PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

DATE: October 21, 2016

UTILITY PATENT APPLICATION TRANSMITTAL LETTER AND FEE TRANSMITTAL FORM (37 CFR § 1.53(b)) FOR ELECTRONIC FILING

Attorney Docket No.: **9900-34860US3**

Inventor(s): **JONATAN SAMUELSSON; RICKARD SJÖBERG**

Applicant: **Telefonaktiebolaget LM Ericsson (publ)**

Entitled: **REFERENCE PICTURE SIGNALING**

Correspondence Address: **Customer No. 20792**

Transmitted herewith for filing under 37 CFR § 1.53(b) is:

1. ☒ **54** pages of Specification
2. ☒ **12** sheets of Formal Drawings (35 USC 113)
3. ☒ Application Data Sheet. See 37 CFR 1.76
4. ☒ Oath or Declaration
   a. ☒ newly executed *(copy)*
   b. ☐ copy from prior application
5. ☒ Power of Attorney ☒ 37 CFR 3.73(c) Statement
6. ☐ Sequence Listing
   a. ☐ computer-readable copy
   b. ☐ paper copy (____ pages)
   c. ☐ statement regarding sequence listing (_____ pages)
7. ☒ Information Disclosure Statement
8. ☐ Preliminary Amendment ***(Please enter all claim amendments prior to calculating the filing fee.)***
9. ☐ Non-publication Request under 35 U.S.C. 122(b)(2)(B)(i).
10. ☐ Other:
11. ☐ Applicant claims small entity status. See 37 CFR § 1.27.

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EXHIBIT 1009

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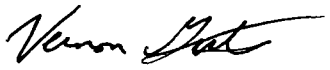
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	9900-34860US3
	Application Number	
Title of Invention	REFERENCE PICTURE SIGNALING	

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Inventor Information:

Inventor 1 Remove

Legal Name

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Legal Name

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Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

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All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

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For further information see 37 CFR 1.33(a).

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Title of the Invention	REFERENCE PICTURE SIGNALING		
Attorney Docket Number	9900-34860US3	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	12	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

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Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	13508442	2013-04-25
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13508442	a 371 of international	PCT/SE2012/050439	2012-04-26
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/SE2012/050439	Claims benefit of provisional	61503019	2011-06-30

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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	9900-34860US3
	Application Number	
Title of Invention	REFERENCE PICTURE SIGNALING	

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	Application Number	
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Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
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Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	Telefonaktiebolaget LM Ericsson (publ)

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Country	SE	Postal Code	164 83
Phone Number		Fax Number	
Email Address			

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	Application Number	
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Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

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See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature				Date (YYYY-MM-DD)	2016-10-21
First Name	Vernon H.	Last Name	Guthrie	Registration Number	63798

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REFERENCE PICTURE SIGNALING

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. Patent Application No. 13/508,442, filed on April 25, 2013, which itself is a 35 U.S.C. § 371 national stage application of PCT International Application No. PCT/SE2012/050439, filed on 26 April 2012, which claims the benefit of priority from U.S. Provisional Application No. 61/503,019, filed 30 June 2011, the entire contents of which are incorporated by reference herein as if set forth in their entireties.

TECHNICAL FIELD

The embodiments generally relate to reference picture management in connection with video encoding and decoding, and in particular to reference picture signaling and buffer management.

BACKGROUND

H.264, also referred to as Moving Picture Experts Group-4 (MPEG-4) Advanced Video Coding (AVC), is the state of the art video coding standard. It consists of a block based hybrid video coding scheme that exploits temporal and spatial prediction.

High Efficiency Video Coding (HEVC) is a new video coding standard currently being developed in Joint Collaborative Team - Video Coding (JCT-VC). JCT-VC is a collaborative project between MPEG and International Telecommunication Union Telecommunication standardization sector (ITU-T). Currently, a Working Draft (WD) is defined that includes large macroblocks (abbreviated LCUs for Largest Coding Units) and a number of other new tools and is considerably more efficient than H.264/AVC.

At a receiver a decoder receives a bit stream representing pictures, i.e. video data packets of compressed data. The compressed data comprises payload and control information. The control information comprises e.g. information of which reference pictures should be stored in a reference picture buffer, also referred to as a decoded picture buffer (DPB). This information is a relative reference to previous received pictures. Further, the decoder decodes the received bit stream and displays the decoded picture. In addition, the decoded pictures are stored in the decoded picture buffer

according to the control information. These stored reference pictures are used by the decoder when decoding subsequent pictures.

A working assumption for the processes of decoded picture buffer operations in the working draft of HEVC is that they will be inherited from H.264/AVC to a very large extent. A simplified flow chart of the scheme as it is designed in H.264/AVC is shown in Fig. 1.

Before the actual decoding of a picture, the *frame_num* in the slice header is parsed to detect a possible gap in *frame_num* if Sequence Parameter Set (SPS) syntax element *gaps_in_frame_num_value_allowed_flag* is 1. The *frame_num* indicates the decoding order. If a gap in *frame_num* is detected, "non-existing" frames are created and inserted into the decoded picture buffer (DPB).

Regardless of whether there was a gap in *frame_num* or not the next step is the actual decoding of the current picture. If the slice headers of the picture contain Memory Management Control Operations (MMCO) commands, adaptive memory control process is applied after decoding of the picture to obtain relative reference to the pictures to be stored in the decoded picture buffer; otherwise a sliding window process is applied to obtain relative reference to the pictures to be stored in the decoded picture buffer. As a final step, the "bumping" process is applied to deliver the pictures in correct order.

A problem with H.264/AVC is its vulnerability to losses of pictures that contains MMCO of type 2, 3, 4, 5 or 6 as described in Table 1 below.

Table 1 – Memory management control operation values for H.264/AVC

memory_management_control_operation	Memory Management Control Operation
0	End *memory_management_control_operation* syntax element loop
1	Mark a short-term reference picture as "unused for reference"
2	Mark a long-term reference picture as "unused for reference"

3	Mark a short-term reference picture as "used for long-term reference" and assign a long-term frame index to it
4	Specify the maximum long-term frame index and mark all long-term reference pictures having long-term frame indices greater than the maximum value as "unused for reference"
5	Mark all reference pictures as "unused for reference" and set the *MaxLongTermFrameIdx* variable to "no long-term frame indices"
6	Mark the current picture as "used for long-term reference" and assign a long-term frame index to it

Loss of a picture that does not contain MMCO, or a picture that contains MMCO of type 0 or 1, is of course severe to the decoding process. Pixel values of the lost picture will not be available and may affect future pictures for a long period of time due to incorrect inter prediction. There is also a risk that reference picture lists for a few pictures following the lost picture will be wrong, for example if the lost picture contained MMCO that marked one short-term reference picture as "unused for reference" that otherwise would have been included in the reference picture list of the following picture. However, the decoding process can generally recover such a loss through usage of constrained intra blocks, intra slices or by other means.

But if a picture containing MMCO of type 2, 3, 4, 5 or 6 is lost there is a risk that the number of long term pictures in the DPB is different from what it would have been if the picture was received, resulting in an "incorrect" sliding window process for all the following pictures. That is, the encoder and decoder will contain a different number of short-term pictures resulting in out-of-sync behavior of the sliding window process. This loss cannot be recovered through usage of constrained intra blocks, intra slices or similar techniques (not even an open Group Of Picture (GOP) Intra picture). The only way to ensure recovery from such a loss is through an Instantaneous Decoder Refresh (IDR) picture or through an MMCO that cancels the effect of the lost MMCO. What makes the situation even worse is that a decoder will not necessarily know that the sliding window process is out-of-sync and thus cannot report

the problem to the encoder or request an IDR picture even in applications where a feedback channel is available.

One way to reduce the risk of loosing important MMCO information is to use *dec_ref_pic_marking_repetition* Supplementary Enhancement Information (SEI) messages. However the encoder will not know if the decoder is capable of making use of *dec_ref_pic_marking_repetition* SEI messages. Further, there is a risk that the *dec_ref_pic_marking_repetition* SEI message is also lost.

There is, thus, a need for an efficient reference picture signaling and buffer management that do not suffer from the shortcomings and limitations of prior art solutions.

SUMMARY

It is a general objective to provide an efficient reference picture signaling and buffer management in connection with video encoding and decoding.

This and other objectives are met by embodiments disclosed herein.

An aspect of the embodiments relates to a method of decoding an encoded representation of a picture of a video stream of multiple pictures. The method comprises retrieving buffer description information defining at least one reference picture from the encoded representation of the picture. At least one picture identifier identifying a respective reference picture of the at least one reference picture is determined based on the buffer description information. The respective reference picture is to be used as decoding reference for the picture. A decoded picture buffer is updated based on the determined at least one picture identifier.

A related aspect of the embodiments defines a decoder configured to decode an encoded representation of a picture of a video stream of multiple pictures. The decoder comprises a data retriever configured to retrieve buffer description information defining at least one reference picture from the encoded representation of the picture. A picture identifier determiner of the decoder is configured to determine, based on the buffer description information, at least one picture identifier identifying a respective reference picture of the at least one reference picture as decoding reference

for the picture. The decoder also comprises a buffer manager configured to update a decoded picture buffer based on the at least one picture identifier.

Another related aspect of the embodiments defines a decoder comprising an input section configured to receive encoded representations of multiple pictures of a video stream. The decoder also comprises a processor configured to process code means of a computer program stored in a memory. The code means causes, when run on the processor, the processor to retrieve buffer description information defining at least one reference picture from an encoded representation of a picture. The processor is also caused to determine, based on the buffer description information, at least one picture identifier identifying a respective reference picture of the at least one reference picture as decoding reference for the picture. The code means further causes the processor to update a decoded picture buffer based on the at least one picture identifier. An output section of the decoder is configured to output decoded pictures of the video stream.

Another aspect of the embodiments relates to a method of encoding a picture of a video stream of multiple pictures. The method comprises determining, for the picture, at least one reference picture of the multiple pictures as encoding reference for the picture. The method also comprises providing, for each reference picture, a picture identifier identifying the reference picture. Buffer description information defining the at least one reference picture is generated based on the at least one picture identifier. The buffer description information is inserted in an encoded representation of the picture.

A related aspect of the embodiments defines an encoder configured to encode a picture of a video stream of multiple pictures. The encoder comprises a reference picture determiner configured to determine, for the picture, at least one reference picture of the video stream as encoding reference for the picture. The encoder also comprises a picture identifier provider configured to provide, for each reference picture, a picture identifier identifying the reference picture. A buffer description information generator is configured to generate buffer description information based on the at least one reference picture identifier. The buffer description information is inserted by a data inserter in an encoded representation of the picture.

Another related aspect of the embodiments defines an encoder comprising an input section configured to receive multiple pictures of a video stream and a processor configured to process code means of a

computer program stored in a memory. The code means causes, when run on the processor, the processor to determine, for a picture of the video stream, at least one reference picture of the video stream as encoding reference for the picture. The processor is also caused to provide, for each reference picture, a picture identifier identifying the reference picture and generate buffer description information based on the at least one picture identifier. The code means further causes the processor to insert the buffer description information in an encoded representation of the picture. The encoder further comprises an output section configured to output encoded representations of pictures.

In clear contrast to the prior art solutions in which correct reference picture management is dependent on that previously encoded pictures have been correctly received and decoded, the embodiments provide buffer description information that is used for reference pictures in an absolute and explicit way instead of a relative or implicit way. Thus, the encoded representation of a picture contains the information about which reference pictures to use for reference during decoding independent of the encoded representations of previous pictures in the video stream.

The embodiments thereby make reference picture management and signaling less vulnerable to errors since the decoder will only have to rely on information contained in the current picture for the reference picture management of the current picture instead of relying on correctly delivered and interpreted buffer operations in previous pictures.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention, together with further objects and advantages thereof, may best be understood by making reference to the following description taken together with the accompanying drawings, in which:

Fig. 1 is a simplified flow chart of the H.264/AVC reference buffer scheme;

Fig. 2 is an example of a coding structure with two temporal layers;

Fig. 3 is a flow chart of a method of encoding a picture according to an embodiment;

Fig. 4 is a video stream of multiple pictures according to an embodiment;

Fig. 5 is an encoded representation of a picture according to an embodiment;

Fig. 6 is a flow chart of an additional, optional step of the method in Fig. 3;

Fig. 7 is a flow chart of additional, optional steps of the method in Fig. 3 and an embodiment of generating buffer description information in Fig. 3;

Fig. 8 is an example of a coding structure with (sub)GOP size 8;

Fig. 9 is a flow chart of a method of decoding an encoded representation of a picture according to an embodiment;

Fig. 10 is a flow chart of an embodiment of determining picture identifier in Fig. 9;

Fig. 11 is a flow chart of an embodiment of retrieving buffer description information in Fig. 9;

Fig. 12 is a flow chart of another embodiment of determining picture identifier in Fig. 9;

Fig. 13 is a flow chart of additional, optional steps of the method in Fig. 9;

Fig. 14 is a flow chart of an additional, optional step of the method in Fig. 9;

Fig. 15 is an example of a coding structure;

Fig. 16 is a simplified flow chart of a reference buffer scheme according to an embodiment;

Fig. 17 is a schematic block diagram of a transmitter according to an embodiment;

Fig. 18 is a schematic block diagram of an encoder according to an embodiment;

Fig. 19 is a schematic block diagram of an encoder according to another embodiment;

Fig. 20 is a schematic block diagram of a receiver according to an embodiment;

Fig. 21 is a schematic block diagram of a decoder according to an embodiment; and

Fig. 22 is a schematic block diagram of a decoder according to another embodiment.

DETAILED DESCRIPTION

Throughout the drawings, the same reference numbers are used for similar or corresponding elements.

The present embodiments generally relate to encoding and decoding of pictures, also referred to as frames in the art, of a video stream. In particular, the embodiments relate to management of reference pictures in connection with video encoding and decoding and the signaling of such reference pictures from the encoder to the decoder.

Video encoding, such as represented by H.264/MPEG-4 AVC and HEVC, utilizes reference pictures as predictions or references for the encoding and decoding of pixel data of a current picture. This is generally referred to as inter coding in the art where a picture is encoded and decoded relative to such reference pictures. In order to be able to decode an encoded picture, the decoder thereby has to know which reference pictures to use for the current encoded picture and has to have access to these reference pictures. Generally, the decoder uses a decoded picture buffer (DPB), also denoted reference picture buffer herein, for storing the reference pictures. It is then important that the reference pictures stored in the decoded picture buffer are indeed the correct reference pictures when decoding an encoded picture otherwise the decoder will use wrong reference pictures during the decoding process causing a degradation of the quality of the presented video.

The prior art techniques may suffer from problems with regard to using incorrect reference pictures when a picture carrying MMCO information is unintentionally lost, which was discussed in the background section. This problem of the prior art can be illustrated by the following H.264-implemented example. Assume that the decoded picture buffer stores three short term pictures with picture identifiers 300, 302 and 303 and two long term pictures with picture identifiers 0 and 3. The encoder might then generate a new encoded picture with a MMCO type 2 command stating that the long term

picture 0 should be unused for reference. If this encoded picture would have been correctly received at the decoder the long term picture 0 would have been marked as unused for reference and the reference picture list would have been {300, 302, 303, 3}. However, if the encoded picture with the MMCO type 2 command is lost, the decoder is not informed that the long term picture 0 should be marked as unused for reference and the reference picture list is therefore instead {300, 302, 303, 0, 3}. If a next encoded picture received at the decoder comprises information that reference picture at position 3 in the reference picture list is to be used as prediction for a macroblock in the picture there will be a problem if the MMCO type 2 command is lost. If the MMCO type 2 command had been correctly received at the decoder, the reference picture at position 3 in the reference picture list would correspond to the long term picture 3 as this reference picture occupies position 3 (if starting with 0) in the reference picture list. However, with a lost MMCO type 2 command position 3 in the reference picture list is instead occupied by the long term picture 0. This means that pixel data from the long term picture 0 will be used as prediction basis instead of the correct pixel data from the long term picture identifier 3.

Thus, the prior art solution has a problem that correct reference picture management is dependant on that previously decoded pictures have been correctly received and decoded.

The present embodiments do not have these problems of the prior art techniques by using a fundamentally different approach for signaling reference pictures as compared to the prior art. The present embodiments instead specify which decoded pictures to be used for reference pictures in an absolute or explicit way instead of a relative or implicit way. Another way to put it is that the encoded representation, i.e. the bitstream, for a current picture contains the information about what pictures to use for reference, i.e. reference pictures, independent of the encoded representations of previous pictures. It can therefore be said that the logical responsibility for maintaining correct decoded picture buffer is moved from the decoder to the bitstream. One way to look at it is to say that the information about what reference pictures to use for inter prediction and motion vector prediction for a picture is included in the control information of the picture. Hence, the state of the decoded picture buffer is signaled for every picture that is encoded and decoded relative to other pictures.

According to an aspect of the embodiments a method is provided that creates buffer description information, e.g. a data structure, such as a general table with absolute information of which pictures to

be used for reference pictures, i.e. stored in a decoded picture buffer (also referred to as a reference picture buffer) to be used for subsequent coding. At least a part of the buffer description information is inserted in the bitstream encoded by an encoder.

Fig. 3 is a flow chart of a method of encoding a picture according to an embodiment. The method generally starts in step S1 where at least one reference picture of a video stream of multiple pictures is determined as encoding reference. In an embodiment, step S1 determines one or more reference pictures that are used as encoding reference for a current picture to be encoded. Hence, the pixel data of the current picture is then encoded with reference to the one or more reference pictures. Alternatively, or in addition, at least one reference picture determined in step S1 could be used as encoding reference for a subsequent picture of the video stream, i.e. a picture to be encoded and decoded after the current picture. This subsequent picture is thereby after the current picture according to a decoding order (and encoding order). In a particular embodiment S1 determines, for the current picture, any reference picture of the video stream as encoding reference for the current picture and any reference picture of the video stream as encoding reference for the subsequent picture. Hence, in a particular embodiment step S1 determines all reference pictures that are prior to the current picture in decoding order and that may be used for inter prediction for the current picture or any picture following the current picture according to the decoding order.

Fig. 4 schematically illustrates this concept by showing a video stream 1 of multiple pictures 10, 40, 42, 50. A current picture 10 may comprise one or more slices 20, 22 comprising pixel blocks 30, such as macroblocks , also referred to as treeblocks, or coding units, to be decoded. The arrows below the pictures 10, 40, 42, 50 indicate the decoding relationship. The current picture 10 is decoded in relation to a previous reference picture 40 and a subsequent reference picture 42. The preceding reference picture 40 is preceding and the subsequent reference picture 42 is subsequent with regard to the current picture 10 according to the output order but both are preceding the current picture 10 according to the decoding order. This subsequent reference picture 42 is furthermore used as reference picture for a subsequent picture 50 in the video stream 1. Hence, in a particular embodiment step S1 could determine reference pictures as pictures 40, 42 in Fig. 4.

A next step S2 of Fig. 3 provides a respective picture identifier for each reference picture of the at least one reference picture determined in step S1. The picture identifier is used, possibly together with other

data, to unambiguously identify a reference picture. Hence, the picture identifier can be regarded as an absolute reference to pictures to be used as reference pictures. This means that it is possible to correctly identify the relevant reference picture given its picture identifier and optionally the other data.

There are various alternatives available that could be used as picture identifier according to the embodiments. For instance, the picture identifier could be the decoding order number, the display order number, the output order number or a combination of display order number and an additional identifier or indeed any other information that can be used to unambiguously identify the picture.

Examples of such picture identifiers include Picture Order Count (*POC*), frame number (*frame_num*) or *POC* and an additional identifier (*additional_picture_id*).

In a particular embodiment, the actual value of the picture identifier is used together with additional information or other data, such as the position of the picture identifier in buffer description information that is generated in step S3 to unambiguously identify the relevant reference picture. Hence, the buffer description identified or obtained by the buffer description information enables an unambiguously identification of the relevant reference picture(s). In an embodiment, the picture identifier itself, such as *POC* or *POC* plus an additional identifier, can be used to unambiguously identify the reference picture.

Unambiguously identify a reference picture is used herein to denote that the picture identifier itself or the picture identifier together with other information in the buffer description information, such as the order at which the buffer description information defines the picture identifiers, is used to explicitly identify a reference picture. Hence, given the picture identifier or the picture identifier and the other information enables identification of the relevant reference picture among the pictures of the video stream.

In a particular embodiment of step S1, the total number of reference pictures determined for the current picture could be restricted by a parameter that can be signaled from the encoder to the decoder, such as a parameter denoted *max_num_ref_frames*.

Step S2 is preferably performed for each reference picture determined in step S1, which is schematically illustrated by the line L1.

The picture identifier(s) provided in step S2 could be read from header portions of the reference picture(s) determined in step S1 or otherwise retrieved from the data representing the reference picture(s) from step S1.

The next step S3 generates information of a buffer description, also referred to as Reference Picture Set (RPS). This information is denoted buffer description information herein. The buffer description information is generated based on the picture identifier(s) provided in step S2. This buffer description information defines, preferably unambiguously defines, the at least one reference picture determined in step S1. Hence, it is possible to derive the respective picture identifier of the at least one reference picture from the buffer description information.

The generated buffer description information is inserted in step S4 in an encoded representation of the current picture. Hence, the encoded picture therefore carries the buffer description information that can be used at the decoder to define and identify the reference pictures that are needed to decode the current picture and/or any subsequent picture of the video stream.

The buffer description information is therefore provided in control information of the encoded picture provided from the encoder to a decoder. At a minimum, the buffer description information contains information needed by the decoder to identify the reference pictures to be used in the decoded picture buffer.

The buffer description information can therefore be regarded as information identifying a buffer description that is a set of reference pictures associated with a current picture. It consists of all reference pictures that are prior to the current picture in decoding order and that may be used for inter prediction of the current picture or any picture following the current picture in decoding order.

In an embodiment, the buffer description information contains or defines information about each picture that is used by the decoder in the decoding process even if the picture is not used for inter prediction or motion vector prediction or any other prediction. Such information could include, but is not limited to, decoding order, display order, temporally layer information and view information.

As mentioned above, the number of reference pictures that can be signaled by the buffer description information could be restricted by the parameter *max_num_ref_frames*. However, the buffer description information may define fewer than this maximum number of pictures, in which case the remaining ones are interpreted as "empty".

The method of Fig. 3 with steps S1 to S4 is preferably performed for each picture in the video stream except any Instantaneous Decoder Refresh (IDR) picture that cause a decoded picture buffer refresh and thereby does not need any buffer description information, which is schematically illustrated by the line L2. Hence, each encoded representation generated by the encoder preferably carries buffer description information defining the reference pictures used for encoding and decoding the current picture and/or any subsequent picture in the video stream.

This approach of the embodiments provides a significant advantage over the relative reference picture signaling of the prior art using MMCO command. The explicit signaling of reference pictures through the buffer description information in each encoded representation of the pictures in the video stream makes reference picture management less vulnerable to errors and increases the error robustness level of the decoder. Thus, instead of relying on correctly delivered and interpreted buffer operations in previous pictures, the decoder will only have to rely on information contained in the encoded representation of the current picture.

In a particular embodiment, the buffer description information inserted in the encoded representation of the picture in step S4 is in fact the buffer description itself. Thus, the buffer description information then comprises a listing of the picture identifier(s) provided in step S2 or data allowing calculation of the picture identifier(s) provided in step S2. This latter case will be further described below in connection with Fig. 6.

For instance, the buffer description could define a list with picture identifiers 3, 5 and 6 as the reference pictures for a current picture. The buffer description information inserted in the encoded representation in step S4 would then include these picture identifiers 3, 5 and 6.

An alternative approach that is generally more bit efficient, i.e. generally requires fewer number of bits or symbols for defining the picture identifiers, is to signal the reference picture properties, i.e. picture

identifiers, relative to the value of these properties as signaled for the current picture. For instance, if the current picture has a picture identifier 7 the list of reference pictures with identifiers 3, 5 and 6 could be defined as -1, -2 and -4, which typically can be represented by fewer bits as compared to 3, 5 and 6, in particular if variable length coding is employed for the picture identifiers.

Fig. 6 schematically illustrates this approach. The method continues from step S2 of Fig. 3. In a next step S10 a difference is calculated for each picture identifier provided in step S2, between the picture identifier and a picture identifier identifying the current picture. As a result of this calculation a difference or delta identifier or value is obtained. The method then continues to step S3 of Fig. 3, where the buffer description information is generated based on the calculated difference(s) or delta identifier(s).

The buffer description information could therefore in this case include the delta identifiers -1, -2 and -4 instead of 3, 5 and 6.

In an embodiment, delta display order information or *deltaPOC* is included in the buffer description encoded with a variable length code (VLC). In a particular embodiment *deltaPOC* is encoded with VLC for *absolute_delta_POC_minus_one* and a flag, i.e. a single bit, for *deltaPOC_sign* signaled only if *number_of_reorder_frames* > 0, otherwise the sign is inferred to be negative.

In the above embodiments providing an explicit signaling of the picture identifiers, either the picture identifiers themselves or the delta identifiers, the buffer description information will in fact constitute the buffer description of the current picture. This buffer description information is then inserted in the encoded representation of the picture.

The buffer description information could be included as control information at a suitable position in the encoded representation. Fig. 5 schematically illustrates an example of an encoded representation 60 of a picture. The encoded representation 60 comprises video payload data 66 that represents the encoded pixel data of the pixel blocks in a slice. The encoded representation 60 also comprises a slice header 65 carrying control information. The slice header 65 forms together with the video payload and a Network Abstraction Layer (NAL) header 64 a NAL unit that is the entity that is output from an encoder. To this NAL unit additional headers, such as Real-time Transport Protocol (RTP) header 63,

User Datagram Protocol (UDP) header 62 and Internet Protocol (IP) header 61, can be added to form a data packet that can be transmitted from the encoder to the decoder. This form of packetization of NAL units merely constitute an example in connection with video transport. Other approaches of handling NAL units, such as file format, MPEG-2 transport streams, MPEG-2 program streams, etc. are possible.

The buffer description information could then be included in the slice header 65, another picture header or another data structure specified by the standard to which the encoder and decoder conforms.

In another embodiment the buffer description information inserted in the encoded representation 60 of the picture does not necessarily have to be the same as the buffer description of the current picture but rather enables identification and retrieval of the buffer description. Thus, in this embodiment the buffer description information inserted in the encoded representation 60 of the picture indirectly defines the at least one reference picture determined in step S1 by pointing towards the buffer description which carries the picture identifiers or the data, such as delta identifiers, enabling calculation of the picture identifiers.

In such a case, the buffer description could be carried by a data structure associated to the encoded representation 60 of the picture. Examples of such data structures include a Picture Parameter Set (PPS) 67 and a Sequence Parameter Set (SPS) 68. The PPS 67 and/or the SPS 68 could be directly included in the encoded representation 60 but is typically associated thereto through the inclusion of a PPS identifier and/or SPS identifier in the encoded representation 60. For instance, each slice header 65 could include a PPS identifier notifying which PPS 67 to apply for the current picture. The relevant PPS 67 may in turn include an SPS identifier notifying which SPS 68 to apply for the PPS 67 and therefore for the current picture.

The buffer description could then be inserted in the PPS 67 or the SPS 68 assigned to the current picture. In such a case, the PPS identifier or SPS identifier that is inserted in the encoded representation 60 constitutes the buffer description information that is inserted in the encoded representation 60. This PPS identifier or SPS identifier enables retrieval of the buffer description that

defines the picture identifiers of the reference pictures and the PPS identifier or SPS identifier therefore indirectly defines the picture identifiers.

PPS 67 and SPS 68 merely constitutes examples of data structures associated to encoded representations 60 of pictures and which can be used to carry buffer description information according to the embodiments.

Fig. 7 illustrates an alternative embodiment where one or more buffer descriptions are signaled in a data structure so that the same buffer description can be used for multiple pictures.

The method starts in step S20 where a data structure, such as a table, is generated. The data structure comprises multiple predefined buffer descriptions each defining at least one reference picture.

Each buffer description of the generated data structure could define the picture identifiers directly, i.e. include a list of picture identifiers. However, such an approach generally requires quite a few predefined buffer description in the data structure. A more efficient approach is to combine the usage of multiple predefined buffer descriptions with signaling of delta identifiers as discussed in the foregoing. In such a case, each predefined buffer description comprises at least one respective delta identifier, which is used at the decoder together with the picture identifier of the current picture to calculate the picture identifier(s) of a predefined buffer description.

Table 1 below illustrates an example of such a data structure with delta identifiers that can be used for a video stream as illustrated in Fig. 8. The video stream of Fig. 8 starts with an IDR picture, which is an Intra (I) frame that removes all dependencies to data transmitted prior to the IDR picture, i.e. it marks all reference pictures as "unused for reference". The IDR picture does not need a buffer description since it empties the decoded picture buffer. The video stream of Fig. 8 is in the form of layered video providing pictures in different temporal layers, identified by temporal identifiers (*temporal_id*) n, n+1 and n+2 in Fig. 8.

Table 1 – data structure with predefined buffer descriptions

Entry	Picture buffer 1	Picture buffer 2	Picture buffer 3	Picture buffer 4
0	dP: -1 tId: 2	dP: -2 tId: 1	dP: -4 tId: 0	dP: -8 tId: 0
1	dP: -1 tId: 0	dP: -2 tId: 2	dP: -5 tId: 0	dP: -9 tId: 0
2	dP: -1 tId: 2	dP: -2 tId: 0	dP: -6 tId: 0	dP: -10 tId: 0
3	dP: -1 tId: 1	dP: -2 tId: 2	dP: -3 tId: 0	dP: -7 tId: 0

Table 1 shows an example of a buffer description table where *deltaPOC* (dP) and *temporal_id* (tId) are indicated. The table is constructed using the scheme of including the two closest reference pictures (POC(current)-1 and POC(current)-2) and the two from the lowest temporal layer in the range from POC(current)-3 to POC(current)-10.

An example use of this table by the encoder is to, for a picture with POC=n, signal table entry (n%4), i.e. n modulo 4, to the decoder. In this example, the decoded picture buffer consists of four pictures (picture buffer 1 to picture buffer 4). Which pictures depends on the POC of the current picture and what entry is used. For example if picture with POC=7 uses entry 3 the reference pictures in the decoded picture buffer will consist of pictures with POC {6, 5, 4, 0}.

The data structure generated in step S20 is signaled from the encoder to the decoder. This signaling can be performed according to various embodiments. The data structure could be carried in the PPS, the SPS, a novel parameter set or in another data structure specified by the standard to which the encoder and decoder conforms. This is schematically illustrated by step S21 where the data structure is inserted in a PPS or a SPS associated with an encoded representation of the video stream. In such a case, step S22 preferably inserts a PPS identifier or SPS identifier in the encoded representation of the picture, such in a slice header. This PPS identifier or SPS identifier then enables identification of the data structure that is available when decoding the current picture.

The method continues to steps S1 and S2 of Fig. 7 where reference pictures are determined and picture identifiers are provided for the current picture. A next step S23 selects, based on the at least one picture identifier provided in step S2, a buffer description from the data structure generated in step S20.

Once such a buffer description, such as an entry in Table 1, has been selected step S24 generates buffer description information comprising an identifier, such as entry number, of the selected buffer description. The method continues to step S4 where the buffer description information is inserted in the encoded representation of the picture.

Thus, in order to specify which buffer description to use for the current picture an identifier can be signaled for the current picture. An example of such an identifier is a non-negative integer signaled in the slice header(s) of the current picture representing the number of the buffer description in the order in which the buffer descriptions are signaled.

In a typical implementation step S20 is performed once for the video stream or once for a set of multiple pictures of the video stream. This means that a single such data structure is then generated for the video stream or for the set of multiple pictures. The following steps S21 to S24 of Fig. 7 are preferably performed for each picture in the video stream or the set of multiple pictures.

Thus, the data structure, such as table, may be created in the encoder and transmitted to the decoder. In the control information of the encoded bitstream the entry number to be used is provided. By using such a table the decoder can obtain absolute information of which pictures to be used as reference pictures by detecting the entry number in the decoded bitstream and using that entry number to look up the entry in the table. The entry is then used to determine which pictures to be stored in the decoded picture buffer.

Introducing buffer description entries in, for instance, the SPS reduces the bit overhead of signaling the buffer descriptions explicitly in the slice header. These buffer descriptions can be used for multiple slices/pictures in the same sequence, i.e. video stream, and thus reduce the number of bits required per picture.

For each buffer description entry in the PPS the *delta_POC* and *temporal_id* of all reference pictures could be present in an embodiment. The optional *additional_picture_id* is preferably inferred to be 0 for pictures described by an entry in the PPS.

According to a further embodiment, explicit signaling of buffer description and reference signaling to an entry in a general data structure with multiple predefined buffer descriptions, such as an entry in the table above, can be combined. In such a case, these can be combined by the decoder to form a final buffer description for the current picture. One way to combine the explicit signaling and the reference signaling is to join the set of reference pictures described by explicit signaling with the set of reference pictures described by the reference signaling to form a joint set of reference pictures.

In such a case, step S3 of Fig. 3 preferably comprises generating the buffer description information to comprise the identifier of the buffer description selected in step S23 and to comprise information defining at least one reference picture. This information defining at least one reference picture could be the picture identifier of the reference picture itself or a delta identifier from which the picture identifier can be calculated.

A picture that is used for reference for a long period of time (long term reference picture) is preferably indicted by explicit description in the slice headers of the pictures for which it is available for reference. The reason is that it would be inconvenient to include every distance in POC numbers in the predefined buffer descriptions signaled in the PPS or SPS.

In a particular embodiment, the encoded representation of the picture preferably comprises a flag to indicate whether explicit signaling of the buffer description information and/or implicit signaling of the buffer description information has been selected for the current picture. This flag could, for instance, be included in the slice header of the encoded representation of the picture or in some other control information field.

In a particular embodiment, a picture 10 can be composed of one or multiple slices 20, 22 as shown in Fig. 4. In such a case, a slice 20, 22 is an independently decodable portion of the picture 10. In other words, an encoded slice can be decoded even if the data of another encoded slice of the same picture 10 is lost.

In such an approach step S1 of Fig. 3 preferably determines at least one reference picture of the video stream for each slice in the picture. It could then be possible that a first slice will use a first set of one or more reference pictures and a second slice will use a second set of one or more reference pictures.

The second set could be equal to the first set or be different from the first set. It is also possible that at least one of the reference pictures is common for the first set and the second set.

Step S2 preferably determines the picture identifiers for all reference pictures determined in step S1 for at least one slice, preferably for all of the slices, in the picture. The buffer description information is then generated in step S3 based on these picture identifiers and thereby defines the reference pictures. In an embodiment, the buffer description generated in step S3 is inserted in a respective slice header of the encoded representation of the picture for each slice. Thus, each slice header of the encoded representation of the picture preferably carries a respective instance of the buffer description information. More preferably, the buffer description information carried in the slice header of a first slice of the picture is the equal to the buffer description information carried in the slice header of a second slice of the picture.

Video encoding and decoding can also be applied to so-called scalable or layered video. For instance, temporal scalability is supported in H.264/MPEG-4 AVC and Scalable Video Coding (SVC) through the definition of subsequences and usage of *temporal_id* in SVC and insertion of "non-existing" frames. However, in order to support temporal scalability, the pictures in the higher temporal layers are restricted when it comes to usage of MMCO. The encoder is responsive of making sure that the MMCOs in one temporal layer does not affect pictures of lower temporal layers differently compared to if the temporal layer is dropped and "non-existing" pictures are inserted and sliding window process is applied.

This imposes restrictions on the encoder in selection of coding structure and reference picture usage. For instance, consider the example in Fig. 2. Assume that the maximum number of reference frames in the decoded picture buffer (*max_num_ref_frames*) is three even though each picture only uses two reference pictures for inter prediction. The reason is that each picture must hold one extra picture from the other temporal layer that will be used for inter prediction by the next picture.

In order to have picture POC=0 and picture POC=2 available when decoding picture POC=4, picture POC=3 must have an explicit reference picture marking command (MMCO) marking picture 1 as unavailable.

However, if temporal layer 1 is removed (for example by a network node) there will be gaps in *frame_num* for all odd numbered pictures. "Non-existing" pictures will be created for these pictures and sliding window process will be applied. That will result in having the "non-existing" picture POC=3 marking picture POC=0 as unavailable. Thus, it will not be available for prediction when picture POC=4 is decoded. Since the encoder cannot make the decoding process be the same for the two cases; when all pictures are decoded and when only the lowest layer is decoded; the coding structure example in Fig. 2 cannot be used for temporal scalability according to prior art.

Thus, prior art solutions have problems with temporal scalability for certain coding structures since the information about the reference pictures for the current picture is affected by the removal of a previous picture from the bitstream as the reference picture information is signaled in a relative way. Using the embodiments, temporal scalability will not be restricted as in the prior since the reference picture for the current picture is not affected by removal of previous pictures from the bitstream since it is signaled in an absolute way.

In the case of a scalable video stream with the pictures grouped into multiple layers step S2 of Fig. 3 preferably comprises providing picture identifier and temporal layer information identifying a layer of the multiple layers to which the reference picture belongs. The buffer description information is then generated in step S3 based on the at least one picture identifier and the temporal layer information. This means that the buffer description information thereby defines the at least one picture identifier and the temporal layer information.

For instance, temporal layer information, such as *temporal_id*, is included for each picture in the buffer description signaled using ceil(log2(*max_temporal_layers_minus1*)) bits for signaling of the *temporal_id*. Temporal scalability is merely an example of multi-layer video to which the embodiments can be applied. Other types include multi-layer video where each picture has a picture identifier and a view identifier. Further examples of scalability include spatial scalability, signal-to-noise ratio (SNR) scalability, bit-depth scalability and chroma format scalability.

The embodiments imply that temporal down-switching is always possible. Each temporal layer together with the lower layers will constitute a sub-sequence. Such sub-sequences need no explicit signaling.

Generally, the encoder is free to select which pictures to include in the buffer description and may base its selection on any aspect, such as the closest pictures in display order. Typically, an encoder selects the buffer description to try to achieve maximum compression while complying to a set of side constraints. One example of such a constraint is a maximum number of reference pictures due to memory size. Another example is that the video stream shall be decodable also when certain coded pictures in the bitstream are removed from the bitstream before decoding. A further example is that only pictures that are available for reference in the decoded picture buffer can be selected as reference pictures.

Thus, in an embodiment step S1 of Fig. 3 comprises determining the at least one reference picture for the current picture by maximizing compression efficiency of the encoded representation of the picture while complying to at least one side constraint. The at least one side constraint is then preferably selected from a predefined maximum number of reference pictures and generating a decodable encoded representation of the video stream also when at least one encoded representation of a picture is removed from the encoded representation of the video stream.

According to another aspect of the embodiments a method is provided in which an encoded video or data stream is received, buffer description information is detected in the encoded video stream and absolute reference to pictures to be used as reference pictures for decoding a current picture or as reference pictures for future decoding is determined based on the buffer description information. The pictures to be used as reference pictures are stored in a decoded picture buffer.

Fig. 9 is a flow chart of a method of decoding an encoded representation of a picture according to an embodiment. The method starts in step S30 where buffer description information defining at least one reference picture is retrieved from the encoded representation of the picture. The buffer description information is used in step S31 to determine at least one picture identifier that, preferably unambiguously, identifies a respective reference picture as decoding reference for the picture. The at least one reference picture identifier determined in step S31 is used in step S32 to update a decoded picture buffer.

Once the decoded picture buffer has been updated to comprise the correct reference pictures needed for decoding the picture the method typically continues to step S33 where the picture is decoded based

on the encoded representation of the picture and at least one of the reference pictures comprised, present or stored in the decoded picture buffer and identified based on the buffer description information.

In a preferred embodiment, the decoding step S33 is performed after updating the decoded picture buffer as indicated in Fig. 9.

The updating of the decoded picture buffer in step S32 preferably implies that the reference picture identified by the determined picture identifier is marked as "used for reference" or marked as "used for prediction" to indicate that this reference pictures is to be used as decoding reference or prediction for the current picture and/or any subsequent picture. In a particular embodiment, reference pictures could be marked as used for short-term reference or as used for long-term reference.

In a particular embodiment step S30 retrieves the buffer description information defining multiple reference pictures from the encoded representation of the picture. In such an embodiment, step S31 could determine, based on the buffer description information, i) at least one picture identifier identifying a respective reference picture as decoding reference for the picture and ii) at least one picture identifier identifying a respective reference picture as decoding reference for a subsequent, according to a decoding order, picture of the video stream. In alternative embodiments, the buffer description information identifies one or more picture identifiers of respective reference picture(s) as decoding reference for the current picture and/or one or more picture identifiers of respective reference picture(s) as decoding reference for a subsequent, according to the decoding order, picture of the video stream.

Step S32 preferably updates the decoded picture buffer to comprise the respective reference picture identified by the at least one picture identifier determined in step S31.

As previously discussed herein, the buffer description information can be provided in a slice header or another control information field of the encoded representation of the picture. In such a case, step S30 of Fig. 9 comprises retrieving the buffer description information from a slice header of the encoded representation of the picture. A multi-slice picture generally comprises multiple slice headers. In such a case each slice header preferably comprises the same buffer description information. It is then sufficient in step S30 to retrieve the buffer description information from the first slice header of the

picture as any remaining slice headers of the picture will include the same buffer description information. The buffer description information in the other slice headers can then be used for error resilience if the first slice is lost.

The buffer description information could explicitly include the picture identifier(s) of the reference picture(s). In such a case, step S30 simply retrieves the at least one picture identifier from the buffer description information.

In an alternative embodiment, the buffer description information comprises delta values or delta identifiers. Fig. 10 is a flow chart illustrating an embodiment of step S31 in Fig. 9 for such a case. The method then continues from step S30 of Fig. 9. A next step S40 retrieves a respective delta identifier based on the buffer description information. The delta identifier(s) is(are) used in step S41 together with a picture identifier of the current picture to calculate the picture identifier(s) of the reference picture(s). The method then continues to step S32 of Fig. 10.

Thus, in this embodiment information available for the current picture is used by the decoder to construct the final buffer description for the current picture from the signaled buffer description information. Such information includes, but is not limited to, current *POC* (POC(curr)), which together with a signaled *deltaPOC* can be used to calculate the *POC* of the reference picture (POC(ref)) as POC(ref)=POC(curr) + *deltaPOC*.

Another embodiment relates to using multiple predefined buffer descriptions. Fig. 11 schematically illustrates such an approach. In a first step S50 a data structure comprising multiple predefined buffer descriptions is retrieved. In a preferred embodiment, the data structure is retrieved based on information carried in the encoded representation of the picture. For instance, the data structure can be signaled from the encoder side to the decoder side as a part of the PPS or the SPS of the encoded representation of the picture. In such a case, the data structure is retrieved from the PPS or the SPS in step S50 based on a PPS identifier or SPS identifier used as part of the buffer description information in the encoded representation of the picture, such as in the slice header. Alternatively, a PPS identifier is retrieved from the slice header and the PPS in turn comprises an SPS identifier that can be used if the data structure is signaled as part of the SPS.

A next step S51 retrieves an identifier of a buffer description as part of the buffer description information from the encoded representation of the picture, such as from the slice header. This identifier is employed in order to identify which predefined buffer description from the data structure retrieved in step S50 to use for the current picture in step S52. The method then continues to step S31 of Fig. 1, where picture identifiers are determined from the identified predefined buffer description.

Using the embodiments it is possible to apply the optimal buffer scheme for any coding structure with very little overhead. What is needed in the slice header is simply a reference to the correct buffer description in the PPS or similar. Note that the buffer description can also be put in a picture header or similar, or a parameter set shared between all slices in a picture. The important property is that the buffer description to be used to decode a specific picture is sent with the picture and not with the previous picture in decoding order as in the prior art. In addition, the buffer description information is used to signal all reference pictures in the decoded picture buffer that should be kept for decoding each respective picture in the video stream instead of signaling delta information that can cause long-term mismatches between the encoder side and the decoding side when a single data packet is unintentionally lost.

As previously disclosed herein, the explicit signaling of buffer description in the encoded representation of a picture and reference signaling to predefined buffer description in a data structure can be combined. One way to combine the explicit signaling and the reference signaling is to join the set of reference pictures described by explicit signaling with the set of reference pictures described by reference signaling to form a joint set of reference pictures. Then one or more reference pictures included in the set of reference pictures described by reference signaling but not included in the explicit signaling are possibly removed from the joint set of reference pictures in order to have a final buffer description with no more than a maximum number (*max_num_ref_frames*) of reference pictures. Preferably pictures are removed in the order that they are listed in the general buffer description, i.e. the predefined buffer description, starting with the last one going forward.

Fig. 12 is a flow chart illustrating such an approach. The method continues from steps S30 in Fig. 9 and step S52 in Fig. S31. Hence, in this embodiment the buffer description information comprises both the identifier of the buffer description retrieved in step S51 of Fig. 11 and information defining at least

one reference picture retrieved in step S30 of Fig. 9. This information retrieved in step S30 could be the actual picture identifier(s) or the previously mentioned delta identifier(s).

A next step S60 determines a first set of at least one picture identifier identifying a respective reference picture from the predefined buffer description identified in step S52 in Fig. 11. Correspondingly, a second set of at least one picture identifier identifying a respective reference picture is determined in step S61 from the information retrieved in step S30 of Fig. 9. Steps S60 and S61 could be performed sequentially in any order or at least partly in parallel.

The following step S62 forms a joint set of picture identifiers based on the first set determined in step S60 and the second set determined in step S61.

An optional but preferred following step S63 compares the total number of picture identifiers (IDS) in the joint set with a maximum number of reference pictures (MAX), i.e. the parameter *max_num_ref_frames* typically signaled in the SPS. If the total number of picture identifiers in the joint set exceeds the maximum number of reference pictures that can be stored in the decoded picture buffer the method continues to step S64. This step S64 removes one or more picture identifiers included in the first set but not in the second set until the total number of picture identifiers in the joint set no longer exceeds the maximum number of reference pictures. Thus, the joint set is thereby updated by removing picture identifiers determined in step S60. The picture identifiers are preferably removed in the order that they are listed in the predefined buffer description identified in step S52 of Fig. 11 starting from the last picture identifier and going forward.

In a particular embodiment, the encoded representation of the picture preferably comprises a flag to indicate whether explicit signaling of the buffer description information and/or implicit signaling of the buffer description information has been selected for the current picture. In such a case, the decoder retrieves the flag from the encoded representation of the picture, such as from the slice header or from some other control information field, in order to determine which type of signaling of the buffer description information that has been used for the current picture.

Fig. 13 is a flow chart illustrating additional steps of the method in Fig. 9, whereby the decoded picture buffer updated in step S32 is used for decoding purposes.

Once the decoded picture buffer has been updated in step S32 pictures may be available in the decoded picture buffer but are not included in the buffer description. Hence, in an embodiment, pictures that are available in the decoded picture buffer but not included in the buffer description are removed by the decoder from the decoded picture buffer or marked as "unused for reference" or "unused for prediction". Thus, in this embodiment removing reference pictures from the decoded picture buffer or marking of pictures as "unused for reference" is performed by the decoder prior to the picture decoding process of the picture containing the buffer description.

Step S70 illustrates this procedure by removing, from the decoded picture buffer, any reference picture stored in the decoded picture buffer and not being associated with any of the at least one picture identifier determined from the buffer description information. In an alternative embodiment of this step S70 the reference picture(s) is(are) not necessarily removed from the decoded picture buffer. This embodiment of step S70 marks any reference picture stored in the decoded picture buffer and not being associated with any of the at least one picture identifier determined from the buffer description information as unused for reference or unused for prediction. This means that the marked reference picture will not be used as prediction basis for the current picture or for any subsequent picture in the video stream. The decoder can therefore output the marked reference picture if there is a need to get an available position in the decoded picture buffer. In a particular embodiment, a picture marked as unused for reference cannot be included in the buffer description and be re-marked as used for reference.

In a particular embodiment, any reference picture present in the decoded picture buffer and associated with any of the picture identifiers determined based on the buffer description information is preferably marked in step S70 as used for reference. In an embodiment, a reference picture could be marked as either used for short-term reference or used for long-term reference. The selection between these two particular alternatives is preferably performed based on the buffer description information.

Step S71 illustrates an additional optional embodiment. This embodiment outputs zero or more of the pictures that are marked as unused for reference by the decoder according to the buffer description for display by the decoder. One such example process for output is the bumping process from H.264/MPEG-4 AVC. Output refers herein to output for display. What pictures to use as reference

pictures and what pictures to output, i.e. display, is separated in H.264 and HEVC. This means that a picture can be output before it is removed as reference picture, i.e. marked as unused for reference, or it can be removed as reference frame by marking it as unused for reference before it is output.

During the decoding process, it may happen that the buffer description contains information about pictures (also referred to as frames) that are not available and therefore can not be used for reference pictures. In an embodiment, a number of "non-existing" pictures is generated by the decoder if the buffer description contains information about pictures that are not available in the decoded picture buffer. Each such picture can be given values to variables holding information that is used by the decoder in the decoding process even if the picture is not used for inter prediction or motion vector prediction. Such information could include, but is not limited to, decoding order number, display order number, temporal layer information, view information, i.e. parameters such as *frame_num*, *POC*, *temporal_id* and *view_id*.

In an embodiment, the generation of non-existing pictures is performed by the decoder prior to the picture decoding process of the picture containing the buffer description information.

Steps S72 and S73 illustrate such an embodiment. Step S72 compares the at least one picture identifier determined from the buffer description information with picture identifiers associated with reference pictures already stored in the decoded picture buffer. If a determined picture identifier is not found among the picture identifiers of the reference pictures stored in the decoded picture buffer the picture associated with the determined picture identifier is determined to be missing or non-existing. In an embodiment, a non-existing picture is optionally generated in step S73 and stored in the decoded picture buffer. This non-existing picture is then assigned any parameters, such as picture identifier, obtained from the buffer description information with regard to this particular picture. The method then continues to step S33 of Fig. 9 where the decoding process can be started.

Pictures that are signaled in the buffer description but do not exist in the decoded picture buffer are preferably marked as "non-existing". However since the *POC* and the *temporal_id* of such pictures are included in the buffer description, no explicit signaling of reference picture list modification is required. If the "non-existing" picture is not used for reference, the decoding process will proceed correctly

without extra signaling (and without the overhead incorporated with signaling reference picture list modifications explicitly).

In an embodiment, the marking of zero or more pictures in step S70 is performed by the decoder in a first step. In a second step, zero or more pictures are output by the decoder in step S71. In a third step zero or more "non-existing" pictures are generated by the decoder in step S73.

In an alternative embodiment, the marking of zero or more pictures is performed by the decoder in a first step in step S70. Then an iterative process of outputting pictures (S71) and generating non-existing pictures (S73) is performed by the decoder for each picture described in the buffer description that is not available in the decoded picture buffer.

The embodiments are strengthened further by applying buffer operations, e.g. the picture marking process, before the picture decoding of the current picture, thus, having the explicit buffer description to apply to the current picture. This makes reference picture management even less vulnerable to errors, improves the possibilities for temporal scalability and reduces the overhead introduced by reference picture list modification signaling.

In an embodiment, the buffer description may contain information that is used by the decoder in reference picture list initialization or reference picture list modification or reference picture list combination. An example is the order in which the pictures are listed in a buffer description can be used as the initial order for one of the reference picture lists in reference picture list initialization. Hence, the buffer description information can be used when the reference picture list is created.

Fig. 14 is a flow chart illustrating such an approach. The method continues from step S32 of Fig. 9. A next step S80 performs reference picture list initialization based on the buffer description information. In a particular embodiment of step S80, the reference picture list initialization is performed based on the buffer description information by ordering reference pictures in a reference picture list according to an order that the buffer description information defines the at least one picture identifier determined in step S31 of Fig. 9.

In an embodiment, restrictions are specified for the pictures included in the buffer description. An example restriction is that a picture A with *temporal_id* tId(A) described in the buffer description for a picture B with *temporal_id* tId(B) may not be a non-existing picture if tId(A) < tId(B).

In an embodiment it is also possible to signal changes to the properties of pictures in the decoded picture buffer through buffer descriptions. An example is to change temporal layer and/or display order of pictures through signaling the new value for temporal layer and/or display order in the buffer description.

Fig. 16 is a simplified flow chart of a reference buffer scheme according to an embodiment. In this scheme all decoded picture buffer operations are applied after parsing of the first slice header of a picture but before the picture decoding, using a description of the decoded picture buffer as illustrated in Fig. 16. The buffer description is, for instance, signaled in the slice header either explicitly or by reference to a predefined structure signaled in a PPS.

The embodiments thereby provide large conceptual changes to the decoding process. In traditional H.264/MPEG-4 AVC and current design of HEVC, relative operations are given to the decoder either implicitly, i.e. sliding window, or explicitly, MMCO, and the decoder is responsible for applying these relative operations and keeping track of the reference pictures, i.e. which pictures can be used for reference. In the proposed scheme the reference pictures, i.e. which pictures can be used for reference, is signaled within the current picture, such as in the slice header, thus removing the need of implicitly and explicitly signaled relative operations.

This means that each picture will have an absolute description of the reference pictures instead of a relative description as in H.264/MEPG-4 AVC where delta information is retrieved from MMCO or from using the sliding window process.

According to a particular embodiment, the buffer description contains *delta_POC*, *temporal_id* and *additional_picture_id* of all reference pictures in the decoded picture buffer in order to provide an absolute reference to the pictures to be used as reference pictures. The *delta_POC* is used to calculate the *POC* of a reference picture as POC(ref) = POC(current) + *delta_POC*. Pictures will, in an embodiment, be identified by the pair *POC* and *additional_picture_id*. *Temporal_id* is included in the

buffer description to enable correct reference picture list modification in the case of lost or removed pictures, e.g. temporal scalability. The scheme is, though, not restricted to the codewords *delta_POC*, *temporal_id* and *additional_picture_id*. Any codeword that is associated with a picture and used in the reference picture handling can be used as picture identifier and may be included in the buffer description, either relative to the value of the current picture, e.g. *POC* and *delta_POC*, or absolute, e.g. *temporal_id*.

All pictures in the decoded picture buffer that are not part of the buffer description are preferably marked as unused for reference.

In H.264/MPEG-4 AVC the process that delivers pictures for output (referred to as "bumping" process in Fig. 1) is sometimes performed prior to decoding, i.e. if there was a gap in *frame_num*. The "bumping" process is also performed after decoding and picture marking.

In the proposed scheme of Fig. 16 the "bumping" process is applied prior to decoding. It could be argued that this imposes extra delay in the decoding process before delivery of pictures for output. However it should be noted that the first picture to display is uniquely defined already after the decoding process step as soon as the number of non-displayed pictures in decoded picture buffer is larger than or equal to *num_reorder_frames*. Thus, a decoder can deliver that picture for display directly after the decoding process step. Thus the delay of the proposed scheme is equal to the delay of the current HEVC scheme.

In H.264/MPEG-4 AVC the syntax element *frame_num* is used to identify pictures in the decoded picture buffer and to detect gaps in *frame_num*. If *gaps_in_frame_num_allowed* is equal to 1 the decoder shall insert "non-existing" frames in the decoded picture buffer in order for the sliding window process to operate correctly.

In the proposed scheme illustrated in Fig. 16 the combination of *POC* and *additional_picture_id* can be used to identify pictures in the decoded picture buffer. The proposed scheme does not need to contain a sliding window process. Therefore, it is proposed to remove the syntax elements *frame_num* and *gaps_in_frame_num_allowed*.

Fig. 15 is an example of a coding structure to which the embodiments can be applied. In the example in Fig. 15, the second picture in decoding order will include POC 0 in its buffer description while the third picture in decoding order will include POC 0 and POC 4 in its buffer description. The fourth picture in decoding order must include not only POC 0 and POC 2 in its buffer description but also POC 4 since that picture will be used for reference in the future. The fifth picture in the decoding order does not need to include POC 0 in its buffer description unless it is going to be used for reference in the future. If POC 0 is not included in the buffer description it will be made unused for reference.

In the example in Fig. 15 *additional_picture_id* (or *additional_id*) is 0 for all pictures. It is recommended to set *additional_picture_id* to 0 unless there are two different pictures available for reference with the same *POC*, due to *POC* wrap-around. If *POC* is the same for two different pictures the *additional_picture_id* is preferably different in order to not unconditionally replace the older picture with the newer one. *Additional_picture_id* can be used in order to provide all the functionalities and possibilities that are provided by long term pictures in H.264/MPEG-4 AVC. Hence, in a particular embodiment the additional_picture_id constituting a part of the picture identifier could be used to signal whether a reference picture is to be used for long-term reference or for short-term reference.

Consider an example where an encoder would like to use a picture A with POC 14 and *additional_picture_id* set to 0, as a "long term picture". The encoder must then make sure that the picture A is included in the buffer description in the slice header of all pictures following A for as long as the encoder wants picture A to be available for reference. If the encoder would like to encode another picture with POC 14 (due to *POC* wrap-around) while A is still available for reference, the encoder should select another value of *additional_picture_id*, for example 1, to avoid that A is replaced as a reference picture.

For pictures that will be used for reference for a short period of time (short term reference pictures) it is recommended to set *additional_picture_id* to 0, in order to minimize the bit overhead. For pictures that will be used for reference for a long period of time (long term pictures) it is recommended that the encoder makes sure that no two pictures with the same *POC* and the same *additional_picture_id* are available for prediction at the same time.

A further aspect of the embodiments defines an encoder configured to create buffer description information defining which pictures to be used for reference pictures, i.e. stored in a decoded picture buffer to be used for subsequent decoding. At least part of the buffer description information is inserted in the bitstream encoded by the encoder.

Fig. 18 is a schematic block diagram of an embodiment of an encoder 100. The encoder 100 is configured to encode a picture of a video stream comprising multiple pictures. The encoder 100 comprises a reference picture determiner 110 configured to determine at least one reference picture for the current picture among the multiple pictures of the video stream. The at least one reference picture is used as encoding reference for the current picture. A picture identifier provider 120 of the encoder 100 is configured to provide a respective picture identifier of each reference picture determined by the reference picture determiner 110. A picture identifier provided by the picture identifier provider 120 identifies its associated reference picture. The picture identifier(s) provided by the picture identifier provider 120 collectively constitute a buffer description for the current picture by listing picture identifier(s) of the reference picture(s) required for encoding and decoding the current picture and optionally also any previous reference picture(s) of the video stream required for encoding and decoding a subsequent picture of the video stream.

The encoder 100 also comprises a buffer description information generator 130 configured to generate information of the buffer description, i.e. the buffer description information, defining the at least one reference picture determined by the reference picture determiner 110. The buffer description information generator 130 is configured to generate this buffer description information based on the at least one picture identifier from the picture identifier provider 120.

A data inserter 140 is implemented in the encoder 100 to insert the buffer description information generated by the buffer description information generator 130 into an encoded representation of the current picture. Hence, the coded bitstream of the video stream with regard to the current picture carries the buffer description information. This means that the encoded representation of the picture will carry the buffer description information that defines the relevant information, i.e. picture identifiers, required by a decoder in order to update the decoded picture buffer for the current picture to thereby enable decoding of the encoded representation of the picture.

As has been previously discussed herein the reference picture determiner 110 is preferably configured to determine any reference picture of the video stream as encoding reference for not only the current picture but also any reference picture, preferably present in the video stream prior to the current picture in the decoding order, as encoding reference for one or more subsequent pictures according to the decoding order.

In a particular embodiment each picture can be composed of one or more slices. Each such slice may then be encoded and decoded independently of other slices of the same picture. Hence, the reference picture determiner 110 preferably determines, for at least one slice, preferably for each slice of the picture, at least one reference picture to be used for encoding and decoding the particular slice. The picture identifier provider 120 preferably provides respective picture identifiers for all reference pictures determined by the reference picture determiner 110 for the current picture, i.e. for all its slices. The buffer description information is thereby generated by the buffer description information generator 130 based on these provided picture identifiers. In a preferred embodiment, the data inserter 140 is configured to insert the buffer description information in a respective slice header of the encoded representation of the picture. In such a case, each slice header of the current picture preferably carries the same buffer description information. This enables decoding of a given slice even, though, another slice of the picture is unintentionally lost.

Also other positions among control information in the encoded representation of the picture are possible for carrying the buffer description information as previously discussed herein.

The buffer description of the embodiments could include the picture identifier(s) of the reference picture(s). Alternatively, the buffer description comprises the previously discussed delta identifier(s) that can be used together with the picture identifier of the current picture to calculate the picture identifier(s) of the reference picture(s).

In such a case the encoder 100 preferably comprises an identifier calculator 150 that is configured to calculate, for each picture identifier provided by the picture identifier provider 120, a difference between the picture identifier and the picture identifier of the current picture. This difference corresponds to the delta identifier for the reference picture. The buffer description information generator 130 is then configured to generate the buffer description information based on the at least

one difference/delta identifier calculated by the identifier calculator 150. The buffer description information thereby defines the at least one picture identifier of the reference picture(s) relative to the picture identifier of the current picture.

The encoded representation of the picture could carry the picture identifiers provided by the picture identifier provider 120 or the delta identifiers calculated by the identifier calculator 150 as buffer description information, for instance in the slice headers. This provides an explicit signaling of the buffer description in the encoded representation of the picture.

In an alternative embodiment, the encoder 100 comprises a data structure generator 160 configured to generate a data structure comprising multiple predefined buffer descriptions. Each such predefined buffer description thereby defines at least one reference picture. The data structure can thereby be used for multiple pictures in the video stream for the purpose of providing the buffer description to be used during decoding for the pictures. The buffer description information generator 130 is thereby configured to select a buffer description of the data structure based on the at least one picture identifier provided by the picture identifier provider 120 for the current picture. The buffer description that correctly matches the at least reference picture identifier is thereby selected and the buffer description information generated by the buffer description information generator 130 comprises an identifier of the selected buffer description.

The data structure generated by the data structure generator 160 could then be inserted in a control information field associated with an encoded representation of the video stream, such as in a PPS or SPS. An identifier of the relevant control information, i.e. a PPS identifier or an SPS identifier (could be in the form of a PPS identifier to a PPS that in turn comprises an SPS identifier to the relevant SPS), is preferably included in control information of the encoded representation of the current picture, such as in the slice header. In an embodiment, the slice header or other control information field thereby carries the control information identifier and the identifier of the selected buffer description as the buffer description information.

The above description embodiments of explicit signaling of picture identifiers and reference signaling of picture identifiers can be combined. In such a case, the buffer description information generator 130 is configured to generate the buffer description information comprising the identifier of the selected buffer

description, preferably also the control information identifier, and comprising information, such as delta identifier or explicit picture identifier, defining a picture identifier of a reference picture.

The encoder 100 could use any of the previously discussed examples of picture identifiers, such as POC value that unambiguously identifiers a reference picture, or a POC value and an additional identifier.

The video stream could be a scalable video stream where the pictures are grouped into multiple layers. In such a case the picture identifier provider 120 is configured to provide, for each reference picture, the picture identifier and temporal layer information or identifier identifying a layer to which the reference picture belongs. The buffer description information generator 130 then generates the buffer description information based on the at least one picture identifier and based on the temporal layer information. Thus, the buffer description information preferably defines the at least one picture identifier and the temporal layer information.

The reference picture determiner 110 is preferably configured to determine the at least one reference picture as encoding reference for inter prediction and/or motion vector prediction for the current picture. The at least one reference picture can thereby be determined by maximizing the compression or coding efficiency of the encoded representation of the picture, i.e. minimizing the number of symbols, such as bits, required for representing the encoded representation. This compression maximization is preferably performed while complying with at least one side constraint selected from having a predefined maximum number of reference pictures and generating a decodable representation of the video stream also when at least one encoded representation of a picture is removed from the encoded representation of the video stream. A further alternative or additional side constraint is that a selected reference picture must be available for reference and prediction in the decoded picture buffer.

The encoder could be implemented at least partly in software. In such an embodiment as shown in Fig. 19, the encoder 300 comprises an input section 310 configured to receive multiple pictures of a video stream. The encoder 300 also comprises a processor 330 configured to process code means of a computer program stored in a memory 340. The code means causes, when run on the processor 330, the processor 330 to determine, for a picture of the video stream, at least one reference picture of the video stream as encoding reference for the picture. The processor 330 is also caused to provide, for

each reference picture, a picture identifier identifying the reference picture and generate, based on the at least one picture identifier, buffer description information defining the at least one reference picture. The processor 330 is further caused to insert the buffer description information in an encoded representation of the picture. The encoder 300 also comprises an output section 320 configured to output the encoded representations of the pictures.

The processor 330 could be a general purpose or specially adapted computer, processor or microprocessor, such as a central processing unit (CPU). The software includes computer program code elements or software code portions effectuating the operation of at least the reference picture determiner 110, the picture identifier provider 120, the buffer description information generator 130, and the data inserter 140 of Fig. 18.

The program may be stored in whole or part, on or in one or more suitable volatile computer readable media or data storage means, such as RAM, or one or more non-volatile computer readable media or data storage means, such as magnetic disks, CD-ROMs, DVD disks, hard discs, in ROM or flash memory. The data storage means can be a local data storage means or is remotely provided, such as in a data server. The software may thus be loaded into the operating memory of a computer or equivalent processing system for execution by a processor. The computer/processor does not have to be dedicated to only execute the above-described functions but may also execute other software tasks. A non-limiting example of program code used to define the encoder 300 include single instruction multiple data (SIMD) code.

Alternatively the encoder can be implemented in hardware. There are numerous variants of circuitry elements that can be used and combined to achieve the functions of the units 110-160 of the encoder 100 in Fig. 18. Such variants are encompassed by the embodiments. Particular examples of hardware implementation of the encoder 100 is implementation in digital signal processor (DSP) hardware and integrated circuit technology, including both general-purpose electronic circuitry and application-specific circuitry.

According to an aspect of the embodiments a transmitter 200 as shown in Fig. 17 is provided. The transmitter 200 comprises an input section 210 configured to receive multiple pictures 10 of a video stream. The pictures 10 are forwarded to an encoder 100, such as illustrated in Fig. 18 or in Fig. 19,

which is configured to encode the multiple pictures 10 to generate respective encoded representations of the multiple pictures. An output section 220 of the transmitter 200 is configured to output the respective encoded representations of the multiple pictures as a coded bitstream carrying the buffer description information of the embodiments.

An aspect of the embodiments relates to a decoder for detecting buffer description information and for determining absolute reference to pictures to be used as reference pictures for decoding based on the detected buffer description and a buffer for storing the pictures to be used as reference pictures.

Fig. 21 is a schematic block diagram of a decoder 400 according to an embodiment. The decoder 400 is configured to decode an encoded representation of a picture of a video stream comprising multiple pictures. The decoder 400 comprises a data retriever 410 configured to retrieve buffer description information defining at least one reference picture from the encoded representation of the picture. The buffer description information is used by a picture identifier determiner 420 that is configured to determine at least one picture identifier identifying a respective reference picture as decoding reference for the picture. The decoder 400 also comprises a buffer manager 430 configured to update a decoded picture buffer of or associated to the decoder 400 based on the at least one picture identifier determined by the picture identifier determiner 420.

In a particular embodiment, the data retriever 410 is configured to retrieve the buffer description information defining multiple picture identifiers from the encoded representation of the picture. The picture identifier determiner 420 is then configured to determine, based on the retrieved buffer description information, at least one picture identifier identifying a respective reference picture as decoding reference for the picture and at least one picture identifier identifying a respective reference picture as decoding reference for a subsequent, according to a decoding order, picture of the video stream.

The buffer manager 430 is preferably configured to update the decoded picture buffer to comprise the respective reference picture identified by the at least one picture identifier.

Thus, the buffer description information carried by the encoded representation of the picture is used to identify which reference picture(s) that need to be stored in the decoded picture buffer for decoding the

current picture and for decoding a subsequent picture of the video stream. The buffer description information thereby provides the information to the decoder 400 required to update the decoded picture buffer to store the correct reference picture(s).

Once the buffer manager 430 has updated the decoded picture buffer the decoder 400 can decode the picture based on the encoded representation of the picture and at least one reference picture stored in the updated decoded picture buffer.

The buffer description information is preferably provided in control information of the encoded representation of the picture. For instance, the data retriever 410 could be configured to retrieve the buffer description information from a slice header of the encoded representation of the picture. In such a case the buffer description information is preferably retrieved from the first slice header received for the current picture since any remaining slice headers of the picture will preferably carry the same buffer description information.

The retrieved buffer description information could include explicit picture identifiers of the reference pictures to be stored in the decoded picture buffer. In an alternative embodiment, the buffer description information defines a respective delta identifier for the reference pictures. The picture identifier determiner 420 is then configured to retrieve the at least one delta identifier from the buffer description information and calculate the at least one picture identifier based on the respective delta identifier and the picture identifier of the current picture, preferably as a sum of the delta identifier and the picture identifier of the current picture.

Instead of explicit signaling of picture identifiers or delta identifiers in the encoded representation of the picture a reference signaling can be used. The data retriever 410 is in this embodiment configured to retrieve an identifier of a buffer description from the encoded representation of the picture. The decoder 400 preferably comprises a buffer description identifier 480 configured to identify a buffer description from a data structure comprising multiple predefined buffer descriptions using the retrieved identifier of the buffer description.

The data retriever 410 is preferably in this embodiment also configured to retrieve the data structure defining the multiple predefined buffer descriptions from a control information field of or associated with an encoded representation of the video stream, such as from a PPS or SPS.

In a particular embodiment a control information field of the encoded representation of the picture, such as slice header, preferably comprises an identifier of the control information field, such as PPS or SPS, carrying the data structure. The data retriever 410 thereby retrieves this identifier and uses it to identify the relevant control information field with the data structure.

In another embodiment the buffer description information comprises the identifier of the buffer description and information, such as picture identifier or delta identifier, identifying at least one picture identifier. The picture identifier determiner 420 is then configured to determine a first set of at least one picture identifier from the identified buffer description, preferably from the data structure. The picture identifier determiner 420 also determines a second set of at least one picture identifier from the information defining at least one picture identifier, where this information has been explicitly signaled in the encoded representation of the picture, such as in the form of a picture identifier or a delta identifier. A joint set of picture identifiers is then formed from the first set and the second set by the picture identifier determiner 420.

In a particular embodiment the decoder 400 comprises a number comparator 440 configured to compare a total number of picture identifiers in the joint set with a maximum number of reference pictures that can be stored in the decoded picture buffer. If the total number of picture identifiers in the joints set exceeds the maximum number of reference pictures the picture identifier determiner 420 is configured to remove one or more picture identifiers included in the first set but not in the second set until the total number of picture identifiers in the joint set no longer exceeds the maximum number of reference pictures.

The buffer manager 430 of decoder 400 is configured, in a particular embodiment, to remove any reference picture present in the decoded picture buffer but not being associated with any of the at least one picture identifier determined from the buffer description information. Hence, any reference picture that is stored in the decoded picture buffer but not identified from the buffer description information is preferably removed from the decoded picture buffer by the buffer manager 430.

In an alternative and preferred approach, the buffer manager 430 is configured to mark all reference pictures stored in the decoded picture buffer but not being associated with any of the at least one picture identifier from the buffer description information as unused for reference, also referred to as unused for prediction.

In a particular embodiment, any reference picture present in the decoded picture buffer and associated with any of the picture identifiers determined based on the buffer description information is preferably marked by the buffer manager 430 as used for reference. In an embodiment, a reference picture could be marked as either used for short-term reference or used for long-term reference. The selection between these two particular alternatives is preferably performed based on the buffer description information.

The buffer manager 430 of the decoder 400 is preferably configured to mark any reference picture prior to the decoder 400 decoding the current picture.

In a particular embodiment the decoder 400 comprises an outputting section 450 configured to output zero or more pictures from the decoded picture buffer for display prior to the decoder 400 decodes the current picture. In a particular embodiment, the outputting section 450 outputs any reference picture marked as unused for reference by the buffer manager 430.

An optional embodiment of the decoder 400 comprises an identifier comparator 460 configured to compare the at least one picture identifier determined by the picture identifier determiner 420 with the picture identifier(s) of reference picture(s) stored in the decoded picture buffer. If any of the at least one picture identifier defined by the buffer description information does not have a matching reference picture in the decoded picture buffer the picture associated with the given picture identifier is determined by the picture identifier determiner 420 to be non-existing or missing.

In an optional embodiment, the picture identifier determiner 420 is configured to generate any non-existing picture and store such a generate picture in the decoded picture buffer. The picture identifier and any other information obtainable from the buffer description information with regard to the non-existing picture is preferably assigned to the generated picture by the picture identifier determiner 420.

The decoder 400 may also comprise a list manager 470 configured to perform reference picture list initialization based on the buffer description information. In a particular embodiment, the list manager 470 is configured to perform the reference picture list initialization by ordering reference pictures in a reference picture list according to an order that the buffer description information defines the at least one picture identifier. Hence, the buffer description information not only defines the picture identifiers of the reference pictures but the order at which these are defined in the buffer description information also provides instructions to the list manager 470 with regard to forming the reference picture list.

The decoder could be implemented at least partly in software. In such an embodiment as shown in Fig. 22, the decoder 600 comprises an input section 610 configured to receive encoded representations of multiple pictures of a video stream. The decoder 600 also comprises a processor 630 configured to process code means of a computer program stored in a memory 640. The code means causes, when run on the processor 630, the processor 630 to retrieve buffer description information defining at least one reference picture from an encoded representation of a picture. The code means also causes the processor 630 to determine at least one picture identifier identifying a respective reference picture from the buffer description information. The respective reference picture is to be used as decoding reference for the picture. The processor 630 is further caused to update a decoded picture buffer 650 based on the at least one picture identifier. The decoder 600 also comprises an output section 620 configured to output the decoded pictures of the video stream.

The processor 630 could be a general purpose or specially adapted computer, processor or microprocessor, such as a central processing unit (CPU). The software includes computer program code elements or software code portions effectuating the operation of at least data retriever 410, the picture identifier determiner 420 and the buffer manager 430 of Fig. 21.

The program may be stored in whole or part, on or in one or more suitable volatile computer readable media or data storage means, such as RAM, or one or more non-volatile computer readable media or data storage means, such as magnetic disks, CD-ROMs, DVD disks, hard discs, in ROM or flash memory. The data storage means can be a local data storage means or is remotely provided, such as in a data server. The software may thus be loaded into the operating memory of a computer or equivalent processing system for execution by a processor. The computer/processor does not have to be dedicated

to only execute the above-described functions but may also execute other software tasks. A non-limiting example of program code used to define the decoder 600 include single instruction multiple data (SIMD) code.

Alternatively the decoder can be implemented in hardware. There are numerous variants of circuitry elements that can be used and combined to achieve the functions of the units 410-480 of the decoder 400 in Fig. 21. Such variants are encompassed by the embodiments. Particular examples of hardware implementation of the decoder 400 is implementation in digital signal processor (DSP) hardware and integrated circuit technology, including both general-purpose electronic circuitry and application-specific circuitry.

According to an aspect of the embodiments a receiver 500 as shown in Fig. 20 is provided. The receiver 500 comprises an input section 510 configured to receive encoded representations of multiple pictures of a video stream. The encoded representation carries buffer description information according to the embodiments. The encoded representations are forwarded to a decoder 400, such as illustrated in Fig. 21 or in Fig. 22, which is configured to decode the encoded representations of the multiple pictures. An output section 520 of the receiver 500 is configured to output decoded pictures of the video stream. The receiver 500 also comprises a decoded picture buffer 530 storing reference pictures to be used by the decoder 400 when decoding the pictures.

ANNEX

The present annex presents a proposed syntax of an embodiment. In the annex added syntax element with regard to the prior art HEVC proposal is marked with underlining and removed syntax elements are marked with strikethrough.

Slice Header

slice_header( ) {	**Descriptor**
first_tb_in_slice	ue(v)
entropy_slice_flag	u(1)
if(!entropy_slice_flag) {	
slice_type	ue(v)
pic_parameter_set_id	ue(v)
~~**frame_num**~~	~~u(v)~~
additional_picture_id	ue(v)
if(IdrPicFlag)	
idr_pic_id	ue(v)
if(pic_order_cnt_type = = 0)	
pic_order_cnt_lsb /*	u(v)
if(!IdrPicFlag){	
buffer_description_reference_flag	u(1)
if(buffer_description_reference_flag = = 1){	
buffer_description_id	ue(v)
}	
if(buffer_description_reference_flag = = 0){	
number_of_explicitly_signaled_pictures	ue(v)
for(**number_of_explicitly_signaled_pictures**) {	
additional_picture_id	ue(v)
if(num_reorder_frames > 0)	
delta_POC_sign	u(1)
absolute_delta_POC_minus_one	ue(v)
temporal_id	u(v)
}	
}	
}	

}	
if(slice_type == P || slice_type == B) {	
num_ref_idx_active_override_flag	u(1)
if(num_ref_idx_active_override_flag) {	
num_ref_idx_l0_active_minus1	ue(v)
if(slice_type == B)	
num_ref_idx_l1_active_minus1	ue(v)
}	
}	
ref_pic_list_modification( )	
ref_pic_list_combination( )	
~~if(nal_ref_idc != 0)~~	
~~dec_ref_pic_marking( )~~	
if(entropy_coding_mode_flag && slice_type != I)	
cabac_init_idc	ue(v)
slice_qp_delta	se(v)
if(adaptive_loop_filter_enabled_flag)	
alf_param()	
if(deblocking_filter_control_present_flag) {	
disable_deblocking_filter_idc	
if(disable_deblocking_filter_idc != 1) {	
slice_alpha_c0_offset_div2	
slice_beta_offset_div2	
}	

}	
if(slice_type = = B)	
collocated_from_l0_flag	u(1)
} else	
if(entropy_coding_mode_flag && slice_type != I)	
cabac_init_idc	ue(v)
}	

Picture Parameter Set

pic_parameter_set_rbsp( ) {	**Descriptor**
pic_parameter_set_id	ue(v)
seq_parameter_set_id	ue(v)
entropy_coding_mode_flag	u(1)
num_ref_idx_l0_default_active_minus1	ue(v)
num_ref_idx_l1_default_active_minus1	ue(v)
pic_init_qp_minus26 /* relative to 26 */	se(v)
constrained_intra_pred_flag	u(1)
number_of_buffer_descriptions	ue(v)
for(number_of_buffer_descriptions){	
number_of_pictures_in_buffer_description	ue(v)
for(number_of_pictures_in_buffer_description) {	
if(num_reorder_frames > 0)	
delta_POC_sign	u(1)
absolute_delta_POC_minus_one	ue(v)
temporal_id	u(v)
}	
rbsp_trailing_bits( )	
}	

Proposed semantics

Decoding process for buffer description application

This process is invoked at the beginning of the decoding process for each I, P, or B picture, prior to decoding of the first Coding Unit in the first slice of the picture and prior to the decoding process for reference picture list construction.

The process may result in marking one or more picture as "unused for reference".

The process may result in the construction of "non-existing" pictures as described in Creation of non-existing pictures.

A reference picture is identified for use in the decoding process by the variables *POC* and *additional_picture_id*.

A reference picture r in the decoded picture buffer is said to be a part of a buffer description if and only if *POC(r)* = *POC(curr)* + *delta_POC(i)* and *additional_picture_id(r)* = *additional_picture_id(i)* for any i in the range of 0 to *number_pictures_in_buffer_description*.

Sequence of operation for buffer description application

Buffer description application proceeds in the following ordered steps:

1. Depending on whether the current picture is an IDR picture, the following applies.
   - If the current picture is an IDR picture, all reference pictures are marked as unused for reference.
   - Otherwise (the current picture is not an IDR picture), the following ordered steps applies:
     I. The buffer description information in the slice header of the first slice of the current picture is used to create a list of reference pictures, referred to as the buffer description as described in Creation of a buffer description.
     II. All reference pictures (in the decoded picture buffer) that are not a part of the buffer description are marked as "unused for reference".
     III. If one or more pictures that are included in the buffer description are not available for reference (i.e. existing in the reference buffer marked as "used for reference") the process described in Creation of non-existing pictures is invoked.
2. The slices of the current picture are decoded.

Creation of a buffer description

If *buffer_description_reference_flag* is 1, a buffer description is created setting *deltaPOC* to the *deltaPOC* of the PPS buffer description entry identified by *buffer_description_id*, *temporal_id* to the *temporal_id* of the PPS buffer description entry identified by *buffer_description_id* and *additional_picture_id* to 0 for each picture i in the range from 0 to *number_of_pictures_in_buffer_description*-1.

If *buffer_description_reference_flag* is 0, a buffer description is created setting *deltaPOC* to the *deltaPOC* of the explicitly signaled buffer description, *temporal_id* to the *temporal_id* of the explicitly signaled buffer description and *additional_picture_id* to *additional_picture_id* of the explicitly signaled buffer description for each picture i in the range from 0 to *number_of_explicitly_signaled_pictures* -1.

Creation of non-existing pictures

This process is preferably invoked for each picture that is included in the buffer description of the current picture but is not available in the decoded picture buffer. That is if the buffer description of the current picture contains an entry i, with a *POC(i)* and *additional_picture_id(i)* such that there is no picture j in the decoded picture buffer marked as "used for reference" with *POC(j)* == *POC(i)* and *additional_picture_id(j)* == *additional_picture_id(i)*.

For each such description a "non-existing" picture is generated with *POC* set to *POC(i)*, *additional_picture_id* set to *additional_picture_id(i)*, *temporal_id* set to *temporal_id(i)* and marked as "non-existing" and "used for reference". The sample values of the generated frames may be set to any value. These generated frames which are marked as "non-existing" shall not be referred to in the inter prediction process.

The embodiments described above are to be understood as a few illustrative examples of the present invention. It will be understood by those skilled in the art that various modifications, combinations and changes may be made to the embodiments without departing from the scope of the present invention. In particular, different part solutions in the different embodiments can be combined in other configurations, where technically possible. The scope of the present invention is, however, defined by the appended claims.

WHAT IS CLAIMED IS:

1. A method of decoding an encoded representation of a picture in a video stream of multiple pictures, said method comprising:

retrieving, using a decoder configured to decode said encoded representation of said picture, buffer description information defining at least one reference picture from said encoded representation of said picture;

determining, based on said buffer description information, at least one reference picture identifier identifying a respective reference picture among said at least one reference picture as a decoding reference for said picture, wherein determining said at least one reference picture identifier comprises:

retrieving, based on said buffer description information, a respective delta identifier; and

calculating said at least one reference picture identifier based on a picture identifier identifying said picture and said respective delta identifier; and

updating a decoded picture buffer based on said at least one reference picture identifier.

2. The method according to claim 1, wherein:

retrieving said buffer description information comprises retrieving said buffer description information defining multiple reference pictures from said encoded representation of said picture; and

determining said at least one reference picture identifier comprises determining, based on said buffer description information, i) at least one picture identifier identifying a respective reference picture among said multiple reference pictures as the decoding reference for said picture and ii) at least one picture identifier identifying a respective reference picture among said multiple reference pictures as a decoding reference for a subsequent, according to a decoding order, picture in said video stream.

3. The method according to claim 1, wherein updating said decoded picture buffer comprises marking all reference pictures present in said decoded picture buffer and not being associated with any of said at least one reference picture identifier determined based on said buffer description information as unused for reference.

4. The method according claim 3, wherein marking any of the reference pictures is performed prior to decoding said picture.

5. The method according to claim 1, wherein delta display order information is included in the buffer description information and is encoded with a variable-length code.

6. The method according to claim 1, wherein determining said at least one reference picture identifier comprises determining, based on said buffer description information, at least one picture order count (POC) value identifying said respective reference picture as the decoding reference for said picture.

7. The method according to claim 6, wherein determining said at least one POC value comprises determining, based on said buffer description information, said at least one picture order count (POC) value and at least one additional identifier identifying said respective reference picture as the decoding reference for said picture.

8. A decoder configured to decode an encoded representation of a picture in a video stream of multiple pictures, said decoder comprising:

a data retriever configured to retrieve buffer description information defining at least one reference picture from said encoded representation of said picture;

a picture identifier determiner configured to determine, based on said buffer description information, at least one reference picture identifier identifying a respective reference picture among said at least one reference picture as a decoding reference for said picture, wherein said picture identifier determiner is configured to i) retrieve, based on said buffer description information, a respective delta identifier, and ii) calculate said at least one reference picture identifier based on a picture identifier identifying said picture and said respective delta identifier; and

a buffer manager configured to update a decoded picture buffer based on said at least one reference picture identifier.

9. The decoder according to claim 8, wherein:

said data retriever is configured to retrieve said buffer description information defining multiple reference pictures from said encoded representation of said picture; and

said picture identifier determiner is configured to determine, based on said buffer description information, i) at least one picture identifier identifying a respective reference picture among said multiple reference pictures as the decoding reference for said picture and ii) at least one picture identifier identifying a respective reference picture among said multiple reference pictures as a decoding reference for a subsequent, according to a decoding order, picture in said video stream.

10. The decoder according to claim 8, wherein said buffer manager is configured to mark all reference pictures present in said decoded picture buffer and not being associated with any of said at least one reference picture identifier determined based on said buffer description information as unused for reference.

11. The decoder according to claim 10, wherein said buffer manager is configured to mark any reference picture prior to said decoder decodes said picture.

12. The decoder according to claim 8, wherein delta display order information is included in the buffer description information and is encoded with a variable-length code.

13. A receiver comprising:

an input section configured to receive encoded representations of multiple pictures in a video stream;

a decoder according to claim 8, configured to decode said encoded representations of said multiple pictures; and

an output section configured to output decoded pictures of said video stream.

14. A decoder comprising:

an input section configured to receive encoded representations of multiple pictures in a video stream;

a processor configured to process code means of a computer program stored in a memory, said code means causes, when run on said processor, said processor to:

retrieve buffer description information defining at least one reference picture from an encoded representation of a picture;

determine, based on said buffer description information, at least one reference picture identifier identifying a respective reference picture among said at least one reference picture as a decoding reference for said picture, wherein determining said at least one reference picture identifier comprises:

retrieving, based on said buffer description information, a respective delta identifier; and

calculating said at least one reference picture identifier based on a picture identifier identifying said picture and said respective delta identifier; and

update a decoded picture buffer based on said at least one reference picture identifier; and

an output section configured to output decoded pictures of said video stream.

15. A method of encoding a picture in a video stream of multiple pictures, said method comprising:

determining, for said picture, at least one reference picture among said multiple pictures as an encoding reference for said picture;

providing, for each reference picture of said at least one reference picture, a reference picture identifier identifying said reference picture;

generating, based on at least one delta identifier that corresponds to a difference between said reference picture identifier and a picture identifier identifying said picture, buffer description information defining said at least one reference picture; and

inserting, using an encoder configured to encode said picture in said video stream, said buffer description information in an encoded representation of said picture.

16. The method according to claim 15, wherein delta display order information is included in the buffer description information and is encoded with a variable-length code.

17. An encoder configured to encode a picture in a video stream of multiple pictures, said encoder comprising:

a reference picture determiner configured to determine, for said picture, at least one reference picture among said multiple pictures as an encoding reference for said picture;

a picture identifier provider configured to provide, for each reference picture among said at least one reference picture, a reference picture identifier identifying said reference picture;

a buffer description information generator configured to generate, based on at least one delta identifier that corresponds to a difference between said reference picture identifier and a picture identifier identifying said picture, buffer description information defining said at least one reference picture; and

a data inserter configured to insert said buffer description information in an encoded representation of said picture.

18. The encoder according to claim 17, wherein delta display order information is included in the buffer description information and is encoded with a variable-length code.

19. An encoder comprising:

an input section configured to receive multiple pictures in a video stream;

a processor configured to process code means of a computer program stored in a memory, said code means causes, when run on said processor, said processor to:

determine, for a picture in said video stream, at least one reference picture among said multiple pictures as an encoding reference for said picture;

provide, for each reference picture among said at least one reference picture, a reference picture identifier identifying said reference picture;

generate, based on at least one delta identifier that corresponds to a difference between said reference picture identifier and a picture identifier identifying said picture, buffer description information defining said at least one reference picture; and

insert said buffer description information in an encoded representation of said picture; and

an output section configured to output encoded representations of pictures.

20. The encoder according to claim 19, wherein delta display order information is included in the buffer description information and is encoded with a variable-length code.

ABSTRACT

An encoded representation of a picture of a video stream is decoded by retrieving buffer description from the encoded representation. The buffer description information is used to determine at least one picture identifier identifying a respective reference picture as decoding reference for the picture. A decoded picture buffer is updated based on the determined picture identifier. The encoded representation of the picture itself comprises the information needed by a decoder to identify the reference pictures required to decode the encoded representation.

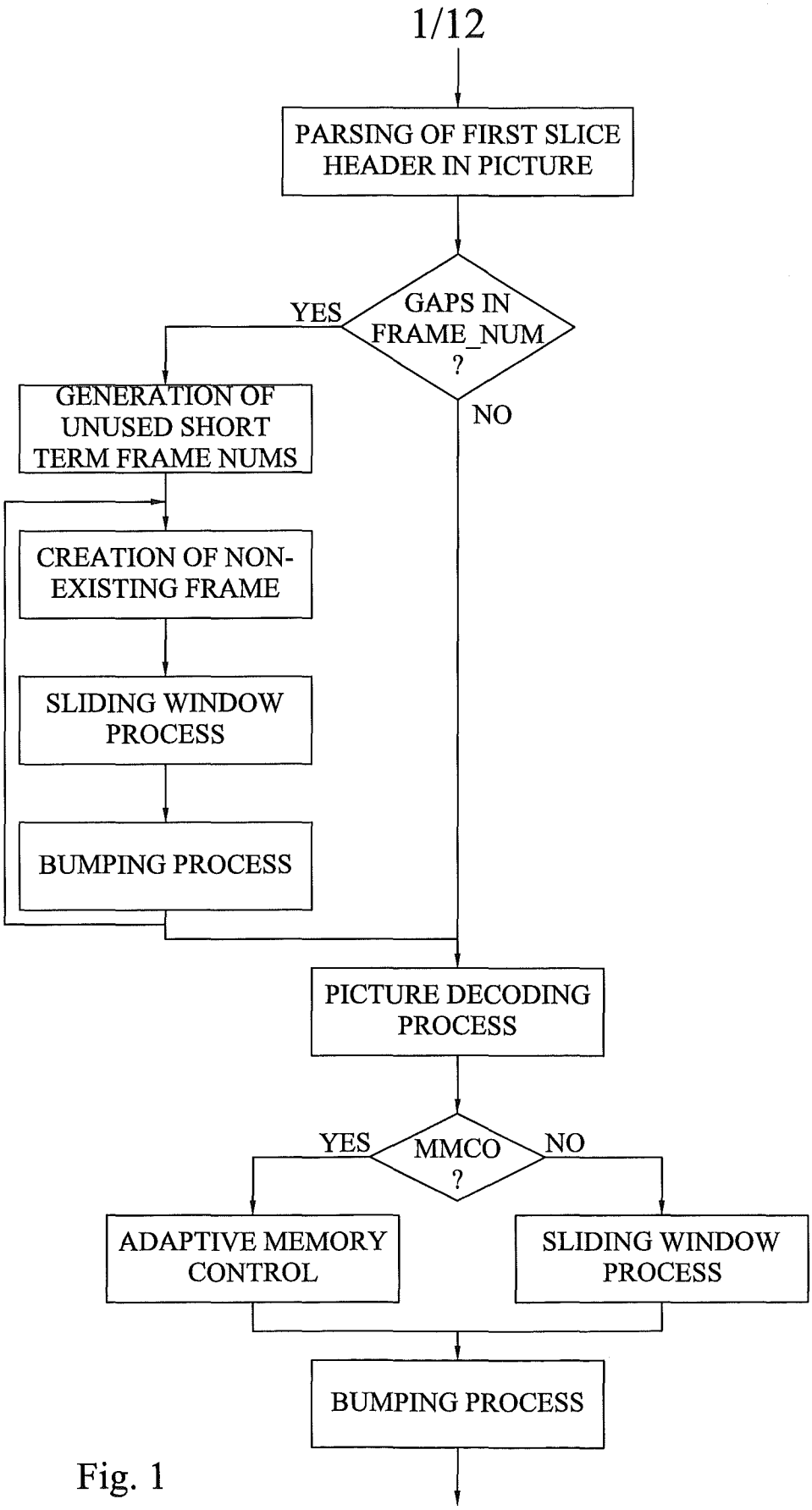
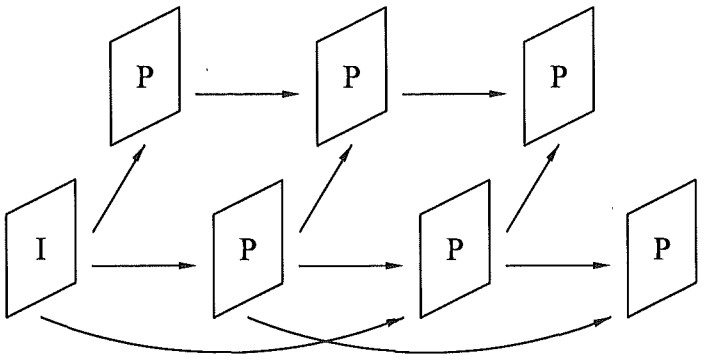

PARSING OF FIRST SLICE HEADER IN PICTURE
GAPS IN FRAME_NUM ?
YES
NO
GENERATION OF UNUSED SHORT TERM FRAME NUMS
CREATION OF NON-EXISTING FRAME
SLIDING WINDOW PROCESS
BUMPING PROCESS
PICTURE DECODING PROCESS
MMCO ?
YES
NO
ADAPTIVE MEMORY CONTROL
SLIDING WINDOW PROCESS
BUMPING PROCESS

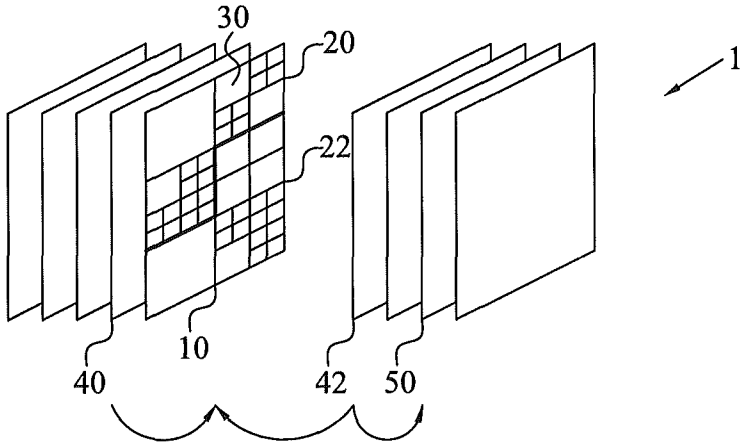
Fig. 1

Fig. 2



POC:	0	1	2	3	4	5	6
FRAME_NUM:	0	1	2	3	4	5	6
TEMPORAL_ID:	0	1	0	1	0	1	0

Fig. 4



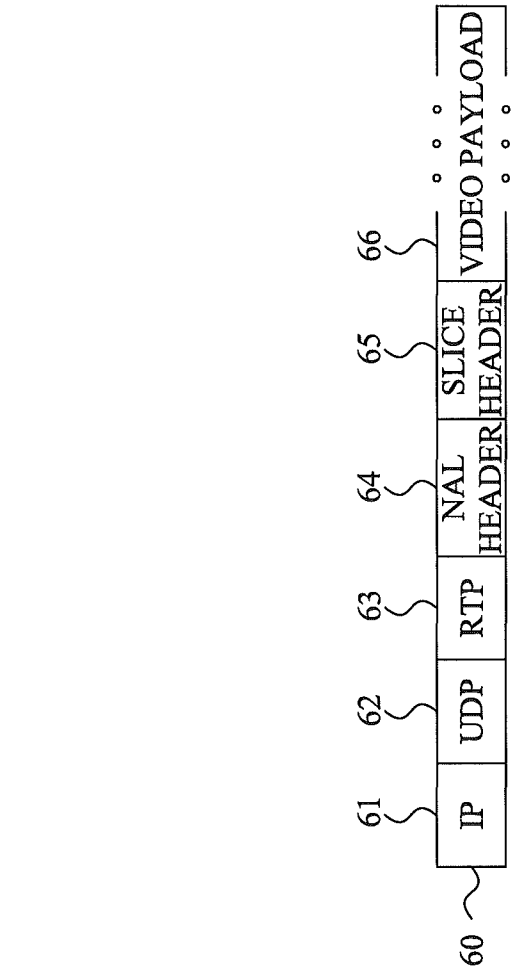

60
61
IP
62
UDP
63
RTP
64
NAL HEADER
65
SLICE HEADER
66
VIDEO PAYLOAD
67
PPS
68
SPS

Fig. 5

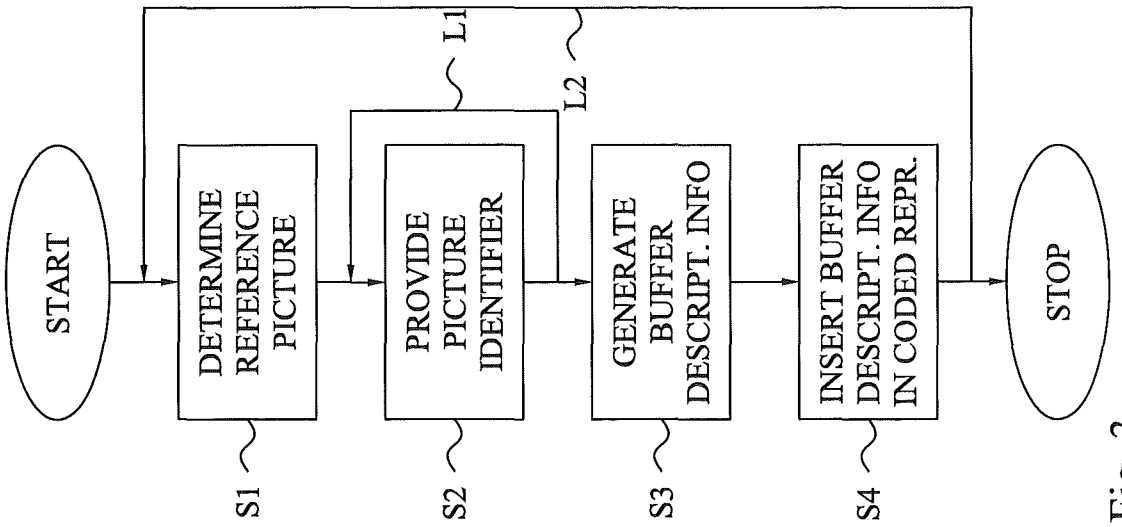

START
DETERMINE REFERENCE PICTURE
PROVIDE PICTURE IDENTIFIER
GENERATE BUFFER DESCRIPT. INFO
INSERT BUFFER DESCRIPT. INFO IN CODED REPR.
STOP
L1
L2
S1
S2
S3
S4

Fig. 3

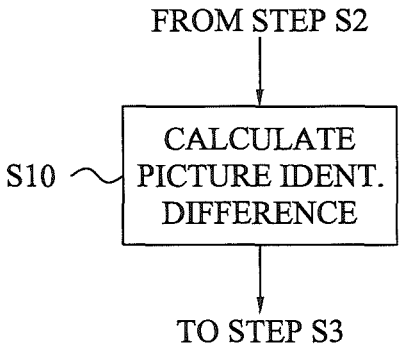

FROM STEP S2
S10
CALCULATE PICTURE IDENT. DIFFERENCE
TO STEP S3

Fig. 6

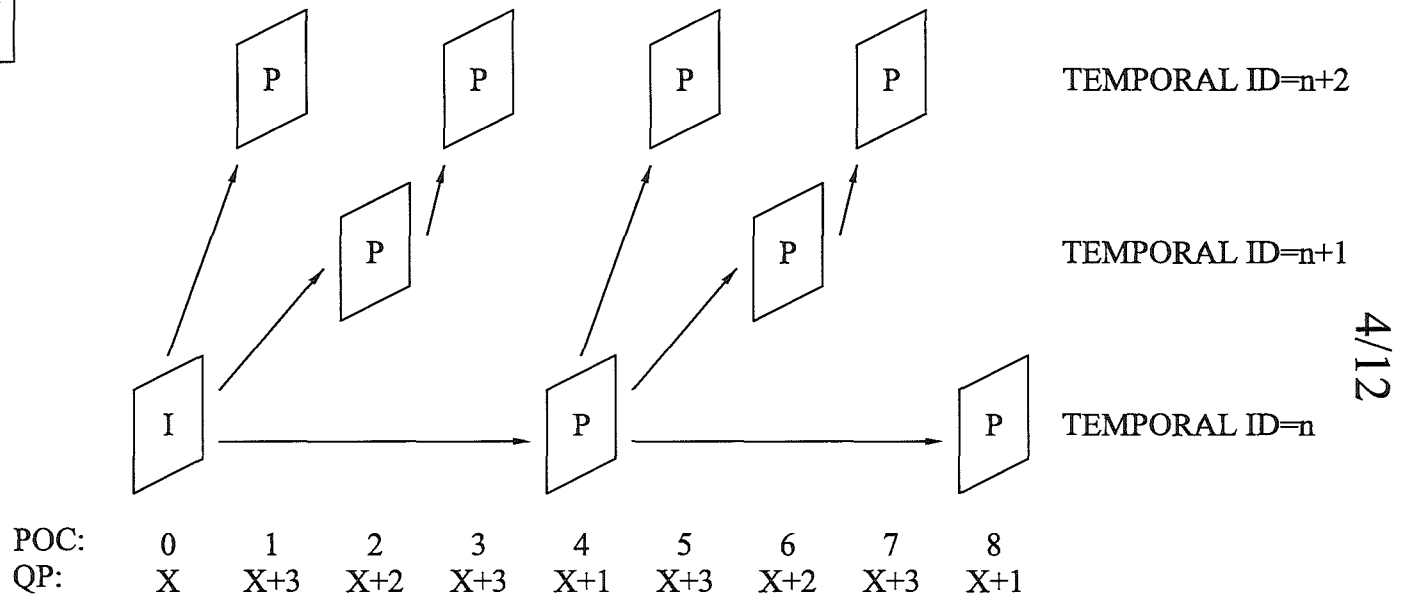

P
P
P
P
TEMPORAL ID=n+2
P
P
TEMPORAL ID=n+1
I
P
P
TEMPORAL ID=n
POC: 0 1 2 3 4 5 6 7 8
QP: X X+3 X+2 X+3 X+1 X+3 X+2 X+3 X+1

Fig. 8

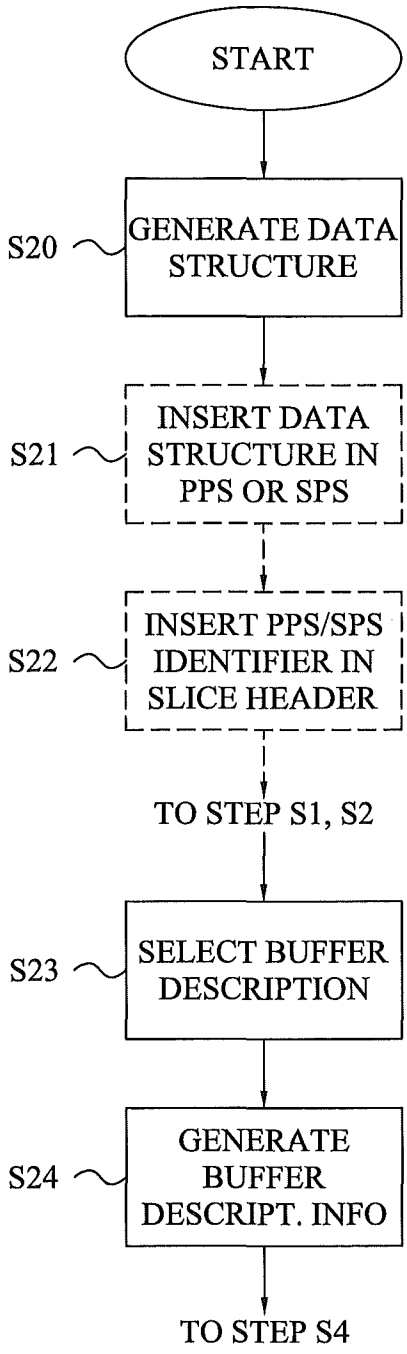

START
S20
GENERATE DATA STRUCTURE
S21
INSERT DATA STRUCTURE IN PPS OR SPS
S22
INSERT PPS/SPS IDENTIFIER IN SLICE HEADER
TO STEP S1, S2
S23
SELECT BUFFER DESCRIPTION
S24
GENERATE BUFFER DESCRIPT. INFO
TO STEP S4

Fig. 7

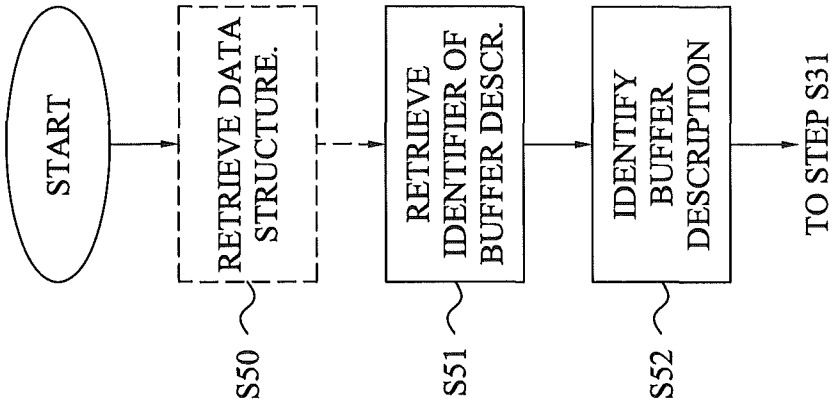


Fig. 11

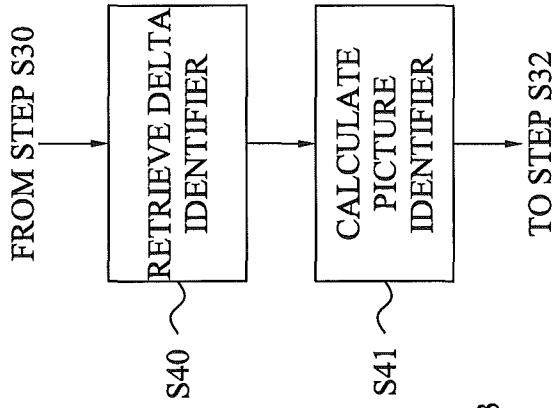


Fig. 10

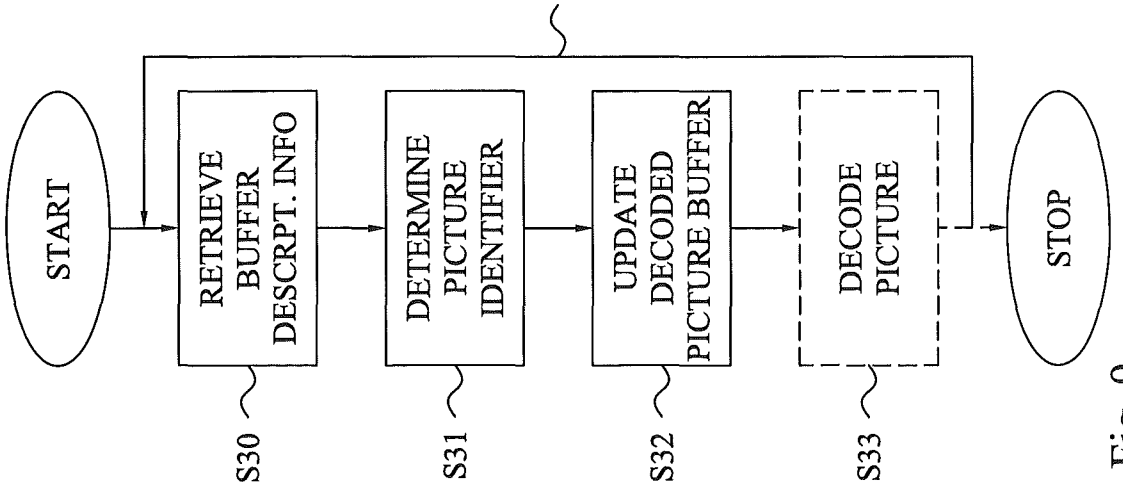


Fig. 9

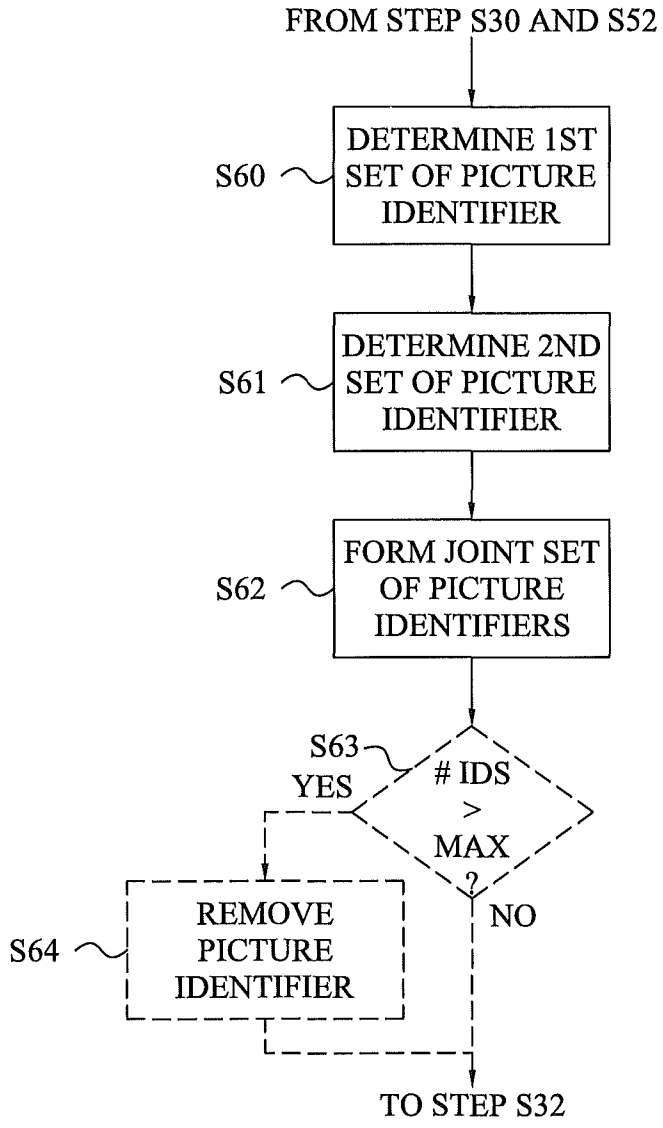

FROM STEP S30 AND S52
S60
DETERMINE 1ST SET OF PICTURE IDENTIFIER
S61
DETERMINE 2ND SET OF PICTURE IDENTIFIER
S62
FORM JOINT SET OF PICTURE IDENTIFIERS
S63
IDS > MAX ?
YES
NO
S64
REMOVE PICTURE IDENTIFIER
TO STEP S32

Fig. 12

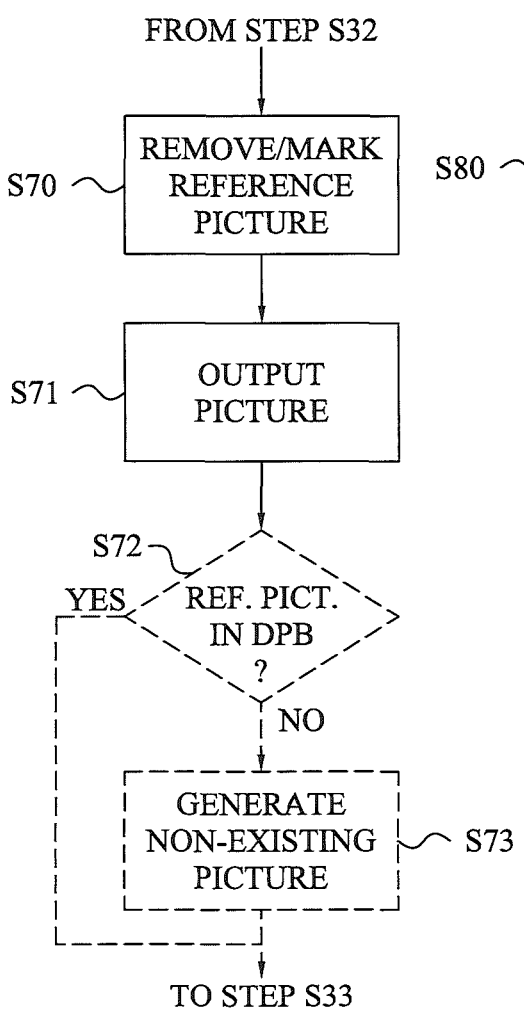


Fig. 13

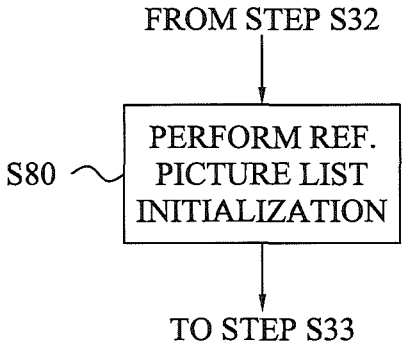
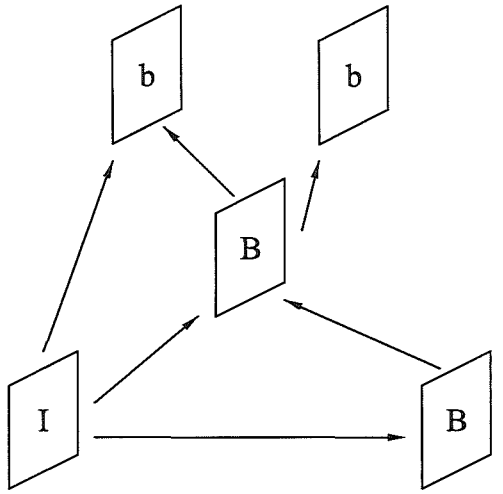


Fig. 14



POC:	0	1	2	3	4
DECODING ORDER:	0	3	2	4	1
ADDITIONAL_PICTURE_ID:	0	0	0	0	0

Fig. 15

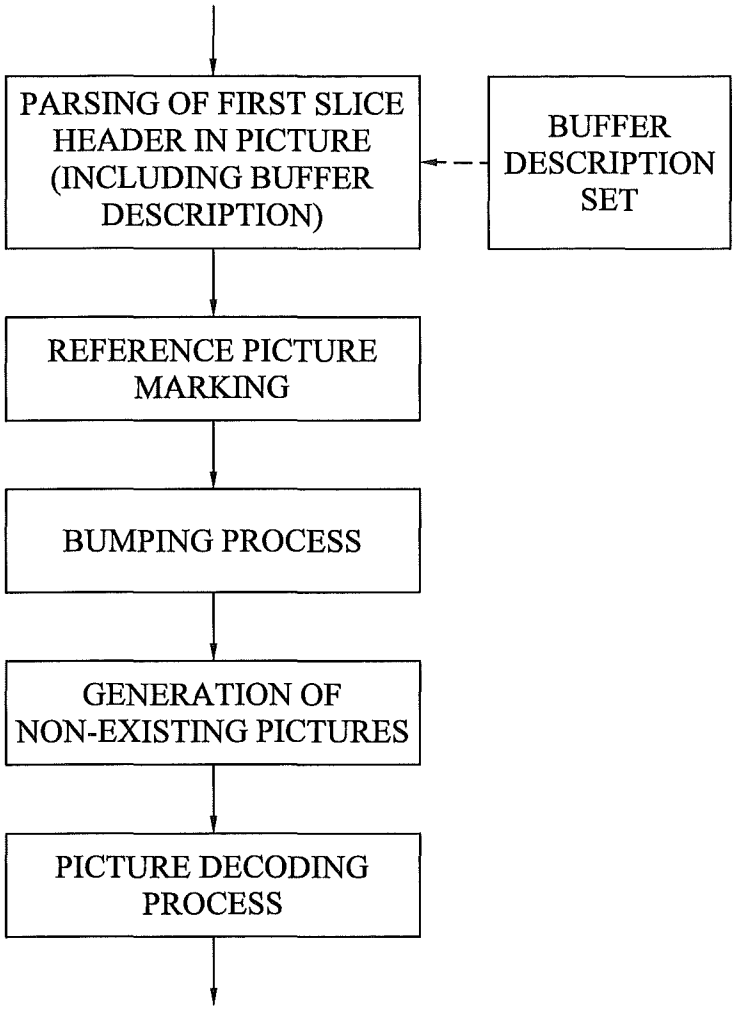

PARSING OF FIRST SLICE HEADER IN PICTURE (INCLUDING BUFFER DESCRIPTION)
BUFFER DESCRIPTION SET
REFERENCE PICTURE MARKING
BUMPING PROCESS
GENERATION OF NON-EXISTING PICTURES
PICTURE DECODING PROCESS

Fig. 16

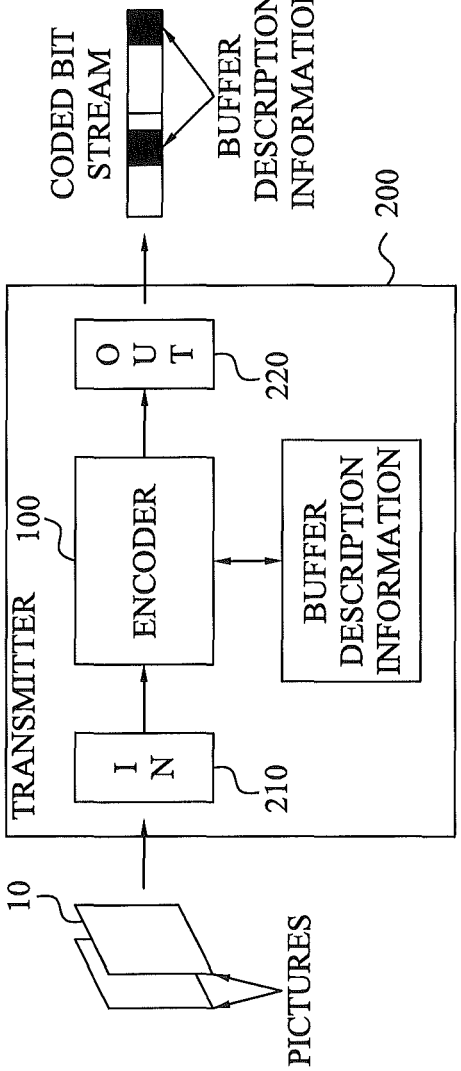

10
PICTURES
TRANSMITTER
100
I N
210
ENCODER
O U T
220
BUFFER DESCRIPTION INFORMATION
200
CODED BIT STREAM
BUFFER DESCRIPTION INFORMATION

Fig. 17

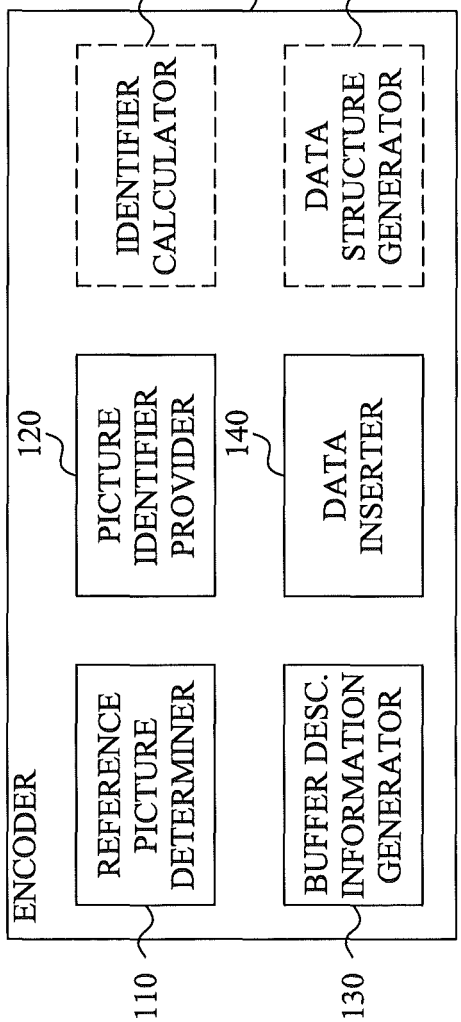

ENCODER
100
110
REFERENCE PICTURE DETERMINER
120
PICTURE IDENTIFIER PROVIDER
130
BUFFER DESC. INFORMATION GENERATOR
140
DATA INSERTER
150
IDENTIFIER CALCULATOR
160
DATA STRUCTURE GENERATOR

Fig. 18

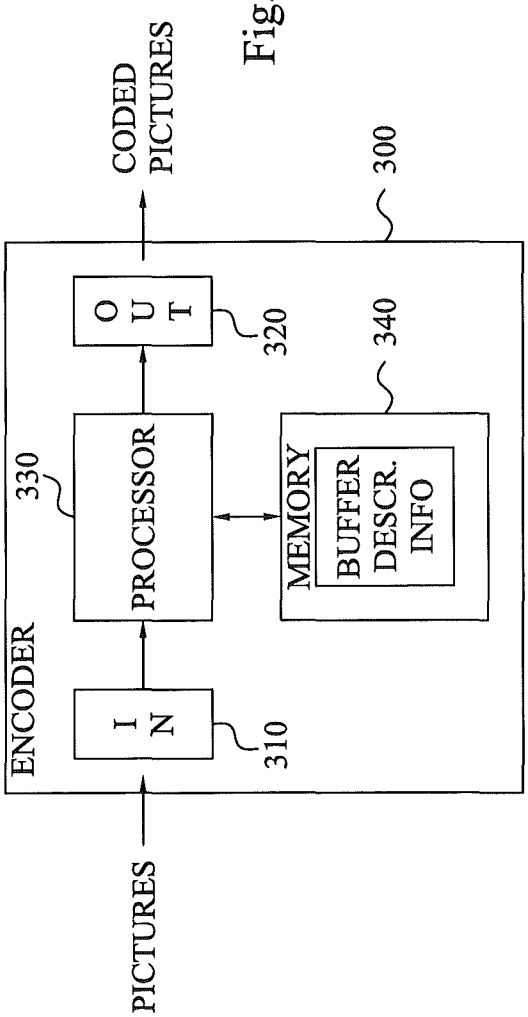

ENCODER
300
330
PROCESSOR
340
MEMORY
BUFFER DESCR. INFO
I N
310
O U T
320
PICTURES
CODED PICTURES

Fig. 19

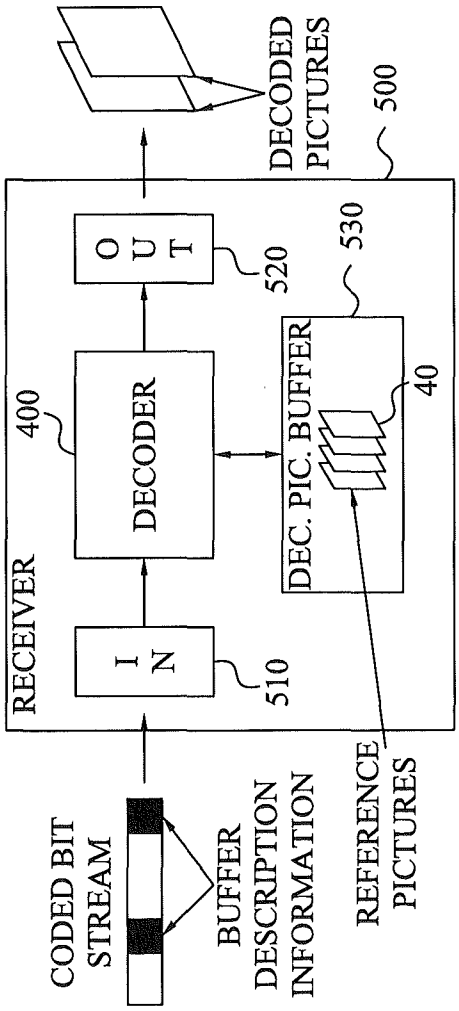

RECEIVER
500
400
DECODER
530
DEC. PIC. BUFFER
40
I N
510
O U T
520
CODED BIT STREAM
BUFFER DESCRIPTION INFORMATION
REFERENCE PICTURES
DECODED PICTURES

Fig. 20

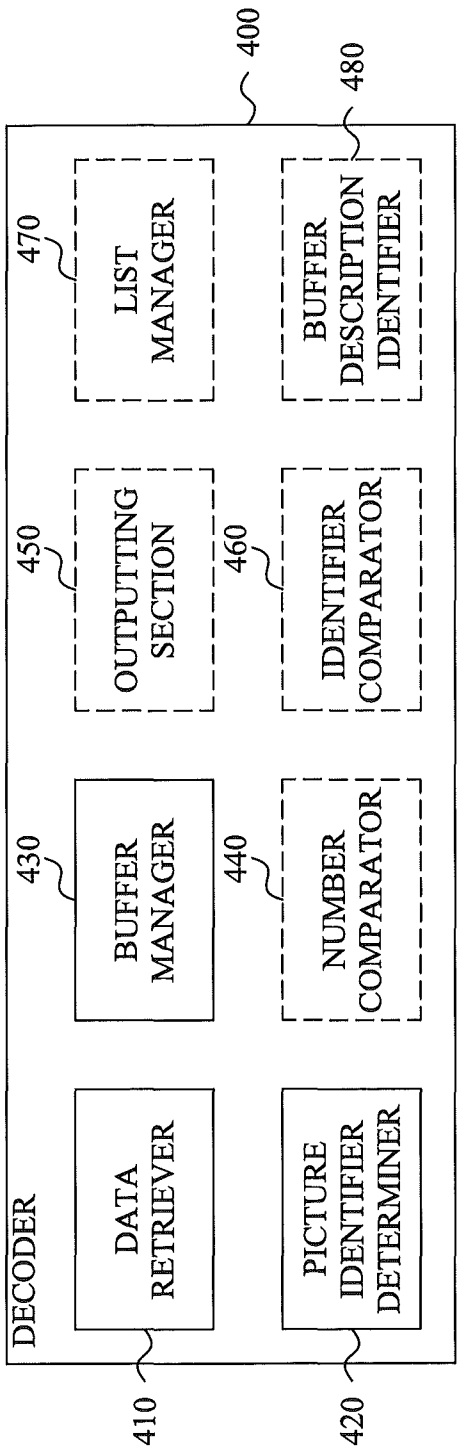

DECODER
400
DATA RETRIEVER
410
BUFFER MANAGER
430
PICTURE IDENTIFIER DETERMINER
420
NUMBER COMPARATOR
440
OUTPUTTING SECTION
450
IDENTIFIER COMPARATOR
460
LIST MANAGER
470
BUFFER DESCRIPTION IDENTIFIER
480

Fig. 21

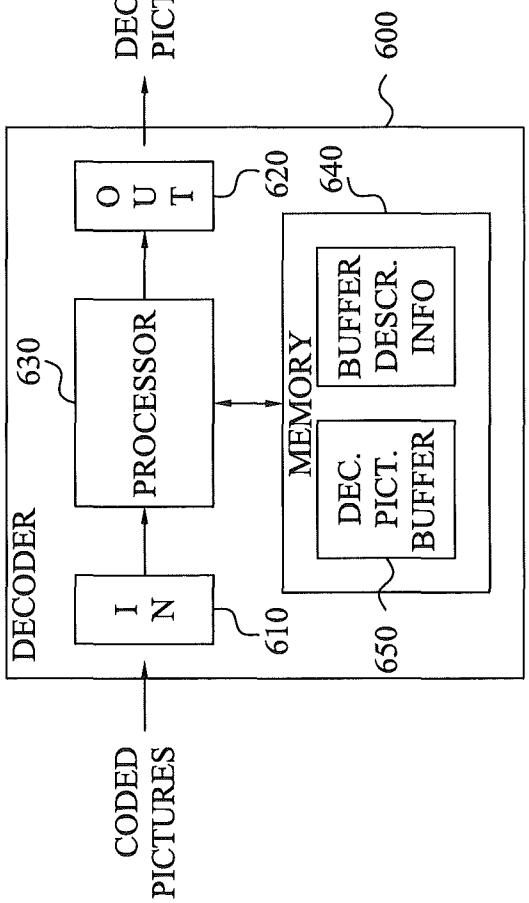

CODED PICTURES
DECODER
600
IN
610
PROCESSOR
630
OUT
620
DECODED PICTURES
MEMORY
650
DEC. PICT. BUFFER
BUFFER DESCR. INFO
640

Fig. 22

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	**REFERENCE PICTURE SIGNALING**

As a below named inventor, I hereby declare that:

This declaration is directed to:
- ☒ The attached application, or
- ☐ United States application or PCT international application number _____ filed on _____,
  - ☐ As amended on _____ (if applicable).

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment specifically referred to above.

I am aware of the duty to disclose information which is material to patentability as defined in 37 C.F.R. § 1.56, including for continuation-in-part applications, material information that became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

LEGAL NAME OF INVENTOR

Signature: _____ Date: 2016-10-07

Legal Name: **Jonatan Samuelsson**

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	**REFERENCE PICTURE SIGNALING**

As a below named inventor, I hereby declare that:

This declaration is directed to:
- ☒ The attached application, or
- ☐ United States application or PCT international application number _____ filed on _____,
- ☐ As amended on _____ (if applicable).

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment specifically referred to above.

I am aware of the duty to disclose information which is material to patentability as defined in 37 C.F.R. § 1.56, including for continuation-in-part applications, material information that became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

LEGAL NAME OF INVENTOR

Signature: Rickard Sjöberg Date: 2016-10-07

Legal Name: **Rickard Sjöberg**

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Telefonaktiebolaget LM Ericsson (publ)

Application No./Patent No.: To Be Assigned Filed/Issue Date: Concurrently Herewith

Titled: REFERENCE PICTURE SIGNALING

Telefonaktiebolaget LM Ericsson (publ), a Corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☑ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 030445, Frame 0731, or for which a copy thereof is attached.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____

   The document was recorded in the United States Patent and Trademark Office at

   Reel _____, Frame _____, or for which a copy thereof is attached.

2. From: _____ To: _____

   The document was recorded in the United States Patent and Trademark Office at

   Reel _____, Frame _____, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
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STATEMENT UNDER 37 CFR 3.73(c)

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The document was recorded in the United States Patent and Trademark Office at

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☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

Signature	10-21-2016 Date
Vernon H. Guthrie Printed or Typed Name	63,798 Title or Registration Number

POWER OF ATTORNEY

The undersigned, being duly authorized representatives of **TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)** (hereinafter referred to as "Ericsson") having its registered office at SE-164 83 Stockholm, Sweden, does hereby authorize **Myers Bigel & Sibley, P.A. practitioners associated with United States Patent and Trademark Office Customer Number 20792** to represent Ericsson before the United States Patent and Trademark Office in any and all matters regarding patents or patent applications filed by Ericsson or wherein Ericsson is the assignee of the entire interest thereto.

This Power of Attorney shall include the right for **Myers Bigel & Sibley, P.A. practitioners associated with United States Patent and Trademark Office Customer Number 20792** to sign and submit in Ericsson's name and on Ericsson's behalf any document, notification, filing, petition or request in connection with any patent applications or patents owned by or assigned to Ericsson.

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We hereby revoke all previous authorization, if any made, in respect of same matter or proceeding. This Power of Attorney shall be valid for **five (5) years** from the date hereof unless earlier revoked. This Power of Attorney may be revoked at any time by Ericsson.

Stockholm, Sweden on

TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)

Signatures: _____ _____

Gabriele Monsler
Vice President Patent Development

Nabil Ayoub
Director Patent Unit RAN2

Date: April 13th, 2016

I, the undersigned, _____, Notary Public of the City of Stockholm hereby certify that

_____ and _____

duly authorized to sign for

TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)

have issued and signed the foregoing document
Fee **Stockholm [Date]**
Crowns **Ex officio:**

_____
Signature: Notary Public of the City of Stockholm

Additional representatives:

Name	Registration Number
Basavaraju, Sridevi	66253
Bigel, Mitchell S.	29614
College, Adam J.	70619
Guthrie, Vernon H. Jr.	63798
Hall, David C.	38904
Hatfield, Scott C.	38176
Moore, David	42011
Purks, David K.	40133
Sabapathypillai, Rohan G.	51074
Stanek, Elizabeth A.	48568
Wall, Timothy J.	50743
Weinstein, Philip L.	65832
Whetzel, John K.	73133

Attorney Docket No. 9900-34860US3 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Samuelsson et al.
Application No.: To be assigned
Filing Date: Concurrently herewith
For: REFERENCE PICTURE SIGNALING

Date: October 21, 2016

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

INFORMATION DISCLOSURE STATEMENT COVER LETTER

Sir:

Attached is an Information Disclosure Statement listing of documents, together with a copy of any listed foreign patent document and/or non-patent literature. A copy of any listed U.S. patent and/or U.S. patent application publication is not provided herewith in accordance with 37 C.F.R. § 1.98(a)(2)(ii).

☒ In accordance with **37 CFR 1.97(b)**, the information disclosure statement is being filed:

☒ (1) within three months of the filing date of a national application other than a continued prosecution application under §1.53(d);

☐ (2) within three months of the date of entry of the national stage as set forth in §1.491 in an international application;

☐ (3) before the mailing of a first Office Action on the merits; or

☐ (4) before the mailing of a first Office Action after the filing of a request for continued examination under §1.114.

☐ In accordance with **37 CFR 1.97(c)**, the information disclosure statement is being filed after the period specified in 37 CFR 1.97(b) above, but before the mailing date of any of a final action under §1.113, a notice of allowance under §1.311, or an action that otherwise closes prosecution in the application, and is accompanied by **one** of the following:

☐ (1) The statement specified under **37 CFR 1.97(e)**, as follows:

☐ Each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; **or**

☐ No item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in §1.56(c) more than three months prior to the filing of the information disclosure statement; **or**

☐ (2) The fee set forth in §1.17(p);

☐ In accordance with **37 CFR 1.97(d)**, the information disclosure statement is being filed after the period specified in 37 CFR 1.97(c) above, but on or before payment of the issue fee, and is accompanied by **both** of the following:

☐ (1) The statement specified under **37 CFR 1.97(e)**, as follows:

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; **or**

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in §1.56(c) more than three months prior to the filing of the information disclosure statement; **and**

☐ (2) The fee set forth in §1.17(p);

In accordance with **37 CFR 1.97(g)**, the information disclosure statement shall not be construed as a representation that a search has been made.

In accordance with **37 CFR 1.97(h)**, the information disclosure statement shall not be construed to be an admission that the information cited in the statement is, or is considered to be, material to patentability as defined in §1.56(b).

☐ The Director is hereby authorized to charge the fee specified in 37 C.F.R. § 1.17(p), and any fee deficiency or credit any overpayment, to Deposit Account No. 50-0220;

☐ The Director is hereby authorized to charge credit card; or

☒ No fee is believed due. However, the Director is hereby authorized to charge any deficiency or credit any overpayment to Deposit Account No. 50-0220.

Respectfully submitted,

Vernon H. Guthrie
Registration No. 63,798
Attorney for Applicant(s)

Customer Number 20792
Myers Bigel, P.A.
P.O. Box 37428, Raleigh, NC 27627
919-854-1400
919-854-1401 (Fax)

INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Complete if Known	
				Application Number	To be assigned
				Filing Date	Concurrently herewith
				First Named Inventor	Jonatan Samuelsson
				Art Unit	TBD
(use as many sheets as necessary)				Examiner Name	TBD
Sheet	A1	of	A2	Attorney Docket Number	9900-34860US3

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No.	Document Number Number-Kind Code (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	1.	US- 2007/0030903 A1	02-2007	Cote	
	2.	US- 2007/0030904 A1	02-2007	Winger	
	3.	US- 2007/0183494 A1	08-2007	Hannuksela	
	4.	US- 2008/0260034 A1	10-2008	Wang et al.	
	5.	US- 2009/0238269 A1	09-2009	Pandit	
	6.	US- 2010/0098174 A1	04-2010	Adachi et al.	
	7.	US- 2010/0118944 A1	05-2010	Tanaka	
	8.	US- 2010/0189182 A1	07-2010	Hannuksela	
	9.	US- 2010/0195721 A1	08-2010	Wu	
	10.	US- 2010/0208828 A1	08-2010	Lu et al.	
	11.	US- 2010/0238822 A1	09-2010	Koyabu	
	12.	US- 2011/0080949 A1	04-2011	Takahashi	
	13.	US- 2012/0230401 A1	09-2012	Chen et al.	

FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No.	Foreign Patent Document Country Code, Number, Kind Code (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T
	14.	EP 1742480 A2	01-10-2007	MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD		
	15.	JP 2008-105389	05-08-2008	Kyodo Printing Co. Ltd.		A
	16.	JP 5616562 B2	10-29-2014			A
	17.	RU 2328090 C2	06-27-2008	LG ELECTRONICS INC		A
	18.	WO 2008-105389 A1	09-04-2008	Sony Corporation		A

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published	T
	19.	Borgwardt, P., "Multi-picture Buffer Semantics for Interlaced Coding", Joint Video Team (JVT) of ISO/IEC MPEG & ITU-T VCEG, 3rd Meeting, Fairfax, Virginia, May 6-10, 2002, 18 Pages	
	20.	Decision on Grant Corresponding to Russian Patent Application No. 2014102959/08; Date Mailed: April 12, 2016; Foreign Text, 9 Pages, English Translation Thereof, 7 Pages.	
	21.	European Examination Report Corresponding to European Application No. 12724780.7, Date Mailed: June 9, 2015, 8 pages.	
	22.	International Search Report and Written Opinion Corresponding to International Application No. PCT/SE2012/050439; Date of Mailing: July 19, 2012; 13 Pages	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(use as many sheets as necessary)* Sheet **A2** of **A2**				***Complete if Known***	
				Application Number	To be assigned
				Filing Date	Concurrently herewith
				First Named Inventor	Jonatan Samuelsson
				Art Unit	TBD
				Examiner Name	TBD
				Attorney Docket Number	9900-34860US3

	23.	Japanese Office Action Corresponding to Japanese Patent Application No. 2014-185639; Date Mailed: November 13, 2015; Foreign Text, 3 Pages, English Translation Thereof, 3 Pages.	
	24.	Japanese Office Action Corresponding to Japanese Patent Application No. 2014-185640; Date Mailed: November 13, 2015; Foreign Text, 3 Pages, English Translation Thereof, 3 Pages.	
	25.	"JCT-VC Document Management System, screenshots relative to the meeting in Torino (July 2011)", JCT-VC Committee, 22 July 2011, pages 1-2, XP55162801, Retrieved from Internet URL: http://phenix.int-evry.fr/jct/, retrieved on 2015-01-16. (2 pages)	
	26.	Shen, Q. et al., "Buffer Requirement Analysis and Reference Picture Marking for Temporal Scalable Video Coding", *Packet Video, IEEE,* November 1, 2007, pages 91-97	
	27.	Sjöberg R. et al., "Absolute signaling of reference pictures", Joint Collaborative Team on Video Coding of WP3 and ISO/IEC JTC1/SC29/WG11, 6th Meeting, Torino, 2011, 10 Pages	
	28.	SJOBERG et al., "Absolute signaling of reference pictures, Document JCTVC-F493, Version 8", 22 July 2011, pages 1-15, XP055193064, Retrieved from Internet URL: http://phenix.int-evry.fr/jct/, retrieved on 2015-01-16. (15 pages)	
	29.	SJOBERG et al., "Attachment to JCTVC-F493 (Absolute Signaling of Reference Pictures), Version 8: Proposed changes to the HEVC Working Draft", 22 July 2011, pages 1-28, XP055193072, Retrieved from Internet URL: http://phenix.int-evry.fr/jct/, retrieved on 2015-01-16. (28 pages).	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 742 480 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
10.01.2007 Bulletin 2007/02

(51) Int Cl.:
H04N 7/26 *(2006.01)*

(21) Application number: **06122290.7**

(22) Date of filing: **07.07.2003**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR

(30) Priority: **11.07.2002 JP 2002202781**
17.07.2002 JP 2002207681
14.01.2003 JP 2003006198

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
03741225.1 / 1 406 451

(71) Applicant: **MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.**
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- **Shen, Sheng Mei**
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- **Kondo, Satoshi**
Kyoto
Kyoto 614-8361 (JP)
- **Hagai, Makoto**
Osaka
Osaka 570-0051 (JP)
- **Abe, Kiyofumi**
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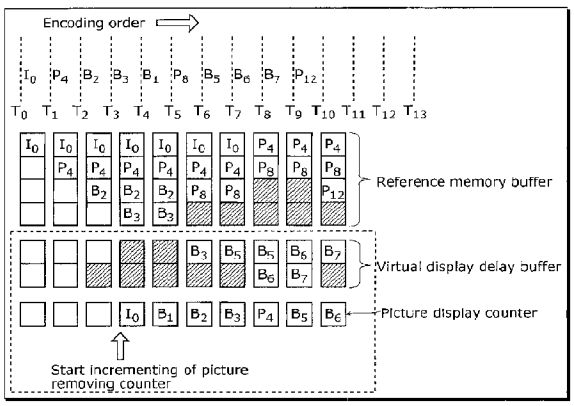
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Remarks:
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(54) Virtual display buffer management method for H.264 Image decoding.

(57) A memory management method for making an area of a buffer in which a reference picture is stored, re-usable for another decoded picture, the method comprising the steps of: marking first information indicating that the reference picture is no longer referred to, to the reference picture; marking second information indicating that the reference picture is already outputted for display, to the reference picture; and erasing an area of the buffer to make it re-usable, based on the first and second information.

Fig. 17



EP 1 742 480 A2

Description

Technical Field

[0001] The present invention relates to a picture encoding method for compressing efficiently a moving picture and a picture decoding method for decoding correctly the encoded picture and displaying it.

Background Art

[0002] Recently, with an arrival of the age of multimedia which handles integrally audio, video and pixel values of others, existing information media, i.e., newspapers, journals, TVs, radios and telephones and other means through which information is conveyed to people, has come under the scope of multimedia. Generally speaking, multimedia refers to something that is represented by associating not only with characters but also with graphics, audio and especially pictures and the like together. However, in order to include the aforementioned existing information media in the scope of multimedia, it appears as a prerequisite to represent such information in digital form.

[0003] However, when calculating the amount of information contained in each of the aforementioned information media as the amount of digital information, the information amount per character requires 1~2 bytes whereas the audio requires more than 64 Kbits (telephone quality) per second and when it comes to the moving picture, it requires more than 100Mbits (present television reception quality) per second. Therefore, it is not realistic to handle the vast information directly in the digital format via the information media mentioned above. For example, a videophone has already been put into practical use via Integrated Services Digital Network (ISDN) with a transmission rate of 64 Kbit/s ~ 1.5 Mbit/s, however, it is not practical to transmit video captured on the TV screen or shot by a TV camera. This therefore requires information compression techniques, and for instance, in the case of the videophone, video compression techniques compliant with H.261 and H.263 standards internationally standardized by ITU-T (International Telecommunication Union-Telecommunication Standardization Sector) are employed. According to information compression techniques compliant with the MPEG-1 standard, picture information as well as music information can be stored in an ordinary music CD (Compact Disc).

[0004] Here, MPEG (Moving Picture Experts Group) is an international standard for compression of moving picture signals and MPEG-1 is a standard that compresses video signals down to 1.5 Mbit/s, that is, to compress information of TV signals approximately down to a hundredth. The transmission rate within the scope of the MPEG-1 standard is limited primarily to about 1.5 Mbit/s, therefore, MPEG-2 which was standardized with the view to meet the requirements of high-quality picture allows data transmission of moving picture signals at a rate of 2~15 Mbit/s. In the present circumstances, a working group (ISO/IEC JTC1/SC29/WG11) in the charge of the standardization of the MPEG-1 and the MPEG-2 has achieved a compression rate which goes beyond what the MPEG-1 and the MPEG-2 have achieved, realized encoding/decoding operations on a per-object basis and standardized MPEG-4 in order to realize a new function required by the era of multi media. In the process of the standardization of the MPEG-4, the standardization of encoding method for a low bit rate was aimed, however, the aim is presently extended to a more versatile encoding of moving pictures at a high bit rate including interlaced pictures.

[0005] Recently, a new picture encoding as a next generation encoding of the MPEG-4 called JVC is under the process of the standardization jointly worked by the ITU-T and the ISO/IEC.

[0006] Fig. 24 is a diagram showing a prediction structure, a decoding order and a display order of pictures. "Picture" is a term indicating either a frame or a field and the term "picture" here is used in stead of frame or field in the present specification. The hatched pictures in Fig. 24 present the pictures to be stored in the memory for reference when other pictures are encoded/decoded.

[0007] 10 is an intra coded picture and P3, P6 and P9 are predictive coded pictures (P-picture). The predictive encoding in the scheme of the JVT standard differs from that of the conventional MPEG-1/2/4. An arbitrary picture is selected out of a plurality of encoded pictures as a reference picture and a predictive image can be generated from the reference picture. For example, a picture P9 may select an arbitrary picture out of three pictures of I0, P3 and P6 and generate a predictive image using the selected picture. Consequently, it heightens a possibility to select the more applicable predictive image than the conventional case of applying MPEG-1/2/4 and thereby improves a compression rate. B1, B2, B4, B5, B7 and B8 are bi-directionally predictive coded pictures (B-picture), differing from inter-picture prediction, wherein a plurality of pictures (two pictures) are selected and a predictive image is generated using the selected pictures and then encoded. It is especially known that the accuracy of the predictive image can be greatly improved and so can be the compression rate by performing interpolation prediction using an average value of two pictures temporally previous and subsequent for generating a predictive image. The marks of "I" for an intra coded picture, "P" for a predictive coded picture and "B" for a bi-directionally predictive coded picture are used in order to differentiate encoding method of each picture.

[0008] In order to refer to the temporally previous and subsequent pictures for the B-pictures, the temporally previous

pictures shall be coded/decoded at first. This is called reordering of pictures and often takes place in the conventional MPEG-1/2/4. Therefore, in contrast with an encoding order (Stream Order), an order of displaying the pictures which are decoded (Display Order) is reordered as shown in Fig. 24 showing a prediction structure, a decoding order and a display order of pictures. B-pictures in the example of Fig. 24 are displayed at the moment when the stream is decoded, therefore, there is no need to store them when they are not referred to by other pictures. However, I-pictures and P-pictures have to be stored in a memory since they are displayed after being decoded when the decoding of the following B-picture is terminated.

[0009] The terms and the meanings of the hatched pictures in the diagram showing the prediction structure, the decoding order and the display order of the pictures are the same as those used in Fig. 24.

[0010] Fig. 26 is a block diagram showing a picture encoding apparatus for realizing a conventional picture encoding method. The following illustrates an operation of the picture encoding apparatus for realizing the conventional picture encoding method in Fig. 26.

[0011] A picture structure determination unit PicStruct determines an encoding type (I-picture, P-picture and B-picture) for each picture, notifies a reference picture control unit RefPicCtrl of the encoding type and the pictures that can be referred to in the encoding and informs also a reordering unit ReOrder of the encoding order of the pictures. The reordering unit ReOrder reorders the order of an input picture PicIn into an encoding order and outputs the reordered pictures to a motion estimation unit ME and a subtraction unit Sub. The motion estimation unit ME refers to the reference pictures stored in a picture memory PicMem1, determines an applicable reference picture and detects a motion vector indicating a pixel position of the reference picture and sends them to a variable length coding unit VLC, the picture memory PicMem1 and a motion compensation unit MC. The picture memory PicMem1 outputs the pixels of the reference picture according to the motion vector MV to the motion compensation unit MC whereas the motion compensation unit MC generates a predictive image using the pixels in the reference picture gained from the picture memory PicMem1 and the motion vector MV.

[0012] The subtraction unit Sub calculates a difference between the picture reordered by the reordering unit ReOrder and the predictive image. The difference is converted to frequency coefficients by an orthogonal transformation unit T and then the frequency coefficients are quantized by the quantization unit Q and outputted as quantized values Coef.

[0013] An inverse quantization unit IQ inverse quantizes the quantized values Coef and restores them as frequency coefficients. The inverse orthogonal transformation unit IT performs inverse frequency conversion for the frequency coefficients to be outputted as pixel differential values. An addition unit Add adds the predictive image to the pixel differential values and obtains a decoded picture.

[0014] The reference picture control unit RefPicCtrl, according to the encoding type of the picture, judges whether or not the decoded picture is to be stored in the picture memory PicMem1 to be referred to as a reference picture and whether or not the decoded picture is to be removed from the picture memory PicMem1 (no longer referred to as a reference picture) and notifies of the operation using a memory control command MMCO.

[0015] A switch SW is turned ON when the memory control command MMCO ordered a storage and thereby the decoded picture is stored in the picture memory PicMem1 as a reference picture. The picture memory PicMem1 releases the area where the decoded picture is stored so that other decoded pictures can be stored when the picture memory PicMem1 instructs that the decoded picture shall be removed from the picture memory PicMem1.

[0016] The variable length coding unit VLC encodes the quantized values Coef, the motion vector MV and the memory control command MMCO and outputs an encoded stream Str.

[0017] The case in which the encoding includes the frequency conversion and the quantization is shown, however, the encoding may be the one without them such as DPCM, ADPCM, and linear predictive encoding. The encoding may be the one in which the frequency conversion and the quantization are integrated or the one that is not accompanied by the quantization after the frequency conversion as in a bit-plane encoding.

[0018] Fig. 27 shows bit streams of the memory control command MMCO. The variable length coding unit VLC encodes "000" which means a release of a whole memory area so that the picture memory is initialized at the beginning of the encoding/decoding or in the head of the GOP (Group Of Picture). Also, the variable length coding unit VLC encodes "01" when the decoded picture is stored in the picture memory. When a picture stored in the picture memory is released at the same time, the variable length coding unit VLC encodes a picture number following the "001" since the picture number to be released has to be indicated. When a plurality of pictures are released, the command to release a picture needs to be encoded for a plural number of times, therefore, a command to store a picture is encoded in addition to the command to release a picture. The variable length coding unit VLC encodes sequentially a plurality of memory control commands MMCO and encodes lastly "1" indicating that the memory control command MMCO is complete. In this way, the memory control command MMCO is encoded as an encoded stream Str.

[0019] Fig. 28 is a block diagram showing a picture decoding apparatus for realizing a conventional picture decoding method. The same numbers are put for the devices that operate in the same manner as the picture encoding apparatus for realizing the conventional picture encoding method shown in Fig. 26.

[0020] A variable length decoding unit VLD decodes an encoded stream Str and outputs a memory control command

MMCO, a motion vector MV and quantized values Coef. A picture time Time is inputted from outside and is a signal for specifying a picture to be displayed. When a picture to be displayed is a decoded picture, an output from the adding unit Add is selected at a selector Sel and sent out to a display unit Disp. When a picture to be displayed is a picture stored in the picture memory PicMem1, it is read out from the picture memory PicMem1, selected at the selector Sel and outputted to a display unit Disp.

[0021] As described above, the picture memory PicMem1 outputs, to the motion compensation unit MC, pixels according to the motion vector MV whereas the motion compensation unit MC generates a predictive image according to the pixels obtained from the picture memory PicMem1 together with the motion vector MV.

[0022] The inverse quantization unit IQ inverse quantizes the quantized values Coef and restores them as frequency coefficients. Furthermore, the inverse orthogonal transformation IT performs inverse frequency conversion for the frequency coefficients to be outputted as pixel differential values. The addition unit Add adds the predictive image to the pixel differential values to generate a decoded picture.

[0023] The picture memory PicMem1 releases the area in which the decoded picture is stored so that other decoded picture can be stored.

[0024] The example of the decoding including the inverse frequency conversion and the inverse quantization is described above, however, the decoding may be the one without them such as DPCM, ADPCM and a linear predictive encoding. The decoding may be the one in which the inverse frequency conversion and the inverse quantization are integrated or the one that is not accompanied by the inverse quantization after the frequency conversion as in a bit-plane encoding.

[0025] With the use of the picture decoding apparatus for realizing the conventional picture decoding method shown in Fig. 28, it is obvious that the combination of the conventional picture encoding types shown in Figs. 24 and 25 allows a correct decoding of the encoded stream Str encoded by the picture encoding apparatus for realizing the conventional picture encoding method shown in Fig. 26.

[0026] The more flexible combination is considered here as a picture encoding type.

[0027] Fig. 1 is a diagram showing a prediction structure, a decoding order and a display order of the pictures, which do not exist in the related art. The prediction structure with respect to B-picture differs in the vicinity of Picture 4 in Fig. 1. Namely, Picture 2 that is a B-picture is stored in the picture memory to be referred to as a predictive image of Picture 1 and Picture 3. Consequently, the encoding order and the display order of each picture are as shown in Fig. 1.

[0028] Pictures B5 and B6 are B-pictures that are not stored since they are not referred to in a predictive coding. However, differing from Fig. 24, the display time for the pictures B5 and B6 has not yet come at the time when they are decoded since it is the time for other picture to be displayed. That is, at the time of decoding the picture B5, the picture P4 shall be displayed and at the time of decoding the picture B6, the picture B5 shall be displayed. Since the pictures B5 and B6 are not stored, they cannot be taken out from the picture memory at the display time. Therefore, the pictures which are not referred to for predictive encoding are not stored in the picture memory, therefore, the pictures B5 and B6 cannot be displayed after being decoded with the use of the conventional encoding/decoding method. Namely in the case of not storing the pictures that are not referred to in predictive encoding as in the example shown in Fig. 24, only Pictures 1, 2, 4, and 7 can be displayed.

[0029] Thus, considering the more flexible combination as a picture encoding type, it is a problem that the pictures which cannot be displayed after being decoded occur. It is conceivable to add another picture memory for display and store the pictures that are not stored in the picture memory PicMem1 in this picture memory for display so that they can be displayed; however, the weak point is that this picture memory requires a huge memory in this case.

[0030] Furthermore, there rises a new problem in the reproduction of a picture in the middle of the stream even if another picture memory for display is introduced. Fig. 2 is a diagram showing a prediction structure, a decoding order and a display order of pictures. The difference comparing with Fig. 25 is that the prediction structure in the vicinity of Picture 7 becomes completely independent. The pictures following a picture I7 are not referred to when the pictures with display time preceding the picture 17 are encoded/decoded. Therefore, the pictures following the picture 17 can be encoded correctly if the decoding starts from the picture 17 and the picture 17 can be reproduced independently. In this way, the insertion of I picture while streaming often takes place. This system to reproduce a picture in the middle of the stream, which complies with MPEG-2, is called GOP (Group Of Picture).

[0031] The correspondence of a reproduced picture of the picture decoding apparatus and that of the picture encoding apparatus in the case of reproducing the picture in the middle of the stream has to be assured, and the easy method is to initialize the whole area of the picture memory. However, Picture 6 is not yet displayed and stored in the picture memory when Picture 7 is decoded, Picture 6 therefore cannot be displayed from the picture memory at its display time if the entire picture memory is initialized before the display of Picture 6 takes place.

[0032] The object of the present invention therefore is to allow the display of the pictures that cannot be displayed after being decoded by taking the memory amount necessary for encoding/decoding of the picture into consideration.

Disclosure of Invention

[0033] In order to achieve the above objects, a picture encoding method of the present invention of predictively encoding an input picture with reference to pictures stored in a picture buffer and decoding the encoded input picture, the picture encoding method comprising: judging whether or not the decoded picture is for reference and whether or not the decoded picture is for output, needing to be stored until display time of the decoded picture; and storing the decoded picture in the picture buffer as one of the following uses: for reference and for output, based on each result of the judgments.

[0034] Here, the picture encoding method may comprise the following steps: a first judgment step of judging whether or not the decoded picture is for reference; a second judgment step of judging whether or not the decoded picture is for output, needing to be stored until display time of the decoded picture; and a management step of managing the picture buffer so that the picture buffer stores the decoded picture judged to be for reference in the first judgment step and the decoded picture judged to be for output in the second judgment step.

[0035] With this structure, the judgment on whether the decoded picture is a picture for output in addition to the judgment on whether the decoded picture is a picture for reference allows a storage not only of a picture for reference but also of a picture that is not referred to in the predictive encoding but cannot be displayed or outputted as a picture for output at the time of decoding. Such judgment and buffer management take place in the picture encoding to simulate a decoding operation, therefore, a picture for output can surely be displayed or outputted at its display time by the decoding apparatus.

[0036] Here, the picture buffer may have a specified size,and the picture encoding method may further comprise: a third judgment step of judging whether or not the picture for reference stored in the picture buffer is no longer used as a reference picture; and a fourth judgment step of judging whether or not the picture for output stored in the picture buffer is already outputted. In the management step, an area storing a picture in the picture buffer is reused within a scope of the specified size based on each result of the judgments in the third and fourth judgment steps.

[0037] With this structure, an area storing a picture is reused in the scope of the specified size of the picture buffer for storing the picture for reference and the picture for output in the management step, therefore, the picture buffer may be adapted for the specified size of essential requirements without wasting the memory.

[0038] Furthermore, the picture encoding method may include an encoding step of encoding, for each sequence, information indicating the specified size for encoding said sequence including a plurality of encoded pictures.

[0039] With this structure, a picture structure to be used for predictive encoding can be defined flexibly for each sequence since the size is specified for each sequence.

[0040] Also, in the management step, one of the decoded picture judged to be for reference in the first judgment step and the decoded picture judged to be for output in the second judgment step may be stored in an area storing a picture that is not for reference and is judged as already outputted in the fourth judgment step when the picture buffer doesn't have an area capable of storing newly a picture.

[0041] With the structure described above, a new picture is stored in an area storing the outputted picture out of areas allocated for a picture for output in the picture buffer. Namely, the area storing the outputted picture is reused so that the display of the decoded picture that is not yet outputted may be more assured.

[0042] Furthermore, in the management step, one of the decoded picture judged to be for reference in the first judgment step and the picture judged to be for output in the second judgment step may be stored in an area storing a picture whose display order is the earliest of the pictures that are not for reference and stored within the picture buffer when the picture buffer doesn't have an area capable of storing newly a picture.

[0043] With the structure described above, there is a high possibility that a decoded picture already outputted is stored in an area storing a picture whose display order is the earliest of the pictures for output, therefore, the display of the decoded picture that is not yet outputted may be more assured although the structure does not allow a correct determination on the display time of respective decoded pictures.

[0044] The picture encoding method may further comprise a releasing step of releasing an area other than an area storing a picture which is stored before a size of the input picture is modified and is not partly or wholly damaged after being stored out of areas storing display pictures,when the size modification takes place in a sequence including a plurality of encoded pictures.

[0045] With the structure described above, the pictures that are not yet outputted at the time of size modification can be outputted as many as possible without being removed since decoded pictures for output can be left in the decoded picture buffer when the size modification takes place.

[0046] Thus, according to the present invention, the pictures that can not be displayed correctly in the related art can be displayed by making the most use of the released memory area without having unnecessary memory, therefore, its practical value is high.

[0047] A picture decoding method, a picture encoding apparatus, a picture decoding apparatus and a program according to the present invention have the same structure, operation, and effects as described above.

[0048] The picture encoding method or the picture decoding method can be any of the compositions described in (1)

through (16) below.

(1) A picture encoding method of predictively encoding a picture signal with reference to a decoded picture stored in a memory after being decoded, the picture encoding method comprising the following steps: generating a predictive image with reference to the decoded picture in the memory and encoding a difference between the predictive image and the picture signal to obtain an encoded stream; decoding the encoded difference between the predictive image and the picture signal, adding the predictive image to the decoded difference to obtain a decoded picture and storing a predetermined decoded picture in the memory; and containing in the encoded stream instruction information indicating whether or not to release a whole area of the memory for making the area reusable.

(2) A picture encoding method of predictively encoding a picture signal with reference to a decoded picture in a memory, the picture encoding method comprising: generating a predictive image with reference to the decoded picture in the memory; encoding a difference between the predictive image and the picture signal to obtain an encoded stream; decoding the encoded difference between the predictive image and the picture signal; adding the predictive image to the decoded difference to obtain a decoded picture; and storing the decoded picture in the memory when the decoded picture is one of i) a picture used for reference in order to generate a predictive image and ii) a picture that is not immediately displayable.

(3) A picture encoding method of predictively encoding a picture signal with reference to a decoded picture, the picture encoding method comprising: generating a predictive image with reference to the decoded picture in a memory; encoding a difference between the predictive image and the picture signal to obtain an encoded stream; decoding the encoded difference between the predictive image and the picture signal, adding the predictive image to the decoded difference to obtain a decoded picture; storing a predetermined decoded picture in the memory and releasing an unnecessary picture in the memory, wherein the predetermined decoded picture is stored in an area storing a picture already displayed in the released area within the memory.

(4) A picture decoding method of predictively decoding an encoded stream with reference to a decoded picture stored in a memory after being decoded, the picture decoding method comprising the following steps of: generating a predictive image with reference to the decoded picture in the memory, adding the predictive image to a picture signal obtained by decoding the encoded stream to obtain a decoded picture and storing a predetermined decoded picture in the memory; and a processing step of performing processing based on instruction information indicating whether or not to release a whole area of the memory obtained by decoding the encoded stream for making the area reusable.

(5) A picture decoding method of predictively decoding an encoded stream with reference to a decoded picture, the picture decoding method comprising: generating a predictive image with reference to the decoded picture in a memory; decoding the encoded stream; adding the predictive image to the decoded encoded stream to obtain a decoded picture; storing a predetermined decoded picture in the memory and releasing an unnecessary picture in the memory, wherein the predetermined decoded picture is stored in an area in which a picture already displayed has been stored in the released area within the memory.

(6) A picture encoding method of predictively encoding a picture signal with reference to a decoded picture, the picture encoding method comprising: generating a predictive image with reference to the decoded picture in a memory; encoding a difference between the predictive image and the picture signal to obtain an encoded stream; decoding the encoded difference between the predictive image and the picture signal, adding the predictive image to the decoded difference to obtain a decoded picture; storing a predetermined decoded picture in the memory and releasing an unnecessary picture in the memory, wherein the predetermined decoded picture is stored in an area in which a picture displayed at the earliest time has been stored in the released area within the memory.

(7) A picture decoding method of predictively decoding an encoded stream with reference to a decoded picture, the picture decoding method comprising: generating a predictive image with reference to the decoded picture in a memory; decoding the encoded stream; adding the predictive image to the decoded picture to obtain a decoded picture; storing a predetermined decoded picture in the memory and releasing an unnecessary picture in the memory, wherein the predetermined decoded picture is stored in an area in which a picture displayed at the earliest time has been stored in the released area within the memory.

(8) A picture encoding method of predictively encoding a picture signal with reference to a decoded picture, the picture encoding method comprising: generating a predictive image with reference to the decoded picture in a memory; encoding a difference between the predictive image and the picture signal to obtain an encoded stream; decoding the encoded difference between the predictive image and the picture signal, adding the predictive image to the decoded difference to obtain a decoded picture; storing a predetermined decoded picture in the memory and releasing an unnecessary picture in the memory, wherein the predetermined decoded picture is stored in an area that is capable of storing a picture and is firstly released in the memory.

(9) A picture decoding method for predictively decoding an encoded stream with reference to a decoded picture, the picture decoding method comprising: generating a predictive image with reference to the decoded picture in the

memory; decoding the encoded stream; adding the predictive image to the decoded encoded stream to obtain a decoded picture; storing a predetermined decoded picture in the memory and releasing an unnecessary picture in the memory, wherein the predetermined decoded picture is stored in an area that is capable of storing a picture and is released firstly in the memory.

(10) A picture encoding apparatus for predictively encoding a picture signal with reference to a decoded picture, the picture encoding apparatus comprising: a prediction unit operable to generate a predictive image with reference to the decoded picture in a memory; an encoding unit operable to encode a difference between the predictive image predicted by the prediction unit and the picture signal to obtain an encoded stream; a decoding unit operable to decode the encoded difference; an addition unit operable to add the predictive image to the difference decoded by the decoding unit; a reference picture control unit operable to determine to store one of i) a picture used for reference in order to generate a predictive image and ii) a picture that is not immediately displayable; and a memory unit operable to store the adding result obtained from the addition unit based on the determination made by the reference picture control unit.

(11) A picture encoding apparatus for predictively encoding a picture signal with reference to a decoded picture, the picture encoding apparatus comprising: a prediction unit operable to generate a predictive image with reference to the decoded picture in a memory; an encoding unit operable to encode a difference between the predictive image predicted by the prediction unit and the picture signal to obtain an encoded stream; a decoding unit operable to decode the encoded difference; an addition unit operable to add the predictive image to the difference decoded by the decoding unit; a reference picture control unit operable to determine whether or not to store an adding result obtained from the addition unit and whether or not to release an unnecessary picture in the memory; and a memory unit operable to store the adding result obtained from the addition unit in an area in which a picture already outputted as a decoded picture has been stored in the released area within the memory based on the determination made by the reference picture control unit.

(12) A picture decoding apparatus for predictively decoding an encoded stream with reference to a decoded picture, the picture decoding apparatus comprising: a decoding unit operable to decode the encoded stream; a prediction unit operable to generate a predictive image with reference to the decoded picture in a memory; an addition unit operable to add the predictive image to the difference between the predictive image and the picture signal decoded by the decoding unit; a reference picture control unit operable to determine whether or not to store the adding result obtained from the addition unit in the memory and whether or not to release an unnecessary picture in the memory; and a memory unit operable to store an adding result obtained from the addition unit in an area in which a picture already outputted as a decoded picture has been stored in the released area in the memory based on the determination made by the reference picture control unit.

(13) A picture encoding apparatus for predictively encoding a picture signal with reference to a decoded picture, the picture encoding apparatus comprising: a prediction unit operable to generate a predictive image with reference to the decoded picture in a memory; an encoding unit operable to encode a difference between the predictive image predicted by the prediction unit and the picture signal to obtain an encoded stream, a decoding unit operable to decode the encoded difference; an addition unit operable to add the predictive image to the difference decoded by the decoding unit; a reference picture control unit operable to determine whether or not to store the adding result obtained from the addition unit in the memory and whether or not to release an unnecessary picture in the memory; and a memory unit operable to store the adding result obtained from the addition unit in an area in which a picture displayed at the earliest time has been stored in the released area within the memory based on the determination made by the reference picture control unit.

(14) A picture decoding apparatus for predictively decoding an encoded stream with reference to a decoded picture, the picture decoding apparatus comprising: a decoding unit operable to decode the encoded stream; a prediction unit operable to generate a predictive image with reference to the decoded picture in a memory; an addition unit operable to add the predictive image to the difference between the predictive image and the picture signal decoded by the decoding unit; a reference picture control unit operable to determine whether or not to store, in the memory, the adding result obtained from the addition unit and whether or not to release an unnecessary picture in the memory; and a memory unit operable to store the adding result obtained from the addition unit in an area in which a picture displayed at the earliest time has been stored in the released area within the memory based on the determination made by the reference picture control unit.

(15) A picture encoding apparatus for predictively encoding a picture signal with reference to a decoded picture, the picture decoding apparatus comprising: a prediction unit operable to generate a predictive image with reference to the decoded picture in a memory; an encoding unit operable to encode a difference between the predictive image predicted by the prediction unit and the picture signal to obtain an encoded stream; a decoding unit operable to decode the encoded difference between the predictive image and the picture signal decoded by the decoding unit; an addition unit operable to add the predictive image to the difference decoded by the decoding unit; a reference picture control unit operable to determine whether or not to store the adding result obtained from the addition unit

in the memory and whether or not to release an unnecessary picture in the memory; and a memory unit operable to store the adding result obtained from the addition unit in an area that is released at the earliest time of the whole released area within the memory based on the determination made by the reference picture control unit.

(16) A picture decoding apparatus for predictively decoding an encoded stream with reference to a decoded picture, the picture decoding apparatus comprising: a decoding unit operable to decode an encoded stream; a prediction unit operable to generate a predictive image with reference to the decoded picture in a memory; an addition unit operable to add the predictive image to the difference between the predictive image and the picture signal decoded by the decoding unit; a reference picture control unit operable to determine whether or not to store, in the memory, the adding result obtained from the addition unit and whether or not to release an unnecessary picture in the memory; and a memory unit operable to store the adding result obtained from the addition unit in an area that is released at the earliest time of the whole released area within the memory based on the determination made by the reference picture control unit.

A storage medium for storing a program in which the picture encoding/decoding method of the present invention is executed by a computer may be any of (17) through (23) below.

(17) A storage medium employing a picture encoding method in which a computer is made to predictively encode a picture signal with reference to a decoded picture, the storage medium comprising: generating a predictive image with reference to a decoded picture in a memory; encoding a difference between the predictive image and the picture signal to obtain an encoded stream; decoding the encoded difference between the encoded predictive image and the picture signal, and adding the predictive image to the decoded difference and then outputting the adding result as a decoded picture, storing the decoded picture in the memory when the decoded picture is one of i) a picture used for reference in order to generate a predictive image and ii) a picture that is not immediately displayable.

(18) A storage medium employing a picture encoding method in which a computer is made to predictively encode a picture signal with reference to a decoded picture, the storage medium comprising: generating a predictive image with reference to the decoded picture in a memory; encoding a difference between the predictive image and the picture signal to obtain an encoded stream; decoding the encoded difference; adding the predictive image to the decoded difference to obtain a decoded picture; storing a predetermined decoded picture in the memory and releasing an unnecessary picture in the memory, wherein the predetermined decoded picture is stored in an area in which a picture already displayed has been stored in the released area within the memory.

(19) A storage medium employing a picture decoding method in which a computer is made to predictively decode an encoded stream with reference to a decoded picture, the storage medium comprising: generating a predictive image with reference to the decoded picture in a memory; decoding the encoded stream; adding the predictive image to the decoded encoded stream to obtain a decoded picture; storing a predetermined decoded picture in the memory and releasing an unnecessary picture in the memory, wherein the predetermined decoded picture is stored in an area in which a picture already displayed has been stored in the released area within the memory.

(20) A storage medium employing a picture encoding method in which a computer is made to predictively encode a picture signal with reference to a decoded picture, the storage medium comprising: generating a predictive image with reference to the decoded picture in a memory; encoding a difference between the predictive image and the picture signal to obtain an encoded stream; decoding the encoded difference; adding the predictive image to the decoded difference to obtain a decoded picture; storing a predetermined decoded picture in the memory and releasing an unnecessary picture in the memory, wherein the predetermined decoded picture is stored in an area in which a picture displayed at the earliest time has been stored in the released area within the memory.

(21) A storage medium employing a picture decoding method in which a computer is made to predictively decode an encoded stream with reference to a decoded picture, the storage medium comprising: generating a predictive image with reference to the decoded picture; decoding the encoded stream; adding the predictive image to the decoded encoded stream to obtain a decoded picture; storing a predetermined decoded picture in the memory and releasing an unnecessary picture in the memory, wherein the decoded picture is stored in an area in which a picture displayed at the earliest time has been stored in the released area within the memory.

(22) A storage medium employing a picture encoding method in which a computer is made to predictively encode a picture signal with reference to a decoded picture, the storage medium comprising: generating a predictive image with reference to the decoded picture in a memory; encoding a difference between the predictive image and the picture signal to obtain an encoded stream; decoding the encoded difference; adding the predictive image to the decoded difference to obtain a decoded picture; storing a predetermined decoded picture in the memory and releasing an unnecessary picture in the memory, wherein the predetermined decoded picture is stored in an area that is capable of storing a picture and is released firstly of the whole released area in the memory.

(23) A storage medium employing a picture encoding method in which a computer is made to predictively encode a picture signal with reference to a decoded picture, the storage medium comprising: generating a predictive image with reference to the decoded picture in a memory; encoding a difference between the predictive image and the picture signal to obtain an encoded stream; decoding the encoded difference; adding the predictive image to the

decoded difference to obtain a decoded picture; storing a predetermined decoded picture in the memory and releasing an unnecessary picture in the memory, wherein the predetermined decoded picture is stored in an area in which a picture displayed at the earliest time has been stored in the released area within the memory.

[0049] A picture encoding method of defining memory constraint conditions for a stream and a picture decoding apparatus and encoding video for the picture encoding apparatus of the present invention may be any of (A1) through (A26) below.

(A1) A picture encoding method of defining memory constraint conditions for a stream and a picture decoding apparatus, the picture encoding method comprising the following steps: determining a first maximum number of reference pictures that can be used; setting a second maximum number of reference pictures used for backward prediction; entering the second maximum number in a header of the stream; generating a virtual display delay buffer; generating a display counter; allocating a sufficient memory space for the reference pictures; and encoding the video. Here, the virtual display delay buffer is a virtual buffer for each picture for display to be stored in an area for display retained in a memory in the picture encoding apparatus and stores information indicating an order of outputting the pictures for display (picture order number or the like). The display counter records or updates a picture order number of the picture to be outputted virtually on the display. The sufficient memory space indicates an area for storing both the reference pictures and the pictures for display.

(A2) The picture encoding method according to (A1), wherein the first maximum number is determined according to a level value indicating a capacity of the decoder.

(A3) The picture encoding method according to (A1) or (A2), wherein the second maximum number is smaller than the first maximum number of reference pictures.

(A4) The picture encoding method according to (A1), (A2) or (A3), wherein the backward prediction of the entire stream is limited by the second maximum number.

(A5) The picture encoding method according to (A1), wherein a size of the virtual display delay buffer is the second maximum number minus 1.

(A6) The picture encoding method according to (A1) or (A5), wherein a physical memory for the virtual display delay buffer includes only display order information of the pictures.

(A7) The picture encoding method according to (A1), wherein the display counter is used for storing display order information of the pictures to be removed from the virtual display delay buffer.

(A8) The picture encoding method according to (A1), comprising the following steps of: predicting a predictive image for a current picture to be coded with reference to usable reference pictures; encoding the current picture; determining whether or not the encoded picture can be used for prediction; decoding the encoded picture; storing the decoded picture in the reference picture buffer; updating the virtual display delay buffer; and updating the display counter.

(A9) The picture encoding method according to (A1) or (A8), wherein one or a plurality of reference pictures can be used for the prediction of the picture when the picture is predictively encoded.

(A10) The picture encoding method according to (A1) or (A8), wherein the reference picture can be used only when the reference picture buffer meets the memory constraint conditions.

(A11) The picture encoding method according to (A1) or (A8), wherein the reference picture is decoded when the current picture is to be used as a reference picture.

(A12) The picture encoding method according to (A1), (A8) or (A10), further comprising the following steps of: determining memory constraint conditions of the number of reference pictures with respect to a following picture; removing an unused reference picture from the reference picture buffer; and adding the decoded picture to the reference picture buffer.

(A13) The picture encoding method according to (A1), (A8), (A10) or (A12), wherein a maximum number of the reference pictures with respect to the following picture equals to what the number of pictures in the virtual display delay buffer is subtracted from the first maximum number for the stream.

(A14) A picture encoding method according to (A1), (A8), (A10) or (A12), wherein the display order information for the display of the unused reference picture is moved to the virtual display delay buffer when the display order information for the display is greater than a value indicated at the display counter.

(A15) The picture encoding method according to (A1) or (A8), wherein the virtual display delay buffer stores the temporal information of the picture when a value indicated in the display order information is greater than a value indicated at the display counter.

(A16) The picture encoding method according to (A1), (A8) or (A15), wherein the virtual display delay buffer removes the display order information of the picture when the value indicated in the display order information is smaller than or equal to the value indicated at the display counter.

(A17) The picture encoding method according to (A1), (A8), (A10), (A12) or (A13), wherein the number of pictures in the virtual display delay buffer is defined according to a total number indicated in the display order information of

the pictures that are present in the virtual display delay buffer.

(A18) The picture encoding method according to (A1) or (A8), wherein the display counter starts updating the display order information in one of cases: when the virtual display delay buffer is full and when the number of encoded pictures equals to the first maximum number.

(A19) The picture encoding method according to (A1), (A8) or (A18), wherein the display counter updates the display order information based on the display order information of each encoded picture.

(A20) The picture encoding method according to (A1), wherein a picture decoding method employed by a picture decoding apparatus comprises the following steps of: determining a maximum post decoder buffer size according to a stream header; determining a minimum number of necessary reference pictures; allocating a sufficient physical memory space for the reference pictures; decoding the stream; and outputting the stream.

(A21) The picture encoding method according to (A1) or (A20), wherein the maximum post decoder buffer size is the second maximum number set by the picture encoding apparatus.

(A22) The picture encoding method according to (A1) or (A20), wherein the minimum number of necessary reference pictures is fixed according to a capacity level of a picture decoding apparatus that can decode the same stream.

(A23) The picture encoding method according to (A1) or (A20), wherein the physical memory space allocated by the picture decoding apparatus can be used for storing both reference pictures and post decoder pictures.

(A24) The picture encoding method according to (A1) or (A20), wherein a total number of reference pictures and post decoder pictures does not surpass the allocated physical memory space.

(A25) The picture encoding method according to (A1) or (A20), wherein a firstly decoded picture is outputted in one of following cases: when the number of decoded pictures equals to the maximum size of post decoder buffer minus 1 and when a total number of decoded pictures equals to the determined minimum number of reference pictures.

(A26) The picture encoding method according to (A1) or (A20), wherein the decoded picture is removed from the post decoder buffer once the decoded picture is sent for output.

Also, a method of decoding a stream based on memory constraint conditions for a stream and a picture decoding apparatus employed by the picture decoding apparatus of the present invention may be any of (A27) through (A37) below.

(A27) A picture decoding method of decoding a stream based on memory constraint conditions for a stream and a picture decoding apparatus, the picture decoding method comprising the following steps of: determining a first maximum number of reference pictures used for a stream; determining a second maximum number of reference pictures used for backward prediction; calculating a minimum size of a post decoder buffer; allocating a sufficient physical memory space for the post reference picture buffer; allocating a sufficient physical memory space for the post decoder buffer; decoding the stream; storing the decoded picture in a reference picture buffer; storing the decoded picture in the post decoder buffer; outputting the decoded picture. Here, the post decoder buffer is an area for display in a reference picture memory in the picture decoding apparatus.

(A28) The picture decoding method according to (A27), wherein the first maximum number is fixed for the picture decoding apparatus according to a capacity level to decode the stream.

(A29) The picture decoding method according to (A27), wherein the second maximum number is defined as the first maximum number minus 1.

(A30) The picture decoding method according to (A27), wherein the minimum size of the post decoder buffer is defined as the second maximum number minus 1.

(A31) The picture decoding method according to (A27) or (A30), wherein the minimum size of the post decoder buffer is obtained from the stream.

(A32) The picture decoding method according to (A27) or (31), wherein the second maximum number is defined as the minimum size of the post decoder buffer plus 1.

(A33) The picture decoding method according to (A27), wherein the minimum size of the reference picture buffer is defined as the first maximum number.

(A34) The picture decoding method according to (A27) or (A33), wherein the reference picture buffer is used only for storing reference pictures.

(A35) The picture decoding method according to (A27), (A30) or (A31), wherein the post decoder buffer is used for storing non-reference pictures.

(A36) The picture decoding method according to (A27), (A32) or (A33), wherein a reference picture is removed from the reference picture buffer when the reference picture is judged as a non-reference picture.

(A37) The picture decoding method according to (A27), (A30), (A31) or (A35), wherein picture in the post decoder buffer is removed from the post decoder buffer when outputted.

[0050] With the structure described above, a correct decoding of the stream can be assured by operating both the stream and the picture decoding apparatus under the same memory constraint conditions. Otherwise, a memory space sufficient for the picture decoding apparatus to decode the stream in process of decoding cannot be assured.

Brief Description of Drawings

[0051]

Fig. 1 is a diagram showing a prediction structure, a decoding order and a display order of pictures.
Fig. 2 is a diagram showing a prediction structure, a decoding order and a display order of the pictures.
Fig. 3 is a block diagram showing a picture encoding apparatus for realizing a picture encoding method of the present invention described in a first embodiment.
Fig. 4 is a flowchart showing an operation of a reference picture control unit of the present invention described in the first embodiment.
Fig. 5A, 5B and 5C are state diagrams showing a storage status of the pictures in the memory.
Fig. 6 is a flowchart showing an operation of the picture encoding apparatus of the present invention described in a second embodiment.
Fig. 7 is a flowchart showing an operation of the picture encoding apparatus of the present invention described in a third embodiment.
Fig. 8 is a flowchart showing an operation of the picture encoding apparatus of the present invention described in a fourth embodiment.
Fig. 9 is a block diagram showing a picture decoding apparatus for realizing a picture decoding method of the present invention described in a fifth embodiment.
Fig. 10 is a flowchart showing an operation of the picture decoding apparatus of the present invention described in the fifth embodiment.
Fig. 11 is a flowchart showing another operation of the picture decoding apparatus of the present invention described in the fifth embodiment.
Fig. 12 is a flowchart showing yet another operation of the picture decoding apparatus of the present invention described in the fifth embodiment.
Fig. 13 is a flowchart showing another operation of the picture decoding apparatus of the present invention described in the fifth embodiment.
Fig. 14 is a block diagram showing a usage of a virtual display delay buffer of a picture encoding apparatus.
Fig. 15 is a block diagram showing a processing of post decoder buffer operation for encoding according to the present invention.
Fig. 16 is a block diagram showing a processing of post decoder buffer operation for decoding according to the present invention.
Fig. 17 is an example of using the virtual display delay buffer of the picture encoding apparatus for limiting the maximum number of the reference pictures.
Fig. 18 is an example of using the virtual display delay buffer for deciding the time to display a first picture.
Fig. 19 is an illustration of a storage medium in order to store a program for realizing the picture encoding method and the picture decoding method of each embodiment in a computing system, described in a seventh embodiment.
Fig. 20 is a block diagram showing an overall structure of a content supply system described in a eighth embodiment.
Fig. 21 is an outline view showing an example of a cell phone using the picture encoding/decoding method of the present invention described in the eighth embodiment.
Fig. 22 is a block diagram of the cell phone.
Fig. 23 is a block diagram showing an example of digital broadcasting system described in the eighth embodiment.
Fig. 24 is a diagram showing a prediction structure, a decoding order and a display order of the pictures.
Fig. 25 is a diagram showing a prediction structure, a decoding order and a display order of the pictures.
Fig. 26 is a block diagram of the picture decoding apparatus for realizing the conventional picture encoding method.
Fig. 27 is a mapping diagram showing examples of codes for a memory control commands MMCO.
Fig. 28 is a block diagram of the picture decoding apparatus for realizing the conventional picture decoding method.

Best Mode for Carrying Out the Invention

[0052] The following describes a first embodiment of the present invention.

(First Embodiment)

[0053] Fig. 3 is a block diagram showing a picture encoding apparatus for realizing a picture encoding method of the present invention. The same referential numbers are put for the devices that operate in the same manner as described in the block showing a picture encoding apparatus for realizing a conventional encoding method shown in Fig. 26 and the explanation is thereby abbreviated.

[0054] Differences between the block diagram in Fig. 26 showing the picture encoding apparatus for realizing the conventional picture encoding method and the block diagram in Fig. 3 showing the picture encoding apparatus for realizing the picture encoding method according to the present invention are that a display picture control unit DisPicCtrl is added to Fig. 3 and that instructions sent from the display picture control unit DisPicCtrl are outputted to a reference picture control unit RefPicCtrl and a picture memory PicMem2.

[0055] In the picture encoding apparatus 100 shown in Fig. 3, a picture size modification unit PicSize for obtaining a picture size modified by external operations as well as an encoding type of each picture (I-picture, P-picture and B-picture) from the picture structure determination unit PicStruct and outputting information indicating the picture size to be modified to a reference picture control unit RefPicCtrl is newly set.

[0056] The operation of the picture memory PicMem2 is almost same as that of the picture memory PicMem1, therefore, only different operations will be explained.

[0057] The display picture control unit DispPicCtrl obtains a picture time Time and judges whether a picture, which is not stored as it is not for reference, can be displayed immediately or not (whether it is necessary to store the picture in the picture memory until its display time). The picture time Time, a signal for specifying a picture to be displayed, is inputted from outside. The picture time can be obtained in the following ways: from the time information outputted from the system for transmitting pictures via a transmission line such as a packet, from the time information in process of formatting a video stream and audio stream for multiplexing them; or from the time information in process of formatting a video stream. The picture time may be either an absolute time which informs of the time for each picture or a relative time which informs of the order of the pictures. Moreover, the intervals of displaying pictures is normally fixed, therefore, the order of displaying pictures may be considered as the display time.

[0058] Now, the case in which the picture is immediately displayable is a case in which the picture gained after the calculation in the adder Add corresponds with the picture to be displayed indicated by the picture time Time. In this case, a picture to be displayed before the picture that is not yet displayed and outputted for encoding is not found in the picture memory PicMem2. When the picture is not immediately displayable, the display picture control unit DispPicCtrl instructs the reference picture control unit RefPicCtrl to store the picture, even though it is not for reference, in the picture memory PicMem2. Consequently, the picture which is not displayed immediately is stored in the picture memory PicMem2 without fail regardless of whether it is for reference or not and can be displayed out of the picture memory PicMem2 in the decoding apparatus.

[0059] Fig. 4 is a flowchart showing an operation of the reference picture control unit RefPicCtrl of the present invention.

[0060] The reference picture control unit RefPicCtrl judges whether or not a decoded picture (picture) is to be stored for reference for a predictive image (Step 10). When the decoded picture is to be used for reference, the operation proceeds to Step 12, otherwise to Step 11.

[0061] In Step 11, the reference picture control unit RefPicCtrl judges whether or not the decoded picture is immediately displayable. "Immediately displayable" here means that the decoded picture can be displayed at the time of being decoded (see for example Picture 1 in Fig. 1). The decoded picture which is not immediately displayable means that it needs to be displayed later (for instance, B5 shown in Fig. 1). When the picture is immediately displayable, the operation is terminated, otherwise, goes on to Step 12.

[0062] In Step 12, the reference picture control unit RefPicCtrl obtains an area capable of storing a picture in the picture memory PicMem2 and instructs to store the decoded picture in the area obtained in the picture memory PicMem2 using a memory control command MMCO in Step 13.

[0063] In this way, the picture which is not displayed immediately is stored in the picture memory PicMem2 and can be outputted for display from the picture memory PicMem2 when the time has come for its display. This does not require an unnecessary picture memory assigned for a picture for display and a picture that needs to be stored for display can be stored in the picture memory assigned for a picture for reference.

[0064] The picture memory PicMem2 includes an area for reference in which a reference picture is stored for generating a predictive image and an area for display in which a picture for display is stored.

[0065] Meanwhile, a picture size can be modified for each GOP (Group Of Picture) mentioned before. The modification of the picture size takes place only when a whole area for reference in the memory storing an unnecessary reference picture is released (make the status of the memory reusable).

[0066] However, when the modification of the picture size takes place as described above, the picture for display that is not yet displayed is stored in the memory area, and it is necessary to determine explicitly a coping strategy of how to handle this picture for display but not yet displayed (whether to delete it or to store it until it is displayed).

[0067] Here, a storing state of pictures in the memory when the change of the picture size takes place is explained in stages.

[0068] Figs. 5A, 5B and 5C are state diagrams showing the storing status of the pictures in the memory in stages.

[0069] In 5A, pictures 200a, 200b and 200c are the pictures for reference (the pictures to be used for reference in order to generate a predictive image) whereas pictures 201a, 201b, 201c, 201d, and 201e are the pictures for display (pictures to be displayed and not displayed yet).

[0070] The pictures 201a, 201b, 201c, 201d and 201e will be displayed in the numeric order as shown in Fig. 5A.

[0071] Fig. 5A illustrates the status in which the whole memory areas assigned for the reference pictures 200a, 200b and 200c are released for the reusability.

[0072] Fig. 5B shows that the picture size is modified following the status shown in Fig. 5A. A reference picture 202a being modified to a bigger size is stored in the memory area in which the reference picture 200a has been stored. Furthermore, the picture for display 201a is outputted for display and its memory area is released.

[0073] Fig. 5C shows a status in which the memory area storing the picture for display 201b is released after the status shown in Fig. 5B. A reference picture 202b being modified into a bigger size is stored in the memory area in which the pictures for display 201a and 201b have been stored and a small memory area 203 is left. Even though the memory area storing the picture for display 201c is released, the reference picture (whose picture size is enlarged) cannot be newly stored.

[0074] Thus, when the picture size is modified, the pictures of different picture sizes are mixed in the memory (the reference pictures whose picture sizes are enlarged and the pictures for display which are not yet displayed and whose sizes are not yet modified).

[0075] Consequently, the memory is used fragmentarily, which produces a small memory area that cannot be used, and the usability is thereby deteriorated. When the data in the memory is repositioned so that the small memory area caused by the modification of the picture size disappears, the memory access increases greatly and thereby it is difficult to realize encoding and decoding operations in actual time.

[0076] When the picture size is modified, two methods are conceivable. The first method is to release the area for display in which the pictures for display that are not yet displayed are stored and the area for reference in which the reference pictures are stored (as a reusable state) and gives up the display of the pictures for display that are not yet displayed. This can prevent the fragmentary use of the memory caused by the mixture of the pictures of different sizes and thereby the deterioration in the usability of the memory can be reduced.

[0077] The modification in the picture size described above takes place as described in the following. The picture size modification unit PicSize shown in Fig. 3 receives the encoding type (I-picture, P-picture and B-picture) of each picture determined by the picture structure determination unit PicStruct and the picture size for the modification inputted from outside and outputs to the reference picture control unit RefPicCtrl an instruction to modify the picture size with the timing to start encoding I-picture. The I-picture is a special I-picture (IDR (Instantaneous Decoding Refresh) picture) to be inserted, for example, in the beginning of the GOP.

[0078] The second method is to switch a method to release the whole area of the memory and discard the pictures for display that are not yet displayed and a method to release only the area for reference in which the reference pictures are stored and display the pictures for display that are not yet displayed before the size modification takes place with a judgment made by a picture decoding apparatus (decoder) for decoding an encoded signal (stream) that is referred to later on so that the display of the pictures for display that are not yet displayed is not obligatory. In this case, the picture decoding apparatus displays the displayable pictures, for instance, the undamaged pictures according to the display order.

[0079] For operating such switching, instruction information (flag) indicating one of the following methods: the method to release the whole area of the memory; and the method to release only the area for reference in which the reference picture is stored, or other identifiable information is contained in the stream Str outputted from the picture encoding apparatus 100.

[0080] On the side of the picture decoding apparatus, the processing is operated based on the instruction information placed in the stream.

[0081] The following examples are conceivable for the judging criteria in order to switch the two methods indicated by the instruction information: a content creator may decide the method according to an application; only the area for reference is released but not the area for display storing a picture for display that is not yet displayed (not releasing the whole area of the memory) when memory can afford to provide the space.

[0082] With the above construction, the picture encoding apparatus can be realized to solve the existing problems.

(Second Embodiment)

[0083] The following describes a second embodiment of the present invention.

[0084] In the present embodiment, the display picture control unit DispPicCtrl shown in Fig. 3 instructs the picture memory PicMem2 not to store a picture newly in the area storing the picture that is not yet displayed, when a picture is stored in the released memory area. Normally, even an area for picture is released, a picture stored right before can be reproduced as long as a picture is not newly stored (overwritten) in the area. Even if a memory area in which the picture that is not yet displayed is released, the picture that is not yet displayed and is released at the time of display but is left without being overwritten can be displayed by storing a picture newly not in the memory area but in the area where the picture that is already displayed is stored. The picture in the released picture area of the picture memory is called picture for display. "Already displayed" here is practically synonymous with "already outputted to a display device".

[0085] Fig. 6 is a flowchart showing an operation of the picture encoding apparatus 100 of the present embodiment. The present embodiment characterizes in determining the storage of the picture by judging whether the picture stored in the released area in the memory is already displayed or not.

[0086] Firstly, in Step 20, the picture encoding apparatus 100 judges whether or not the decoded picture is to be stored in the picture memory PicMem2 based on the instructions indicated in the memory control command MMCO.

[0087] In the case of storing the decoded picture in the picture memory, the released picture area is obtained (Step 21) and whether a picture stored in the released picture area is already displayed or not is verified (Step 22). When it is not yet displayed, the operation goes back to Step 21 and the processing continues until the released area in which the picture already displayed has been stored is found.

[0088] When such released area is found, the decoded picture is stored in the area (Step 23).

[0089] Thus, when the picture to be displayed is displayed, the picture that is not yet displayed is stored in the memory without being overwritten until its display time since the area storing the displayed picture is reused.

[0090] Whether a picture stored in the memory is already displayed or not can be judged by the display picture control unit DispPicCtrl managing information on whether or not the picture is displayed.

[0091] Whether a picture area is a released area or not can be judged by referring to the information on whether or not each picture area is released, for instance, "used (usable as a reference picture)" or "unused (no longer used as a reference picture)" stored in the picture memory PicMem2 according to the memory control command MMCO.

[0092] With the above structure, the picture encoding apparatus of the present invention can be realized so as to overcome the existing problems.

[0093] Thus, overwriting of a picture newly to the picture that is not yet displayed can be prevented so that the latter picture can be outputted for display from the area that is already released but not overwritten at the display time. The picture that needs to be stored for display can be stored without requiring an unnecessary memory.

[0094] As the operation in the case which requires the modification in the picture size is same as in the first embodiment, the explanation is abbreviated.

(Third Embodiment)

[0095] The following describes a third embodiment of the present invention.

[0096] Fig. 7 is a flowchart of an operation of the picture encoding apparatus 100 of the third embodiment of the present invention. The present embodiment characterizes in determining the storage of the picture according to the time when the memory is released.

[0097] Firstly, in Step 30, the picture encoding apparatus 100 judges whether or not the decoded picture is to be stored in the picture memory PicMem2 based on the instruction indicated in the memory control command MMCO.

[0098] In the case of storing the decoded picture in the picture memory, the released picture memory area whose display time is the earliest within released area is obtained (Step 31) and the decoded picture is stored in the obtained area (Step 32).

[0099] The memory area in which the picture is decoded and stored at the earliest time instead of the memory area released at the earliest display time may be allocated as an area to store the picture. For, there is a high possibility that the pictures stored in these memory areas are already displayed.

[0100] These earliest times are not necessarily based on time and may be the earliest time according to an order, for instance, it may be the earliest time according to a display order. For example, it is highly possible that a picture whose display order is the earliest is already displayed and a memory area storing such picture can be reused in turn as a storing area in the memory regardless of whether it is already displayed or not. Normally, the intervals of displaying pictures is regular, therefore, the order of displaying pictures may be considered as the display time.

[0101] Thus, overwriting of a picture newly onto the picture that is not yet displayed can be prevented so that the latter picture can be outputted for display from the area that is already released but not overwritten at the display time. The picture that needs to be stored for display can be stored without requiring an unnecessary memory. The processing of storing the picture which needs to be stored for display can be carried out regardless of whether the picture stored in the picture memory PicMem2 is already displayed or not. When the earliest time indicates the earliest time in display time, whether or not the picture is stored at the earliest time can be judged by the display picture control unit DispPicCtrl managing the information on whether or not the picture is displayed.

[0102] As an operation in a case in which a modification of a picture size is required is same as the one described in the first embodiment, the explanation is abbreviated.

(Fourth Embodiment)

[0103] The following illustrates a fourth embodiment of the present invention.

[0104] Fig. 8 is a flowchart showing an operation of the picture encoding apparatus 100 according to the fourth

embodiment of the present invention. The present embodiment characterizes in determining a storage of the picture according to an order of releasing the memory.

[0105] Firstly, in Step 40, the picture encoding apparatus 100 judges whether or not the decoded picture is to be stored in the picture memory PicMem2 based on the instruction indicated in the memory control command MMCO.

[0106] In the case of storing the decoded picture in the picture memory, the picture memory area released at the earliest time within released area is obtained (Step 41) and the decoded picture is stored in the obtained area (Step 42).

[0107] Since it is a system who manages the information on display time, it is difficult to obtain the display time depending on a method to fabricate a video decoding apparatus. It is highly possible that the picture with the earliest display time is stored in the area firstly released than the area released at the later time. Namely, it is with high possibility that the picture firstly released is already displayed. Therefore, there is a high possibility that the picture that is not yet displayed is not overwritten when the decoded picture is stored in the picture area firstly released.

[0108] Whether the picture area is a released area or not can be judged by referring to the information on whether or not each picture area is released, for instance, "used (usable as a reference picture)" or "unused (no longer used as a reference picture)" that is stored in the picture memory PicMem2 according to the memory control command MMCO. Or, the usage of the picture area can be fixed beforehand to a predetermined procedure in order to judge whether the picture area is the one that is firstly released according to the procedure. For example, this can be judged by the picture memory PicMem2 functioning as a memory using a first-in first-out (FIFO) method by which the contents of record whose time records that picture is to be stored newly is sequentially discarded in turn and the latest pictures of a fixed number of frames (or number of pictures) are always stored. Thus, overwriting a picture newly to a picture that is not yet displayed can be prevented so that the latter picture can be outputted for display from the area that is already released but not overwritten at the display time.

[0109] As an operation in the case in which the modification of the picture size is required is same as the one described in the first embodiment, the explanation is abbreviated.

(Fifth Embodiment)

[0110] The following illustrates a fifth embodiment of the present invention.

[0111] Fig. 9 is a block diagram of a picture decoding apparatus for realizing the picture decoding method of the present invention. The same referential numbers are put for the devices that operate in the same manner as a picture encoding apparatus for realizing the picture encoding method according to the present invention shown in the block diagram of Fig. 3 and a picture decoding apparatus for realizing the conventional picture decoding method shown in the block diagram of Fig. 28 and the explanation is thereby abbreviated.

[0112] The difference between the picture decoding apparatus 150 shown in Fig. 9 and the example of conventional apparatus shown in Fig. 28 is that a picture size modification detection unit PicSizeDet and a display picture control unit DispPicCtrl are newly set. The picture size modification detection unit PicSizDet outputs a command to modify the picture size in the timing of starting encoding of a special I-picture (IDR picture) based on the picture size for the modification obtained from outside and the memory control command MMCO obtained from the variable length decoding unit VLD.

[0113] The display picture control unit DispPicCtrl instructs the picture memory PicMem2 not to store a picture newly in the area for the picture that is not yet displayed when storing the new picture in the released area. Normally, even though an area for a picture is released, data of a picture that is stored right before is left in the memory and can be reproduced as long as a picture is not newly stored (overwritten) in the area. The picture that is released at the time of display but left without being overwritten can be displayed by storing a picture newly in the area where the picture that is already displayed is stored even if the memory area in which the picture that is not yet displayed is released. "Already displayed" here is practically synonymous with "already outputted to a display device".

[0114] Thus, when the picture to be displayed is displayed, the picture that is not yet displayed is stored in the memory without being overwritten until its display time since the area storing the displayed picture is reused.

[0115] With the above structure, the picture decoding apparatus of the present invention can be realized in order to overcome the existing problems. The picture decoding apparatus 150 may decode an encoded signal that is encoded by the picture encoding apparatus 100 shown in the third and fourth embodiments. In this case, the operation for the use of the picture memory is as same as the one described for the picture encoding apparatus shown in the third and fourth embodiments. Namely, for the reusability of the picture area that is released (no longer used for reference) in the picture memory, either method of deciding the area for the picture to be newly stored described in the first through third embodiments may be employed.

[0116] The following describes methods of storing the picture in the memory when decoding the encoded signal encoded by the picture encoding apparatus shown in the third and fourth embodiments.

[0117] Firstly, the method of storing the picture in the memory at the time of decoding the encoded signal encoded by the picture encoding apparatus shown in the third embodiment is explained.

[0118] The picture decoding apparatus 150 judges whether or not the decoded picture outputted from the addition

unit Add in the picture decoding apparatus 150 is to be stored in the picture memory PicMem2 based on the instruction indicated in the memory control command MMCO.

[0119] When storing the decoded picture in the picture memory, the picture memory area firstly released is obtained and the decoded picture is stored in the obtained area.

[0120] Here, the memory area in which the picture is decoded and stored at the earliest time or the memory area in which the picture with the earliest display time is stored instead of the memory area that is released at the earliest time may be allocated as an area to store the picture. For there is a high possibility that the pictures stored in these memory areas are already displayed.

[0121] Since it is a system that manages the information on display time, it is difficult to obtain the display time depending on a method to fabricate a picture decoding apparatus. It is highly possible that the picture with the earliest display time is stored in the area in which the picture is stored at the earliest time than the one in which the picture is stored at the later time. It is with high possibility that the picture stored at the earliest time is already displayed since it is natural that the picture with early display time is already displayed. Therefore, there is a high possibility that the picture that is not displayed yet is not overwritten when the decoded picture is stored in the area in which the picture stored at the earliest time has been stored. When the earliest time corresponds with the earliest time when the picture is encoded, whether the picture is encoded at the earliest time, for instance, can be judged by the prediction structure and the decoding order of the picture.

[0122] These earliest times are not necessarily based on time and may be the earliest time according to an order, for instance, it may be the earliest time according to a display order. For example, it is highly possible that a picture whose display order is the earliest is already displayed and a memory area storing such picture can be reused in turn as a storing area in the memory regardless of whether it is already displayed or not. Normally, the intervals of displaying pictures is regular, therefore, the order of displaying pictures may be considered as the display time.

[0123] Thus, overwriting of a picture newly onto the picture that is not yet displayed can be prevented so that the latter picture can be outputted for display from the area that is already released but not overwritten at the display time. Also, the picture that needs to be stored for display can be stored without requiring an unnecessary memory.

[0124] The processing of storing the picture which needs to be stored for display can be carried out regardless of whether the picture stored in the picture memory PicMem2 is already displayed or not. When the earliest time indicates the earliest time in display time, whether or not the picture is stored at the earliest time can be judged by the display picture control unit DispPicCtrl managing the information on whether or not the picture is displayed.

[0125] The following describes a method of storing a picture in the memory when decoding the encoded signal encoded by the picture encoding apparatus shown in the fourth embodiment.

[0126] The picture decoding apparatus 150 judges whether or not the decoded picture outputted from the addition unit Add mentioned above of the picture decoding method 150 is to be stored in the picture memory PicMem2 based on the instruction indicated in the memory control command MMCO.

[0127] In the case of storing the decoded picture in the picture memory, the picture memory firstly released is obtained and the decoded picture is stored in the obtained area.

[0128] Since it is a system that manages the information on display time, it is difficult to obtain the display time depending on a method to fabricate a video decoding apparatus. It is highly possible that the picture with the earliest display time is stored in the area firstly released than the area released at the later time. Namely, it is likely that the picture firstly released is already displayed. Therefore, there is a high possibility that the picture that is not yet displayed is not overwritten by storing the decoded picture in the picture area firstly released.

[0129] Whether the picture area is a firstly released picture area or not can be judged by referring to the information on whether or not each picture area is released, for instance, "used (usable as a reference picture)" or "unused (no longer used as a reference picture)", that is stored in the picture memory PicMem2 according to the memory control command MMCO, including the order of releasing the pictures. Or, the usage of the picture area can be fixed beforehand to a predetermined procedure in order to judge whether the picture area is the one that is firstly released according to the procedure. For example, this can be judged by the picture memory PicMem2 functioning as a memory using a first-in first-out (FIFO) method by which the contents of record with old recording time is sequentially discarded when the new data is recorded so that the latest pictures of a fixed number of frames (or number of pictures) are always stored.

[0130] Thus, overwriting of a picture newly to a picture that is not yet displayed can be prevented and the picture can be outputted for display from the area that is already released but not overwritten at the display time.

[0131] The display unit Disp may be installed in the exterior of the picture decoding apparatus 150 in stead of being included in it so that the picture decoding apparatus 150 may send only the data necessary for displaying a picture at the display unit Disp.

[0132] Here, an operation of the picture decoding apparatus 150 when the picture size is modified, as already explained in the second embodiment, is illustrated. However, the operation is as same as the one described in the third and the fourth embodiments, therefore, the explanation is abbreviated.

[0133] A method corresponding to the first method in the case in which the picture size is modified shown in the second

embodiment is that the picture decoding apparatus 150 releases a whole area in the memory including the area for reference in which the reference picture is stored and the area for display in which the picture for display is stored and performs initialization when receiving a command to modify the picture size.

[0134] Fig. 10 is a flowchart showing an operation of the picture encoding apparatus 150.

[0135] The picture encoding apparatus 150 judges whether or not a signal outputted from the picture size modification detection unit PicSizeDet indicates a modification of a picture size (Step 100). When it does (Yes in Step 100), the picture encoding apparatus 150 releases a whole memory area of the picture memory PicMem2 (as a reusable state), initializes it (Step 102) and ends the processing.

[0136] When the picture size is not modified (No in Step 100), the picture decoding apparatus 150 judges whether or not the memory control command MMCO outputted from the variable length decoding unit VLD indicates the release (initialization) of the whole memory area in the picture memory PicMem2 (Step 101) and if it does (Yes in Step 101), releases the whole memory area (Step 102), if not (No in Step 101), release only the area for reference in which the reference picture is stored (Step 103) and ends the processing.

[0137] Thus releasing the whole area of the memory prevents the fragmentary use of the memory caused by the mixture of the pictures of different sizes and thereby the deterioration in the usability of the memory can be reduced.

[0138] Next, an operation of the picture decoding apparatus 150 corresponding to the second method in the case of the modification of the picture size shown in the second embodiment is explained.

[0139] In the case of modifying the picture size, the methods are switched from one to the other: a method of releasing the whole area of the memory or a method of releasing only the area for reference in which the reference picture is stored and displaying the displayable picture out of the pictures that are not yet displayed with the judgment made by the picture decoding apparatus 150.

[0140] As described in the second embodiment, the instruction information (flag) indicating either to release the whole memory area or to release only the area for reference is contained in the memory control command MMCO in the stream Str outputted from the picture encoding apparatus 100.

[0141] The picture decoding apparatus 150 determines either of the two methods described above based on the instruction information contained in the memory control command MMCO.

[0142] Fig. 11 is a flowchart showing a determination operation.

[0143] Firstly, the picture decoding apparatus 150 judges whether or not the instruction information (flag) indicates the initialization of the whole area of the memory (Step 150). When it indicates the initialization of the whole area (Yes in Step 150), the picture decoding apparatus 150 releases the whole area, for initialization, including the area for display storing the picture for display that is not yet displayed (Step 151), otherwise (No in Step 150), releases only the area for reference for initialization (Step 152).

[0144] When the instruction information (flag) does not indicate the initialization of the whole area, the picture decoding apparatus 150 releases only the area for reference. As for the picture that is not displayed yet and stored in an area other than the area for reference, the picture decoding apparatus 150 judges the picture and displays the displayable.

[0145] The following describes the operation of the picture decoding apparatus 150 in the case of initializing only the area for reference, with reference to a flowchart.

[0146] Fig. 12 is a flowchart showing an operation of the picture decoding apparatus 150 (decoder).

[0147] The picture decoding apparatus 150 judges whether or not the signal outputted from the picture size modification detection unit PicSizeDet indicates a modification of a picture size (Step 200). Unless it indicates the modification of the picture size (No in Step 200), the picture decoding apparatus 150 displays the picture to be displayed that is not yet displayed stored in the area for display (Step 203).

[0148] Meanwhile, when the signal indicates the modification of the picture size (Yes in Step 200) the picture decoding apparatus 150 determines whether or not the picture for display stored in the area for display is the one before the modification of the size takes place (Step 201). When it is not the case (No in Step 201), the picture decoding apparatus 150 displays the picture to be displayed that is not yet displayed (Step 203). When it is the case (Yes in Step 201), the picture decoding apparatus 150 judges whether or not the picture for display is displayable or not and display it based on the judgment (Step 202)

[0149] The following describes an operation of the picture decoding apparatus 150 for a judgment on whether the picture can be displayed or not.

[0150] Fig. 13 is a flowchart showing the operation of the picture decoding apparatus 150 with regards to a display of the picture.

[0151] In Fig. 13, the same marks are put for the same processing as described in Fig. 12.

[0152] The picture decoding apparatus 150 judges whether or not the picture for display stored in the area for display is the one before the modification of the size takes place (Step 201). When the picture is not the one before the modification takes place (No in Step 201), the picture decoding apparatus 150 displays the picture. On the other hand, when the picture is the one before the modification takes place (Yes in Step 201), the picture decoding apparatus 150 determines whether the picture to be displayed is damaged or not (Step 211). When the picture is not damaged (No in Step 211)

the picture is considered as displayable and thereby displayed (Step 210). When it is damaged (Yes in Step 211), the preceding picture, for instance, is displayed instead. Here, not being damaged means that the picture to be displayed is not overwritten so that a new picture data is stored even the picture is a part of a picture being stored. In this way, the picture decoding apparatus 150 judges whether or not the picture to be displayed is damaged, determines the undamaged picture as displayable and displays it.

[0153] Thus, as explained in the flowcharts of Figs. 11, 12 and 13, the picture decoding apparatus 150 displays the picture that is not displayed yet according to the instruction information (flag) indicating whether or not to initialize the whole area of the memory when the modification of the picture size takes place.

[0154] Owing to the picture decoding method of the picture decoding apparatus 150 as described above, an appropriate decoding is realized by switching either to initialize the whole area of the memory or to initialize only the area for reference and display the picture for display that is not yet displayed even when the modification of the picture size is performed. Namely, when the free area in the memory is small, for instance, the whole area in the memory is initialized for reuse whereas when it is large, the case can be handled flexibly by allowing the display of the picture that is not yet displayed after initializing only the area for reference.

(Sixth Embodiment)

[0155] The following terms are used in a sixth embodiment. Namely, a reference picture buffer is an area combining an area for reference and the one for display in the picture memory PicMem2 in a picture encoding apparatus. A virtual display delay buffer is a virtual buffer for each picture for display to be stored in the area for display that is retained in the picture memory PicMem2 in the picture encoding apparatus and stores temporal reference numbers of the pictures for display (picture numbers or the like). A reference memory buffer is an area for reference in the picture memory PicMem2 in a picture decoding apparatus. A post decoder buffer is an area for display in the picture memory PicMem2 in the picture decoding apparatus. The temporal reference numbers are the numbers that are assigned for the pictures according to the order of display time and may be an equivalent of the picture time Time.

[0156] Firstly, the explanation starts with the picture encoding apparatus. The virtual display delay buffer is used to limit the maximum number of the reference pictures used for predictive encoding performed by the picture encoding apparatus.

[0157] Fig. 14 shows processing of determining a relationship between the virtual display delay buffer and the maximum number of the backward reference pictures. Each module in Fig. 14 presents a function block or a processing step of a picture structure determination unit PicStruct, a reference picture control unit RefPicCtrl and a display picture control unit DispPicCtrl. As shown in the diagram, the maximum number of the reference pictures allowed, N_R for this profile and level is determined in module 401. This value is defined for each profile and level and thereby the encoder encodes the value of profile/level, an equivalent of N_R, as information on a stream and a decoder obtains N_R according to the value of profile/level in the stream. The picture encoding apparatus, then set the maximum number of backward reference pictures, N_B, optimal for encoding a video sequence in module 402. The size of the virtual display delay buffer can be determined based on this N_B value. When the N_B is less than 2, the virtual display delay buffer is not required. However when N_B is greater than or equal to 2, a virtual display delay buffer that can store N_B-1 number of pictures is created in module 404. The information on the picture stored in the virtual display delay buffer is retained in the memory or in any register. This virtual display delay buffer does not require a large physical memory space in the picture encoding apparatus. This is because only the descriptions of the reference pictures (picture numbers or the like) for identifying not a whole part of the reconstructed (decoded) picture but which reconstructed picture are stored in the virtual display delay buffer since the judgment to see which picture is stored in the virtual display delay buffer for its display unless the picture decoded by the picture decoding apparatus needs to be displayed (outputted). Besides the virtual display delay buffer, a display counter is created in module 405 and the value is retained either in the memory or in any register. The display counter is used to judge whether to remove an unnecessary picture from the virtual display delay buffer. The picture encoding apparatus then generates a picture size for N_R number of reference pictures in the memory space based on the profile and level definition.

$$\text{Maximum virtual display delay buffer size} = N_B - 1 \qquad (1),$$

where $N_B < N_R$

[0158] Fig. 15 shows the post encoding processing in the picture encoding apparatus, that is, a processing of storing a picture decoded after being encoded (referred to as an encoded picture or simply a picture) in the reference memory buffer. The module in the diagram presents a function block or a processing step in the reference picture control unit RefPicCtrl and the display picture control unit DispPicCtrl. After a single picture is encoded in module 501, whether or

not the picture is to be used as a reference picture is determined in module 502. When the picture is a reference picture, the maximum number of the possible reference pictures is calculated based on equation (2).

$$NMax = N_R - Fv \qquad (2)$$

[0159] Here, NMax presents the maximum number of the possible reference pictures whereas N_R presents the maximum number of the reference pictures allowed in the profile and level definition. Fv presents a virtual display delay buffer fullness, that is, the number presently used out of the size of the virtual display delay buffer (N_B-1).

[0160] When the number of the reference pictures in the reference picture buffer is less than NMax, the encoded picture is reconstructed (decoded) in module 506 and stored in the reference picture buffer in module 507. When there isn't sufficient space, the picture encoding apparatus retains a necessary area in the reference picture buffer by removing certain unused reference pictures (no longer used as reference pictures) from the buffer, as shown in module 504. When there are no unused reference pictures to be removed from the buffer, the encoded picture is not used as a reference picture. When the encoded picture is not a reference picture, the temporal reference number of the encoded picture is compared with the one indicated at the display counter in module 505. When the temporal reference number of the non-reference picture is less than the one indicated at the display counter, the virtual display delay buffer is updated in module 508. In module 508, the virtual display delay buffer removes the picture having the temporal reference number equal to or earlier than the one indicated at the display counter and adds the temporal reference number of the current non-reference picture into the buffer. The number of the pictures in the virtual buffer having the temporal reference number less than the one indicated in the display counter becomes the fullness of the buffer. The display counter only starts updating operation with initiative when the number of the encoded picture equals to N_B or when the virtual display counter is full, no matter which may be earlier. After that, the display counter is updated for every picture that is encoded in module 509.

[0161] Fig. 16 shows the post decoding processing in the picture decoding apparatus, that is, processing of storing a picture decoded by the picture decoding apparatus (referred to as a decoded picture or simply a picture) in the reference picture buffer. The modules in the diagram show the function blocks or the processing steps in the display picture control unit DispPicCtrl. A picture is decoded in module 601. In module 602, the picture decoding apparatus determines whether or not the picture needs to be stored as a reference picture. If the decoded picture is to be stored as a reference picture, it is stored in the reference picture buffer in module 606, otherwise, the picture decoding apparatus examines whether it is time to display (output) this picture in module 603. If the time has not come yet for the picture to be displayed (outputted), the picture is stored in the post decoder buffer in module 604 until its display time. Both the post decoder buffer and the reference picture buffer share physically the same memory area. In other words, each area of the same memory can be used as a reference picture buffer for some occasions and as a post decoder buffer for other occasions.

[0162] In module 605, the picture decoding apparatus then determines a picture to be displayed (outputted) either from the reference picture buffer or the post decoder buffer based on the display timing. Once a picture from the post decoder buffer is displayed (outputted), it is removed from the buffer. On the other hand, a reference picture is only to be removed from the reference picture buffer or shifted to the post decoder buffer when the stream indicates that the reference picture is no longer used for reference.

[0163] Fig. 17 is an example of a method using a virtual display delay buffer for determining the maximum number of reference pictures at each picture interval. In this example, the maximum number of reference pictures allowed, N_R, shall be 4. The picture encoding apparatus sets the maximum number of backward reference pictures, N_B, to be 3. Thus, virtual display delay buffer in which two pictures are storable is generated (the area is retained). The display counter is used for storing and updating the temporal reference number of the picture to be virtually displayed (outputted). In the reference memory buffer shown in the diagram, the vacant area shows that the area is vacant, the area described with its picture type and the number shows that the picture for reference is stored, and the hatched area shows that the picture for display is stored. Also, in the virtual display delay buffer, the vacant area shows that the area is vacant, the area described with its picture type and the number shows that the temporal reference number of the picture for display in the reference memory buffer is stored and the hatched area shows that the reference memory buffer does not have a storing area for the picture for display. The virtual display delay buffer whose number corresponds to the number of the hatched area in the reference memory buffer stores the temporal reference numbers of the pictures for display.

[0164] As shown in the diagram, the pictures B2 and B3 are used as reference pictures and thereby they are stored in the reference memory buffer together with 10 and P4, and the display counter starts updating after the picture B3 is encoded. At time T6, B5 is not used as a reference picture, however, this is because the temporal reference number is greater than the one indicated at the display counter and needs to be updated by the virtual display delay buffer. Therefore, the fullness of the virtual display delay buffer Fv at that time is 1 and the maximum number of possible reference pictures NMax is 3.

[0165] Similarly at time T7, the picture B6 needs to be updated by the virtual display delay buffer whereas B5 cannot be removed yet due to its temporal reference number greater than the one indicated at the display counter. Thus, NMax at that time indicates 2. The reference picture 10 has to be removed from the reference memory buffer due to the insufficient memory. B7 at that time then can be predicted only with the use of P4 and P8.

[0166] Fig. 18 shows an example in which the display counter is firstly incremented using the virtual display delay buffer. N_R shall be 5 in the example. The picture encoding apparatus sets the maximum number of multiple backward reference pictures N_B to be 3. Thus a virtual display delay buffer in which two pictures are storable is generated.

[0167] As shown in the diagram, B1, B2, B3 and B4 are not used for reference pictures whereas B7 and B8 are. B1 and B2 are therefore stored in the virtual display delay buffer at time T3 in order to wait for the display. Since the virtual display delay buffer is full at time T3, the display counter starts updating at time T3. The reason why the display counter needs to wait at least until the virtual display delay buffer becomes full before it can start updating is that it needs to handle the reordering of the B-pictures that is likely to occur in the picture decoding apparatus.

[0168] As shown in Fig. 17, the picture decoding apparatus sometimes use a part of the reference picture buffer as a post decoder buffer. The picture decoding apparatus therefore operates the reference picture buffer based on a fixed physical memory size of the reference picture buffer so that some parts of the reference picture buffer are used for reference pictures and the rest is used as the post decoder buffer. For example, at time T3, the whole reference picture buffer is used to store reference pictures whereas at time T7, only two areas of the reference picture buffer are used to store the reference pictures of P4 and P8. The rest is used to store post decoder pictures B5 and B6.

[0169] The maximum number of the reference pictures to be used at the picture decoding apparatus side is defined in the profile and level definition for the picture encoding apparatus. The picture encoding apparatus therefore can use up to the maximum number of the reference pictures defined by the profile and level. Thus, it is required that the picture encoding apparatus controls the reference pictures and performs encoding so that the same operation can be realized (the number of reference pictures does not surpass the predetermined value) when the picture decoding apparatus operates based on the constraint conditions.

[0170] Similarly, the picture decoding apparatus has the same number of reference pictures as the picture encoding apparatus does. In addition, additional memory space is needed for the post decoder buffer. The maximum number of post decoder pictures is defined by equation (3).

$$N_P = N_R - 2 \qquad (3)$$

[0171] Here, N_P presents the maximum number of post decoder pictures whereas N_R presents the maximum number of the reference pictures defined by the profile and level definition.

[0172] The maximum number of post decoder pictures shall be therefore considered in the design of the picture decoding apparatus so that the picture decoding apparatus complies with the profile and level definition. The maximum number of the post decoder pictures can be either calculated with the use of the equation (3) or specified in the profile and level definition. Once the maximum number of post decoder pictures is specified in the profile and level definition, the maximum number of backward prediction pictures can be calculated based on equation (4).

$$N_B = N_P + 1 \qquad (4)$$

[0173] Here, N_B presents the maximum number of backward prediction pictures in the reference picture buffer. In the present embodiment, N_B presents the minimum memory requirements required by the picture decoding apparatus so as to decode a stream complying with the profile and level definition.

[0174] It is possible to limit the number of pictures used for backward prediction in order to reduce the number of the additional post decoder pictures added to the reference picture buffer by the side of the picture decoding apparatus. For example, when the maximum number of the pictures used for backward prediction is limited to 2, only one additional post decoder picture is required to be added to the reference picture buffer, which can prevent the allocation of unnecessary physical memory space for the post decoder pictures on the side of the picture decoding apparatus.

(Seventh Embodiment)

[0175] Furthermore, it is possible to easily perform the processing shown in the above embodiments in an independent computing system by recording a program for realizing the picture encoding method and the picture decoding method shown in the above-mentioned embodiments onto the storage medium such as a flexible disk.

[0176] Fig. 19 is an illustration for realizing the picture encoding/decoding method of the above embodiments using a program recorded onto a storage medium like a flexible disk.

[0177] Fig. 19B shows a full appearance of a flexible disk, its structure at cross section and the flexible disk itself whereas Fig. 19A shows an example of a physical format of the flexible disk as a main body of a storing medium. A flexible disk FD1 is contained in a case F, a plurality of tracks Tr are formed concentrically from the periphery to the inside on the surface of the disk, and each track is divided into 16 sectors Se in the angular direction. Therefore, as for the flexible disk storing the above-mentioned program, data as the aforementioned program is stored in an area assigned for it on the flexible disk FD1.

[0178] Fig. 19C shows a structure for recording and reading out the program on the flexible disk FD1. When the program is recorded on the flexible disk FD1, the computing system Cs writes in data as the program via a flexible disk drive FDD. When the picture encoding method and the picture decoding method for realizing the picture encoding method and the picture decoding method as the program on the flexible disk are constructed in the computing system, the program is read out from the flexible disk by the flexible disk drive FDD and then transferred to the computing system Cs.

[0179] The above explanation is made on an assumption that a storing medium is a flexible disk, but the same processing can also be performed using an optical disk. In addition, the storing medium is not limited to a flexible disk and an optical disk, but any other medium such as an IC card and a ROM cassette capable of recording a program can be used.

(Eighth Embodiment)

[0180] The following is an explanation of the applications of the picture encoding method as well as the picture decoding method as shown in the above-mentioned embodiments, and a system using them.

[0181] Fig. 20 is a block diagram showing an overall configuration of a content supply system ex100 for realizing content distribution service. The area for providing communication service is divided into cells of desired size, and cell sites ex107~ex110 which are fixed wireless stations are placed in respective cells.

[0182] This content supply system ex100 is connected to devices such as Internet ex101, an Internet service provider ex102, a telephone network ex104, as well as a computer ex111, a PDA (Personal Digital Assistant) ex112, a camera ex113, a cell phone ex114 and a cell phone with a camera ex115 via the cell sites ex107~ex110.

[0183] However, the content supply system ex100 is not limited to the configuration as shown in Fig. 20 and may be connected to a combination of any of them. Also, each device may be connected directly to the telephone network ex104, not through the cell sites ex107~ex110.

[0184] The camera ex113 is a device capable of shooting video such as a digital video camera. The cell phone ex114 may be a cell phone of any of the following system: a PDC (Personal Digital Communications) system, a CDMA (Code Division Multiple Access) system, a W-CDMA (Wideband-Code Division Multiple Access) system or a GSM (Global System for Mobile Communications) system, a PHS (Personal Handyphone System) or the like.

[0185] A streaming server ex103 is connected to the camera ex113 via the telephone network ex104 and also the cell site ex109, which realizes a live distribution or the like using the camera ex113 based on the coded data transmitted from the user. Either the camera ex113 or the server which transmits the data may code the data. Also, the picture data shot by a camera ex116 may be transmitted to the streaming server ex103 via the computer ex111. In this case, either the camera ex116 or the computer ex111 may code the picture data. An LSI ex117 included in the computer ex111 or the camera ex116 actually performs encoding processing. Software for encoding and decoding pictures may be integrated into any type of storage medium (such as a CD-ROM, a flexible disk and a hard disk) that is a recording medium which is readable by the computer ex111 or the like. Furthermore, a cell phone with a camera ex115 may transmit the picture data. This picture data is the data encoded by the LSI included in the cell phone ex115.

[0186] The content supply system ex100 encodes contents (such as a music live video) shot by a user using the camera ex113, the camera ex116 or the like in the same way as shown in the above-mentioned embodiments and transmits them to the streaming server ex103, while the streaming server ex103 makes stream distribution of the content data to the clients at their requests. The clients include the computer ex111, the PDA ex112, the camera ex113, the cell phone ex114 and so on capable of decoding the above-mentioned encoded data. In the content supply system ex100, the clients can thus receive and reproduce the encoded data, and can further receive, decode and reproduce the data in real time so as to realize personal broadcasting.

[0187] When each device in this system performs encoding or decoding, the picture encoding method or the picture decoding method shown in the above-mentioned embodiments can be used.

[0188] A cell phone will be explained as an example of the device.

[0189] Fig. 21 is a diagram showing the cell phone ex115 using the picture encoding method and the picture decoding method explained in the above-mentioned embodiments. The cell phone ex115 has an antenna ex201 for communicating with the cell site ex110 via radio waves, a camera unit ex203 such as a CCD camera capable of shooting moving and still pictures, a display unit ex202 such as a liquid crystal display for displaying the data such as decoded pictures and

the like shot by the camera unit ex203 or received by the antenna ex201, a body unit including a set of operation keys ex204, a audio output unit ex208 such as a speaker for outputting audio, a audio input unit ex205 such as a microphone for inputting audio, a storage medium ex207 for storing coded or decoded data such as data of moving or still pictures shot by the camera, data of received e-mails and that of moving or still pictures, and a slot unit ex206 for attaching the storage medium ex207 to the cell phone ex115. The storage medium ex207 stores in itself a flash memory element, a kind of EEPROM (Electrically Erasable and Programmable Read Only Memory) that is a nonvolatile memory electrically erasable from and rewritable to a plastic case such as an SD card, or the like.

[0190] Next, the cell phone ex115 will be explained with reference to Fig. 22. In the cell phone ex115, a main control unit ex311, designed in order to control overall each unit of the main body which contains the display unit ex202 as well as the operation keys ex204, is connected mutually to a power supply circuit unit ex310, an operation input control unit ex304, a picture encoding unit ex312, a camera interface unit ex303, an LCD (Liquid Crystal Display) control unit ex302, a picture decoding unit ex309, a multiplexing/demultiplexing unit ex308, a read/write unit ex307, a modem circuit unit ex306 and a audio processing unit ex305 via a synchronous bus ex313.

[0191] When a call-end key or a power key is turned ON by a user's operation, the power supply circuit unit ex310 supplies respective units with power from a battery pack so as to activate the camera attached digital cell phone ex115 as a ready state.

[0192] In the cell phone ex115, the audio processing unit ex305 converts the audio signals received by the audio input unit ex205 in conversation mode into digital audio data under the control of the main control unit ex311 including a CPU, ROM and RAM, the modem circuit unit ex306 performs spread spectrum processing of the digital audio data, and the communication circuit unit ex301 performs digital-to-analog conversion and frequency transform of the data, so as to transmit it via the antenna ex201. Also, in the cell phone ex115, the communication circuit unit ex301 amplifies the data received by the antenna ex201 in conversation mode and performs frequency transform and analog-to-digital conversion to the data, the modem circuit unit ex306 performs inverse spread spectrum processing of the data, and the audio processing unit ex305 converts it into analog audio data, so as to output it via the audio output unit ex208.

[0193] Furthermore, when transmitting an e-mail in data communication mode, the text data of the e-mail inputted by operating the operation keys ex204 of the main body is sent out to the main control unit ex311 via the operation input control unit ex304. In the main control unit ex311, after the modem circuit unit ex306 performs spread spectrum processing of the text data and the communication circuit unit ex301 performs digital-to-analog conversion and frequency transform for the text data, the data is transmitted to the cell site ex110 via the antenna ex201.

[0194] When picture data is transmitted in data communication mode, the picture data shot by the camera unit ex203 is supplied to the picture encoding unit ex312 via the camera interface unit ex303. When it is not transmitted, it is also possible to display the picture data shot by the camera unit ex203 directly on the display unit ex202 via the camera interface unit ex303 and the LCD control unit ex302.

[0195] The picture encoding unit ex312, which includes the picture encoding apparatus as explained in the present invention, compresses and codes the picture data supplied from the camera unit ex203 by the encoding method used for the picture encoding apparatus as shown in the above-mentioned first embodiment so as to transform it into encoded picture data, and sends it out to the multiplexing/demultiplexing unit ex308. At this time, the cell phone ex115 sends out the audio received by the audio input unit ex205 during the shooting with the camera unit ex203 to the multiplexing/demultiplexing unit ex308 as digital audio data via the audio processing unit ex305.

[0196] The multiplexing/demultiplexing unit ex308 multiplexes the encoded picture data supplied from the picture encoding unit ex312 and the audio data supplied from the audio processing unit ex305 using a predetermined method, then the modem circuit unit ex306 performs spread spectrum processing of the multiplexed data obtained as a result of the multiplexing, and lastly the communication circuit unit ex301 performs digital-to-analog conversion and frequency transform of the data for the transmission via the antenna ex201.

[0197] As for receiving data of a moving picture file which is linked to a Web page or the like in data communication mode, the modem circuit unit ex306 performs inverse spread spectrum processing of the data received from the cell site ex110 via the antenna ex201, and sends out the multiplexed data obtained as a result of the inverse spread spectrum processing.

[0198] In order to decode the multiplexed data received via the antenna ex201, the multiplexing/demultiplexing unit ex308 separates the multiplexed data into an encoded stream of picture data and that of audio data, and supplies the encoded picture data to the picture decoding unit ex309 and the audio data to the audio processing unit ex305 respectively via the synchronous bus ex313.

[0199] Next, the picture decoding unit ex309, including the picture decoding apparatus as explained in the above-mentioned invention, decodes the encoded stream of picture data using the decoding method corresponding to the encoding method as shown in the above-mentioned embodiments to generate reproduced moving picture data, and supplies this data to the display unit ex202 via the LCD control unit ex302, and thus the picture data included in the moving picture file linked to a Web page, for instance, is displayed. At the same time, the audio processing unit ex305 converts the audio data into analog audio data, and supplies this data to the audio output unit ex208, and thus the audio

data included in the moving picture file linked to a Web page, for instance, is reproduced.

[0200] The present invention is not limited to the above-mentioned system as such ground-based or satellite digital broadcasting has been in the news lately and at least either the picture encoding apparatus or the picture decoding apparatus described in the above-mentioned embodiments can be incorporated into a digital broadcasting system as shown in Fig. 23. More specifically, an encoded stream of video information is transmitted from a broadcast station ex409 to or communicated with a broadcast satellite ex410 via radio waves. Upon receipt of it, the broadcast satellite ex410 transmits radio waves for broadcasting. Then, a home-use antenna ex406 with a satellite broadcast reception function receives the radio waves, and a television (receiver) ex401 or a set top box (STB) ex407 decodes the encoded stream for reproduction. The picture decoding apparatus as shown in the above-mentioned embodiment can be implemented in a reproducing apparatus ex403 for reading out and decoding the encoded stream recorded on a storage medium ex402 that is a recording medium such as CD and DVD. In this case, the reproduced video signals are displayed on a monitor ex404. It is also conceivable to implement the picture decoding apparatus in the set top box ex407 connected to a cable ex405 for a cable television or the antenna ex406 for satellite and/or ground-based broadcasting so as to reproduce them on a monitor ex408 of the television ex401. The picture decoding apparatus may be incorporated into the television, not in the set top box. Also, a car ex412 having an antenna ex411 can receive signals from the satellite ex410 or the cell site ex107 for reproducing moving pictures on a display device such as a car navigation system ex413 set in the car ex412.

[0201] Furthermore, the picture encoding apparatus as shown in the above-mentioned embodiments can encode picture signals and record them on a recording medium. As a concrete example, a recorder ex420 such as a DVD recorder for recording picture signals on a DVD disk ex421, a disk recorder for recording them on a hard disk, or the like can be cited. They can be recorded on an SD card ex422. If the recorder ex420 includes the picture decoding apparatus as shown in the above-mentioned embodiments, the picture signals recorded on the DVD disk ex421 or the SD card ex422 can be reproduced for display on the monitor ex408.

[0202] As for the structure of the car navigation system ex413, the structure without the camera unit ex203, the camera interface unit ex303 and the picture encoding unit ex312, out of the components shown in Fig. 22, for example, is conceivable. The same applies for the computer ex111, the television (receiver) ex401 and others.

[0203] In addition, three types of implementations can be conceived for a terminal such as the above-mentioned cell phone ex114; a sending/receiving terminal implemented with both an encoder and a decoder, a sending terminal implemented with an encoder only, and a receiving terminal implemented with a decoder only.

[0204] As described above, it is possible to use the picture encoding method or the picture decoding method described in the above-mentioned embodiments for any of the above-mentioned devices and systems, and by thus doing, the effects described in the above-mentioned embodiments can be obtained. Also, the present invention is not limited to the above-mentioned embodiments and a wide range of variations or modifications within the scope of the following claims are possible.

[0205] In the present embodiment, the term "display" means to output after reordering the order of the pictures into a display order. Namely, a process for outputting a decoded picture to a display device is described as "display". An operation of outputting the decoded picture in order to record it onto other recording device, for instance, applies to this special usage of "display". When the display device has a picture memory, it is possible to transmit the decoded picture to the display device earlier than the actual display time.

Industrial Applicability

[0206] The present invention is used for a picture encoding apparatus for encoding a picture by a predictive encoding with reference to a decoded picture stored in a decoded picture buffer, decoding the encoded picture and storing the decoded picture in the decoded picture buffer and a picture encoding apparatus for decoding the picture encoded by a predictive encoding with reference to a decoded picture stored in a decoded picture buffer and storing the decoded picture in the decoded picture buffer.

[0207] It follows a list of further embodiments of the invention:

Embodiment 1. A picture encoding method of predictively encoding an input picture with reference to pictures stored in a picture buffer and decoding the encoded input picture, the picture encoding method comprising:

judging whether or not the decoded picture is for reference and whether or not the decoded picture is for output, needing to be stored until display time of the decoded picture; and

storing the decoded picture in the picture buffer as one of the following uses: for reference and for output, based on each result of the judgments.

Embodiment 2. The picture encoding method with the features of embodiment 1, comprising:

a first judgment step of judging whether or not the decoded picture is for reference;
a second judgment step of judging whether or not the decoded picture is for output, needing to be stored until display time of the decoded picture; and
a management step of managing the picture buffer so that the picture buffer stores the decoded picture judged to be for reference in the first judgment step and the decoded picture judged to be for output in the second judgment step.

Embodiment 3. The picture encoding method with the features of embodiment 2,
wherein the picture buffer has a specified size,
the method further comprises:

a third judgment step of judging whether or not the picture for reference stored in the picture buffer is no longer used as a reference picture; and
a fourth judgment step of judging whether or not the picture stored in the picture buffer is already outputted, and

in the management step, an area storing a picture in the picture buffer is reused within a scope of the specified size based on each result of the judgments in the third and fourth judgment steps.

Embodiment 4. The picture encoding method with the features of embodiment 3, further comprising an encoding step of encoding, for each sequence, information indicating the specified size for encoding said sequence including a plurality of encoded pictures.

Embodiment 5. The picture encoding method with the features of embodiment 3,
wherein in the management step, one of the picture judged to be for reference in the first judgment step and the picture judged to be for output in the second judgment step is stored in an area storing a picture that is not for reference and is judged as already outputted in the fourth judgment step, when the picture buffer doesn't have an area capable of storing newly a picture.

Embodiment 6. The picture encoding method with the features of embodiment 3,
wherein in the management step, one of the picture judged to be for reference in the first judgment step and the picture judged to be for output in the second judgment step is stored in an area storing a picture whose display order is the earliest of the pictures that are not for reference and stored in the picture buffer, when the picture buffer doesn't have an area capable of storing newly a picture.

Embodiment 7. The picture encoding method with the features of embodiment 1, further comprising a releasing step of releasing an area other than an area storing a picture which is stored before a size of the input picture is modified and is not partly or wholly damaged after being stored, out of areas storing display pictures, when the size modification takes place in a sequence including a plurality of encoded pictures.

Embodiment 8. A picture decoding method of decoding an input picture that is predictively encoded with reference to pictures stored in a picture buffer, the picture decoding method comprising:

judging whether or not the decoded picture is for reference and whether or not the decoded picture is for output, needing to be stored until display time of the decoded picture; and
storing the decoded picture in the picture buffer as one of the following uses: for reference and for output, based on each result of the judgments.

Embodiment 9. The picture decoding method with the features of embodiment 8, comprising:

a first judgment step of judging whether or not the decoded picture is for reference;
a second judgment step of judging whether or not the decoded picture is for output, needing to be stored until display time of the decoded picture; and
a management step of managing the picture buffer so that the picture buffer stores the decoded picture judged to be for reference in the first judgment step and the decoded picture judged to be for output in the second judgment step.

Embodiment 10. The picture decoding method with the features of embodiment 9,
wherein the picture buffer has a specified size,

the method further comprises:

a third judgment step of judging whether or not the picture for reference stored in the picture buffer is no longer used as a reference picture; and
a fourth judgment step of judging whether or not the picture stored in the picture buffer is already outputted, and

in the management step, an area storing a picture in the picture buffer is reused within a scope of the specified size based on each result of the judgments in the third and fourth judgment steps.

Embodiment 11. The picture decoding method with the features of embodiment 10, further comprising a decoding step of obtaining the specified size of a sequence unit for each sequence including a plurality of encoded pictures.

Embodiment 12. The picture decoding method with the features of embodiment 10,
wherein in the management step, one of the decoded picture judged to be for reference in the first judgment step and the decoded picture judged to be for output in the second judgment step is stored in an area storing a picture that is not for reference and is judged as already outputted in the fourth judgment step, when the picture buffer doesn't have an area capable of storing newly a picture.

Embodiment 13. The picture decoding method with the features of embodiment 10,
wherein in the management step, one of the decoded picture judged to be for reference in the first judgment step and the picture judged to be for output in the second judgment step is stored in an area storing a picture whose display order is the earliest of the pictures that are not for reference and stored in the picture buffer, when the picture buffer doesn't have an area capable of storing newly a picture.

Embodiment 14. The picture decoding method with the features of embodiment 8, further comprising an outputting step of outputting an area other than an area storing a picture which is stored before a size of the input picture is modified and is not partly or wholly damaged after being stored, out of pictrures that are not for reference and stored in the picture buffer, when the size modification takes place in a sequence including a plurality of encoded pictures.

Embodiment 15. A picture encoding apparatus for predictively encoding an input picture with reference to pictures stored in a picture buffer and decoding the encoded input picture,
wherein the picture encoding apparatus judges whether or not the decoded picture is for reference and whether or not the decoded picture is for output, needing to be stored until display time of the decoded picture, and stores the decoded picture in the picture buffer as one of the following uses: for reference and for output, based on each result of the judgments.

Embodiment 16. The picture encoding apparatus with the features of embodiment 15, comprising:

a first judgment unit operable to judge whether or not a decoded picture is for reference;
a second judgment unit operable to judge whether or not a decoded picture is for output, needing to be stored until display time of the decoded picture; and
a management unit operable to manage the picture buffer so that the picture buffer stores the picture judged to be for reference by the first judgment unit and the picture judged to be for output by the second judgment unit.

Embodiment 17. The picture encoding apparatus with the features of embodiment 16,
wherein the picture buffer has a specified size,
the apparatus further comprises:

a third judgment unit operable to judge whether or not the picture for reference stored in the picture buffer is no longer used as a reference picture; and
a fourth judgment unit operable to judge whether or not the picture stored in the picture buffer is already outputted, and
the management unit reuses an area storing a picture in the picture buffer within a scope of the specified size based on each result of the judgments made by the third and fourth judgment units.

Embodiment 18. The picture encoding apparatus with the features of embodiment 17, further comprising an encoding step of encoding, for each sequence, information indicating the specified size for encoding said sequence including a plurality of encoded pictures.

Embodiment 19. The picture encoding apparatus with the features of embodiment 17,
wherein the management unit stores one of the decoded picture judged to be for reference by the first judgment unit and the decoded picture judged to be for output by the second judgment unit in an area storing a picture that is not for reference and is judged as already outputted by the fourth judgment unit, when the picture buffer doesn't have an area capable of storing newly a picture.

Embodiment 20. The picture encoding apparatus with the features of embodiment 17,
wherein the management unit stores one of a picture judged to be for reference by the first judgment unit and a picture judged to be for output by the second judgment unit in an area storing a picture whose display order is the earliest of the pictures that are not for reference and stored in the picture buffer when the picture buffer doesn't have an area capable of storing newly a picture.

Embodiment 21. The picture encoding apparatus with the features of embodiment 15, further comprising a releasing step of releasing an area other than an area storing a picture which is stored before a size of the input picture is modified and is not partly or wholly damaged after being stored, out of areas storing pictures for display, when the size modification takes place in a sequence including a plurality of encoded pictures.

Embodiment 22. A picture decoding apparatus for decoding an input picture that is predictively encoded with reference to pictures stored in a picture buffer,
wherein the picture decoding apparatus judges whether or not the decoded picture is for reference and whether or not the decoded picture is for output, needing to be stored until display time of the decoded picture, and stores the decoded picture in the picture buffer as one of the following uses: for reference and for output, based on each result of the judgments.

Embodiment 23. The picture decoding apparatus with the features of embodiment 22, comprising:

a first judgment unit operable to judge whether or not the decoded picture is for reference;
a second judgment unit operable to judge whether or not the decoded picture is for output, needing to be stored until display time of the decoded picture; and
a management unit operable to manage the picture buffer so that the picture buffer stores the picture judged to be for reference by the first judgment unit and the picture judged to be for output by the second judgment unit.

Embodiment 24. The picture decoding apparatus with the features of embodiment 23,
wherein the picture buffer has a specified size,
the apparatus further comprises:

a third judgment unit operable to judge whether or not the picture for reference stored in the picture buffer is no longer used as a reference picture; and
a fourth judgment unit operable to judge whether or not the picture stored in the picture buffer is already outputted, and
the management unit reuses an area storing a picture in the picture buffer within a scope of the specified size based on each result of the judgments made by the third and fourth judgment units.

Embodiment 25. The picture decoding apparatus with the features of embodiment 24, further comprising a decoding unit operable to obtain the specified size of a sequence unit for each sequence including a plurality of encoded pictures.

Embodiment 26. The picture decoding apparatus with the features of embodiment 24,
wherein the management unit stores one of the decoded picture judged to be for reference by the first judgment unit and the decoded picture judged to be for output by the second judgment unit in an area storing a picture that is not for reference and is judged as already outputted by the fourth judgment unit, when the picture buffer doesn't have an area capable of storing newly a picture.

Embodiment 27. The picture decoding apparatus with the features of embodiment 24,
wherein the management unit stores one of a picture judged to be for reference by the first judgment unit and a picture judged to be for output by the second judgment unit in an area storing a picture whose display order is the earliest of the pictures that are not for reference and stored in the picture buffer, when the picture buffer doesn't have an area capable of storing newly a picture.

Embodiment 28. The picture decoding apparatus with the features of embodiment 22 further comprises an outputting step of outputting an area other than an area storing a picture which is stored before a size of the input picture is modified and is not partly or wholly damaged after being stored when the size modification takes place in a sequence including a plurality of encoded pictures.

Embodiment 29. A program causing a computer to execute either the picture encoding method with the features of embodiment 1 through embodiment 7 or the picture decoding method with the features of embodiment 8 through embodiment 14.

Claims

1. A memory management method for making an area of a buffer in which a reference picture is stored, re-usable for another decoded picture, the method comprising the steps of:

   marking first information indicating that the reference picture is no longer referred to, to the reference picture;
   marking second information indicating that the reference picture is already outputted for display, to the reference picture; and
   making the area of the buffer re-usable, based on the first and second information.

2. The memory management method according to claim 1,
   wherein, in the case that the first information is marked before the marking of the second information, the area of the buffer is made re-usable after the marking of the second information.

3. The memory management method according to claim 1,
   wherein, in the case that the first information is marked after the marking of the second information, the area of the buffer is made re-usable after the marking of the first information.

4. A decoding apparatus for decoding a coded picture signal, the apparatus comprising:

   a decoding unit operable to decode the coded picture signal to obtain a decoded picture;
   a buffer which stores the decoded picture;
   a reference picture management unit operable to judge whether the decoded picture is to be stored in the buffer as a reference picture, and further operable to judge whether the buffer has a picture that is no longer used as a reference picture; and
   a display picture management unit operable to judge whether a decoded non-reference picture is a picture to be displayed prior to other decoded pictures stored in the buffer or a picture to be stored in the buffer until a display time of the decoded non-reference picture, and further operable to judge whether or not the decoded picture stored in the buffer is already outputted for display,

   wherein the buffer is managed based on judgment made by the reference picture management unit and the display picture management unit.

Fig. 1

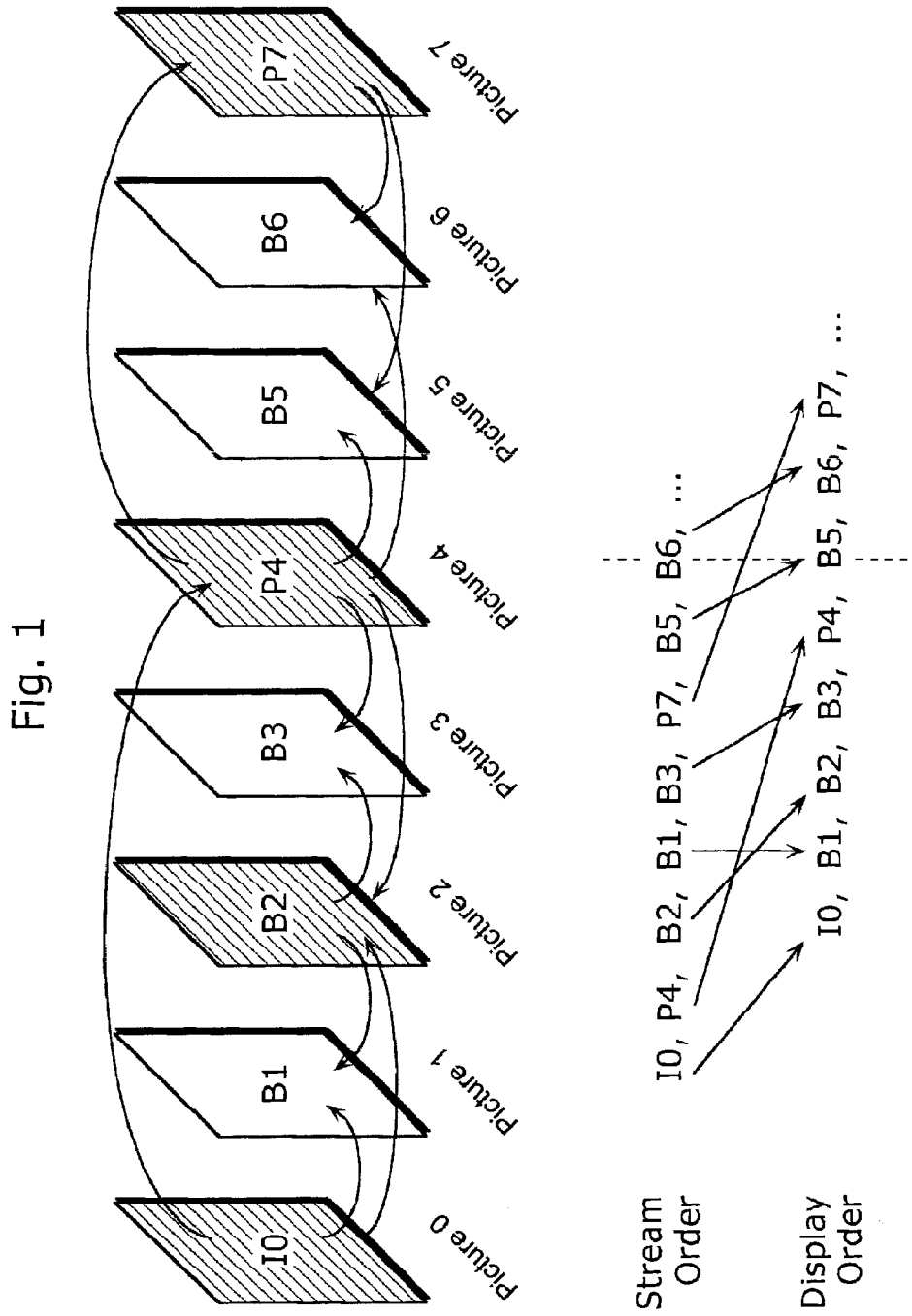

I0
B1
B2
B3
P4
B5
B6
P7
Picture 0
Picture 1
Picture 2
Picture 3
Picture 4
Picture 5
Picture 6
Picture 7
Stream Order
I0, P4, B2, B1, B3, P7, B5, B6, ...
Display Order
I0, B1, B2, B3, P4, B5, B6, P7, ...

Fig. 2

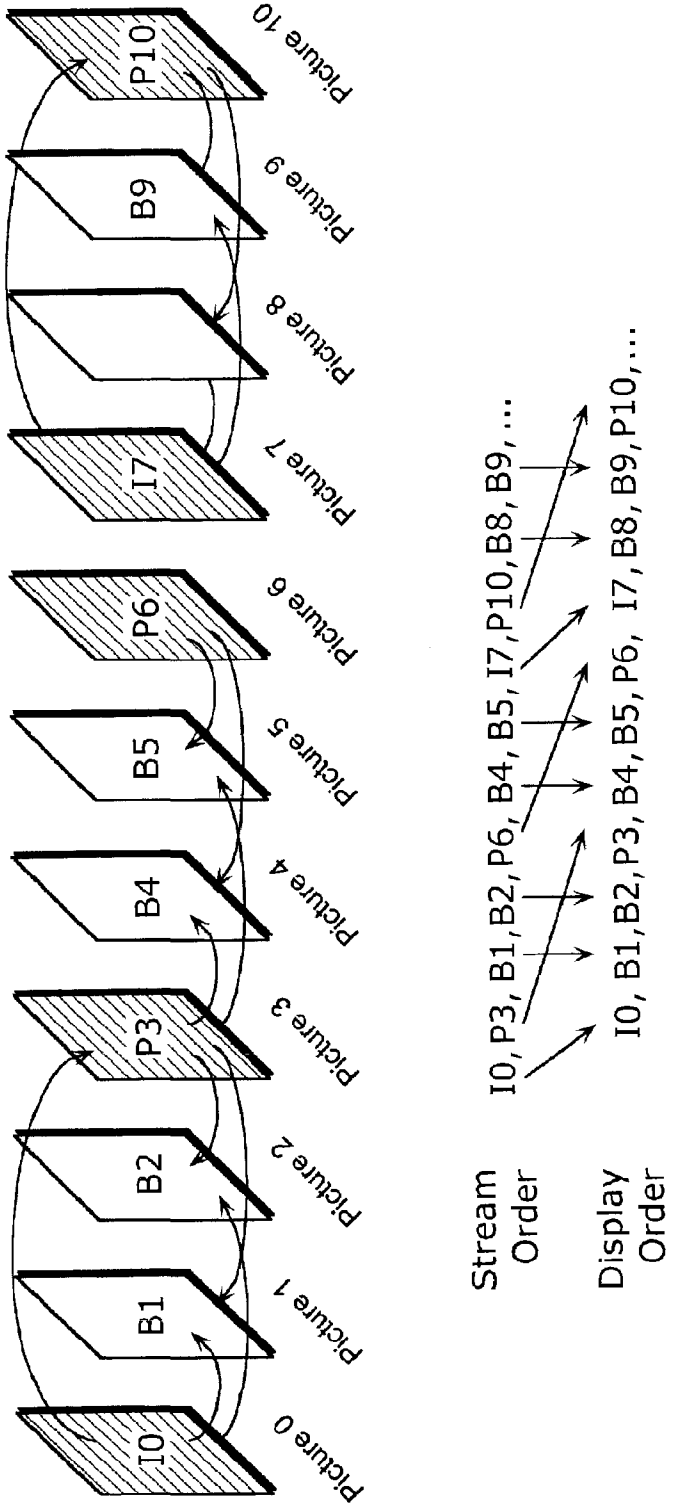

I0
B1
B2
P3
B4
B5
P6
I7
B8
B9
P10
Picture 0
Picture 1
Picture 2
Picture 3
Picture 4
Picture 5
Picture 6
Picture 7
Picture 8
Picture 9
Picture 10
Stream Order
I0, P3, B1, B2, P6, B4, B5, I7, P10, B8, B9, ...
Display Order
I0, B1, B2, P3, B4, B5, P6, I7, B8, B9, P10, ...

Fig. 3

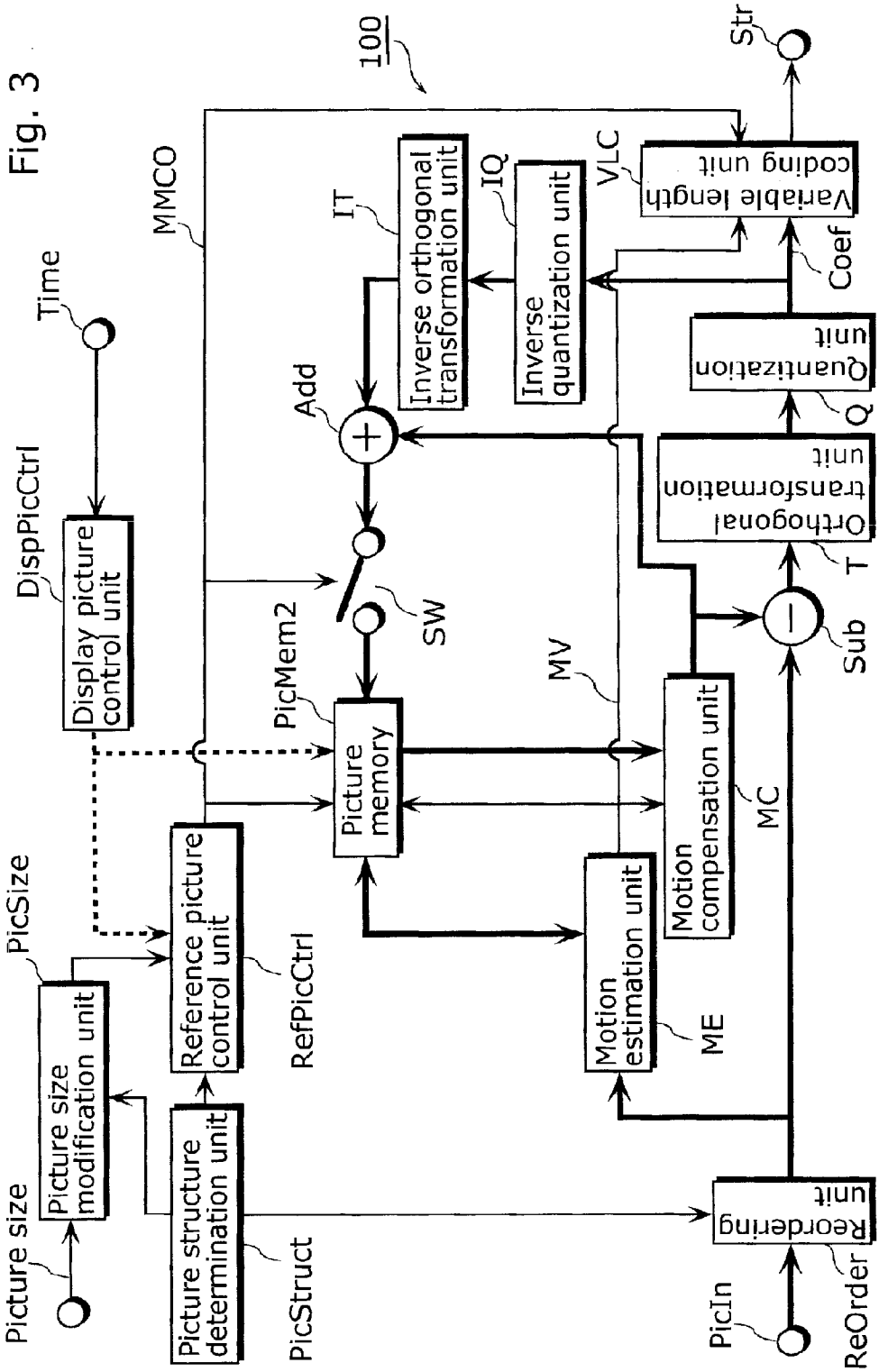
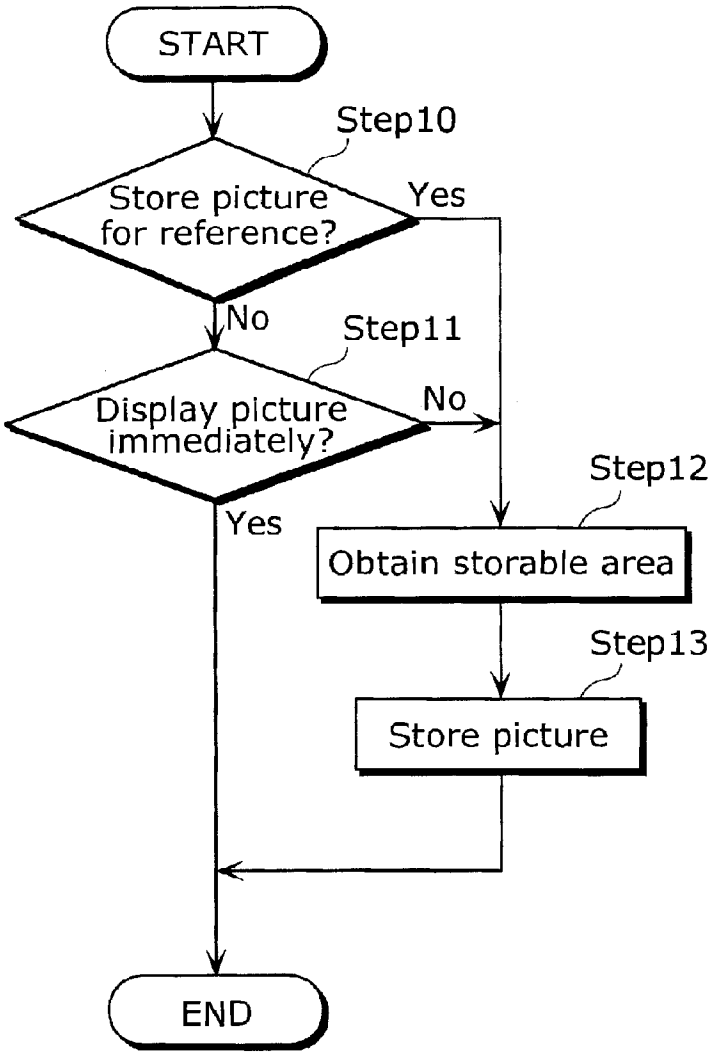

100
Str
Time
MMCO
IT
IQ
VLC
Inverse orthogonal transformation unit
Inverse quantization unit
Variable length coding unit
Coef
DispPicCtrl
Add
Quantization unit
Q
Display picture control unit
Orthogonal transformation unit
T
SW
Sub
PicMem2
MV
Picture memory
Motion compensation unit
MC
PicSize
Reference picture control unit
RefPicCtrl
Motion estimation unit
ME
Picture size modification unit
Picture size
Picture structure determination unit
PicStruct
Reordering unit
PicIn
ReOrder

Fig. 4


START
Step10
Store picture for reference?
Yes
No
Step11
Display picture immediately?
No
Yes
Step12
Obtain storable area
Step13
Store picture
END

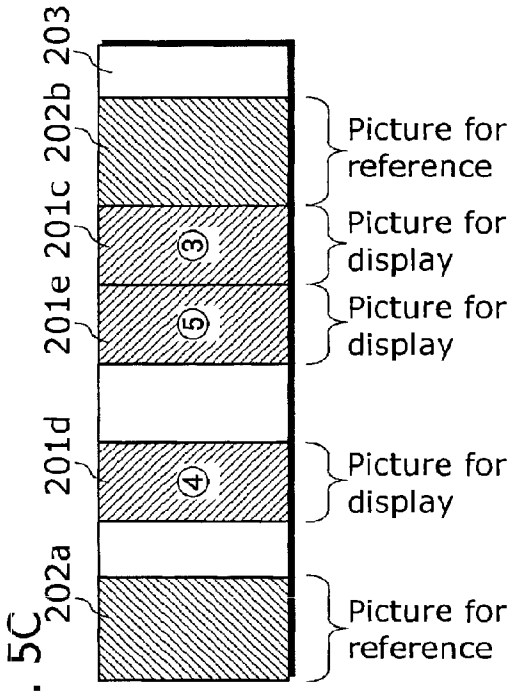


Fig. 5C

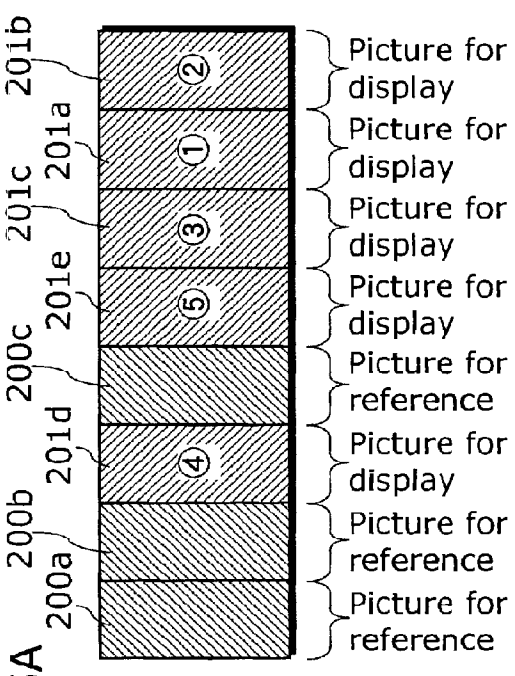


Fig. 5A

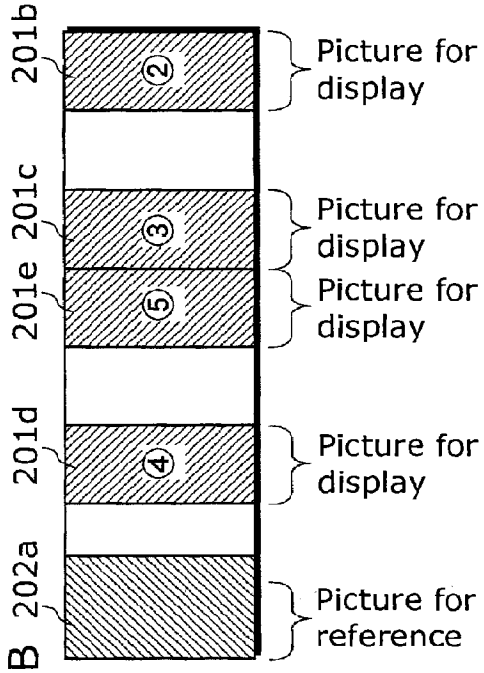


Fig. 5B

Fig. 6

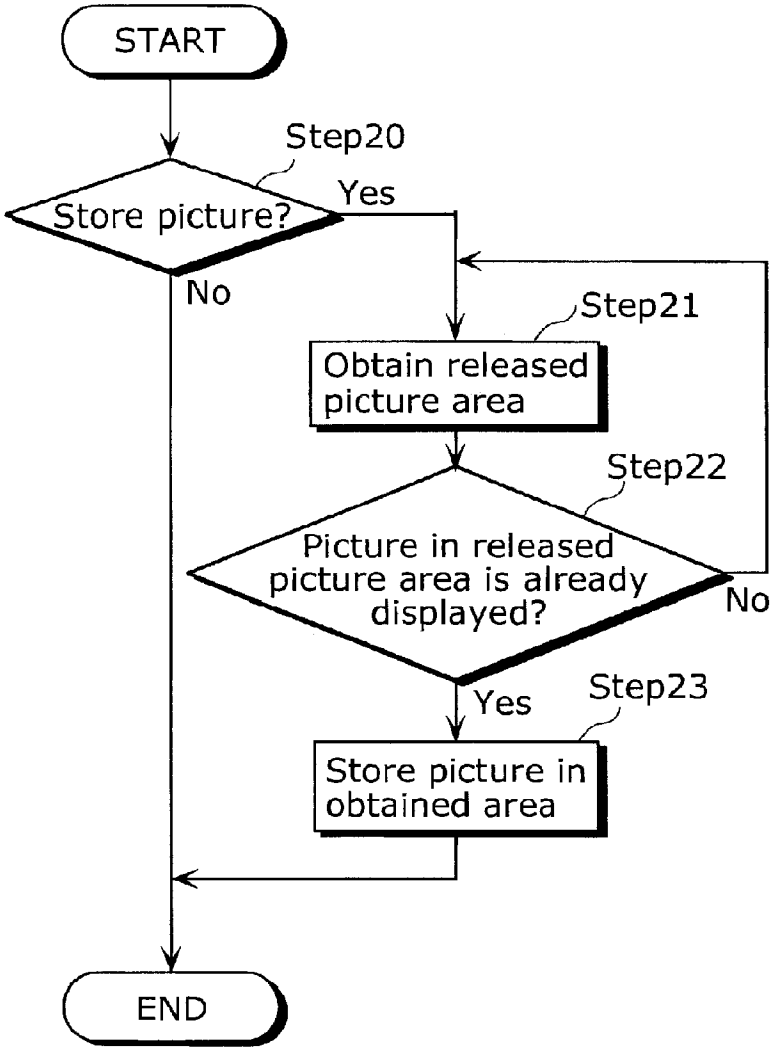

START
Step20
Store picture?
Yes
No
Step21
Obtain released picture area
Step22
Picture in released picture area is already displayed?
No
Yes
Step23
Store picture in obtained area
END

Fig. 7

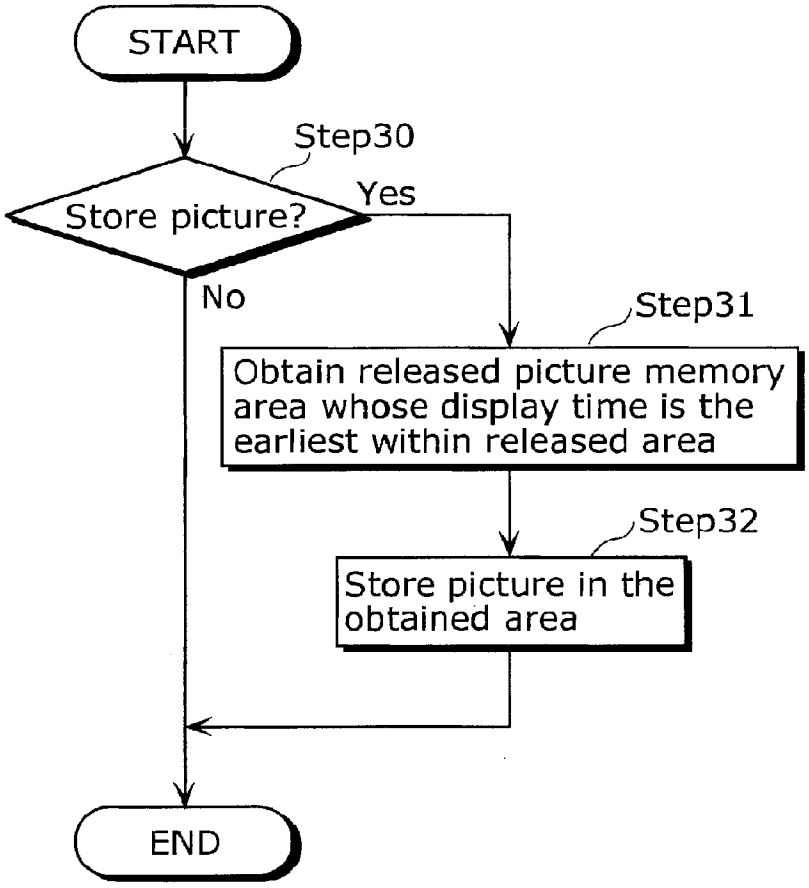
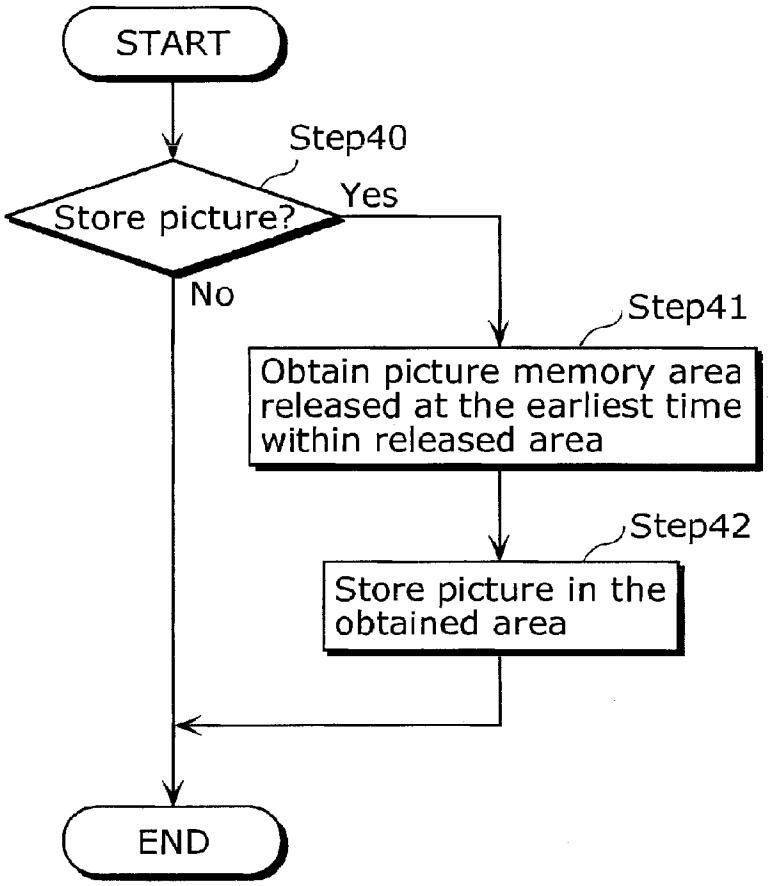

START
Step30
Store picture?
Yes
No
Step31
Obtain released picture memory area whose display time is the earliest within released area
Step32
Store picture in the obtained area
END

Fig. 8


START
Step40
Store picture?
Yes
No
Step41
Obtain picture memory area released at the earliest time within released area
Step42
Store picture in the obtained area
END

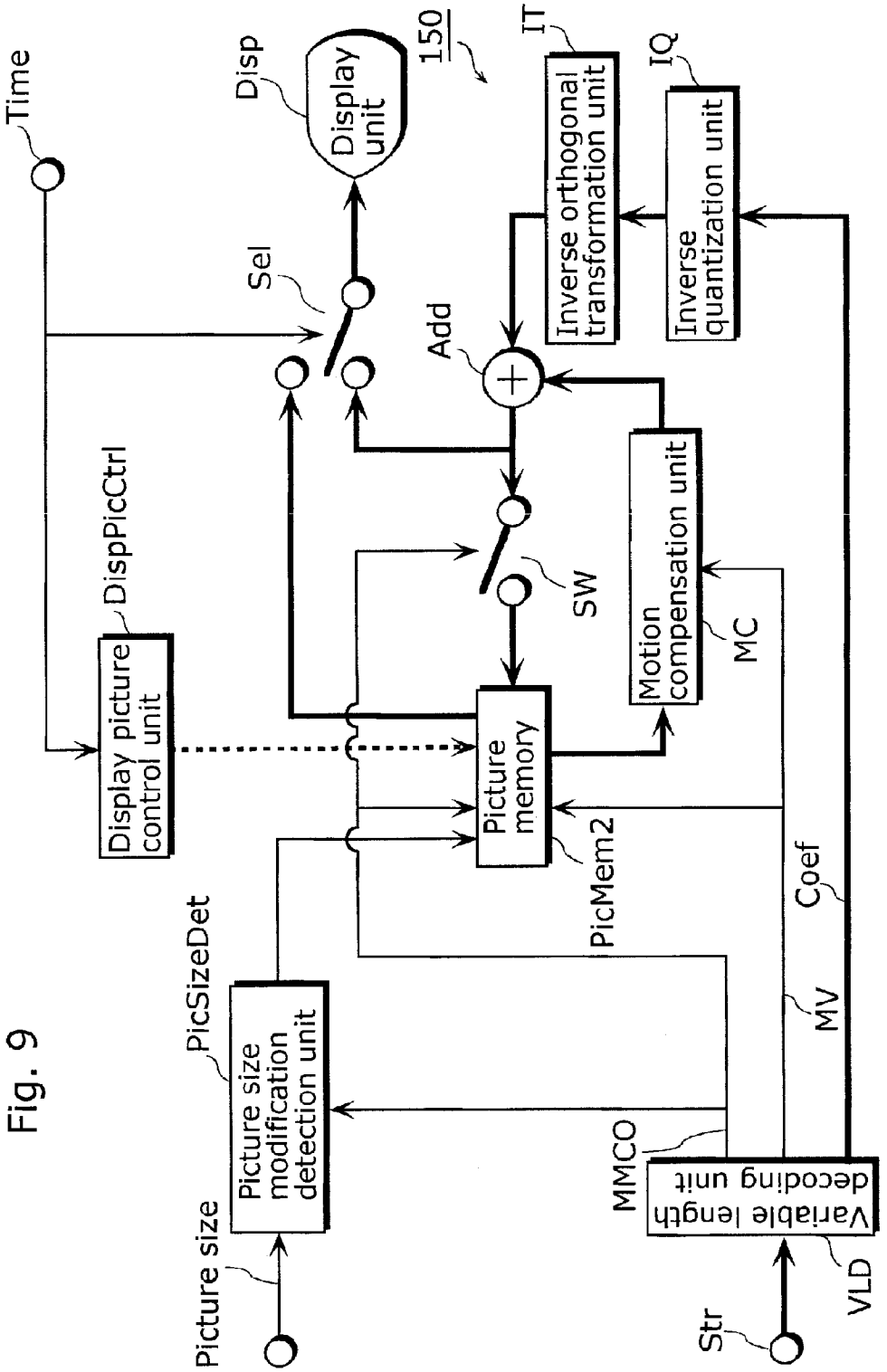

Time
Disp
Display unit
150
IT
Inverse orthogonal transformation unit
IQ
Inverse quantization unit
Sel
Add
DispPicCtrl
Display picture control unit
SW
Motion compensation unit
MC
Picture memory
PicMem2
Coef
MV
PicSizeDet
Picture size modification detection unit
MMCO
Variable length decoding unit
VLD
Picture size
Str

Fig. 9

Fig. 10

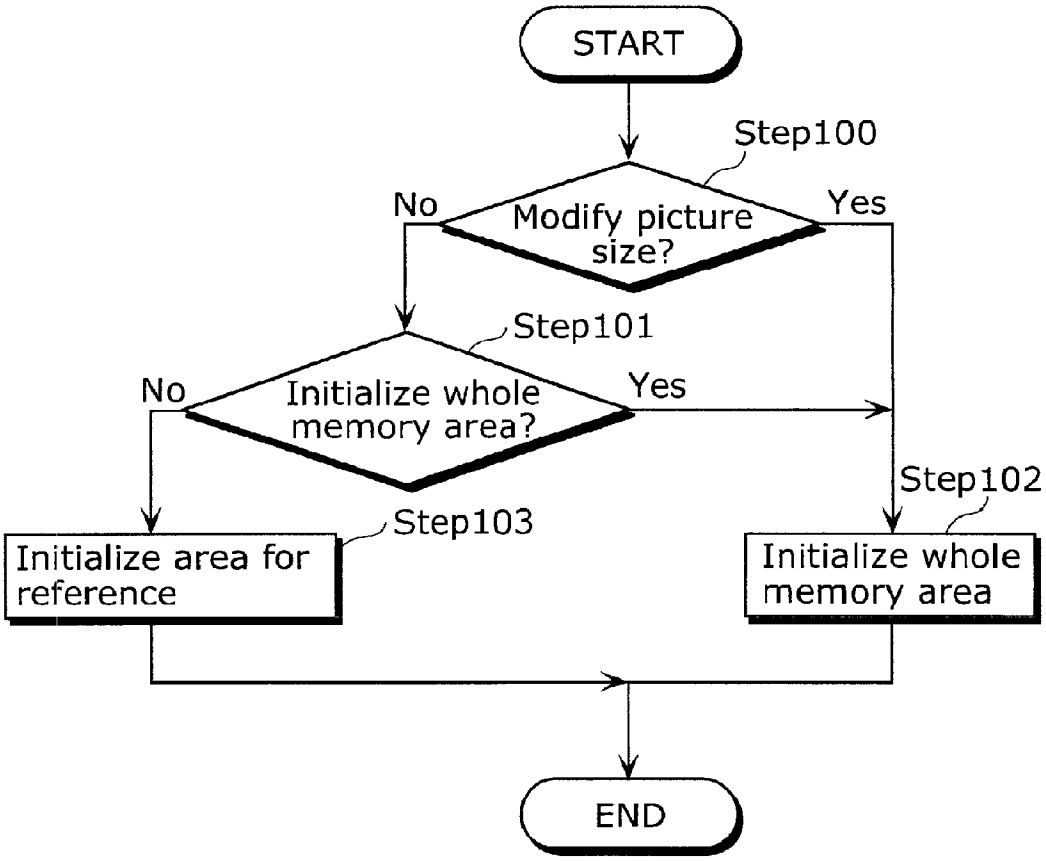

START
Step100
Modify picture size?
No
Yes
Step101
Initialize whole memory area?
No
Yes
Step102
Step103
Initialize area for reference
Initialize whole memory area
END

Fig. 11

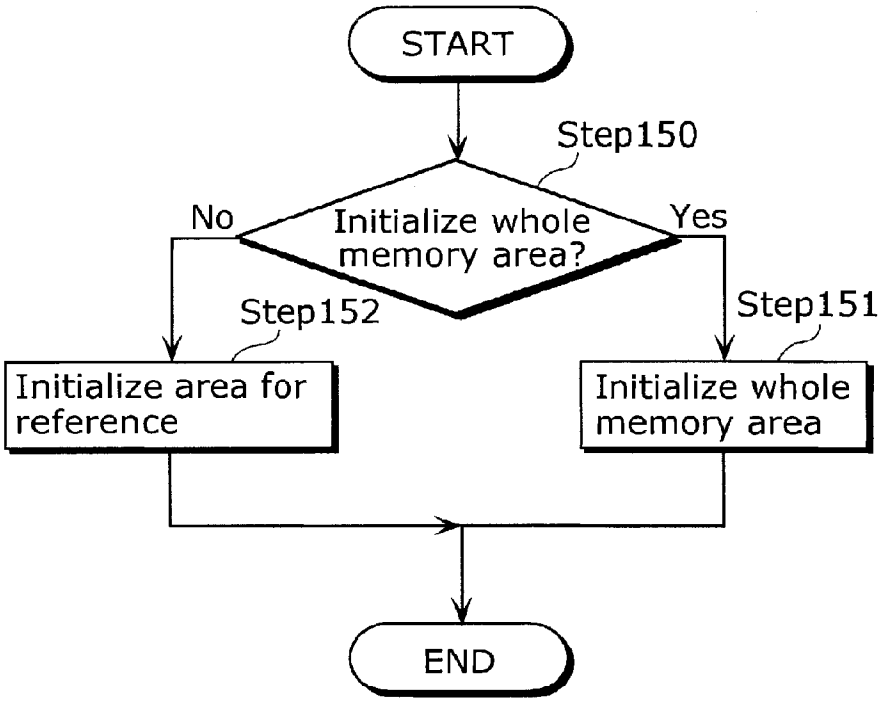

START
Step150
Initialize whole memory area?
No
Yes
Step152
Step151
Initialize area for reference
Initialize whole memory area
END

Fig. 12

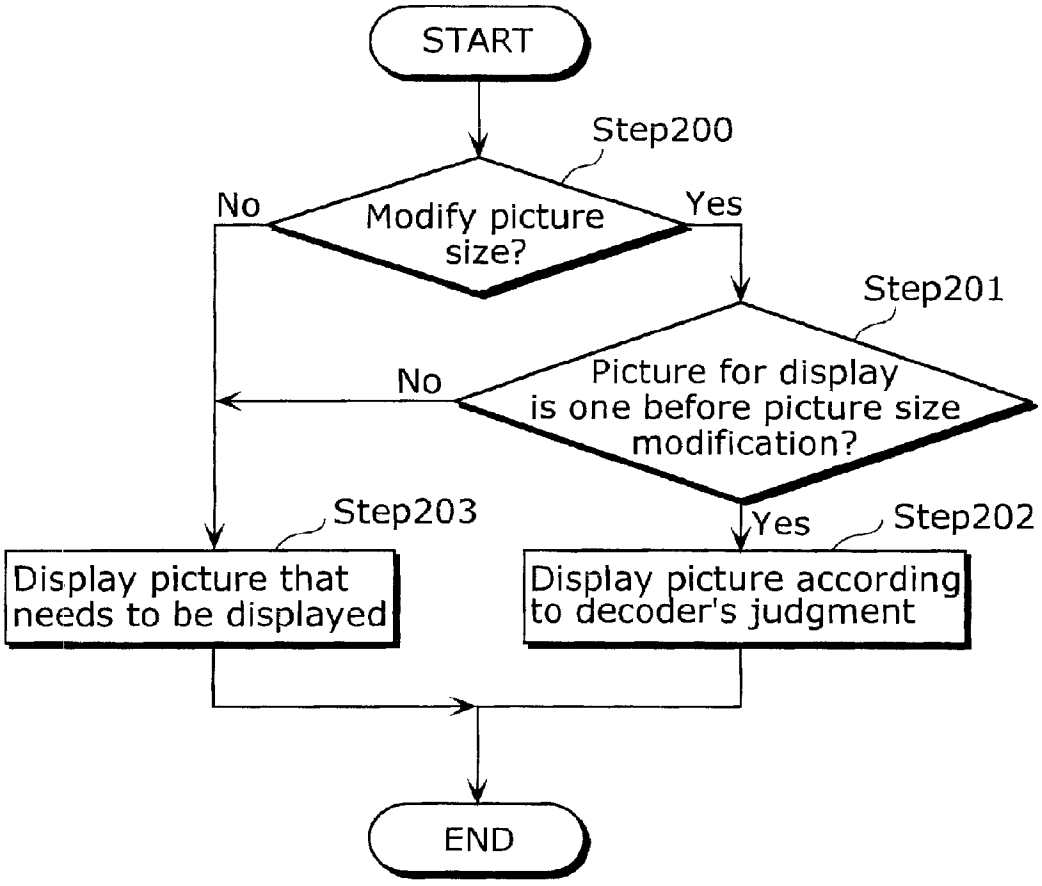

START
Step200
Modify picture size?
No
Yes
Step201
Picture for display is one before picture size modification?
No
Yes
Step203
Display picture that needs to be displayed
Step202
Display picture according to decoder's judgment
END

Fig. 13

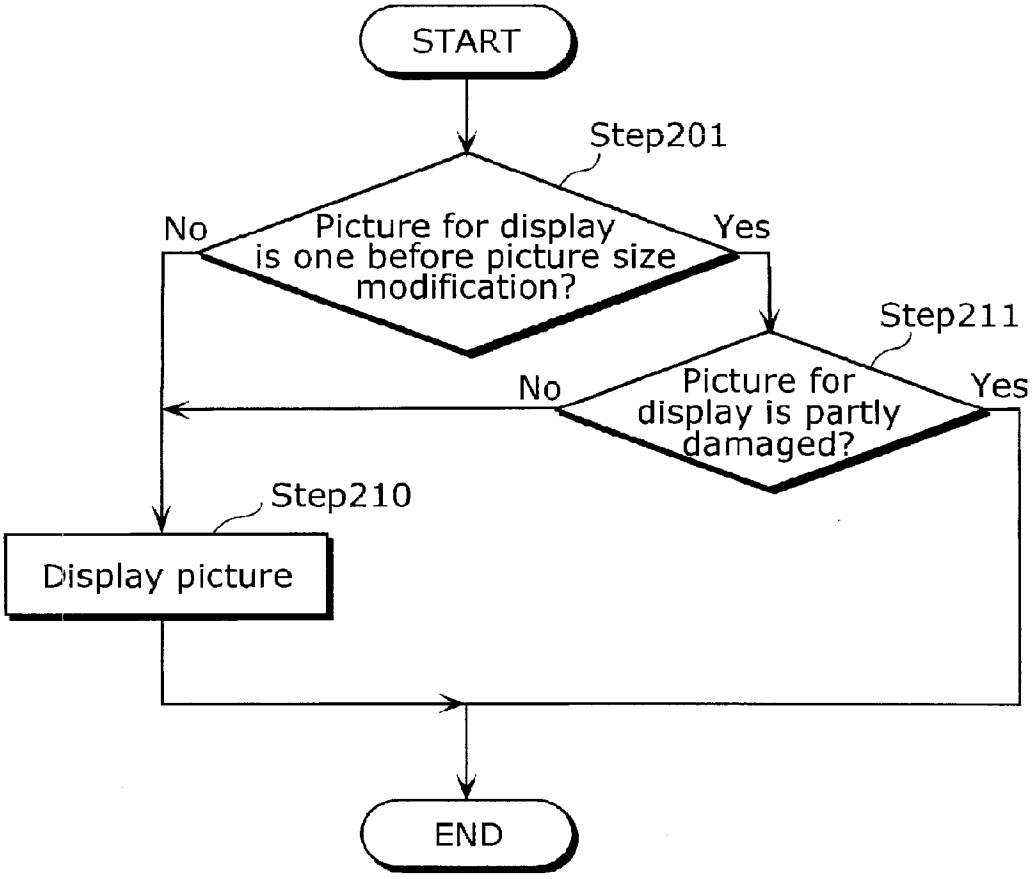

START
Step201
Picture for display is one before picture size modification?
No
Yes
Step211
Picture for display is partly damaged?
No
Yes
Step210
Display picture
END

Fig. 14

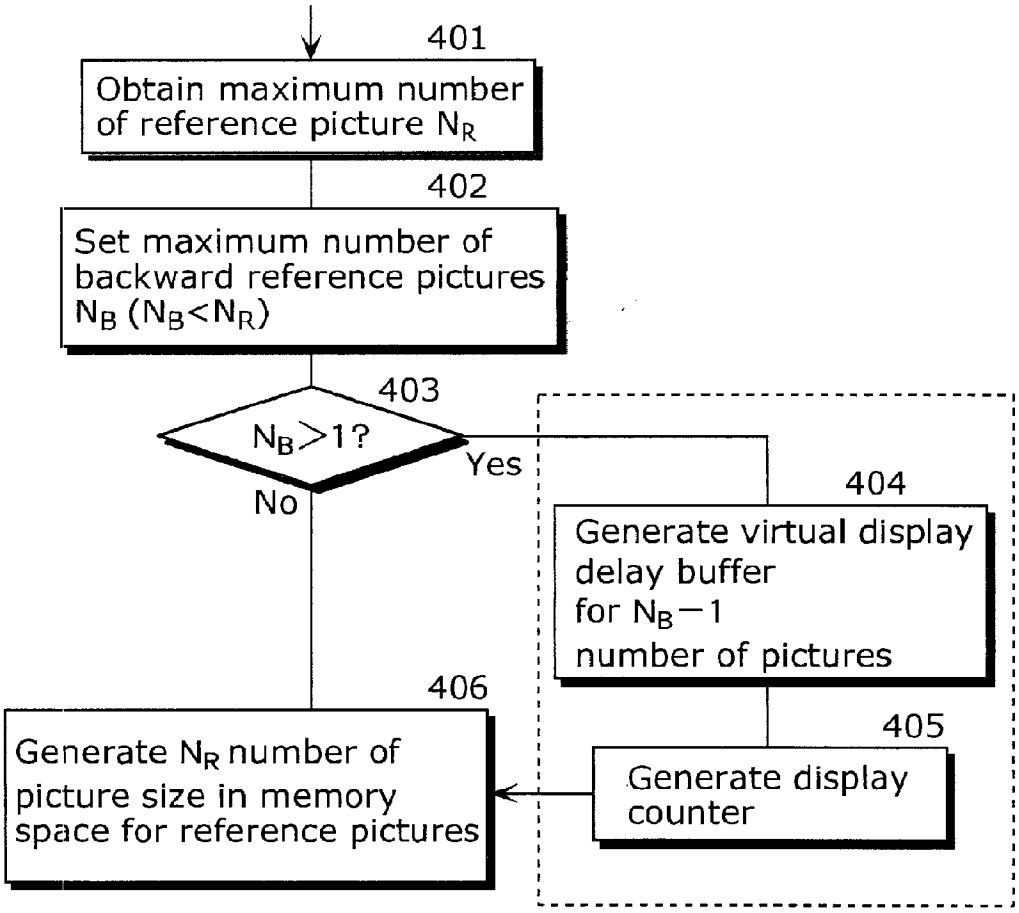

401
Obtain maximum number of reference picture N_R
402
Set maximum number of backward reference pictures N_B (N_B<N_R)
403
N_B>1?
Yes
No
404
Generate virtual display delay buffer for N_B−1 number of pictures
405
Generate display counter
406
Generate N_R number of picture size in memory space for reference pictures

Fig. 15

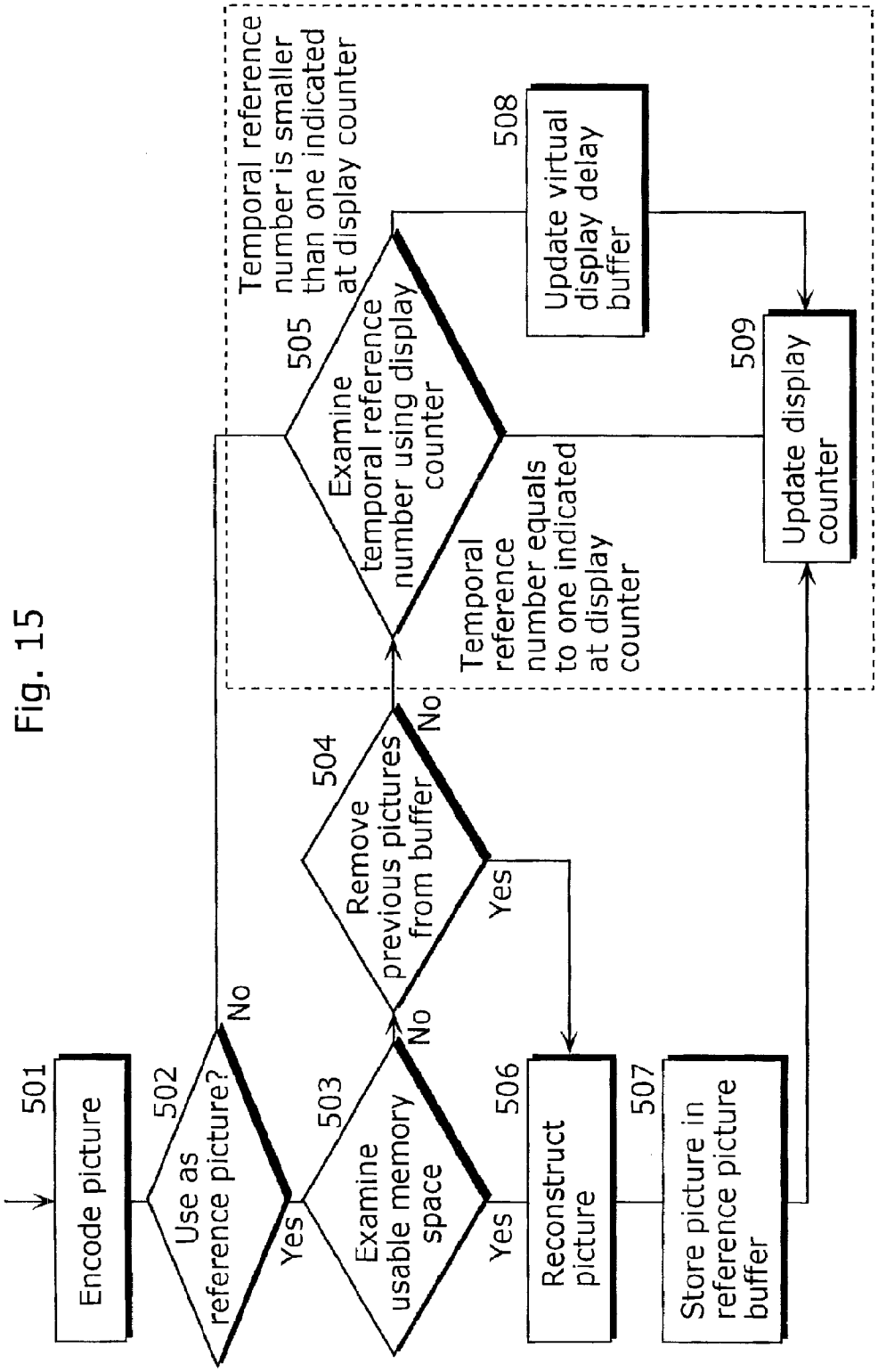

501
Encode picture
502
Use as reference picture?
No
Yes
503
Examine usable memory space
No
Yes
504
Remove previous pictures from buffer
No
Yes
505
Examine temporal reference number using display counter
Temporal reference number is smaller than one indicated at display counter
Temporal reference number equals to one indicated at display counter
506
Reconstruct picture
507
Store picture in reference picture buffer
508
Update virtual display delay buffer
509
Update display counter

Fig. 16

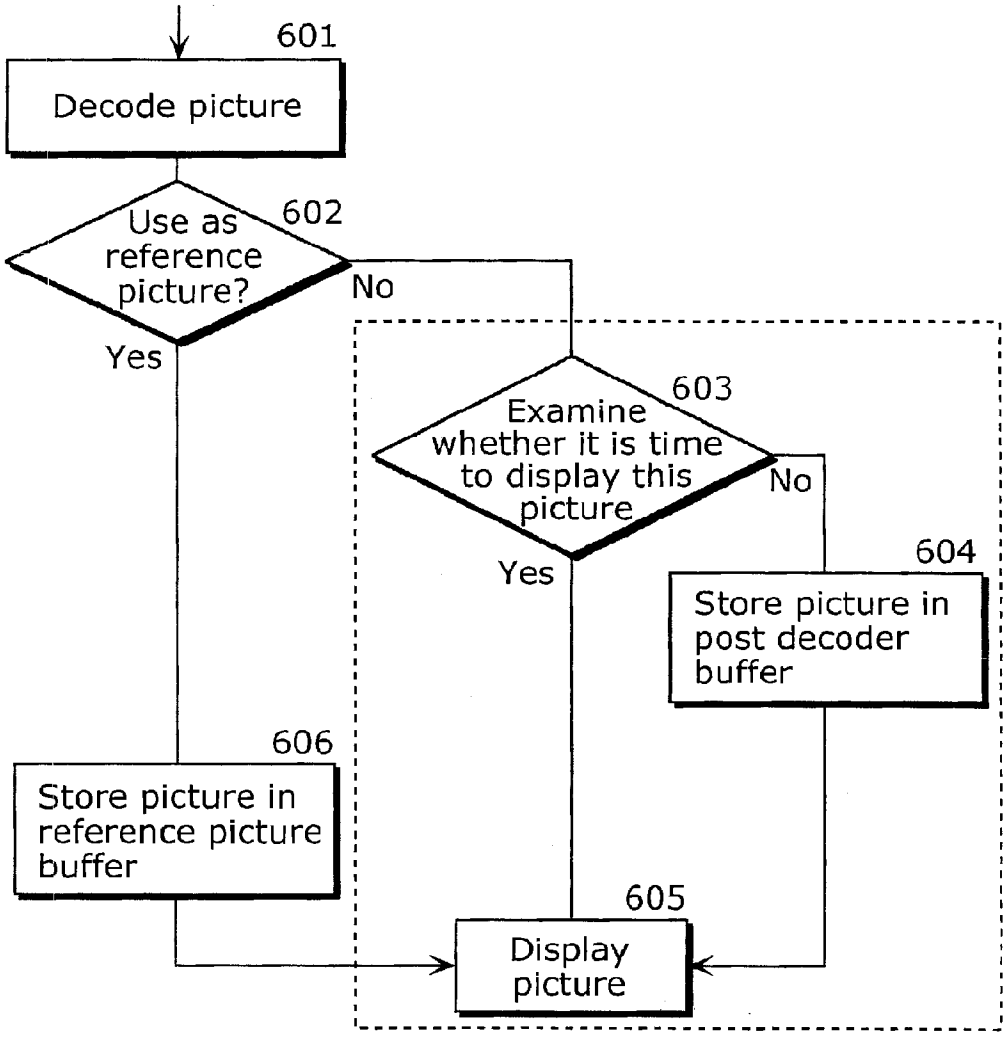

601
Decode picture
602
Use as reference picture?
No
Yes
603
Examine whether it is time to display this picture
No
Yes
604
Store picture in post decoder buffer
606
Store picture in reference picture buffer
605
Display picture

Fig. 17

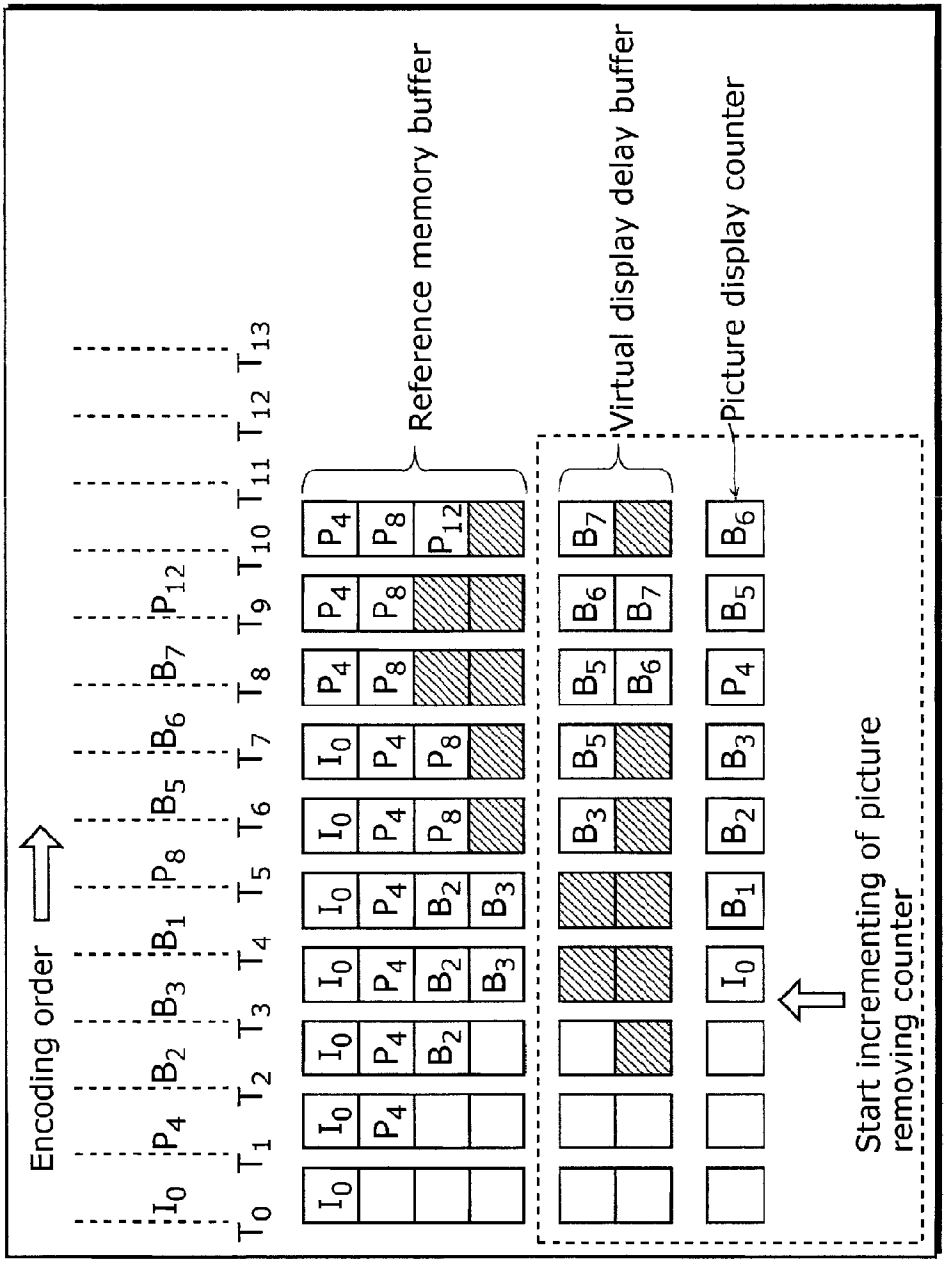

Encoding order
Reference memory buffer
Virtual display delay buffer
Picture display counter
Start incrementing of picture removing counter

Fig. 18

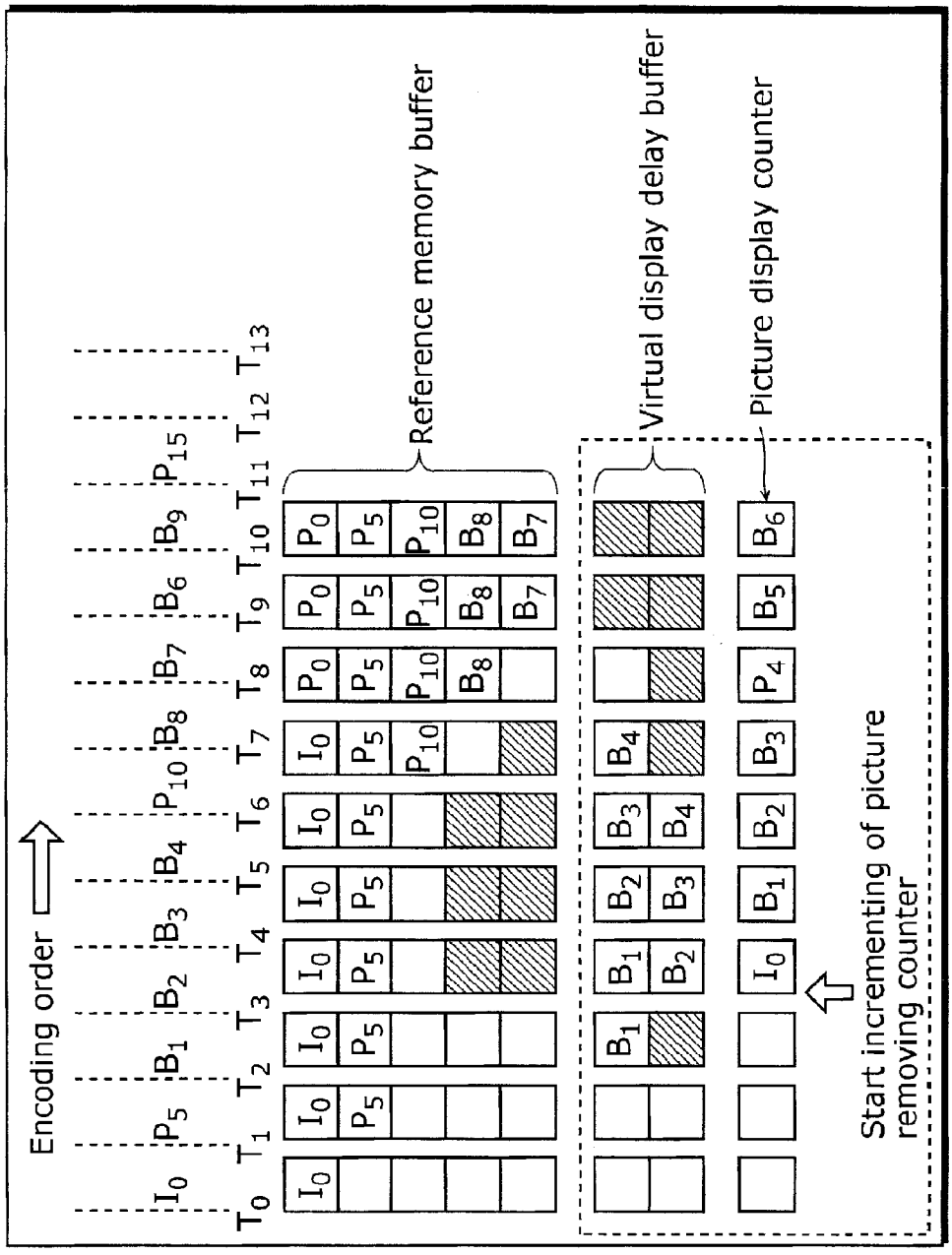

Encoding order
Reference memory buffer
Virtual display delay buffer
Picture display counter
Start incrementing of picture removing counter
I0 P5 B1 B2 B3 B4 P10 B7 B6 B9 P15
T0 T1 T2 T3 T4 T5 T6 T7 T8 T9 T10 T11 T12 T13

Fig. 19A

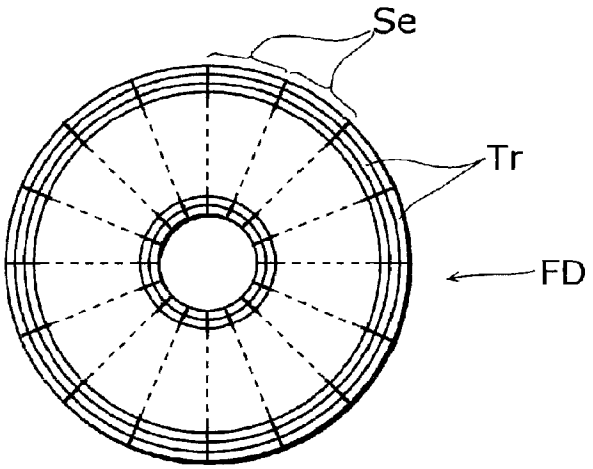


Fig. 19B

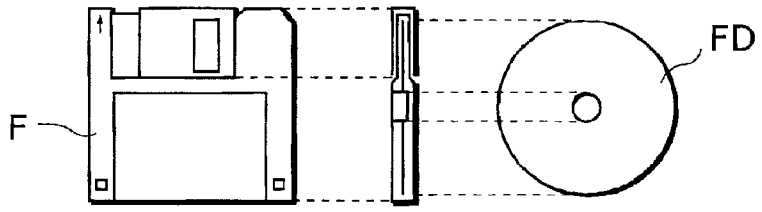
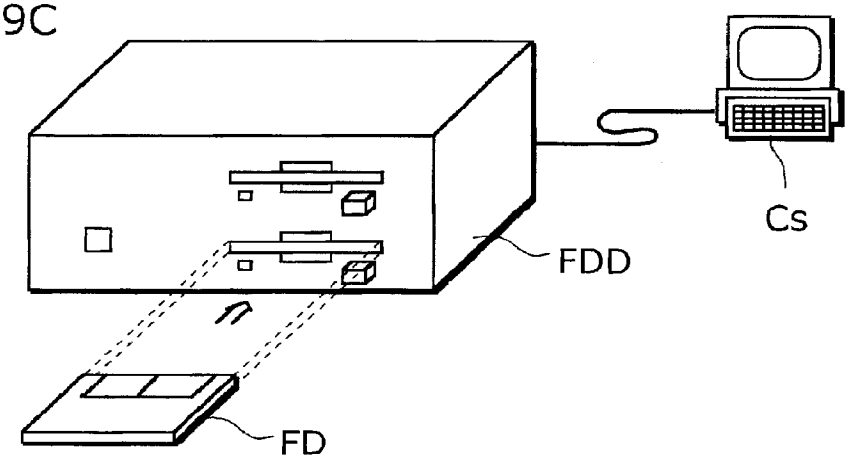


Fig. 19C



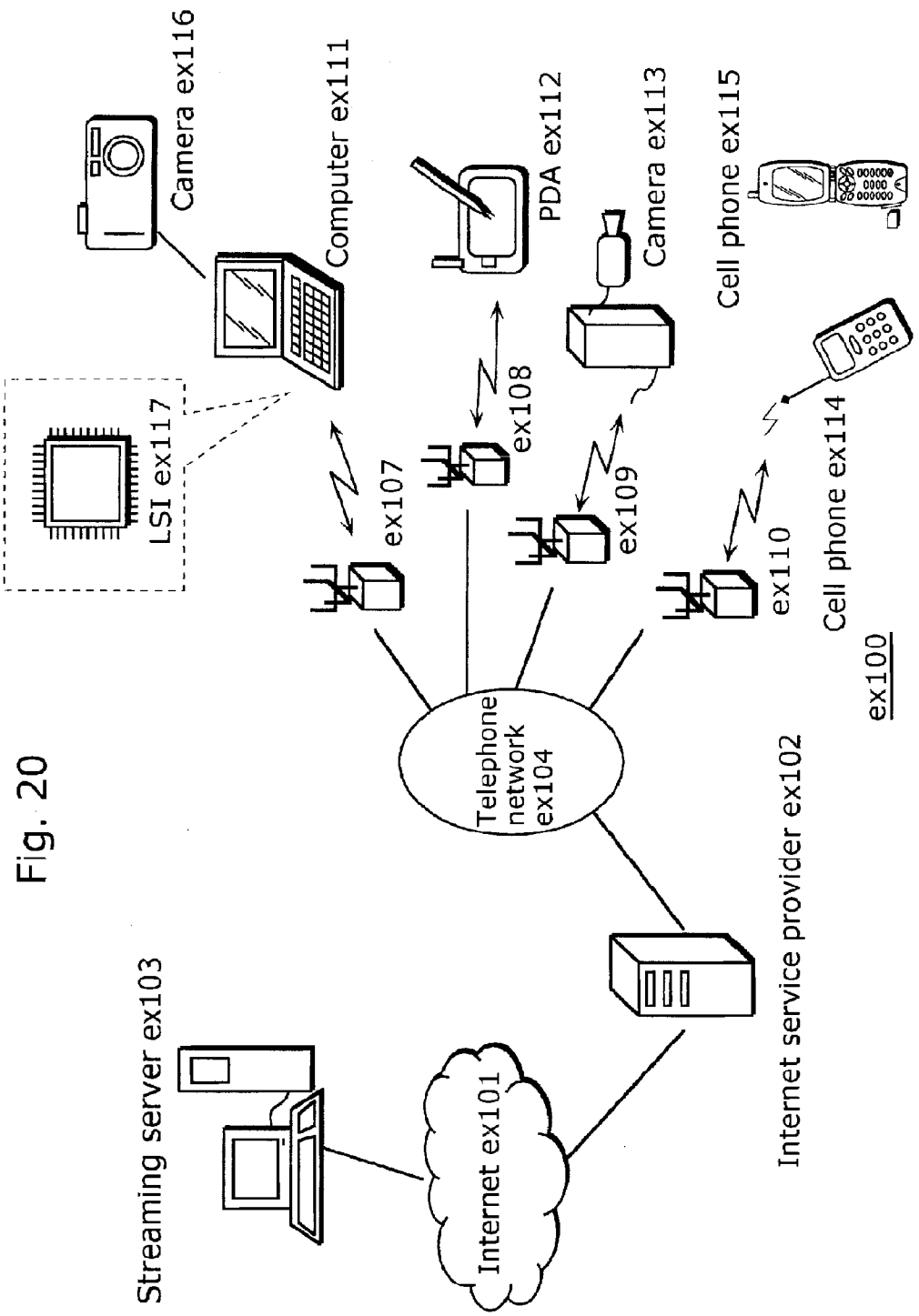

Camera ex116
Computer ex111
PDA ex112
Camera ex113
Cell phone ex115
LSI ex117
ex107
ex108
ex109
ex110
Cell phone ex114
Telephone network ex104
ex100
Streaming server ex103
Internet ex101
Internet service provider ex102

Fig. 20

Fig. 21

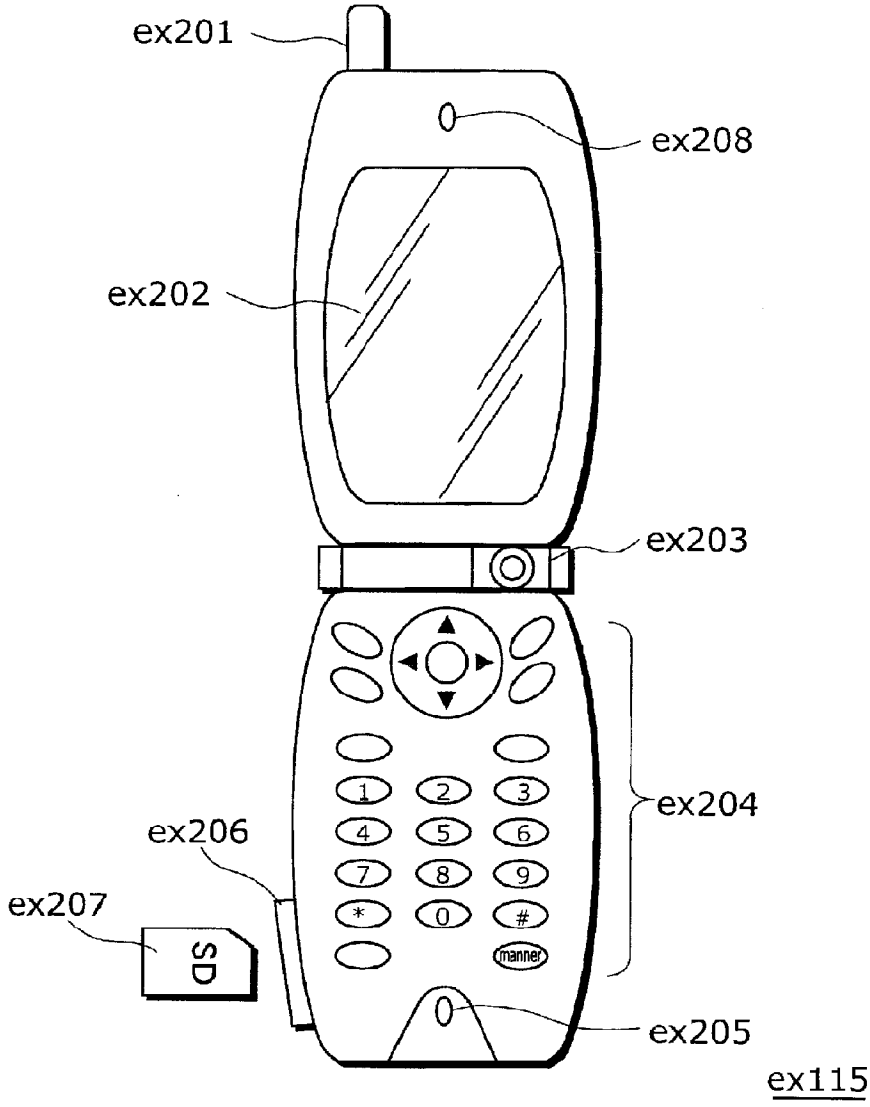

ex201
ex208
ex202
ex203
ex204
ex206
ex207
SD
ex205
ex115
manner

Fig. 22

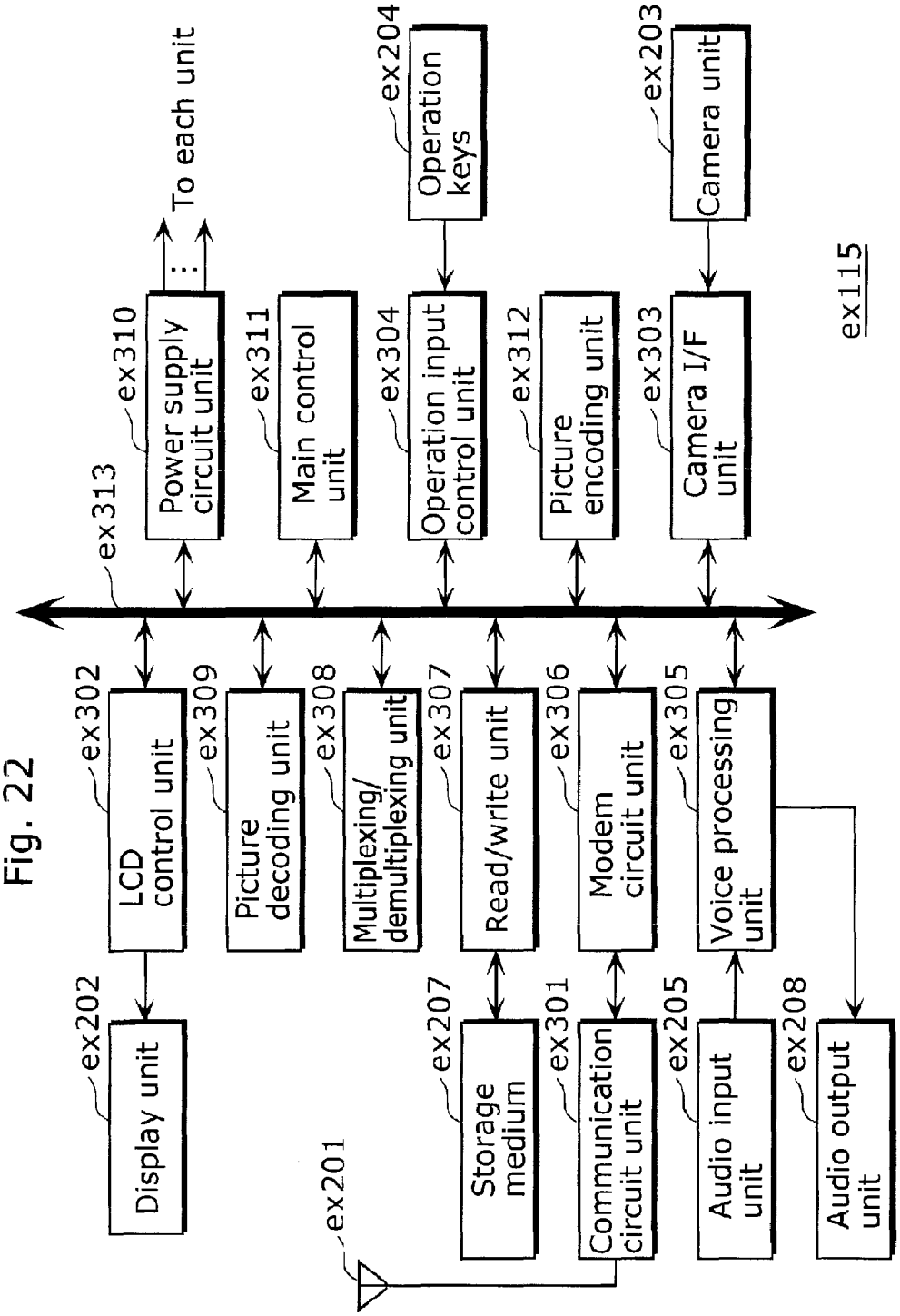

ex115
ex313
ex310
Power supply circuit unit
To each unit
ex311
Main control unit
ex304
Operation input control unit
ex204
Operation keys
ex312
Picture encoding unit
ex303
Camera I/F unit
ex203
Camera unit
ex302
LCD control unit
ex309
Picture decoding unit
ex308
Multiplexing/ demultiplexing unit
ex307
Read/write unit
ex306
Modem circuit unit
ex305
Voice processing unit
ex202
Display unit
ex207
Storage medium
ex301
Communication circuit unit
ex205
Audio input unit
ex208
Audio output unit
ex201

Fig. 23

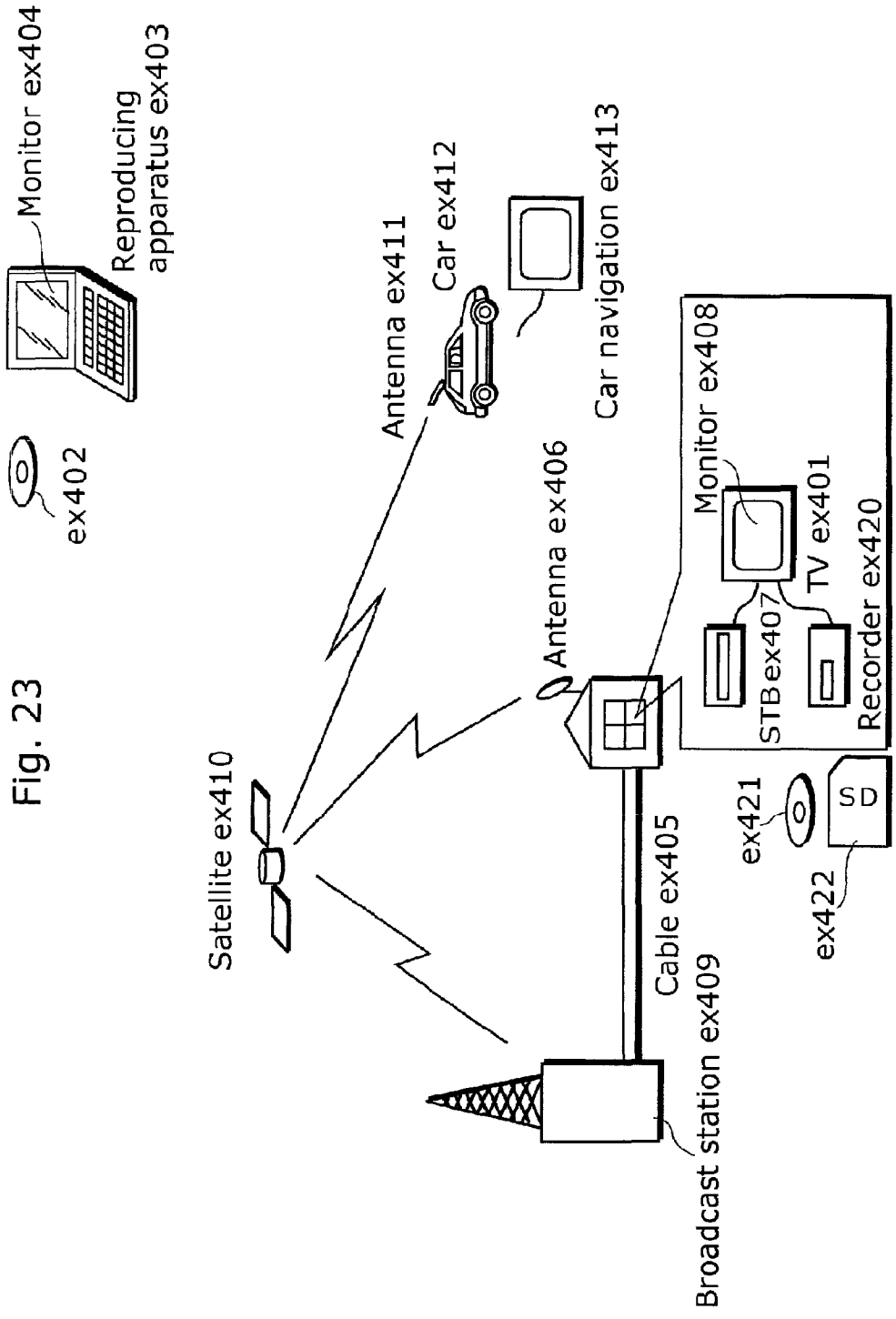

Monitor ex404
Reproducing apparatus ex403
ex402
Antenna ex411
Car ex412
Car navigation ex413
Antenna ex406
Monitor ex408
TV ex401
STB ex407
Recorder ex420
Satellite ex410
Cable ex405
ex421
SD
ex422
Broadcast station ex409

Fig. 24

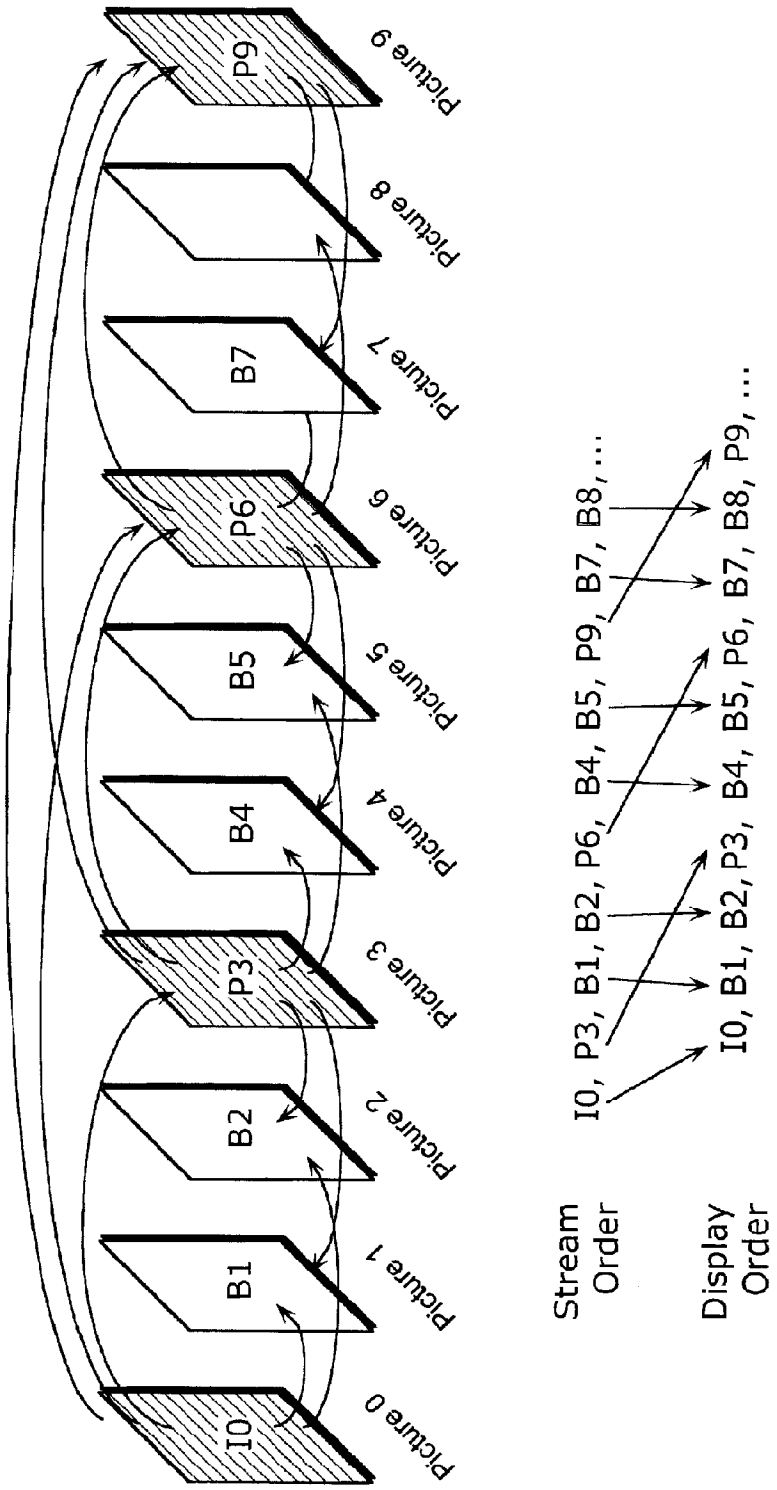

I0
B1
B2
P3
B4
B5
P6
B7
P9
Picture 0
Picture 1
Picture 2
Picture 3
Picture 4
Picture 5
Picture 6
Picture 7
Picture 8
Picture 9
Stream Order
I0, P3, B1, B2, P6, B4, B5, P9, B7, B8, ...
Display Order
I0, B1, B2, P3, B4, B5, P6, B7, B8, P9, ...

Fig. 25

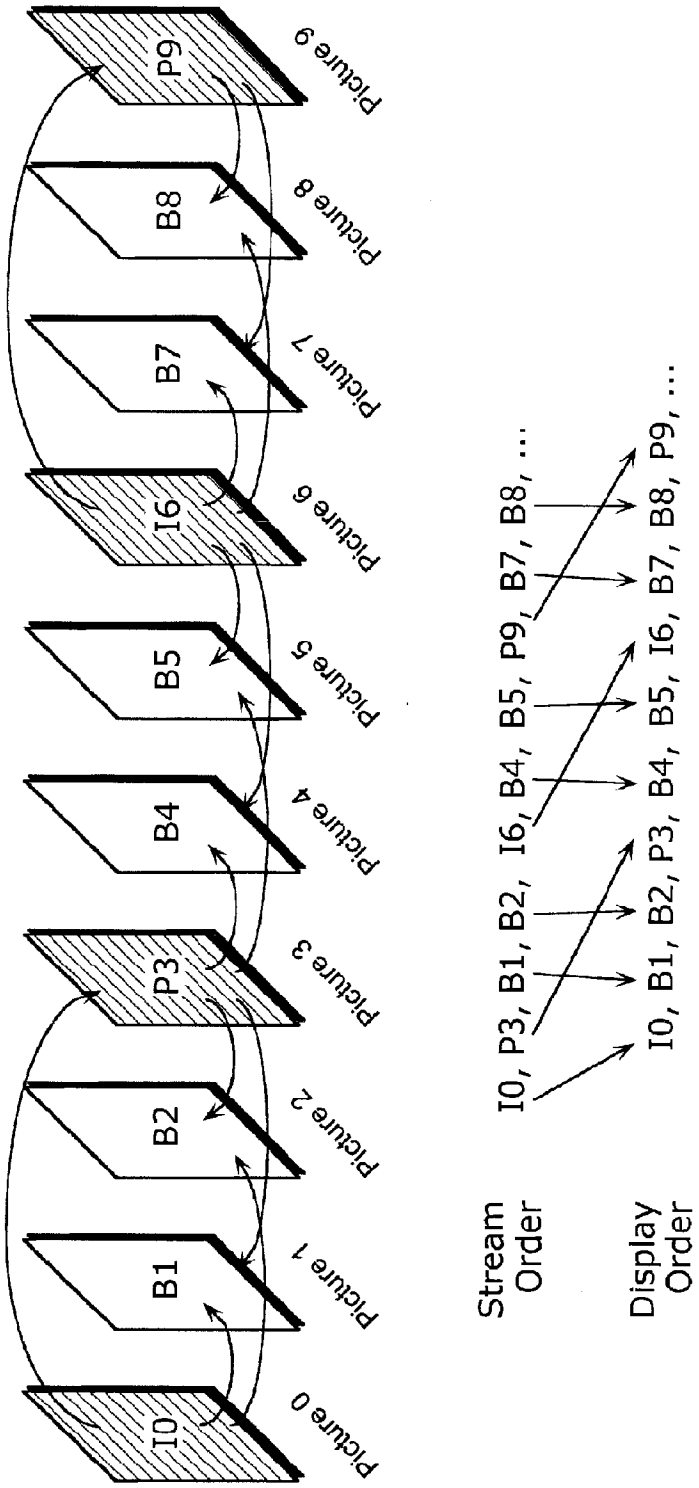

I0
B1
B2
P3
B4
B5
I6
B7
B8
P9
Picture 0
Picture 1
Picture 2
Picture 3
Picture 4
Picture 5
Picture 6
Picture 7
Picture 8
Picture 9
Stream Order
I0, P3, B1, B2, I6, B4, B5, P9, B7, B8, ...
Display Order
I0, B1, B2, P3, B4, B5, I6, B7, B8, P9, ...

Fig. 26

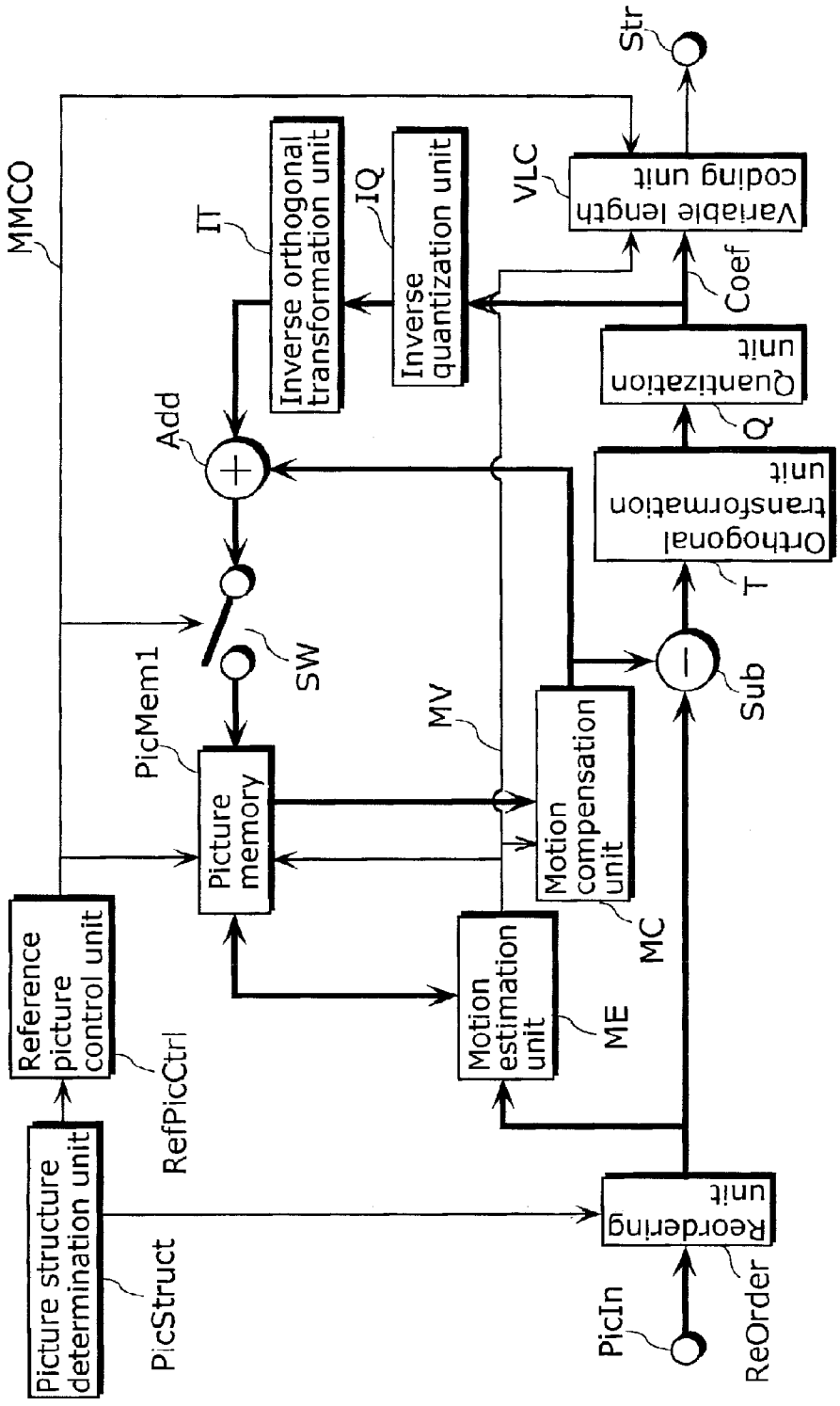

Str
MMCO
IT
Inverse orthogonal transformation unit
IQ
Inverse quantization unit
VLC
Variable length coding unit
Coef
Add
Quantization unit
Q
Orthogonal transformation unit
T
SW
PicMem1
MV
Picture memory
Motion compensation unit
Sub
Reference picture control unit
RefPicCtrl
Motion estimation unit
ME
MC
Picture structure determination unit
PicStruct
Reordering unit
PicIn
ReOrder

Fig. 27

Meanings	Codes
End of coding	'1'
Storage of picture	'01'
Release of picture	'001'+picture number to be released
Release whole memory	'000'

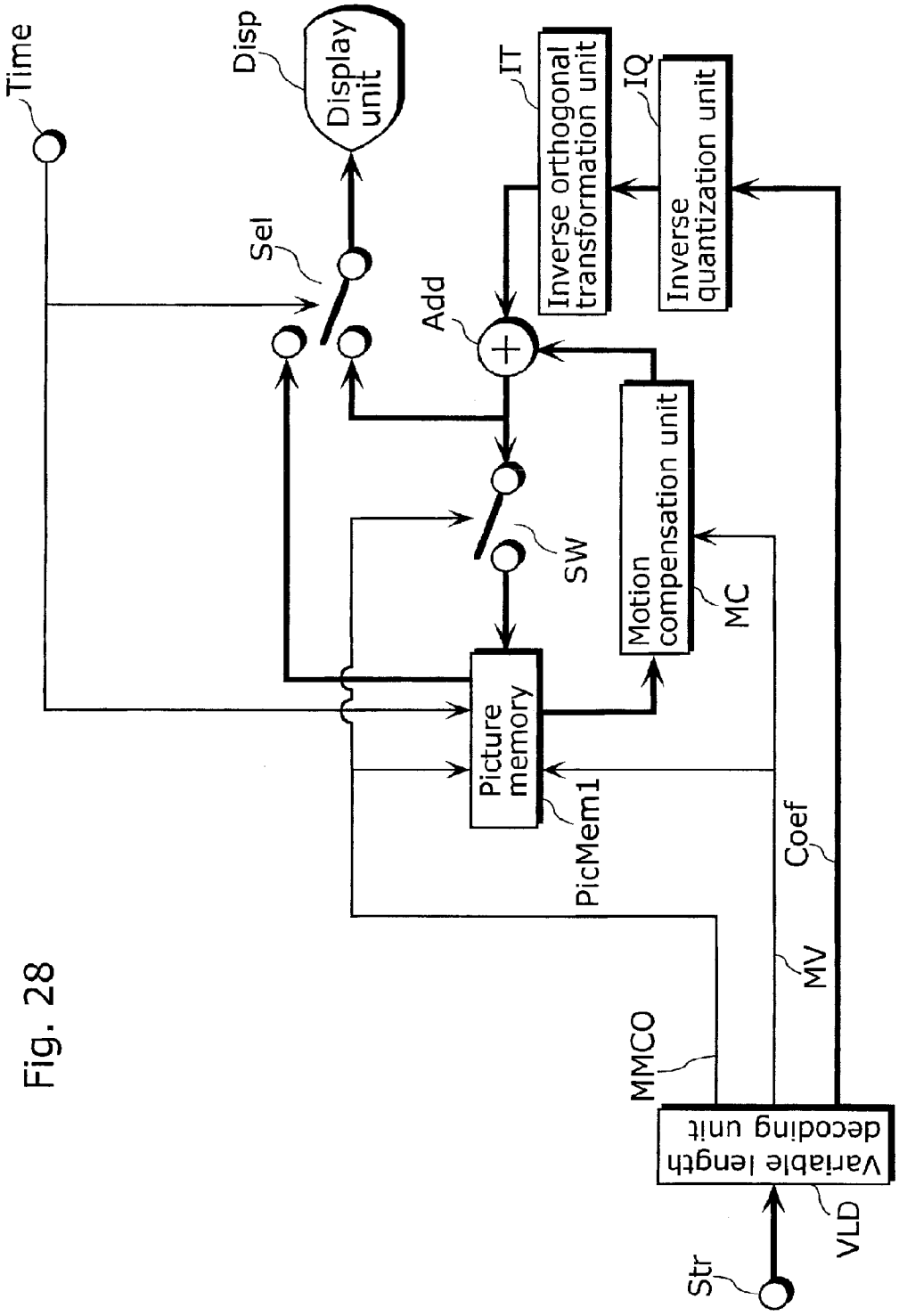

Time
Disp
Display unit
Sel
IT
Inverse orthogonal transformation unit
IQ
Inverse quantization unit
Add
SW
Motion compensation unit
MC
Picture memory
PicMem1
Coef
MV
MMCO
Variable length decoding unit
VLD
Str

Fig. 28

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

2012 -07- 19

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/SE2012/050439	26.04.2012	30.06.2011

International Patent Classification (IPC) or both national classification and IPC
INV. H04N7/26 H04N7/36 H04N7/50 H04N7/64

Applicant
TELEFONAKTIEBOLAGET L M ERICSSON (PUBL)

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☒ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☒ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:

European Patent Office
P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk - Pays Bas
Tel. +31 70 340 - 2040
Fax: +31 70 340 - 3016

Date of completion of this opinion
see form PCT/ISA/210

Authorized Officer
Colesanti, Carlo
Telephone No. +31 70 340-0

Form PCT/ISA/237 (Cover Sheet) (July 2009)

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing filed or furnished:

   a. (means)

      ☐ on paper

      ☐ in electronic form

   b. (time)

      ☐ in the international application as filed

      ☐ together with the international application in electronic form

      ☐ subsequently to this Authority for the purposes of search

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. II Priority

1. ☒ The validity of the priority claim has not been considered because the International Searching Authority does not have in its possession a copy of the earlier application whose priority has been claimed or, where required, a translation of that earlier application. This opinion has nevertheless been established on the assumption that the relevant date (Rules 43*bis*.1 and 64.1) is the claimed priority date.

2. ☐ This opinion has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rules 43*bis*.1 and 64.1). Thus for the purposes of this opinion, the international filing date indicated above is considered to be the relevant date.

3. Additional observations, if necessary:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	5-7, 11-15, 20, 25-27, 31-35, 44-46, 52-54
	No:	Claims	1-4, 8-10, 16-19, 21-24, 28-30, 36-43, 47-51, 55, 56
Inventive step (IS)	Yes:	Claims	5-7, 11-15, 25-27, 31-35, 44-46, 52-54
	No:	Claims	1-4, 8-10, 16-24, 28-30, 36-43, 47-51, 55, 56
Industrial applicability (IA)	Yes:	Claims	1-56
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VI Certain documents cited

1. Certain published documents (Rules 43*bis*.1 and 70.10)

and / or

2. Non-written disclosures (Rules 43*bis*.1 and 70.9)

see form 210

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

D1 BORGWARDT: "Multi- Picture Buffer Semantics for Interlace", 3. JVT MEETING; 60. MPEG MEETING; 06-05-2002 - 10-05-2002; FAIRFAX,US; (JOINT VIDEO TEAM OF ISO/IEC JTC1/SC29/WG11 AND ITU-T SG. 16), no. JVT-C049, 10 May 2002, XP030005158, ISSN: 0000-0442

D2 QIU SHEN ET AL: "Buffer requirement analysis and reference picture marking for temporal scalable video coding", PACKET VIDEO 2007, IEEE, PI, 1 November 2007, pages 91-97, XP031170603, ISBN: 978-1-4244-0980-8

1. The present application does not meet the criteria of Article 33(2) PCT, because the subject-matter of independent claims 1, 21, 38-40, 48, 55 and 56 is not new.

1.1 With reference to the subject-matter of independent claim 1, document D1 discloses:

A method of decoding an encoded representation of a picture of a video stream of multiple pictures (D1 is an input document to JVT: it is, thus, meant to build upon the H.264 video coding and decoding standard), said method comprises:

retrieving buffer description information defining at least one reference picture from said encoded representation of said picture (D1, page 7, section 8.2.13.1: the MMCO represents "buffer description information" that - by specifying the status of the reference frames buffer for decoding the coming pictures - defines "at least one reference picture"); and

determining, based on said buffer description information, at least one picture identifier identifying a respective reference picture of said at least one reference picture as decoding reference for said picture (D1, section 8.2.13 with its sub-sections and in particular, with Table 8-2: the MMCO is used to define the status of the reference frame buffer. By specifying which reference pictures are "unused" (and which, conversely are still to be used), the MMCO

parameters play a kay role in "identifying a respective reference picture of said at least one reference picture as decoding reference for said picture"); and

updating a decoded picture buffer based on said at least one picture identifier (D1, initial part of section 8.2.13 with its sub-section 8.2.13.1: this is the very purpose of the MMCO).

1.2 The same reasoning and objection (lack of novelty, Article 33 (2) PCT) applies, mutatis mutandis, to the subject- matter of the corresponding independent claims 21, 38-40, 48, 55 and 56.

1.3 For the sake of completeness, it is worthwhile remarking that the subject-matter of independent claims 1, 21, 38-40, 48, 55 and 56 is not new (Article 33 (2) PCT) also with respect to what very succinctly disclosed in D1, section 1.B;

2. Dependent claims 2-4, 8-10, 16-20, 22-24, 28-30, 36, 37, 41-43, 47 and 49-51 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty (Article 33(2) PCT) and/or inventive step (Article 33(3) PCT).

i.) Claims 2 and 22 (lack of novelty, Article 33 (2) PCT): see D1, last paragraph of section 8.2.13 together with sub-section 8.2.13.1: Reference pictures for future frames are not marked as "unused" and are kept in the updated picture buffer;

ii.) Claims 3, 23, 41 and 49 (lack of novelty, Article 33(2) PCT): see D1, first paragraph of section 8.2.13.1: a plurality of MMCO parameters in a row can be signalled. Moreover, said parameters specify the buffer status for decoding subsequent pictures in the bitstream (not for decoding the current picture);

iii.) Claims 4 and 24 (lack of novelty, Article 33 (2) PCT): see D1, first two lines of section 8.2.13: the buffer is updated after decoding the current picture, i.e. before decoding the successive frames.

iv.) Claims 8 and 28 (lack of novelty, Article 33 (2) PCT): implicit feature, the very purpose of decoding is to display the decoded pictures

v.) Claims 9, 29, 42 and 50 (lack of novelty, Article 33 (2) PCT): D1, section 3: by proposing a change, D1 clearly states that, according to H.264 (at least as it was at the time of publication of D1), the PRBT syntax element and the further reference buffer management instructions are signalled at the level of a slice (see also section 8.2.13 and sub-sections);

vi.) Claims 10, 30, 43 and 51 (lack of novelty, Article 33 (2) PCT): see D1, section 8.2.13.2;

vii.) Claims16 and 36 (lack of novelty, Article 33(2) PCT): the detection and handling of "non existing" pictures (pictures which are referred to for motion compensated prediction, but which are not present in the buffer) is known from D2, Section I.B, page 2, last 8 lines of the left-hand column.
It is worthwhile remarking that the detection and handling of "non existing" pictures should probably also be considered as implicitly disclosed by D1.

viii.) Claims 17 and 37 (lack of novelty, Article 33(2) PCT): the reset MMCO command can be seen as a form of "initialisation" of the reference picture list see D1, section 8.2.13.1.

ix.) Claims 18 and 19 (lack of novelty, Article 33(2) PCT): using the POC values for reference picture identification is disclosed in D2, section V., page 6, right- hand column, point 3);

x.) Claim 20 (lack of inventive step, Article 33(2) PCT): though in a very specific embodiment, D2 discloses the use of layer information (TL) in the framework of reference picture buffer management for (temporally) scalable video coding and decoding, see D2, section IV.A;

xi.) Claim 47 (taking into account the objection set out in Item VIII, point 2.ii): the claim seems to try to address the very scenario and purpose dealt with in D2 as a whole, see in particular D2, section I.C. The subject-matter of claim 47 is, therefore, not new (Article 33(2) PCT).

3. Provided that the objection put forward under Item VIII, point 1 is dealt with, the combination of the features of dependent claims 5-7, 11-15, 25-27, 31-35, 44-46 and 52-54 would be new and inventive over the available prior art.

i.) Claims 5-7, 15, 25-27 and 35 sketch an alternative reference picture marking mechanism with respect to the ones foreseen by D1 and D2. In particular, the picture marking condition is reversed. While taken alone this detail can be seen as a mere implementation option, if considered in the framework of a reference picture managing mechanism based on absolute signalling (see Item VIII, point 1), it is new and inventive over D1 and D2.

ii.) Claims 11-14, 31-34, 44-46 and 52-54 sketch an alternative reference picture management scheme based on a data structure comprising multiple predefined buffer descriptions. Provided that the core feature (guaranteeing absolute signalling and how this is achieved) of a such a management scheme is properly included, said signalling scheme would be new and inventive over D1 and D2.

In more general terms, a reference picture management scheme allowing the decoder to identify which pictures should be used as reference pictures without needing to involve also the side information of previous pictures, departs very significantly from the signalling and buffer management schemes illustrated in D1 and D2, all either consisting in a simple sliding window mechanism or relying heavily on the side information conveyed by several previous pictures.

Re Item VI

Certain documents cited

1. Following document was published after the priority claimed by the present application but before its filing date. In case the priority should turn out being invalid said document would become part of the state of the art (Rule 64.1 PCT):

D3 SJÖBERG R ET AL: "Absolute signaling of reference pictures", 6. JCT-VC MEETING; 97. MPEG MEETING; 14-7-2011 - 22-7-2011; TORINO; (JOINT COLLABORATIVE TEAM ON VIDEO CODING OF ISO/ IEC JTC1/SC29/WG11 AND ITU-T SG.16); URL: HTTP://WFTP3.ITU.INT/ AV-ARCH/JCTVC-SITE/, no. JCTVC-F493, 22 July 2011, XP030009516,

D3 is, therefore, an "intermediate document" within the meaning of chapter 16, paragraph 16.57 of the PCT International Search and Preliminary Examination Guidelines.

Re Item VIII

Certain observations on the international application

The application fails to meet the requirements of Article 6 PCT.

1. The independent (and actually also the dependent) claims are not properly supported by the description (Article 6 PCT) in that they fail to include the very most crucial feature of the invention as disclosed in the description, namely the fact that "the bitstream, for a current picture contains the information about what pictures to use for reference, i.e. reference pictures, independent of the encoded representations of previous pictures". (Keep in mind also following formulations: "the information about what reference pictures to use for inter prediction and motion vector prediction for a picture is included in the control information of the picture" and "the state of the decoded picture buffer is signaled for every picture that is encoded and decoded relative to other pictures"), see description, page 8, line 28 to page 9, line 2.

2. Following wordings do not have a well defined technical meaning. This leads to a lack of clarity (Article 6 PCT) in the claims in which they are used:

i.) "delta identifier" and "one picture identifier based on a picture identifier" (the latter formulation seems to define a feature by referring to the very same feature), see claims 10, 30, 43 and 51;

ii.) "side constraint selected from a predefined maximum number of reference pictures", see claim 47.

Possible steps after receipt of the international search report (ISR) and written opinion of the International Searching Authority (WO-ISA)

General information	For all international applications filed on or after 01/01/2004 the competent ISA will establish an ISR. It is accompanied by the WO-ISA. Unlike the former written opinion of the IPEA (Rule 66.2 PCT), the WO-ISA is not meant to be responded to, but to be taken into consideration for further procedural steps. This document explains about the possibilities.
Amending claims under Art. 19 PCT	Within 2 months after the date of mailing of the ISR and the WO-ISA the applicant may file amended claims under Art. 19 PCT directly with the International Bureau of WIPO. The PCT reform of 2004 did not change this procedure. For further information please see Rule 46 PCT as well as form PCT/ISA/220 and the corresponding Notes to form PCT/ISA/220.
Filing a demand for international preliminary examination	In principle, the WO-ISA will be considered as the written opinion of the IPEA. This should, in many cases, make it unnecessary to file a demand for international preliminary examination. If the applicant nevertheless wishes to file a demand this must be done before expiry of 3 months after the date of mailing of the ISR/WO-ISA or 22 months after priority date, whichever expires later (Rule 54bis PCT). Amendments under Art. 34 PCT can be filed with the IPEA as before, normally at the same time as filing the demand (Rule 66.1 (b) PCT). If a demand for international preliminary examination is filed and no comments/amendments have been received the WO-ISA will be transformed by the IPEA into an IPRP (International Preliminary Report on Patentability) which would merely reflect the content of the WO-ISA. The demand can still be withdrawn (Art. 37 PCT).
Filing informal comments	After receipt of the ISR/WO-ISA the applicant may file informal comments on the WO-ISA directly with the International Bureau of WIPO. These will be communicated to the designated Offices together with the IPRP (International Preliminary Report on Patentability) at 30 months from the priority date. Please also refer to the next box.
End of the international phase	At the end of the international phase the International Bureau of WIPO will transform the WO-ISA or, if a demand was filed, the written opinion of the IPEA into the IPRP, which will then be transmitted together with possible informal comments to the designated Offices. The IPRP replaces the former IPER (international preliminary examination report).
Relevant PCT Rules and more information	Rule 43 PCT, Rule 43bis PCT, Rule 44 PCT, Rule 44bis PCT, PCT Newsletter 12/2003, OJ 11/2003, OJ 12/2003

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PATENT COOPERATION TREATY

PCT

2012 -07- 19

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
P34860WO1		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/SE2012/050439	26/04/2012	30/06/2011
Applicant		
TELEFONAKTIEBOLAGET L M ERICSSON (PUBL)		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**
   a. With regard to the **language,** the international search was carried out on the basis of:
      [X] the international application in the language in which it was filed
      [ ] a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
   b. [ ] This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).
   c. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. [ ] **Certain claims were found unsearchable** (See Box No. II)

3. [ ] **Unity of invention is lacking** (see Box No III)

4. With regard to the **title,**
   [X] the text is approved as submitted by the applicant
   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**
   [X] the text is approved as submitted by the applicant
   [ ] the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings,**
   a. the figure of the **drawings** to be published with the abstract is Figure No. 16
      [X] as suggested by the applicant
      [ ] as selected by this Authority, because the applicant failed to suggest a figure
      [ ] as selected by this Authority, because this figure better characterizes the invention
   b. [ ] none of the figures is to be published with the abstract

INTERNATIONAL SEARCH REPORT

International application No
PCT/SE2012/050439

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04N7/26 H04N7/36 H04N7/50 H04N7/64
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, COMPENDEX, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	SJÃBERG R ET AL: "Absolute signaling of reference pictures", 6. JCT-VC MEETING; 97. MPEG MEETING; 14-7-2011 - 22-7-2011; TORINO; (JOINT COLLABORATIVE TEAM ON VIDEO CODING OF ISO/IEC JTC1/SC29/WG11 AND ITU-T SG.16); URL: HTTP://WFTP3.ITU.INT/AV-ARCH/JCTVC-SITE/,, no. JCTVC-F493, 22 July 2011 (2011-07-22), XP030009516, the whole document ----- -/--	1-56

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 July 2012	19/07/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Colesanti, Carlo

1

Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	BORGWARDT: "Multi-Picture Buffer Semantics for Interlace", 3. JVT MEETING; 60. MPEG MEETING; 06-05-2002 - 10-05-2002; FAIRFAX,US; (JOINT VIDEO TEAM OF ISO/IEC JTC1/SC29/WG11 AND ITU-T SG.16),, no. JVT-C049, 10 May 2002 (2002-05-10), XP030005158, ISSN: 0000-0442 Section 8.2.13 with sub-sections and with Table 8-3	1-4, 8-10,17, 21-24, 28-30, 37-43, 48-51, 55,56
X	QIU SHEN ET AL: "Buffer requirement analysis and reference picture marking for temporal scalable video coding", PACKET VIDEO 2007, IEEE, PI, 1 November 2007 (2007-11-01), pages 91-97, XP031170603, ISBN: 978-1-4244-0980-8 the whole document	1-4, 8-10, 16-24, 28-30, 36-43, 47-51, 55,56

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Espacenet

Bibliographic data: JP5616562 (B2) — 2014-10-29

REFERENCE PICTURE SIGNALING

Inventor(s):

Applicant(s):

Classification: - international: ***H04N19/503; H04N19/70; H04N19/89***
- cooperative: **H04N19/00533**; **H04N19/31**; **H04N19/433**; **H04N19/44**; **H04N19/46**; **H04N19/573**; **H04N19/58**; **H04N19/61**; **H04N19/70**; **H04N19/89**

Application number: JP20140518486 20120426

Priority number (s): US201161503019P 20110630 ; WO2012SE50439 20120426

Also published as: JP2014523690 (A) WO2013002700 (A1) US2013215975 (A1) RU2014102959 (A) MX2013014857 (A) more

Abstract not available for JP5616562 (B2)
Abstract of corresponding document: WO2013002700 (A1)

An encoded representation (60) of a picture (10) of a video stream (1) is decoded by retrieving buffer description from the encoded representation (60). The buffer description information is used to determine at least one picture identifier identifying a respective reference picture (40, 42) as decoding reference for the picture (10). A decoded picture buffer (530, 650) is updated based on the determined picture identifier. The encoded representation (60) of the picture (10) itself comprises the information needed by a decoder (400) to identify the reference pictures (40, 42) required to decode the encoded representation (60)

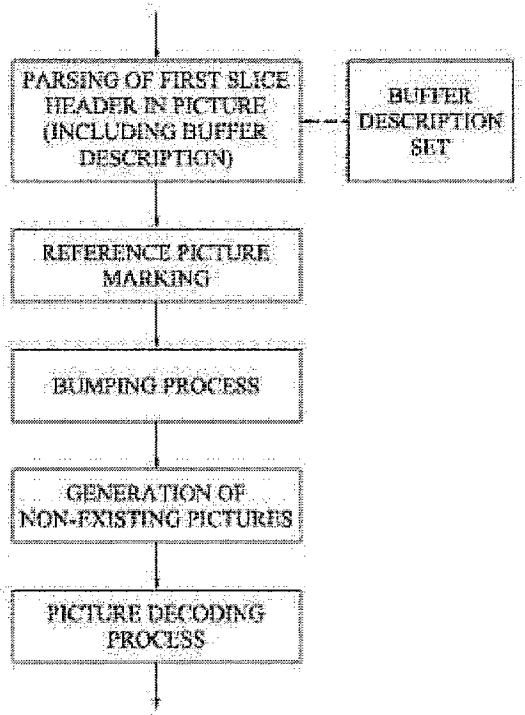

PARSING OF FIRST SLICE HEADER IN PICTURE (INCLUDING BUFFER DESCRIPTION)
BUFFER DESCRIPTION SET
REFERENCE PICTURE MARKING
BUMPING PROCESS
GENERATION OF NON-EXISTING PICTURES
PICTURE DECODING PROCESS

Fig. 16

(19)日本国特許庁(JP)　(12)特　許　公　報(B2)　(11)特許番号
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(51)Int.Cl.　F I
H04N 19/70 (2014.01)　H04N 19/70
H04N 19/503 (2014.01)　H04N 19/503

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(33)優先権主張国　米国 (US)

早期審査対象出願

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最終頁に続く

(54)【発明の名称】参照ピクチャ信号伝送

(57)【特許請求の範囲】
【請求項１】
ビデオストリーム（１）の複数のピクチャ（１０、４０、４２、５０）のうちの１つのピクチャ（１０）の符号化表現（６０）を復号する方法であって、
前記ピクチャ（１０）の符号化表現（６０）から少なくとも１つの参照ピクチャ（４０、４２）を定義するバッファ記述情報を取得する工程（Ｓ３０）と、
前記バッファ記述情報に基づいて、前記少なくとも１つの参照ピクチャ（４０、４２）のうちの参照ピクチャ（４０、４２）の各々を示す少なくとも１つのピクチャ識別子を、前記ピクチャ（１０）の復号参照として決定する工程（Ｓ３１）と、
前記少なくとも１つのピクチャ識別子に基づいて、復号されたピクチャバッファ（５３０、６５０）を更新する工程（Ｓ３２）と、を有する
ことを特徴とする方法。
【請求項２】
前記復号されたピクチャバッファ（５３０、６５０）を更新する前記工程（Ｓ３２）は、前記少なくとも１つのピクチャ識別子により示される前記参照ピクチャ（４０、４２）の各々を含むように前記復号されたピクチャバッファ（５３０、６５０）を更新する工程（Ｓ３２）を有することを特徴とする請求項１に記載の方法。
【請求項３】
前記バッファ記述情報を取得する前記工程（Ｓ３０）は、前記ピクチャ（１０）の符号化表現（６０）から、複数の参照ピクチャ（４０、４２）を定義する前記バッファ記述情

報を取得する工程（Ｓ３０）を有し、
前記少なくとも１つのピクチャ識別子を決定する前記工程（Ｓ３１）は、前記バッファ記述情報に基づいて、ｉ）前記複数の参照ピクチャ（４０、４２）のうちの参照ピクチャ（４０、４２）の各々を示す少なくとも１つのピクチャ識別子を、該ピクチャの復号参照として決定し、ｉｉ）前記複数の参照ピクチャ（４０、４２）の各々を示す少なくとも１つのピクチャ識別子を、前記ビデオストリーム（１）の復号順に係り後続するピクチャ（５０）の復号参照として決定する工程（Ｓ３１）を有する
ことを特徴とする請求項１または２に記載の方法。
【請求項４】
前記ピクチャ（１０）の符号化表現（６０）及び前記復号されたピクチャバッファ（５３０、６５０）に含まれる少なくとも１つの参照ピクチャ（４０、４２）に基づいて前記ピクチャ（１０）を復号する工程（Ｓ３３）をさらに有し、
前記ピクチャ（１０）を復号する前記工程は、前記復号されたピクチャバッファ（５３０、６５０）の更新する工程の後に行われる
ことを特徴とする請求項１乃至３のいずれか１項に記載の方法。
【請求項５】
前記復号されたピクチャバッファ（５３０、６５０）を更新する前記工程（Ｓ３２）は、前記復号されたピクチャバッファ（５３０、６５０）に含まれる全ての参照ピクチャであって、前記バッファ記述情報に基づいて決定された前記少なくとも１つのピクチャ識別子のいずれとも関連づけられていないピクチャを、参照に用いないものとしてマークする工程（Ｓ７０）を有することを特徴とする請求項１乃至４のいずれか１項に記載の方法。
【請求項６】
前記復号されたピクチャバッファ（５３０、６５０）を更新する前記工程（Ｓ３２）は、前記復号されたピクチャバッファに含まれる参照ピクチャであって、前記バッファ記述情報に基づいて決定された前記少なくとも１つのピクチャ識別子のうちの１つのピクチャ識別子が関連づけられたピクチャを、参照に用いるものとして、好ましくは短期参照または長期参照に用いるものとしてマークする工程（Ｓ７０）を有することを特徴とする請求項１乃至５のいずれか１項に記載の方法。
【請求項７】
参照ピクチャのいずれかをマークする前記工程は、前記ピクチャ（１０）を復号する前記工程に先立って実行されることを特徴とする請求項５または６に記載の方法。
【請求項８】
前記ピクチャ（１０）を復号する前記工程に先立って、表示用の前記復号されたピクチャバッファ（５３０、６５０）から０以上のピクチャを出力する工程（Ｓ７１）をさらに有することを特徴とする請求項１乃至７のいずれか１項に記載の方法。
【請求項９】
前記バッファ記述情報を取得する前記工程（Ｓ３０）は、前記ピクチャ（１０）の符号化表現（６０）のスライスヘッダ（６５）から前記バッファ記述情報を取得する工程を有することを特徴とする請求項１乃至８のいずれか１項に記載の方法。
【請求項１０】
前記少なくとも１つのピクチャ識別子を決定する前記工程（Ｓ３１）は、
前記バッファ記述情報に基づいて、各デルタ識別子を取得する工程（Ｓ４０）と、
前記ピクチャ（１０）を示すピクチャ識別子及び前記各デルタ識別子に基づいて、前記少なくとも１つの参照ピクチャ（４０、４２）を示す前記少なくとも１つのピクチャ識別子を算出する工程（Ｓ４１）と、を有する
ことを特徴とする請求項１乃至９のいずれか１項に記載の方法。
【請求項１１】
前記バッファ記述情報を取得する前記工程（Ｓ３０）は、
前記少なくとも１つの参照ピクチャ（４０、４２）を定義するバッファ記述を示す前記バッファ記述情報を、前記ピクチャ（１０）の符号化表現（６０）から取得する工程（

Ｓ５１）と、
前記バッファ記述情報に基づいて、各々が少なくとも１つの参照ピクチャ（４０、４２）を定義する複数の予め定義されたバッファ記述を含む１つのデータ構造から、前記バッファ記述を同定する工程（Ｓ５２）と、を有する
ことを特徴とする請求項１乃至１０のいずれか１項に記載の方法。
【請求項１２】
前記ビデオストリーム（１）の１つの符号化表現に関連づけられた、１つのピクチャパラメータセット（６７）または１つのシーケンスパラメータセットから前記データ構造を取得する工程（Ｓ５０）をさらに有することを特徴とする請求項１１に記載の方法。
【請求項１３】
前記バッファ記述情報は、前記バッファ記述を示す識別子及び少なくとも１つの参照ピクチャ（４０、４２）を定義する情報を含み、
前記少なくとも１つのピクチャ識別子を決定する前記工程（Ｓ３１）は、
前記バッファ記述に基づいて、参照ピクチャの各々を示す少なくとも１つの参照ピクチャ（４０、４２）の第１のセットを決定する工程（Ｓ６０）と、
前記少なくとも１つのピクチャ識別子を定義する情報に基づいて、参照ピクチャの各々を示す少なくとも１つのピクチャ識別子の第２のセットを決定する工程（Ｓ６１）と、
前記第１のセット及び前記第２のセットに基づいて、ピクチャ識別子のジョイントセットを形成する工程（Ｓ６２）と、を有する
ことを特徴とする請求項１１または１２に記載の方法。
【請求項１４】
前記ジョイントセット内のピクチャ識別子の総数と参照ピクチャの最大数とを比較する工程（Ｓ６３）と、
前記ピクチャ識別子の総数が前記参照ピクチャの最大数を上回る場合に、前記第１のセットに含まれ、かつ前記第２のセットに含まれない１以上のピクチャ識別子を、前記ジョイントセット内のピクチャ識別子の総数が前記参照ピクチャの最大数を超えない数まで前記ジョイントセットから削除する工程（Ｓ６４）と、をさらに有する
ことを特徴とする請求項１３に記載の方法。
【請求項１５】
前記復号されたピクチャバッファ（５３０、６５０）を更新する前記工程（Ｓ３２）は、前記復号されたピクチャバッファ（５３０、６５０）内に存在し、前記バッファ記述情報から決定される前記少なくとも１つのピクチャ識別子のいずれかに関連付けられていない全ての参照ピクチャを、前記復号されたピクチャバッファ（５３０、６５０）から削除する工程（Ｓ７０）を有することを特徴とする請求項１乃至１４のいずれか１項に記載の方法。
【請求項１６】
前記決定された少なくとも１つのピクチャ識別子と、前記復号されたピクチャバッファ（５３０、６５０）内に存在する参照ピクチャが関連付けられたピクチャ識別子とを比較する工程（Ｓ７２）と、
所定のピクチャを示すピクチャ識別子が前記決定された少なくとも１つのピクチャ識別子から発見され、前記所定のピクチャが前記復号されたピクチャバッファ（５３０、６５０）に存在しない場合に、所定のピクチャが存在しないと決定する工程（Ｓ７３）と、をさらに有する
ことを特徴とする請求項１乃至１５のいずれか１項に記載の方法。
【請求項１７】
前記バッファ記述情報に基づいて、参照ピクチャリストの初期化を行う工程（Ｓ８０）をさらに有することを特徴とする請求項１乃至１６のいずれか１項に記載の方法。
【請求項１８】
前記少なくとも１つのピクチャ識別子を決定する前記工程（Ｓ３１）は、前記バッファ記述情報に基づいて、前記参照ピクチャ（４０、４２）の各々を示す少なくとも１つのピ

クチャオーダカウント（ＰＯＣ）値を、前記ピクチャ（１０）の復号参照として決定する工程（Ｓ３１）を有することを特徴とする請求項１乃至１７のいずれか１項に記載の方法。

【請求項１９】

前記少なくとも１つのＰＯＣ値を決定する前記工程（Ｓ３１）は、前記バッファ記述情報に基づいて、前記少なくとも１つのピクチャオーダカウント（ＰＯＣ）値と、前記参照ピクチャ（４０、４２）の各々を示す少なくとも１つの追加識別子とを、前記ピクチャ（１０）の復号参照として決定する工程（Ｓ３１）を有することを特徴とする請求項１８に記載の方法。

【請求項２０】

前記ビデオストリーム（１）は、複数のレイヤにグループ化されたピクチャ（１０、４０、４２、５０）を有するスケーラブルビデオストリームであり、

前記バッファ記述情報を取得する前記工程（Ｓ３０）は、前記少なくとも１つのピクチャ識別子を定義する前記バッファ記述情報と、前記参照ピクチャ（４０、４２）の各々が所属する前記複数のレイヤの各レイヤを定義するレイヤ情報とを取得する工程（Ｓ３０）を有する

ことを特徴とする請求項１乃至１９のいずれか１項に記載の方法。

【請求項２１】

ビデオストリーム（１）の複数のピクチャ（１０、４０、４２、５０）のうちの１つのピクチャ（１０）の符号化表現（６０）を復号する復号器（４００）であって、

前記ピクチャ（１０）の符号化表現（６０）から少なくとも１つの参照ピクチャ（４０、４２）を定義するバッファ記述情報を取得するデータ取得器（４１０）と、

前記バッファ記述情報に基づいて、前記少なくとも１つの参照ピクチャ（４０、４２）のうちの参照ピクチャ（４０、４２）の各々を示す少なくとも１つのピクチャ識別子を、前記ピクチャ（１０）の復号参照として決定するピクチャ識別子決定器（４２０）と、

前記少なくとも１つのピクチャ識別子に基づいて、復号されたピクチャバッファ（５３０）を更新するバッファマネージャ（４３０）と、を有する

ことを特徴とする復号器。

【請求項２２】

前記バッファマネージャ（４３０）は、前記少なくとも１つのピクチャ識別子により示される前記参照ピクチャ（４０、４２）の各々を含むように前記復号されたピクチャバッファ（５３０）を更新することを特徴とする請求項２１に記載の復号器。

【請求項２３】

前記データ取得器（４１０）は、前記ピクチャ（１０）の符号化表現（６０）から、複数の参照ピクチャ（４０、４２）を定義する前記バッファ記述情報を取得し、

前記ピクチャ識別子決定器（４２０）は、前記バッファ記述情報に基づいて、ｉ）前記複数の参照ピクチャ（４０、４２）のうちの参照ピクチャ（４０、４２）の各々を示す少なくとも１つのピクチャ識別子を、該ピクチャの復号参照として決定し、ｉｉ）前記複数の参照ピクチャ（４０、４２）の各々を示す少なくとも１つのピクチャ識別子を、前記ビデオストリーム（１）の復号順に係り後続するピクチャ（５０）の復号参照として決定する

ことを特徴とする請求項２１または２２に記載の復号器。

【請求項２４】

前記復号器（４００）は、前記バッファマネージャ（４３０）が前記復号されたピクチャバッファ（５３０）を更新した後に、前記ピクチャ（１０）の符号化表現（６０）及び前記復号されたピクチャバッファ（５３０）に含まれる少なくとも１つの参照ピクチャ（４０、４２）に基づいて前記ピクチャ（１０）を復号することを特徴とする請求項２１乃至２３のいずれか１項に記載の復号器。

【請求項２５】

前記バッファマネージャ（４３０）は、前記復号されたピクチャバッファ（５３０）に

含まれる全ての参照ピクチャであって、前記バッファ記述情報に基づいて決定された前記少なくとも１つのピクチャ識別子のいずれとも関連づけられていないピクチャを、参照に用いないものとしてマークすることを特徴とする請求項２１乃至２４のいずれか１項に記載の復号器。

【請求項２６】

前記バッファマネージャ（４３０）は、前記復号されたピクチャバッファに含まれる参照ピクチャであって、前記バッファ記述情報に基づいて決定された前記少なくとも１つのピクチャ識別子のうちの１つのピクチャ識別子が関連づけられたピクチャを、参照に用いるものとして、好ましくは短期参照または長期参照に用いるものとしてマークすることを特徴とする請求項２１乃至２５のいずれか１項に記載の復号器。

【請求項２７】

前記バッファマネージャ（４３０）は、前記復号器（４００）が前記ピクチャ（１０）を復号することに先立って実行されることを特徴とする請求項２５または２６に記載の復号器。

【請求項２８】

前記復号器（４００）が前記ピクチャ（１０）を復号することに先立って、表示用の前記復号されたピクチャバッファ（５３０）から０以上のピクチャを出力する出力部（４５０）をさらに有することを特徴とする請求項２１乃至２７のいずれか１項に記載の復号器。

【請求項２９】

前記データ取得器（４１０）は、前記ピクチャ（１０）の符号化表現（６０）のスライスヘッダ（６５）から前記バッファ記述情報を取得することを特徴とする請求項２１乃至２８のいずれか１項に記載の復号器。

【請求項３０】

前記ピクチャ識別子決定器（４２０）は、ｉ）前記バッファ記述情報に基づいて、各デルタ識別子を取得し、ｉｉ）前記ピクチャ（１０）を示すピクチャ識別子及び前記各デルタ識別子に基づいて、前記少なくとも１つの参照ピクチャ（４０、４２）を示す前記少なくとも１つのピクチャ識別子を算出することを特徴とする請求項２１乃至２９のいずれか１項に記載の復号器。

【請求項３１】

前記データ取得器（４１０）は、前記少なくとも１つの参照ピクチャ（４０、４２）を定義するバッファ記述を示す前記バッファ記述情報を、前記ピクチャ（１０）の符号化表現（６０）から取得し、

前記復号器（４００）は、前記バッファ記述情報に基づいて、各々が少なくとも１つの参照ピクチャ（４０、４２）を定義する複数の予め定義されたバッファ記述を含む１つのデータ構造から、前記バッファ記述を同定するバッファ記述同定器（４８０）をさらに有する

ことを特徴とする請求項２１乃至３０のいずれか１項に記載の復号器。

【請求項３２】

前記データ取得器（４１０）は、前記ビデオストリーム（１）の１つの符号化表現に関連づけられた、１つのピクチャパラメータセット（６７）または１つのシーケンスパラメータセットから前記データ構造を取得することを特徴とする請求項３１に記載の復号器。

【請求項３３】

前記バッファ記述情報は、前記バッファ記述を示す識別子及び少なくとも１つの参照ピクチャ（４０、４２）を定義する情報を含み、

前記ピクチャ識別子決定器（４２０）は、ｉ）前記バッファ記述に基づいて、参照ピクチャの各々を示す少なくとも１つのピクチャ識別子の第１のセットを決定し、ｉｉ）前記少なくとも１つのピクチャ識別子を定義する情報に基づいて、参照ピクチャの各々を示す少なくとも１つのピクチャ識別子の第２のセットを決定し、ｉｉｉ）前記第１のセット及び前記第２のセットに基づいて、ピクチャ識別子のジョイントセットを形成する

ことを特徴とする請求項３１または３２に記載の復号器。
【請求項３４】
前記ジョイントセット内のピクチャ識別子の総数と参照ピクチャの最大数とを比較する数値比較器（４４０）をさらに有し、
前記ピクチャ識別子決定器（４２０）は、前記ピクチャ識別子の総数が前記参照ピクチャの最大数を上回る場合に、前記第１のセットに含まれ、かつ前記第２のセットに含まれない１以上のピクチャ識別子を、前記ジョイントセット内のピクチャ識別子の総数が前記参照ピクチャの最大数を超えない数まで前記ジョイントセットから削除する
ことを特徴とする請求項３３に記載の復号器。
【請求項３５】
前記バッファマネージャ（４３０）は、前記復号されたピクチャバッファ（５３０）内に格納され、前記バッファ記述情報から決定される前記少なくとも１つのピクチャ識別子のいずれかに関連付けられていない全ての参照ピクチャを、前記復号されたピクチャバッファ（５３０）から削除することを特徴とする請求項２１乃至３４のいずれか１項に記載の復号器。
【請求項３６】
前記決定された少なくとも１つのピクチャ識別子と、前記復号されたピクチャバッファ（５３０）内に存在する参照ピクチャが関連付けられたピクチャ識別子とを比較する識別子比較器（４６０）をさらに有し、
前記ピクチャ識別子決定器（４２０）は、所定のピクチャを示すピクチャ識別子が前記決定された少なくとも１つのピクチャ識別子から発見され、前記所定のピクチャが前記復号されたピクチャバッファ（５３０）に存在しない場合に、所定のピクチャが存在しないと決定する
ことを特徴とする請求項２１乃至３５のいずれか１項に記載の復号器。
【請求項３７】
前記バッファ記述情報に基づいて、参照ピクチャリストの初期化を行うリストマネージャ（４７０）をさらに有することを特徴とする請求項２１乃至３６のいずれか１項に記載の復号器。
【請求項３８】
ビデオストリーム（１）の複数のピクチャ（１０、４０、４２、５０）の符号化表現（６０）を受信する入力部（５１０）と、
前記複数のピクチャ（１０、４０、４２、５０）の符号化表現を復号する、請求項２１乃至３７のいずれか１項に記載の復号器（４００）と、
前記ビデオストリーム（１）の復号されたピクチャを出力する出力部（５２０）と、を有する
ことを特徴とする受信機（５００）。
【請求項３９】
ビデオストリーム（１）の複数のピクチャ（１０、４０、４２、５０）の符号化表現（６０）を受信する入力部（６１０）と、
メモリ（６４０）に格納されたコンピュータプログラムのコード手段を処理するプロセッサ（６３０）であって、前記コード手段が該プロセッサ（６３０）において実行された場合に、
ピクチャ（１０）の符号化表現（６０）から少なくとも１つの参照ピクチャ（４０、４２）を定義するバッファ記述情報を取得し、
前記バッファ記述情報に基づいて、前記少なくとも１つの参照ピクチャ（４０、４２）の各々を示す少なくとも１つのピクチャ識別子を、前記ピクチャ（１０）の復号参照として決定し、
前記少なくとも１つのピクチャ識別子に基づいて、復号されたピクチャバッファ（６５０）を更新するプロセッサ（６３０）と、
前記ビデオストリーム（１）の復号されたピクチャを出力する出力部（６２０）と、を

有する
ことを特徴とする復号器（６００）。
【請求項４０】
ビデオストリーム（１）の複数のピクチャ（１０、４０、４２、５０）のうちの１つのピクチャ（１０）を符号化する方法であって、
前記複数のピクチャ（１０、４０、４２、５０）のうちの少なくとも１つの参照ピクチャを、前記ピクチャ（１０）の符号化参照として決定する工程（Ｓ１）と、
前記少なくとも１つの参照ピクチャ（４０、４２）の各々について、前記参照ピクチャ（４０、４２）を示すピクチャ識別子を提供する工程（Ｓ２）と、
前記少なくとも１つのピクチャ識別子に基づいて、前記少なくとも１つの参照ピクチャ（４０、４２）を定義するバッファ記述情報を生成する工程（Ｓ３）と、
前記ピクチャ（１０）の符号化表現（６０）内に前記バッファ記述情報を挿入する工程（Ｓ４）と、を有する
ことを特徴とする方法。
【請求項４１】
前記少なくとも１つの参照ピクチャ（４０、４２）を決定する工程（Ｓ１）は、前記ピクチャ（１０）に対し、前記複数のピクチャ（１０、４０、４２、５０）のうちの参照ピクチャ（４０、４２）のいずれかを前記ピクチャ（１０）の符号化参照として決定し、前記複数のピクチャ（１０、４０、４２、５０）のうちの参照ピクチャ（４２）のいずれかを、前記ビデオストリーム（１）の復号順に係り後続するピクチャ（５０）の符号化参照として決定する工程（Ｓ１）を有することを特徴とする請求項４０に記載の方法。
【請求項４２】
前記ピクチャ（１０）は、少なくとも１つのスライス（２０、２２）を含み、
前記少なくとも１つの参照ピクチャ（４０、４２）を決定する工程（Ｓ１）は、前記複数のピクチャ（１０、４０、４２、５０）のうちの少なくとも１つの参照ピクチャ（４０、４２）を、前記ピクチャ（１０）の少なくとも１つのスライス（２０、２２）用に決定する工程を有し、
前記バッファ記述情報を挿入する工程（Ｓ４）は、前記ピクチャ（６０）の符号化表現（６０）のスライスヘッダ（６５）の各々に含まれる前記バッファ記述情報を、前記ピクチャ（１０）のスライス（２０、２２）の各々に挿入する工程を有する
ことを特徴とする請求項４０または４１に記載の方法。
【請求項４３】
前記少なくとも１つのピクチャ識別子の各々について、前記少なくとも１つの参照ピクチャ（４０、４２）の参照ピクチャを示すピクチャ識別子と前記ピクチャ（１０）を示すピクチャ識別子との差を算出する工程（Ｓ１０）をさらに有し、
前記バッファ記述情報を生成する工程（Ｓ３）は、前記少なくとも１つの差に基づいて、前記ピクチャ（１０）を示すピクチャ識別子に関連した前記少なくとも１つのピクチャ識別子を定義する前記バッファ記述情報を生成する工程を有する
ことを特徴とする請求項４０乃至４２のいずれか１項に記載の方法。
【請求項４４】
各々が少なくとも１つの参照ピクチャ（４０、４２）を定義する複数の所定のバッファ記述を含むデータ構造を生成する工程（Ｓ２０）をさらに有し、
前記バッファ記述情報を生成する工程（Ｓ３）は、
前記少なくとも１つのピクチャ識別子に基づいて、前記データ構造のバッファ記述を選択する工程（Ｓ２３）と、
前記選択されたバッファ記述の識別子を含む前記バッファ記述情報を生成する工程（Ｓ２４）と、を有する
ことを特徴とする請求項４０乃至４３のいずれか１項に記載の方法。
【請求項４５】
前記ビデオストリーム（１）の符号化表現に関連付けられた、ピクチャパラメータセッ

ト（６７）またはシーケンスパラメータセット（６８）に前記データ構造を挿入する工程（Ｓ２１）と、
前記バッファ記述情報の一部として、前記ピクチャ（１０）の符号化表現（６０）のスライスヘッダ（６５）に前記ピクチャパラメータセット（６７）または前記シーケンスパラメータセット（６８）の識別子を挿入する工程（Ｓ２２）と、を有する
ことを特徴とする請求項４４に記載の方法。
【請求項４６】
前記バッファ記述情報を生成する工程（Ｓ２３）は、前記選択されたバッファ記述の識別子と、前記少なくとも１つの参照ピクチャ（４０、４２）の参照ピクチャを定義する情報とを含む前記バッファ記述情報を生成する工程を有することを特徴とする請求項４４または４５に記載の方法。
【請求項４７】
前記少なくとも１つの参照ピクチャ（４０、４２）を決定する工程（Ｓ１）は、
少なくとも１つの側面拘束に従って、前記ピクチャ（１０）に対し、前記ピクチャ（１０）の符号化表現（６０）の圧縮効率を最大化することにより前記少なくとも１つの参照ピクチャ（４０、４２）を決定する工程であって、
前記側面拘束は、
ｉ）参照ピクチャの所定の最大数、および
ｉｉ）ピクチャの少なくとも１つの符号化表現が前記ビデオストリーム（１）の符号化表現から削除された場合にも、前記ビデオストリーム（１）の復号可能な符号化表現を生成すること、
から選択される
ことを特徴とする請求項４０乃至４６のいずれか１項に記載の方法。
【請求項４８】
ビデオストリーム（１）の複数のピクチャ（１０、４０、４２、５０）のうちの１つのピクチャ（１０）を符号化する符号化器（１００）であって、
前記複数のピクチャ（４０、４２、５０）のうちの少なくとも１つの参照ピクチャを、前記ピクチャ（１０）の符号化参照として決定する参照ピクチャ決定器（１１０）と、
前記少なくとも１つの参照ピクチャ（４０、４２）の各々について、前記参照ピクチャ（４０、４２）を示すピクチャ識別子を提供するピクチャ識別子提供器（１２０）と、
前記少なくとも１つのピクチャ識別子に基づいて、前記少なくとも１つの参照ピクチャ（４０、４２）を定義するバッファ記述情報を生成するバッファ記述情報生成器（１３０）と、
前記ピクチャ（１０）の符号化表現（６０）内に前記バッファ記述情報を挿入するデータ挿入器（１４０）と、を有する
ことを特徴とする符号化器。
【請求項４９】
前記参照ピクチャ決定器（１１０）は、前記ピクチャ（１０）に対し、前記複数のピクチャ（１０、４０、４２、５０）のうちの参照ピクチャ（４０、４２）のいずれかを前記ピクチャ（１０）の符号化参照として決定し、前記複数のピクチャ（１０、４０、４２、５０）のうちの参照ピクチャ（４２）のいずれかを、復号順に係り後続するピクチャ（５０）の符号化参照として決定することを特徴とする請求項４８に記載の符号化器。
【請求項５０】
前記ピクチャ（１０）は、少なくとも１つのスライス（２０、２２）を含み、
前記参照ピクチャ決定器（１１０）は、前記複数のピクチャ（１０、４０、４２、５０）の少なくとも１つの参照ピクチャ（４０、４２）を、前記ピクチャ（１０）の少なくとも１つのスライス（２０、２２）用に決定し、
前記データ挿入器（１４０）は、前記ピクチャ（１０）の符号化表現（６０）のスライスヘッダ（６５）の各々に含まれる前記バッファ記述情報を、前記ピクチャ（１０）のスライス（２０、２２）の各々に挿入する

ことを特徴とする請求項４８または４９に記載の符号化器。
【請求項５１】
前記少なくとも１つのピクチャ識別子の各々について、前記少なくとも１つの参照ピクチャ（４０、４２）の参照ピクチャを示すピクチャ識別子と前記ピクチャ（１０）を示すピクチャ識別子との差を算出する識別子算出器（１５０）をさらに有し、
前記バッファ記述情報生成器（１３０）は、前記少なくとも１つの差に基づいて、前記ピクチャ（１０）を示すピクチャ識別子に関連した前記少なくとも１つのピクチャ識別子を定義する前記バッファ記述情報を生成する
ことを特徴とする請求項４８乃至５０のいずれか１項に記載の符号化器。
【請求項５２】
各々が少なくとも１つのピクチャ識別子を定義する複数の所定のバッファ記述を含むデータ構造を生成するデータ構造生成器（１６０）をさらに有し、
前記バッファ記述情報生成器（１３０）は、ｉ）前記少なくとも１つのピクチャ識別子に基づいて、前記データ構造のバッファ記述を選択し、ｉｉ）前記選択されたバッファ記述の識別子を含む前記バッファ記述情報を生成する
ことを特徴とする請求項４８乃至５１のいずれか１項に記載の符号化器。
【請求項５３】
前記データ挿入器（１４０）は、ｉ）前記ビデオストリーム（１）の符号化表現に関連付けられた、ピクチャパラメータセット（６７）またはシーケンスパラメータセット（６８）に前記データ構造を挿入し、ｉｉ）前記バッファ記述情報の一部として、前記ピクチャ（１０）の符号化表現（６０）のスライスヘッダ（６５）に前記ピクチャパラメータセット（６７）または前記シーケンスパラメータセット（６８）の識別子を挿入することを特徴とする請求項５２に記載の符号化器。
【請求項５４】
前記バッファ記述情報生成器（１３０）は、前記選択されたバッファ記述の識別子と、前記少なくとも１つの参照ピクチャ（４０、４２）のうちの１つの参照ピクチャを定義する情報とを含む前記バッファ記述情報を生成することを特徴とする請求項５２または５３に記載の符号化器。
【請求項５５】
ビデオストリーム（１）の複数のピクチャ（１０、４０、４２、５０）を受信する入力部（２１０）と、
前記複数のピクチャ（１０、４０、４２、５０）の符号化表現（６０）の各々を生成するために、前記複数のピクチャ（１０、４０、４２、５０）を符号化する、請求項４８乃至５４のいずれか１項に記載の符号化器（１００）と、
前記複数のピクチャ（１０、４０、４２、５０）の符号化表現（６０）の各々を出力する出力部（２２０）と、を有する
ことを特徴とする送信機（２００）。
【請求項５６】
ビデオストリーム（１）の複数のピクチャ（１０、４０、４２、５０）を受信する入力部（３１０）と、
メモリ（３４０）に格納されたコンピュータプログラムのコード手段を処理するプロセッサ（３３０）であって、前記コード手段が該プロセッサ（３３０）において実行された場合に、
前記ビデオストリーム（１）の１つのピクチャ（１０）について、前記複数のピクチャ（１０、４０、４２、５０）の少なくとも１つの参照ピクチャ（４０、４２）を、該ピクチャ（１０）の符号化参照として決定し、
前記少なくとも１つの参照ピクチャ（４０、４２）の各々について、前記参照ピクチャ（４０、４２）を示すピクチャ識別子を提供し、
前記少なくとも１つのピクチャ識別子に基づいて、前記少なくとも１つの参照ピクチャ（４０、４２）を定義するバッファ記述情報を生成し、

前記ピクチャ（１０）の符号化表現（６０）に前記バッファ記述情報を挿入するプロセッサ（３３０）と、
ピクチャ（１０）の符号化表現（６０）を出力する出力部（３２０）と、を有する
ことを特徴とする符号化器（３００）。
【発明の詳細な説明】
【技術分野】
【０００１】
本発明の実施形態は、概してビデオの符号化及び復号に関連した参照ピクチャ管理に関し、特に参照ピクチャ信号伝送及びバッファ管理に関する。
【背景技術】
【０００２】
ＭＰＥＧ－４（Moving Picture Experts Group-4）高度映像符号化（ＡＶＣ：Advanced Video Coding）とも呼ばれるＨ．２６４は、最先端の映像符号化基準である。Ｈ．２６４は、時間及び空間予測を利用するブロックベースのハイブリッド映像符号化方式で構成される。
【０００３】
高効率映像符号化（ＨＥＶＣ：High Efficiency Video Coding）は、映像符号化共同研究部会（ＪＣＴ－ＶＣ：Joint Collaborative Team-Video Coding）において現在開発されている新しいビデオ符号化基準である。ＪＣＴ－ＶＣは、ＭＰＥＧと国際電気通信連合－電気通信標準化部門（ＩＴＵ－Ｔ：International Telecommunication Union Telecommunication standardization sector）との共同プロジェクトである。現在、大きなマクロブロック（最大符号化単位はＬＣＵと省略される）及び複数の他の新しいツールを含むために、Ｈ．２６４／ＡＶＣよりかなり効率的なワーキングドラフト（ＷＤ：Working Draft）が規定されている。
【０００４】
受信機において、復号器は、ピクチャ、即ち圧縮データのビデオデータパケットを示すビットストリームを受信する。圧縮データは、ペイロード及び制御情報を含む。制御情報は、復号ピクチャバッファ（ＤＰＢ：decoded picture buffer）とも呼ぶ参照ピクチャバッファに参照ピクチャが格納されるべきであるという情報等を含む。該情報は、以前に受信したピクチャについての相対的な参照である。さらに復号器は、受信したビットストリームを復号し、復号ピクチャを表示する。また、復号ピクチャは、制御情報に従って復号ピクチャバッファに格納される。復号器は、後続のピクチャを復号する際に格納されたこれらの参照ピクチャを使用する。
【０００５】
ＨＥＶＣのワーキングドラフトにおける復号ピクチャバッファ操作の処理についての作業仮定は、それらが大部分はＨ．２６４／ＡＶＣから継承されることである。方式がＨ．２６４／ＡＶＣで設計された時の方式の簡略化されたフローチャートを図１に示す。
【０００６】
ピクチャを実際に復号する前に、スライスヘッダにおけるframe_numは、シーケンスパラメータセット（ＳＰＳ：Sequence Parameter Set）構文要素gaps_in_frame_num_value_allowed_flagが１の場合にframe_numの起こり得る欠落を検出するように構文解析される。frame_numは復号順序を示す。frame_numの欠落が検出される場合、「存在していない」フレームが作成されて、復号ピクチャバッファ（ＤＰＢ）に挿入される。
【０００７】
frame_numに欠落があったか否かに関係なく、次の工程は現在のピクチャを実際に復号することである。ピクチャのスライスヘッダがメモリ管理制御動作（ＭＭＣＯ：Memory Management Control Operations）コマンドを含む場合、復号ピクチャバッファに格納されるピクチャについての相対的な参照を取得するためにピクチャを復号した後に適応メモリ制御処理が適用され、ピクチャのスライスヘッダがＭＭＣＯコマンドを含まない場合、復号ピクチャバッファに格納されるピクチャについての相対的な参照を取得するためにスラ

イドウィンドウ処理が適用される。最終工程として、ピクチャを正確な順序で配信するために「バンプ」処理が適用される。

【０００８】

Ｈ．２６４／ＡＶＣに関する問題は、以下の表１において開示されるようなタイプ２、３、４、５又は６のＭＭＣＯを含むピクチャの損失に対する脆弱性である。

【０００９】

【表１】

memory_management_control_operation	メモリ管理制御動作
0	memory_management_control_operation構文要素ループを終了する。
1	短期参照ピクチャを「参照のために未使用」のものとしてマーク付けする。
2	長期参照ピクチャを「参照のために未使用」のものとしてマーク付けする。
3	短期参照ピクチャを「長期参照のために使用済み」のものとしてマーク付けし、長期フレーム指標を短期参照ピクチャに割り当てる。
4	最大長期フレーム指標を特定し、最大値より大きい長期フレーム指標を有する全ての長期参照ピクチャを「参照のために未使用」のものとしてマーク付けする。
5	全ての参照ピクチャを「参照のために未使用」のものとしてマーク付けし、MaxLongTermFrameIdx変数を「長期フレーム指標なし」に設定する。
6	現在のピクチャを「長期参照のために使用済み」のものとしてマーク付けし、長期フレーム指標を現在のピクチャに割り当てる。

Ｈ．２６４／ＡＶＣに係るメモリ管理制御動作値

【００１０】

ＭＭＣＯを含まないピクチャ又はタイプ０又は１のＭＭＣＯを含むピクチャの損失は、当然、復号処理にとって深刻である。損失ピクチャの画素値は使用可能にはならないため、正確でないインター予測のために長期間にわたり将来のピクチャに影響を及ぼすだろう。例えばある短期参照ピクチャを「参照に使用しない」ものとしてマーク付けしない場合に、後続するピクチャの参照ピクチャリストに含まれる短期参照ピクチャを「参照に使用しない」ものとしてマーク付けしたＭＭＣＯを損失ピクチャが含んでいた場合、損失ピクチャに後続する少数のピクチャについての参照ピクチャリストが間違っている危険性もある。しかしながら、復号処理は、一般的には、条件付きのイントラブロック、イントラスライスを使用して、あるいは他の手段によりこのような損失を回復できる。

【００１１】
しかしながら、タイプ２、３、４、５又は６のＭＭＣＯを含むピクチャが損失される場合、ＤＰＢにおける長期ピクチャの数がピクチャが受信された場合のものとは異なる危険性があり、その結果、全ての後続のピクチャに対して「正確でない」スライドウィンドウ処理が行わる。即ち、符号化器及び復号器が異なる数の短期ピクチャを含む結果、スライドウィンドウ処理の非同期の挙動が生じる。条件付きのイントラブロック、イントラスライス又は同様の技術を使用しても該損失を回復できない（オープンピクチャ群（ＧＯＰ：Group Of Picture）イントラピクチャ）でさえ回復できない）。このような損失からの回復を保証する唯一の方法は、瞬時復号リフレッシュ（ＩＤＲ：Instantaneous Decoder Refresh）ピクチャ又は損失ＭＭＣＯの影響を相殺するＭＭＣＯを介することである。状況をさらに悪化させているのは、スライドウィンドウ処理が同期していないために、問題を符号化器に報告できないこと、あるいはフィードバックチャネルが使用可能である適応例においてでさえＩＤＲピクチャを要求できないことを復号器が必ずしも認識していないことである。

【００１２】
重要なＭＭＣＯ情報を損失する危険性を低下させる１つの方法は、dec_ref_pic_marking_repetition付加拡張情報（ＳＥＩ：Supplementary Enhancement Information）メッセージを使用することである。しかしながら、符号化器は、復号器がdec_ref_pic_marking_repetition SEIメッセージを利用できるかが分からない。また、dec_ref_pic_marking_repetition SEIメッセージも失われる危険性がある。

【００１３】
従って、従来技術の解決策の欠点及び制限による影響を受けない効率的な参照ピクチャ信号伝送及びバッファ管理が必要である。

【発明の概要】

【００１４】
ビデオの符号化及び復号に関連する、効率的な参照ピクチャの信号伝送及びバッファ管理を提供することが全体的な目標である。

【００１５】
このこと及び他の目標は、本明細書に記載された実施形態により満たされる。

【００１６】
実施形態の一態様は、ビデオストリームの複数のピクチャのうちの１つのピクチャの符号化表現を復号する方法に関する。方法は、ピクチャの符号化表現から少なくとも１つの参照ピクチャを定義するバッファ記述情報を取得する工程を有する。少なくとも１つの参照ピクチャのうちの参照ピクチャの各々を示す少なくとも１つのピクチャ識別子は、バッファ記述情報に基づいて決定される。各参照ピクチャはピクチャの復号参照として用いられる。復号されたピクチャバッファは、少なくとも１つのピクチャ識別子に基づいて更新される。

【００１７】
実施形態の関連する態様は、ビデオストリームの複数のピクチャのうちの１つのピクチャの符号化表現を復号する復号器を規定する。復号器は、ピクチャの符号化表現から少なくとも１つの参照ピクチャを定義するバッファ記述情報を取得するデータ取得器を有する。復号器のピクチャ識別子決定器は、バッファ記述情報に基づいて、少なくとも１つの参照ピクチャのうちの参照ピクチャの各々を示す少なくとも１つのピクチャ識別子を、ピクチャの復号参照として決定する。また復号器は、少なくとも１つのピクチャ識別子に基づいて、復号されたピクチャバッファを更新するバッファマネージャを有する。

【００１８】
実施形態の他の関連する態様は、ビデオストリームの複数のピクチャの符号化表現を受信する入力部を有する復号器を規定する。また復号器は、メモリに格納されたコンピュータプログラムのコード手段を処理するプロセッサを有する。コード手段は、該プロセッサにおいて実行された場合に、ピクチャの符号化表現から少なくとも１つの参照ピクチャを

定義するバッファ記述情報をプロセッサに取得させる。またプロセッサは、バッファ記述情報に基づいて、少なくとも１つの参照ピクチャの各々を示す少なくとも１つのピクチャ識別子を、ピクチャの復号参照として決定させられる。さらにコード手段はプロセッサに、少なくとも１つのピクチャ識別子に基づいて、復号されたピクチャバッファを更新させられる。復号器の出力部は、ビデオストリームの復号されたピクチャを出力する。

【００１９】

実施形態の他の態様は、ビデオストリームの複数のピクチャのうちの１つのピクチャを符号化する方法に関する。方法は、複数のピクチャのうちの少なくとも１つの参照ピクチャを、ピクチャの符号化参照として決定する工程を有する。また方法は、少なくとも１つの参照ピクチャの各々について、参照ピクチャを示すピクチャ識別子を提供する工程を有する。少なくとも１つの参照ピクチャを定義するバッファ記述情報は、少なくとも１つのピクチャ識別子に基づいて生成される。バッファ記述情報は、ピクチャの符号化表現内に挿入される。

【００２０】

実施形態の関連する態様は、ビデオストリームの複数のピクチャのうちの１つのピクチャを符号化する符号化器を規定する。符号化器は、複数のピクチャのうちの少なくとも１つの参照ピクチャを、ピクチャの符号化参照として決定する参照ピクチャ決定器を有する。また符号化器は、少なくとも１つの参照ピクチャの各々について、参照ピクチャを示すピクチャ識別子を提供するピクチャ識別子提供器を有する。バッファ記述情報生成器は、少なくとも１つのピクチャ識別子に基づいてバッファ記述情報を生成する。バッファ記述情報は、データ挿入器によりピクチャの符号化表現内に挿入される。

【００２１】

実施形態の他の関連する態様は、ビデオストリームの複数のピクチャを受信する入力部と、メモリに格納されたコンピュータプログラムのコード手段を処理するプロセッサとを有する符号化器を規定する。コード手段は、該プロセッサにおいて実行された場合に、ビデオストリームの１つのピクチャについて、複数のピクチャの少なくとも１つの参照ピクチャを、該ピクチャの符号化参照としてプロセッサに決定させる。またプロセッサは、参照ピクチャの各々について、該参照ピクチャを示すピクチャ識別子を提供させられ、少なくとも１つのピクチャ識別子に基づいてバッファ記述情報を生成させられる。さらにコード手段はプロセッサに、ピクチャの符号化表現にバッファ記述情報を挿入させる。さらに符号化器は、ピクチャの符号化表現を出力する出力部を有する。

【００２２】

参照ピクチャを修正する従来技術の解決策との明確に対比すると、以前の符号化ピクチャが正しく受信されて復号されることとは管理は独立しており、実施形態は相対的あるいは暗黙的な方法に代わり、絶対的かつ明白な方法で参照ピクチャが用いられるバッファ記述情報を提供する。従って、ピクチャの符号化表現は、復号の際に参照に用いるための、ビデオストリームにおいて以前のピクチャの符号化表現とは独立した、参照ピクチャについての情報を含む。

【００２３】

従って、復号器が、以前のピクチャにおいて正しくもたらされ解釈されたバッファ操作を信頼する代わりに、現在のピクチャの参照ピクチャ管理について、現在のピクチャに含まれる情報のみを信頼するため実施形態は参照ピクチャ管理及びエラーに対する脆弱性が低い信号伝達をもたらす。

【００２４】

添付の図面と共に以下の説明を参照することにより、本発明は本発明の更なる目的及び利点と共に最適に理解されるだろう。

【図面の簡単な説明】

【００２５】

【図１】Ｈ．２６４／ＡＶＣ参照バッファ方式を示す簡略化されたフローチャート。

【図２】２つの時間層を有する符号化構造の一例を示す図。

【図３】一実施形態に係るピクチャを符号化する方法を示すフローチャート。
【図４】一実施形態に係る複数のピクチャのビデオストリームを示す図。
【図５】一実施形態に係るピクチャの符号化表現を示す図。
【図６】図３の方法の更なるオプションのステップを示すフローチャート。
【図７】図３の方法の更なるオプションのステップ及び図３のバッファ記述情報を生成する一実施形態を示すフローチャート。
【図８】（サブ）ＧＯＰサイズ８を有する符号化構造の一例を示す図。
【図９】一実施形態に係るピクチャの符号化表現を復号する方法を示すフローチャート。
【図１０】図９のピクチャ識別子を決定する一実施形態を示すフローチャート。
【図１１】図９のバッファ記述情報を取得する一実施形態を示すフローチャート。
【図１２】図９のピクチャ識別子を決定する別の実施形態を示すフローチャート。
【図１３】図９の方法の更なるオプションのステップを示すフローチャート。
【図１４】図９の方法の更なるオプションのステップを示すフローチャート。
【図１５】符号化構造の一例を示す図。
【図１６】一実施形態に係る参照バッファ方式を示す簡略化されたフローチャート。
【図１７】一実施形態に係る送信機を示す概略ブロック図。
【図１８】一実施形態に係る符号化器を示す概略ブロック図。
【図１９】別の実施形態に係る符号化器を示す概略ブロック図。
【図２０】一実施形態に係る受信機を示す概略ブロック図。
【図２１】一実施形態に係る復号器を示す概略ブロック図。
【図２２】別の実施形態に係る復号器を示す概略ブロック図。
【発明を実施するための形態】
【００２６】
図中、同一の、あるいは対応する要素に対して同一の参照番号が使用される。
【００２７】
本発明の実施形態は、一般的にはビデオストリームの当該技術分野においてフレームとも呼ぶピクチャの符号化及び復号に関する。特に、実施形態は、ビデオの符号化及び復号と関連した参照ピクチャの管理、並びに符号化器から復号器へのこのような参照ピクチャの信号伝送に関する。
【００２８】
例えばＨ．２６４／ＭＰＥＧ－４　ＡＶＣ及びＨＥＶＣにより示されるビデオ符号化は、現在のピクチャの画素データの符号化及び復号のための予測又は参照として参照ピクチャを利用する。一般的には、これを当技術分野においてインター符号化と呼ぶ。インター符号化において、ピクチャは、このような参照ピクチャに対して符号化及び復号される。符号化ピクチャを復号できるためには、復号器は、現在の符号化ピクチャに対してどの参照ピクチャを使用するかを認識し、且つこれらの参照ピクチャへアクセスできなければならない。一般的には、復号器は、参照ピクチャを格納するために、本明細書において参照ピクチャバッファとも示される復号ピクチャバッファ（ＤＰＢ）を使用する。従って、復号ピクチャバッファに格納された参照ピクチャが符号化ピクチャを復号する際に実際に正確な参照ピクチャであることが重要である。そうでない場合、復号器は、復号処理の間に間違った参照ピクチャを使用することになり、その結果、提示されるビデオの品質が低下する。
【００２９】
従来技術の手法は、ＭＭＣＯ情報を搬送するピクチャが偶然損失される場合に、背景技術において説明した、正確でない参照ピクチャを使用することに係る問題の影響を受ける可能性がある。従来技術の該問題は、以下のＨ．２６４により実現される例により示されうる。復号ピクチャバッファは、ピクチャ識別子３００、３０２及び３０３を有する３つの短期ピクチャ、並びにピクチャ識別子０及び３を有する２つの長期ピクチャを格納すると仮定する。そして符号化器は、長期ピクチャ０が参照に使用しないべきことを示すＭＭＣＯタイプ２を有する新しい符号化ピクチャを生成してもよい。該符号化ピクチャが復号

器において正確に受信されていれば、長期ピクチャ０は参照に使用しないものとしてマーク付けされており、参照ピクチャリストは｛３００，３０２，３０３，３｝となっているだろう。しかしながら、ＭＭＣＯタイプ２コマンドを有する符号化ピクチャが損失される場合、復号器は、長期ピクチャ０が参照に使用しないものとしてマーク付けされるべきであること、及び故に参照ピクチャリストが代わりに｛３００，３０２，３０３，０，３｝となることを通知されない。参照ピクチャリストの位置３における参照ピクチャがピクチャにおけるマクロブロックについての予測として使用されるという情報を復号器において受信された次の符号化ピクチャが含む場合、ＭＭＣＯタイプ２コマンドが損失される場合に問題となる。ＭＭＣＯタイプ２コマンドが復号器において正確に受信されていた場合、参照ピクチャリストの位置３における参照ピクチャは、該参照ピクチャが参照ピクチャリストの位置３（０から開始する場合）を占有する時に長期ピクチャ３に対応する。しかしながら、ＭＭＣＯタイプ２コマンドを損失した状態では、参照ピクチャリストの位置３は、代わりに長期ピクチャ０により占有される。これは、長期ピクチャ０からの画素データが長期ピクチャ識別子３からの正確な画素データの代わりに予測基準として使用されることを意味する。

【００３０】

従って、従来技術の解決策は、以前に復号ピクチャが正確に受信及び復号されているということに正確な参照ピクチャ管理が依存するという問題がある。

【００３１】

本発明の実施形態は、従来技術と比較して根本的に異なる参照ピクチャを信号伝送する方法を使用することにより、従来技術の手法のこれらの問題がなくなる。代わりに、本発明の実施形態は、相対的又は黙示的な方法ではなく、絶対的又は明示的な方法で参照ピクチャに対してどの符号化ピクチャを使用するかを特定する。換言すると、現在のピクチャについての符号化表現、即ちビットストリームは、先行のピクチャの符号化表現に関係なく、参照のためにどんなピクチャを使用するか、即ち参照ピクチャに関する情報を含む。従って、正確な復号ピクチャバッファを維持する論理的な信頼性は、復号器からビットストリームに移ったと言える。その１つの見方は、ピクチャについてのインター予測及び動きベクトル予測のためにどんな参照ピクチャを使用するかに関する情報がピクチャの制御情報に含まれると言うことである。従って、復号ピクチャバッファの状態は、他のピクチャに対して符号化及び復号される全てのピクチャに対して信号伝送される。

【００３２】

実施形態の一態様によれば、例えば参照ピクチャに対して使用されるピクチャ、即ち後続の符号化のために使用される復号ピクチャバッファ（参照ピクチャバッファとも呼ぶ）に格納されるピクチャに関する絶対情報を含む一般的なテーブル等のデータ構造であるバッファ記述情報を作成する方法が提供される。バッファ記述情報の少なくとも一部は、符号化器により符号化されたビットストリームに挿入される。

【００３３】

図３は、一実施形態に係るピクチャを符号化する方法を示すフローチャートである。一般的には方法は、ステップＳ１から開始し、複数のピクチャのビデオストリームの少なくとも１つの参照ピクチャは、符号化参照として決定される。一実施形態において、ステップＳ１は、符号化される現在のピクチャについての符号化参照として使用される１つ以上の参照ピクチャを決定する。従って、次に、現在のピクチャの画素データは、１つ以上の参照ピクチャを参照して符号化される。あるいは又はさらに、ステップＳ１で決定された少なくとも１つの参照ピクチャは、ビデオストリームの後続のピクチャ、即ち現在のピクチャの後に符号化及び復号されるピクチャについての符号化参照として使用されてよい。その結果、該後続のピクチャは、復号順序（及び符号化順序）に従って現在のピクチャの後である。特定の一実施形態において、Ｓ１は、現在のピクチャに対して、ビデオストリームのいずれかの参照ピクチャを現在のピクチャについての符号化参照として決定し、ビデオストリームのいずれかの参照ピクチャを後続のピクチャについての符号化参照として決定する。従って、特定の一実施形態において、ステップＳ１は、復号順序で現在のピク

チャに先行し、且つ現在のピクチャ又は復号順序に従って現在のピクチャに後続するいずれかのピクチャについてのインター予測のために使用されてもよい全ての参照ピクチャを決定する。

【００３４】

図４は、複数のピクチャ１０、４０、４２、５０のビデオストリーム１を示すことで該概念を概略的に示す。現在のピクチャ１０は、復号されるツリーブロックとも呼ぶマクロブロック等の画素ブロック３０を含む１つ以上のスライス２０、２２、即ち符号化ユニットを含んでもよい。ピクチャ１０、４０、４２、５０の下の矢印は、復号の関係を示す。現在のピクチャ１０は、先行の参照ピクチャ４０及び後続の参照ピクチャ４２に関連して復号される。出力順序に従って現在のピクチャ１０に関して、先行の参照ピクチャ４０は先行しており、後続の参照ピクチャ４２は後続しているが、双方とも復号順序に従って現在のピクチャ１０に先行している。該後続の参照ピクチャ４２は、ビデオストリーム１における後続のピクチャ５０についての参照ピクチャとしても使用される。従って、特定の一実施形態において、ステップＳ１は、参照ピクチャを図４のピクチャ４０、４２として決定できる。

【００３５】

図３の次のステップＳ２は、ステップＳ１で決定された少なくとも１つの参照ピクチャの各参照ピクチャについてのそれぞれのピクチャ識別子を提供する。ピクチャ識別子は、参照ピクチャを明確に識別するために、場合によっては他のデータと共に使用される。従って、ピクチャ識別子は、参照ピクチャとして使用されるピクチャについての絶対参照であると考えられうる。これは、ピクチャ識別子及び選択的に他のデータを与えられれば適切な参照ピクチャを正確に識別できることを意味する。

【００３６】

実施形態に係るピクチャ識別子として使用可能な使用可能な種々の代替例がある。例えばピクチャ識別子は、復号順序番号、表示順序番号、出力順序番号又は表示順序番号と更なる識別子との組合せ、あるいは実際にはピクチャを明確に識別するために使用可能な他のいずれかの情報であってよい。

【００３７】

このようなピクチャ識別子の例には、ピクチャ順序カウント（ＰＯＣ：Picture Order Count）、フレーム番号（frame_num）又はＰＯＣ及び更なる識別子（additional_picture_id）を含む。

【００３８】

特定の一実施形態において、ピクチャ識別子の実際値は、適切な参照ピクチャを明確に識別するために、更なる情報又は他のデータ、例えばステップＳ３で生成されるバッファ記述情報におけるピクチャ識別子の位置と共に使用される。従って、バッファ記述情報により識別又は取得されたバッファ記述により、適切な参照ピクチャを明確に識別できるようになる。一実施形態において、ＰＯＣあるいはＰＯＣ及び更なる識別子等のピクチャ識別子自体は、参照ピクチャを明確に識別するために使用可能である。

【００３９】

参照ピクチャを明確に識別することは、本明細書では、ピクチャ識別子が単独で又はバッファ記述情報がピクチャ識別子を規定する順序等のバッファ記述情報の他の情報と共に参照ピクチャを明示的に識別するために使用されることを示すために使用される。従って、ピクチャ識別子又はピクチャ識別子及び他の情報を与えられることにより、ビデオストリームのピクチャの中から適切な参照ピクチャを識別できるようになる。

【００４０】

ステップＳ１の特定の一実施形態において、現在のピクチャに対して決定された参照ピクチャの総数は、符号化器から復号器に信号伝送可能なパラメータ、例えばmax_num_ref_framesで示されたパラメータにより制限されうる。

【００４１】

ステップＳ２は、ステップＳ１で決定された各参照ピクチャに対して実行されることが

好ましく、これは線Ｌ１により概略的に示される。

【００４２】

ステップＳ２で提供されたピクチャ識別子は、ステップＳ１で決定された参照ピクチャのヘッダ部分から読み出されてよく、あるいはステップＳ１からの参照ピクチャを示すデータから取得されてよい。

【００４３】

次のステップＳ３は、参照ピクチャセット（ＲＰＳ：Reference Picture Set）とも呼ぶバッファ記述の情報を生成する。該情報は、本明細書においてバッファ記述情報で示される。バッファ記述情報は、ステップＳ２で提供されたピクチャ識別子に基づいて生成される。該バッファ記述情報は、ステップＳ１で決定された少なくとも１つの参照ピクチャを規定、好ましくは明確に規定する。従って、バッファ記述情報から少なくとも１つの参照ピクチャのそれぞれのピクチャ識別子を導出できる。

【００４４】

生成されたバッファ記述情報は、ステップＳ４で現在のピクチャの符号化表現に挿入される。従って、符号化ピクチャは、ビデオストリームの現在のピクチャ及び／又はいずれかの後続のピクチャを復号するのに必要とされる参照ピクチャを規定且つ識別するために復号器において使用可能なバッファ記述情報を搬送する。

【００４５】

従って、バッファ記述情報は、符号化器から復号器に提供された符号化ピクチャの制御情報において提供される。最低でも、バッファ記述情報は、復号ピクチャバッファにおいて使用される参照ピクチャを識別するために復号器により必要とされる情報を含む。

【００４６】

従って、バッファ記述情報は、現在のピクチャと関連付けられた参照ピクチャのセットであるバッファ記述を識別する情報であると考えられうる。バッファ記述情報は、復号順序で現在のピクチャに先行し、且つ現在のピクチャ又は復号順序で現在のピクチャに後続するいずれかのピクチャのインター予測のために使用されてもよい全ての参照ピクチャから構成される。

【００４７】

一実施形態において、インター予測又は動きベクトル予測、あるいは他のいずれかの予測のためにピクチャが使用されない場合でも、バッファ記述情報は、復号処理において復号器により使用される各ピクチャに関する情報を含む、あるいは規定する。このような情報は、復号順序、表示順序、時間層情報及びビュー情報を含んでよいが、それらに限定されない。

【００４８】

上述したように、バッファ記述情報により信号伝送可能な参照ピクチャの数は、パラメータmax_num_ref_framesにより制限されうる。しかしながら、バッファ記述情報は、該ピクチャの最大数より少ないピクチャを規定してもよく、その場合、残りのピクチャは「空」として解釈される。

【００４９】

ステップＳ１～Ｓ４を有する図３の方法は、復号ピクチャバッファをリフレッシュさせるいかなる瞬時復号リフレッシュ（ＩＤＲ）ピクチャも除くビデオストリームにおける各ピクチャに対して実行されることが好ましいため、いかなるバッファ記述情報も必要ない。これは線Ｌ２により概略的に示される。従って、符号化器により生成された各符号化表現は、ビデオストリームにおける現在のピクチャ及び／又はいずれかの後続のピクチャを符号化及び復号するために使用された参照ピクチャを規定するバッファ記述情報を搬送することが好ましい。

【００５０】

実施形態のこのアプローチは、ＭＭＣＯコマンドを使用する従来技術の相対的な参照ピクチャ信号伝送よりかなり有利である。ビデオストリームにおけるピクチャの各符号化表現におけるバッファ記述情報を介した参照ピクチャの明示的な信号伝送により、参照ピク

チャ管理が誤差による影響をあまり受けないようにし、復号器の誤差ロバスト性レベルを向上させる。従って、復号器は、先行のピクチャにおいて正確に配信及び解釈されたバッファ動作に依存するのではなく、現在のピクチャの符号化表現に含まれた情報のみに依存すればよい。

【００５１】

特定の一実施形態において、ステップＳ４でピクチャの符号化表現に挿入されたバッファ記述情報は、実際にはバッファ記述情報そのものである。従って、バッファ記述情報は、ステップＳ２で提供されたピクチャ識別子のリスト又はステップＳ２で提供されたピクチャ識別子の算出を可能にするデータを含む。図６に関連して、後者のケースが以下においてさらに開示される。

【００５２】

例えばバッファ記述は、ピクチャ識別子３、５及び６を有するリストを現在のピクチャについての参照ピクチャとして規定できる。そして、ステップＳ４で符号化表現に挿入されたバッファ記述情報は、これらのピクチャ識別子３、５及び６を含む。

【００５３】

一般的によりビット効率がよい、即ち一般的にピクチャ識別子を規定するためにより少ない数のビット又は記号を必要とする別のアプローチは、現在のピクチャに対して信号伝送された時にこれらの特性の値に対して参照ピクチャの特性、即ちピクチャ識別子を信号伝送することである。例えば、現在のピクチャがピクチャ識別子７を有する場合、識別子３、５及び６を有する参照ピクチャのリストは、特にピクチャ識別子に対して可変長符号化が採用される場合に一般的には３、５及び６と比較してより少ないビットで示されうる－１、－２及び－４として規定されうる。

【００５４】

図６は、本アプローチを概略的に示している。方法は、図３のステップＳ２から継続する。次のステップＳ１０において、ステップＳ２で提供された各ピクチャ識別子に対して、ピクチャ識別子と現在のピクチャを識別するピクチャ識別子との差分が算出される。該計算の結果、差分、デルタ識別子又は値が得られる。その後、図３のステップＳ３に進み、算出された差分又はデルタ識別子に基づいてバッファ記述情報が生成される。

【００５５】

従って、このケースでは、バッファ記述情報は、デルタ識別子３、５及び６ではなく、－１、－２及び－４を含むことができる。

【００５６】

一実施形態において、デルタ表示順序情報又はdeltaPOCは、可変長コード（ＶＬＣ：variable length code）で符号化されたバッファ記述に含まれる。特定の一実施形態において、deltaPOCは、absolute_delta_POC_minus_one及びフラグ、即ち単一のビットに対して、number_of_reorder_frames＞０の場合にのみ信号伝送されたdeltaPOC_signに対してＶＬＣで符号化され、そうでない場合符号は負であると推測される。

【００５７】

ピクチャ識別子、即ちピクチャ識別子自体又はデルタ識別子の明示的な信号伝送を提供する上述の実施形態において、バッファ記述情報は、実際には現在のピクチャのバッファ記述を構成する。そして、該バッファ記述情報はピクチャの符号化表現に挿入される。

【００５８】

バッファ記述情報は、適切な位置における制御情報として符号化表現に含まれうる。図５は、ピクチャの符号化表現６０の一例を概略的に示す。符号化表現６０は、スライスにおける画素ブロックの符号化画素データを示すビデオペイロードデータ６６を含む。符号化表現６０は、制御情報を搬送するスライスヘッダ６５も含む。スライスヘッダ６５は、ビデオペイロード及びネットワーク抽象化層（ＮＡＬ：Network Abstraction Layer）ヘッダ６４と共に、符号化器から出力されるエンティティであるＮＡＬユニットを形成する。リアルタイムトランスポートプロトコル（ＲＴＰ：Real-time Transport Protocol）ヘッダ６３、ユーザデータグラムプロトコル（ＵＤＰ：User Datagram Protocol）ヘッダ６

２及びインターネットプロトコル（ＩＰ：Internet Protocol）ヘッダ６１等の更なるヘッダを該ＮＡＬユニットに追加して、符号化器から復号器に送信可能なデータパケットを形成できる。この形態のＮＡＬユニットのパケット化は、ビデオ転送と関連した一例を構成するにすぎない。例えばファイル形式、ＭＰＥＧ－２トランスポートストリーム、ＭＰＥＧ－２プログラムストリーム等のＮＡＬユニットを処理する他の方法が可能である。

【００５９】

そしてバッファ記述情報は、符号化器及び復号器が準拠する基準により規定されたスライスヘッダ６５、別のピクチャヘッダ又は別のデータ構造に含まれうる。

【００６０】

別の実施形態において、ピクチャの符号化表現６０に挿入されたバッファ記述情報は、必ずしも現在のピクチャのバッファ記述と同一でなくてもよく、バッファ記述の識別及び取得を可能にする。従って、本実施形態において、ピクチャの符号化表現６０に挿入されたバッファ記述情報は、ピクチャ識別子を算出できるようにするピクチャ識別子又はデルタ識別子等のデータを搬送するバッファ記述の方向を指し示すことにより、ステップＳ１で決定された少なくとも１つの参照ピクチャを間接的に規定する。

【００６１】

このようなケースでは、バッファ記述は、ピクチャの符号化表現６０に関連付けられたデータ構造により搬送されうる。このようなデータ構造の例には、ピクチャパラメータセット（ＰＰＳ：Picture Parameter Set）６７及びシーケンスパラメータセット（ＳＰＳ：Sequence Parameter Set）６８が含まれる。ＰＰＳ６７及び／又はＳＰＳ６８は、符号化表現６０に直接含まれてよいが、一般的にはＰＰＳ識別子及び／又はＳＰＳ識別子を符号化表現６０に含むことでそれらと関連付けられる。例えば各スライスヘッダ６５は、現在のピクチャに対してどのＰＰＳ６７を適用するかを通知するＰＰＳ識別子を含むことができる。その結果、適切なＰＰＳ６７は、ＰＰＳ６７、即ち現在のピクチャに対してどのＳＰＳ６８を適用するかを通知するＳＰＳ識別子を含んでもよい。

【００６２】

そしてバッファ記述は、現在のピクチャに割り当てられたＰＰＳ６７又はＳＰＳ６８に挿入されうる。このようなケースでは、符号化表現６０に挿入されるＰＰＳ識別子又はＳＰＳ識別子は、符号化表現６０に挿入されるバッファ記述情報を構成する。該ＰＰＳ識別子又はＳＰＳ識別子により、参照ピクチャのピクチャ識別子を規定するバッファ記述を取得できるようになるため、ＰＰＳ識別子又はＳＰＳ識別子はピクチャ識別子を間接的に規定する。

【００６３】

ＰＰＳ６７及びＳＰＳ６８は、符号化表現６０に関連付けられ且つ実施形態に係るバッファ記述情報を搬送するために使用可能なデータ構造の例を構成するにすぎない。

【００６４】

図７は、複数のピクチャに対して同一のバッファ記述を使用できるように、データ構造において１つ以上のバッファ記述が信号伝送される別の一実施形態を示す。

【００６５】

方法はステップＳ２０から開始し、テーブル等のデータ構造が生成される。データ構造は、各々が少なくとも１つの参照ピクチャを規定する複数の予め定義されたバッファ記述を含む。

【００６６】

生成されたデータ構造の各バッファ記述は、ピクチャ識別子を直接規定でき、即ちピクチャ識別子のリストを含むことができる。しかしながら、一般的にはこのような方法は、データ構造におけるかなり複数の予め定義されたバッファ記述を必要とする。より効率的な方法は、複数の予め定義されたバッファ記述の使用を上述したようなデルタ識別子の信号伝送と組み合わせることである。このようなケースでは、予め定義されたバッファ記述の各々は、予め定義されたバッファ記述のピクチャ識別子を算出するために、現在のピクチャのピクチャ識別子と共に復号器において使用される少なくとも１つのそれぞれのデル

タ識別子を含む。

【００６７】

以下の表１は、図８に示されるようなビデオストリームに対して使用可能なデルタ識別子を有するこのようなデータ構造の一例を示す。図８のビデオストリームは、ＩＤＲピクチャの前に送信されたデータへの全ての依存を除去するイントラ（Ｉ）フレームであるＩＤＲピクチャから開始する。即ち、図８のビデオストリームは、全ての参照ピクチャを「参照に使用しない」ものとしてマーク付けする。ＩＤＲピクチャは、復号ピクチャバッファを空にするためにバッファ記述を必要としない。図８のビデオストリームは、図８の時間識別子（temporal_id）ｎ、ｎ＋１及びｎ＋２により識別された異なる時間層におけるピクチャを提供する階層ビデオの形態である。

【００６８】

【表１】

エントリ	ピクチャバッファ１	ピクチャバッファ２	ピクチャバッファ３	ピクチャバッファ４
0	dP:-1 tId:2	dP:-2 tId:1	dP:-4 tId:0	dP:-8 tId:0
1	dP:-1 tId:0	dP:-2 tId:2	dP:-5 tId:0	dP:-9 tId:0
2	dP:-1 tId:2	dP:-2 tId:0	dP:-6 tId:0	dP:-10 tId:0
3	dP:-1 tId:1	dP:-2 tId:2	dP:-3 tId:0	dP:-7 tId:0

予め定義されたバッファ記述を有するデータ構造

【００６９】

表１は、deltaPOC（ｄＰ）及びtemporal_id（ｔＩｄ）が示されるバッファ記述テーブルの一例を示す。表は、最も近い２つの参照ピクチャ（POC(current)-1及びPOC(current)-2）、並びにPOC(current)-3～POC(current)-10で最も低い時間層からの２つの参照ピクチャを含む方式を使用して構成される。

【００７０】

符号化器による該表の使用の一例は、ＰＯＣ＝ｎのピクチャの場合にテーブルエントリ（ｎ％４）、即ち４を法とするｎを復号器に信号伝送することである。この例において、復号ピクチャバッファは、４つのピクチャ（ピクチャバッファ１～ピクチャバッファ４）から構成される。いずれのピクチャが現在のピクチャのＰＯＣに依存するか、及びどのようなエントリが使用されるか。例えば、ＰＯＣ＝７のピクチャがエントリ３を使用する場合、復号ピクチャバッファにおける参照ピクチャは、ＰＯＣ｛６，５，４，０｝のピクチャから構成される。

【００７１】

ステップＳ２０で生成されたデータ構造は、符号化器から復号器に信号伝送される。該信号伝送は、種々の実施形態に従って実行可能である。データ構造は、ＰＰＳ、ＳＰＳ、新規なパラメータセット、あるいは符号化器及び復号器が準拠する基準により規定された別のデータ構造において実行可能である。これは、データ構造がビデオストリームの符号化表現と関連付けられたＰＰＳ又はＳＰＳに挿入されるステップＳ２１により概略的に示される。このようなケースでは、ステップＳ２２は、ＰＰＳ識別子又はＳＰＳ識別子をスライスヘッダ等のピクチャの符号化表現に挿入することが好ましい。そして、該ＰＰＳ識別子又はＳＰＳ識別子により、現在のピクチャを復号する際に使用可能なデータ構造を識別できるようになる。

【００７２】

図７のステップＳ１及びＳ２に進み、参照ピクチャが決定され、現在のピクチャに対してピクチャ識別子が提供される。次のステップＳ２３は、ステップＳ２で提供された少なくとも１つのピクチャ識別子に基づいて、ステップＳ２０で生成されたデータ構造からバッファ記述を選択する。

【００７３】

表１におけるエントリ等のこのようなバッファ記述が選択されると、ステップＳ２４は、選択されたバッファ記述のエントリ番号等の識別子を含むバッファ記述情報を生成する。ステップＳ４に進み、バッファ記述情報はピクチャの符号化表現に挿入される。

【００７４】

従って、現在のピクチャに対してどのバッファ記述を使用するかを特定するために、識別子が現在のピクチャに対して信号伝送されうる。このような識別子の一例は、バッファ記述が信号伝送される順序でバッファ記述の番号を示す現在のピクチャのスライスヘッダにおいて信号伝送された非負整数である。

【００７５】

一般的な一実現例において、ステップＳ２０は、ビデオストリームに対して１回又はビデオストリームの複数のピクチャのセットに対して１回実行される。これは、次に単一のこのようなデータ構造がビデオストリーム又は複数のピクチャのセットに対して生成されることを意味する。図７の以下のステップＳ２１～Ｓ２４は、ビデオストリームにおける各ピクチャ又は複数のピクチャのセットに対して実行されることが好ましい。

【００７６】

従って、表等のデータ構造は、符号化器において作成されて復号器に送信されてもよい。符号化ビットストリームの制御情報において、使用されるエントリ番号が提供される。このような表を使用することにより、復号器は、復号ビットストリームにおいてエントリ番号を検出し且つ表においてエントリを参照するために該エントリ番号を使用することにより、どのピクチャが参照ピクチャとして使用されるかに関する絶対情報を取得できる。そしてエントリは、どのピクチャが復号ピクチャバッファに格納されるかを決定するために使用される。

【００７７】

ＳＰＳ等にバッファ記述エントリを導入することにより、スライスヘッダにおいて明示的にバッファ記述に信号伝送する付加ビットが減少する。これらのバッファ記述は、同一のシーケンス、即ちビデオストリームにおける複数のスライス／ピクチャに対して使用可能であるため、ピクチャ毎に必要とされるビット数が減少する。

【００７８】

ＰＰＳにおけるバッファ記述エントリ毎に、全ての参照ピクチャのdelta_POC及びtemporal_idが一実施形態において存在しうる。オプションのadditional_picture_idは、ＰＰＳにおけるエントリにより記述されたピクチャに対して０であると推測されることが好ましい。

【００７９】

更なる一実施形態によれば、複数の予め定義されたバッファ記述を有する一般的なデータ構造におけるエントリ、例えば上記の表におけるエントリに対する参照信号伝送と、バッファ記述の明示的な信号伝送とが組み合わせ可能である。このようなケースでは、これらは、現在のピクチャについての最終的なバッファ記述を形成するように、復号器により組み合わせ可能である。明示的な信号伝送と参照信号伝送とを組み合わせる１つの方法は、明示的な信号伝送により記述された参照ピクチャのセットを参照信号伝送により記述された参照ピクチャのセットと結合して、参照ピクチャのジョイントセットを形成することである。

【００８０】

このようなケースでは、図３のステップＳ３は、ステップＳ２３で選択されたバッファ記述の識別子を含み且つ少なくとも１つの参照ピクチャを規定する情報を含むようにバッファ記述情報を生成することを含むことが好ましい。少なくとも１つの参照ピクチャを規定する該情報は、参照ピクチャ自体のピクチャ識別子又はピクチャ識別子を算出できるデルタ識別子であってよい。

【００８１】

長期間参照のために使用されるピクチャ（長期参照ピクチャ）は、それが参照のために使用可能なピクチャのスライスヘッダにおいて明示的な記述により示されることが好まし

い。その理由は、ＰＰＳ又はＳＰＳにおいて信号伝送された予め定義されたバッファ記述内にＰＯＣ番号における全ての間隔を含めることは不都合だからである。

【００８２】

特定の一実施形態において、ピクチャの符号化表現は、バッファ記述情報の明示的な信号伝送及び／又はバッファ記述情報の黙示的な信号伝送が現在のピクチャに対して選択されているかを示すフラグを含むことが好ましい。例えば該フラグは、ピクチャの符号化表現のスライスヘッダ又は他の何らかの制御情報フィールドに含まれうる。

【００８３】

特定の一実施形態において、ピクチャ１０は、図４に示されるような１つ又は複数のスライス２０、２２によって構成されうる。このようなケースでは、スライス２０、２２は、ピクチャ１０の個別に復号可能な部分である。換言すると、符号化スライスは、同一のピクチャ１０の別の符号化スライスのデータが損失する場合でも復号されうる。

【００８４】

このような方法において、図３のステップＳ１は、ピクチャにおける各スライスに対してビデオストリームの少なくとも１つの参照ピクチャを決定することが好ましい。そして、第１のスライスが１つ以上の参照ピクチャの第１のセットを使用し且つ第２のスライスが１つ以上の参照ピクチャの第２のセットを使用することが可能でありうる。第２のセットは、第１のセットと同一でも異なっていてもよい。参照ピクチャの少なくとも１つが第１のセット及び第２のセットに対して共通である可能性もある。

【００８５】

ステップＳ２は、ピクチャにおける少なくとも１つのスライス、好ましくは全てのスライスに対してステップＳ１で決定された全ての参照ピクチャについてのピクチャ識別子を決定することが好ましい。そしてバッファ記述情報は、これらのピクチャ識別子に基づいてステップＳ３で生成されることにより、参照ピクチャを規定する。一実施形態において、ステップＳ３で生成されたバッファ記述は、各スライスについてのピクチャの符号化表現のそれぞれのスライスヘッダに挿入される。従って、ピクチャの符号化表現の各スライスヘッダは、バッファ記述情報のそれぞれのインスタンスを搬送することが好ましい。ピクチャの第１のスライスのスライスヘッダにおいて搬送されたバッファ記述情報は、ピクチャの第２のスライスのスライスヘッダにおいて搬送されたバッファ記述情報に等しいことがより好ましい。

【００８６】

ビデオの符号化及び復号は、いわゆるスケーラブルビデオ又は階層ビデオにも適用可能である。例えば時間スケーラビリティは、部分列の定義、スケーラブルビデオ符号化（ＳＶＣ：Scalable Video Coding）におけるtemporal_idの使用及び「存在していない」フレームの挿入により、Ｈ．２６４／ＭＰＥＧ－４　ＡＶＣ及びＳＶＣにおいてサポートされる。しかしながら、時間スケーラビリティをサポートするために、上位時間層におけるピクチャは、ＭＭＣＯの使用に関しては制限される。符号化器は、時間層が取り除かれ、「存在していない」ピクチャが挿入され、且つスライドウィンドウ処理が適用される場合と比較して異なる方法で、ある時間層におけるＭＭＣＯが下位時間層のピクチャに影響を及ぼさないことを保証することに応答する。

【００８７】

これは、符号化構造及び参照ピクチャの使用の選択について符号化器に制限を課す。例えば、図２の例を考える。各ピクチャはインター予測のために２つの参照ピクチャしか使用しないが、復号ピクチャバッファにおける参照フレームの最大数（max_num_ref_frames）は３であると仮定する。その理由は、各ピクチャが次のピクチャによるインター予測のために使用される他の時間層から余分に１つのピクチャを保持しなければならないからである。

【００８８】

ピクチャＰＯＣ＝４を復号する際に使用可能なピクチャＰＯＣ＝０及びピクチャＰＯＣ＝２を有するために、ピクチャＰＯＣ＝３は、ピクチャ１を使用不可能なものとしてマー

ク付けする明示的な参照ピクチャマーク付けコマンド（ＭＭＣＯ）を有さなければならない。

【００８９】

しかしながら、時間層１が除去される（例えば、ネットワークノードにより）場合、全ての奇数の番号を付けられたピクチャに対してframe_numに欠落がある。これらのピクチャに対して「存在していない」ピクチャが作成され、スライドウィンドウ処理が適用される。その結果、ピクチャＰＯＣ＝０を使用不可能なものとしてマーク付けする「存在していない」ピクチャＰＯＣ＝３を有することとなる。従って、ピクチャＰＯＣ＝４が復号される場合、それは予測のために使用不可能となる。符号化器が２つのケースに対して復号処理を同一にできないため、全てのピクチャが復号される場合及び最下位層のみが復号される場合、従来術に係る時間スケーラビリティに対して図２の符号化構造の例を使用できない。

【００９０】

従って、参照ピクチャ情報が相対的に信号伝送される時に現在のピクチャについての参照ピクチャに関する情報がビットストリームから先行のピクチャを除去することによる影響を受けるため、従来技術の解決策は、特定の符号化構造に対する時間スケーラビリティに関する問題がある。実施形態を使用することにより、参照ピクチャ情報が絶対的に信号伝送されるために現在のピクチャについての参照ピクチャがビットストリームから先行のピクチャを除去することによる影響を受けないため、時間スケーラビリティは従来技術におけるように制限されない。

【００９１】

複数の層にグループ化されたピクチャを有するスケーラブルビデオストリームのケースでは、図３のステップＳ２は、複数の層の中から参照ピクチャが属する層を識別する時間層情報及びピクチャ識別子を提供することを含むことが好ましい。そしてバッファ記述情報は、少なくとも１つのピクチャ識別子及び時間層情報に基づいてステップＳ３で生成される。これは、バッファ記述情報が少なくとも１つのピクチャ識別子及び時間層情報をそのように規定することを意味する。

【００９２】

例えば、temporal_id等の時間層情報は、temporal_idの信号伝送のためにceil(log2(max_temporal_layers_minus1))ビットを使用して信号伝送されたバッファ記述における各ピクチャに対して含まれる。時間スケーラビリティは、実施形態が適用可能な多層ビデオの一例にすぎない。他の種類は、各ピクチャがピクチャ識別子及びビュー識別子を有する多層ビデオを含む。スケーラビリティの更なる例には、空間スケーラビリティ、信号対雑音比（ＳＮＲ：signal-to-noise ratio）スケーラビリティ、ビット深度スケーラビリティ及びクロマフォーマットスケーラビリティが含まれる。

【００９３】

実施形態は、時間ダウンスイッチングが常に可能であることを示す。各時間層は、下位層と共に部分列を構成する。このような部分列は、明示的な信号伝送を必要としない。

【００９４】

概して、符号化器は、どのピクチャをバッファ記述に含むかを自由に選択し、その選択を表示順序で最も近いピクチャ等のいずれかの態様に基づかせてもよい。一般的には、符号化器は、側面拘束のセットに準拠しつつ最大圧縮を実現しようとバッファ記述を選択する。このような制約の一例は、メモリサイズによる参照ピクチャの最大数である。別の例は、ビットストリームにおける特定の符号化ピクチャが復号前にビットストリームから除去される場合もビデオストリームが復号可能であるべきことである。更なる例は、復号ピクチャバッファにおいて参照するために使用可能なピクチャだけが参照ピクチャとして選択されうることである。

【００９５】

従って、一実施形態において、図３のステップＳ１は、少なくとも１つの側面拘束に準拠しつつ、ピクチャの符号化表現の圧縮効率を最大限にすることで現在のピクチャについ

ての少なくとも１つの参照ピクチャを決定することを含む。そして少なくとも１つの側面拘束は、参照ピクチャの予め定義された最大数から選択され、且つピクチャの少なくとも１つの符号化表現がビデオストリームの符号化表現から除去される場合もビデオストリームの復号可能な符号化表現を生成することが好ましい。

【００９６】

実施形態に別の態様によれば、符号化ビデオ又はデータストリームが受信され、バッファ記述情報が符号化ビデオストリームにおいて検出され、且つ現在のピクチャを復号するために参照ピクチャとして又は更なる復号のために参照ピクチャとして使用されるピクチャについての絶対参照がバッファ記述情報に基づいて決定される方法が提供される。参照ピクチャとして使用されるピクチャは、復号ピクチャバッファに格納される。

【００９７】

図９は、一実施形態に係るピクチャの符号化表現を復号する方法を示すフローチャートである。方法はステップＳ３０から開始し、少なくとも１つの参照ピクチャを規定するバッファ記述情報は、ピクチャの符号化表現から取得される。バッファ記述情報は、それぞれの参照ピクチャをピクチャについての復号参照として好ましくは明確に識別する少なくとも１つのピクチャ識別子を決定するために、ステップＳ３１で使用される。ステップＳ３１で決定された少なくとも１つの参照ピクチャ識別子は、復号ピクチャバッファを更新するためにステップＳ３２で使用される。

【００９８】

ピクチャを復号するために必要とされる正確な参照ピクチャを含むように復号ピクチャバッファが更新されると、一般的にはステップＳ３３に進み、ピクチャは、ピクチャの符号化表現と、並びに復号ピクチャバッファに含まれるか、存在するかあるいは格納される参照ピクチャのうちの少なくとも１つとに基づいて復号され、バッファ記述情報に基づいて識別される。

【００９９】

好適な一実施形態において、復号ステップＳ３３は、図９に示されるように復号ピクチャバッファを更新した後で実行される。

【０１００】

ステップＳ３２での復号ピクチャバッファの更新は、決定されたピクチャ識別子により識別された参照ピクチャが「参照に使用する」ものとしてマーク付けされる、あるいは「予測に使用する」ものとしてマーク付けされて、該参照ピクチャが現在のピクチャ及び／又はいずれかの後続のピクチャについての復号参照又は予測として使用されることを示すことを意味することが好ましい。好適な一実施形態において、参照ピクチャは、短期参照に使用するもの又は長期参照に使用するものとしてマーク付けされうる。

【０１０１】

特定の一実施形態において、ステップＳ３０は、複数の参照ピクチャを規定するバッファ記述情報をピクチャの符号化表現から取得する。このような一実施形態において、ステップＳ３１は、バッファ記述情報に基づいて、i）それぞれの参照ピクチャをピクチャについての復号参照として識別する少なくとも１つのピクチャ識別子、及びii）それぞれの参照ピクチャを復号順序に従ってビデオストリームの後続のピクチャについての復号参照として識別する少なくとも１つのピクチャ識別子を決定できる。別の実施形態において、バッファ記述情報は、それぞれの参照ピクチャの１つ以上のピクチャ識別子を現在のピクチャについての復号参照として識別し、且つ／あるいはそれぞれの参照ピクチャの１つ以上のピクチャ識別子を復号順序に従ってビデオストリームの後続のピクチャについての復号参照として識別する。

【０１０２】

ステップＳ３２は、ステップＳ３１で決定された少なくとも１つのピクチャ識別子により識別されたそれぞれの参照ピクチャを含むように復号ピクチャバッファを更新することが好ましい。

【０１０３】

本明細書において上述したように、バッファ記述情報は、ピクチャの符号化表現の別の制御情報フィールド又はスライスヘッダにおいて提供されうる。このようなケースでは、図９のステップＳ３０は、ピクチャの符号化表現のスライスヘッダからバッファ記述情報を取得することを含む。一般的には、マルチスライスピクチャは複数のスライスヘッダを含む。このようなケースでは、各スライスヘッダは、同一のバッファ記述情報を含むことが好ましい。従って、ピクチャのいずれかの残りのスライスヘッダが同一のバッファ記述情報を含むため、ステップＳ３０でピクチャの第１のスライスヘッダからバッファ記述情報を取得すれば十分である。そして、第１のスライスが損失される場合、他のスライスヘッダにおけるバッファ記述情報は、誤り耐性のために使用可能である。

【０１０４】

バッファ記述情報は、参照ピクチャのピクチャ識別子を明示的に含むことができる。このようなケースでは、ステップＳ３０は、単にバッファ記述情報から少なくとも１つのピクチャ識別子を取得する。

【０１０５】

別の一実施形態において、バッファ記述情報は、デルタ値又はデルタ識別子を含む。図１０は、このようなケースに対する図９のステップＳ３１の一実施形態を示すフローチャートである。方法は、図９のステップＳ３０から継続する。次のステップＳ４０は、バッファ記述情報に基づいてそれぞれのデルタ識別子を取得する。デルタ識別子は、参照ピクチャのピクチャ識別子を算出するために、現在のピクチャのピクチャ識別子と共にステップＳ４１で使用される。その後、図１０のステップＳ３２に進む。

【０１０６】

従って、本実施形態において、現在のピクチャに対して使用可能な情報は、信号伝送されたバッファ記述情報から現在のピクチャについての最終的なバッファ記述を構成するために復号器により使用される。このような情報は、信号伝送されたdeltaPOCと共に参照ピクチャ（POC(ref)）のＰＯＣをPOC(ref)=POC(curr)+deltaPOCとして計算するために使用可能である現在のＰＯＣ（POC(curr)）を含むが、それに限定されない。

【０１０７】

別の実施形態は、複数の予め定義されたバッファ記述を使用することに関する。図１１は、このような方法を概略的に示す。第１のステップＳ５０において、複数の予め定義されたバッファ記述を含むデータ構造が取得される。好適な一実施形態において、データ構造は、ピクチャの符号化表現において搬送された情報に基づいて取得される。例えばデータ構造は、ピクチャの符号化表現のＰＰＳ又はＳＰＳの一部として符号化器側から復号器側に信号伝送されてよい。このようなケースでは、データ構造は、スライスヘッダ等のピクチャの符号化表現におけるバッファ記述情報の一部として使用されたＰＰＳ識別子又はＳＰＳ識別子に基づいて、ステップＳ５０でＰＰＳ又はＳＰＳから取得される。あるいは、ＰＰＳ識別子はスライスヘッダから取得され、その結果、ＰＰＳは、データ構造がＳＰＳの一部として信号伝送される場合に使用可能なＳＰＳ識別子を含む。

【０１０８】

次のステップＳ５１は、スライスヘッダ等のピクチャの符号化表現からバッファ記述情報の一部としてバッファ記述の識別子を取得する。該識別子は、ステップＳ５０で取得されたデータ構造からのどの予め定義されたバッファ記述を現在のピクチャに対して使用するかをステップＳ５２で識別するために採用される。その後、図１のステップＳ３１に進み、識別された予め定義されたバッファ記述からピクチャ識別子が決定される。

【０１０９】

実施形態を使用することにより、オーバヘッドが殆どない任意の符号化構造に対しても最適なバッファ方式を適用することが可能である。スライスヘッダにおいて必要とされるものは、単にＰＰＳ等における正確なバッファ記述についての参照である。なお、バッファ記述は、ピクチャヘッダ等又はピクチャにおける全てのスライスの間で共有されたパラメータセットにも入力されうる。重要な特性は、特定のピクチャを復号するために使用されるバッファ記述がピクチャと共に送出され、従来技術におけるような復号順序で先行の

ピクチャと共には送出されないことである。また、単一のデータパケットが偶然損失される場合に符号化器側と復号器側との間で長期の不一致を引き起こしうるデルタ情報を信号伝送するのではなく、ビデオストリームにおいて各ピクチャを復号するために維持されるべき復号ピクチャバッファにおける全ての参照ピクチャを信号伝送するために、バッファ記述情報が使用される。

【０１１０】

本明細書において上述したように、ピクチャの符号化表現におけるバッファ記述の明示的な信号伝送と、データ構造における予め定義されたバッファ記述についての参照信号伝送とが組み合わせ可能である。明示的な信号伝送と参照信号伝送とを組み合わせる１つの方法は、明示的な信号伝送により記述された参照ピクチャのセットを参照信号伝送により記述された参照ピクチャのセットと結合して、参照ピクチャのジョイントセットを形成することである。その後、参照信号伝送により記述された参照ピクチャのセットに含まれるが、明示的な信号伝送には含まれない１つ以上の参照ピクチャは、参照ピクチャの最大数（max_num_ref_frames）しか含まない最終的なバッファ記述を有するために、場合によっては参照ピクチャのジョイントセットから除去される。ピクチャは、進行する最後のピクチャから開始する一般的なバッファ記述、即ち予め定義されたバッファ記述において一覧表示されるような順序で除去されることが好ましい。

【０１１１】

図１２は、このような方法を示すフローチャートである。方法は、図９のステップ３０及び図Ｓ３１のステップＳ５２から継続する。従って、本実施形態において、バッファ記述情報は、図１１のステップＳ５１で取得されたバッファ記述の識別子及び図９のステップＳ３０で取得された少なくとも１つの参照ピクチャを規定する情報の双方を含む。ステップＳ３０で取得された該情報は、実際のピクチャ識別子又は上述のデルタ識別子でよい。

【０１１２】

次のステップＳ６０は、図１１のステップＳ５２で識別された予め定義されたバッファ記述からそれぞれの参照ピクチャを識別する少なくとも１つのピクチャ識別子の第１のセットを決定する。同様に、それぞれの参照ピクチャを識別する少なくとも１つのピクチャ識別子の第２のセットは、図９のステップＳ３０で取得された情報からステップＳ６１で決定される。ステップＳ６０及びＳ６１は、いずれかの順序で逐次的に又は少なくとも部分的に並列に実行されてよい。

【０１１３】

後続のステップＳ６２は、ステップＳ６０で決定された第１のセット及びステップＳ６１で決定された第２のセットに基づいてピクチャ識別子のジョイントセットを形成する。

【０１１４】

選択的であるが好適な後続のステップＳ６３は、ジョイントセットにおけるピクチャ識別子の総数（ＩＤＳ：total number of picture identifiers）を参照ピクチャの最大数（ＭＡＸ）、即ち一般的にはＳＰＳにおいて信号伝送されたパラメータmax_num_ref_framesと比較する。ジョイントセットにおけるピクチャ識別子の総数が復号ピクチャバッファに格納可能な参照ピクチャの総数を超える場合、ステップＳ６４に継続する。ジョイントセットにおけるピクチャ識別子の総数が参照ピクチャの最大数を超えなくなるまで、該ステップＳ６４は、第１のセットに含まれるが第２のセットには含まれない１つ以上のピクチャ識別子を除去する。従って、ジョイントセットは、ステップＳ６０で決定されたピクチャ識別子を除去することで更新される。ピクチャ識別子は、最後のピクチャ識別子から開始して進行する図１１のステップＳ５２で識別された予め定義されたバッファ記述において一覧表示されるような順序で除去されることが好ましい。

【０１１５】

特定の一実施形態において、ピクチャの符号化表現は、バッファ記述情報の明示的な信号伝送及び／又はバッファ記述情報の黙示的な信号伝送が現在のピクチャに対して選択されているかを示すフラグを含むことが好ましい。このようなケースでは、復号器は、どの

種類のバッファ記述情報の信号伝送が現在のピクチャに対して使用されているかを決定するために、ピクチャの符号化表現、例えばスライスヘッダ又は他の何らかの制御情報フィールドからフラグを取得する。

【０１１６】

図１３は、図９の方法の更なるステップを示すフローチャートである。ステップＳ３２で更新された復号ピクチャバッファは、復号の目的のために使用される。

【０１１７】

復号ピクチャバッファがステップＳ３２で更新されると、ピクチャは、復号ピクチャバッファにおいて使用可能であってもよいが、バッファ記述には含まれない。従って、一実施形態において、復号ピクチャバッファにおいて使用可能であるがバッファ記述には含まれないピクチャは、復号器により、復号ピクチャバッファから除去される、あるいは「参照に使用されない」のもの又は「予測に使用されない」のものとしてマーク付けされる。従って、本実施形態において、復号ピクチャバッファから参照ピクチャを除去すること又はピクチャを「参照に使用されない」のものとしてマーク付けすることは、バッファ記述を含むピクチャのピクチャ復号処理の前に復号器により実行される。

【０１１８】

ステップＳ７０は、復号ピクチャバッファに格納され、且つバッファ記述情報から決定された少なくとも１つのピクチャ識別子のいずれとも関連付けられない任意の参照ピクチャを復号ピクチャバッファから除去することにより、該手順を示す。該ステップＳ７０の別の一実施形態において、参照ピクチャは、必ずしも復号ピクチャバッファから除去されなくてもよい。ステップＳ７０の本実施形態は、復号ピクチャバッファに格納され、且つバッファ記述情報から決定された少なくとも１つのピクチャ識別子のいずれとも関連付けられない任意の参照ピクチャを参照に使用しないもの又は予測に使用しないものとしてマーク付けする。これは、マーク付けされた参照ピクチャがビデオストリームにおける現在のピクチャ又はいずれの後続のピクチャに対しても予測基準として使用されないことを意味する。従って、復号器は、復号ピクチャバッファにおいて使用可能な位置を得る必要がある場合にマーク付けされた参照ピクチャを出力できる。特定の一実施形態において、参照に使用しないものとしてマーク付けされたピクチャをバッファ記述に含んで参照に使用するものとして再度マーク付けすることはできない。

【０１１９】

特定の一実施形態において、復号ピクチャバッファに存在し且つバッファ記述情報に基づいて決定されたピクチャ識別子のうちのいずれかと関連付けられたいずれかの参照ピクチャは、参照に使用するものとしてステップＳ７０でマーク付けされることが好ましい。一実施形態において、参照ピクチャは、短期参照に使用するもの又は長期参照に使用するものとしてマーク付けされうる。これらの２つの特定の代替例は、バッファ記述情報に基づいて選択されることが好ましい。

【０１２０】

ステップＳ７１は、更なるオプションの一実施形態を示す。本実施形態は、復号器により表示するためにバッファ記述に従って復号器により参照に使用しないものとしてマーク付けされるゼロ以上のピクチャを出力する。出力の１つのこのような処理の例は、Ｈ．２６４／ＭＰＥＧ－４　ＡＶＣからのバンプ処理である。本明細書において、出力は、表示するために出力することを示す。参照ピクチャとしてどのようなピクチャを使用するか及びどのようなピクチャを出力、即ち表示するかは、Ｈ．２６４及びＨＥＶＣにおいて区別される。これは、ピクチャが参照ピクチャとして除去される、即ち参照に使用しないものとしてマーク付けされる前に出力されうること、又はピクチャが出力される前にピクチャを参照に使用しないものとしてマーク付けすることで参照フレームとして除去されうることを意味する。

【０１２１】

復号処理の間、使用不可能であるために参照ピクチャに対して使用できないピクチャ（フレームとも呼ぶ）に関する情報をバッファ記述が含むことが生じる可能性がある。一実

施形態において、バッファ記述が復号ピクチャバッファにおいて使用不可能なピクチャに関する情報を含む場合、複数の「存在していない」ピクチャは復号器により生成される。このようなピクチャの各々は、ピクチャがインター予測又は動きベクトル予測のために使用されない場合でも復号処理において復号器により使用される情報を保持する変数についての所定の値であってよい。このような情報は、復号順序番号、表示順序番号、時間層情報、ビュー情報、即ちframe_num、POC、temporal_id及びview_id等のパラメータを含んでよいが、それに限定されない。

【０１２２】

一実施形態において、存在していないピクチャは、バッファ記述情報を含むピクチャのピクチャ復号処理の前に復号器により生成される。

【０１２３】

ステップＳ７２及びＳ７３は、このような一実施形態を示す。ステップＳ７２は、バッファ記述情報から決定された少なくとも１つのピクチャ識別子を復号ピクチャバッファに既に格納されている参照ピクチャと関連付けられたピクチャ識別子と比較する。決定されたピクチャ識別子が復号ピクチャバッファに格納された参照ピクチャのピクチャ識別子の中で見つけられない場合、決定されたピクチャ識別子と関連付けられたピクチャは、紛失している又は存在していないと決定される。一実施形態において、存在していないピクチャは、選択的に、ステップＳ７３で生成され、復号ピクチャバッファに格納される。そして、該存在していないピクチャは、該特定のピクチャに関するバッファ記述情報から取得されたピクチャ識別子等のいずれかのパラメータを割り当てられる。その後、図９のステップＳ３３に進み、復号処理が開始されうる。

【０１２４】

バッファ記述において信号伝送されるが復号ピクチャバッファには存在しないピクチャは、「存在していない」ものとしてマーク付けされることが好ましい。しかしながら、このようなピクチャのＰＯＣ及びtemporal_idがバッファ記述に含まれるため、参照ピクチャの明示的な信号伝送の変形は必要とされない。「存在していない」ピクチャが参照のために使用されない場合、復号処理は、余分な信号伝送なしで（及び参照ピクチャリストの変形の明示的な信号伝送と共に含まれるオーバヘッドなしで）正確に進む。

【０１２５】

一実施形態において、ステップＳ７０でゼロ以上のピクチャをマーク付けすることは、第１の工程で復号器により実行される。第２の工程において、ゼロ以上のピクチャはステップＳ７１で復号器により出力される。第３の工程において、ゼロ以上の「存在していない」ピクチャは、ステップＳ７３で復号器により生成される。

【０１２６】

別の一実施形態において、ゼロ以上のピクチャをマーク付けすることは、ステップＳ７０の第１の工程で復号器により実行される。その後、ピクチャを出力し（Ｓ７１）且つ存在していないピクチャを生成する（Ｓ７３）反復過程は、復号ピクチャバッファにおいて使用不可能なバッファ記述において記述されたピクチャ毎に復号器により実行される。

【０１２７】

実施形態は、現在のピクチャのピクチャ復号の前にピクチャマーク付け処理等のバッファ動作を適用することにより、即ち明示的なバッファ記述を現在のピクチャに適用させることによりさらに補強される。これにより、参照ピクチャ管理が誤差による影響をあまり受けないようにし、時間スケーラビリティの可能性を向上させ、参照ピクチャリストの変形の信号伝送により生じたオーバヘッドを減少する。

【０１２８】

一実施形態において、バッファ記述は、参照ピクチャリストの初期化又は参照ピクチャリストの変形、あるいは参照ピクチャリストの合成において復号器により使用される情報を含んでもよい。一例は、ピクチャがバッファ記述において一覧表示される順序が参照ピクチャリストの初期化において参照ピクチャリストのうちの１つに対する初期の順序として使用可能なことである。従って、バッファ記述情報は、参照ピクチャリストが作成され

る際に使用可能である。

【０１２９】

図１４は、このような方法を示すフローチャートである。方法は、図９のステップＳ３２から継続する。次のステップＳ８０は、バッファ記述情報に基づいて参照ピクチャリストの初期化を実行する。ステップＳ８０の特定の一実施形態において、参照ピクチャリストの初期化は、バッファ記述情報が図９のステップＳ３１で決定された少なくとも１つのピクチャ識別子を規定する順序に従って参照ピクチャリストにおいて参照ピクチャを順序付けすることにより、バッファ記述情報に基づいて実行される。

【０１３０】

一実施形態において、制限は、バッファ記述に含まれたピクチャに対して特定される。制限の一例は、temporal_id tId(B)を有するピクチャＢについてのバッファ記述において記述されたtemporal_id tId(A)を有するピクチャＡが、tId(A)＜tId(B)の場合に存在していないピクチャでなくてもよいことである。

【０１３１】

一実施形態において、バッファ記述を通して復号ピクチャバッファにおけるピクチャの特性に変更を信号伝送することも可能である。一例は、バッファ記述における時間層及び／又は表示順序に対して新しい値を信号伝送することにより、ピクチャの時間層及び／又は表示順序を変更することである。

【０１３２】

図１６は、一実施形態に係る参照バッファ方式を示す簡略化されたフローチャートである。この方式において、全ての復号ピクチャバッファは、図１６に示されるような復号ピクチャバッファの記述を使用して、ピクチャの第１のスライスヘッダを構文解析した後ではあるがピクチャ復号の前に適用される。例えばバッファ記述は、明示的に又はＰＰＳにおいて信号伝送された予め定義された構造を参照することにより、スライスヘッダにおいて信号伝送される。

【０１３３】

それにより、実施形態は、復号処理を概念的に大きく変更する。従来のＨ．２６４／ＭＰＥＧ－４　ＡＶＣ及びＨＥＶＣの現在の設計において、相対動作は、黙示的に、即ちスライドウィンドウ又は明示的に、即ちＭＭＣＯに与えられ、復号器は、これらの相対動作を適用し且つ参照ピクチャ、即ちいずれのピクチャが参照のために使用可能であるかを追跡する信頼性を有する。提案された方式において、参照ピクチャ、即ちいずれのピクチャが参照のために使用可能であるかが現在のピクチャ内で、例えばスライスヘッダにおいて信号伝送されることにより、黙示的且つ明示的に信号伝送された相対動作の必要性を除去する。

【０１３４】

これは、デルタ情報がＭＭＣＯ又はスライドウィンドウ処理を使用することから取得されるＨ．２６４／ＭＰＥＧ－４　ＡＶＣのように、各ピクチャが参照ピクチャ記述の相対記述ではなく、絶対記述を有することを意味する。

【０１３５】

特定の一実施形態によれば、バッファ記述は、参照ピクチャとして使用されるピクチャについての絶対参照を提供するために、復号ピクチャバッファにおける全ての参照ピクチャのdelta_POC、temporal_id及びadditional_picture_idを含む。delta_POCは、参照ピクチャのＰＯＣをPOC(ref)=POC(current)+delta_POCとして計算するために使用される。ピクチャは、一実施形態において、ＰＯＣとadditional_picture_idとの対により識別される。temporal_idは、時間スケーラビリティ等の損失又は除去されたピクチャの場合に正確な参照ピクチャリストの変形を可能にするようにバッファ記述に含まれる。しかしながら、方式は、コードワードのdelta_POC、temporal_id及びadditional_picture_idに制限されない。ピクチャと関連付けられ且つ参照ピクチャ処理において使用されるいずれかのコードワードは、ピクチャ識別子として使用可能であり、ＰＯＣ及びdelta_POC等の現在のピクチャの値に対して相対的、あるいはtemporal_id等の現在のピクチャに対して絶対

的なバッファ記述に含まれてもよい。

【０１３６】

バッファ記述の一部ではない復号ピクチャバッファにおける全てのピクチャは、参照に使用しないものとしてマーク付けされることが好ましい。

【０１３７】

Ｈ．２６４／ＭＰＥＧ－４　ＡＶＣにおいて、出力のためにピクチャを配信する処理（図１において「バンプ」処理と呼ぶ）は、復号の前に、即ちframe_numに欠落があった場合に実行されることもある。「バンプ」処理は、復号及びピクチャマーク付けの後にも実行される。

【０１３８】

図１６の提案された方式において、「バンプ」処理は復号の前に適用される。これにより、出力のためにピクチャを配信する前に復号処理が必要以上に遅延することが示されうる。しかしながら、表示するための第１のピクチャは、復号ピクチャバッファにおける表示されていないピクチャの数がnum_reorder_frames以上になるとすぐに、復号処理工程の後に既に一意に規定されている。従って、復号器は、復号処理工程の直後に表示するために該ピクチャを配信できる。従って、提案された方式の遅延は、現在のＨＥＶＣ方式の遅延に等しい。

【０１３９】

Ｈ．２６４／ＭＰＥＧ－４　ＡＶＣにおいて、構文要素frame_numは、復号ピクチャバッファにおけるピクチャを識別し且つframe_numの欠落を検出するために使用される。gaps_in_frame_num_allowedが１に等しい場合、復号器は、スライドウィンドウ処理が正確に動作するように「存在していない」フレームを復号ピクチャバッファに挿入するべきである。

【０１４０】

図１６に示される提案された方式において、ＰＯＣとadditional_picture_idとの組合せは、復号ピクチャバッファにおけるピクチャを識別するために使用可能である。提案された方式は、スライドウィンドウ処理を含む必要はない。従って、構文要素frame_num及びgaps_in_frame_num_allowedを除去することが提案される。

【０１４１】

図１５は、実施形態を適用できる符号化構造の一例を示す。図１５の例において、復号順序における第２のピクチャがＰＯＣ０をバッファ記述に含む一方で、復号順序における第３のピクチャは、ＰＯＣ０及びＰＯＣ４をバッファ記述に含む。復号順序における第４のピクチャは、将来参照のために使用されるため、ＰＯＣ０及びＰＯＣ２だけではなくＰＯＣ４もバッファ記述に含まなければならない。復号順序における第５のピクチャは、将来参照のために使用されることがない限り、ＰＯＣ０をバッファ記述に含む必要はない。ＰＯＣ０は、バッファ記述に含まれない場合に参照に使用しないとされる。

【０１４２】

図１５の例において、additional_picture_id（即ち、additional_id）は、全てのピクチャに対して０である。ＰＯＣラップアラウンドのために同一のＰＯＣと共に参照するために使用可能な２つの異なるピクチャがない限り、additional_picture_idを０に設定することが推奨される。ＰＯＣが２つの異なるピクチャに対して同一である場合、additional_picture_idは、より古いピクチャをより新しいピクチャで無条件に置換しないように異なることが好ましい。additional_picture_idは、Ｈ．２６４／ＭＰＥＧ－４　ＡＶＣにおいて長期ピクチャにより提供される全ての機能性及び可能性を提供するために使用可能である。従って、特定の一実施形態において、ピクチャ識別子の一部を構成するadditional_picture_idは、参照ピクチャが長期参照又は短期参照のために使用されるかを信号伝送するために使用可能である。

【０１４３】

符号化器がＰＯＣ１４を有するピクチャＡ及び０に設定されたadditional_picture_idを「長期ピクチャ」として使用したい例について考える。このとき符号化器は、ピクチャ

Ａを参照のために使用可能にしたければ、Ａに後続する全てのピクチャのスライスヘッダにおけるバッファ記述にピクチャＡが含まれることを保証しなければならない。符号化器は、Ａが参照のために依然として使用可能である間にＰＯＣ１４を有する別のピクチャ（ＰＯＣラップアラウンドのために）を符号化したい場合、additional_picture_idの別の値、例えば１を選択してＡが参照ピクチャとして置換されることを回避すべきである。

【０１４４】

短期間の参照のために使用されるピクチャ（短期参照ピクチャ）の場合、ビットオーバヘッドを最小限にするためにadditional_picture_idを０に設定することが推奨される。長期間の参照のために使用されるピクチャ（長期ピクチャ）の場合、同一のＰＯＣ及び同一のadditional_picture_idを有する２つのピクチャが同時に予測のために使用可能ではないことを符号化器が保証することが推奨される。

【０１４５】

実施形態の更なる態様は、どのピクチャが参照ピクチャに対して使用されるか、即ち後続の復号のために使用される復号ピクチャバッファに格納されるかを規定するバッファ記述情報を作成するように構成された符号化器を規定する。バッファ記述情報の少なくとも一部は、符号化器により符号化されたビットストリームに挿入される。

【０１４６】

図１８は、符号化器１００の一実施形態を示す概略ブロック図である。符号化器１００は、複数のピクチャを含むビデオストリームのピクチャを符号化するように構成される。符号化器１００は、ビデオストリームの複数のピクチャのうちの現在のピクチャに対して少なくとも１つの参照ピクチャを決定するように構成された参照ピクチャ決定器１１０を備える。少なくとも１つの参照ピクチャは、現在のピクチャについての符号化参照として使用される。符号化器１００のピクチャ識別子提供器１２０は、参照ピクチャ決定器１１０により決定された各参照ピクチャのそれぞれのピクチャ識別子を提供するように構成される。ピクチャ識別子提供器１２０により提供されたピクチャ識別子は、関連付けられた参照ピクチャを識別する。ピクチャ識別子提供器１２０により提供されたピクチャ識別子は、現在のピクチャを符号化及び復号するために必要とされる参照ピクチャ、並びに選択的に更にはビデオストリームの後続のピクチャを符号化及び復号するために必要とされるビデオストリームのいずれかの先行の参照ピクチャのピクチャ識別子を一覧表示することにより、現在のピクチャについてのバッファ記述をセットで構成する。

【０１４７】

符号化器１００は、参照ピクチャ決定器１１０により決定された少なくとも１つの参照ピクチャを規定するバッファ記述の情報、即ちバッファ記述情報を生成するように構成されたバッファ記述情報生成器１３０も備える。バッファ記述情報生成器１３０は、ピクチャ識別子提供器１２０からの少なくとも１つのピクチャ識別子に基づいて該バッファ記述情報を生成するように構成される。

【０１４８】

データ挿入器１４０は、バッファ記述情報生成器１３０により生成されたバッファ記述情報を現在のピクチャの符号化表現に挿入するように符号化器１００において実現される。従って、現在のピクチャについてのビデオストリームの符号化ビットストリームは、バッファ記述情報を搬送する。これは、現在のピクチャについての復号ピクチャバッファを更新することでピクチャの符号化表現を復号できるようにするために復号器により必要とされる関連情報、即ちピクチャ識別子を規定するバッファ記述情報をピクチャの符号化表現が搬送することを意味する。

【０１４９】

本明細書において上述したように、参照ピクチャ決定器１１０は、復号順序で現在のピクチャの前にビデオストリームに存在することが好ましい現在のピクチャだけではなくいかなる参照ピクチャにも対する符号化参照として、復号順序に従って１つ以上の後続のピクチャについての符号化参照としてビデオストリームのいずれかの参照ピクチャを決定するように構成されることが好ましい。

【０１５０】
特定の一実施形態において、各ピクチャは１つ以上のスライスから構成されうる。そして、このようなスライスの各々は、同一のピクチャの他のスライスに関係なく符号化及び復号されてもよい。従って、参照ピクチャ決定器１１０は、少なくとも１つのスライスに対して、即ち好ましくはピクチャの各スライスに対して、特定のスライスを符号化及び復号するために使用される少なくとも１つの参照ピクチャを決定することが好ましい。ピクチャ識別子提供器１２０は、現在のピクチャに対して、即ちその全てのスライスに対して参照ピクチャ決定器１１０により決定された全ての参照ピクチャについてのそれぞれのピクチャ識別子を提供することが好ましい。これにより、バッファ記述情報は、これらの提供されたピクチャ識別子に基づいてバッファ記述情報生成器１３０により生成される。好適な一実施形態において、データ挿入器１４０は、バッファ記述情報をピクチャの符号化表現のそれぞれのスライスヘッダに挿入するように構成される。このようなケースでは、現在のピクチャの各スライスヘッダは、同一のバッファ記述情報を搬送することが好ましい。これにより、ピクチャの別のスライスが偶然損失された場合であっても、所定のスライスを復号できるようになる。

【０１５１】
ピクチャの符号化表現における制御情報のうちの他の位置も、本明細書において上述したようにバッファ記述情報を搬送するために可能である。

【０１５２】
実施形態のバッファ記述は、参照ピクチャのピクチャ識別子を含むことができる。あるいは、バッファ記述は、参照ピクチャのピクチャ識別子を算出するための現在のピクチャのピクチャ識別子と共に使用可能な上述のデルタ識別子を含む。

【０１５３】
このようなケースでは、符号化器１００は、ピクチャ識別子提供器１２０により提供されたピクチャ識別子毎に、ピクチャ識別子と現在のピクチャのピクチャ識別子との差分を算出するように構成される識別子計算器１５０を備えることが好ましい。該差分は、参照ピクチャについてのデルタ識別子に対応する。そしてバッファ記述情報生成器１３０は、識別子計算器１５０により算出された少なくとも１つの差分／デルタ識別子に基づいてバッファ記述情報を生成するように構成される。それにより、バッファ記述情報は、現在のピクチャのピクチャ識別子についての参照ピクチャの少なくとも１つのピクチャ識別子を規定する。

【０１５４】
ピクチャの符号化表現は、ピクチャ識別子提供器１２０により提供されたピクチャ識別子又は識別子計算器１５０により算出されたデルタ識別子を例えばスライスヘッダにおけるバッファ記述情報として搬送できる。これにより、ピクチャの符号化表現におけるバッファ記述の明白な信号伝送を提供する。

【０１５５】
別の一実施形態において、符号化器１００は、複数の予め定義されたバッファ記述を含むデータ構造を生成するように構成されたデータ構造生成器１６０を備える。それにより、このような予め定義されたバッファ記述の各々は、少なくとも１つの参照ピクチャを規定する。それにより、データ構造は、ピクチャの復号の間に使用されるバッファ記述を提供するために、ビデオストリームにおける複数のピクチャに対して使用可能である。それにより、バッファ記述情報生成器１３０は、現在のピクチャに対してピクチャ識別子提供器１２０により提供された少なくとも１つのピクチャ識別子に基づいて、データ構造のバッファ記述を選択するように構成される。それにより、少なくとも参照ピクチャ識別子を正確に一致させるバッファ記述が選択され、バッファ記述情報生成器１３０により生成されたバッファ記述情報は、選択されたバッファ記述の識別子を含む。

【０１５６】
そして、データ構造生成器１６０により生成されたデータ構造は、ＰＰＳ又はＳＰＳ等のビデオストリームの符号化表現と関連付けられた制御情報フィールドに挿入されうる。

関連制御情報の識別子、即ちＰＰＳ識別子又はＳＰＳ識別子（ひいては適切なＳＰＳについてのＳＰＳ識別子を含むＰＰＳについてのＰＰＳ識別子の形態でありうる）は、スライスヘッダ等の現在のピクチャの符号化表現の制御情報に含まれることが好ましい。一実施形態において、それにより、スライスヘッダ又は他の制御情報フィールドは、制御情報識別子及び選択されたバッファ記述の識別子をバッファ記述情報として搬送する。

【０１５７】

ピクチャ識別子の明示的な信号伝送の上述の実施形態と、ピクチャ識別子の参照信号伝送の上述の実施形態とが組み合わせ可能である。このようなケースでは、バッファ記述情報生成器１３０は、選択されたバッファ記述の識別子、好ましくは制御情報識別子も含み、且つ参照ピクチャのピクチャ識別子を規定するデルタ識別子又は明示的なピクチャ識別子等の情報を含むバッファ記述情報を生成するように構成される。

【０１５８】

符号化器１００は、ピクチャ識別子の上述の例、例えば参照ピクチャを明確に識別するＰＯＣ値又はＰＯＣ値及び更なる識別子のうちのいずれを使用してもよい。

【０１５９】

ビデオストリームは、ピクチャが複数の層にグループ化されるスケーラブルビデオストリームであってよい。このようなケースでは、ピクチャ識別子提供器１２０は、ピクチャ識別子及び時間層情報又は参照ピクチャが属する層を識別する識別子を各参照ピクチャに提供するように構成される。そしてバッファ記述情報生成器１３０は、少なくとも１つのピクチャ識別子及び時間層情報に基づいてバッファ記述情報を生成する。従って、バッファ記述情報は、少なくとも１つのピクチャ識別子及び時間層情報を規定することが好ましい。

【０１６０】

参照ピクチャ決定器１１０は、現在のピクチャについてのインター予測及び／又は動きベクトル予測のために、少なくとも１つの参照ピクチャを符号化参照として決定するように構成されることが好ましい。少なくとも１つの参照ピクチャは、ピクチャの符号化表現の圧縮又は符号化の効率を最大限にすること、即ち符号化表現を示すために必要とされるビット等の記号の数を最小限にすることで決定されうる。参照ピクチャの予め定義された最大数を有することから選択された少なくとも１つの側面拘束に準拠し、且つピクチャの少なくとも１つの符号化表現がビデオストリームの符号化表現から除去される場合にもビデオストリームの復号可能な表現を生成している間に、この圧縮最大化が実行されることが好ましい。更なる別の又は追加の側面拘束は、選択された参照ピクチャが復号ピクチャバッファにおける参照及び予測のために使用可能でなければならないことである。

【０１６１】

符号化器は、ソフトウェアで少なくとも部分的に実現可能である。図１９に示されるようなこのような一実施形態において、符号化器３００は、ビデオストリームの複数のピクチャを入力するように構成された入力部３１０を備える。符号化器３００は、メモリ３４０に格納されたコンピュータプログラムのコード手段を処理するように構成されたプロセッサ３３０も備える。コード手段は、プロセッサ３３０上で実行された時に、ビデオストリームの少なくとも１つの参照ピクチャをピクチャについての符号化参照としてビデオストリームのピクチャに対してプロセッサ３３０に決定させる。さらにプロセッサ３３０は、参照ピクチャを識別するピクチャ識別子を各参照ピクチャに提供し、且つ少なくとも１つの参照ピクチャを規定するバッファ記述情報を少なくとも１つのピクチャ識別子に基づいて生成するようにされる。またプロセッサ３３０は、バッファ記述情報をピクチャの符号化表現に挿入するようにされる。符号化器３００は、ピクチャの符号化表現を出力するように構成された出力部３２０も備える。

【０１６２】

プロセッサ３３０は、中央処理装置（ＣＰＵ：central processing unit）等の汎用又は専用のコンピュータ、プロセッサ又はマイクロプロセッサであってよい。ソフトウェアは、少なくとも図１８の参照ピクチャ決定器１１０、ピクチャ識別子提供器１２０、バッ

ファ記述情報生成器１３０及びデータ挿入器１４０の動作を実施するコンピュータプログラムコード要素又はソフトウェアコード部分を含む。

【０１６３】

プログラムは、ＲＡＭ等の１つ以上の適切な揮発性コンピュータ可読媒体又はデータ格納手段、あるいは磁気ディスク、ＣＤ－ＲＯＭ、ＤＶＤディスク、ハードディスク等の１つ以上の不揮発性コンピュータ可読媒体又はデータ格納手段上あるいはそれらに、ＲＯＭ又はフラッシュメモリに全てあるいは部分的に格納されてもよい。データ格納手段は、ローカルデータ格納手段であってよく、あるいはデータサーバ等にリモートで提供される。従って、ソフトウェアは、コンピュータの動作メモリ又はプロセッサにより実行するための同等の処理システムにロードされてもよい。コンピュータ／プロセッサは、上述の機能を実行することだけに専念する必要はなく、他のソフトウェアタスクも実行してもよい。符号化器３００を規定するために使用されたプログラムコードの例は単一命令多重データ（ＳＩＭＤ：single instruction multiple data）コードを含むが、それに限定されない。

【０１６４】

あるいは、符号化器はハードウェアで実現されてよい。図１８における符号化器１００のユニット１１０～１６０の機能を実現するために使用及び組み合わせ可能な回路網素子の多くの変形例がある。このような変形例は実施形態により含まれる。符号化器１００のハードウェアの実現例の特定の例は、デジタル信号プロセッサ（ＤＳＰ：digital signal processor）ハードウェア、並びに汎用電子回路網及び特定用途向け回路網の双方を含む集積回路技術において実現される。

【０１６５】

実施形態の一態様によれば、図１７に示されるような送信機２００が提供される。送信機２００は、ビデオストリームの複数のピクチャ１０を受信するように構成された入力部２１０を備える。ピクチャ１０は、複数のピクチャ１０を符号化して複数のピクチャのそれぞれの符号化表現を生成するように構成される図１８又は図１９に示されるような符号化器１００に転送される。送信機２００の出力部２２０は、複数のピクチャのそれぞれの符号化表現を実施形態のバッファ記述情報を搬送する符号化ビットストリームとして出力するように構成される。

【０１６６】

実施形態の一態様は、バッファ記述情報を検出し、且つ検出されたバッファ記述に基づいて復号するために参照ピクチャとして使用されるピクチャについての絶対参照を決定する復号器、並びに参照ピクチャとして使用されるピクチャを格納するバッファに関する。

【０１６７】

図２１は、一実施形態に係る復号器４００を示す概略ブロック図である。復号器４００は、複数のピクチャを含むビデオストリームのピクチャの符号化表現を復号するように構成される。復号器４００は、ピクチャの符号化表現から少なくとも１つの参照ピクチャを規定するバッファ記述情報を取得するように構成されたデータ取得器４１０を備える。バッファ記述情報は、それぞれの参照ピクチャをピクチャについての符号化参照として識別する少なくとも１つのピクチャ識別子を決定するように構成されるピクチャ識別子決定器４２０により使用される。復号器４００は、ピクチャ識別子決定器４２０により決定された少なくとも１つのピクチャ識別子に基づいて、復号器４００のあるいは復号器４００に関連付けられた復号ピクチャバッファを更新するように構成されたバッファマネージャ４３０も備える。

【０１６８】

特定の一実施形態において、データ取得器４１０は、ピクチャの符号化表現から複数のピクチャ識別子を規定するバッファ記述情報を取得するように構成される。そしてピクチャ識別子決定器４２０は、取得されたバッファ記述情報に基づいて、それぞれの参照ピクチャをピクチャについての復号参照として識別する少なくとも１つのピクチャ識別子及びそれぞれの参照ピクチャを復号順序に従ってビデオストリームの後続のピクチャについて

の復号参照として識別する少なくとも１つのピクチャ識別子を決定するように構成される。

【０１６９】

バッファマネージャ４３０は、復号ピクチャバッファを更新して少なくとも１つのピクチャ識別子により識別されたそれぞれの参照ピクチャを含むように構成されることが好ましい。

【０１７０】

従って、ピクチャの符号化表現により搬送されたバッファ記述情報は、現在のピクチャ及びビデオストリームの後続のピクチャを復号するために復号ピクチャバッファに格納される必要のあるのはどの参照ピクチャであるかを識別するために使用される。それにより、バッファ記述情報は、正確な参照ピクチャを格納するように復号ピクチャバッファを更新することを必要とされる復号器４００に情報を提供する。

【０１７１】

バッファマネージャ４３０が復号ピクチャバッファを更新すると、復号器４００は、ピクチャの符号化表現に基づくピクチャ及び更新された復号ピクチャバッファに格納された少なくとも１つの参照ピクチャを復号できる。

【０１７２】

バッファ記述情報は、ピクチャの符号化表現の制御情報において提供されることが好ましい。例えばデータ取得器４１０は、ピクチャの符号化表現のスライスヘッダからバッファ記述情報を取得するように構成されてよい。このようなケースでは、ピクチャのいずれかの残りのスライスヘッダが同一のバッファ記述情報を搬送することが好ましいため、バッファ記述情報は、現在のピクチャに対して受信された第１のスライスヘッダから取得されることが好ましい。

【０１７３】

取得されたバッファ記述情報は、復号ピクチャバッファに格納される参照ピクチャの明示的なピクチャ識別子を含みうる。別の一実施形態において、バッファ記述情報は、参照ピクチャについてのそれぞれのデルタ識別子を規定する。そしてピクチャ識別子決定器４２０は、バッファ記述情報から少なくとも１つのデルタ識別子を取得し、且つ好ましくは現在のピクチャのデルタ識別子とピクチャ識別子の和として、現在のピクチャのピクチャ識別子及びそれぞれのデルタ識別子に基づいて少なくとも１つのピクチャ識別子を算出するように構成される。

【０１７４】

ピクチャの符号化表現におけるピクチャ識別子又はデルタ識別子の明示的な信号伝送の代わりに、参照信号伝送が使用されてよい。データ取得器４１０は、本実施形態においてピクチャの符号化表現からバッファ記述の識別子を取得するように構成される。復号器４００は、取得されたバッファ記述の識別子を使用して複数の予め定義されたバッファ記述を含むデータ構造からバッファ記述を識別するように構成されたバッファ記述識別器４８０を備えることが好ましい。

【０１７５】

データ取得器４１０は、本実施形態において、ＰＰＳ又はＳＰＳ等のビデオストリームの符号化表現のあるいはそれと関連付けられた制御情報フィールドから複数の予め定義されたバッファ記述を規定するデータ構造を取得するようにさらに構成されることが好ましい。

【０１７６】

特定の一実施形態において、スライスヘッダ等のピクチャの符号化表現の制御情報フィールドは、データ構造を搬送するＰＰＳ又はＳＰＳ等の制御情報フィールドの識別子を含むことが好ましい。それにより、データ取得器４１０は、該識別子を取得して、データ構造を有する関連制御情報フィールドを識別するためにそれを使用する。

【０１７７】

別の実施形態において、バッファ記述情報は、少なくとも１つのピクチャ識別子を識別

するピクチャ識別子又はデルタ識別子等のバッファ記述及び情報の識別子を含む。そしてピクチャ識別子決定器４２０は、識別されたバッファ記述、好ましくはデータ構造から少なくとも１つのピクチャ識別子の第１のセットを決定するように構成される。ピクチャ識別子決定器４２０は、少なくとも１つのピクチャ識別子を規定する情報から少なくとも１つのピクチャ識別子の第２のセットも決定する。この場合、該情報は、例えばピクチャ識別子又はデルタ識別子の形態でピクチャの符号化表現において明示的に信号伝送されている。そして、ピクチャ識別子の結合信号は、ピクチャ識別子決定器４２０により第１のセット及び第２のセットから形成される。

【０１７８】

特定の一実施形態において、復号器４００は、ジョイントセットにおけるピクチャ識別子の総数を復号ピクチャバッファに格納可能な参照ピクチャの最大数と比較するように構成された数比較器４４０を備える。ジョイントセットにおけるピクチャ識別子の総数が参照ピクチャの最大数を超える場合、ジョイントセットにおけるピクチャ識別子の総数が参照ピクチャの最大数を超えなくなるまで、ピクチャ識別子決定器４２０は、第１のセットに含まれるが第２のセットには含まれない１つ以上のピクチャ識別子を除去するように構成される。

【０１７９】

復号器４００のバッファマネージャ４３０は、特定の一実施形態において、復号ピクチャバッファに存在するがバッファ記述情報から決定された少なくとも１つのピクチャ識別子のいずれとも関連付けられないいずれかの参照ピクチャを除去するように構成される。従って、復号ピクチャバッファに格納されるがバッファ記述情報から識別されない任意の参照ピクチャは、バッファマネージャ４３０により復号ピクチャバッファから除去されることが好ましい。

【０１８０】

別の好適なアプローチにおいて、バッファマネージャ４３０は、復号ピクチャバッファに格納されるが、バッファ記述情報からの少なくとも１つのピクチャ識別子のいずれにも関連付けられていない全ての参照ピクチャを、予測に使用しないものとも呼ぶ、参照に使用しないものとしてマーク付けするように構成される。

【０１８１】

特定の一実施形態において、復号ピクチャバッファに存在し且つバッファ記述情報に基づいて決定されたピクチャ識別子のいずれかと関連付けられたいずれかの参照ピクチャは、参照に使用するものとしてバッファマネージャ４３０によりマーク付けされることが好ましい。一実施形態において、参照ピクチャは、短期参照に使用するもの又は長期参照に使用するものとしてマーク付けされうる。これらの２つの特定の代替例は、バッファ記述情報に基づいて選択されることが好ましい。

【０１８２】

復号器４００のバッファマネージャ４３０は、復号器４００が現在のピクチャを復号する前にいずれかの参照ピクチャをマーク付けするように構成されることが好ましい。

【０１８３】

特定の一実施形態において、復号器４００は、復号器４００が現在のピクチャを復号する前に表示するために復号ピクチャバッファからゼロ以上のピクチャを出力するように構成された出力部４５０を備える。特定の一実施形態において、出力部４５０は、バッファマネージャ４３０により参照に使用しないものとしてマーク付けされたいずれかの参照ピクチャを出力する。

【０１８４】

復号器４００のオプションの一実施形態は、ピクチャ識別子決定器４２０により決定された少なくとも１つのピクチャ識別子を復号ピクチャバッファに格納された参照ピクチャのピクチャ識別子と比較するように構成された識別子比較器４６０を備える。バッファ記述情報により規定された少なくとも１つのピクチャ識別子のいずれも復号ピクチャバッファにおいて一致する参照ピクチャを有さない場合、所定のピクチャ識別子と関連付けられ

たピクチャは、ピクチャ識別子決定器４２０により存在していない又は紛失していると決定される。

【０１８５】

オプションの一実施形態において、ピクチャ識別子決定器４２０は、いずれかの存在していないピクチャを生成し、且つそのように生成されたピクチャを復号ピクチャバッファに格納するように構成される。ピクチャ識別子及び存在していないピクチャに関するバッファ記述情報から取得可能な他のいずれかの情報は、ピクチャ識別子決定器４２０により生成されたピクチャに割り当てられることが好ましい。

【０１８６】

復号器４００は、バッファ記述情報に基づいて参照ピクチャリストの初期化を実行するように構成されたリストマネージャ４７０も備えてもよい。特定の一実施形態において、リストマネージャ４７０は、バッファ記述情報が少なくとも１つのピクチャ識別子を規定する順序に従って参照ピクチャリストにおいて参照ピクチャを順序付けすることにより、参照ピクチャリストの初期化を実行するように構成される。従って、バッファ記述情報は、参照ピクチャのピクチャ識別子だけではなく、これらがバッファ記述情報において規定される順序も規定し、参照ピクチャリストを形成することに関する命令をリストマネージャ４７０にさらに提供する。

【０１８７】

復号器は、ソフトウェアで少なくとも部分的に実現可能である。図２２に示されるようなこのような一実施形態において、復号器６００は、ビデオストリームの複数のピクチャの符号化表現を入力するように構成された入力部６１０を備える。復号器６００は、メモリ６４０に格納されたコンピュータプログラムのコード手段を処理するように構成されたプロセッサ６３０も備える。コード手段は、プロセッサ６３０上で実行された時に、ピクチャの符号化表現から少なくとも１つの参照ピクチャを規定するバッファ記述情報をプロセッサ６３０に取得させる。さらにコード手段は、バッファ記述情報からそれぞれの参照ピクチャを識別する少なくとも１つのピクチャ識別子をプロセッサ６３０に決定させる。それぞれの参照ピクチャは、ピクチャについての符号化参照として使用される。またプロセッサ６３０は、少なくとも１つのピクチャ識別子に基づいて復号ピクチャバッファ６５０を更新するようにされる。復号器６００は、ビデオストリームの復号ピクチャを出力するように構成された出力部６２０も備える。

【０１８８】

プロセッサ６３０は、中央処理装置（ＣＰＵ）等の汎用又は専用のコンピュータ、プロセッサ又はマイクロプロセッサであってよい。ソフトウェアは、少なくとも図２１のデータ検出器４１０、ピクチャ識別子決定器４２０及びバッファマネージャ４３０の動作を実施するコンピュータプログラムコード要素又はソフトウェアコード部分を含む。

【０１８９】

プログラムは、ＲＡＭ等の１つ以上の適切な揮発性コンピュータ可読媒体又はデータ格納手段、あるいは磁気ディスク、ＣＤ－ＲＯＭ、ＤＶＤディスク、ハードディスク等の１つ以上の不揮発性コンピュータ可読媒体又はデータ格納手段上あるいはそれらに、ＲＯＭ又はフラッシュメモリに全てあるいは部分的に格納されてもよい。データ格納手段は、ローカルデータ格納手段であってよく、あるいはデータサーバ等にリモートで提供される。従って、ソフトウェアは、コンピュータの動作メモリ又はプロセッサにより実行するための同等の処理システムにロードされてもよい。コンピュータ／プロセッサは、上述の機能を実行することだけに専念する必要はなく、他のソフトウェアタスクも実行してもよい。復号器６００を規定するために使用されたプログラムコードの例は単一命令多重データ（ＳＩＭＤ）コードを含むが、それに限定されない。

【０１９０】

あるいは、復号器はハードウェアで実現されてよい。図２１における復号器４００のユニット４１０～４８０の機能を実現するために使用及び組み合わせ可能な回路網素子の多くの変形例がある。このような変形例は実施形態により含まれる。復号器４００のハード

ウェアの実現例の特定の例は、デジタル信号プロセッサ（ＤＳＰ）ハードウェア、並びに汎用電子回路網及び特定用途向け回路網の双方を含む集積回路技術において実現される。

【０１９１】

実施形態の一態様によれば、図２０に示されるような受信機５００が提供される。受信機５００は、ビデオストリームの複数のピクチャの符号化表現を入力するように構成された入力部５１０を備える。符号化表現は、実施形態に係るバッファ記述情報を搬送する。符号化表現は、複数のピクチャの符号化表現を復号するように構成される図２１又は図２２に示されるような復号器４００に転送される。受信機５００の出力部５２０は、ビデオストリームの復号ピクチャを出力するように構成される。受信機５００は、ピクチャを復号する際に復号器４００により使用される参照ピクチャを格納する復号ピクチャバッファ５３０も備える。

【０１９２】

付録

本発明の付録は、提案された一実施形態の構文を提示する。付録において、従来技術のＨＥＶＣの提案に対して追加された構文要素は、下線を引くことでマーク付けされ、除去された構文要素は取り消し線でマーク付けされる。

【０１９３】

スライスヘッダ

slice_header( ) {	Descriptor
first_tb_in_slice	ue(v)
entropy_slice_flag	u(1)
if(!entropy_slice_flag) {	
slice_type	ue(v)
pic_parameter_set_id	ue(v)
~~**frame_num**~~	~~u(v)~~
additional_picture_id	ue(v)
if(IdrPicFlag)	
idr_pic_id	ue(v)
if(pic_order_cnt_type = = 0)	
pic_order_cnt_lsb /*	u(v)
if(!IdrPicFlag){	
buffer_description_reference_flag	u(1)
if(buffer_description_reference_flag = = 1){	
buffer_description_id	ue(v)
}	
if(buffer_description_reference_flag = = 0){	
number_of_explicitly_signaled_pictures	ue(v)
for(**number_of_explicitly_signaled_pictures**) {	
additional_picture_id	ue(v)
if(num_reorder_frames > 0)	
delta_POC_sign	u(1)
absolute_delta_POC_minus_one	ue(v)
temporal_id	u(v)
}	
}	
}	
}	
if(slice_type = = P || slice_type = = B) {	
num_ref_idx_active_override_flag	u(1)

if(num_ref_idx_active_override_flag) {	
num_ref_idx_l0_active_minus1	ue(v)
if(slice_type = = B)	
num_ref_idx_l1_active_minus1	ue(v)
}	
}	
ref_pic_list_modification( )	
ref_pic_list_combination( )	
~~if(nal_ref_idc != 0)~~	
~~dec_ref_pic_marking( )~~	
if(entropy_coding_mode_flag && slice_type != I)	
cabac_init_idc	ue(v)
slice_qp_delta	se(v)
if(adaptive_loop_filter_enabled_flag)	
alf_param()	
if(deblocking_filter_control_present_flag) {	
disable_deblocking_filter_idc	
if(disable_deblocking_filter_idc != 1) {	
slice_alpha_c0_offset_div2	
slice_beta_offset_div2	
}	
}	
if(slice_type = = B)	
collocated_from_l0_flag	u(1)
} else	
if(entropy_coding_mode_flag && slice_type != I)	
cabac_init_idc	ue(v)
}	

【０１９４】
ピクチャパラメータセット

pic_parameter_set_rbsp( ) {	Descriptor
pic_parameter_set_id	ue(v)
seq_parameter_set_id	ue(v)
entropy_coding_mode_flag	u(1)
num_ref_idx_l0_default_active_minus1	ue(v)
num_ref_idx_l1_default_active_minus1	ue(v)
pic_init_qp_minus26 /* relative to 26 */	se(v)
constrained_intra_pred_flag	u(1)
number_of_buffer_descriptions	ue(v)
for(number_of_buffer_descriptions){	
number_of_pictures_in_buffer_description	ue(v)
for(number_of_pictures_in_buffer_description) {	
if(num_reorder_frames > 0)	
delta_POC_sign	u(1)
absolute_delta_POC_minus_one	ue(v)
temporal_id	u(v)
}	
rbsp_trailing_bits( )	
}	

【０１９５】
提案されたセマンティクス
バッファ記述の適応例に対する復号処理
該処理は、ピクチャの第１のスライスにおける第１の符号化ユニットの復号の前及び参照ピクチャリストを構成するための復号処理の前に、Ｉ、Ｐ又はＢの各ピクチャについての復号処理の開始時に呼び出される。
【０１９６】
処理の結果、１つ以上のピクチャを「参照に使用しない」ものとしてマーク付けしてもよい。
【０１９７】
処理の結果、存在していないピクチャの作成において開示されるような「存在していない」ピクチャが構成されてもよい。
【０１９８】
参照ピクチャは、変数ＰＯＣ及びadditional_picture_idによる復号処理において使用するために識別される。
【０１９９】
０からnumber_pictures_in_buffer_descriptionまでのいずれかのｉに対して、POC(r)=POC(curr)+delta_POC(i)及びadditional_picture_id(r)=additional_picture_id(i)の場合かつその場合に限り、復号ピクチャバッファにおける参照ピクチャｒはバッファ記述の一部であると言われる。
【０２００】

バッファ記述の適応例に対する動作の手順

バッファ記述の適応例は、以下の順序付けされた工程で進行する

１．現在のピクチャがＩＤＲピクチャであるかに応じて、以下が適用される。

－現在のピクチャがＩＤＲピクチャである場合、全ての参照ピクチャは参照に使用しないものとしてマーク付けされる。

－そうでない場合（現在のピクチャがＩＤＲピクチャではない）、以下の順序付けされた工程が適用される。

I．現在のピクチャの第１のスライスのスライスヘッダにおけるバッファ記述情報は、バッファ記述の作成において開示されるようなバッファ記述とも呼ぶ参照ピクチャのリストを作成するために使用される。

II．バッファ記述の一部ではない全ての参照ピクチャ（復号ピクチャバッファにおける）は、「参照に使用しない」ものとしてマーク付けされる。

III．バッファ記述に含まれる１以上のピクチャが参照のために使用可能ではない（即ち、「参照に使用する」ものとしてマーク付けされた参照バッファに存在する）場合、存在していないピクチャの作成において開示された処理が呼び出される。

２．現在のピクチャのスライスが復号される。

【０２０１】

バッファ記述の作成

buffer_description_reference_flagが１の場合、０からnumber_of_pictures_in_buffer_description-1までの各ピクチャｉに対して、deltaPOCをbuffer_description_idにより識別されたＰＰＳバッファ記述エントリのdeltaPOC、temporal_idをbuffer_description_idにより識別されたＰＰＳバッファ記述エントリのtemporal_id及びadditional_picture_idを０に設定してバッファ記述情報が作成される。

【０２０２】

buffer_description_reference_flagが０の場合、０からnumber_of_explicitly_signaled_pictures-1までの各ピクチャｉに対して、deltaPOCを明示的に信号伝送されたバッファ記述のdeltaPOC、temporal_idを明示的に信号伝送されたバッファ記述のtemporal_id及びadditional_picture_idを明示的に信号伝送されたバッファ記述のadditional_picture_idに設定してバッファ記述が作成される。

【０２０３】

存在していないピクチャの作成

該処理は、現在のピクチャのバッファ記述に含まれるが復号ピクチャバッファにおいては使用可能ではない各ピクチャに対して呼び出されることが好ましい。即ち、現在のピクチャのバッファ記述がエントリｉを含む場合、POC(i)及びadditional_picture_id(i)を有するため、POC(j)==POC(i)及びadditional_picture_id(j)==additional_picture_id(i)の場合に「参照に使用する」ものとしてマーク付けされた復号ピクチャバッファにおけるピクチャｊはない。

【０２０４】

このような記述の各々に対して、「存在していない」ピクチャは、POC(i)に設定されたＰＯＣ、additional_picture_id(i)に設定されたadditional_picture_id、temporal_id(i)に設定されたtemporal_idで用いて生成され、「存在していない」もの及び「参照に使用する」ものとしてマーク付けされる。生成されたフレームのサンプル値は、いかなる値に設定されてもよい。「存在していない」ものとしてマーク付けされるこれらの生成されたフレームは、インター予測処理では参照されるべきではない。

【０２０５】

上述の実施形態は、本発明のいくつかの説明的な例として理解されるべきである。本発明の範囲から逸脱せずに、種々の変形、組合せ及び変更が実施形態に対して行なわれてもよいことは、当業者には理解されるだろう。特に、異なる実施形態における異なる部分の解決策は、技術的に可能な場合には他の構成で組み合わせ可能である。しかしながら、本発明の範囲は、添付の特許請求の範囲により規定される。

【図１】

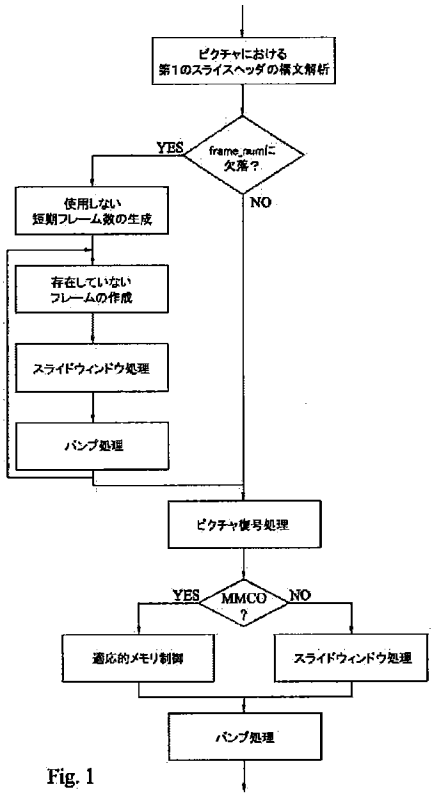
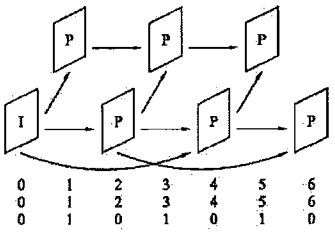


Fig. 1

【図２】

Fig. 2



【図３】

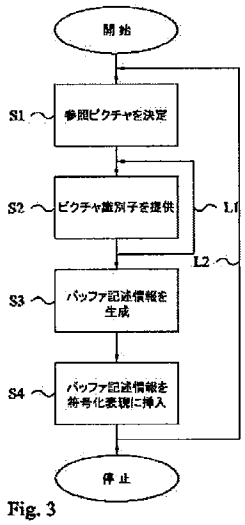
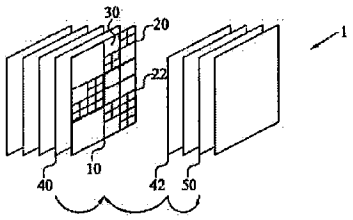


Fig. 3

【図４】

Fig. 4



【図５】

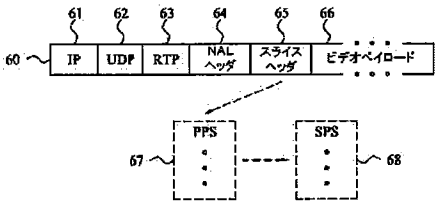


Fig. 5

【図６】

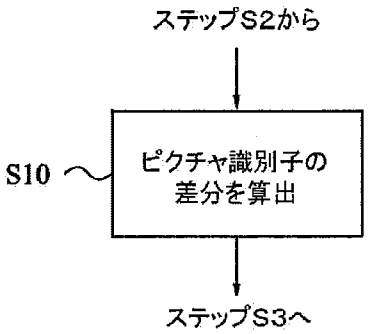


Fig. 6

【図７】

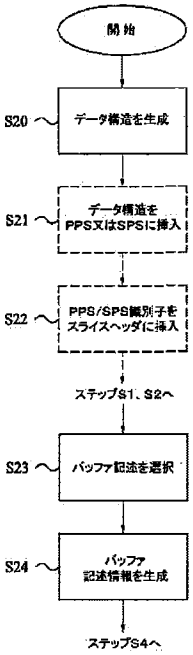


Fig. 7

【図８】

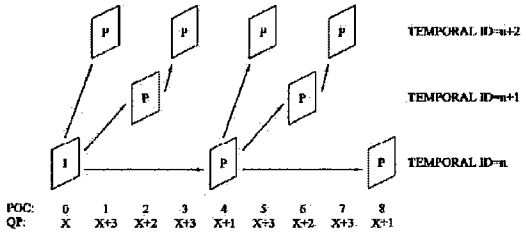


Fig. 8

【図９】

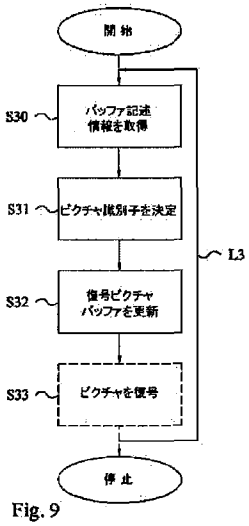


Fig. 9

【図１０】

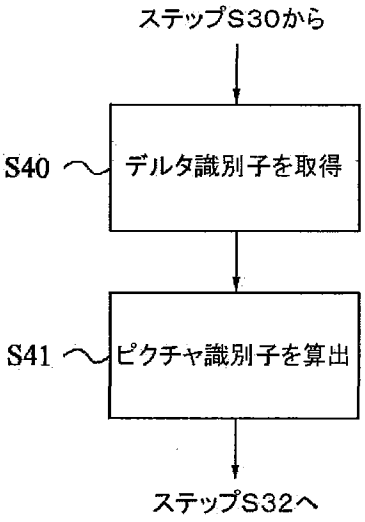


Fig. 10

【図１１】

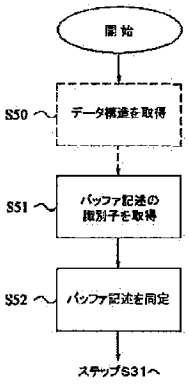


Fig. 11

【図１２】

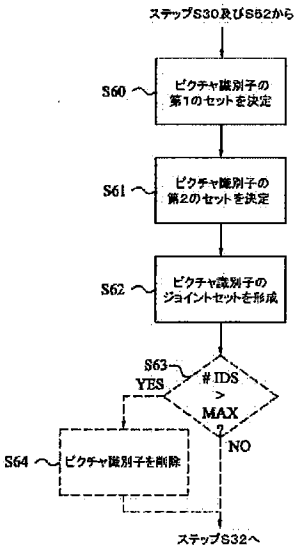


Fig. 12

【図１３】

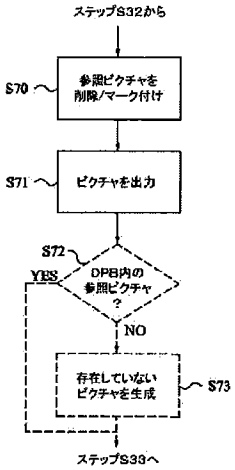


Fig. 13

【図１４】

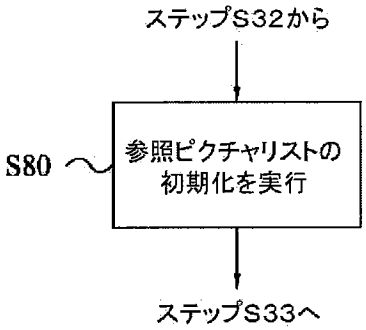


Fig. 14

【図１５】

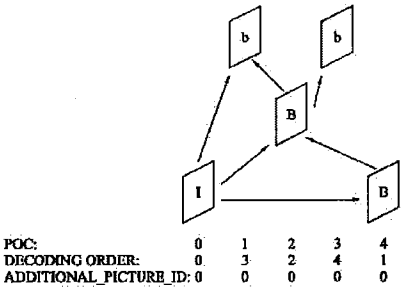


Fig. 15

【図１６】

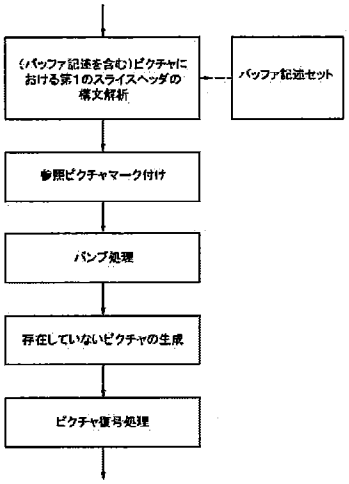


Fig. 16

【図１７】

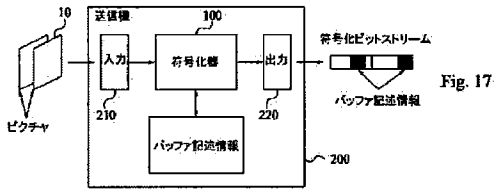


Fig. 17

【図１８】

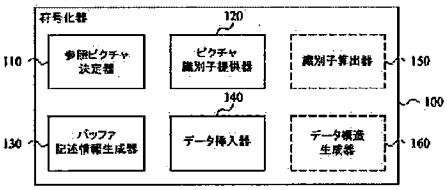


Fig. 18

【図１９】

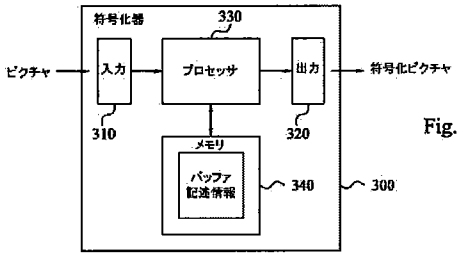


Fig. 19

【図２０】

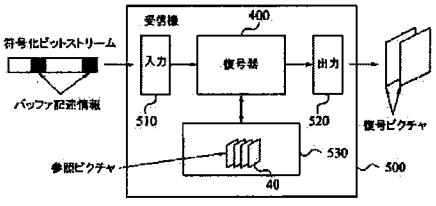


Fig. 20

【図２１】

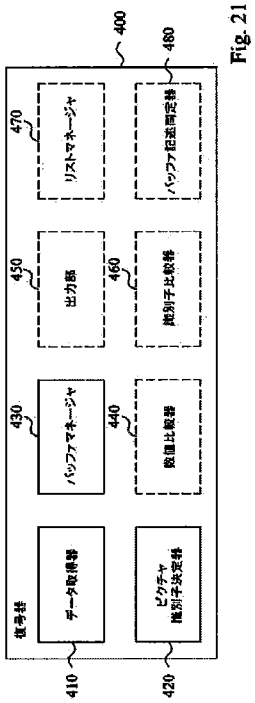


Fig. 21

【図２２】

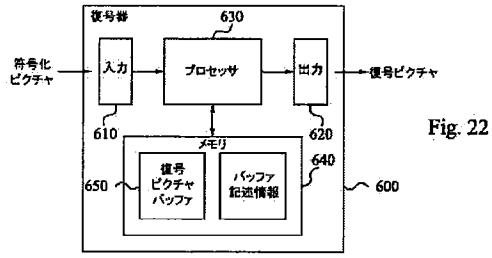

復号器
630
符号化
ピクチャ
入力
プロセッサ
出力
復号ピクチャ
610
620
メモリ
640
650
復号
ピクチャ
バッファ
バッファ
記述情報
600

Fig. 22

フロントページの続き

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(56)参考文献 国際公開第２００８／１０５３８９ (WO, A1)

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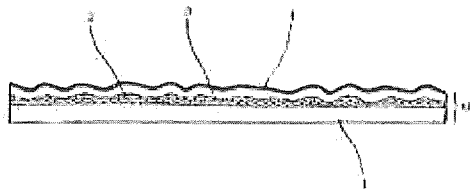
(71)Applicant : KYODO PRINTING CO LTD
(72)Inventor : KAAI AKIRA
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(30)Priority

Priority number	Priority date	Priority country
2006213750	04.08.2006	JP
2006264364	28.09.2006	JP

(54) PRINTING PAPER, AND REPRODUCED PICTURE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a reproduced picture of a high quality texture having a unique uneven impression which is peculiar to mineral pigments.
SOLUTION: The printing paper 6 has an undercoat uneven layer 2 which is formed on a base material 1, and a receiving layer 3 which is formed on the undercoat uneven layer. In the undercoat uneven layer, an average height difference between the protruding sections and the recess sections is set to be within a range of 70 to 90 μm, and the forming density of the protruding sections and/or the recess sections is set to be within a range of 80 to 800 pieces/cm2.



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B41M 5/50	(2006.01)			
B41M 5/52	(2006.01)			

審査請求 未請求　請求項の数 26　ＯＬ　（全 21 頁）

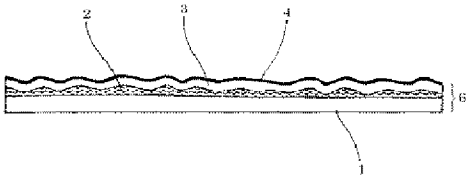
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(33)優先権主張国　日本国 (JP)

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最終頁に続く

(54)【発明の名称】印刷用紙および複製画

(57)【要約】
【課題】岩絵の具独特の凹凸感を有する質感の高い複製画を提供する。
【解決手段】基材１上に形成された下地凹凸層２と、下地凹凸層上に形成された受容層３を有する印刷用紙６であって、下地凹凸層は、凸部と凹部の平均高度差が７０～９０μmの範囲内であり、凸部又は／及び凹部の形成密度が８０～８００個／ｃｍ^{2}の範囲内であることを特徴とする。
【選択図】図１



【特許請求の範囲】
【請求項1】
基材上に形成された下地凹凸層と、該下地凹凸層上に形成された受容層を有する印刷用紙であって、前記下地凹凸層は、凸部と凹部の平均高度差が７０～９０μｍの範囲内であり、凸部又は／及び凹部の形成密度が８０～８００個／ｃｍ^{2}の範囲内であることを特徴とする印刷用紙。
【請求項2】
基材上に形成されたカール防止層と、該カール防止層上に形成された下地凹凸層と、該下地凹凸層上に形成された受容層を有する印刷用紙であって、前記下地凹凸層は、凸部と凹部の平均高度差が７０～９０μｍの範囲内であり、凸部又は／及び凹部の形成密度が８０～８００個／ｃｍ^{2}の範囲内であることを特徴とする印刷用紙。
【請求項3】
前記カール防止層が、ジグリセリン６０～８０重量部及び水４０～２０重量部（両者の合計は１００重量部）と、ジグリセリンと水の合計１００重量部に対して３～３９重量部の炭酸カルシウムと、を含有する水性インキにより形成されることを特徴とする請求項２に記載の印刷用紙。
【請求項4】
前記下地凹凸層は、凸部又は／及び凹部の平均形成密度が３７０～４１０個／ｃｍ^{2}の範囲内であることを特徴とする請求項１乃至３のいずれか一項に記載の印刷用紙。
【請求項5】
前記下地凹凸層は、寒水粉と炭酸カルシウム粉を含有することを特徴とする請求項１乃至４のいずれか一項に記載の印刷用紙。
【請求項6】
前記寒水粉は粒径が３００μｍ以下であり、その粒度分布において、粒径６０～７０μｍの範囲内に第一のピークを有し、粒径１９０～２００μｍの範囲内に第二のピークを有しており、前記炭酸カルシウム粉の平均粒径が３～５μｍであることを特徴とする請求項５に記載の印刷用紙。
【請求項7】
基材上に形成された下地凹凸層と、該下地凹凸層上に形成された受容層を有する印刷用紙であって、前記下地凹凸層は、凸部と凹部の平均高度差が８０～９５μｍの範囲内であり、凸部又は／及び凹部の形成密度が１９０～１１００個／ｃｍ^{2}の範囲内であることを特徴とする印刷用紙。
【請求項8】
基材上に形成されたカール防止層と、該カール防止層上に形成された下地凹凸層と、該下地凹凸層上に形成された受容層を有する印刷用紙であって、前記下地凹凸層は、凸部と凹部の平均高度差が８０～９５μｍの範囲内であり、凸部又は／及び凹部の形成密度が１９０～１１００個／ｃｍ^{2}の範囲内であることを特徴とする印刷用紙。
【請求項9】
前記カール防止層が、ジグリセリン６０～８０重量部及び水４０～２０重量部（両者の合計は１００重量部）と、ジグリセリンと水の合計１００重量部に対して３～３９重量部の炭酸カルシウムと、を含有する水性インキにより形成されることを特徴とする請求項８に記載の印刷用紙。
【請求項10】
前記下地凹凸層は、凸部又は／及び凹部の平均形成密度が４５０～４９０個／ｃｍ^{2}の範囲内であることを特徴とする請求項７乃至９のいずれか一項に記載の印刷用紙。
【請求項11】
前記下地凹凸層は、寒水粉と炭酸カルシウム粉を含有することを特徴とする請求項７乃至１０のいずれか一項に記載の印刷用紙。
【請求項12】

前記寒水粉は粒径が３００μｍ以下であり、その粒度分布において、粒径７０～９０μｍの範囲内にピークを有しており、前記炭酸カルシウム粉の平均粒径が３～５μｍであることを特徴とする請求項１１に記載の印刷用紙。

【請求項13】

基材上に形成された下地凹凸層と、該下地凹凸層上に形成された受容層を有する印刷用紙であって、前記下地凹凸層は、凸部と凹部の平均高度差が３０～５０μｍの範囲内であり、凸部又は／及び凹部の形成密度が８０～８００個／ｃｍ^{2}の範囲内であることを特徴とする印刷用紙。

【請求項14】

基材上に形成されたカール防止層と、該カール防止層上に形成された下地凹凸層と、該下地凹凸層上に形成された受容層を有する印刷用紙であって、前記下地凹凸層は、凸部と凹部の平均高度差が３０～５０μｍの範囲内であり、凸部又は／及び凹部の形成密度が８０～８００個／ｃｍ^{2}の範囲内であることを特徴とする印刷用紙。

【請求項15】

前記カール防止層が、ジグリセリン６０～８０重量部及び水４０～２０重量部（両者の合計は１００重量部）と、ジグリセリンと水の合計１００重量部に対して３～３９重量部の炭酸カルシウムと、を含有する水性インキにより形成されることを特徴とする請求項１４に記載の印刷用紙。

【請求項16】

前記下地凹凸層は、凸部又は／及び凹部の平均形成密度が３７０～４１０個／ｃｍ^{2}の範囲内であることを特徴とする請求項１３乃至１５のいずれか一項に記載の印刷用紙。

【請求項17】

前記下地凹凸層は、寒水粉と炭酸カルシウム粉を含有することを特徴とする請求項１３乃至１６のいずれか一項に記載の印刷用紙。

【請求項18】

前記寒水粉は粒径が３００μｍ以下であり、その粒度分布において、粒径４０～５０μｍの範囲内にピークを有しており、前記炭酸カルシウム粉の平均粒径が３～５μｍであることを特徴とする請求項１７に記載の印刷用紙。

【請求項19】

基材上に形成された下地凹凸層と、該下地凹凸層上に形成された受容層を有する印刷用紙であって、前記下地凹凸層は、凸部と凹部の平均高度差が２５～４５μｍの範囲内であり、凸部又は／及び凹部の形成密度が２０～５００個／ｃｍ^{2}の範囲内であることを特徴とする印刷用紙。

【請求項20】

基材上に形成されたカール防止層と、該カール防止層上に形成された下地凹凸層と、該下地凹凸層上に形成された受容層を有する印刷用紙であって、前記下地凹凸層は、凸部と凹部の平均高度差が２５～４５μｍの範囲内であり、凸部又は／及び凹部の形成密度が２０～５００個／ｃｍ^{2}の範囲内であることを特徴とする印刷用紙。

【請求項21】

前記カール防止層が、ジグリセリン６０～８０重量部及び水４０～２０重量部（両者の合計は１００重量部）と、ジグリセリンと水の合計１００重量部に対して３～３９重量部の炭酸カルシウムと、を含有する水性インキにより形成されることを特徴とする請求項２０に記載の印刷用紙。

【請求項22】

前記下地凹凸層は、凸部又は／及び凹部の平均形成密度が１５０～１９０個／ｃｍ^{2}の範囲内であることを特徴とする請求項１９乃至２１のいずれか一項に記載の印刷用紙。

【請求項23】

前記下地凹凸層は、寒水粉と炭酸カルシウム粉を含有することを特徴とする請求項１９乃至２２のいずれか一項に記載の印刷用紙。

【請求項24】

前記寒水粉は粒径が３００μm以下であり、その粒度分布において、粒径２０～３０μmの範囲内にピークを有しており、前記炭酸カルシウム粉の平均粒径が３～５μmであることを特徴とする請求項２３に記載の印刷用紙。

【請求項25】

前記受容層は、平均粒径が３～５μm、白色度が９８%以上の炭酸カルシウム粉を含有することを特徴とする請求項１乃至２４のいずれか一項に記載の印刷用紙。

【請求項26】

請求項１乃至２５のいずれか一項に記載の印刷用紙上に絵柄層を有することを特徴とす

【発明の詳細な説明】

【技術分野】

【0001】

本発明は、印刷用紙、特には岩絵の具調の日本画の複製画を描くのに適する印刷用紙及びその複製画に関する。

【背景技術】

【0002】

岩絵の具は粒状、粉状の原料鉱物を膠水等を用いて彩色するものであり、この岩絵の具を用いて描いた日本画は表面が粗面状の微小な多数の凹凸を有する。

【0003】

岩絵の具調の日本画には独特の色調があるほか、前記の粗面状の表面形状が特殊な風合を醸成し、これが絵画の美しさを創成する一要素となっているため、岩絵の具調の日本画の複製に当たっては、その絵画の色調の他に粗面状の表面状態も再現する必要がある。

【0004】

従来、岩絵の具調の日本画を複製する際には、基材にオフセット印刷で絵柄層を形成し透明凹凸加工フィルムを積層させることで岩絵の具独特の凹凸感を表現していたが、フィルムのてかりが原因で、本物の日本画の風合いが表現しづらいという問題があった。

【0005】

一方、特許文献１には、和紙等の基底材上に、マテリアル層を形成し、該マテリアル層上に色材受理層を形成し、色材受理層上にオリジナル画像に対応した画像を再生する複製物の製造方法が開示されている。

【0006】

【特許文献1】特開２００５－１４３８７号公報

【発明の開示】

【発明が解決しようとする課題】

【0007】

特許文献１に開示されている複製物の製造方法では、前記マテリアル層は、バインダと白色顔料とから成る地塗材と、添加材とから成り、厚みのある立体的な肌合いを表現したり、凹凸やざらざら等の質感を出すために用いられている。また、色材受理層の形成には市販の色材受理材を用いている。

【0008】

特許文献１に開示された方法によれば、従来のような透明凹凸加工フィルムを積層させることなく凹凸形状を形成しているため、前述したようなてかりによる問題を解消することができる。

【0009】

しかしながら、本発明者らの検討によれば、特許文献１のように単に凹凸を有するマテリアル層上に市販の色材受理材を用いて色材受理層を形成しただけでは、岩絵の具独特の凹凸感を十分に表現することは困難であると共に、色材受理層自体の密着性にも問題があることが判明した。

【0010】

そこで本出願人は、より本物に近い岩絵の具独特のきめ細かい凹凸感を十分に表現できる複製画、更には受理層の密着性を向上せしめ表面剥離を防止した商品価値の高い複製画

として特願２００５－３５２８５３号を提案した。
【0011】
本発明は，平均粒度が小さい岩絵の具を用いて日本画等を描いた場合でも、より本物に近い岩絵の具独特の凹凸感を有する質感の高い複製画を再現できる印刷用紙およびその複製画を提供することを目的としたものである。
【課題を解決するための手段】
【0012】
上記の課題を解決すべく成された本発明の構成は以下の通りである。
【0013】
即ち、本発明の第１の印刷用紙は、基材上に形成された下地凹凸層と、該下地凹凸層上に形成された受容層を有する印刷用紙であって、前記下地凹凸層は、凸部と凹部の平均高度差が７０～９０μｍの範囲内であり、凸部又は／及び凹部の形成密度が８０～８００個／ｃｍ^{2}の範囲内であることを特徴とする。
【0014】
また、本発明の第２の印刷用紙は、紙基材上に形成されたカール防止層と、該カール防止層上に形成された下地凹凸層と、該下地凹凸層上に形成された受容層を有する印刷用紙であって、前記下地凹凸層は、凸部と凹部の平均高度差が７０～９０μｍの範囲内であり、凸部又は／及び凹部の形成密度が８０～８００個／ｃｍ^{2}の範囲内であることを特徴とし、また、前記カール防止層が、ジグリセリン６０～８０重量部及び水４０～２０重量部（両者の合計は１００重量部）と、ジグリセリンと水の合計１００重量部に対して３～３９重量部の炭酸カルシウムと、を含有する水性インキにより形成されることを特徴とする。
【0015】
また、前記下地凹凸層は、凸部又は／及び凹部の平均形成密度が３７０～４１０個／ｃｍ^{2}の範囲内であることを特徴とする。
【0016】
また、前記下地凹凸層は、寒水粉と炭酸カルシウム粉を含有することを特徴とする。
【0017】
また、前記寒水粉は粒径が３００μｍ以下であり、その粒度分布において、粒径６０～７０μｍの範囲内に第一のピークを有し、粒径１９０～２００μｍの範囲内に第二のピークを有しており、前記炭酸カルシウム粉の平均粒径が３～５μｍであることを特徴とする。
【0018】
また、本発明の第３の印刷用紙は、基材上に形成された下地凹凸層と、該下地凹凸層上に形成された受容層を有する印刷用紙であって、前記下地凹凸層は、凸部と凹部の平均高度差が８０～９５μｍの範囲内であり、凸部又は／及び凹部の形成密度が１９０～１１００個／ｃｍ^{2}の範囲内であることを特徴とする。
【0019】
また、本発明の第４の印刷用紙は、基材上に形成されたカール防止層と、該カール防止層上に形成された下地凹凸層と、該下地凹凸層上に形成された受容層を有する印刷用紙であって、前記下地凹凸層は、凸部と凹部の平均高度差が８０～９５μｍの範囲内であり、凸部又は／及び凹部の形成密度が１９０～１１００個／ｃｍ^{2}の範囲内であることを特徴とし、また、前記カール防止層が、ジグリセリン６０～８０重量部及び水４０～２０重量部（両者の合計は１００重量部）と、ジグリセリンと水の合計１００重量部に対して３～３９重量部の炭酸カルシウムと、を含有する水性インキにより形成されることを特徴とする。
【0020】
また、前記下地凹凸層は、凸部又は／及び凹部の平均形成密度が４５０～４９０個／ｃｍ^{2}の範囲内であることを特徴とする。
【0021】

また、前記下地凹凸層は、寒水粉と炭酸カルシウム粉を含有することを特徴とする。
【0022】
また、前記寒水粉は粒径が３００μｍ以下であり、その粒度分布において、粒径７０～９０μｍの範囲内にピークを有しており、前記炭酸カルシウム粉の平均粒径が３～５μｍであることを特徴とする。
【0023】
また、本発明の第５の印刷用紙は、基材上に形成された下地凹凸層と、該下地凹凸層上に形成された受容層を有する印刷用紙であって、前記下地凹凸層は、凸部と凹部の平均高度差が３０～５０μｍの範囲内であり、凸部又は／及び凹部の形成密度が８０～８００個／ｃｍ^{2}の範囲内であることを特徴とする。
【0024】
また、本発明の第６の印刷用紙は、基材上に形成されたカール防止層と、該カール防止層上に形成された下地凹凸層と、該下地凹凸層上に形成された受容層を有する印刷用紙であって、前記下地凹凸層は、凸部と凹部の平均高度差が３０～５０μｍの範囲内であり、凸部又は／及び凹部の形成密度が８０～８００個／ｃｍ^{2}の範囲内であることを特徴とし、また、前記カール防止層が、ジグリセリン６０～８０重量部及び水１０～２０重量部（両者の合計は１００重量部）と、ジグリセリンと水の合計１００重量部に対して３～３９重量部の炭酸カルシウムと、を含有する水性インキにより形成されることを特徴とする。
【0025】
また、前記下地凹凸層は、凸部又は／及び凹部の平均形成密度が３７０～４１０個／ｃｍ^{2}の範囲内であることを特徴とする。
【0026】
また、前記下地凹凸層は、寒水粉と炭酸カルシウム粉を含有することを特徴とする。
【0027】
また、前記寒水粉は粒径が３００μｍ以下であり、その粒度分布において、粒径１０～５０μｍの範囲内にピークを有しており、前記炭酸カルシウム粉の平均粒径が３～５μｍであることを特徴とする。
【0028】
また、本発明の第７の印刷用紙は、基材上に形成された下地凹凸層と、該下地凹凸層上に形成された受容層を有する印刷用紙であって、前記下地凹凸層は、凸部と凹部の平均高度差が２５～４５μｍの範囲内であり、凸部又は／及び凹部の形成密度が２０～５００個／ｃｍ^{2}の範囲内であることを特徴とする。
【0029】
また、本発明の第８の印刷用紙は、基材上に形成されたカール防止層と、該カール防止層上に形成された下地凹凸層と、該下地凹凸層上に形成された受容層を有する印刷用紙であって、前記下地凹凸層は、凸部と凹部の平均高度差が２５～４５μｍの範囲内であり、凸部又は／及び凹部の形成密度が２０～５００個／ｃｍ^{2}の範囲内であることを特徴とし、また、前記カール防止層が、ジグリセリン６０～８０重量部及び水４０～２０重量部（両者の合計は１００重量部）と、ジグリセリンと水の合計１００重量部に対して３～３９重量部の炭酸カルシウムと、を含有する水性インキにより形成されることを特徴とする。
【0030】
また、前記下地凹凸層は、凸部又は／及び凹部の平均形成密度が１５０～１９０個／ｃｍ^{2}の範囲内であることを特徴とする。
【0031】
また、前記下地凹凸層は、寒水粉と炭酸カルシウム粉を含有することを特徴とする。
【0032】
また、前記寒水粉は粒径が３００μｍ以下であり、その粒度分布において、粒径２０～３０μｍの範囲内にピークを有しており、前記炭酸カルシウム粉の平均粒径が３～５μｍであることを特徴とする。
【0033】

また、第１～第８の印刷用紙において、前記受容層は、平均粒径が３～５μｍ、白色度が９８％以上の炭酸カルシウム粉を含有することを特徴とする。

【0034】

また、前記印刷用紙上に絵柄層を有することを特徴とする。

【発明の効果】

【0035】

本発明の印刷用紙によれば、下地凹凸層の凸部と凹部の平均高度差、及び凸部又は／及び凹部の形成密度を特定の範囲内としたことにより、この上に形成した受容層上に形成される絵柄層自体が岩絵の具調の凹凸を表現でき、より本物に近い岩絵の具独特の凹凸感を有する質感の高い複製画を得ることができる。

【0036】

更に、原画の質感に合わせた使い分けが可能となり、岩絵の具の複製画の幅が広がることとなる。

【0037】

そして、本発明の第２、第４、第６及び第８の印刷用紙によれば、更に、基材の上にカール防止層を設けたことにより、カール防止層が基材への水分の浸透を防ぐ役割を果たす為、用紙のカール（波打ち）を防止できる。従って、例えば、インクジェットプリンター等で複製画を印刷する場合に、ヘッドが用紙に当たる等の障害が軽減され、出力がより安定されることとなる。

【発明を実施するための最良の形態】

【0038】

以下、本発明の実施形態例を図面を参照して説明する。

【0039】

図１は本発明の第１、第３、第５及び第７の印刷用紙を用いた複製画の一部を模式的に示した断面図であり、１は基材、２は下地凹凸層、３は受容層、４は絵柄層である。尚、基材１、下地凹凸層２、及び受容層３を合わせたものが本発明の印刷用紙６である。

【0040】

図２は本発明の第２、第４、第６及び第８の印刷用紙を用いた複製画の一部を模式的に示した断面図であり、１は基材、２は下地凹凸層、３は受容層、４は絵柄層、５はカール防止層である。尚、基材１、下地凹凸層２、受容層３及びカール防止層５を合わせたものが本発明の印刷用紙６である。

【0041】

図示のように、本発明の複製画には、基材１上に形成された下地凹凸層２と、下地凹凸層２上に形成された受容層３と、受容層３上に形成された絵柄層４を有する第１、第３、第５及び第７の複製画と、基材１上に形成されたカール防止層５と、カール防止層５上に形成された下地凹凸層２と、下地凹凸層２上に形成された受容層３と、受容層３上に形成された絵柄層４を有する第２、第４、第６及び第８の複製画がある。

【0042】

［基材］

基材１としては、用紙、フィルム、布、プラスチック板、木質基材等を用いることができる。

【0043】

本発明の複製画を製造する際、好ましくは水系のインキを使用するため、第１、第３、第５及び第７の複製画の基材１としては、吸水性が良くあまりカールしない用紙が好ましく、例えば画材紙（上質紙）や和紙が好適であり、特に坪量が２５０～３２０ｇ／m^2であるものが最も好ましい。坪量が２５０ｇ／m^2未満であると、吸水によってカールが生じ易くなる。一方、坪量が３２０ｇ／m^2を超えると、紙厚が厚くなりその表面が印字ヘッドに触れやすくなるため、画像形成が困難となる。

【0044】

また、第２、第４、第６及び第８の複製画には、防水壁としての役割を果たすカール防

止層５が基材上に形成されている為、第２、第４、第６及び第８の複製画の基材１は特に限定されないが、吸水性が良くあまりカールしない用紙が好ましい。

【0045】

［カール防止層］

カール防止層５の材料としては、基材１への水分の浸透を防ぐ役割を果たすものを用いればよく、例えば水性インキ、油性インキ等が挙げられる。具体的には、公知の油性インキに、色材としての顔料を含有した油性インキ等が挙げられ、特に、基材が白色であればホワイトインキを用いる等、基材１と同系色のインキを用いることが好ましい。

【0046】

また、受容層３が、カール防止層５に接する場合には、ジグリセリン６０～８０重量部、好ましくは６５～７５重量部及び水４０～２０重量部、好ましくは３５～２５重量部（両者の合計は１００重量部）と、ジグリセリンと水の合計１００重量部に対して３～３９重量部、好ましくは２５～３５重量部の炭酸カルシウムと、を含有する水性インキを用いることが好ましい。この様な水性インキを用いることにより、受容層３がカール防止層５に弾かれずに積層され、更に、カール防止層５の印刷適性（印刷し易さ、乾燥し易さ）、絵柄層４の発色性が向上する。特に、ジグリセリンと水の合計１００重量部に対して２５～３５重量部の炭酸カルシウムを含有する場合には、絵柄層４の発色性が向上する。

そして、カール防止層５の形成には公知の方法、例えば、オフセット印刷方式、グラビア印刷方式、フレキソ印刷方式、スクリーン印刷方式等を用いることができる。

【0047】

また、カール防止層５の厚さは、３５～４８μｍの範囲内であることが好ましい。この厚さにすることにより、カール防止層５が防水壁としての役割を果たし、基材１が各層から流入する水分を吸収しなくなる。

【0048】

更に、カール防止層５に光輝性顔料を含有させて、受容層３及び下地凹凸層２を部分的に形成することで、意匠性を高めることもできる。

【0049】

［下地凹凸層］

岩絵の具独特の凹凸感を持たせるためには、第１及び第２の複製画では、下地凹凸層２は、凸部と凹部の平均高度差が、７０～９０μｍの範囲内であることが必要である。この平均高度差が７０μｍ未満であると、中程度の粗さを持つ岩絵の具独特の凹凸感を有する質感が得られない場合がある。一方、この平均高度差が９０μｍを超えると、凹凸が目立ち過ぎ、中程度の粗さを持つ岩絵の具独特の凹凸感を有する質感が得られない場合がある。

【0050】

また、第１及び第２の複製画では、下地凹凸層２は、凸部又は／及び凹部の形成密度が８０～８００個／ｃｍ^{2}の範囲内であることが必要である。この形成密度が８０／ｃｍ^{2}より少ないと、中程度の粗さを持つ岩絵の具独特の凹凸感を有する質感が得られない場合がある。一方、この形成密度が８００／ｃｍ^{2}よりも多いと、凹凸が目立ち過ぎ、中程度の粗さを持つ岩絵の具独特の凹凸感を有する質感が得られない場合がある。

【0051】

更に、第１及び第２の複製画では、下地凹凸層２は、凸部又は／及び凹部の平均形成密度が３７０～４１０個／ｃｍ^{2}の範囲内であることが好ましい。これにより複製画全体として十分満足できる岩絵の具調を得ることができる。

【0052】

一方、第３及び第４の複製画では、下地凹凸層２は、凸部と凹部の平均高度差が、８０～９５μｍの範囲内であることが必要である。この平均高度差が８０μｍ未満であると、細かい粗さを持つ岩絵の具独特の凹凸感を有する質感が得られない場合がある。一方、この平均高度差が９５μｍを超えると、凹凸が目立ち過ぎ、細かい粗さを持つ岩絵の具独特の凹凸感を有する質感が得られない場合がある。

【0053】
　また、第３及び第４の複製画では、下地凹凸層２は、凸部又は／及び凹部の形成密度が１９０～１１００個／ｃｍ^{2}の範囲内であることが必要である。この形成密度が１９０／ｃｍ^{2}より少ないと、細かい粗さを持つ岩絵の具独特の凹凸感を有する質感が得られない場合がある。一方、この形成密度が１１００／ｃｍ^{2}よりも多いと、凹凸が目立ち過ぎ、細かい粗さを持つ岩絵の具独特の凹凸感を有する質感が得られない場合がある。
【0054】
　更に、第３及び第４の複製画では、下地凹凸層２は、凸部又は／及び凹部の平均形成密度が４５０～４９０個／ｃｍ^{2}の範囲内であることが好ましい。これにより複製画全体として十分満足できる岩絵の具調を得ることができる。
【0055】
　また、第５及び第６の複製画では、下地凹凸層２は、凸部と凹部の平均高度差が、３０～５０μｍの範囲内であることが必要である。この平均高度差が３０μｍ未満であると、極めて細い粗さを持つ岩絵の具独特の凹凸感を有する質感が得られない場合がある。一方、この平均高度差が５０μｍを超えると、凹凸が目立ち過ぎ、極めて細い粗さを持つ岩絵の具独特の凹凸感を有する質感が得られない場合がある。
【0056】
　更に、第５及び第６の複製画では、下地凹凸層２は、凸部又は／及び凹部の形成密度が８０～８００個／ｃｍ^{2}の範囲内であることが必要である。この形成密度が８０／ｃｍ^{2}より少ないと、極めて細い粗さを持つ岩絵の具独特の凹凸感を有する質感が得られない場合がある。一方、この形成密度が８００／ｃｍ^{2}よりも多いと、凹凸が目立ち過ぎ、極めて細い粗さを持つ岩絵の具独特の凹凸感を有する質感が得られない場合がある。
【0057】
　また、第５及び第６の複製画では、下地凹凸層２は、凸部又は／及び凹部の平均形成密度が３７０～４１０個／ｃｍ^{2}の範囲内であることが好ましい。これにより複製画全体として十分満足できる岩絵の具調を得ることができる。
【0058】
　また、第７及び第８の複製画では、下地凹凸層２は、凸部と凹部の平均高度差が、２５～４５μｍの範囲内であることが必要である。この平均高度差が２５μｍ未満であると、より極めて細い粗さを持つ岩絵の具独特の凹凸感を有する質感が得られない場合がある。一方、この平均高度差が４５μｍを超えると、凹凸が目立ち過ぎ、より極めて細い粗さを持つ岩絵の具独特の凹凸感を有する質感が得られない場合がある。
【0059】
　更に、第７及び第８の複製画では、下地凹凸層２は、凸部又は／及び凹部の形成密度が２０～５００個／ｃｍ^{2}の範囲内であることが必要である。この形成密度が２０／ｃｍ^{2}より少ないと、より極めて細い粗さを持つ岩絵の具独特の凹凸感を有する質感が得られない場合がある。一方、この形成密度が５００／ｃｍ^{2}よりも多いと、凹凸が目立ち過ぎ、より極めて細い粗さを持つ岩絵の具独特の凹凸感を有する質感が得られない場合がある。
【0060】
　また、第７及び第８の複製画では、下地凹凸層２は、凸部又は／及び凹部の平均形成密度が１５０～１９０個／ｃｍ^{2}の範囲内であることが好ましい。これにより複製画全体として十分満足できる岩絵の具調を得ることができる。
【0061】
　下地凹凸層の凸部と凹部の高度差および形成密度は、例えばコンフォーカル顕微鏡（共焦点顕微鏡）やＳＥＭ（走査型電子顕微鏡）等を用いて観察・測定することができる。コンフォーカル顕微鏡の場合には表面形状を観察し、その結果から高度差測定を行うことができる。また、ＳＥＭの場合には、例えば垂直スライサーにて断面加工後、断面観察を行って高度差測定を行うことができる。
【0062】
　本発明で規定する下地凹凸層の凸部と凹部の形成密度は、コンフォーカル顕微鏡により

観察される高度差が５０μｍ以上のものだけをカウントした値である。なお、後述の実施例に記載の下地凹凸層の凸部と凹部の形成密度は、レーザーテック（株）製のオプテリクスＣ１３０を用いて２１３０μｍ×１７１０μｍの領域を表面観察した結果から算出した値である。

【0063】

［下地凹凸層の形成］

本発明の複製画を製造する際、好ましくは上記のような表面凹凸形状を有する下地凹凸層を、少なくともエチレン酢酸ビニルエマルジョンと寒水粉と炭酸カルシウム粉を含有する水系の下地凹凸層形成用スクリーンインキを用いて形成する。

【0064】

エチレン酢酸ビニルエマルジョンは接着剤としての機能を有し、基材又はカール防止層への下地凹凸層の密着性を高めるためのものである。このエチレン酢酸ビニルエマルジョンは、下地凹凸層形成用スクリーンインキに２０～２５重量％含有せしめるのが好ましく、２１～２３重量％が特に好ましい。２０重量％未満であると、十分な密着性が得られずに、下地凹凸層が剥離し易くなったり、下地凹凸層に掠れが生じ易くなる。一方、２５重量％を超えると、前述したような下地凹凸層の凸部と凹部の高度差および形成密度を実現するのが難しく、岩絵の具独特の凹凸感を有する質感を得ることが難しい。

【0065】

寒水粉（方解石の粉）と炭酸カルシウム粉（胡粉：牡蠣や帆立貝の粉）は、岩絵の具独特の凹凸感を得るためのものである。岩絵の具（天然岩絵の具、新岩絵の具、合成岩絵の具）には、方解石や胡粉などの粒状、粉状の原料鉱物が含有されており、本発明ではこのような実際に使われている岩絵の具材を下地凹凸層に含有せしめることにより、岩絵の具調の絵肌を美しく再現することができる。

【0066】

寒水粉は、下地凹凸層形成用スクリーンインキに４４～４６重量％含有せしめるのが好ましい。４４重量％未満であると、岩絵の具調が弱く、岩絵の具独特の凹凸感を有する質感を得ることが難しい。一方、４６重量％を超えると、凹凸が目立ち過ぎ満足できる岩絵の具調を得ることが難しくなると共に、インクの印刷適性が悪化する。

【0067】

前記寒水粉の粒径は、３００μｍ以下が好ましい。岩絵の具に実際に含有されている方解石の粒径は概ね２００μｍ以下であり、前記寒水粉の粒径が３００μｍを超えると、十分満足できる岩絵の具調を得るのが難しくなる。

【0068】

また、第１及び第２の複製画の場合、前記寒水粉は、その粒度分布において、粒径６０～７０μｍの範囲内に第一のピークを有し、粒径１９０～２００μｍの範囲内に第二のピークを有するものが好ましい。このような粒度分布を有していれば、本発明の凸部と凹部の平均高度差が７０～９０μｍの範囲内である下地凹凸層を再現性良く安定して形成することができる。

【0069】

更に、第３及び第４の複製画の場合、前記寒水粉は、その粒度分布において、粒径７０～９０μｍの範囲内にピークを有するものが好ましい。このような粒度分布を有していれば、本発明の凸部と凹部の平均高度差が８０～９５μｍの範囲内である下地凹凸層を再現性良く安定して形成することができる。

【0070】

また、第５及び第６の複製画の場合、前記寒水粉は、その粒度分布において、粒径４０～５０μｍの範囲内にピークを有するものが好ましい。このような粒度分布を有していれば、本発明の凸部と凹部の平均高度差が３０～５０μｍの範囲内である下地凹凸層を再現性良く安定して形成することができる。

【0071】

更に、第７及び第８の複製画の場合、前記寒水粉は、その粒度分布において、粒径２０

～３０μｍの範囲内にピークを有するものが好ましい。このような粒度分布を有していれば、本発明の凸部と凹部の平均高度差が２５～４５μｍの範囲内である下地凹凸層を再現性良く安定して形成することができる。

【0072】

前記炭酸カルシウム粉の平均粒径は、３～５μｍが好ましい。岩絵の具に実際に含有されている胡粉（日本画の白色画材）の粒径は概ね５μｍ前後であり、前記炭酸カルシウム粉の平均粒径が５μｍを超えると、十分満足できる岩絵の具調を得るのが難しくなる。また、前記炭酸カルシウム粉は、白色度が高い高純度のものが好ましい。

【0073】

岩絵の具画材の胡粉は、盛り上げたり、白色の下地を作る目的で使用されており、本発明の実施例で用いている炭酸カルシウム粉（商品名シェルライム／北海道共同石灰（株）製）は、帆立貝殻を原料とし、平均粒径が３～５μｍ、白色度が９８％の高純度であることから、胡粉の質感を表現するのに最適である。

【0074】

なお、下地凹凸層２は全面に形成される場合だけではなく、オリジナル画像の表面凹凸に応じて部分的に形成される場合があり、また、オリジナル画像に対応した凹凸形状を得るために部分的に重ね刷りをして盛り上げる場合もある。

【0075】

［受容層］

本発明では凹凸形状を有する面にオリジナル画像に対応した絵柄層を形成するため、この絵柄層形成には非接触型のインクジェット方式が好適である。このため、前記下地凹凸層２上に、インクジェットプリンターによる印刷適性を有する受容層３を設ける。

【0076】

従来よりインクジェットプリンターによる印刷適性を持つ受容層には、インク発色性、インク吸収性に優れ、高精細な画質・高い印字濃度を発現するために、シリカや炭酸カルシウム等の顔料を利用することは広く知られている。

【0077】

しかしながら、本発明では前述したような凹凸形状を有する下地凹凸層２上に受容層３を設けるため、従来の受容層の組成では十分な密着性が得られず、表面剥離し易くなるという問題がある。

【0078】

このため本発明の複製画を製造する際、好ましくは従来の受容層の組成に加え、更に硬化剤を含有する水系の受容層形成用スクリーンインキを用いて受容層３を形成する。

【0079】

前記硬化剤としては水酸基と架橋反応する例えばイソシアネート等が適宜用いられる。この硬化剤は、受容層形成用スクリーンインキに６．５～１１．５重量％の割合で含有せしめるのが好ましい。６．５重量％未満であると、硬化剤による十分な効果が得られず、密着性が不十分となり易い。一方、１１．５重量％を超えると、十分な密着性が得られるものの、絵柄層を形成した際に色の鮮やかさが劣る結果となり易い。

【0080】

また、受容層形成用スクリーンインキには、岩絵の具画材の胡粉の質感を十分に表現するために、平均粒径が３～５μｍであり、白色度が高く、白色度９８％以上の高純度の炭酸カルシウム粉を含有せしめるのが好ましい。

【0081】

受容層３の厚さは１２～２５μｍ程度であり、その表面は前述のような岩絵の具調の凹凸を有する下地凹凸層２の凹凸形状を反映したものとなる。

【0082】

なお、受容層３は全面に形成される場合だけではなく、絵柄層に応じて部分的に形成される場合もある。

【0083】

［絵柄層］
絵柄層４は、受容層３上にインクジェットプリンターによって形成される。岩絵の具調の凹凸を有する下地凹凸層２の凹凸形状を反映した受容層３の表面に形成される絵柄層４は、それ自体が岩絵の具調の凹凸を表現でき、より本物に近い岩絵の具独特の凹凸感を有し、質感の高い複製画が得られる。
【実施例】
【0084】
以下に本発明の実施例を説明する。なお、以下に記載の部はすべて重量部である。
【0085】
＜実施例１＞
本発明の第１の複製画の実施例として、画材紙上に以下のようにして下地凹凸層および受容層を形成し、この受容層上にインクジェットプリンターによって絵柄層を形成した例を説明する。
【0086】
［下地凹凸層の形成］
下地凹凸層形成用インキを下記のＡ液とＢ液を用いて調製し（Ａ液／Ｂ液＝１００部／３０部）、スクリーン版として８０メッシュ（膜厚：８μｍ）、ベタ版（１００％網版）を用い、画材紙（かきた：３００ｇ／ｍ²）上にスクリーン印刷方式で塗工した。
Ａ液：カルボキシメエチルセルロース（＃１１９０／ダイセル化学工業（株）製）　１．６部
　　水　１００部
　　寒水粉（粒径３００μｍ以下）　２２０部
　　炭酸カルシウム（粒径３～５μｍ）
　　（シェルライムＨＰＣ／北海道共同石灰（株）製）　５０部
Ｂ液：エチレン酢酸ビニルエマルジョン（ＥＨ－００４、新田ゼラチン（株）製）　１００部
　　水　１０部
【0087】
尚、本実験例で用いた寒水粉は、その粒度分布において、粒径６０～７０μｍ付近に第一のピークを有し、粒径１９０～２００μｍ付近に第二のピークを有している。
【0088】
また、得られた下地凹凸層の、凸部と凹部の平均高度差は７０～９０μｍ、凸部又は／及び凹部の形成密度は８０～８００個／ｃｍ²、凸部又は／及び凹部の平均形成密度は３７０～４１０個／ｃｍ²であった。
【0089】
［受容層の形成］
受容層形成用インキを下記のＡ液とＢ液と硬化剤（イソシアネート「アクアネート＃１２０」日本ポリウレタン工業（株）製）を用いて調製し（Ａ液／Ｂ液／硬化剤＝７０部／１００部／１０部）、スクリーン版として１５０メッシュ（膜厚：８μｍ）、ベタ版（１００％網版）を用い、下地凹凸層上にスクリーン印刷方式で塗工した。スクリーン版として１５０メッシュを用いているのは、下地凹凸層形成時よりも目の細かな版を用いることにより、下地凹凸層の凹凸に追従させるためである。なお、本発明においては、１５０～２００メッシュが好適に用いられる。
Ａ液：６％ＰＶＡ水溶液（＃２２４／クラレ（株）製）　１００部
　　シリカ（平均粒径：５．５μｍ）
　　（Ｇ－０１６６／東ソー・シリカ（株）製）　１５部
Ｂ液：６％ＰＶＡ水溶液（＃２２４／クラレ（株）製）　１００部
　　炭酸カルシウム（粒径３～５μｍ、白色度９８％）
　　（シェルライムIIＰＣ／北海道共同石灰（株）製）　５０部
【0090】

次に、受容層上にインクジェットプリンターによって絵柄層を形成し、目視によって質感再現性を評価したところ、絵柄層自体が岩絵の具調の凹凸を十分に表現できており、岩絵の具独特の凹凸感を有する質感の高い複製画が得られた。

【0091】

＜実施例２＞

本発明の第２の複製画の実施例として、画材紙上に以下のようにしてカール防止層、下地凹凸層および受容層を形成し、この受容層上にインクジェットプリンターによって絵柄層を形成した例を説明する。

【0092】

［カール防止層の形成］

カール防止層形成用インキを用いて、スクリーン版として２００メッシュ（膜厚：８μｍ）、ベタ版（１００％網版）を用い、画材紙（ファブリアーノ紙：２２０ｇ／ｍ^2）上にスクリーン印刷方式で二度刷りした。なお、油性インキとしては、ホワイトインキ（ＪＲＰ白／（株）セイコーアドバンス製）を用いた。

【0093】

［下地凹凸層の形成］

実施例１と同様である。

【0094】

得られた下地凹凸層の、凸部と凹部の平均高度差は７０～９０μｍ、凸部又は／及び凹部の形成密度は８０～８００個／ｃｍ^2、凸部又は／及び凹部の平均形成密度は３７０～４１０個／ｃｍ^{2}であった。

【0095】

［受容層の形成］

下地凹凸層上にスクリーン印刷方式で二度刷りした以外は実施例１と同様である。

【0096】

次に、受容層上にインクジェットプリンターによって絵柄層を形成したところ、実施例１と同様に、岩絵の具独特の凹凸感を有する質感の高い複製画が得られ、更に、基材が各層の水分を吸収しなくなり、用紙のカールを防ぎ、インクジェットプリンターの出力がより安定した。

【0097】

＜実施例３＞

本発明の第３の複製画の実施例として、画材紙上に以下のようにして下地凹凸層および受容層を形成し、この受容層上にインクジェットプリンターによって絵柄層を形成した例を説明する。

【0098】

［下地凹凸層の形成］

下地凹凸層形成用インキを下記のＡ液とＢ液を用いて調製し（Ａ液／Ｂ液＝１００部／３０部）、スクリーン版として８０メッシュ（膜厚：８μｍ）、ベタ版（１００％網版）を用い、画材紙（かきた：３００ｇ／ｍ^2）上にスクリーン印刷方式で塗工した。

Ａ液：カルボキシメチルセルロース（＃１１９０／ダイセル化学工業（株）製）　１．６部

水　１００部

寒水粉（粒径３００μｍ以下）　２２０部

炭酸カルシウム（粒径３～５μｍ）

（シェルライムＨＰＣ／北海道共同石灰（株）製）　５０部

Ｂ液：エチレン酢酸ビニルエマルジョン（ＥＨ－００４、新田ゼラチン（株）製）　１００部

水　１０部

【0099】

尚、本実験例で用いた寒水粉は、その粒度分布において、粒径７０～９０μｍ付近にピ

ークを有している。

【0100】

また、得られた下地凹凸層の、凸部と凹部の平均高度差は８０～９５μｍ、凸部又は／及び凹部の形成密度は１９０～１１００個／ｃｍ^2、凸部又は／及び凹部の平均形成密度は４５０～４９０個／ｃｍ^{2}であった。

【0101】

［受容層の形成］

受容層形成用インキを下記のＡ液とＢ液と硬化剤（イソシアネート「アクアネート＃１２０」日本ポリウレタン工業（株）製）を用いて調製し（Ａ液／Ｂ液／硬化剤＝７０部／１００部／１０部）、スクリーン版として１５０メッシュ（膜厚：８μｍ）、ベタ版（１００％網版）を用い、下地凹凸層上にスクリーン印刷方式で塗工した。スクリーン版として１５０メッシュを用いているのは、下地凹凸層形成時よりも目の細かな版を用いることにより、下地凹凸層の凹凸に追従させるためである。なお、本発明においては、１５０～２００メッシュが好適に用いられる。

Ａ液：６％ＰＶＡ水溶液（＃２２４／クラレ（株）製）	１００部
シリカ（平均粒径：５．５μｍ）	
（Ｇ－０１６６／東ソー・シリカ（株）製）	１５部
Ｂ液：６％ＰＶＡ水溶液（＃２２４／クラレ（株）製）	１００部
炭酸カルシウム（粒径３～５μｍ、白色度９８％）	
（シェルライムＨＰＣ／北海道共同石灰（株）製）	５０部

【0102】

次に、受容層上にインクジェットプリンターによって絵柄層を形成し、目視によって質感再現性を評価したところ、絵柄層自体が岩絵の具調の凹凸を十分に表現できており、岩絵の具独特の凹凸感を有する質感の高い複製画が得られた。

【0103】

＜実施例４＞

本発明の第４の複製画の実施例として、画材紙上に以下のようにしてカール防止層、下地凹凸層および受容層を形成し、この受容層上にインクジェットプリンターによって絵柄層を形成した例を説明する。

【0104】

［カール防止層の形成］

カール防止層形成用インキを用いて、スクリーン版として２００メッシュ（膜厚：８μｍ）、ベタ版（１００％網版）を用い、画材紙（ファブリアーノ紙：２２０ｇ／ｍ^2）上にスクリーン印刷方式で二度刷りした。なお、油性インキとしては、ホワイトインキ（ＪＲＰ白／（株）セイコーアドバンス製）を用いた。

【0105】

［下地凹凸層の形成］

実施例３と同様である。

【0106】

得られた下地凹凸層の、凸部と凹部の平均高度差は８０～９５μｍ、凸部又は／及び凹部の形成密度は１９０～１１００個／ｃｍ^2、凸部又は／及び凹部の平均形成密度は４５０～４９０個／ｃｍ^{2}であった。

【0107】

［受容層の形成］

下地凹凸層上にスクリーン印刷方式で二度刷りした以外は実施例３と同様である。

【0108】

次に、受容層上にインクジェットプリンターによって絵柄層を形成したところ、実施例３と同様に、岩絵の具独特の凹凸感を有する質感の高い複製画が得られ、更に、紙基材が各層の水分を吸収しなくなり、用紙のカールを防ぎ、インクジェットプリンターの出力がより安定した。

【0109】
＜実施例５＞
本発明の第５の複製画の実施例として、画材紙上に以下のようにして下地凹凸層および受容層を形成し、この受容層上にインクジェットプリンターによって絵柄層を形成した例を説明する。
【0110】
［下地凹凸層の形成］
下地凹凸層形成用インキを下記のＡ液とＢ液を用いて調製し（Ａ液／Ｂ液＝１００部／３０部）、スクリーン版として８０メッシュ（膜厚：８μｍ）、ベタ版（１００％網版）を用い、画材紙（かきた：３００ｇ／ｍ²）上にスクリーン印刷方式で塗工した。
Ａ液：カルボキシメエチルセルロース（＃１１９０／ダイセル化学工業（株）製）
１．６部
水　１００部
寒水粉（粒径３００μｍ以下）　２２０部
炭酸カルシウム（粒径３～５μｍ）
（シェルライムＨＰＣ／北海道共同石灰（株）製）　５０部
Ｂ液：エチレン酢酸ビニルエマルジョン（ＥＨ－００４、新田ゼラチン（株）製）
１００部
水　１０部
【0111】
尚、本実験例で用いた寒水粉は、その粒度分布において、粒径４０～５０μｍ付近にピークを有している。
【0112】
また、得られた下地凹凸層の、凸部と凹部の平均高度差は３０～５０μｍ、凸部又は／及び凹部の形成密度は８０～８００個／ｃｍ²、凸部又は／及び凹部の平均形成密度は３７０～４１０個／ｃｍ²であった。
【0113】
［受容層の形成］
受容層形成用インキを下記のＡ液とＢ液と硬化剤（イソシアネート「アクアネート＃１２０」日本ポリウレタン工業（株）製）を用いて調製し（Ａ液／Ｂ液／硬化剤＝７０部／１００部／１０部）、スクリーン版として１５０メッシュ（膜厚：８μｍ）、ベタ版（１００％網版）を用い、下地凹凸層上にスクリーン印刷方式で塗工した。スクリーン版として１５０メッシュを用いているのは、下地凹凸層形成時よりも目の細かな版を用いることにより、下地凹凸層の凹凸に追従させるためである。なお、本発明においては、１５０～２００メッシュが好適に用いられる。
Ａ液：６％ＰＶＡ水溶液（＃２２４／クラレ（株）製）　１００部
シリカ（平均粒径：５．５μｍ）
（Ｇ－０１６６／東ソー・シリカ（株）製）　１５部
Ｂ液：６％ＰＶＡ水溶液（＃２２４／クラレ（株）製）　１００部
炭酸カルシウム（粒径３～５μｍ、白色度９８％）
（シェルライムＨＰＣ／北海道共同石灰（株）製）　５０部
【0114】
次に、受容層上にインクジェットプリンターによって絵柄層を形成し、目視によって質感再現性を評価したところ、絵柄層自体が岩絵の具調の凹凸を十分に表現できており、岩絵の具独特の凹凸感を有する質感の高い複製画が得られた。
【0115】
＜実施例６＞
本発明の第６の複製画の実施例として、画材紙上に以下のようにしてカール防止層、下地凹凸層および受容層を形成し、この受容層上にインクジェットプリンターによって絵柄層を形成した例を説明する。

【0116】
［カール防止層の形成］
カール防止層形成用インキを用いて、スクリーン版として２００メッシュ（膜厚：８μｍ）、ベタ版（１００％網版）を用い、画材紙（ファブリアーノ紙：２２０ｇ／ｍ²）上にスクリーン印刷方式で二度刷りした。なお、油性インキとしては、ホワイトインキ（ＪＲＰ白／（株）セイコーアドバンス製）を用いた。
【0117】
［下地凹凸層の形成］
実施例５と同様である。
【0118】
得られた下地凹凸層の、凸部と凹部の平均高度差は３０～５０μｍ、凸部又は／及び凹部の形成密度は８０～８００個／ｃｍ²、凸部又は／及び凹部の平均形成密度は３７０～４１０個／ｃｍ²であった。
【0119】
［受容層の形成］
下地凹凸層上にスクリーン印刷方式で二度刷りした以外は実施例５と同様である。
【0120】
次に、受容層上にインクジェットプリンターによって絵柄層を形成したところ、実施例５と同様に、岩絵の具独特の凹凸感を有する質感の高い複製画が得られ、更に、基材が各層の水分を吸収しなくなり、用紙のカールを防ぎ、インクジェットプリンターの出力がより安定した。
【0121】
＜実施例７＞
本発明の第７の複製画の実施例として、画材紙上に以下のようにして下地凹凸層および受容層を形成し、この受容層上にインクジェットプリンターによって絵柄層を形成した例を説明する。
【0122】
［下地凹凸層の形成］
下地凹凸層形成用インキを下記のＡ液とＢ液を用いて調製し（Ａ液／Ｂ液＝１００部／３０部）、スクリーン版として１００メッシュ（膜厚：８μｍ）、ベタ版（１００％網版）を用い、画材紙（かきた：３００ｇ／ｍ²）上にスクリーン印刷方式で塗工した。
Ａ液：カルボキシメエチルセルロース（＃１１９０／ダイセル化学工業（株）製）　１．６部
　水　１００部
　寒水粉（粒径３００μｍ以下）　２２０部
　炭酸カルシウム（粒径３～５μｍ）
　（シェルライムＨＰＣ／北海道共同石灰（株）製）　５０部
Ｂ液：エチレン酢酸ビニルエマルジョン（ＥＨ－００４、新田ゼラチン（株）製）　１００部
　水　１０部
【0123】
尚、本実験例で用いた寒水粉は、その粒度分布において、粒径２０～３０μｍ付近にピークを有している。
【0124】
また、得られた下地凹凸層の、凸部と凹部の平均高度差は２５～４５μｍ、凸部又は／及び凹部の形成密度は２０～５００個／ｃｍ²、凸部又は／及び凹部の平均形成密度は１５０～１９０個／ｃｍ²であった。
【0125】
［受容層の形成］
受容層形成用インキを下記のＡ液とＢ液と硬化剤（イソシアネート「アクアネート＃１

２０」日本ポリウレタン工業（株）製）を用いて調製し（Ａ液／Ｂ液／硬化剤＝７０部／１００部／１０部）、スクリーン版として１５０メッシュ（膜厚：８μｍ）、ベタ版（１００％網版）を用い、下地凹凸層上にスクリーン印刷方式で塗工した。スクリーン版として１５０メッシュを用いているのは、下地凹凸層形成時よりも目の細かな版を用いることにより、下地凹凸層の凹凸に追従させるためである。なお、本発明においては、１５０～２００メッシュが好適に用いられる。

Ａ液：６％ＰＶＡ水溶液（＃２２４／クラレ（株）製）　１００部
　　シリカ（平均粒径：５．５μｍ）
　　（Ｇ－０１６６／東ソー・シリカ（株）製）　１５部
Ｂ液：６％ＰＶＡ水溶液（＃２２４／クラレ（株）製）　１００部
　　炭酸カルシウム（粒径３～５μｍ、白色度９８％）
　　（シェルライムＨＰＣ／北海道共同石灰（株）製）　５０部

【0126】

次に、受容層上にインクジェットプリンターによって絵柄層を形成し、目視によって質感再現性を評価したところ、絵柄層自体が岩絵の具調の凹凸を十分に表現できており、岩絵の具独特の凹凸感を有する質感の高い複製画が得られた。

【0127】

＜実施例８＞

本発明の第８の複製画の実施例として、画材紙上に以下のようにしてカール防止層、下地凹凸層および受容層を形成し、この受容層上にインクジェットプリンターによって絵柄層を形成した例を説明する。

【0128】

［カール防止層の形成］

カール防止層形成用インキを用いて、スクリーン版として２００メッシュ（膜厚：８μｍ）、ベタ版（１００％網版）を用い、画材紙（ファブリアーノ紙：２２０ｇ／ｍ^2）上にスクリーン印刷方式で二度刷りした。なお、油性インキとしては、ホワイトインキ（ＪＲＰ白／（株）セイコーアドバンス製）を用いた。

【0129】

［下地凹凸層の形成］

実施例７と同様である。

【0130】

得られた下地凹凸層の、凸部と凹部の平均高度差は２５～４５μｍ、凸部又は／及び凹部の形成密度は２０～５００個／ｃｍ^2、凸部又は／及び凹部の平均形成密度は１５０～１９０個／ｃｍ^{2}であった。

【0131】

［受容層の形成］

下地凹凸層上にスクリーン印刷方式で二度刷りした以外は実施例７と同様である。

【0132】

次に、受容層上にインクジェットプリンターによって絵柄層を形成したところ、実施例７と同様に、岩絵の具独特の凹凸感を有する質感の高い複製画が得られ、更に、基材が各層の水分を吸収しなくなり、用紙のカールを防ぎ、インクジェットプリンターの出力がより安定した。

【0133】

＜実施例９＞

受容層がカール防止層に接する実施例として、以下のようにして和紙上に透明のカール防止層を形成し、カール防止層上に透明の受容層を形成し、この透明の受容層上にインクジェットプリンターによって絵柄層を形成した例を説明する。

【0134】

［カール防止層の形成］

カール防止層形成用インキに、５５～８５％ジグリセリン（ジグリセリン８０１（阪本

薬品工業製））水溶液１００重量部に、炭酸カルシウム（北海道共同石灰ＩＰＣ）を表１～３に示す割合で配合した水性インキを用いて、スクリーン版として３５０メッシュ（膜厚：８μｍ）、ベタ版（１００％網版）を用い、和紙（特漉き二号紙：１１０ｇ／ｍ²）上にシルクスクリーン印刷方式で印刷した。

【0135】

［受容層の形成］

受容層形成用インキを下記のＡ液とＢ液と硬化剤（イソシアネート「アクアネート＃１２０」日本ポリウレタン工業（株）製）を用いて調製し（Ａ液／Ｂ液／硬化剤＝５０部／５０部／１０部）、スクリーン版として１５０メッシュ（膜厚：８μｍ）、ベタ版（１００％網版）を用い、カール防止層上にシルクスクリーン印刷方式で塗工した。

Ａ液：６％ＰＶＡ水溶液（＃２２４／クラレ（株）製）	１００部
含水シリカ（平均粒径：５．５μｍ）	
（Ｇ－０１６６／東ソー・シリカ（株）製）	１５部
Ｂ液：６％ＰＶＡ水溶液（＃２２４／クラレ（株）製）	１００部
無水シリカ（平均粒径：５．５μｍ）	
（アエロジル３８０Ｓ／日本アエロジル（株）製）	８部

【0136】

次に、受容層上にインクジェットプリンターによって絵柄層を形成し、以下の方法で評価した。その評価を表１～３に示す。尚、カール防止効果の評価が△または×である場合には、その他の評価は行わなかった。

【0137】

（１）カール防止効果

プリンターの印字ヘッドが印刷用紙のエッジに接触するかどうかについて、以下の基準で評価した。

○：印刷用紙に接触せず印字。

△：印刷用紙のエッジにやや接触するが、印刷品質に影響を及ぼさない。

×：印刷用紙のエッジに接触し、印刷品質に影響を及ぼす。

【0138】

（２）密着性

受容層の密着について、以下の基準で評価した。

○：指で擦っても、受容層形成インキが指に付着しない。

△：指で擦ると、受容層形成インキが指にやや付着する。

×：指で擦ると、受容層形成インキが指に付着し、一部は印刷用紙から剥落する。

【0139】

（３）印刷適性

カール防止層の印刷し易さ（インキ粘度）、乾燥し易さ（インキ乾燥性）について、以下の基準で評価した。

○：印刷し易さ（インキ粘度）、乾燥し易さ（インキ乾燥性）とも問題なし。

△：印刷し易さ（インキ粘度）、あるいは乾燥し易さ（インキ乾燥性）がやや悪い。

×：印刷し易さ（インキ粘度）、あるいは乾燥し易さ（インキ乾燥性）が悪い。

【0140】

（４）印刷品質

インクジェットプリンターで出力した絵柄について、目視で発色性やインキの滲みを、以下の基準で評価した。

○：発色性は良好、インキの滲みは無し。

△：発色性がやや劣る、あるいはインキの滲みがややある。

×：発色性が劣る、あるいはインキの滲みがある。

【0141】

【表1】

ｼﾞｸﾞﾘｾﾘﾝ55重量%水溶液/炭酸ｶﾙｼｳﾑ(重量部)	100/0	100/2	100/5	100/10	100/20	100/30	100/39	100/40	100/60
ｶｰﾙ防止効果	△	△	△	△	△	△	△	△	△

【0142】
【表2】

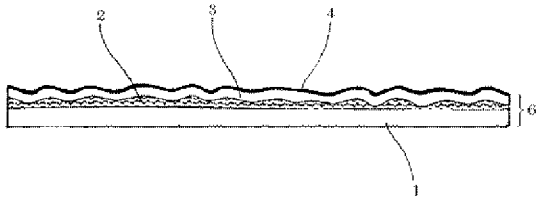
ｼﾞｸﾞﾘｾﾘﾝ70重量%水溶液/炭酸ｶﾙｼｳﾑ(重量部)	100/0	100/2	100/5	100/10	100/20	100/30	100/39	100/40	100/60
ｶｰﾙ防止効果	○	○	○	○	○	○	○	○	○
密着性	○	○	○	○	○	○	○	△	△
印刷適性	△	△	○	○	○	○	○	○	○
印刷品質	△	△	○	○	○	○	○	△	△

【0143】
【表3】

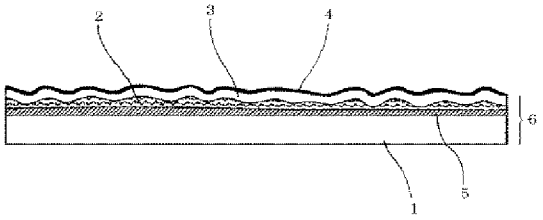
ｼﾞｸﾞﾘｾﾘﾝ85重量%水溶液/炭酸ｶﾙｼｳﾑ(重量部)	100/0	100/2	100/5	100/10	100/20	100/30	100/39	100/40	100/60
ｶｰﾙ防止効果	○	○	○	○	○	○	○	○	○
密着性	○	○	○	○	○	○	○	△	△
印刷適性	△	△	△	△	△	△	△	△	△
印刷品質	△	△	△	△	△	△	△	△	△

【図面の簡単な説明】
【0144】
【図1】本発明の第１、第３、第５及び第７の複製画の一部を模式的に示した断面図である。
【図2】本発明の第２、第４、第６及び第８の複製画の一部を模式的に示した断面図である。
【符号の説明】
【0145】
１　基材
２　下地凹凸層
３　受容層
４　絵柄層
５　カール防止層
６　印刷用紙

【図1】



【図2】



Ｆターム(参考) 2H186 BA12　BA13　BB02Y BB02Z BB13Y BB13Z BB14X BB23X BB33Y BB33Z
BB36Y BB36Z BB44Y BB44Z BB52X BC05Z BC27X BC38X BC38Y BC38Z
BC76X CA07　DA12

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METHOD OF SELECTION OF REFERENCE IMAGE

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Applicant(s): LG ELECTRONICS INC [KR] ± (EHL DZHI EHLEKTRONIKS INK)

Classification: - international: *G06T7/20; H04N19/50; H04N19/503; H04N19/577; H04N19/85; H04N7/24*
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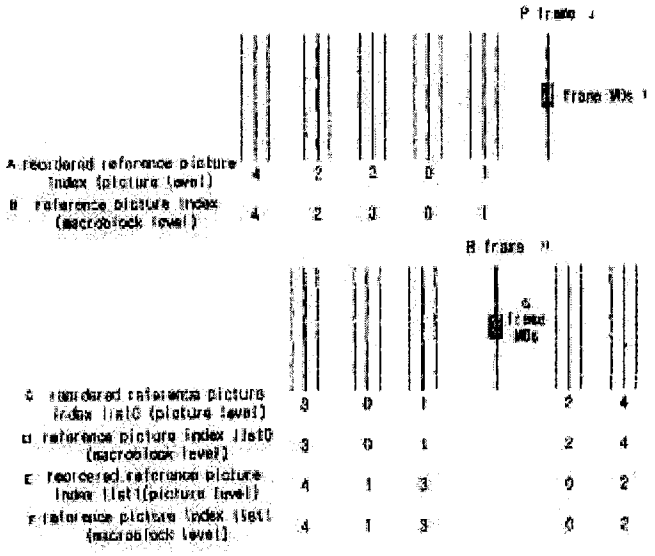
Application number: RU20050121238 20050707

Priority number(s): KR20030013198 20030303

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Abstract of RU2328090 (C2)

FIELD: technological processes. ^ SUBSTANCE: invention is related to the field of coding and decoding of moving image. The method of reference image selection for field macroblock processing consists of the following: definition of at least one list of reference images by using order of imaging, at that at least one list of reference images has information about indices of reference images; selection of at least one reference image for processing of field macroblock, from at least one list of reference images, by using information about indices of reference images, moreover, at least one



selected reference image is a field, and evenness of at least one selected reference field is based on evenness of current image field macroblock and information about index of reference image;; at that, if information about index of reference image represents even number of index, then at least one selected reference field has the same evenness of the field, that the field macroblock, and if information about index of reference image represents uneven number of index, then at least one selected reference field has evenness of field that is different from evenness of field macroblock. ^ EFFECT: improves efficiency of moving image coding with application of multiple reference images. ^ 5 cl, 12 dwg

РОССИЙСКАЯ ФЕДЕРАЦИЯ

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ФЕДЕРАЛЬНАЯ СЛУЖБА
ПО ИНТЕЛЛЕКТУАЛЬНОЙ СОБСТВЕННОСТИ,
ПАТЕНТАМ И ТОВАРНЫМ ЗНАКАМ

(12) ОПИСАНИЕ ИЗОБРЕТЕНИЯ К ПАТЕНТУ

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Адрес для переписки:
115184, Москва, Средний Овчинниковский пер., 12, ЗАО "Инэврика", пат.пов. В.К.Козырьковой, рег. № 607

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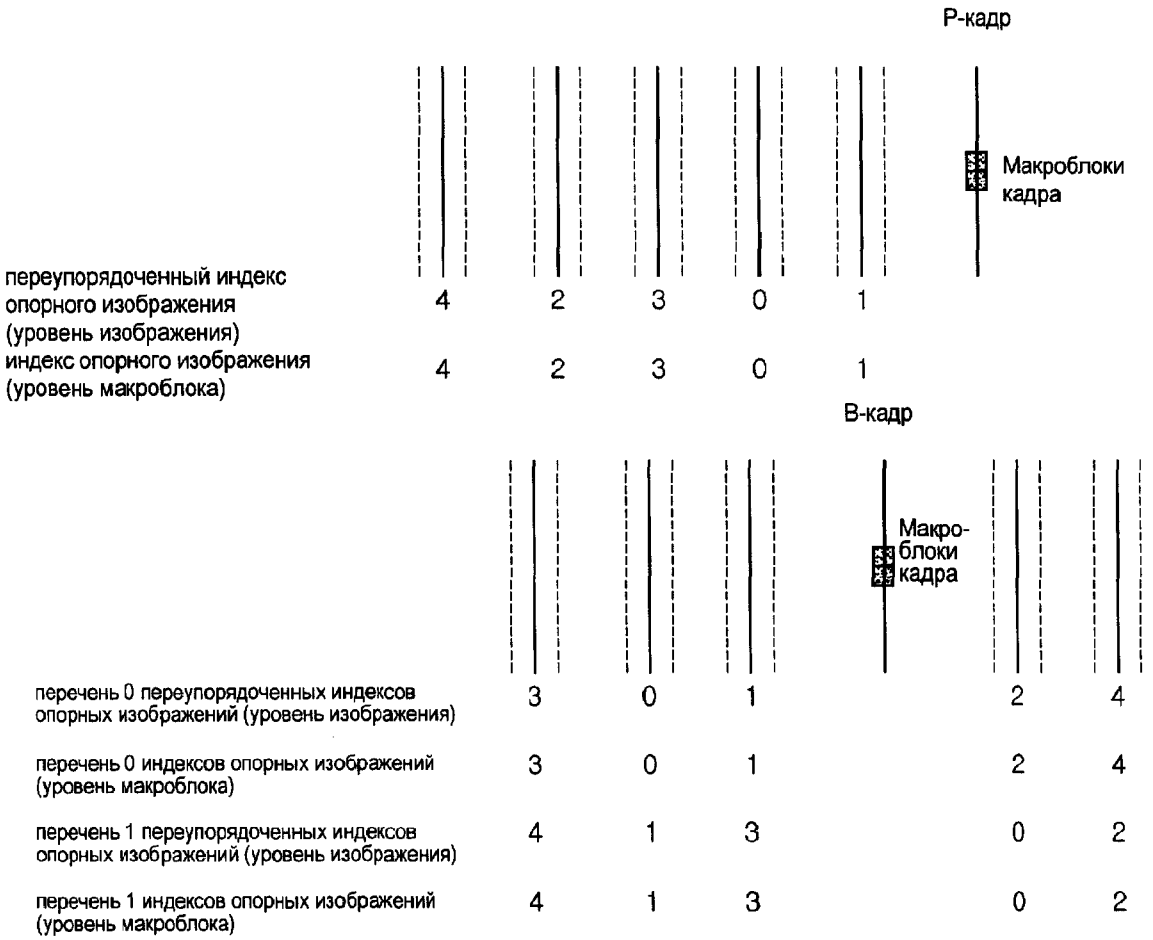
(54) СПОСОБ ВЫБОРА ОПОРНОГО ИЗОБРАЖЕНИЯ

(57) Реферат:

Изобретение относится к области кодирования и декодирования движущегося изображения. Техническим результатом является повышение эффективности кодирования движущегося изображения с использованием множества опорных изображений, достигаемым за счет того, что способ выбора опорного изображения для обработки макроблока поля содержит: определение, по меньшей мере, одного перечня опорных изображений путем использования порядка отображения, при этом, по меньшей мере, один перечень опорных изображений имеет информацию об индексах опорных изображений; выбор, по меньшей мере, одного опорного изображения для обработки макроблока поля, по меньшей мере, из одного перечня опорных изображений, путем использования информации об индексах опорных изображений, причем, по меньшей мере, одно выбранное опорное изображение является полем, а четность, по меньшей мере, одного выбранного опорного поля основана на четности макроблока поля текущего изображения и информации об индексе опорного изображения; при этом, если информация об индексе опорного изображения представляет собой четный номер индекса, то, по меньшей мере, одно выбранное опорное поле имеет ту же четность поля, что и макроблок поля, а если информация об индексе опорного изображения представляет собой нечетный номер индекса, то, по меньшей мере, одно выбранное опорное поле имеет четность поля, отличную от четности макроблока поля. 4 з.п. ф-лы, 12 ил.

RU 2328090 C2

RU 2328090 C2



Фиг. 7

RU 2328090 C2

RU 2328090 C2

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(54) METHOD OF SELECTION OF REFERENCE IMAGE

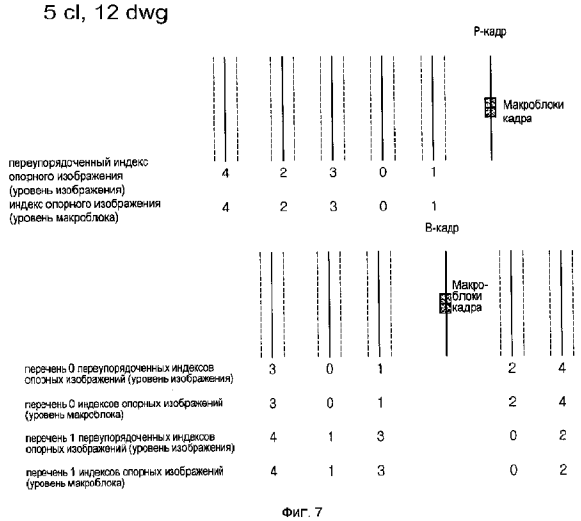
(57) Abstract:

FIELD: technological processes.

SUBSTANCE: invention is related to the field of coding and decoding of moving image. The method of reference image selection for field macroblock processing consists of the following: definition of at least one list of reference images by using order of imaging, at that at least one list of reference images has information about indices of reference images; selection of at least one reference image for processing of field macroblock, from at least one list of reference images, by using information about indices of reference images, moreover, at least one selected reference image is a field, and evenness of at least one selected reference field is based on evenness of current image field macroblock and information about index of reference image; at that, if information about index of reference image represents even number of index, then at least one selected reference field has the same evenness of the field, that the field macroblock, and if information about index of reference image represents uneven number of index, then at least one selected reference field has evenness of field that is different from evenness of field macroblock.

EFFECT: improves efficiency of moving image coding with application of multiple reference images.

5 cl, 12 dwg



Фиг. 7

RU 2328090 C2

RU 2328090 C2

Область техники, к которой относится изобретение

Настоящее изобретение относится к области кодирования и декодирования движущегося изображения.

Предшествующий уровень техники

Системы кодирования движущегося изображения компенсируют движение, используя информацию о векторе движения. В случае системы кодирования движущегося изображения, в которой используется множество опорных изображений, для компенсации движения необходима информация об индексе опорного изображения, а также информация о векторе движения. Индекс опорного изображения представляет собой значение, используемое для различения множества опорных изображений между собой. Кодер передает индекс опорного изображения на декодер. Декодер выбирает опорное изображение, указанное индексом опорного изображения, и осуществляет компенсацию движения с использованием выбранного опорного изображения.

Обычно методы развертки видеоизображения делятся на метод прогрессивной развертки и метод чересстрочной развертки. В случае прогрессивной развертки видеоизображение одного кадра состоит из данных, которые выбираются в одно и то же время. В случае чересстрочной развертки видеоизображение одного кадра состоит из данных, которые выбираются в разные моменты времени, и выборки построчно чередуются.

Чересстрочное видеоизображение кадра обычно делится на два поля, называемых верхним полем и нижним полем. При чересстрочной развертке один кадр делится на два видеоизображения полей. При такой детализации видеоизображение обрабатывают исходя из единицы изображения. Кадр или поле можно отнести к изображению.

Предлагается три способа кодирования движущегося изображения с чересстрочной разверткой. Первый способ кодирования представляет собой способ кодирования изображения типа "поле", при котором осуществляют процесс кодирования, рассматривая каждое поле как независимое изображение на уровне изображения или сегмента. Второй способ кодирования представляет собой способ кодирования изображения типа "кадр", при котором осуществляют процесс кодирования после объединения двух полей в один кадр на уровне изображения или сегмента. Третий способ кодирования представляет собой способ кодирования изображения типа "кадр" с макроблоком кадра/поля, при котором осуществляют процесс кодирования путем объединения двух полей в один кадр и выбора режима кадра или режима поля на уровне макроблока.

В третьем способе кодирования два смежных по вертикали макроблока связывают в пару и кодирование осуществляют в единице из пары макроблоков. На фиг.1 номера, присвоенные макроблокам в парах, указывают адреса макроблоков, используемые для различения макроблоков между собой.

Здесь макроблок кадра представляет собой макроблок, кодируемый как верхний и нижний макроблоки из пары макроблоков в единицах кадра. Другими словами, каждый макроблок кодируют в единицах кадра после объединения двух полей в один кадр.

Между тем, макроблок поля представляет собой макроблок, который кодируют как верхний и нижний макроблоки пар макроблоков в единицах поля. Пару макроблоков делят на компоненты верхнего и нижнего полей и каждое поле кодируют независимо. В то же время пары макроблоков переупорядочивают таким образом, что верхний и нижний макроблоки могут содержать, соответственно, только компонент верхнего поля или только компонент нижнего поля. Верхний макроблок называется макроблоком верхнего поля, а нижний макроблок называется макроблоком нижнего поля.

Опорный буфер для хранения множества опорных изображений конфигурируют в единицах кадра. При кодировании изображения типа "кадр" все опорные изображения рассматриваются как единицы кадра, в котором два поля объединены в один кадр, а одно изображение из опорных изображений типа "кадр" используют для компенсации движения. Соответственно, значения присваиваются индексам опорных изображений в единицах кадра.

Индекс опорного изображения для P-кадра получают посредством сортировки всех опорных кадров в порядке, обратном порядку кодирования, и затем последовательного назначения индекса с шагом возрастания, равным единице, отсортированным опорным кадрам. Индекс опорного изображения для B-кадра классифицируется по перечню 0 или перечню 1 (перечень 0 - перечень индексов, присвоенных опорным кадрам, хранящимся в буфере опорных кадров, используемых при межкадровом предсказании P-кадров, SP-кадров и B-кадров, перечень 1 - перечень индексов, присвоенных опорным кадрам, хранящимся в буфере опорных кадров, используемых при межкадровом предсказании только B-кадров, согласно международному стандарту H.264 (MPEG-4, раздел 10) - примеч. перевод.) и определяется на основе порядка отображения опорных кадров.

Прежде всего в случае перечня 0 для опорных кадров индексы назначают в обратном порядке относительно опорных кадров, отображаемых с отставанием от B-кадра, а затем остальные индексы назначают в порядке отображения опорных кадров, отображаемых с опережением B-кадра. В случае перечня 1 для опорных кадров, в отличие от перечня 0 для опорных кадров, индексы назначают в порядке отображения опорных кадров, отображаемым с опережением B-кадра, а затем остальные индексы назначают в обратном порядке относительно опорных кадров, отображаемых с отставанием от B-кадра. На фиг.2 показан индекс опорного изображения для P-кадра, когда размер опорного буфера равен 5, а на фиг.3 показаны перечни 0 и 1 индексов опорных изображений для B-кадра.

При кодировании изображений типа "поле" поля всех опорных изображений считаются независимыми изображениями, причем одно из изображений опорных полей используется для компенсации движения. Соответственно, значения присваиваются индексам опорных изображений в единицах поля. В то же время опорные поля объединяют в единицу кадра и затем индексы опорных изображений в каждом поле P-кадра сортируют в порядке, обратном по отношению к порядку кодирования кадра. Затем значения индексов с шагом возрастания, равным единице, поочередно присваивают опорным полям в порядке от опорного поля с четностью, равной четности текущего изображения, до опорного поля с четностью, отличной от четности текущего изображения, при последовательном обходе отсортированных опорных кадров.

Кроме того, в случае перечней 0 и 1 индексов опорных изображений для каждого поля B-кадра все опорные поля объединяют в единицы кадра, а затем опорные кадры сортируют таким же способом, как и в способе определения индекса опорного изображения для B-кадра. После этого индексы, возрастающие на единицу, поочередно присваивают опорным полям в порядке от опорного поля с четностью, равной четности текущего изображения, и до опорного поля с четностью, отличной от четности текущего изображения, при последовательном обходе отсортированных опорных кадров.

На фиг.4 показаны индексы опорных изображений верхнего и нижнего полей P-кадра, когда размер опорного буфера равен 5, а на фиг.5 показаны перечни 0 и 1 индексов опорных изображений для верхнего и нижнего полей B-кадра, которые можно использовать в качестве опорных.

В целях повышения эффективности кодирования система кодирования движущегося изображения с использованием множества опорных изображений обеспечивает функцию переупорядочения индексов опорных изображений перед декодированием изображения или сегмента. Индексы опорных изображений произвольно переупорядочивают так, чтобы повысить эффективность кодирования после определения первоначального индекса опорного изображения для изображений типа "кадр" и поля. На фиг.6 показан результат определения первоначального индекса опорного изображения для P-кадра и произвольного переупорядочения индексов в соответствии с указанным выше методом.

Когда система кодирования движущегося изображения с использованием множества опорных изображений кодирует движущееся изображение с чересстрочной разверткой в изображение типа "кадр", имеющее макроблоки кадра/поля, все опорные изображения для макроблока кадра рассматриваются как единица кадра, и одно из опорных изображений типа "кадр" должно использоваться для компенсации движения. Кроме того, все опорные

изображения для макроблока поля считаются независимыми изображениями, и одно из опорных изображений типа "поле" должно использоваться для компенсации движения.

Соответственно, при кодировании изображения типа "кадр" с выбором режимов кодирования кадра/поля на уровне макроблока необходимо назначить значения индексу опорного изображения в единице кадра или единице поля в соответствии с режимом кодирования каждого макроблока.

Сущность изобретения

Пример осуществления настоящего изобретения обеспечивает информацию об опорном изображении, используемом для компенсации движения путем определения индекса опорного изображения по-разному, в соответствии с режимом кодирования макроблока, когда движущееся изображение с чересстрочной разверткой кодируют с изображением типа "кадр", имеющим макроблоки кадра/поля в системе кодирования движущегося изображения с использованием множества опорных изображений.

В одном примере осуществления настоящего изобретения способ выбора опорного изображения для обработки макроблока поля включает выбор, по меньшей мере, одного опорного изображения, для обработки макроблока поля, по меньшей мере, из одного перечня опорных изображений, в котором используется информация об индексе опорного изображения. Здесь каждое выбранное, по меньшей мере, одно опорное изображение является полем. Например, опорное поле может быть верхним полем или нижним полем.

В другом примере осуществления настоящего изобретения указанный способ может дополнительно включать в себя обработку макроблока поля с использованием, по меньшей мере, одного выбранного опорного изображения.

Еще в одном примере осуществления настоящего изобретения указанный способ может включать формирование, по меньшей мере, одного перечня опорных изображений. Например, операция формирования может включать инициализацию, по меньшей мере, одного перечня опорных изображений и переупорядочение, по меньшей мере, одного перечня опорных изображений.

В другом примере осуществления настоящего изобретения, если информация об индексе опорного изображения представляет собой четный номер индекса, то, по меньшей мере, одно выбранное опорное поле имеет такую же четность поля, как и макроблок поля.

В еще одном примере осуществления настоящего изобретения, если информация об индексе опорного изображении представляет собой нечетный номер индекса, то, по меньшей мере, одно выбранное опорное поле имеет четность поля, отличную от четности макроблока поля.

В примере осуществления настоящего изобретения способ выбора опорного изображения для обработки макроблока поля включает выбор, по меньшей мере, одного опорного изображения для обработки макроблока поля, по меньшей мере, из одного перечня опорных изображений, в котором используется информация об индексе опорного изображения. Здесь каждое, по меньшей мере, одно выбранное опорное изображение является полем, причем четность выбранного, по меньшей мере, одного опорного поля может быть основана на четности макроблока поля и на информации об индексе опорного изображения.

Краткое описание чертежей

Прилагаемые чертежи, которые включены для лучшего понимания настоящего изобретения и составляют неотъемлемую часть настоящего описания, иллюстрируют примеры осуществления изобретения и вместе с описанием служат для объяснения принципов настоящего изобретения.

На чертежах:

на фиг.1 показана пара макроблоков в изображении типа "кадр", имеющем обычный макроблок кадра/поля;

на фиг.2 показаны индексы опорных изображений P-кадра при кодировании в системе кодирования движущегося изображения в соответствии с известным техническим решением;

на фиг.3 показаны перечни 0 и 1 индексов опорных изображений B-кадра при кодировании в системе кодирования движущегося изображения в соответствии с известным техническим решением;

на фиг.4 показаны индексы опорных изображений при кодировании верхнего и нижнего полей P-кадра в системе кодирования движущегося изображения в соответствии с известным техническим решением;

фиг.5 иллюстрирует перечни 0 и 1 индексов опорных изображений при кодировании верхнего и нижнего полей B-кадра в системе кодирования движущегося изображения в соответствии с известным техническим решением;

на фиг.6 показаны индексы опорных изображений, переупорядоченных при кодировании P-кадра в системе кодирования движущегося изображения в соответствии с известным техническим решением;

на фиг.7 показаны индексы опорных изображений P-кадра и B-кадра, имеющих макроблоки кадра, в системе кодирования движущегося изображения в соответствии с настоящим изобретением;

на фиг.8 показаны индексы опорных изображений P-кадра и B-кадра, имеющих макроблок поля, в системе кодирования движущегося изображения в соответствии с примером осуществления настоящего изобретения (случай 1);

на фиг.9 показаны индексы опорных изображений P-кадра и B-кадра, имеющих макроблоки поля, в системе кодирования движущегося изображения в соответствии с другим примером осуществления настоящего изобретения (случай 2);

на фиг.10 показаны индексы опорных изображений P-кадра, имеющего макроблоки поля, в системе кодирования движущегося изображения в соответствии еще с одним примером осуществления настоящего изобретения (случай 3);

на фиг.11 показаны индексы опорных изображений B-кадра, имеющего макроблоки поля, в системе кодирования движущегося изображения в соответствии с другим примером осуществления настоящего изобретения (случай 3); и

на фиг.12 показаны индексы опорных изображений P-кадра и B-кадра, имеющих макроблоки поля, в системе кодирования движущегося изображения в соответствии с еще одним примером осуществления настоящего изобретения (случай 4).

Подробное описание предпочтительных примеров осуществления настоящего изобретения

Ниже будут подробно описаны наглядные примеры осуществления настоящего изобретения со ссылкой на прилагаемые чертежи.

Как утверждалось ранее, системы кодирования движущегося изображения компенсируют движение, используя информацию о векторе движения. В случае системы кодирования движущегося изображения, в которой используется множество опорных изображений, для компенсации движения используется информация об индексах опорных изображений, а также информация о векторах движения. Индекс опорного изображения представляет собой значение, которое используется для различения множества опорных изображений между собой. Кодер передает индекс опорного изображения на декодер. Декодер выбирает опорное изображение, указанное индексом опорного изображения, и, используя выбранное опорное изображение, осуществляет компенсацию движения.

При кодировании движущегося изображения с чересстрочной разверткой в изображение типа "кадр", имеющее макроблоки кадра/поля, система кодирования движущегося изображения, в которой используется множество опорных изображений, осуществляет компенсацию движения из опорного кадра с целью кодирования кадра в макроблоке кадра. Другими словами, опорные изображения могут рассматриваться в качестве единицы кадра. Однако система кодирования движущегося изображения осуществляет компенсацию движения из опорного поля с целью кодирования поля в макроблоках поля. Другими словами, опорные изображения могут рассматриваться в качестве единицы поля.

Соответственно, для изображений типа "кадр", имеющих макроблок кадра/поля, используются индексы, имеющие различную структуру на уровне макроблока. Например, в

макроблоке кадра используется индекс опорного изображения единицы кадра, а в макроблоке поля используется индекс опорного изображения единицы поля. Следует иметь в виду, что индексы опорных изображений могут быть переупорядочены на уровне изображения или сегмента.

Следовательно, в изображении типа "кадр", имеющем макроблоки изображения/поля, должно учитываться опорное изображение в единице кадра на уровне изображения или сегмента, и должны быть переупорядоченные индексы опорных изображений единицы кадра. Индекс опорного изображения можно определить в соответствии с режимом кодирования макроблока на основе индексов опорного изображения единицы кадра на уровне макроблока.

В настоящем изобретении обеспечивается пример осуществления способа определения индексов опорных изображений в изображении типа "кадр", имеющем макроблоки кадра/поля. Указанный способ включает в себя процесс определения индексов опорных изображений на уровне изображения (или сегмента) и процесс определения индексов опорных изображений на уровне макроблока.

[1] Определение (или инициализация) индексов опорных изображений на уровне изображения (или сегмента).

Опорные изображения могут рассматриваться в единице кадра на уровне изображения или сегмента, а индексы опорных изображений единицы кадра вычисляются.

В способе определения индекса опорного изображения для P-кадра опорные изображения сортируют в порядке, обратном порядку кодирования, а индексы назначают при последовательном обходе отсортированных опорных кадров.

Индексы опорных изображений для B-кадра определяются на основе порядка отображения опорных кадров. Прежде всего, в случае перечня 0 для опорных кадров индексы назначают в обратном порядке относительно опорных кадров, отображаемых с отставанием от B-кадра, а остальные индексы назначают в порядке отображения опорных кадров, отображаемых с опережением B-кадра.

В случае перечня 1 для опорных кадров, в отличие от перечня 0 для опорных кадров, индексы назначают в порядке отображения опорных кадров, которые по порядку отображения выше B-кадра, а остальные индексы назначают в обратном порядке по отношению к опорным кадрам, которые по порядку отображения ниже B-кадра.

В этом и другом примере осуществления, описанном ниже, в целях повышения эффективности кодирования система кодирования движущегося изображения с использованием множества опорных изображений может обеспечить функцию переупорядочения индексов опорных изображений перед декодированием изображения или сегмента. Индексы опорных изображений произвольно переупорядочивают так, чтобы повысить эффективность кодирования после определения первоначального индекса опорного изображения для изображений типа "кадр" и "поле". При переупорядочении опорных индексов изображений в целях повышения эффективности кодирования могут быть переупорядочены индексы опорных изображений единицы кадра.

[2] Определение (или переупорядочение) индекса опорного изображения на уровне макроблока

Индекс опорного изображения модифицируют в соответствии с режимом кодирования макроблока при осуществлении кодирования в единице пары макроблоков по отношению к индексам опорных изображений единицы кадра, полученным на уровне изображения (сегмента). Этот процесс будет описан ниже.

[2.1] Случай макроблока кадра

Поскольку компенсация движения может быть применена к макроблокам кадра из опорного изображения, индексом опорного изображения может быть индекс единицы кадра. Соответственно, используются индексы опорных изображений единицы кадра, полученные на уровне изображения (или сегмента).

Опорный кадр, сохраненный в опорном буфере, можно сконфигурировать с парой полей, имеющих четности (например, верхнего и нижнего полей), противоположные одна другой.

На фиг.7 показаны индексы опорных изображений для макроблока кадра в P-кадре и B-кадре, когда размер опорного буфера равен 5.

[2.2] Случай макроблока поля

Поскольку компенсация движения может быть применена к макроблокам поля из опорного поля, индекс опорного изображения может быть индексом единицы поля. В этом случае пара полей, имеющих противоположные четности, также присутствует в опорном буфере. Соответственно, каждый опорный кадр делится на два поля при последовательном обходе опорного кадра в соответствии с индексами опорных изображений единицы кадра, получаемыми на уровне изображения (или сегмента). Затем индексы опорных изображений заново назначают каждому полю. Индексы опорных изображений для двух полей каждого опорного кадра назначают разными способами (Случаи с 1 по 4).

(Случай 1)

Независимо от того, относится ли макроблок текущего поля к макроблокам верхнего и нижнего полей, нижний индекс назначают верхнему опорному полю, а верхний индекс назначают нижнему опорному полю при последовательном обходе опорных кадров в порядке индексов опорных изображений, полученных на уровне изображения (или сегмента).

Другими словами, индексы верхнего и нижнего опорных полей могут быть заданы следующими выражениями.

Индекс верхнего опорного поля=2×индекс изображения опорного кадра

Индекс нижнего опорного поля=2×индекс изображения опорного кадра+1

На фиг.8 показаны индексы опорных изображений для макроблоков полей P-кадра и B-кадра.

(Случай 2)

Независимо от того, относится ли макроблок текущего поля к макроблокам верхнего и нижнего полей, нижний индекс назначают нижнему опорному полю, а верхний индекс назначают верхнему опорному полю при последовательном обходе опорных кадров в порядке индексов опорных изображений, полученных на уровне изображения (или сегмента).

Другими словами, индексы верхнего и нижнего опорных полей могут быть заданы следующими выражениями.

Индекс верхнего опорного поля=2×индекс изображения опорного изображения+1

Индекс нижнего опорного поля=2×индекс изображения опорного изображения

На фиг.9 показаны индексы опорных кадров для макроблоков полей P-кадра и B-кадра.

(Случай 3)

Индексы, возрастающие с шагом в единицу, поочередно назначаются опорным полям, начиная с опорного поля, имеющего четность, равную четности текущего поля, до опорного поля, имеющего четность, отличную от четности текущего поля, при последовательном обходе опорных кадров в соответствии с порядком индексов опорных изображений уровня изображения (или сегмента). На фиг.10 и 11 показаны индексы опорных изображений для макроблоков полей P-кадра и B-кадра.

(Случай 4)

Независимо от того, относится ли макроблок текущего поля к макроблокам верхнего и нижнего полей, нижний индекс назначают опорному полю, близкому по времени к текущему полю, а верхний индекс назначают опорному полю, отдаленному по времени от текущего поля, при последовательном обходе опорных кадров в порядке индексов опорных изображений уровня изображения (или сегмента).

Другими словами, индексы опорных полей могут быть заданы следующими выражениями.

Индекс опорного поля, близкого к текущему полю=2×индекс изображения опорного изображения

Индекс опорного поля, удаленного от текущего поля=2×индекс изображения опорного

изображения+1

На фиг.12 показаны индексы опорных изображений для макроблока поля P-кадра и B-кадра.

Хотя настоящее изобретение описано и проиллюстрировано здесь со ссылкой на наглядные примеры его осуществления, специалистам в данной области техники будет очевидно, что в настоящем изобретении могут быть сделаны различные изменения и модификации, без отступления от его сущности и объема. Таким образом, подразумевается, что настоящее изобретение охватывает модификации и изменения.

В соответствии со способом кодирования движущегося изображения, согласно, по меньшей мере, одному примеру осуществления настоящего изобретения, когда система кодирования движущегося изображения с использованием множества опорных изображений кодирует движущееся изображение с чересстрочной разверткой в изображение типа "кадр", имеющее макроблоки кадра/поля, система кодирования движущегося изображения эффективно обеспечивает информацию об опорном изображении, используемую для компенсации движения, посредством различно определяемых индексов опорных изображений в соответствии с режимами кодирования макроблоков.

Формула изобретения

1. Способ выбора опорного изображения для обработки макроблока поля, содержащий: определение, по меньшей мере, одного перечня опорных изображений путем использования порядка отображения, при этом, по меньшей мере, один перечень опорных изображений имеет информацию об индексах опорных изображений; выбор, по меньшей мере, одного опорного изображения для обработки макроблока поля, по меньшей мере, из одного перечня опорных изображений путем использования информации об индексах опорных изображений, причем, по меньшей мере, одно выбранное опорное изображение является полем, а четность, по меньшей мере, одного выбранного опорного поля основана на четности макроблока поля текущего изображения и информации об индексе опорного изображения; при этом, если информация об индексе опорного изображения представляет собой четный номер индекса, то, по меньшей мере, одно выбранное опорное поле имеет ту же четность поля, что и макроблок поля, а если информация об индексе опорного изображения представляет собой нечетный номер индекса, то, по меньшей мере, одно выбранное опорное поле имеет четность поля, отличную от четности макроблока поля.

2. Способ по п.1, в котором, если информация об индексе опорного изображения представляет собой четный номер индекса и макроблок поля текущего изображения является макроблоком верхнего поля, то, по меньшей мере, одно выбранное опорное поле является верхним полем.

3. Способ по п.1, в котором, если информация об индексе опорного изображения представляет собой четный номер индекса и макроблок поля текущего изображения является макроблоком нижнего поля, то, по меньшей мере, одно выбранное опорное поле является нижним полем.

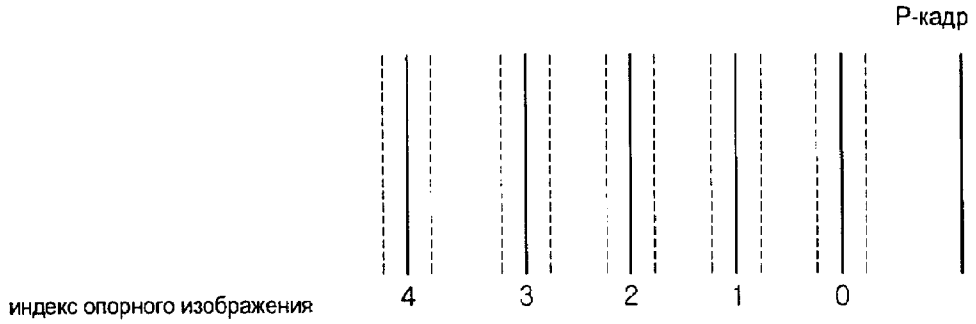
4. Способ по п.1, в котором, если информация об индексе опорного изображения представляет собой нечетный номер индекса и макроблок поля текущего изображения является макроблоком верхнего поля, то, по меньшей мере, одно выбранное опорное поле является нижним полем.

5. Способ по п.1, в котором, если информация об индексе опорного изображения представляет собой нечетный номер индекса и макроблок поля текущего изображения является макроблоком нижнего поля, то, по меньшей мере, одно выбранное опорное поле является верхним полем.

0	2	4	6
1	3	5	7
8	10	12	14
9	11	13	15

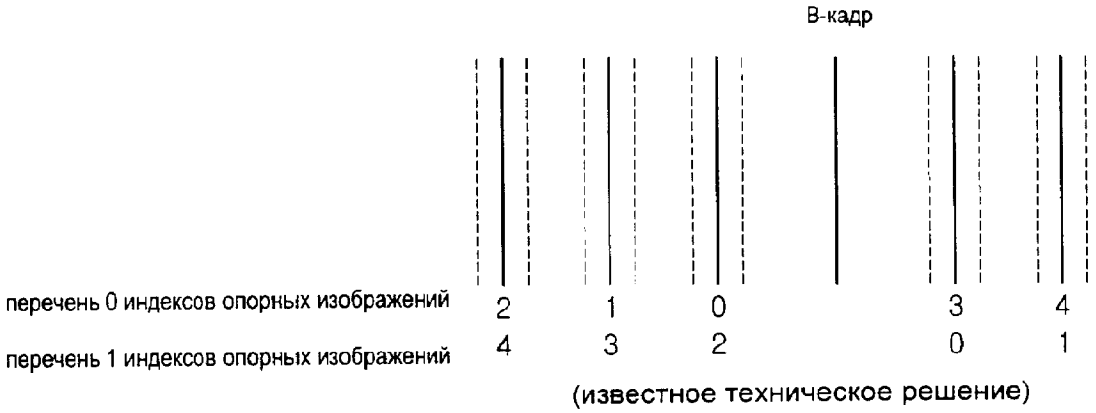
(известное техническое решение)

Фиг.1



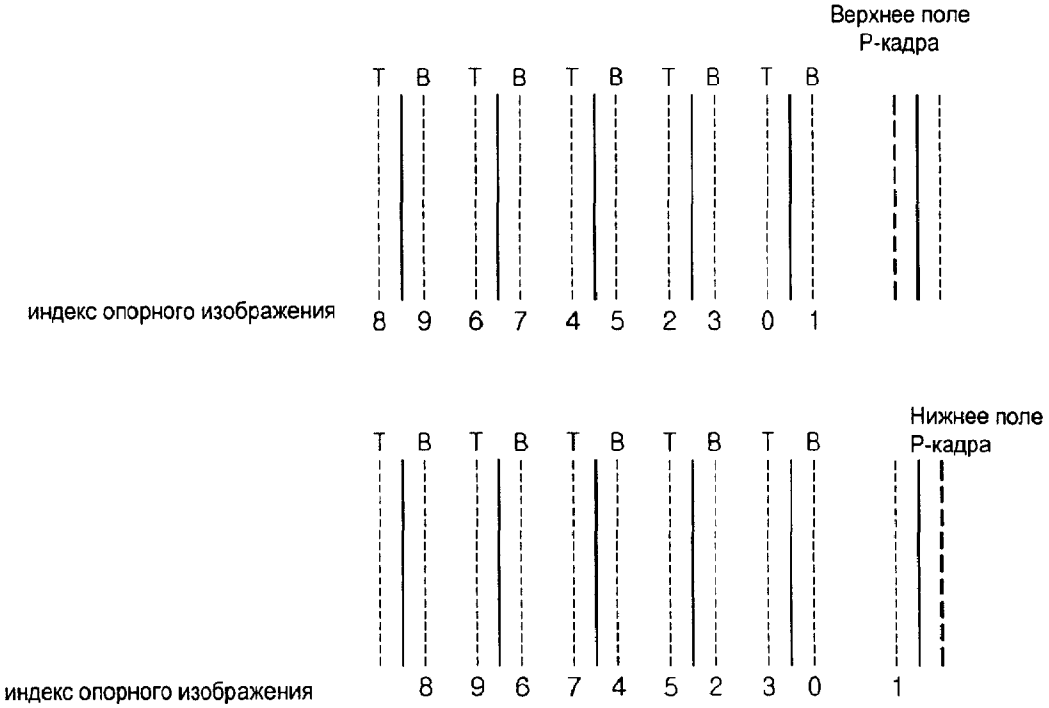
(известное техническое решение)

Фиг.2



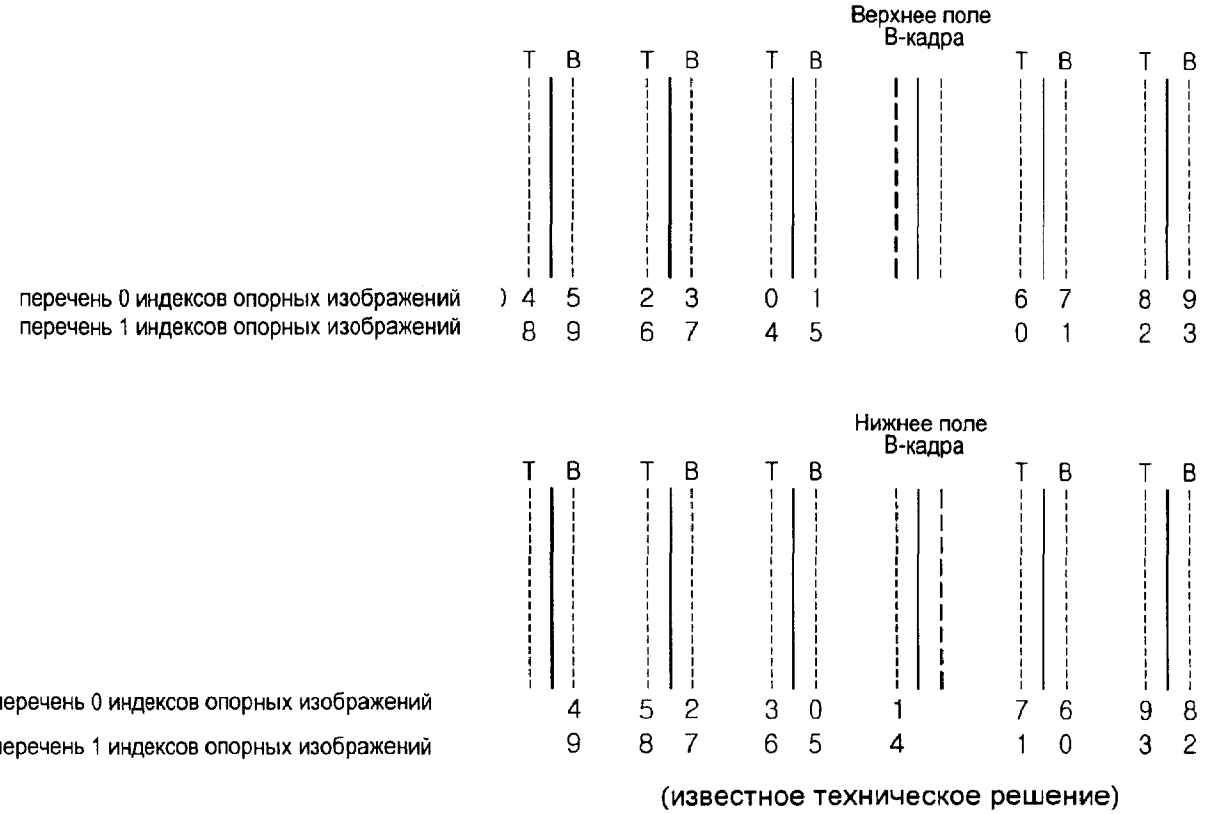
(известное техническое решение)

Фиг. 3



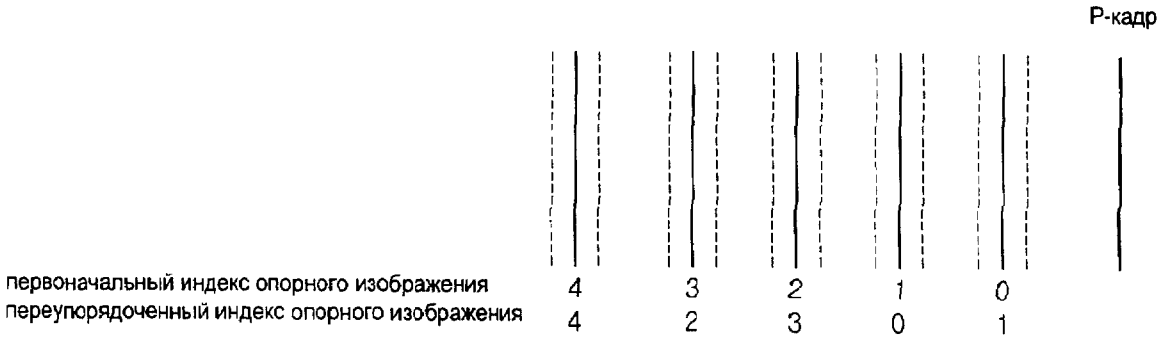
(известное техническое решение)

Фиг. 4



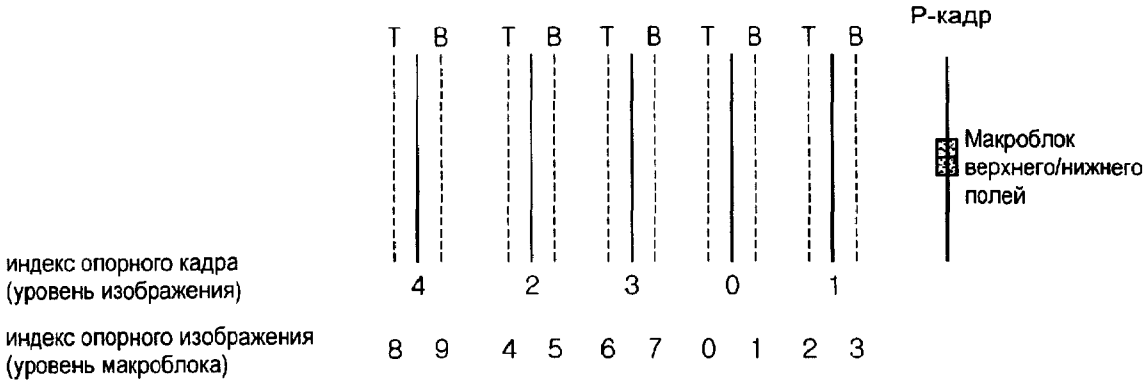
(известное техническое решение)

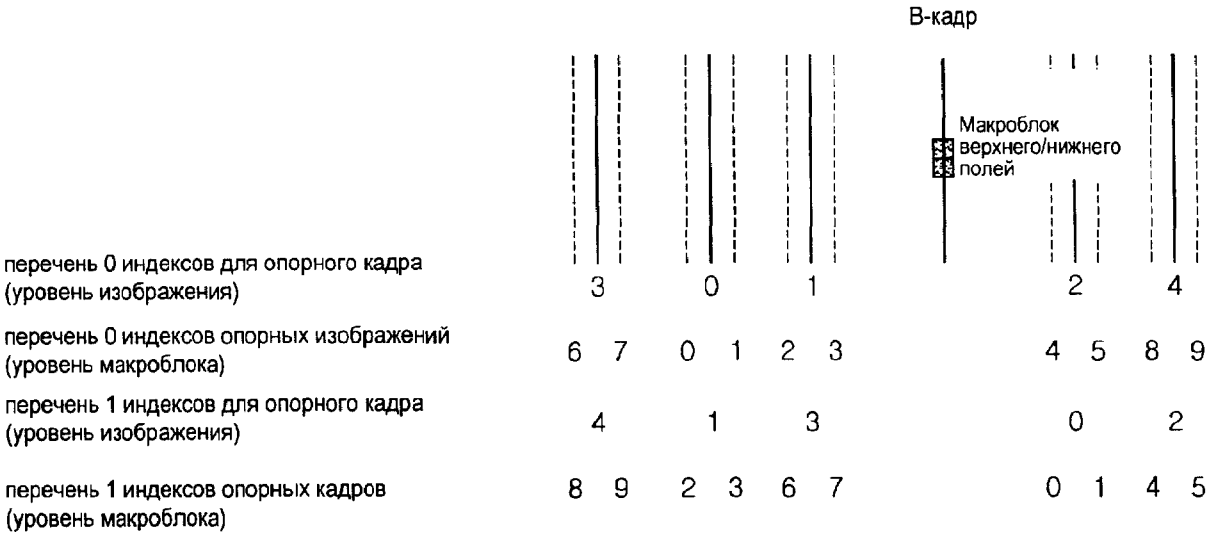
Фиг. 5



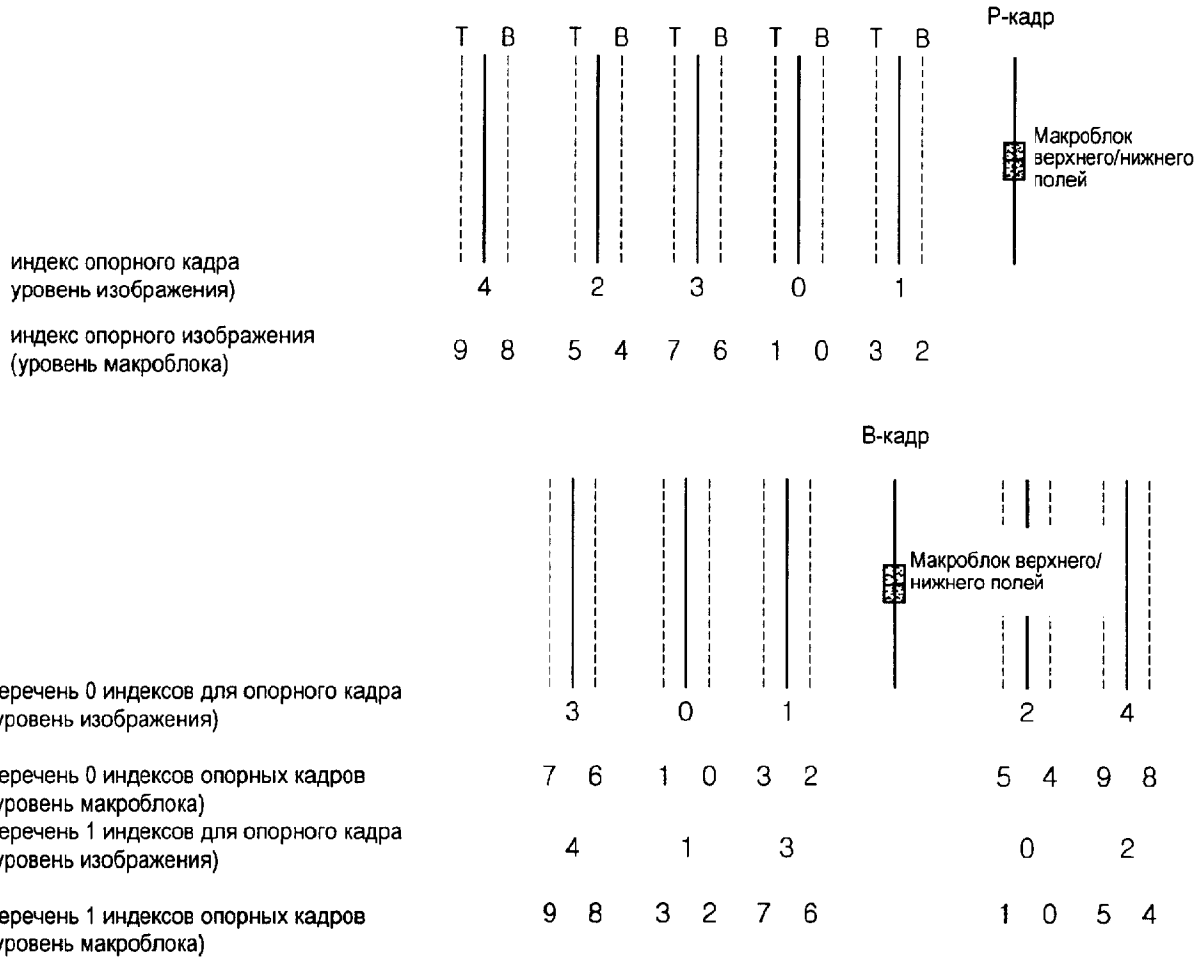
(известное техническое решение)

Фиг. 6

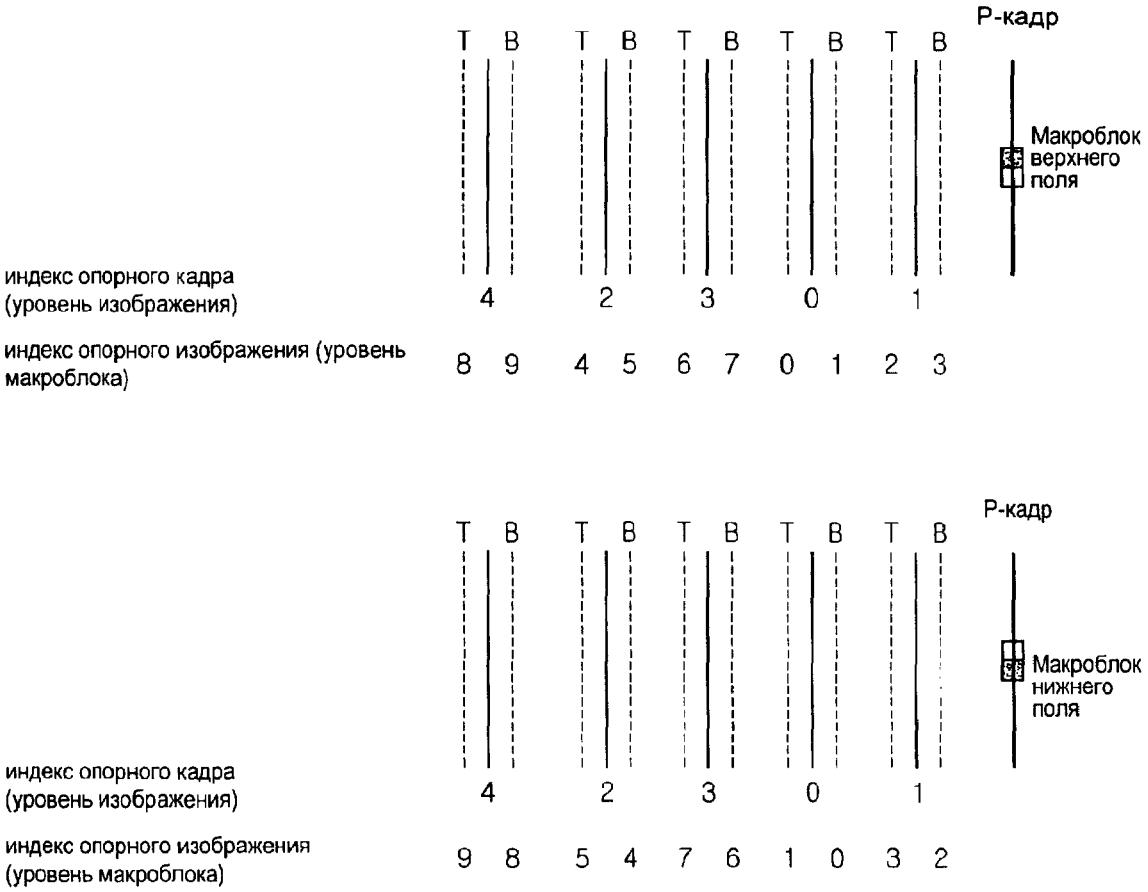




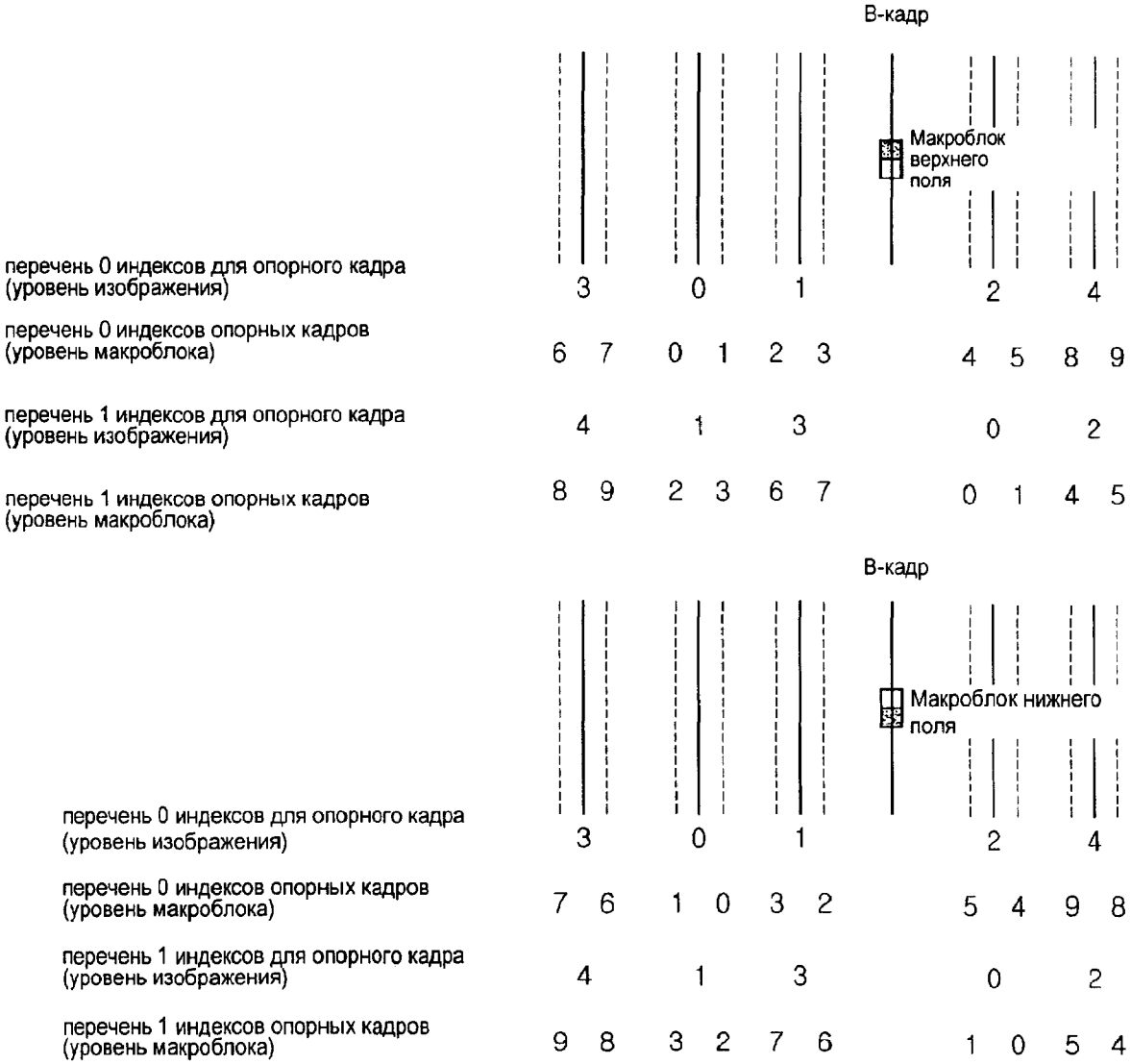
Фиг. 8


P-кадр
T B T B T B T B T B
Макроблок верхнего/нижнего полей
индекс опорного кадра (уровень изображения)
4 2 3 0 1
индекс опорного изображения (уровень макроблока)
9 8 5 4 7 6 1 0 3 2
B-кадр
Макроблок верхнего/нижнего полей
перечень 0 индексов для опорного кадра (уровень изображения)
3 0 1 2 4
перечень 0 индексов опорных кадров (уровень макроблока)
7 6 1 0 3 2 5 4 9 8
перечень 1 индексов для опорного кадра (уровень изображения)
4 1 3 0 2
перечень 1 индексов опорных кадров (уровень макроблока)
9 8 3 2 7 6 1 0 5 4

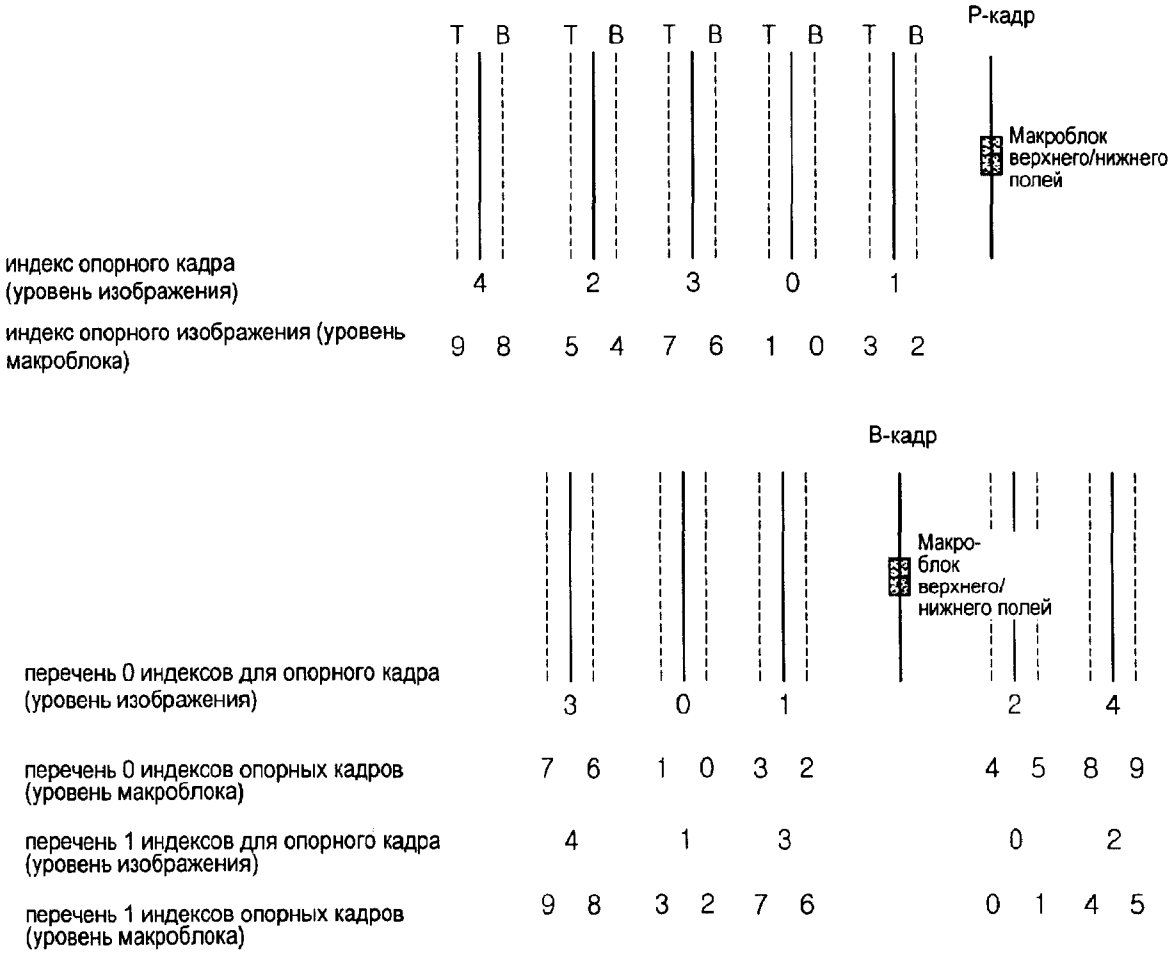
Фиг. 9


P-кадр
T B T B T B T B T B
Макроблок верхнего поля
индекс опорного кадра (уровень изображения)
4 2 3 0 1
индекс опорного изображения (уровень макроблока)
8 9 4 5 6 7 0 1 2 3
P-кадр
T B T B T B T B T B
Макроблок нижнего поля
индекс опорного кадра (уровень изображения)
4 2 3 0 1
индекс опорного изображения (уровень макроблока)
9 8 5 4 7 6 1 0 3 2

Фиг. 10


B-кадр
Макроблок верхнего поля
перечень 0 индексов для опорного кадра (уровень изображения)
3 0 1 2 4
перечень 0 индексов опорных кадров (уровень макроблока)
6 7 0 1 2 3 4 5 8 9
перечень 1 индексов для опорного кадра (уровень изображения)
4 1 3 0 2
перечень 1 индексов опорных кадров (уровень макроблока)
8 9 2 3 6 7 0 1 4 5
B-кадр
Макроблок нижнего поля
перечень 0 индексов для опорного кадра (уровень изображения)
3 0 1 2 4
перечень 0 индексов опорных кадров (уровень макроблока)
7 6 1 0 3 2 5 4 9 8
перечень 1 индексов для опорного кадра (уровень изображения)
4 1 3 0 2
перечень 1 индексов опорных кадров (уровень макроблока)
9 8 3 2 7 6 1 0 5 4

ФИГ. 11


Р-кадр
T B T B T B T B T B
Макроблок верхнего/нижнего полей
индекс опорного кадра (уровень изображения)
4 2 3 0 1
индекс опорного изображения (уровень макроблока)
9 8 5 4 7 6 1 0 3 2
В-кадр
Макро-блок верхнего/ нижнего полей
перечень 0 индексов для опорного кадра (уровень изображения)
3 0 1 2 4
перечень 0 индексов опорных кадров (уровень макроблока)
7 6 1 0 3 2 4 5 8 9
перечень 1 индексов для опорного кадра (уровень изображения)
4 1 3 0 2
перечень 1 индексов опорных кадров (уровень макроблока)
9 8 3 2 7 6 0 1 4 5

Фиг. 12

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(19) 世界知的所有権機関
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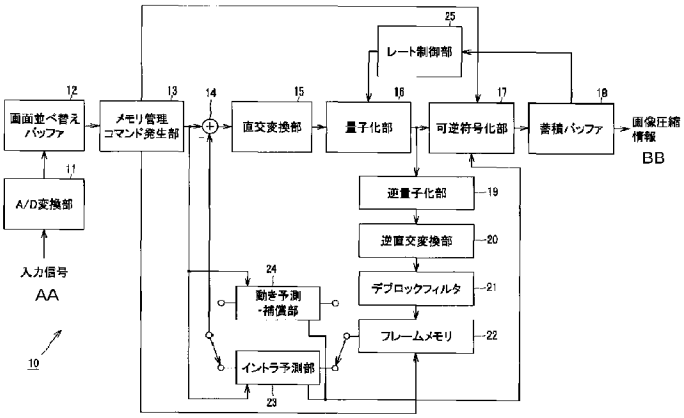
(81) 指定国 (表示のない限り、全ての種類の国内保護が可能): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG,

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(54) **Title:** IMAGE INFORMATION CODING DEVICE AND CODING METHOD

(54) 発明の名称: 画像情報符号化装置及び符号化方法

[図1]



AA INPUT SIGNAL
11 A/D CONVERTING UNIT
12 SCREEN REARRANGING BUFFER
13 MEMORY MAGAGING COMMAND GENERATING UNIT
15 ORTHOGONAL CONVERTING UNIT
16 QUANTIZING UNIT
17 RECIPROCAL CODING UNIT
18 STORAGE BUFFER
BB IMAGE COMPRESSED INFORMATION
25 RATE CONTROL UNIT
19 REVERSE QUANTIZING UNIT
20 REVERSE ORTHOGONAL CONVERTING UNIT
21 DEBLOCK FILTER
22 FRAME MEMORY
23 INTRA-ESTIMATING UNIT
24 MOVING ESTIMATE AND COMPENSATING UNIT

(57) **Abstract:** In an image information coding device that outputs image compressed information in accordance with an AVC coding system, it is possible to make an optimum reference relationship in a GOP structure comprised of a hierarchy B picture and random access from an I picture that is not an instant decoder renewal picture. In the case where a multiple frame estimate is carried out, a memory managing control command, which manages pictures in a decoded image buffer, is used to register a long term reference B picture laid in a P picture or the I picture with a memory managing control command generating unit (13); a reference image list order command in the B picture laid between the P picture or the I picture and the reference B picture is used to dispose the reference B picture in the first part of the reference image list; the maximum value of a long term frame index in the P picture or the I picture is set to be [0] with the memory management control command, so that the long term reference picture in the decoded image buffer is set to be in a non-reference picture; and random access from the I picture, which is not the instant decoder renewal picture, is carried out.

(57) 要約: ＡＶＣ符号化方式に基づく画像圧縮情報を出力する画像情報符号化装置において、階層Ｂピクチャで構成されるＧＯＰ構造における最適な参照関係及び瞬時復号器更新ピクチャでないＩピクチャからのランダムアクセスを可能にする。 マルチプルフレーム予測を行う際に、メモリ管理制御コマンド発生部（１３）により、復号画像バッファ内のピクチャを管理するメモリ

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WO 2008/105389 A1

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管理制御コマンドを用いて、Ｐピクチャもしくは Ｉピクチャの間にある参照Ｂピクチャを長期間参照ピクチャに登録し、Ｐピクチャもしくは Ｉピクチャと参照Ｂピクチャの間にあるＢピクチャにおいて参照画像リスト順序コマンドを用いて参照Ｂピクチャを参照画像リストの最初に配置し、メモリ管理制御コマンドにより、Ｐピクチャもしくは Ｉピクチャで長期間フレームインデックスの最大値を［０］に設定することにより、復号画像バッファ内の長期間参照ピクチャを非参照ピクチャに設定し、瞬時復号器更新ピクチャでない Ｉピクチャからのランダムアクセスを行う。

明 細 書

画像情報符号化装置及び符号化方法

技術分野

[0001] 本発明は、MPEG、H. 26x等のように、離散コサイン変換若しくはカルーネン・レーベ変換等の直交変換と動き補償とによって圧縮された画像情報(ビットストリーム)を、衛星放送、ケーブルTV、インターネット、携帯電話などのネットワークメディアを介して受信する際に、若しくは光、磁気ディスク、フラッシュメモリのような記憶メディア上で処理する際に用いられる画像情報符号化装置及び符号化方法に関する。本出願は、2007年2月28日に日本国で出願された特許出願である特願2007－050778を基礎出願として優先権を主張してなされる出願であり、この出願は参照することにより、本出願に援用される。

背景技術

[0002] 近年、画像情報をデジタルデータとして取り扱い、その際、効率の高い情報の伝送、蓄積を目的とし、画像情報特有の冗長性を利用して、離散コサイン変換等の直交変換と動き補償とにより圧縮するMPEGなどの方式に準拠した装置が、放送局などの情報配信、及び一般家庭における情報受信の双方において普及しつつある。

特に、汎用画像符号化方式として定義されているMPEG2(ISO／IEC 13818－2)は、飛び越し走査画像及び順次走査画像の双方、並びに標準解像度画像及び高精細画像を網羅する標準であって、プロフェッショナル用途及びコンシューマ用途の広範なアプリケーションに現在広く用いられている。MPEG2圧縮方式を用いることにより、例えば720×480画素を持つ標準解像度の飛び越し走査画像の場合には、4～8Mbps、1920×1088画素を持つ高解像度の飛び越し走査画像の場合には、18～22Mbpsの符号量(ビットレート)を割り当てることで、高い圧縮率と良好な画質の実現が可能である。

MPEG2は主として放送用に適合する高画質符号化を対象としていたが、MPEG1より低い符号量(ビットレート)、つまりより高い圧縮率の符号化方式には対応していなかった。携帯端末の普及により、今後そのような符号化方式のニーズは高まると思

われ、これに対応してMPEG4符号化方式の標準化が行われた。画像符号化方式に関しては、1998年12月にISO／IEC 14496－2としてその規格が国際標準に承認された。

さらに、近年、当初テレビ会議用の画像符号化を目的として、H. 26L （ITU－T Q6／16 VCEG）という標準の規格化が進んでいる。H. 26Lは、MPEG2やMPEG4といった従来の符号化方式に比べ、その符号化、復号化により多くの演算量が要求されるものの、より高い符号化効率が実現されることが知られている。また、現在、MPEG4の活動の一環として、このH. 26Lをベースに、H. 26Lではサポートされない機能をも取り入れ、より高い符号化効率を実現する標準化がJoint Model of Enhanced－Compression Video Codingとして行われている。標準化のスケジュールとしては、2003年3月には、H. 264及びMPEG－4 Part10（Advanced Video Coding）という名の元に国際標準となった。

図13は、このAVC規格に基づいた画像圧縮情報を出力とする画像情報符号化装置100の概略構成を示すブロック図である。

この画像情報符号化装置100は、A／D変換部101、画面並べ替えバッファ102、加算器103、直交変換部104、量子化部105、可逆符号化部106、蓄積バッファ107、逆量子化部108、逆直交変換部109、デブロックフィルタ110、フレームメモリ111、イントラ予測部112、動き予測・補償部113、レート制御部114などからなる。

この図13に示す画像情報符号化装置100では、A／D変換部101は、入力された画像信号をデジタル信号に変換して画面並べ替えバッファ102に供給する。そして、画面並べ替えバッファ102は、当該画像情報符号化装置100から出力する画像圧縮情報の画像群（GOP:Group of Pictures）構造に応じて、フレームの並べ替えを行う。

ここで、イントラ符号化、すなわち、単一のフレームを用いて符号化が行われる画像情報に関しては、入力画像情報と、イントラ予測部112により生成される画素値の差分情報とが直交変換部104に入力される。そして、直交変換部104で、離散コサイン変換、カルーネン・レーベ変換等の直交変換が施される。直交変換部104は、直交変換により得られる変換係数を量子化部105に供給する。

量子化部105は、直交変換部104から供給される変換係数に対して量子化処理を施し、量子化した変換係数を可逆符号化部106に供給する。

可逆符号化部106は、量子化部105から供給される量子化された変換係数に対して、可変長符号化、算術符号化等の可逆符号化を施す。この可逆符号化部106により可逆符号化された変換係数は、蓄積バッファ107に蓄積され、画像圧縮情報として出力される。

量子化部105の挙動は、レート制御部114によって制御される。また、量子化部105は、量子化した変換係数を逆量子化部108に供給する。さらに、量子化した変換係数は、逆直交変換部109で逆直交変換処理が施されて、復号化画像情報となり、デブロックフィルタ110でブロック歪の除去が施された後、その情報はフレームメモリ111に蓄積される。イントラ予測部112において、当該ブロック／マクロブロックに対して適用されたイントラ予測モードに関する情報は、可逆符号化部106に伝送され、画像圧縮情報におけるヘッダ情報の一部として符号化される。

一方、インター符号化、すなわち、複数のフレームを用いて符号化が行われる画像情報に関しては、画面並べ替えバッファ102からの画像情報は動き予測・補償部113に入力される。動き予測・補償部113は、同時に参照される画像情報をフレームメモリ111から読み出し、動き予測・補償処理を施して参照画像情報を生成し、この参照画像情報を加算器103に供給する。加算器103は、画面並べ替えバッファ102からの画像情報を参照画像情報との差分信号に変換する。動き予測・補償部113は、同時に動きベクトル情報を可逆符号化部106に供給する。可逆符号化部106は、その動きベクトル情報に対して可変長符号化、算術符号化といった可逆符号化処理を施し、画像圧縮情報のヘッダ部に挿入される情報を形成する。その他の処理はイントラ符号化を施される画像圧縮情報に関する処理と同様である。

図14は、離散コサイン変換若しくはカルーネン・レーベ変換等の直交変換と動き補償とにより画像圧縮を実現する画像情報復号化装置200の概略構成を示すブロック図である。

この画像情報復号化装置200は、蓄積バッファ201、可逆複号化部202、逆量子化部203、逆直交変換部204、加算器205、画面並べ替えバッファ206、D／A変換

部207、フレームメモリ208、動き予測・補償部209、イントラ予測部210、デブロックフィルタ211などからなる。

この図14に示す画像情報復号化装置200では、蓄積バッファ201は、入力された画像圧縮情報を一時的に格納して、格納した画像圧縮情報を可逆復号化部202に転送する。可逆復号化部202は、蓄積バッファ201から転送されてくる画像圧縮情報に対して、定められた画像圧縮情報のフォーマットに基づき、可変長復号化、算術復号化等の処理を施す。また、可逆復号化部202は、当該フレームがイントラ符号化されたものである場合には、画像圧縮情報のヘッダ部に格納されたイントラ予測モード情報についても復号し、その情報をイントラ予測部210に供給する。さらに、可逆復号化部202は、当該フレームがインター符号化されたものである場合には、画像圧縮情報のヘッダ部に格納された動きベクトル情報についても復号し、その情報を動き予測・補償部209に供給する。

逆量子化部203は、可逆復号化部202から供給される量子化された変換係数を逆量子化し、変換係数として逆直交変換部204に供給する。逆直交変換部204は、逆量子化部203から供給される変換係数に対して、定められた方式に基づき、4次の逆直交変換を施す。

ここで、当該フレームがイントラ符号化されたものである場合には、逆直交変換処理が施された画像情報は、加算器205に供給され、イントラ予測部210で生成された予測画像情報と合成され、更に、デブロックフィルタ211でブロック歪の除去が施された後、画面並べ替えバッファ206に格納され、D／A変換部207によりD／A変換処理がなされた後に出力される。

一方、当該フレームがインター符号化されたものである場合には、動き予測・補償部209は、可逆復号化部202により可逆復号化処理が施された動きベクトル情報、及び、フレームメモリ208に格納された画像情報を元に参照画像情報を生成し、加算器205に供給する。加算器205は、この参照画像情報と逆直交変換部204の出力とを合成する。その他の処理はイントラ符号化されたフレームに関する処理と同様である。

本願の先行技術文献としては、例えば特開2003－289544号公報、特開2004－

289808号公報、特開2004－274732号公報、特開2004－187264号公報、特開2004－274694号公報、及び特開2006－129177号公報があげられる。

発明の開示

発明が解決しようとする課題

[0003] ところで、AVC符号化方式においては、複数のピクチャを参照することが可能である。これらのピクチャは、予測に用いる復号画像を格納するための画像バッファメモリである復号画像バッファ(DPB:Decoded picture buffer)に保存される。復号画像バッファ(DPB)内では、短期間に参照されるピクチャを短期間参照ピクチャ(used for short-term reference)、長期間にわたって参照されるピクチャを長期間参照ピクチャ(used for long-term reference)、参照されないピクチャを非参照ピクチャ(unused for reference)として各ピクチャがそれぞれマーキングされる。

デコードされたピクチャは、一度この復号画像バッファ(DPB)に保存され、出力順を並び替えて指定された出力タイミングで出力される。

復号画像バッファ(DPB)のサイズは、プロファイル(profile)及びレベル(level)により定義されており、ピクチャの枚数ではなく、ビット量として定義されている。つまり、同じプロファイル、レベルであってもピクチャの画枠に応じて枚数が変化する。例えばメイン(Main)プロファイル、レベル4の場合には、予測に用いる復号画像を格納するための画像バッファの最大サイズ(MaxDPB:Maximum Decoded Picture Buffer Size)は、12288．0×1024bytesであるので、1440×1088、4:2:0の場合には、復号画像バッファ(DPB)に保存できるピクチャは5枚となる。一方、1920×1088、4:2:0の場合には、復号画像バッファ(DPB)に保存できるピクチャは、4枚となる。このDPBサイズの中で出力順と、参照関係とに矛盾がないようにエンコードを行う必要がある。

復号画像バッファ(DPB)の管理法には2種類の管理法がある。第1の管理法が移動窓メモリ管理法(Sliding window process)である。第2の管理法が適応メモリ管理法(Adaptive memory control process)である。移動窓メモリ管理法は、復号画像バッファ(DPB)を先入れ先出し(FIFO:First In First Out)方式で管理し、フレーム番号(frame_num)の小さいものから順に開放される方式である。適応メモリ管理法では、復号画像バッファ(DPB)内のピクチャを任意に管理することができる。この適応メモリ管理

法で用いられる管理コマンドは、メモリ管理制御(MMCO:Memory management control operation)コマンドと呼ばれ、短期間参照ピクチャを非参照ピクチャに設定したり、長期間参照ピクチャを非参照ピクチャに設定したり、短期間参照ピクチャに長期間フレームインデックス(long-term frame index)を割り当てることで長期間参照ピクチャに設定したり、長期間フレームインデックスの最大値を設定したり、すべての参照ピクチャを非参照ピクチャに設定したりすることができる。

適応メモリ管理法では、参照ピクチャは、参照画像リスト(reference picture list)により管理される。参照画像リストは、参照画像リスト順序(Reference picture list reordering)を用いることで任意の順番に入れ替えることができる。参照画像リスト順序を用いない場合には、短期間参照ピクチャ、長期間参照ピクチャの順で参照画像リストが生成される。

近年の研究により階層Bピクチャ構造と呼ばれるGOP構造が符号化効率及び画質の面で注目されている。図15の(A),(B)は、代表的な階層Bピクチャ構造(GOP－1)の一例を示す図である。図15の(A)では、ピクチャの種類及び表示順情報(POC:Picture Order Count)を表示順(Display order)に示すとともに、各ピクチャの参照関係を矢印で示している。また、図15の(B)では、各ピクチャの復号順(Decode order)を示している。また、図15の(A),(B)では、Brは参照されるBピクチャを表している。

しかし、この構造は、多くの並び替えバッファが必要となることから、図16に示すようなGOP構造(GOP－2)を用いる場合がある。図16の(A)はピクチャの種類及び表示順情報(POC)を表示順(Display order)に示すとともに、各ピクチャの参照関係を矢印で示している。また、図16の(B)は、復号順(Decode order)に示している。また、図16の(A),(B)では、Brは、参照されるBピクチャを表している。上述の如く、メインプロファイル、レベル4で画枠が1920×1088、4:2:0の場合には、復号画像バッファ(DPB)に保存できるピクチャは4枚となる。

GOP－2の構造では、復号画像バッファ(DPB)に保存できるピクチャの枚数が4枚(max_dec_frame_buffering=4)、でかつ、参照に使えるピクチャの枚数が3枚(num_ref_frames=3)である場合には、図17の(A)～(D)に示すような参照関係になる。

図17の(A)では、ピクチャの種類及び表示順情報を表示順に示すとともに、各ピク

チャの参照関係を矢印で示している。また、図17の(B)では、各ピクチャの復号順を示している。さらに、図17の(C)，(D)では、各時刻T0，T1，・・・，T15，・・・における復号画像バッファ(参照画像バッファ、非参照画像バッファ)及び表示バッファの内容を示している。この場合、図17の(A)に太線の矢印で示すように時間的に最も近い参照面が存在しない。また、Iピクチャを飛び越して参照しているため瞬時復号器更新ピクチャでないIピクチャからのランダムアクセスが不可能である。

ここで、IDRピクチャは、画像シーケンスの先頭のピクチャである。瞬時復号器更新ピクチャは、Iスライス又はスイッチング Iスライスからなり、参照画像バッファの状態やフレーム番号、表示順情報など、ビットストリームを復号するために必要なすべての状態がリセットされる。H．264／AVCでは、Iピクチャの後ろにある、PピクチャからIピクチャより前のピクチャを参照するフレーム間予測が許容されているので、状態を完全にリセットするには通常のIピクチャでは不十分で、瞬時復号器更新ピクチャを用いる必要がある。

このように、従来の手法では、最も時間的に近く画像の相関が高いと考えられるピクチャを参照できないのに加え、瞬時復号器更新ピクチャでないIピクチャからのランダムアクセスができないという問題を有する。

そこで、本発明の目的は、上述の如き従来の問題点に鑑み、AVC符号化方式に基づく画像圧縮情報を出力する画像情報符号化装置において、階層Bピクチャで構成されるGOP構造における最適な参照関係及び瞬時復号器更新ピクチャでないIピクチャからのランダムアクセスを実現することにある。

本発明の更に他の目的、本発明によって得られる具体的な利点は、以下に説明される実施の形態の説明から一層明らかにされる。

本発明では、上述の課題を解決するために、メモリ管理制御コマンド及び参照画像リスト順序コマンドの処理により、最も効率的な参照関係、及び、瞬時復号器更新ピクチャでないIピクチャからのランダムアクセスを可能にする。

すなわち、本発明は、動き予測を用いて画像情報の符号化処理を行い、画像圧縮情報を出力する画像情報符号化装置であって、復号画像バッファ内のピクチャを管理するメモリ管理制御コマンドを発生するメモリ管理制御コマンド発生手段を備え、マ

ルチプルフレーム予測を行う際に、上記メモリ管理制御コマンド発生手段は、メモリ管理制御（MMCO）コマンドにより、Pピクチャもしくは Iピクチャの間にある参照Bピクチャを長期間参照ピクチャに登録し、Pピクチャもしくは Iピクチャと参照Bピクチャの間にあるBピクチャにおいて参照画像リスト順序コマンドにより参照Bピクチャを参照画像リストの最初に配置し、メモリ管理制御コマンドにより、Pピクチャもしくは Iピクチャで長期間フレームインデックスの最大値を[0]に設定することにより、復号画像バッファ内の長期間参照ピクチャを非参照ピクチャに設定し、瞬時復号器更新ピクチャでない Iピクチャからのランダムアクセスを行うことを特徴とする。

また、本発明は、動き予測を用いて画像情報の符号化処理を行い、画像圧縮情報を出力する画像情報符号化方法であって、マルチプルフレーム予測を行う際に、復号画像バッファ内のピクチャを管理するメモリ管理制御コマンドにより、Pピクチャもしくは Iピクチャの間にある参照Bピクチャを長期間参照ピクチャに登録し、Pピクチャもしくは Iピクチャと参照Bピクチャの間にあるBピクチャにおいて参照画像リスト順序コマンドにより参照Bピクチャを参照画像リストの最初に配置し、メモリ管理制御コマンドにより、Pピクチャもしくは Iピクチャで長期間フレームインデックスの最大値を[0]に設定することにより、復号画像バッファ内の長期間参照ピクチャを非参照ピクチャに設定し、瞬時復号器更新ピクチャでない Iピクチャからのランダムアクセスを行うことを特徴とする。

ここで、本発明の特徴となるメモリ管理制御コマンド発生手段の動作原理について述べる。

メモリ管理制御コマンド発生手段は、GOP構造に応じて効率の良い参照関係を実現し、かつ瞬時復号器更新（IDR）ピクチャでない Iピクチャからのランダムアクセスが可能になるようなメモリ管理制御コマンド及び参照画像リスト順序コマンドの発行を行うものである。ここでは、図16で示すようなGOP構造で最大復号フレームバッファ数（max_dec_frame_buffering）＝4、参照フレーム数（num_ref_frames）＝3の場合を例にとって説明する。

この構造は多くの並び替えバッファが必要となることから、上述の如く図16に示すようなGOP構造（GOP－2）を用いる場合がある。上述の如く、メインプロファイル、レベ

ル4で画枠が1920×1088、4:2:0の場合、復号画像バッファ(DPB)に保存できるピクチャは4枚となる。そして、GOP－2の構造において復号画像バッファ(DPB)が4枚(max_dec_frame_buffering=4)、参照に使えるピクチャ枚数が3枚(num_ref_frames=3)の場合、図17の(A)～(D)に示すような参照関係になる。

メモリ管理制御コマンドを使用しない場合は、図17に示すように、復号順(Decode order)でP及びIピクチャ後のBピクチャが時間的に直前のP及びIピクチャを飛び越し、参照Bピクチャを参照している。これを回避するためには、メモリ管理制御コマンドで参照Bピクチャを非参照ピクチャに設定すれば良い。

参照Bピクチャのタイミングでメモリ管理制御コマンド(MMCO=1)を使用して、短期間参照ピクチャである、以前の参照Bピクチャを非参照ピクチャに設定すれば良いが、その際にコマンドを出力する現在のピクチャ番号との差分を表すピクチャ番号差分値をストリームに出力する必要がある。ピクチャ番号はスライスヘッダ上にあるフレーム番号(framc_num)により決定する。フレーム番号はピクチャを一意に決定するための値である。

瞬時復号器更新ピクチャ以外のIピクチャからのランダムアクセスでは、フレーム番号はIピクチャ以降の値しか存在しない。したがって、メモリ管理制御コマンド(MMCO=1)を使用して非参照ピクチャに設定するにも指し示すピクチャが復号画像バッファに存在しない。

そこで、本発明では、MMCO＝4の長期間フレームインデックスの最大値を変更するメモリ管理制御コマンドを使用する。このとき、長期間フレームインデックスの最大値を[0]とすると、以前に存在した長期間参照ピクチャを復号画像バッファから開放することができる。この仕組みを利用して、参照Bピクチャを長期間参照ピクチャに設定し、その後参照に不要となったタイミングで長期間フレームインデックスの最大値を変更するコマンドにより長期間参照ピクチャを開放する。これにより瞬時復号器更新ピクチャ以外のIピクチャからのランダムアクセス時にも矛盾のないコマンドを発行することができる。

参照画像リストは、参照画像リスト順序コマンドを用いない場合、短期間参照ピクチャ、長期間参照ピクチャの順で生成される。このため参照Bピクチャを長期間参照ピク

チャに設定した場合は、リストの最後の参照番号を振られる。これは符号化効率の面で不利になるために、参照画像リスト順序コマンドを用いて、最も小さい参照番号を振る。

以上の処理を継続的に行うことにより図6の(A)～(D)に示すような参照関係が実現できる。

図面の簡単な説明

[0004] [図1]図1は、本発明を適用したAVC符号化方式の画像情報符号化装置の構成例を示すブロック図である。

[図2]図2は、上記画像情報符号化装置において瞬時復号器更新(IDR)ピクチャでないIピクチャからのランダムアクセスを行うための処理手順を示すフローチャートである。

[図3]図3は、上記画像情報符号化装置において上記ランダムアクセスを行う画像群(GOP:Group of Pictures)構造を示す模式図である。

[図4]図4は、上記画像情報符号化装置においてフレーム構造のGOPについて上記ランダムアクセスを行うために用いるメモリ管理制御コマンドの詳細を示す図である。

[図5]図5は、上記画像情報符号化装置においてフレーム構造のGOPについて上記ランダムアクセスを行うために用いる参照画像リスト順序コマンドの詳細を示す図である。

[図6]図6は、上記画像情報符号化装置においてフレーム構造のGOPについて上記ランダムアクセスを行った場合の各情報の状態を模式的に示す図である。

[図7]図7は、上記画像情報符号化装置において上記ランダムアクセスが行われるフレーム構造のGOPの構成例を模式的に示す図である。

[図8]図8は、上記画像情報符号化装置においてフレーム構造のGOPについて上記ランダムアクセスを行った場合の復号画像バッファ(短期間参照画像バッファ、長期間参照画像バッファ、非参照画像バッファ)の状態を模式的に示す図である。

[図9]図9は、上記画像情報符号化装置において上記ランダムアクセスを行うフィールド構造の画像群(GOP:Group of Pictures)を示す模式図である。

[図10]図10は、上記画像情報符号化装置においてフィールド構造のGOPについて

上記ランダムアクセスを行うために用いるメモリ管理制御コマンドの詳細を示す図である。

[図11]図11は、上記画像情報符号化装置においてフィールド構造のGOPについて上記ランダムアクセスを行うために用いる参照画像リスト順序コマンドの詳細を示す図である。

[図12A]図12Aは、上記画像情報符号化装置においてフィールド構造のGOPについて上記ランダムアクセスを行った場合の各情報の状態を模式的に示す図である。

[図12B]図12Bは、上記画像情報符号化装置においてフィールド構造のGOPについて上記ランダムアクセスを行った場合の各情報の状態を模式的に示す図である。

[図13]図13は、従来のAVC符号化方式に基づく画像圧縮情報を出力する画像情報符号化装置の構成例を示すブロック図である。

[図14]図14は、従来のAVC符号化方式に基づく画像圧縮情報を入力する画像情報復号装置の構成例を示すブロック図である。

[図15]図15は、代表的な階層Bピクチャ構造を模式的に示す図である。

[図16]図16は、簡略化した階層Bピクチャ構造を模式的に示す図である。

[図17]図17は、階層Bピクチャ構造において、メモリ管理制御コマンド及び参照画像リスト順序コマンドを使用しない場合の復号画像バッファ及び参照関係を模式的に示す図である。

発明を実施するための最良の形態

[0005] 以下、本発明の実施の形態について、図面を参照して詳細に説明する。なお、本発明は以下の例に限定されるものではなく、本発明の要旨を逸脱しない範囲で、任意に変更可能であることは言うまでもない。

本発明は、例えば図1に示すような構成の画像情報符号化装置10に適用される。

この画像情報符号化装置10は、A／D変換部11、画面並べ替えバッファ12、メモリ管理制御(MMCO:Memory management control operation)コマンド発生部13、加算器14、直交変換部15、量子化部16、可逆符号化部17、蓄積バッファ18、逆量子化部19、逆直交変換部20、デブロックフィルタ21、フレームメモリ22、イントラ予測部23、動き予測・補償部24、レート制御部25などからなる。

この図1に示す画像情報符号化装置10では、A／D変換部11は、入力された動画像信号をデジタル信号に変換して画面並べ替えバッファ12に供給する。

画面並べ替えバッファ12は、A／D変換部11によりデジタル信号に変換された入力画像情報について、当該画像情報符号化装置10から出力する画像圧縮情報の画像群(GOP:Group of Pictures)構造に応じて、フレームの並べ替えを行い、並べ替え済みの入力画像情報を、メモリ管理制御コマンド発生部13を介して加算器14、直交変換部15、イントラ予測部23、及び動き予測・補償部24に供給する。

MMCOコマンド発生部13は、画面並べ替えバッファ12から供給される入力画像情報について、例えば、画像群(GOP:Group of Pictures)構造に応じて効率の良い参照関係を実現し、かつ瞬時復号器更新(IDR:Instantaneous Decoding Refresh)ピクチャでないIピクチャからのランダムアクセスが可能になるようなMMCOコマンド及び参照画像リスト順序(Reference picture list reordering)コマンドを、可逆符号化部17及びフレームメモリ22に対して発行する。

加算器14は、MMCOコマンド発生部13を介して供給される入力画像情報とイントラ若しくはインター予測画像情報との差分値をマクロブロック毎に生成する。

ここで、イントラ符号化、すなわち、単一のフレームを用いて符号化が行われる画像情報に関しては、入力画像情報と、イントラ予測部23により生成されるイントラ予測画像情報の差分値とが直交変換部15に入力される。また、インター符号化、すなわち、複数のフレームを用いて符号化が行われる画像情報に関しては、入力画像情報と、動き予測・補償部24により生成される参照画像情報の差分値とが直交変換部15に入力される。

直交変換部15は、加算器14から供給されるマクロブロック毎の差分値について、可変の変換サイズ単位で離散コサイン変換、カルーネン・レーベ変換等の直交変換、ここでは、離散コサイン変換(DCT:Discrete Cosine Transform)を行い、得られる直交変換(DCT)係数を量子化部16に供給する。

量子化部16は、直交変換部15から供給される変換係数に対して量子化処理を施し、量子化した変換係数を可逆変換部17及び逆量子化部19に供給する。

量子化部16の挙動は、レート制御部25によって制御されている。

可逆変換部17は、量子化部16から供給される量子化された変換係数に対して、可変長符号化、算術符号化等の可逆符号化、例えば、CABAC（Context-Adaptive Binary Arithmetic Coding）符号化を施す。この可逆変換部17により可逆符号化された変換係数は、蓄積バッファ18に蓄積され、画像圧縮情報として出力される。

また、逆量子化部19は、量子化部16から供給される量子化された直交変換係数の逆量子化処理を行い、直交変換係数を逆直交変換部20に供給する。

逆直交変換部20は、逆量子化部19から供給される直交変換係数の逆直交変換処理を行い、得られる復号画像情報を、デブロックフィルタ21を介してフレームメモリ22に供給する。

デブロックフィルタ21は、復号画像情報に含まれるブロック歪を除去する。

フレームメモリ22は、復号画像情報を蓄積する。

イントラ予測部23は、フレームメモリ22から、隣接する、既に符号化済の画像情報を取り出して、これを元に、直交変換サイズに適したイントラ予測処理のみを行う。

動き予測・補償部24は、参照画像情報に対して動きベクトルの探索及びインター予測画像情報の生成を行う。

レート制御部25は、フィードバック制御により量子化部16の動作の制御を行い、出力となる画像圧縮情報の符号量制御を行う。

そして、この画像情報符号化装置10では、瞬時復号器更新ピクチャでないIピクチャからのランダムアクセスを図2のフローチャートに従って行う。

すなわち、この画像情報符号化装置10では、ランダムアクセスを開始すると、先ず、ステップS1では、復号画像バッファを空の状態にする。

次のステップS2では、Iピクチャの復号処理を行う。

次のステップS3では、メモリ管理制御コマンド（MMCO=4）により長期間フレームインデックス（long-term frame index）の最大値を[－1]に設定する。

次のステップS4では、Iピクチャを復号画像バッファに保存する。

次のステップS5では、Bsピクチャの復号処理を行う。

次のステップS6では、メモリ管理制御コマンド（MMCO=4）により長期間フレームインデックス（long-term frame index）の最大値を[0]に設定する。

次のステップS7では、メモリ管理制御コマンド(MMCO=6)により長期間フレームインデックス(long-term frame index)の値を[0]に設定する。

次のステップS8では、Bsピクチャを復号画像バッファに保存する。

次のステップS9では、Bピクチャの復号処理を行う。

次のステップS10では、参照画像リスト順序コマンドによりL1のref_idx0にBsピクチャを指定する。

次のステップS11では、Bピクチャを復号画像バッファに保存する。

次のステップS12では、Bピクチャの復号処理を行う。

次のステップS13では、参照画像リスト順序コマンドによりL0のref_idx0にBsピクチャを指定する。

次のステップS14では、Bピクチャを復号画像バッファに保存する。

次のステップS15では、GOPの終わりであるか否かを判定する。

このステップS15における判定結果がNO、すなわち、GOPの終わりでない場合には、次のステップS16に進み、また、上記ステップS15における判定結果がYES、すなわち、GOPの終わりである場合には、上記ステップS2に戻る。

次のステップS16では、Pピクチャの復号処理を行う。

次のステップS17では、メモリ管理制御コマンド(MMCO=4)により長期間フレームインデックス(long-term frame index)の最大値を[－1]に設定する。

次のステップS18では、Pピクチャを復号画像バッファに保存して、上記ステップS5に戻る。

そして、上記ステップS5から上記ステップS18の処理を繰り返し行い、上記ステップS15における判定結果がYES、すなわち、GOPの終わりまで復号処理を行ったならば、上記ステップS2に戻って次のGOPのIピクチャを復号する。

すなわち、この画像情報符号化装置10では、上記メモリ管理制御コマンド発生部13は、例えば、GOP構造が図3に示すようなフレーム構造で、B0 Br1 B2 I3 B4 Br5 B6 P7 B8 Br9 B10 P11 B12 Br13 B14 P15で、復号順序がI3 Br1 B0 B2 P7 Br5 B4 B6 P11 Br9 B8 B10 P15 Br13 B12 B14のような階層構造の場合には、図4及び図5に示すように、表示順情報(POC)を16

で割ったときの余りを表すPOC％16の値に対応させて定義したメモリ管理制御コマンド（#COMMAND=0～#COMMAND=6）及び参照画像リスト順序コマンド（#COMMAND=0～#COMMAND=3）を発生するようにして、I3で長期間フレームインデックスの最大値を[0]に設定し、Br1でメモリ管理制御コマンド（MMCO=4）により長期間フレームインデックスの最大値を[1]に設定し、Br1を長期間参照ピクチャに設定し、B0で参照画像リスト順序コマンドによりI3及びBr1を参照し、B1で参照画像リスト順序コマンドによりI3及びBr1を参照する処理を続けることで、図6の（A）～（D）に示すように、シンタックスが矛盾することなく、瞬時復号器更新ピクチャでないIピクチャからのランダムアクセスを行うことができる。

ここで、図6の（A）はピクチャの種類及び 表示順情報を表示順序に示すとともに各ピクチャの参照関係を矢印にて示している。また、図6の（B）は、各ピクチャの復号順序を示している。さらに、図6の（C），（D）は、各時刻T0，T1，・・・，T15，・・・における復号画像バッファ（参照画像バッファ、非参照画像バッファ）及び表示バッファの内容を示している。

また、例えば図7に示すように、表示順序（Display Order）がB0 Bs1 B2 I3 B4 Bs5 B6 P7 B8 Bs9 B10 P11 ・・・で、復号順序がI3 Bs1 B0 B2 P7 Bs5 B4 B6 P11 Bs9 B8 B10 ・・・のような階層構造を有し、矢印で示すような参照関係にある場合には、この画像情報符号化装置10では、各ステップでの復号画像バッファの状態は、図8に示すようになる。図8の（s1）～（s18）は、ステップS1～ステップS18の各ステップにおける復号画像バッファ（DPB）（短期間参照画像バッファ、長期間参照画像バッファ、非参照画像バッファ）の状態を示している。また、図8の（s19）～（s32）は、繰り返し行われる上記ステップS5～ステップS18の各ステップにおける復号画像バッファ（短期間参照画像バッファ、長期間参照画像バッファ、非参照画像バッファ）の状態を示している。

このように、上記メモリ管理制御コマンド発生部13は、GOP構造がBピクチャを参照するような階層構造の場合には、MMCOコマンドを発行することで、限られた復号画像バッファでフレーム間時間が最も短く効率の良い参照関係を可能にしている。

また、上記メモリ管理制御コマンド発生部13は、GOP構造がBピクチャを参照する

ような階層構造の場合には、参照画像リスト順序コマンドを用いることで、限られた復号画像バッファでフレーム間時間が最も短く効率の良い参照関係を可能にしている。

さらに、上記メモリ管理制御コマンド発生部13は、MMCOコマンドを利用して参照されるBピクチャを長期間参照ピクチャに設定し、かつPピクチャ及びIピクチャにおいて長期間フレームインデックスの最大値を[0]に設定することで、長期間ピクチャを開放することにより瞬時復号器更新ピクチャでないIピクチャからのランダムアクセスをシンタックスが矛盾することなく可能にしている。

なお、以上の説明した本発明の実施の形態では、最大復号フレームバッファ数(max_dec_frame_buffering)＝4、参照フレーム数(num_ref_frames)＝3の場合を例にとって、GOP構造がフレーム構造の場合について、参照ピクチャBsは長期間参照ピクチャに設定するものとして、長期間ピクチャを開放することにより瞬時復号器更新ピクチャでないIピクチャからのランダムアクセスをシンタックスが矛盾することなく可能にしたが、これらの値が異なる場合でもそれに相当するMMCOコマンド及び参照画像リスト順序コマンドを生成することにより、瞬時復号器更新ピクチャでないIピクチャからのランダムアクセス時に復号画像バッファに存在しない参照ピクチャを指し示すことがないため、全く矛盾のないストリームを実現することができる。

また、本発明の実施の形態では、GOP構造がフレーム構造の場合について説明したが、GOP構造がフィールド構造であっても、最大復号フレームバッファ数(max_dec_frame_buffering)＝4、参照フレーム数(num_ref_frames)＝3の場合、Pピクチャの先頭で以前の長期間参照ピクチャを非参照ピクチャに設定し、参照ピクチャBsは長期間参照ピクチャに設定するものとして、長期間ピクチャを開放することにより瞬時復号器更新(IDR)ピクチャでないIピクチャからのランダムアクセスをシンタックスが矛盾することなく行うことができる。

すなわち、この画像情報符号化装置10において、上記メモリ管理制御コマンド発生部13は、例えば、GOPが図9に示すようなフィールド構造で、B－6 B－5 Br－4 Br－3 B－2 B－1 I0 P1 B2 B3 Br4 Br5 B6 B7 P8 P9 B10 B11 Br9 B12 Br13 B14 B15 P16 P17 B18 B19 Br20 Br21 B22 B23 P24 P25で、復号順序がI6 P7 B2 B3 B0 B1 B4 B5 P14 P15 B

10 B11 B8 B9 B12 B13 P22 P23 B18 B19 B16 B17 B20 B21 P30 P31 B2 B27 B24 B25 B28 B29 P30 P31 B32・・・のような階層構造の場合には、図10及び図11に示すように、表示順情報(POC)を32で割ったときの余りを表すPOC%32の値に対応させて定義したメモリ管理制御コマンド(#COMMAND=0～#COMMAND=6)及び参照画像リスト順序コマンド(#COMMAND=0～#COMMAND=3)を発生するようにして、I6で長期間フレームインデックス(long-term frame index)の最大値を[0]に設定し、Br1でメモリ管理制御コマンド(MMCO=4)により長期間フレームインデックスの最大値を[1]に設定し、Br1を長期間参照ピクチャに設定し、B3で参照画像リスト順序コマンドによりI6及びBr1を参照し、B3で参照画像リスト順序コマンドによりI6及びBr1を参照する処理を続けることで、図12A及び図12Bに示すように、シンタックスが矛盾することなく、瞬時復号器更新ピクチャでないIピクチャからのランダムアクセスを行うことができる。

なお、本発明は、前述した実施の形態に限定されるものではなく、実施段階では本発明の要旨を逸脱しない範囲内で種々の変更が可能である。例えば、本発明の構成のうち、本質的部分以外の構成をこの構成と同様の作用効果を奏する出願時に予見不可能な技術的構成に置換して得られる発明は、本発明に包含され得る。更に前述した実施の形態には種々の段階の発明が含まれており、開示される複数の構成要件における適宜な組み合わせにより種々の発明が生成され得る。例えば実施の形態に示される全構成要件からいくつかの要件が省略されることで発明が生成される場合には、その生成された発明を実施する段階では省略部分が周知慣用技術で補われるものである。

その他、本発明は、その要旨を逸脱しない範囲内で種々変更して実施することができる。

本発明では、マルチプルフレーム予測を行う際に、復号画像バッファ内のピクチャを管理するメモリ管理制御コマンドにより、Pピクチャもしくは Iピクチャの間にある参照Bピクチャを長期間参照ピクチャに登録し、Pピクチャもしくは Iピクチャと参照Bピクチャの間にあるBピクチャにおいて参照画像リスト順序コマンドにより参照Bピクチャを参照画像リストの最初に配置し、メモリ管理制御コマンドにより、Pピクチャもしくは Iピク

チャで長期間フレームインデックスの最大値を[0]に設定することにより、復号画像バッファ内の長期間参照ピクチャを非参照ピクチャに設定し、瞬時復号器更新ピクチャでないIピクチャからのランダムアクセスを行うので、長期間フレームインデックスの最大値を変更するメモリ管理制御コマンドを発行することで長期間フレームインデックスを指定することなく長期間参照ピクチャをメモリから開放することができ、瞬時復号器更新ピクチャでないIピクチャからのランダムアクセス時にDPBに存在しない参照ピクチャを指し示すことがないため、全く矛盾のないストリームを実現することができる。

請求の範囲

[1] 1．動き予測を用いて画像情報の符号化処理を行い、画像圧縮情報を出力する画像情報符号化装置であって、

復号画像バッファ内のピクチャを管理するメモリ管理制御コマンドを発生するメモリ管理制御コマンド発生手段を備え、

マルチプルフレーム予測を行う際に、上記メモリ管理制御コマンド発生手段は、メモリ管理制御コマンドにより、Pピクチャもしくは Iピクチャの間にある参照Bピクチャを長期間参照ピクチャに登録し、Pピクチャもしくは Iピクチャと参照Bピクチャとの間にあるBピクチャにおいて参照画像リスト順序コマンドにより参照Bピクチャを参照画像リストの最初に配置し、メモリ管理制御コマンドにより、Pピクチャもしくは Iピクチャで長期間フレームインデックスの最大値を[0]に設定することにより、復号画像バッファ内の長期間参照ピクチャを非参照ピクチャに設定し、瞬時復号器更新ピクチャでない Iピクチャからのランダムアクセスを行うことを特徴とする画像情報符号化装置。

[2] 2．上記メモリ管理制御コマンド発生手段は、画像群構造がBピクチャを参照する階層構造の場合に、メモリ管理制御コマンドを発行してPピクチャもしくは Iピクチャの間にある参照Bピクチャを長期間参照ピクチャに登録し、さらに、メモリ管理制御コマンドにより、Pピクチャもしくは Iピクチャで長期間フレームインデックスの最大値を[0]に設定することにより、復号画像バッファ内の長期間参照ピクチャを非参照ピクチャに設定することを特徴とする請求の範囲第1項記載の画像情報符号化装置。

[3] 3．上記メモリ管理制御コマンド発生手段は、画像群構造がBピクチャを参照する階層構造の場合に、Pピクチャもしくは Iピクチャと参照Bピクチャの間にあるBピクチャにおいて参照画像リスト順序コマンドにより参照Bピクチャを参照画像リストの最初に配置することを特徴とする請求の範囲第1項記載の画像情報符号化装置。

[4] 4．上記メモリ管理制御コマンド発生手段は、画像群構造が B0 Br1 B2 I3 B4 Br5 B6 P7 B8 Br9 B10 P11 B12 Br13 B14 P15で、復号処理順序が I3 Br1 B0 B2 P7 Br5 B4 B6 P11 Br9 B8 B10 P15 Br13 B12 B14のような階層構造の場合に、I3で長期間フレームインデックスの最大値を[0]に設定し、Br1でメモリ管理制御コマンドにより長期間フレームインデックスの最大値を[

1]に設定し、Br1を長期間参照ピクチャに設定し、B0で参照画像リスト順序コマンドによりI3及びBr1を参照し、B1で参照画像リスト順序コマンドによりI3及びBr1を参照することで、瞬時復号器更新ピクチャでないIピクチャからのランダムアクセスを行うことを特徴とする請求の範囲第1項記載の画像情報符号化装置。

[5] 5．長期間フレームインデックスの最大値を変更するコマンドを発行することで長期間フレームインデックスを指定することなく復号画像バッファ内の長期間参照ピクチャを開放することを特徴とする請求の範囲第4項記載の画像情報符号化装置。

[6] 6．画像群構造が2つのフィールドを独立した2つのピクチャとして扱うフィールド構造であって、上記メモリ管理制御コマンド発生手段は、長期間フレームインデックスの最大値を変更するコマンドを発行することで長期間フレームインデックスを指定することなく復号画像バッファ内の長期間参照ピクチャを開放することを特徴とする請求の範囲第1項記載の画像情報符号化装置。

[7] 7．動き予測を用いて画像情報の符号化処理を行い、画像圧縮情報を出力する画像情報符号化方法であって、

マルチプルフレーム予測を行う際に、復号画像バッファ内のピクチャを管理するメモリ管理制御コマンドにより、Pピクチャもしくは Iピクチャの間にある参照Bピクチャを長期間参照ピクチャに登録し、

Pピクチャもしくは Iピクチャと参照Bピクチャの間にあるBピクチャにおいて参照画像リスト順序コマンドにより参照Bピクチャを参照画像リストの最初に配置し、

メモリ管理制御コマンドにより、Pピクチャもしくは Iピクチャで長期間フレームインデックスの最大値を[0]に設定することにより、復号画像バッファ内の長期間参照ピクチャを非参照ピクチャに設定し、

瞬時復号器更新ピクチャでないIピクチャからのランダムアクセスを行うことを特徴とする画像情報符号化方法。

[図1]

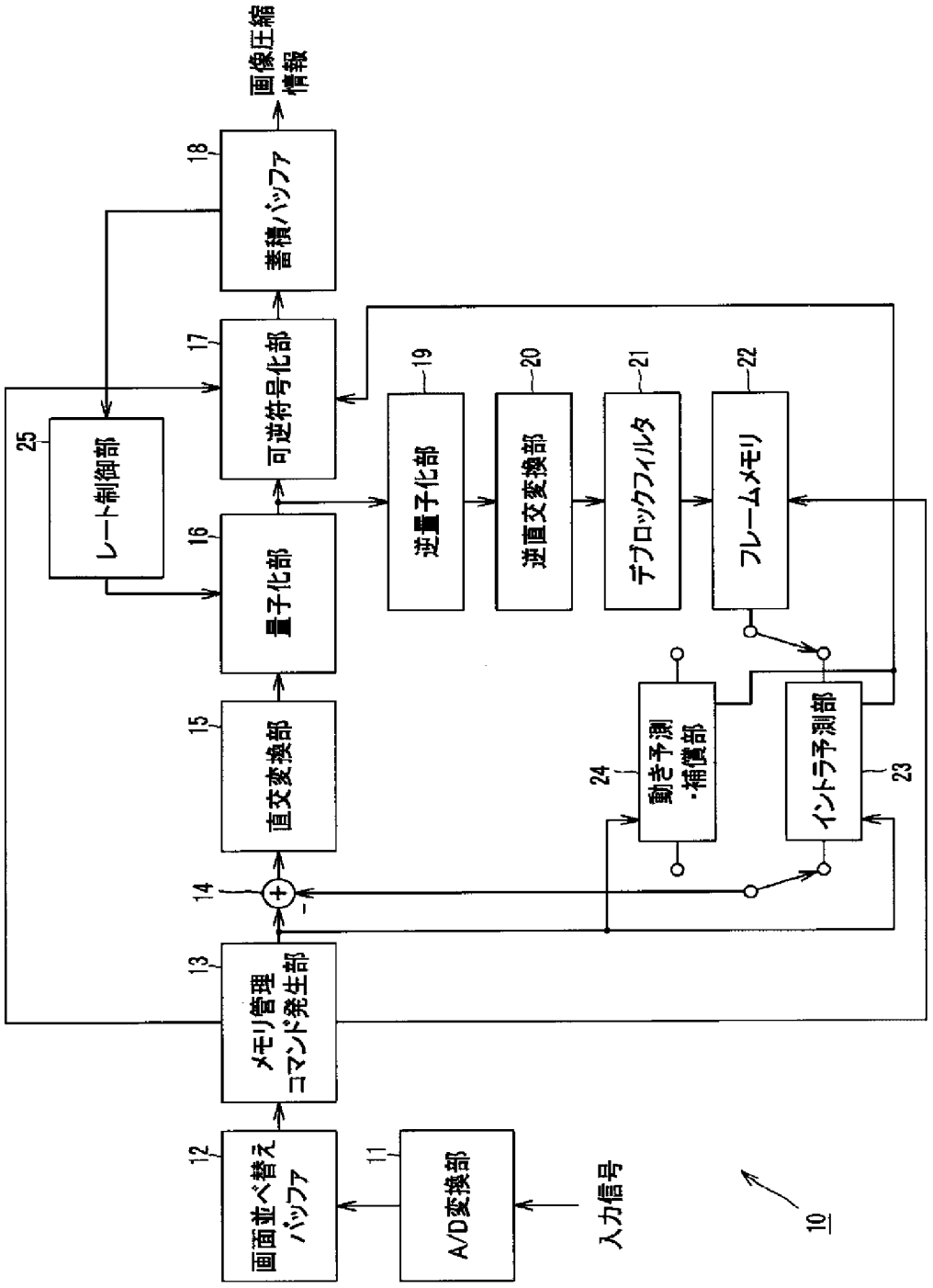

画像圧縮情報
18
蓄積バッファ
17
可逆符号化部
25
レート制御部
16
量子化部
15
直交変換部
14
13
メモリ管理コマンド発生部
12
画面並べ替えバッファ
11
A/D変換部
入力信号
10
19
逆量子化部
20
逆直交変換部
21
デブロックフィルタ
22
フレームメモリ
24
動き予測・補償部
23
イントラ予測部

FIG.1

[図2]

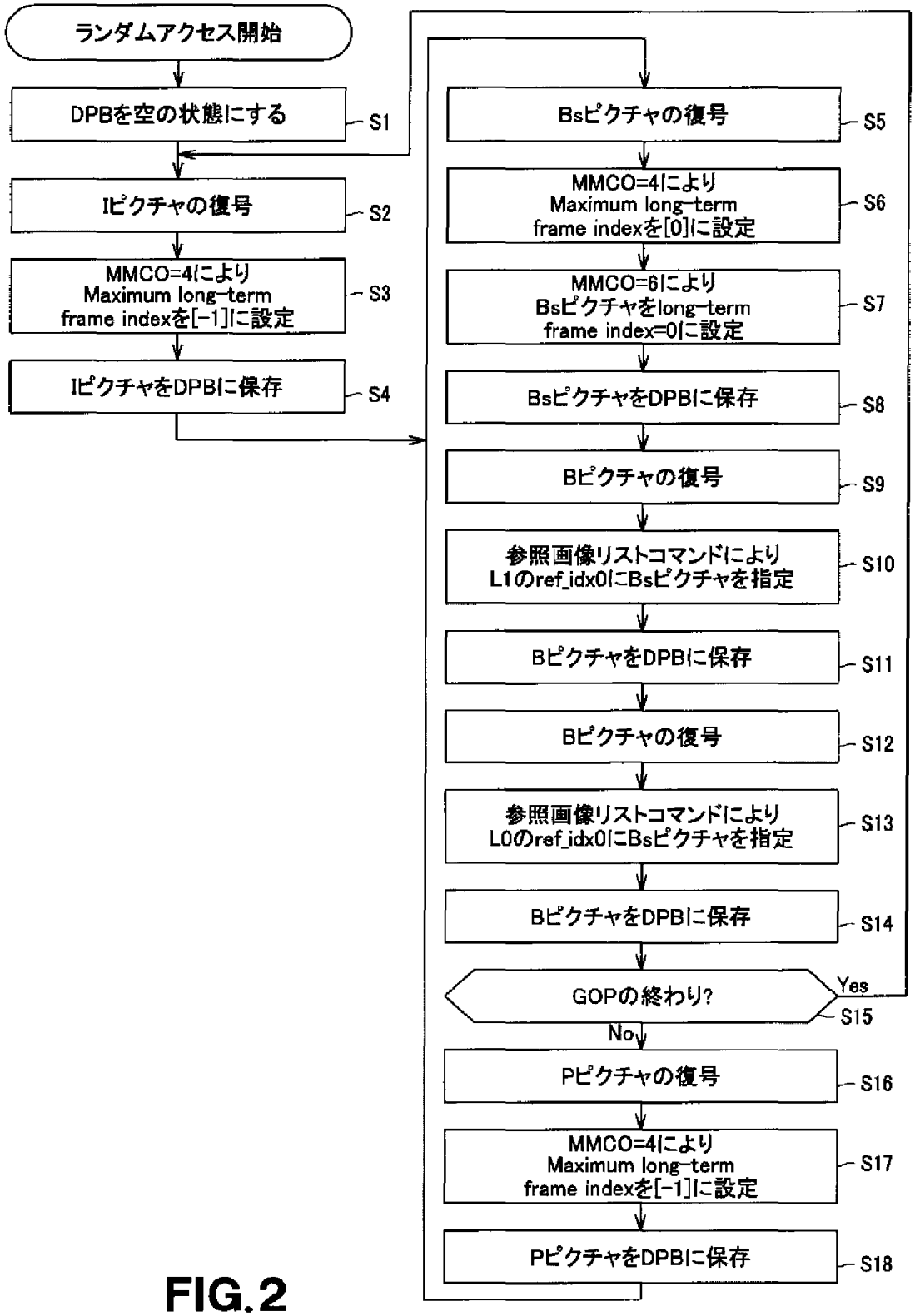

ランダムアクセス開始
DPBを空の状態にする
S1
Iピクチャの復号
S2
MMCO=4により
Maximum long-term
frame indexを[-1]に設定
S3
IピクチャをDPBに保存
S4
Bsピクチャの復号
S5
MMCO=4により
Maximum long-term
frame indexを[0]に設定
S6
MMCO=6により
Bsピクチャをlong-term
frame index=0に設定
S7
BsピクチャをDPBに保存
S8
Bピクチャの復号
S9
参照画像リストコマンドにより
L1のref_idx0にBsピクチャを指定
S10
BピクチャをDPBに保存
S11
Bピクチャの復号
S12
参照画像リストコマンドにより
L0のref_idx0にBsピクチャを指定
S13
BピクチャをDPBに保存
S14
GOPの終わり?
Yes
S15
No
Pピクチャの復号
S16
MMCO=4により
Maximum long-term
frame indexを[-1]に設定
S17
PピクチャをDPBに保存
S18

FIG.2

[図3]

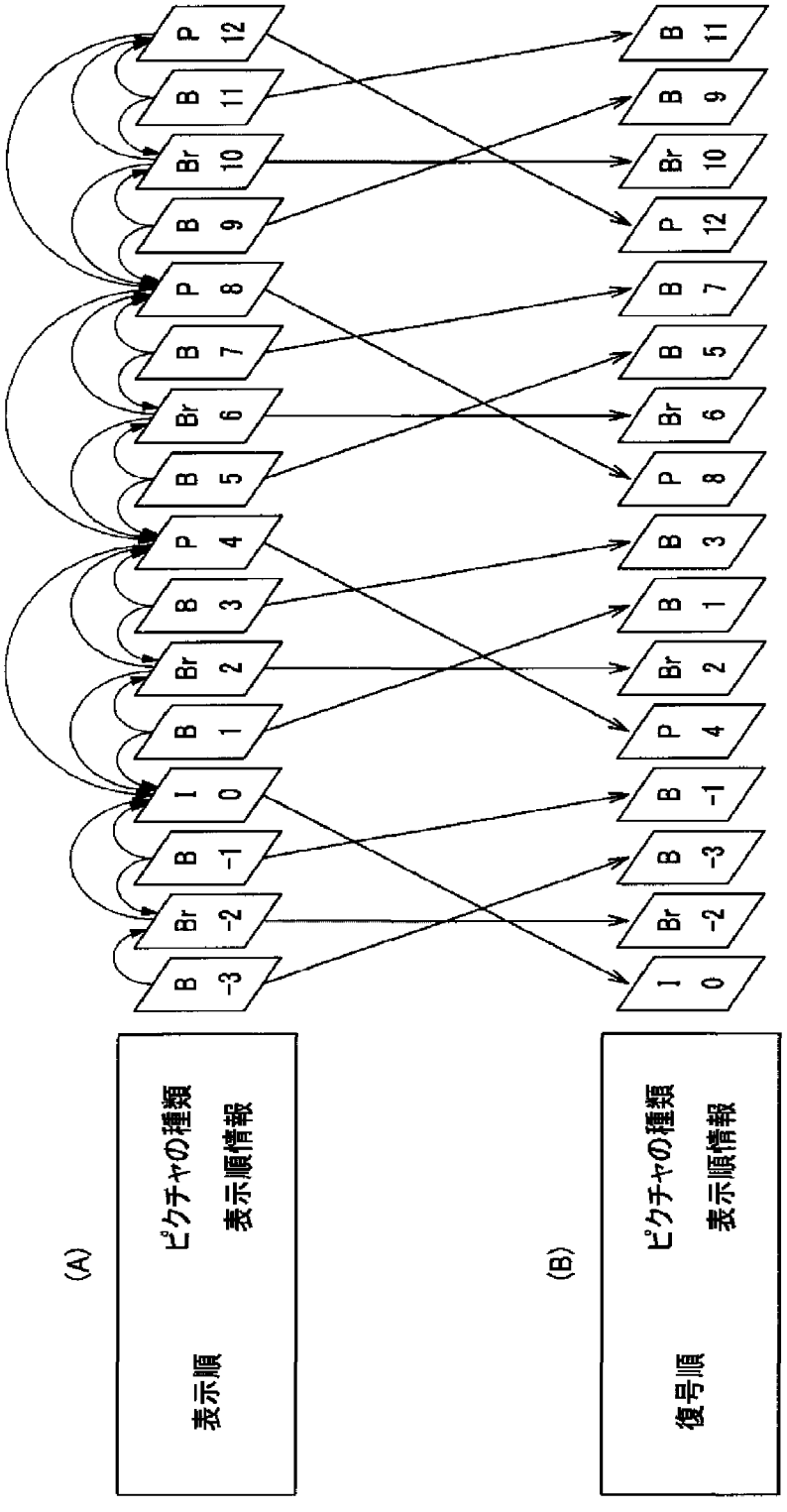

(A)
ピクチャの種類
表示順情報
表示順
B -3
Br -2
B -1
I 0
B 1
Br 2
B 3
P 4
B 5
Br 6
B 7
P 8
B 9
Br 10
B 11
P 12
(B)
ピクチャの種類
表示順情報
復号順
1 0
Br -2
B -3
B -1
P 4
Br 2
B 1
B 3
P 8
Br 6
B 5
B 7
P 12
Br 10
B 9
B 11

FIG.3

[図4]

POC%16	MMCO command	詳細
0	400	long term をすべて破棄
-2	41600	max_long_term_frame_index=0 (1frame分)にし、Bs をLong_term_frame_index=0に設定
4	400	long term をすべて破棄
3	41600	max_long_term_frame_index=0 (1frame分)にし、Bs をLong_term_frame_index=0に設定
8	400	long term をすべて破棄
6	41600	max_long_term_frame_index=0 (1frame分)にし、Bs をLong_term_frame_index=0に設定
12	400	long term をすべて破棄
10	41600	max_long_term_frame_index=0 (1frame分)にし、Bs をLong_term_frame_index=0に設定
14	41600	max_long_term_frame_index=0 (1frame分)にし、Bs をLong_term_frame_index=0に設定

COMMAND == 0 NAL_MMCO_END
COMMAND == 1 NAL_MMCO_MARK_SHORT_TERM_PIC_UNUSED
COMMAND == 2 NAL_MMCO_MARK_LONG_TERM_PIC_UNUSED
COMMAND == 3 NAL_MMCO_ASSIGN_LONG_TERM_FRAME_INDEX
COMMAND == 4 NAL_MMCO_SPECIFY_MAX_LONG_TERM_FRAME_INDEX
COMMAND == 5 NAL_MMCO_RESET_ALL_REF_PIC
COMMAND == 6 NAL_MMCO_ASSIGN_LONG_TERM_FRAME_INDEX_CURRENT

FIG.4

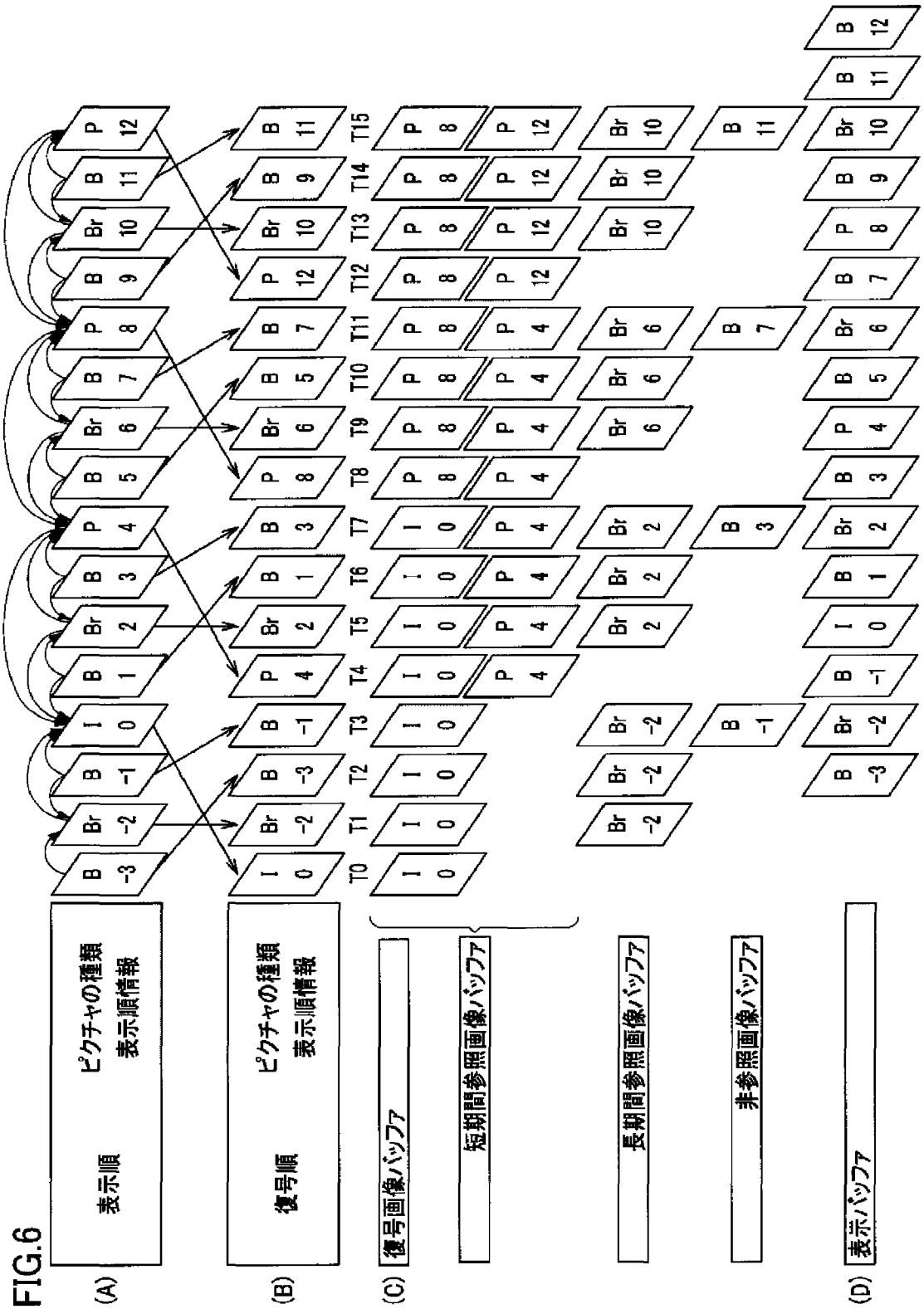
[図5]

POC%16	list	ref_pic_list_reordering	詳細
-3	1	20213	[0] long_term_pic_num 1 に設定する。
-1	0	20213	[0] long_term_pic_num 1 に設定する。
1	1	20213	[0] long_term_pic_num 1 に設定する。
3	0	20213	[0] long_term_pic_num 1 に設定する。
5	1	20213	[0] long_term_pic_num 1 に設定する。
7	0	20213	[0] long_term_pic_num 1 に設定する。
9	1	20213	[0] long_term_pic_num 1 に設定する。
11	0	20213	[0] long_term_pic_num 1 に設定する。
13	1	20213	[0] long_term_pic_num 1 に設定する。
15	0	20213	[0] long_term_pic_num 1 に設定する。

COMMAND == 0 NAL_REORDERING_ABS_DIFF_PIC_NUM_NEGATIVE
COMMAND == 1 NAL_REORDERING_ABS_DIFF_PIC_NUM_POSITIVE
COMMAND == 2 NAL_REORDERING_LONG_TERM_PIC_NUM
COMMAND == 3 NAL_REORDERING_END

FIG.5

[図6]


FIG.6
(A)
表示順
ピクチャの種類
表示順情報
(B)
復号順
ピクチャの種類
表示順情報
(C)
復号画像バッファ
短期間参照画像バッファ
長期間参照画像バッファ
非参照画像バッファ
(D)
表示バッファ
T0
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
T13
T14
T15

[図7]

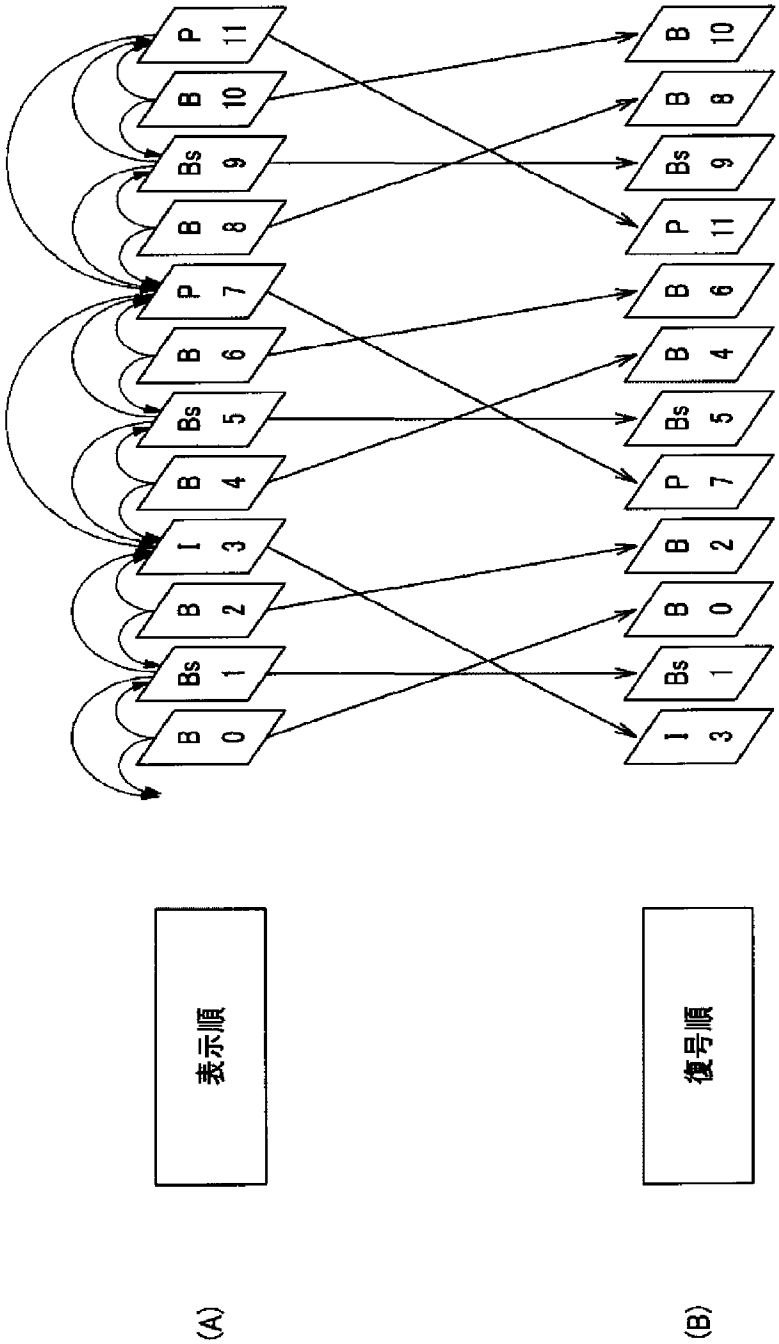

表示順
復号順
(A)
(B)
B 0
Bs 1
B 2
I 3
B 4
Bs 5
B 6
P 7
B 8
Bs 9
B 10
P 11
1 3
Bs 1
B 0
B 2
P 7
Bs 5
B 4
B 6
P 11
Bs 9
B 8
B 10

FIG.7

[図8]

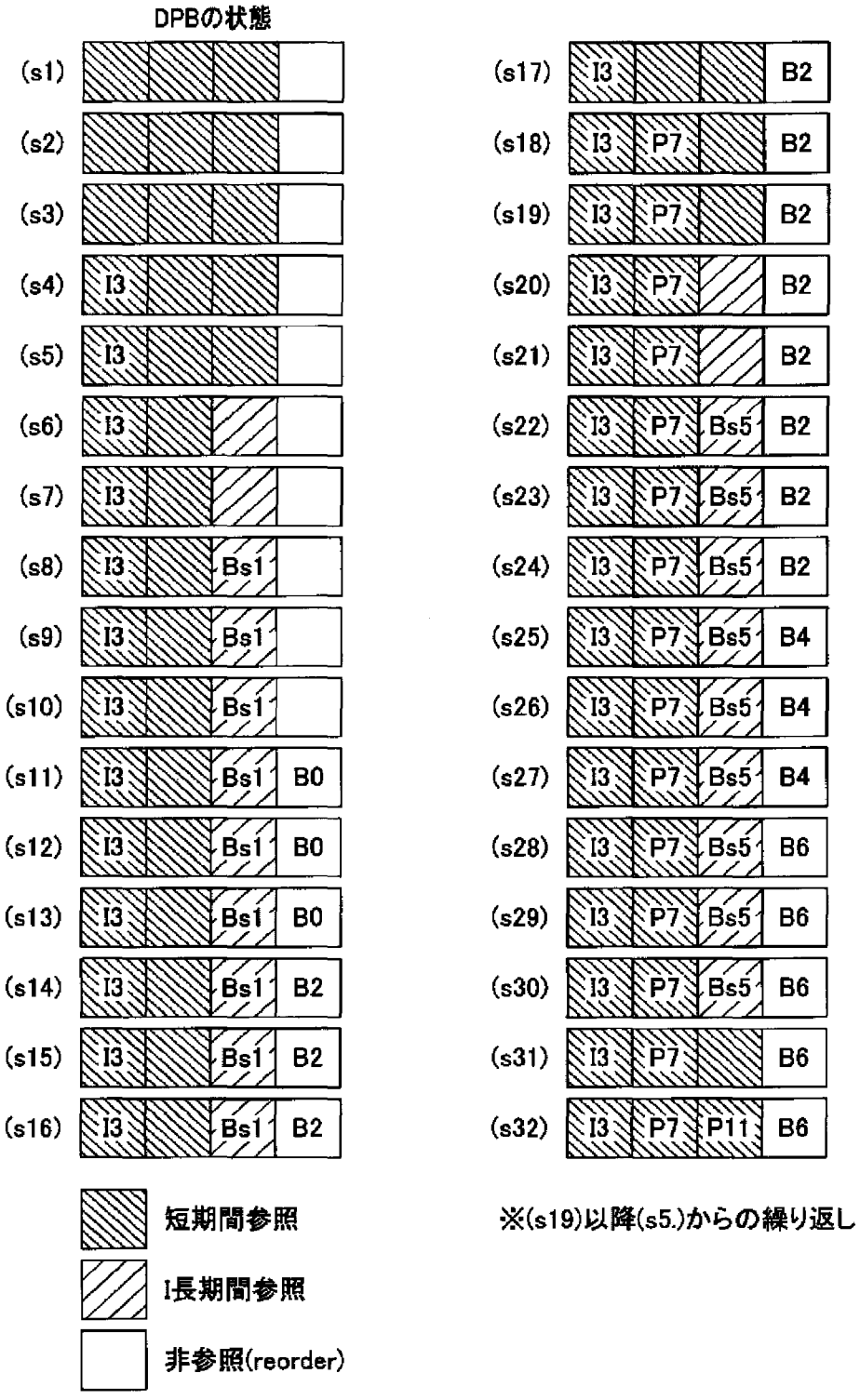

DPBの状態
(s1)
(s2)
(s3)
(s4) I3
(s5) I3
(s6) I3
(s7) I3
(s8) I3 Bs1
(s9) I3 Bs1
(s10) I3 Bs1
(s11) I3 Bs1 B0
(s12) I3 Bs1 B0
(s13) I3 Bs1 B0
(s14) I3 Bs1 B2
(s15) I3 Bs1 B2
(s16) I3 Bs1 B2
(s17) I3 B2
(s18) I3 P7 B2
(s19) I3 P7 B2
(s20) I3 P7 B2
(s21) I3 P7 B2
(s22) I3 P7 Bs5 B2
(s23) I3 P7 Bs5 B2
(s24) I3 P7 Bs5 B2
(s25) I3 P7 Bs5 B4
(s26) I3 P7 Bs5 B4
(s27) I3 P7 Bs5 B4
(s28) I3 P7 Bs5 B6
(s29) I3 P7 Bs5 B6
(s30) I3 P7 Bs5 B6
(s31) I3 P7 B6
(s32) I3 P7 P11 B6
短期間参照
I長期間参照
非参照(reorder)
※(s19)以降(s5.)からの繰り返し

FIG.8

[図9]

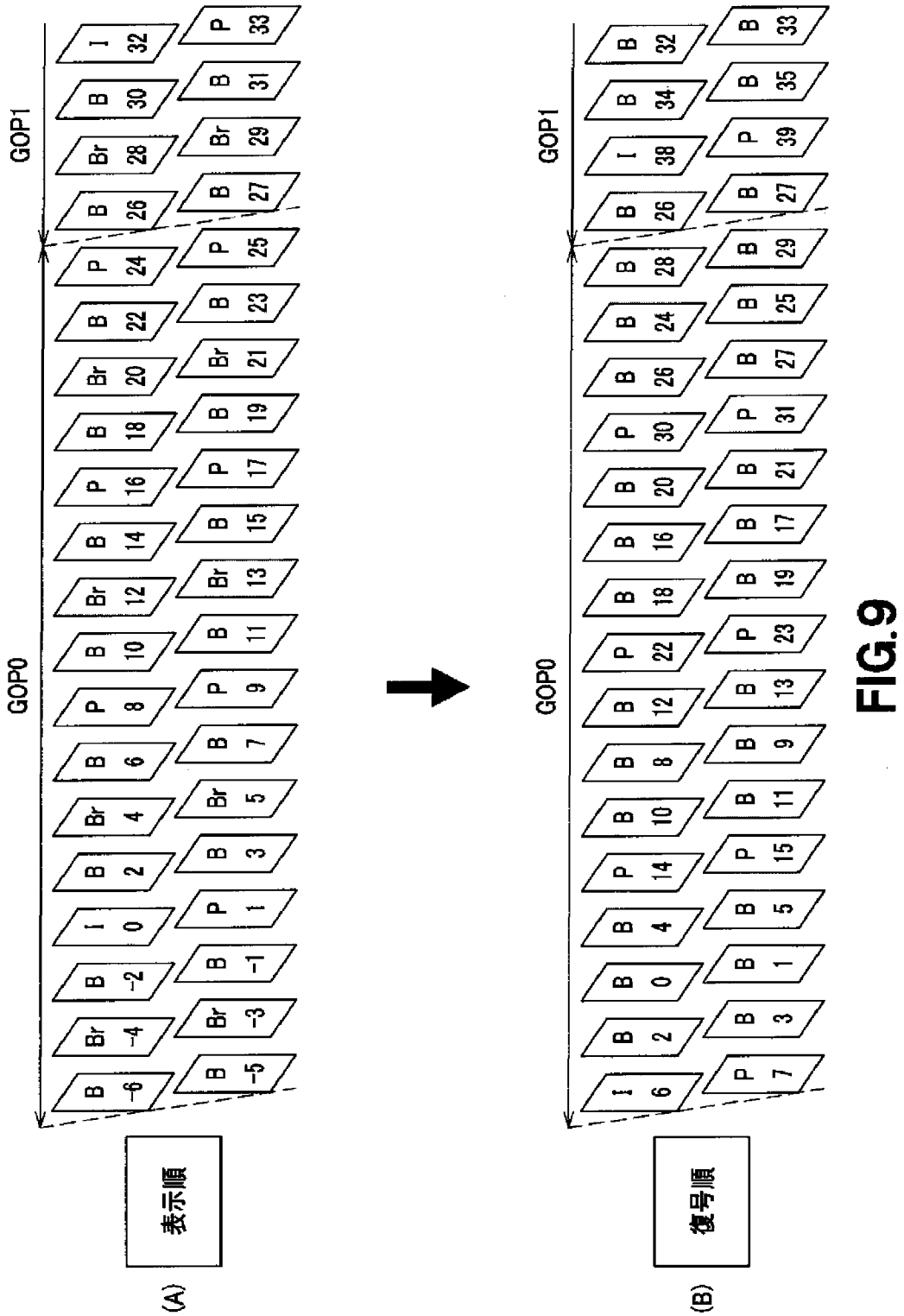

GOP0
GOP1
B -6
Br -4
B -2
I 0
B 2
Br 4
B 6
P 8
B 10
Br 12
B 14
P 16
B 18
Br 20
B 22
P 24
B 26
Br 28
B 30
I 32
B -5
Br -3
B -1
P 1
B 3
Br 5
B 7
P 9
B 11
Br 13
B 15
P 17
B 19
Br 21
B 23
P 25
B 27
Br 29
B 31
P 33
表示順
(A)
GOP0
GOP1
I 6
B 2
B 0
B 4
P 14
B 10
B 8
B 12
P 22
B 18
B 16
B 20
P 30
B 26
B 24
B 28
B 29
I 38
B 34
B 32
P 7
B 3
B 1
B 5
P 15
B 11
B 9
B 13
P 23
B 19
B 17
B 21
P 31
B 27
B 25
P 39
B 35
B 33
復号順
(B)

FIG.9

[図10]

POC%32	MMCO command	詳細
0	400	long term をすべて破棄
-3	41300600	max_long_term_frame_index=0 (1frame分)に、Bs topとBs botをLong_term_frame_index=0に設定
8	400	long term をすべて破棄
5	41300600	max_long_term_frame_index=0 (1frame分)に、Bs topとBs botをLong_term_frame_index=0に設定
16	400	long term をすべて破棄
13	41300600	max_long_term_frame_index=0 (1frame分)に、Bs topとBs botをLong_term_frame_index=0に設定
24	400	long term をすべて破棄
21	41300600	max_long_term_frame_index=0 (1frame分)に、Bs topとBs botをLong_term_frame_index=0に設定
29	41300600	max_long_term_frame_index=0 (1frame分)に、Bs topとBs botをLong_term_frame_index=0に設定

COMMAND == 0 NAL_MMCO_END
COMMAND == 1 NAL_MMCO_MARK_SHORT_TERM_PIC_UNUSED
COMMAND == 2 NAL_MMCO_MARK_LONG_TERM_PIC_UNUSED
COMMAND == 3 NAL_MMCO_ASSIGN_LONG_TERM_FRAME_INDEX
COMMAND == 4 NAL_MMCO_SPECIFY_MAX_LONG_TERM_FRAME_INDEX
COMMAND == 5 NAL_MMCO_RESET_ALL_REF_PIC
COMMAND == 6 NAL_MMCO_ASSIGN_LONG_TERM_FRAME_INDEX_CURRENT

FIG.10

[図11]

POC%32	list	ref_pic_list_reordering	詳細
-6	1	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
-5	1	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
-2	0	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
-1	0	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
1	0	003	[0] I-pictureに設定する。
2	1	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
3	1	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
6	0	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
7	0	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
10	1	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
11	1	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
14	0	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
15	0	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
18	1	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
19	1	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
22	0	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
23	0	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
26	1	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
27	1	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
30	0	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。
31	0	20213	[0] long_term_pic_num 1 [1] long_term_pic_num 0に設定する。

COMMAND == 0 NAL_REORDERING_ABS_DIFF_PIC_NUM_NEGATIVE
COMMAND == 1 NAL_REORDERING_ABS_DIFF_PIC_NUM_POSITIVE
COMMAND == 2 NAL_REORDERING_LONG_TERM_PIC_NUM
COMMAND == 3 NAL_REORDERING_END

FIG.11

[図12A]

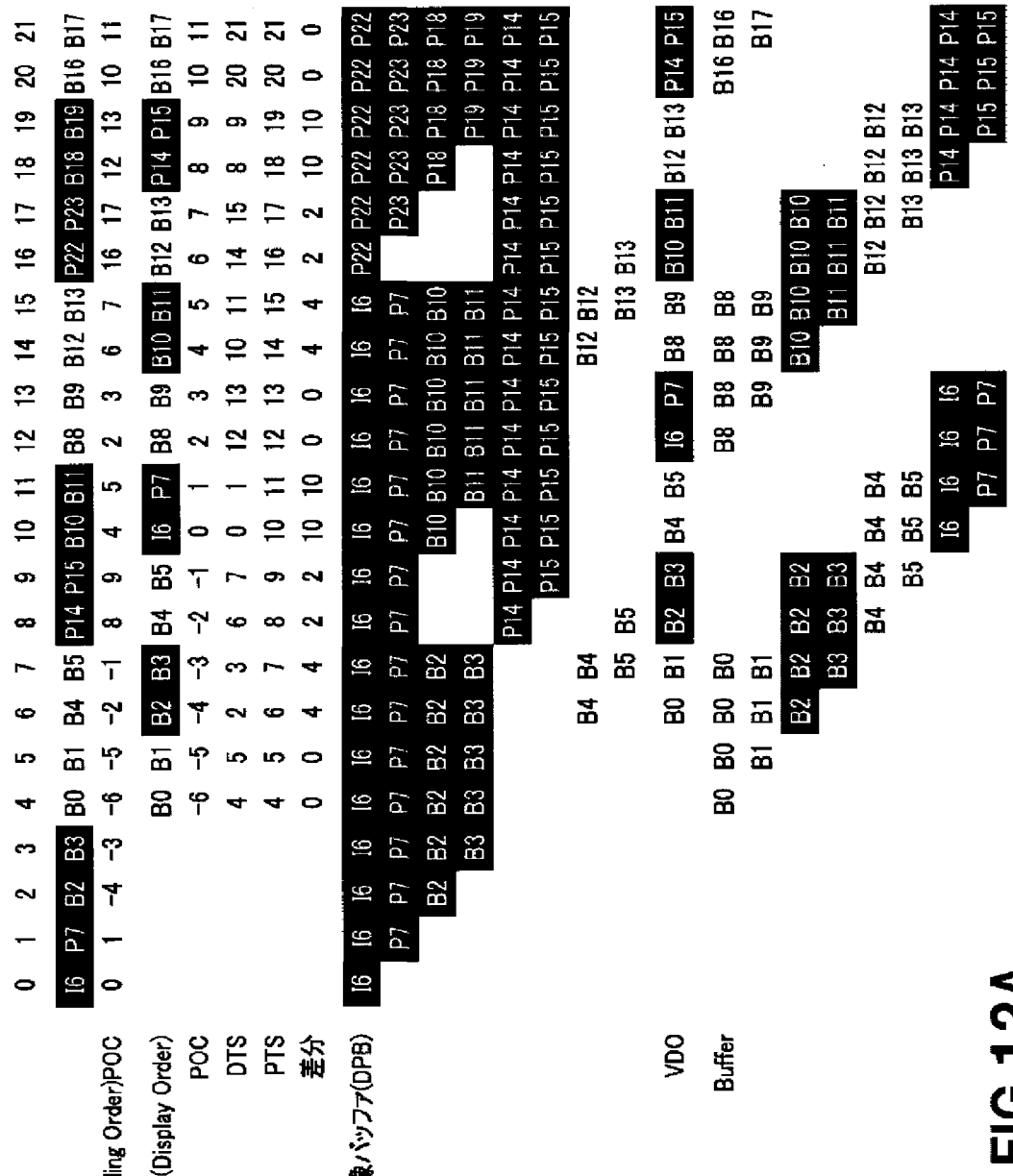

符号化順(Coding Order)/POC
表示順(Display Order)
POC
DTS
PTS
差分
復号画像/バッファ(DPB)
VDO
Buffer

FIG.12A

[図12B]


符号化順(Coding Order)POC
表示順(Display Order)
POC
DTS
PTS
差分
復号画像バッファ(DPB)
VDO
Buffer

FIG.12B

[図13]

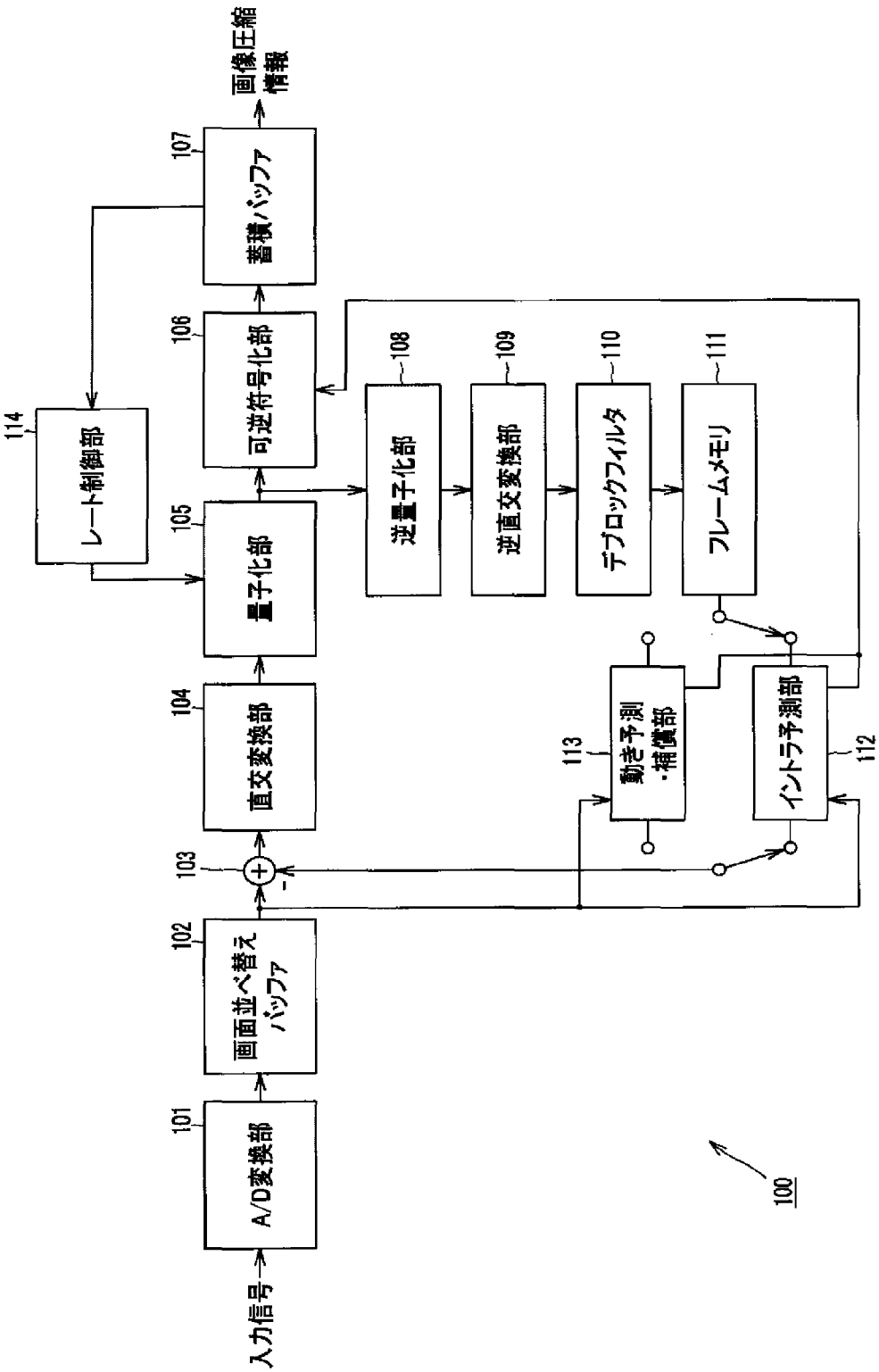

入力信号
A/D変換部
101
画面並べ替えバッファ
102
103
直交変換部
104
量子化部
105
可逆符号化部
106
蓄積バッファ
107
画像圧縮情報
レート制御部
114
逆量子化部
108
逆直交変換部
109
デブロックフィルタ
110
フレームメモリ
111
動き予測・補償部
113
イントラ予測部
112
100

FIG.13

[図14]

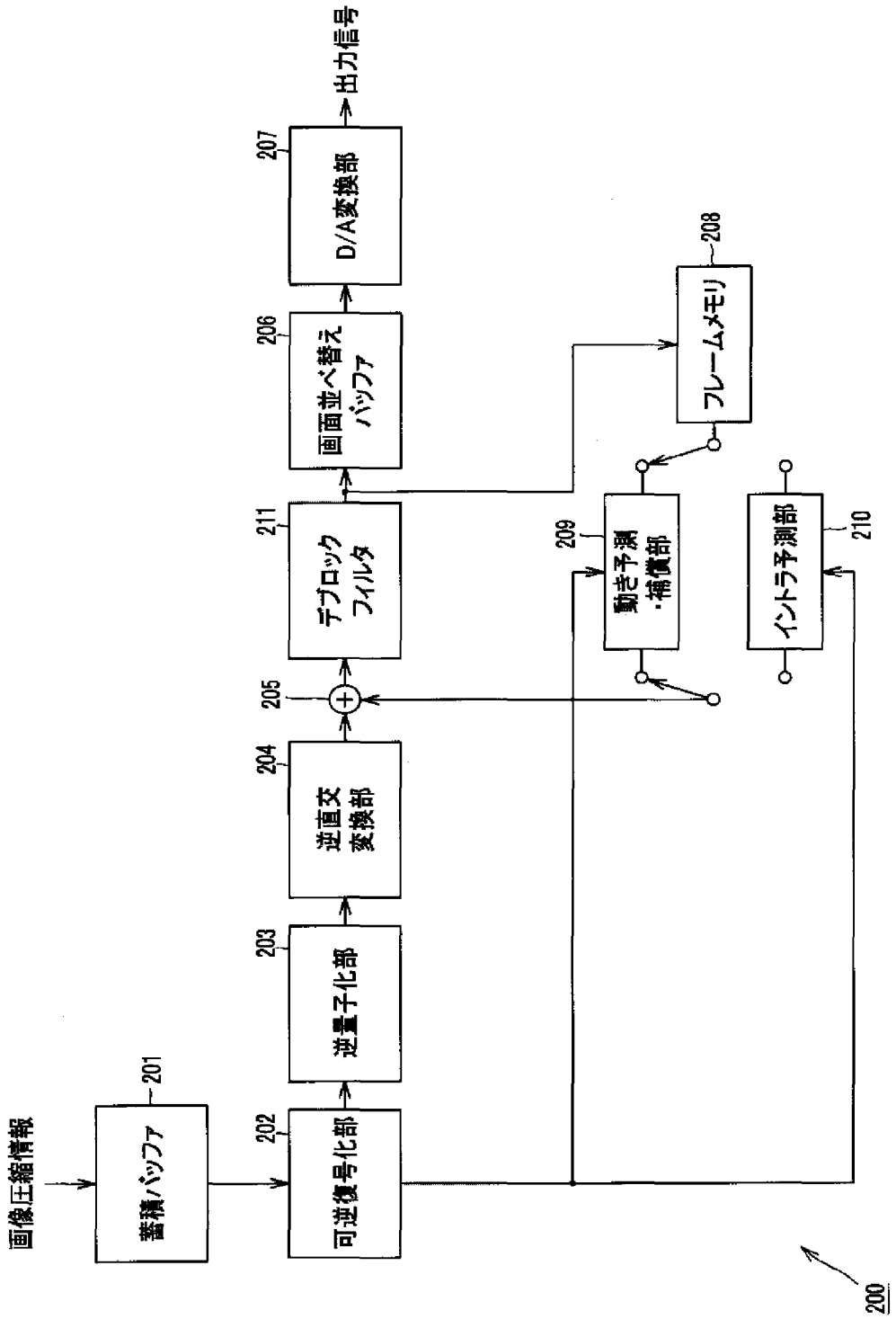

画像圧縮情報
蓄積バッファ
201
可逆復号化部
202
逆量子化部
203
逆直交変換部
204
205
デブロックフィルタ
211
画面並べ替えバッファ
206
D/A変換部
207
出力信号
フレームメモリ
208
動き予測・補償部
209
イントラ予測部
210
200

FIG.14

[図15]

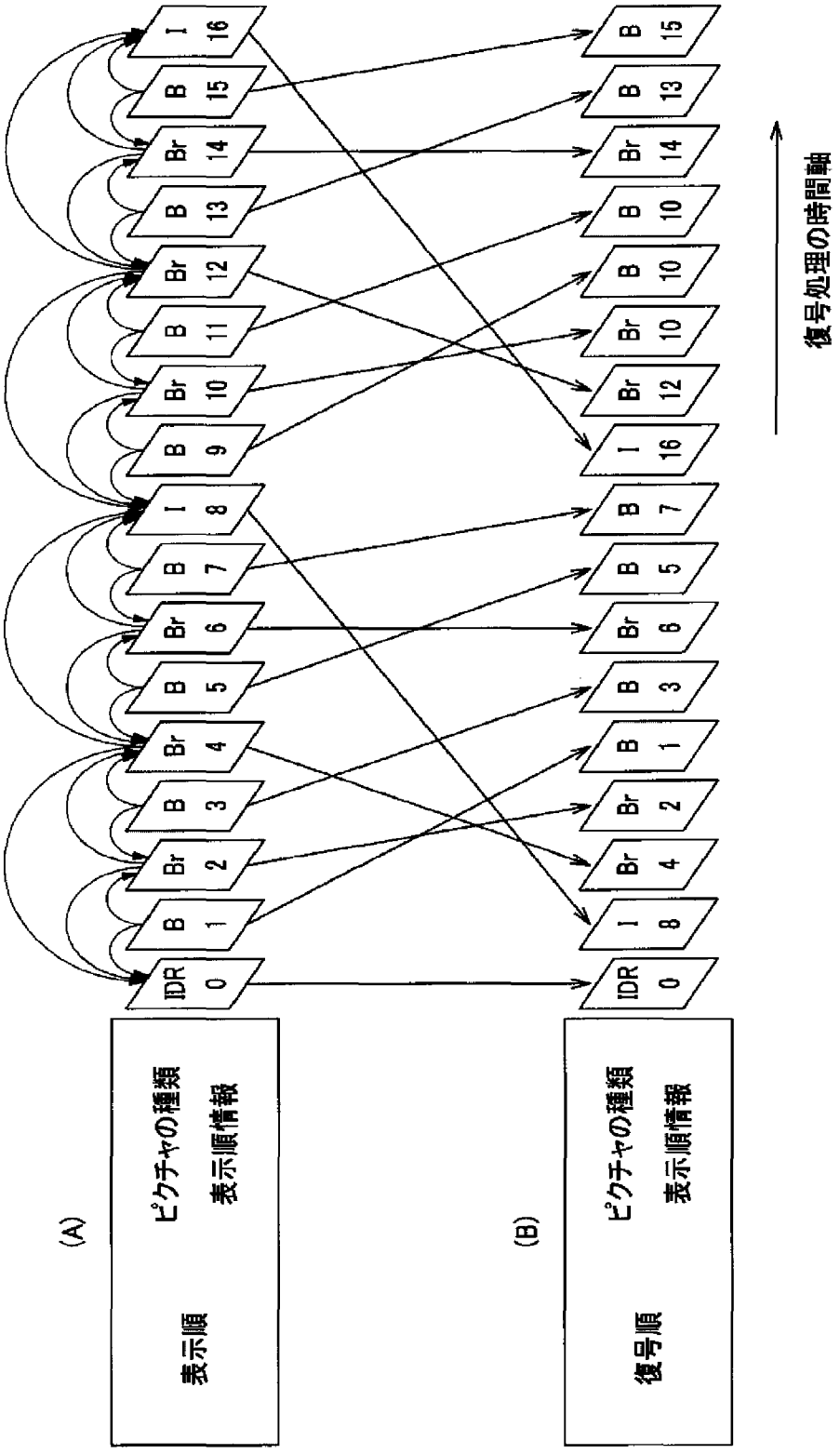

(A)
ピクチャの種類
表示順情報
表示順
IDR 0
B 1
Br 2
B 3
Br 4
B 5
Br 6
B 7
I 8
B 9
Br 10
B 11
Br 12
B 13
Br 14
B 15
I 16
(B)
ピクチャの種類
表示順情報
復号順
IDR 0
I 8
Br 4
B 1
Br 2
B 3
Br 6
B 5
B 7
I 16
Br 12
Br 10
B 10
B 10
Br 14
B 13
B 15
復号処理の時間軸

FIG.15

[図16]

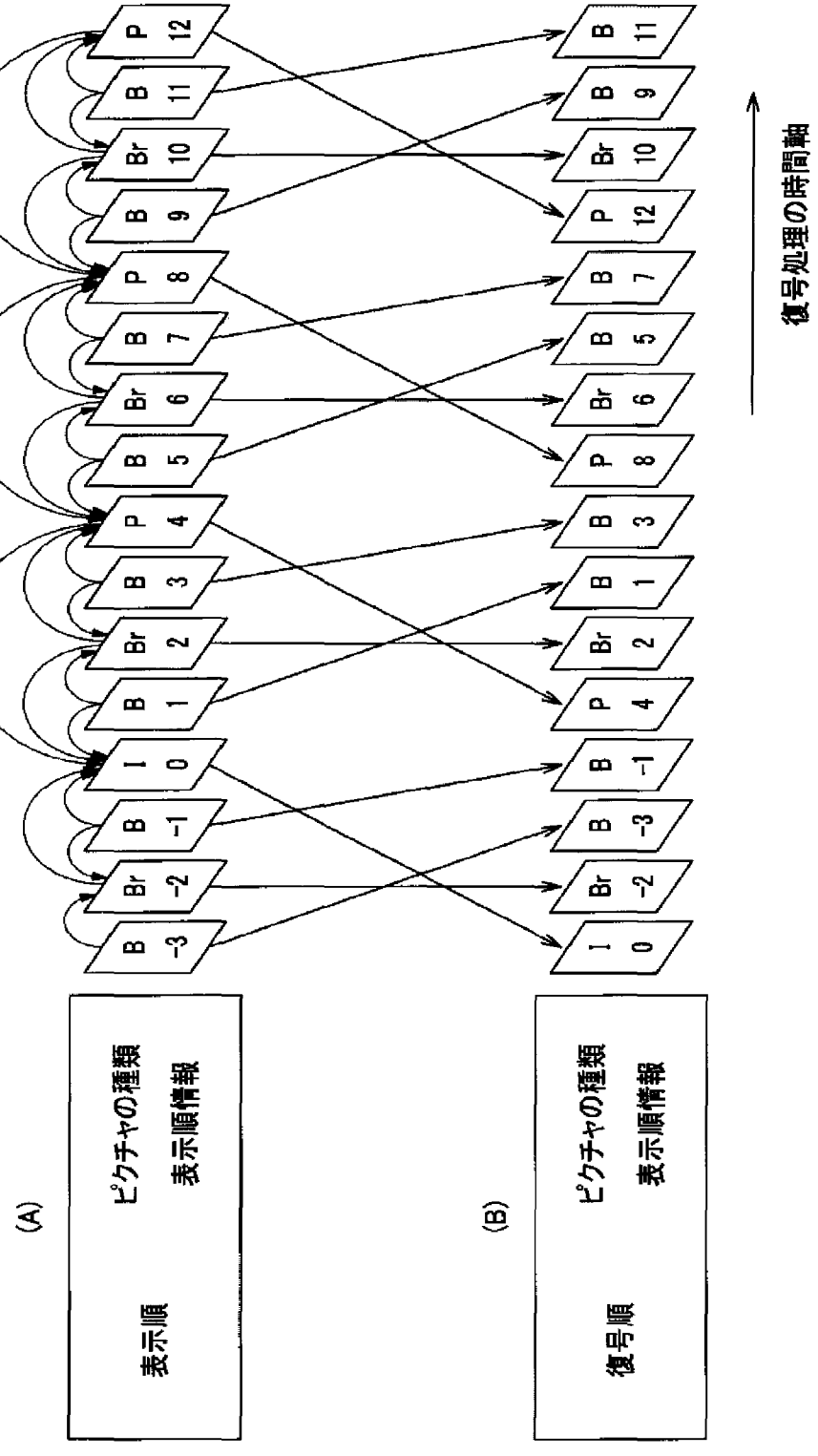
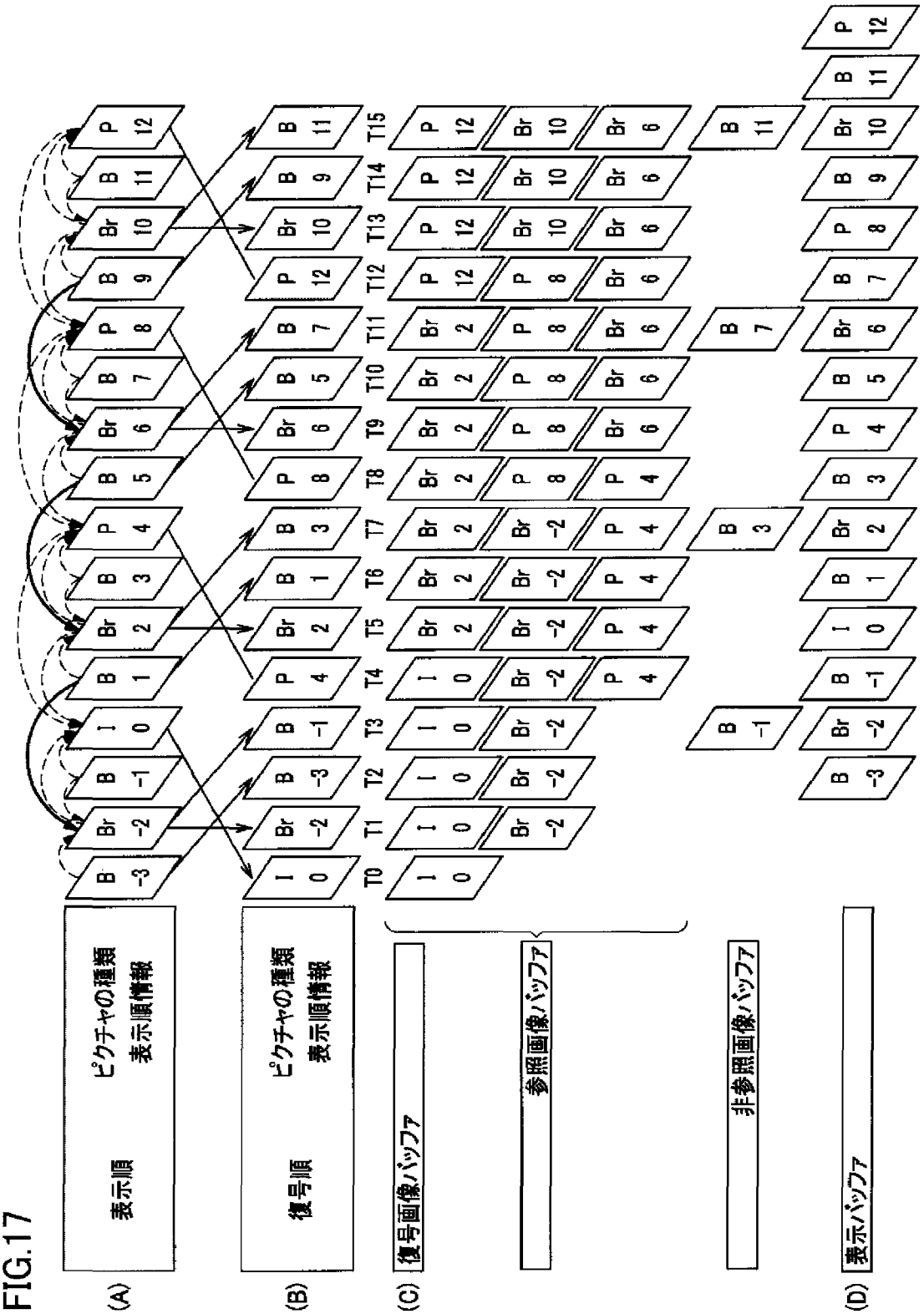

(A)
ピクチャの種類
表示順情報
表示順
B -3
Br -2
B -1
I 0
B 1
Br 2
B 3
P 4
B 5
Br 6
B 7
P 8
B 9
Br 10
B 11
P 12
(B)
ピクチャの種類
表示順情報
復号順
I 0
Br -2
B -3
B -1
P 4
Br 2
B 1
B 3
P 8
Br 6
B 5
B 7
P 12
Br 10
B 9
B 11
復号処理の時間軸

FIG.16

[図17]

FIG.17


(A)
ピクチャの種類
表示順情報
表示順
(B)
ピクチャの種類
表示順情報
復号順
(C)
復号画像バッファ
参照画像バッファ
非参照画像バッファ
(D)
表示バッファ
T0
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
T13
T14
T15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/053248

A. CLASSIFICATION OF SUBJECT MATTER
H04N7/32(2006.01)i, *H04N5/92*(2006.01)n

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04N7/32, H04N5/92

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2008
Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004-248265 A (Matsushita Electric Industrial Co., Ltd.), 02 September, 2004 (02.09.04), Full text; all drawings & US 2006/0056705 A1 & EP 1589760 A1 & WO 2004/066633 A1 & KR10-2005-0089797 A & CN 1739299 A	1-7
A	JP 2004-187264 A (NTT Docomo Inc.), 02 July, 2004 (02.07.04), Par. Nos. [0018] to [0020] & US 2004/0071354 A1 & EP 1408698 A2 & KR 10-2004-0033275 A & CN 1512753 A	1-7

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 April, 2008 (04.04.08)	15 April, 2008 (15.04.08)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/053248

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2005/107253 A1 (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.), 10 November, 2005 (10.11.05), Full text; all drawings & US 2007/0116426 A1 & KR 10-2007-0000429 A & CN 1951113 A	1-7

国際調査報告

国際出願番号　ＰＣＴ／ＪＰ２００８／０５３２４８

Ａ．　発明の属する分野の分類（国際特許分類（ＩＰＣ））

Int.Cl.　H04N7/32(2006.01)i, H04N5/92(2006.01)n

Ｂ．　調査を行った分野

調査を行った最小限資料（国際特許分類（ＩＰＣ））

Int.Cl.　H04N7/32, H04N5/92

最小限資料以外の資料で調査を行った分野に含まれるもの

日本国実用新案公報	１９２２－１９９６年
日本国公開実用新案公報	１９７１　２００８年
日本国実用新案登録公報	１９９６－２００８年
日本国登録実用新案公報	１９９４－２００８年

国際調査で使用した電子データベース（データベースの名称、調査に使用した用語）

Ｃ．　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求の範囲の番号
A	JP 2004-248265 A (松下電器産業株式会社) 2004.09.02, 全文, 全図 & US 2006/0056705 A1 & EP 1589760 A1 & WO 2004/066633 A1 & KR 10-2005-0089797 A & CN 1739299 A	１－７
A	JP 2004-187264 A (株式会社エヌ・ティ・ティ・ドコモ) 2004.07.02, 段落【0018】-【0020】 & US 2004/0071354 A1 & EP 1408698 A2 & KR 10-2004-0033275 A & CN 1512753 A	１－７

☑　Ｃ欄の続きにも文献が列挙されている。

☐　パテントファミリーに関する別紙を参照。

＊　引用文献のカテゴリー

「Ａ」特に関連のある文献ではなく、一般的技術水準を示すもの

「Ｅ」国際出願日前の出願または特許であるが、国際出願日以後に公表されたもの

「Ｌ」優先権主張に疑義を提起する文献又は他の文献の発行日若しくは他の特別な理由を確立するために引用する文献（理由を付す）

「Ｏ」口頭による開示、使用、展示等に言及する文献

「Ｐ」国際出願日前で、かつ優先権の主張の基礎となる出願の日の後に公表された文献

「Ｔ」国際出願日又は優先日後に公表された文献であって出願と矛盾するものではなく、発明の原理又は理論の理解のために引用するもの

「Ｘ」特に関連のある文献であって、当該文献のみで発明の新規性又は進歩性がないと考えられるもの

「Ｙ」特に関連のある文献であって、当該文献と他の１以上の文献との、当業者にとって自明である組合せによって進歩性がないと考えられるもの

「＆」同一パテントファミリー文献

国際調査を完了した日	国際調査報告の発送日
０４．０４．２００８	１５．０４．２００８

国際調査機関の名称及びあて先
日本国特許庁（ＩＳＡ／ＪＰ）
郵便番号１００－８９１５
東京都千代田区霞が関三丁目４番３号

特許庁審査官（権限のある職員）　５Ｃ　３８６３
坂東　大五郎
電話番号　０３－３５８１－１１０１　内線　３５４１

Ｃ（続き）．　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求の範囲の番号
A	WO 2005/107253 A1 (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.) 2005.11.10, 全文, 全図 & US 2007/0116426 A1 & KR 10-2007-0000429 A & CN 1951113 A	１－７

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	REFERENCE PICTURE SIGNALING
First Named Inventor/Applicant Name:	Jonatan Samuelsson
Filer:	Vernon H. Guthrie Jr./Meredith Downing
Attorney Docket Number:	9900-34860US3

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	280	280
UTILITY SEARCH FEE	1111	1	600	600
UTILITY EXAMINATION FEE	1311	1	720	720
Pages:				
Claims:				
INDEPENDENT CLAIMS IN EXCESS OF 3	1201	3	420	1260
Miscellaneous-Filing:				
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**2860**

Electronic Acknowledgement Receipt

EFS ID:	27287353
Application Number:	15299997
International Application Number:	
Confirmation Number:	3363
Title of Invention:	REFERENCE PICTURE SIGNALING
First Named Inventor/Applicant Name:	Jonatan Samuelsson
Customer Number:	20792
Filer:	Vernon H. Guthrie Jr./Meredith Downing
Filer Authorized By:	Vernon H. Guthrie Jr.
Attorney Docket Number:	9900-34860US3
Receipt Date:	21-OCT-2016
Filing Date:	
Time Stamp:	14:51:23
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$2860
RAM confirmation Number	102416INTEFSW14542500
Deposit Account	500220
Authorized User	Meredith Downing

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.17 (Patent application and reexamination processing fees)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	P34860_US3_2016-10-21_Transmittal.pdf	150483 b4ba82ebbf8d893a1f35b284c83b444a6fb0faab	no	2
Warnings:					
Information:					
2	Application Data Sheet	P34860_US3_2016-10-21_ADS.pdf	807363 d8907582b422e64a76315524069 44f5c5344e73f	no	8
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
3		P34860_US3_2016-10-21_Specification.pdf	5993193 a2a442d3bf84ad94b069b4201e30467f887177a9	yes	54

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Specification	1	48
Claims	49	53
Abstract	54	54

Warnings:					
Information:					
4	Drawings-only black and white line drawings	P34860_US3_2016-10-21_Figures.pdf	235920 88d08fceefb786a3eca1ad2da85f239ee29219d1	no	12
Warnings:					
Information:					

5	Oath or Declaration filed	P34860_US3_2016-10-21_Declaration.pdf	179863 d4288f306ac871e7db28bf0d3c7c69c26ea8f381	no	2
Warnings:					
Information:					
6		P34860_US3_2016-10-21_373POA.pdf	320591 a51d61c5b460c9ff081c7300c094c934149c2363	yes	4

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Assignee showing of ownership per 37 CFR 3.73	1	2
	Power of Attorney	3	4

Warnings:					
Information:					
7		P34860_US3_2016-10-21_IDS.pdf	438672 787d054052ab4e52272e94124644c40ab23a476b	yes	4

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Transmittal Letter	1	2
	Information Disclosure Statement (IDS) Form (SB08)	3	4

Warnings:					
Information:					
8	Non Patent Literature	P34860_Borgwardt.pdf	922562 a0bd19c9ad97c0a743dfbd8ef6ed1a9c95f05c09	no	18
Warnings:					
Information:					
9	Foreign Reference	P34860_EP1742480.pdf	2745235 64eaa416943424c4e4b524d1780d61425b36c2b8	no	55
Warnings:					
Information:					

10	Other Reference-Patent/App/Search documents	P34860_EPexam.pdf	297596 94dba23d4c788403982a49f48157ba66153 1dae8	no	8
Warnings:					
Information:					
11	Other Reference-Patent/App/Search documents	P34860_ISR.pdf	603695 c176dc37f191cce61b36e40e8d5cd967041 d4954	no	13
Warnings:					
Information:					
12	Non Patent Literature	P34860_JCTVC.pdf	229201 6a49f0e310a6a397c3dbb4f6261e3331c6fe 44f1	no	2
Warnings:					
Information:					
13	Foreign Reference	P34860_JP5616562.pdf	2947945 e9090effa4f619f773f4a1f01bbb52450da2e 7e9	no	50
Warnings:					
Information:					
14	Foreign Reference	P34860_JP2008105389.pdf	1078784 5692ee053c46d6fbafb5225c0bff51b1350b dbe2	no	22
Warnings:					
Information:					
15	Other Reference-Patent/App/Search documents	P34860_JPOA1.pdf	144711 2b0df5551e392b953924cbfff94282bd9028 adb3	no	6
Warnings:					
Information:					
16	Other Reference-Patent/App/Search documents	P34860_JPOA2.pdf	110481 5e4c1ed04974e622289a7ea9ef216090d7e 134b6	no	6
Warnings:					
Information:					

17	Foreign Reference	P34860_RU2328090.pdf	857348 5a57bbf4de73c7571c6e7341ead2ea8ae89f bd37	no	19
Warnings:					
Information:					
18	Other Reference-Patent/App/Search documents	P34860_RUdecision.pdf	542744 a47f7703b9d6aeeec4f32c6893745fbf0e7ca 4c1	no	16
Warnings:					
Information:					
19	Non Patent Literature	P34860_Shen.pdf	577817 0f744348f883bcc4b8308c161030471b31d 36b8b	no	7
Warnings:					
Information:					
20	Non Patent Literature	P34860_Sjoberg.pdf	1105405 2e4f0c14520f0b6d5b767d8cf7702b67ab64 3301	no	15
Warnings:					
Information:					
21	Non Patent Literature	P34860_Sjoberg2.pdf	1883072 03e69f9f4324972fdbe47dd8f2a80dcd20db 5dcc	no	28
Warnings:					
Information:					
22	Non Patent Literature	P34860_Sjoberg3.pdf	440987 7378aa1edd4127d3a8d2ff669e994cf08134 31f7	no	10
Warnings:					
Information:					
23	Foreign Reference	P34860_WO2008105389.pdf	1768879 1e533145f18fd0a498c163f2fe7ff84726f2d8 c0	no	44
Warnings:					
Information:					

24	Fee Worksheet (SB06)	fee-info.pdf	36971 95a755df067740d063d084ca548d4ff5164a1ad7	no	2

Warnings:	
Information:	
Total Files Size (in bytes):	24419518

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
15/299,997	10/21/2016	2482	2860	9900-34860US3	20	6

CONFIRMATION NO. 3363

20792
MYERS BIGEL, P.A.
PO BOX 37428
RALEIGH, NC 27627

FILING RECEIPT

OC000000088899213

Date Mailed: 11/02/2016

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Jonatan Samuelsson, Stockholm, SWEDEN;
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Applicant(s)

Telefonaktiebolaget LM Ericsson (publ), Stockholm, SWEDEN;

Power of Attorney: The patent practitioners associated with Customer Number 20792

Domestic Priority data as claimed by applicant

This application is a CON of 13/508,442 04/25/2013
which is a 371 of PCT/SE2012/050439 04/26/2012
which claims benefit of 61/503,019 06/30/2011

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 11/01/2016

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/299,997**

Projected Publication Date: 02/09/2017

Non-Publication Request: No

Early Publication Request: No

Title

REFERENCE PICTURE SIGNALING

Preliminary Class

375

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 15/299,997

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	280
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	600
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	720
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*			OR	x 80 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	6 minus 3 =	* 3				x 420 =	1260
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	2860

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/299,997	10/21/2016	Jonatan Samuelsson	9900-34860US3	3363

20792 7590 01/26/2017

MYERS BIGEL, P.A.
PO BOX 37428
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EXAMINER	
RAHMAN, MOHAMMAD J	

ART UNIT	PAPER NUMBER
2487	

MAIL DATE	DELIVERY MODE
01/26/2017	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 15/299,997	Applicant(s) SAMUELSSON ET AL.	
	Examiner MOHAMMAD J. RAHMAN	Art Unit 2487	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10/21/2016*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *1-20* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-20* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *10/21/2016* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date *10/21/2016*.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

1. The present application is being examined under the pre-AIA first to invent provisions.

Detailed Action

2. This office Action is in response to an application filed on 10/21/2016 claiming priority to CON of 13/508,442 filed on 04/25/2013 claiming priority to 371 of PCT/SE2012/050439 filed on 04/26/2012 and 61/503,019 filed on 06/30/2011, in which claims 1-20 are pending and are being examined.

Information Disclosure Statement

3. This information disclosure statement (IDS) submitted on 10/21/2016. The submission is in compliance with the provisions of 37 CFR 1.97 and 37 CFR 1.98. Accordingly, the information disclosure statement is being considered by the examiner.

Examiner's Note

4. Claims 1-7 refer to "A method of decoding an encoded representation of a picture", Claims 8-12 refer to " A decoder configured to decode an encoded representation of a picture", Claim 13 refers to "A receiver", Claim 14 refers to "A decoder", Claims 15-16 refer to " A method of encoding a picture in a video stream", Claims 17-18 refer to "An encoder configured to encode a picture in a video stream" and Claims 19-20 refer to "An encoder". Claims 8-20 are similarly rejected in light of rejection of claims 1-7 or any combination thereof. It is well known in the art that encoding and decoding are reverse processes of video coding method/system. Claim 13 is an independent claim but a limitation is dependent upon claim 8, it is suggested to re-write the claim as a complete independent form or a dependent form for further advancement of the prosecution and avoid any confusion related to claim construction, e.g., Pfizer, Inc. v. Ranbaxy Laboratories Ltd., No. 06-1179 (Fed. Cir. Aug. 2, 2006).

Double Patenting

5. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP §§ 706.02(l)(1) - 706.02(l)(3) for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

6. Claim 1, 8, 13, 14, 15, 17 and 19 rejected on the ground of nonstatutory double patenting as being unpatentable over claim 1 of U.S. Patent No. US 9,247,262 B2. Although the claims at issue are not identical, they are not patentably distinct from each other because the subject matter claimed in the instant application is anticipated by the Conflicting patent and is covered by the patent since the patent and the application are claiming common subject matter, below is a list of limitations that perform the same function, however, different terminology may be used in both sets to describe the limitations, as follows, Claim 1 is used as an example to analyze the common subject matter:

Conflicting Patent No. US 9,247,262 B2	Instant Application:-15/299,997
1. A method of decoding an encoded representation of a current picture of a video stream of multiple pictures, the method comprising: retrieving, from the encoded representation of the current picture, a buffer description defining at least one list of multiple reference pictures independent of encoded representations of previous pictures; determining, for each reference picture number i of the at least one list, except a first reference picture of the at least one list according to a list order of the at least one list, a picture identifier identifying the reference picture by: retrieving a respective delta picture identifier (absolute_delta_poc(i)) for the reference picture from the buffer description, the delta picture identifier signaled relative to a preceding reference picture of the at least one list according to the list order; calculating deltaPOC(i), where deltaPOC(i) equals deltaPOC(i-1)+absolute_delta_poc(i) if the at least one list defines the multiple reference pictures in ascending order; deltaPOC(i-1)-absolute_delta_poc(i) if the at least one list defines the multiple reference pictures in descending order; and calculating the picture identifier identifying the reference picture (POC(i)) as POC(i)=POC(currPic)+deltaPOC(i), where POC(currPic) represents a picture identifier of the current picture; determining a picture identifier identifying the first reference picture based on picture identifier information retrieved from the buffer description for the first reference picture and based on the picture identifier of the current picture;	1. A method of decoding an encoded representation of a picture in a video stream of multiple pictures, said method comprising: retrieving, using a decoder configured to decode said encoded representation of said picture, buffer description information defining at least one reference picture from said encoded representation of said picture; determining, based on said buffer description information, at least one reference picture identifier identifying a respective reference picture among said at least one reference picture as a decoding reference for said picture, wherein determining said at least one reference picture identifier comprises: retrieving, based on said buffer description information, a respective delta identifier; and calculating said at least one reference picture identifier based on a picture identifier identifying said picture and said respective delta identifier; and updating a decoded picture buffer based on said at least one reference picture identifier.

updating a decoded picture buffer based on the determined picture identifiers.	

As demonstrated, the claim of US patent US 9,247,262 B2 anticipate the features of the claim of instant application 15/299,997. Similar provisional analysis can be done for copending application 14/394,497, Claim 29 and copending application 13/508,442, Claim 10, provisional analysis because the applications are not patented yet.

A nonstatutory type (35 U.S.C. 101) double patenting rejection can be overcome by amending the conflicting claims so they are no longer coextensive in scope or filing of a terminal disclaimer.

35 USC § 112 6th Analysis

7. Claim limitation, recited in Claim 14, "a processor configured to process code means ….." have been interpreted under 35 U.S.C. 112(f) or 35 U.S.C. 112 (pre-AIA), sixth paragraph, because it uses a non-structural term "code means" coupled with functional language "process" without reciting sufficient structure to achieve the function. Furthermore, the non-structural term is not preceded by a structural modifier. A review of the specification shows that the following appears to be the corresponding structure described in the specification for the 35 U.S.C. 112(f) or 35 U.S.C. 112 (pre-AIA), sixth paragraph limitation: Page 5, line 4-13, line 31-32, Page 6, line 1-7 and Page 36, line 27-32, etc.. If applicant wishes to provide further explanation or dispute the examiner's interpretation of the corresponding structure, applicant must identify the corresponding structure with reference to the specification by page and line number, and to the drawing, if any, by reference characters in response to this Office action. If applicant does **not** wish to have the claim limitation treated under 35 U.S.C. 112(f) or 35 U.S.C. 112 (pre-AIA), sixth paragraph, applicant may amend the claim so that it will clearly not invoke 35 U.S.C. 112(f) or 35 U.S.C. 112 (pre-AIA), sixth paragraph, or present a sufficient showing that the claim recites sufficient structure, material, or acts for performing the claimed function to preclude application of 35 U.S.C. 112(f) or 35 U.S.C. 112 (pre-AIA), sixth paragraph. For more information, see MPEP § 2173 et seq. and

Supplementary Examination Guidelines for Determining Compliance with 35 U.S.C. § 112 and for Treatment of Related Issues in Patent Applications, 76 FR 7162, 7167 (Feb. 9, 2011).

Claim Rejections - 35 USC § 112

8. The following is a quotation of 35 U.S.C. 112(b):

> (b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

> The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9. Claim 14 recite limitations that has been interpreted under 35 USC 112(f) or 35 USC 112 (pre-AIA), sixth paragraph, because it uses a non-structural term "code means" coupled with functional language "process" without reciting sufficient structure to achieve the function. Furthermore, the non-structural term is not preceded by a structural modifier. Though it is understood that the "code means" may refer to the program stored in the memory, there is no structure for this program. It is suggested to use known limitation similar to "program stored in the memory", "instructions stored in the memory", etc., to avoid any confusion.

A review of the specification shows that the specification does not have the underlining structure for the functional claim, rendering the claim indefinite.

Claim Rejections - 35 USC § 103

10. The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject

matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

11. Claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Borgwardt et al. ("Multi-Picture Buffer Semantics for Interlace", JVT-C049, May 10 2002), hereinafter Borgwardt, in view of Lu et al. (US 20100208828 A1), hereinafter Lu, further in view of Koyabu et al. (US 20100238822 A1), hereinafter Koyabu. Borgwardt and Lu is cited by applicant in IDS.

Regarding claim 1, Borgwardt discloses a method of decoding an encoded representation of a picture in a video stream of multiple pictures, said method comprising **(1. Frames and Fields in the Multi-Picture Buffer, Paragraph 1)**: retrieving, using a decoder configured to decode said encoded representation of said picture, buffer description information defining at least one reference picture from said encoded representation of said picture **(Section 8.2.13.1, status of the reference frames buffer, MMCO, decoder decodes the encoded picture using the reference picture)**; determining, based on said buffer description information, at least one reference picture identifier identifying a respective reference picture among said at least one reference picture as a decoding reference for said picture, wherein determining said at least one reference picture identifier comprises **(Section 8.2.11, Reference Picture selection)**; and calculating said at least one reference picture identifier based on a picture identifier identifying said picture; and updating a decoded picture buffer based on said at least one reference picture identifier **(Section 8.2.13.1, Table 8-3, MMCO; 8.2.12, paragraph 2, ordered set of reference pictures, ref_idx_fwd or ref_idx_bwd)**.

Borgwardt discloses all the elements of claim 1 but Borgwardt does not appear to explicitly disclose retrieving, based on said buffer description information.

However, Lu from the same or similar endeavor teaches retrieving, based on said buffer description information **([0025], DPB, accessing reference pictures)**.

It would have been obvious to one of ordinary skill in the art at the time of invention to modify Borgwardt to incorporate the teachings of Lu to effectively manage memory space for storing pictures **(Lu, [0013])**.

Borgwardt in view of Lu discloses all the elements of claim 1 but they do not appear to explicitly disclose a respective delta identifier.

However, Koyabu from the same or similar endeavor teaches a respective delta identifier **([0061], POC and delta_pic_order_cnt)**.

It would have been obvious to one of ordinary skill in the art at the time of invention to modify Borgwardt in view of Lu to incorporate the teachings of Koyabu for enhancing the responsiveness to special reproduction of stream data **(Koyabu, [0002]).**

Regarding claim 2, Borgwardt in view of Lu further in view of Koyabu discloses the method according to claim 1, wherein: retrieving said, buffer description information comprises retrieving said buffer description information defining multiple reference pictures from said encoded representation of said picture; and determining said at least one reference picture identifier comprises determining, based on said buffer description information, i) at least one picture identifier identifying a respective reference picture among said multiple reference pictures as the decoding reference for said picture and ii) at least one picture identifier identifying a respective reference picture among said multiple reference pictures as a decoding reference for a subsequent, according to a decoding order, picture in said video stream **(Borgwardt, Section 8.2.13.1, Table 8-3, MMCO; 8.2.12, paragraph 2, ordered set of reference pictures, ref_idx_fwd or ref_idx_bwd, Lu, Fig. 3, Koyabu, [0061], element S20-S23)**.

Regarding claim 3, Borgwardt in view of Lu further in view of Koyabu discloses the e method according to claim 1, wherein updating said decoded picture buffer comprises marking all reference pictures present in said decoded picture buffer and not being associated with any of said at least one reference picture identifier determined based on said buffer description information as unused for reference **(Borgwardt, Section 8.2.13.1, Table 8-3, MMCO; 8.2.12, paragraph 2, ordered set of**

reference pictures, ref_idx_fwd or ref_idx_bwd, Lu, Fig. 3, [0025], line 23-28, Koyabu, [0061], element S20-S23).

Regarding claim 4, Borgwardt in view of Lu further in view of Koyabu discloses the method according claim 3, wherein marking any of the reference pictures is performed prior to decoding said picture (**Borgwardt, Section 8.2.13.1, Table 8-3, MMCO; 8.2.12, paragraph 2, ordered set of reference pictures, ref_idx_fwd or ref_idx_bwd, Lu, Fig. 3, Koyabu, [0061], element S20-S23**).

Regarding claim 5, Borgwardt in view of Lu further in view of Koyabu discloses the method according to claim 1, wherein delta display order information is included in the buffer description information and is encoded with a variable-length code (**Borgwardt, Section 8.2.13.1, Table 8-3, MMCO; 8.2.12, paragraph 2, ordered set of reference pictures, ref_idx_fwd or ref_idx_bwd, Lu, Fig. 3, Koyabu, [0061], element S20-S23, [0051], entropy coding mode, it is obvious to the ordinary skill in the art that the buffer description information can be encoded with a variable-length code**).

Regarding claim 6, Borgwardt in view of Lu further in view of Koyabu discloses the method according to claim 1, wherein determining said at least one reference picture identifier comprises determining, based on said buffer description information, at least one picture order count (POC) value identifying said respective reference picture as the decoding reference for said picture (**Borgwardt, Section 8.2.13.1, Table 8-3, MMCO; 8.2.12, paragraph 2, ordered set of reference pictures, ref_idx_fwd or ref_idx_bwd, Lu, Fig. 3, Koyabu, [0061], element S20-S23**).

Regarding claim 7, Borgwardt in view of Lu further in view of Koyabu discloses the method according to claim 6, wherein determining said at least one POC value comprises determining, based on said buffer description information, said at least one picture order count (POC) value and at least one additional identifier identifying said respective reference picture as the decoding reference for said picture

(Borgwardt, **Section 8.2.13.1, Table 8-3, MMCO; 8.2.12, paragraph 2, ordered set of reference pictures, ref_idx_fwd or ref_idx_bwd, Lu, Fig. 3, Koyabu, [0061], element S20-S23**).

Regarding claim 8-20, See Examiner's Note.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MOHAMMAD J. RAHMAN whose telephone number is (571)270-7190. The examiner can normally be reached on Monday-Thursday 8:30am-7:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dave Czekaj can be reached on 571 272-7327. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/MOHAMMAD J RAHMAN/
Examiner, Art Unit 2487

Notice of References Cited	Application/Control No. 15/299,997	Applicant(s)/Patent Under Reexamination SAMUELSSON ET AL.	
	Examiner MOHAMMAD J. RAHMAN	Art Unit 2487	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-2009/0052550 A1	02-2009	Lamy-Bergot; Catherine	H04N19/70	375/240.26
*	B	US-2010/0238822 A1	09-2010	Koyabu; Kyohei	G11B27/005	370/252
	C	US-				
	D	US-				
	E	US-				
	F	US-				
	G	US-				
	H	US-				
	I	US-				
	J	US-				
	K	US-				
	L	US-				
	M	US-				

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
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CONFIRMATION NO. 3363

SERIAL NUMBER	FILING or 371(c) DATE RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
15/299,997	10/21/2016	375	2487	9900-34860US3

APPLICANTS

Telefonaktiebolaget LM Ericsson (publ), Stockholm, SWEDEN;

INVENTORS

Jonatan Samuelsson, Stockholm, SWEDEN;
Rickard Sjöberg, Stockholm, SWEDEN;

**** CONTINUING DATA ***************************

This application is a CON of 13/508,442 04/25/2013
which is a 371 of PCT/SE2012/050439 04/26/2012
which claims benefit of 61/503,019 06/30/2011

**** FOREIGN APPLICATIONS ***************************

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11/01/2016

Foreign Priority claimed	☐ Yes ☑ No	☐ Met after Allowance	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
35 USC 119(a-d) conditions met	☐ Yes ☑ No		SWEDEN	12	20	6
Verified and Acknowledged	/MOHAMMAD J RAHMAN/ Examiner's Signature	Initials				

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RALEIGH, NC 27627
UNITED STATES

TITLE

REFERENCE PICTURE SIGNALING

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15299997	SAMUELSSON ET AL.
	Examiner	Art Unit
	MOHAMMAD J RAHMAN	2487

CPC- SEARCHED		
Symbol	Date	Examiner
H04N19/$, Limited text search	1/22/2017	JR

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES		
Search Notes	Date	Examiner
Inventor search	1/22/2017	JR
Assignee search	1/22/2017	JR
EAST search, History included	1/22/2017	JR

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15299997	SAMUELSSON ET AL.
	Examiner	Art Unit
	MOHAMMAD J RAHMAN	2487

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	01/22/2017								
	1	✓								
	2	✓								
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	19	✓								
	20	✓								

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	124	(Samuelsson-Jonatan$ Sj$1berg-Rickard$).in.	US-PGPUB; USPAT	OR	ON	2017/01/22 15:11
L2	0	15/299997.app.	US-PGPUB; USPAT	OR	ON	2017/01/22 15:11
L3	26631	(ericsson).as.	US-PGPUB; USPAT	OR	ON	2017/01/22 15:11
L4	52922	(H04N19/$).cpc.	US-PGPUB; USPAT	OR	ON	2017/01/22 15:12
L5	227	(buffer and reference and (picture list) and (relative delta)).clm.	US-PGPUB; USPAT	OR	ON	2017/01/22 15:14
L6	5	L5 and L1	US-PGPUB; USPAT	OR	ON	2017/01/22 15:14
L7	4	L5 and L3	US-PGPUB; USPAT	OR	ON	2017/01/22 15:22
L8	107	L5 and L4	US-PGPUB; USPAT	OR	ON	2017/01/22 15:22
L9	25	L5 and L4 and (delta with reference)	US-PGPUB; USPAT	OR	ON	2017/01/22 15:23
L10	5	(@ad<"20110630") and L5 and L4 and (delta with reference)	US-PGPUB; USPAT	OR	ON	2017/01/22 15:23
L11	1	"9247262".pn.	US-PGPUB; USPAT	OR	ON	2017/01/22 15:23
L12	52	(@ad<"20110630") and (delta with reference with picture) and (reference with buffer)	US-PGPUB; USPAT	OR	ON	2017/01/22 15:33
L13	5	(@ad<"20110630") and ((delta with reference with picture) same (reference with buffer))	US-PGPUB; USPAT	OR	ON	2017/01/22 15:34
L14	221	(@ad<"20110630") and ((delta with reference) same (reference with buffer))	US-PGPUB; USPAT	OR	ON	2017/01/22 15:35
L15	198	(@ad<"20110630") and ((delta with reference with buffer))	US-PGPUB; USPAT	OR	ON	2017/01/22 15:35
L16	5	(@ad<"20110630") and (delta with reference with buffer) and (decoded with	US-PGPUB;	OR	ON	2017/01/22 15:36

		picture with buffer)	USPAT			

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (use as many sheets as necessary) Sheet A1 of A2	Complete if Known	
	Application Number	To be assigned
	Filing Date	Concurrently herewith
	First Named Inventor	Jonatan Samuelsson
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	9900-34860US3

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Examiner Initials*	Cite No.	Document Number Number-Kind Code (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
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Examiner Signature	/Mohammad J Rahman/	Date Considered	01/22/2017

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (use as many sheets as necessary)				Complete if Known	
				Application Number	To be assigned
				Filing Date	Concurrently herewith
				First Named Inventor	Jonatan Samuelsson
				Art Unit	TBD
				Examiner Name	TBD
Sheet	A2	of	A2	Attorney Docket Number	9900-34860US3

	23.	Japanese Office Action Corresponding to Japanese Patent Application No. 2014-185639; Date Mailed: November 13, 2015; Foreign Text, 3 Pages, English Translation Thereof, 3 Pages.	
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Examiner Signature	/Mohammad J Rahman/	Date Considered	01/22/2017

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/299,997	10/21/2016	Jonatan Samuelsson	9900-34860US3

CONFIRMATION NO. 3363

20792
MYERS BIGEL, P.A.
PO BOX 37428
RALEIGH, NC 27627

PUBLICATION NOTICE

OC000000089106084

Title:REFERENCE PICTURE SIGNALING

Publication No.US-2017-0041633-A1
Publication Date:02/09/2017

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The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

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By: Roger Burleigh

Roger Burleigh
Director U.S. Patent Department, Ericsson

Date: 3/1/17

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Roger Burleigh

duly authorized to sign for

TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)

has issued and signed the foregoing document.

Pamela Kay Ewing

Signature: Notary Public

Pamela Kay Ewing
Notary Public,
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Expires 11-14-2018

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Applicant/Patent Owner: TELEFONAKTIEBOLAGET L M ERICSSON (PUBL)

Application No./Patent No.: 15/299,997 Filed/Issue Date: October 21, 2016

Titled: REFERENCE PICTURE SIGNALING

TELEFONAKTIEBOLAGET L M ERICSSON (PUBL), a corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

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1. ☑ The assignee of the entire right, title, and interest.

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   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

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4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

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B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

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This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: Jonatan Samuelsson, Rickard Sjöberg To: TELEFONAKTIEBOLAGET L M ERICSSON (PUBL)

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The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☐ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Timothy J. Wall/	March 13, 2017
Signature	Date
Timothy J. Wall	146825
Printed or Typed Name	Title or Registration Number

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	28606449
Application Number:	15299997
International Application Number:	
Confirmation Number:	3363
Title of Invention:	REFERENCE PICTURE SIGNALING
First Named Inventor/Applicant Name:	Jonatan Samuelsson
Customer Number:	20792
Filer:	Timothy Jennings Wall/Jo Bryan
Filer Authorized By:	Timothy Jennings Wall
Attorney Docket Number:	9900-34860US3
Receipt Date:	13-MAR-2017
Filing Date:	21-OCT-2016
Time Stamp:	11:24:54
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	POWER.pdf	199846 8738c3e9f0e8b5e4b6671a7e523808ffc0db7136	no	1

Warnings:

Information:					
2	Assignee showing of ownership per 37 CFR 3.73	Statement.pdf	122534 e388c6d0df10f38f240e68f26ad2632a46027050	no	3
Warnings:					
Information:					
			Total Files Size (in bytes):	322380	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/299,997	10/21/2016	Jonatan Samuelsson	9900-34860US3

CONFIRMATION NO. 3363

POWER OF ATTORNEY NOTICE

20792
MYERS BIGEL, P.A.
PO BOX 37428
RALEIGH, NC 27627

OC000000089972188

Date Mailed: 03/20/2017

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 03/13/2017.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/qtran/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/299,997	10/21/2016	Jonatan Samuelsson	9900-34860US3

CONFIRMATION NO. 3363

146825
Sage Patent Group/Telefonaktiebolaget LM Ericsson
PO BOX 30789
RALEIGH, NC 27622-0789

POA ACCEPTANCE LETTER

OC000000089972200

Date Mailed: 03/20/2017

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 03/13/2017.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/qtran/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(use as many sheets as necessary)*				***Complete if Known***	
				Application Number	15/299,997
				Filing Date	October 21, 2016
				First Named Inventor	Samuelsson et al.
				Art Unit	2487
				Examiner Name	Mohammad J. Rahman
Sheet	**B1**	of	**B1**	Attorney Docket Number	9900-34860US3

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No.	Document Number Number-Kind Code (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	1.	US- 2009/0238261 A	09-24-2009	Bhavani et al.	
		US-			
		US-			
		US-			
		US-			
		US-			
		US-			

FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No.	Foreign Patent Document Country Code, Number, Kind Code (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published	T
	2.	Letter reporting Office Action in corresponding Japanese Patent Application No. 2015-141592; Date Mailed: March 27, 2017; Reporting Letter 2 Pages, Japanese Office Action 2 Pages.	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Electronic Acknowledgement Receipt

EFS ID:	29004923
Application Number:	15299997
International Application Number:	
Confirmation Number:	3363
Title of Invention:	REFERENCE PICTURE SIGNALING
First Named Inventor/Applicant Name:	Jonatan Samuelsson
Customer Number:	146825
Filer:	David C. Hall/Nina Dhillon
Filer Authorized By:	David C. Hall
Attorney Docket Number:	9900-34860US3
Receipt Date:	24-APR-2017
Filing Date:	21-OCT-2016
Time Stamp:	13:19:35
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	P34860_US3_IDS_Transmittal_B.pdf	21339 13b28d284fc98c89884247b2fb5fcc18b4db9d87	no	2

Warnings:

Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	P34860_US3_IDS_SB08_B.pdf	22573 78d6496f7fae224fbce4619450bf9a076cadaaef	no	1
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
3	Non Patent Literature	P34860_JP4_2017-04-13_Report.pdf	227578 57da03f263fd59d005b9cc7d3f032f1e9fb475d3	no	2
Warnings:					
Information:					
4	Non Patent Literature	P34860_JP4_2017-03-27_Office_Action.pdf	387563 0438b9bbf9b511940e72c876b75c83789f688839	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	659053		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Attorney Docket No. 9900-34860US3 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Samuelsson et al.
Application No.: 15/299,997
Filing Date: October 21, 2016
For: REFERENCE PICTURE SIGNALING

Confirmation No.: 3363
Group Art Unit: 2487
Examiner: Rahman, Mohammad J.

Date: April 24, 2017

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

INFORMATION DISCLOSURE STATEMENT TRANSMITTAL

Sir:

Attached is an Information Disclosure Statement listing of documents, together with a copy of any listed foreign patent document and/or non-patent literature. A copy of any listed U.S. patent and/or U.S. patent application publication is not provided herewith in accordance with 37 C.F.R. § 1.98(a)(2)(ii).

☐ In accordance with **37 CFR 1.97(b)**, the information disclosure statement is being filed:

- ☐ (1) within three months of the filing date of a national application other than a continued prosecution application under §1.53(d);
- ☐ (2) within three months of the date of entry of the national stage as set forth in §1.491 in an international application;
- ☐ (3) before the mailing of a first Office Action on the merits; or
- ☐ (4) before the mailing of a first Office Action after the filing of a request for continued examination under §1.114.

☒ In accordance with **37 CFR 1.97(c)**, the information disclosure statement is being filed after the period specified in 37 CFR 1.97(b) above, but before the mailing date of any of a final action under §1.113, a notice of allowance under §1.311, or an action that otherwise closes prosecution in the application, and is accompanied by **one** of the following:

☒ (1) The statement specified under **37 CFR 1.97(e)**, as follows:

☒ Each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; **or**

☐ No item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in §1.56(c) more than three months prior to the filing of the information disclosure statement; **or**

☐ (2) The fee set forth in §1.17(p);

☐ In accordance with **37 CFR 1.97(d)**, the information disclosure statement is being filed after the period specified in 37 CFR 1.97(c) above, but on or before payment of the issue fee, and is accompanied by **both** of the following:

☐ (1) The statement specified under **37 CFR 1.97(e)**, as follows:

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; **or**

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in §1.56(c) more than three months prior to the filing of the information disclosure statement; **and**

☐ (2) The fee set forth in §1.17(p);

In accordance with **37 CFR 1.97(g)**, the information disclosure statement shall not be construed as a representation that a search has been made.

In accordance with **37 CFR 1.97(h)**, the information disclosure statement shall not be construed to be an admission that the information cited in the statement is, or is considered to be, material to patentability as defined in §1.56(b).

☐ The Director is hereby authorized to charge the fee specified in 37 C.F.R. § 1.17(p), and any fee deficiency or credit any overpayment, to Deposit Account No. 60-1438;

☐ The Director is hereby authorized to charge credit card; or

☒ No fee is believed due. However, the Director is hereby authorized to charge any deficiency or credit any overpayment to Deposit Account No. 60-1438.

Respectfully submitted,

/David C. Hall/

David C. Hall
Registration No. 38,904
Attorney for Applicant(s)

Customer Number 146825
Sage Patent Group
P.O. Box 30789, Raleigh, NC 27622
984-219-3358
984-538-0416 (Fax)

Attorney Docket No. 9900-34860US3 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application: Samuelsson et al.
Application No.: 15/299,997
Filed: October 21, 2016
For: REFERENCE PICTURE SIGNALING

Confirmation No.: 3363
Group Art Unit: 2487
Examiner: Rahman, Mohammad J.

Date: April 24, 2017

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313

AMENDMENT AND RESPONSE TO JANUARY 26, 2017 OFFICIAL ACTION

Sir:

Applicant provides the present Amendment to address the issues raised in the Office Action mailed January 26, 2017.

It is not believed that an extension of time and/or additional fee(s), including fees for additional claims, are required, beyond those that may otherwise be provided for in documents accompanying this paper. In the event, however, that an extension of time is necessary to allow consideration of this paper, such an extension is hereby petitioned under 37 C.F.R. §1.136(a). Any additional fees believed to be due in connection with this paper may be charged to our Deposit Account No. 60-1438.

Amendments to the Claims begin on page 2 of this paper.
Remarks begin on page 9 of this paper.

This listing of claims will replace all prior versions and listings of the claims in the application:

Listing of the Claims:

1. (Currently amended) A method of decoding an encoded representation of a picture in a video stream of multiple pictures, said method comprising:

retrieving, using a decoder configured to decode said encoded representation of said picture, buffer description information defining at least one reference picture, wherein said buffer description information is retrieved from said encoded representation of said picture;

determining, based on said buffer description information, at least one reference picture identifier, said at least one reference picture identifier identifying a respective reference picture among said at least one reference picture, said respective reference picture comprising [[as]] a decoding reference for said picture, wherein determining said at least one reference picture identifier comprises:

(i) retrieving, based on said buffer description information, a respective delta identifier; and

(ii) calculating said at least one reference picture identifier based on a picture identifier identifying said picture and said respective delta identifier; and

updating a decoded picture buffer based on said at least one reference picture identifier.

2. (Original) The method according to claim 1, wherein:

retrieving said buffer description information comprises retrieving said buffer description information defining multiple reference pictures from said encoded representation of said picture; and

determining said at least one reference picture identifier comprises determining, based on said buffer description information, i) at least one picture identifier identifying a respective reference picture among said multiple reference pictures as the decoding reference for said picture and ii) at least one picture identifier identifying a respective reference picture among said

multiple reference pictures as a decoding reference for a subsequent, according to a decoding order, picture in said video stream.

3. (Original) The method according to claim 1, wherein updating said decoded picture buffer comprises marking all reference pictures present in said decoded picture buffer and not being associated with any of said at least one reference picture identifier determined based on said buffer description information as unused for reference.

4. (Original) The method according claim 3, wherein marking any of the reference pictures is performed prior to decoding said picture.

5. (Original) The method according to claim 1, wherein delta display order information is included in the buffer description information and is encoded with a variable-length code.

6. (Original) The method according to claim 1, wherein determining said at least one reference picture identifier comprises determining, based on said buffer description information, at least one picture order count (POC) value identifying said respective reference picture as the decoding reference for said picture.

7. (Original) The method according to claim 6, wherein determining said at least one POC value comprises determining, based on said buffer description information, said at least one picture order count (POC) value and at least one additional identifier identifying said respective reference picture as the decoding reference for said picture.

8. (Currently amended) A decoder configured to decode an encoded representation of a picture in a video stream of multiple pictures, said decoder comprising:

a data retriever configured to retrieve buffer description information defining at least one reference picture, wherein said buffer description information is retrieved from said encoded representation of said picture;

a picture identifier determiner configured to determine, based on said buffer description information, at least one reference picture identifier, said at least one reference picture identifier identifying a respective reference picture among said at least one reference picture, said respective reference picture comprising [[as]] a decoding reference for said picture, wherein said picture identifier determiner is configured to i) retrieve, based on said buffer description information, a respective delta identifier, and ii) calculate said at least one reference picture identifier based on a picture identifier identifying said picture and said respective delta identifier; and

a buffer manager configured to update a decoded picture buffer based on said at least one reference picture identifier.

9. (Original) The decoder according to claim 8, wherein:

said data retriever is configured to retrieve said buffer description information defining multiple reference pictures from said encoded representation of said picture; and

said picture identifier determiner is configured to determine, based on said buffer description information, i) at least one picture identifier identifying a respective reference picture among said multiple reference pictures as the decoding reference for said picture and ii) at least one picture identifier identifying a respective reference picture among said multiple reference pictures as a decoding reference for a subsequent, according to a decoding order, picture in said video stream.

10. (Original) The decoder according to claim 8, wherein said buffer manager is configured to mark all reference pictures present in said decoded picture buffer and not being associated with any of said at least one reference picture identifier determined based on said buffer description information as unused for reference.

11. (Original) The decoder according to claim 10, wherein said buffer manager is configured to mark any reference picture prior to said decoder decodes said picture.

12. (Original) The decoder according to claim 8, wherein delta display order information is included in the buffer description information and is encoded with a variable-length code.

13. (Original) A receiver comprising:

an input section configured to receive encoded representations of multiple pictures in a video stream;

a decoder according to claim 8, configured to decode said encoded representations of said multiple pictures; and

an output section configured to output decoded pictures of said video stream.

14. (Currently Amended) A decoder comprising:

an input section configured to receive encoded representations of multiple pictures in a video stream;

a processor; and

a memory coupled to said processor and comprising instructions stored in said memory, said processor configured to process said instructions ~~code means of a computer program stored in a memory~~, wherein said instructions ~~code means causes~~, when run on said processor, cause said processor to:

retrieve buffer description information defining at least one reference picture, wherein said buffer description information is retrieved from an encoded representation of a picture;

determine, based on said buffer description information, at least one reference picture identifier, said at least one reference picture identifier identifying a respective reference picture among said at least one reference picture, said respective

reference picture comprising [[as]] a decoding reference for said picture, wherein determining said at least one reference picture identifier comprises:

retrieving, based on said buffer description information, a respective delta identifier; and

calculating said at least one reference picture identifier based on a picture identifier identifying said picture and said respective delta identifier; and

update a decoded picture buffer based on said at least one reference picture identifier; and

an output section configured to output decoded pictures of said video stream.

15. (Currently amended) A method of encoding a picture in a video stream of multiple pictures, said method comprising:

determining, for said picture, at least one reference picture among said multiple pictures as an encoding reference for said picture;

providing, for each reference picture of said at least one reference picture, a reference picture identifier identifying said reference picture;

generating, based on at least one delta identifier that corresponds to a difference between said reference picture identifier and a picture identifier identifying said picture, buffer description information defining said at least one reference picture; and

inserting, using an encoder configured to encode said picture in said video stream, said buffer description information [[in]] into an encoded representation of said picture.

16. (Original) The method according to claim 15, wherein delta display order information is included in the buffer description information and is encoded with a variable-length code.

17. (Currently amended) An encoder configured to encode a picture in a video stream of multiple pictures, said encoder comprising:

a reference picture determiner configured to determine, for said picture, at least one reference picture among said multiple pictures as an encoding reference for said picture;

a picture identifier provider configured to provide, for each reference picture among said at least one reference picture, a reference picture identifier identifying said reference picture;

a buffer description information generator configured to generate, based on at least one delta identifier that corresponds to a difference between said reference picture identifier and a picture identifier identifying said picture, buffer description information defining said at least one reference picture; and

a data inserter configured to insert said buffer description information [[in]] into an encoded representation of said picture.

18. (Original) The encoder according to claim 17, wherein delta display order information is included in the buffer description information and is encoded with a variable-length code.

19. (Currently Amended) An encoder comprising:

an input section configured to receive multiple pictures in a video stream;

a processor configured to process code ~~means~~ of a computer program stored in a memory, said code ~~means~~ causes, when run on said processor, said processor to:

determine, for a picture in said video stream, at least one reference picture among said multiple pictures as an encoding reference for said picture;

provide, for each reference picture among said at least one reference picture, a reference picture identifier identifying said reference picture;

generate, based on at least one delta identifier that corresponds to a difference between said reference picture identifier and a picture identifier identifying said picture, buffer description information defining said at least one reference picture; and

insert said buffer description information [[in]] into an encoded representation of said picture; and

an output section configured to output encoded representations of pictures.

20. (Original) The encoder according to claim 19, wherein delta display order information is included in the buffer description information and is encoded with a variable-length code.

REMARKS

Applicant appreciates the examination of the present application evidenced by the Office Action of January 26, 2017 ("Office Action"). Applicant has amended the claims as provided above, and respectfully submits that the application is in condition for allowance for at least the reasons explained below.

Claim 13 has been amended to independent form. Applicant requests that the objection thereto be withdrawn. Office Action, p. 2.

Claims 1, 8, 13, 14, 15 17 and 19 stand rejected under the nonstatutory, judicially created doctrine of obviousness-type double patenting over Claim 1 of U.S. Patent No. 9,247,262. Office Action, page 4. To place the application in condition for allowance, Applicant has submitted herewith a Terminal Disclaimer disclaiming the additional term over U.S. Patent No. 9,247,262. Applicant provides the Terminal Disclaimer solely to expedite issuance of the present application and does not admit that the present invention is obvious in light of U.S. Patent No. 9,247,262. Accordingly, withdrawal of the obviousness-type double patenting rejection of Claims 1, 8, 13, 14, 15 17 and 19 is respectfully requested.

Claim 14 has been amended as suggested in the Office Action to recite "instructions stored in said memory." Office Action, p. 6. Accordingly, Applicant respectfully submits that Claim 14 does not invoke 35 USC 112(f) or 35 USC 112 (pre-AIA) sixth paragraph.

Claims 1-20 stand rejected under 35 USC § 103(a) as being unpatentable over Borgwardt et al., "Multi-Picture Buffer Semantics for Interlace," JVT-C049, May 10, 2002 ("Borgwardt") in view of U.S. Publication No. 2010/0208828 to Lu et al., ("Lu") and further in view of U.S. Publication No. 2010/0238822 to Koyabu et al. ("Koyabu"). Office Action at p. 7.

Claim 1 has been amended for clarity to recite as follows (emphasis added):

> 1. A method of decoding an encoded representation of a picture in a video stream of multiple pictures, said method comprising:
>
> retrieving, using a decoder configured to decode said encoded representation of said picture, buffer description information defining at least one reference picture, wherein said buffer description information is retrieved from said encoded representation of said picture;

> determining, based on said buffer description information, at least one reference picture identifier, said at least one reference picture identifier identifying a respective reference picture among said at least one reference picture, said respective reference picture comprising a decoding reference for said picture, wherein determining said at least one reference picture identifier comprises:
>
> (i) retrieving, based on said buffer description information, a respective delta identifier; and
>
> (ii) calculating said at least one reference picture identifier based on a picture identifier identifying said picture and said respective delta identifier; and
>
> updating a decoded picture buffer based on said at least one reference picture identifier.

In particular, Claim 1, which is directed to a method of decoding an encoded representation of a picture in a video stream of multiple pictures, has been amended to recite "retrieving … buffer description information defining at least one reference picture, wherein said buffer description information is retrieved from said encoded representation of said picture," and "determining, based on said buffer description information, at least one reference picture identifier, said at least one reference picture identifier identifying a respective reference picture among said at least one reference picture, said respective reference picture comprising a decoding reference for said picture." Similar amendments have been made to independent claims 8, 13 and 14.

As explained in the Specification, the use of Memory Management Control Operation (MMCO) commands to control which reference frames to mark in a decoded reference buffer as unused for reference has a drawback in that, if an MMCO command is lost, an incorrect picture may subsequently be used as a decoding reference, resulting in degradation of the decoded video stream. In particular, the Specification explains that:

> [0050] The prior art techniques may suffer from problems with regard to using incorrect reference pictures when a picture carrying MMCO information is unintentionally lost, which was discussed in the background section. This problem of the prior art can be illustrated by the following H.264-implemented example. Assume that the decoded picture buffer stores three short term pictures with picture identifiers 300, 302 and 303 and two long term pictures with picture identifiers 0 and 3. The encoder might then generate a new encoded picture with a MMCO type 2 command stating that the long term

> picture 0 should be unused for reference. If this encoded picture would have been correctly received at the decoder the long term picture 0 would have been marked as unused for reference and the reference picture list would have been {300, 302, 303, 3}. **However, if the encoded picture with the MMCO type 2 command is lost, the decoder is not informed that the long term picture, 0 should be marked as unused for reference and the reference picture list is therefore instead (300, 302, 303, 0, 3). If a next encoded picture received at the decoder comprises information that reference picture at position 3 in the reference picture list is to be used as prediction for a macroblock in the picture there will be a problem if the MMCO type 2 command is lost**. If the MMCO type 2 command had been correctly received at the decoder, the reference picture at position 3 in the reference picture list would correspond to the long term picture 3 as this reference picture occupies position 3 (if starting with 0) in the reference picture list. **However, with a lost MMCO type 2 command position 3 in the reference picture list is instead occupied by the long term picture 0. This means that pixel data from the long term picture 0 will be used as prediction basis instead of the correct pixel data from the long term picture identifier 3**.
>
> [0051] Thus, the prior art solution has a problem that correct reference picture management is dependant on that previously decoded pictures have been correctly received and decoded. (Specification, parass 0050-0051, emphasis added).

Embodiments represented by Claim 1 avoid this problem by including, within the encoded picture itself, buffer description information that identifies the reference picture(s) needed to decode the picture. Thus, Claim 1 recites "retrieving … buffer description information defining at least one reference picture, wherein said buffer description information is retrieved from said encoded representation of said picture." The reference picture functions as a decoding reference for the encoded picture. In this way, each encoded picture may *itself* include sufficient information to identify the reference pictures needed for decoding the encoded picture. As explained in the Specification:

> [0052] The present embodiments do not have these problems of the prior art techniques by using a fundamentally different approach for signaling reference pictures as compared to the prior art. The present embodiments instead specify which decoded pictures to be used for reference pictures in an absolute or explicit way instead of a relative or implicit way. **Another way to put it is that the encoded representation, i.e. the bitstream, for a current picture contains the information about what pictures to use for reference, i.e. reference pictures, independent of the encoded representations of previous pictures. It can therefore be said that the logical responsibility for maintaining**

> **correct decoded picture buffer is moved from the decoder to the bitstream**. One way to look at it is to say that the information about what reference pictures to use for inter prediction and motion vector prediction for a picture is included in the control information of the picture. Hence, the state of the decoded picture buffer is signaled for every picture that is encoded and decoded relative to other pictures. (Specification, para. 0052, emphasis added).

In sharp contrast, the primary reference, Borgwardt et al., "Multi-picture Buffer Semantics for Interlace," JVT-C049, Ma7y 10, 2002 ("Borgwardt") describes various proposals for modifying MMCO storage management commands. Borgwardt does not disclose or suggest encoding reference picture identifiers that define reference pictures needed to decode an encoded picture into the encoded representation of the picture itself. Borgwardt is a proposal to the Joint Video Team (JVT) of ISO/IEC MPEG for modifications of frames and fields in the multi-picture buffer (MPB) of a video decoder. See Borgwardt, p. 1. Section 1 of Borgwardt summarizes the motivation for one part of the proposal, which is the need for the multi-picture buffer to store both frames and fields, while Section 2 summarizes the portion of the proposal to decouple the MMCO command RPBT to begin storage management of the MPB from the RPSLI flag which indicates the presence of reference picture selection layer. See Borgwardt, pp. 1-2. The proposed text for the working draft is set forth in Section 3 of Borgwardt. Nothing in Borgwardt discloses or suggests storing reference picture identifiers within an encoded picture itself.

In particular, the Office Action cites Section 8.2.13.1 of Borgwardt, as disclosing the recitation of "retrieving, using a decoder configured to decode said encoded representation of said picture, buffer description information defining at least one reference picture from said encoded representation of said picture." Office Action, p. 7. Section 8.2.13.1 of Borgwardt is directed to MMCO, and defines when MMCO commands are present. See Borgwardt, p. 7. The cited recitation of Claim 1 recites "retrieving, using a decoder configured to decode said encoded representation of said picture, buffer description information defining at least one reference picture," and has been amended to clarify that "said buffer description information is retrieved from said encoded representation of said picture." As explained above, this approach is in direct contrast to the use of MMCO commands to identify reference pictures needed for decoding an encoded picture.

The Office Action further cites Section 8.2.11 of Borgwardt as disclosing the recitation of "determining, based on said buffer description information, at least one reference picture identifier identifying a respective reference picture among said at least one reference picture as a decoding reference for said picture." Office Action, p. 7. Section 8.2.11 of Borgwardt discusses the RPSLI flag, which indicates the presence of Reference Picture Selection Layer (RPSL). The presence of the RPSL determines how the default buffer indexing order is applied ("If RPSL is sent, the buffer indexing used to decode the current slice and to manage the contents of the picture buffer is sent using the following code words." Borgwardt, p. 2). Section 8.2.11 of Borgwardt provides no description or teaching whatsoever of determining a reference picture identifier identifying a respective reference picture as a decoding reference for said picture, much less determining a reference picture identifier identifying a respective reference as a decoding reference for said picture from buffer description information contained within the encoded picture itself.

U.S. Publication No. 2010/0208828 to Lu et al. is cited as disclosing "retrieving based on said buffer description information," Office Action at p. 7, but does not disclose or suggest the recitations missing from Borgwardt. Moreover, although the cited passage at para. 0025 of Lu discusses accessing reference pictures, it does not disclose or suggest retrieving information relating to reference pictures from buffer description information included in an encoded picture itself.

Additionally, U.S. Publication No. 2010/0238822 to Koyabu et al. is cited as disclosing a delta identifier. Office Action, p. 8. However, the delta identifier discussed at para. 0061 of Koyabu et al. is provided for calculating a picture order count, not a picture identifier for a reference picture.

Applicant will now explain further differences between Claim 1 and Borgwardt in view of Lu and Koyabu. In the process to which Borgwardt applies, a current picture is first decoded to obtain a decoded picture (see, e.g., the picture decoding process illustrated in Fig. 1 of the present application). During this decoding process the content of the decoded picture buffer is indexed or organized according to a defined scheme. See, e.g., Borgwardt, section 8.2.12.1. Once the current picture has been decoded the decoded picture buffer is modified using a sliding

window process or using MMCO commands, i.e. adaptive memory control (see Borgwardt, section 8.2.13).

ln a sliding window approach, the current decoded picture is added to the decoded picture buffer with default relative index O. If the decoded picture buffer does not have sufficient capacity to store the current picture, the picture with the largest default relative index among the short-term pictures in the decoded picture buffer is marked as unused (see Borgwardt, sections 8.2.12.1 and 8.2.13). Hence, in this approach the "oldest" short-term picture, i.e. with lowest picture number, is replaced by the current decoded picture. Thus, in a sliding window approach, no information is included in the encoded presentation of the current picture that enables determination of any picture identifiers of reference pictures. In sharp contrast, Claim 1 has been amended to recite "wherein the buffer description information explicitly defines said at least one reference picture by means of said encoded representation of said picture which contains, in said data structure, information about which reference picture to use for reference during decoding, independently of the encoded representation of previous pictures in the video stream."

ln addition, in the system of Borgwardt, the update of the decoded picture buffer is not performed based on any such determined picture identifiers. ln clear contrast a simple FIFO mechanism is employed. In adaptive memory control, MMCO commands or parameters are included in the encoded representation of the current picture. Such MMCO commands do not affect the content of the decoded picture buffer for the current picture but rather only for the decoding process of subsequent pictures (see Borgwardt, section 8.2.13.1).

These MMCO commands can be used to change the marking of pictures stored in the decoded picture buffer (Table 8-3 in Borgwardt). An MMCO command has a code number and an associated data field (for code number 1-3) specifying a difference picture number (DPN) or a long- term picture index (LPIN) (Table 8-3, sections 8.2.13.2 and 8.2.13.3 in Borgwardt).

However, note that the MMCO commands with associated DPN or LPlN are not used in Borgwardt to determine at least one picture identifier identifying a respective reference picture as decoding reference for the picture (the encoded representation-of which the MMCO command was retrieved from). ln contrast, Borgwardt explicitly states that "MMCO commands do not affect the buffer contents or the decoding process for the decoding of the current picture; rather,

they specify the necessary buffer status for the decoding of subsequent pictures in the bitstream." (see Borgwardt, section 8.2.13.1). Accordingly, the MMCO commands as disclosed in Borgwardt do not affect the decoded picture buffer for the (current) picture nor do they define any picture identifier(s) identifying any reference picture(s) as a decoding reference for the (current) picture.

For at least the foregoing reasons, Claim 1 is submitted to be patentable over the cited references. Independent Claims 8, 13-15, 17 and 19 are submitted to be patentable over the cited references for at least similar reasons.

As each of the dependent claims depends from a base claim that is believed to be in condition for allowance, Applicant does not believe that it is necessary to argue the allowability of each of these claims individually. Applicant does not necessarily concur with the interpretation of these claims, or with the bases for rejection set forth in the Office Action. Applicant therefore reserves the right to address the patentability of these claims individually as necessary in the future.

CONCLUSION

Accordingly, Applicant submits that all pending claims in the present application are in condition for allowance, and a Notice of Allowance is respectfully requested in due course. The Examiner is encouraged to contact the undersigned representative by telephone should any additional issues need to be addressed.

Respectfully submitted,

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TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT	Docket Number (Optional) 9900-34860US3

In re Application of: Telefonaktiebolaget LM Ericsson (publ)

Application No.: 15/299,997

Filed: October 21, 2016

For: REFERENCE PICTURE SIGNALING

The owner*, Telefonaktiebolaget LM Ericsson (publ), of 100 percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term **prior patent** No. 9,247,262 as the term of said prior patent is defined in 35 U.S.C. 154 and 173, and as the term of said **prior patent** is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the **prior patent** are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

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2. ☑ The undersigned is an attorney or agent of record. Reg. No. 38,904

/David C. Hall/ — Signature
April 24, 2017 — Date

David C. Hall — Typed or printed name

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Electronic Patent Application Fee Transmittal

Application Number:	15299997
Filing Date:	21-Oct-2016
Title of Invention:	REFERENCE PICTURE SIGNALING
First Named Inventor/Applicant Name:	Jonatan Samuelsson
Filer:	David C. Hall/Nina Dhillon
Attorney Docket Number:	9900-34860US3

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
STATUTORY OR TERMINAL DISCLAIMER	1814	1	160	160
		Total in USD ($)		**160**

Electronic Acknowledgement Receipt

EFS ID:	29005150
Application Number:	15299997
International Application Number:	
Confirmation Number:	3363
Title of Invention:	REFERENCE PICTURE SIGNALING
First Named Inventor/Applicant Name:	Jonatan Samuelsson
Customer Number:	146825
Filer:	David C. Hall/Nina Dhillon
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1		P34860_US3_Response_to_Non-Final_Office_Action_2017-01-26.pdf	85885 944d02d8f2ae0a2e11d51d4fb86b2459448ddfc4	yes	15
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Amendment/Req. Reconsideration-After Non-Final Reject		1	1	
	Claims		2	8	
	Applicant Arguments/Remarks Made in an Amendment		9	15	
Warnings:					
Information:					
2	Terminal Disclaimer Filed	P34860_US3_Terminal_Disclaimer.pdf	189285 122693319fd6a3fe0c60bc40be98e7cd190c34e6	no	2
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30475 14e30430cb1c3e6d3e2cb94b4ea1b7e9aad1f584	no	2
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/299,997	Filing Date 10/21/2016	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT **04/24/2017**

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0	X $80 =	0
Independent (37 CFR 1.16(h))	* 6	Minus	***6	= 0	X $420 =	0
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	0

AMENDMENT

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
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LIE
TAMMY D. MCBETH BROWN

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Application Number	Application/Control No.	Applicant(s)/Patent under Reexamination	
	15/299,997	SAMUELSSON ET AL.	

Document Code - DISQ	Internal Document – DO NOT MAIL

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Date Filed : 4/24/17	This patent is subject to a Terminal Disclaimer	

Approved/Disapproved by:

Felicia D. Roberts

9,247,262

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NOTICE OF ALLOWANCE AND FEE(S) DUE

146825 7590 06/30/2017

Sage Patent Group/Telefonaktiebolaget LM Ericsson
PO BOX 30789
RALEIGH, NC 27622-0789

EXAMINER
RAHMAN, MOHAMMAD J

ART UNIT	PAPER NUMBER
2487	

DATE MAILED: 06/30/2017

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/299,997	10/21/2016	Jonatan Samuelsson	9900-34860US3	3363

TITLE OF INVENTION: REFERENCE PICTURE SIGNALING

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	10/02/2017

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

146825 7590 06/30/2017
Sage Patent Group/Telefonaktiebolaget LM Ericsson
PO BOX 30789
RALEIGH, NC 27622-0789

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	10/02/2017

EXAMINER	ART UNIT	CLASS-SUBCLASS
RAHMAN, MOHAMMAD J	2487	375-240250

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ❑ Applicant certifying micro entity status. See 37 CFR 1.29
  NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27
  NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ❑ Applicant changing to regular undiscounted fee status.
  NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

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Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 15/299,997	Applicant(s) SAMUELSSON ET AL.	
	Examiner MOHAMMAD J. RAHMAN	Art Unit 2487	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *04/24/2017*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *1-20*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 04/24/2017
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/MOHAMMAD J RAHMAN/
Examiner, Art Unit 2487

1. The present application is being examined under the pre-AIA first to invent provisions.

DETAILED ACTION

2. This office Action is in response to the correspondence on 04/24/2017. Applicant's argument, filed on 04/24/2017 has been entered and carefully considered. Claims 1, 8, 14, 15, 17, and 19 are amended. Claims 1-20 are pending.

Information Disclosure Statement

3. This information disclosure statement (IDS) submitted on 07/18/2011. The submission is in compliance with the provisions of 37 CFR 1.97 and 37 CFR 1.98. Accordingly, the information disclosure statement is being considered by the examiner.

Terminal Disclaimer

4. The terminal disclaimer filed on 04/24/2017 has been reviewed and is approved.

Examiner's Amendment

5. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with David C. Hall on 06/23/2017 to amend claim 13 as follows:

In The Claims

Attached claim amendment.

Allowable Subject Matter

6. The following is a statement of reasons for the indication of allowable subject matter:

The Applicants' replies make evident the reasons for allowance, satisfying the "record as a whole" proviso of the rule 37 CFR 1.104(e). The substance of applicants' remarks, filed on 04/24/2017, are persuasive, as such the reasons for allowance are in all probability evident from the record and no statement is deemed necessary (see MPEP 1302. 14).

A further search was conducted which failed to yield any prior art. Therefore, the prior art fails to teach or render obvious these limitations taken within the others in the claim.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled “Comments on Statement of Reasons for Allowance.”

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MOHAMMAD J. RAHMAN whose telephone number is (571)270-7190. The examiner can normally be reached on Monday-Thursday 8:30am-7:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, Dave Czekaj can be reached on 571 272-7327. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Mohammad J Rahman/
Art Unit 2487

Notice of References Cited	Application/Control No. 15/299,997	Applicant(s)/Patent Under Reexamination SAMUELSSON ET AL.	
	Examiner MOHAMMAD J. RAHMAN	Art Unit 2487	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-2011/0142130 A1	06-2011	Lin; Chia-Ping	H04N19/172	375/240.16
*	B	US-2012/0069903 A1	03-2012	Lim; Jae Hyun	H04N13/0066	375/240.12
	C	US-				
	D	US-				
	E	US-				
	F	US-				
	G	US-				
	H	US-				
	I	US-				
	J	US-				
	K	US-				
	L	US-				
	M	US-				

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15299997	SAMUELSSON ET AL.
	Examiner	Art Unit
	MOHAMMAD J RAHMAN	2487

CPC- SEARCHED		
Symbol	Date	Examiner
H04N19/$, Limited text search	1/22/2017	JR

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES		
Search Notes	Date	Examiner
Inventor search	1/22/2017	JR
Assignee search	1/22/2017	JR
EAST search, History included	1/22/2017	JR
Updated search	6/23/2017	JR

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
	EAST search, History included	6/23/2017	JR

Rahman, Mohammad

From: David Hall <DHall@sagepat.com>
Sent: Friday, June 23, 2017 2:07 PM
To: Rahman, Mohammad
Cc: Nina Dhillon
Subject: USSN 15/299,997; Our Ref 9900-34860US3TS

Examiner Rahman,

Per our discussion, following is a proposed amendment to place Claim 13 in independent form.

13. (Currently amended) A receiver comprising:

an input section configured to receive encoded representations of multiple pictures in a video stream;

a decoder ~~according to claim 8,~~ configured to decode said encoded representations of said multiple pictures; and

an output section configured to output decoded pictures of said video stream;

wherein said decoder comprises:

a data retriever configured to retrieve buffer description information defining at least one reference picture, wherein said buffer description information is retrieved from an encoded representation of at least one picture of said multiple pictures;

a picture identifier determiner configured to determine, based on said buffer description information, at least one reference picture identifier, said at least one reference picture identifier identifying a respective reference picture among said at least one reference picture, said respective reference picture comprising a decoding reference for said at least one picture, wherein said picture identifier determiner is configured to i) retrieve, based on said buffer description information, a respective delta identifier, and ii) calculate said at least one reference picture identifier based on a picture identifier identifying said at least one picture and said respective delta identifier; and

a buffer manager configured to update a decoded picture buffer based on said at least one reference picture identifier.

To make the claim independent, the amendment adds in the language from claim 8 as amended, except that the "picture" in claim 8 becomes "at least one picture of said multiple pictures." If you have any questions, please do not hesitate to contact me.

Best Regards,

David C. Hall

SAGE
PATENT GROUP
4242 Six Forks Road | Suite 1550
Raleigh | North Carolina | 27609
Phone | 984-219-3470
Email | dhall@sagepat.com

Please send a copy of all time-sensitive correspondence to instructions@sagepat.com. This e-mail transmission, and any documents, files or previous e-mail messages attached to it, may contain confidential information that is legally privileged. If you are not the intended recipient, or a person responsible for delivering it to the intended recipient, you are hereby notified that any disclosure, copying, distribution or use of any of the information contained in or attached to this message is STRICTLY PROHIBITED. If you have received this transmission in error, please immediately notify us by reply e-mail and destroy the original transmission and its attachments. Thank you.

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15299997	SAMUELSSON ET AL.
	Examiner	**Art Unit**
	MOHAMMAD J RAHMAN	2487

CPC								
Symbol							**Type**	**Version**
H04N		19	/	573			F	2014-11-01
H04N		19	/	70			I	2014-11-01
H04N		19	/	89			I	2014-11-01
H04N		19	/	31			I	2014-11-01
H04N		19	/	433			I	2014-11-01
H04N		19	/	58			I	2014-11-01
H04L		47	/	50			A	2013-01-01
H04L		65	/	4069			A	2013-01-01
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CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
			/					
			/					

(Assistant Examiner)	(Date)	**Total Claims Allowed:** 20	
/MOHAMMAD J RAHMAN/ Examiner.Art Unit 2487	06/23/2017	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	Fig. 3

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15299997	SAMUELSSON ET AL.
	Examiner	**Art Unit**
	MOHAMMAD J RAHMAN	2487

US ORIGINAL CLASSIFICATION		INTERNATIONAL CLASSIFICATION										
CLASS	SUBCLASS	CLAIMED					NON-CLAIMED					
		H	0	4	N	19 / 573 (2014.0)						
CROSS REFERENCE(S)		H	0	4	N	19 / 433 (2014.01.01)						
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)											

(Assistant Examiner)	(Date)	Total Claims Allowed: 20	
/MOHAMMAD J RAHMAN/ Examiner.Art Unit 2487	06/23/2017	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	Fig. 3

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15299997	SAMUELSSON ET AL.
	Examiner	**Art Unit**
	MOHAMMAD J RAHMAN	2487

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	17	17												
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(Assistant Examiner)	(Date)	**Total Claims Allowed:** 20	
/MOHAMMAD J RAHMAN/ Examiner.Art Unit 2487	06/23/2017	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	Fig. 3

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (use as many sheets as necessary)				Complete if Known	
				Application Number	15/299,997
				Filing Date	October 21, 2016
				First Named Inventor	Samuelsson et al.
				Art Unit	2487
				Examiner Name	Mohammad J. Rahman
Sheet	**B1**	of	**B1**	Attorney Docket Number	9900-34860US3

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No.	Document Number Number-Kind Code (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	1.	US- 2009/0238261 A	09-24-2009	Bhavani et al.	
		US-			
		US-			
		US-			
		US-			
		US-			
		US-			

FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No.	Foreign Patent Document Country Code, Number, Kind Code (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published	T
	2.	Letter reporting Office Action in corresponding Japanese Patent Application No. 2015-141592; Date Mailed: March 27, 2017; Reporting Letter 2 Pages, Japanese Office Action 2 Pages.	

Examiner Signature	/Mohammad J Rahman/	Date Considered	06/23/2017

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /JR/

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1	15/299997.app.	US-PGPUB; USPAT	OR	ON	2017/06/23 12:24
L2	137	(Samuelsson-Jonatan$ Sj$1berg-Rickard$).in.	US-PGPUB; USPAT	OR	ON	2017/06/23 12:26
L3	27446	(ericsson).as.	US-PGPUB; USPAT	OR	ON	2017/06/23 12:26
L4	54957	(H04N19/$).cpc.	US-PGPUB; USPAT	OR	ON	2017/06/23 12:26
L5	244	(buffer and reference and (picture list) and (relative delta)).clm.	US-PGPUB; USPAT	OR	ON	2017/06/23 12:26
L6	6	L5 and L2	US-PGPUB; USPAT	OR	ON	2017/06/23 12:27
L7	4	L5 and L3	US-PGPUB; USPAT	OR	ON	2017/06/23 12:27
L8	119	L5 and L4	US-PGPUB; USPAT	OR	ON	2017/06/23 12:27
L9	28	L5 and L4 and (delta with reference)	US-PGPUB; USPAT	OR	ON	2017/06/23 12:27
L10	5	(@ad<"20110630") and L5 and L4 and (delta with reference)	US-PGPUB; USPAT	OR	ON	2017/06/23 12:27
L11	5	(@ad<"20110630") and ((delta with reference with picture) same (reference with buffer))	US-PGPUB; USPAT	OR	ON	2017/06/23 12:27
L12	4	(@ad<"20110630") and (delta with POC) and (decoded with picture with buffer) and (reference with buffer)	US-PGPUB; USPAT	OR	ON	2017/06/23 12:28
L13	2	(US-20090052550-$ or US-20100238822-$).did.	US-PGPUB	OR	ON	2017/06/23 12:28
L14	1	"20090238261".pn.	US-PGPUB; USPAT	OR	ON	2017/06/23 13:03
L15	56	(@ad<"20110630") and (delta with reference) and (decoded with picture with buffer) and (reference with buffer)	US-PGPUB; USPAT	OR	ON	2017/06/23 13:29
L16	50	(@ad<"20110630") and (delta with reference with picture) and (decoded with picture with buffer) and (reference with buffer)	US-PGPUB; USPAT	OR	ON	2017/06/23 13:29

L17	0	(@ad<"20110630") and ((delta with reference with picture) same encod$3) and (decoded with picture with buffer) and (reference with buffer)	US-PGPUB; USPAT	OR	ON	2017/06/23 13:31
L18	2	(@ad<"20110630") and ((delta with reference with picture) same stream) and (decoded with picture with buffer) and (reference with buffer)	US-PGPUB; USPAT	OR	ON	2017/06/23 13:32
L19	0	(@ad<"20110630") and ((delta with reference with picture) same (header pps sps rpsei)) and (decoded with picture with buffer) and (reference with buffer)	US-PGPUB; USPAT	OR	ON	2017/06/23 13:33
L20	0	(@ad<"20110630") and (delta with reference with picture) and (decoded with picture with buffer) and (reference with buffer) and poc	US-PGPUB; USPAT	OR	ON	2017/06/23 13:34
L21	43	(@ad<"20110630") and (delta with reference with picture) and (decoded with picture with buffer) and (reference with buffer) and (picture with count)	US-PGPUB; USPAT	OR	ON	2017/06/23 13:34
L22	0	(@ad<"20110630") and (delta with reference with picture) and (decoded with picture with buffer) and (reference with buffer) and (picture with order with count)	US-PGPUB; USPAT	OR	ON	2017/06/23 13:34
L23	0	(@ad<"20110630") and (delta near2 reference near2 picture) and (decoded with picture with buffer) and (reference with buffer)	US-PGPUB; USPAT	OR	ON	2017/06/23 13:35
L24	0	(@ad<"20110630") and (delta near2 reference near2 picture) and (reference with buffer)	US-PGPUB; USPAT	OR	ON	2017/06/23 13:35
L25	6	("2009/0238261").URPN.	USPAT	OR	ON	2017/06/23 13:35
L26	0	(@ad<"20110630") and L25	US-PGPUB; USPAT	OR	ON	2017/06/23 13:36
L27	61	("20040218668" | "20050123056" | "20060083298" | "20060294171" | "20070086521" | "20070168644" | "20070206673" | "20070247549" | "20080117985" | "20080137742" | "20080165860" | "20080232467" | "20080260034" | "20080301742" | "20080317138" | "20090003445" | "20090003447" | "20090080533" | "20090150620" | "20090168886" | "20090220010" | "20090238261" | "20090262804" | "20090296811" | "20090304068" | "20100020870" | "20100046619" | "20100118933" | "20100135385" | "20100158120" | "20100189173" | "20100189182" | "20100238822" | "20100262711" | "20100266042" | "20110013889" | "20110032999" | "20110080949" | "20110090957" | "20110142130" | "20110200112" | "20110246659" | "20120069903" | "20120185570" | "20120230401" | "20120230409" | "20120230433" | "20120320984" | "7149247" | "7253831" | "7430361" | "7492387" |	US-PGPUB; USPAT; USOCR	OR	ON	2017/06/23 13:37

		"7495587" | "7782903" | "7782950" | "7801223" | "7869501" | "8036272" | "8073059" | "8175154" | "8194741").PN.				

6/ 23/ 2017 1:39:09 PM
C:\ Users\ mrahman7\ Documents\ EAST\ Workspaces\ 15299997_Final.wsp

EAST Search History

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L28	244	(buffer and reference and (picture list) and (relative delta)).clm.	US-PGPUB; USPAT	OR	ON	2017/06/23 13:39
L29	108	(buffer and (picture list) and ((relative delta) with reference)).clm.	US-PGPUB; USPAT	OR	ON	2017/06/23 13:40
L30	4	(buffer and (picture list) and ((relative delta) with reference with identifier)).clm.	US-PGPUB; USPAT	OR	ON	2017/06/23 13:40

6/ 23/ 2017 1:50:46 PM
C:\ Users\ mrahman7\ Documents\ EAST\ Workspaces\ 15299997_Final.wsp

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15299997	SAMUELSSON ET AL.
	Examiner	Art Unit
	MOHAMMAD J RAHMAN	2487

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	01/22/2017	06/23/2017							
1	1	✓	=							
2	2	✓	=							
3	3	✓	=							
4	4	✓	=							
5	5	✓	=							
6	6	✓	=							
7	7	✓	=							
8	8	✓	=							
9	9	✓	=							
10	10	✓	=							
11	11	✓	=							
12	12	✓	=							
13	13	✓	=							
14	14	✓	=							
15	15	✓	=							
16	16	✓	=							
17	17	✓	=							
18	18	✓	=							
19	19	✓	=							
20	20	✓	=							

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

146825 7590 06/30/2017
Sage Patent Group/Telefonaktiebolaget LM Ericsson
PO BOX 30789
RALEIGH, NC 27622-0789

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/299,997	10/21/2016	Jonatan Samuelsson	9900-34860US3	3363

TITLE OF INVENTION: REFERENCE PICTURE SIGNALING

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	10/02/2017

EXAMINER	ART UNIT	CLASS-SUBCLASS
RAHMAN, MOHAMMAD J	2487	375-240250

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 Sage Patent Group
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Telefonaktiebolaget LM Ericsson (publ)
(B) RESIDENCE: (CITY and STATE OR COUNTRY): Stockholm, Sweden

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
☒ Issue Fee
☐ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
☐ A check is enclosed.
☒ Payment by credit card. Form PTO-2038 is attached.
☐ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
☐ Applicant certifying micro entity status. See 37 CFR 1.29
NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
☐ Applicant asserting small entity status. See 37 CFR 1.27
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
☐ Applicant changing to regular undiscounted fee status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /David C. Hall/ Date September 28, 2017
Typed or printed name David C. Hall Registration No. 38,904

Electronic Patent Application Fee Transmittal

Application Number:	15299997
Filing Date:	21-Oct-2016
Title of Invention:	REFERENCE PICTURE SIGNALING
First Named Inventor/Applicant Name:	Jonatan Samuelsson
Filer:	David C. Hall/Nina Dhillon
Attorney Docket Number:	9900-34860US3

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	960	960

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**960**

Electronic Acknowledgement Receipt

EFS ID:	30504911
Application Number:	15299997
International Application Number:	
Confirmation Number:	3363
Title of Invention:	REFERENCE PICTURE SIGNALING
First Named Inventor/Applicant Name:	Jonatan Samuelsson
Customer Number:	146825
Filer:	David C. Hall/Nina Dhillon
Filer Authorized By:	David C. Hall
Attorney Docket Number:	9900-34860US3
Receipt Date:	28-SEP-2017
Filing Date:	21-OCT-2016
Time Stamp:	14:10:04
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$960
RAM confirmation Number	092917INTEFSW14102600
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	P34860_US3_Issue_Fee_Transmittal.pdf	177339 493faafd6c9370f470f5caf117f96697eb46aafe	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30490 da17a99fe5d23e5e5e2cee40ccd1f7ea87f5f621	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	207829		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/299,997	10/31/2017	9807418	9900-34860US3	3363

146825 7590 10/11/2017

Sage Patent Group/Telefonaktiebolaget LM Ericsson
PO BOX 30789
RALEIGH, NC 27622-0789

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Jonatan Samuelsson, Stockholm, SWEDEN;
Telefonaktiebolaget LM Ericsson (publ), Stockholm, SWEDEN;
Rickard Sjöberg, Stockholm, SWEDEN;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

PTO/SB/44 (09-07)
Approved for use through 01/31/2020. OMB 0651-0033
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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(Also Form PTO-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 9,807,418 B2

APPLICATION NO. : 15/299,997

ISSUE DATE : October 31, 2017

INVENTOR(S) : Samuelsson, et al.

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the Face Page, in Field (63), in Column 1, Line 3, delete "2012." and insert - - 2012, now Pat. No. 9,706,223. - -, therefor.

On the Face Page, in the Figure, for Step"S4", in Line 3, delete "CODED" and insert - - ENCODED - -, therefor.

In Fig. 3, Sheet 3 of 12, for Step"S4", in Line 3, delete "CODED" and insert - - ENCODED - -, therefor.

In Column 1, Line 7, delete "2013," and insert - - 2013, now Pat. No. 9,706,223 - -, therefor.

In Column 6, Line 7, delete "picture, 0" and insert - - picture 0 - -, therefor.

In Column 6, Line 9, delete "(300, 302, 303, 0, 3)." and insert - - {300, 302, 303, 0, 3}. - -, therefor.

In Column 8, Line 58, delete "Decoder." and insert - - Decoder - -, therefor.

MAILING ADDRESS OF SENDER (Please do not use customer number below):

6300 Legacy, MS EVR 1-C-11
Plano, TX 75024
972-583-8656

This collection of information is required by 37 CFR 1.322, 1.323, and 1.324. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1.0 hour to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Attention Certificate of Corrections Branch, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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PTO/SB/44 (09-07)
Approved for use through 01/31/2020. OMB 0651-0033
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.
(Also Form PTO-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 9,807,418 B2

APPLICATION NO. : 15/299,997

ISSUE DATE : October 31, 2017

INVENTOR(S) : Samuelsson, et al.

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In Column 11, Line 10, delete "Infra" and insert - - Intra - -, therefor.

In Column 11, Line 30, delete "(tld)" and insert - - (tId) - -, therefor.

In Column 14, Line 28, delete "ceil(log 2" and insert - - ceil(log2 - -, therefor.

In Column 17, Line 16, delete "steps S30" and insert - - step S30 - -, therefor.

In Column 17, Line 17, delete "FIG. S31." and insert - - FIG. 11. - -, therefor.

In Column 20, Line 6, delete "tld(A)" and insert - - tId(A) - -, therefor.

In Column 20, Line 7, delete "tld(B)" and insert - - tId(B) - -, therefor.

In Column 20, Line 8, delete "tld(A)<tld(B)." and insert - - tId(A)<tId(B). - -, therefor.

In Column 20, Line 51, delete "delfa_POC," and insert - - delta_POC, - -, therefor.

MAILING ADDRESS OF SENDER (Please do not use customer number below):

6300 Legacy, MS EVR 1-C-11
Plano, TX 75024
972-583-8656

This collection of information is required by 37 CFR 1.322, 1.323, and 1.324. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1.0 hour to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Attention Certificate of Corrections Branch, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/SB/44 (09-07)
Approved for use through 01/31/2020. OMB 0651-0033
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.
(Also Form PTO-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 9,807,418 B2

APPLICATION NO. : 15/299,997

ISSUE DATE : October 31, 2017

INVENTOR(S) : Samuelsson, et al.

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In Column 30, Line 64, delete "buffer description_" and insert - - buffer_description_ - -, therefor.

In Column 32, Line 16, delete "_picture_id (I)" and insert - - _picture_id(i) - -, therefor.

In Column 33, Line 15, in Claim 4, delete "according" and insert - - according to - -, therefor.

MAILING ADDRESS OF SENDER (Please do not use customer number below):

6300 Legacy, MS EVR 1-C-11
Plano, TX 75024
972-583-8656

This collection of information is required by 37 CFR 1.322, 1.323, and 1.324. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1.0 hour to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Attention Certificate of Corrections Branch, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF: U.S. Patent No. 9,807,418

USPTO CONFIRMATION CODE: 3363

APPLICATION NO.: 15/299,997

FILED: October 21, 2016

EXAMINER: Mohammad J Rahman

GROUP ART UNIT: 2487

FOR: REFERENCE PICTURE SIGNALING

37 CFR 1.322 & 37 CFR 1.323 REQUEST FOR CERTIFICATE OF CORRECTION FOR USPTO AND/OR APPLICANT MISTAKE

HONORABLE COMMISSIONER OF PATENTS & TRADEMARKS

SIR:

The following is a request for a certificate of correction in Serial Number 15/299,997, now Patent Number 9,807,418.

A certificate of correction under 35 USC 254 is respectfully requested in the above-identified patent.

The errors were the fault of both the applicant and USPTO and, accordingly, please charge **$100.00** to our Deposit Account No. 50-1379. In the event that a further fee is required, please charge the amount to the same Deposit Account.

The exact locations where the errors appear in the patent and patent application are as follows:

On the Face Page, in Field (63), in Column 1, Line 3, delete "2012." and insert - - 2012, now Pat. No. 9,706,223. - -, therefor.
(BIBLIOGRAPHIC DATA SHEET DATED JANUARY 26, 2017, PAGE 1 OF 1, UNDER "CONTINUING DATA", LINE 1)

On the Face Page, in the Figure, for Step"S4", in Line 3, delete "CODED" and insert - - ENCODED - -, therefor.
(ORIGINALLY FILED SPECIFICATION, IN THE DRAWINGS DATED OCTOBER 21, 2016, SHEET 3/12 (PAGE 155 OF FW), FIGURE 3, STEP "S4", LINE 3)

In Fig. 3, Sheet 3 of 12, for Step"S4", in Line 3, delete "CODED" and insert - - ENCODED - -, therefor.
(ORIGINALLY FILED SPECIFICATION, IN THE DRAWINGS DATED OCTOBER 21, 2016, SHEET 3/12 (PAGE 155 OF FW), FIGURE 3, STEP "S4", LINE 3)

In Column 1, Line 7, delete "2013," and insert - - 2013, now Pat. No. 9,706,223 - -, therefor.
(ORIGINALLY FILED SPECIFICATION DATED OCTOBER 21, 2016, PAGE 1 (PAGE 99 OF FW), LINE 4)

In Column 6, Line 7, delete "picture, 0" and insert - - picture 0 - -, therefor.
(ORIGINALLY FILED SPECIFICATION DATED OCTOBER 21, 2016, PAGE 9 (PAGE 107 OF FW), LINE 4)

In Column 6, Line 9, delete "(300, 302, 303, 0, 3)." and insert - - {300, 302, 303, 0, 3}. - -, therefor.
(ORIGINALLY FILED SPECIFICATION DATED OCTOBER 21, 2016, PAGE 9 (PAGE 107 OF FW), LINE 5)

In Column 8, Line 58, delete "Decoder." and insert - - Decoder - -, therefor.
(ORIGINALLY FILED SPECIFICATION DATED OCTOBER 21, 2016, PAGE 13 (PAGE 111 OF FW), LINE 7)

In Column 11, Line 10, delete "Infra" and insert - - Intra - -, therefor.
(ORIGINALLY FILED SPECIFICATION DATED OCTOBER 21, 2016, PAGE 16 (PAGE 114 OF FW), LINE 25)

In Column 11, Line 30, delete "(tld)" and insert - - (tId) - -, therefor.
(ORIGINALLY FILED SPECIFICATION DATED OCTOBER 21, 2016, PAGE 17 (PAGE 115 OF FW), LINE 2)

In Column 14, Line 28, delete "ceil(log 2" and insert - - ceil(log2 - -, therefor.
(ORIGINALLY FILED SPECIFICATION DATED OCTOBER 21, 2016, PAGE 21 (PAGE 119 OF FW), LINE 24)

In Column 17, Line 16, delete "steps S30" and insert - - step S30 - -, therefor.
(ORIGINALLY FILED SPECIFICATION DATED OCTOBER 21, 2016, PAGE 25 (PAGE 123 OF FW), LINE 29)

In Column 17, Line 17, delete "FIG. S31." and insert - - FIG. 11. - -, therefor.
(ORIGINALLY FILED SPECIFICATION DATED OCTOBER 21, 2016, PAGE 25 (PAGE 123 OF FW), LINE 30)

In Column 20, Line 6, delete "tld(A)" and insert - - tId(A) - -, therefor.
(ORIGINALLY FILED SPECIFICATION DATED OCTOBER 21, 2016, PAGE 30 (PAGE 128 OF FW), LINE 2)

In Column 20, Line 7, delete "tld(B)" and insert - - tId(B) - -, therefor.
(ORIGINALLY FILED SPECIFICATION DATED OCTOBER 21, 2016, PAGE 30 (PAGE 128 OF FW), LINE 3)

In Column 20, Line 8, delete "tld(A)<tld(B)." and insert - - tId(A)<tId(B). - -, therefor.
(ORIGINALLY FILED SPECIFICATION DATED OCTOBER 21, 2016, PAGE 30 (PAGE 128 OF FW), LINE 3)

In Column 20, Line 51, delete "delfa_POC," and insert - - delta_POC, - -, therefor.
(ORIGINALLY FILED SPECIFICATION DATED OCTOBER 21, 2016, PAGE 31 (PAGE 129 OF FW), LINE 2)

In Column 30, Line 64, delete "buffer description_" and insert - - buffer_description_ - -, therefor.
(ORIGINALLY FILED SPECIFICATION DATED OCTOBER 21, 2016, PAGE 48 (PAGE 146 OF FW), LINE 2)

In Column 32, Line 16, delete "_picture_id (I)" and insert - - _picture_id(i) - -, therefor.
(ORIGINALLY FILED SPECIFICATION DATED OCTOBER 21, 2016, PAGE 48 (PAGE 146 OF FW), LINE 16)

In Column 33, Line 15, in Claim 4, delete "according" and insert - - according to - -, therefor.
(AMENDMENTS TO THE CLAIMS DATED APRIL 24, 2017, PAGE 3 OF 15, CLAIM 4, LINE 1)

The requested corrections are attached on Form PTO 1050.

Respectfully Submitted

, 2017

/Ronald J. Ward,Reg#54870/

DATE

Ronald J. Ward
Registration No. 54,870
Attorney of Record

Electronic Patent Application Fee Transmittal

Application Number:	15299997
Filing Date:	21-Oct-2016
Title of Invention:	REFERENCE PICTURE SIGNALING
First Named Inventor/Applicant Name:	Jonatan Samuelsson
Filer:	Steven Ware Smith/Michelle Sanderson
Attorney Docket Number:	9900-34860US3

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Certificate of correction	1811	1	100	100

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**100**

Electronic Acknowledgement Receipt

EFS ID:	31441200
Application Number:	15299997
International Application Number:	
Confirmation Number:	3363
Title of Invention:	REFERENCE PICTURE SIGNALING
First Named Inventor/Applicant Name:	Jonatan Samuelsson
Customer Number:	146825
Filer:	Steven Ware Smith/Michelle Sanderson
Filer Authorized By:	Steven Ware Smith
Attorney Docket Number:	9900-34860US3
Receipt Date:	08-JAN-2018
Filing Date:	21-OCT-2016
Time Stamp:	20:27:53
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$100
RAM confirmation Number	010918INTEFSW00007028501379
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Certificate of Correction	P34860-US3_2018-01-08_CoC_PTO-1050.pdf	118082 af928ededa13e216de23e3232372ea2ecf9175b4	no	4
Warnings:					
Information:					
2	Transmittal Letter	P34860-US3_2018-01-08_CoC_Request_Letter.pdf	115416 4dce60d30922f277ff00ab612fead09120b55735	no	4
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30329 c2a9e83e29ae6f09021b503f2c555dffe416be78	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	263827		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/299,997	10/21/2016	Jonatan Samuelsson	9900-34860US3	3363

146825 7590 05/24/2018

Sage Patent Group/Telefonaktiebolaget LM Ericsson
PO BOX 30789
RALEIGH, NORTH CAROLINA 27622-0789
UNITED STATES OF AMERICA

EXAMINER
RAHMAN, MOHAMMAD J

ART UNIT	PAPER NUMBER
2487	

NOTIFICATION DATE	DELIVERY MODE
05/24/2018	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

instructions@sagepat.com

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

Patent No.: 9807418
Issue Date: 31 October 2017
Appl. No.: 15/299,997
Filed: 21 October 2016

PART (A) RESPONSE FOR CERTIFICATES OF CORRECTION

This is a decision on the Certificate of Correction request filed ____.

The request for issuance of Certificate of Correction for the above-identified correction(s) under the provisions of 37 CFR 1.322 and/or 1.323 is hereby:

(Check one)
☑ Approved ☐ Approved in Part ☐ Denied

Comments: ____

PART (B) PETITION UNDER 37 CFR 1.324 OR 37 CFR 1.48

☐ This is a decision on the petition filed ____ to correct inventorship under 37 CFR 1.324.

☐ This is a decision on the request under 37 CFR 1.48, petition filed ____. In view of the fact that the patent has already issued, the request under 37 CFR 1.48 has been treated as a petition to correct inventorship under 37 CFR 1.324.

The petition is hereby: ☐ Granted ☐ Dismissed

Comment: ____

The patented filed is being forwarded to Certificate of Corrections Branch for issuance of a certificate naming only the actual inventor or inventors.

/DAVID J CZEKAJ/
Technology Center 2400
Phone: (571)272-7327

Certificates of Correction Branch email: CustomerServiceCoC@uspto.gov CoC Central Phone Number: (703) 756-1814

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 9,807,418 B2
APPLICATION NO. : 15/299997
DATED : October 31, 2017
INVENTOR(S) : Samuelsson et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the Title Page

In Item (63), in Column 1, Line 3, delete "2012." and insert -- 2012, now Pat. No. 9,706,223. --, therefor.

In the Figure, for Step "S4", in Line 3, delete "CODED" and insert -- ENCODED --, therefor.

In the Drawings

In Fig. 3, Sheet 3 of 12, for Step "S4", in Line 3, delete "CODED" and insert -- ENCODED --, therefor.

In the Specification

In Column 1, Line 7, delete "2013," and insert -- 2013, now Pat. No. 9,706,223 --, therefor.

In Column 6, Line 7, delete "picture, 0" and insert -- picture 0 --, therefor.

In Column 6, Line 9, delete "(300, 302, 303, 0, 3)." and insert -- {300, 302, 303, 0, 3}. --, therefor.

In Column 8, Line 58, delete "Decoder." and insert -- Decoder --, therefor.

In Column 11, Line 10, delete "Infra" and insert -- Intra --, therefor.

In Column 11, Line 30, delete "(tld)" and insert -- (tId) --, therefor.

In Column 14, Line 28, delete "ceil(log 2" and insert -- ceil(log2 --, therefor.

In Column 17, Line 16, delete "steps S30" and insert -- step S30 --, therefor.

Signed and Sealed this
Twelfth Day of June, 2018

Andrei Iancu
Director of the United States Patent and Trademark Office

In Column 17, Line 17, delete "FIG. S31." and insert -- FIG. 11. --, therefor.

In Column 20, Line 6, delete "tld(A)" and insert -- tId(A) --, therefor.

In Column 20, Line 7, delete "tld(B)" and insert -- tId(B) --, therefor.

In Column 20, Line 8, delete "tld(A)<tld(B)." and insert -- tId(A)<tId(B). --, therefor.

In Column 20, Line 51, delete "delfa_POC," and insert -- delta_POC, --, therefor.

In Column 30, Line 64, delete "buffer description_" and insert -- buffer_description_ --, therefor.

In Column 32, Line 16, delete "_picture_id (I)" and insert -- _picture_id(i) --, therefor.

In the Claims

In Column 33, Line 15, in Claim 4, delete "according" and insert -- according to --, therefor.