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(71) Applicant (for all designated States except US): THOM-SON LICENSING S.A. [FR/FR]; 46 Quai Alphonse Le Gallo, 92648 Boulogne Cedex (FR).

(72) Inventors; and
(75) Inventors/Applicants (for US only): LIN, Shu [CN/US];

9339 D Notre Dame Drive, Indianapolis, IN 46240 (US). WILLIS, Donald, Henry [US/US]; 5175 East 74th Place, Indianapolis, IN 46250 (US).

(74) Agents: TRIPOLI, Joseph, S. et al.; Thomson multimedia Licencing Inc., P.O. Box 5312, Princeton, NJ 08543-5312 (US).

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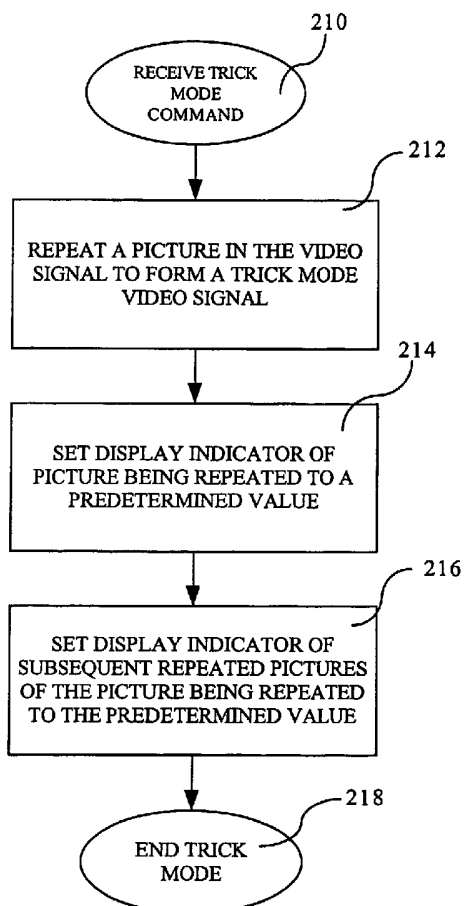
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(54) Title: TRICK MODE ON BIDIRECTIONAL PREDICTIVE FRAMES

(57) Abstract: A method (200) and system (100) for performing a trick mode on a video signal. The method includes the steps of receiving (210) a trick mode command, in response to the trick mode command, repeating (212) a picture in the video signal to form a trick mode video signal in which the picture contains a display indicator; setting (214) the display indicator of the picture being repeated to a predetermined value; and setting (216) the display indicators of subsequent repeated pictures of the picture being repeated to the predetermined value. In one arrangement, the trick mode can be a freeze trick mode, and the picture to be repeated can be a bidirectional predictive picture. In addition, the display indicator can be a temporal reference field having an integer value.

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TRICK MODE ON BIDIRECTIONAL PREDICTIVE FRAMES

BACKGROUND OF THE INVENTION

1.   Technical Field

The inventive arrangements relate generally to video systems and more

5   particularly to video systems that record or play back digitally encoded video

sequences.

2.   Description of Related Art

Digital televisions (DTV) and high-definition televisions (HDTV) are gaining

popularity in today's consumer electronics marketplace. Many purchasers of these

10   types of televisions also buy digital video recorders or players, such as a digital video

disc (DVD) recorder or player, for purposes of viewing previously recorded programs

or recording their favorite programs. Notably, the combination of a DTV (or an

HDTV) and a digital video recorder or player can be an integral part of a home

theater entertainment system.

15   A digital video recorder or player typically contains an MPEG decoder to

decode the digitally encoded multimedia data that is stored on the discs that the

recorder or player plays. If the digital video recorder or player is connected to a

conventional (non-DTV or non-HDTV) television, the digitally encoded signal will be

decoded by the digital video recorder's or player's MPEG decoder before being

20   displayed on the conventional television. Significantly, however, many DTV's

contain their own MPEG decoders, as the MPEG decoder in the majority of digital

video recorders or players cannot handle the decoding of video signals for such

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televisions. As such, if a digital video recorder or player is connected to a DTV, the video signal read from the disc is remotely decoded by the DTV's decoder. This configuration can be referred to as a remote decoder arrangement.

There is, however, an important disadvantage to decoding digitally encoded

5　signals with a remote DTV decoder. Namely, certain trick mode commands, such as a freeze or pause command, can be problematic. When a freeze trick mode is initiated, there is no way to determine exactly how long the trick mode will remain in effect. Consequently, it is impossible to calculate how many times a particular picture will be displayed during this type of trick mode. This uncertainty can interfere

10　with the display order of the pictures being transferred to the decoder in the DTV, as the DTV decoder is not under the control of the digital video recorder and has no way of knowing that a freeze trick mode has been initiated. Thus, a need exists for a method and system for performing a trick mode without negatively affecting the display order of the pictures in the video signal and without increasing system costs

15　or complexity.

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Summary of the Invention

The present invention concerns a method of performing a trick mode on a
video signal. The invention includes the steps of: receiving a trick mode command;
in response to the trick mode command, repeating a picture in the video signal to

5   form a trick mode video signal in which the picture contains a display indicator;
setting the display indicator of the picture being repeated to a predetermined value;
and setting the display indicators of subsequent repeated pictures of the picture
being repeated to the predetermined value. In one arrangement, the trick mode can
be a freeze trick mode, and the picture to be repeated can be a bidirectional

10   predictive picture. In addition, the display indicator can be a temporal reference field
having an integer value.

In one aspect of the invention, the method can further include the step
transmitting at least a first reference picture and a second reference picture to
predict the picture to be repeated in which each reference picture can contain a

15   display indicator. In another aspect, the method can further include the steps of:
setting the display indicator of the first reference picture to a predetermined value
such that the predetermined value of the display indicator of the first reference
picture can be lower than the predetermined value of the display indicators of the
pictures being displayed during the trick mode; and setting the display indicator of

20   the second reference picture to a predetermined value such that the predetermined
value of the display indicator of the second reference picture can be greater than the
predetermined value of the display indicators of the pictures being displayed during
the trick mode.

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In another arrangement, each of the display indicators can be temporal reference fields having integer values. Also, the step of setting the display indicator of the second reference picture can include the step of setting the integer value of the temporal reference field of the second reference picture an integer value higher than the integer value of the temporal reference field of the picture being repeatedly displayed during the trick mode to maintain a proper display order. Moreover, at least a portion of the trick mode video signal can be decoded by a remote decoder.

The invention also concerns a system for performing a trick mode on a video signal. The system includes: a controller for reading data from a storage medium and outputting the video signal; and a processor programmed to: receive a trick mode command; in response to the trick mode command, repeat a picture in the video signal to form a trick mode video signal in which the picture contains a display indicator; set the display indicator of the picture being repeated to a predetermined value; and set the display indicators of subsequent repeated pictures of the picture being repeated to the predetermined value. The system also includes suitable software and circuitry to implement the methods as described above.

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Brief Description of the Drawings

FIG. 1 is a block diagram of a system that can perform a trick mode on bidirectional predictive pictures in accordance with the inventive arrangements.

FIG. 2 is a flow chart that illustrates an operation of performing a trick mode on bidirectional predictive pictures in accordance with the inventive arrangements.

FIG. 3 shows a typical group of pictures structure in display order.

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Detailed Description of the Preferred Embodiments

A system 100 for implementing the various advanced operating features in accordance with the inventive arrangements is shown in block diagram form in FIG. 1. The invention, however, is not limited to the particular system illustrated in FIG. 1,

5 as the invention can be practiced with any other system capable of receiving a digitally encoded signal and transferring that signal to a display device. In addition, the system 100 is not limited to reading data from or writing data to any particular type of storage medium, as any storage medium capable of storing digitally encoded data can be used with the system 100.

10 The system 100 can include a controller 110 for reading data from and writing data to a storage medium 112. The system 100 can also have a microprocessor 114 and a display device 118. It should be understood that all or portions of the controller 110 and the microprocessor 114 can be a bitstream source 120 within contemplation of the present invention. Control and data interfaces can also be

15 provided for permitting the microprocessor 114 to control the operation of the controller 110 and other components in the bitstream source 120. Suitable software or firmware can be provided in memory for the conventional operations performed by the microprocessor 114. Further, program routines can be provided for the microprocessor 114 in accordance with the inventive arrangements.

20 In one arrangement, the display device 118 can contain its own decoder 116 for decoding all or a portion of any video signal read from the storage medium 112 and processed by the bitstream source 120. In this particular arrangement, the decoder (not shown) in the bitstream source 120 typically does not decode the video

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signal read from the storage medium 112. This particular embodiment can be

referred to as a remote decoder arrangement, and the decoder 116 in the display

device 118 can be referred to as a remote decoder. It should be noted, however,

that the invention is not limited to this arrangement, as the invention can be practiced

5   with other suitable systems.

In operation, the controller 110 can read a video signal containing a plurality

of digitally encoded pictures from the storage medium 112. In one arrangement, if

the microprocessor 114 receives a trick mode command, then the microprocessor

114 can repeatedly transmit a picture in the video signal to the decoder 116 thereby

10   forming a trick mode video signal. The microprocessor 114 can execute the

repeating step by transmitting repeats or duplicates of the picture to be repeated.

These duplicates of the picture to be repeated during the trick mode can be referred

to as subsequent repeated pictures. In one aspect of the invention, the picture to be

repeated can be a bidirectional predictive (B) picture, and the trick mode can be a

15   freeze trick mode.

During the trick mode, the picture being repeated can be repeatedly displayed

(through the use of the subsequent repeated pictures) at the display device 118. In

addition, this picture and the subsequent repeated pictures can include a display

indicator, which is typically used to enable the decoder 116 to determine when a

20   picture is to be displayed, at least relative to other pictures in a video signal. In one

arrangement, the microprocessor 114 can set the display indicator of the picture to

be repeated and the subsequent repeated pictures to a predetermined value to

reflect an intended display order. This predetermined value of the display indicator

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of the picture being repeated can be the same as the predetermined value of the

display indicators of the subsequent repeated pictures. In addition, the

microprocessor can set to a predetermined value the display indicators of any

reference frames that may be used to predict the picture to be repeated during the

5   trick mode. The overall operation of the invention will be discussed in greater detail

below.

Performing Trick Mode On Bidirectional Predictive Frames

FIG. 2 illustrates a flowchart 200 that demonstrates one way in which a trick

mode on B pictures can be executed. In one arrangement, the invention can be

10   practiced in a remote decoder arrangement. For purposes of the invention, a remote

decoder arrangement can be any system in which at least a portion of the pictures in

a video signal can be decoded by a decoder that is external to and not under the

control of a bitstream source that is providing the pictures to the decoder. As an

example, the bitstream source can be an optical storage medium player or recorder,

15   such as a digital video player or recorder that reads multimedia data from an optical

storage medium and transfers this data over a transmission channel to a digital

television, which contains its own decoder. It is understood, however, that the

invention is not limited to this example or even a remote decoder arrangement, as

the invention can be practiced in any other suitable system or arrangement.

20   At step 210, a trick mode command can be received. In one arrangement, the

trick mode command can be a freeze or pause trick mode command. For purposes

of the invention, a freeze trick mode can be a trick mode in which a particular picture

in the video signal can be repeatedly displayed on a display device for an amount of

time determined by a viewer. Although the invention is discussed primarily in terms

of a freeze trick mode, it must be noted that the invention can be practiced with any

other suitable trick mode. Once the trick mode command is received, at step 212, a

picture in the video signal can be repeated to form a trick mode video signal.

5   In one arrangement and as noted earlier, the picture to be repeated can be a

B picture, and the repeats or duplicates of this picture can be referred to as

subsequent repeated pictures. In addition, the picture to be repeated and the

subsequent repeated pictures can include a display indicator. It is understood,

however, that the picture to be repeated is not limited to a B picture, as other suitable

10   picture types can be used with the invention.

         At step 214, the display indicator of the picture to be repeated can be set to a

predetermined value. At step 216, the display indicators of subsequent repeated

pictures of the picture being repeated can also be set to this predetermined value.

As such, the value of the display indicator for each of the pictures to be displayed

15   during the trick mode can be the same. The display indicator can be a temporal

reference field. A temporal reference field is typically a ten bit field located in the

picture header of digitally encoded pictures. This field normally has an integer value,

and some decoders rely on this value to determine when a picture is to be displayed.

The invention, however, is not limited in this regard, as other suitable display

20   indicators can be used to reflect an intended display order.

         An example of the process described in steps 212 – 216 is discussed below.

Referring to FIG. 3, a typical group of pictures (GOP) structure 300 in display order is

shown. The GOP can include B pictures, predictive (P) pictures and intra (I)

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pictures. The subscript numbers represent integer values of each picture's temporal

reference field and can indicate when a particular picture will be displayed relative to

the other pictures in the GOP, at least during normal playback. For instance, the first

picture in the GOP, B_0, will be displayed first followed by B_1, I_2 and so on. Those

5   skilled in the art will appreciate that the invention is not limited to use on this

particular type of GOP and that the integer values of the temporal reference fields

are not limited to these particular values.

As is known in the art, when transmitting a B picture for decoding and display,

the two reference pictures from which the B picture is predicted must be sent to the

10   decoder and decoded before the B picture. Once the reference pictures are

decoded, the B picture can be decoded, and the pictures are displayed according to

their display order, which can be obtained from the integer values of the temporal

reference fields. As an example, if the reference pictures are P pictures P_5 and P_8

and the B picture B_6 is to be decoded and displayed, then P_5 and P_8 are decoded

15   first followed by B_6; however, the display order is as follows: P_5, B_6 and P_8 (for

convenience, this example ignores picture B_7).

Continuing with this example, to reflect the intended display order, the integer

value of the temporal reference field of picture P_5 can be set to a predetermined

value of 5, the integer value of the temporal reference field of picture B_6 can be set to

20   6 and the integer value of the temporal reference field of picture P_8 can be set to 8.

As the reference pictures are transmitted to the decoder and decoded prior to picture

B_6, however, the value of the temporal reference fields of the reference pictures are

set before the value of the temporal reference field of picture B_6.

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Such a process can be problematic if a freeze trick mode is to be performed

on picture B_6 (or any other B picture for that matter). Specifically, as picture B_6 is

repeated, the value of the temporal reference fields of each of the subsequent

repeated pictures is set to reflect their intended display order. Thus, the value of the

5   temporal reference fields of subsequent repeated pictures of picture B_6 are typically

incrementally increased during the freeze trick mode. As noted earlier, however, the

integer value of the temporal reference field of reference picture P_8 will remain the

same, and once the freeze trick mode is stopped, picture P_8 may be displayed out of

order as the decoder, particularly if it is remotely located, is unaware that a trick

10   mode has been initiated.

In accordance with the inventive arrangements, however, the integer value of

picture B_6 can be set to 6, and the integer values of the temporal reference fields of

subsequent repeated pictures of picture B_6 can also be set to a value of 6. Thus,

referring back to flowchart 200, when the freeze trick mode is stopped at step 218,

15   the second reference picture, P_8, can be displayed in its proper order. It must be

noted that the foregoing discussion is merely one example of how the invention can

be practiced and that other GOP structures and other pictures can be used with the

invention.

Although the present invention has been described in conjunction with the

20   embodiments disclosed herein, it should be understood that the foregoing

description is intended to illustrate and not limit the scope of the invention as defined

by the claims.

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CLAIMS:

1   1.   A method of performing a trick mode on a video signal, comprising the

2   steps of:

3   receiving a trick mode command;

4   in response to the trick mode command, repeating a picture in the video

5   signal to form a trick mode video signal, wherein the picture contains a display

6   indicator;

7   setting the display indicator of the picture being repeated to a predetermined

8   value; and

9   setting the display indicators of subsequent repeated pictures of the picture

10   being repeated to the predetermined value.

1   2.   The method according to claim 1, comprising the step of executing a

2   freeze trick mode.

1   3.   The method according to claim 1, comprising the step of repeating a

2   bidirectional predictive picture.

1   4.   The method according to claim 1, comprising the step of setting the

2   display indicator as a temporal reference field having an integer value.

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1   5.   The method according to claim 1, further comprising the step of

2   transmitting at least a first reference picture and a second reference picture to

3   predict the picture to be repeated, wherein each reference picture contains a display

4   indicator.

1   6.   The method according to claim 5, further comprising the steps of:

2   setting the display indicator of the first reference picture to a predetermined

3   value such that the predetermined value of the display indicator of the first reference

4   picture is lower than the predetermined value of the display indicator of the picture

5   being repeatedly displayed during the trick mode; and

6   setting the display indicator of the second reference picture to a

7   predetermined value such that the predetermined value of the display indicator of the

8   second reference picture is greater than the predetermined value of the display

9   indicator of the picture being repeatedly displayed during the trick mode.

1   7.   The method according to claim 6, comprising the step of setting each

2   of the display indicators as temporal reference fields having integer values; and,

3   wherein said step of setting the display indicator of the second reference picture

4   further comprises the step of setting the integer value of the temporal reference field

5   of the second reference picture an integer value higher than the integer value of the

6   temporal reference field of the picture being repeatedly displayed during the trick

7   mode to maintain a proper display order.

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1   8.   The method according to claim 1, further comprising the step of

2   decoding at least a portion of the trick mode video signal at a remote location.

1   9.   A method of performing a trick mode on a video signal, comprising the

2   steps of:

3   receiving a freeze trick mode command;

4   in response to the freeze trick mode command, repeating a bidirectional

5   predictive picture in the video signal to form a trick mode video signal, wherein the

6   bidirectional predictive picture contains a display indicator;

7   setting the display indicator of the bidirectional predictive picture being

8   repeated to a predetermined value; and

9   setting the display indicators of subsequent repeated bidirectional predictive

10   pictures of the bidirectional predictive picture being repeated to the predetermined

11   value.

1   10.   The method according to claim 9, comprising the steps of implementing

2   the receiving, repeating and both setting steps at a first location and decoding at

3   least a portion of the trick mode video signal at a second location.

1   11.   A system for performing a trick mode on a video signal, comprising:

2   a controller for reading data from a storage medium and outputting the video

3   signal; and

4   a processor programmed to:

5   receive a trick mode command;

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6   in response to the trick mode command, repeat a picture in the video

7   signal to form a trick mode video signal, wherein the picture contains a display

8   indicator;

9   set the display indicator of the picture being repeated to a

10   predetermined value; and

11   set the display indicators of subsequent repeated pictures of the picture

12   being repeated to the predetermined value.

1   12.   The system according to claim 11, wherein the trick mode is a freeze

2   trick mode.

1   13.   The system according to claim 11, wherein the picture to be repeated

2   is a bidirectional predictive picture.

1   14.   The system according to claim 11, wherein the display indicator is a

2   temporal reference field having an integer value.

1   15.   The system according to claim 11, wherein the processor is further

2   programmed to transmit at least a first reference picture and a second reference

3   picture to predict the picture to be repeated, wherein each reference picture contains

4   a display indicator.

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1   16.   The system according to claim 15, wherein the processor is further

2   programmed to:

3   set the display indicator of the first reference picture to a predetermined value

4   such that the predetermined value of the display indicator of the first reference

5   picture is lower than the predetermined value of the display indicator of the picture

6   being repeatedly displayed during the trick mode; and

7   set the display indicator of the second reference picture to a predetermined

8   value such that the predetermined value of the display indicator of the second

9   reference picture is greater than the predetermined value of the display indicator of

10   the picture being repeatedly displayed during the trick mode.

1   17.   The system according to claim 16, wherein each of the display

2   indicators are temporal reference fields having integer values and the processor is

3   further programmed to perform the step of setting the display indicator of the second

4   reference picture by setting the integer value of the temporal reference field of the

5   second reference picture an integer value higher than the integer value of the

6   temporal reference field of the picture being repeatedly displayed during the trick

7   mode to maintain a proper display order.

1   18.   The system according to claim 11, wherein at least a portion of the trick

2   mode video signal is decoded by a remote decoder.

1   19.   A system for performing a trick mode on a video signal, comprising:

2   a controller for reading data from a storage medium and outputting the video

3   signal; and

4   a processor programmed to:

5   receive a freeze trick mode command;

6   in response to the freeze trick mode command, repeat a bidirectional

7   predictive picture in the video signal to form a trick mode video signal, wherein the

8   picture contains a display indicator;

9   set the display indicator of the bidirectional predictive picture being

10   repeated to a predetermined value; and

11   set the display indicators of subsequent repeated bidirectional

12   predictive pictures of the bidirectional predictive picture being repeated to the

13   predetermined value.

1   20.   The system according to claim 19, further comprising a remote decoder

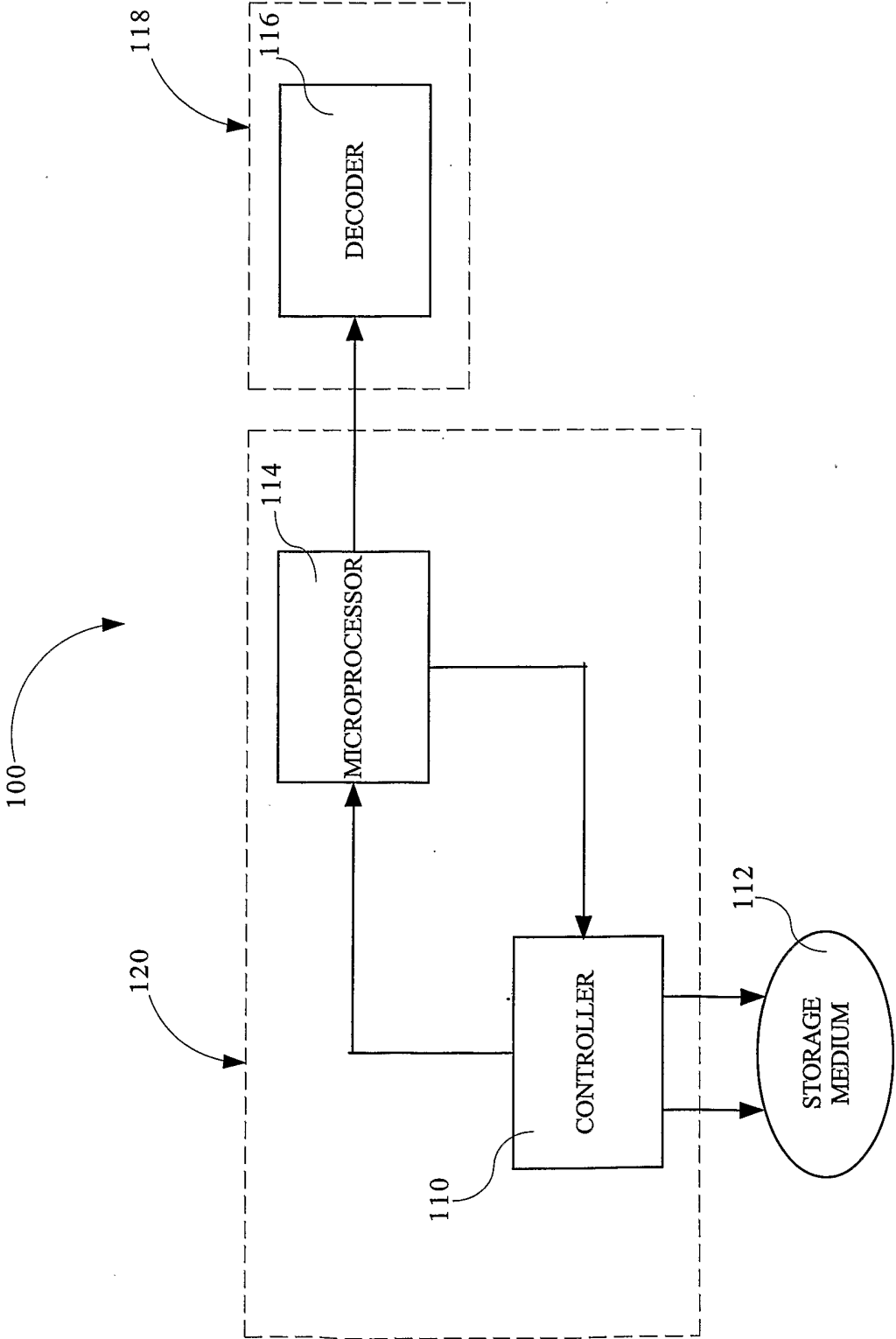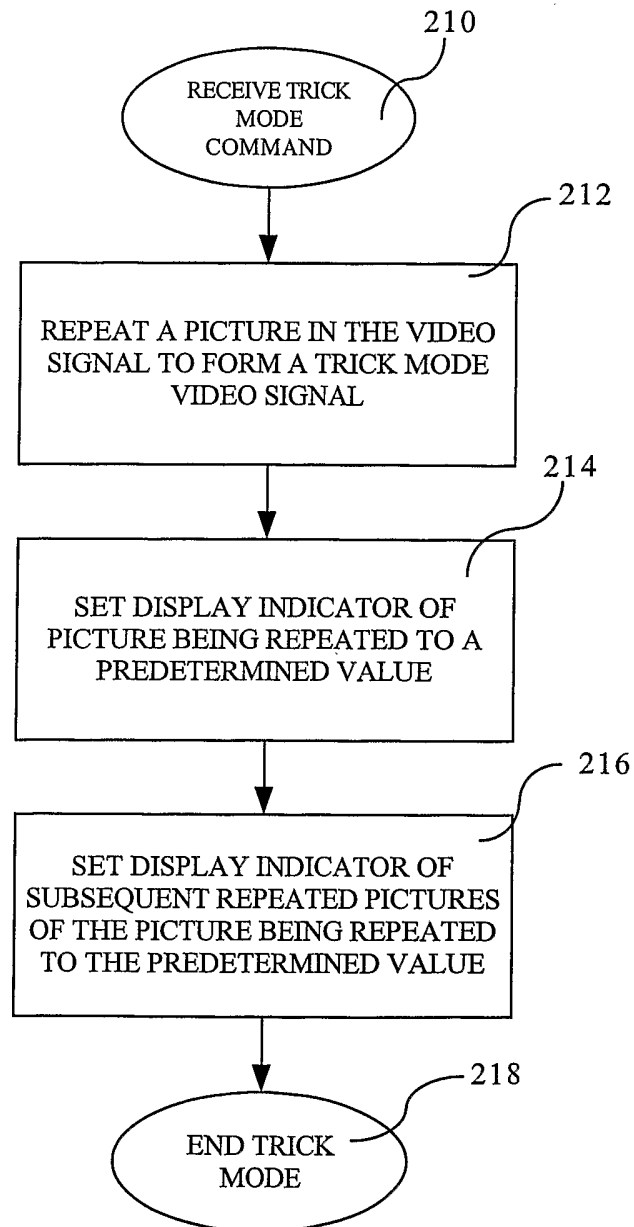2   for decoding at least a portion of the trick mode video signal.
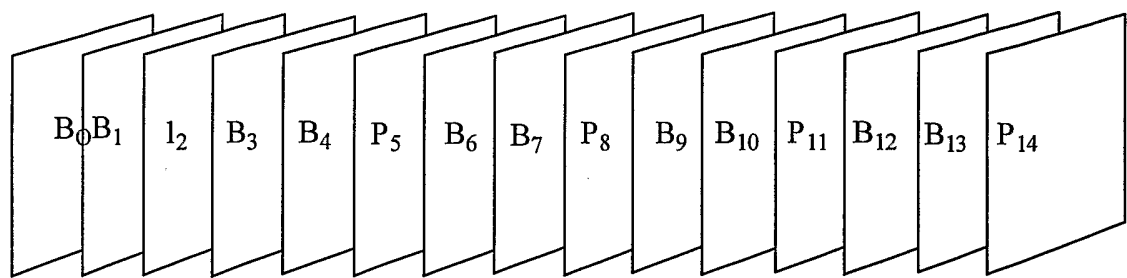
FIG. 1

200

FIG. 2

300

FIG. 3

INTERNATIONAL SEARCH REPORT

A.	CLASSIFICATION OF SUBJECT MATTER

IPC(7)   :   H04N 5/91, 5/917, 5/781, 5/783, 5/85, 5/76; 7/26
US CL   :   386/68, 69, 70, 109, 110, 111, 125, 126

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)
    U.S. : 386/68, 69, 70, 109, 110, 111, 125, 126

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	WO 96/13121 A1 (MCLAREN) 02 May 1996 (02.05.0996) page 9, lines 29-37. page 9 lines 1-9	1, 2, 5, 9, 11, 12, 15 ---------- 3, 7, 10, 13, 17
Y	US 5,978,855 A (METZ et al) 02 November 1999 (02.11.1999) Figure 1. Column 45, lines 36-43	3,4,6-8,13-14,16-17
Y	US 5,841,939 A (TAKAHASHI et al) 24 November 1998 (24.11.1998), column 12, lines 34-40.	3,4,6-8,13-14,16-17

☐ Further documents are listed in the continuation of Box C.   ☐ See patent family annex.

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    Box PCT
    Washington, D.C. 20231
Facsimile No. (703)305-3230
	Authorized officer
	Andrew Christensen
	Telephone No. (703)305-3900

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