

1 Image Processing Apparatus

BACKGROUND OF THE INVENTION

Field of the Invention

5 The present invention relates to an image processing apparatus, and, more particularly to an image processing apparatus for compressing a digital image and transmitting compressed data to a transmission medium or a storage medium or the like.

10 Related Background Art

Fig. 7 illustrates a conventional image encoding apparatus in which image data received at a terminal 101 is analog-to-digital (hereinafter abbreviated to "A/D") converted in an A/D converter 102 before it is formed into a variable-length compressed code in an encoding unit 103. Then, data about the variable-length compressed code is temporarily stored in a transmission buffer memory 104 before it is transmitted to a transmission path 106. At this time, a control coefficient for use to control the quantity of data about the variable-length compressed code generated in the encoding unit 103 is generated depending upon the degree of the data occupancy of a buffer memory 104 and the transmission rate of the transmission path 106 so as to be fed back to the encoding unit 103 via a filter 105. As a result compressed data about an image can,

1 in an averaged manner, be transmitted at a rate of
the transmission path 106. Data received via the
transmission path 106 is temporarily stored in a
receiving buffer memory 107 so as to, together with
5 the supplied control coefficient, be transmitted to a
decoding unit 108. As a result, variable-length
compressed encoded data is extended and decoded
before it is digital-to-analog converted in a D/A
converter 109 so that an image is transmitted through
10 a terminal 110.

A variety of systems for compressing the
color image to be performed in the encoding unit 103
shown in Fig. 7 have been disclosed. Among others a
so-called ADCT system has been suggested as a
15 preferable color imaging encoding system.

Fig. 8 is a schematic structural view which
illustrates an image encoding apparatus structured to
act according to the above-described ADCT system.
The above-described apparatus is arranged to receive
20 an image constituted by 8 bits, that is, data
converted into 256 gradations/color by the A/D
converter 102 shown in Fig. 7, the input image being
composed of three or four colors, that is, RGB, YUV,
YPbPr, $L^*a^*b^*$ or YMCK or the like. The input image
25 is, by a DCT unit 201, immediately subjected to a
two-dimensional discrete cosine transformation
(hereinafter abbreviated to a "DCT") in units of

1 sub-blocks each of which is composed of 8 x 8 pixels.
Then, its conversion coefficient is linearly
quantized in a linear quantizing unit 202. Each
conversion coefficient has a different quantizing
5 step size which is made to be a value obtained by,
by K, multiplying an 8 x 8 quantization matrix
element the 8 x 8 quantization matrix being employed
while taking into consideration the difference in
each conversion coefficient of the visual sensitivity
10 for sensing the quantization noise, where K is called
a "control coefficient". The value of K is used to
control the image quality and the quantity of
compressed and generated data. Table 1 shows an
example of a quantization matrix element stored in
15 a quantization matrix storage unit 203. That is,
since the quantization step is reduced when K is
enlarged, the image quality deteriorates and the data
quantity decreases.

20

25

Table 1

	16	11	10	16	24	40	51	61
	12	12	14	19	26	58	60	55
5	14	13	16	24	40	57	69	56
	14	17	22	29	51	87	80	62
	18	22	37	56	68	109	103	77
	24	35	55	64	81	104	113	92
	49	64	78	87	103	121	120	101
10	72	92	95	98	112	100	103	99

After the quantization has been completed, a DC conversion component (hereinafter called a "DC component") is, in a one-dimensional prediction unit 204, subjected to a one-dimensional forecasting between adjacent sub-blocks. As a result, the forecasted error is huffman-encoded in a huffman encoding unit 205.

Then, the quantization output denoting the forecasted error is divided into groups so that the identification number of a group which includes the forecasted error is huffman-encoded before the value of the quantization output in the group is expressed by an isotonic code.

An AC conversion component (hereinafter called an "AC component") except for the DC component is encoded in a zigzag scanning unit 206 in such a

1 manner that the above-described quantization output
is zigzag scanned in a direction from the low
frequency component to the high frequency component
as shown in Fig. 9. That is, conversion coefficients
5 (hereinafter called a "significant coefficient"), the
quantization output of each of which is not zero, are
classified into groups depending upon their values.
Then, the identification number of the group and the
number of the conversion coefficients (hereinafter
10 called an "invalid coefficient"), the quantization
output of which is zero and which are held between
significant coefficients positioned in front of it,
are caused to form a pair so as to be huffman encoded
in the huffman encoding unit 207. Then, the value
15 of the quantization output in the group is expressed
by an isotonic code.

However, the thus-arranged image encoding
apparatus receives the quantity of information to be
compressed and generated is different for each image.
20 Therefore, it is very difficult to estimate the
buffer memory quantity shown in Fig. 7. If the same
is too small, a portion of types of images become
destructive. If the same is too large, the required
capacity of hardware becomes too large, causing a
25 problem to arise in that the system cannot stably
designed. In this case, the cost is raised
excessively. Furthermore, since control coefficient

1 K is arranged to be fed back, the same image is
controlled with a different control coefficient
depending upon the previous image. Therefore, the
image quality is undesirably changed with time,
5 causing a problem to arise in that an image, the
quality of which is unsatisfactory level, will be
formed. Furthermore, since the terminative end of
an image and the control region of recorded data do
not coincide with each other, the joint recording,
10 searching, editing functions and the like cannot
easily be realized in view of the fact that the
transmission path comprises the recording medium such
as a magnetic tape or an optical disk.

In addition, in a case where the above-
15 described technology is applied to a still image
system which has no buffer memory, the control
coefficient of which is made to be a predetermined
coefficient and in which no feedback is performed.
Therefore, a problem arises in that the time required
20 to complete transmission of one image cannot be
specified. Another problem arises in that it is
impossible to estimate the capacity required to
record one image.

On the other hand, a variety of code length
25 control technologies have been disclosed in U.S.
Patent Application S.N. 669,655, U.S. Patent

1 Application S.N. 738,562 and new U.S. Patent
Application based on Japanese Patent Application Nos.
2-204793, 2-204798, 2-201104, 2-204797 and 2-281955.

5 SUMMARY OF THE INVENTION

An object of the present invention is to overcome the problems experienced with the above-described conventional technology. That is, an object of the present invention is to, at high speed,
10 control the quantity of data compression at the time of compressing data.

In order to achieve the above-described objects, according to one aspect of the present invention, there is provided an image processing
15 apparatus comprising: input means for inputting image data; first encoding means for encoding the image data with first parameter; second encoding means for encoding the image data with second parameter; first counting means for counting the
20 first amount of encoded image data encoded by the first encoding means; second counting means for counting second amount of encoded image data encoded by the second encoding means; and calculating means for calculating third parameter, with which the image
25 data is encoded to a predetermined amount of encoded data, in accordance with both of the first and the second amounts of encoded image data.

1 Another object of the present invention is
to improve the algorithm for controlling the quantity
of data to be compressed at the time of compressing
data.

5 Another object of the present invention is to
provide a reliable data compressing algorithm.

 In order to achieve the above-described
object, according to another aspect of the present
invention, there is provided an image processing
10 method comprising steps of: input step of inputting
image data; first encoding step of encoding the image
data with first parameter; second encoding step of
encoding the image data with second parameter; first
counting step of counting the first amount of encoded
15 image data encoded in the first encoding step; second
counting step of counting second amount of encoded
image data encoded in the second encoding step; and
calculating step of calculating third parameter,
with the image data is encoded to a predetermined
20 amount of encoded data, in accordance with both of
the first and the second amounts of encoded image data.

 Another object of the present invention is to
provide a structure capable of determining
compression parameter by a simple structure.

25 In order to achieve the above-described
object, according to an aspect of the present invention,
there is provided an image processing apparatus

1 comprising: input means for inputting image data;
first quantizing means for quantizing the image data
with first quantizing step; second quantizing means
for quantizing the image data with second quantizing
5 step; and third quantizing means for quantizing the
image data with third quantizing step, wherein the
first, second and third quantizing means perform
quantizing in parallel and the difference between the
second quantizing step and the third quantizing step
10 is larger than the difference between the first
quantizing step and the second quantizing step on
condition that the first quantizing step, the second
quantizing step and the third quantizing step
increases in this sequential order.

15 Another object of the present invention is to
provide an algorithm for compressing a moving image
which is freed from a rupture.

Another object of the present invention is to
reduced the memory capacity.

20 Another object of the present invention is to
satisfactorily reproduce an image.

Other and further objects, features and
advantages of the invention will be appear more fully
from the following description.

25

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a structure block diagram which

1 illustrates a first embodiment of the present
invention;

Fig. 2 illustrates an image to be transmitted
in a structure according to the embodiment of the
5 present invention;

Fig. 3 illustrates a calculating method
according to a first embodiment of the present
invention;

Fig. 4 is a structure view which illustrates
10 a second embodiment of the present invention;

Fig. 5 illustrates a calculating method
according to a second embodiment of the present
invention;

Fig. 6 illustrates a calculation flow
15 according to a second embodiment of the present
invention;

Fig. 7 is a structural block diagram
according to a conventional example;

Fig. 8 illustrates an ordinary variable-
20 length encoding system;

Fig. 9, in detail, illustrates the ordinary
variable-length encoding system;

Fig. 10 illustrates the relationship between
control coefficients and information quantities;

25 Fig. 11 illustrates the relationship between
control coefficients and information quantities;

Fig. 12 illustrates a further-detailed

1 calculating method according to a fourth embodiment
of the present invention;

Fig. 13 illustrates a calculating flow
according to the fourth embodiment of the present
5 invention;

Fig. 14 illustrates a further-detailed
calculating method according to a fifth embodiment
of the present invention;

Fig. 15 illustrates a calculating flow
10 according to the fifth embodiment of the present
invention;

Fig. 16 is a block diagram which illustrates
a sixth embodiment of the image encoding apparatus
according to the present invention;

15 Fig. 17 is a block diagram which illustrates
the schematic structure of a conventional encoding
system which employs a DCT conversion;

Fig. 18 illustrates a quantization process
shown in Fig. 17;

20 Fig. 19 illustrates a quantization process
shown in Fig. 17;

Fig. 20 illustrates a sixth embodiment of the
present invention;

Fig. 21 illustrates the sixth embodiment of
25 the present invention; and

Fig. 22 illustrates the embodiment shown in
Fig. 16.

1 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Embodiment

A first embodiment of the present invention is characterized in that a control coefficient, with
5 which a desired information quantity can be obtained, is obtained at the time of compressing a moving image in each image data, the desired information quantity being obtained in such a manner that N is made to be continuous integers, plural trials are performed in
10 such a manner that the Nth control coefficient is small and as well as the N+1th control coefficient is large, and the desired information quantity is obtained by a primary approximation made with the information quantity generated by the trial performed
15 by the Nth control coefficient and the information quantity generated by the trial performed by the N+1th control coefficient.

According to the above-described method, the quantity of compressed and generated information is
20 made to be a predetermined value. Therefore, a system, the capacity of the buffer memory of which can be reduced and which exhibits an excellent stability such that it will not be ruptured by the image can easily be designed. Furthermore,
25 the control coefficient is not fed back, constant image quality can be obtained from the same image and as well as the frame joining, searching, editing

1 functions and the like can easily be realized in a
case where the transmission path comprises a
recording medium such as a magnetic tape or a
recording medium. In addition, in a case where the
5 above-described technology is applied to a still
image system which has no buffer memory and in which
no feedback is performed, the time required to
complete transmission of one image can be specified.
Furthermore, the capacity required to record one
10 image can be made to be a predetermined quantity.

Then, the embodiment of the present invention
will now be described with reference to the drawings.
Fig. 1 is a structural block diagram which
illustrates an image processing apparatus according
15 to the present invention. An image received from a
video camera or a host computer or an image scanner
or the like is A/D converted by an A/D converter 2
before it is variable-length encoded by an encoding
unit (1) given reference numeral 3 by the above-
20 described so-called ADCT system. At this time,
control coefficient K is, as Q_1 which is a constant
value, compressed for one frame of the image. As a
result, compressed information quantity B_1 is
obtained so as to be transmitted to a calculating
25 unit 5.

Simultaneously, the image is also variable-
length encoded by an encoding unit (2) given

1 reference numeral 4 by the so-called ADCT system.
At this time, control coefficient K is, as Q_2 , which
is a constant value, compressed for one frame of the
image. As a result, compressed information quantity
5 B_2 is obtained so as to be transmitted to a
calculating unit 5. Reference numeral 6 represents
an image data delay unit for delaying the image,
which has been A/D-converted, by about one image
frame.

10 Reference numeral 7 represents an encoding
unit (0) for compressing and encoding the optimum
control coefficient $K = Q_0$ calculated by a linear
approximation of Q_1 , Q_2 , B_1 and B_2 in the calculating
unit 5 so as to cause compressed and encoded data to
15 be stored in a transmission buffer memory 8.
Quantity B_0 of data compressed and encoded with the
optimum control coefficient $K = Q_0$ is previously
stored in a memory such as a ROM, a RAM and the like
so as to be transmitted to the calculating unit 5 in
20 which it is calculated.

Reference numeral 9 represents a transmission
path comprising a transmission medium such as ground
waves or an optical space or the like exemplified by
an optical fiber, a satellite or microwaves in a case
25 of the instantaneous transmission. If the same is
the accumulated transmission, it is a storage medium
such as a tape type medium exemplified by a digital

1 VTR or a DAT or the like, a disc-like medium such as
a floppy disk or an optical disk or the like or a
solid medium such as a semiconductor memory.

The transmission rate is determined depending
5 upon the quantity of information about the original
image, the compression rate and a required
transmission time such that it is varied from several
tens of Kbits/second to several tens of Mbits/second.

On the other hand, data received through the
10 transmission path 9 is temporarily stored in a
receiving buffer memory 10 so that compressed and
encoded data read from the receiving buffer memory 10
is extended and decoded in the decoding unit 11 with
optimum control coefficient Q_0 which has been
15 received simultaneously with the above-described
data item. Then, it is digital-to-analog converted
a D/A converting unit so that an image is transmitted
through a terminal 13.

Referring to Figs. 2 and 3, the present
20 invention will now be described in detail. Fig. 2
illustrates an example of an image to be transmitted,
one frame of the image being an A/D converted image
composed of 1280 pixels, each of which is constituted
by 8 bits, in the horizontal direction and 1088
25 pixels in the longitudinal direction. The data
capacity of one image is made of $1,280 \times 1,088 \times 8 =$
11,141,120 bits. If the image is transmitted as a

1 moving image at a speed of 30 frames/second a high
speed transmission path capable of realizing
11,141,120 x 30 = 334,233,600 bits/second must be
used.

5 On the other hand, the transmission path is
usually arranged to act at a predetermined
transmission rate. Therefore, an information
quantity which exceeds the predetermined transmission
rate will cause a rupture to occur and thereby the
10 transmission cannot be made. Assuming that a
transmission path, the transmission rate of which is
36.0000 Mbits/second, is used and as well as assuming
that the redundant degree except for image
information such as a sink code, an ID code and a
15 parity is 5%, the transmission rate at which image
information is able to be transmitted is 34.2000
Mbits/second and thereby the compressed information
quantity for one image (one frame) is 1.1400
Mbits/frame. Therefore, the image for one frame must
20 be compressed to a degree which is 10.23% or less.
Furthermore, dummy data composed of the residual
quantity: $1,140,000 - (11,141,120 \times 0.1023) =$
263.424 bits/frame, that is, $263.424 \times 30 = 7,902.72$
bits/second must be inserted.

25 Assuming that the control coefficient is a
certain value and thereby the compressed information
quantity of a certain image is 10%, the capacity of

1 image information is $334,233,600 \times 0.1 = 33,423,360$
bits/seconds and thereby dummy data of 34,200,000 -
($334,233,600 \times 0.1$) = 776,640 bits/second must be
inserted.

5 Assuming that the control coefficient is a
certain value and thereby the compressed information
quantity of a certain image is 11%, the capacity of
image information is $334,233,600 \times 0.11 = 36,765,696$
bits/seconds and thereby dummy data of 34,200,000 -
10 ($344,233,600 \times 0.1$) = -2,565,696 bits/second which
exceeds the transmission rate of the transmission
path, causing a rupture to occur.

Therefore, it is necessary to constitute a
structure in such a manner that the target
15 compression rate is made to be 10.23% and optimum
control coefficient Q_0 is given to the encoding unit
(0) given reference numeral 7 shown in Fig. 1 in
order to obtain an approximate value which does not
exceeds the target compression rate 10.23%.

20 Fig. 3 illustrates a process of determining
optimum control coefficient Q_0 , wherein a case in
which the information quantity is compressed and
encoded to about 1/10 by the so-called ADCT system
is illustrated.

25 The encoding system is arranged to be
similarly to that shown in Fig. 8 such that 8
horizontal pixels x 8 longitudinal pixels are

1 collected into a DCT sub-block and the DCT conversion
is performed in units of the DCT sub-blocks before
the conversion coefficient is linearly quantized.
Each conversion coefficient has a different
5 quantizing step size which is made to be a value
obtained by multiplying an 8×8 quantization matrix
element shown in Table 1 by K, the 8×8 quantization
matrix being employed while taking the difference
in each conversion coefficient of the visual
10 sensitivity for sensing the quantization noise into
consideration. The value of K is used to control the
image quality and the quantity of generated data so
that the above-described desired compression ratio of
about 1/10 is realized. After the quantization has
15 been completed, a DC conversion component is, as a
subtraction value from zero, subjected to a one-
dimensional forecasting between adjacent sub-blocks.
Then, the forecasted error is huffman-encoded. Then,
the quantization output denoting the forecasted
20 error is divided into groups so that the
identification number of a group which includes the
forecasted error is huffman-encoded before the value
of the quantization output in the group is expressed
by an isotonic code. AC conversion component except
25 for the DC component is encoded in such a manner
that the above-described quantization output is
zigzag scanned from the low frequency component to

1 the high frequency component. That is, the
significant coefficients are classified into groups
depending upon their values and the identification
number of the group and the number of the invalid
5 coefficients held between significant coefficients
positioned in front of it are caused to form a pair
so as to be huffman encoded. At this time, two
control coefficients Q_1 and Q_2 are selected and
relationships $Q_1 < Q_0$ and $Q_0 < Q_2$ are held.

10 Fig. 3 illustrates the relationship between
control coefficient K for an ordinary one image frame
and compressed information quantity Y. The above-
described relationship between Y and K is expressed
by function g, that is, $Y = g(K)$, where function g
15 is considered such that it extremely approximates
a log curve expressed by:

$$Y = g(K) = p \log K + q$$

(where p and q are constants) ... (1)

Then, encoding of control coefficient Q_1 is
20 performed in the encoding unit (1) given reference
numeral 3 shown in Fig. 1 so that compressed
information quantity B_1 is obtained.

Furthermore, encoding of control coefficient
 Q_2 is performed in the encoding unit (1) given
25 reference numeral 3 shown in Fig. 1 so that
compressed information quantity B_2 is obtained.

In the calculating unit 5 shown in Fig. 1,

1 a straight $Y = aK + b$ (wherein a and b are constants)
which connects two points (Q_1, B_1) and (Q_2, B_2) is
calculated.

5
$$Y = \frac{B_1 - B_2}{Q_1 - Q_2} \cdot K + \frac{Q_2 \cdot B_1}{Q_2 - Q_1} - \frac{Q_1 \cdot B_2}{Q_2 - Q_1} \dots (2)$$

Transformation is performed so that the following
equation is obtained:

10
$$K = \frac{(Q_2 - Q_1) \cdot Y - Q_2 \cdot B_1 + Q_1 \cdot B_2}{B_2 - B_1} \dots (3)$$

Then, by making B_0 shown in Fig. 3 to be the
desired copression ratio (10.23%) so that optimum
15 control coefficient Q_0 can be obtained by
substituting B_0 into Y in Equation (2).

$$Q_0 = \frac{(Q_2 - Q_1) B_0 - Q_2 \cdot B_1 + Q_1 \cdot B_2}{B_2 - B_1} \dots (4)$$

20 Actually, since the compressed information
quantity generated with optimum control coefficient
 Q_0 is a value on $Y = g(K)$, it is B_0 . Since equation
(1) is a downward-convex log curve, the straight,
which connects two points on the downward-convex
25 curve, necessarily is positioned on this curve as
shown in Fig. 3. This means a fact that: $B_0 > B_0$ so
that the desired compression ratio is not exceeded in

1 any case. Therefore, the risk of a rupture can be
eliminated.

Since Q_1 , Q_2 and B_0 of Equation (4) are known
constant values and therefore it is necessary to be
5 capable of obtaining only B_1 and B_2 by a trial of
encoding. Therefore, the encoding units (1) and (2)
respectively given reference numerals 3 and 4 shown
in Fig. 1 are required to generate only the
compressed information quantity.

10 Although the calculating unit 5 shown in Fig.
1 calculates the above-described Equation (4), the
calculation may be performed by using a CPU or a
look-up table which uses a ROM or a RAM or the like.

Although the above-described embodiment is
15 arranged in such a manner that the relationship
between the control coefficients and the compressed
information quantities are expressed by a log curve,
the actual relationship is sometimes different from
this such that it can sometimes be approximated by a
20 quadratic curve or a tertiary curve depending upon
the way of the quantization and the type of encoding
employed in the encoding unit. However, any of the
cases are commonly characterized in that each curve
is a downward-convex curve (the tangent is always
25 present below the curve). Therefore, the above-
described method of determining the control
coefficient can be effectively employed because

1 of the above-described characteristics.

Second Embodiment

Fig. 4 is a structural block diagram which illustrates a second embodiment of the image encoding apparatus according to the present invention. An image received through a terminal 20 is A/D converted by an A/D converter 21 before it is variable-length encoded by an encoding unit (1) given reference numeral 22 by the above-described so-called ADCT system. At this time, control coefficient K is, as Q_1 which is a constant value, compressed for one frame of the image. As a result, compressed information quantity B_1 is obtained so as to be transmitted to a comparison and calculating unit 26.

15 Simultaneously, the image is also variable-length encoded by an encoding unit (2) given reference numeral 23 by the so-called ADCT system. At this time, control coefficient K is, as Q_2 , which is a constant value, compressed for one frame of the image. As a result, compressed information quantity B_2 is obtained so as to be transmitted to a comparison and calculating unit 26. The same is similarly variable-length encoded by an encoding unit (3) given reference numeral 24 by the so-called ADCT system. At this time, control coefficient K is, as Q_3 , which is a constant value, compressed for one

25

1 frame of the image. As a result, compressed
information quantity B_3 is obtained so as to be
transmitted to the comparison and calculating unit
26. Furthermore, the same is similarly variable-
5 length encoded by an encoding unit (4) given
reference numeral 25 by the so-called ADCT system.
At this time, control coefficient K is, as Q_4 , which
is a constant value, compressed for one frame of the
image. As a result, compressed information quantity
10 B_4 is obtained so as to be transmitted to the
comparison and calculating unit 26.

Reference numeral 27 represents an image data
delay unit for delaying the image, which has been
A/D-converted, by about one image frame. Reference
15 numeral 28 represents an encoding unit (0) for
compressing and encoding the optimum control
coefficient $K = Q_0$ calculated by the comparison and
calculating unit 26 so as to cause compressed and
encoded data to be stored in a transmission buffer
20 memory 29.

Reference numeral 30 represents a
transmission path. Data received through the
transmission path 30 is temporarily stored in a
receiving buffer memory 31. Compressed and encoded
25 data read from the receiving buffer memory 31 is, in
the encoding and decoding unit 32, extended and
decoded with optimum control coefficient Q_0 which has

1 been received simultaneously. Then, it is digital-
to-analog converted in the D/A converter 33 so that
an image is transmitted from a terminal 34.

Then, the second embodiment of the present
5 invention will now be described with reference to
Figs. 5 and 6.

Then, a description will be made with reference
to a case in which an image to be transmitted is,
as shown in Fig. 2, similar to that according to the
10 above-described first embodiment and image for one
frame is compressed to 10.23% or smaller,
respectively.

That is, it is necessary to constitute a
structure in such a manner that the target
15 compression rate is made to be 10.23% and optimum
control coefficient Q_0 is given to the encoding unit
(0) given reference numeral 28 shown in Fig. 4
in order to obtain an approximate value which does
not exceed the target compression rate 10.23%.

20 Fig. 5 illustrates a process of determining
optimum control coefficient Q_0 .

The encoding system is arranged to employ
the so-called ADCT system shown in Fig. 8 similarly
to the first embodiment.

25 Then, an assumption is made that four control
coefficients Q_1 , Q_2 , Q_3 and Q_4 are selected which
hold relationships $Q_1 < Q_0$ and $Q_0 < Q_4$.

1 Fig. 5 illustrates the relationship between
control coefficient K for an ordinary one image frame
and compressed information quantity Y . The above-
described relationship between Y and K is expressed
5 by function g , that is, $Y = g(K)$.

In this state, $Y = g(K)$ extremely
approximates to a log curve.

Then, encoding of control coefficient Q_1 is
performed in the encoding unit (1) given reference
10 numeral 22 shown in Fig. 4 so that compressed
information quantity B_1 is obtained. Encoding of
control coefficient Q_2 is performed in the encoding
unit (2) given reference numeral 23 shown in Fig. 4
so that compressed information quantity B_2 is
15 obtained. Encoding of control coefficient Q_3 is
performed in the encoding unit (3) given reference
numeral 24 shown in Fig. 4 so that compressed
information quantity B_3 is obtained. Encoding of
control coefficient Q_4 is performed in the encoding
20 unit (4) given reference numeral 25 shown in Fig. 4
so that compressed information quantity B_4 is
obtained. Then, the flow of the comparison and
calculating unit 26 shown in Fig. 4 will now be
described with reference to Fig. 6.

25 In the comparison and calculating unit 26
shown in Fig. 4, target compression information
quantity B_0 is subjected to comparisons with B_1 , B_2 ,

1 B_3 and B_4 obtained by the above-described compressing
 and encoding trial such that $B_0 \leq B_1$, $B_0 \leq B_2$, $B_0 \leq$
 B_3 and $B_0 \leq B_4$, respectively (steps S1 to S4) so as
 to obtain N with which B_0 holds a relationship $B_N \leq$
 5 $B_0 \leq B_{N+1}$ (wherein N is a positive integer) (steps
 S5 to S7). If N is obtained, an error takes place in
 the subject case (step S9).

At the time at which N is detected, straight
 line $Y = aK + b$ (where a and b are constants) which
 10 connects (Q_N, B_N) and (Q_{N+1}, B_{N+1}) to each other is
 calculated in the comparison and calculating unit 26
 shown in Fig. 4. As a result, control coefficient K
 is obtained from Equation (5):

$$15 \quad K = \frac{(Q_{N+1} - Q_N) \cdot Y - Q_{N+1} \cdot B_N + Q_N \cdot B_{N+1}}{B_{N+1} - B_N} \quad \dots (5)$$

Then, by making B_0 shown in Fig. 5 to be the
 desired compression ratio (10.23%) so that optimum
 control coefficient Q_0 can be obtained by
 20 substituting B_0 into Y in Equation (5).

$$Q_0 = \frac{(Q_{N+1} - Q_N) \cdot B_0 - Q_{N+1} \cdot B_N + Q_N \cdot B_{N+1}}{B_{N+1} - B_N} \quad \dots (6)$$

25 Actually, since the compressed information
 quantity generated with optimum control coefficient
 Q_0 is a value on $Y - g(K)$, it is B_0 . This means a

1 fact that: $B_0 > B_0$ so that the desired compression
ratio is not exceeded in any case. Therefore, the
risk of a rupture in the transmission path can be
prevented.

5 Among the above-described values, Q_1 , Q_2 , Q_3 ,
 Q_4 and B_0 are known constant values in the apparatus
and therefore it is necessary to be capable of
obtaining only B_1 , B_2 , B_3 and B_4 by the trial of
encoding. Therefore, the encoding units (1), (2),
10 (3) and (4) given reference numerals 22, 23, 24 and
25 shown in Fig. 4 are required to generate only the
compressed information quantity.

Although the above-described Equation (6) is
calculated in the above-described comparison and
15 calculating unit 26 shown in Fig. 4, the calculation
may be performed by using a CPU or the like or a
look-up table which uses a ROM or a RAM or the like.
Although the above-described second embodiment is
arranged in such a manner that the number of the
20 encoding units for generating only the encoded
information quantity is made to be four, the above-
described number can be increased, resulting an
effect to be obtained in that the optimum control
coefficinet infinitely approximates the desired
25 compressed information quantity while being limited
to be smaller than the same. As a result, encoding
can efficiently be performed. Therefore, the present

1 invention is not limited to the above-described
number of the encoding units. Furthermore, although
the above-described ordinary encoding system as shown
in Fig. 8 is employed in the encoding unit for the
5 purpose of easily making the description, another
encoding system may be employed. In addition, in the
above-described case, the DCT unit shown in Fig. 8 is
commonly employed in the encoding units. Therefore,
the necessity of possessing the same by a plurality
10 of numbers and therefore they can be unified into
one unit.

The frequency conversion is not limited to
the DCT but another orthogonal conversion such as the
Adhamal conversion or the like may be employed.

15 In addition, the present invention is not
limited to the block size arranged to be 8 x 8
pixels.

Furthermore, the encoding method after the
quantization has been completed is not limited to the
20 Huffman encoding method. For example, an
arithmetical encoding method or a run-length encoding
method may be employed.

In addition, the present invention is not
limited to the primary approximation but a structure
25 in which an approximation of the linear approximation
is employed is included in the scope of the present
invention.

1 As described above, according to the present
invention, the quantity of compressed data can
satisfactorily be controlled.

Third Embodiment

5 A third embodiment of the present invention
comprises a means for obtaining a desired information
quantity at the time of performing compressing of
each image data for one frame in such a manner that
the control coefficient with which the desired
10 information can be obtained is processed such that N
is made to be continuous integers, plural trials are
performed in such a manner that the N th control
coefficient is small and as well as the $N+1$ th
control coefficient is large, and the desired
15 information quantity is obtained by a primary
approximation made with the information quantity
generated by the trial performed by the N th control
coefficient and the information quantity generated by
the trial performed by the $N+1$ th control
20 coefficient.

In addition, the structure of the third
embodiment is characterized by a means for deforming
the first-order term or the zero order term or the
zero order term and the first-order term of the
25 obtained primary approximation.

The basic block structure according to this
embodiment is arranged to be similarly to that shown

1 in Fig. 1.

Fig. 10 illustrates a case in which control coefficient K and information quantity Y hold a special relationship.

5 In a case where the information quantities when the quantization is performed with control coefficients Q_1 and Q_2 are B_1 and B_2 respectively and as well as the original information quantity is B_0 , the control coefficient when the same is obtained by
10 linear approximation $Y = aK + b$ as shown in Fig. 10 becomes Q_0 . Furthermore, actual information B_0' when the quantization is performed with control coefficient Q_0 holds a relationship $B_0' > B_0$, causing a rupture to occur.

15 Therefore, by adding predetermined information quantity β (a constant) to approximation $Y = aK + b$ obtained with information quantities B_1 and B_2 , approximation $Y' = aK + b + \beta$ can be obtained. Then, quantization with control
20 coefficient $Q_0\beta$ obtained with desired information quantity B_0 is performed so that the actual information quantity becomes β_0'' . As a result, a relationship $B_0'' < B_0$ and thereby the quantity becomes information quantity B_0 or less. Therefore,
25 information can be quantized and compressed so as to be transmitted while preventing a rupture.

Since $Y = q(K)$ is, in Fig. 10, ordinarily a

1 downward convex, it is preferable that the above-
described constant β holds a relationship $\beta > 0$. By
adding β thus-determined, the possibility of
occurrence of a rupture can be decreased. The
5 structure may be arranged in such a manner that β is
set manually to the calculating unit 5 in accordance
with the supplied image or the same is automatically
set in accordance with the characteristics of the
image.

10 Fig. 11 illustrates control coefficient K and
information quantity Y in a case where approximation
 $Y = aK + b$ shown in Fig. 10 is transformed (amended)
into $Y' = (a + \alpha) K + b + \beta$. As described with
reference to Fig. 3, by performing quantization with
15 desired information quantity B_0 and control
coefficient $Q_0\alpha\beta$ obtained by approximation $Y = (a +$
 $\alpha) K + b + \beta$, the actual information quantity becomes
 B_0'' which holds a relationship $B_0'' < B_0$. Since the
information quantity is desired information quantity
20 B_0 , quantization and compression can be performed so
as to transmit information.

Furthermore, it is preferable that α holds a
relationship $\alpha > 0$ similarly to β .

According to the above-described embodiment
25 of the present invention, the above-described primary
approximation is corrected. As a result,
quantization compression can be performed while

1 preventing a rupture even if the image is an image of
a type in which the quantization control coefficient
and the information quantity hold a special
relationship.

5 Furthermore, the present invention is not
limited to the primary approximation. For example,
a structure in which a linear approximation or the
like is employed is included in the scope of the
present invention.

10 Fourth Embodiment

A fourth embodiment of the present invention
is characterized in that a control coefficient, with
which a desired information quantity can be obtained,
is obtained at the time of compressing a moving image
15 in each image data, the desired information quantity
being obtained in such a manner that N is made to be
continuous integers, plural trials are performed in
such a manner that the N th control coefficient is
small and as well as the $N+1$ th control coefficient
20 is large, and the desired information quantity is
obtained by a primary approximation made with the
information quantity generated by the trial performed
by the N th control coefficient and the information
quantity generated by the trial performed by the $N+1$
25 th control coefficient.

Furthermore, the fourth embodiment is
characterized in that, in a case where the desired

1 information quantity is larger than the information
quantity generated by the trial made with the first
control coefficient as a result of the trial of a
plurality of variable-length compressing and encoding
5 with M-types of control coefficients, or in a case
where the same is smaller than the information
quantity generated by the trial made with the Mth
control coefficient, the control coefficient for
variable-length encoding is encoded as a
10 predetermined constant value.

Since the basic block structure according to
this embodiment is the same as that shown in Fig. 1,
its description is omitted here.

Fig. 13 is a flow chart for the calculation
15 to be performed in the structure according to this
embodiment.

In a case where the image is very simple such
as a color bar and the original information quantity
is small as designated by a curve shown in Fig. 12B
20 as a result of a trial performed by using two control
coefficients Q_1 and Q_2 shown in Fig. 1, a relationship
 $B_0 > B_{1B}$ is held (S101) and the calculating unit 5
shown in Fig. 1 transmits Q_1 to the encoding unit 7
while making $Q_0 = Q_1$.

25 In a case where the image is, as designated
by a curve shown in Fig. 12A, very complicated such
as a zone plate and the original information quantity

1 is very large as a result of the trial performed by
using two control coefficients Q_1 and Q_2 , a
relationship $B_0 < B_{2A}$ is held (S102) and the
calculating unit 5 shown in Fig. 1 transmits Q_{MAX} -
5 5 to the encoding unit 7 while making $Q_0 = Q_{MAX} = 5$
(S104). In a case where $B_{2A} < B_0 \leq B_{1B}$, Q_0 is
calculated similarly to the first embodiment (S105).

As a result, the desired compression ratio
is not exceeded in any case and a rupture will not
10 take place on the transmission path.

Fifth Embodiment

A fifth embodiment of the present invention
is a modification to the second embodiment. Since
the basic structure is the same as that shown in
15 Fig. 4, its description is omitted here.

Fig. 15 is a flow chart for the calculation
to be performed in the structure according to this
embodiment, the flow chart being basically arranged
to be the same as that shown in Fig. 6.

20 In a case where the image is very simple such
as a color bar and the original information quantity
is small as designated by a curve shown in Fig. 14B
as a result of a trial performed by using four
control coefficients Q_1 , Q_2 , Q_3 and Q_4 shown in Fig.
25 4, a relationship $B_0 > B_{1B}$ is held and the calculating
unit 26 shown in Fig. 6 performs a transmission to the
encoding unit 0 while making $Q_0 = Q_1$ (S9).

1 In a case where the image is, as designated
by a curve shown in Fig. 14A, very complicated such
as a zone plate and the original information quantity
is very large as a result of the trial performed by
5 using four control coefficients Q_1 , Q_2 , Q_3 and Q_4 , a
relationship $B_0 < B_{4A}$ is held and the calculating
unit 26 shown in Fig. 6 performs a transmission to
the encoding unit 0 while making $Q_0 = Q_{MAX} = 5$ (S10).

 Although the above-described embodiment is
10 arranged in such a manner that the relationship
between the control coefficients and the compressed
information quantities are expressed by a log curve,
the actual relationship is sometimes different
from this such that it can sometimes be approximated
15 by a quadratic curve or a tertiary curve depending
upon the way of the quantization and the type of
encoding employed in the encoding unit. However,
any of the cases are commonly characterized in that
each curve is a downward-convex curve (the tangent is
20 always present below the curve). Therefore, the
above-described method of determining the control
coefficient can be effectively employed because of
the above-described characteristics.

Sixth Embodiment

25 In general, in a case where an image signal
is transmitted, the transmission path possesses a
transmission capacity per unit time. Therefore, it

1 is preferable that, in a case where one frame must
be transmitted at a predetermined moment as a case of
a moving image, the quantity of the code to be
transmitted be a quantity fixed in units of frames
5 or image blocks. Although the overall quantity of
the code can be adjusted by changing the quantization
step coefficient in the quantization process, the
quantization step coefficient must be forecasted
in order to cause the overall quantity of encoded
10 data to be included in the set code quantity because
the quantity of encoded data is different depending
upon the image. The relationship between the above-
described quantization step coefficient and the
overall quantity of the encoded data establish a
15 monotone decreasing function. Furthermore, an
average image is expressed by a logarithmic curve as
shown in Fig. 18.

As a method of estimating the quantization
step size by utilizing the above-described
20 characteristics, there has, according to the above-
described embodiments, been suggested a method in
which the quantization step coefficient is processes
from the quantization to VLC at each of a plurality
of different points, the quantity of the code at each
25 point is measured and the primary approximation
between the measuring points is performed.

Fig. 19 illustrates the above-described

1 method of estimating the quantization step size.
As described above, the quantization step coefficient
is measured at a plurality of the measuring points
and the region between the measuring points is
5 discriminated. Then, the region between the two
measuring points and indicating the discriminated
region is primary-approximated so that the
quantization step coefficient is estimated.

However, the above-described method
10 encounters a problem in that many measuring points
must be provided in order to reduce the error from
the set quantity of the code, the plurality of
measurement operations must be performed in parallel
in order to shorten the time required to complete the
15 treatment and the size of hardware of the apparatus
cannot be reduced if the number of the measuring
points is increased in order to improve the accuracy
of the measured results.

According to this embodiment to be described
20 later, there is provided an encoding apparatus for
quantizing conversion data obtained by converting
image information into a reading frequency region in
units of blocks composed of a plurality of pixels and
for variable-length encoding quantized conversion
25 data, the encoding apparatus comprising means for
measuring the quantity of code by, in parallel,
performing quantization to variable-length encoding

1 (VLC) with a predetermined plural quantization step
coefficients, and a calculating means for, from the
measured quantity of the code, estimating a
quantization step coefficient for a desired quantity
5 of the code by a linear approximation, wherein the
interval between the points at each of which the
quantity of the code is measured are widened in
proportion to the quantization step coefficient.

Since the structure is constituted in such
10 a manner that the interval between the points at
each of which the quantity of the code is measured
is set as described above, the approximation error of
the estimated quantization quantity can be relatively
approximated to a constant value in comparison to a
15 case in which the measuring points are equally
disposed with respect to the quantization step
coefficient. In particular, in a case where the
quantity of the quantized code is large, the interval
between the measuring points can be narrowed.
20 Therefore, an effect can be obtained in that the
approximation error of the above-described estimated
quantization quantity can be reduced. As a result,
the estimation accuracy of the quantity of the
quantized code can be improved while necessitating
25 a small number of measuring points.

Fig. 16 is a block diagram which illustrates
a sixth embodiment of an encoding apparatus according

1 to the present invention and structure in such a
4 manner that the present invention is applied to a
transmission apparatus for transmitting an image
signal.

5 Referring to Fig. 16, reference numeral 322
represents an input terminal for receiving a digital
image signal. The image signal supplied for each
line is, in a block forming circuit 324, divided into
blocks each of which is composed of, for example, 8
10 longitudinal pixels and 8 horizontal pixels.

Pixel data in each block is converted into
data about the frequency region in a DCT conversion
circuit 326. The above-described conversion data
is temporarily stored in a memory 328 and as well as
15 the same is linearly quantized in quantizing circuits
338a to 338n with different quantization step
coefficients k_1 to k_n received from generating
circuits 334a to 334n for generating the
predetermined quantization step coefficients k_1 to
20 k_n . According to this embodiment, quantization step
coefficients k_1 to k_n generated in the generating
circuits 334a to 334n are not made in such a manner
that the step interval is equalized as shown in Fig.
19 but the same is widened in inverse proportion to
25 the quantity of the quantized code as shown in Fig.
22.

Data quantized by the quantizing circuits

1 338a to 338n is variable-length encoded by VLCs
340a to 340n so that code quantities nb_1 to nb_n for
each data are obtained. However, the actual encoded
data is not transmitted here but only the quantity of
5 the code is measured before it is transmitted to a
calculating circuit 342.

In the calculating circuit 342, code
quantities nb_1 to nb_n at each measuring point and
set code quantities nb_0 determined from the
10 transmission rate are subjected to a comparison so as
to approximate a measuring point which is larger than
 nb_0 and nearest nb_0 and a measuring point which is
smaller than nb_0 and nearest nb_0 are approximated by
a straight line. As a result, quantization step
15 coefficient k_0 with respect to set code quantity nb_0
is estimated before it is transmitted to the
quantizing circuit 330. The quantizing circuit 330
receives conversion encoding data transmitted after
it has been delayed by a predetermined period by the
20 memory 328 so as to perform the linear quantization
with estimated quantizing step coefficient k_0 before
its result is supplied to a VLC 332.

In the VLC 332, the variable-length encoding
operation is performed so that its result is
25 transmitted to the transmission path through a
terminal 336 while extremely reducing the error with
respect to a predetermined transmission rate.

1 According to the above-described structure,
the relationship between the total code quantity
nb and quantization step coefficient k extremely
approximates a log curve. Therefore, the
5 quantization step coefficient is selected in such
a manner that the measuring points are set in an
exponential function manner as shown in Fig. 20 so
that, for example, the interval between the measured
results of the code quantities is made to be
10 equalized and the quantization error is made to be
constant.

Furthermore, an image of a type which
encounters a quantization error because of its large
code quantity can be processed to improve it in such
15 a manner that the measuring points are, as shown in
Fig. 21, set adjacent to the points as each of which
the quantization step coefficient is small.

Then, this embodiment will now be described
in detail with reference to Figs. 16 and 22.

20 First, two quantization step coefficients
 k_3 and k_4 are selected, k_3 and k_4 being arranged
to hold the following relationships with optimum
quantization step coefficient k_0 :

$$k_3 < k_4, \quad k_0 < k_4$$

25 Referring to Fig. 16, the linear quantization
and the VLC are performed with the quantization step
coefficients k_3 and k_4 so that compressed code

1 quantities nb_3 and nb_4 are obtained. Referring to
Fig. 22, point (k_3, nb_3) and point (k_4, nb_4) are
connected to each other by a straight line so that
estimated value k_0' of the quantization step
5 coefficient is obtained from code quantity nb_0 set
for each predetermined period.

Actually, since optimum quantization step
coefficient k_0 with respect to nb_0 is on a curve
shown in Fig. 22, compressed code quantity nb_0' with
10 respect to k_0' and nb_0 always hold the following
relationship:

$$nb_0' < nb_0$$

As a result, the desired code quantity cannot
be exceeded in any case so that it can be quantized.

15 As a result of the above-described structure,
in a case where the code quantity is small and
thereby the estimated error of the quantization
step coefficient becomes small, the measuring points
is decreased. In a case where the code quantity is
20 large and thereby the error becomes large, the
measuring points are increased. Therefore, the
estimation accuracy of the quantization step
coefficient can be improved.

Although the above-described embodiments are
25 arranged in such a manner that the size of the formed
block is made to be 8 x 8, the size may be varied.

Furthermore, an orthogonal conversion

1 (frequency conversion) except for the DCT may be
employs.

As described above, according to the image
processing apparatus according to the present
5 invention, the data quantity for a predetermined
region can be set to a desired data quantity while
reducing the quantity of hardware and exhibiting
satisfactory high accuracy.

The above-described embodiments are not
10 limited to a moving image but the same can be applied
to a still image.

Furthermore, the portion to which the image,
which has been A/D converted is supplied is not
limited to the monitor. It may be a printer such as
15 laser beam printer or an ink jet printer.

In addition, a plurality of the encoding
unit may be arranged to act in parallel. As an
alternative to this, it may be arranged to act
sequentially in a case where software of a computer
20 is used.

Although the invention has been described in
its preferred form with a certain degree of
particularly, it is understood that the present
disclosure of the preferred form has been changed in
25 the details of construction and the combination and
arrangement of parts may be resorted to without
departing from the spirit and the scope of the
invention as hereinafter claimed.



* C L M S *

6

1 WHAT IS CLAIMED IS:

1. An image processing apparatus comprising:
input means for inputting image data;
first encoding means for encoding the image
5 data with first parameter;
second encoding means for encoding the image
data with second parameter;
first counting means for counting the first
amount of encoded image data encoded by said first
10 encoding means;
second counting means for counting second
amount of encoded image encoded by said second
encoding means; and
calculating means for calculating third
15 parameter, with which the image data is encoded to a
predetermined amount of encoded data, in accordance
with both of the first and the second amounts of
encoded image data.
- 20 2. An image processing apparatus according
to Claim 1, wherein said calculating means calculates
the third parameter by using a primary approximation
in accordance with the first and the second amounts.
- 25 3. An image processing apparatus according
to Claim 1, wherein said first and second encoding
means respectively include quantizing means and said





1 parameter is a quantizing step.

4. An image processing apparatus according
to Claim 1, wherein said first and second encoding
5 means perform encoding in parallel.

5. An image processing apparatus according
to Claim 1, wherein the value of said second
parameter is larger than that of said first parameter
10 and said first amount is larger than said second
amount.

6. An image processing method comprising
steps of:

15 input step of inputting image data;
first encoding step of encoding the image
data with first parameter;
second encoding step of encoding the image
data with second parameter;

20 first counting step of counting the first
amount of encoded image data encoded in said first
encoding step;
second counting step of counting second
amount of encoded image data encoded in said second
25 encoding step; and
calculating step of calculating third
parameter, with the image data is encoded to a





1 predetermined amount of encoded data, in accordance
with both of the first and the second amounts of
encoded image data.

5 7. An image processing apparatus comprising:
input means for inputting image data;
first encoding means for encoding the image
data with first parameter;
second encoding means for encoding the image
10 data with second parameter;
first counting means for counting first
amount of encoded image data encoded by said first
encoding means; and
second counting means for counting second
15 amount of encoded image data encoded by said second
encoding means,
wherein, in a case where said first and
second amounts of encoded image data is deviated from
a predetermined range, the image data is encoded by
20 using a predetermined parameter.

8. An image processing apparatus according
to Claim 7, wherein said first and second encoding
means perform encoding by employing orthogonal
25 transformation.

9. An image processing apparatus according





1 to Claim 7, wherein said first and second encoding
means perform encoding in parallel.

10. An image processing apparatus according
5 to Claim 7, wherein said input means sequentially
inputs a plurality of pictures.

11. An image processing apparatus according
to Claim 7, further comprising memory means for
10 storing said predetermined parameter.

12. An image processing method comprising
steps of:

input step of inputting image data;
15 first encoding step of encoding the image
data with first parameter;
second encoding step of encoding the image
data with second parameter;
first counting step of counting first amount
20 of encoded image data encoded in said first encoding
step; and

second counting step of counting second
amount of encoded image data encoded in said second
encoding step,
25 wherein, in a case where said first and
second amounts of encoded image data is deviated from
a predetermined range, the image data is encoded by





1 using a predetermined parameter.

13. An image processing apparatus
comprising:

5 input means for inputting image data;
first quantizing means for quantizing the
image data with first quantizing step;
second quantizing means for quantizing the
image data with second quantizing step; and
10 third quantizing means for quantizing the
image data with third quantizing step,
wherein said first, second and third
quantizing means perform quantizing in parallel; and
the difference between said second quantizing
15 step and said third quantizing step is larger than
the difference between said first quantizing step and
said second quantizing step on condition that the
first quantizing step, the second quantizing step and
the third quantizing step increases in this
20 sequential order.

14. An image processing apparatus according
to Claim 13 further comprising counting means for
counting the amount of image data quantized by said
25 first, second and third quantizing means.

15. An image processing apparatus according





1 to Claim 14 further comprising processing means for
processing the input data input by said input means
in accordance with the amount counted by said
counting means.

5

16. An image processing apparatus according
to Claim 15, wherein said processing means performs
variable-length coding.

10

17. An image processing method comprising
steps of:

input step of inputting image data;

first quantizing step of quantizing the image
data with first quantizing step;

15

second quantizing step of quantizing the
image data with second quantizing step; and

third quantizing step of quantizing the image
data with third quantizing step;

20

wherein said first, second and third
quantizing steps are executed in parallel;

the difference between said second quantizing
step and said third quantizing step is larger than
the difference between said first quantizing step and
said second quantizing step on condition that the
25 first quantizing step, the second quantizing step and
the third quantizing step increases in this
sequential order.





1 18. An image processing apparatus
- comprising:
 input means for inputting image data;
 first encoding means for encoding the image
5 data with first parameter;
 second encoding means for encoding the image
 data with second parameter;
 first counting means for counting first
 amount of encoded image data encoded by said first
10 encoding means;
 second counting means for counting second
 amount of encoded image data encoded by said second
 encoding means; and
 calculating means for calculating third
15 parameter, with which the image data is encoded to a
 predetermined amount of data, by a primary
 approximation by using the first and the second
 amounts of encoded image data.

20 19. An image processing apparatus according
 to Claim 18, wherein said first and second encoding
 means respectively include quantizing means and said
 parameter is a quantizing step.

25 20. An image processing apparatus according
 to Claim 18, wherein said first and second encoding
 means perform encoding in parallel.





1 21. An image processing apparatus according
to Claim 18, wherein the value of said second
parameter is larger than that of said first parameter
and said first amount is larger than said second
5 amount.

 22. An image processing method comprising
steps of:
 input step of inputting image data;
10 first encoding step of encoding the image
data with first parameter;
 second encoding step of encoding the image
data with second parameter;
 first counting step of counting first amount
15 of encoded image data encoded in said first encoding
step;
 second counting step of counting second
amount of encoded image data encoded in said second
encoding step; and
20 calculating means for calculating third
parameter, with which the image data is encoded to a
predetermined amount of data, by a primary
approximation by using the first and the second
amounts of encoded image data.

25



ABSTRACT

IMAGE PROCESSING APPARATUS

1

-

An image processing apparatus including:
an input device for inputting image data; a first
encoding device for encoding the image data with
5 first parameter; a second encoding device for
encoding the image data with second parameter; a
first counting device for counting the first amount
of encoded image data encoded by the first encoding
device; a second counting device for counting second
10 amount of encoded image data encoded by the second
encoding device; and a calculating device for
calculating third parameter, with which the image
data is encoded to a predetermined amount of encoded
data, in accordance with both of the first and the
15 second amounts of encoded image data.

20

25

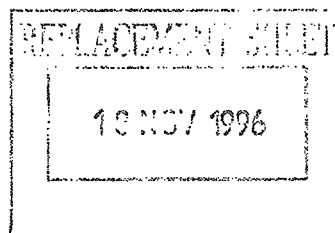
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- 52 -

ABSTRACTIMAGE PROCESSING APPARATUS

An image processing apparatus including: an input device for inputting image data; a first encoding device for encoding the image data with first parameter; a second encoding device for encoding the image data with second parameter; a first counting device for counting the first amount of encoded image data encoded by the first encoding device; a second counting device for counting second amount of encoded image data encoded by the second encoding device; and a calculating device for calculating third parameter, with which the image data is encoded to a predetermined amount of encoded data, in accordance with both of the first and the second amounts of encoded image data.

FIGURE 1

1-1010930
1010930
1010930



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REPLACEMENT SHEET

What is claimed is :

1. An image processing apparatus comprising :
input means for inputting image data;
first counting means for counting a first encoded data amount
corresponding to first encoded image data encoded by using a first control
coefficient which determines the first encoded data amount;
second counting means for counting a second encoded data amount
corresponding to second encoded image data encoded by using a second control
coefficient which determines the second encoded data amount; and
generating means for generating encoded image data corresponding to the
image data input by said input means in accordance with both the first and second
encoded data amounts,
wherein said first and second counting means perform counting operations
of the first and second encoded data amounts on the same image data in parallel.
2. An image processing apparatus according to claim 1, further comprising
determining
means for calculating a third control coefficient by using the first encoded data
amount and the second encoded data amount.
3. An image processing apparatus according to claim 1, further comprising
first and second
encoding means each of which includes quantizing means and said control
coefficient is a quantizing step.
4. An image processing apparatus according to claim 3, wherein said first
and second
encoding means perform encoding in parallel.

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5. An image processing apparatus according to claim 1, wherein the value of the second control coefficient is larger than that of the first control coefficient and the first amount of encoded image data is larger than the second amount of encoded image data.

6. An image processing method comprising:
an input step of inputting image data ;
a first counting step of counting a first encoded data amount corresponding to first encoded image data encoded by using a first control coefficient which determines the first encoded data amount;
a second counting step of counting a second encoded data amount corresponding to second encoded image data encoded by using a second control coefficient which determines the second encoded data amount; and
a generating step of generating encoded image data corresponding to the image data input in said input step in accordance with both the first and second encoded data amounts,
wherein said first and second counting steps are performed for generating the first and second encoded data amounts on the same image data in parallel.

7. An image processing apparatus comprising :
input means for inputting image data;
first encoding means for encoding the image data with a first control coefficient which determines a first encoded data amount;
second encoding means for encoding the image data with a second control coefficient which determines a second encoded data amount;
first counting means for counting the first encoded data amount of image data encoded by said first encoding means;
second counting means for counting the second encoded data amount of image data encoded by said second encoding means; and



generating means for generating encoded image data corresponding to the image data input by said input means,
wherein said generating means has a first mode in which the encoded image data is generated in accordance with both the first and second encoded data amounts and a second mode in which the encoded image data is generated by using a predetermined fixed control coefficient which determines a third encoded data amount.

8. An image processing apparatus according to claim 7, wherein said first and second encoding means perform encoding by employing orthogonal transformation.
9. An image processing apparatus according to claim 7, wherein said first and second encoding means perform encoding in parallel.
10. An image processing apparatus according to claim 7, wherein said input means sequentially inputs a plurality of pictures.
11. An image processing apparatus according to claim 7, further comprising memory means for storing said predetermined fixed parameter.
12. An image processing method comprising :
an input step of inputting image data :
a first encoding step of encoding the image data with a first control coefficient which determines a first encoded data amount;



a second encoding step of encoding the image data with a second control coefficient which determines a second encoded data amount;
a first counting step of counting the first encoded data amount of image data encoded in the first encoding step;
a second counting step of counting the second encoded data amount of image data encoded in the second encoding step; and
a generating step of generating encoded image data corresponding to the image data input by said input step,
wherein said generating step has a first mode in which the encoded image data is generated in accordance with both the first and second encoded data amounts and a second mode in which the encoded image data is generated by using a predetermined fixed control coefficient which determines a third encoded data amount.

13. An image processing apparatus comprising :

input means for inputting image data;
first quantizing means for quantizing the image data with a first quantizing step ;
second quantizing means for quantizing the image data with a second quantizing step; and
third quantizing means for quantizing the image data with a third quantizing step,
wherein a difference between said second quantizing step and said third quantizing step is larger than a difference between said first quantizing step and said second quantizing step when the first quantizing step, the second quantizing step and the third quantizing step increase in sequential order.

14. An image processing apparatus according to claim 13 further comprising
counting means for
counting the amount of image data quantized by said first, second and third quantizing means.

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15. An image processing apparatus according to claim 14 further comprising processing means for processing the input data input by said input means in accordance with the amount counted by said counting means.

16. An image processing apparatus according to claim 15, wherein said processing means performs variable-length coding.

17. An image processing method comprising :
an input step of inputting image data;
a first quantizing step of quantizing the image data with a first quantizing coefficient which determines a first quantizing amount;
a second quantizing step of quantizing the image data with a second quantizing coefficient which determines a second quantizing amount; and
a third quantizing step of quantizing the image data with a third quantizing coefficient which determines a third quantizing amount,
wherein a difference between said second quantizing coefficient and said third quantizing coefficient is larger than a difference between said first quantizing coefficient and said second quantizing coefficient on the condition that the first quantizing coefficient, the second quantizing coefficient and the third quantizing coefficient increase in sequential order.

18. An image processing apparatus comprising :
input means for inputting image data;
first counting means for counting a first encoded data amount corresponding to first encoded image data encoded by using a first control coefficient which determines the first encoded data amount ;

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second counting means for counting a second encoded data amount corresponding to second encoded image data encoded by using a second control coefficient which determines the second encoded data amount; and determining means for determining a third control coefficient which determines a third encoded data amount, with which the image data is encoded to a predetermined amount of data, by a primary approximation by using the first and second encoded data amounts.

19. An image processing apparatus according to claim 18, further comprising first and second

encoding means, each of which includes quantizing means and said control coefficient is a quantizing step.

20. An image processing apparatus according to claim 18, wherein said first and second encoding means perform encoding in parallel.

21. An image processing apparatus according to claim 18, wherein the value of the said second control coefficient is larger than that of said first control coefficient and said first amount of encoded image data is larger than said second amount of encoded image data.

22. An image processing method comprising :
an input step of inputting image data;
a first counting step of counting a first encoded data amount corresponding to first encoded image data encoded by using a first control coefficient which determines the first encoded data amount :
a second counting step of counting a second encoded data amount corresponding to second encoded image data encoded by using a second control coefficient which determines the second encoded data amount ;

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a determining step of determining a third control coefficient which determines a third encoded data amount, with which the image data is encoded to a predetermined amount of data, by a primary approximation by using the first and the second encoded data amounts.

23. A image processing apparatus comprising :

input means for inputting image data;

first counting means for counting a first encoded data amount corresponding to first encoded image data encoded by using a first encoding control coefficient which determines the first encoded data amount ;

second counting means for counting a second encoded data amount corresponding to second encoded image data encoded by using a second encoding control coefficient which determines the second encoded data amount; and

generating means for generating encoded image data corresponding to the image data input by said input means,

wherein said generating means has a first mode in which the encoded image data is generated in accordance with both the first and second encoded data amounts and a second mode in which the encoded image data is generated by using a predetermined fixed control coefficient which determines a third encoded data amount.

24. An image processing apparatus according to claim 23, wherein said

generating means performs

the encoding by employing an orthogonal transformation.

25. An image processing apparatus according to claim 23, wherein said first and second counting

means perform the counting in parallel.

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26. An image processing apparatus according to claim 23, wherein said input means sequentially inputs a plurality of pictures.

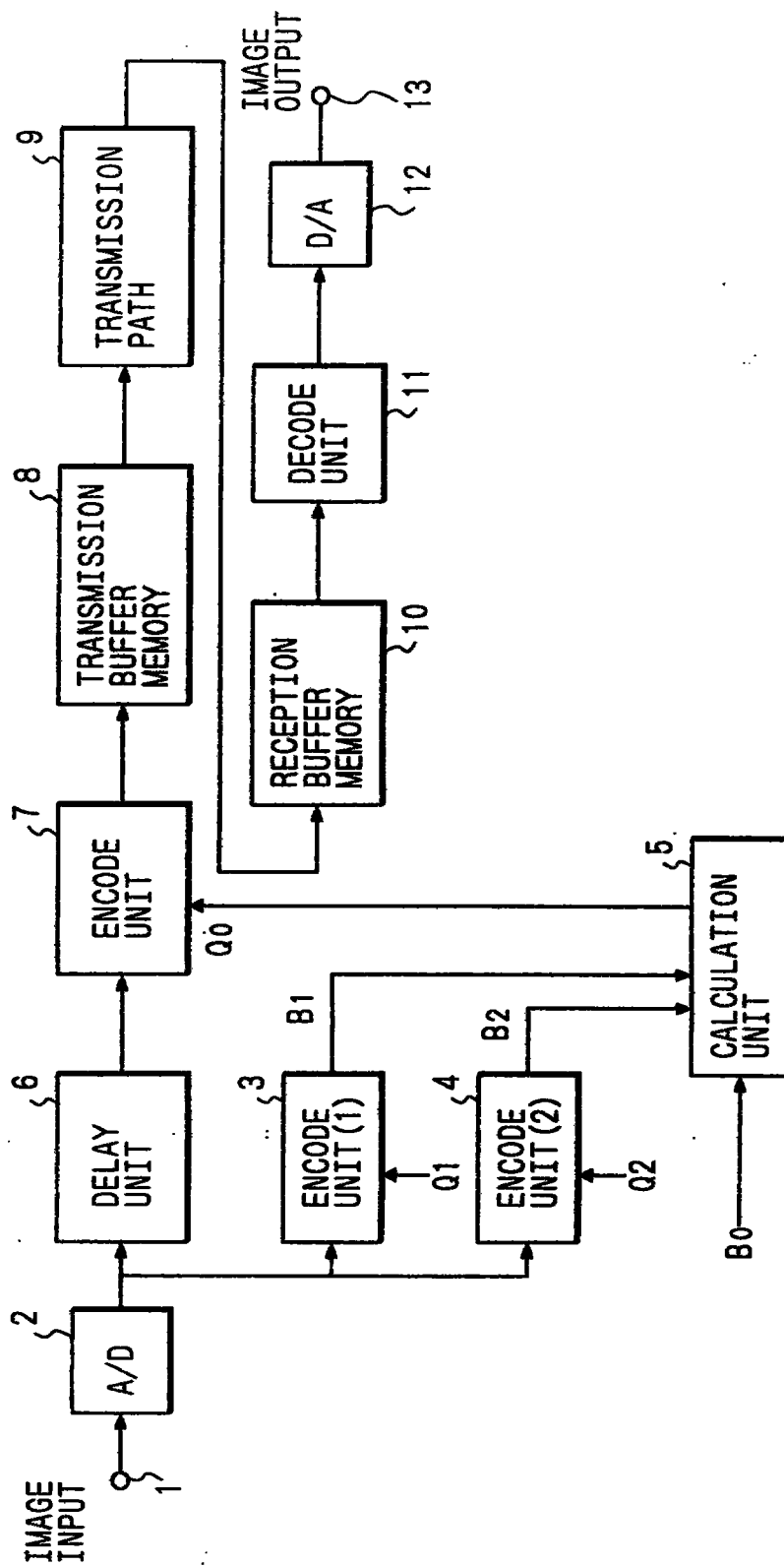
27. An image processing apparatus according to claim 23, further comprising memory means for storing the predetermined fixed control coefficient.

28. An image processing method comprising :
an input step of inputting the image data;
a first counting step of counting a first encoded data amount corresponding to first encoded image data encoded by using a first encoding control coefficient which determines the first encoded data amount;
a second counting step of counting a second encoded data amount corresponding to second encoded image data encoded by using a second encoding control coefficient which determines the second encoded data amount; and a generating step of generating encoded image data corresponding to the image data input by said input step, wherein said generating step has a first mode in which the encoded image data is generated in accordance with both the first and second encoded data amounts and a second mode in which the encoded image data is generated by using a predetermined fixed control coefficient which determines a third encoded data amount.

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FIG. 1



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FIG. 2

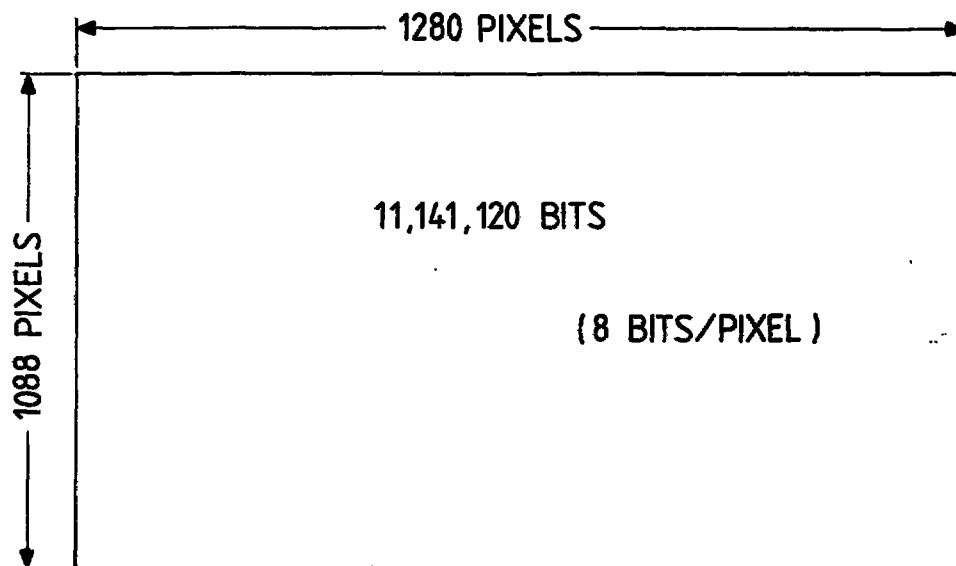


FIG. 3

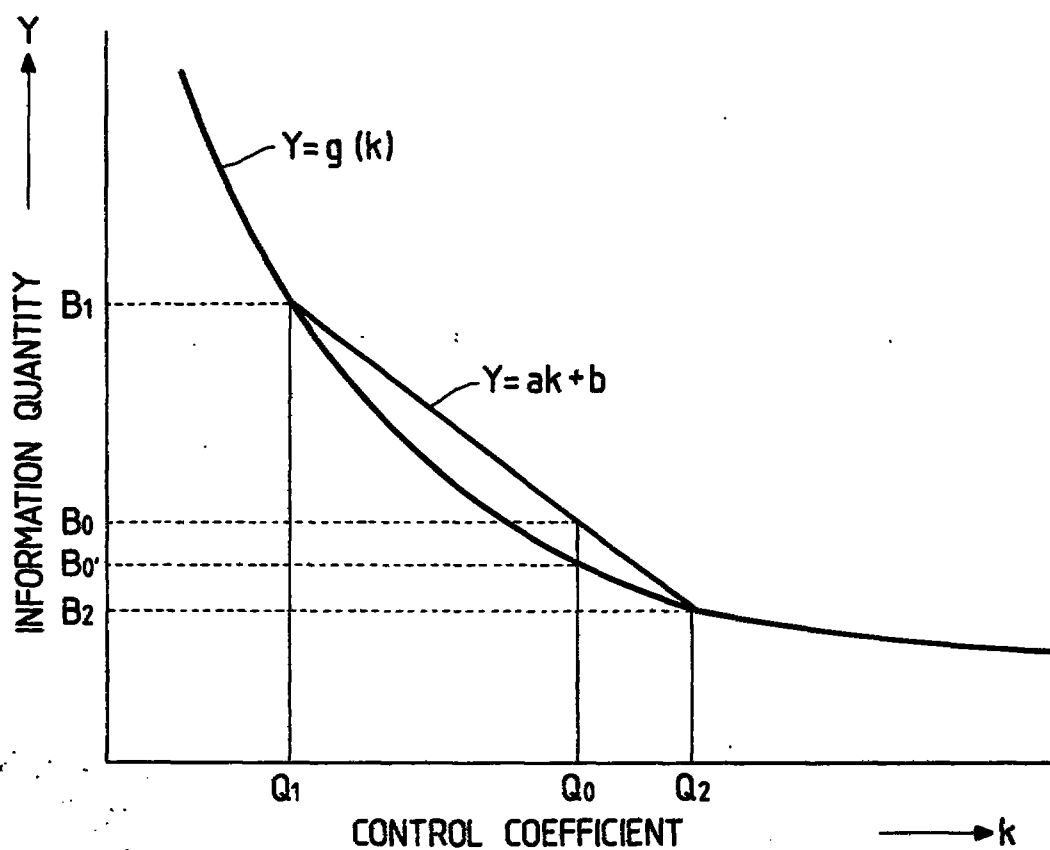
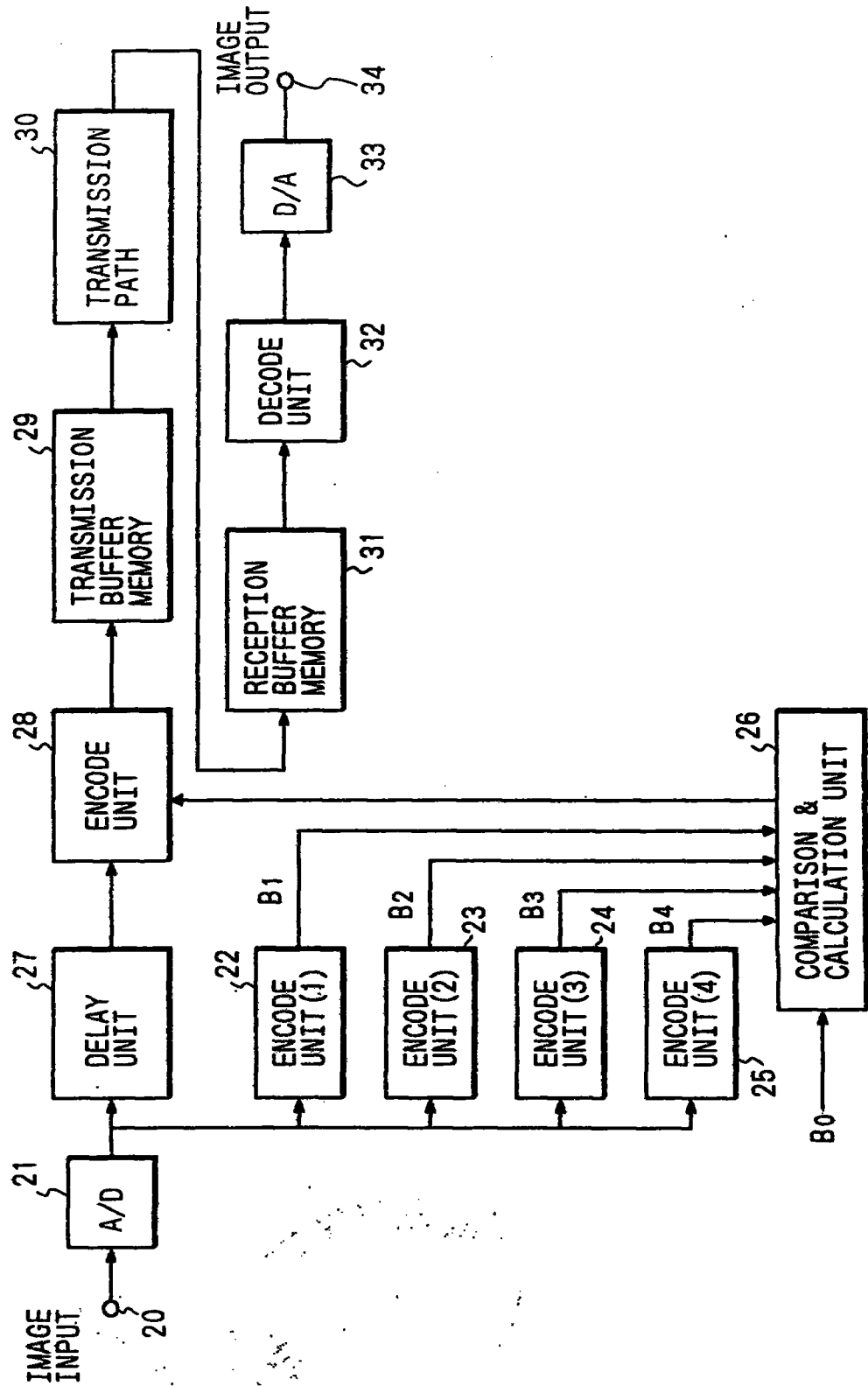


FIG. 4



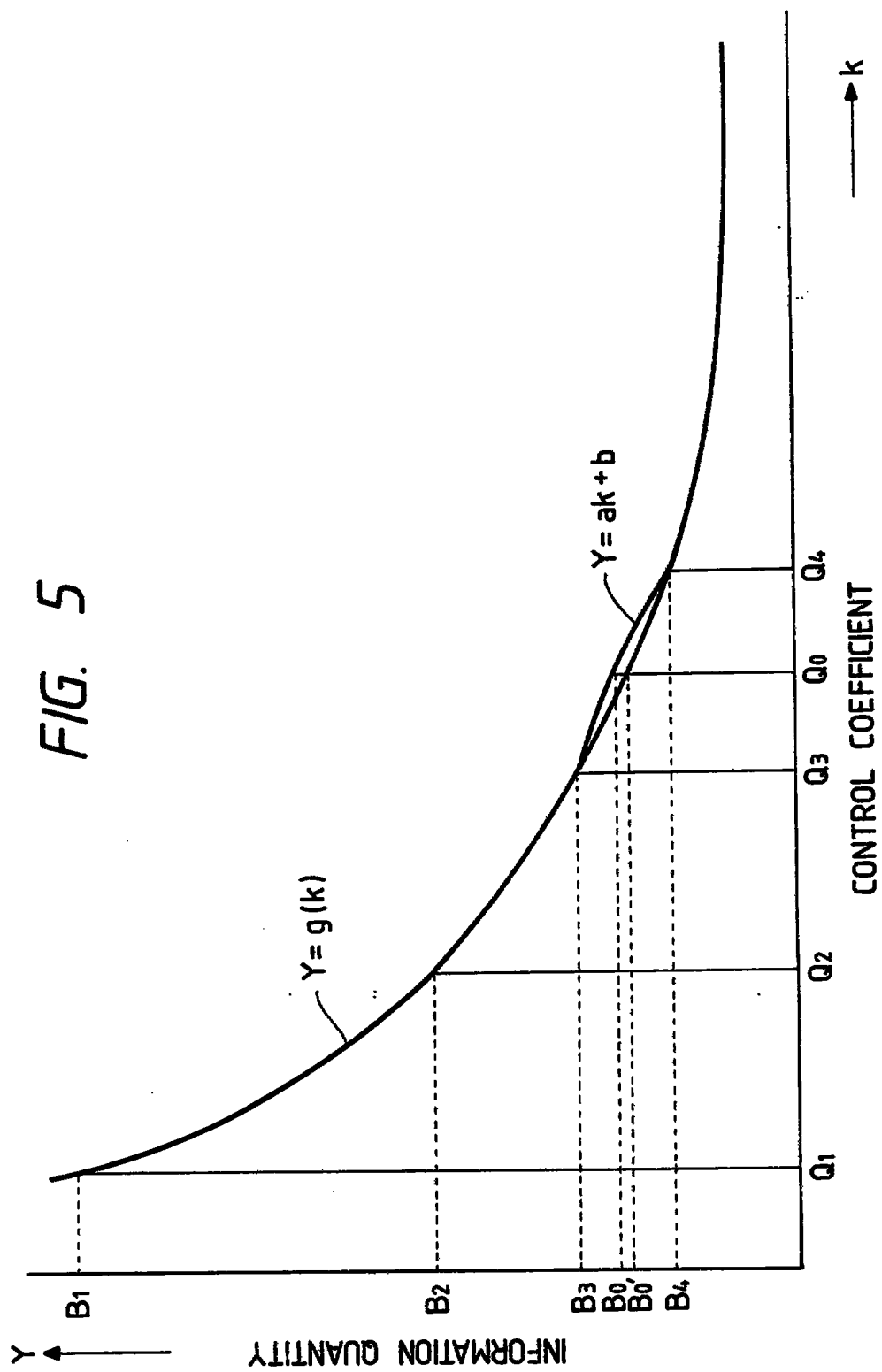


FIG. 6

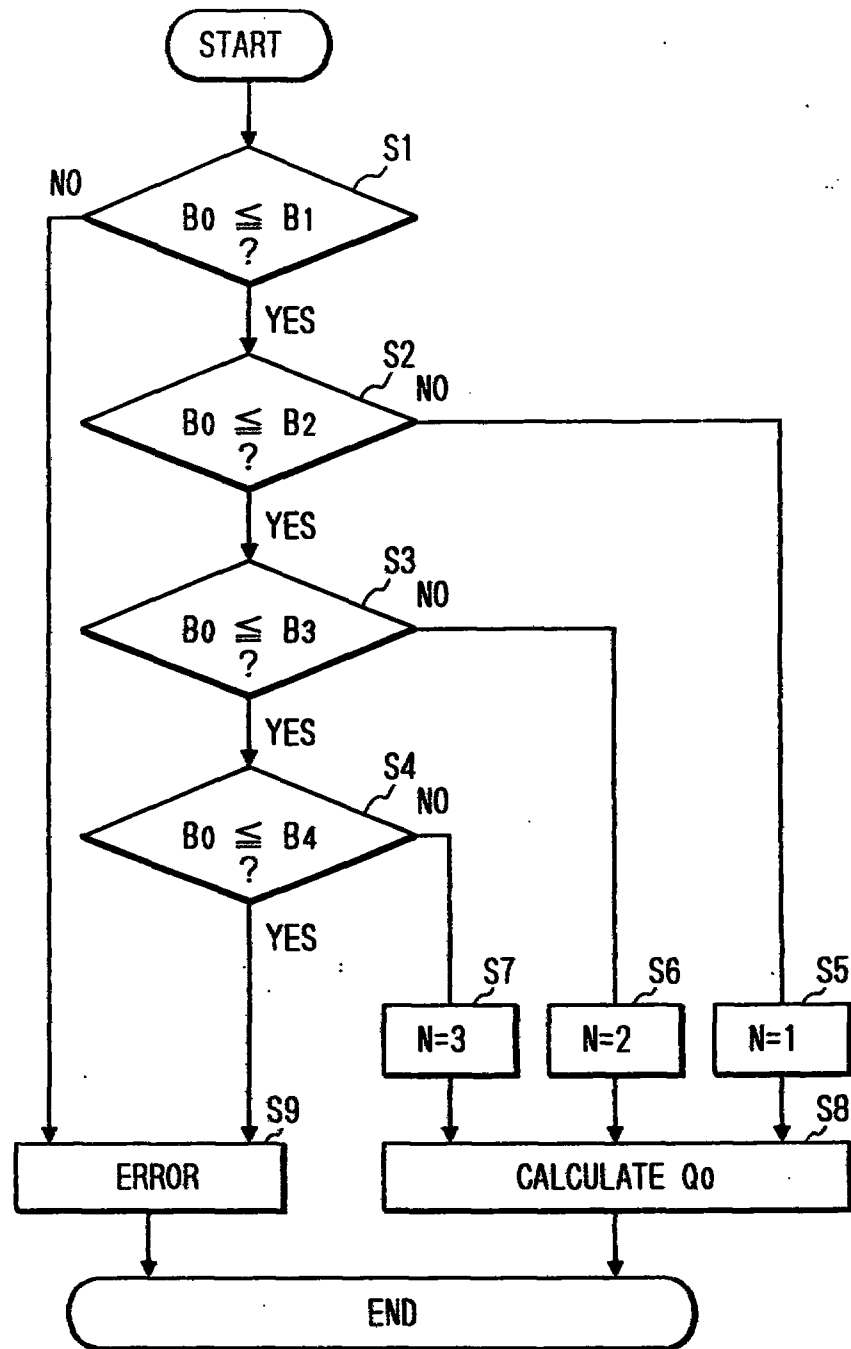


FIG. 7

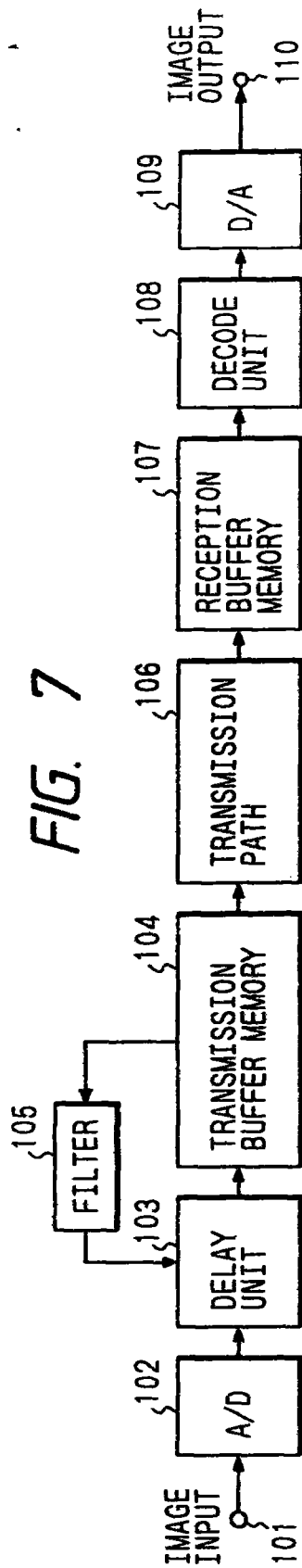


FIG. 8

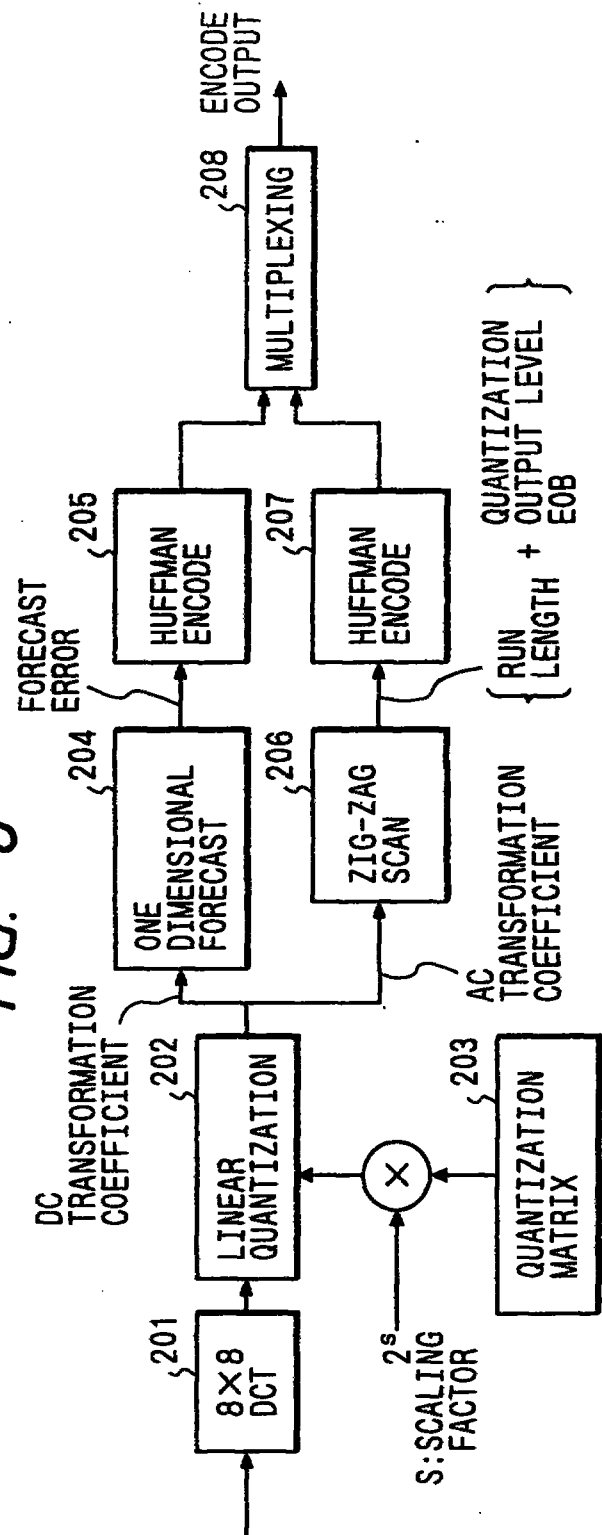


FIG. 9

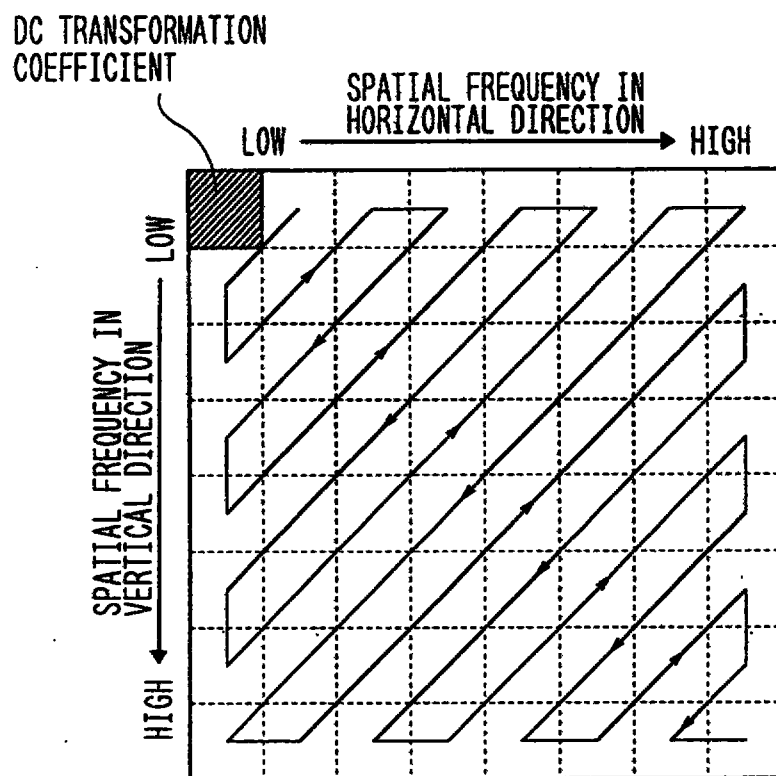


FIG. 10

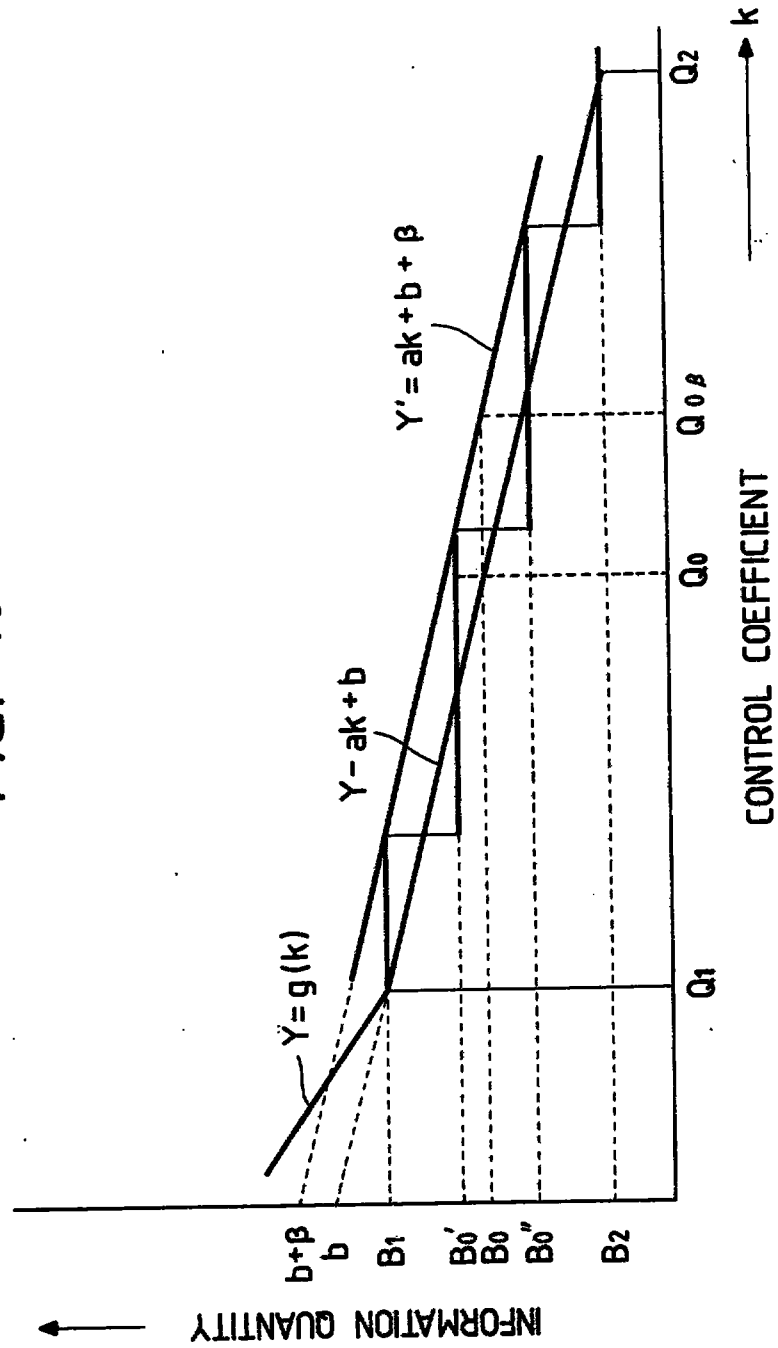


FIG. 11

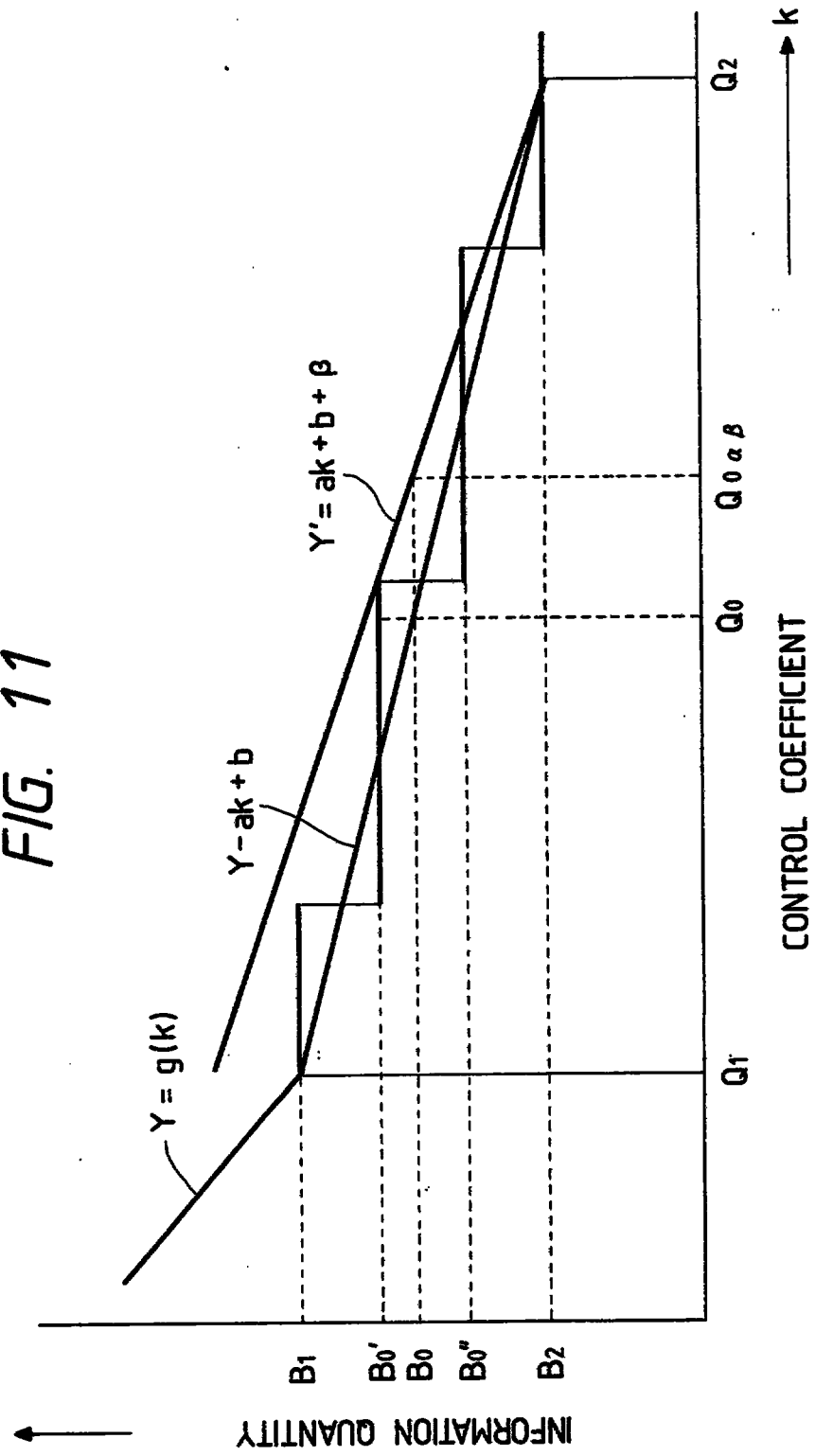


FIG. 12

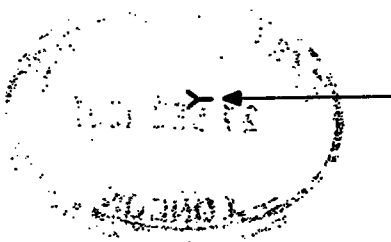
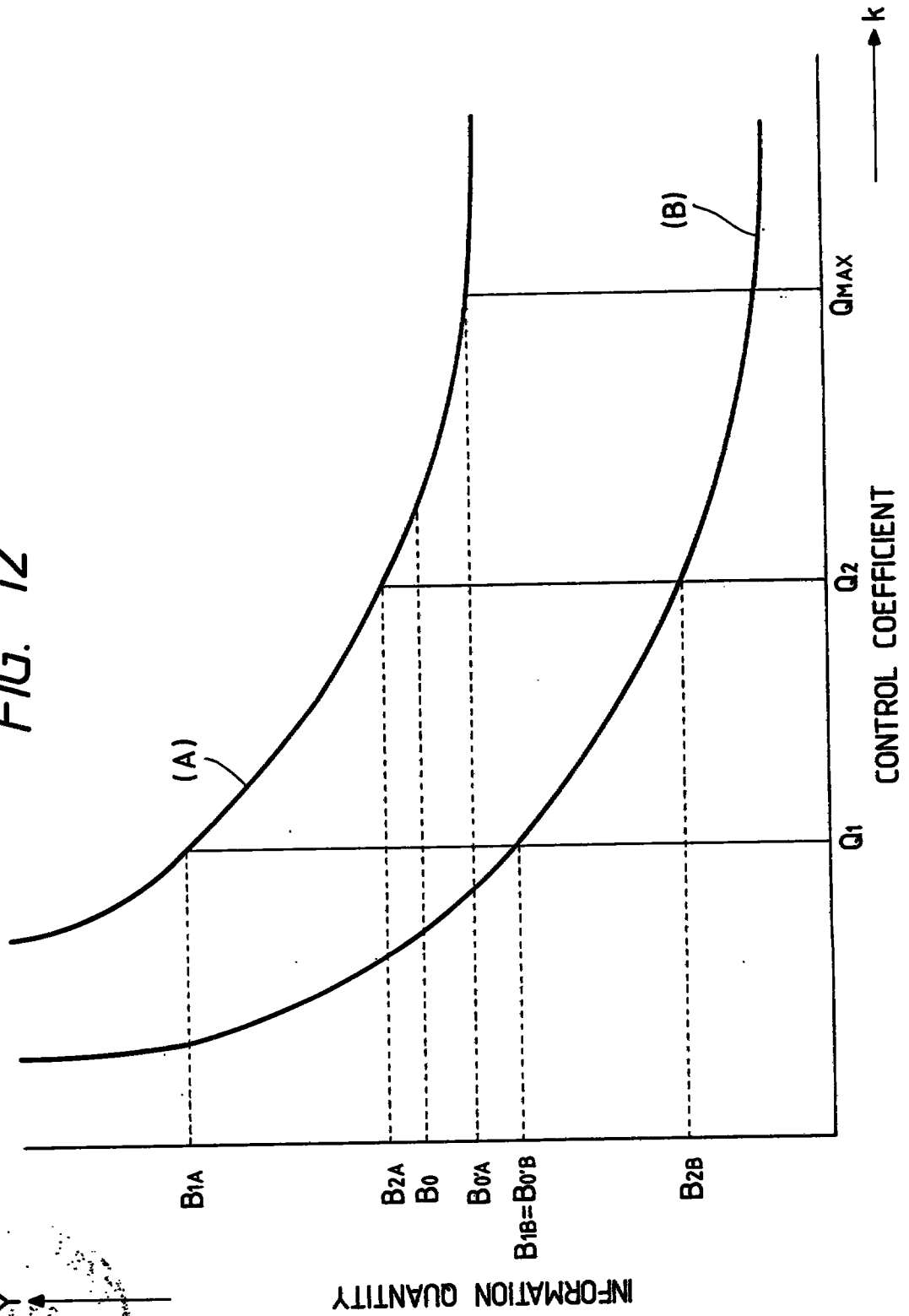


FIG. 13

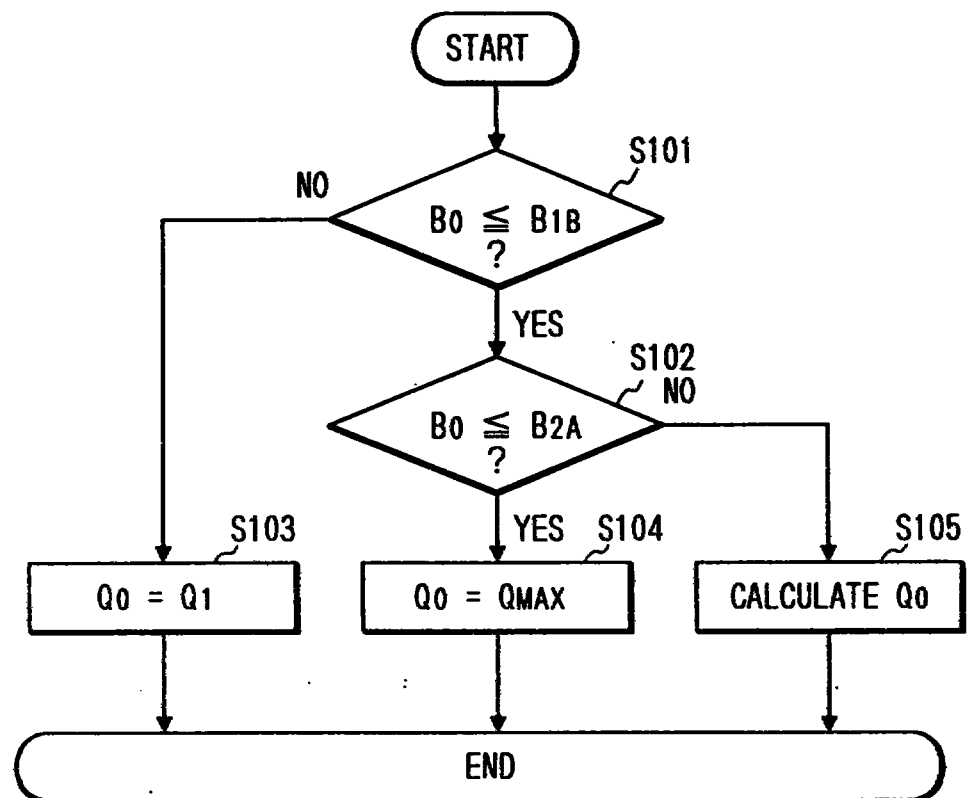


FIG. 15

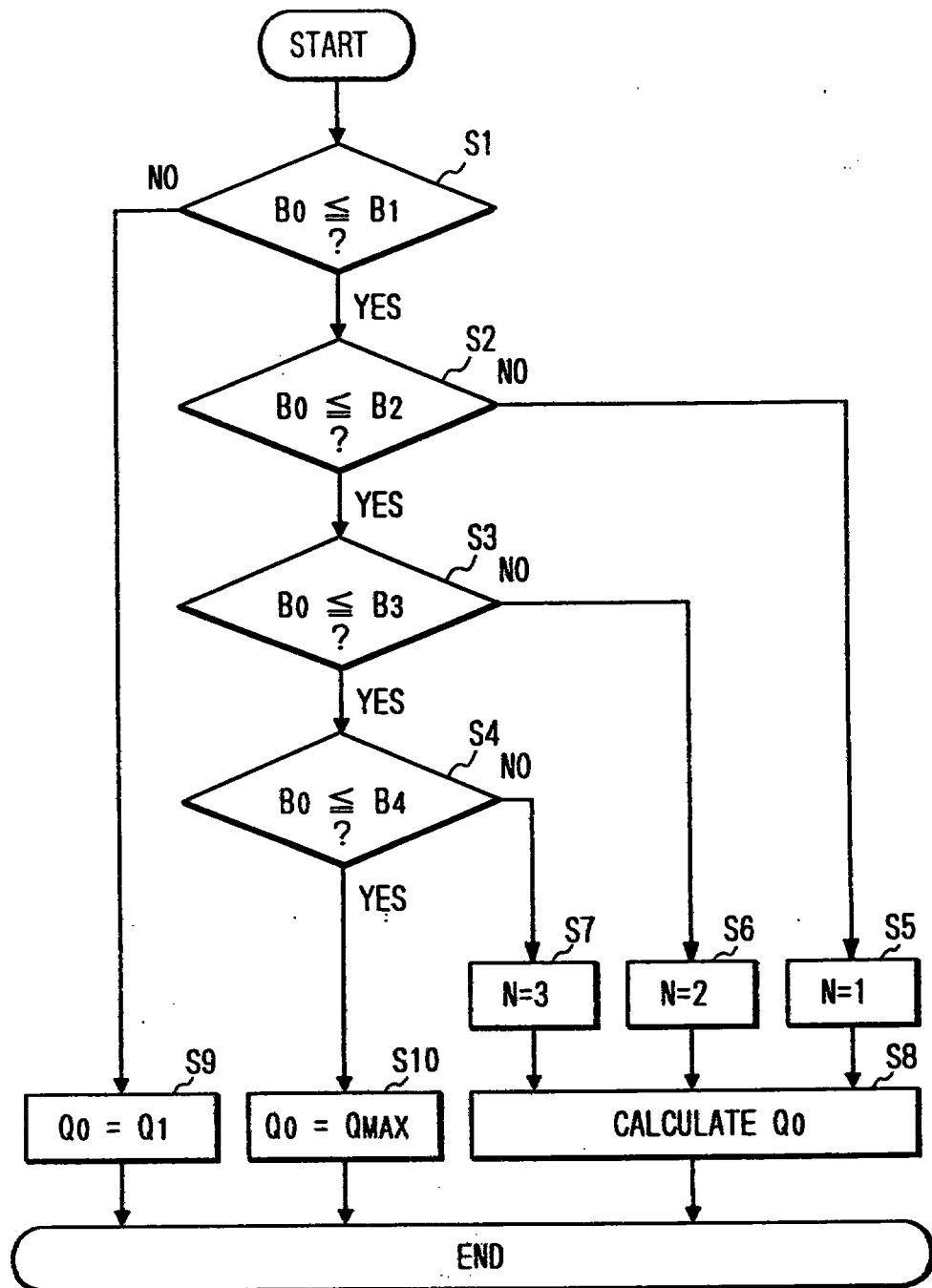


FIG. 17

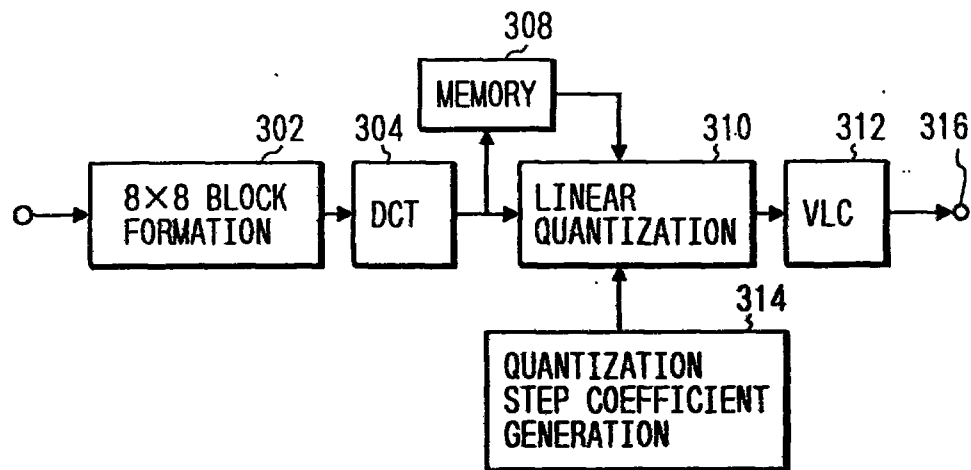


FIG. 18

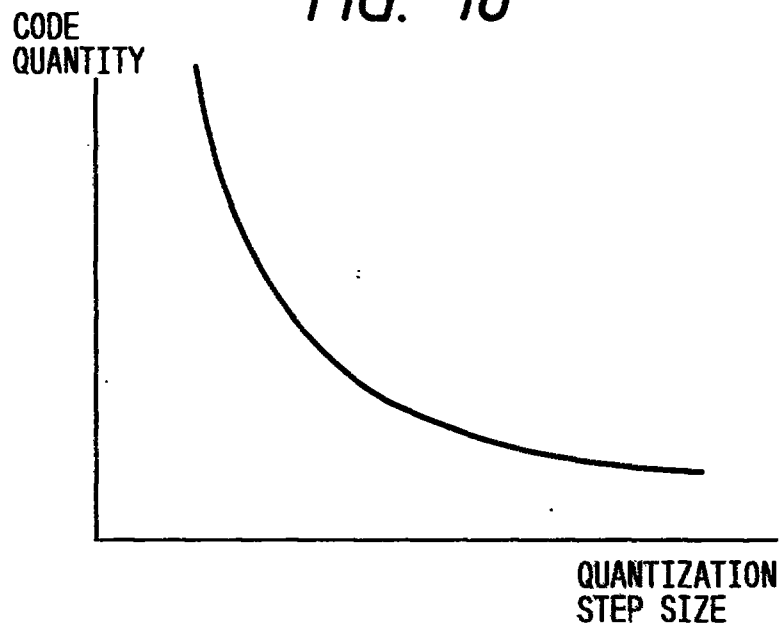


FIG. 19

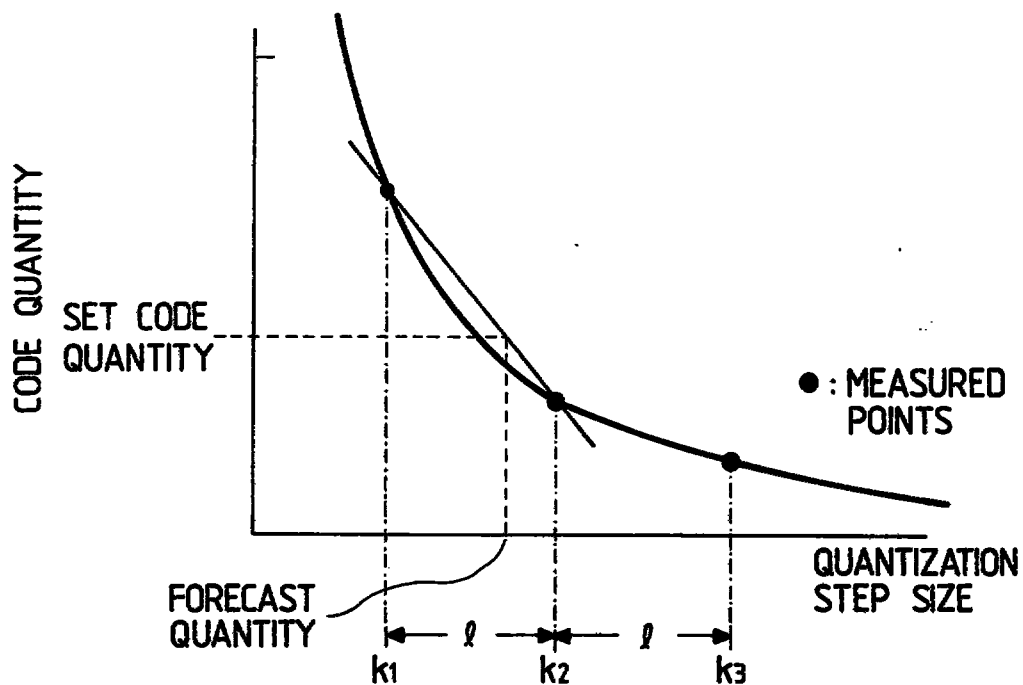


FIG. 20

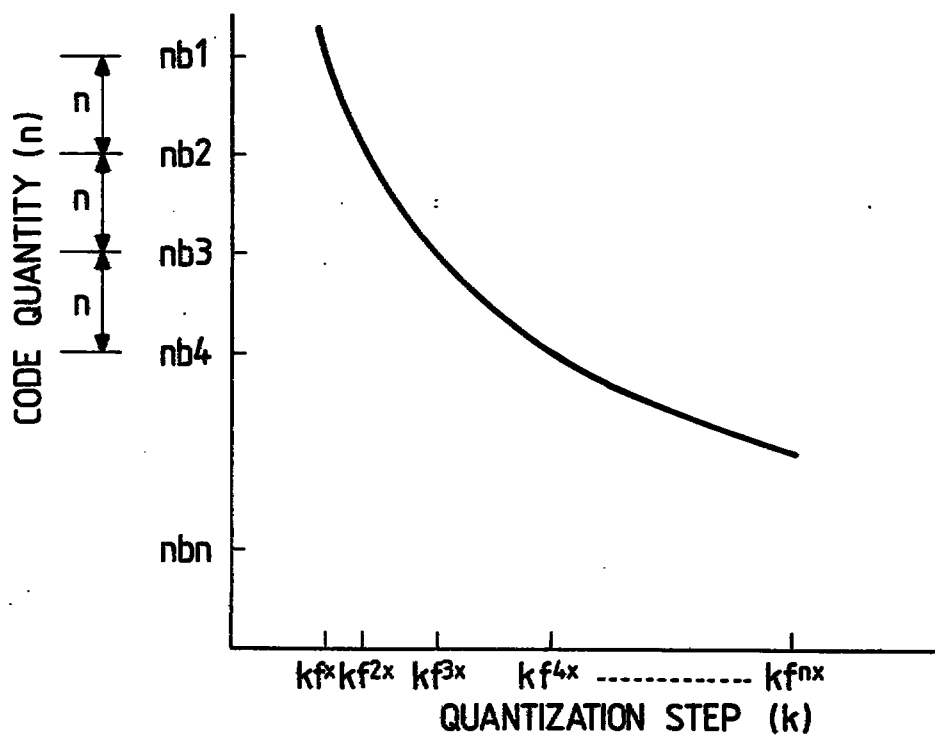


FIG. 21

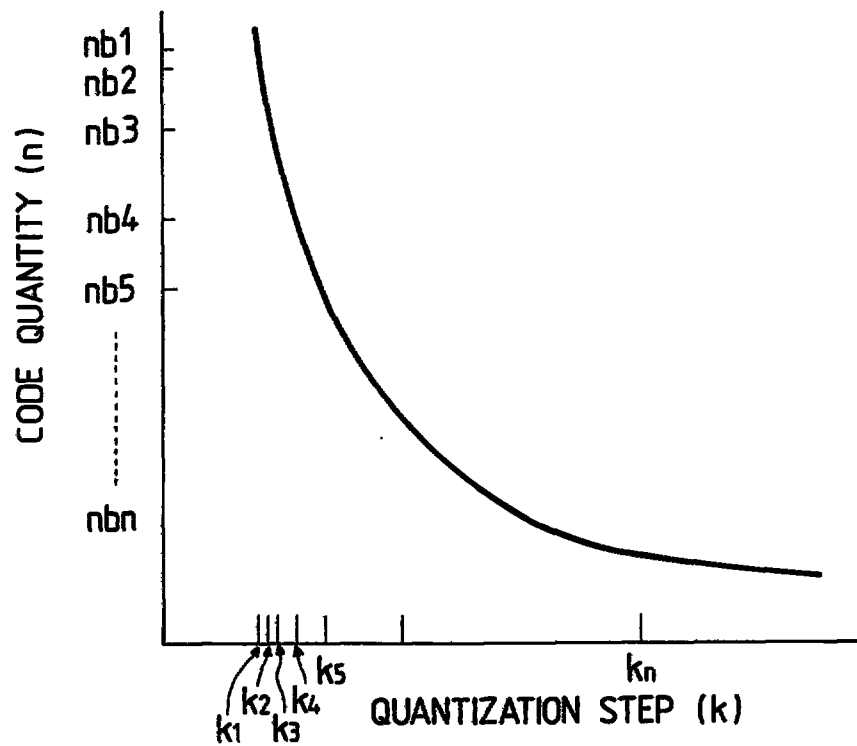


FIG. 22

