



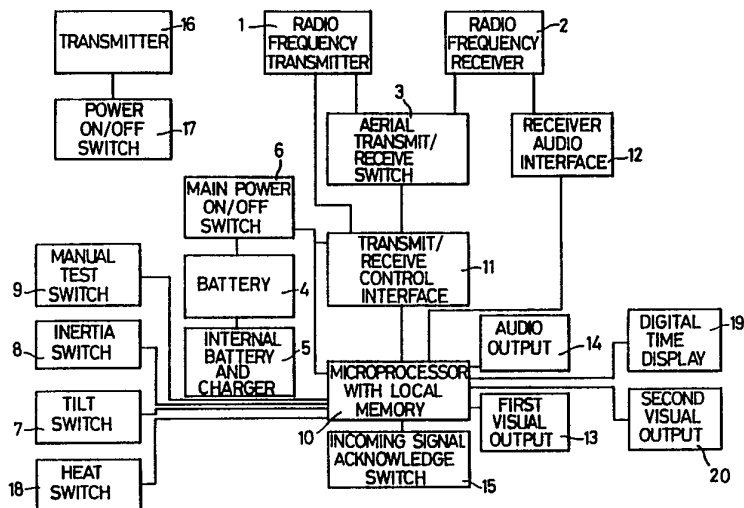
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification <sup>5</sup> : <b>G08G 1/16</b></p>	<p><b>A1</b></p>	<p>(11) International Publication Number: <b>WO 93/16453</b> (43) International Publication Date: 19 August 1993 (19.08.93)</p>
-------------------------------------------------------------------------------------	------------------	-------------------------------------------------------------------------------------------------------------------------------------

(21) International Application Number: PCT/GB93/00338  
 (22) International Filing Date: 18 February 1993 (18.02.93)  
 (30) Priority data: 9203356.2 18 February 1992 (18.02.92) GB  
 (71)(72) Applicant and Inventor: LOCHEAD, Richard, Charles, Kearney [GB/GB]; 10 Tower Lane, Bearsted, Maidstone, Kent ME14 4JJ (GB).  
 (74) Agents: LINN, S., Jonathan et al.; Mewburn Ellis, 2 Cursitor Street, London EC4A 1BQ (GB).  
 (81) Designated States: AT, AU, BB, BG, BR, CA, CH, DE, DK, ES, FI, GB, HU, JP, KP, KR, LK, LU, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, UA, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, SN, TD, TG).

**Published**  
*With international search report.  
 Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.*

(54) Title: ROAD ACCIDENT WARNING SYSTEM



(57) Abstract

A warning system for the prevention for road traffic accidents is described in which a vehicle carries a transmitter (1) and a receiver (2). A sensor (7, 8, 18) on the vehicle may trigger the transmitter to emit a warning signal. A corresponding receiver in a second vehicle may then receive that warning signal and alert the driver by producing an alerting signal. The warning signal consists of two parts: an urgent warning signal and a subsequent non-urgent warning signal, and the alerting signal consists of corresponding urgent alerting and non-urgent alerting signals. Thus the recipient of the alerting signal knows whether the accident has just occurred or has been present for some time. In a preferred embodiment the receiving vehicle retransmits the warning signal only when it is a non-urgent warning signal. Additionally, the invention relates to a warning system in which the recipient of the alerting signal may transmit a further warning signal if the alerting signal is of a given characteristic, such as signal strength, clarity, or signal to noise ratio.

*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	FR	France	MR	Mauritania
AU	Australia	GA	Gabon	MW	Malawi
BB	Barbados	GB	United Kingdom	NL	Netherlands
BE	Belgium	GN	Guinea	NO	Norway
BF	Burkina Faso	GR	Greece	NZ	New Zealand
BG	Bulgaria	HU	Hungary	PL	Poland
BJ	Benin	IE	Ireland	PT	Portugal
BR	Brazil	IT	Italy	RO	Romania
CA	Canada	JP	Japan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	KZ	Kazakhstan	SK	Slovak Republic
CI	Côte d'Ivoire	LI	Liechtenstein	SN	Senegal
CM	Cameroon	LK	Sri Lanka	SU	Soviet Union
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	MC	Monaco	TG	Togo
DE	Germany	MG	Madagascar	UA	Ukraine
DK	Denmark	ML	Mali	US	United States of America
ES	Spain	MN	Mongolia	VN	Viet Nam
FI	Finland				

**ROAD ACCIDENT WARNING SYSTEM**

This invention relates to a warning system for the prevention of road traffic accidents.

Road accidents especially on motorways present a considerable danger to approaching traffic. Fixed warning panels on motorways are very infrequent, and warning cones and the like placed by the police are highly local to the incident and usually not posted until some time after it occurred.

In conditions of poor visibility, due to fog or heavy rain for instance, such warning panels and cones may be virtually useless anyway. Even if drivers see the warnings they may not have time to respond before they find themselves party to an accident.

A basic system for providing immediate warning of an accident over a useful radius, so that following motorists may be aware that a problem exists and slow down or if possible take a diversion, has been proposed in an earlier application, WO91/16699. That application discloses a warning system for prevention of road traffic accidents, the system having a limited range transmitter and a receiver, each for mounting in motor vehicles, and a sensor for detection of (a) sudden acceleration or deceleration or (b) rolling over of a vehicle in which the transmitter is mounted, the transmitter being for emitting a warning signal when the sensor detects (a) and/or (b) and the receiver having means for emitting after receipt of such a warning signal an alerting signal to a driver of a vehicle in which the receiver is mounted. The receiving vehicle may also retransmit the warning signal. All receivers and transmitters are on a given frequency (which may be a frequency associated with a given carriageway of a road).

The alerting signal from such a receiver mounted in a vehicle will tell the driver that an accident has

occurred in the vicinity so that he may take precautions. The alerting signal is stated to be preferably audible and a suitable range for the transmitters is given as being one to two kilometers.

5           A traffic warning system is also known where such a receiver has a directional antenna to prevent reception of unwanted signals, e.g. from an accident which is behind the receiving vehicle.

10           There are several possible problems with the above systems. Firstly a recipient of a warning signal has no idea how imminent the danger is, and this may precipitate unnecessary action and possibly further accidents. Secondly there is the possibility of interference with a 'genuine' transmission and/or  
15           reception of a spurious 'non-genuine' transmission.

          It is the object of the present invention to attempt to alleviate these possible problems.

          In a first aspect, the present invention provides a system in which the transmitted warning  
20           signal is capable of causing two or more responses. Upon impact, for a first time period, the transmitted signal is of a first type, e.g. it carries an 'urgent message', and an alerting signal (possibly audible or visual) produced by the receiver corresponds  
25           accordingly. For a second time period, a signal of a second type, e.g. it carries a 'non-urgent' message, is transmitted, and the alerting signal produced by the receiver is different. For example, the urgent alerting signal may be louder (if audible) or brighter (if  
30           visual) and/or more rapidly modulated. Preferably the first time period is of specific duration e.g. one second, and the second time period is indefinite. In the preferred embodiment the second time period is subsequent to the first.

35           Thus, as soon as an accident occurs, all vehicles within the reception zone (suitably a circle of between 0.2 and 0.5 km radius) will receive an 'urgent message' and should act accordingly. Once the

transmitted signal has changed to carrying a 'non-urgent message', any vehicle subsequently entering the reception zone will be aware that the accident has already occurred and is at least, say, 0.2 - 0.5 km away. Thus, the vehicle will be aware that immediate action is probably unnecessary, and further accidents may be avoided.

If the desired reception radius is chosen to be below a certain limit e.g. 200-300m then the power of the transmitter needed to be used may be below a threshold at which a dedicated frequency band is required. This would reduce the need for compliance with various regulations and controls, and in addition the transmitter would be less expensive.

If the signals are to be retransmissible by each vehicle, then it is preferable that the 'urgent message' is not retransmissible, but that the non-urgent message is retransmissible, so that a receiving vehicle may be sure that either (a) the accident has just happened and it is within, say, 0.2 - 0.5 km, or (b) the accident has already happened and it is at least 0.2 - 0.5 km away, accordingly.

A further preferred feature is the inclusion in the transmitted signal of time data, i.e. the time that has elapsed since the accident occurred. This time data may be displayed on e.g. a digital display in a receiving vehicle, and may be included in any retransmitted signal so that subsequent receiving vehicles can also display the time data. Whilst such time data would not give an accurate indication of the distance to the accident site, it might give an indication of such distance, dependant on traffic flow etc. Such distance information could be obtained from the strength of the transmitted signal, but with the possibilities of reflection and/or retransmission, such information may be unreliable.

According to a second aspect, the present invention provides a system in which the transmitter

warning signal includes re-transmission data. Preferably all recipients re-transmit the signal. The warning signal may comprise an urgent and non-urgent portion as described above and may be of the power specifications described above.

5  
10  
15  
Preferably in the first warning signal transmitted (e.g. the signal produced by a carrier involved in an accident) the re-transmission data includes data to indicate that this is the first such transmission e.g. a reference number such as 1. For each subsequent re-transmission the reference number is incremented. The number of permissible re-transmissions may be limited e.g. to 20, and thus the radius of transmission from the accident site is correspondingly limited.

20  
25  
30  
Additionally, a receiver may be controlled so as to only re-transmit the received warning signal with the lowest reference number. If a number of recipients e.g. vehicle drivers, are within range of the initial transmission the farthest away of the recipients will receive not only the initial transmission but also each subsequent re-transmission. However the receiver will identify the lowest reference number (in this case 1) and its subsequent re-transmission will contain e.g. the reference number 2. This helps prevent uncontrolled re-transmission and ensures that the maximum re-transmission radius can be reached. Again this can then be used to provide an indication of distance to the accident site.

35  
According to a third aspect, the present invention provides a system in which a transmitter associated with a receiver is activatable if a received signal is of a given characteristic. Such a characteristic may be e.g. a minimum signal strength, clarity of information contained within the signal, or signal-to-noise ratio.

For example, if the received signal is strong enough, or clear enough, i.e. the receiving vehicle is

close to the accident there is no need to re-transmit it and the transmitter is not activated. A vehicle further away from the accident may receive a weaker signal and there is then a need for re-transmission. This would  
5 reduce the number of retransmissions thereby reducing the possibility of interference with the warning signal.

Preferably, the user of the receiving vehicle activates the transmitter manually (i.e. tries to re-transmit the signal) and the transmitting system, or an  
10 associated control mechanism, makes a decision on whether or not to actually re-transmit the warning signal. Thus the system will be barred from being operated manually to transmit a warning signal if the system is already receiving a warning signal which is  
15 not of the given characteristic.

Additionally or alternatively the transmitted warning signal may be encoded in order to prevent confusion between 'genuine' and 'non-genuine' (i.e. spurious) transmission and thus false alarms by the  
20 receiver.

Any of the above aspects may be used separately or together. Further options discussed below may apply to either or both of the above aspects.

A vehicle equipped with a system according to  
25 the present invention may additionally be equipped with a second visual output warning unit. This may be a display unit mounted in the rear window or external to the vehicle, and may be activated upon receipt of a warning signal, e.g. to flash, or display e.g.  
30 "ACCIDENT". This would alert other non-equipped vehicles to the danger of the accident.

Preferably, the system is capable of storing and displaying the details of the vehicle in which it is incorporated and may also display the accident history  
35 of the vehicle. This would allow purchasers of the vehicle to check its history and also prevent systems being transferred between vehicles. In addition to this, the system may 'self-destruct', i.e. wipe its

memory or refuse to operate if it were tampered with or removed from its parent vehicle.

A further feature of the present invention may be the provision of hand-held transmission and/or  
5 reception devices for use by e.g. pedestrians, cyclists, equestrians, etc. Signals transmitted by such devices may include information about the type of user, and a system mounted in a vehicle may recognise such  
10 information. The alert signal in the vehicle may be different from both the urgent and/or non-urgent alert signals depending on the user of the hand-held device, and a display unit mounted in the vehicle may display such information. Alternatively, or additionally, an audible display, e.g. a voice synthesizer, may display  
15 such information. Such a different alert signal could be classified as a 'caution' warning signal, and thus such hand-held devices could be operated at roadworks or similar hazards.

A system mounted in a vehicle may, in addition  
20 to impact and roll-over alarm triggers, include a heat sensor, to trigger the alarm in the event of a fire.

The following is an illustrative example of a warning system embodying the invention.

Fig. 1 is a schematic circuit diagram of a  
25 warning system embodying aspects of the invention.

A radio frequency transmitter 1 and a radio frequency receiver 2 are mounted in the same unit in a motor vehicle. Both the transmitter 1 and receiver 2 are connected to a signal aerial with a transmit/receive  
30 switch 3. Warning signals are transmitted at a high frequency, over about 500 MHz, so that the aerial is under 200 mm in length. The system runs on power supplied by the battery 4 of the vehicle with a back-up, internal battery and charger 5 to provide power to the  
35 system when needed to allow transmission of a warning signal to continue for at least 20 minutes after an accident and when the main battery has failed. A main power on/off switch 6 enables the whole system to be



turned off.

Four switches 7,8,9,18 are connected to a microprocessor 10. Tilt switch 7 is to sense when the vehicle has rolled over. Inertia switch 8 is to sense sudden acceleration or deceleration of the vehicle. A manual test switch 9 is provided to enable the system to be tested. Heat switch 18 senses temperature in the vehicle and may detect a fire. When the microprocessor with local memory 10 receives a signal from one or more of the switches 7,8,9,18 it actuates the radio frequency transmitter 1 via a transmit/receive control interface 11. The transmitter 1 will then within one second of actuation emit a signal of a first type, which is an 'urgent message', for a fixed duration period e.g. one second, followed by a 'non-urgent message' warning signal of a second type for an indefinite period. The signal is a modulated signal with a type-coded tone burst of a duration less than one second and is encoded to prevent confusion with spurious transmissions. The intervals between bursts are random so as to tend to avoid interference between two transmitters actuated simultaneously. The range of this transmission is suitably about 0.2 - 0.5 kilometres.

The radio frequency receiver 2 will pick up warning signals from transmitters within range. The receiver 2 is connected via a receiver audio interface 12 to the microprocessor 10. Receipt of a warning signal results in an alerting signal being emitted to the driver. In this embodiment, the alerting signal has a visual component provided by a first visual output 13 and an audible component provided by audio output 14. The warning system has an incoming signal acknowledge switch 15 to enable the driver to silence the alerting signal once he is aware of the warning.

The alerting signal emitted upon receipt of an 'urgent message' warning signal is different to that emitted upon receipt of a 'non-urgent message' warning signal, e.g. it may be louder or modulated more quickly.

The receiver may further actuate the transmitter associated with it, for one or both of two purposes. One is to address the original transmitter to acknowledge reception of its signal and, optionally, increase the intervals between its transmissions. The other may be to "relay" the warning signal to further receivers.

However, if the receiver is receiving an 'urgent message' warning signal, it may not actuate its associated transmitter, in order to prevent retransmission of the signal outside the original reception zone of 0.2 - 0.5 km. Also if the receiver may monitor a particular characteristic e.g. strength or signal/noise ratio of the incoming signal, and, if the characteristic is above a predetermined threshold, the signal may not be retransmitted, even by manual operation of the transmitter.

The transmitted warning signal includes time data such as the amount of time that has elapsed since the original transmitter was first activated, and this data is included in any retransmission. The time data may be displayed on a digital time display 19, mounted in the vehicle.

The transmitted warning signal also includes re-transmission data which indicates the number of re-transmissions that have taken place. This re-transmission data may be incremented on each subsequent re-transmission and may be used to gauge the distance to the accident site.

The vehicle is further equipped with a second visual output 20. This is activated upon receipt of a warning signal, and is visible to other road users i.e. may be mounted in the rear window of the vehicle. The second visual output may flash, or may display e.g. the word "ACCIDENT", and thus other vehicles not equipped will be alerted.

The illustrated warning system may be in conjunction with a separate transmitter 16 to be carried

by a pedestrian, cyclist, horse rider or other person who is relatively inconspicuous on the road. This transmitter 16 emits a signal which may be picked up by receiver 2 over a range of about e.g. 100 metres.

5 Transmitter 16 has a power on/off switch 17 so that the user is able to choose when a warning signal is to be emitted. Such transmitters 16 should generally only be used by road users in conditions of poor visibility or particular danger, and not all the time in town  
10 centres. An exception would be use by blind or other disabled people who are particularly vulnerable. Also a transmitter 16 may be placed at a temporary obstruction such as a skip or roadworks at a dangerous bend or in any situation where visibility is especially poor.

15 The signal emitted by transmitter 16 may be different to either of those emitted by transmitter 1, thus enabling a receiver to distinguish such signals. Either or both of the visual outputs may display a predetermined signal or message. The display may be a  
20 'caution' display, and so would be appropriate to use at roadworks as above.

The warning system should be mounted within a road vehicle securely so that it will be unlikely to break loose in an impact or roll-over and will withstand  
25 the maximum stress to be encountered in a collision. It may be supplied as original equipment in a new vehicle or retro-fitted to a vehicle of any age. The inertia switch may be a fuel cut-off inertia switch already installed in the vehicle.

30 The system is capable of storing data regarding both the details of the vehicle and its accident history, and can display such data upon request. Also the system may make such data unobtainable if there has been an attempt to tamper with it e.g. if the power has  
35 been lost. This would prevent "falsifying" of the details and help purchasers of used vehicles.

CLAIMS

1. An accident warning system having a transmitter (1) a receiver (2), and a sensor (7, 8, 18) for detection of a warning conditon, the transmitter having means (3) for  
5 emitting a warning signal when it is triggered, and the receiver having means for emitting (13, 14) an alerting signal after receipt of a warning signal produced by a transmitter of a different like warning system, wherein the warning signal includes an urgent warning signal  
10 for a first time period and a non-urgent warning signal for a second time period, and the alerting signal includes corresponding urgent alerting and non-urgent alerting signals.
2. An accident warning system according to Claim 1 in  
15 which the second time period is subsequent to the first time period.
3. An accident warning system according to Claim 1 or Claim 2 in which, subsequent to the receipt of the non-urgent warning signal by the receiver, a further non-urgent warning signal is transmissable by the  
20 transmitter.
4. An accident warning system according to any of the above claims in which, upon receipt of the urgent warning signal by the receiver, the transmitter is  
25 inoperable for at least a part of the duration of the urgent warning signal.
5. An accident warning system according to any of the above claims in which the warning signal includes time data, and the system further includes display means on  
30 which the time data is displayable.
6. An accident warning system according to any of the above claims in which the warning signal is re-

transmissible by a recipient thereof and the signal includes re-transmission data for indicating the number of times that the signal has been re-transmitted.

5 7. An accident warning system having a transmitter (1) and a receiver (2), each for mounting in a vehicle or carrying by a road user, and a sensor (7, 8, 18) for detection of a warning condition, the transmitter having means (3) for emitting a warning signal when it is triggered, and the receiver having means (13, 14) for  
10 emitting an alerting signal after receipt of such a warning signal produced by a transmitter of a different system, further including comparison means (10) for determining if the warning signal is of a predetermined characteristic, and in which, if the warning signal is  
15 of a predetermined characteristic, a further warning signal is transmissible by the transmitter.

20 8. An accident warning system according to claim 7 in which the given characteristic is signal strength, or clarity of information contained within the signal, or signal-to-noise ratio.

9. An accident warning system according to any of the above claims further including visual display means activatable upon receipt of an alerting signal.

25 10. An accident warning system according to any of the above claims in which the warning signal includes user data and the alerting signal is variable according to the user data.

30 11. A transmitter for use in an accident warning system, the transmitter being capable of transmitting a warning signal which includes an urgent warning signal for a first time period and a non-urgent warning signal for a second time period.

12. A receiver for use in an accident warning system, the receiver having means for emitting an alerting signal after receipt of a warning signal produced by a transmitter, the alerting signal including an urgent alerting signal for a first time period and a non-urgent alerting signal for a second time period.

13. An accident warning system having a transmitter (1) a receiver (2), and a sensor (7, 8, 18) for detection of a warning condition, the transmitter having means (3) for emitting a warning signal when it is triggered, and the receiver having means for emitting (13, 14) an alerting signal after receipt of a warning signal produced by a transmitter of a different like warning system, wherein the warning signal is re-transmissible by a recipient thereof and the warning signal includes re-transmission data for indicating the number of times that the warning signal has been re-transmitted.

14. An accident warning system substantially as one of the embodiments herein described with reference to Fig. 1 of the accompanying drawings.

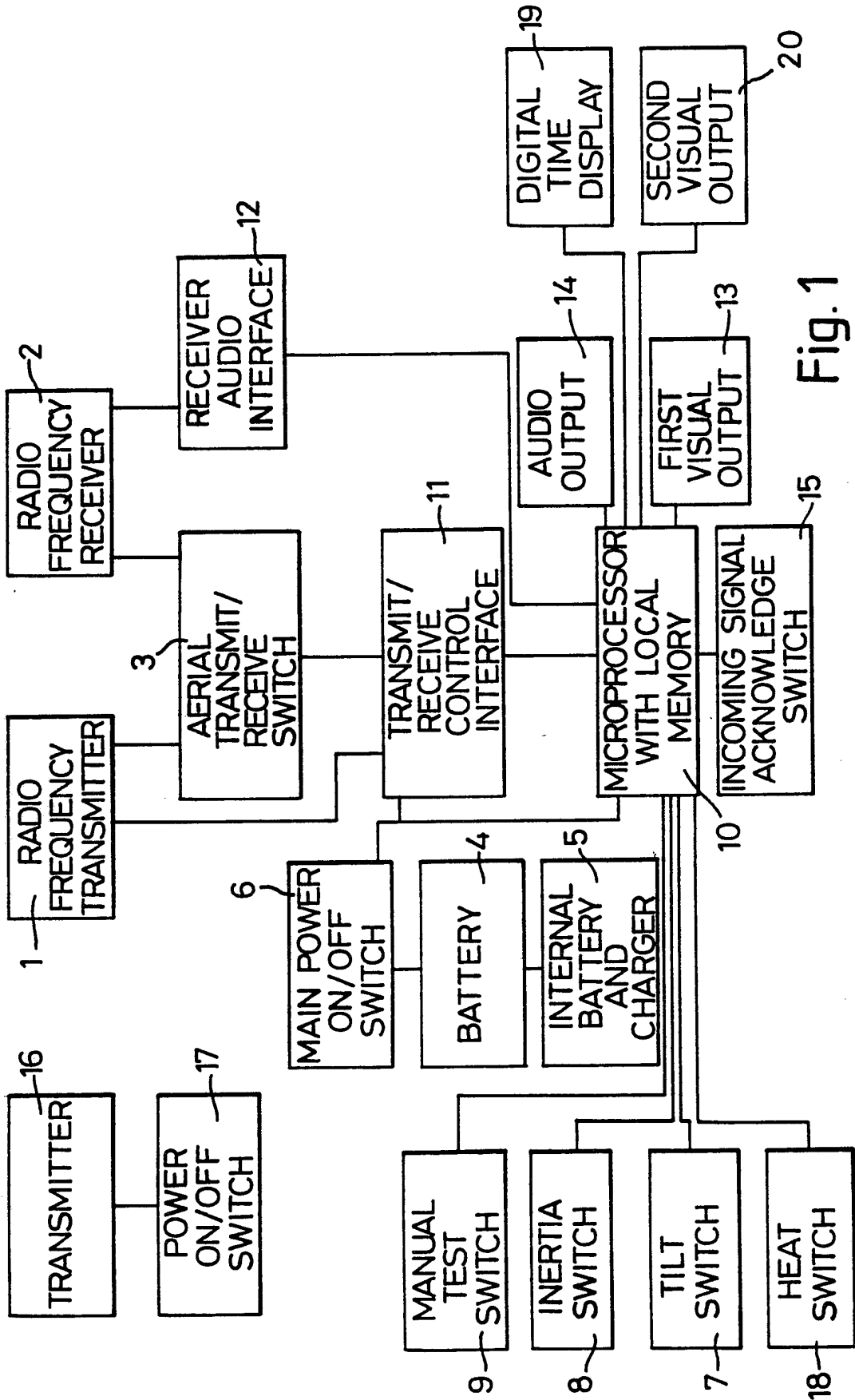


Fig. 1

<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 Int.Cl. 5 G08G1/16		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
Int.Cl. 5	G08G ; G08B	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b>		
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>
Y	WO,A,9 116 699 (LOCHEAD) 31 October 1991 cited in the application see the whole document	1-4,7-9, 11,12,14
Y	DE,A,2 719 223 (SIEMENS AG) 5 October 1978 see the whole document	1,2,11, 12
Y	FR,A,2 240 492 (GENDROT) 7 March 1975 see claims	3,4,7,14 1
Y	EP,A,0 441 576 (BOWMAN) 14 August 1991 see the whole document	7-9 1
A	---	---
-/--		
<p><sup>10</sup> Special categories of cited documents:</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	
28 MAY 1993	11. 06. 93	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	REEKMANS M.V.	



III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	FR,A,2 240 490 (GENDROT) 7 March 1975 see claims ----	1,3,4,7
A	US,A,3 366 958 (SEABORN) 30 January 1968 see the whole document ----	1
A	US,A,4 219 799 (WEBER) 26 August 1980 see claims ----	1,2
A	US,A,4 010 461 (STODOLSKI) 1 March 1977 see column 1, line 63 - column 2, line 2 ----	1,11,12
A	GB,A,2 005 886 (HONEYWELL INC.) 25 April 1979 see claims 1,2 -----	1

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

GB 9300338  
SA 70358

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  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 28/05/93

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A-9116699	31-10-91	AU-A- 7671291	11-11-91
		EP-A- 0525050	03-02-93
DE-A-2719223	05-10-78	None	
FR-A-2240492	07-03-75	BE-A- 818625	02-12-74
		DE-A- 2438066	20-02-75
		NL-A- 7410702	11-02-75
EP-A-0441576	14-08-91	GB-A- 2241367	28-08-91
FR-A-2240490	07-03-75	DE-A- 2438066	20-02-75
		NL-A- 7410702	11-02-75
US-A-3366958		None	
US-A-4219799	26-08-80	None	
US-A-4010461	01-03-77	None	
GB-A-2005886	25-04-79	US-A- 4282519	04-08-81
		DE-A- 2843237	19-04-79
		FR-A- 2405510	04-05-79
		JP-A- 54060896	16-05-79
		SE-A- 7810177	07-04-79