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(54) VIDEO DECODING DEVICE AND VIDEO DECODING METHOD

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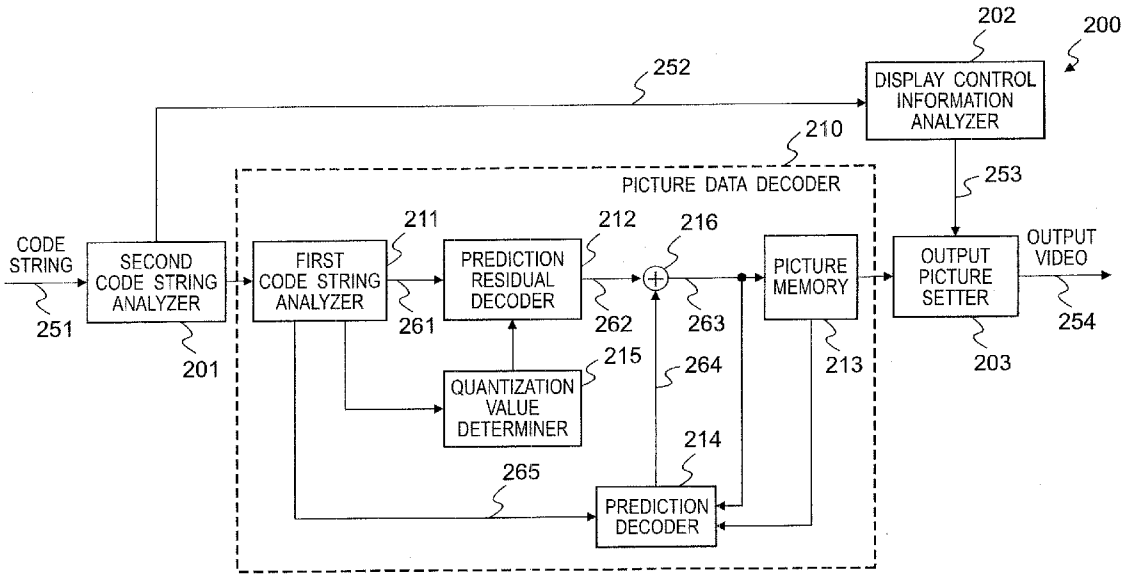
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USPC **375/240.25**

(57) **ABSTRACT**

A video decoding device, in the case where a video of the progressive format is inputted, processes a frame as a picture, in the case where a video of the interlace format is inputted, processes a field as a picture. A video decoding device performs display control corresponding to a format of the both video by analyzing display control information in display control information analyzer. The display control information includes sequence unit display control information which is commonly used in a display process of all pictures that belong to a sequence to be decoded and picture unit display control information which is individually used in a display process of a picture to be decoded. A second code string analyzer acquires each of the sequence unit display control information and the picture unit display control information from an extended information area in units of pictures.



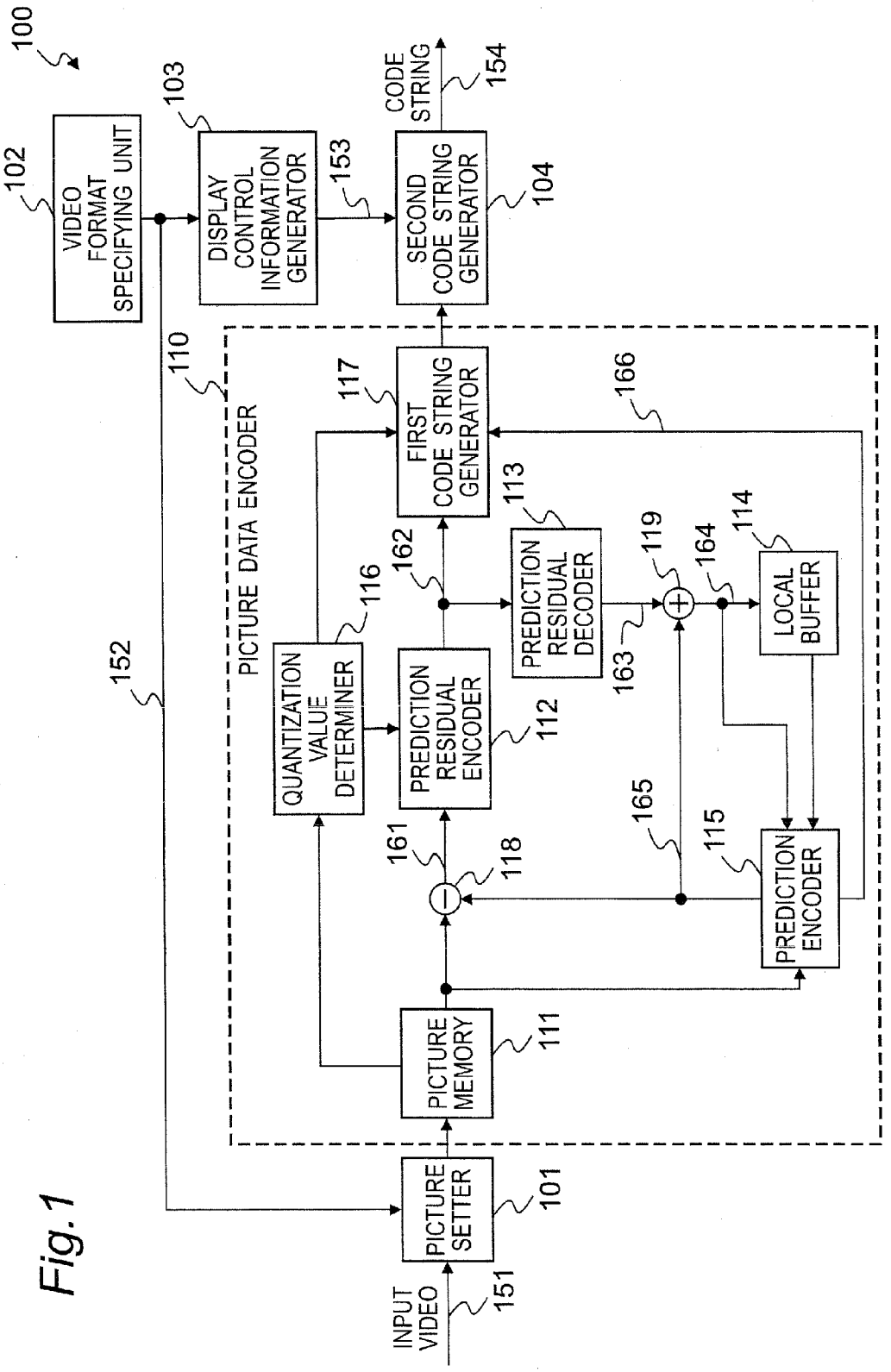

100
VIDEO FORMAT SPECIFYING UNIT
102
DISPLAY CONTROL INFORMATION GENERATOR
103
153
SECOND CODE STRING GENERATOR
104
CODE STRING
154
110
PICTURE DATA ENCODER
FIRST CODE STRING GENERATOR
117
166
QUANTIZATION VALUE DETERMINER
116
162
PREDICTION RESIDUAL DECODER
113
119
164
LOCAL BUFFER
114
152
PREDICTION RESIDUAL ENCODER
112
163
161
118
165
115
PREDICTION ENCODER
PICTURE MEMORY
111
PICTURE SETTER
101
INPUT VIDEO
151

Fig. 1

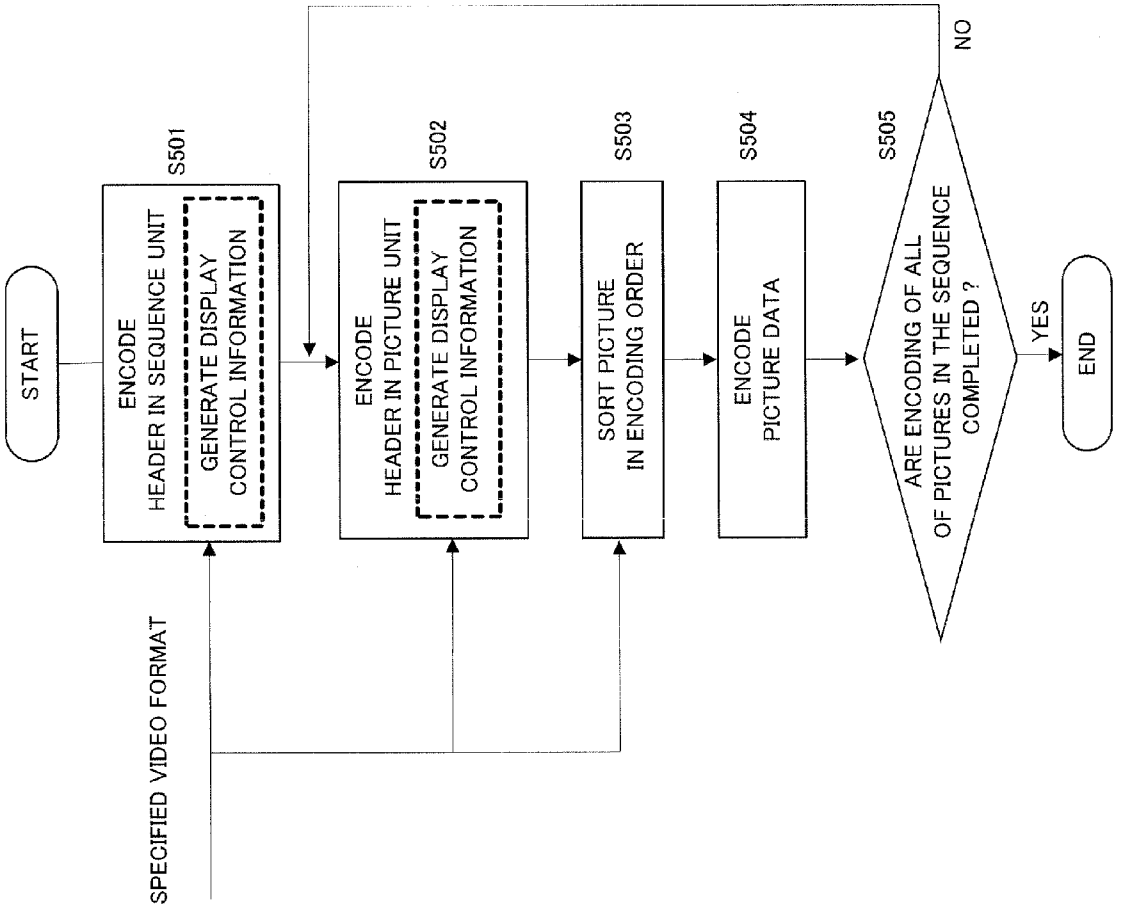

START
ENCODE HEADER IN SEQUENCE UNIT
GENERATE DISPLAY CONTROL INFORMATION
S501
ENCODE HEADER IN PICTURE UNIT
GENERATE DISPLAY CONTROL INFORMATION
S502
SORT PICTURE IN ENCODING ORDER
S503
ENCODE PICTURE DATA
S504
ARE ENCODING OF ALL OF PICTURES IN THE SEQUENCE COMPLETED ?
S505
NO
YES
END
SPECIFIED VIDEO FORMAT

Fig.2

Fig.3

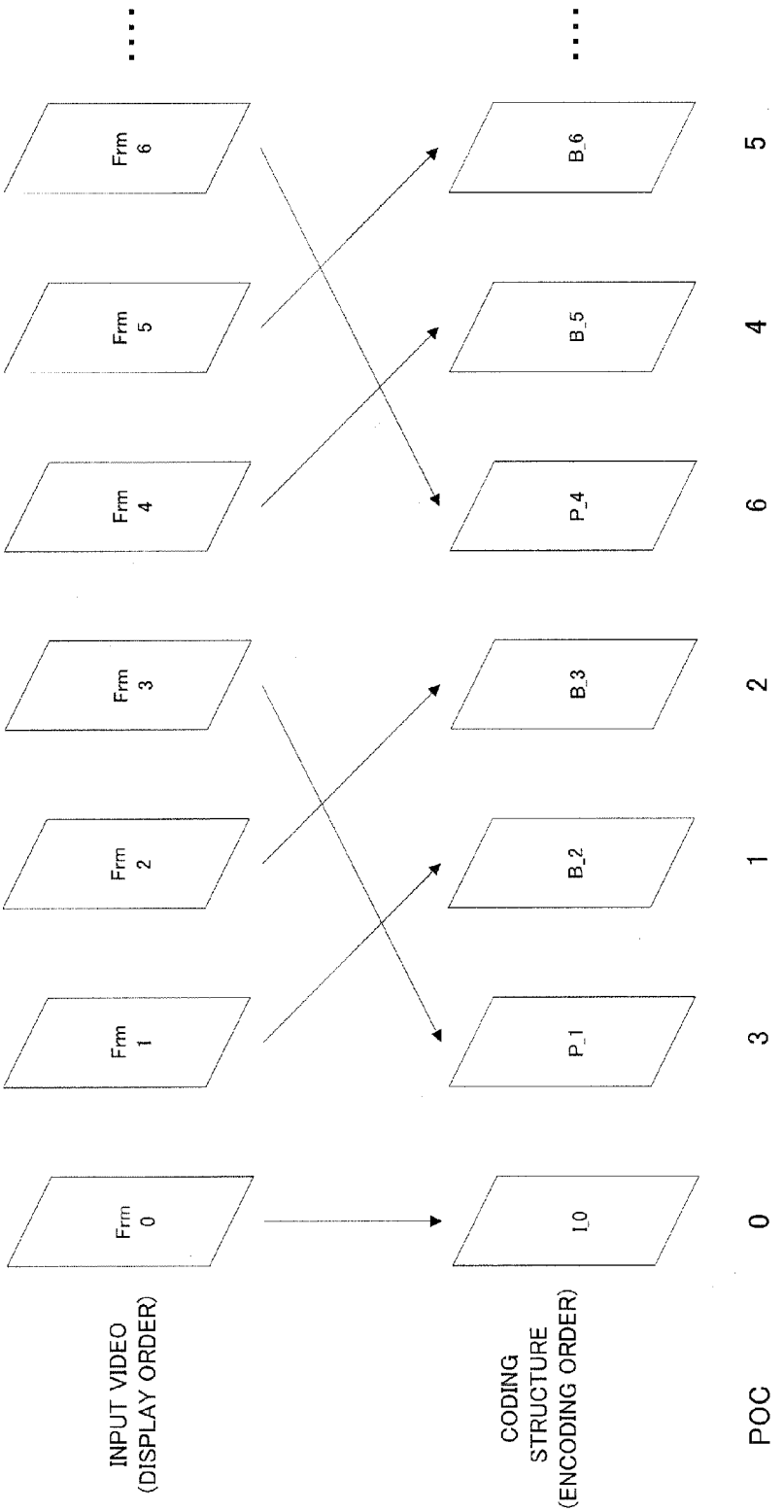

INPUT VIDEO
(DISPLAY ORDER)
CODING
STRUCTURE
(ENCODING ORDER)
POC
Frm 0
Frm 1
Frm 2
Frm 3
Frm 4
Frm 5
Frm 6
I_0
P_1
B_2
B_3
P_4
B_5
B_6
0
3
1
2
6
4
5

Fig.4

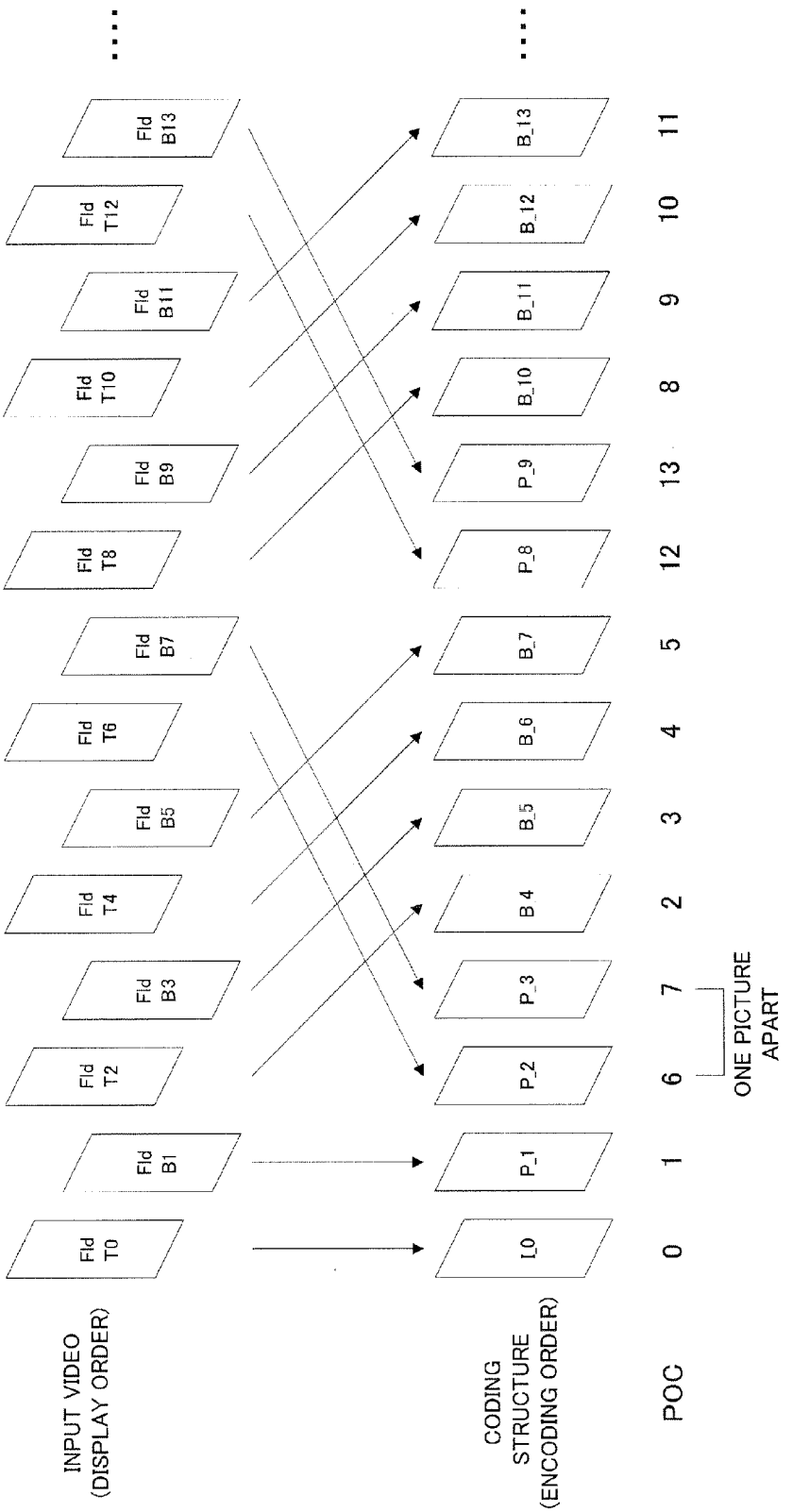
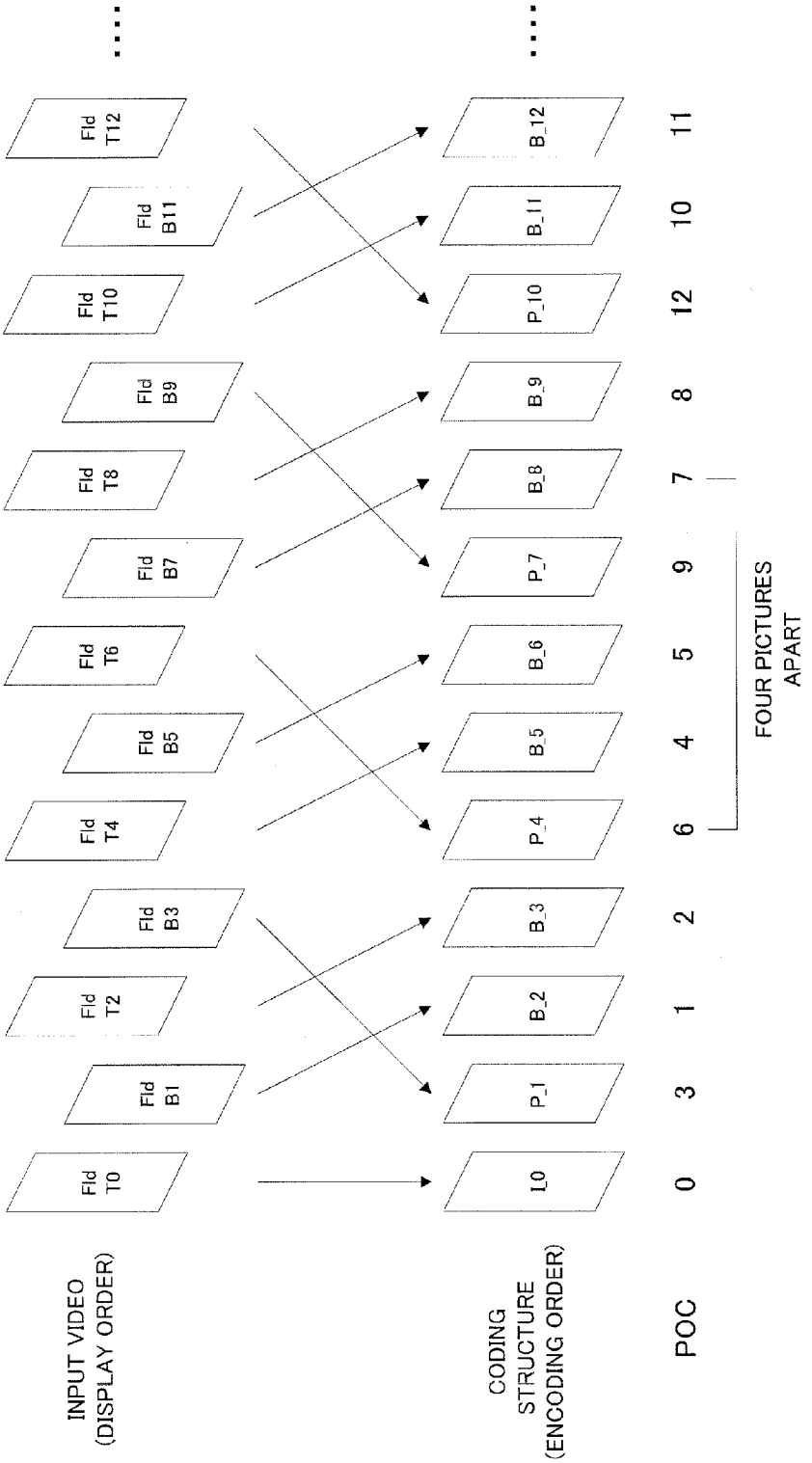

INPUT VIDEO (DISPLAY ORDER)
CODING STRUCTURE (ENCODING ORDER)
POC
Fld T0
Fld B1
Fld T2
Fld B3
Fld T4
Fld B5
Fld T6
Fld B7
Fld T8
Fld B9
Fld T10
Fld B11
Fld T12
Fld B13
I_0
P_1
P_2
P_3
B 4
B_5
B_6
B_7
P_8
P_9
B_10
B_11
B_12
B_13
0
1
6
7
2
3
4
5
12
13
8
9
10
11
ONE PICTURE APART

Fig.5


INPUT VIDEO
(DISPLAY ORDER)
CODING
STRUCTURE
(ENCODING ORDER)
POC
0
3
1
2
6
4
5
9
7
8
12
10
11
Fld T0
Fld B1
Fld T2
Fld B3
Fld T4
Fld B5
Fld T6
Fld B7
Fld T8
Fld B9
Fld T10
Fld B11
Fld T12
I0
P_1
B_2
B_3
P_4
B_5
B_6
P_7
B_8
B_9
P_10
B_11
B_12
FOUR PICTURES
APART

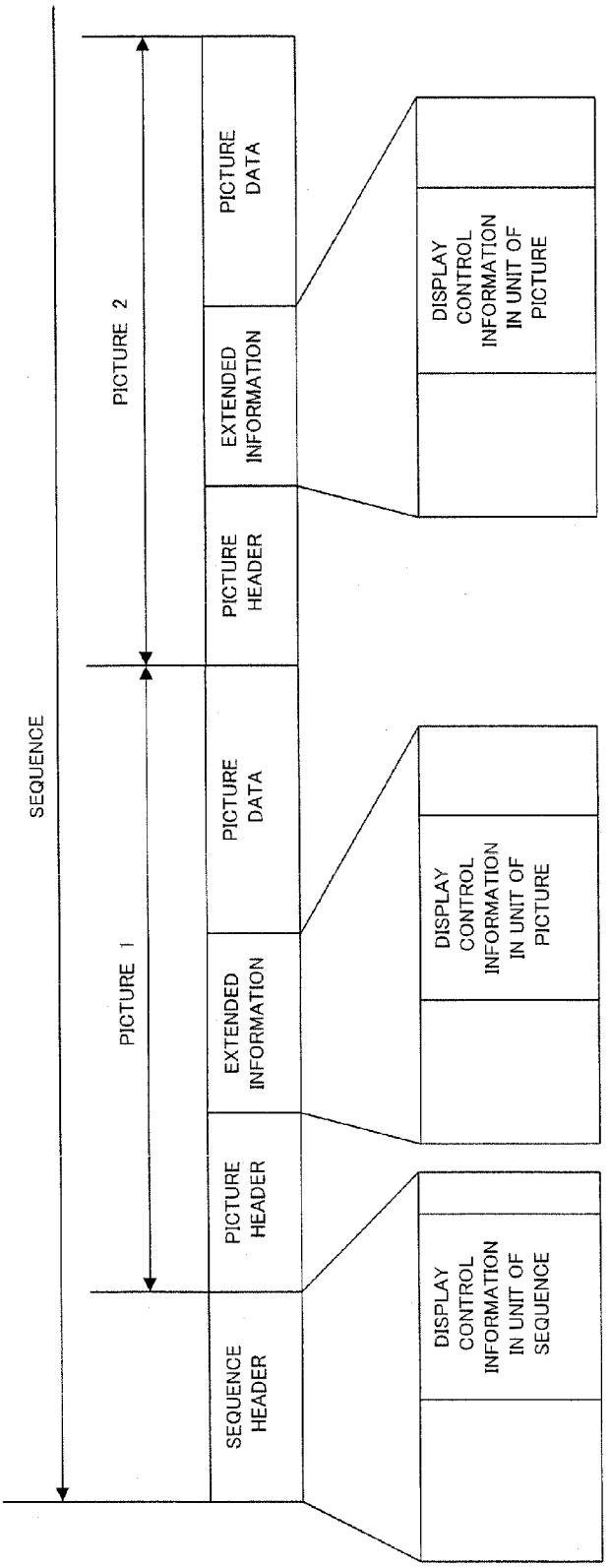

SEQUENCE
PICTURE 1
PICTURE 2
SEQUENCE HEADER
PICTURE HEADER
EXTENDED INFORMATION
PICTURE DATA
PICTURE HEADER
EXTENDED INFORMATION
PICTURE DATA
DISPLAY CONTROL INFORMATION IN UNIT OF SEQUENCE
DISPLAY CONTROL INFORMATION IN UNIT OF PICTURE
DISPLAY CONTROL INFORMATION IN UNIT OF PICTURE

Fig.6

Fig.7

```
seq_parameter_set_data( ) {
    ......
    vui_parameters ( ) {
        ......
        interlace_flag;
        if ( interlace_flag == 1 ) {
            continual_flag;
            if ( continual_flag == 0 ) {
                max_distance_num;
            }
        }
        ......
    }
}
```

interlace_flag;

0 : video format is progressive format

1 : video format is interlace format

continual_flag;

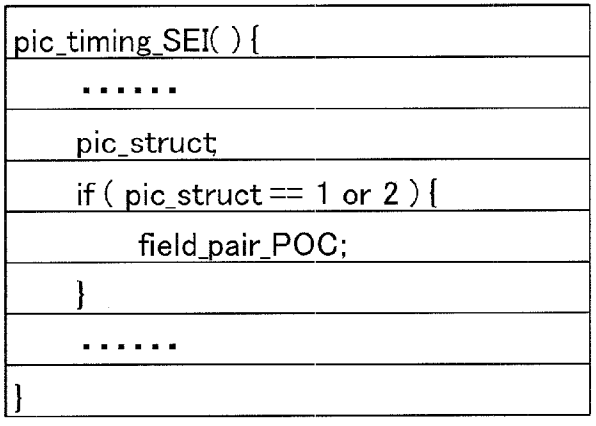
0 : top field and the bottom field are not continual in encoding order

1 top field and the bottom field are continual in encoding order

max_distance_num;

maximum number of pictures in which top field and bottom field belonging to the same frame apart from each other in the encoding order in sequence

Fig.8



pic_struct

0 : frame

1 : top field

2 : bottom field

.....

field_pair_POC;

specifying POCs of a pair of fields about frame belonging to objective field

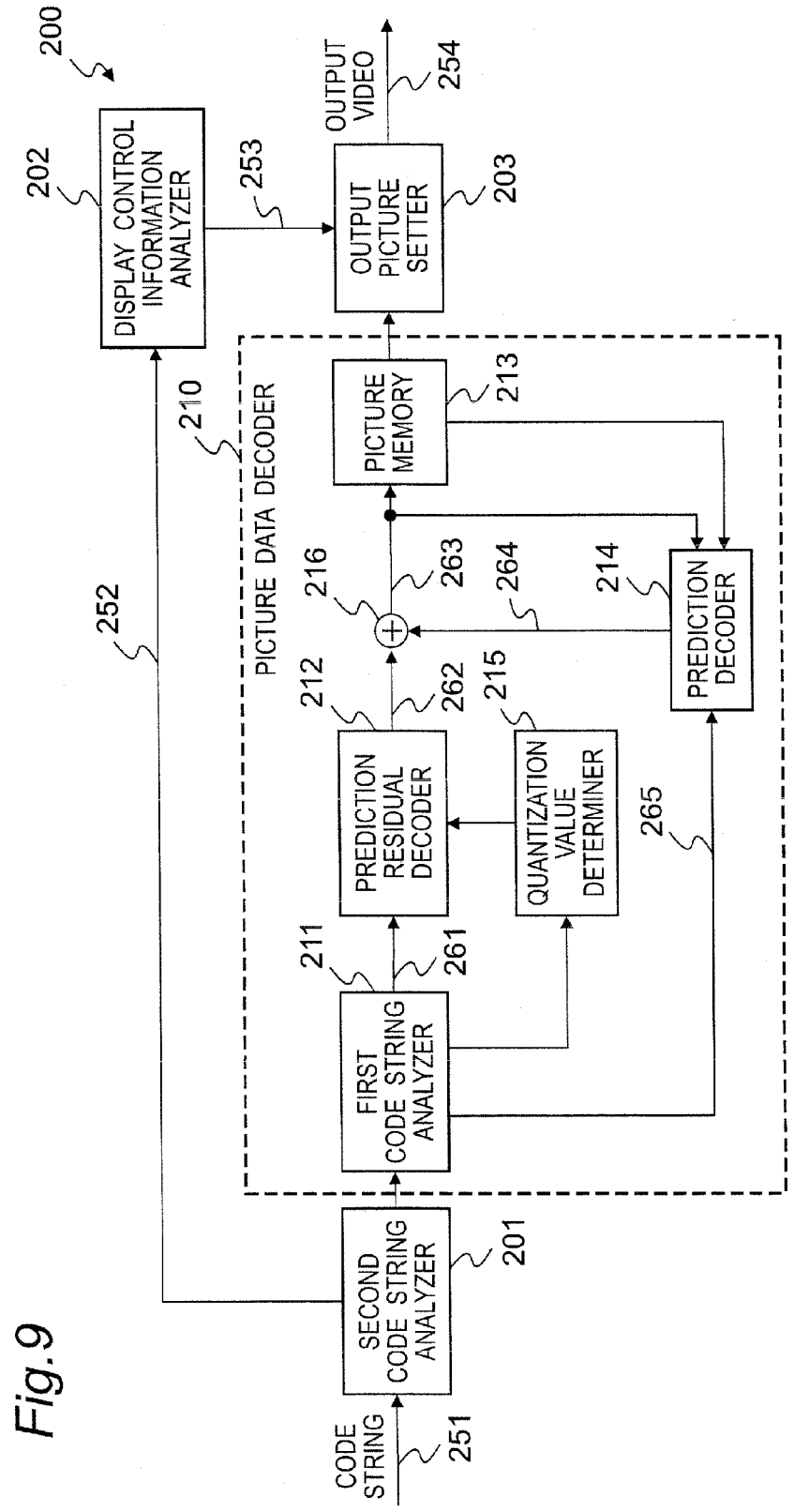

200
202
DISPLAY CONTROL INFORMATION ANALYZER
253
OUTPUT PICTURE SETTER
203
OUTPUT VIDEO
254
210
PICTURE DATA DECODER
PICTURE MEMORY
213
252
216
263
264
214
PREDICTION DECODER
212
262
215
PREDICTION RESIDUAL DECODER
QUANTIZATION VALUE DETERMINER
265
211
261
FIRST CODE STRING ANALYZER
SECOND CODE STRING ANALYZER
201
CODE STRING
251

Fig.9

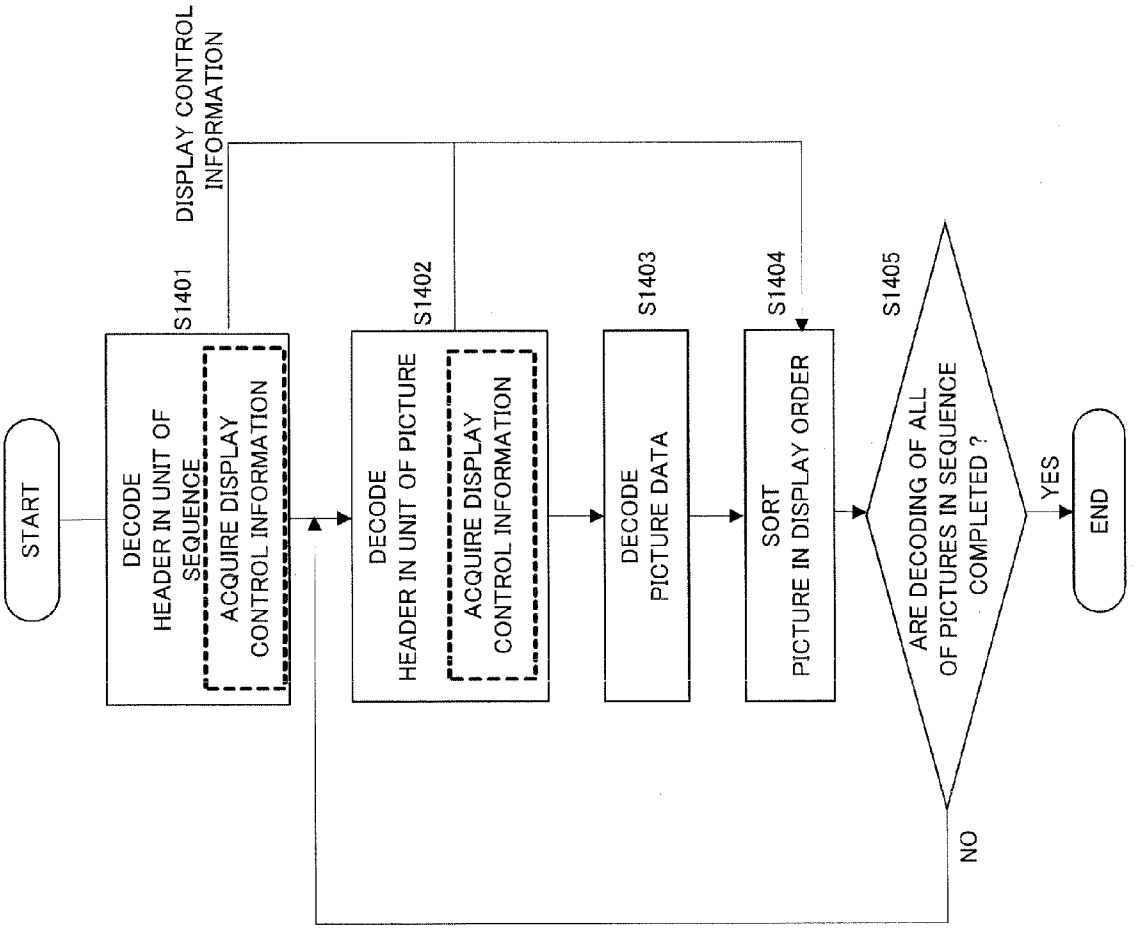

START
DECODE HEADER IN UNIT OF SEQUENCE
ACQUIRE DISPLAY CONTROL INFORMATION
S1401
DISPLAY CONTROL INFORMATION
DECODE HEADER IN UNIT OF PICTURE
ACQUIRE DISPLAY CONTROL INFORMATION
S1402
DECODE PICTURE DATA
S1403
SORT PICTURE IN DISPLAY ORDER
S1404
ARE DECODING OF ALL OF PICTURES IN SEQUENCE COMPLETED ?
S1405
YES
NO
END

Fig. 10

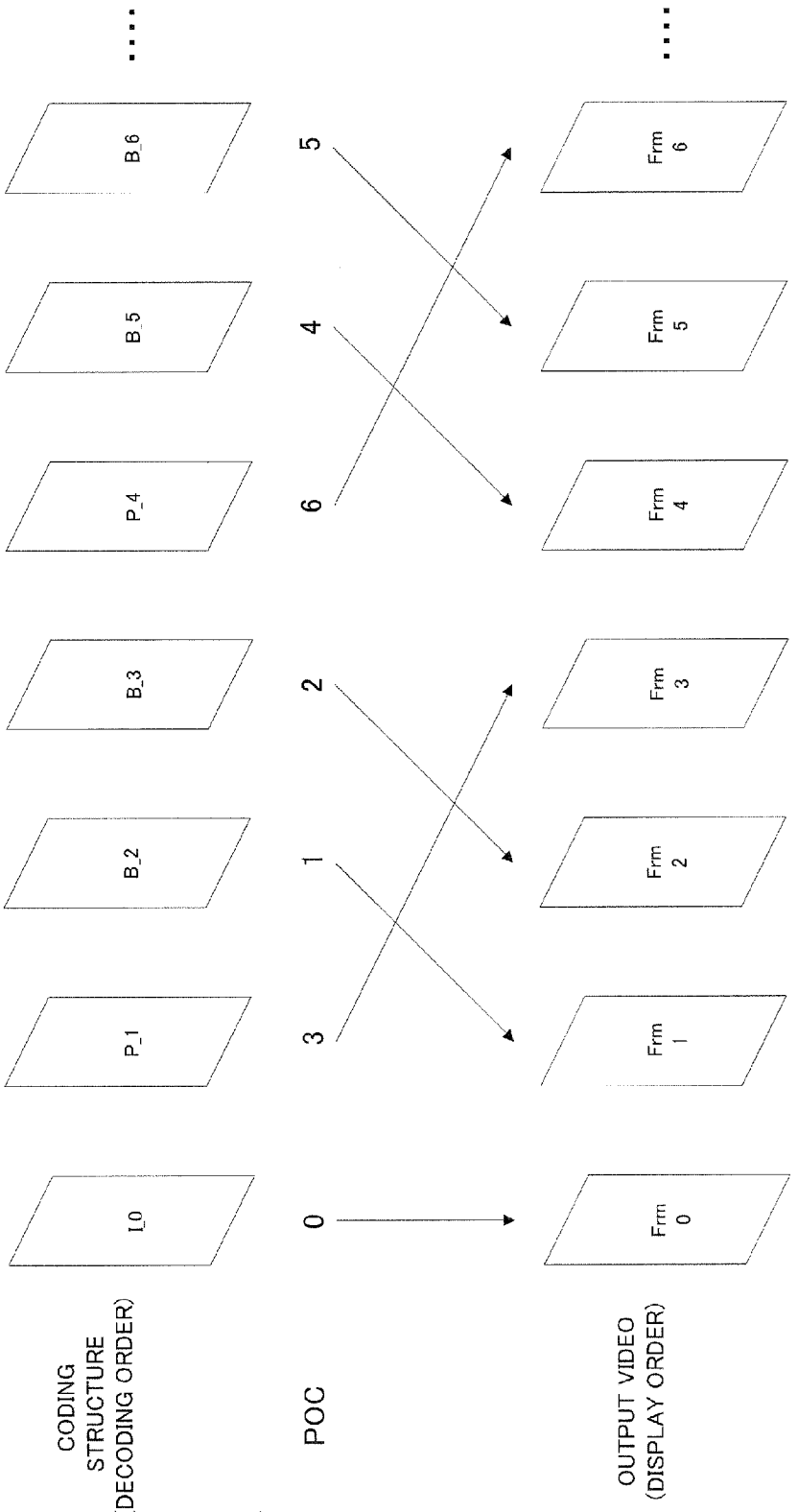

CODING STRUCTURE (DECODING ORDER)
I_0
P_1
B_2
B_3
P_4
B_5
B_6
POC
0
3
1
2
6
4
5
OUTPUT VIDEO (DISPLAY ORDER)
Frm 0
Frm 1
Frm 2
Frm 3
Frm 4
Frm 5
Frm 6

Fig. 11

Fig.12

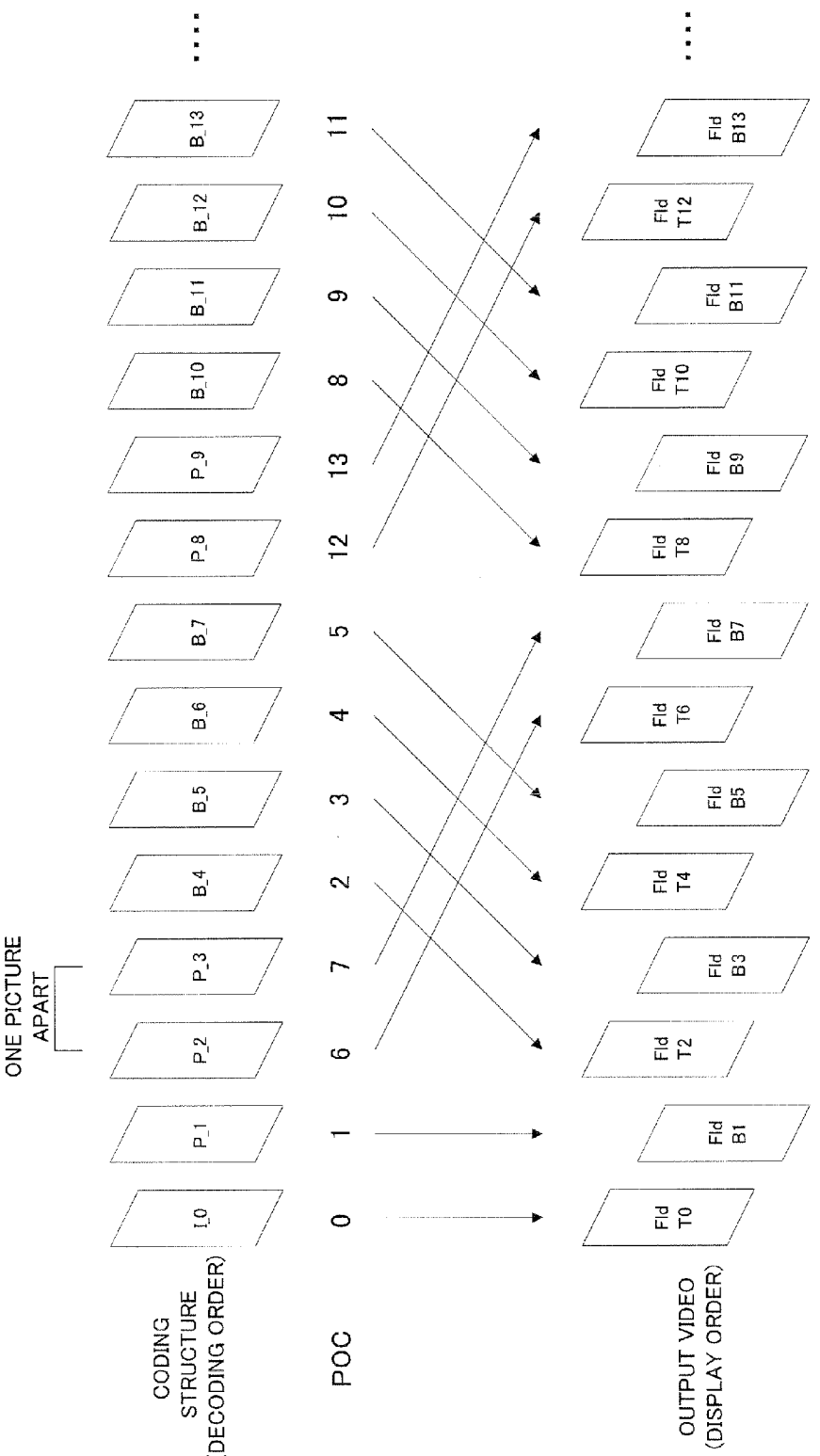
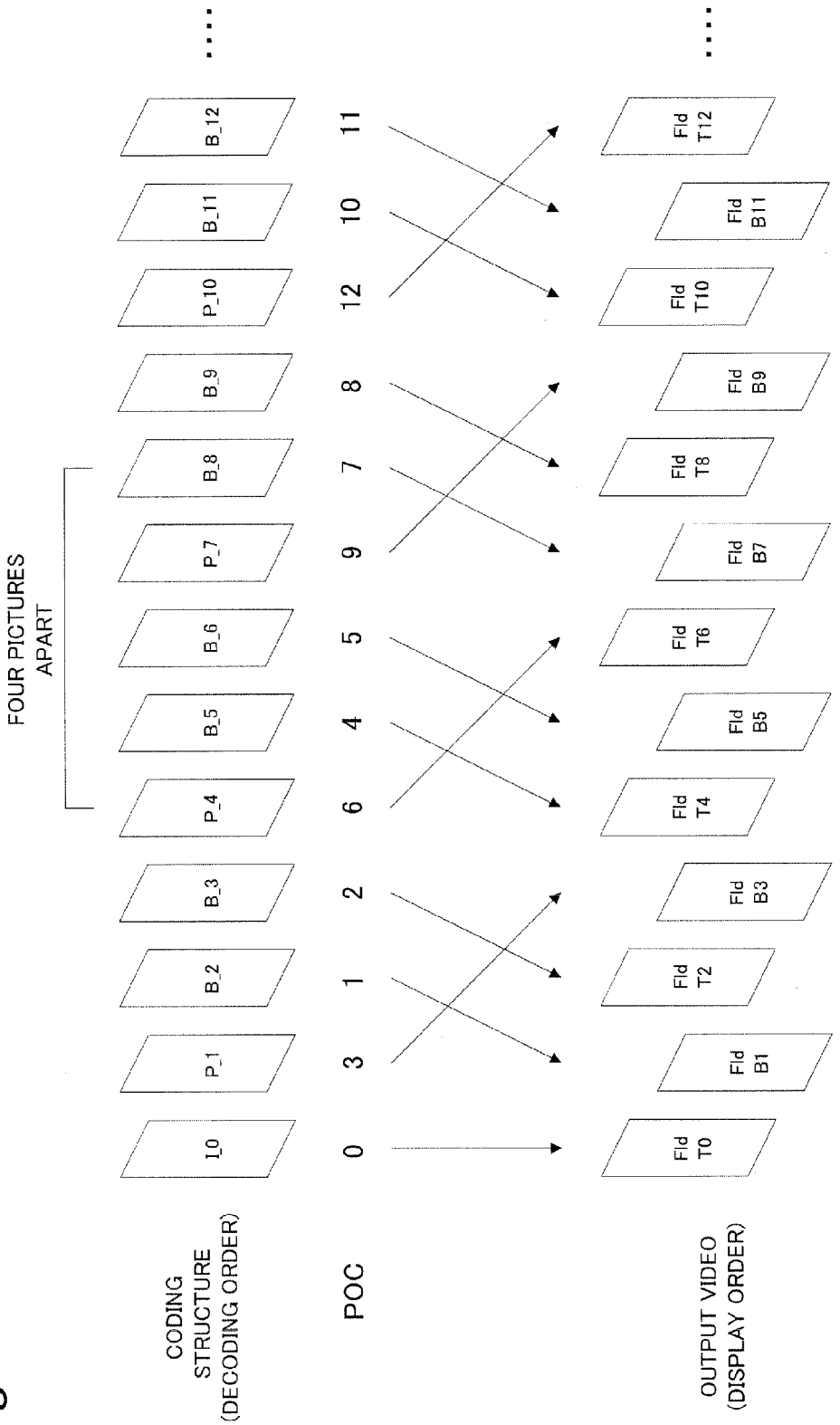

ONE PICTURE APART
CODING STRUCTURE (DECODING ORDER)
I_0
P_1
P_2
P_3
B_4
B_5
B_6
B_7
P_8
P_9
B_10
B_11
B_12
B_13
POC
0
1
6
7
2
3
4
5
12
13
8
9
10
11
OUTPUT VIDEO (DISPLAY ORDER)
Fld T0
Fld B1
Fld T2
Fld B3
Fld T4
Fld B5
Fld T6
Fld B7
Fld T8
Fld B9
Fld T10
Fld B11
Fld T12
Fld B13

Fig. 13


CODING STRUCTURE (DECODING ORDER)
FOUR PICTURES APART
I_0
P_1
B_2
B_3
P_4
B_5
B_6
P_7
B_8
B_9
P_10
B_11
B_12
....
POC
0
3
1
2
6
4
5
9
7
8
12
10
11
OUTPUT VIDEO (DISPLAY ORDER)
Fld T0
Fld B1
Fld T2
Fld B3
Fld T4
Fld B5
Fld T6
Fld B7
Fld T8
Fld B9
Fld T10
Fld B11
Fld T12
....

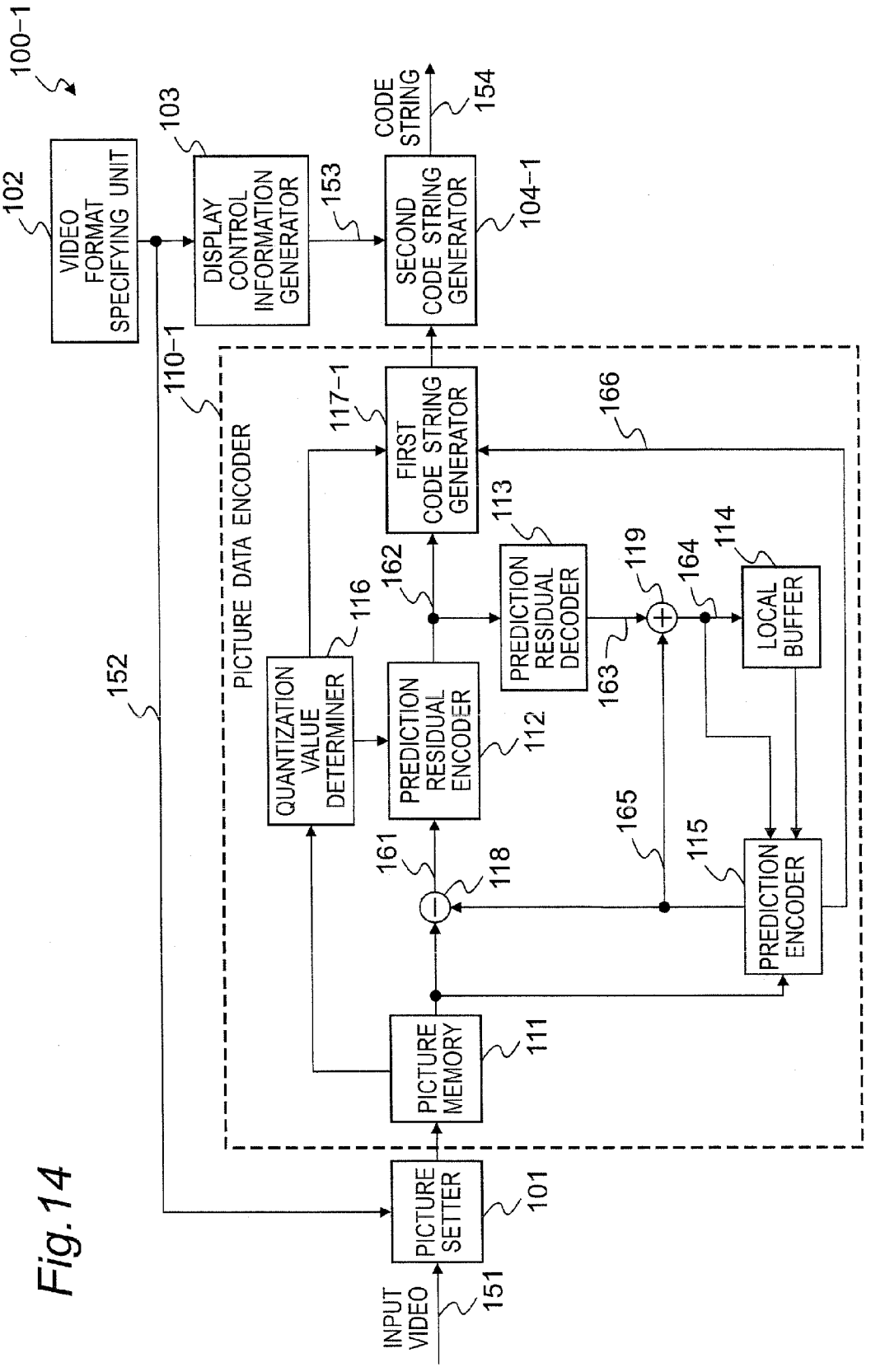

100-1
VIDEO FORMAT SPECIFYING UNIT
102
DISPLAY CONTROL INFORMATION GENERATOR
103
153
SECOND CODE STRING GENERATOR
104-1
CODE STRING
154
110-1
PICTURE DATA ENCODER
FIRST CODE STRING GENERATOR
117-1
166
QUANTIZATION VALUE DETERMINER
116
PREDICTION RESIDUAL ENCODER
112
162
PREDICTION RESIDUAL DECODER
113
163
119
164
LOCAL BUFFER
114
152
161
118
165
115
PREDICTION ENCODER
PICTURE MEMORY
111
PICTURE SETTER
101
INPUT VIDEO
151

Fig.14

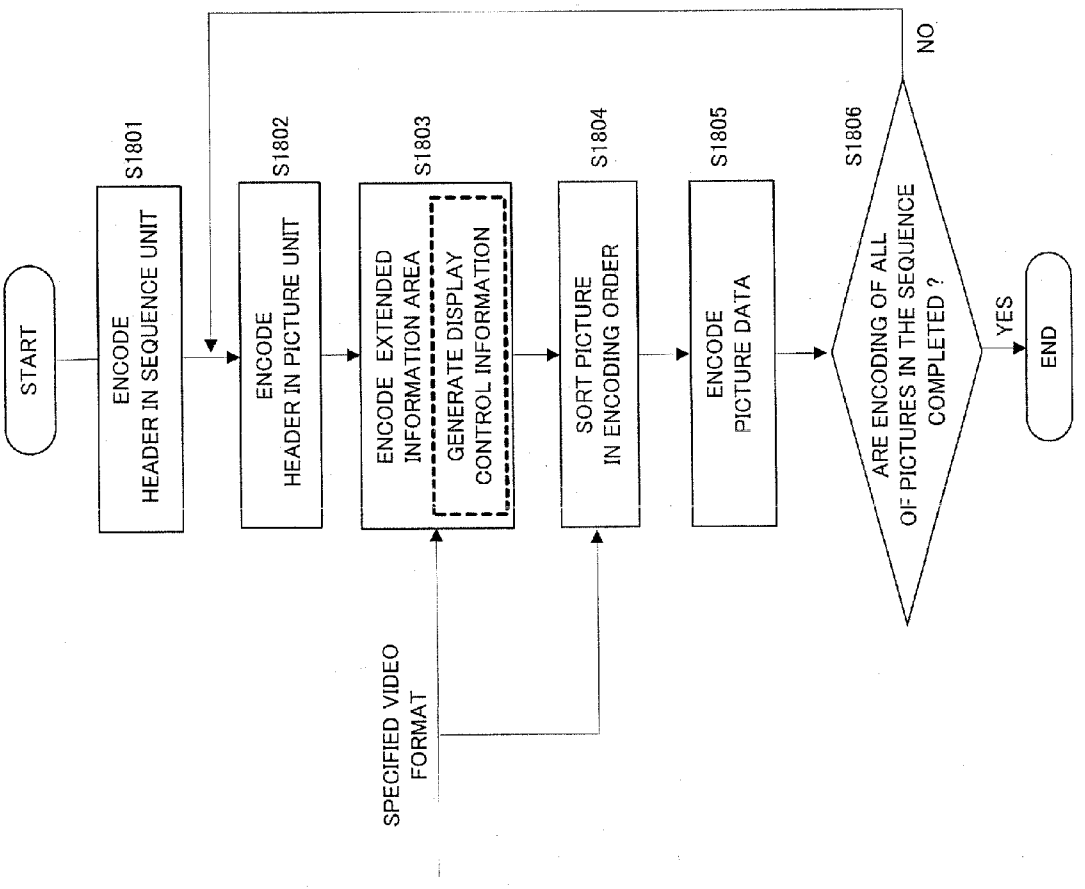

START
ENCODE HEADER IN SEQUENCE UNIT
S1801
ENCODE HEADER IN PICTURE UNIT
S1802
ENCODE EXTENDED INFORMATION AREA
GENERATE DISPLAY CONTROL INFORMATION
S1803
SORT PICTURE IN ENCODING ORDER
S1804
ENCODE PICTURE DATA
S1805
ARE ENCODING OF ALL OF PICTURES IN THE SEQUENCE COMPLETED ?
S1806
NO
YES
END
SPECIFIED VIDEO FORMAT

Fig. 15

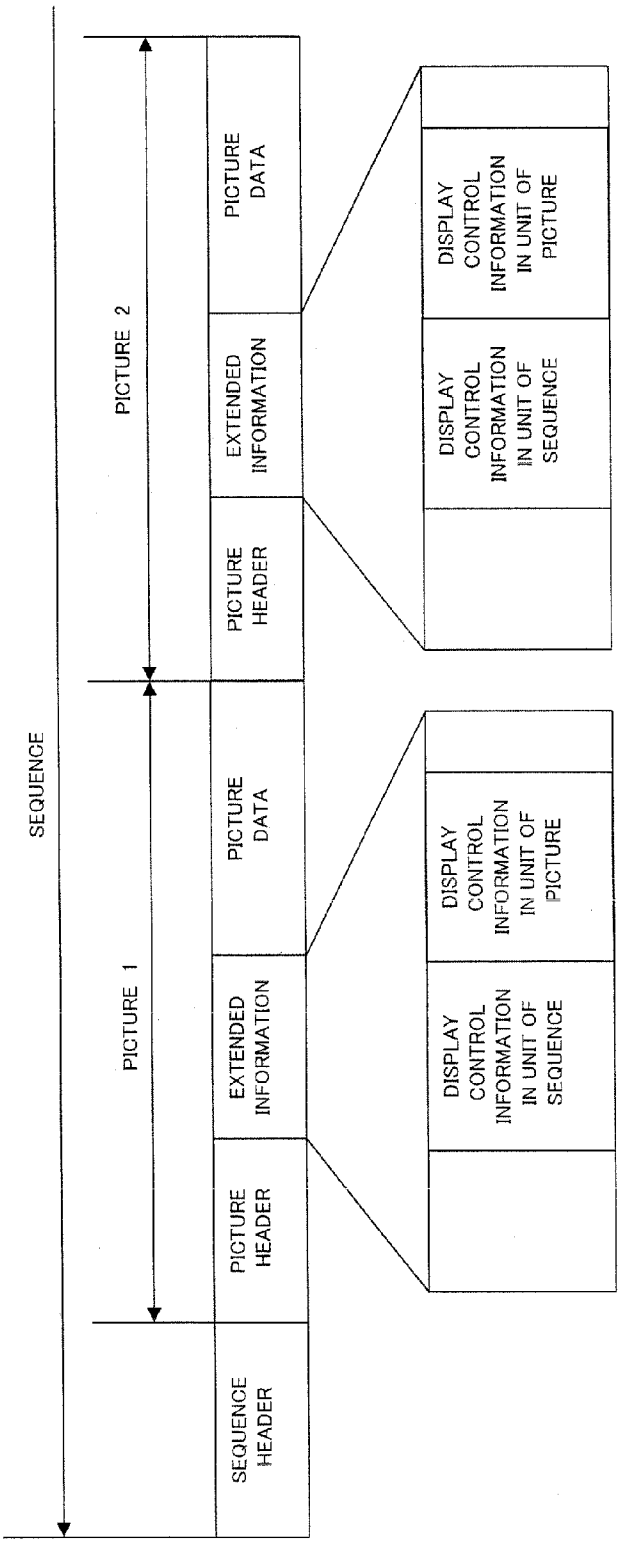

SEQUENCE
SEQUENCE HEADER
PICTURE 1
PICTURE HEADER
EXTENDED INFORMATION
PICTURE DATA
DISPLAY CONTROL INFORMATION IN UNIT OF SEQUENCE
DISPLAY CONTROL INFORMATION IN UNIT OF PICTURE
PICTURE 2
PICTURE HEADER
EXTENDED INFORMATION
PICTURE DATA
DISPLAY CONTROL INFORMATION IN UNIT OF SEQUENCE
DISPLAY CONTROL INFORMATION IN UNIT OF PICTURE

Fig. 16

Fig.17

```
pic_timing_SEI( ) {
    ......
    interlace_flag;
    if ( interlace_flag == 1 ) {
        continual_flag;
        if ( continual_flag == 0 ) {
            max_distance_num;
        }
    }
    ......
    pic_struct;
    if ( pic_struct == 1 or 2 ) {
        field_pair_POC;
    }
    ......
}
```

interlace_flag;

0 : video format is progressive format

1 : video format is interlace format

continual_flag;

0 : top field and the bottom field are not continual in encoding order

1 top field and the bottom field are continual in encoding order

max_distance_num;

maximum number of pictures in which top field and bottom field belonging to the same frame apart from each other in the encoding order in sequence

pic_struct;

0 : frame

1 : top field

2 : bottom field

.....

field_pair_POC;

specifying POCs of a pair of fields about frame belonging to objective field

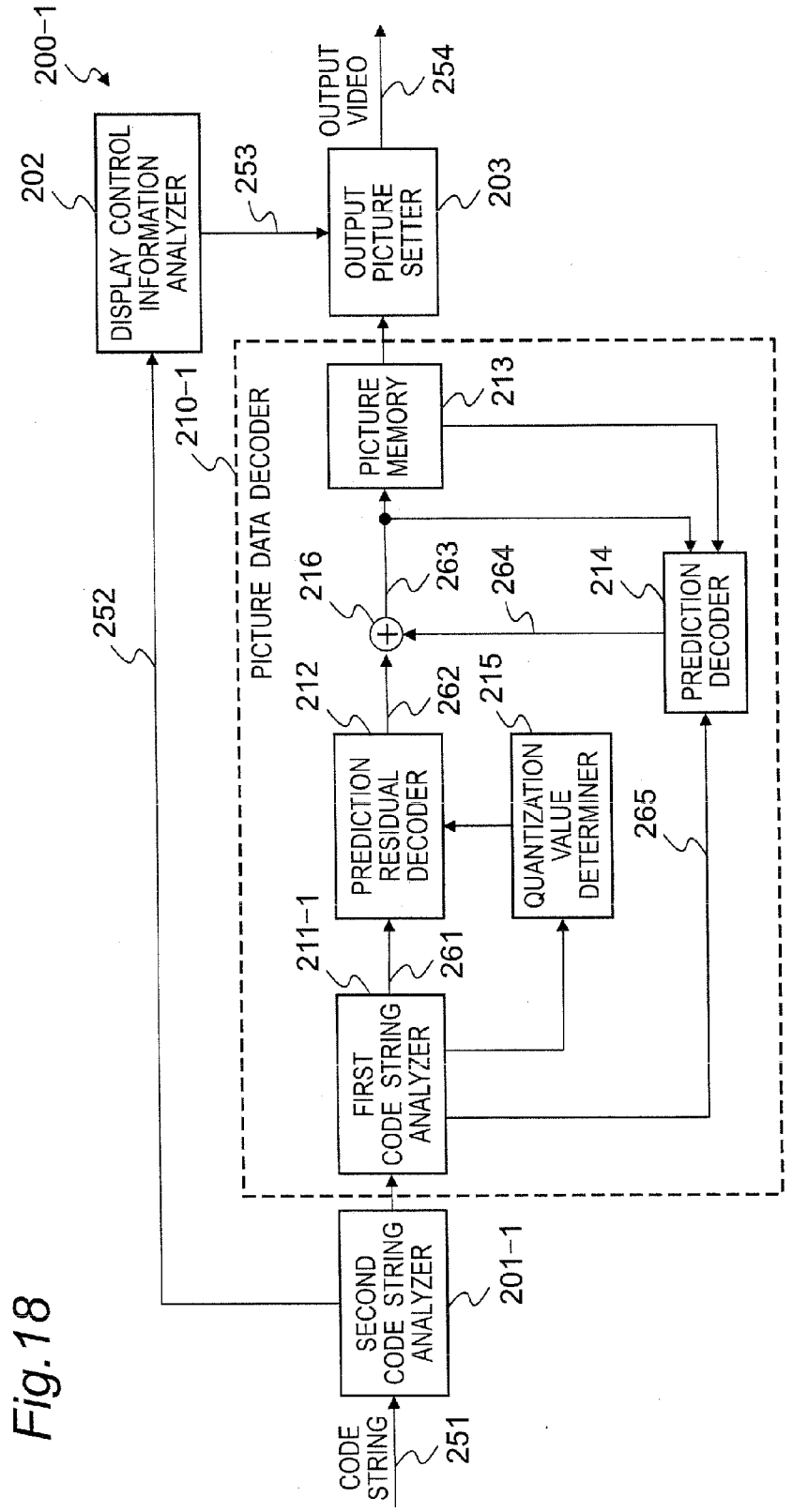

200-1
202
DISPLAY CONTROL INFORMATION ANALYZER
253
OUTPUT PICTURE SETTER
203
OUTPUT VIDEO
254
210-1
PICTURE DATA DECODER
PICTURE MEMORY
213
252
216
263
264
214
PREDICTION DECODER
212
262
215
PREDICTION RESIDUAL DECODER
QUANTIZATION VALUE DETERMINER
265
211-1
261
FIRST CODE STRING ANALYZER
SECOND CODE STRING ANALYZER
201-1
CODE STRING
251

Fig. 18

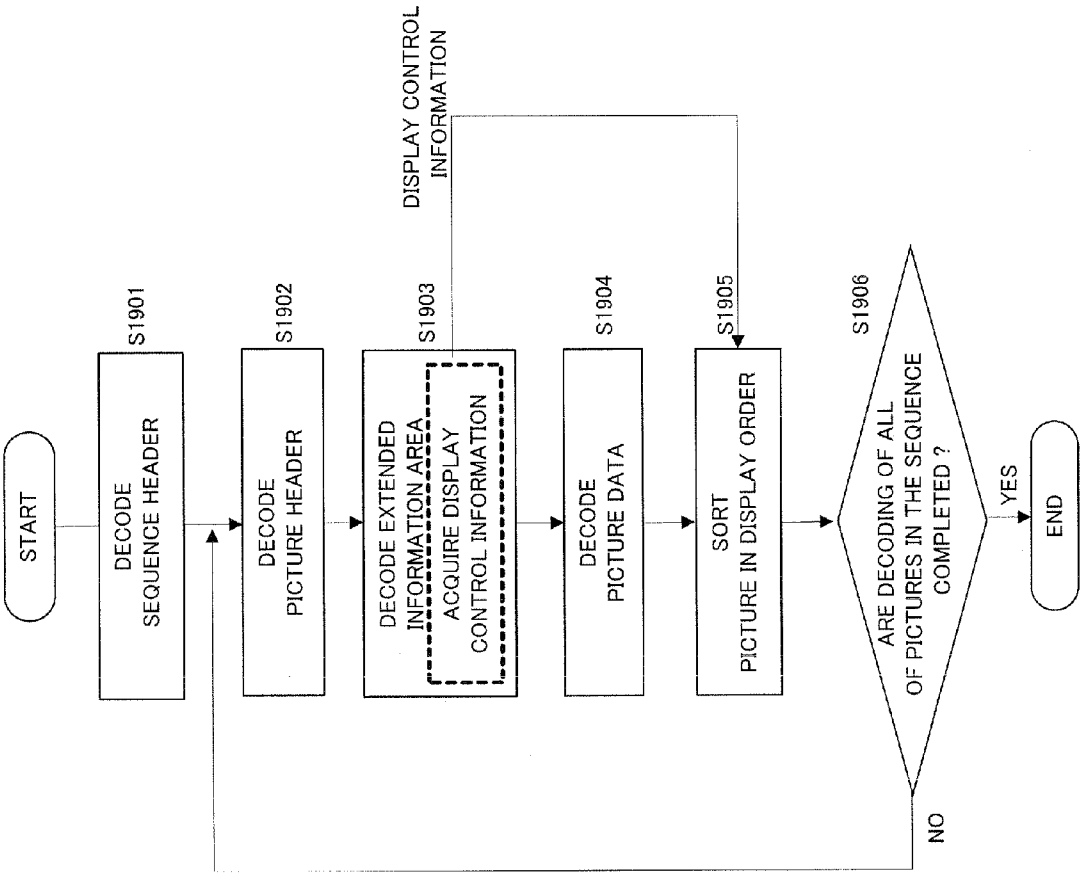

START
DECODE SEQUENCE HEADER
S1901
DECODE PICTURE HEADER
S1902
DECODE EXTENDED INFORMATION AREA
ACQUIRE DISPLAY CONTROL INFORMATION
S1903
DISPLAY CONTROL INFORMATION
DECODE PICTURE DATA
S1904
SORT PICTURE IN DISPLAY ORDER
S1905
ARE DECODING OF ALL OF PICTURES IN THE SEQUENCE COMPLETED ?
S1906
YES
NO
END

Fig. 19

Fig.20

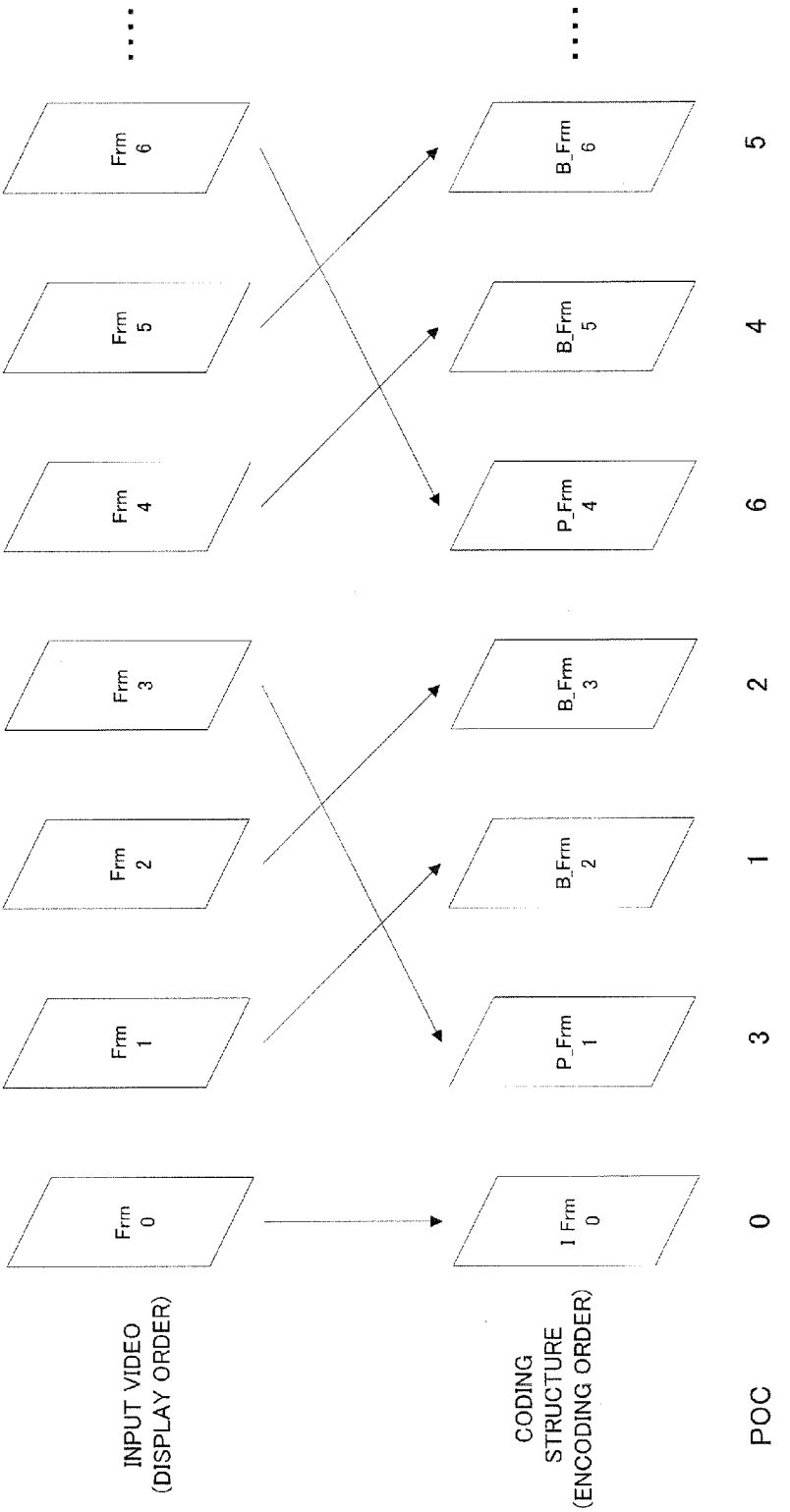
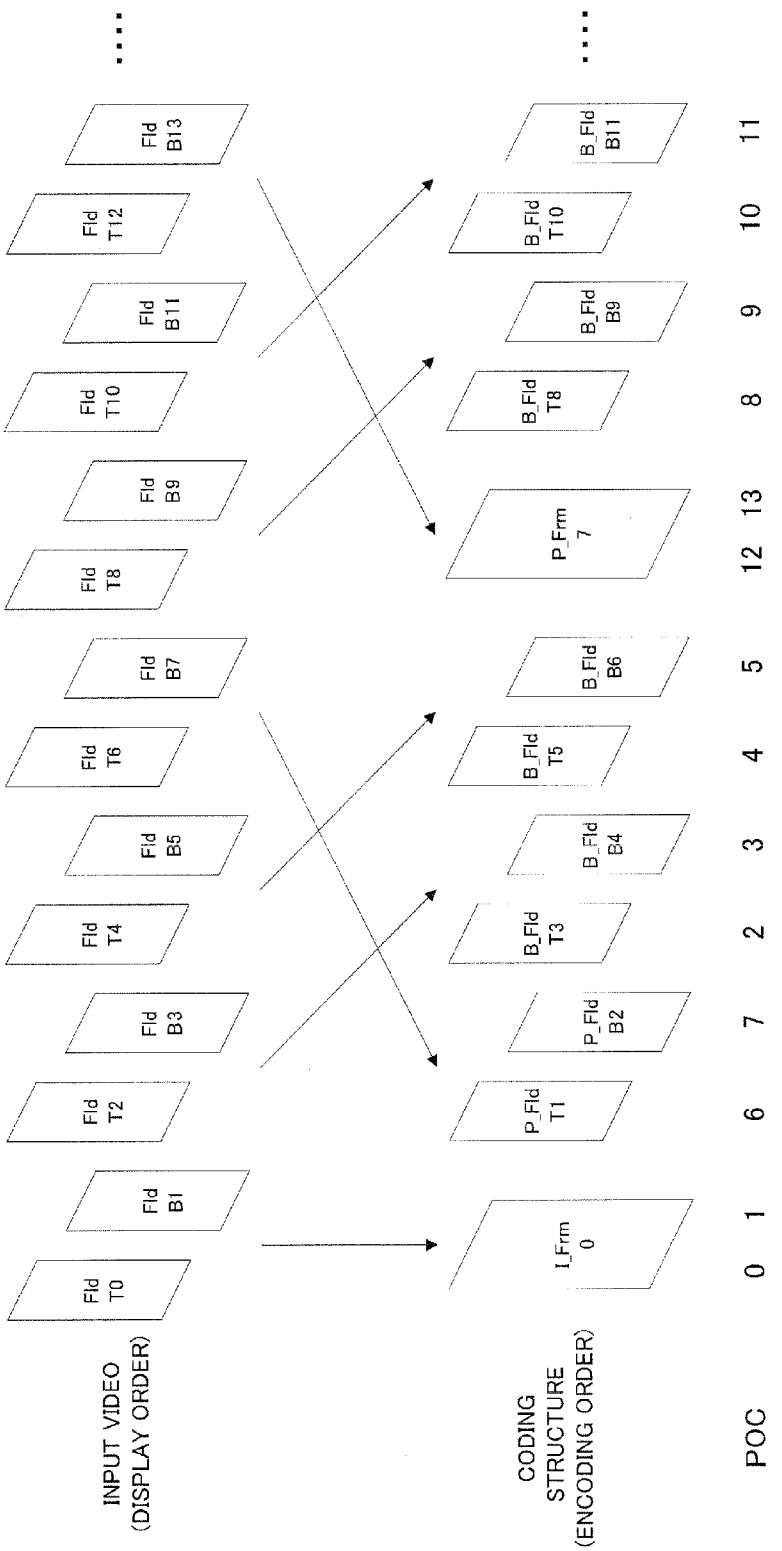

INPUT VIDEO (DISPLAY ORDER)
CODING STRUCTURE (ENCODING ORDER)
POC
Frm 0
Frm 1
Frm 2
Frm 3
Frm 4
Frm 5
Frm 6
I Frm 0
P_Frm 1
B_Frm 2
B_Frm 3
P_Frm 4
B_Frm 5
B_Frm 6
0
3
1
2
6
4
5

Fig.21


INPUT VIDEO
(DISPLAY ORDER)
Fld T0
Fld B1
Fld T2
Fld B3
Fld T4
Fld B5
Fld T6
Fld B7
Fld T8
Fld B9
Fld T10
Fld B11
Fld T12
Fld B13
CODING
STRUCTURE
(ENCODING ORDER)
I_Frm 0
P_Fld T1
P_Fld B2
B_Fld T3
B_Fld B4
B_Fld T5
B_Fld B6
P_Frm 7
B_Fld T8
B_Fld B9
B_Fld T10
B_Fld B11
POC
0 1 6 7 2 3 4 5 12 13 8 9 10 11

VIDEO DECODING DEVICE AND VIDEO DECODING METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This is a continuation application of International Application No. PCT/JP2012/003910, with an international filing date of Jun. 14, 2012, which claims priorities of Japanese Patent Application No.: 2011-134891 filed on Jun. 17, 2011, and Japanese Patent Application No.: 2011-175815 filed on Aug. 11, 2011, the contents of which are incorporated herein by references.

BACKGROUND

[0002] 1. Technical Field

[0003] The present disclosure relates to a video decoding device and a video decoding method for receiving input encoded progressive video signals and encoded interlace received video signals and decoding the video signals.

[0004] 2. Related Art

[0005] In recent years, as multimedia application programs have been developed, integrated use of information from various media including video, audio, and text has prevailed. However, a digitized video contains a large amount of data. Then, video compression technologies are essential to store and transmit a video.

[0006] On the other hand, standardization of compression technologies is also important for interoperation of the compressed video data. For example, as standard specifications of video compression technologies, H.261, H.263, and H.264 of ITU-T (International Telecommunication Union Telecommunication Standardization Sector), MPEG-1, MPEG-2, MPEG-4, and MPEG-4AVC of ISO/IEC (International Organization for Standardization), and the like are known. Further, a standardization activity for the next-generation video coding system called HEVC (High-Efficiency Video Coding) is currently carried out by ITU-T jointly with ISO/IEC.

[0007] In those kinds of video coding, a picture to be encoded is divided into encoded unit blocks and redundancy in a time direction and redundancy in a spatial direction are reduced for each of the blocks. Those kinds of video coding compress the amount of information in that manner. In inter predictive coding for reducing time redundancy, a forward or backward picture is referenced, so that movement is detected and a predicted image is created for each block, and then, a difference image between the created predicted image and the block to be encoded is acquired. In intra predictive coding for reducing spatial redundancy, a predicted image is generated from pixel information of surrounding encoded blocks, and then, a difference image between the acquired predicted image and the block to be encoded is acquired. Subsequently, orthogonal transform such as discrete cosine transform and quantization are applied to the acquired difference image and then a code string is generated by using variable length coding, and as a result, the amount of information is compressed.

[0008] In decoding, the code string which is generated by the above described encoding process is analyzed, so that predictive information and residual coefficient information are acquired. Further, inter predictive decoding and intra-frame predictive decoding are applied by using the predictive information, so that a predicted image is generated. Then, inverse quantization and inverse orthogonal transform are applied to the residual coefficient information, so that a difference image is generated, and then, the generated predicted image and the generated difference image are added, so that a final output image is restored.

[0009] As two formats of video to be encoded and decoded, a progressive format and an interlace format are used on this occasion.

[0010] In the progressive format, all of the pixels of a screen are simultaneously imaged to be a frame. On the other hand, in the interlace format, a frame is composed of two fields: a top field, which contains only the pixels of even-numbered lines imaged among the pixels of a screen; and a bottom field, which contains only the pixels of odd-numbered lines imaged among the pixels of a screen.

[0011] FIGS. **20** and **21** illustrate methods of encoding a progressive video and an interlace video based on H.264, respectively. As illustrated in FIG. **20**, in encoding a progressive video, a frame is encoded as a picture. For example, Frm3 is encoded as P_Frm1. In the encoding, information specifying a display order called POC (Picture Order Count) is assigned to each picture. For example, since P_Frm1 is displayed at the position of Frm3 in the display order, 3 is assigned to P_Frm1 as the POC.

[0012] On the other hand, as illustrated in FIG. **21**, a method of encoding a field as a picture and a method of encoding two fields as a picture are known for encoding the interlace video. For example, FldT6 and FldB7 are encoded as pictures of separate field structures such as P_FldT1 and P_FldB2, whereas FldT12 and FldB13 are encoded as a picture of a single frame structure such as P_Frm7. A value of the POC is assigned to a picture in the case where a field is encoded as a picture of a field structure, whereas two values of the POC are assigned to a picture in the case where two fields are encoded as a picture of a frame structure. For example, since P_Frm7 is displayed as divided pictures at two positions of FldT12 and FldB13, 12 and 13 are assigned to P_Frm7 as the POCs (ITU-T H.264: Advanced video coding for generic audiovisual services (March 2010)).

[0013] On the other hand, since the HEVC is a coding system which only enables encoding of a progressive video, only a method of encoding a frame as a picture as illustrated in FIG. **20** is defined in the HEVC (JCT-VC WD2: Working Draft 2 of High-Efficiency Video Coding (March 2011)).

SUMMARY

[0014] It is expected that the progressive format will replace the interlace format to be the mainstream video format in the future. But on the other hand, since many of the existing video contents have been created in the interlace format, effective use of these contents will be also needed in the future.

[0015] However, as described above, the HEVC which is currently in the standardization process defines an encoding method only for the progressive format and does not enable encoding of interlace contents.

[0016] One non-limiting and exemplary embodiment solves the above described problem, and easily realizes supporting of the interlace format in encoding and decoding of a video by using the HEVC.

[0017] A video decoding device according to the present disclosure decodes a code string in units of pictures, the code string being acquired as a result of encoding video signals in an interlace video format or a progressive video format in units of pictures. The video decoding device includes:

[0018] a second code string analyzer that analyzes the code string to acquire an extended information area code string and a first code string;

[0019] an extended information area decoder that acquires display control information to be used in displaying a decoded picture, from the extended information area code string;

[0020] a picture data decoder that decodes the first code string to acquire the picture by using common syntax analyzing method and a common signal processing method, which are not dependent on the video formats; and

[0021] an output picture setter that, in the case where the display control information indicates the progressive format, sets the acquired picture as a frame and outputs the frame one by one in a display order, and in the case where the display control information indicates the interlace format, sets the acquired picture as a field and outputs a pair of top field and bottom field in a display order when the pair of top field and bottom field are acquired, wherein

[0022] the display control information includes sequence unit display control information and picture unit display control information, the sequence unit display control information being commonly used in a display process of all pictures that belong to a sequence to be decoded and the picture unit display control information being individually used in a display process of a picture to be decoded, and

[0023] the extended information area decoder acquires each of the sequence unit display control information and the picture unit display control information from an extended information area in units of pictures.

[0024] A video decoding method according to the present invention decodes a code string in units of pictures, the code string being acquired as a result of encoding video signals in an interlace video format or a progressive video format in units of pictures. The video decoding method includes:

[0025] analyzing the code string to acquire an extended information area code string and a first code string;

[0026] acquiring display control information to be used in displaying a decoded picture, from the extended information area code string;

[0027] decoding the first code string to acquire the picture by using common syntax analyzing method and a common signal processing method, which are not dependent on the video formats; and

[0028] in the case where the display control information indicates the progressive format, sets the acquired picture as a frame and outputs the frame one by one in a display order, and in the case where the display control information indicates the interlace format, sets the acquired picture as a field and outputs a pair of top field and bottom field in a display order when the pair of top field and bottom field are acquired, wherein

[0029] the display control information includes sequence unit display control information and picture unit display control information, the sequence unit display control information being commonly used in a display process of all pictures that belong to a sequence to be decoded and the picture unit display control information being individually used in a display process of a picture to be decoded, and

[0030] each of the sequence unit display control information and the picture unit display control information is acquired from an extended information area in units of pictures.

[0031] The present disclosure can be realized not only as the above described video decoding device but also as a program or an integrated circuit that is equivalent to each unit included in the video decoding device.

[0032] The video decoding device according to the present disclosure enables a decoding process and display control to be applied to picture data under a common control without increasing the processing amount for both a code string that is acquired as a result of encoding a progressive video and a code string that is acquired as a result of encoding an interlace video. Therefore, the video decoding device facilitates implementation of a decoding device.

[0033] Generally, in a video decoding device, a decoding process for decoding an encoded code string to generate a decoded video and a display process for displaying the generated decoded video on a corresponding display device by adapting the video to the device are controlled as different levels. For example, such a method is possible that the former process is formed by hardware and the latter process is formed by software. The method can reduce the man-hours for development, for example, in developing the devices that are different in the display method such as a television set and a personal computer by using common hardware for performing the decoding process and only creating software programs for performing the display process respectively for the devices.

[0034] In the present disclosure, the extended information area in that only the information unnecessary for the encoding process (display control information, and the like) is described and the other areas in that information necessary for the decoding process is described are completely separated. As a result, the present disclosure facilitates sending of only the code strings needed by respective levels of the level of performing the decoding process and the level of performing the display process to the respective levels for the purpose like the above described use, therefore, improves independence of each level. That is, it allows to form the level of performing the decoding process (hardware) by using completely the common components in both the decoding device that supports the progressive and the decoding device that supports the interlace.

BRIEF DESCRIPTION OF DRAWINGS

[0035] FIG. **1** is a block diagram illustrating a configuration of a video encoding device according to a first embodiment.

[0036] FIG. **2** is a flow chart of encoding process according to the first embodiment.

[0037] FIG. **3** is a conceptual diagram for describing an example of a method of sort in a progressive input video in an encoding order according to the first embodiment.

[0038] FIG. **4** is a conceptual diagram for describing an example of a method of sort in an interlace input video in an encoding order according to the first embodiment.

[0039] FIG. **5** is a conceptual diagram for describing another example of a method of sort in the interlace input video in an encoding order according to the first embodiment.

[0040] FIG. **6** is a conceptual diagram for describing a configuration of a code string generated by the embodiment.

[0041] FIG. **7** is a conceptual diagram for describing an example of a syntax of a sequence header generated by the embodiment.

[0042] FIG. **8** is a conceptual diagram for describing an example of a syntax of extended information generated by the embodiment.

[0043] FIG. **9** is a block diagram illustrating a configuration of a video decoding device according to a second embodiment.

[0044] FIG. **10** is a flow chart of decoding process according to the second embodiment.

[0045] FIG. **11** is a conceptual diagram for describing an example of a method of sort in a progressive decoded video in a display order according to the second embodiment.

[0046] FIG. **12** is a conceptual diagram for describing an example of a method of sort in an interlace decoded video in a display order according to the second embodiment.

[0047] FIG. **13** is a conceptual diagram for describing another example of a method of sort in the interlace decoded video in a display order according to the second embodiment.

[0048] FIG. **14** is a block diagram illustrating a configuration of a video encoding device according to a third embodiment.

[0049] FIG. **15** is a flow chart of encoding process according to the third embodiment.

[0050] FIG. **16** is a conceptual diagram for describing a configuration of a code string generated by the third embodiment.

[0051] FIG. **17** is a conceptual diagram for describing an example of a syntax of extended information generated by the third embodiment.

[0052] FIG. **18** is a block diagram illustrating a configuration of a video decoding device according to a fourth embodiment.

[0053] FIG. **19** is a flow chart of decoding process according to the fourth embodiment.

[0054] FIG. **20** is a conceptual diagram for describing a conventional encoding method of a progressive video.

[0055] FIG. **21** is a conceptual diagram for describing a conventional encoding method of an interlace video.

DETAILED DESCRIPTION

Background of the Embodiments

[0056] As described in the section of Problem to be Solved by the Invention, the HEVC which is currently in the standardization process defines an encoding method only for the progressive format and does not enable encoding of interlace contents.

[0057] In order to make the HEVC support the interlace format, an approach of introducing the same encoding control as that of H.264 which has been described with reference to FIG. **21** can be considered.

[0058] However, on the condition that the approach is adopted, the cases where the picture to be encoded has a frame structure like P_Frm7, or has a top field structure like P_FldT1, or has a bottom field structure like P_FldB2 have to be distinguished from each other when the encoding process and the decoding process are performed.

[0059] Further, in the HEVC, coding information of pictures which have been encoded once is referenced when the encoding process is performed on the picture to be encoded. Therefore, for example, in the case where the encoding object is P_Frm7 and the pictures which have their coding information referenced are P_FldT1 and P_FldB2, the coding information of the two pictures which have field structures has to be processed for reference into the coding information of a picture which has a frame structure. That substantially complicates the encoding process.

[0060] Then, in the video encoding device of the embodiments, in the case where video format information indicates the progressive format, a frame of the video signals is set as a picture, and in the case where the video format information indicates the interlace format, a field of the video signals is set as a picture. Subsequently, pixel data included in the set picture is encoded by using a common signal processing method and a common syntax structure which are not dependent on video formats.

[0061] Further, in the video decoding device of the embodiments, the first code string is decoded to acquire the picture by using the common syntax analyzing method and the common signal processing method, which are not dependent on the video formats. Then, in the case where the display control information indicates the progressive format, the acquired picture is set as a frame and the frames are output one by one in a display order, and in the case where the display control information indicates the interlace format, the acquired picture is set as a field and a pair of top field and bottom field are output in a display order when the pair of top field and bottom field are acquired.

[0062] The video encoding device and the video decoding device of the embodiments will be described in detail below.

First Embodiment

Encoding Process

[0063] The first embodiment will be described with reference to the drawings.

1. Configuration of a Video Encoding Device

[0064] FIG. **1** is a block diagram of a video encoding device according to the embodiment.

[0065] The video encoding device **100** includes a picture setter **101**, a video format specifying unit **102**, a display control information generator **103**, a second code string generator **104**, and a picture data encoder **110**. The picture data encoder **110** includes a picture memory **111**, a prediction residual encoder **112**, a prediction residual decoder **113**, a local buffer **114**, a prediction encoder **115**, a quantization value determiner **116**, and a first code string generator **117**.

[0066] The picture setter **101** sorts input video signals **151** which are input in a display order in units of pictures in an encoding order according to video format signals **152** input from the video format specifying unit **102**, and outputs the sorted input video signals **151** to the picture data encoder **110**. At this moment, in the case where the video format of the picture is the progressive format, a frame corresponding to the input video signals **151** is set as a picture, and in the case where the video format is the interlace format, a field corresponding to the input video signals **151** is set as a picture.

[0067] The picture data encoder **110** divides each picture input from the picture setter **101** into blocks and performs an encoding process in units of blocks to generate a code string of picture data. At this moment, a common encoding process is applied in units of pictures without depending on whether the video format is the progressive format or the interlace format, and the generated code string of the picture data has a common syntax.

[0068] The video format specifying unit **102** determines whether the video to be encoded is in the progressive format or the interlace format based on information specified from outside or information indicated by the input video signals.

Then, the video format specifying unit **120** outputs the video format signals **152** to the display control information generator **103** and the picture setter **101**.

[0069] The display control information generator **103** generates display control information signals **153** according to the video format signals **152** input from the video format specifying unit **102** and outputs the display control information signals **153** to the second code string generator **104**.

[0070] Here, the display control information signals **153** are control information signals which are used in a video decoding device corresponding to the video encoding device **100** in displaying a decoded video.

[0071] The second code string generator **104** encodes the display control information signals **153** output from the display control information generator **103** and information about encoding control in units of sequences and encoding control in units of pictures as header information to generate a picture upper layer code string. Further, the second code string generator **104** associates the generated picture upper layer code string with the code string of picture data generated by the picture data encoder **110** to generate code string signals **154** to be finally output.

[0072] Now, processes of the picture data encoder **110** will be described.

[0073] The picture memory **111** divides an input picture output from the picture setter **101** in units of pictures into blocks each of which includes a plurality of pixels. A block is a unit of the encoding process. In response to a readout instruction issued from a difference calculator **118**, the prediction encoder **115**, and the quantization value determiner **116** in units of blocks resulting from division, corresponding image signals are outputted. The block has, for example, horizontal 64 pixels by vertical 64 pixels, horizontal 32 pixels by vertical 32 pixels, or horizontal 16 pixels by vertical 16 pixels. That is, the block may be in any size as far as the processing after that is available to the block in the size.

[0074] The prediction residual encoder **112** performs orthogonal transform on difference image signals **161** output from the difference calculator **118**. Further, the prediction residual encoder **112** quantizes an orthogonal transform coefficient of each of the acquired frequency components and generates residual encoding signals **162**. Then, the prediction residual encoder **112** outputs the generated residual encoding signals **162** to the prediction residual decoder **113** and the first code string generator **117**. At this moment, the prediction residual encoder **112** quantizes the orthogonal transform coefficient by using a quantization value determined by the quantization value determiner **116**.

[0075] The prediction residual decoder **113** recovers difference image information by performing inverse quantization and inverse orthogonal transform on the residual encoding signals **162** output from the prediction residual encoder **112**. Then, the prediction residual decoder **113** outputs generated residual decoding signals **163** to an addition calculator **119**.

[0076] The local buffer **114** stores reconstructed image signals **164** output from the addition calculator **119**. The reconstructed image signals **164** are used as referential pixel data in a predictive encoding process in encoding of pictures after the pictures currently to be encoded. In response to a readout instruction from the prediction encoder **115**, the local buffer **114** outputs the stored reconstructed image signals **164** to the prediction encoder **115** as pixel data.

[0077] The prediction encoder **115** generates predicted image signals **165** by using intra prediction or inter prediction based on the image signals output from the picture memory **111**. Then, the prediction encoder **115** outputs the generated predicted image signals **165** to the difference calculator **118** and the addition calculator **119**. When the prediction encoder **115** uses the inter prediction, it uses the reconstructed image signals **164** of already encoded past pictures which have been stored in the local buffer **114**. When the prediction encoder **115** uses the intra prediction, it uses the reconstructed image signals **164** of the current pictures of an already encoded block adjacent to the block to be encoded. Mode determination on whether to use the intra prediction or the inter prediction is based on estimation of which of the prediction methods can reduce the amount of information of residual signals (the amount of information of the residual encoding signals **162**, the code string strings **154**, and the like) more.

[0078] The quantization value determiner **116** determines the quantization value for quantizing the difference image signals **161** in the prediction residual encoder **112** based on the pictures stored in the picture memory **111**. As a determination method of the quantization value in the quantization value determiner **116**, a so-called rate control-based determination method of the quantization value, by which the quantization value is set to make a bit rate of the code string signals **154** approach a target bit rate, may be used.

[0079] The first code string generator **117** generates the code string of picture data by performing variable length coding on the residual encoding signals **162** output from the prediction residual encoder **112**, prediction information signals **166** output from the prediction encoder **115**, the quantization value output from the quantization value determiner **116**, and information about the other encoding control.

[0080] The difference calculator **118** generates the difference image signals **161** which is a differential value between the image signal read out from the picture memory **111** and the predicted image signals **165** output from the prediction encoder **115**. Then, the difference calculator **118** outputs the generated difference image signals **161** to the prediction residual encoder **112**.

[0081] The addition calculator **119** generates the reconstructed image signals **164** by adding the residual decoding signals **163** output from the prediction residual decoder **113** and the predicted image signals **165** output from the prediction encoder **115**. Then, the addition calculator **119** outputs the generated reconstructed image signals **164** to the local buffer **114**.

2. Generation Method of Display Control Information

[0082] A method of generating the display control information signals **153** in the display control information generator **103** and describing the display control information signals **153** in a code string in the second code string generator **104** and a method of sort in an input video in an encoding order in the picture setter **101** in response to the video format signals **152** from the video format specifying unit **102** will be described specifically with reference to the flow chart of the entire encoding process of FIG. **2**.

[0083] First, the second code string generator **104** performs code string generation on header areas in units of sequences (S**501**). Specifically, the second code string generator **104** describes the display control information in units of sequences generated by the display control information generator **103** into header areas in units of sequences in a code string. The display control information generator **103** gener-

ates display control information in units of sequences according to the video format specified by the video format specifying unit **102**.

[0084] Next, the second code string generator **104** performs code string generation on header areas in units of pictures (S**502**). Specifically, the second code string generator **104** describes the display control information in units of pictures generated by the display control information generator **103** in extended information areas in units of pictures in a code string. The display control information generator **103** generates display control information in units of pictures according to the video format specified by the video format specifying unit **102**.

[0085] Next, the picture setter **101** sorts the input picture which is input in a display order in an encoding order and selects a picture to be encoded (S**503**). Specifically, the picture setter **101** sorts the input picture according to the video format specified by the video format specifying unit **102**.

[0086] Next, the picture data encoder **110** performs a series of encoding process described with reference to FIG. **1** to generate a code string of picture data (S**504**). Meanwhile, in step S**504**, a common encoding process is applied without depending on whether the video format is the progressive format or the interlace format

[0087] Next, when the processes on the currently processed picture to be encoded are completed, the operation returns to step S**502** to proceed to the encoding process of the next picture, and the processes from step S**502** to step S**504** are repeated until the encoding processes of all of the pictures in the sequence are completed (S**505**).

3. Sort of Pictures

[0088] A sort process of pictures in step S**503** will be described in detail with reference to FIGS. **3**, **4**, and **5**.

[0089] A method illustrated in FIG. **3** is an example of a sort method of pictures in the case where the video format is the progressive format. This sort method is completely the same as the conventional process on the progressive format described with reference to FIG. **20**. An input frame undergoes sort and is encoded as a picture. In the inter prediction, only the picture which has been encoded earlier in the encoding order can be referenced. That is, in the case where sort as illustrated in FIG. **3** is performed, P_1 can reference only I_0, and B_2 can reference I_0 and P_1. In terms of the display order, since P_1 corresponds to Frm3, P_1 can reference only Frm0 in the forward direction, and since B_2 corresponds to Frm1, B_2 can reference Frm0 in the forward direction and Frm3 in the backward direction. With the sort performed on the encoding order of the pictures as described above, a reference method of referential pictures in the inter prediction is allowed to be controlled and more effective prediction becomes available. Meanwhile, I_0 is a picture which only undergoes the intra prediction without referencing the other pictures.

[0090] On the other hand, methods illustrated in FIGS. **4** and **5** are examples of a sort method of pictures in the case where the video format is the interlace format. Unlike the conventional processes on the interlace format described with reference to FIG. **21**, the methods always perform sort and encoding on an input field as a picture. Also a POC which is information specifying the display order is always assigned to each picture. The encoding processes are performed on each of the pictures, which have undergone the sort, in completely the same method as in the case where the progressive format is input, without depending on whether each of the sorted pictures is a top field or a bottom field.

[0091] In the example of FIG. **4**, the top field and the bottom field belonging to a frame are always paired in the sort. For example, FldT6 and FldB7 undergo the sort as P_2 and P_3, so that they are always continual with each other in the encoding order. That applies to all of the other pictures. With the above described sort performed, the input top field and bottom field are allowed to be continually transferred to the encoding process and a memory management process in the picture setter **101** can be simplified.

[0092] In contrast, in FIG. **5**, the sort is performed regardless of which frame the top field and the bottom field belong to. In a coding structure alone, FIG. **5** is completely in the same structure as that in the case of the progressive format described in FIG. **3**, but FldT6 and FldB7, for example, are sorted to be P_4 and B_8 which become apart from each other by four pictures in the encoding order. The other pictures are also sorted to be apart from each other by one picture to four pictures in the encoding order. With the above described sort, the pictures are allowed to undergo the process in completely the same encoding order both in the progressive format and the interlace format. However, it is needed to transfer the input top field and bottom field to the encoding process with the fields shifted by maximum of four pictures, which complicates the memory management process in the picture setter **101**.

4. Configuration and Syntax of the Code String

[0093] Now, a configuration of the code string generated by the embodiment will be described with reference to FIG. **6**.

[0094] The code string indicated by the code string signals **154** output from the second code string generator **104** includes a sequence header area in which encoding control information in units of sequences is described, a picture header area in which encoding control information in units of pictures is described, an extended information area in which auxiliary information in units of pictures is described, and picture data. Here, the display control information in units of sequences described in step S**501** of FIG. **2** is described in the sequence header area. Further, the display control information in units of pictures described in step S**502** of FIG. **2** is described in the extended information area. The respective types of information other than the display control information are described in the code string of a common syntax without depending on whether the video format is the progressive format or the interlace format.

[0095] Here, the syntax of the sequence header area in which the display control information in units of sequences is described will be described in detail with reference to FIG. **7**. In FIG. **7**, things other than the syntax related to the embodiment are omitted.

[0096] The syntax header is encoded in the syntax configuration in seq_parameter_set_data( ). As the display control information in units of sequences, there are three parameters interlace_flag, continual_flag, and max_distance_num. These parameters are described in the area of vui_parameters ( ) in which video information in the sequence headers is collected.

[0097] The parameter interlace_flag specifies whether the video format of the objective sequence is the progressive format or the interlace format. Specifically, interlace_flag has the value 0 in the case where the video format of the objective sequence is the progressive format and has the value 1 in the

case where the video format of the objective sequence is the interlace format. However, interlace_flag is not limited to the above described configuration and may have the value 1 in the case of the progressive format and the value 0 in the case of the interlace format.

[0098] The parameter continual_flag specifies whether the positional relationship between the top field and the bottom field belonging to the same frame is always continual in the encoding order in the case where the video format of the objective sequence is the interlace format. Specifically, continual_flag has the value 0 in the case where the positional relationship between the top field and the bottom field belonging to the same frame is not always continual in the encoding order, and has the value 1 in the case where the positional relationship is always continual. That is, continual_flag is the value 1 in the case where such sort as described in FIG. **4** is performed, and has the value 0 in the case where such sort as described in FIG. **5** is performed. With the parameter, the corresponding decoding device is informed whether it is allowed to perform decoding and display control on always continual two pictures as a pair. That facilitates determination on possibility of decoding. However, continual_flag is not limited to the above described configuration and may have the value 1 in the case where the positional relationship between the top field and the bottom field belonging to the same frame is not always continual in the encoding order, and have the value 0 in the case where the positional relationship is always continual.

[0099] The parameter max_distance_num specifies the maximum number of pictures between the top field and the bottom field belonging to the same frame apart from each other in the encoding order in the case where continual_flag has the value 0. For example, in the case where such sort as described in FIG. **5** is performed, P__4 and B__8 is the combination by which the fields are the most apart from each other and the maximum number is four. With the parameter, the decoding device corresponding to the video encoding device **100** is allowed to determine the number of pictures which has to be waited for the top field and the bottom field belonging to the same frame to be continual. That facilitates determination of the capacity of the picture memory needed and the determination on possibility of decoding.

[0100] The parameter names and parameter values described here are merely examples and the other parameter names and parameter values may be used to realize the same functions. Further, not all of the parameters described here but only a part of the parameters may be used. Although an example in which each of the above described parameters is described in the area of vui_parameters ( ) has been described here, each of the parameters may be described in any other area as far as the area allows the control information in units of sequences to be described.

[0101] Now, the syntax of the extended information area in which the display control information in units of pictures is described will be described in detail with reference to FIG. **8**. In FIG. **8**, things other than the syntax related to the embodiment are omitted.

[0102] The extended information area includes a group of parameters called SEI (Supplemental Enhancement Information). The parameter pic_timing_SEI( ) of FIG. **8** is one of the SEI and has a function of specifying decoding timing and display timing of the pictures to be encoded. As the display control information in units of pictures, there are two parameters pic_struct and field_pair_POC. These parameters are described in the area of pic_timing_SEI ( ).

[0103] The parameter pic_struct is a parameter for specifying the display format of the pictures to be encoded. The parameter pic_struct has the value 0 in the case where the picture is to be displayed as a frame in the progressive format, the value 1 in the case where the picture is to be displayed as a top field of the interlace format, the value 2 in the case where the picture is to be displayed as a bottom field of the interlace format. In the case where the picture is to be displayed in another display, the parameter pic_struct has a corresponding value format. The parameter pic_struct is not limited to the above described configuration and may have the value 1 in the case where the picture is to be displayed as a frame in the progressive format, the value 0 in the case where the picture is to be displayed as a top field of the interlace format, the value 2 in the case where the picture is to be displayed as a bottom field of the interlace format. In the case where the picture is to be displayed in another display format, the parameter pic_struct has a corresponding value. That is, the parameter pic_struct may have any value as far as the value provides information specifying the case where the picture is to be displayed as a frame in the progressive format, the case where the picture is to be displayed as a top field of the interlace format, and the case where the picture is to be displayed as a bottom field of the interlace format.

[0104] The parameter field_pair_POC is information indicating the POCs of a pair of fields belonging to the same frame in the case where pic_struct specifies that the picture to be encoded is to be displayed as a top field or a bottom field of the interlace format. For example, in FIG. **4**, in the case where the picture to be encoded is P__2, the picture to form a pair with P__2 is P__3, therefore, field_pair_POC is 7. Similarly, in FIG. **5**, in the case where the picture to be encoded is B__8, the picture to form a pair with B__8 is P__4, therefore, field_pair_POC is 6. With the parameter, the corresponding decoding device is allowed to determine which of the pictures is the top field and the bottom field belonging to the same frame and, therefore, to perform display control corresponding to the interlace format.

[0105] Meanwhile, field_pair_POC may specify the POC value by a differential value of the POC instead of specifying the POC value as it is. For example, in FIG. **4**, in the case where the picture to be encoded is P__2, the picture to form a pair with P__2 is P__3, therefore, field_pair_POC is 7-6=1. Similarly, in FIG. **5**, in the case where the picture to be encoded is B__8, the picture to form a pair with B__8 is P__4, therefore, field_pair_POC is 6-7=−1. With the differential value like that, the picture to from a pair with the picture to be encoded can be specified with a less amount of code.

[0106] In the case where continual_flag described in FIG. **7** has the value 1, it is ensured that the top field and the bottom field belonging to the same frame are in positional relationship of always continual in the encoding order. Therefore, since the picture to form a pair with the picture to be encoded can be easily determined, field_pair_POC needs not to be described.

[0107] The parameters pic_struct and field_pair_POC which are the display control information in units of pictures may be described only in the case where the video format of the objective sequence is the interlace format. In that case, pic_struct only needs to be the information which can identify

the case in which the encoding object is to be displayed as a top field and the case in which the encoding object is to be displayed as a bottom field.

[0108] The parameter names and parameter values described here are merely examples and the other parameter names and parameter values may be used to realize the same functions. Further, not all of the parameters described here but only a part of the parameters may be used. Although an example in which each of the above described parameters is described in the area of pic_timing_SEI( ) has been described here, each of the parameters may be described in any other area as far as the area allows the control information in units of pictures to be described.

5. Summarization

5-1. Configuration

[0109] The video encoding device **100** of the embodiment encodes the input video signals in units of pictures. The video encoding device **100** includes:

[0110] the video format specifying unit **102** (video format information acquiring unit) which acquires video format information indicating whether the video format of the video signals is the interlace format or the progressive format;

[0111] the display control information generator **103** which generates display control information to be used for displaying a video indicated by encoded video signals as a video in a video format indicated by the video format information based on the video format information;

[0112] the picture setter **101** which, in the case where the video format information indicates the progressive format, sets a frame of the video signals as a picture and sorts the pictures in the encoding order, and in the case where the video format information indicates the interlace format, sets a field of the video signals as a picture and sorts the pictures in the encoding order;

[0113] the picture data encoder **110** which generates a block layer code string by encoding pixel data included in a set picture for each block, which is a unit of encoding process, by using a common signal processing method and a common syntax structure which are not dependent on the video formats, further generates a slice layer code string by encoding the coding control information, which is applied in units of slices in encoding the pixel data, by using the common signal processing method and the common syntax structure which are not dependent on the video formats, and outputs a first code string which is acquired by that the block layer code string is associated with the slice layer code string;

[0114] the second code string generator **104** (picture upper layer encoder) which generates the picture upper layer code string by encoding the coding control information which is applied in units of pictures in encoding the pixel data, the coding control information which is applied in units of sequences, and the display control information; and

[0115] the second code string generator **104** which outputs a second code string, the second code string being acquired by that the first code string is associated with the picture upper layer code string.

[0116] For example, the display control information generator **103** generates display control information including sequence unit display control information and picture unit display control information, the sequence unit display control information being commonly used in the display process of all pictures which belong to a sequence to be encoded and the picture unit display control information being individually used in the display process of a picture to be encoded.

[0117] For example, the second code string generator **104** (picture upper layer encoder) stores the sequence unit display control information in a video information area included in the sequence header which is generated in units of sequences in the picture upper layer code string.

[0118] For example, the second code string generator **104** (picture upper layer encoder) stores the sequence unit display control information of the same value in each extended information area of each picture belonging to the same sequence in the picture upper layer code string.

[0119] For example, the second code string generator **104** (picture upper layer encoder) stores the picture unit display control information in the extended information area which is generated in units of pictures in the picture upper layer code string.

[0120] For example, the display control information generator **103** generates the sequence unit display control information which includes a first identifier specifying whether the video signals to be encoded are in the progressive format or the interlace format.

[0121] For example, the display control information generator **103** generates the sequence unit display control information which includes a second identifier specifying whether two fields which belong to the same frame are always continual with each other in the encoding order in the sequence in the case where the video signals to be encoded is in the interlace format.

[0122] For example, the display control information generator **103** generates the sequence unit display control information which includes information indicating the maximum value of an interval between the first field and the second field which belong to the same frame in the encoding order in the sequence in the case where the video signals to be encoded are in the interlace format.

[0123] For example, the display control information generator **103** generates the picture unit display control information which includes a third identifier specifying that the picture to be encoded is (1) to be displayed as a frame which belongs to the progressive video signals, (2) to be displayed as a top field which belongs to the interlace video signals, (3) to be displayed as a bottom field which belongs to the interlace video signals, or (4) to be displayed in another display format in the display process of the picture to be encoded.

[0124] For example, the display control information generator **103** generates the picture unit display control information which includes a third identifier specifying that the picture to be encoded is (1) to be displayed as a top field which belongs to the interlace video signals or (2) to be displayed as a bottom field which belongs to the interlace video signals in the display process of the picture to be encoded only in the case where the video signals to be encoded are in the interlace format.

[0125] For example, the display control information generator **103** generates the picture unit display control information which includes specification information specifying a picture that is paired with the picture to be encoded and belongs to the same frame as that of the picture to be encoded in the case where the picture to be encoded is to be decoded and displayed as a top field or a bottom field which belongs to the interlace video signals.

[0126] For example, the display control information generator **103** describes, as the specification information, display order information which is assigned to the picture that is paired with the picture to be encoded and belongs to the same frame as that of the picture to be encoded.

[0127] For example, the display control information generator **103** describes, as the specification information, a difference value between the display order information which is assigned to the picture to be encoded and the display order information which is assigned to the picture that is paired with the picture to be encoded and belongs to the same frame as that of the picture to be encoded.

[0128] The video encoding method of the embodiment encodes the input video signals in units of pictures. The video encoding method comprising:

[0129] acquiring video format information indicating whether the video format of the video signals is the interlace format or the progressive format,

[0130] generating display control information to be used for displaying encoded video signals as video signals in the video format indicated by the video format information based on the video format information,

[0131] in the case where the video format information indicates the progressive format, setting a frame of the video signals as a picture and performing sort on the pictures in the encoding order and, on the other hand, in the case where the video format information indicates the interlace format, setting a field of the video signals as a picture and performing sort on the pictures in the encoding order,

[0132] generating a block layer code string by encoding pixel data included in a set picture for each block, which is a unit of encoding process, by using a common signal processing method and a common syntax structure which are not dependent on the video formats, further generating a slice layer code string by encoding the coding control information, which is applied in units of slices in encoding the pixel data, by using the common signal processing method and the common syntax structure which are not dependent on the video formats, and outputting a first code string which acquired by that the block layer code string is associated with the slice layer code string,

[0133] generating the picture upper layer code string by encoding the coding control information which is applied in units of pictures in encoding the pixel data, the coding control information which is applied in units of sequences, and the display control information, and

[0134] outputting a second code string which is acquired by that the first code string is associated with the picture upper layer code string.

5-2. Effects and the Like

[0135] With the video encoding device **100** according to the embodiment, an encoding process is allowed to be performed on picture data under a common control with the processing amount being not increased both in the case where the progressive video is input and in the case where the interlace video is input, therefore, the video encoding device **100** facilitates implementation of a encoding device.

Second Embodiment

Decoding Process

[0136] The second embodiment will be described with reference to the drawings.

1. Configuration of a Video Decoding Device

[0137] FIG. **9** is a block diagram of a video decoding device according to the embodiment.

[0138] The video decoding device **200** includes a second code string analyzer **201**, a display control information analyzer **202**, a picture data decoder **210**, and an output picture setter **203**. The picture data decoder **210** includes a first code string analyzer **211**, a prediction residual decoder **212**, a picture memory **213**, a prediction decoder **214**, and a quantization value determiner **215**.

[0139] The second code string analyzer **201** extracts display control information and information about decoding control in units of sequences and decoding control in units of pictures from a code string of header information included in input code string signals **251**. Then, the second code string analyzer **201** outputs the extracted information to the display control information analyzer **202** as display control information signals **252**.

[0140] The picture data decoder **210** generates a decoded image of an objective picture by performing a decoding process in units of blocks on a code string of picture data included in the input code string signals **251**. At this moment, a common decoding process is applied in units of pictures whether the video format is the progressive format or the interlace format and, further, the code string of the picture data to be decoded has a common syntax.

[0141] The display control information analyzer **202** analyzes the display control information signals **252** output from the second code string analyzer **201** to determine whether the video to be decoded is in the progressive format or the interlace format. Then, the display control information analyzer **202** outputs display control signals **253** based on the determination result to the output picture setter **203**.

[0142] The output picture setter **203** sorts the decoded pictures generated by the picture data decoder **210** in an outputting order according to the display control signals **253** output from the display control information analyzer **202**. Then, the output picture setter **203** outputs the pictures which have undergone the sort to outside as output video signals **254**. The output video signals **254** may be in the progressive format and in the interlace format. In the case where the output video signals **254** are in the progressive format, display control is performed on a picture as a frame, and in the case where the output video signals **254** are in the interlace format, the display control is performed on a picture as a field.

[0143] Now, processes of the picture data decoder **210** will be described.

[0144] The first code string analyzer **211** performs analyzing of decoding control information and analyzing of the picture data in units of blocks by performing variable length decoding on the code string of picture data of the input code string signals **251**. The first code string analyzer **211** outputs residual encoding signals **261** which are acquired as a result of analyzing, to the prediction residual decoder **212**. Further, the first code string analyzer **211** outputs prediction information signals **265** which are acquired as a result of analyzing to the prediction decoder **214**. Still further, the first code string analyzer **211** outputs quantization value information which is acquired as a result of analyzing to the quantization value determiner **215**.

[0145] The prediction residual decoder **212** generates residual decoding signals **262** by performing inverse quantization and inverse orthogonal transform on the residual encoding signals **261** output from the first code string ana-

lyzer **211** and outputs the residual decoding signals **262** to an addition calculator **216**. At this moment, the prediction residual decoder **212** performs inverse quantization on the residual encoding signals **261** by using a quantization value determined in the quantization value determiner **215**.

[0146] The picture memory **213** stores reconstructed image signals **263** output from the addition calculator **216**. The reconstructed image signals **263** are used as referential pixel data in a predictive decoding process in decoding of pictures after the pictures currently to be decoded. In response to a readout instruction from the prediction decoder **214**, the picture memory **213** outputs the stored reconstructed image signals **263** to the prediction decoder **214** as pixel data. The reconstructed image signals **263** are concurrently output to the output picture setter **203** as a final output image.

[0147] The prediction decoder **214** generates predicted image signals **264** by using intra prediction or inter prediction based on the prediction information signals **265** output from the first code string analyzer **211** and outputs the predicted image signals **264** to the addition calculator **216**. When the prediction decoder **214** uses the inter prediction, it uses the reconstructed image signals **263** of already decoded past pictures which have been stored in the picture memory **213**. When the prediction decoder **214** uses the intra prediction, it uses the reconstructed image signals **263** of the current pictures of an already decoded block adjacent to the block to be decoded. Determination on whether to use the intra prediction or the inter prediction is performed according to the input prediction information signals **265**.

[0148] The addition calculator **216** generates the reconstructed image signals **263** by adding the residual decoding signals **262** output from the prediction residual decoder **212** and the predicted image signals **264** output from the prediction decoder **214** and outputs the reconstructed image signals **263** to the picture memory **213**.

2. Display Control Method

[0149] A method of analyzing the display control information in the display control information analyzer **202** and performing sort on the decoded pictures in an output order in the output picture setter **203** to be an output image will be described specifically with reference to the flow chart of the entire decoding process of FIG. **10**.

[0150] First, the second code string analyzer **201** performs code string analyzing of header areas in units of sequences (S**1401**). At this moment, the display control information analyzer **202** acquires the display control information in units of sequences.

[0151] Next, the second code string analyzer **201** performs code string analyzing of header areas in units of pictures (S**1402**). At this moment, the display control information analyzer **202** acquires the display control information in units of pictures.

[0152] Next, the picture data decoder **210** performs a series of decoding process described with reference to FIG. **9** to generate a decoded image of the objective pictures (S**1403**). Meanwhile, in step S**1403**, a common decoding process is applied without depending on whether the video format is the progressive format or the interlace format.

[0153] Next, the output picture setter **203** sorts the decoded image which is stored in a decoding order in a display order and a process of selecting a picture to be displayed (S**1404**). At this moment, the output picture setter **203** sorts the pictures according to a display control method acquired as a result of analyzing by the display control information analyzer **202**.

[0154] Next, when the processes on the currently processed picture to be decoded are completed, the operation returns to step S**1402** to proceed to the decoding process of the next picture, and the processes from step S**1402** to step S**1404** are repeated until the decoding processes of all of the pictures in the sequence are completed (S**1405**).

3. Sort of Pictures

[0155] A sort process of pictures in step S**1404** will be described in detail with reference to FIGS. **11**, **12**, and **13**.

[0156] A method illustrated in FIG. **11** is an example of a sort method of pictures in the case where the video format is the progressive format. This sort method is the reverse of the sort process for the progressive format performed in the encoding device described with reference to FIG. **3**, and in the sort method, each of the decoded pictures is always sorted as a frame and displayed.

[0157] On the other hand, methods illustrated in FIGS. **12** and **13** are examples of a sort method of pictures in the case where the video format is the interlace format. These sort methods are the reverse of the sort processes for the interlace format performed in the encoding device described with reference to FIGS. **4** and **5**, and in the sort methods, each of the decoded pictures is always sorted as a field and displayed.

[0158] In FIG. **12**, the top field and the bottom field belonging to a frame are always paired in the sort. For example, P__2 and P__3 undergo the sort as FldT6 and FldB7, so that they are always continual with each other in the display order. That applies to all of the other pictures. With the above described sort performed, the decoded top field and bottom field are allowed to be continually transferred to the display process and a memory management process in the output picture setter **203** can be simplified.

[0159] In contrast, in FIG. **13**, the sort is performed regardless of which frame the top field and the bottom field belong to. In a coding structure alone, FIG. **13** is completely in the same structure as that in the case of the progressive format described in FIG. **11**, but P__4 and B__8, for example, are sorted to be FldT6 and FldB7, therefore, the two fields which have apart from each other by four pictures in the decoding order need to undergo the sort to be paired. Also for the other pictures, the two pictures which have become apart from each other by one picture to four pictures in the decoding order have undergone the sort to be paired. With the above described sort, the pictures are allowed to undergo the process in completely the same decoding order both in the progressive format and the interlace format. However, it is needed to transfer the decoded top field and bottom field to the display process with the fields shifted by maximum of four pictures, which complicates the memory management process in the output picture setter **203**.

[0160] In the picture memory **213**, for the purpose of limiting the memory capacity, a process for ensuring an area for pictures to be stored is performed in such a manner as deleting a picture which has become unnecessary among the stored pictures from the memory. At this moment, the picture which meets two conditions that (1) the picture is no longer used as referential pixel data in the predictive encoding process and that (2) the picture has already been transferred to the display process can be deleted. That is, in the case where the video format is the interlace format, when the decoding process on the pictures of both the top field and the bottom field belong-

ing to a frame has completed and the display process on both of the pictures has completed, the pictures can be deleted from the picture memory **213**.

4. Configuration and Syntax of the Code String

[0161] Since the configuration and syntax of the code string to be decoded in the embodiment are completely the same as those described in the first embodiment with reference to FIGS. **6** to **8**, the description of them will be omitted here.

5. Summarization

5-1. Configuration

[0162] A video decoding device **200** of the embodiment decodes a code string in units of pictures, the code string being acquired as a result of encoding video signals in an interlace video format or a progressive video format in units of pictures. The video decoding device **200** includes:

[0163] the second code string analyzer **201** which analyzes the code string to acquire a picture upper layer code string and a first code string;

[0164] the second code string analyzer **201** (picture upper layer decoder) which acquires, from the picture upper layer code string, coding control information used in encoding the video signals and display control information to be used for displaying decoded pictures;

[0165] the picture data decoder **210** which decodes the first code string for each block, which is a unit of decoding process, to acquire the picture by using common syntax analyzing method, a common signal processing method, and information commonly used in encoding regardless of the video format among the coding control information, which are not dependent on the video formats; and

[0166] the output picture setter **203** which, in the case where the display control information indicates the progressive format, sets the acquired picture as a frame and outputs the frame one by one in a display order, and in the case where the display control information indicates the interlace format, sets the acquired picture as a field and outputs a pair of top field and bottom field in a display order when the pair of top field and bottom field are acquired.

[0167] For example, the second code string analyzer **201** (picture upper layer decoder) includes sequence unit display control information and picture unit display control information, the sequence unit display control information being commonly used in a display process of all pictures which belong to a sequence to be decoded and the picture unit display control information being individually used in a display process of a picture to be decoded.

[0168] For example, the second code string analyzer **201** (picture upper layer decoder) acquires the sequence unit display control information in a video information area included in the sequence header which is analyzed in units of sequences in the picture upper layer code string.

[0169] For example, each extended information area of each picture unit which belongs to the same sequence stores the sequence unit display control information of the same value.

[0170] For example, the second code string analyzer **201** (picture upper layer decoder) acquires the picture unit display control information from the extended information area which is analyzed in units of pictures in the picture upper layer code string.

[0171] For example, the second code string analyzer **201** (picture upper layer decoder) acquires the sequence unit display control information which includes a first identifier specifying whether the video signals to be decoded are in the progressive format or the interlace format, and

[0172] the output picture setter **203** changes an output method of the picture based on the acquired first identifier.

[0173] For example, in the case where the video signals to be decoded are in the interlace format, the second code string analyzer **201** (picture upper layer decoder) acquires the sequence unit display control information which includes a second identifier specifying whether two fields which belong to the same frame are always continual with each other in the decoding order in the sequence, and

[0174] the output picture setter **203** changes the output method of the picture based on the acquired second identifier.

[0175] For example, in the case where the video signals to be decoded are in the interlace format, the second code string analyzer **201** (picture upper layer decoder) acquires the sequence unit display control information which includes information indicating the maximum value of an interval between the first field and the second field which belong to the same frame in the decoding order in the sequence, and

[0176] the output picture setter **203** changes the output method of the picture based on the acquired information indicating the maximum value.

[0177] For example, the second code string analyzer **201** (picture upper layer decoder) acquires the picture unit display control information which includes a third identifier specifying that the picture to be decoded is (1) to be displayed as a frame which belongs to the progressive video signals, (2) to be displayed as a top field which belongs to the interlace video signals, (3) to be displayed as a bottom field which belongs to the interlace video signals, or (4) to be displayed in another display format in the display process of the picture to be decoded, and

[0178] the output picture setter **203** changes the output method of the picture based on the acquired third identifier.

[0179] For example, the second code string analyzer **201** (picture upper layer decoder) acquires the picture unit display control information which includes a third identifier specifying that the picture to be decoded is (1) to be displayed as a top field which belongs to the interlace video signals or (2) to be displayed as a bottom field which belongs to the interlace video signals in the display process of the picture to be decoded only in the case where the video signals to be decoded are in the interlace format, and

[0180] the output picture setter **203** changes the output method of the picture based on the acquired third identifier.

[0181] For example, the second code string analyzer **201** (picture upper layer decoder) acquires the picture unit display control information which includes specification information specifying a picture that is paired with the picture to be decoded and belongs to the same frame as that of the picture to be decoded in the case where the picture to be decoded is to be displayed as a top field or a bottom field which belongs to the interlace video signals, and

[0182] the output picture setter **203** outputs the picture to be decoded by setting the picture to be decoded as paired with the picture specified in the specification information.

[0183] For example, the second code string analyzer **201** (picture upper layer decoder) acquires, as the specification information, display order information which is assigned to

the picture that is paired with the picture to be decoded and belongs to the same frame as that of the picture to be decoded.

[0184] For example, the second code string analyzer **201** (picture upper layer decoder) acquires, as the specification information, a difference value between the display order information which is assigned to the picture to be decoded and the display order information which is assigned to the picture that is paired with the picture to be decoded and belongs to the same frame as that of the picture to be decoded.

[0185] A video decoding method of the embodiment decodes a code string in units of pictures, the code string being acquired as a result of encoding video signals in an interlace video format or a progressive video format in units of pictures. The video decoding method comprising:

[0186] analyzing the code string to acquire a picture upper layer code string and a first code string,

[0187] acquiring, from the picture upper layer code string, coding control information used in encoding the video signals and display control information to be used for displaying decoded pictures,

[0188] decoding the first code string for each block, which is a unit of decoding process, to acquire the picture by using common syntax analyzing method, a common signal processing method, and information commonly used in encoding regardless of the video format among the coding control information, which are not dependent on the video formats, and

[0189] in the case where the display control information indicates the progressive format, setting the acquired picture as a frame and outputting the frame one by one in a display order, and in the case where the display control information indicates the interlace format, setting the acquired picture as a field and outputting a pair of top field and bottom field in a display order when the pair of top field and bottom field are acquired.

5-2. Effects and the Like

[0190] With the video decoding device **200** according to the embodiment, a decoding process and display control are allowed to be performed on picture data under a common control with the processing amount being not increased for both a code string which is acquired as a result of encoding a progressive video and a code string which is acquired as a result of encoding an interlace video. That facilitates implementation of a decoding device.

Third Embodiment

Another Example of Encoding Process

[0191] The third embodiment will be described with reference to the drawings.

1. Configuration of a Video Encoding Device

[0192] FIG. **14** is a block diagram of a video encoding device according to the embodiment.

[0193] The video encoding device **100-1** includes a picture data encoder **110-1** and a second code string generator **104-1** in place of the picture data encoder **110** and the second code string generator **104** of the video encoding device **100** of the first embodiment. The picture data encoder **110-1** includes a first code string generator **117-1** in place of the first code string generator **117**.

[0194] For convenience of the description, a detailed description of the same configuration as that of the first embodiment will be omitted below. Further, in FIG. **14**, blocks which have the same functions as those of the blocks in FIG. **1** are denoted by the same numbers as the blocks in FIG. **1**.

[0195] The picture data encoder **110-1** divides each picture input from the picture setter **101** into blocks and performs an encoding process in units of blocks to generate a code string of picture data. At this moment, a common encoding process is applied in units of pictures without depending on whether the video format is the progressive format or the interlace format and, the generated code string of the picture data has a common syntax. Also in the embodiment, the picture data encoder **110-1** generates a code string of sequence header and a code string of picture header.

[0196] The first code string generator **117-1** generates the code string of picture data by performing variable length coding on the residual encoding signals **162** output from the prediction residual encoder **112**, prediction information signals **166** output from the prediction encoder **115**, the quantization value output from the quantization value determiner **116**, and information about the other encoding control. In the embodiment, the first code string generator **117-1** encodes information about encoding control in units of sequences and encoding control in units of pictures as header information to generate the code string of sequence header and the code string of picture header.

[0197] The second code string generator **104-1** encodes the display control information signals **153** output from the display control information generator **103** to generate an extended information area code string. The display control information signals **153** include the display control information in units of sequences and the display control information in units of pictures. Further, the second code string generator **104-1** associates the generated extended information area code string and the code string generated by the picture data encoder **110**, the code string of picture data including a sequence header, a picture header, and picture data, to generate the code string signals **154** to be finally output.

2. Generation Method of Display Control Information

[0198] A method of generating the display control information signals **153** in the display control information generator **103** and describing the display control information signals **153** in a code string in the second code string generator **104-1** and a method of sort in an input video in an encoding order in the picture setter **101** when the video format signals **152** are received from the video format specifying unit **102** will be described specifically with reference to the flow chart of the entire encoding process of FIG. **15**.

[0199] First, the first code string generator **117-1** performs code string generation on header areas in units of sequences (S**1801**).

[0200] Next, the first code string generator **117-1** performs code string generation on header areas in units of pictures (S**1802**).

[0201] Next, the display control information generator **103** generates display control information in units of sequences and display control information in units of pictures according to the video format specified by the video format specifying unit **102** (S**1803**). The second code string generator **104-1**

encodes and describes the respective kinds of display control information in the extended information area in the code string.

[0202] Next, the picture setter **101** sorts the input picture which is input in a display order in an encoding order and selects a picture to be encoded (S**1804**). At this moment, the picture setter **101** sorts the pictures according to the video format specified by the video format specifying unit **102**.

[0203] Next, the picture data encoder **110-1** performs the above described series of encoding process to generate a code string of picture data (S**1805**). Meanwhile, in step S**1805**, a common encoding process is applied without depending on whether the video format is the progressive format or the interlace format.

[0204] Next, when the processes on the currently processed picture to be encoded are completed, the operation returns to step S**1802** to proceed to the encoding process of the next picture, and the processes from step S**1802** to step S**1805** are repeated until the encoding processes of all of the pictures in the sequence are completed (S**1806**).

3. Sort of Pictures

[0205] As for the sort process of pictures in step S**1804**, the same processes as those described with reference to FIGS. **3**, **4**, and **5** in the first embodiment are performed. Therefore, the description of the process will be omitted.

4. Configuration and Syntax of the Code String

[0206] Now, a configuration of the code string generated by the embodiment will be described with reference to FIG. **16**.

[0207] The generated code string includes a sequence header area in which coding control information in units of sequences is described, a picture header area in which coding control information in units of pictures is described, an extended information area in which auxiliary information in units of pictures is described, and picture data. Both of the display control information in units of sequences and the display control information in units of pictures are described in the extended information area. The respective types of information other than the display control information are described in the code string of a common syntax without depending on whether the input video format is the progressive format or the interlace format.

[0208] Now, the syntax of the extended information area in which the display control information in units of sequences and the display control information in units of pictures are described will be described in detail with reference to FIG. **17**. In FIG. **17**, things other than the syntax related to the embodiment are omitted.

[0209] In FIG. **17**, all of interlace_flag, continual_flag, max_distance_flag, pic_struct, and field_pair_POC are described in pic_timing_SEI( ). Since details of the parameters are completely the same as those described in FIGS. **7** and **8**, the descriptions will be omitted here.

[0210] Since the extended information area is encoded for each of the pictures, as for interlace_flag, continual_flag, and max_distance_flag of the display control information in units of sequences, the same values are always repeated for each picture in the sequence although it is redundant. However, with all of the display control information described collectively as illustrated in FIG. **17**, all of the syntax areas other than the extended information area may be in a common syntax without depending on whether the video format is the progressive format or the interlace format. Therefore, the encoding process can be further simplified.

[0211] The parameter names and parameter values described here are merely examples and the other parameter names and parameter values may be used to realize the same functions. Further, not all of the parameters described here but only a part of the parameters may be used. Although an example in which each of the above described parameters is described in the area of pic_timing_SEI( ) has been described here, each of the parameters may be described in any other area as far as the area allows the control information in units of pictures to be described.

5. Summarization

5-1. Configuration

[0212] The video encoding device **100-1** of the embodiment encodes the input video signals in units of pictures. The video encoding device **100-1** includes:

[0213] the video format specifying unit **102** (video format information acquiring unit) which acquires video format information indicating whether the video format of the video signals is the interlace format or the progressive format;

[0214] the display control information generator **103** which generates display control information to be used for displaying a video indicated by encoded video signals as a video in a video format indicated by the video format information based on the video format information;

[0215] the picture setter **101** which, in the case where the video format information indicates the progressive format, sets a frame of the video signals as a picture and sorts the pictures in the encoding order, and in the case where the video format information indicates the interlace format, sets a field of the video signals as a picture and sorts the pictures in the encoding order;

[0216] the picture data encoder **110-1** which outputs a first code string by encoding the pixel data included in the set picture by using a common signal processing method and a common syntax structure which are not dependent on the video formats;

[0217] the second code string generator **104-1** (extended information area encoder) encodes the display control information to generate the extended information area code string; and

[0218] the second code string generator **104-1** which outputs a second code string, the second code string being acquired by that the first code string is associated with the extended information area code string, wherein

[0219] the display control information includes sequence unit display control information and picture unit display control information, the sequence unit display control information being commonly used in a display process of all pictures which belong to a sequence to be encoded and the picture unit display control information being individually used in a display process of a picture to be encoded, and

[0220] the second code string generator **104-1** (extended information area encoder) stores the extended information area code string in the extended information area which is generated in units of pictures.

[0221] For example, the second code string generator **104-1** (extended information area encoder) stores the sequence unit display control information of the same value in each extended information area of each picture belonging to the same sequence.

[0222] For example, the display control information generator **103** generates the sequence unit display control information which includes a first identifier specifying whether the video signals to be encoded are in the progressive format or the interlace format.

[0223] For example, the display control information generator **103** generates the sequence unit display control information which includes a second identifier specifying whether two fields which belong to the same frame are always continual with each other in the encoding order in the sequence in the case where the video signals to be encoded is in the interlace format.

[0224] For example, the display control information generator **103** generates the sequence unit display control information which includes information indicating the maximum value of an interval between the first field and the second field which belong to the same frame in the encoding order in the sequence in the case where the video signals to be encoded are in the interlace format.

[0225] For example, the display control information generator **103** generates the picture unit display control information which includes a third identifier specifying that the picture to be encoded is (1) to be displayed as a frame which belongs to the progressive video signals, (2) to be displayed as a top field which belongs to the interlace video signals, (3) to be displayed as a bottom field which belongs to the interlace video signals, or (4) to be displayed in another display format, in the display process of the picture to be encoded.

[0226] For example, the display control information generator **103** generates the picture unit display control information which includes a third identifier specifying that the picture to be encoded is (1) to be displayed as a top field which belongs to the interlace video signals or (2) to be displayed as a bottom field which belongs to the interlace video signals in the display process of the picture to be encoded only in the case where the video signals to be encoded are in the interlace format.

[0227] For example, the display control information generator **103** generates the picture unit display control information which includes specification information specifying a picture that is paired with the picture to be encoded and belongs to the same frame as that of the picture to be encoded in the case where the picture to be encoded is to be decoded and displayed as a top field or a bottom field which belongs to the interlace video signals.

[0228] For example, the display control information generator **103** describes, as the specification information, display order information which is assigned to the picture that is paired with the picture to be encoded and belongs to the same frame as that of the picture to be encoded.

[0229] For example, the display control information generator **103** describes, as the specification information, a difference value between the display order information which is assigned to the picture to be encoded and the display order information which is assigned to the picture that is paired with the picture to be encoded and belongs to the same frame as that of the picture to be encoded.

[0230] The video encoding method of the embodiment encodes the input video signals in units of pictures. The video encoding method comprises:

[0231] acquiring video format information indicating whether the video format of the video signals is the interlace format or the progressive format,

[0232] generating display control information to be used for displaying the video indicated by the encoded video signals as a video in the video format indicated by the video format information based on the video format information,

[0233] in the case where the video format information indicates the progressive format, performing sort on a plurality of frames included in the video signals in the encoding order and also setting each of the plurality of frames as a picture, and in the case where the video format information indicates the interlace format, performing sort on a plurality of fields included in the video signals in the encoding order and also setting each of the plurality of fields as a picture,

[0234] outputting a first code string by encoding the pixel data included in the set picture by using a common signal processing method and a common syntax structure which are not dependent on the video formats,

[0235] encoding the display control information to generate the extended information area code string,

[0236] outputting a second code string which is acquired by that the first code string is associated with the extended information area code string, wherein

[0237] the display control information includes sequence unit display control information and picture unit display control information, the sequence unit display control information being commonly used in a display process of all pictures which belong to a sequence to be encoded and the picture unit display control information being individually used in a display process of a picture to be encoded, and

[0238] storing each of the sequence unit display control information and the picture unit display control information in the extended information area which is generated in units of pictures.

5-2. Effects and the Like

[0239] With the video encoding device **100-1** according to the embodiment, an encoding process is allowed to be performed on picture data under a common control with the processing amount being not increased both in the case where the progressive video is input and in the case where the interlace video is input, therefore, the video encoding device **100-1** facilitates implementation of a encoding device.

[0240] Generally, in a video decoding device, a decoding process for decoding an encoded code string to generate a decoded image and a display process for displaying the generated decoded image on a corresponding display device by adapting the image to the device are controlled as different levels. For example, such a method is possible that the former process is formed by hardware and the latter process is formed by software. The method can reduce the man-hours for development, for example, in developing the devices which are different in the display method such as a television set and a personal computer, by using common hardware for performing the decoding process and only creating software programs for performing the display process respectively for the devices.

[0241] In the embodiment, the extended information area in which only the information unnecessary for the encoding process (display control information, and the like) is described and the other areas in which information necessary for the decoding process is described are completely separated as in the code string described in FIG. **16**. As a result, the present disclosure facilitates sending of only the code strings needed by respective levels of the level of performing the decoding process and the level of performing the display

process to the respective levels for the purpose like the above described use, therefore, improves independence of each level. That is, it allows to form the level of performing the decoding process (hardware) by using completely the common components in both the decoding device which supports the progressive format and the decoding device which supports the interlace format.

Fourth Embodiment

Another Example of Decoding Process

[0242] The fourth embodiment will be described with reference to the drawings.

1. Configuration of a Video Decoding Device

[0243] FIG. **18** is a block diagram of a video decoding device according to the embodiment.

[0244] The video decoding device **200-1** includes a picture data decoder **210-1** and a second code string analyzer **201-1** in place of the picture data decoder **210** and the second code string analyzer **201** of the video decoding device **200** of the second embodiment. The picture data decoder **210-1** includes a first code string analyzer **211-1** in place of the first code string analyzer **211**.

[0245] For convenience of the description, a detailed description of the same configuration as that of the second embodiment will be omitted below. Further, in FIG. **18**, blocks which have the same functions as those of the blocks in FIG. **1** are denoted by the same numbers as the blocks in FIG. **1**.

[0246] The second code string analyzer **201** extracts at least display control information from the extended information area of the code string of header information included in the input code string signals **251**. Then, the second code string analyzer **201** outputs the extracted information to the display control information analyzer **202** as display control information signals **252**.

[0247] The picture data decoder **210** generates a decoded image of an objective picture by performing a decoding process in units of blocks on a code string of picture data included in the input code string signals **251**. At this moment, a common decoding process is applied in units of pictures without depending on whether the video format is the progressive format or the interlace format and, further, the code string of the picture data to be decoded has a common syntax.

[0248] The first code string analyzer **211** performs analyzing of decoding control information and analyzing of the picture data in units of blocks by performing variable length decoding on the code string of picture data of the input code string signals **251**. The decoding control information includes information about decoding control in units of sequences and decoding control in units of pictures. The first code string analyzer **211** outputs residual encoding signals **261** which are acquired as a result of analyzing, to the prediction residual decoder **212**. Further, the first code string analyzer **211** outputs prediction information signals **265** which are acquired as a result of analyzing to the prediction decoder **214**. Still further, the first code string analyzer **211** outputs quantization value information which is acquired as a result of analyzing to the quantization value determiner **215**.

2. Display Control Method

[0249] A method of analyzing the display control information in the display control information analyzer **202** and performing sort on the decoded pictures in an output order in the output picture setter **203** to be an output image will be described specifically with reference to the flow chart of the entire decoding process of FIG. **19**.

[0250] First, the first code string analyzer **211-1** performs code string analyzing of header areas in units of sequences (S**1901**).

[0251] Next, the first code string analyzer **211-1** performs code string analyzing of header areas in units of pictures (S**1902**).

[0252] Next, the second code string analyzer **201-1** performs code string analyzing of extended information area (S**1903**). At this moment, the display control information analyzer **202** acquires the display control information in units of sequences and the display control information in units of pictures.

[0253] Next, the picture data decoder **210-1** performs a series of decoding process to generate a decoded image of the objective pictures (S**1904**). Meanwhile, in step S**1904**, a common decoding process is applied without depending on whether the video format is the progressive format or the interlace format.

[0254] Next, the output picture setter **203** sorts the decoded image which is stored in the decoding order in a display order and selects a picture to be displayed (S**1905**). At this moment, the output picture setter **203** sorts the pictures according to a display control method acquired as a result of analyzing by the display control information analyzer **202**.

[0255] Next, when the processes on the currently processed picture to be decoded are completed, the operation returns to step S**1902** to proceed to the decoding process of the next picture, and the processes from step S**1902** to step S**1904** are repeated until the decoding processes of all of the pictures in the sequence are completed (S**1905**).

3. Sort of Pictures

[0256] As for the sort process of pictures in step S**1905**, the same processes as those described with reference to FIGS. **11**, **12**, and **13** in the second embodiment are performed. Therefore, the description of the sort process will be omitted.

4. Configuration and Syntax of the Code String

[0257] Since the configuration and syntax of the code string to be decoded in the embodiment are completely the same as those described in the first embodiment with reference to FIGS. **6** to **8**, the description of them will be omitted here.

5. Summarization

5-1. Configuration

[0258] The video decoding device **200-1** of the embodiment decodes a code string in units of pictures, the code string being acquired as a result of encoding video signals in an interlace video format or a progressive video format in units of pictures. The video decoding device **200-1** includes:

[0259] the second code string analyzer **201-1** which analyzes the code string to acquire an extended information area code string and a first code string;

[0260] the second code string analyzer **201-1** (extended information area decoder) which acquires display control

information to be used in displaying a decoded picture, from the extended information area code string;

[0261] the picture data decoder **210-1** which decodes the first code string to acquire the picture by using common syntax analyzing method and a common signal processing method, which are not dependent on the video formats; and

[0262] the output picture setter **203** which, in the case where the display control information indicates the progressive format, sets the acquired picture as a frame and outputs the frame one by one in a display order, and in the case where the display control information indicates the interlace format, sets the acquired picture as a field and outputs a pair of top field and bottom field in a display order when the a pair of fields are acquired, wherein

[0263] the display control information includes sequence unit display control information and picture unit display control information, the sequence unit display control information being commonly used in a display process of all pictures which belong to a sequence to be decoded and the picture unit display control information being individually used in a display process of a picture to be decoded, and

[0264] the extended information area decoder **201-1** acquires each of the sequence unit display control information and the picture unit display control information from an extended information area in units of pictures.

[0265] For example, each extended information area of each picture unit which belongs to the same sequence stores the sequence unit display control information of the same value.

[0266] For example, the second code string analyzer **201-1** (extend information area decoder) acquires the sequence unit display control information which includes a first identifier specifying whether the video signals to be decoded are in the progressive format or the interlace format, and

[0267] the output picture setter **203** changes the output method of the picture based on the acquired first identifier.

[0268] For example, in the case where the video signals to be decoded are in the interlace format, the second code string analyzer **201-1** (extend information area decoder) acquires the sequence unit display control information which includes a second identifier specifying whether two fields which belong to the same frame are always continual with each other in the decoding order in the sequence, and

[0269] the output picture setter **203** changes the output method of the picture based on the acquired second identifier.

[0270] For example, in the case where the video signals to be decoded are in the interlace format, the second code string analyzer **201-1** (extend information area decoder) acquires the sequence unit display control information which includes information indicating the maximum value of an interval between the first field and the second field which belong to the same frame in the decoding order in the sequence, and

[0271] the output picture setter **203** changes the output method of the picture based on the acquired information indicating the maximum value.

[0272] For example, the second code string analyzer **201-1** (extend information area decoder) acquires the picture unit display control information which includes a third identifier specifying that the picture to be decoded is (1) to be displayed as a frame which belongs to the progressive video signals, (2) to be displayed as a top field which belongs to the interlace video signals, (3) to be displayed as a bottom field which belongs to the interlace video signals, or (4) to be displayed in another display format in the display process of the picture to be decoded, and

[0273] the output picture setter **203** changes the output method of the picture based on the acquired third identifier.

[0274] For example, the second code string analyzer **201-1** (extend information area decoder) acquires the picture unit display control information which includes a third identifier specifying that the picture to be decoded is (1) to be displayed as a top field which belongs to the interlace video signals or (2) to be displayed as a bottom field which belongs to the interlace video signals, in the display process of the picture to be decoded only in the case where the video signals to be decoded are in the interlace format, and

[0275] the output picture setter **203** changes the output method of the picture based on the acquired third identifier.

[0276] For example, the second code string analyzer **201-1** (extend information area decoder) acquires the picture unit display control information which includes specification information specifying a picture that is paired with the picture to be decoded and belongs to the same frame as that of the picture to be decoded in the case where the picture to be decoded is to be displayed as a top field or a bottom field which belongs to the interlace video signals, and

[0277] the output picture setter **203** outputs the picture to be decoded by setting the picture to be decoded as paired with the picture specified in the specification information.

[0278] For example, the second code string analyzer **201-1** (extended information area decoder) acquires, as the specification information, display order information which is assigned to the picture that is paired with the picture to be decoded and belongs to the same frame as that of the picture to be decoded.

[0279] For example, the second code string analyzer **201-1** (extended information area decoder) acquires, as the specification information, a difference value between the display order information which is assigned to the picture to be decoded and the display order information which is assigned to the picture that is paired with the picture to be decoded and belongs to the same frame as that of the picture to be decoded.

[0280] A video decoding method of the embodiment decodes a code string in units of pictures, the code string being acquired as a result of encoding video signals in an interlace video format or a progressive video format in units of pictures. The video decoding method comprises:

[0281] analyzing the code string to acquire an extended information area code string and a first code string,

[0282] acquiring display control information to be used in displaying a decoded picture, from the extended information area code string,

[0283] decoding the first code string to acquire the picture by using common syntax analyzing method and a common signal processing method, which are not dependent on the video formats, and

[0284] in the case where the display control information indicates the progressive format, setting the acquired picture as a frame and outputting the frame one by one in a display order, and in the case where the display control information indicates the interlace format, setting the acquired picture as a field and outputting a pair of top field and bottom field in a display order when the pair of top field and bottom field are acquired, wherein

[0285] the display control information includes sequence unit display control information and picture unit display con-

trol information, the sequence unit display control information being commonly used in a display process of all pictures which belong to a sequence to be decoded and the picture unit display control information being individually used in a display process of a picture to be decoded, and

[0286] each of the sequence unit display control information and the picture unit display control information is acquired from an extended information area in units of pictures.

5-2. Effects and the Like

[0287] With the video decoding device **200-1** according to the embodiment, a decoding process and display control are allowed to be performed on picture data under a common control with the processing amount being not increased for both a code string which is acquired as a result of encoding a progressive video and a code string which is acquired as a result of encoding an interlace video. That facilitates implementation of a decoding device.

[0288] As described in the third embodiment, in the present embodiment, the extended information area in which only the information unnecessary for the encoding process (display control information, and the like) is described and the other areas in which information necessary for the decoding process is described are completely separated. As a result, the present disclosure facilitates sending of only the code strings needed by respective levels of the level of performing the decoding process and the level of performing the display process to the respective levels for the purpose like the above described use, therefore, improves independence of each level. That is, it allows to form the level of performing the decoding process (hardware) by using completely the common components in both the decoding device which supports the progressive format and the decoding device which supports the interlace format.

Other Embodiments

[0289] Programs having the functions equivalent to the respective units included in the video encoding device and the video decoding device described in the above embodiments can be recorded in a recording medium such as a flexible disk. That facilitates implementation of the processes described in the above embodiments in an independent computer system. The recording medium is not limited to the flexible disk and may be any medium as far as it can record a program, such as an optical disk, an IC card, and a ROM cassette.

[0290] The functions equivalent to the respective units included in the video encoding device and the video decoding device described in the above embodiments can be realized as large scale integrated circuits (LSI). The large scale integrated circuits may be made into a chip which includes some or all of the functions. The LSI may be referred to as IC, system LSI, super LSI, and ultra LSI according to the integration density.

[0291] Further, the technique of making the above described functions into an integrated circuit is not limited to LSI, and the functions may be implemented by a dedicated circuit or a general purpose processor. An FPGA (Field Programmable Gate Array) which is capable of programming the manufactured LSI or a reconfigurable processor which is capable of reconfiguring connection and setting of the circuit cells inside the LSI may be used.

[0292] Furthermore, when a new technology of an integrated circuit will be developed to replace the LSI and the like as a result of advancement of the semiconductor technology or another derivative technology, it is a matter of course that the new technology may be used in making the functional blocks into an integrated circuit.

[0293] The present disclosure may be applied to a broadcast wave recording apparatus including the above described video encoding device and video decoding device, such as a DVD recorder and a BD recorder, which compresses and records the broadcast waves sent from a broadcast station.

[0294] At least some of the functions of the video encoding device and the video decoding device according to the above described embodiments or their modifications may be combined together.

INDUSTRIAL APPLICABILITY

[0295] The present disclosure is useful as a video encoding device which encodes each picture of an input video and outputs the encoded video data or a video decoding device which decodes the encoded video data to generate a decoded image in a video camera, a digital camera, a video recorder, a mobile phone, and a personal computer, for example.

What is claimed is:

1. A video decoding device for decoding a code string in units of pictures, the code string being acquired by encoding video signals in an interlace video format or a progressive video format in units of pictures, comprising:

a second code string analyzer that analyzes the code string to acquire an extended information area code string and a first code string;

an extended information area decoder that acquires display control information to be used in displaying a decoded picture, from the extended information area code string;

a picture data decoder that decodes the first code string to acquire the picture by using common syntax analyzing method and a common signal processing method, which are not dependent on the video formats; and

an output picture setter that, in the case where the display control information indicates the progressive format, sets the acquired picture as a frame and outputs the frame one by one in a display order, and in the case where the display control information indicates the interlace format, sets the acquired picture as a field and outputs a pair of top field and bottom field in a display order when the pair of top field and bottom field are acquired, wherein

the display control information includes sequence unit display control information and picture unit display control information, the sequence unit display control information being commonly used in a display process of all pictures that belong to a sequence to be decoded and the picture unit display control information being individually used in a display process of a picture to be decoded, and

the extended information area decoder acquires each of the sequence unit display control information and the picture unit display control information from an extended information area in units of pictures.

2. The video decoding device according to claim **1**, wherein each extended information area of each picture that belongs to the same sequence stores the sequence unit display control information of the same value.

3. The video decoding device according to claim **1**, wherein the extended information area decoder acquires the

sequence unit display control information that includes a first identifier specifying whether the video signals to be decoded are in the progressive format or the interlace format, and

the output picture setter changes the output method of the picture based on the acquired first identifier.

4. The video decoding device according to claim **1**, wherein in the case where the video signals to be decoded are in the interlace format, the extended information area decoder acquires the sequence unit display control information that includes a second identifier specifying whether two fields that belong to the same frame are always continual with each other in a decoding order in the sequence, and

the output picture setter changes the output method of the picture based on the acquired second identifier.

5. The video decoding device according to claim **1**, wherein in the case where the video signals to be decoded are in the interlace format, the extended information area decoder acquires the sequence unit display control information that includes information indicating a maximum value of an interval between a first field and a second field that belong to the same frame in the decoding order in the sequence, and

the output picture setter changes the output method of the picture based on the acquired information indicating the maximum value.

6. The video decoding device according to claim **1**, wherein the extended information area decoder acquires the picture unit display control information that includes a third identifier specifying that the picture to be decoded is (1) to be displayed as a frame that belongs to the progressive video signals, (2) to be displayed as a top field that belongs to the interlace video signals, (3) to be displayed as a bottom field that belongs to the interlace video signals, or (4) to be displayed in another display format in the display process of the picture to be decoded, and

the output picture setter changes the output method of the picture based on the acquired third identifier.

7. The video decoding device according to claim **1**, wherein only in the case where the video signals to be decoded are in the interlace format, the extended information area decoder acquires the picture unit display control information that includes a third identifier specifying that the picture to be decoded is (1) to be displayed as a top field that belongs to the interlace video signals or (2) to be displayed as a bottom field that belongs to the interlace video signals in the display process of the picture to be decoded, and

the output picture setter changes the output method of the picture based on the acquired third identifier.

8. The video decoding device according to claim **1**, wherein, in the case where the picture to be decoded is to be displayed as a top field or a bottom field that belongs to the interlace video signals, the extended information area decoder acquires the picture unit display control information that includes specification information specifying a picture that is paired with the picture to be decoded and belongs to the same frame as that of the picture to be decoded, and

the output picture setter outputs the picture to be decoded by setting the picture to be decoded as paired with the picture specified in the specification information.

9. The video decoding device according to claim **8**, wherein the extended information area decoder acquires, as the specification information, display order information that is assigned to the picture that is paired with the picture to be decoded and belongs to the same frame as that of the picture to be decoded.

10. The video decoding device according to claim **8**, wherein the extended information area decoder acquires, as the specification information, a difference value between display order information that is assigned to the picture to be decoded and display order information that is assigned to the picture that is paired with the picture to be decoded and belongs to the same frame as that of the picture to be decoded.

11. A video decoding method for decoding a code string in units of pictures, the code string being acquired by encoding video signals in an interlace video format or a progressive video format in units of pictures, comprising:

analyzing the code string to acquire an extended information area code string and a first code string;

acquiring display control information to be used in displaying a decoded picture, from the extended information area code string;

decoding the first code string to acquire the picture by using common syntax analyzing method and a common signal processing method, which are not dependent on the video formats; and

in the case where the display control information indicates the progressive format, sets the acquired picture as a frame and outputs the frame one by one in a display order, and in the case where the display control information indicates the interlace format, sets the acquired picture as a field and outputs a pair of top field and bottom field in a display order when the pair of top field and bottom field are acquired, wherein

the display control information includes sequence unit display control information and picture unit display control information, the sequence unit display control information being commonly used in a display process of all pictures that belong to a sequence to be decoded and the picture unit display control information being individually used in a display process of a picture to be decoded, and

each of the sequence unit display control information and the picture unit display control information is acquired from an extended information area in units of pictures.

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