

DESCRIPTION

The present invention relates to a system of identification between at least one interrogation station or interrogator and at least one and possibly a plurality of response stations or responders.

5 More specifically, the invention is applicable to the identification of a responder from an interrogation station, one of the two elements, either the responder or the interrogator, being mobile with respect to the other and identification being obtained without contact,
10 the transfer of the information being effected by the radio route.

Numerous systems of this type allowing identification of a responder are known, and Figure 1 illustrates the various functions performed within the framework of the
15 presently known systems of interrogation followed by an identification response.

According to Figure 1, it is seen that a (fixed or mobile) interrogation station emits a coded signal
5 on a radio wavelength, particularly and preferably
20 on a submetric wavelength.

More especially, ultrahigh frequency radio waves are used, the term "ultrahigh frequency wave" being used in the course of the present specification as designating waves of radio frequency higher than 100 MHz.

25 To that end, the interrogation station or interrogator 1 comprises a wave generator or oscillator 4 supplying the antenna 3 for the emission of the interrogation wave 5. This signal is picked up by the antenna 6 of a badge 2 which may transmit the signal to the detector 7, which
30 alerts the control electronics 8, triggering off memorization of the signal picked up in the floating memory 9 and supply of the modulator 10.

The signal received by the badge 2, after modulation,

is transmitted to the antenna 3 which re-emits as an echo a response wave 11 of the same nature as the interrogation wave, but after modulation.

This wave, received in turn by the antenna 3 of the fixed station, may be processed by the mixer 12 with a view to extracting a low-frequency signal corresponding to the modulation of the carrier wave, this low frequency signal after amplification at 14 may be processed in a microprocessor 13, in order in particular to analyze the signal and to determine the contents of the information.

This same device, limited to the interrogator, is illustrated by the diagram of Figure 2.

Patent EP 245 606 discloses a radio-frequency (RF) transponder capable of being used in an automatic/remote control apparatus, of the type comprising a plurality of RF transponders designed so as to cooperate with at least one out of a plurality of parameter measuring instruments, disposed at a distance with respect to an interrogator/receiver which transmits an RF activation signal to the transponders and which receives and processes the signals from the RF transponder transmitted from the transponders in response to the activation signal, the transponder comprising an activation circuit to trigger off transmission of the transponder signals in random manner on reception of the activation signal.

US Patent 3 716 856 also discloses a transponder beacon for a coherent-pulse Doppler radar, comprising an antenna constituted by two networks of radiating sources adapted to radiate electromagnetic waves presenting a polarization perpendicular to one another, four directional couplers mounted in two's at the output of each network, two detection circuits, amplification and threshold, each associated with a directional coupler of each network, a hybrid junction connected to the other two directional couplers, two detection circuits, amplification and thresh-

hold, mounted at the outputs of the hybrid junction,
a logic circuit receiving output signals from said detec-
tion circuits, amplification and threshold, two micro-wave
phase phase-shift circuits, respectively mounted at the
5 outputs of the network, and a control circuit for control-
ling the phase shift circuits so as to provoke a linear
variation of the phase shift produced by the phase shift
circuits. According to this known device, when polarization
is circular in the clockwise or anti-clockwise direction,
10 the two shift circuits introduce a phase shift of π
radians. The directions of propagation received and emitted
being opposite, the signal received by the radar antenna
must present, with respect to said radar antenna, an
opposite circular polarization.

15 The invention contributes improvements and considera-
bly developed possibilities of use to the systems of
identification by interrogation-response of the specified
type.

A first object of the invention is considerably
20 to broaden the possibilities of reception of the interroga-
tion signal from the responder, defining in broadened
and directional manner the listening zone served by the
interrogation station.

According to the developments described hereinbelow,
25 it is possible to direct the emission lobe, consequently
defining the listening zone, in a direction and in a
preferential zone in space in which the presence of a
responder is normally expected.

According to another object, the invention aims
30 at broadening the spectrum of the positionings of the
responder in the state of receptivity with respect to
the interrogator.

This development eliminates the servitudes of the
known devices which ensure a good receptivity of the
35 interrogation signal by the responders only in privileged

and relatively limited positions of said responder.

A further object of the invention aims at broadening the practical possibilities of use of the identification system, particularly in the presence of a plurality of
5 responders capable of being presented concomitantly at the interrogation station.

Within the framework of the developments described hereinafter, it will thus be possible to produce an interrogation system adapted to detect in discriminatory manner
10 and separately, each of the responders although these latter are presented substantially at the same time at the interrogator, avoiding response signals interfering with one another.

Finally, a last object of the invention allows reliable listening of the response signal by an interrogation
15 station, without risk of interference with the adjacent interrogation stations.

To that end, according to the invention, the process for identifying, between an interrogator formed by a
20 transmitter-receiver of radio, preferably ultra-high frequency, waves, and a responder receiving said wave and re-transmitting it as a echo after specific coded modulation towards the interrogator, this echo wave being received and demodulated by the interrogator, whereupon
25 the latter extracts the identification code therefrom, is characterized by the steps consisting in: transmitting with the aid of the interrogator by means of an antenna adapted to transmit a rectilinear polarization having a predetermined plane of polarization, an interrogation
30 signal constituted by a radio wave emitted in rectilinear polarization; receiving this wave at the responder with the aid of an antenna adapted to receive a circular polarization in a first direction of rotation; re-transmitting by the responder towards the interrogator a response
35 signal constituted by a radio wave of the same nature

as the interrogation wave, but whose polarization is circular and presents a second direction of rotation opposite the first; this wave being bearer of a modulation introduced at the responder; receiving said response
5 signal at the interrogator by means of an antenna adapted to receive a rectilinear polarization whose plane of polarization is perpendicular to the plane of polarization of the transmission antenna of the interrogator.

10 The process preferably includes a step of differentiation by the responder between the interrogation signal and the response signal, as a function of the directions of rotation, opposite one another, of the polarization of the interrogation wave received and the re-transmission wave transmitted by the responder.

15 The step of transmission by the interrogator of the interrogation signal advantageously consists in defining a directional radiation lobe privileging certain zones of space close to the interrogator and corresponding to a programmed listening zone.

20 More particularly, the process includes phases of supply switching such that each successive interrogation transmission of the interrogator defines a radiation lobe oriented in space in a direction different with respect to the preceding transmission.

25 More especially still, the process comprises a step of time control of the responder adapted to interrupt in time the re-transmission signal modulated with respect to the interrogation signal and a step consisting in delaying at random the modulated re-transmission of the
30 wave with a delay time variable and different for each response of a responder, so that the interrogator may effect a discrimination between the respective response signals of at least two responders adjacent with respect to one another.

35 Each response signal re-transmitted by the responder

is advantageously a burst of pulses, at several successive times, the bursts being spaced apart sequentially as a function of the random delay mentioned above and therefore by successively different periods.

5 The above-mentioned step of reception and of re-transmission may be effected from one face of the responder or the other.

 The process preferentially comprises a step of adjustment of the interrogation frequency within a determined
10 band corresponding to the reception band of a plurality of responders, so as to differentiate the transmission frequencies of a plurality of interrogators in close position, and to separate at the level of each interrogator the response signals of the responders with respect to
15 the interrogation signals of the adjacent interrogators.

 The invention also relates to an identification device of the type comprising at least one interrogator and at least one responder which respectively comprise means for transmitting-receiving radio, preferably ultra-
20 high frequency, waves, the responder presenting a modulator adapted to effect a specific coded modulation of the wave transmitted by the interrogator and connected to transmitter-receiver means in order to re-transmit the coded wave as an echo towards the interrogator, while
25 the latter presents a demodulator adapted to extract the specific code of the echo wave, characterized in that the transmitter-receiver means of the interrogator comprise an antenna provided with a topography adapted to generate a wave of rectilinear polarization in a pre-
30 determined plane and the transmitter-receiver means of the responder comprise a reception antenna of circular polarization in a first direction of rotation, as well as a re-transmission antenna adapted to transmit towards the interrogator a response signal of circular polariza-
35 tion, but of which the direction of rotation is opposite the first, the re-transmission antenna of the responder

being connected to the modulator while the interrogator is provided with a reception antenna adapted to receive a rectilinear polarization whose plane is perpendicular to that of the polarization of the wave transmitted by the transmission antenna.

Two antennas of the responder respectively for reception of the interrogation wave and for re-transmission thereof as an echo after modulation, are advantageously adjacent and arranged symmetrically, and the transmitter-receiver means of the responder comprise at least one antenna disposed on one face of the responder or the other.

The interrogator comprises a plurality of interrogation antennas connected together by a supply network and supplied in accordance with determined characteristics of amplitude and of phase, adapted to allow a transmission of the interrogation signal defining a directional radiation lobe.

According to a preferred embodiment, at least one responder is constituted by a substantially flat badge, at least one of the antennas of circular polarization is contained in a plane parallel to a large face of the badge and the transmitter-receiver means of the responder comprise an ultra-high frequency circuit for reception, modulation and re-transmission, a logic circuit which is provided with a clock, a memory and electronic means for controlling and monitoring the ultra-high frequency circuit, while the responder presents a preferential supply source.

More particularly, on one face of the badge, the antennas are twinned and rest on a dielectric plane, each being connected to two supply micro-strips connected to a modulator transistor which is supplied via a resistor with the aid of an integrated control circuit piloted

by quartz.

Other characteristics and advantages of the invention will appear from the following description given in connection with some particular embodiments presented by way
5 of non-limiting example and with reference to the accompanying drawings.

Figure 1 shows a general skeleton diagram of an interrogation and response system used within the framework of the invention, of which Figure 2 gives a schematic
10 representation.

Figure 2bis represents a skeleton diagram showing the polarizations of the interrogation and response waves.

Figure 3 gives a diagram of an embodiment of an interrogation station or interrogator produced in accordance with the invention.
15

Figure 4 gives two examples of antennas respectively for transmission (or interrogation) and reception (response) at the level of the interrogator.

Figure 5 represents a variant showing a network
20 of two transmission antennas disposed on the interrogator.

Figure 6 shows a general shape of the radiation lobe capable of being obtained by the network of two transmission antennas of Figure 5.

Figure 7 shows a network of four transmission antennas
25 capable of being used on an interrogator.

Figure 8 shows a variant embodiment of transmission antennas disposed on the interrogation station, the two twinned antennas being capable of being supplied in differential manner by a commutator, defining two different
30 radiation lobes as a function of the supply conditions.

Figure 9 shows a block diagram of pulse modulation of the responder.

Figures 10 and 11 show two twinned antennas capable of being used with the framework of the re-transmission
35 of the response signal by the responder.

Figure 12 shows a variant embodiment of a responder in which the antennas of Figure 11 are disposed on each of the faces of the response badge, allowing the latter to be used in reception and transmission by its two faces.

5 Figure 13 shows a view of a variant embodiment of a responder equipped with two twinned circular-slot antennas.

Figure 14 shows the responder of Figure 13 by its opposite face, while

10 Figure 15 shows a view in section of the badge of Figures 13 and 14 along lines XV-XV respectively of Figures 13 and 14.

Figure 16 illustrates the embodiment of a micro-band supplying an antenna with circular polarization slot
15 of the badge of Figures 13, 14 and 15.

Figure 17 shows a diagram illustrating the shift of the frequencies between two adjacent interrogators to avoid interferences.

Figure 18 and Figure 19 illustrate the possibilities
20 of angular positioning of the responder respectively according to the prior art (Figure 18) and within the scope of the present invention (Figure 19).

Figure 20 shows a timing diagram illustrating the receptions of response signals from a plurality of badges.

25 The device of the invention which will be described hereinafter lies within the framework of systems of identification by question and responses such as defined previously and in connection with the general diagrams of Figures 1 and 2.

30 According to a first characteristic of the invention, the interrogation wave 5 is transmitted from an antenna 3a (Figure 2bis and Figure 4) provided with a topography adapted to generate transmission of a wave in vertical polarization. This wave is for example transmitted on

a frequency of 2.45 GHZ and it is constituted by a non-modulated maintained wave. This wave is for example transmitted on a frequency of 2.45 GHZ and it is constituted by a non-modulated maintained wave.

5 This interrogation wave will be received at the level of the responder by the antenna 6a with circular polarization in a first direction of rotation of the polarization.

10 Figure 2bis shows antennas with circular polarization slot as represented in greater detail in particular in Figure 13.

15 The interest of a circular polarization reception is to allow a reception of the signal, i.e. of the interrogation wave 5, by the responder in a much broader range of angular positionings and which is illustrated in Figures 18 and 19.

20 Figure 18 shows a responder badge 2a in accordance with presently known techniques and which is positioned at right angles with respect to the ideal straight line D connecting the responder badge to the interrogator; in this position, the badge is in position of maximum receptivity; and it is seen that, around this ideal position, clearances are allowed along three beat axes corresponding to segments A, B and C; in the presently known
25 techniques, the aperture angle about the ideal position substantially does not exceed 22° , i.e. each of the segments A, B, C, illustrating the extreme possibilities of positioning of the badge does not exceed 45° .

30 Figure 19 represents the badge according to the invention which consequently comprises a reception antenna with circular polarization.

It is seen that, if the segments A' and B' are equivalent to segments A and B of the preceding badge, the badge according to the invention may be positioned in

its plane at any angular value, segment C' defining the geometrical locus of the active positions of the badge 2b in its plane, attaining 360° .

5 In fact, it will be understood that, whatever the position of the responder badge 2b, the circular polarization antenna 6a (Figure 2bis) will always be in a position to pick up a plane polarization wave (whatever the positioning of the responder in this plane).

10 Thus, according to this first characteristic of the invention, the responder is adapted, as seen in Figure 19, to be positioned in its plane in indifferented manner while remaining in position of receptivity of the interrogation signal.

15 In parallel, it is seen, still according to Figure 2bis, that the reception antenna 6a is associated with the symmetrical antenna 6b, of the type with slot and circular polarization inverted with respect to the direction of rotation of the polarization of the reception antenna 6a.

20 And this re-transmission antenna 6b returns the response signal (after modulation as set forth in greater detail hereinafter), the response wave here being with circular polarization and of direction opposite the polarization of the reception antenna 6a.

25 In this way, by reversing the directions of rotation of the polarization, an interference between the reception antenna 6a and the transmitting antenna 6b is thus avoided; due to the reversal of the direction of polarization, the antenna 6a is not in a position to receive the response signal 11.

30 The interrogator itself receives the response signal 11 (with circular polarization) by the antenna 3b of the type with plane polarization, the plane of polarization of the antenna 3b being offset by 90° with respect to the plane of polarization of the transmitting antenna 3a.

Due to this offset, interferences between the transmission signals transmitted by the antenna 3a which cannot be received by antenna 3b due to the offset of the polarization planes, are also avoided at the level of the interrogator.
5

However, the antenna 3b with plane polarization is in a position to receive in the circular polarization wave 11 the horizontal component. Under these conditions, there is obtained both at the level of the interrogator and at the level of the responder, a decoupling between the two antennas respectively of opposite and non-compatible polarizations, with the result that the reception antenna, at the level of each of the elements, cannot receive as a parasite the signal transmitted by the adjacent antenna.
10
15

Furthermore, there are found at the level of the response wave 11 the advantages of the circular polarization which were signalled at the level of reception by the antenna 6a; due to the circular polarization, the response wave 11 will be received by the antenna 3b whatever the positioning in its plane of the responder and therefore of the re-transmission antenna 6b; in fact, whatever this position, the circular polarization will automatically generate a component coming in register with the plane of polarization of the reception antenna 3b.
20
25

It is therefore seen that, due to this first characteristic of the invention, the possibilities of use of the responders are considerably broadened, since the responder being positioned in a plane substantially at right angles with respect to the straight line connecting it to the interrogator (with tolerances of 45° in elevation and in azimuth), the responder may in this position be rotated equally well in its plane of 360° without modifying
30

the quality of reception and of re-transmission.

Figures 3 to 8 illustrate variant embodiments of the invention, showing in particular configurations of antennas disposed in network so as to orient the radiation lobe in a preferential zone in space.

Figure 2bis shows a single transmission antenna.

However, it may be advantageous to replace this single antenna by a network of antennas with a view to privileging certain zones in space corresponding to preferential listening zones.

Figure 3 gives by way of example a first form of a network with two antennas, both for transmission and for reception.

Figure 3 generally shows the interrogation station comprising the same means as shown in Figures 1 and 2 (and given the same references).

The interrogation station of Figure 3 is shown, in addition, with a variable gain amplifier 15, interposed between the demodulation mixer 12a and the reception antenna 18, described hereinafter; downstream of the demodulation mixer 12a is also shown an amplifier 16 and an analog/digital converter 17.

Figure 3 shows a configuration of specific antennas both at the level of the transmission antenna 19 and at the level of the reception antenna 18.

The two antennas 19a and 19b being combined and disposed in this example to generate an oblique radiation lobe; which corresponds to an adjacent and identical reception lobe at the level of antenna 18.

Figure 5 shows a variant of a network of two antennas 20a, 20b, twinned and disposed side by side.

These twinned antennas will allow the transmission of a radiation lobe largely spread out on either side the plane of the antenna so as preferentially to cover

the zones located on each side.

This arrangement broadens the radiation lobe in a horizontal plane while maintaining it substantially confined within a vertical plane.

5 A radiation lobe 21 shown in Figure 6 is attained, spread out laterally on either side of the axis 20x joining the two elementary antennas 20a and 20b while avoiding a loss in height.

10 This configuration may be advantageous when it is desired to watch or listen to a zone located around a mean level in height but capable of being broadly distributed to the right and to the left of the level of the antenna.

Figure 7 shows a new example illustrating a network 15 22 of four antennas 22a, 22b, 22c and 22d connected to a common supply.

It will be understood that the interrogation may be made in vertical polarization and in horizontal polarization (the important point being that the transmission 20 antennas on the one hand, and reception antennas on the other hand, adopt polarization planes offset by 90°).

In the example of Figure 3, the transmission antennas 19a and 19b are in horizontal polarization while the antennas of Figures 5, 7 and 8 function in vertical polarization. 25

In all these examples, the dimension of antenna L is determined by the formula $L = l_g/2 - 2d_{lo}$, in which d_{lo} is a coefficient corresponding to the taking into account of the edge effect and l_g is the guided wavelength 30 of the working signal.

Figure 8 illustrates a new development of the invention in which the twinned antennas 20a and 20c respectively are of the type shown in Figure 5, but their network comprises micro-bands for connection joined upstream

to the supply 25 via a commutator 26, and connected on the supply common to the two antennas 20c and 20d at different levels.

Consequently, action on the commutator 26 makes
5 it possible to supply the pair of antennas 20c and 20d either via channel 23 or channel 24.

The preferential supply thus oriented towards one antenna to the detriment of the other generates the transmission of a radiation lobe 27 (corresponding to a preferential supply of the antenna 20c), thus allowing listening
10 of a zone in space in a transmission lobe 27 whose axis 28 forms an angle with the plane of the two antennas 20c and 20d.

Commutation of the supply on channel 24 then immediately
15 ly makes it possible to orient the transmission lobe 27' along axis 28' symmetrical to axis 28.

From the same network of antennas 20c and 20d, one may thus listen alternately to the right-hand part then the left-hand part of the surveillance zone.

20 Figures 9, 10, 11, 12, 13, 14, 15 and 16 illustrate the embodiment of the invention at the level of the responder.

The responder within the framework of an important development of the invention comprises an original characteristic aiming at allowing the discrimination of the response signals capable of being transmitted by two or more responders present simultaneously in a listening zone served by the interrogation signal, consequently provoking in principle the transmission at the level
25 of the two responders of simultaneous response signals, therefore unintelligible for the interrogator.
30

Within the framework of the implementation of the invention, the responder comprises a random delay generator which is provided to determine, between a plurality of

re-transmissions of successive response signals,, a shift in time; With the result that each response signal is, in time, strictly independent of the interrogation signal and also independent of the preceding re-transmission signal:

This important characteristic is illustrated in particular in Figure 20.

This Figure shows a timing diagram showing the positioning in time, from the moment T 0 corresponding to any reference time, of the re-transmission in echo or response signals coming from four responders A, B, C and D respectively, presenting substantially at the same time within the listening zone served by the radiation lobe. In Figure 20 and to render the representations clear, the proportions between the transmission times and the intervals of silence are not respected.

As we have seen, theoretically, the responders receiving substantially at the same time the interrogation wave, returned as an echo substantially at the same time a response signal, the response signals superposed on the same frequency consequently being inaudible for the interrogator.

It is seen in Figure 20 that each response signal A1, B1, C1 etc... is constituted by a burst of elementary pulses 29a, 29b, corresponding to a codification specific to the responders.

In the present case, codification by modulation of the response signal is effected by modulation of pulses.

As will be set forth in greater detail hereinafter, the interrogation wave is a non-modulated, maintained and continuous wave consequently received permanently by the interrogator for the whole period during which it is located within the radiation lobe.

This wave is re-transmitted by modulated segments at irregular intervals and which correspond to the response transmissions A1, A2, A3, etc... for badge A, B1, B2,

B3 for badge B, etc...

According to an important characteristic of the invention, each responder badge comprises in its logic circuit a random delay generator such that the re-transmissions of response signals are erratic in time and without temporal ties either with the reception of the wave of the interrogation or with the transmission of the preceding response signal.

Particularly in the light of Figure 20, it is therefore seen that, consequently, the response signals being distributed at random in time, shifts are automatically obtained, due to the application of the law of large numbers, which make it possible to discriminate the response signals transmitted by one responder with respect to another.

On the response diagrams of Figure 20, it is seen in particular that, at first, the responder D transmits separately a signal D1 which may therefore be received by the interrogator and thus allowing identification of the responder D.

Immediately afterwards, the responders B and C transmit substantially with overlap in time, with the result that the two signals D1 and C1 interfering with one another will not be recognized by the interrogator; it may be admitted that the same also applies to signal A1 which is substantially in position of interference with the signal D2 and signal C2, so that none of these three signals can be separated from the whole.

Signal B2 then intervenes, which is clearly detached from the other signals and which therefore allows identification of the responder B.

The same applies to responder C which may be identified at the level of its response signal C3 perfectly offset with respect to the others.

Signal D3 is also isolated and would allow a new

identification of the responder D (which has already been recognized at the level of response D1).

It is seen in this example that the responder A has still not been identified; responses A2 and A3 coming
5 into interference with other signals will not allow its separate identification.

It is at the level of the response signal A4, then possibly A5 or even A6 that the badge A may in turn be identified.

10 It will be understood that, under these conditions, although four responders are simultaneously in response position in the radiation lobe, the interrogator will, however, be in a position, thanks to the random shifts of the response signals, to receive the necessary informa-
15 tion peculiar to the identification of all the responders.

The value of the random delay is determined at the level of the delay generator and this delay is in fact a pseudo-random delay limited between a minimum value and a maximum value.

20 The minimum value is a function of the duration of transmission of the response signal and it depends on the maximum number of badges capable of being identified simultaneously; this minimum value thus being a multiple (depending on the number of badges capable of being re-
25 ceived simultaneously) of the average duration of the burst of pulses corresponding to a signal.

The maximum value is determined for a given range of the interrogator by the maximum dwell time of the responder within the radiation lobe corresponding to
30 the listening zone.

The embodiment of the responder is illustrated by Figures 9, 10, 11, 12, 13, 14, 15 and 16.

Figure 10 gives a first embodiment in which the signal received by the antenna 36 after having woken

the detector 37 is received by the commutator 38a with a view to re-transmission thereof after a random delay time as described hereinbefore, re-transmission being effected after pulse modulation under the control of the control electronics 38 connected to the memory 39.

It is seen that, in this case, the modulated signal is re-transmitted in a polarization direction 40 at right angles to the direction of polarization 41 corresponding to reception.

Circular polarization, advantageously employed, may be obtained at the level of the responder by antenna configurations as illustrated in Figures 10, 11 and 12.

Antennas 36a and 36b are provided with topographies allowing receptions and transmissions in circular polarization in two directions of rotation of the polarization inverted on one antenna with respect to the other; this as described previously.

Figure 12 shows an example of assembly of the two antennas of Figures 10 and 11 on a responder badge.

One antenna thus being allocated to transmission while the other antenna is allocated to reception.

And according to an original characteristic of the invention, the responder badge of Figure 12 is provided with a possibility of receptivity on its two faces and comprises to that end an antenna 36a and an antenna 36b on a first face 42 while, on the opposite face, the two antennas 36a' and 36b' appear, disposed in a configuration identical to antennas 36a and 36b on face 42 and separated by a common layout plan.

In this way, according to the example of Figure 12, a responder is produced, capable of receiving the interrogation wave and of returning it as an echo with the response signal, whatever its positioning with respect to the interrogator, the two faces of the responder,

front and back respectively, also being operational.

Figures 13, 14, 15 and 16 illustrate more specifically an embodiment of a responder presenting as set forth hereinabove two twinned antennas with circular polarization and of opposite direction of rotation with respect to each other, making it possible to carry out the means of the invention simply and efficiently.

In this embodiment, antennas with circular polarization of the slot type have been used.

10 These antennas have the known property of allowing reception by one face or by the other, and they are constituted by a circular interruption of continuity or slot 43, 43' disposed on the metal plate 44 itself resting on a dielectric 45.

15 The antennas constituted by the slots 43, 43' are supplied by a micro-band 46, 46' of specific shape shown in greater detail in Figure 16.

It is seen that this micro-band comprises two arms 46a and 46b disposed radially with respect to the circular slot 43 and these two radial branches being joined by segment 46c.

20 This micro-band 46 is itself supplied from the connection 47.

In known manner, this type of supply by micro-band 25 along the two radial arms 46b and 46a determines the transmission in circular polarization and the diameter of the slot determines the frequency of the transmission.

Considering the median axis a1 of the radial arm 46a, the median axis a2 of the radial arm 46b, the median axis of the connection a3 and finally the median curved line C1 of the segment 46c, it is determined that the difference between the distances C1 and C2 are defined as equalling a quarter of the transmission wavelength.

The two micro-bands 46 and 46' being positioned

symmetrically consequently determine at the level of the slot antennas 43, 43', waves of circular polarization of directions of rotation inverted from one antenna with respect to the other, as described previously.

5 The supply connections 47 and 47' are in turn bridged by the transistor 48 supplied with interposition of the resistor 49 by the integrated circuit 50.

 This latter is preferably of the type with permanent low-voltage supply from battery 51.

10 The integrated circuit 50 may be connected with the outside by connection 52 for programming of the memorized code and it is associated with a quartz clock 53.

 The integrated circuit comprises a random delay generator making it possible to supply the modulation transistor 48 in irregular intervals as set forth hereinbefore.

 Under these conditions, it will be understood that the transistor 48 is supplied permanently but at irregular intervals. As long as the responder of Figures 13, 14 and 15 lies outside a zone of radiation, the transistor "modulates empty".

20 As soon as the responder penetrates in a radiation lobe, the slot antenna 43 receives the interrogation signal on a determined frequency (on which the antenna is precisely set).

25 The reception antenna 43 is then placed in communication, or not, with the re-transmission antenna 43', depending on whether the re-transmission micro-band 46' is or not in communication with the reception micro-band 46 by the supply of the modulation transistor 48.

30 In the intervals separating the successive transmissions of a response signal (in the form of a burst of pulses), the re-transmission antenna 43 is isolated from

the reception antenna with the result that the interrogation signal received by the antenna 43 cannot be conveyed up to the re-transmission antenna 43' and this antenna remains silent.

5 During the period of activation of the transistor 48 under the control of the integrated circuit 50, communication is made between the two connections 47 and 47', therefore between the two micro-bands 46 and 46' and the signal received by the antenna 43 may be conveyed
10 towards antenna 43', receiving, on passage, the pulse modulation determined by the transistor 48.

And as described hereinbefore, re-transmission is effected on wave with circular polarization with direction of rotation inverted with respect to the direction of
15 rotation of the polarization of the reception antenna 43 which can therefore not be troubled or disturbed by a parasitic reception of the transmission of its neighbouring antenna.

A last development of the invention is illustrated
20 in Figure 17.

According to this development, each interrogator may have its frequency regulated and adjusted within 12 reception bands of the antennas of the interrogators in service.

25 It is seen in Figure 17 that the signal Frl corresponds to the setting of an interrogation frequency of a first given interrogator.

This interrogation signal will be accompanied at the level of the response of the modulation signals illustrated by the side bands Frla and Frlb.
30

It is seen that, due possibly to the constructional tolerances, an adjacent interrogator set in principle on a frequency Frl identical to the first, might be accidentally offset on an adjacent frequency, for example frequen-

cy Fr2.

This frequency Fr2 lies precisely within the side band Fr1a.

Consequently, the interrogator receiving its response
5 signal Fr1 and its side bands Fr1a and Fr1b will receive
at the same time the parasitic signal constituted by
the interrogation transmission Fr2 of the adjacent interro-
gator.

To avoid this phenomenon, it is provided to set
10 the frequencies of the interrogation signals within the
exploitation band, the frequencies of the interrogators
capable of being employed near one another being offset
on the frequency spectrum by a length greater than the
width of the side bands Fr1a and Fr1b.

15 These risks of interference between the reception
of an interrogator receiving both its own echo from a
responder and at the same time the interrogation signal
from the adjacent interrogator are thus avoided.

From a certain spacing distance such as Fr1 and
20 Fr3, it is easy, by a set of filters, to eliminate the
parasitic signals.



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CLAIMS

1. Process for identifying, between an interrogator (1) formed by a transmitter-receiver (5) of radio, preferably ultra-high frequency, waves, and a responder (2) receiving said wave and re-transmitting it as an echo after specific coded modulation towards the interrogator, this echo wave (11) being received and demodulated by the interrogator, whereupon the latter extracts the identification code therefrom, characterized by the steps consisting in: transmitting with the aid of the interrogator (1) by means of an antenna adapted to transmit a rectilinear polarization having a predetermined plane of polarization, an interrogation signal constituted by a radio wave emitted in rectilinear polarization; receiving this wave at the responder with the aid of an antenna adapted to receive a circular polarization in a first direction of rotation; re-transmitting by the responder towards the interrogator a response signal constituted by a radio wave of the same nature as the interrogation wave, but whose polarization is circular and presents a second direction of rotation opposite the first; this wave being bearer of a modulation introduced at the responder; receiving said response signal at the interrogator by means of an antenna adapted to receive a rectilinear polarization whose plane of polarization is perpendicular to the plane of polarization of the transmission antenna of the interrogator.

2. Process of identification according to Claim 1, characterized by a step of differentiation by the responder (2) between the interrogation signal and the response signal, as a function of the directions of rotation, opposite one another, of the polarization of the interrogation wave (6a) received and the re-transmission wave (6b) transmitted by the responder.

3. Process of identification according to one of Claims



1 or 2, characterized in that the step of transmission by the interrogator (1) of the interrogation signal consists in defining a directional radiation lobe (21) privileging certain zones of space close to the interrogator
5 and corresponding to a programmed listening zone.

4. Process of identification according to Claim 3, characterized by phases of supply switching such that each successive interrogation transmission of the interrogator (1) defines a radiation lobe (27, 27') oriented
10 in space in a direction different with respect to the preceding transmission.

5. Process of identification according to one of Claims 1 to 4, characterized by a step of time control of the responder (2) adapted to interrupt in time the re-transmission signal modulated with respect to the interrogation
15 signal and by a step consisting in delaying at random the modulated re-transmission of the wave with a delay time variable and different for each response of a responder (2), so that the interrogator may effect a discrimination between the respective response signals of at least
20 two responders (2) adjacent with respect to one another.

6. Process of identification according to Claim 5, characterized in that each response signal re-transmitted by the responder (2) is a burst of pulses (29), at several
25 successive times, the bursts being spaced apart sequentially as a function of the random delay mentioned above and therefore by successively different periods.

7. Process of identification according to one of Claims 1 to 6, characterized in that the above-mentioned step
30 of reception and of re-transmission may be effected from one face of the responder (2) or the other.

8. Process of identification according to one of Claims 1 to 7, characterized by a step of adjustment of the interrogation frequency within a determined band corresponding to the reception band of a plurality of responders
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(2), so as to differentiate the transmission frequencies of a plurality of interrogators (1) in close position, and to separate at the level of each interrogator the response signals of the responders (2) with respect to the interrogation signals of the adjacent interrogators (1).

9. Identification device of the type comprising at least one interrogator (1) and at least one responder (2) which respectively comprise means (3, 6) for transmitting-receiving radio, preferably ultra-high frequency, waves (5, 11), the responder (2) presenting a modulator (10) adapted to effect a specific coded modulation of the wave (5) transmitted by the interrogator (1) and connected to transmitter-receiver means (6) in order to re-transmit the coded wave (11) as an echo towards the interrogator, while the latter presents a demodulator (12, 13, 14) adapted to extract the specific code of the echo wave (11), characterized in that the transmitter-receiver means of the interrogator (1) comprise an antenna (3a) provided with a topography adapted to generate a wave of rectilinear polarization in a predetermined plane and the transmitter-receiver means of the responder (2) comprise a reception antenna (6a) of circular polarization in a first direction of rotation, as well as a re-transmission antenna (6b) adapted to transmit towards the interrogator (1) a response signal of circular polarization, but of which the direction of rotation is opposite the first, the re-transmission antenna (6b) of the responder (2) being connected to the modulator while the interrogator (1) is provided with a reception antenna adapted to receive a rectilinear polarization whose plane is perpendicular to that of the polarization of the wave transmitted by transmission antenna (3a).

10. Identification device according to Claim 9, characterized in that two antennas of the responder (2) respective-



ly for reception of the interrogation wave (6a) and for re-transmission thereof (6b) as an echo after modulation, are adjacent and arranged symmetrically.

11. Identification device according to Claim 9 or 10, characterized in that the transmitter-receiver means of the responder (2) comprise at least one antenna disposed on one face of the responder or the other.

12. Identification device according to one of Claims 9, 10 or 11, characterized in that the interrogator (1) comprises a plurality of interrogation antennas (19a, 19b, 20a, 20b) connected to one another by a supply network and supplied in accordance with determined characteristics of amplitude and of phase, adapted to allow a transmission of the interrogation signal defining a directional radiation lobe (21).

13. Identification device according to Claim 12, characterized in that the supply network connecting said antennas (20c, 20d) comprise switching means (26, 23, 24).

14. Identification device according to one of Claims 9 to 13, characterized in that it comprises at least two responders (2) which each comprise time control means adapted to sequentially disconnect the transmitter-receiver means (6) transmitting the modulated response signal, and connected to a random delay generator which determines the duration of momentary disconnection of the transmitter-receiver means (6) provoked by said control means.

15. Identification device according to one of Claims 9 to 14, characterized in that at least one responder is constituted by a substantially flat badge (2b), that at least one of the antennas of circular polarisation (6a, 6b) is contained in a plane parallel to a large face of the badge and that the transmitter-receiver means of the responder comprise an ultra-high frequency circuit for reception, modulation and re-transmission, a logic



circuit which is provided with a clock, a memory and electronic means for controlling and monitoring the ultra-high frequency circuit, while the responder (2) presents a preferential supply source.

5 16. Identification device according to Claim 15, characterized in that the badge (2) comprises on each face two antennas (36a, 36b, 36a', 36b'), one for reception and one for re-transmission, the two groups of antennas being separated by a ground plane.

10 17. Identification device according to Claim 15 or 16, characterized in that the badge (2) comprises two antennas (43, 43') of the circular slot type and positioned side by side, symmetrically on a plane (45).

15 18. Identification device according to Claim 17, characterized in that, on one face of the badge, the antennas (43, 43') are twinned and rest on a dielectric plane (45), each being connected to two supply micro-strips (46, 46') connected to a modulator transistor (48) which is supplied via a resistor (49) with the aid of an integrated control circuit (50) piloted by quartz (53).

20 19. Identification device according to Claim 18, characterized in that the integrated circuit (50) constitutes a permanent low-voltage supply and with long life duration, such as those used in electronic timepieces.