



(11) **EP 1 126 418 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
22.08.2001 Bulletin 2001/34

(51) Int Cl.7: **G07C 1/30, G07B 15/02**

(21) Application number: **00128230.0**

(22) Date of filing: **27.12.2000**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR
 Designated Extension States:
AL LT LV MK RO SI

(72) Inventor: **Mondardini, Massimo**
10123 Torino (IT)

(74) Representative: **Modiano, Guido, Dr.-Ing. et al**
Spandonari & Modiano S.r.l.,
Corso Duca degli Abruzzi, 16
10129 Torino (IT)

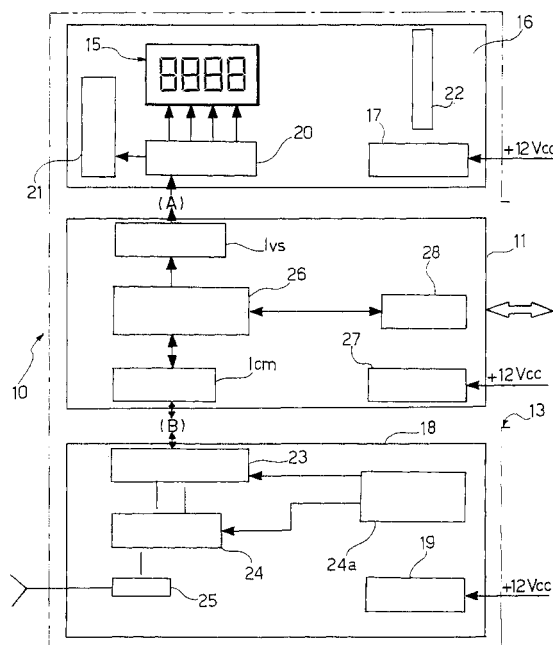
(30) Priority: **31.12.1999 IT TO991183**

(71) Applicant: **Urmet Sud Costruzioni**
Elettro-Telefoniche S.p.A.
00128 Roma (IT)

(54) **Automatic fee-charging and verification system, particularly for paid parking spaces for motor vehicles**

(57) The system comprises user devices (10) to be installed, upon parking, in the individual motor vehicles and verification terminals (30), provided at least in a portable configuration, to be assigned to patrolling control personnel. The user devices (10) are provided with a numeric display module (15) and with prepaid fee-charging modules (11-11') which include logic controller means (26) which, activated at the beginning of the parking period, decrease according to the preset hourly rate the credit of the fee-charging module (11), indicating the residual credit on the display means. The verification terminals (30) comprise radio transmission means and radio reception means, the former being capable of transmitting by radio from outside the vehicle data and querying signals to the user devices (10), the latter being capable of receiving by radio corresponding information transmitted as reply by a radio transponder module (18) with which each individual user device (10) is fitted.

FIG. 2



Description

[0001] The present invention relates to an automatic fee-charging and verification system, suitable for applications in motor vehicle traffic control and in the control of accesses to reserved areas in general, and particularly suitable for use in paid parking spaces for the temporary placement of the motor vehicles.

[0002] More particularly, the invention relates to an automatic fee-charging and verification system based on the use of prepaid fee-charging modules which, as will become better apparent hereinafter, can be inserted or are permanently integrated in a component of the system: in the first case, the entire component is configured as a disposable type; in the second case, only the fee-charging module, substantially constituted by a card of the chip-card type, is of the disposable type.

[0003] Automatic fee-charging systems for paid parking spaces are already known and widely used in which the user uses prepaid cards, generally of the magnetic-strip type, which are suitable to be inserted in a control and validation terminal located proximate to said parking space.

[0004] Such terminal, which has a keyboard whereon the user keys in the required parking time, issues a printed receipt with the time data of the parking period and decreases the residual credit, correspondingly validating the magnetic strip of the card until it is fully used up.

[0005] These known systems suffer several drawbacks, the main ones being awkward use for the user, significant susceptibility to fraud and vulnerability of the control terminal.

[0006] As regards awkward use, the user must first stop at said terminal, or go to it after parking the vehicle, in order to acquire - by inserting the prepaid card in the terminal and keying in the required parking time - the printed receipt to be placed in view inside the motor vehicle.

[0007] As regards fraud, it is known that it is easy to fraudulently duplicate magnetic-strip cards, whereas the simple printed receipt issued by the control and validation terminal in itself provides no valid assurance against forgery.

[0008] The vulnerability of the control and validation terminal is also evident: it is constituted by a fixed installation usually located outdoors in unprotected places and being therefore exposed both to vandalism and to the action of weather; both of these circumstances require said terminal to have a very sturdy, accurately built, hermetic and preferably armored structure.

[0009] The aim of the present invention is essentially to eliminate the above drawbacks of known systems, and within the scope of this aim the invention has the important object of providing an automatic fee-charging and control system whose management is extremely easy both for users and for control personnel, to whom, in particular, the system can report, when requested by appropriately provided verification means with which

such personnel is equipped, data related to the authenticity of the fee-charging modules used in the individual motor vehicles and data related to the fee charging in progress.

[0010] Another important object of the present invention is to provide a system which is substantially immune to fraud essentially thanks to the inherent difficulty of forging the devices that compose said system.

[0011] Other important objects of the invention are to provide a system which allows to automatically set the rate, which can be varied according to city zones, time bands and to workday or holiday parking, and to provide a system which is simple and straightforward to use and in particular does not require the user to perform any adjustment or presetting, since the system can be remotely adjusted and set up by dedicated verification means.

[0012] Another important and particular object of the invention is to provide an automatic fee-charging and verification system which is structurally simple and particularly requires no special installation on board the motor vehicles that use it.

[0013] According to the present invention, this aim and these and other objects which will become better apparent hereinafter from the following detailed description are achieved with an automatic fee-charging and verification system which has the specific features stated in the appended claims.

[0014] Substantially, the invention is based on the inventive concept of providing the system with user devices to be installed, upon parking, in the individual motor vehicles and with verification terminals which are at least predominantly constituted by portable hand-held devices to be assigned to patrolling control personnel; of providing the user devices with display means and with prepaid fee-charging modules which include logic circuit means which, by being activated at the beginning of the parking period, decrease according to the preset hourly rate the credit of said fee-charging module, indicating the residual credit on said display means; and of providing the verification terminals with radio transmission and radio reception means, the former being capable of transmitting querying signals and any data to the user devices, the latter being capable of receiving the corresponding information transmitted as reply by a radio transponder with which each individual user device is fitted.

[0015] The characteristics, purposes and advantages of the system according to the present invention will become better apparent from the following detailed description and with reference to the accompanying drawings given by way of non-limitative example, wherein:

Figure 1 is a perspective view of a user device of the type with an insertable fee-charging module, and of a verification terminal of the portable type, which provide the automatic fee-charging and verification system according to the invention;

Figure 2 is an electrical block diagram of the user device;

Figure 2a is a perspective view of another embodiment of the user device, provided in a throwaway version and integrating the fee-charging module;

Figure 3 is an electrical block diagram of the verification terminal.

[0016] In Figure 1, the reference numeral 1 generally designates the system according to the invention, which is characterized by the presence of two fundamental elements which are respectively constituted by a user device 10 and by a verification terminal 30. The user device, suitable to be installed in the parked vehicle, is based on the use of automatic fee-charging modules 11 which, in the example shown in Figure 1, are of the throwaway type and are provided as chip-cards.

[0017] The fee-charging module 11 is conceived on the one hand to decrease, according to the hourly parking rate or the like, the initial credit loaded thereon as a stored data item and provide the user with visual information regarding the residual credit on said module, and on the other hand to transmit, when requested by the verification terminal 30, a number of data which essentially concern the authenticity of said module and the parameters of the fee charging in progress.

[0018] For this purpose, the user device is constituted by a rigid enclosure 12 which is provided with an opening 13 for inserting and accommodating the removable module 11, with power supply means associated with a tang 14 which can be inserted in the lighter socket of the motor vehicle and is provided with a positive voltage contact 14a and with ground contacts 14b, and with a numeric display 15 for displaying the residual credit on the module 11.

[0019] With reference to Figure 2, it can be noted that a module 16 for driving the numeric display 15, with a corresponding power supply section 17, and a radio transponder module 18 for data transmission, with a corresponding power supply section 19, are also installed on board the user device 10.

[0020] The module 16 substantially comprises logic circuits 20 for driving the display 15 and a tone generator 21, as well as lighting means 22 for nighttime illumination of the display 15.

[0021] The radio transponder module 18 substantially comprises a modulator/demodulator circuit 23 operatively and bidirectionally connected to a radio frequency amplifier 24 which is in turn bidirectionally connected to a transceiver antenna circuit 25 and is suitable to amplify, without appreciable distortion, the level of the signal transmitted or received by such antenna. The module is completed by auxiliary circuits 24a which are suitable to optimize the operation of the radio transponder 18 according to the maximum range required by the system operator.

[0022] The automatic fee-charging module 11 cooperates with the modules 16 and 18 and substantially in-

tegrates power supply circuits 27 and logic controller means 26 with logic circuits which are suitable to perform at least the following functions:

- 5 -- sending, by way of a dedicated interface lvs, activation data to the circuit 20 of the driver module 16 of the display 15;
- performing both the charge counting function and the residual credit updating function, storing said credit in a non-volatile memory 28;
- 10 -- communicating digital data bidirectionally with the outside - over a dedicated interface lcn which is operatively connected to the modulator/demodulator circuit 23 - with a method protected by means of algorithms for encoding-decoding and encrypting-decrypting said digital data.
- 15

[0023] Therefore, and in accordance with the aim and objects of the invention, the automatic fee-charging module 11, besides transmitting to the verification terminals 30 which are external to the parked vehicle its own identification data and the data related to the fee charging in progress, is structured so that it can receive from the verification terminals any data for presetting the parking rate, for example according to division into city zones, time bands and/or workday or holiday parking.

[0024] In the embodiment shown in Figure 2a, the user device 10', provided in the fully throwaway version, differs from what has been described above only in that it includes the fee-charging module 11', which is provided in an integrated manner together with the circuits of the driver module 16 and the radio transponder module 18, on a single printed circuit medium being shown schematically in the figure and designated by the letter S: the device 10' therefore does not have the opening 13 for accommodating the removable module 11.

[0025] The structure of the verification terminals 30 is now described with reference to Figures 1 and 3; in the illustrated example, the terminals are constituted by hand-held portable devices provided with a handgrip 31 which accommodates suitable power supply batteries and suitable to be carried by patrolling verification personnel.

[0026] In this version for portable use, the terminal 30 essentially performs at least the following functions:

- authentication of the user device 10 that is present inside the verified vehicle;
- verification of the correct activation and correct operation of said device;
- 50 -- optional manual entry and storage, by way of the alphanumeric keyboard 32, of data related to fines charged to the parked vehicle due to illegal parking and the like.
- 55

[0027] For this purpose, the terminal 30 includes power supply circuits CA with accumulators AA and a microcontroller μ P which is programmed to perform all the

functions for the control of the various sections that compose the terminal, to process the digital data that arrive from the interface lrx of a radio receiver unit Rx, and to control a radio transmitter unit Tx by way of corresponding interface and modulation circuits ltx.

[0028] The radio receiver unit Rx comprises in the following order: a receiver antenna 33, a coherent demodulator 34, a low-pass filter 35, a low-frequency amplifier 36 and an A/D (Analog/Digital) converter 37.

[0029] The radio transmitter unit Tx in turn comprises in the following order: a radio frequency oscillator 38, a radio frequency amplifier 39 and a transmitting antenna 40.

[0030] The program of the microcontroller μ P resides in an EPROM memory, designated by the reference numeral 41, while a RAM memory 42 is used, conventionally, as working storage for all the operations performed by the microcontroller μ P. A DSP (Digital Signal Processor) unit is further associated with said microcontroller in order to optimize the execution of the encoding-decoding and encryption-decryption of the transceived data.

[0031] A communication interface lcs, equipped with a suitable connector 43, is provided for the communication of data over serial lines toward remote systems for automatic control and/or processing, not shown, and additional circuits 44 interface the microcontroller μ P with the alphanumeric keyboard 32 and with circuits 45 for driving an alphanumeric display 46. The interface and modulation circuits ltx are provided in order to control the oscillator of the unit Tx which allows to broadcast the radio frequency signal toward the radio transponder 18 of the user device 10; in turn, the radio transponder reflects toward the verification terminal 30 a fraction of the radio signal, after remodulating it according to the data to be sent in response. The remodulated signal, received by the unit Rx of the terminal, is first of all sent to the coherent demodulator 34 which, for control purposes, measures its phase with reference to the phase of the oscillator 38, and is then converted in the A/D converter from a low-frequency demodulated signal into digital data which the microcontroller μ P stores in its RAM 42 and processes by using the DSP unit in accordance with the programming code stored in the EPROM 41.

[0032] For the specified functions, the operator has interactive access to the functions of the terminal by means of the alphanumeric keyboard and display 32-46.

[0033] The disclosures in Italian Patent Application No. TO99A001183 from which this application claims priority are incorporated herein by reference.

[0034] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. An automatic fee-charging and verification system (1), particularly for paid parking spaces for motor vehicles, characterized in that it comprises user devices (10) to be installed, upon parking, in the individual motor vehicles and verification terminals (30), provided at least in a portable configuration, to be assigned to patrolling control personnel; in that the user devices (10) are provided with a numeric display module (15) and with prepaid fee-charging modules (11-11') which include logic controller means (26) which, by being activated at the beginning of the parking period, decrease according to the preset hourly rate the credit of said fee-charging module (11), indicating the residual credit on said display means; and in that the verification terminals (30) comprise radio transmission means (Tx) and radio reception means (Rx), the former being capable of transmitting by radio from outside the vehicle data and querying signals to the user devices (10), the latter being capable of receiving by radio corresponding information transmitted as reply by a radio transponder module (18) with which each individual user device (10) is fitted.
2. The system (1) according to claim 1, characterized in that the user device (10) is provided with throw-away fee-charging modules (11) and is constituted by a rigid enclosure (12) provided with an opening (13) for removable insertion and accommodation of the fee-charging module (11), and with power supply means (14a-14b) associated with a tang (14) which can be inserted in the power socket of the lighter of the motor vehicle.
3. The system according to claim 1, characterized in that the user device (10') is provided as a fully disposable type and includes the fee-charging module (11'), which is integrated with said display module (15) and said radio transponder module (18) on a single printed circuit support (S).
4. The system (1) according to claims 1 and 2 or 3, characterized in that the verification terminals (30) of the portable type are constituted by hand-held devices provided with a handgrip (31) which accommodates power supply batteries, with an alphanumeric keyboard (32) and with an alphanumeric display (46).
5. The system (1) according to claims 1, 2 or 3, characterized in that the user device (10) includes means (16) for driving the numeric display (15) and a radio transponder module (18) which comprises at least one modulator/demodulator circuit (23) which is operatively and bidirectionally connected to a radio frequency amplifier (24) which is in turn

bidirectionally connected to a transceiver antenna circuit (25).

6. The system according to claims 1 and 5, characterized in that the fee-charging module (11-11') cooperates with the means (16) for driving the display (15) and with the radio transponder module (18), and in that the logic controller means (26) of said module are programmed to perform at least the following functions:
 - sending, by way of a dedicated interface (lvs), activation data to the circuit (20) of the driver means (16) of the display (15);
 - performing both charge counting and residual credit updating, storing said credit in a non-volatile memory (28) and displaying it on the display (15);
 - communicating digital data bidirectionally with the outside - over a dedicated interface (lcm) which is operatively connected to the modulator/demodulator (23) of the radio transponder (18) - with a method protected by means of algorithms for encoding-decoding and encrypting-decrypting said digital data.
7. The system according to claims 1 and 4, characterized in that each verification terminal (30) includes a microcontroller (μ P) which is programmed to perform all the functions for controlling the various sections that compose the terminal, for processing the digital data that arrive from a receiver interface (lrx) of the radio receiver means (Rx) and for controlling, by way of corresponding interface and modulation circuits (ltx), the radio transmitter means (Tx).
8. The system according to claims 1, 4 and 7, characterized in that said radio receiver means (Rx) of the verification terminal (30) comprise a receiver unit which includes a receiving antenna (33), a coherent demodulator (34), a low-pass filter (35), a low-frequency amplifier (36) and an A/D converter (37) which is operatively connected to said receiver interface (lrx).
9. The system according to claims 1, 7 and 8, characterized in that said radio transmitter means (Tx) of the verification terminal (30) comprise a transmission unit which is operatively connected to said interface and modulation circuits (ltx) and includes a radio frequency oscillator (38), a radio frequency amplifier (39) and a transmitting antenna (40).
10. The system according to claims 8 and 9, characterized in that said radio frequency oscillator (38) of the radio transmitter means (Tx) is interconnected to the coherent demodulator (34) of the radio receiver (Rx), which measures the phase of the received

signal with reference to the phase of said oscillator (38).

11. The system according to claims 1 and 7, characterized in that said microcontroller (μ P) has a DSP (Digital Signal Processor) unit associated therewith, said unit being designed to optimize the operations for encoding-decoding and encrypting-decrypting the transceived digital data.
12. The system according to claim 7, characterized in that said microcontroller (μ P) is operatively connected, by way of a communications interface (lcs) provided with a connector (43), to a serial line which is connected to remote devices for automatic control and data processing.
13. The system according to claim 1 and any one of claims 2 to 12, characterized in that it further comprises verification terminals of the fixed-installation type.

FIG. 1

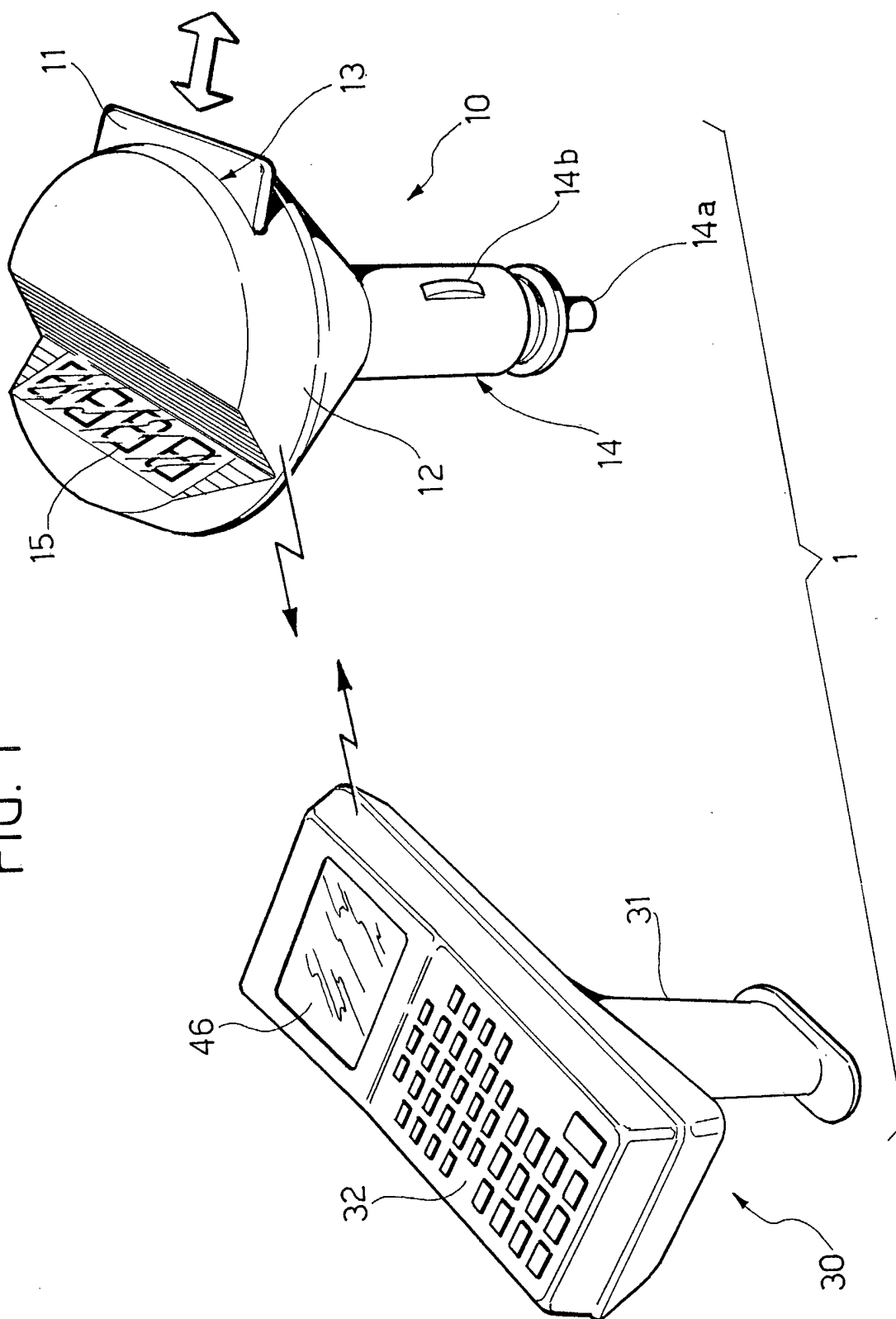


FIG. 2

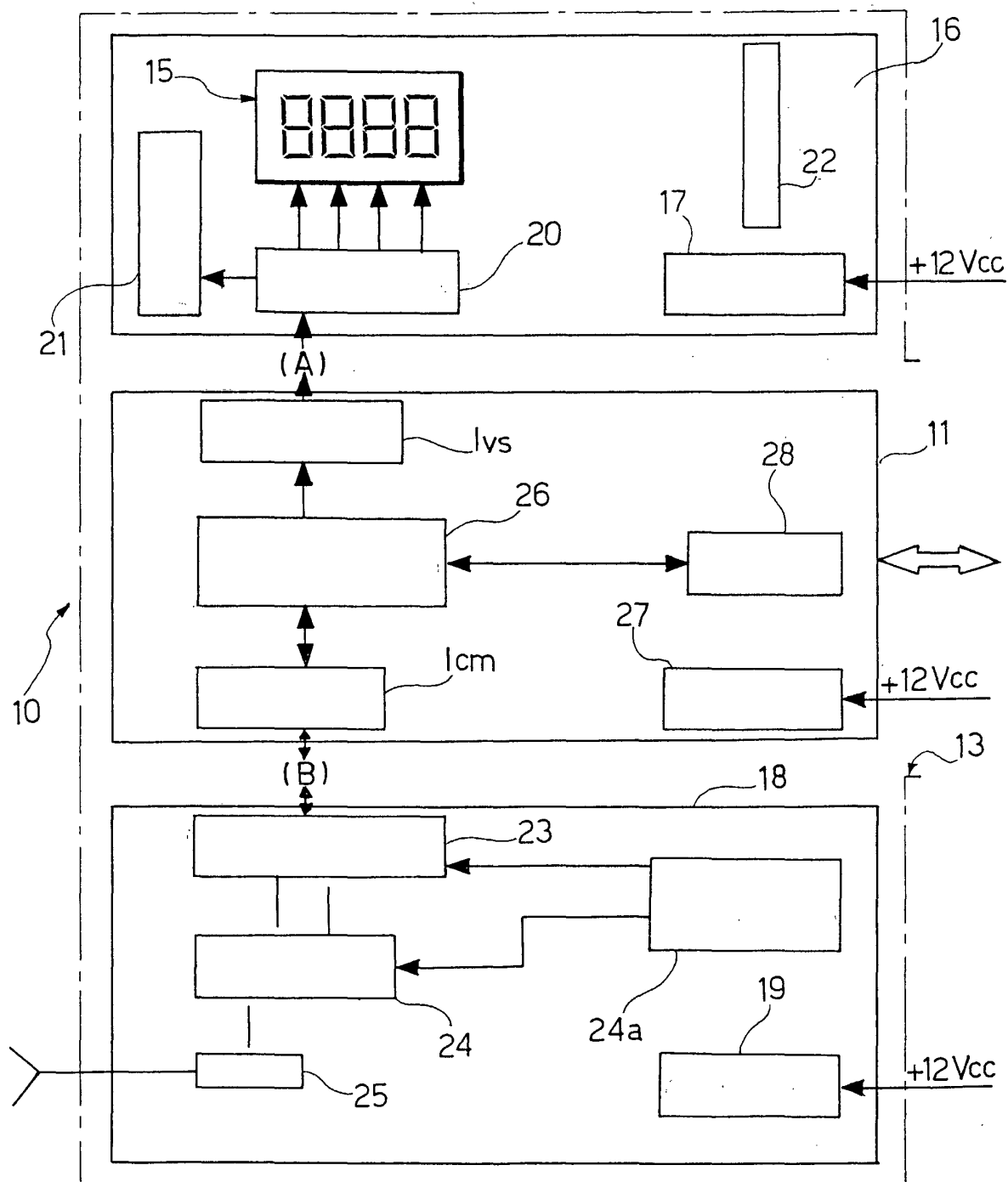


FIG. 2a

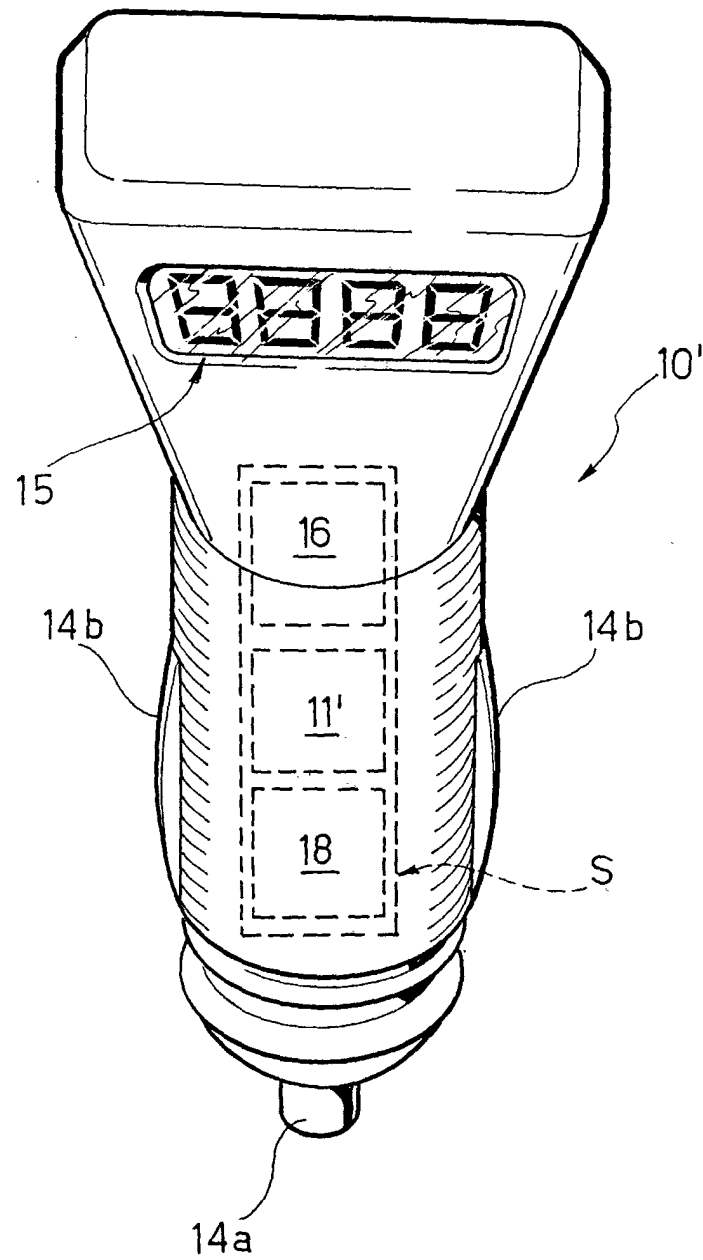
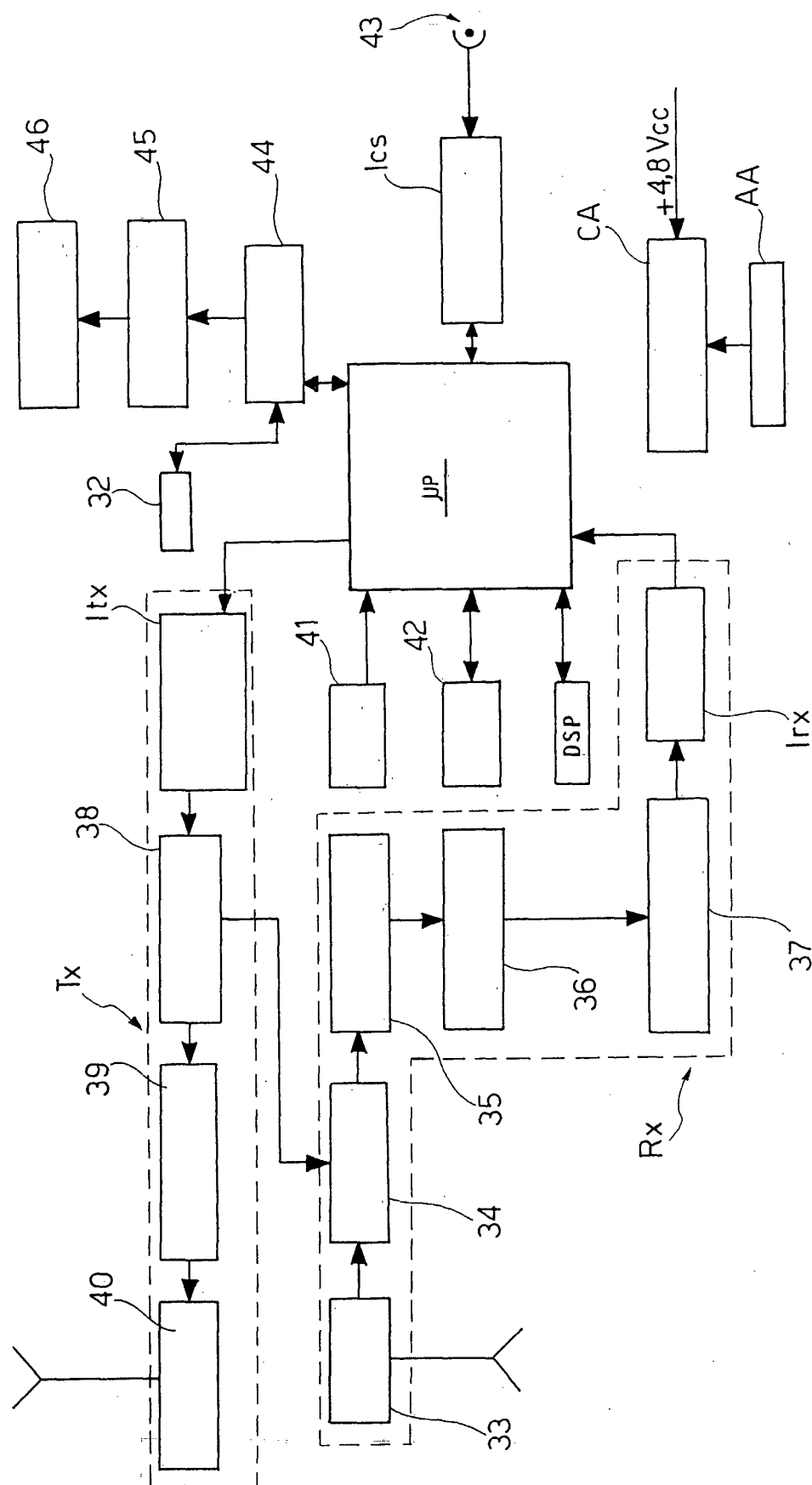


FIG. 3





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 12 8230

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X,P	US 6 102 285 A (ELIAS) 15 August 2000 (2000-08-15)	1,2	G07C1/30 G07B15/02
Y,P	* column 2, line 53 - column 3, line 22 *	4-13	
A	* column 3, line 38 - column 6, line 3; figures 1-3 *	3	

Y	US 5 266 947 A (FUJIWARA ET AL.) 30 November 1993 (1993-11-30)	4,5,13	
A	* column 2, line 14 - column 9, line 49; figures 1-11 *	1-3	

Y	US 5 153 583 A (MURDOCH) 6 October 1992 (1992-10-06)	6-12	
A	* column 8, line 11 - column 18, line 28; figures 1-10C *	1	

X	WO 93 19435 A (MIKROKIT HARDWARE OY) 30 September 1993 (1993-09-30)	1	
A	* page 3, line 12 - page 5, line 26; figures 1-3 *	2-13	

X	FR 2 641 635 A (HECKMANN ET AL.) 13 July 1990 (1990-07-13)	1,2	
A	* page 1, line 3 - page 2, line 2 * * page 2, line 11 - page 3, line 21; figures 1-3 *	3-13	G07C G07B

X	US 5 382 780 A (CARMEN) 17 January 1995 (1995-01-17)	1	
A	* column 3, line 56 - column 12, line 16; figures 1-10 *	2-13	

A	FR 2 594 985 A (AUBERT) 28 August 1987 (1987-08-28)	1	
	* page 4, line 24 - page 11, line 32; figures 1-4 *		

	-/--		
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		20 June 2001	Rivero, C
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/92 (P04/C01)



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 12 8230

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.CI.7)
A	US 4 310 890 A (TREHN ET AL.) 12 January 1982 (1982-01-12) * column 4, line 24 - column 7, line 23; figures 6-9 *	1	
A,P	FR 2 782 815 A (FRANCE TELECOM S.A.) 3 March 2000 (2000-03-03) * page 12, line 26 - page 21, line 17; figures 1-8 *	1	
A	EP 0 463 557 A (MENAHEM) 2 January 1992 (1992-01-02) * column 2, line 53 - column 7, line 52; figures 1-8 *	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.CI.7)
Place of search THE HAGUE		Date of completion of the search 20 June 2001	Examiner Rivero, C
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04C01)

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

EP 00 12 8230

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European 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.

20-06-2001

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6102285 A	15-08-2000	NONE	
US 5266947 A	30-11-1993	JP 4274600 A JP 6068395 A	30-09-1992 11-03-1994
US 5153583 A	06-10-1992	AT 124829 T AU 2781089 A WO 8905067 A CA 1326889 A DE 3854129 D DE 3854129 T EP 0393089 A JP 3502032 T ZA 8808681 A	15-07-1995 14-06-1989 01-06-1989 08-02-1994 10-08-1995 14-12-1995 24-10-1990 09-05-1991 25-07-1990
WO 9319435 A	30-09-1993	FI 89753 B AU 3753193 A	30-07-1993 21-10-1993
FR 2641635 A	13-07-1990	NONE	
US 5382780 A	17-01-1995	AU 7831494 A CN 1102492 A WO 9510099 A ZA 9407304 A	01-05-1995 10-05-1995 13-04-1995 07-07-1995
FR 2594985 A	28-08-1987	NONE	
US 4310890 A	12-01-1982	SE 411600 B AT 3595 T BR 7903273 A DE 2965491 D EP 0006079 A JP 55018795 A	14-01-1980 15-06-1983 11-12-1979 07-07-1983 12-12-1979 09-02-1980
FR 2782815 A	03-03-2000	BR 9913327 A WO 0013148 A	15-05-2001 09-03-2000
EP 463557 A	02-01-1992	IL 94780 A	12-12-1991

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82