

# EXHIBIT D



US008228979B2

(12) **United States Patent**  
**Washino**

(10) **Patent No.:** **US 8,228,979 B2**  
(45) **Date of Patent:** **Jul. 24, 2012**

(54) **WIDE-BAND MULTI-FORMAT AUDIO/VIDEO PRODUCTION SYSTEM WITH FRAME-RATE CONVERSION**

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/348,804**

(22) Filed: **Jan. 5, 2009**

(65) **Prior Publication Data**

US 2009/0174813 A1 Jul. 9, 2009

**Related U.S. Application Data**

(63) Continuation of application No. 10/117,496, filed on Apr. 5, 2002, now Pat. No. 7,474,696, which is a continuation of application No. 09/305,953, filed on May 6, 1999, now Pat. No. 6,370,198, which is a continuation-in-part of application No. 08/834,912, filed on Apr. 7, 1997, now Pat. No. 5,999,220.

(60) Provisional application No. 60/084,522, filed on May 7, 1998.

(51) **Int. Cl.**  
**H04B 1/66** (2006.01)  
**H04N 7/01** (2006.01)

(52) **U.S. Cl.** ..... **375/240.01**; 348/446

(58) **Field of Classification Search** ..... 348/555, 348/556, 722, 441, 445, 448, 426, 432, 454, 348/558, 568, 446; 375/240.26, 240.29, 375/240.01, 240.16, 240.24

See application file for complete search history.

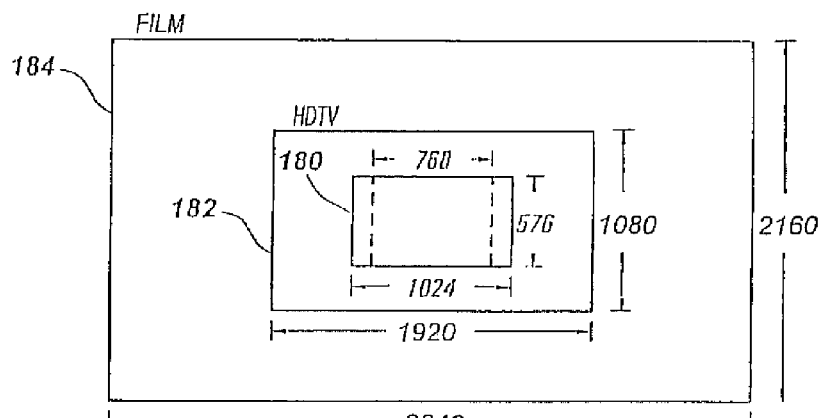
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(57) **ABSTRACT**

A multi-format digital video production system enables a user to process an input video program to produce an output version of the program in a final format which may have a different frame rate, pixel dimensions, or both. An internal production format of 24 fps is preferably chosen to provide the greatest compatibility with existing and planned formats associated with HDTV standard 4:3 or widescreen 16:9 high-definition television, and film. Images are re-sized horizontally and vertically by pixel interpolation, thereby producing larger or smaller image dimensions so as to fill the particular needs of individual applications. Frame rates are adapted by inter-frame interpolation or by traditional schemes, including "3:2 pull-down" for 24-to-30 fps conversions. Simple speed-up (for 24-to-25 conversions) or slow-down (for 25-to-24 conversions) for playback, or by manipulating the frame rate itself using a program storage facility with asynchronous reading and writing capabilities. The step of converting the signal to a HDTV format is preferably performed using a modified upconversion process for wideband signals (utilizing a higher sampling clock frequency) and a resizing to HDTV format frame dimensions in pixels.

**14 Claims, 14 Drawing Sheets**



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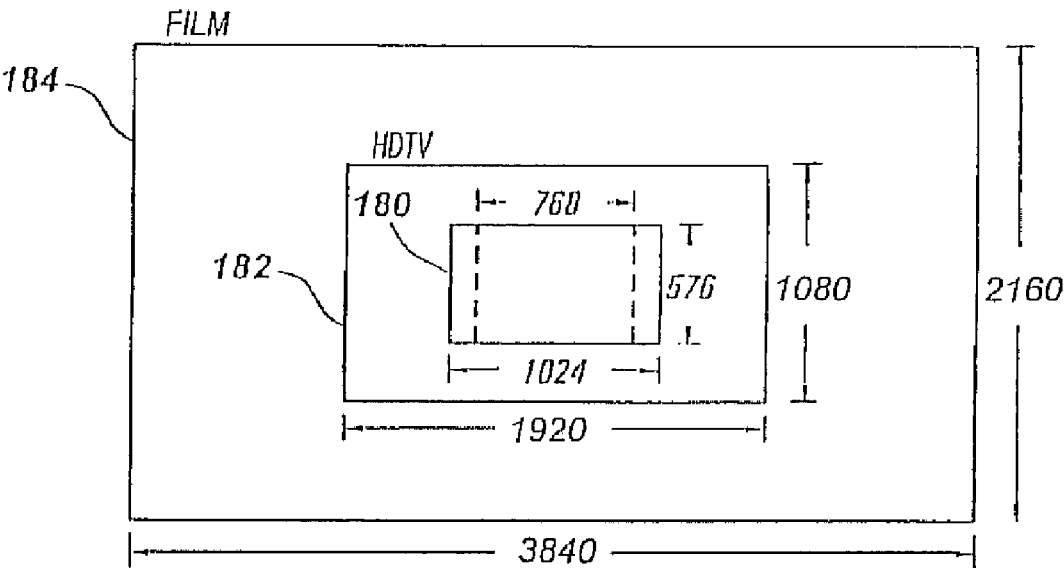


Figure 1a

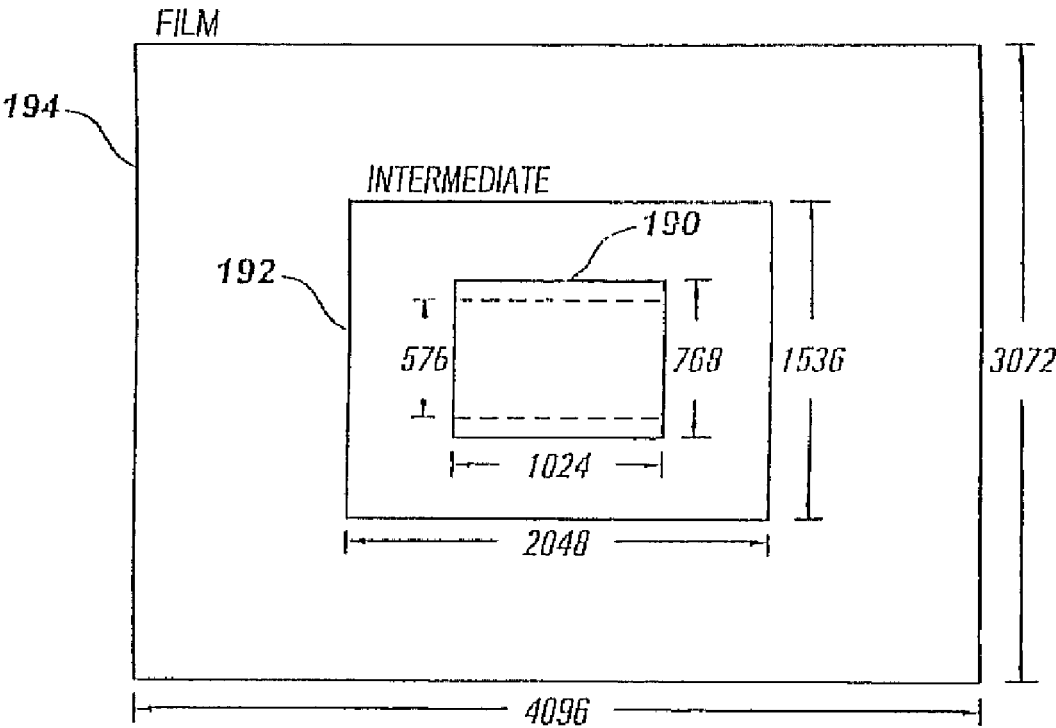


Figure 1b

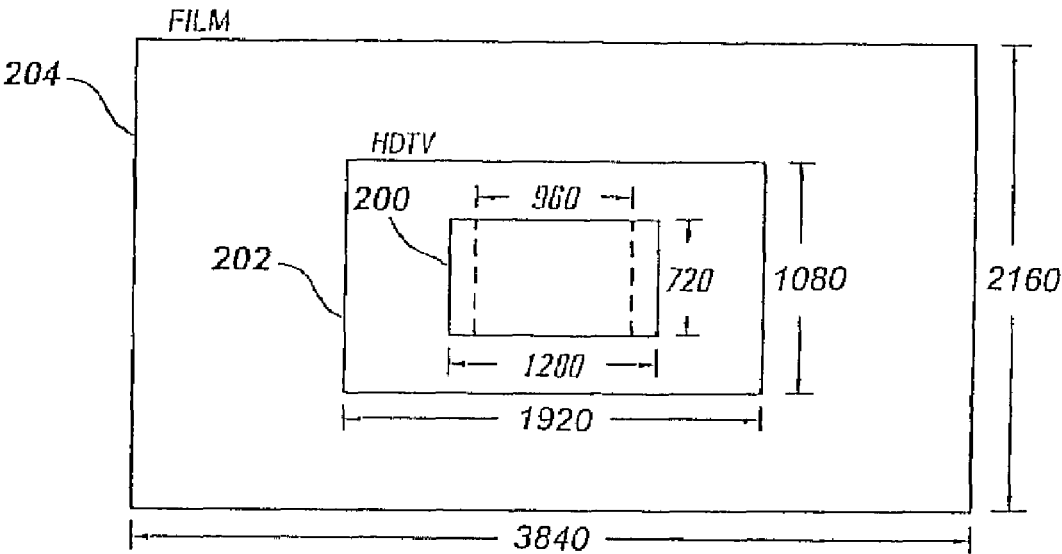


Figure 1c

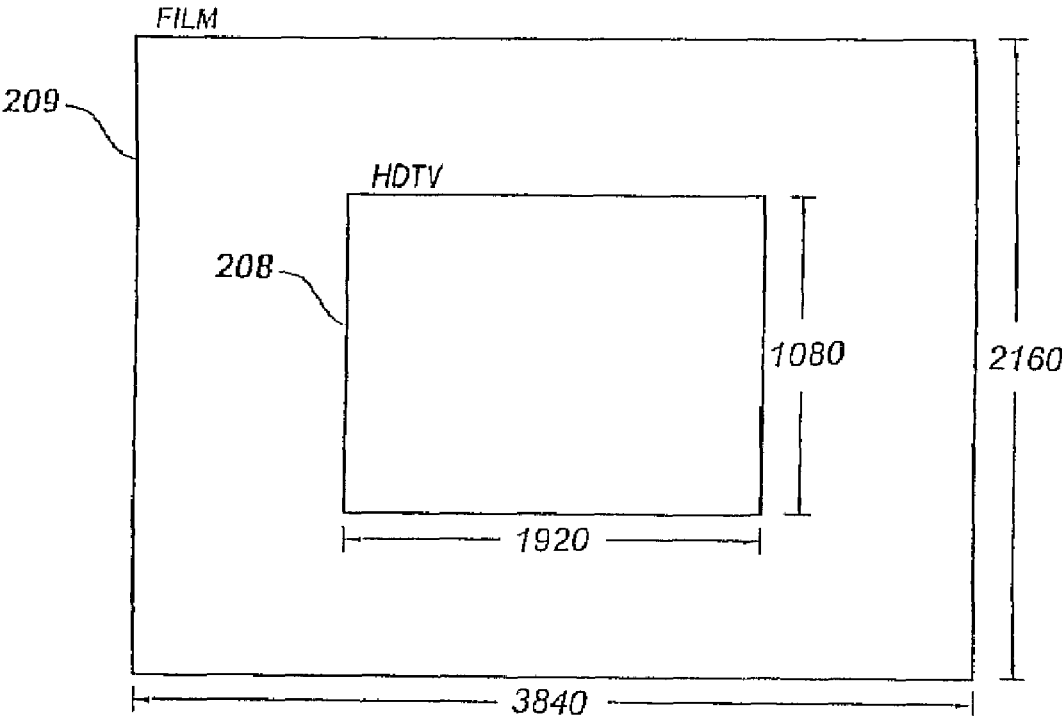


Figure 1d

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