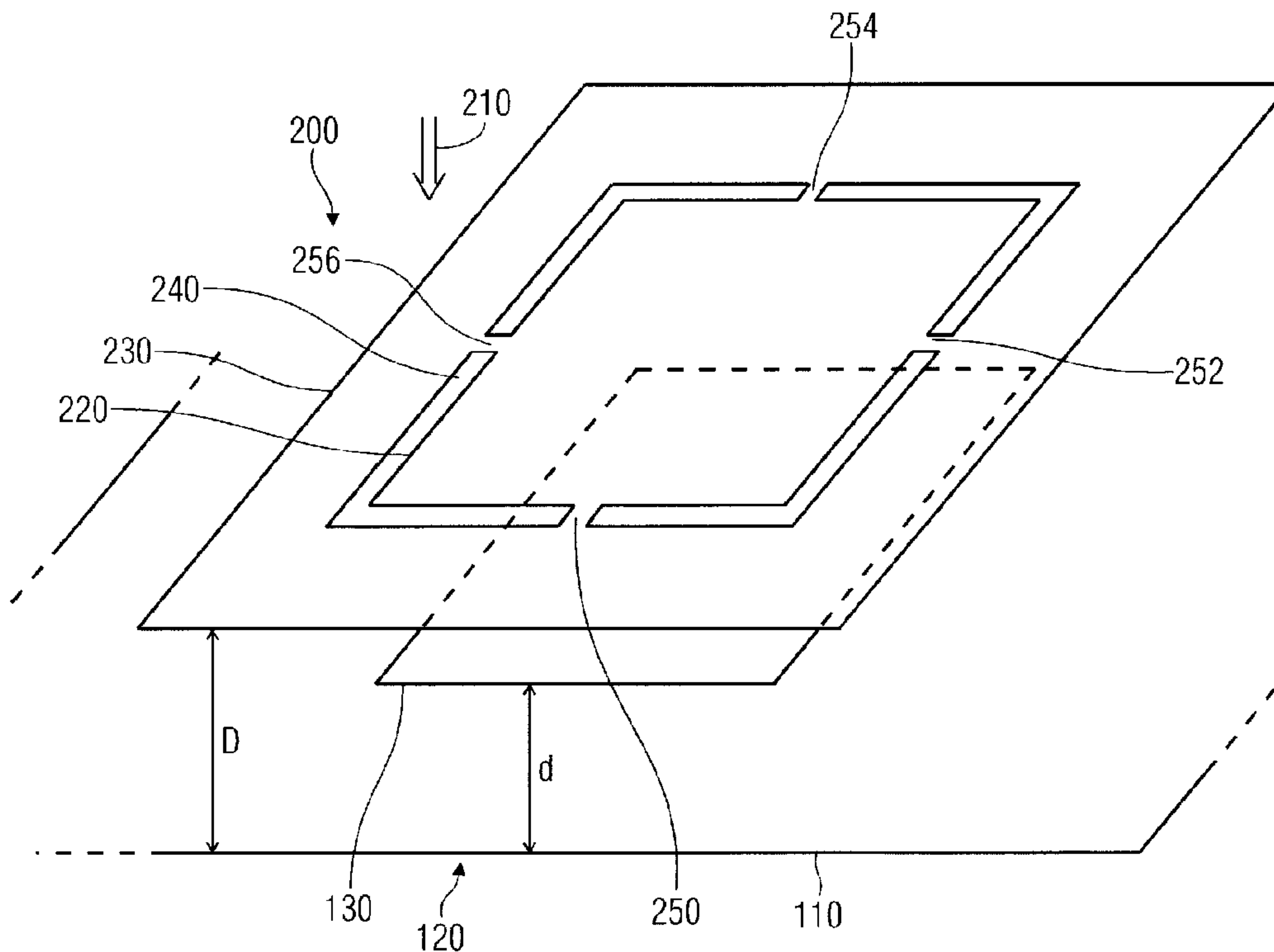




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 (54) Title: PLANAR MULTIBAND ANTENNA



(57) **Abrégé/Abstract:**

The present invention provides a planar multiband antenna with an earth surface (110), a first radiation electrode (130), a second radiation electrode (220), a third radiation electrode (230) and a feed device. The feed device is designed to feed the first radiation electrode (130). The first radiation electrode (130) is arranged at least partially between the earth surface (110) and the second radiation electrode (220) and does not protrude beyond an outer circumference of the third radiation electrode (230). The third radiation electrode (230) is arranged such that it completely surrounds an outer circumference of the second radiation electrode (220), there being a gap between the second radiation electrode (220) and the third radiation electrode (230).

**Lossless encoding of information with guaranteed maximum
bitrate**

Abstract

5

A compact encoded representation of information values not exceeding a predefined size can be derived when a first encoding rule generating an encoded representation of the information values of variable length is compared to a
10 second encoding rule generating an encoded representation of the information values of fixed length and when the encoding rule resulting in the encoded representation requiring the lower number of information units is chosen. Thus, the maximum bit rate can be guaranteed to be at least
15 the maximum bit rate of the second encoding rule deriving the second encoded representation. Signaling the choice of the encoding rule by some rule information together with the encoded representation of the information values, the correct information values can later on be derived on a
20 decoder side, using a decoding rule fitting the encoding rule used during the encoding.

Fig. 1

**Lossless encoding of information with guaranteed maximum
bitrate**

Field of the invention

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The present invention relates to lossless encoding of information values, in particular to a concept to guarantee a maximum bit rate for an encoded representation of the information values.

10

Background of the invention and prior art

In recent times, the multi-channel audio reproduction technique is becoming more and more important. This may be due to the fact that audio compression/encoding techniques such as the well-known mp3 technique have made it possible to distribute audio records via the Internet or other transmission channels having a limited bandwidth. The mp3 coding technique has become so famous because of the fact that it allows distribution of all the records in a stereo format, i.e., a digital representation of the audio record including a first or left stereo channel and a second or right stereo channel.

Nevertheless, there are basic shortcomings of conventional two-channel sound systems. Therefore, the surround technique has been developed. A recommended multi-channel-surround representation includes, in addition to the two stereo channels L and R, an additional center channel C and two surround channels Ls, Rs. This reference sound format is also referred to as three/two-stereo, which means three front channels and two surround channels. Generally, five transmission channels are required. In a playback environment, at least five speakers at five decent places are needed to get an optimum sweet spot in a certain distance of the five well-placed loudspeakers.

Several techniques are known in the art for reducing the amount of data required for transmission of a multi-channel audio signal. Such techniques are called joint stereo techniques. To this end, reference is made to Fig. 5, which shows a joint stereo device 60. This device can be a device implementing e.g. intensity stereo (IS) or binaural cue coding (BCC). Such a device generally receives - as an input - at least two channels (CH1, CH2, ... CHn), and outputs at least a single carrier channel and parametric data. The parametric data are defined such that, in a decoder, an approximation of an original channel (CH1, CH2, ... CHn) can be calculated.

Normally, the carrier channel will include subband samples, spectral coefficients, time domain samples etc., which provide a comparatively fine representation of the underlying signal, while the parametric data do not include such samples of spectral coefficients but include control parameters for controlling a certain reconstruction algorithm such as weighting by multiplication, time shifting, frequency shifting, phase shifting, etc. . The parametric data, therefore, include only a comparatively coarse representation of the signal or the associated channel. Stated in numbers, the amount of data required by a carrier channel will be in the range of 60 - 70 kbit/s, while the amount of data required by parametric side information for one channel will typically be in the range of 1,5 - 2,5 kbit/s. An example for parametric data are the well-known scale factors, intensity stereo information or binaural cue parameters as will be described below.

The BCC Technique is for example described in the AES convention paper 5574, "Binaural Cue Coding applied to Stereo and Multi-Channel Audio Compression", C. Faller, F. Baumgarte, May 2002, Munich, in the IEEE WASPAA Paper "Efficient representation of spatial audio using perceptual parametrization", October 2001, Mohonk, NY, in "Binaural cue coding applied to audio compression with flexible

rendering", C. Faller and F. Baumgarte, AES 113th Convention, Los Angeles, Preprint 5686, October 2002 and in "Binaural cue coding - Part II: Schemes and applications", C. Faller and F. Baumgarte, IEEE Trans. on Speech and Audio Proc., volume level. 11, no. 6, Nov. 2003.

In BCC encoding, a number of audio input channels are converted to a spectral representation using a DFT (Discrete Fourier Transform) based transform with overlapping windows. The resulting uniform spectrum is divided into non-overlapping partitions. Each partition approximately has a bandwidth proportional to the equivalent rectangular bandwidth (ERB). The BCC parameters are then estimated between two channels for each partition. These BCC parameters are normally given for each channel with respect to a reference channel and are furthermore quantized. The transmitted parameters are finally calculated in accordance with prescribed formulas (encoded), which may also depend on the specific partitions of the signal to be processed.

A number of BCC parameters do exist. The ICLD parameter, for example, describes the difference (ratio) of the energies contained in 2 compared channels. The ICC parameter (inter-channel coherence/correlation) describes the correlation between the two channels, which can be understood as the similarity of the waveforms of the two channels. The ICTD parameter (inter-channel time difference) describes a global time shift between the 2 channels whereas the IPD parameter (inter-channel phase difference) describes the same with respect to the phases of the signals.

One should be aware that, in a frame-wise processing of an audio signal, the BCC analysis is also performed frame-wise, i.e. time-varying, and also frequency-wise. This means that, for each spectral band, the BCC parameters are individually obtained. This further means that, in case an

audio filter bank decomposes the input signal into for example 32 band pass signals, a BCC analysis block obtains a set of BCC parameters for each of the 32 bands.

- 5 A related technique, also known as parametric stereo, is described in J. Breebaart, S. van de Par, A. Kohlrausch, E. Schuijers, "High-Quality Parametric Spatial Audio Coding at Low Bitrates", AES 116th Convention, Berlin, Preprint 6072, May 2004, and E. Schuijers, J. Breebaart, H. Purnhagen, J. Engdegard, "Low Complexity Parametric Stereo Coding", AES 10 116th Convention, Berlin, Preprint 6073, May 2004.

Summarizing, recent approaches for parametric coding of multi-channel audio signals ("Spatial Audio Coding", 15 "Binaural Cue Coding" (BCC) etc.) represent a multi-channel audio signal by means of a downmix signal (could be monophonic or comprise several channels) and parametric side information ("spatial cues") characterizing its perceived spatial sound stage. It is desirable to keep the 20 rate of side information as low as possible in order to minimize overhead information and leave as much of the available transmission capacity for the coding of the downmix signals.

25 One way to keep the bit rate of the side information low is to losslessly encode the side information of a spatial audio scheme by applying, for example, entropy coding algorithms to the side information.

30 Lossless coding has been extensively applied in general audio coding in order to ensure an optimally compact representation for quantized spectral coefficients and other side information. Examples for appropriate encoding schemes and methods are given within the ISO/IEC standards 35 MPEG1 part 3, MPEG2 part 7 and MPEG4 part 3.

These standards and, for example, also the IEEE paper "Noiseless Coding of Quantized Spectral Coefficients in

MPEG-2 Advanced Audio Coding", S. R. Quackenbush, J. D. Johnston, IEEE WASPAA, Mohonk, NY, October 1997 describe state of the art techniques that include the following measures to losslessly encode quantized parameters:

5

- Multi-dimensional Huffman Coding of quantized spectral coefficients .
- Using a common (multi-dimensional) Huffman Codebook for
10 sets of coefficients
- Coding the value either as a hole or coding sign information and magnitude information separately (i.e. have only Huffman codebook entries for a given absolute
15 value which reduces the necessary codebook size, "signed" vs. "unsigned" codebooks)
- Using alternative codebooks of different largest absolute values (LAVs), i.e. different maximum absolute
20 values within the parameters to be encoded
- Using alternative codebooks of different statistical distribution for each LAV
- 25 • Transmitting the choice of Huffman codebook as side information to the decoder
- Using "sections" to define the range of application of each selected Huffman codebook
- 30 • Differential encoding of scalefactors over frequency and subsequent Huffman coding of the result

Another technique for the lossless encoding of coarsely
35 quantized values into a single PCM code is proposed within the MPEG1 audio standard (called grouping within the standard and used for layer 2). This is explained in more detail within the standard ISO/IEC 11172-3:93.

The publication "Binaural cue coding - Part II: Schemes and applications", C. Faller and F. Baumgarte, IEEE Trans. on Speech and Audio Proc., volume level. 11, no. 6, Nov. 2003
5 gives some information on coding of BCC parameters. It is proposed, that quantized ICLD parameters are differentially encoded

- over frequency and the result is subsequently Huffman
10 encoded (with a one-dimensional Huffman code)
- over time and the result is subsequently Huffman
encoded (with a one-dimensional Huffman code),

15 and that finally, the more efficient variant is selected as the representation of an original audio signal.

As mentioned above, it has been proposed to optimize
compression performance by applying differential coding
20 over frequency and, alternatively, over time and select the more efficient variant. The selected variant is then signaled to a decoder via some side information.

The prior art techniques described above are useful to
25 reduce the amount of data that, for example, has to be transmitted by means of an audio- or videostream. Using the described techniques of lossless encoding based on entropy-coding schemes generally results in a bit stream with a non-constant bit rate.

30 Although the prior art techniques are suited to significantly reduce the size of the data to be transferred, they all share one basic shortcoming. Since entropy coding mainly compresses information values that
35 are believed to occur often within the data set to be compressed, a number of consecutively occurring rare parameters will result in very high code length. Since such a parameter combination is likely to occur sometimes within

a complex data stream to be encoded, a resulting bit stream will in general have sections with a comparatively high bit rate.

- 5 If, within these sections, the bit rate exceeds the maximum feasible bit rate of the transport medium, e.g. the maximum net data rate of a wireless connection during a streaming application, the transfer of encoded data will be stalled or even interrupted, being of course most disadvantageous.

10

Summary of the invention

15 It is the object of the present invention to provide a concept to losslessly encode information values, simultaneously guaranteeing a lower maximum bit rate.

In accordance with a first aspect of the present invention, this object is achieved by an encoder for encoding of
20 information values that are described by more than one bit to derive an encoded representation of the information values, comprising: a bit estimator adapted to estimate a number of information units required for encoding the information values using a first encoding rule and using a
25 second encoding rule, the first encoding rule being such that the information values, when encoded, result in encoded representations having different numbers of information units, the second encoding rule being such that the information values, when encoded, result in encoded
30 representations having identical numbers of information units, wherein the encoded representation is derived from a combination of information values having at least two information values combined; and a provider adapted to provide an encoded representation being derived using the
35 encoding rule resulting in the smaller number of information units for the encoded representation and to provide a rule information indicating the encoding rule on which the encoded representation is based.

In accordance with a second aspect of the present invention, this object is achieved by a decoder for decoding an encoded representation of information values
5 that are described by more than one bit and for processing a rule information indicating an encoding rule used for encoding the information values, comprising: a receiver for receiving the encoded representation and the rule information; and a decompressor for decoding the encoded
10 representation, the decompressor being operative to derive the information value using, depending on the rule information, a first decoding rule or a second decoding rule, the first decoding rule being such that the information values are derived from encoded representations
15 having different numbers of information units and using a second decoding rule, the second decoding rule being such that the information values are derived from encoded representations having identical numbers of information values, wherein the information values are derived from
20 combinations of information values having at least two information values combined within the encoded representation.

In accordance with a third aspect of the present invention,
25 this object is achieved by a method for encoding of information values that are described by more than one bit to derive an encoded representation of the information values, the method comprising: estimating a number of information units required for encoding the information
30 values using a first encoding rule and using a second encoding rule, the first encoding rule being such that the information values, when encoded, result in encoded representations having different numbers of information units, the second encoding rule being such that the
35 information values, when encoded, result in encoded representations having identical numbers of information units, wherein the encoded representation is derived from a combination of information values having at least two

information values combined; and providing an encoded representation being derived using the encoding rule resulting in the smaller number of information units for the encoded representation and to provide a rule information indicating the encoding rule on which the encoded representation is based.

In accordance with a fourth aspect of the present invention, this object is achieved by a computer program implementing the above method, when running on a computer.

In accordance with a fifth aspect of the present invention, this object is achieved by a method for decoding an encoded representation of information values that are described by more than one bit and for processing a rule information indicating an encoding rule used for encoding the information values, the method comprising: receiving the encoded representation and the rule information; and decoding the encoded representation using, depending on the rule information, a first decoding rule or a second decoding rule, the first decoding rule being such that the information values are derived from encoded representations having different numbers of information units and using a second decoding rule, the second decoding rule being such that the information values are derived from encoded representations having identical numbers of information values, wherein the information values are derived from combinations of information values having at least two information values combined within the encoded representation.

In accordance with a sixth aspect of the present invention, this object is achieved by a computer program implementing the above method, when running on a computer.

In accordance with a seventh aspect of the present invention, this object is achieved by an encoded representation of information values, wherein the encoded

representation includes: a first part generated using a first encoding rule, the first encoding rule being such that the information values, when encoded, result in encoded representations having different numbers of information units; a second part generated using a second encoding rule, the second encoding rule being such that the information values, when encoded, result in encoded representations having identical numbers of information units, wherein the encoded representation is derived from a combination of information values having at least two information values combined; and a rule information indicating the encoding rule used.

The present invention is based on the finding that a compact encoded representation of information values not exceeding a predefined size can be derived when a first encoding rule generating an encoded representation of the information values of variable-length is compared to a second encoding rule generating an encoded representation of the information values of fixed length and when the encoding rule resulting in the encoded representation requiring the lower number of information units is chosen. Thus, the maximum bit rate can be guaranteed to be at most the bit rate of the second encoding rule deriving the second encoded representation. By signaling the choice of the encoding rule by some rule information together with the encoded representation of the information values, the correct information values can later on be derived on a decoder side, using a decoding rule matching with the encoding rule used during the encoding.

The principle shall be summarized in more detail in the following paragraphs presuming a properly designed variable length code matching the statistics of the information values to be encoded.

When applying entropy coding of quantized values, the actual demand required for representing a data set is known

to depend on the values to be coded. Generally, the more likely the values are the less bits are consumed. Conversely, very unlikely data sets will require a high bit rate. In this way, it may happen that a very high data rate is required for some data blocks, which can be disadvantageous, e.g. if the transmission channel has a limited transmission capacity.

The proposed method is able to guarantee a known upper limit for the bit demand of encoding entropy coded data sets, even for the case of very infrequent values. Specifically, the method ensures that the bit demand does not exceed the bit demand for using a PCM code. The encoding method can be summarized as follows:

15

- The data set is encoded using a regular entropy (e.g. Huffman) coding process. The resulting bit demand is stored.
- The bit demand for a PCM representation is calculated. Note that this is simply the number of values to be coded multiplied by the PCM code length or by a fraction of the PCM code length and is thus easy to compute.
- If the bit demand for entropy coding exceeds the bit demand for PCM encoding, PCM encoding is selected and signaled to the decoder via an appropriate side information.

30

The decoding stage works correspondingly.

In a preferred embodiment of the current invention, quantized values are encoded comparing an entropy coding scheme and a PCM code.

35

In the above-described embodiment of the current invention, the maximum bit rate is defined by the word length of the PCM code. Thus, knowing this word length, one can advantageously design a system of an encoder, a transport

medium and a decoder, assuring a safe operation by selecting the transport medium such that its transport capacity exceeds the maximum bit rate defined by the PCM code.

5

In a second preferred embodiment, based on the previous embodiment of the present invention, several information values are additionally combined into a single value which can be represented more efficiently using PCM encoding, i.e. which has a range close to a power of two. The grouping is described in more detail by the following example:

Values of a quantized variables with a range of 0...4 (i.e. 5 possible different values) cannot be efficiently represented with a PCM code since the smallest possible code length of 3 bits wastes 3 out of the possible $2^3=8$ values. Combining 3 such variables (thus having $5^3=125$ possible combinations) into a single code of 7 bits length significantly reduces the amount of redundancy since $5^3=125$ is almost $2^7=128$.

Consequently, a combined implementation of the proposed concept for upper-bounding the bit demand with this approach will use a grouped PCM encoding for determining the upper limit of data rate (and the fall-back way of encoding) for the PCM alternative.

This combined implementation has the obvious advantage of being able to further reduce the maximum bit rate.

Brief description of the drawings

Preferred embodiments of the present invention are subsequently described by referring to the enclosed drawings, wherein:

Fig. 1 shows an inventive encoder;

- Fig. 2 shows an example of the bit estimation according to the inventive concept;
- 5 Fig. 3a shows grouping of 2 information values prior to PCM-encoding;
- Fig. 3b shows grouping of 3 information values;
- 10 Fig. 4 shows an inventive decoder; and
- Fig. 5 shows a multi-channel audio encoder according to the prior art.

15

Detailed description of the preferred embodiments

Fig. 1 shows a block diagram of an inventive encoder to encode information values or to derive an encoded
20 representation of the information values, guaranteeing a fixed maximum bit rate. The encoder 100 comprises a bit estimator 102 and a provider 104.

Information values 106 to be encoded are input to the bit
25 estimator 102 and to the provider 104. In one possible implementation the bit estimator 102 estimates the number of information units required by using a first encoding rule and using a second encoding rule. The information, which encoding rule results in the encoded representation
30 requiring the lower number of information units, is made available to the provider 104 via the rule-data link 108. The provider 104 then encodes the information values 106 with the signaled encoding rule and delivers the encoded representation 110 as well as a rule information 112,
35 indicating the encoding rule used, at his outputs.

In a modification of the previously described embodiment of the invention, the bit estimator 102 encodes the

information values 106 using the first and the second encoding rule. The bit estimator 102 then counts the information units required for the two encoded representations and delivers the encoded representation with the lower number of information units and the rule information to the provider 104. The possible transfer of an already encoded representation from the bit estimator 102 to the provider 104 is indicated by the dashed data link 114 in Fig. 1. The provider 104 then simply forwards the already encoded representation to its output and additionally delivers the rule information 112.

Fig. 2 illustrates how the bit estimator 102 estimates the number of bits necessary to derive an encoded representation by comparing a Huffman code with a PCM code.

The Huffman code-book 120 is used to assign integer values 122 to code-words 124 that are represented by a sequence of bits. It is to be noted here, that the Huffman-Codebook is chosen as simple as possible here to focus on the basic idea of the inventive concept.

The PCM code used for the comparison and to guarantee a maximum constant bit rate consists of PCM code-words of a length of 4 bits, allowing for 16 possible code-words, as indicated within the PCM description 126.

In the simple example shown here, the information values 128 to be encoded are represented by six consecutive integers (011256), that means, each information value has only ten possible settings. The information values 128 are input to the bit estimator 102, which derives the number of bits necessary to build the encoded representation using the Huffman code-book, as indicated in the Huffman section 130 of the bit estimator 102 and using the PCM representation, as indicated in the PCM section 132. As can be seen in Fig. 2, the entropy-encoded representation of the information values requires 22 bits, whereas the PCM

representation requires 24 bits, being the number of information values multiplied with the bit length of a single PCM code-word. An inventive encoder would in the case of Fig. 2 decide to go for the entropy-encoded representation of the information values and signal an appropriate rule information that is output along with the entropy-encoded representation.

Figures 3a and 3b show possibilities to further decrease the maximum bit rate by advantageously grouping the information values 128 together to form groups of information values that are PCM encoded.

In the following, the same information values 128 as in Fig. 2 are used to emphasize the impact the PCM grouping can have on the inventive concept of encoding information values.

As again a single information value only has 10 possible settings, one can advantageously combine two consecutive information values to groups of information values 140a to 140c before building a PCM representation of the then combined values. This is possible, since a 7-bit PCM code allows for 128 different combinations, whereas a group of two arbitrary information values can only build 100 different combinations.

Each of the groups 140a - 140c of information values is now assigned to a single 7-Bit-PCM code-word 142a - 142c. As can be seen from Fig. 3a, applying the grouping strategy prior to building a PCM representation results in an encoded representation of the information values 128 having only 21 bits, compared to the 24 bits required for the non-grouped PCM representation of Fig. 2. In the above grouping strategy, a mean value of 3.5 bits is consumed by each information value within a data stream (7 bits / 2 information values).

As Figure 3b shows, one can further increase the efficiency of the grouping by grouping 3 values together in groups of information values 146a and 146b. These can form 1000 possible combinations, that can be covered by a 10-Bit-PCM code, as shown by the PCM-codewords 148a and 148b in Fig. 3. Thus, the PCM representation requires only 20 bits, further decreasing the mean value of bits per information value to 3.33 (10/3).

As one can clearly see, the bit rate needed for encoding can benefit significantly by the grouping of the values, as the maximum bit rate would be 12.5% (16.7%) lower for the given examples of Figures 3a and 3b. Additionally applying the grouping to the example of Fig. 2 would even make the bit estimator 102 go for a different decision and signal that the PCM code yields the encoded representation requiring the lower number of bits.

Fig. 4 shows a block diagram of a decoder according to the present invention. The decoder 160 comprises a decompressor 162 and a receiver 163 for providing an encoded representation 110 and a rule information 112, indicating an encoding rule used for encoding the information values.

The decompressor 162 processes the rule information 112 to derive a decoding rule appropriate to derive the information values 106 from the encoded representation 110.

The decompressor 162 then decompresses the encoded representation 110 using the decoding rule and provides the information values 106 at its output.

The descriptions in the previous paragraphs detail the inventive concept by comparing an entropy encoding scheme producing a code of variable bit length with a PCM encoding scheme producing a code of fixed bit length. The inventive concept is in no way limited to the types of codes that are compared during the encoding process. Basically, any

combination of two or more codes is appropriate to be compared and to derive an encoded representation of information values being as compact as possible, especially being more compact than if derived by using just one code.

5

The present invention is described in the context of audio-encoding, where parameters, describing for example spatial properties of an audio signal, are encoded and decoded according to the inventive concept. The inventive concept, 10 guaranteeing a maximum bit rate for encoded content, can advantageously be applied to any other parametric representation or information values also.

Implementations where previously quantized parameters are 15 entropy encoded are specially suited, since then the encoding efficiency is expected to be high. Nonetheless, also the direct spectral representation of an audio or video signal may be used as input to the inventive encoding scheme. Especially, when a signal is described by various 20 different portions of the signal following each other in time, wherein the time portions are described by parameters comprising a frequency representation of the signal, the encoding measures described above can be employed over frequency and over time. Also PCM grouping may be applied, 25 grouping together parameters over time or over frequency.

Although the inventive decoder, as described above, derives the information which decoding rule to use to decode the encoded representation by means of a rule information 30 signaling the rule to the decoder, it is also possible in an alternative embodiment that the decoder 160 derives from the encoded representation 110 directly what decoding rule to use, for example by recognizing a special sequence of bits within the encoded representation, having the 35 advantage that the side information signaling the rule information can be omitted.

Depending on certain implementation requirements of the inventive methods, the inventive methods can be implemented in hardware or in software. The implementation can be performed using a digital storage medium, in particular a disk, DVD or a CD having electronically readable control signals stored thereon, which cooperate with a programmable computer system such that the inventive methods are performed. Generally, the present invention is, therefore, a computer program product with a program code stored on a machine readable carrier, the program code being operative for performing the inventive methods when the computer program product runs on a computer. In other words, the inventive methods are, therefore, a computer program having a program code for performing at least one of the inventive methods when the computer program runs on a computer.

While the foregoing has been particularly shown and described with reference to particular embodiments thereof, it will be understood by those skilled in the art that various other changes in the form and details may be made without departing from the spirit and scope thereof. It is to be understood that various changes may be made in adapting to different embodiments without departing from the broader concepts disclosed herein and comprehended by the claims that follow.

What is claimed is:

1. Encoder for lossless encoding of information values
describing an audio signal, the information values
5 described by more than one bit to derive an encoded
representation of the information values, comprising:

a bit estimator adapted to estimate a number of
information units required for encoding the
10 information values using a first encoding rule and
using a second encoding rule,

the first encoding rule being such that the
information values, when encoded, result in
15 encoded representations having different numbers
of information units,

the second encoding rule being such that the
information values, when encoded, result in
20 encoded representations having identical numbers
of information units, wherein the encoded
representation is derived assigning a single
codeword of fixed length to a combination of
information values having at least two
25 information values combined; and

a provider. adapted to provide an encoded
representation being derived using the encoding rule
resulting in the smaller number of information units
30 for the encoded representation and to provide a rule
information indicating the encoding rule on which the
encoded representation is based.
2. Encoder in accordance with claim 1, in which the first
35 encoding rule is such that the number of information
units required by the encoded representation of a
fixed number of information values depends on the
underlying information values.

3. Encoder in accordance with claim 1, in which the first encoding rule is such that deriving the encoded representation includes using a Huffman code-book.
- 5
4. Encoder in accordance with claim 1, in which the first encoding rule is such, that deriving the encoded representation includes deriving a differentially encoded representation of the information values.
- 10
5. Encoder in accordance with claim 4, in which the differentially encoded representation is differentially encoded in time or in frequency.
- 15
6. Encoder in accordance with claim 1, in which the information values include BCC parameters describing the spatial properties of a multi-channel audio signal and in which the BCC parameters are chosen from the following list of BCC parameters:
- 20
- ICC (inter-channel coherence/correlation)
 - ICLD (inter-channel level difference)
 - ICTD (inter-channel time difference)
 - IPD (inter-channel phase difference).
- 25
7. Encoder in accordance with claim 1, in which the information units are bits.
8. Decoder for decoding an encoded representation of information values describing an audio signal that are described by more than one bit and for processing a rule information indicating an encoding rule used for encoding the information values, comprising:
- 30
- a receiver for receiving the encoded representation and the rule information; and
- 35

a decompressor for decoding the encoded representation, the decompressor being operative to derive the information values using, depending on the rule information, a first decoding rule or a second decoding rule,

5

the first decoding rule being such that the information values are derived from encoded representations having different numbers of information units; and

10

the second decoding rule being such that the information values are derived from codewords of fixed length having identical numbers of information values, wherein the information values are derived from combinations of information values having at least two information values combined that are represented by one codeword of fixed length.

15

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9. Decoder in accordance with claim 8, in which the first decoding rule is such that deriving the information values includes using a Huffman code-book.

25

10. Decoder in accordance with claim 8, in which the second decoding rule is such that deriving the information values includes assigning a combination of information values having at least two information values combined to a PCM codeword of the encoded representation.

30

11. Decoder in accordance with claim 8, in which the encoded representation of information values is based on information values comprising parameters describing a frame of an audio signal.

35

12. Decoder in accordance with claim 8, in which the encoded representation of information values is based

on information values comprising BCC parameters describing the spatial properties of a multi-channel audio signal and in which the BCC parameters are chosen out of the following list of BCC parameters:

5

ICC (inter-channel coherence/correlation)
ICLD (inter-channel level difference)
ICTD (inter-channel time difference)
IPD (inter-channel phase difference).

10

13. A method for lossless encoding of information values describing an audio signal, the information values described by more than one bit, to derive an encoded representation of the information values, the method comprising:

15

estimating a number of information units required for encoding the information values using a first encoding rule and using a second encoding rule,

20

the first encoding rule being such that the information values, when encoded, result in encoded representations having different numbers of information units,

25

the second encoding rule being such that the information values, when encoded, result in encoded representations having identical numbers of information units, wherein the encoded representation is derived assigning a codeword of fixed length from a combination of information values having at least two information values combined; and

30

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providing an encoded representation being derived using the encoding rule resulting in the smaller number of information units for the encoded representation and to provide a rule information

indicating the encoding rule on which the encoded representation is based.

14. A method for decoding an encoded representation of information values describing an audio signal, the information values described by more than one bit, and for processing a rule information indicating an encoding rule used for encoding the information values, the method comprising:
- 5
- 10 receiving the encoded representation and the rule information; and
- 15 decoding the encoded representation using, depending on the rule information, a first decoding rule or a second decoding rule,
- 20 the first decoding rule being such that the information values are derived from codewords of fixed length having different numbers of information units and using a second decoding rule,
- 25 the second decoding rule being such that the information values are derived from encoded representations having identical numbers of information values, wherein the information values are derived from combinations of information values having at least two
- 30 information values combined that are represented by one codeword of fixed length.
15. Computer program having a program code for performing, when running on a computer, a method for lossless encoding of information values describing an audio signal, the information values described by more than one bit, to derive an encoded representation of the information values, the method comprising:
- 35

estimating a number of information units required for encoding the information values using a first encoding rule and using a second encoding rule,

5

the first encoding rule being such that the information values, when encoded, result in encoded representations having different numbers of information units,

10

the second encoding rule being such that the information values, when encoded, result in encoded representations having identical numbers of information units, wherein the encoded representation is derived assigning a single codeword of fixed length to a combination of information values having at least two information values combined; and

15

20

providing an encoded representation being derived using the encoding rule resulting in the smaller number of information units for the encoded representation and to provide a rule information indicating the encoding rule on which the encoded representation is based.

25

16. Computer program having a program code for performing, when running on a computer, a method for decoding an encoded representation of information values describing an audio signal, the information values described by more than one bit, and for processing a rule information indicating an encoding rule used for encoding the information values, the method comprising:

30

35

receiving the encoded representation and the rule information; and

decoding the encoded representation using, depending on the rule information, a first decoding rule or a second decoding rule,

5 the first decoding rule being such that the information values are derived from encoded representations having different numbers of information units; and

10 the second decoding rule being such that the information values are derived from codewords of fixed length having identical numbers of information values, wherein the information values are derived from combinations of
15 information values having at least two information values combined that are represented by one codeword of fixed length.

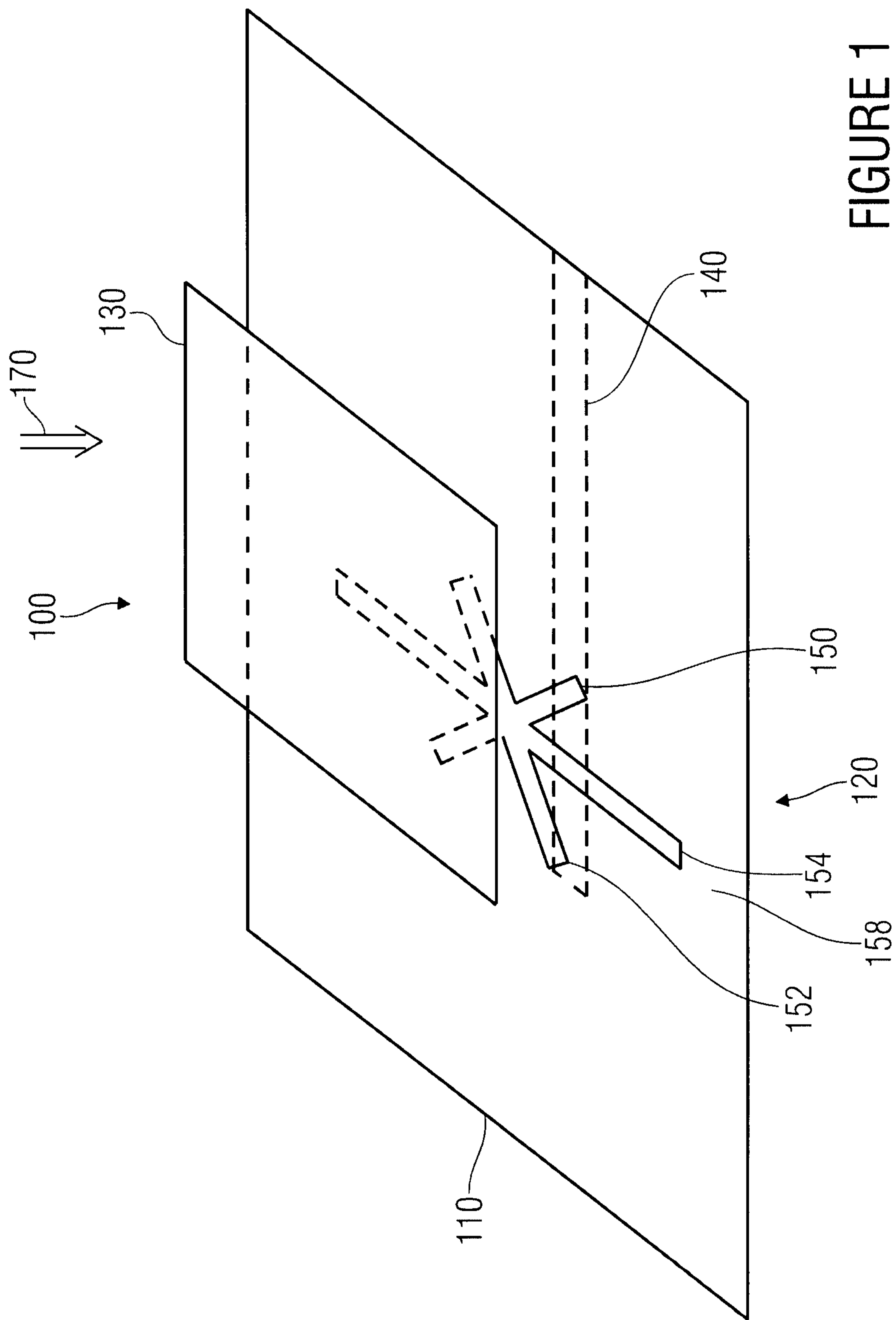
17. Encoded representation of information values, wherein
20 the encoded representation includes:

 a first part generated using a first encoding rule, the first encoding rule being such that the information values, when encoded, result in
25 encoded representations having different numbers of information units

 a second part generated using a second encoding rule, the second encoding rule being such that
30 the information values, when encoded, result in codewords of fixed length having identical numbers of information units, wherein the encoded representation is derived from a combination of information values having at least two
35 information values combined that are represented by one codeword of fixed length; and

a rule information indicating the encoding rule used.

18. Encoded representation in accordance with claim 17,
which is stored on a computer-readable medium.



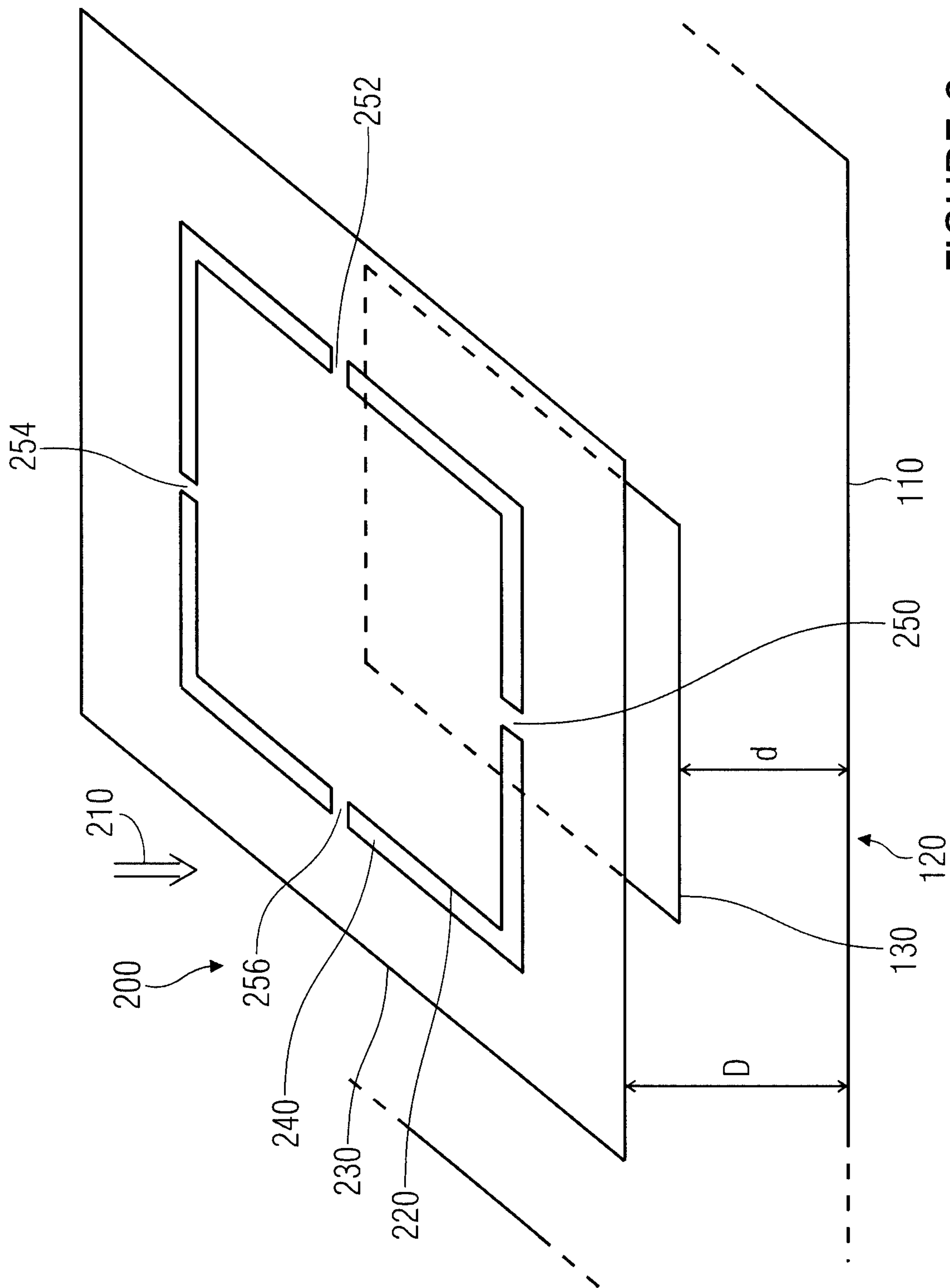


FIGURE 2

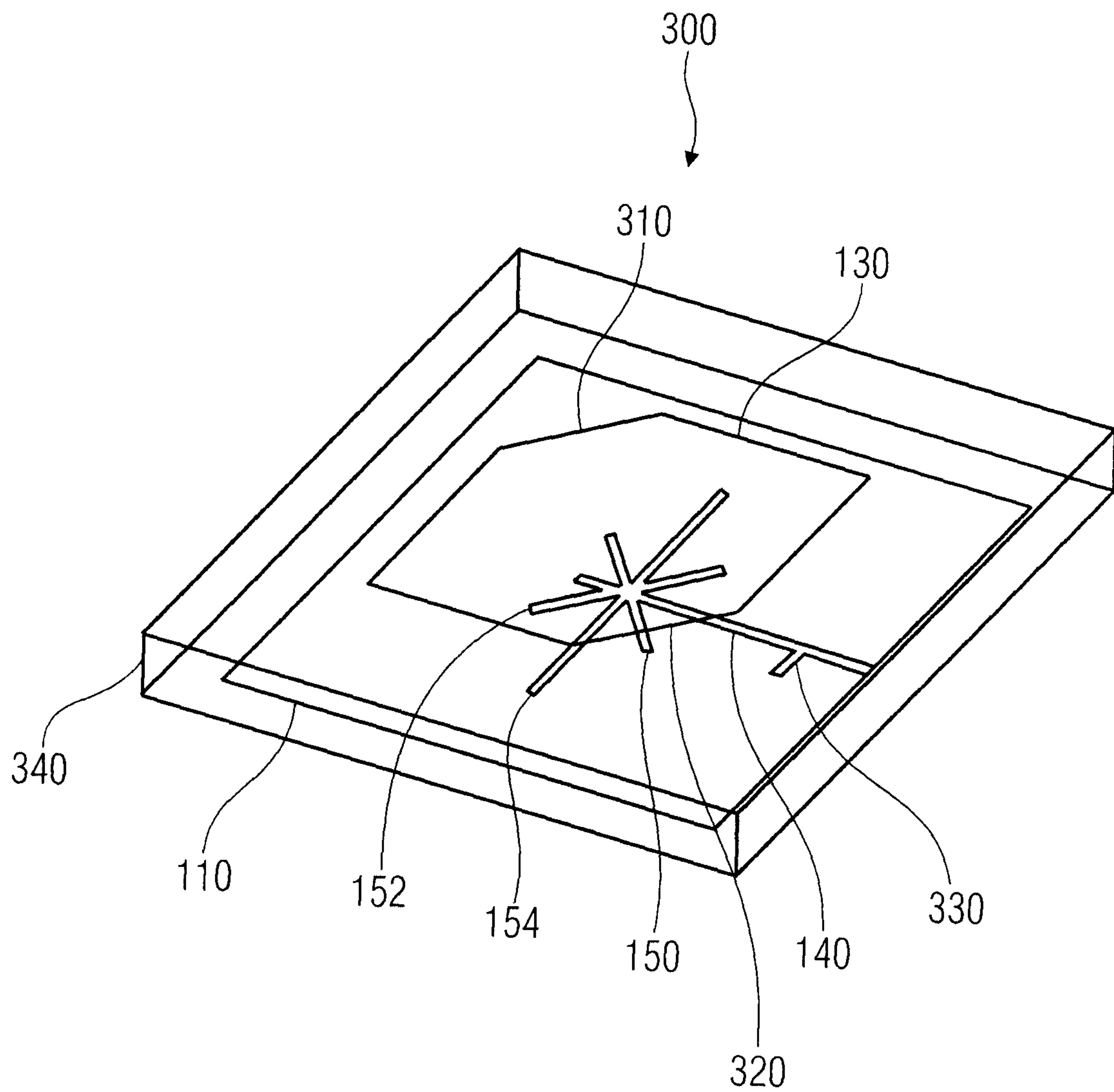


FIGURE 3

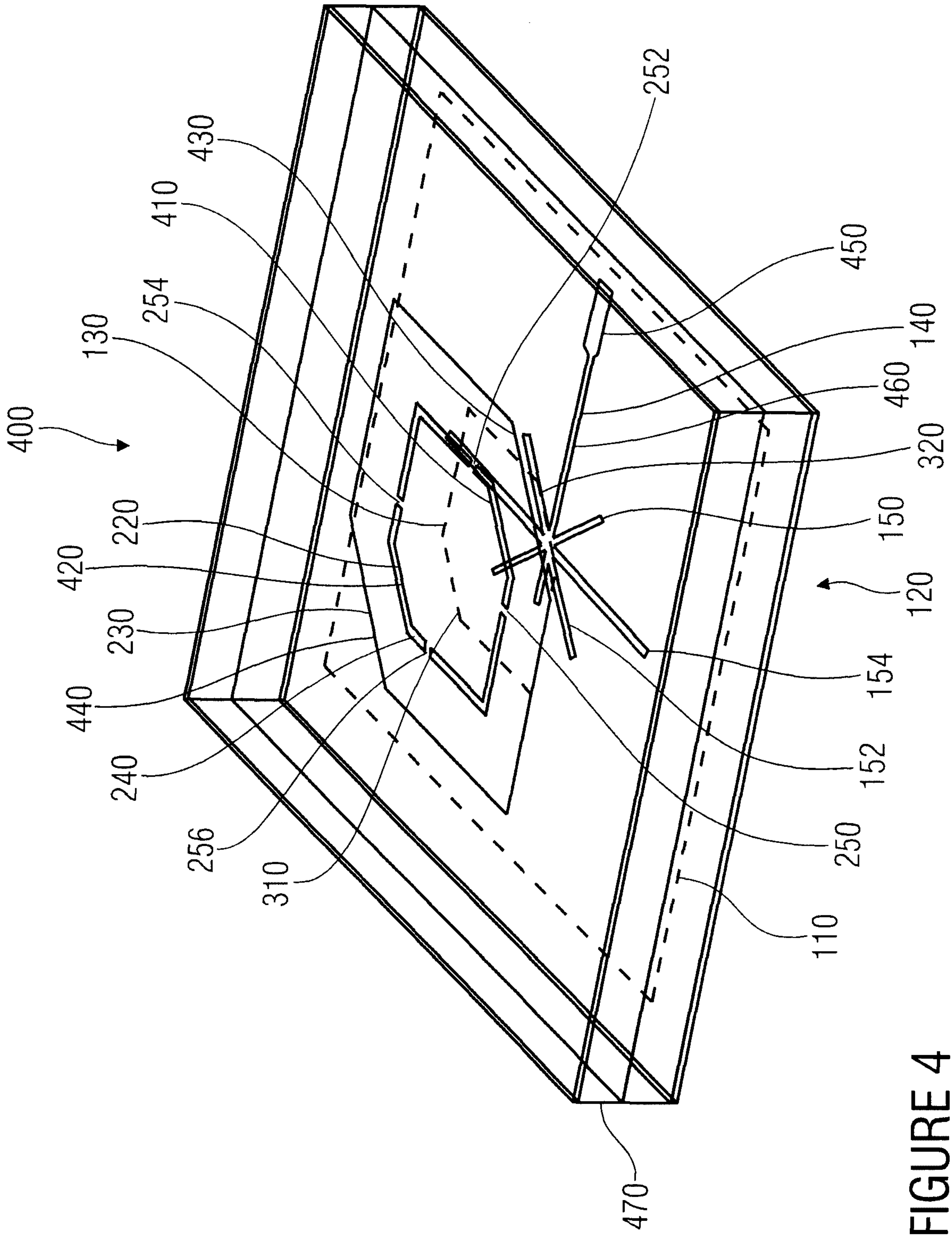


FIGURE 4

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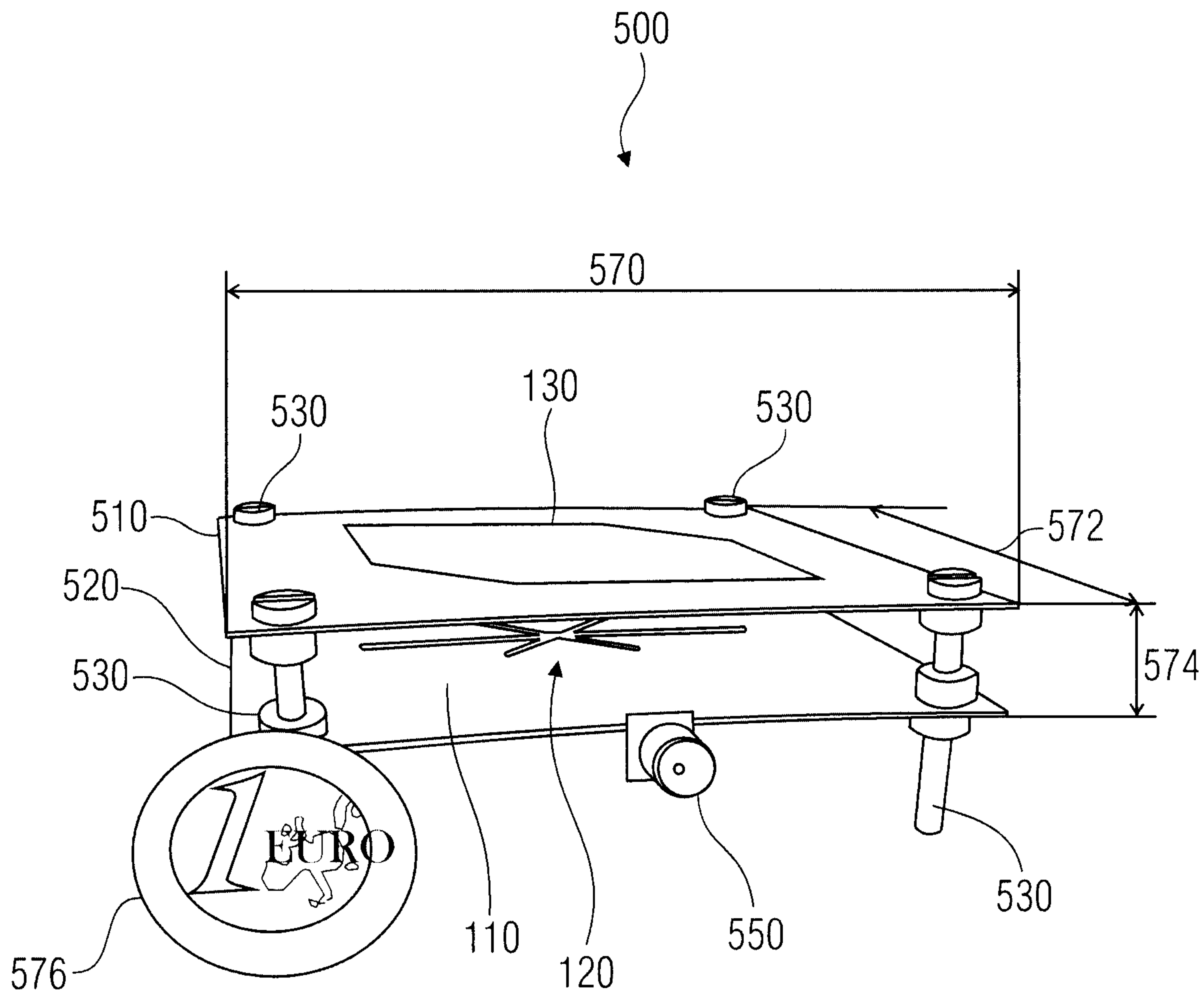


FIGURE 5

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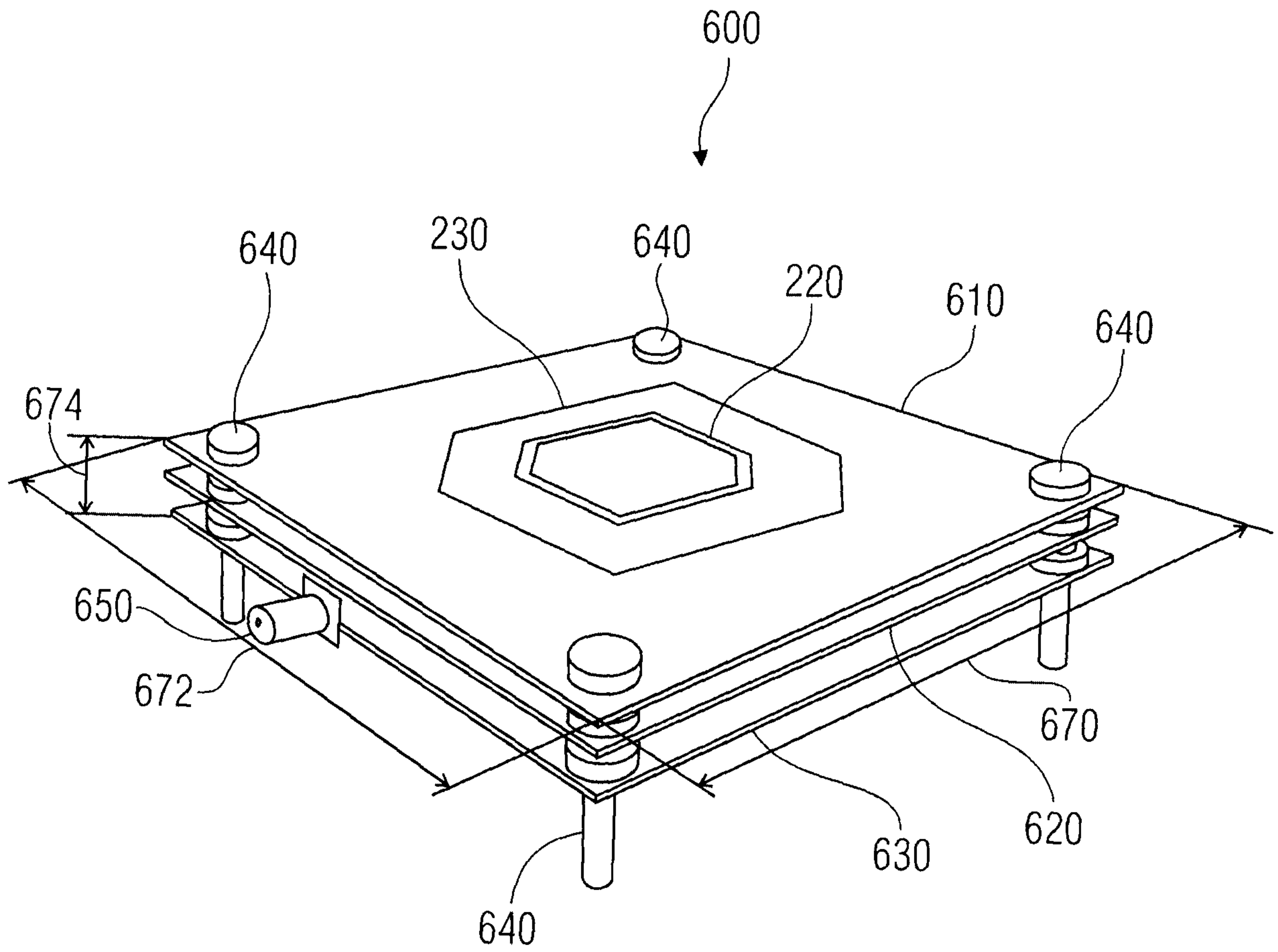


FIGURE 6

FIGURE 7

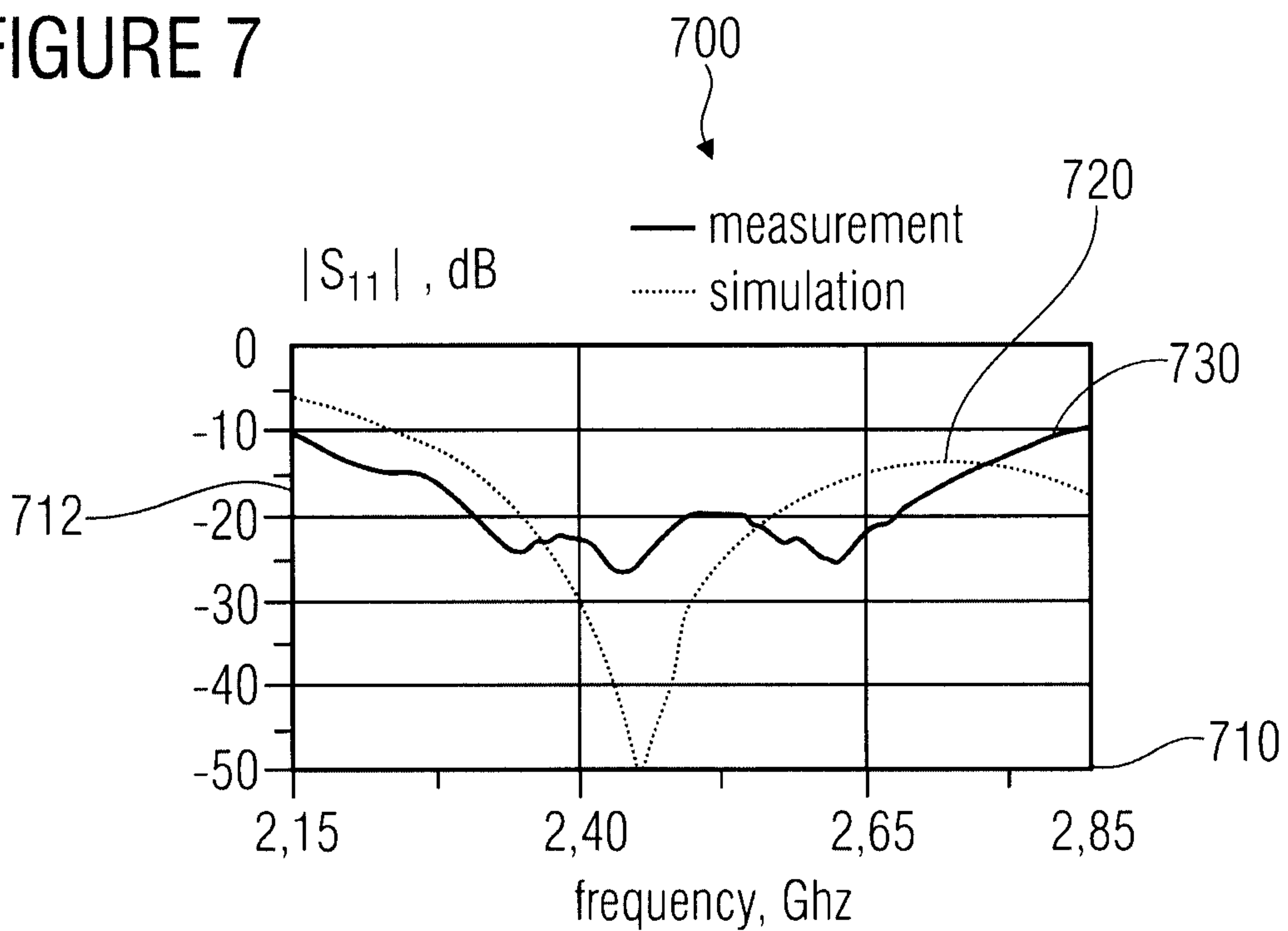
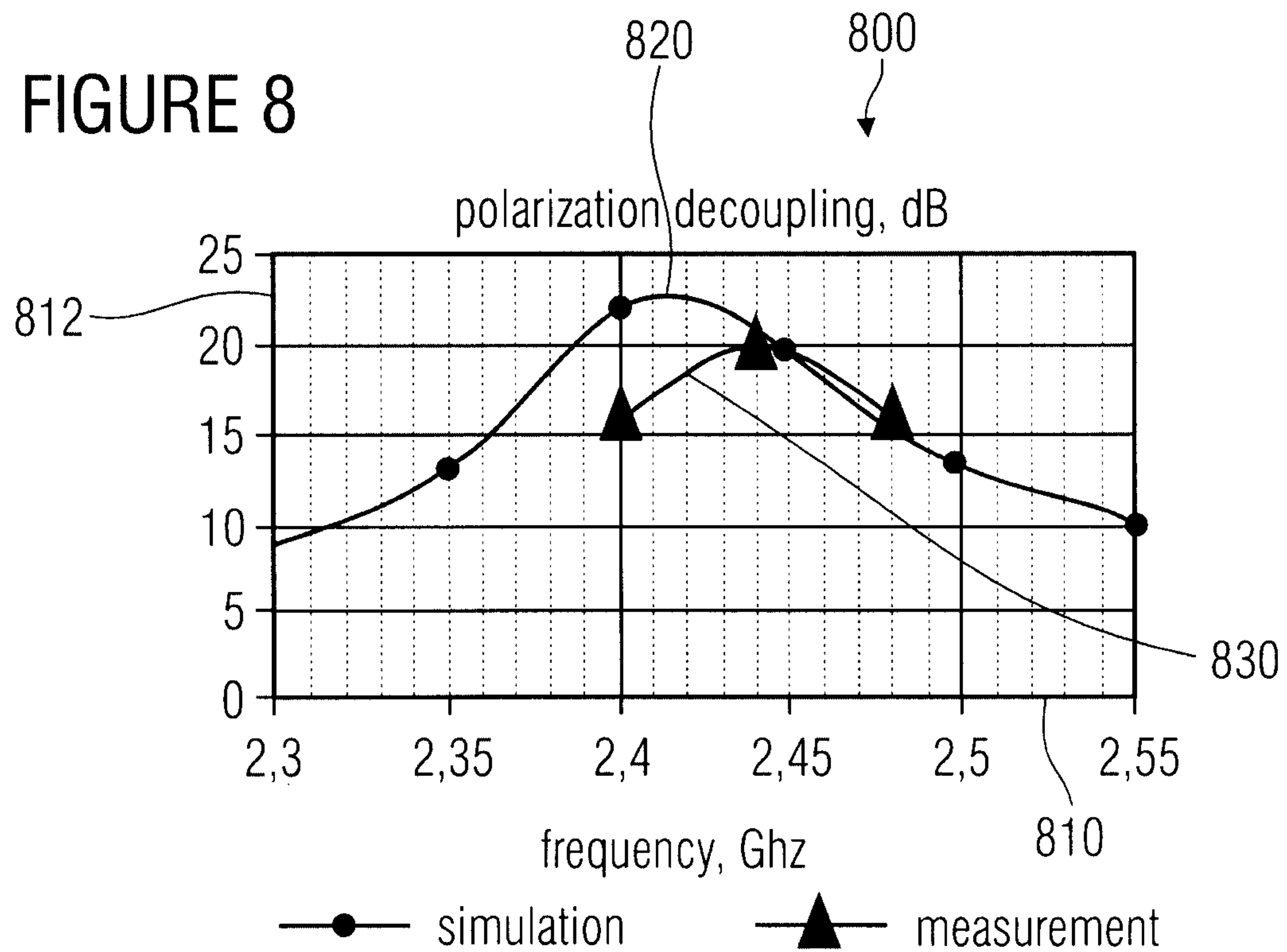


FIGURE 8



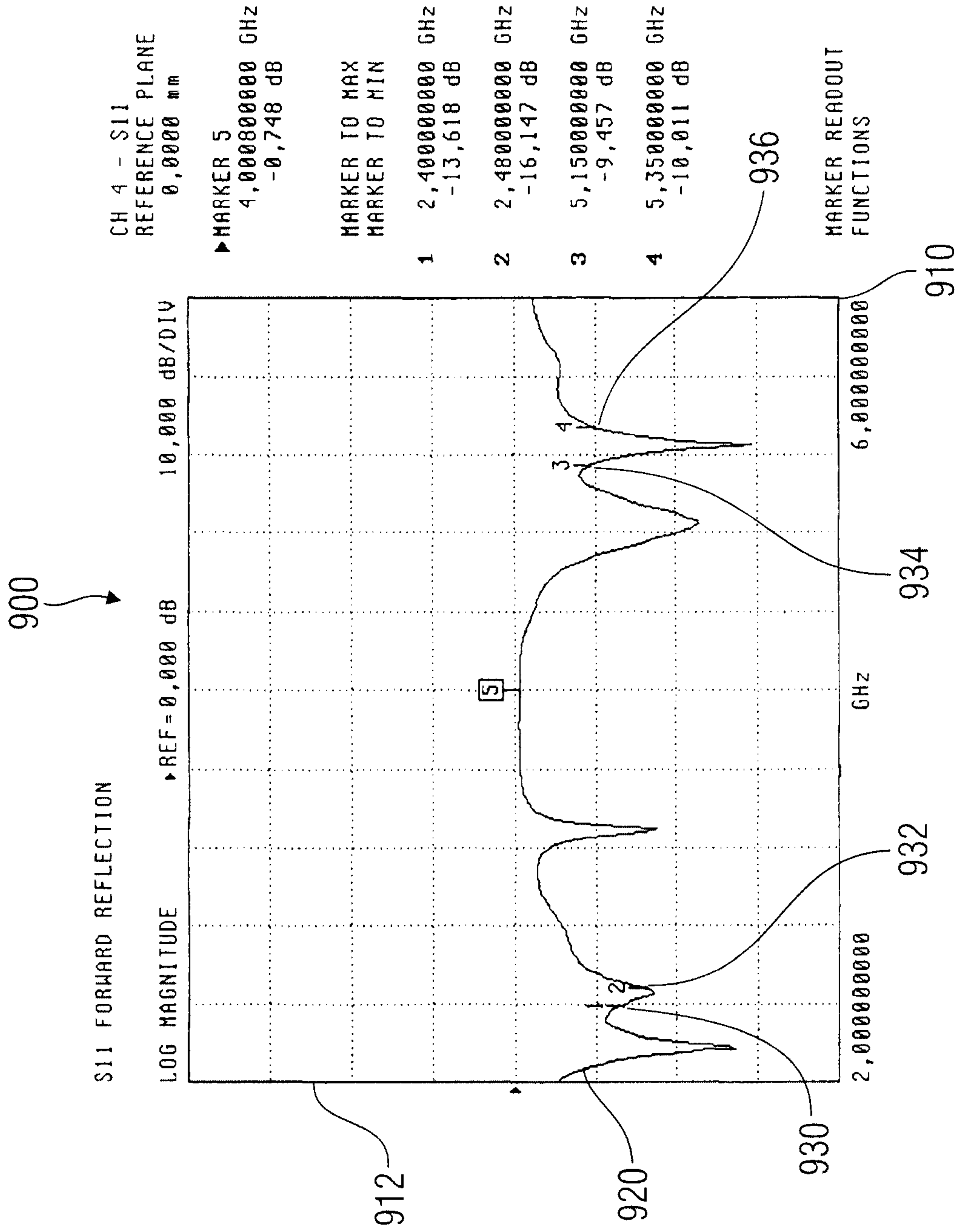


FIGURE 9

