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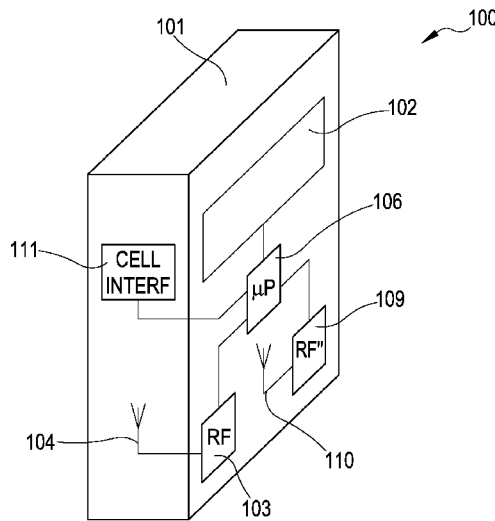
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FIG.3



(57) Abstract: Device of research of people buried by avalanche (100), characterized in that it comprises a body or box (101) suitable containing therein a radiofrequency circuit (103) electrically coupled with at least an antenna (104; 104', 104'', 104''') transmitting in use a position radio signal; said device of research of people buried by avalanche (100) comprises: - a first operative mode of transmission wherein it transmits said position radio signal, wherein said position radio signal is modulated by means of a modulation 4-QAM wherein the modulating signal transports identification data in advance stored; - and a second operative mode of reception alternatively activatable respective to said first operative mode wherein said at least an antenna (104; 104', 104'', 104''') receives a position radio signal transmitted by other devices of research of people buried by avalanche.

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DEVICE, SYSTEM AND METHOD FOR SEARCHING PEOPLE
BURIED UNDER AVALANCHES

DESCRIPTION

Field of the invention

The present invention concerns in its most general aspect the field of radio operative electronic devices.

In detail, the present invention concerns a device of research of people buried by avalanches.

The present invention further concerns a system of research of people buried by avalanches which further comprises the device object of the present invention.

The present invention concerns finally a method of research of people buried by avalanches, wherein said device is used.

Background art

The people that move in a mountain environment, in particular in case of presence of snow often wear devices of research of people buried by avalanches of a known type.

Said devices, commonly known with the name of ARVA or ARTVA (in italian *Apparecchio di Ricerca dei Travolti in Valanga* and in French *Appareil de Recherche de Victimes en Avalanche*) is a small electronic radio emitting device, having inside a radiofrequency circuit electrically connected with an antenna – typically of a magnetic type and provided with a plurality of windings on a ferrite core – which is suitable for transmitting a weak radiofrequency signal, suitable for being received by ARVA or ARTVA receiving devices.

Each device of research of people buried by avalanche is provided with of two operative modes:

- a first “transmitter” mode, wherein it actually transmits said radiofrequency device through the antenna; and
- a second “receiver” mode, wherein it is configured for not to transmit but for receiving the signal coming from other devices of research of people buried by avalanche.

The first “transmitter” mode is typically manually activated by the user before starting the trip in the mountain and is kept for the whole duration of the trip, so that to have guarantee that during the whole period of time of the trip, in case of avalanche everyone can always be findable.

The radiofrequency device that is transmitted by the device of research of people buried by avalanche is standardized. Said radiofrequency device, according to ETSI EN 300 718-1 standard, is a radio signal with carrier frequency $f_c=457\text{kHz}$, transmitted with A1A or OOK modulation that as from figure 1 has a minimum on-time $T_{on}=70\text{ms}$ and a minimum off-time $T_{off}=400\text{ms}$.

The period T of the signal is equal to 1000ms with a tolerable range of $\pm 300\text{ms}$.

The intensity of electromagnetic field which is transmitted by the device of research of people buried by avalanche is equal to a minimum of $-6\text{dB}\mu\text{A/m}$ at a distance of 10m .

The second “receiver” mode is instead used by rescue team.

In the simplest embodiment, the second “receiver” mode, by means of user interface means that preferably but in a non-limiting extent comprise small speakers or display (depicted in figure 2), allow the rescuing user to visualize the intensity of field 3 of the person buried by the avalanche. The strongest the intensity of field visualized by the device of research of people buried by avalanche into the second mode “receiver” is strong, the greater is the proximity between the buried and the rescuer.

During the years it has been demonstrated that the use of ARVA has drastically contributed in reducing the time required for extracting people buried by avalanche, and has significantly contributed to save human lives.

Some models of devices of research of people buried by avalanche have furthermore knobs or equivalent technical means suitable for reducing the sensitivity of the receiver stage, so that when coming closer to the position of the buried person, it is possible to discriminate with an always greater detail its exact position.

The applicant has observed that the devices of research of people buried by avalanche, do not allow to know many data that could be useful to the rescuer. In particular, do not allow to know who is under the avalanche, and neither what are the vital conditions.

Nonetheless, the applicant, also thanks to the experience gained in the field of rescue, kept into account the fact that mountain trips never take place with people alone but involve more or less numerous groups, has considered that technically potential reflections or superimpositions of radiofrequency signals transmitted by a plurality of devices of research of people buried by avalanche, in particular in case of relatively reciprocal proximity, can bring to big drawbacks in terms of capacity of discrimination and identification of victims.

The scope of the present invention is therefore to describe a device of research of people buried by avalanche which allows for solving the aforementioned drawbacks.

A further scope of the present invention is to describe a system of research of people buried by avalanche which is capable of solving the aforementioned drawbacks.

Finally, a further scope of the present invention is to describe a method of research of people buried by avalanche which allows for solving the aforementioned drawbacks.

Summary of the invention

The applicant has observed that in case of devices of research of people buried by avalanche, can be realized. According to the present invention is realized a device of research of people buried by avalanche characterized in that it comprises a body or box suitable for containing inside a radiofrequency circuit electrically coupled with at least a transmitting antenna in use a position radio signal; said device of research of people buried by avalanche comprises:

- a first operative mode of transmission wherein it transmits said position radio signal, wherein said position radio signal is modulated by means of a modulation 4-QAM wherein the modulating signal carries identification data in advance stored;
- and a second operative mode of reception alternatively activable respective to said first operative mode wherein said at least one antenna receives a position radio signal which is transmitted by other devices of research of people buried by avalanche.

According to an aspect of the present invention, in said first operative mode said position radio signal is continuously transmitted and is a LF or MF signal.

For the purposes of the present invention, as "LF" shall be intended a radio signal comprised in the frequencies interval between 3kHz and 300kHz.

For the purposes of the present invention, as "MF" shall be intended a radio signal comprised in the frequencies interval between 300kHz and 3MHz.

According to a further aspect of the present invention, within said radiofrequency circuit there is a mixer stage with an in-phase branch and a quadrature branch having inputs fed with two digital data streams, and in that of comprising a microprocessor configured at least for processing said identification data received on an input thereof and subdivide said two digital data streams for feeding them towards said inputs of said mixer stage.

According to a further aspect of the present invention, said device comprises a receiver stage comprising a mixer stage electrically coupled to said at least one antenna feeding through its outputs a signal comparator from which the identification data that were transmitted by other devices of research of people buried by avalanche are extracted.

According to a further aspect of the present invention, said receiver stage further comprises an amplifier stage interposed between said mixer stage and said signal comparator wherein said amplifier stage has a couple of branches respectively coupled with a first and a second output of said mixer stage.

According to a further aspect of the present invention, said device comprises a plurality of antennas each oriented orthogonally respective to the others.

In detail, at least one antenna has a ferrite core with non-circular section.

According to a further aspect of the present invention, said device comprises a second radiofrequency circuit operating in the VHF/UHF band and a second antenna electrically coupled with said second radiofrequency circuit, wherein said second radiofrequency circuit transmits an own data signal.

In detail, said second radiofrequency circuit is selectively activated da motion sensor means in case said motion sensor means do not detect movements of a user wearing said device for an interval of time beyond a predetermined interval or in case said motion sensor means detect an acceleration beyond a value which is predetermined in advance.

In detail, said data signal transmits an alphanumeric code suitable for being received and visualized by radio rescue devices provided to rescuers.

According to a further aspect of the present invention, said device comprises furthermore one module of interface towards a cellular telephonic device, said interface module being configured for sending a command of activation of a transmission of a text message, a numeric data or telephone call by said cellular telephonic device towards one or more predetermined addressees.

In detail, with said command of activation of said transmission, said cellular telephone further transmits a georeferenced position data, in case said data is updated after a predetermined period of time.

According to the present invention is realized a cellular telephone cover, said cover comprising the device of research of people buried by avalanche according to any of the features previously described.

In detail, said cover is realized in a material shielding the radio waves transmitted from said cellular telephone towards said device of research of people buried by avalanche.

According to a further aspect of the present invention, said cover comprises an antenna coupled to said first radiofrequency circuit and conceived for retransmitting the position radio signal emitted from said first radiofrequency circuit.

According to a further aspect of the present invention, said cover comprises a battery.

According to the present invention is finally realized a garment, comprising a plurality of antennas electrically coupled with the first radiofrequency circuit of a device of research of people buried by avalanche according to the features described above.

In detail, said plurality of antennas comprises:

- a first, a second and a third antenna (701, 702, 703) each of the which is an antenna oriented in a direction orthogonal respective to the others.

More in detail, said first antenna is arranged in a sleeve of said garment, said second antenna is arranged in a chest portion of said garment and the third antenna is arranged in a dorsal portion of said garment.

Detailed description of the invention

With the reference number 100 in figure 3 is indicated in its complex a device of research of people buried by avalanche.

The device 100 comprises in particular a box 101 wherein there are preferably a display or equivalent technical means suitable for providing a user interface 102, and a radiofrequency circuit 103 that is electrically connected with an antenna 104, preferably but in a non-limiting extent realized by means of a Litz wire wound on a ferrite core and transmits a position radio signal.

For the purposes of the present invention, as position radio signal shall be intended a radio signal transmitted by one or more antennas positioned in close proximity one another and suitable for being received by receiving stations in such a way its origin can be determined.

The radiofrequency circuit 103 is a circuit conceived for transmitting a radio signal radio in the frequencies interval between 3kHz – 3MHz, and is therefore capable of operating in the LF – MF. Said intervals of frequencies have demonstrated be particularly suitable for being transmitted through a layer of snow, and are therefore susceptible of being received by rescue personnel that is separated from the buried person exactly by said snow layer.

The device 100 object of the present invention is configured as an ARVA or ARTVA device and is configured for being worn by people that go traveling in mountains in such a way that – in the unfortunate case they are submersed by an avalanche, they can be favorably retrievable.

The device 100 object of the present invention comprises a first operative “transmitter” mode and a second operative “receiver” mode. The first mode “transmitter” is typically manually activated by the user before starting the trip in the mountain and is kept for the entire duration of the trip, so that to have guarantee that during the entire interval of time of the trip, in case of avalanche people can always be retrievable, since in said operative mode the radio signal transmitted by the device is transmitted continuously. The second “receiver” mode is in contrast used by the rescue personnel. In the simplest embodiment, the second “receiver” mode, by means of user interface means that preferably but

in a non-limiting extent comprise small speakers or display (being part of the user interface 102), that allow to the rescuer visualize the intensity of field for the avalanche buried person. The stronger the intensity of field which is visualized by the device of research of people buried by avalanche into the second mode “receiver” is, the greater the proximity between the buried and the rescuer is.

The device 100, through the radiofrequency circuit 103, transmits a radio signal at a frequency of 457kHz. This guarantees a compatibility of the device object of the present invention with other devices of a known type, and in particular renders the device object of the present invention compatible with ETSI EN 300 718-1 standard.

As it is shown in figure 4, the radiofrequency signal transmitted by the radiofrequency circuit 103 is a QAM modulated signal. More precisely, the radiofrequency device is a signal modulated with QPSK modulation, i.e. with four baud each formed by 2 bits.

As it is known, in the traditional modulation, included the A1A of ARTVA devices of a known type, the bandwidth BW required by the modulation, observed the period T[s] of the modulation, and observed as n the number of bits which are transmitted observes the following law:

$$n = \frac{T}{\frac{1}{BW}}$$

and that is, defined R_b the bitrate [bps] of the modulation $BW=R_b$.

In the case of the QPSK modulation that is used in the present invention, in contrast, the number of bits that are transmitted observes the following law:

$$n = \frac{T}{\frac{1}{BW}} N, \text{ wherein } N=2 \text{ being QPSK a 2-QAM modulation.}$$

In other words, for the QPSK $BW=0.5 R_b$.

In other words, the QPSK modulation advantageously allows having a spectral efficiency which is double respective to the ordinary A1A modulation, and furthermore keeps a backward compatibility with this last. This, in practice, translates in the fact that the radiofrequency circuit 103 transmits a radiofrequency signal that even if differing from the traditional one is equivalently receivable by the devices of research of people buried by avalanche of a traditional type without losing precision and efficiency.

This guarantees that the device 100 object of the present invention is not only receivable through other homologous, but also by common standard ARVA devices, even if in a “degraded” operation, wherein the data that is transmitted by means the QPSK modulation is lost into the reception with traditional devices at a level of transported information, even being said radiofrequency signal anyway receivable and valuable in terms of intensity and direction of arrival.

The fact of having chosen a QPSK modulation, in addition, renders the device 100 object of the present invention less sensitive to interferences, and therefore there is greater guarantee that transmitted data can reach the receiver without corruption. Even if the applicant has clear in mind that known channel or source coding are suitable for enhancing the interference immunity for the signal far more than a QPSK makes respective to an A1A modulation, said choice is appeared the best in terms of ratio between the signal processing complexity, easiness and robustness of circuits and actual immunity to noise.

Furthermore, the QPSK modulation involves only variations of phase for the modulated signal, but not of its amplitude that would in contrast be object of envelope variations in a modulation as the 8-QAM. Consequently the average power on the period of the signal modulated by the radiofrequency circuit 103 always results constant, and this facilitates the reception also by part of conventional devices, since it does not need to face abrupt variations of intensity typical of the used modulation.

As it is shown in figure 5, the radiofrequency circuit 103 comprises a local oscillator 200, that feeds a filter stage 201 suitable for obtaining the carrier signal at 457kHz, which in turn has an output suitable for feeding a first input of the mixer 202. The mixer 202 furthermore has a second input that receives in input the signal produced on the output of the exit of the filter stage 201; a phase shifter 203 shift the phase of 90° before feeding it on the second input of the mixer 202. The output I and Q of the mixer 202 will feed respective inputs of an adder 204, that generates in output the modulated signal to be transmitted to the antenna 104.

Figure 6 shows a receiver stage 106 that is part of the device 100 object of the present invention, and that is activated in case said device operates into the second mode “receiver”.

In detail the receiver stage 106 comprises a mixer 307 provided with an input of the modulated signal 301 connected to the antenna 104 by means of adapted uncoupling means 302 comprising a circulator, and further comprises a couple of inputs 303, 304 fed by respective local oscillators 305.

The mixer 307 comprises a couple of outputs that feed respective inputs of an amplifiers stage 308. The amplifier stage 308, preferably, but in a non-limiting extent, comprises a couple of independent branches 308', 308'', each comprising a cascade of two operational amplifiers 309 which are connected in series and fed by a respective output.

Each of the outputs of the amplifier stage 308 feeds a respective input of a signal comparator 310 from which are extracted digital data 311 that were transmitted and modulated.

Figure 6 shows a sequence of digital data sent to the modulator. Through the QPSK modulation, data are brought on the two I and Q branches alternatively. The demodulation will be performed equivalently, recombining the data in a single sequence.

In detail, as it is shown always in figure 7, the data are generated through a microprocessor 107 with a frequency of 80Hz. Said speed of generation of data is rendered possible since the bandwidth of the system available for resting compatible with the standards is 160Hz.

An example of the data signal 400 used as input of the radiofrequency circuit 103 and subsequently modulated and sent to the antenna is illustrated in figure 8, from which it can be inferred what has already been said, that is to say that the amplitude of the envelope of the modulated signal 333 rests constant in time, since only its phase is changed. With the QPSK modulated signal, in substance, there are bauds of 2 bit, and four possible phase variations.

Figure 9 shows a detail of the antenna object of the present invention. In detail the antenna 104 is constituted by a plurality of windings 501 of electrically conductive metallic material which are wound on a ferrite core. The ferrite core is preferably but in a non-limiting extent of a cylindrical type, and the more its diameter increases, the greater is its directivity. The windings 501 are realized by means of a Litz wire, that is typically used for frequencies that start from some kHz up to 1 MHz for all those applications where there is presence of skin effect in the conductor itself. the electrically conductive metallic material, in a preferred and non-limiting embodiment, is realized by means of enameled wire. Said enameling advantageously allows for reducing the skin effect of proximity and allows therefore of having a greater antenna efficiency. Preferably, the wire that realizes the windings 501, has a diameter of 0,5 mm.

In a preferred and non-limiting embodiment said ferrite has a non-cylindrical section. Said non-cylindrical section modifies the directivity of the antenna in the E-plane and consequently can be advantageously used for generating a directivity of the antenna towards a specific direction.

In a further embodiment of the device 100 shown in figure 10, there are many antennas 104', 104'', 104''' each of which has an own principal directivity given by the non-cylindrical section of the ferrite core.

The three antennas 104', 104'', 104''' are positioned in such a way to have an inclination orthogonal one respect to the other, so that to cover the three principal axes X, Y, Z of the device 100. For the purposes of the present invention, the orthogonal inclination of each of the three antennas 104', 104'', 104''' is read on the axis of the ferrite core, and is such that to render the radiation zeros of said antennas on the plane H, that lie exactly on the axis of the ferrite core, oriented on three different orthogonal axes. This ensures the maximum efficiency of radiation around the device.

Thanks to the directivity induced by the shape of the ferrite it is possible to optimize the overall gain of the array of antennas in a specific direction in such a way to have an optimized coverage of signal transmission and reception, that renders for example possible to distinguish people buried at a depth deeper respective to the depth beyond which the normal devices of research of people buried by avalanche cannot operate.

As it is shown in detail in figure 11, on the microprocessor 106 is sent a data string that in the herein shown embodiments corresponds to the string "CIAO". At each word of the string "CIAO" there is a sequence of 8 bits, that is necessary kept into account of the length of the alphabet. The sequence of 8 bits, is divided in two streams of data that arrive on the in phase I and quadrature Q signals and are sent to the modulator.

In a preferred and non-limiting embodiment of the present invention, the device 100 is configured for transmitting in continuity a data string containing a univocal identification code of the device itself. This univocal identification code is assigned at the moment of the sale of the device 100 and is therefore univocally associated to the owner of the device itself.

The device object of the present invention optionally comprises a second radiofrequency circuit 109, electrically connected with an own antenna 110. The second radiofrequency circuit 109 is configured for operating in the frequencies interval VHF/UHF, preferably on the frequency of 869.8 MHz, in Europe, that is considered a further standard frequency for search and rescue devices.

In detail, the second radiofrequency circuit 109 is configured for transmits a data signal.

In a first embodiment, the radiofrequency circuit 109 transmits the same type of data which is transmitted by the first radiofrequency circuit 103, and that is the univocal code.

In a second embodiment, the radiofrequency circuit 109 transmits data of a different type respective to those which are transmitted by the first radiofrequency circuit 103. In detail, in said second embodiment, the second radiofrequency circuit transmits signals of a different type respective to those that are transmitted by the first radiofrequency circuit. Preferably, said second radiofrequency circuit 109 is coupled with a respiratory sensor or an heartbeat sensor which is arranged on the user that wears the device object of the present invention.

This allows the rescuers to receive vital parameters useful to understand the situation of the patient and, in case, if the person buried by the avalanche is still alive or not.

In detail, said second radiofrequency circuit 109 is not always active but is selectively activated in case motion sensors do not detect movements of the body for a predetermined interval of time or, as well, detect accelerations beyond a predetermined threshold – for example sign of a fall. The selective activation of the second radiofrequency circuit 109 advantageously allows for safeguarding the battery of the device object of the present invention, prolonging the operative duration.

Optionally the second radiofrequency circuit 109 can be advantageously configured for transmitting a signal of rescue request towards a government-assigned frequency for rescue request. Said frequency, for the Swiss area, is 161.300 MHz, and is constantly monitored by the REGA rescue aerial assistance, so that to promptly receive calls for rescue request by users which are involved in zones wherein the cellular coverage is not present.

In detail, through the transmission of a signal of rescue request towards the attributed frequency, it is possible to put in direct communication a rescue operations center to with the person involved in the avalanche, saving time useful for searching him and performing the first rescue operations.

Optionally, furthermore, the device 100 object of the present invention has a module of interface 111 with the cellular telephone. Said interface module can equivalently operate with a cabled or wireless connection.

The interface module 111 is configured for automatically detecting the presence of said cellular telephone, and when the second radiofrequency circuit 111 is activated, for activating also an automatic transmission of a message, numeric data or call from the cellular towards one or more predefined addressees. Preferably, in said transmission, is further transmitted the last position retrieved for the cellular, if available and – preferably – not older than 5 minutes. The position is retrieved through a GPS module of the cellular telephone, of a known type. This allows for having trace of an approximate position of the user, but without causing transmissions that could deviate the rescuers respective to the exact position of the person buried by the avalanche.

The device 100 object of the present invention is introduced in the more general context of a system of research of people buried by avalanche.

As it is shown in figure 12 the system 600, further than the device 100, also comprises a layer or cover 602 for cellular phones 601. The cover 602 comprises therein a plurality of devices among which:

- a battery 603, suitable for prolonging the duration of the battery of the cellular telephone 601, and provided with a suitable connector towards the power supply connector of the battery of the cellular telephone 601 itself;
- an antenna 604 suitable for retransmitting the radiofrequency signal transmitted by the first radiofrequency circuit 103.

In a preferred and non-limiting embodiment, the device 100 object of the present invention is integrated into the cover 602. In such a case the cover itself is realized with a material suitable to shield the transmission of radio waves at a frequency lower than the MHz between the cellular telephone 601 and the device 100 itself; this advantageously allows to have more operative efficiencies for the transmission stage and, most of all, for the receiver of the device 100.

Furthermore the system object of the present invention comprises further a garment, preferably a jacket or a softshell, provided with of a plurality of antennas 701-703 positioned various parts of the body, that are electrically coupled to a connection socket 112 present on the body of the device 100. The garment has furthermore a pocket for containing the body of the device 100.

Preferably, as it is shown in figure 13, the garment 800 comprises a first antenna 701 arranged on the sleeve, in correspondence of the humeral portion of the sleeve. A second antenna 702 is instead arranged in correspondence of the chest portion of the garment. A third antenna 703 is arranged finally in correspondence of a dorsal portion of the garment.

In a preferred and non-limiting embodiment, the three antennas 701-703 are each oriented in such a way to have an axis of the ferrite orthogonal respective to the axes of the ferrite present on the remaining antennas. Consequently, being the antennas as represented in figure 9 already directive along the plane H, there is advantageously a greater efficiency of radiation of the signal at 457kHz towards any direction around the person.

Furthermore, the presence of antennas in a garment enhances the radiation efficiency, since there are less layers to separate the antenna from the external environment and this, even slightly, finds itself surely farther than the body respective to what it would be if it were integrated within a traditional case worn at chest level, wherein the body most acts as a radio shield.

Also in terms of reception the device 100 object of the present invention can interface itself as mentioned before with the application hardware of the cellular telephone. This advantageously allows for having trace and direct interpretation of the data transmitted by the device 100. In case, the cellular telephone application can be a *bridge* towards external mobile devices like for example and in a non-limiting extent a smartwatch with which the user – either rescuer or subject under the avalanche – can interact in a known way.

At an higher level, through the sending of signals by the cellular telephone of the person involved in the avalanche, it is possible to activate the sending of drones directly in proximity of the last identified position through the cellular telephone. Advantageously this allows having a greater operative efficiency and for example transporting heavy materials automatically without involving people – like the rescuers – that moving lighter can operate in operative scenarios being also technically critical more freely (let's think to the case of subjects involved in high altitude avalanches, wherein the reachable route involves significant alpine climbing difficulty).

The advantages offered by the device object of the present invention are clear in the light of the description that precedes. It in particular allows having a greater efficiency also of discrimination of close echoes due to two or more people submerged in the same point.

The diagrams of figure 12 and of figure 13 illustrate two diagrams of intensity of signal received on the period T by two subjects (“A”, “B”) that transmit not only radiofrequency signals with different amplitude, but also in time instants which

are very close. So, in the case of the diagram of figure 12, the absence of univocal identification codes, in particular in case provided with low correlation, would not allow to the traditional devices of research of people buried by avalanche of being capable of being distinguished actually as many people; instead this is possible through the system object of the present invention, that allows yet from the beginning to provide to the rescue operative structure the exact position and number of individuals involved in the avalanche.

Furthermore, the presence of an high level interface with mobile cellular devices allows to have a sufficient bandwidth for transmitting a huge amount of data, that with the few Hz that are available in the 457 kHz band would not be transmissible in reasonable times.

Furthermore, the system object of the present invention allows of optimizing the transmission of the radiofrequency device also towards those zones that traditionally, in contrast, would not allow to have an optimal coverage, not only in terms of direction of radiation respective to the person involved in the avalanche, but also in terms of emission spectrum. The actual possibility of combination of low frequency signals (the standard signal at 457 kHz) with higher frequency signals (VHF/UHF and cellular signals) conveniently allows optimizing the actual reachability of a person capable of performing or anyway alerting the rescues.

It is finally clear that to the object of the present invention can be applied additions, adaptations or variants, obvious for a skilled person, without for this departing from the scope of protection provided by the annexed claims.

CLAIMS

1. Device of research of people buried by avalanche (100), characterized in that it comprises a body or box (101) suitable a containing therein a radiofrequency circuit (103) electrically coupled with at least an antenna (104; 104', 104'', 104''') transmitting in use a position radio signal; said device of research of people buried by avalanche (100) comprises:
 - a first operative mode of transmission wherein it transmits said position radio signal, wherein said position radio signal is modulated by means of a modulation 4-QAM wherein the modulating signal transports identification data in advance stored;
 - and a second operative mode of reception alternatively activatable respective to said prima operative mode wherein said at least an antenna (104; 104', 104'', 104''') receives a position radio signal transmitted by other devices of research of people buried by avalanche.
2. Device of research of people buried by avalanche (100) according to claim 1, characterized in that in said prima operative mode said position radio signal is transmitted continuously and is a LF or MF signal.
3. Device of research of people buried by avalanche (100) according to claim 1 or claim 2, characterized in that it comprises within said radiofrequency circuit (100) a mixer stage (202) with an in phase (I) and a quadrature (Q) branch having inputs fed with two stream of digital data, and in that it comprises a microprocessor (106) configured at least for processing said identification data received on an its input and subdivide it in said two streams of digital data for feeding them towards said inputs of said mixer stage (202).
4. Device of research of people buried by avalanche (100) according to any of the preceding claims 1-3, characterized in that it comprise a receiver stage

comprising one or more mixer stage (307) electrically coupled to said at least one antenna (104; 104', 104'', 104''') feeding through its output a signal comparator (310) from which identification data (311) that were transmitted by other devices of research of people buried by avalanche are extracted.

5. Device of research of people buried by avalanche (100) according to claim 4, characterized in that it comprises an amplifier stage (308) interposed between said mixer stage (307) and said signal comparator (310), wherein said amplifier stage (308) has a couple of branches (308', 308'') respectively coupled with a first and a second exit of said mixer stage (307).
6. Device of research of people buried by avalanche (100) according to any of the preceding claims, characterized in that it comprises a plurality of antennas (104', 104'', 104''') orientate each orthogonally respective to the others.
7. Device of research of people buried by avalanche (100) according to any of the preceding claims, characterized in that at least an antenna (104; 104', 104'', 104''') has a ferrite core with a non-circular section.
8. Device of research of people buried by avalanche (100) according to any of the preceding claims, characterized in that it comprises a second radiofrequency circuit (109) operating in the VHF/UHF and a second antenna electrically coupled with said second radiofrequency circuit (109), wherein said second radiofrequency circuit transmits a own data signal.
9. Device of research of people buried by avalanche (100) according to claim 9, characterized in that said secondo radiofrequency circuit (109) is selectively activated da motion sensor means in case said motion sensor means no more detect movements of a user wearing said device (100) for a period of time exceeding a predetermined interval or in case said motion sensor means detect an acceleration higher than a value predetermined in advance.

10. Device of research of people buried by avalanche (100) according to claim 8 or claim 9, wherein said data signal transmits an alphanumeric code suitable for being received and visualized by radio rescue devices provided to rescuers.
11. Device of research of people buried by avalanche (100) according to any of the preceding claims, characterized in that it comprises one module of interface (111) towards a cellular telephonic device, said interface module (111) being configured for sending a command of activation of a transmission of a text message, a numeric data or a telephone call by said cellular telephonic device towards one or more predetermined assignees.
12. Device of research of people buried by avalanche (100) according to claim 11, wherein with said command of activation of the said transmission, said cellular telephone further transmits a georeferenced position data, in case said data has been updated more recently respective to a predetermined period of time.
13. Cover (602) for cellular telephones (601), said cover comprising the device of research of people buried by avalanche (100) according to any of the preceding claims 1-12.
14. Cover (602) for cellular telephones (601) according to claim 13, characterized in that it is realized in material shielding the radio waves which are transmitted by said cellular telephone towards said device of research of people buried by avalanche (100).
15. Cover (602) for cellular telephones (601) according to any of the claims 13 or 14, characterized in that it comprises an antenna (604) coupled to said first radiofrequency circuit (103) and conceived for retransmitting the position radio signal emitted from said first radiofrequency circuit (103).
16. Cover (602) for cellular telephones (601) characterized in that it comprises a battery (603).

17. Garment (800), comprising a plurality of antennas (701-703) electrically coupled with the first radiofrequency circuit (103) of a device of research of people buried by avalanche (100) according to any of the preceding claims 1-12.
18. Garment (800) according to claim 17, characterized in that said plurality of antennas comprises:
 - a first, a second and a third antenna (701, 702, 703) each of which is an antenna oriented in direction orthogonal respective to the others.
19. Garment (800) according to claim 18, wherein said first antenna (701) is arranged in a sleeve of said garment (800), said second antenna (702) is arranged in a chest portion of said garment (800) and the third antenna (703) is arranged in a dorsal portion of said garment (800).

FIG.1

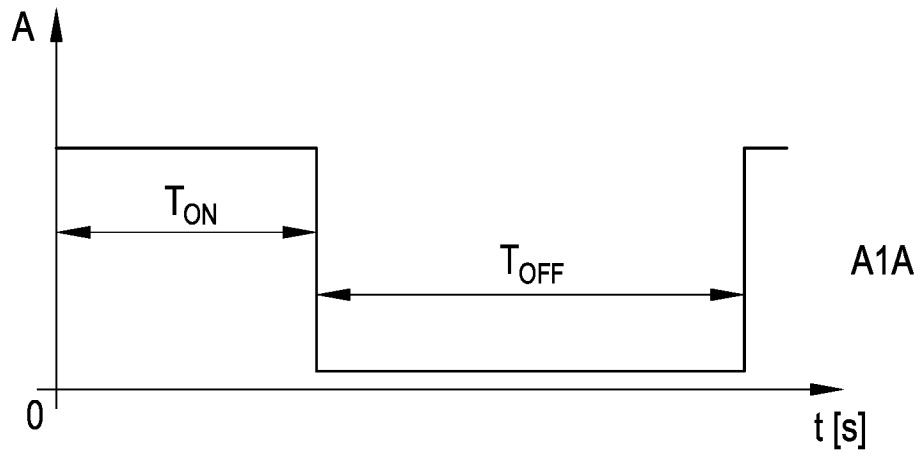


FIG.2

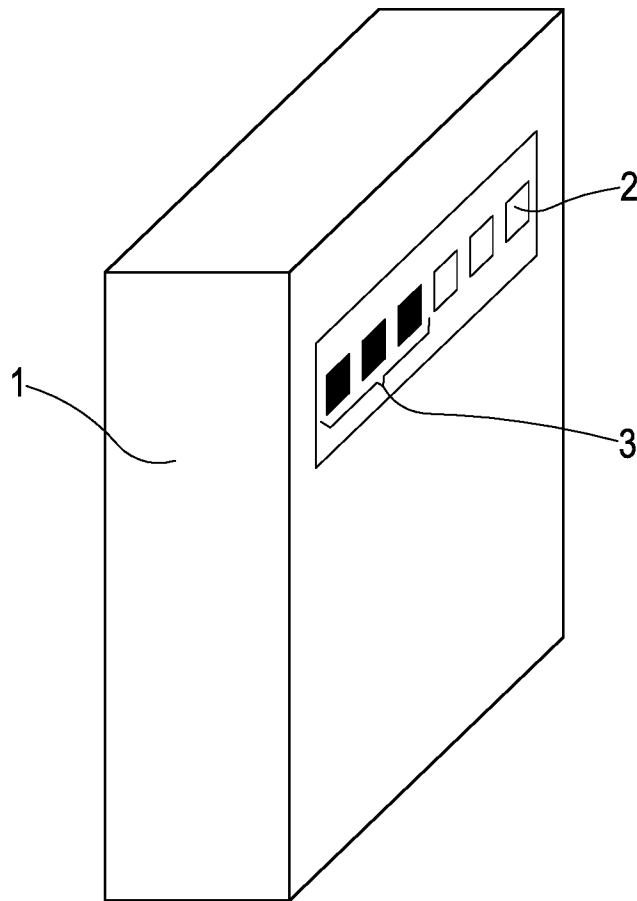


FIG.3

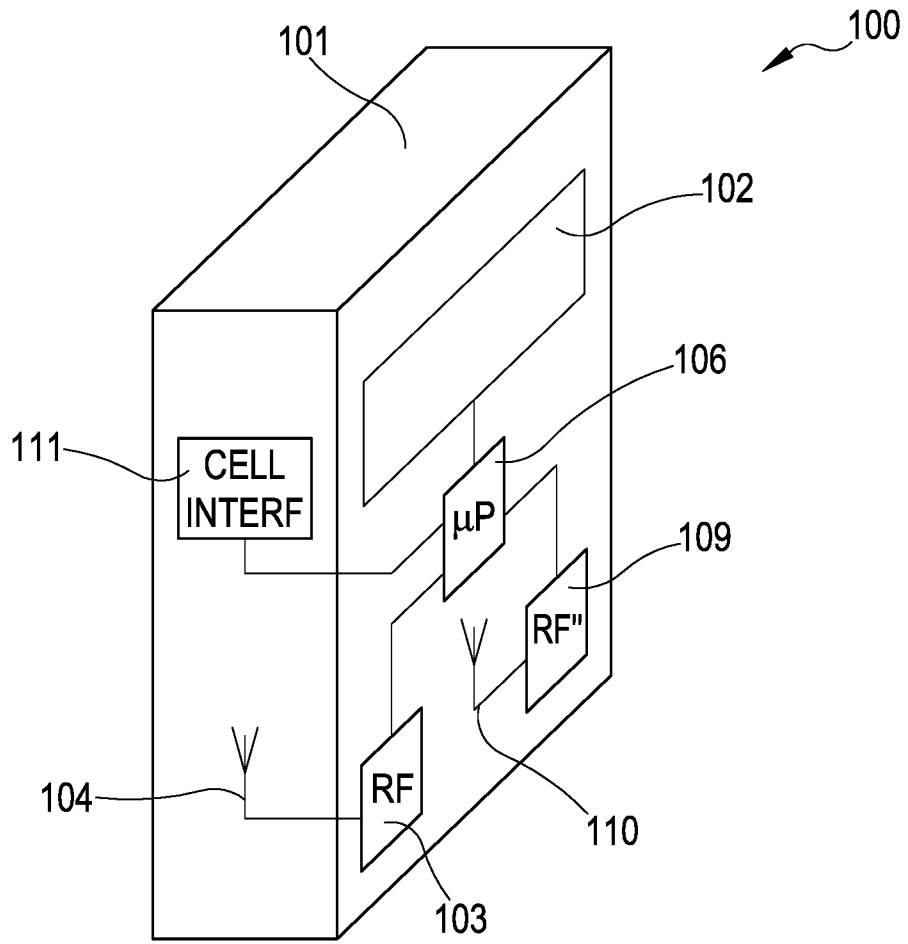
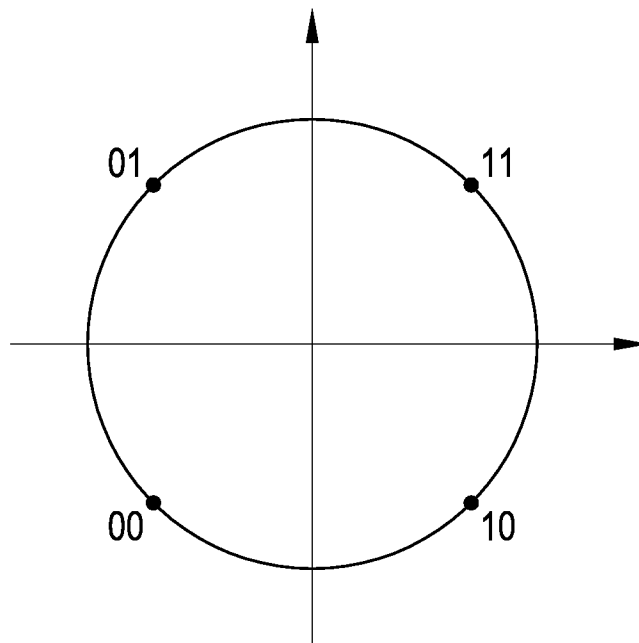


FIG.4



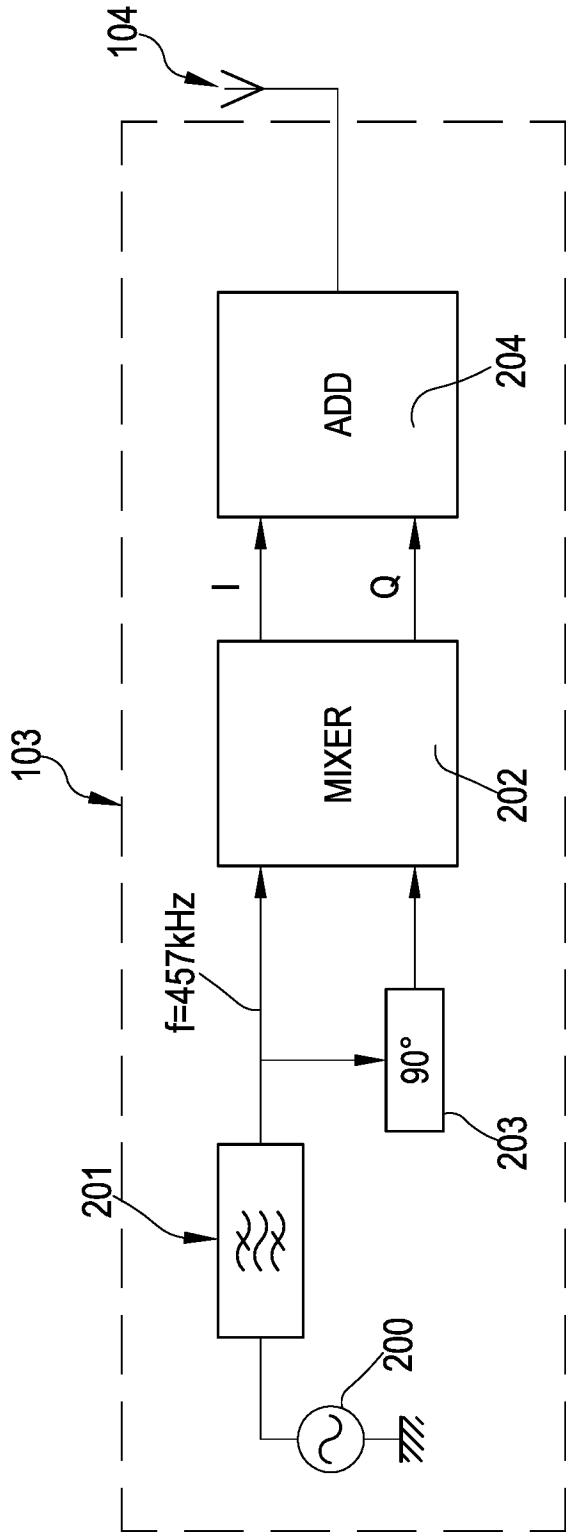


FIG.5

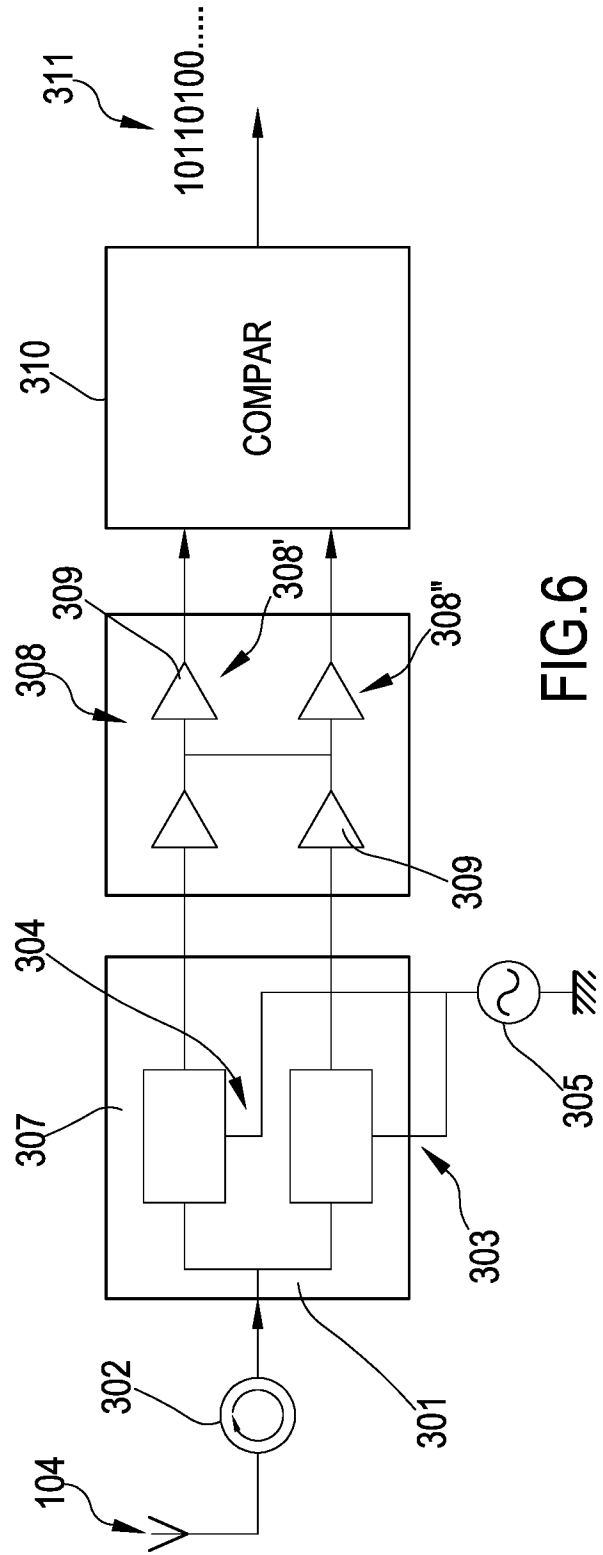


FIG.6

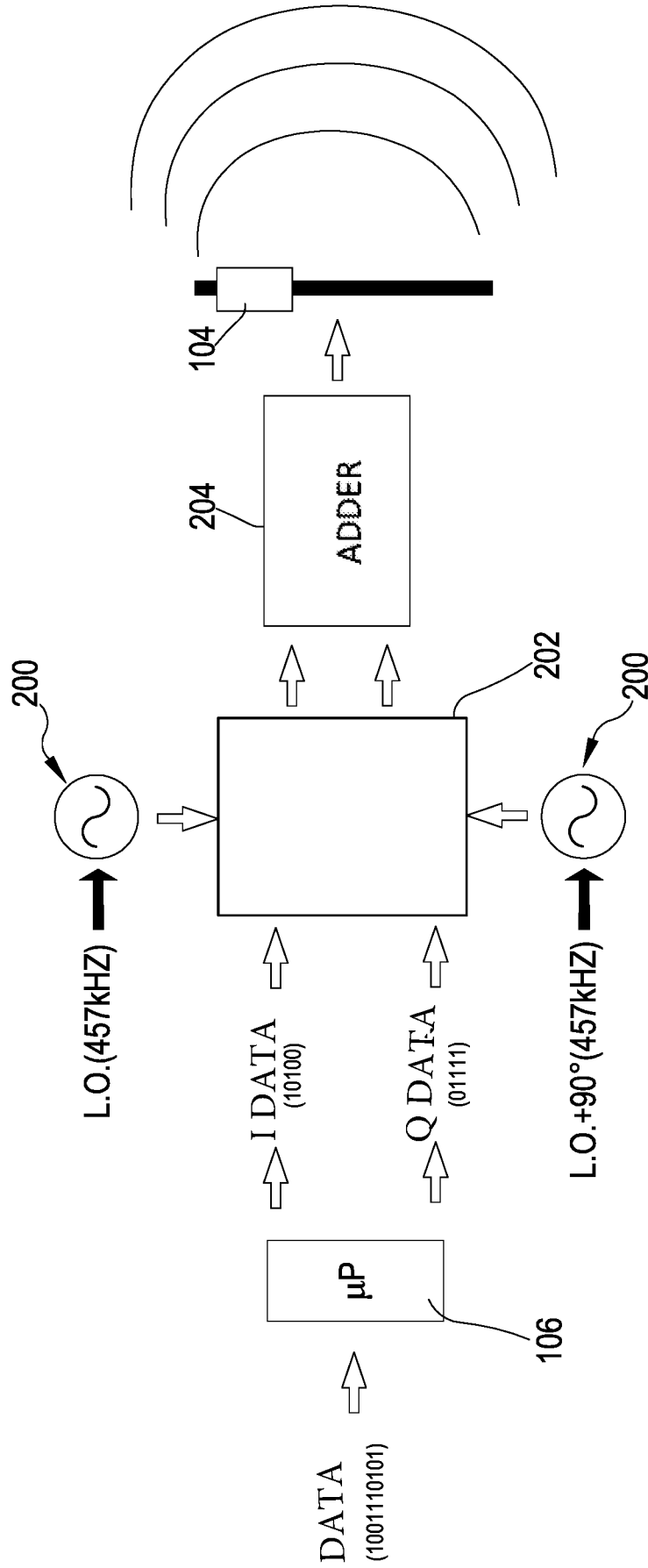
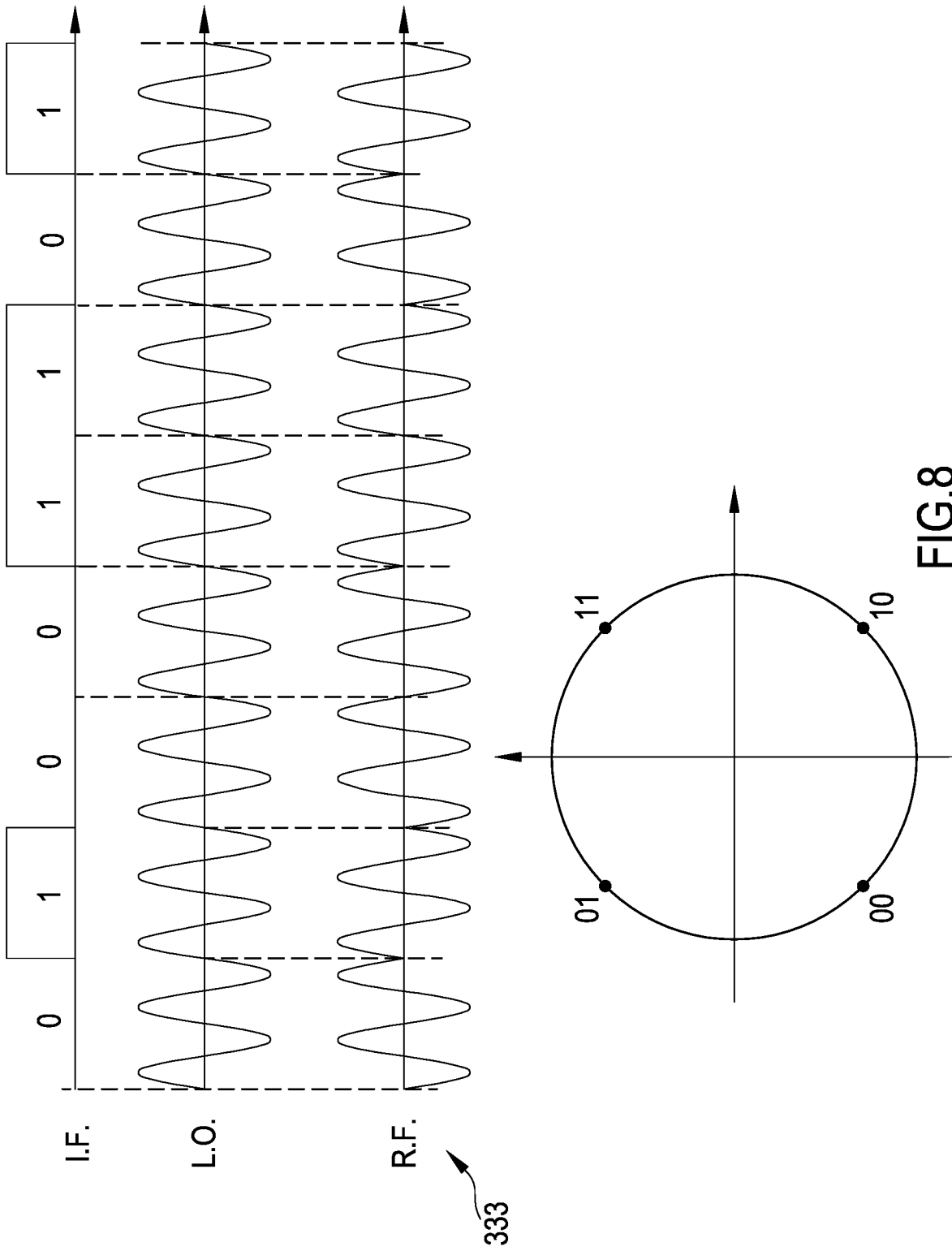
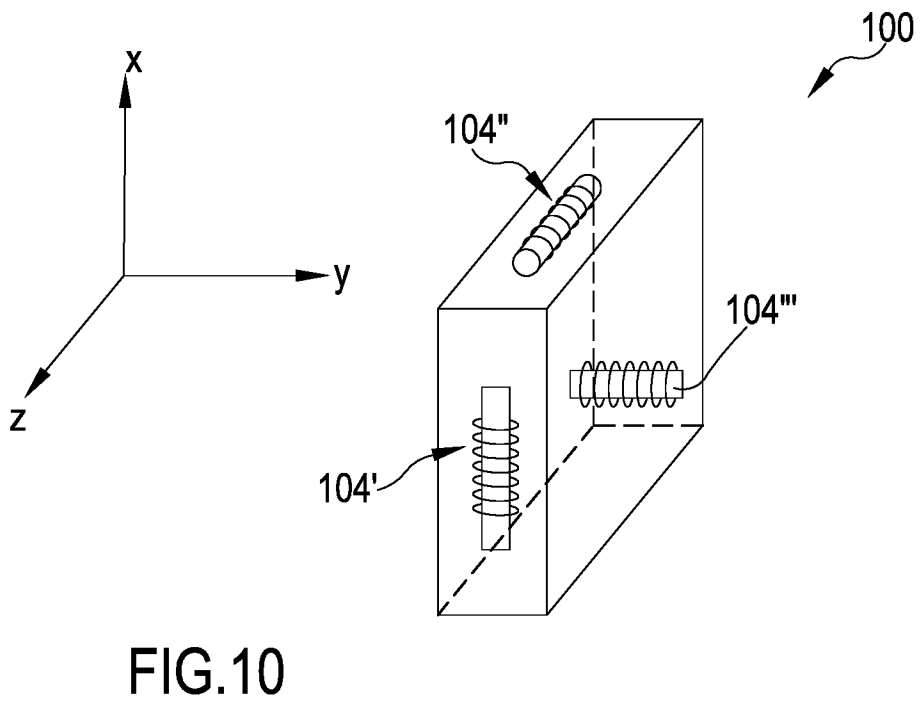
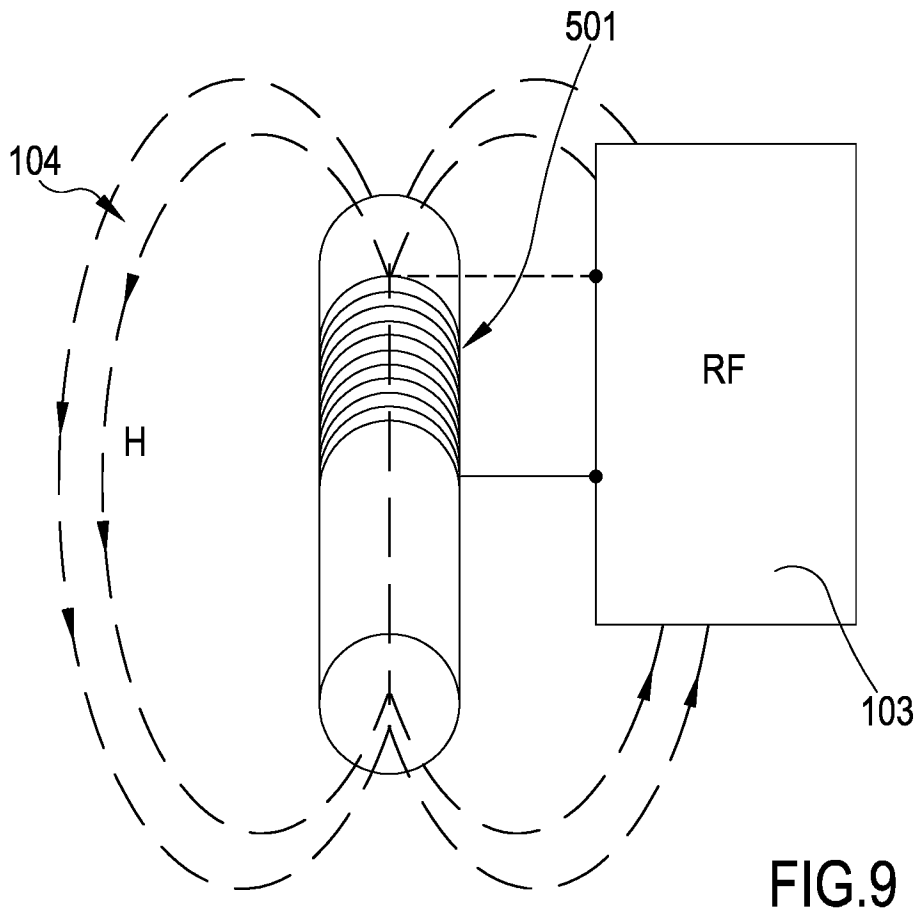


FIG. 7





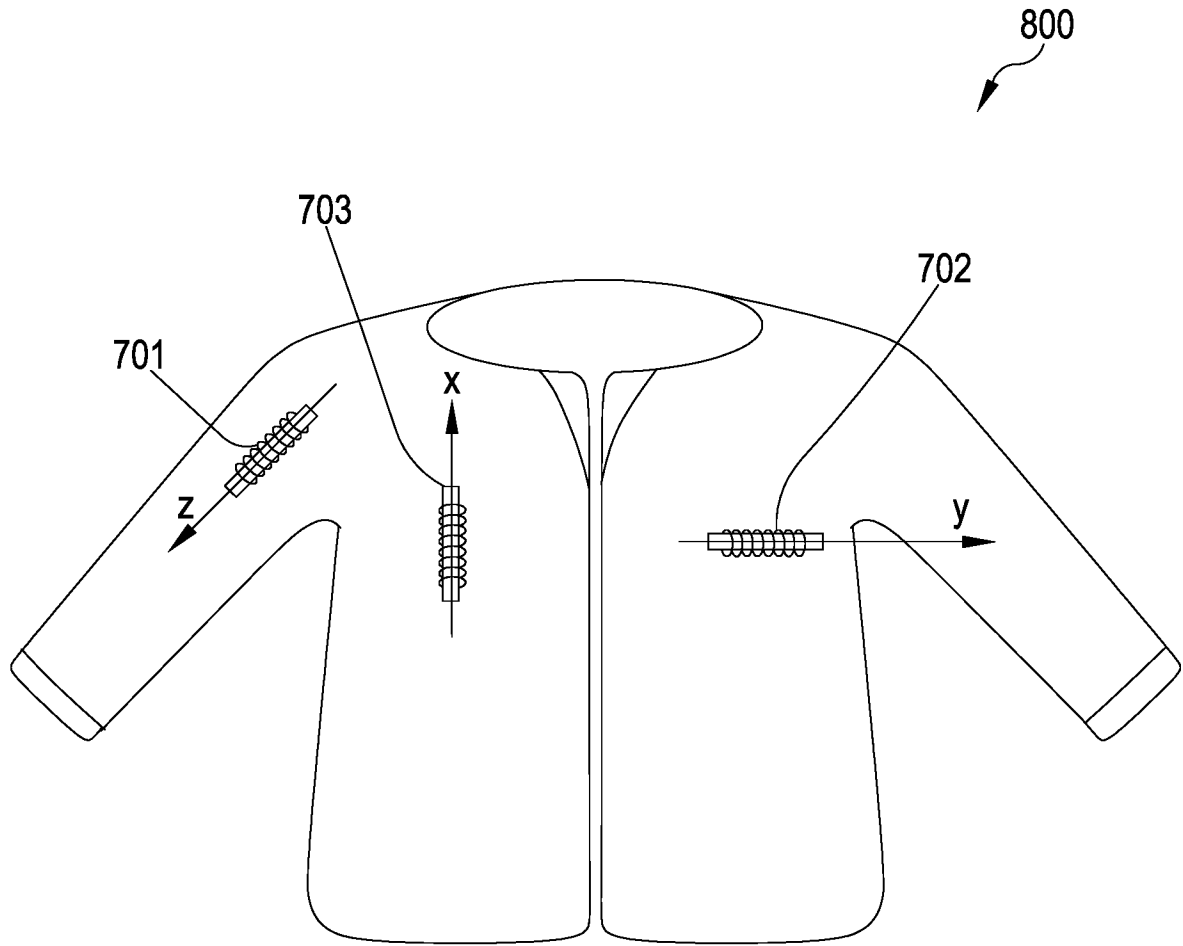


FIG.11

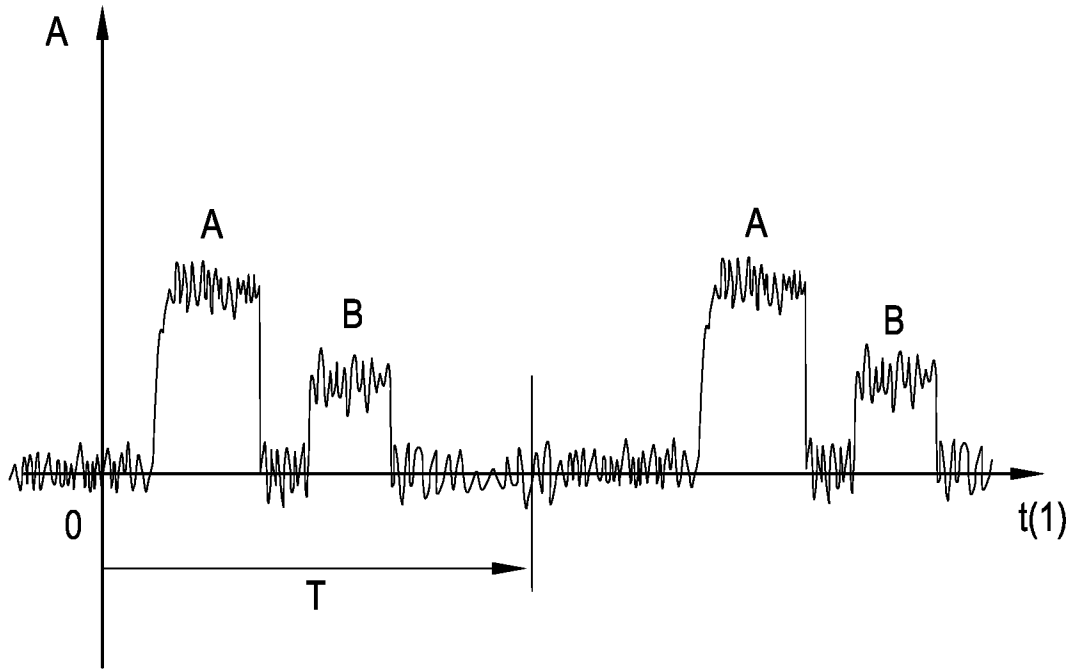


FIG.12

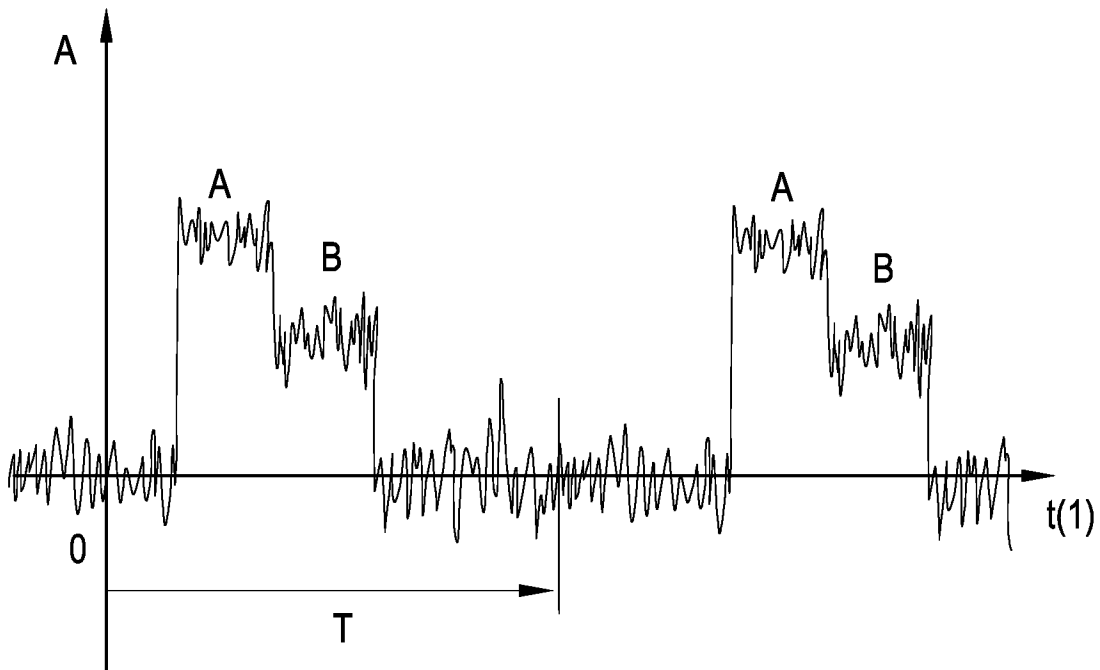


FIG.13

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2017/050260

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01S5/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
G01S A63B A62B H04B H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data, COMPENDEX, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 1 591 800 A2 (GIRSBERGER ELEKTRONIK AG [CH]) 2 November 2005 (2005-11-02) figures 1, 2 paragraphs [0001] - [0008], [0012] - [0018]	1-19
Y	----- US 2006/148423 A1 (SHARPE RICHARD [US]) 6 July 2006 (2006-07-06) paragraphs [0003] - [0010], [0018] - [0038], [0050] - [0057] ----- -/--	1-19

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance	"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
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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)	"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
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	"&" document member of the same patent family

Date of the actual completion of the international search 1 June 2017	Date of mailing of the international search report 22/06/2017
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Tancredi, Urbano
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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2017/050260

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	<p>Yoan Gregoire ET AL: "MEOSAR New GNSS Role in Search and Rescue", 1 December 2014 (2014-12-01), pages 57-69, XP055376064, www.insidegnss.com Retrieved from the Internet: URL:http://www.insidegnss.com/auto/novdec14-WP_0.pdf [retrieved on 2017-05-26] pages 57-58, first section pages 64-65, section Second-Generation Beacon Design</p>	1-19
A	<p>----- CH 706 278 A1 (GIRSBERGER ELEKTRONIK AG [CH]) 30 September 2013 (2013-09-30) figure 1 pages 3-4, 16</p>	1,6,7, 17-19
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A	<p>----- EP 2 899 806 A1 (ORTOVOX SPORTARTIKEL GMBH [DE]) 29 July 2015 (2015-07-29) figure 1 paragraphs [0019], [0028], [0058]</p> <p>-----</p>	1,17-19

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