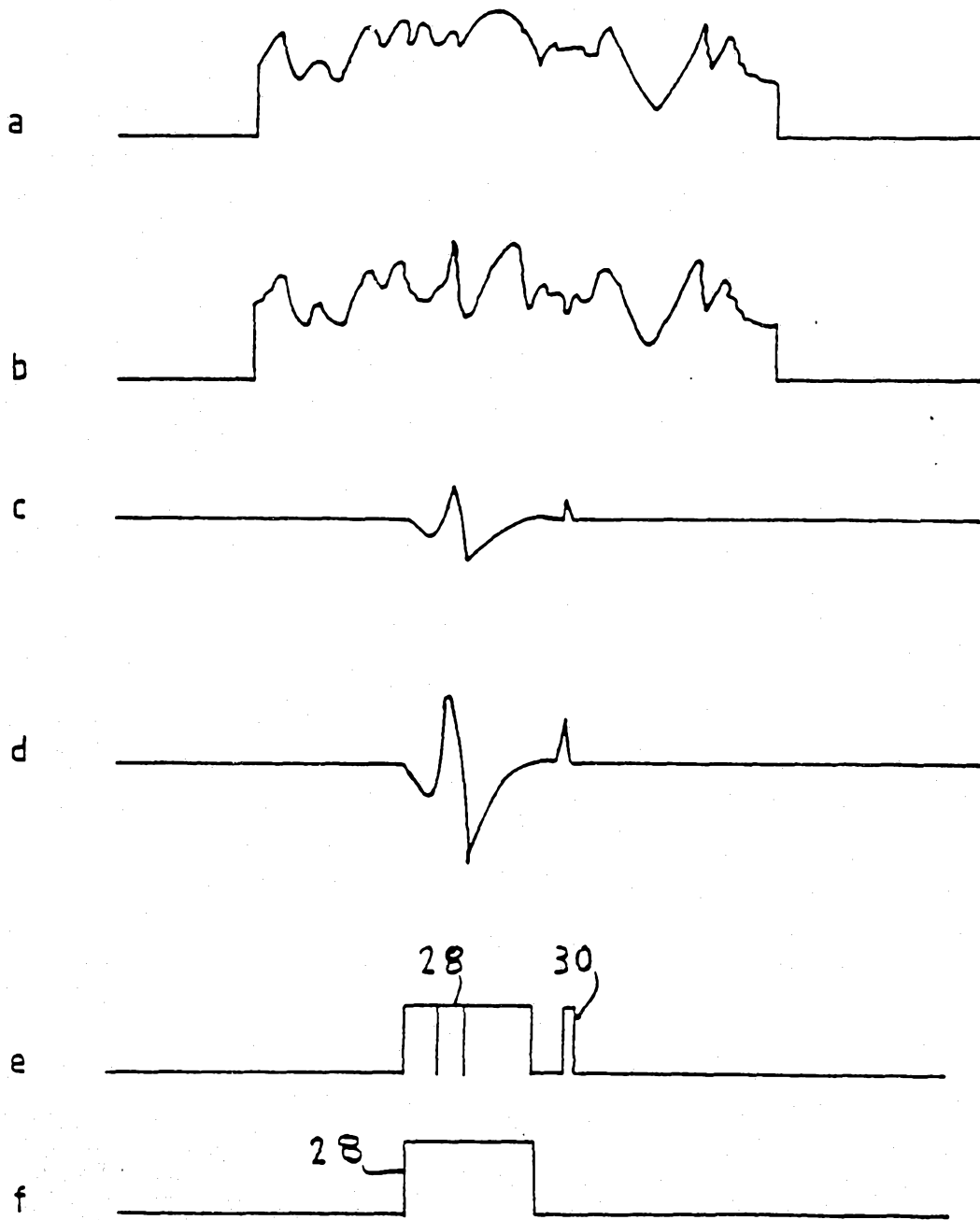
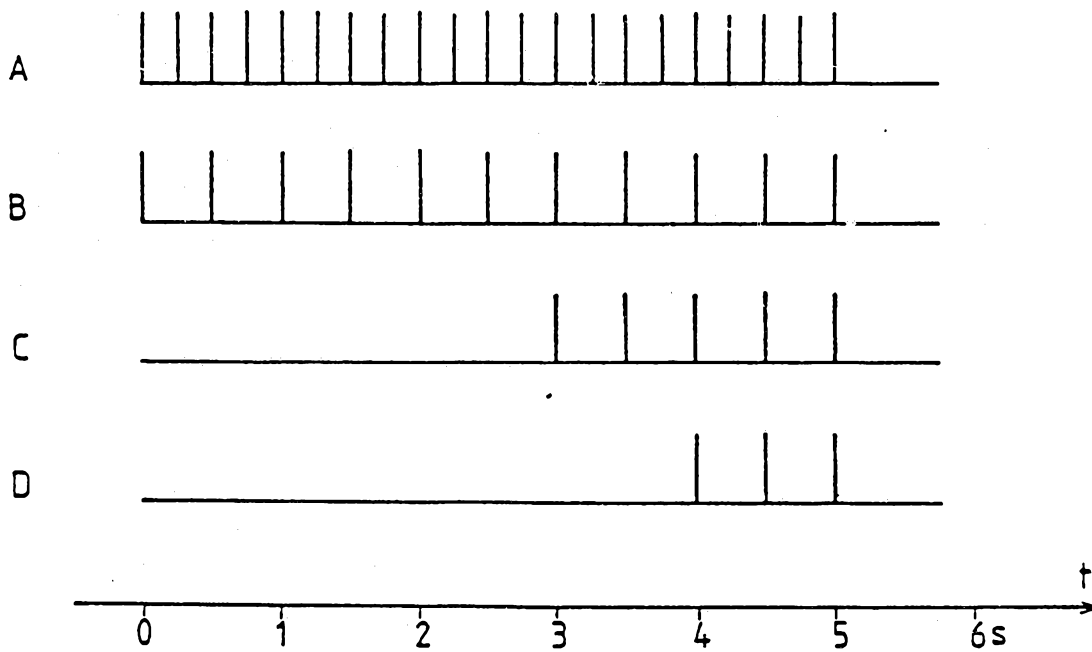


FIG.3



INTERNATIONAL SEARCH REPORT

International Application No PCT/FR 88/00282

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		
Int.Cl. ⁴ : G 08 B 13/18; H 04 H 9/00; G 07 C 9/00		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. ⁴ :	G 07 C; G 06 M; G 08 B; G 08 G; G 01 V; H 04 H	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹²
A	FR, A, 2417222 (THOMSON-CSF) 7 September 1979, see page 2, line 33 - page 3, line 35; page 5, line 35 - page 7, line 23; page 9, line 21 - page 11, line 7, figures -.-	1-5,9-11,13
A	GB, A, 2146152 (AGB RESEARCH) 11 April 1985, see abstract; page 2, lines 25-59; figures -.-	1,8,9,14
A	US, A, 4258351 (SHIGETA et al.) 24 March 1981, see abstract; column 1, line 38 - column 2, line 39; claims; figures -.-	1,9
A	US, A, 3851096 (COLLINS et al.) 26 November 1974 see column 1, lines 3-38; column 5, line 52 - column 6, line 37; figures -.-	1,9
A	GB, A, 2158324 (LICENTIA) 6 November 1985, see abstract; claims; figures -.-	1,9
A	EP, A, 0017821 (HIRADASTECHNIKA SZÖVETKEZET) 29 October 1980, see abstract; page 4, line 8 - page 6, line 14; figures -.-	1,9
A	GB, A, 2180642 (HOCHIKI) 1 April 1987 -.-	
<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 principles 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	
13 September 1988 (13.09.88)	6 October 1988 (06.10.88)	
International Searching Authority	Signature of Authorized Officer	
European Patent Office		

ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.

FR 8800282

SA 22769

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 European Patent Office EDP file on 23/09/88. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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		FR-A- 2586821	06-03-87
		DE-A- 3629384	05-03-87

ANNEXE AU RAPPORT DE RECHERCHE INTERNATIONALE
RELATIF A LA DEMANDE INTERNATIONALE NO.

FR 8800282

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La présente annexe indique les membres de la famille de brevets relatifs aux documents brevets cités dans le rapport de recherche international visé ci-dessus.
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Les renseignements fournis sont donnés à titre indicatif et n'engagent pas la responsabilité de l'Office européen des brevets.

Document brevet cité au rapport de recherche	Date de publication	Membre(s) de la famille de brevet(s)	Date de publication
FR-A- 2417222	07-09-79	Aucun	
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