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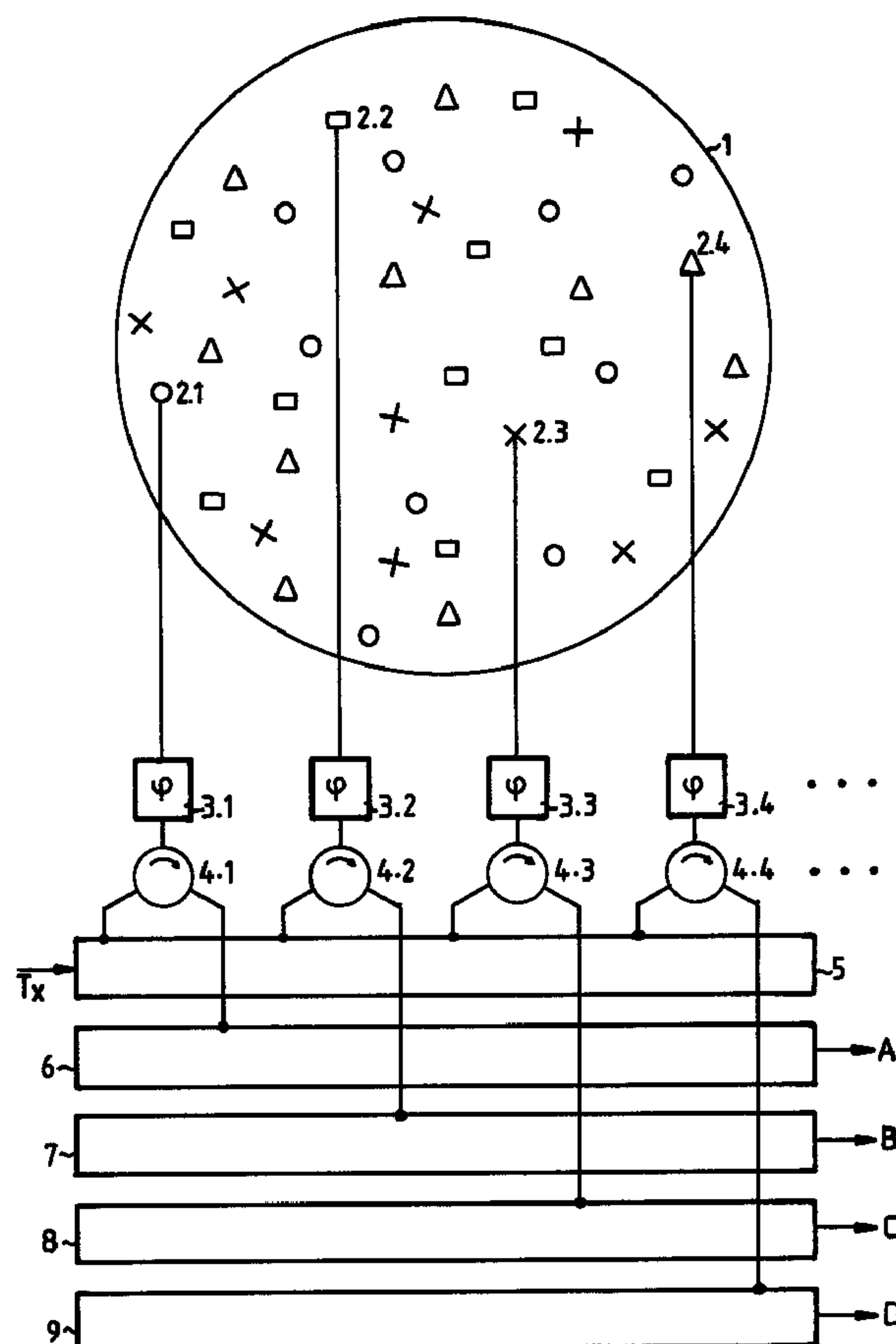
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(54) Titre : ANTENNE RESEAU ET METHODE D'EXPLOITATION D'ANTENNE RESEAU

(54) Title: ARRAY ANTENNA AND METHOD FOR OPERATING AN ARRAY ANTENNA



(57) Abrégé/Abstract:

Array antenna of the monopulse type for realizing, on the basis of at least two groups of radiators, of at least two receiving beams for obtaining a difference signal. According to the invention, the at least two groups are homogeneously distributed within the antenna volume. In a transmit mode, the radiators are steered collectively, in a receive mode, the radiators are combined per group.



Abstract:

Array antenna of the monopulse type for realizing, on the basis of at least two groups of radiators, of at least two
5 receiving beams for obtaining a difference signal.

According to the invention, the at least two groups are homogeneously distributed within the antenna volume. In a transmit mode, the radiators are steered collectively, in a receive mode, the radiators are combined per group.

Array antenna and method for operating an array antenna

The invention relates to an array antenna, comprising a set of radiators for the transmission or reception of microwave
5 radiation, which radiators are distributed at least substantially homogeneously within the volume of an imaginary three-dimensional body, preferably spherical in shape, where each individual radiator is via an adjustable phase shifter connected to a transmitting network to choose
10 a direction in which microwave radiation can be transmitted.

An array antenna of this type is known from DE-A 28.22.845. For fire-control applications, however, this known array
15 antenna is unsuitable for determining the position of a target with sufficient accuracy. For an accurate determination, it is required to generate for a target the error voltages known in the art, for instance in azimuth and elevation, for instance under the application of a
20 monopulse antenna.

An array antenna of the monopulse type is known from patent specification EP-B 0.207.511. The spherical antenna disclosed in this specification is divided into eight
25 octants by means of which the error voltages are determined by combining the output signals of the eight octants. The known array antenna is most satisfactory if a target is situated on an intersecting line of two dividing planes between the octants, because this would imply symmetry
30 between the various antenna parts. For targets that do not fulfil this condition, the array antenna performance is suboptimal.

The array antenna according to the invention obviates this
35 drawback and is characterized in that to enable reception, the set of radiators is divided into two, three or four

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subsets, that for each subset the radiators are distributed at least substantially homogeneously within the body and that there are provided two, three or four receiving networks connected to the subsets for simultaneously
5 choosing two, three or four directions from which microwave radiation can be received.

The invention additionally relates to a method for operating an array antenna, comprising a set of radiators for the transmission or reception of microwave radiation,
10 which radiators are distributed at least substantially homogeneously within the volume of an imaginary three-dimensional body, preferably spherical in shape, whereby in a transmit mode, a transmitter signal is applied, via adjustable phase shifters and a transmitting network, to at
15 least substantially all radiators for generating a microwave beam in a predetermined direction.

The inventive method is characterized in that in a receive mode, two, three or four subsets of at least substantially equal numbers of radiators are combined via
20 adjustable phase shifters and two, three or four receiving networks for choosing two, three or four directions from which microwave radiation can be received.

A favourable realization of the method is characterized in that in the transmit mode, the microwave
25 beam is directed at a target and that in the receive mode, the two, three or four directions are chosen such that the output signals of the two, three or four receiving networks can be combined to yield a sum signal and at least one difference signal.

30 According to one aspect of the present invention, there is provided an array antenna, comprising a set of

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radiators for the transmission and reception of microwave radiation, which radiators are distributed at least substantially homogeneously within the volume of an imaginary three-dimensional body, preferably spherical in shape, where each individual radiator is via an adjustable phase shifter connected to a transmitting network to choose a direction in which microwave radiation can be transmitted, characterized in that to enable reception, the set of radiators is divided into two, three or four subsets, that for each subset the radiators are distributed at least substantially homogeneously within the body and that there are provided two, three or four receiving networks connected to the subsets for simultaneously choosing two, three or four directions from which microwave radiation can be received.

According to another aspect of the present invention, there is provided a method for operating an array antenna, comprising a set of radiators for the transmission or reception of microwave radiation, which radiators are distributed at least substantially homogeneously within the volume of an imaginary three-dimensional body, preferably spherical in shape, whereby in a transmit mode, a transmitter signal is applied, via adjustable phase shifters and a transmitting network, to at least substantially all radiators for generating a microwave beam in a predetermined direction, characterized in that in a receive mode, two, three or four subsets of at least substantially equal numbers of radiators are combined via adjustable phase shifters and two, three or four receiving networks for choosing two, three or four directions from which microwave radiation can be received.

The invention will now be explained in further detail with reference to the figure, which schematically

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represents how a set of radiators $2,i$ is homogeneously distributed within a sphere 1, at least such that, after steering the

radiators in phase in a known manner, a beam with a favourable main lobe/side lobe ratio is obtained. According to the invention, the set of radiators is divided into four subsets, each of which is likewise homogeneously distributed within sphere 1. By way of illustration, the radiators of the different subsets are marked with circlets, squares, crosses and triangles. Via a bidirectional phase shifter 3,i and a circulator 4,i, each radiator 2,i is connected to a transmitting network 5 which distributes microwave energy supplied by a transmitter (not shown) over all radiators 2,i. The radiators 2,i of the four different subsets are via the corresponding circulators 4,i connected to four receiving networks 6,7,8,9, such that received microwave radiation can be transmitted combined as four signals A,B,C,D.

In a first operational mode, the phase shifters 3,i are in a known manner adjusted such that microwave energy supplied via transmitting network 5 is unidirectionally transmitted as a beam. Via phase shifters 3,i, received echo signals are coherently combined in a known manner to yield four mutually coherent echo signals at the outputs A,B,C,D which can subsequently be summed in order to obtain one echo signal.

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In a second operational mode, the phase shifters 3,i can in a known manner be adjusted such that microwave energy supplied via transmitting network 5 is unidirectionally transmitted as a beam. After transmission, the phase shifters 3.i are readjusted such that the four subsets generate four different receiving beams, each of which makes a small angle with the transmitted beam. It would then make sense to position the beams such that a conventional monopulse measurement is performed so that the received echo signals can via the phase shifters 3.i be coherently combined to yield four monopulse output signals

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A,B,C,D which can subsequently be converted into sum and difference signals.

Another possibility is to realize the invention with merely
5 two subsets of radiators $2, i$, in which case an error
voltage in azimuth or in elevation can fully analogously be
determined from the signals A and B in a radar
transmission. The even radar transmissions can then for
instance be used to determine an error voltage in azimuth,
10 the odd transmissions serving to determine an error voltage
in elevation.

Yet another possibility is to realize the invention with
three subsets of radiators $2, i$; in this case three
15 receiving beams are realized, one of which is for instance
positioned above the transmission beam and two below the
transmission beam, one to the left and one to the right,
after which the error voltages in azimuth and elevation can
in an obvious manner be determined from the signals A, B
20 and C.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE
PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. Array antenna, comprising a set of radiators for the
5 transmission and reception of microwave radiation, which
radiators are distributed at least substantially
homogeneously within the volume of an imaginary three-
dimensional body, preferably spherical in shape, where each
individual radiator is via an adjustable phase shifter
10 connected to a transmitting network to choose a direction
in which microwave radiation can be transmitted,
characterized in that to enable reception, the set of
radiators is divided into two, three or four subsets, that
for each subset the radiators are distributed at least
15 substantially homogeneously within the body and that there
are provided two, three or four receiving networks
connected to the subsets for simultaneously choosing two,
three or four directions from which microwave radiation can
be received.

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2. Method for operating an array antenna, comprising a
set of radiators for the transmission or reception of
microwave radiation, which radiators are distributed at
least substantially homogeneously within the volume of an
25 imaginary three-dimensional body, preferably spherical in
shape, whereby in a transmit mode, a transmitter signal is
applied, via adjustable phase shifters and a transmitting
network, to at least substantially all radiators for
generating a microwave beam in a predetermined direction,
30 characterized in that in a receive mode, two, three or four
subsets of at least substantially equal numbers of
radiators are combined via adjustable phase shifters and
two, three or four receiving networks for choosing two,
three or four directions from which microwave radiation can
35 be received.

3. Method as claimed in claim 2, characterized in that in the transmit mode, the microwave beam is directed at a target and that in the receive mode, the two, three or four directions are chosen such that the output signals of the
5 two, three or four receiving networks can be combined to yield a sum signal and at least one difference signal.

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