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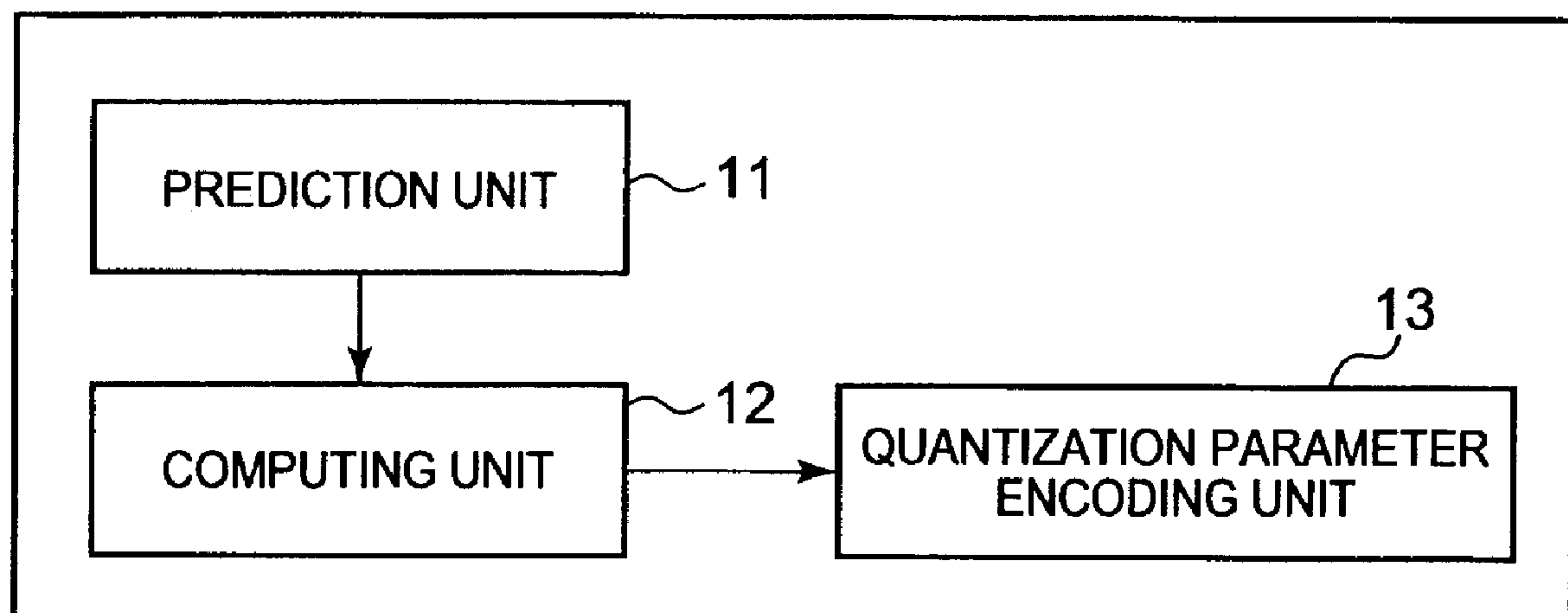
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(54) Titre : PROCEDE POUR CODER UN PARAMETRE DE QUANTIFICATION VIDEO ET PROCEDE POUR DECODER UN PARAMETRE DE QUANTIFICATION VIDEO
(54) Title: METHOD FOR CODING VIDEO QUANTIZATION PARAMETER AND METHOD FOR DECODING VIDEO QUANTIZATION PARAMETER



(57) Abrégé/Abstract:

A video quantization parameter coding device is provided with a prediction unit (11) for generating a prediction quantization parameter from a past reconstruction quantization parameter, a computation unit (12) for generating a differential quantization parameter from the quantization parameter and the prediction quantization parameter, and a quantization parameter coding means (13) for binary arithmetically coding a first bin indicating whether or not the differential quantization parameter is significant, a second bin indicating whether the differential quantization parameter is positive or negative, and another bin indicating the absolute value of the differential quantization parameter, if the differential quantization parameter is significant.



Abstract

A video quantization parameter encoder includes: a prediction unit 11 for generating a predicted quantization parameter from a past reconstructed quantization parameter; a computing unit 12 for generating a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and quantization parameter encoding means 13 for binary arithmetic encoding a first bin indicating whether or not the delta quantization parameter is significant, a second bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, in the case where the delta quantization parameter is significant.

Description

**Title of Invention: METHOD FOR CODING VIDEO QUANTIZATION
PARAMETER AND METHOD FOR DECODING VIDEO QUANTIZATION
PARAMETER**

5 Technical Field

[0001]

The present invention relates to a technique for coding a video quantization parameter for video coding that uses context-based adaptive binary arithmetic coding, and
10 for example relates to a video quantization parameter coding method, a video quantization parameter decoding method, a video quantization parameter coder, a video quantization parameter decoder, a video quantization parameter coding program, and a video quantization
15 parameter decoding program that are suitably applicable to a video coding device, a video decoding device, and the like.

Background Art

20 [0002]

Non Patent Literatures (NPLs) 1 and 2 each disclose a video encoding technique that uses context-based adaptive binary arithmetic coding (CABAC).

[0003]

25 Fig. 15 is a block diagram showing a structure of a video quantization parameter encoding device in the video encoding technique that uses CABAC. The video quantization parameter encoder shown in Fig. 15 (hereafter referred to as the typical video quantization parameter encoder)
30 includes a predictor 101, a buffer 102, a binarizer 1030, an adaptive binary arithmetic encoder 104, and a switch (SW) 111.

[0004]

A predicted quantization parameter (predicted QP:

PQP) supplied from the predictor 101 is subtracted from a quantization parameter (QP) input to the typical video quantization parameter encoder. The QP from which the PQP has been subtracted is referred to as the delta quantization parameter (delta QP: DQP).

[0005]

In NPL 1, the PQP is a reconstructed quantization parameter (last reconstructed QP: LastRQP) of a last reconstructed image block. In NPL 2, the PQP is a reconstructed quantization parameter (left reconstructed QP: LeftRQP) of a left adjacent image block or a reconstructed quantization parameter (LastRQP) of a last reconstructed image block.

[0006]

The PQP is added to the DQP and the sum is stored in the buffer 102 as a reconstructed quantization parameter (reconstructed QP: RQP), for subsequent quantization parameter encoding.

[0007]

The binarizer 1030 binarizes the DQP to obtain a bin string. One bit of the bin string is referred to as a bin. In the bin string, a bin that is binary arithmetic coded first is referred to as the first bin (1st bin), a bin that is binary arithmetic coded second is referred to as the second bin (2nd bin), and a bin that is binary arithmetic coded nth is referred to as the nth bin (nth bin). The bin and the bin string are defined in 3.9 and 3.12 in NPL 1.

[0008]

Fig. 16 is an explanatory diagram showing a correspondence table between the DQP (rightmost column) and the bin string (center column) in NPLs 1 and 2.

[0009]

A bin string index in the leftmost column in Fig. 16 indicates an index of a bin string corresponding to a DQP

value. The bin string index is 1 in the case where the DQP is 0, $2 * DQP - 1$ in the case where the DQP is greater than 0, and $-2 * DQP + 1$ in the case where the DQP is less than 0 (where "*" denotes multiplication).

5 [0010]

A context index in the lowermost row in Fig. 16 indicates an index of a context used for binary arithmetic encoding of a bin in a corresponding column. For example, the bin string corresponding to $DQP = -1$ is 110, in which
10 the value of the first bin is 1, the value of the second bin is 1, and the value of the third bin is 0. The context index used for binary arithmetic encoding of the first bin is 0, the context index used for binary arithmetic encoding of the second bin is 2, and the context index used for
15 binary arithmetic encoding of the third bin is 3. The context mentioned here is a combination of a most probable symbol (PS) of the bin and its probability.

[0011]

The adaptive binary arithmetic encoder 104 binary
20 arithmetic codes each bin of the bin string supplied via the switch 111 beginning with the first bin, using the context associated with the corresponding context index. The adaptive binary arithmetic encoder 104 also updates the context associated with the context index according to the
25 value of the binary arithmetic coded bin, for subsequent binary arithmetic encoding. Detailed operations of adaptive binary arithmetic encoding are described in 9.3.4 in NPL 1.

[0012]

30 The typical quantization parameter encoder codes the input video quantization parameter based on the above-mentioned operations.

Citation List

Non Patent Literature(s)

[0013]

NPL 1: ISO/IEC 14496-10 Advanced Video Coding

NPL 2: "WD3: Working Draft 3 of High-Efficiency
5 Video Coding", Document: JCTVC-E603, Joint Collaborative
Team on Video Coding (JCT-VC) of ITU-T SG16 WP3 and ISO/IEC
JTC 1/SC29/WG11 5th Meeting: Geneva, CH, 16-23 March, 2011

Summary of Invention**10 Technical Problem**

[0014]

As can be seen from Fig. 16, the typical
quantization parameter encoder performs binarization
without distinguishing between information about whether
15 the significant DQP is positive or negative and information
about the absolute value of the significant DQP. The
typical quantization parameter encoder therefore has a
problem of being unable to suitably code the significant
DQP due to the following three factors.

20 [0015]

The first factor is that, since the second bin (bin
in the column "2nd") and the subsequent bins (bins in the
columns from "3rd" onward) include information about three
or more states which cannot be expressed by one bin, it is
25 impossible to binary arithmetic code the bins using
appropriate contexts. Information that can be expressed by
one bin is information of which one of two states holds
true. However, the second bin and the subsequent bins
include information about three or more states which cannot
30 be expressed by one bin. In detail, in Fig. 16, the second
bin includes the information of whether the DQP is positive
or negative and the information indicating whether or not
the absolute value of the significant DQP is greater than
or equal to 1. The subsequent bins from the third bin (in

the columns from "3rd" onward) include the information of whether the DQP is positive or negative and the information indicating the magnitude of the absolute value of the significant DQP. Hence, it is impossible to binary arithmetic code, with appropriate contexts, the second bin and the subsequent bins including information about three or more states which cannot be expressed by one bin.

[0016]

The second factor is that redundant bins cannot be efficiently reduced in the case where the DQP range is asymmetric between positive and negative. When the DQP range is asymmetric between positive and negative, a specific DQP needs to be coded without reducing redundant bins, due to the presence of a bin string of a DQP that is not transmitted. For example, the DQP range defined in NPLs 1 and 2 is from -26 to 25, which is asymmetric between positive and negative. In Fig. 16, DQP = -26 needs to be coded without reducing the redundant 52nd and 53rd bins, due to the presence of the bin string of DQP = 26 that is not transmitted.

[0017]

The third factor is that the number of bins included in the bin string handled by the typical quantization parameter encoder is approximately twice the number of bins in the case of separately binarizing the information of whether the significant DQP is positive or negative and the absolute value of the significant DQP. A large number of bins lead to an increase in the amount of coded data and a decrease in the speed of the DQP encoding process and decoding process.

[0018]

The present invention has an object of enabling suitable encoding of a video quantization parameter for video encoding that uses context-based adaptive binary

arithmetic encoding, by resolving each of the above-mentioned factors.

Solution to Problem

5 [0019]

A video quantization parameter encoding method according to the present invention is a video quantization parameter encoding method for encoding a quantization parameter for a video encoding process that is based on
10 context-based adaptive binary arithmetic encoding, the video quantization parameter encoding method including: generating a predicted quantization parameter from a past reconstructed quantization parameter; generating a delta quantization parameter from a quantization parameter and
15 the predicted quantization parameter; and binary arithmetic encoding a first bin (bin: each bit in a bit string obtained by binarizing the delta quantization parameter DQP) indicating whether or not the delta quantization parameter is significant, a second bin indicating whether
20 the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, in the case where the delta quantization parameter is significant.

[0020]

25 A video quantization parameter decoding method according to the present invention is a video quantization parameter decoding method for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, the
30 video quantization parameter decoding method including: generating a predicted quantization parameter from a past reconstructed quantization parameter; and binary arithmetic decoding a first bin indicating whether or not a delta quantization parameter is significant, a second bin

indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter.

[0021]

5 A video quantization parameter encoder according to the present invention is a video quantization parameter encoder for encoding a quantization parameter for a video encoding process that is based on context-based adaptive binary arithmetic encoding, the video quantization
10 parameter encoder including: prediction means for generating a predicted quantization parameter from a past reconstructed quantization parameter; computing means for generating a delta quantization parameter from a quantization parameter and the predicted quantization
15 parameter; and quantization parameter encoding means for binary arithmetic encoding a first bin indicating whether or not the delta quantization parameter is significant, a second bin indicating whether the delta quantization parameter is positive or negative, and other bins
20 indicating an absolute value of the delta quantization parameter, in the case where the delta quantization parameter is significant.

[0022]

25 A video quantization parameter decoder according to the present invention is a video quantization parameter decoder for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, the video quantization
parameter decoder including: prediction means for
30 generating a predicted quantization parameter from a past reconstructed quantization parameter; and quantization parameter decoding means for binary arithmetic decoding a first bin indicating whether or not a delta quantization parameter is significant, a second bin indicating whether

the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter.

[0023]

5 A video quantization parameter encoding program according to the present invention causes a computer in a video quantization parameter encoder for encoding a quantization parameter for a video encoding process that is based on context-based adaptive binary arithmetic encoding,
10 to execute: a process of generating a predicted quantization parameter from a past reconstructed quantization parameter; a process of generating a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and a process of
15 binary arithmetic encoding a first bin indicating whether or not the delta quantization parameter is significant, a second bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization
20 parameter, in the case where the delta quantization parameter is significant.

[0024]

 A video quantization parameter decoding program according to the present invention causes a computer in a
25 video quantization parameter decoder for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, to execute: a process of generating a predicted quantization parameter from a past reconstructed
30 quantization parameter; and a process of binary arithmetic decoding a first bin indicating whether or not a delta quantization parameter is significant, a second bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute

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value of the delta quantization parameter.

[0024a]

According to another aspect of the present disclosure, there is provided a video quantization parameter encoding method for encoding a quantization parameter for a video encoding process that is based on context-based adaptive binary arithmetic encoding, the video quantization parameter encoding method comprising: generating a predicted quantization parameter from a past reconstructed quantization parameter; generating a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and binary arithmetic encoding a first bin indicating whether or not the delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, in the case where the delta quantization parameter is significant, wherein the binary arithmetic encoding is performed using no context for the sign bin, using a first context for the first bin and using a context different from the first context for the other bins.

[0024b]

A further aspect provides a video quantization parameter decoding method for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, the video quantization parameter decoding method comprising: generating a predicted quantization parameter from a past reconstructed quantization parameter; and binary arithmetic decoding a first bin indicating whether or

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not a delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, wherein the binary arithmetic

- 5 decoding is performed using no context for the sign bin, using a first context for the first bin and using a context different from the first context for the other bins.

[0024c]

- There is also provided a video quantization parameter encoder
- 10 for encoding a quantization parameter for a video encoding process that is based on context-based adaptive binary arithmetic encoding, the video quantization parameter encoder comprising: prediction means for generating a predicted quantization parameter from a past reconstructed quantization parameter; computing means for generating
- 15 a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and quantization parameter encoding means for binary arithmetic encoding a first bin indicating whether or not the delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is
- 20 positive or negative, and other bins indicating an absolute value of the delta quantization parameter, in the case where the delta quantization parameter is significant, wherein the quantization parameter encoding means performs the binary arithmetic encoding using no context for the sign bin, using a first context for the
- 25 first bin and using a context different from the first context for the other bins.

[0024d]

In accordance with a still further aspect, there is provided a video quantization parameter decoder for decoding a

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quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, the video quantization parameter decoder comprising: prediction means for generating a predicted quantization parameter from a past
5 reconstructed quantization parameter; and quantization parameter decoding means for binary arithmetic decoding a first bin indicating whether or not a delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an
10 absolute value of the delta quantization parameter, wherein the quantization parameter decoding means performs the binary arithmetic decoding using no context for the sign bin, using a first context for the first bin and using a context different from the first context for the other bins.

15 [0024e]

According to another aspect, there is provided a computer readable information recording medium storing a video quantization parameter encoding program for causing a computer in a video quantization parameter encoder for encoding a quantization
20 parameter for a video encoding process that is based on context-based adaptive binary arithmetic encoding, to execute: generating a predicted quantization parameter from a past reconstructed quantization parameter; generating a delta quantization parameter from a quantization parameter and the predicted quantization
25 parameter; and binary arithmetic encoding a first bin indicating whether or not the delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, in the case where the delta
30 quantization parameter is significant, wherein the binary arithmetic encoding is performed using no context for the sign bin,

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using a first context for the first bin and using a context different from the first context for the other bins.

[0024f]

5 A further aspect provides a computer readable information recording medium storing a video quantization parameter decoding program for causing a computer in a video quantization parameter decoder for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, to execute: generating a predicted
10 quantization parameter from a past reconstructed quantization parameter; and binary arithmetic decoding a first bin indicating whether or not a delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value
15 of the delta quantization parameter, wherein the binary arithmetic decoding is performed using no context for the sign bin, using a first context for the first bin and using a context different from the first context for the other bins.

[0024g]

20 There is also provided a video quantization parameter encoding method for encoding a quantization parameter for a video encoding process that is based on context-based adaptive binary arithmetic encoding, the video quantization parameter encoding method comprising: generating a predicted quantization parameter
25 from a past reconstructed quantization parameter; generating a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and binary-arithmetic-encoding a first bin indicating whether or not the delta quantization parameter is significant, a sign bin indicating

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whether the delta quantization parameter is positive or negative, in the case where the delta quantization parameter is significant, and other bins indicating an absolute value of the delta quantization parameter, in the case where the delta quantization parameter is significant, wherein the binary-arithmetic-encoding is performed using no context for the sign bin, using a first context for the first bin and using a context different from the first context for the other bins, and wherein the other bins are binary-arithmetic-encoded, using the same context for a predetermined bin and a bin subsequent to the predetermined bin.

[0024h]

In accordance with a still further aspect, there is provided a video quantization parameter decoding method for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, the video quantization parameter decoding method comprising: generating a predicted quantization parameter from a past reconstructed quantization parameter; and binary-arithmetic-decoding a first bin indicating whether or not a delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, wherein the binary-arithmetic-decoding is performed using no context for the sign bin, using a first context for the first bin and using a context different from the first context for the other bins, and wherein the other bins are binary-arithmetic-decoded, using the same context for a predetermined bin and a bin subsequent to the predetermined bin.

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[0024i]

According to another aspect, there is provided a video quantization parameter encoder for encoding a quantization parameter for a video encoding process that is based on context-based adaptive binary arithmetic encoding, the video quantization parameter encoder comprising: prediction means for generating a predicted quantization parameter from a past reconstructed quantization parameter; computing means for generating a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and quantization parameter encoding means for binary-arithmetic-encoding a first bin indicating whether or not the delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, in the case where the delta quantization parameter is significant, wherein quantization parameter encoding means performs the binary-arithmetic-encoding using no context for the sign bin, using a first context for the first bin and using a context different from the first context for the other bins, and wherein quantization parameter encoding means binary-arithmetic-encodes the other bins using the same context for a predetermined bin and a bin subsequent to the predetermined bin.

[0024j]

A further aspect provides a video quantization parameter decoder for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, the video quantization parameter decoder comprising: prediction means for generating a predicted quantization parameter from a past reconstructed quantization parameter; and quantization

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parameter decoding means for binary-arithmetic-decoding a first bin indicating whether or not a delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, wherein the quantization parameter decoding means performs the binary-arithmetic-decoding using no context for the sign bin, using a first context for the first bin and using a context different from the first context for the other bins, and wherein the quantization parameter decoding means binary-arithmetic-decodes the other bins using the same context for a predetermined bin and a bin subsequent to the predetermined bin.

[0024k]

There is also provided a computer readable information recording medium storing a video quantization parameter encoding program for causing a computer in a video quantization parameter encoder for encoding a quantization parameter for a video encoding process that is based on context-based adaptive binary arithmetic encoding, to execute: generating a predicted quantization parameter from a past reconstructed quantization parameter; generating a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and binary-arithmetic-encoding a first bin indicating whether or not the delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, in the case where the delta quantization parameter is significant, and other bins indicating an absolute value of the delta quantization parameter, in the case where the delta quantization parameter is significant, wherein the binary-arithmetic-encoding is performed using no context for the sign bin, using a first context for the first bin and using a context

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different from the first context for the other bins, and wherein the other bins are binary-arithmetic-encoded, using the same context for a predetermined bin and a bin subsequent to the predetermined bin.

5 [00241]

In accordance with a still further aspect, there is provided a computer readable information recording medium storing a video quantization parameter decoding program for causing a computer in a video quantization parameter decoder for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, to execute: generating a predicted quantization parameter from a past reconstructed quantization parameter; and binary-arithmetic-decoding a first bin indicating whether or not a delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, wherein the binary-arithmetic-decoding is performed using no context for the sign bin, using a first context for the first bin and using a context different from the first context for the other bins, and wherein the other bins are binary-arithmetic-decoded, using the same context for a predetermined bin and a bin subsequent to the predetermined bin.

[0024m]

25 According to another aspect, there is provided a video quantization parameter decoding method for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, the video quantization parameter decoding method comprising: binary-

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arithmetic-decoding a first bin indicating whether or not a delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter; generating a delta quantization parameter by de-binarizing the first bin, the other bins and the sign bin; and generating a re-constructed quantization parameter by adding a predicted quantization parameter to the delta quantization parameter, wherein the binary-arithmetic-decoding is performed using no context for the sign bin, using a first context for the first bin and using a second context for the other bins.

[0024n]

A further aspect provides a video quantization parameter decoder for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, the video quantization parameter decoder comprising: quantization parameter decoding means for binary-arithmetic-decoding a first bin indicating whether or not a delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter; de-binarization means for generating a delta quantization parameter by de-binarizing the first bin, the other bins and the sign bin; and adding means for generating a re-constructed quantization parameter by adding a predicted quantization parameter to the delta quantization parameter, wherein the quantization parameter decoding means performs the binary-arithmetic-decoding using no context for the sign bin, using a first context for the first bin and using a second context for the other bins.

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[0024o]

There is also provided a computer readable information recording medium storing a video quantization parameter decoding program for causing a computer in a video quantization parameter
5 decoder for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, to execute: binary-arithmetic-decoding a first bin indicating whether or not a delta quantization parameter is significant, a sign bin indicating whether the delta
10 quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter; generating a delta quantization parameter by de-binarizing the first bin, the other bins and the sign bin; and generating a reconstructed quantization parameter by adding a predicted
15 quantization parameter to the delta quantization parameter, wherein the binary-arithmetic-decoding is performed using no context for the sign bin, using a first context for the first bin and using a second context for the other bins.

Advantageous Effects of Invention

20 [0025]

According to the present invention, it is possible to suitably code a video quantization parameter for video encoding that uses context-based adaptive binary arithmetic encoding.

Brief Description of Drawings

25 [0026]

[Fig. 1] Fig. 1 is a block diagram showing a structure of a video quantization parameter encoder in Exemplary Embodiment 1.

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[Fig. 2] Fig. 2 is a flowchart showing operations of the video quantization parameter encoder in Exemplary Embodiment 1.

[Fig. 3] Fig. 3 is an explanatory diagram showing an example of a correspondence table between a DQP and a bin string.

5 [Fig. 4] Fig. 4 is a block diagram showing a structure of a video quantization parameter decoder in Exemplary Embodiment 2.

[Fig. 5] Fig. 5 is a flowchart showing operations of the video quantization parameter decoder in Exemplary Embodiment 2.

10 [Fig. 6] Fig. 6 is a block diagram showing a structure of a video quantization parameter encoder in Exemplary Embodiment 3.

[Fig. 7] Fig. 7 is a block diagram showing a structure of a video quantization parameter decoder in Exemplary Embodiment 3.

[Fig. 8] Fig. 8 is a flowchart showing operations of the video quantization parameter decoder in Exemplary

Embodiment 3.

[Fig. 9] Fig. 9 is a block diagram showing a structure of a video quantization parameter encoder in Exemplary Embodiment 4.

5 [Fig. 10] Fig. 10 is a block diagram showing a structure of a video quantization parameter decoder in Exemplary Embodiment 4.

[Fig. 11] Fig. 11 is an explanatory diagram showing another example of the correspondence table between the DQP
10 and the bin string.

[Fig. 12] Fig. 12 is a block diagram showing an example of a structure of an information processing system capable of realizing functions of a video quantization parameter encoder and a video quantization parameter decoder
15 according to the present invention.

[Fig. 13] Fig. 13 is a block diagram showing characteristic components in a video quantization parameter encoder according to the present invention.

[Fig. 14] Fig. 14 is a block diagram showing
20 characteristic components in a video quantization parameter decoder according to the present invention.

[Fig. 15] Fig. 15 is a block diagram showing a structure of a typical video quantization parameter encoder.

[Fig. 16] Fig. 16 is an explanatory diagram showing a
25 typical example of the correspondence table between the DQP and the bin string.

Description of Embodiments

[0027]

30 The following describes exemplary embodiments of the present invention with reference to drawings.

[0028]

Exemplary Embodiment 1

Fig. 1 is a block diagram showing a structure of a

video quantization parameter encoder in Exemplary Embodiment 1 of the present invention. The video quantization parameter encoder shown in Fig. 1 includes a predictor 101, a buffer 102, a binarizer 1031, an adaptive
 5 binary arithmetic encoder 104, a binary arithmetic encoder 105, a switch (SW) 111, and a switch (SW) 112.

[0029]

A predicted quantization parameter PQP supplied from the predictor 101 is subtracted from a quantization
 10 parameter QP input to the video quantization parameter encoder.

[0030]

The PQP is added to a delta quantization parameter DQP ($DQP = QP - PQP$) and the sum is stored in the buffer
 15 102 as a reconstructed quantization parameter RQP ($RQP = DQP + PQP$), for subsequent quantization parameter encoding.

[0031]

The binarizer 1031 which is a feature of the present invention binarizes the input DQP in a manner that
 20 information indicating whether or not the DQP is significant is associated with the first bin (bin(1)), information indicating whether the significant DQP is positive or negative is associated with the second bin (bin(2)), and information indicating the absolute value of
 25 the DQP is associated with the third and subsequent bins (bin(n): $n = 3, 4, \dots$). This is formulated as follows.

[0032]

bin(1) = func1(DQP) ...

(1)

30 bin(2) = func2(DQP) ...

(2)

bin(n) = func3($n - 2, |DQP|$) ...

(3).

[0033]

Here, $\text{func1}(a)$ is a function that returns 0 if a is 0 and returns 1 if a is not 0, $\text{func2}(a)$ is a function that returns 0 if a is positive and returns 1 if a is not positive, and $\text{func3}(a, b)$ is a function that returns 1 if a is less than b and returns 0 otherwise. Note that $\text{bin}(n)$ ($n = 2, 3, \dots$) is coded only in the case where the DQP has a significant value (i.e. in the case where $\text{func1}(\text{DQP})$ is 1).
[0034]

The adaptive binary arithmetic encoder 104 binary arithmetic codes each bin ($\text{bin}(n): n = 1, 3, 4, \dots$), other than the second bin, of the bin string supplied via the switch 111 using the context associated with the context index corresponding to the bin, and outputs the coded data via the switch 112. The adaptive binary arithmetic encoder 104 also updates the context associated with the context index according to the value of the binary arithmetic coded bin, for subsequent binary arithmetic encoding.
[0035]

The binary arithmetic encoder 105 binary arithmetic codes, with equal probability, the second bin of the bin string supplied via the switch 111, and outputs the coded data via the switch 112.
[0036]

This completes the description of the structure of the video quantization parameter encoder in this exemplary embodiment.
[0037]

The following describes operations of the binarizer 1031, the adaptive binary arithmetic encoder 104, and the binary arithmetic encoder 105 which are features of the video quantization parameter encoder in this exemplary embodiment, using a flowchart in Fig. 2.
[0038]

The adaptive binary arithmetic encoder 104 starts

the process, with an initial value parameter n being set to 3.

[0039]

5 In step S101, the binarizer 1031 binarizes the DQP in a manner that the information indicating whether or not the DQP is significant is associated with the first bin, the information indicating whether or not the significant DQP is positive is associated with the second bin, and the information indicating the absolute value of the DQP is
10 associated with the third and subsequent bins.

[0040]

In step S102, the adaptive binary arithmetic encoder 104 adaptive binary arithmetic codes bin(1).

[0041]

15 In step S103, the binary arithmetic encoder 105 determines whether or not the DQP is significant. In the case where the DQP is significant, the binary arithmetic encoder 105 proceeds to step S104. Otherwise, the binary arithmetic encoder 105 ends the process. In step S104, the
20 binary arithmetic encoder 105 binary arithmetic codes bin(2). In step S105, the adaptive binary arithmetic encoder 104 adaptive binary arithmetic codes bin(n).

[0042]

In step S106, the adaptive binary arithmetic encoder
25 104 determines whether or not all bins of the bin string have been coded. In the case where all bins have been coded, the adaptive binary arithmetic encoder 104 ends the process. Otherwise, the adaptive binary arithmetic encoder 104 increments n and proceeds to step S105, to adaptive
30 binary arithmetic code the subsequent bin(n).

[0043]

This completes the description of the operations of the binarizer 1031, the adaptive binary arithmetic encoder 104, and the binary arithmetic encoder 105 which are

features of the video quantization parameter encoder in this exemplary embodiment.

[0044]

Fig. 3 is an explanatory diagram showing an example of a correspondence table between the DQP (rightmost column) and the bin string (center column) according to the present invention.

[0045]

In Fig. 3, X in the second column of the bin string denotes 1-bit information indicating whether or not the DQP is positive, i.e. whether the DQP is positive or negative. Suppose $X = 0$ denotes positive and $X = 1$ denotes negative. For example, the bin string of $DQP = 1$ is 100, and the bin string of $DQP = -1$ is 110. Meanwhile, na in the context index row denotes that no context is used (i.e. the most probable symbol and its probability are fixed).

[0046]

The binarization process according to the present invention resolves the three factors causing the problem mentioned above, as follows.

[0047]

The first factor is resolved by binary arithmetic encoding the second bin and the subsequent bins using appropriate contexts. In Fig. 3, the second bin indicates only the information of whether the DQP is positive or negative, that is, information of which one of two states holds true. Likewise, the third bin indicates only the information of whether or not the absolute value of the DQP is greater than 1, that is, information of which one of two states holds true. Thus, the second bin and the third bin are binary arithmetic coded using appropriate contexts. The fourth and subsequent bins can be equally designed to indicate only the information of whether or not the absolute value of the DQP is greater than a given value,

that is, information of which one of two states holds true, by adding context indexes according to columns.

[0048]

The second factor is resolved because, given that
5 the decoder is able to identify whether the DQP is positive or negative from the value of the second bin, the encoder can efficiently reduce redundant bins even when the DQP range is asymmetric between positive and negative. In detail, in Fig. 3, in the case of encoding DQP = -26, the
10 redundant 28th bin does not need to be coded because the decoder is able to identify DQP = -26 when the 27th bin is 1 on the ground that the minimum value of the DQP is -26. Moreover, in the case of encoding DQP = 25, the redundant 27th bin does not need to be coded because the decoder is
15 able to identify DQP = 25 when the 26th bin is 1 on the ground that the maximum value of the DQP is 25.

[0049]

The third factor is resolved because the number of bins included in the bin string in this exemplary
20 embodiment is the same as the number of bins in the case of separately binarizing the information of whether the significant DQP is positive or negative and the absolute value of the significant DQP, as is clear from the comparison between the correspondence table shown in Fig.
25 16 and the correspondence table shown in Fig. 3.

[0050]

Exemplary Embodiment 2

Fig. 4 is a block diagram showing a structure of a video quantization parameter decoder corresponding to the
30 video quantization parameter encoder in Exemplary Embodiment 1. The video quantization parameter decoder shown in Fig. 4 includes a predictor 201, a buffer 202, a de-binarizer 2031, an adaptive binary arithmetic decoder 204, a binary arithmetic decoder 205, a switch (SW) 211,

and a switch (SW) 212.

[0051]

The adaptive binary arithmetic decoder 204 binary arithmetic decodes bin(1) from the coded data supplied via the switch 212, and supplies the decoded data to the de-binarizer 2031 via the switch 211. The adaptive binary arithmetic decoder 204 also updates the context associated with the context index corresponding to the first bin according to the value of the binary arithmetic decoded bin, for subsequent binary arithmetic decoding.

[0052]

In the case where bin(1) is 1, the binary arithmetic decoder 205 binary arithmetic decodes bin(2) from the coded data supplied via the switch 212, and supplies the decoded data to the de-binarizer 2031 via the switch 211.

[0053]

In the case where bin(1) is 1, the adaptive binary arithmetic decoder 204 further binary arithmetic decodes bin(n) ($n = 3, 4, \dots$) from the coded data supplied via the switch 212 until a bin whose value is 0 is decoded, and supplies the decoded data to the de-binarizer 2031 via the switch SW 211. The adaptive binary arithmetic decoder 204 updates the context associated with the context index corresponding to the nth bin according to the value of the binary arithmetic decoded bin, for subsequent binary arithmetic decoding.

[0054]

The de-binarizer 2031 outputs the DQP whose value is 0, in the case where the bin string is 0 ($n = 1$). Otherwise ($n \geq 3$), the de-binarizer 2031 outputs the DQP whose value is obtained by the following equation.

[0055]

$$\begin{aligned} \text{DQP} &= (1 - 2 * \text{bin}(2)) * (n - 2) \\ &\dots (4). \end{aligned}$$

Here, "*" in equation (4) denotes multiplication.

[0056]

The PQP supplied from the predictor 201 is added to the DQP supplied from the de-binarizer 2031, to obtain the
5 RQP.

[0057]

The RQP is also stored in the buffer 202 for subsequent quantization parameter decoding.

[0058]

10 This completes the description of the structure of the video quantization parameter decoder in this exemplary embodiment.

[0059]

The following describes operations of the de-
15 binarizer 2031, the adaptive binary arithmetic decoder 204, and the binary arithmetic decoder 205 which are features of the video quantization parameter decoder in this exemplary embodiment, using a flowchart in Fig. 5.

[0060]

20 The adaptive binary arithmetic decoder 204 starts the process, with an initial value parameter n being set to 3.

[0061]

In step S201, the adaptive binary arithmetic decoder
25 204 adaptive binary arithmetic decodes bin(1).

[0062]

In step S202, the binary arithmetic decoder 205 determines whether or not the value of bin(1) is 1. In this example, "1" indicates that the DQP is significant.
30 In the case where the value of bin(1) is 1, the binary arithmetic decoder 205 proceeds to step S203. Otherwise, the binary arithmetic decoder 205 proceeds to step S206.

[0063]

In step S203, the binary arithmetic decoder 205

binary arithmetic decodes bin(2). In step S204, the adaptive binary arithmetic decoder 204 adaptive binary arithmetic decodes bin(n).

[0064]

5 In step S205, the adaptive binary arithmetic decoder 204 determines whether or not all bins have been decoded, i.e. whether or not the value of bin(n) is 0. In the case where all bins have been decoded, the adaptive binary arithmetic decoder 204 proceeds to step S206. Otherwise,
10 the adaptive binary arithmetic decoder 204 increments n and proceeds to step S204, to adaptive binary arithmetic decode the subsequent bin(n).

[0065]

In step S206, the de-binarizer 2031 de-binarizes the
15 decoded bin string to determine the DQP.

[0066]

This completes the description of the operations of the de-binarizer 2031, the adaptive binary arithmetic decoder 204, and the binary arithmetic decoder 205 which
20 are features of the video quantization parameter decoder in this exemplary embodiment.

[0067]

Exemplary Embodiment 3

Exemplary Embodiments 1 and 2 describe the video
25 quantization parameter encoder and the video quantization parameter decoder that have no constraint on the DQP range. In the case where there is a constraint on the DQP range, it is possible to reduce redundant bins of the DQP using the DQP range. Figs. 6 and 7 are block diagrams showing
30 structures of a video quantization parameter encoder and a video quantization parameter decoder as an improvement on Exemplary Embodiments 1 and 2 to use the DQP range (combination of minimum DQP and maximum DQP).

[0068]

A binarizer 1032 in Fig. 6 uses the combination of the minimum DQP ($\text{minDQP} \leq 0$) and the maximum DQP ($\text{maxDQP} \geq 0$). The binarizer 1032 computes the first bin, the second bin, and a maximum number cMax of the third and subsequent
 5 bins of the DQP by the following equations.

[0069]

$$\text{bin}(1) = \text{func1}(\text{DQP}) \quad \dots$$

(5)

$$\text{bin}(2) = \text{func2}(\text{DQP}) \quad \dots$$

10 (6)

$$\text{cMax} = \max(0, \text{func4}(\text{minDQP}, \text{maxDQP}, \text{DQP}) - 1) \\ \dots (7).$$

Here, $\text{func4}(a, b, c)$ is a function that returns $-a$ if c is negative and returns b if c is positive. Note that
 15 $\text{bin}(n)$ ($n = 2, 3, \dots$) is coded only in the case where the DQP has a significant value (i.e. in the case where $\text{func1}(\text{DQP})$ is 1).

[0070]

When $\text{cMax} \geq 1$, the binarizer 1032 computes $\text{bin}(n)$ (n
 20 $= 3, \dots, 2 + \text{cMax}$) by the following equation.

[0071]

$$\text{bin}(n) = \text{func5}(n - 2, \text{cMax}, |\text{DQP}|) \quad \dots$$

(8).

[0072]

25 Here, $\text{func5}(a, b, c)$ is a function that returns 1 if b and c are equal, returns 1 if c is less than b and also a is less than c , and returns 0 otherwise (if c is less than b and also a and c are equal). The third and subsequent bins (with syntax element value $|\text{DQP}|$) obtained by equation
 30 (8) are the same as the bins of the bin string obtained by the truncated unary (TU) binarization process described in 9.3.2.2 in NPL 1.

[0073]

In the video quantization parameter decoder shown in

Fig. 7 corresponding to the video quantization parameter encoder shown in Fig. 6, a de-binarizer 2032 computes cMax based on minDQP, maxDQP, and binary arithmetic decoded bin(2), by the following equation.

5 [0074]

$$cMax = \max(0, \text{func6}(\text{minDQP}, \text{maxDQP}, \text{bin}(2)) - 1) \dots (9).$$

Here, func6(a, b, c) is a function that returns -a if c is 1 (i.e. if the value of the decoded DQP is negative according to the definition of func2(a)), and returns b if c is 0 (i.e. if the value of the decoded DQP is positive according to the definition of func2(a)).

[0075]

The de-binarizer 2032 further determines the DQP.

15 In detail, in the case where $cMax \geq 1$ and the value of the last decoded bin is 1, the de-binarizer 2032 uses the following equation (10).

[0076]

$$DQP = (1 - 2 * \text{bin}(2)) * (n - 1) \dots (10).$$

[0077]

In the case where $cMax = 0$ and $\text{bin}(1) = 1$, the de-binarizer 2032 uses the following equation (11).

[0078]

$$25 \quad DQP = (1 - 2 * \text{bin}(2)) \dots (11).$$

[0079]

Otherwise, the de-binarizer 2032 uses equation (4).

[0080]

30 As is clear from equations (10) and (11), the de-binarizer 2032 determines the DQP by estimating the value of any redundant bin reduced in the video encoding process, based on the maximum number cMax of the third and subsequent bins determined by the DQP range and bin(2) (the

positive or negative sign of the DQP).

[0081]

The following describes operations of the de-binarizer 2032, the adaptive binary arithmetic decoder 204,
5 and the binary arithmetic decoder 205 in the video quantization parameter decoder in Fig. 7, using a flowchart in Fig. 8.

[0082]

The adaptive binary arithmetic decoder 204 starts
10 the process, with an initial value parameter n being set to 3.

[0083]

In step S301, the adaptive binary arithmetic decoder 204 adaptive binary arithmetic decodes bin(1).

15 [0084]

In step S302, the binary arithmetic decoder 205 determines whether or not the value of bin(1) is 1. In the case where the value of bin(1) is 1, the binary arithmetic decoder 205 proceeds to step S303. Otherwise, the binary
20 arithmetic decoder 205 proceeds to step S308.

[0085]

In step S303, the binary arithmetic decoder 205 binary arithmetic decodes bin(2).

[0086]

25 In step S304, the de-binarizer 2032 computes cMax. In step S305, the de-binarizer 2032 determines whether or not cMax is greater than or equal to 1. In the case where cMax is greater than or equal to 1, the de-binarizer 2032 proceeds to step S306. Otherwise, the de-binarizer 2032
30 proceeds to step S308.

[0087]

In step S306, the adaptive binary arithmetic decoder 204 adaptive binary arithmetic decodes bin(n).

[0088]

In step S307, the adaptive binary arithmetic decoder 204 determines whether or not all bins have been decoded. All bins have been decoded if a condition that the value of $\text{bin}(n)$ is 0, a condition that the value of $n - 2$ is equal to $c\text{Max}$, or both of these conditions are met. In the case where all bins have been decoded, the adaptive binary arithmetic decoder 204 proceeds to step S308. Otherwise, the adaptive binary arithmetic decoder 204 increments n and proceeds to step S306, to adaptive binary arithmetic decode the subsequent $\text{bin}(n)$.
[0089]

In step S308, the de-binarizer 2032 de-binarizes the decoded bin string to determine the DQP.
[0090]

This completes the description of the operations of the de-binarizer 2032, the adaptive binary arithmetic decoder 204, and the binary arithmetic decoder 205 in the video quantization parameter decoder shown in Fig. 7.
[0091]

Fig. 3 also shows an example of reducing redundant bins of the DQP in the video quantization parameter encoder shown in Fig. 6 where $\text{minDQP} = -26$ and $\text{maxDQP} = 25$. Regarding the bin string of $\text{DQP} = -26$, it is clear that the redundant 28th bin is not coded because the decoder is able to identify $\text{DQP} = -26$ when the 27th bin is 1. That is, the video quantization parameter encoder in this exemplary embodiment described above can reduce, through the use of the DQP range and the coded second bin (the positive or negative sign of the DQP), any redundant bin among the bins of the DQP that are coded after the positive or negative sign of the DQP, even in the case where the range of the absolute value of the DQP is different between positive and negative. Likewise, the video quantization parameter decoder in this exemplary embodiment described above can

determine the DQP by estimating, through the use of the DQP range and the coded positive or negative sign of the DQP, the value of any redundant bin reduced in the video quantization parameter encoding process among the bins of the DQP that are decoded after the positive or negative sign of the DQP, even in the case where the range of the absolute value of the DQP is different between positive and negative.

[0092]

In the above-mentioned video quantization parameter encoder shown in Fig. 6 and video quantization parameter decoder shown in Fig. 7, minDQP and maxDQP may be generated from the range of the quantization parameter (combination of minimum QP and maximum QP) and the predicted quantization parameter PQP.

[0093]

Exemplary Embodiment 4

Figs. 9 and 10 are block diagrams showing structures of a video quantization parameter encoder and a video quantization parameter decoder as an improvement to generate minDQP and maxDQP based on the combination of the minimum QP (minQP) and the maximum QP (maxQP) and the PQP.

[0094]

The video quantization parameter encoder shown in Fig. 9 further includes a range determiner 106, and the video quantization parameter decoder shown in Fig. 10 further includes a range determiner 206, as is clear from the comparison with Figs. 6 and 7. The range determiners 106 and 206 each compute minDQP and maxDQP by the following equations.

[0095]

$$\text{minDQP} = \text{minQP} - \text{PQP} \quad \dots (12)$$

$$\text{maxDQP} = \text{maxQP} - \text{PQP} \quad \dots (13).$$

[0096]

The inclusion of the range determiners 106 and 206 enables more effective reduction of redundant bins when the QP to be coded is closer in value to minQP or maxQP.

[0097]

5 In a video quantization parameter encoder and a video quantization parameter decoder where minDQP = -26 and maxDQP = 25, equations (12) and (13) may be replaced with the following equations (12)' and (13)'.

[0098]

10 $\text{minDQP} = \max(-26, \text{minQP} - \text{PQP}) \quad \dots$

(12)'

$\text{maxDQP} = \min(25, \text{maxQP} - \text{PQP}) \quad \dots$

(13)'.

[0099]

15 The above-mentioned video quantization parameter encoder and video quantization parameter decoder according to the present invention may operate based on a correspondence table in which the value of the context index is fixed for bins from a predetermined column onward
20 as shown in Fig. 11, instead of using the example shown in Fig. 3.

[0100]

In the correspondence table shown in Fig. 11, the value of the context index is fixed to 3 for the bins in
25 the fourth and subsequent columns. In Fig. 11, the first bin indicates only the information of whether or not the DQP is significant, that is, information of which one of two states holds true. The second bin indicates only the information of whether the DQP is positive or negative,
30 that is, information of which one of two states holds true. The third bin indicates only the information of whether or not the absolute value of the DQP is greater than 1, that is, information of which one of two states holds true. The fourth and subsequent bins indicate only the information of

whether or not the bin string terminates, that is,
information of which one of two states holds true.
[0101]

Thus, the video quantization parameter encoder
5 according to the present invention may binary arithmetic
code the first bin indicating whether or not the DQP is
significant, the second bin indicating whether the DQP is
positive or negative, the third bin indicating whether or
not the absolute value of the DQP is greater than 1, and
10 the bin indicating whether or not the bin string terminates.
[0102]

As described above, according to the present
invention, a video quantization parameter for video
encoding that uses context-based adaptive binary arithmetic
15 encoding can be suitably coded by providing means for
performing binarization in a manner that the information
indicating whether or not the delta quantization parameter
is significant is associated with the first bin, the
information indicating whether the significant delta
20 quantization parameter is positive or negative is
associated with the second bin, and the information
indicating the absolute value of the significant delta
quantization parameter is associated with the third and
subsequent bins.
25 [0103]

According to the present invention, the above-
mentioned suitable encoding is achieved by three features:
assigning an appropriate context to each bin of the delta
quantization parameter; reducing redundant bins of the
30 delta quantization parameter; and reducing the number of
bins included in the bin string of the delta quantization
parameter.
[0104]

Each of the exemplary embodiments described above

may be realized not only by hardware but also by a computer program.

[0105]

An information processing system shown in Fig. 12
5 includes a processor 1001, a program memory 1002, a storage medium 1003 for storing video data, and a storage medium 1004 for storing a bitstream. The storage medium 1003 and the storage medium 1004 may be separate storage media, or storage areas included in the same storage medium. As a
10 storage medium, a magnetic storage medium such as a hard disk is available.

[0106]

In the information processing system shown in Fig. 12, a program for realizing the functions of the blocks
15 (except the block of the buffer) shown in each of Figs. 1, 4, 6, 7, 9, and 10 is stored in the program memory 1002. The processor 1001 realizes the functions of the video quantization parameter encoder or the video quantization parameter decoder shown in each of Figs. 1, 4, 6, 7, 9, and
20 10, by executing processes according to the program stored in the program memory 1002.

[0107]

Fig. 13 is a block diagram showing characteristic components in a video quantization parameter encoder
25 according to the present invention. As shown in Fig. 13, the video quantization parameter encoder according to the present invention includes: a prediction unit 11 for generating a predicted quantization parameter from a past reconstructed quantization parameter; a computing unit 12
30 for generating a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and quantization parameter encoding unit 13 for binary arithmetic encoding a first bin indicating whether or not the delta quantization parameter is significant, a

second bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, in the case where the delta quantization parameter is significant.

[0108]

Fig. 14 is a block diagram showing characteristic components in a video quantization parameter decoder according to the present invention. As shown in Fig. 14, the video quantization parameter decoder according to the present invention includes: a prediction unit 21 for generating a predicted quantization parameter from a past reconstructed quantization parameter; and quantization parameter decoding unit 22 for binary arithmetic decoding a first bin indicating whether or not a delta quantization parameter is significant, a second bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter.

[0109]

The exemplary embodiments described above may be partly or wholly described in the following supplementary notes, though the present invention is not limited to the following structures.

[0110]

(Supplementary note 1) A video quantization parameter encoding method including: generating a predicted quantization parameter from a past reconstructed quantization parameter; generating a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and binary arithmetic encoding a first bin indicating whether or not the delta quantization parameter is significant, a second bin indicating whether the delta quantization parameter is positive or negative,

and other bins indicating an absolute value of the delta quantization parameter, in the case where the delta quantization parameter is significant, wherein the video quantization parameter encoding method includes a step of
5 reducing a redundant bin of the other bins using a range of the delta quantization parameter.

[0111]

(Supplementary note 2) The video quantization parameter encoding method according to supplementary note 1,
10 including a step of setting the range to a range defined in a standard or the like.

[0112]

(Supplementary note 3) The video quantization parameter encoding method according to supplementary note 2,
15 including a step of generating the range from a range of the reconstructed quantization parameter and a value of the predicted quantization parameter.

[0113]

(Supplementary note 4) A video quantization parameter
20 decoding method including: generating a predicted quantization parameter from a past reconstructed quantization parameter; and binary arithmetic decoding a first bin indicating whether or not a delta quantization parameter is significant, a second bin indicating whether
25 the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, wherein the video quantization parameter decoding method includes a step of estimating a redundant bin of the other bins reduced in a video encoding
30 process, using a range of the delta quantization parameter.

[0114]

(Supplementary note 5) The video quantization parameter decoding method according to supplementary note 4, including a step of setting the range to a range defined in

a standard or the like.

[0115]

(Supplementary note 6) The video quantization parameter decoding method according to supplementary note 5,

5 including a step of generating the range from a range of the reconstructed quantization parameter and a value of the predicted quantization parameter.

[0116]

(Supplementary note 7) A video quantization parameter

10 encoder including: prediction means for generating a predicted quantization parameter from a past reconstructed quantization parameter; computing means for generating a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and quantization
15 parameter encoding means for binary arithmetic encoding a first bin indicating whether or not the delta quantization parameter is significant, a second bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta
20 quantization parameter, in the case where the delta quantization parameter is significant, wherein the video quantization parameter encoder includes reduction means for reducing a redundant bin of the other bins using a range of the delta quantization parameter.

25 [0117]

(Supplementary note 8) The video quantization parameter encoder according to supplementary note 7, wherein the reduction means sets the range to a range defined in a standard or the like.

30 [0118]

(Supplementary note 9) The video quantization parameter encoder according to supplementary note 8, wherein the reduction means generates the range from a range of the reconstructed quantization parameter and a value of the

predicted quantization parameter.

[0119]

(Supplementary note 10) A video quantization parameter decoder including: prediction means for generating a
5 predicted quantization parameter from a past reconstructed quantization parameter; and quantization parameter decoding means for binary arithmetic decoding a first bin indicating whether or not a delta quantization parameter is
10 significant, a second bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, wherein the video quantization parameter decoder includes estimation means for estimating a redundant bin of the other bins reduced in a video encoding process, using a
15 range of the delta quantization parameter.

[0120]

(Supplementary note 11) The video quantization parameter decoder according to supplementary note 10, wherein the reduction means sets the range to a range defined in a
20 standard or the like.

[0121]

(Supplementary note 12) The video quantization parameter decoder according to supplementary note 11, wherein the reduction means generates the range from a range of the
25 reconstructed quantization parameter and a value of the predicted quantization parameter.

[0122]

(Supplementary note 13) A video quantization parameter encoding method including: generating a predicted
30 quantization parameter from a past reconstructed quantization parameter; generating a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and binary arithmetic encoding a first bin indicating whether or not the delta quantization

parameter is significant, a bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, in the case where the delta quantization parameter is significant, wherein the video quantization parameter encoding method includes a step of reducing a redundant bin of the other bins using information of whether the delta quantization parameter is positive or negative and a range of the delta quantization parameter.

[0123]

(Supplementary note 14) The video quantization parameter encoding method according to supplementary note 13, including a step of performing the binary arithmetic encoding using different contexts for the first bin and the bin indicating whether the delta quantization parameter is positive or negative.

[0124]

(Supplementary note 15) The video quantization parameter encoding method according to supplementary note 13, including a step of setting the range to a range defined in a standard or the like.

[0125]

(Supplementary note 16) A video quantization parameter decoding method including: generating a predicted quantization parameter from a past reconstructed quantization parameter; and binary arithmetic decoding a first bin indicating whether or not a delta quantization parameter is significant, a bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, wherein the video quantization parameter decoding method includes a step of estimating a redundant bin of the other bins reduced in a video encoding

process, using information of whether the delta quantization parameter is positive or negative and a range of the delta quantization parameter, the information being obtained by decoding the bin indicating whether the delta quantization parameter is positive or negative.

[0126]

(Supplementary note 17) The video quantization parameter decoding method according to supplementary note 16, including a step of performing the binary arithmetic decoding using different contexts for the first bin and the bin indicating whether the delta quantization parameter is positive or negative.

[0127]

(Supplementary note 18) The video quantization parameter decoding method according to supplementary note 16, including a step of setting the range to a range defined in a standard or the like.

[0128]

(Supplementary note 19) A video quantization parameter encoder including: prediction means for generating a predicted quantization parameter from a past reconstructed quantization parameter; computing means for generating a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and quantization parameter encoding means for binary arithmetic encoding a first bin indicating whether or not the delta quantization parameter is significant, a bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, in the case where the delta quantization parameter is significant, wherein the video quantization parameter encoder includes reduction means for reducing a redundant bin of the other bins using information of whether the delta quantization parameter is

positive or negative and a range of the delta quantization parameter.

[0129]

(Supplementary note 20) The video quantization parameter encoder according to supplementary note 19, wherein the

[0130]

(Supplementary note 21) The video quantization parameter encoder according to supplementary note 19, wherein the reduction means sets the range to a range defined in a standard or the like.

[0131]

(Supplementary note 22) A video quantization parameter decoder including: prediction means for generating a predicted quantization parameter from a past reconstructed quantization parameter; and quantization parameter decoding means for binary arithmetic decoding a first bin indicating whether or not a delta quantization parameter is significant, a bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, wherein the video quantization parameter decoder includes estimation means for estimating a redundant bin of the other bins reduced in a video encoding process, using information of whether the delta quantization parameter is positive or negative and a range of the delta quantization parameter, the information being obtained by decoding the bin indicating whether the delta quantization parameter is positive or negative.

[0132]

(Supplementary note 23) The video quantization parameter decoder according to supplementary note 22, wherein the

binary arithmetic decoding is performed using different contexts for the first bin and the bin indicating whether the delta quantization parameter is positive or negative.

[0133]

- 5 (Supplementary note 24) The video quantization parameter decoder according to supplementary note 22, wherein the reduction means sets the range to a range defined in a standard or the like.

[0134]

- 10 Though the present invention has been described with reference to the above exemplary embodiments and examples, the present invention is not limited to the above exemplary embodiments and examples. Various changes understandable by those skilled in the art can be made to the structures
15 and details of the present invention within the scope of the present invention.

[0135]

This application claims priority based on Japanese Patent Application No. 2011-142453 filed on June 28, 2011.

20

Reference Signs List

[0136]

- 25 11 prediction unit
 12 computing unit
 13 quantization parameter encoding unit
 21 prediction unit
 22 quantization parameter decoding unit
30 101 predictor
 102 buffer
 1031, 1032 binarizer
 104 adaptive binary arithmetic encoder
 105 binary arithmetic encoder

106 range determiner
111 switch
112 switch
201 predictor
5 202 buffer
2031, 2032 de-binarizer
204 adaptive binary arithmetic decoder
205 binary arithmetic decoder
206 range determiner
10 211 switch
212 switch

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CLAIMS:

1. A video quantization parameter encoding method for encoding a quantization parameter for a video encoding process that is based on context-based adaptive binary arithmetic
5 encoding, the video quantization parameter encoding method comprising:

generating a predicted quantization parameter from a past reconstructed quantization parameter;

10 generating a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and

binary arithmetic encoding a first bin indicating whether or not the delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter
15 is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, in the case where the delta quantization parameter is significant,

wherein the binary arithmetic encoding is performed using no context for the sign bin, using a first context for
20 the first bin and using a context different from the first context for the other bins.

2. A video quantization parameter decoding method for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic
25 encoding, the video quantization parameter decoding method comprising:

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generating a predicted quantization parameter from a past reconstructed quantization parameter; and

binary arithmetic decoding a first bin indicating whether or not a delta quantization parameter is significant, a
5 sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter,

wherein the binary arithmetic decoding is performed using no context for the sign bin, using a first context for
10 the first bin and using a context different from the first context for the other bins.

3. A video quantization parameter encoder for encoding a quantization parameter for a video encoding process that is based on context-based adaptive binary arithmetic encoding, the
15 video quantization parameter encoder comprising:

prediction means for generating a predicted quantization parameter from a past reconstructed quantization parameter;

computing means for generating a delta quantization
20 parameter from a quantization parameter and the predicted quantization parameter; and

quantization parameter encoding means for binary arithmetic encoding a first bin indicating whether or not the delta quantization parameter is significant, a sign bin
25 indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the

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delta quantization parameter, in the case where the delta quantization parameter is significant,

wherein the quantization parameter encoding means performs the binary arithmetic encoding using no context for the sign bin, using a first context for the first bin and using a context different from the first context for the other bins.

4. A video quantization parameter decoder for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, the video quantization parameter decoder comprising:

prediction means for generating a predicted quantization parameter from a past reconstructed quantization parameter; and

quantization parameter decoding means for binary arithmetic decoding a first bin indicating whether or not a delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter,

20 wherein the quantization parameter decoding means performs the binary arithmetic decoding using no context for the sign bin, using a first context for the first bin and using a context different from the first context for the other bins.

5. A computer readable information recording medium storing a video quantization parameter encoding program for causing a computer in a video quantization parameter encoder for encoding a quantization parameter for a video encoding

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process that is based on context-based adaptive binary arithmetic encoding, to execute:

generating a predicted quantization parameter from a past reconstructed quantization parameter;

5 generating a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and

 binary arithmetic encoding a first bin indicating whether or not the delta quantization parameter is significant,
10 a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter, in the case where the delta quantization parameter is significant,

 wherein the binary arithmetic encoding is performed
15 using no context for the sign bin, using a first context for the first bin and using a context different from the first context for the other bins.

6. A computer readable information recording medium storing a video quantization parameter decoding program for
20 causing a computer in a video quantization parameter decoder for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, to execute:

 generating a predicted quantization parameter from a
25 past reconstructed quantization parameter; and

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binary arithmetic decoding a first bin indicating whether or not a delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter,

wherein the binary arithmetic decoding is performed using no context for the sign bin, using a first context for the first bin and using a context different from the first context for the other bins.

7. A video quantization parameter encoding method for encoding a quantization parameter for a video encoding process that is based on context-based adaptive binary arithmetic encoding, the video quantization parameter encoding method comprising:

generating a predicted quantization parameter from a past reconstructed quantization parameter;

generating a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and

binary-arithmetic-encoding a first bin indicating whether or not the delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, in the case where the delta quantization parameter is significant, and other bins indicating an absolute value of the delta quantization parameter, in the case where the delta quantization parameter is significant,

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wherein the binary-arithmetic-encoding is performed using no context for the sign bin, using a first context for the first bin and using a context different from the first context for the other bins, and

5 wherein the other bins are binary-arithmetic-encoded, using the same context for a predetermined bin and a bin subsequent to the predetermined bin.

8. The video quantization parameter encoding method according to claim 7,

10 wherein when the binary-arithmetic-encoding is performed, updating context variables comprising a most probable symbol and a probability of the most probable symbol according to a corresponding bin.

9. The video quantization parameter encoding method
15 according to claim 8,

wherein in the case where the delta quantization parameter is not significant, a value of the first bin is set to zero, and in the case where the delta quantization parameter is significant, the value of the first bin is set to one.

20 10. The video quantization parameter encoding method according to claim 9,

wherein in the case where the delta quantization parameter comprises a positive value, a value of the sign bin is set to zero, in the case where the delta quantization
25 parameter comprises a negative value, the value of the sign bin is set to one.

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11. A video quantization parameter decoding method for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, the video quantization parameter decoding method
5 comprising:

generating a predicted quantization parameter from a past reconstructed quantization parameter; and

binary-arithmetic-decoding a first bin indicating whether or not a delta quantization parameter is significant, a
10 sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter,

wherein the binary-arithmetic-decoding is performed using no context for the sign bin, using a first context for
15 the first bin and using a context different from the first context for the other bins, and

wherein the other bins are binary-arithmetic-decoded, using the same context for a predetermined bin and a bin subsequent to the predetermined bin.

20 12. The video quantization parameter decoding method according to claim 11,

wherein when the binary-arithmetic-decoding is performed, updating context variables comprising a most probable symbol and a probability of the most probable symbol
25 according to a corresponding bin.

13. The video quantization parameter decoding method

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according to claim 12,

wherein in the case where a value of the first bin is zero, the delta quantization parameter is not significant, and in the case where the value of the first bin is one, the delta
5 quantization parameter is significant.

14. The video quantization parameter decoding method according to claim 13,

wherein in the case where a value of the sign bin is zero, the delta quantization parameter comprises a positive
10 value, and in the case where the value of the sign bin is one, the delta quantization parameter comprises a negative value.

15. A video quantization parameter encoder for encoding a quantization parameter for a video encoding process that is based on context-based adaptive binary arithmetic encoding, the
15 video quantization parameter encoder comprising:

prediction means for generating a predicted quantization parameter from a past reconstructed quantization parameter;

20 computing means for generating a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and

quantization parameter encoding means for binary-arithmetic-encoding a first bin indicating whether or not the delta quantization parameter is significant, a sign bin
25 indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the

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delta quantization parameter, in the case where the delta quantization parameter is significant,

wherein quantization parameter encoding means performs the binary-arithmetic-encoding using no context for the sign
5 bin, using a first context for the first bin and using a context different from the first context for the other bins, and

wherein quantization parameter encoding means binary-arithmetic-encodes the other bins using the same context for a predetermined bin and a bin subsequent to the predetermined
10 bin.

16. The video quantization parameter encoder according to claim 15,

wherein when performing the binary-arithmetic-encoding, the quantization parameter encoding means updates
15 context variables comprising a most probable symbol and a probability of the most probable symbol according to a corresponding bin.

17. The video quantization parameter encoder according to claim 16,

20 wherein in the case where the delta quantization parameter is not significant, a value of the first bin is set to zero, and in the case where the delta quantization parameter is significant, the quantization parameter encoding means sets the value of the first bin to one.

25 18. The video quantization parameter encoder according to claim 17,

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wherein in the case where the delta quantization parameter comprises a positive value, a value of the sign bin is set to zero, in the case where the delta quantization parameter comprises a negative value, the quantization
5 parameter encoding means sets the value of the sign bin to one.

19. A video quantization parameter decoder for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, the video quantization parameter decoder comprising:

10 prediction means for generating a predicted quantization parameter from a past reconstructed quantization parameter; and

quantization parameter decoding means for binary-
arithmetic-decoding a first bin indicating whether or not a
15 delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter,

wherein the quantization parameter decoding means
20 performs the binary-arithmetic-decoding using no context for the sign bin, using a first context for the first bin and using a context different from the first context for the other bins, and

wherein the quantization parameter decoding means
binary-arithmetic-decodes the other bins using the same context
25 for a predetermined bin and a bin subsequent to the predetermined bin.

20. The video quantization parameter decoder according to

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claim 19,

wherein when performing the binary-arithmetic-decoding, the quantization parameter decoding means updates context variables comprising a most probable symbol and a probability of the most probable symbol according to a corresponding bin.

21. The video quantization parameter decoder according to claim 20,

wherein in the case where a value of the first bin is zero, the delta quantization parameter is not significant ,and in the case where the value of the first bin is one, the delta quantization parameter is significant.

22. The video quantization parameter decoder according to claim 21,

wherein in the case where a value of the sign bin is zero, the delta quantization parameter comprises a positive value, and in the case where the value of the sign bin is one, the delta quantization parameter comprises a negative value.

23. A computer readable information recording medium storing a video quantization parameter encoding program for causing a computer in a video quantization parameter encoder for encoding a quantization parameter for a video encoding process that is based on context-based adaptive binary arithmetic encoding, to execute:

generating a predicted quantization parameter from a past reconstructed quantization parameter;

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generating a delta quantization parameter from a quantization parameter and the predicted quantization parameter; and

5 binary-arithmetic-encoding a first bin indicating
whether or not the delta quantization parameter is significant,
a sign bin indicating whether the delta quantization parameter
is positive or negative, in the case where the delta
quantization parameter is significant, and other bins
10 indicating an absolute value of the delta quantization
parameter, in the case where the delta quantization parameter
is significant,

 wherein the binary-arithmetic-encoding is performed
using no context for the sign bin, using a first context for
the first bin and using a context different from the first
15 context for the other bins, and

 wherein the other bins are binary-arithmetic-encoded,
using the same context for a predetermined bin and a bin
subsequent to the predetermined bin.

24. The information recording medium according to
20 claim 23,

 wherein when the binary-arithmetic-encoding is
performed, updating context variables comprising a most
probable symbol and a probability of the most probable symbol
according to a corresponding bin.

25 25. The information recording medium according to
claim 24,

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wherein in the case where the delta quantization parameter is not significant, a value of the first bin is set to zero, and in the case where the delta quantization parameter is significant, the value of the first bin is set to one.

5 26. The information recording medium according to claim 25,

wherein in the case where the delta quantization parameter comprises a positive value, a value of the sign bin is set to zero, in the case where the delta quantization
10 parameter comprises a negative value, the value of the sign bin is set to one.

27. A computer readable information recording medium storing a video quantization parameter decoding program for causing a computer in a video quantization parameter decoder
15 for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, to execute:

generating a predicted quantization parameter from a past reconstructed quantization parameter; and

20 binary-arithmetic-decoding a first bin indicating whether or not a delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter,

25 wherein the binary-arithmetic-decoding is performed using no context for the sign bin, using a first context for the first bin and using a context different from the first

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context for the other bins, and

wherein the other bins are binary-arithmetic-decoded, using the same context for a predetermined bin and a bin subsequent to the predetermined bin.

5 28. The information recording medium according to claim 27,

wherein when the binary-arithmetic-decoding is performed, updating context variables comprising a most probable symbol and a probability of the most probable symbol
10 according to a corresponding bin.

29. The information recording medium according to claim 28,

wherein in the case where a value of the first bin is zero, the delta quantization parameter is not significant, and
15 in the case where the value of the first bin is one, the delta quantization parameter is significant.

30. The information recording medium according to claim 29,

wherein in the case where a value of the sign bin is
20 zero, the delta quantization parameter comprises a positive value, and in the case where the value of the sign bin is one, the delta quantization parameter comprises a negative value.

31. A video quantization parameter decoding method for decoding a quantization parameter for a video decoding process
25 that is based on context-based adaptive binary arithmetic encoding, the video quantization parameter decoding method

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comprising:

binary-arithmetic-decoding a first bin indicating whether or not a delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter;

generating a delta quantization parameter by de-binarizing the first bin, the other bins and the sign bin; and

generating a re-constructed quantization parameter by adding a predicted quantization parameter to the delta quantization parameter,

wherein the binary-arithmetic-decoding is performed using no context for the sign bin, using a first context for the first bin and using a second context for the other bins.

32. The video quantization parameter decoding method according to claim 31,

wherein when the binary-arithmetic-decoding is performed, updating context variables comprising a most probable symbol and a probability of the most probable symbol according to a corresponding bin.

33. The video quantization parameter decoding method according to claim 32,

wherein in the case where a value of the first bin is zero, the delta quantization parameter is not significant, and in the case where the value of the first bin is one, the delta

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quantization parameter is significant.

34. The video quantization parameter decoding method according to claim 33,

5 wherein in the case where a value of the sign bin is zero, the delta quantization parameter comprises a positive value, and in the case where the value of the sign bin is one, the delta quantization parameter comprises a negative value.

35. A video quantization parameter decoder for decoding a quantization parameter for a video decoding process that is
10 based on context-based adaptive binary arithmetic encoding, the video quantization parameter decoder comprising:

quantization parameter decoding means for binary-
arithmetic-decoding a first bin indicating whether or not a
delta quantization parameter is significant, a sign bin
15 indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute value of the delta quantization parameter;

de-binarization means for generating a delta
quantization parameter by de-binarizing the first bin, the
20 other bins and the sign bin; and

adding means for generating a re-constructed
quantization parameter by adding a predicted quantization
parameter to the delta quantization parameter,

wherein the quantization parameter decoding means
25 performs the binary-arithmetic-decoding using no context for the sign bin, using a first context for the first bin and using

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a second context for the other bins.

36. The video quantization parameter decoder according to claim 35,

5 wherein when performing the binary-arithmetic-decoding, the quantization parameter decoding means updates context variables comprising a most probable symbol and a probability of the most probable symbol according to a corresponding bin.

10 37. The video quantization parameter decoder according to claim 36,

wherein in the case where a value of the first bin is zero, the delta quantization parameter is not significant, and in the case where the value of the first bin is one, the delta quantization parameter is significant.

15 38. The video quantization parameter decoder according to claim 37,

20 wherein in the case where a value of the sign bin is zero, the delta quantization parameter comprises a positive value, and in the case where the value of the sign bin is one, the delta quantization parameter comprises a negative value.

25 39. A computer readable information recording medium storing a video quantization parameter decoding program for causing a computer in a video quantization parameter decoder for decoding a quantization parameter for a video decoding process that is based on context-based adaptive binary arithmetic encoding, to execute:

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binary-arithmetic-decoding a first bin indicating whether or not a delta quantization parameter is significant, a sign bin indicating whether the delta quantization parameter is positive or negative, and other bins indicating an absolute
5 value of the delta quantization parameter;

generating a delta quantization parameter by de-binarizing the first bin, the other bins and the sign bin; and

generating a re-constructed quantization parameter by adding a predicted quantization parameter to the delta
10 quantization parameter,

wherein the binary-arithmetic-decoding is performed using no context for the sign bin, using a first context for the first bin and using a second context for the other bins.

40. The information recording medium according to
15 claim 39,

wherein when the binary-arithmetic-decoding is performed, updating context variables comprising a most probable symbol and a probability of the most probable symbol according to a corresponding bin.

20 41. The information recording medium according to claim 40,

wherein in the case where a value of the first bin is zero, the delta quantization parameter is not significant, and in the case where the value of the first bin is one, the delta
25 quantization parameter is significant.

42. The information recording medium according to

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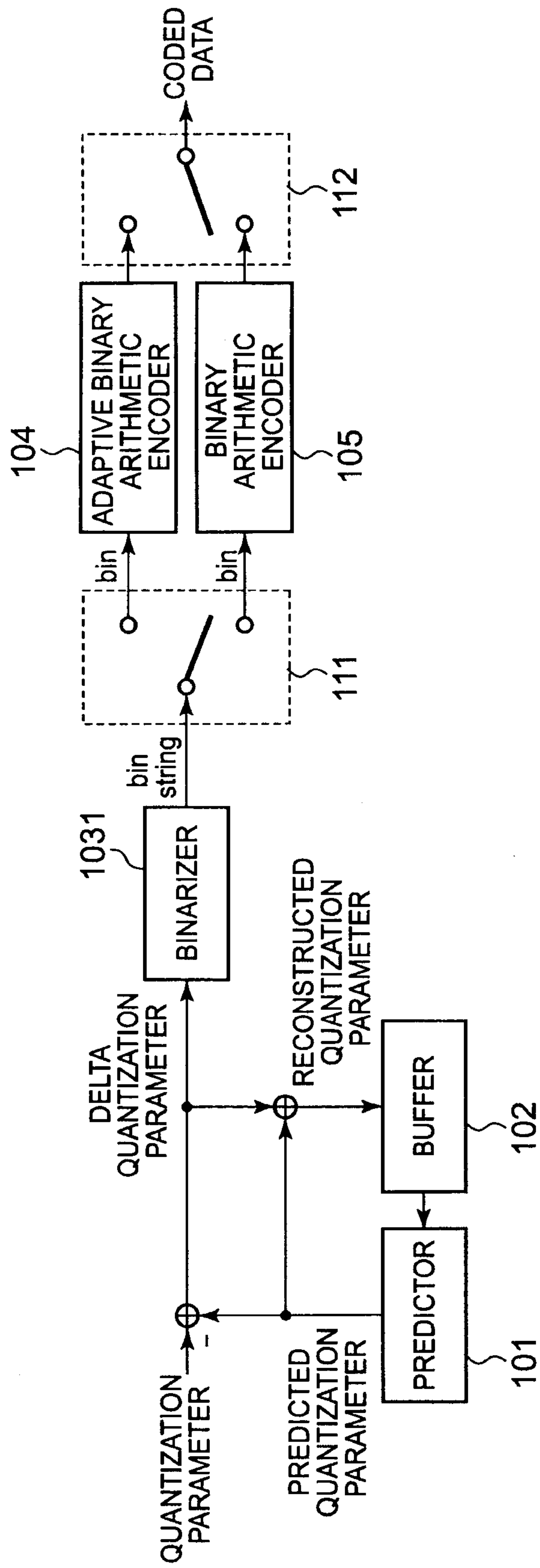
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claim 41,

wherein in the case where a value of the sign bin is zero, the delta quantization parameter comprises a positive value, and in the case where the value of the sign bin is one,
5 the delta quantization parameter comprises a negative value.

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FIG. 1



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FIG. 2

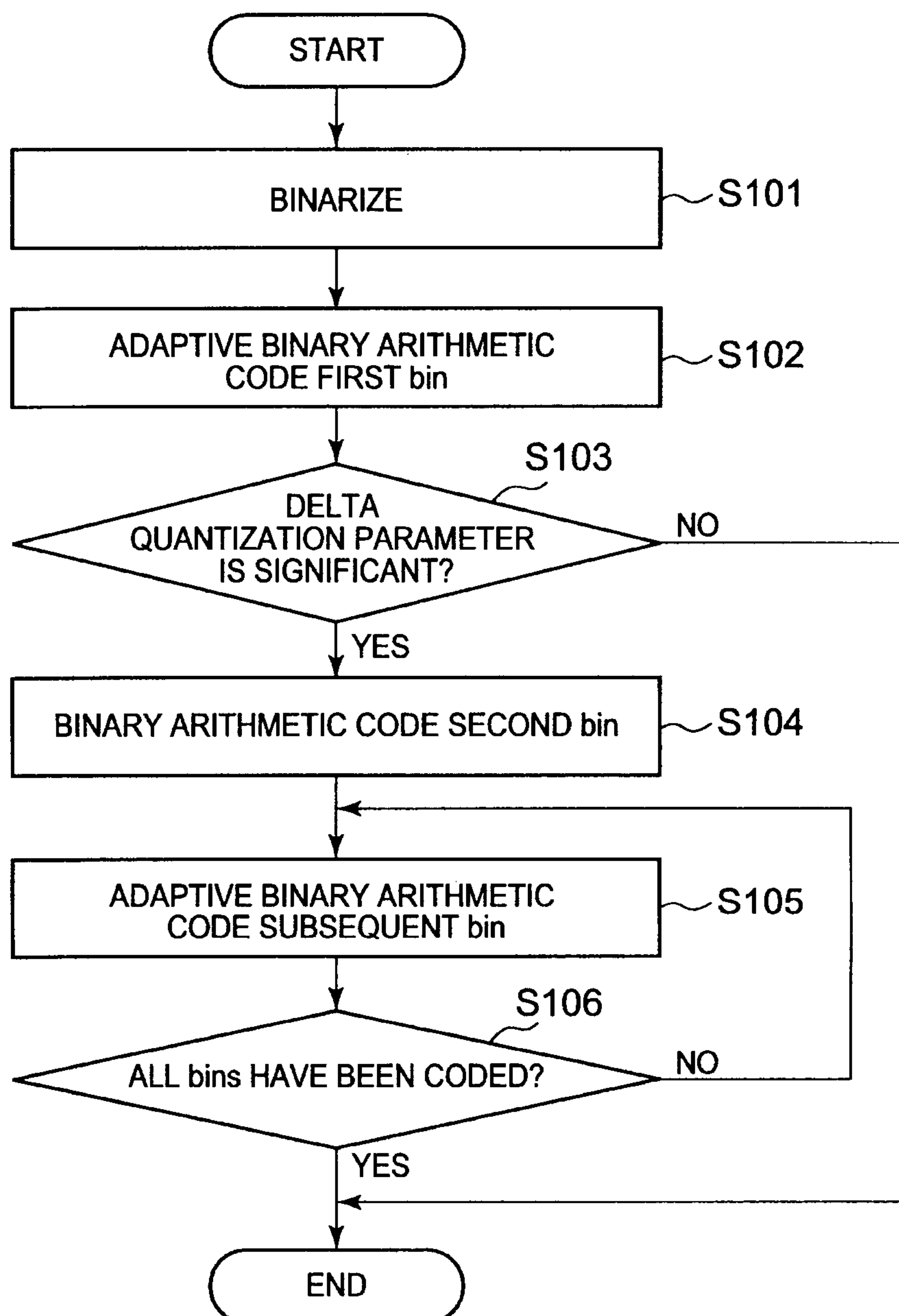
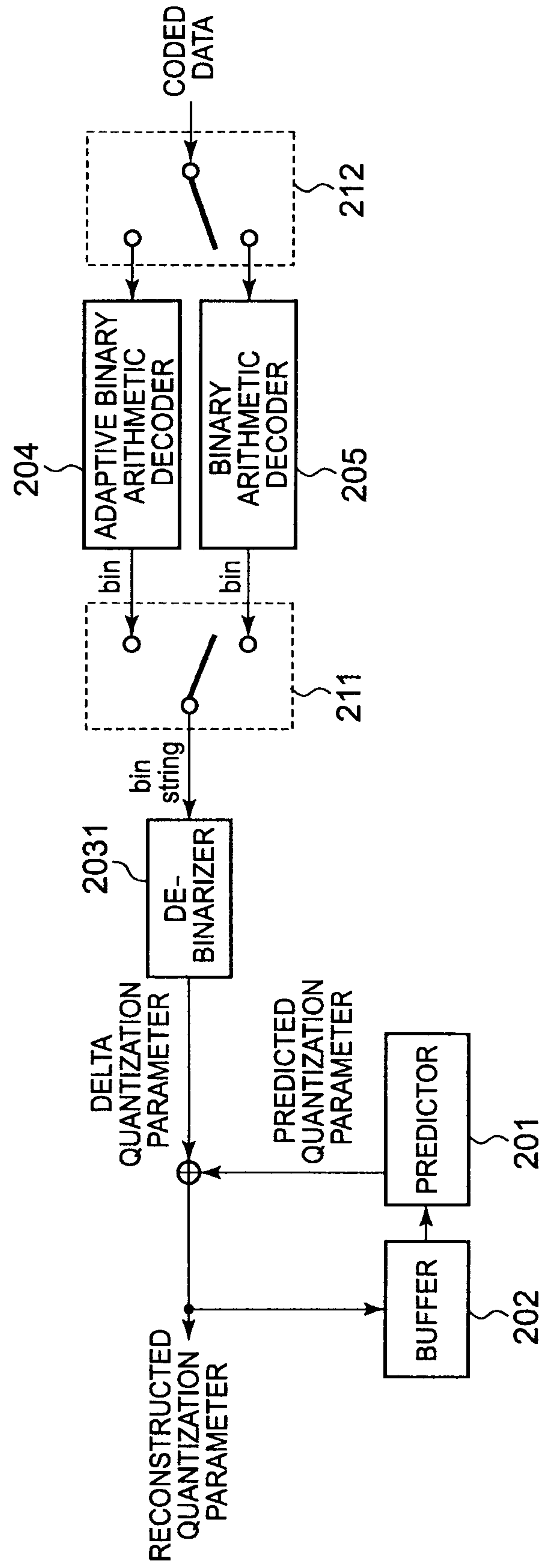


FIG. 3

BIN STRING INDEX	BIN STRING										DQP
	1st	2nd	3rd	4th	5th	6th	7th	...	26th	27th	
1	0										0
2	1	X	0								1 or -1
3	1	X	1	0							2 or -2
4	1	X	1	1	0						3 or -3
5	1	X	1	1	1	0					4 or -4
6	1	X	1	1	1	1	0				5 or -5
...											
26	1	X	1	1	1	1	1	...	1	0	25 or -25
27	1	X	1	1	1	1	1	...	1	1	26 or -26
CONTEXT INDEX	0	na	2	3	4	5	6	...	27	28	

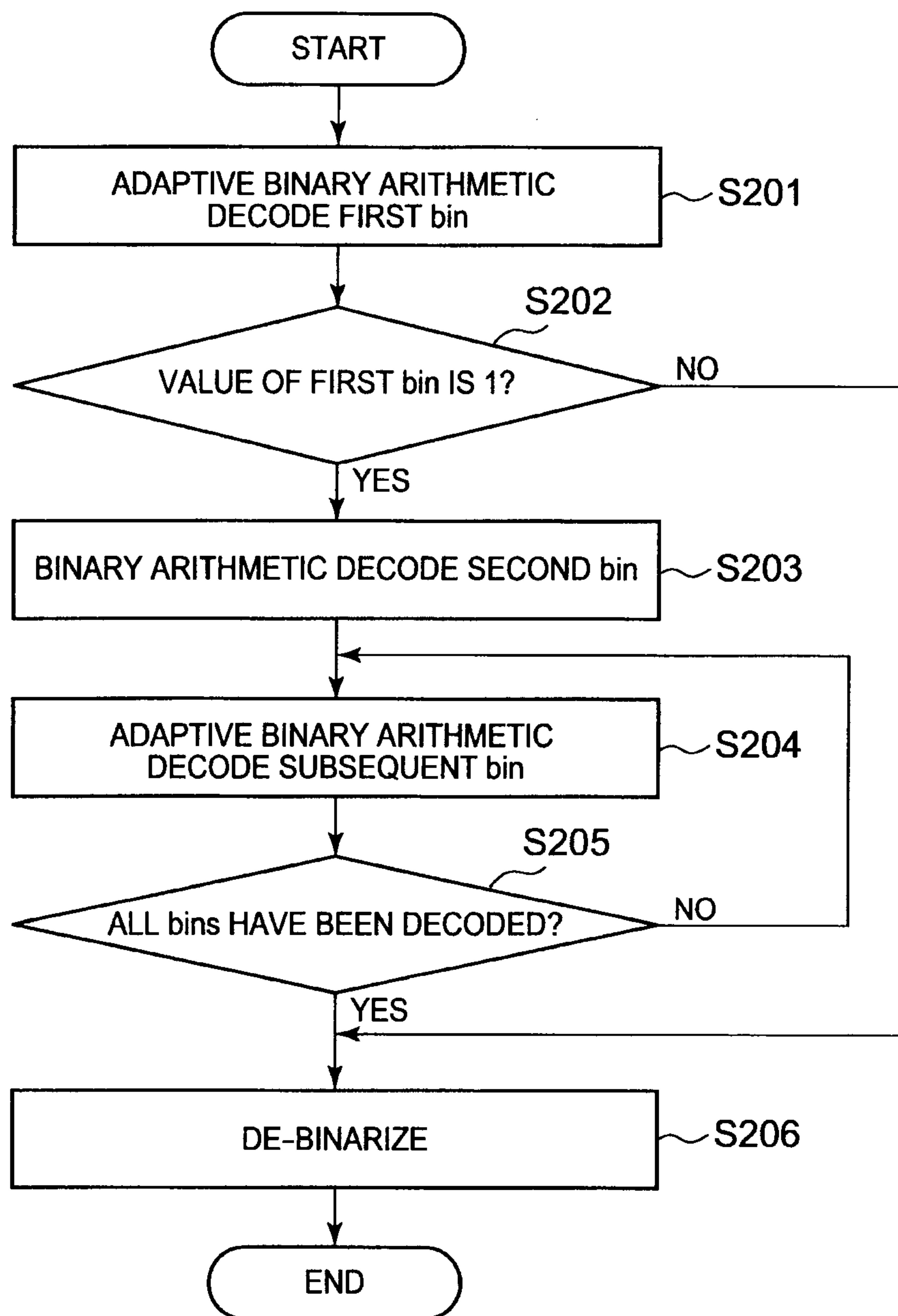
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FIG. 4



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FIG. 5



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FIG. 6

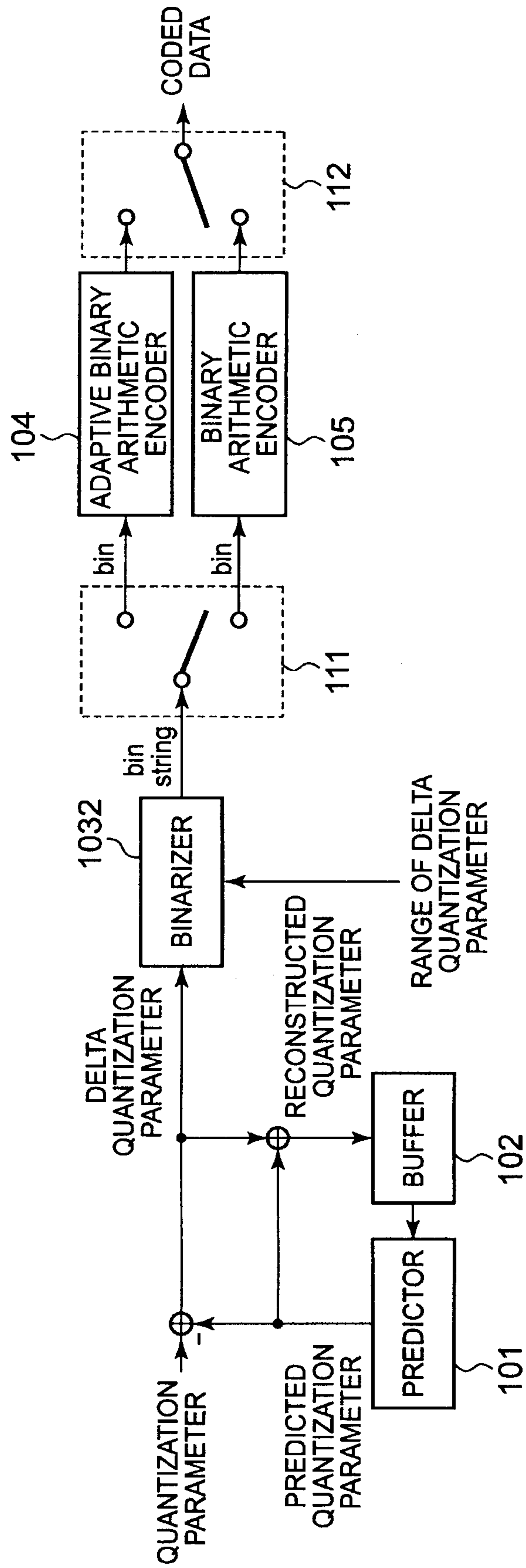
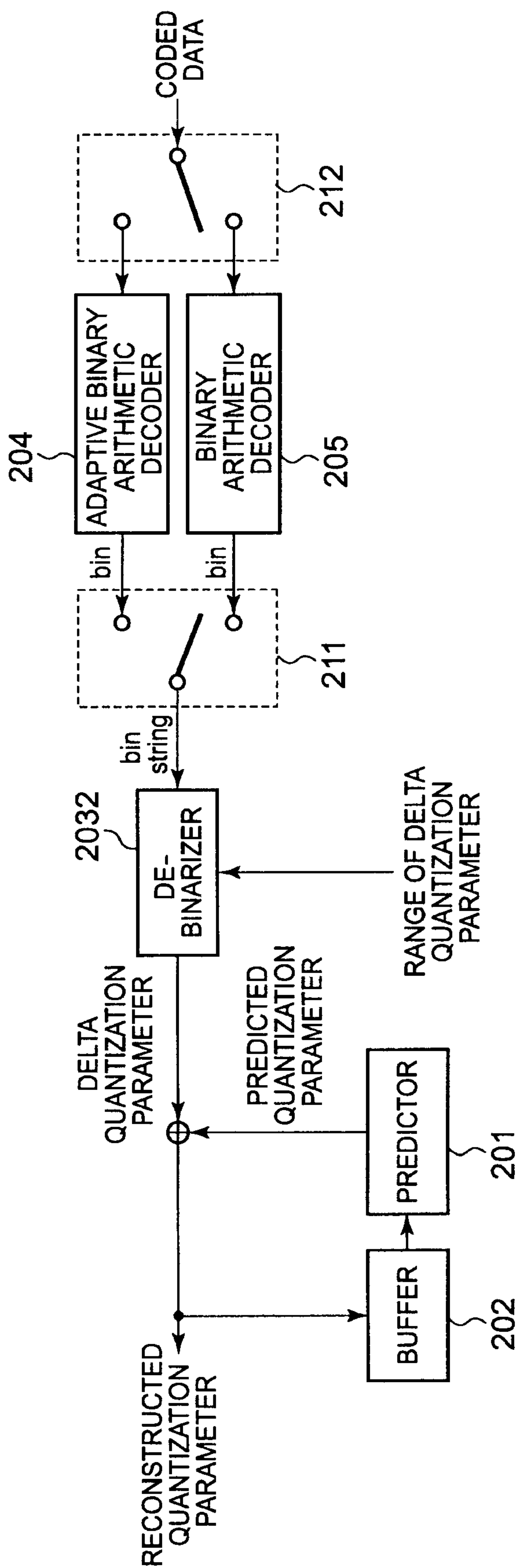
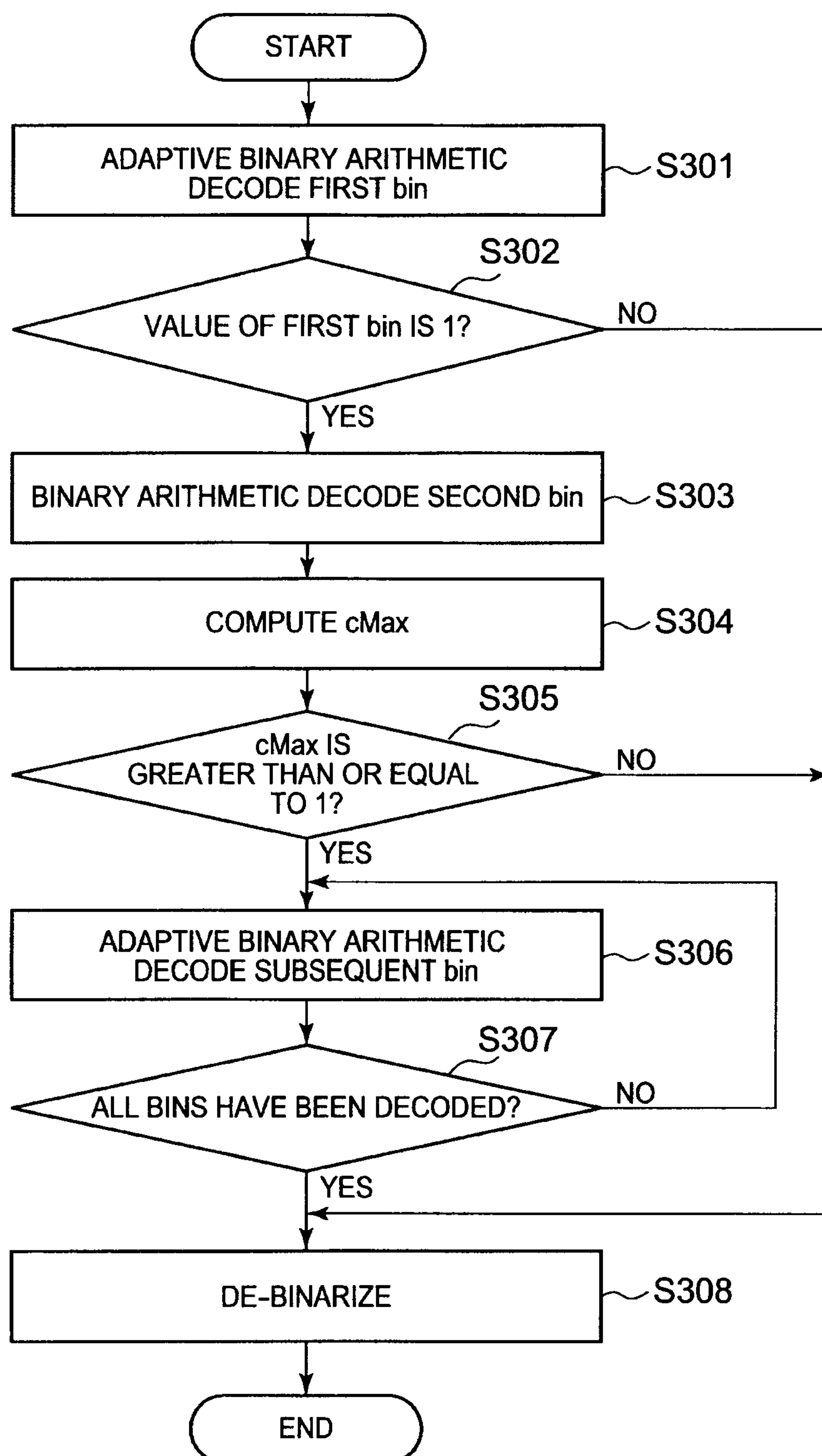


FIG. 7



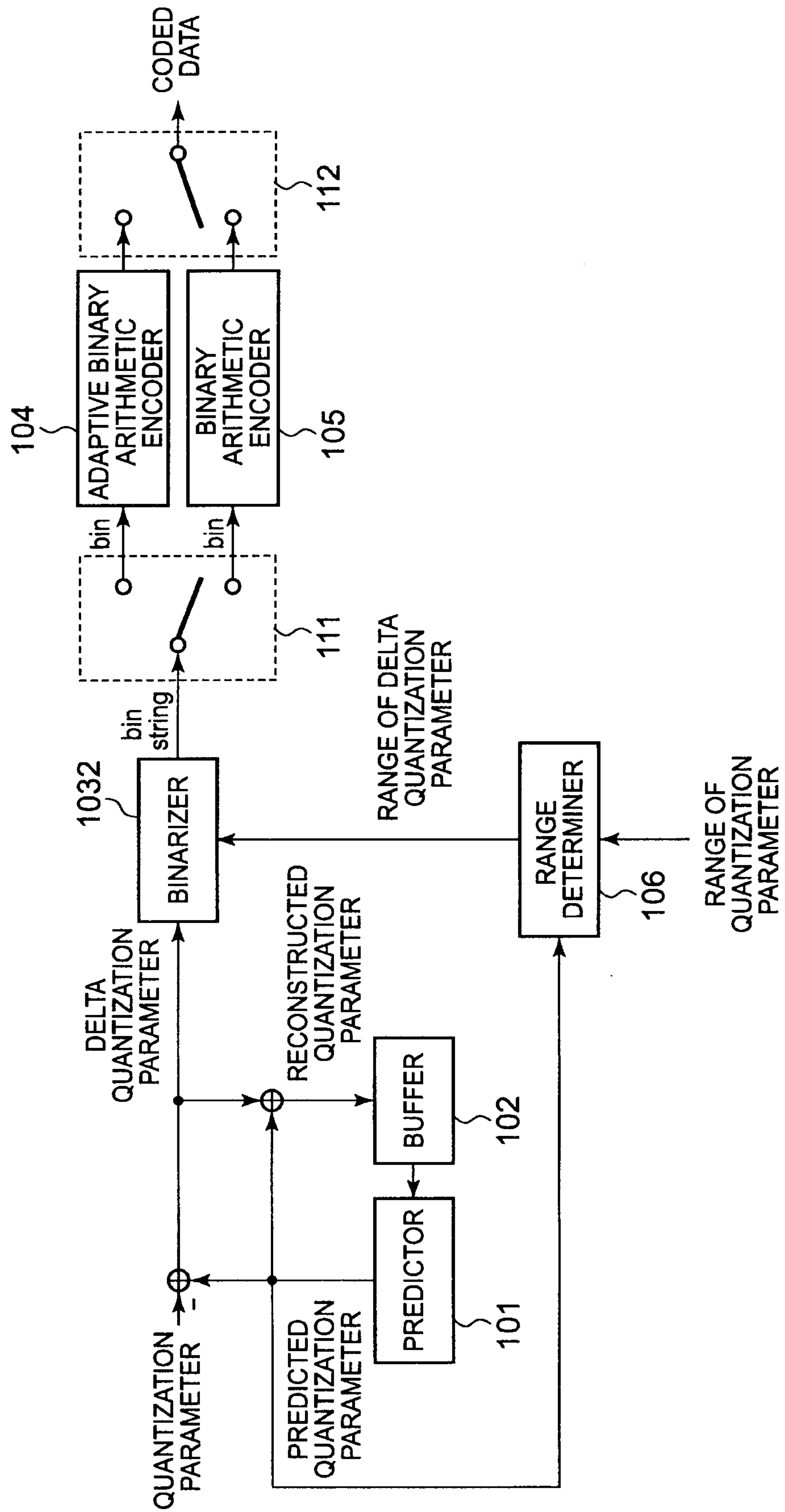
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FIG. 8



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FIG. 9



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FIG. 10

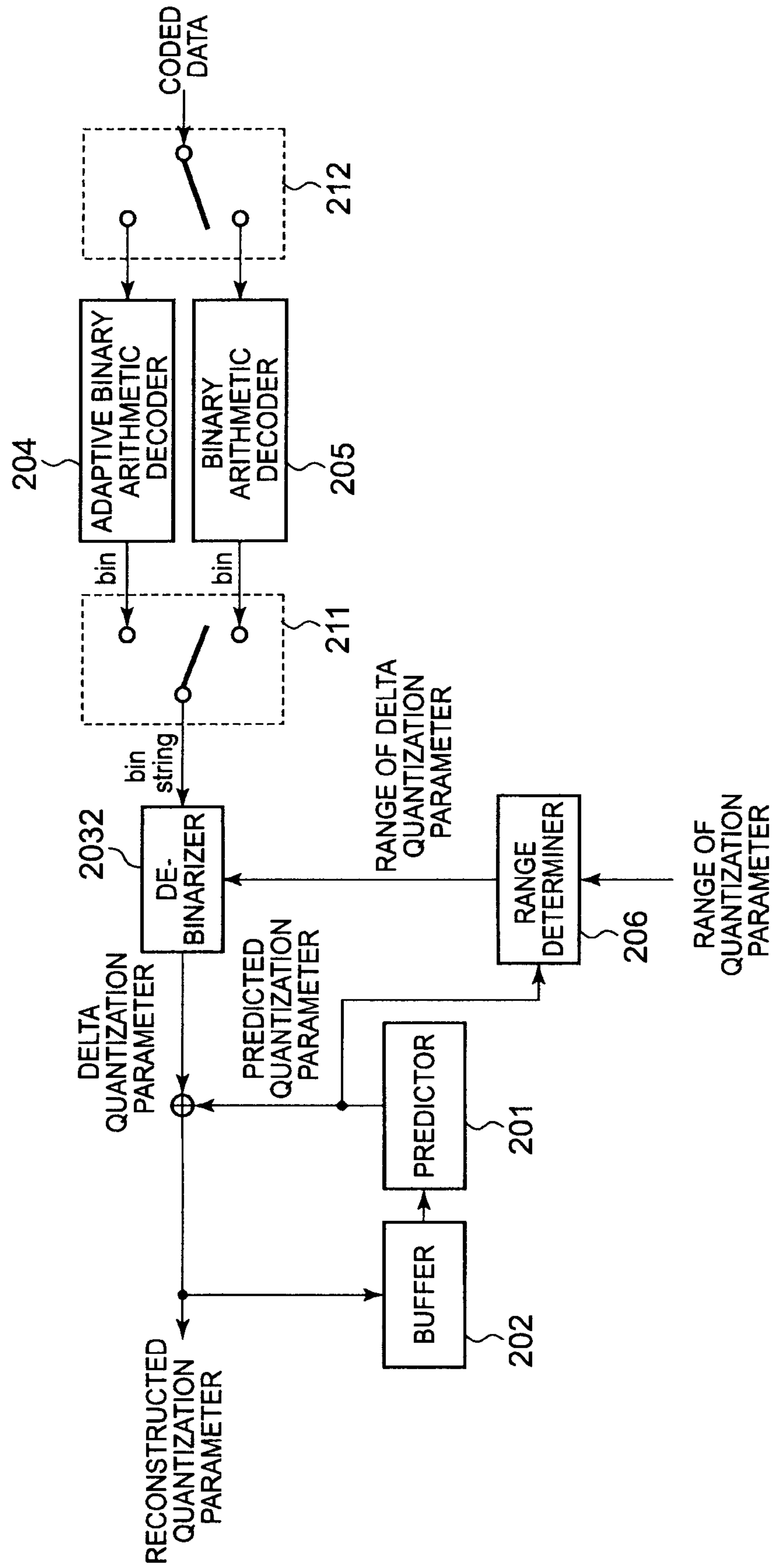
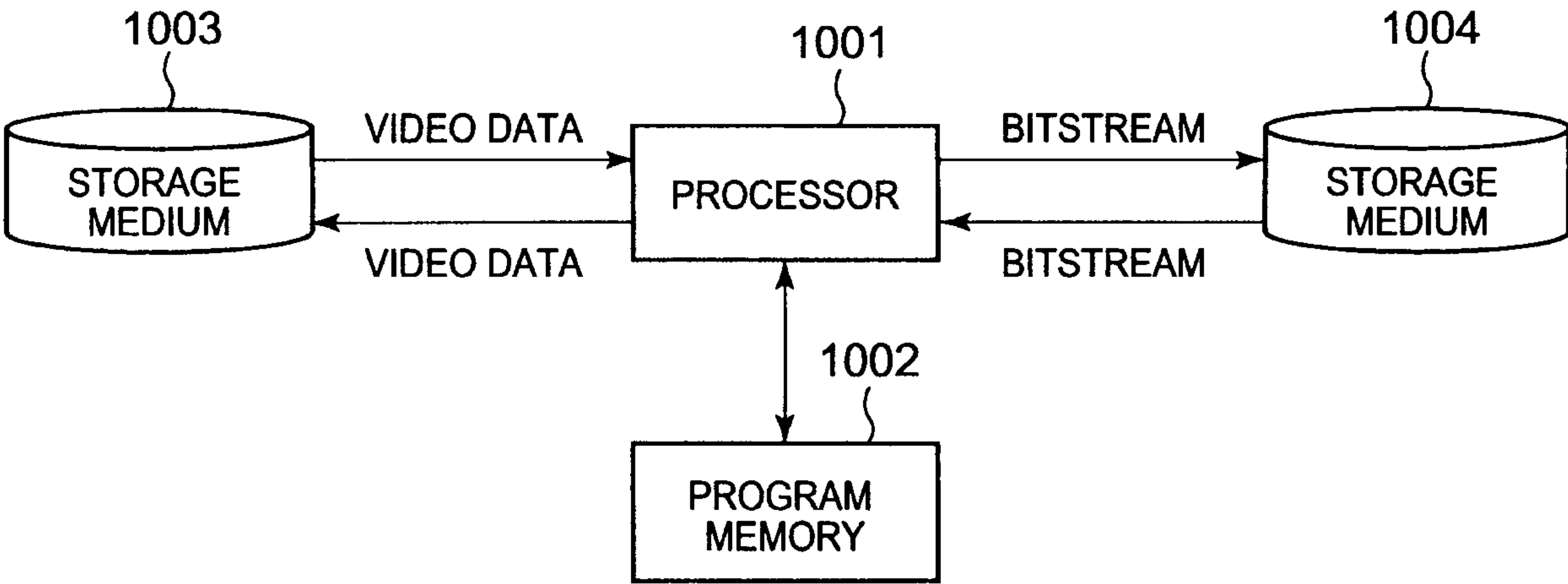


FIG. 11

BIN STRING INDEX	BIN STRING										DQP
	1st	2nd	3rd	4th	5th	6th	7th	...	26th	27th	
1	0										0
2	1	X	0								1 or -1
3	1	X	1	0							2 or -2
4	1	X	1	1	0						3 or -3
5	1	X	1	1	1	0					4 or -4
6	1	X	1	1	1	1	0				5 or -5
...											
26	1	X	1	1	1	1	1	...	1	0	25 or -25
27	1	X	1	1	1	1	1	...	1	1	26 or -26
CONTEXT INDEX	0	na	2	3	3	3	3	...	3	3	

FIG. 12



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FIG. 13

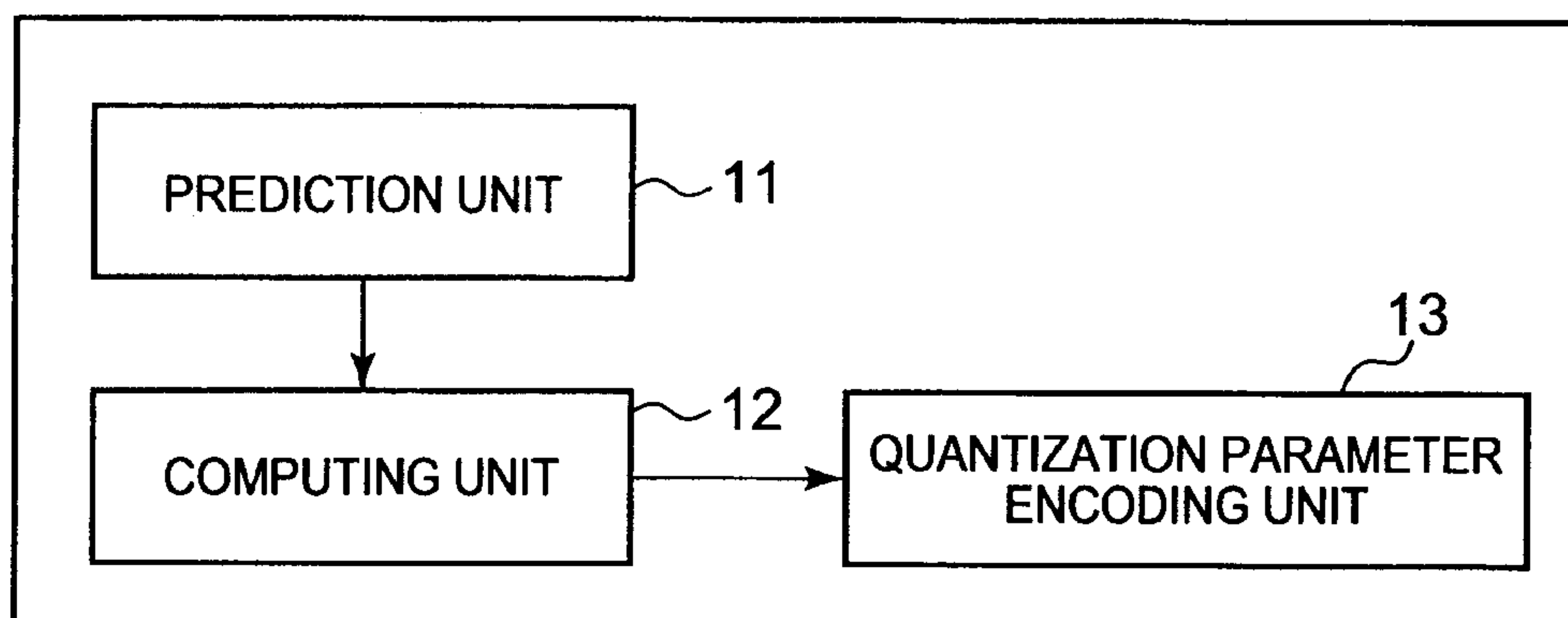


FIG. 14

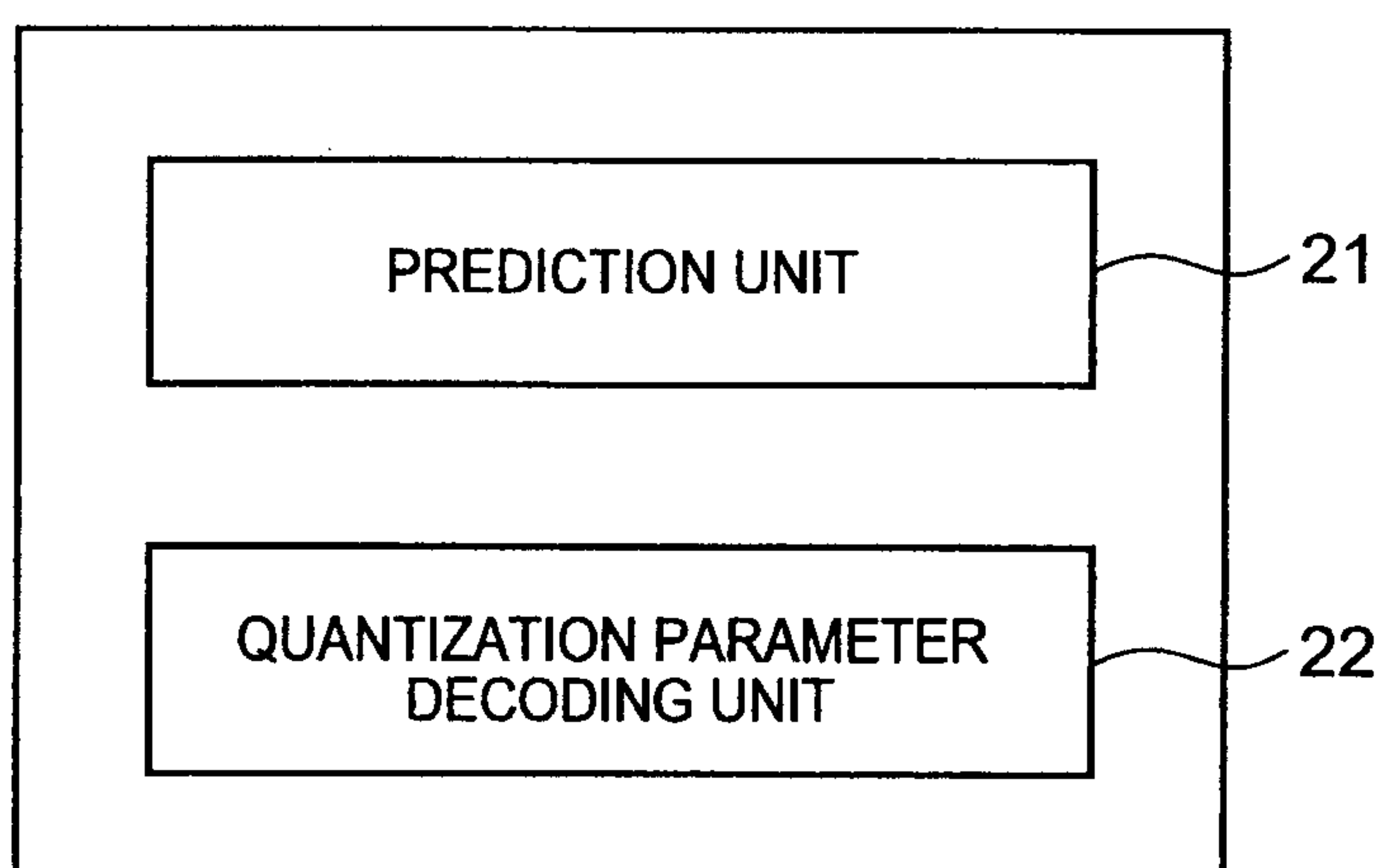


FIG. 15

PRIOR ART

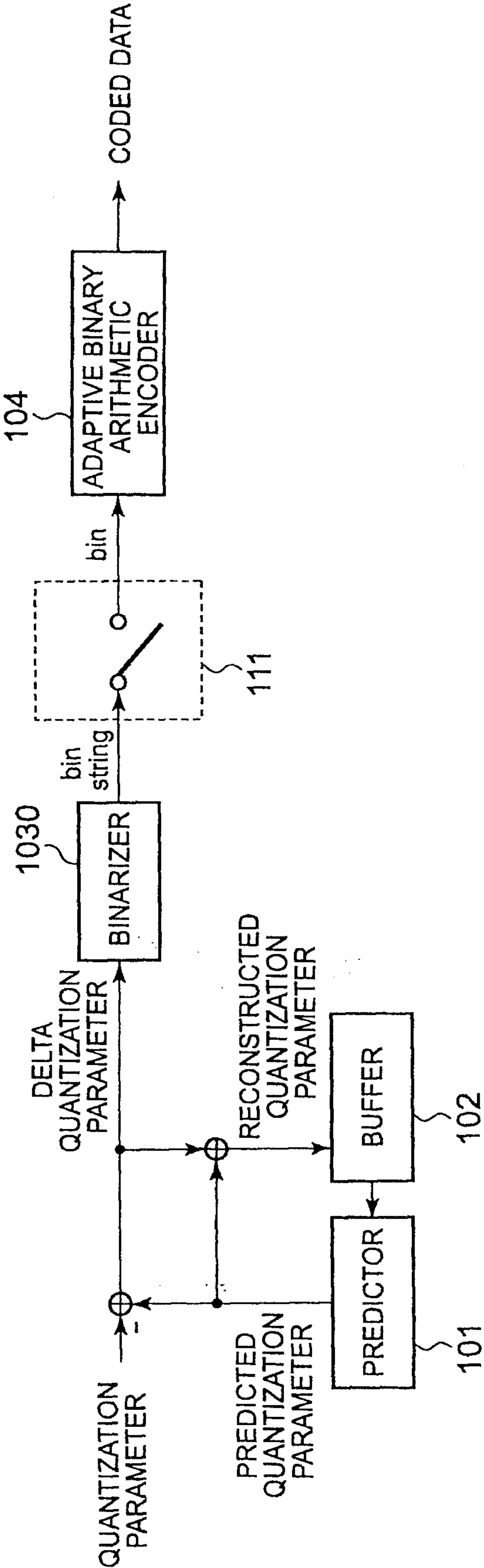


FIG. 16

PRIOR ART

BIN STRING INDEX	BIN STRING													DQP
	1st	2nd	3rd	4th	5th	6th	7th	...	49th	50th	51st	52nd	53rd	
1	0													0
2	1	0												1
3	1	1	0											-1
4	1	1	1	0										2
5	1	1	1	1	0									-2
6	1	1	1	1	1	0								-3
...														
50	1	1	1	1	1	1	1	...	1	0				25
51	1	1	1	1	1	1	1	...	1	1	0			-25
52	1	1	1	1	1	1	1	...	1	1	1	0		26
53	1	1	1	1	1	1	1	...	1	1	1	1	0	-26
CONTEXT INDEX	0	2	3	3	3	3	3	...	3	3	3	3	3	

PREDICTION UNIT

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COMPUTING UNIT

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QUANTIZATION PARAMETER
ENCODING UNIT

13

