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(12) **United States Patent**
Washino

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

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5,999,220 A * 12/1999 Washino 348/441

* cited by examiner

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Sprinkle, Anderson & Citkowski, PC

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

(57) **ABSTRACT**

(21) **Appl. No.:** **09/305,953**

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. The present invention thus encourages production at relatively low pixel dimensions to make use of lower-cost general-purpose technology and to maintain high signal-to-noise ratio, and then subsequently expands the resultant image into a so-called up-converted program. This is in contrast to alternative approaches, which recommend operating at HDTV-type resolution, then down-converting, as necessary, to smaller image formats.

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Related U.S. Application Data

(63) 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.**⁷ **H04N 7/12; H04N 5/46;**
H04N 7/01

(52) **U.S. Cl.** **375/240.26; 348/441; 348/445;**
348/555; 348/556; 348/722

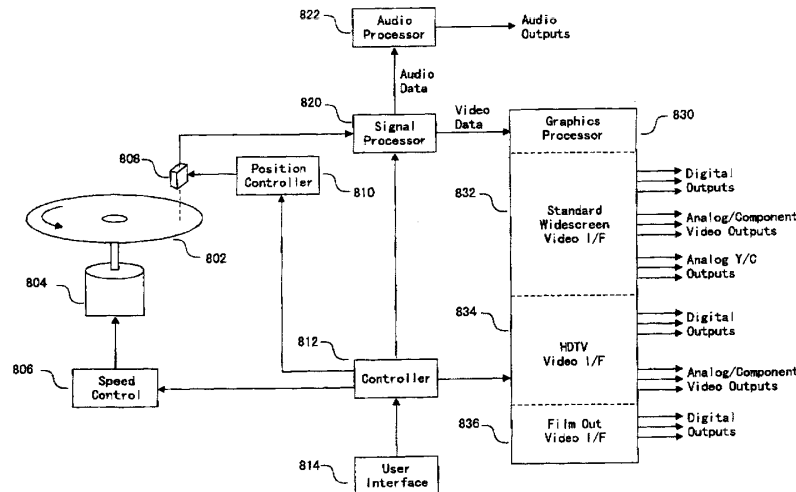
(58) **Field of Search** **348/441, 445,**
348/448, 426, 432, 454, 558, 568, 555-556,
722, 911, 575; 358/527, 524; 375/240.26,
240.29

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29 Claims, 14 Drawing Sheets



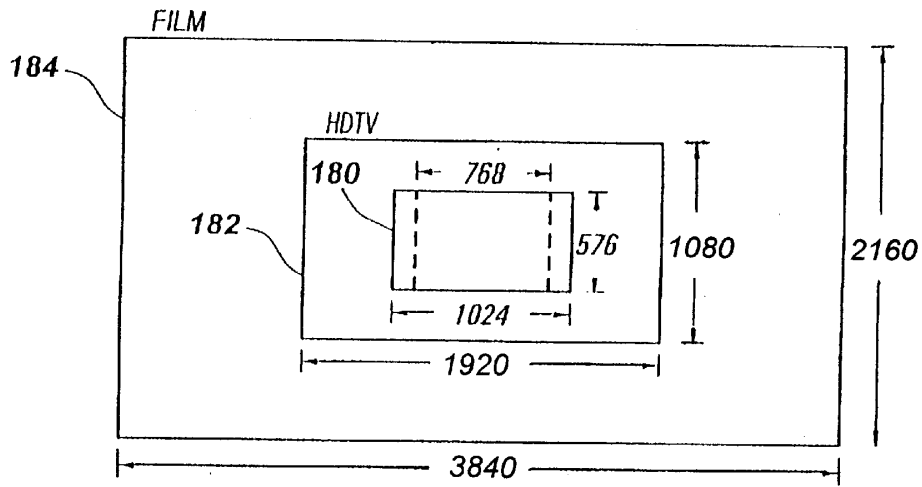


Figure 1a

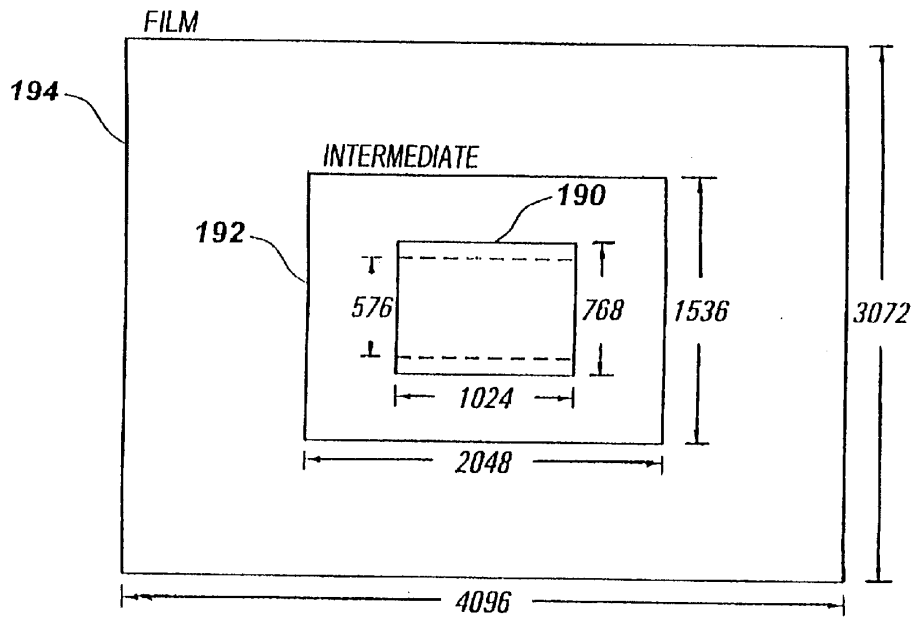


Figure 1b

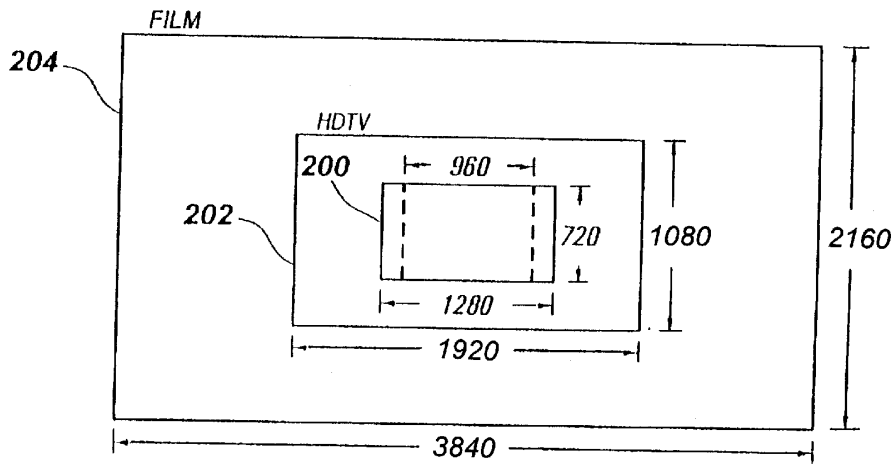


Figure 1c

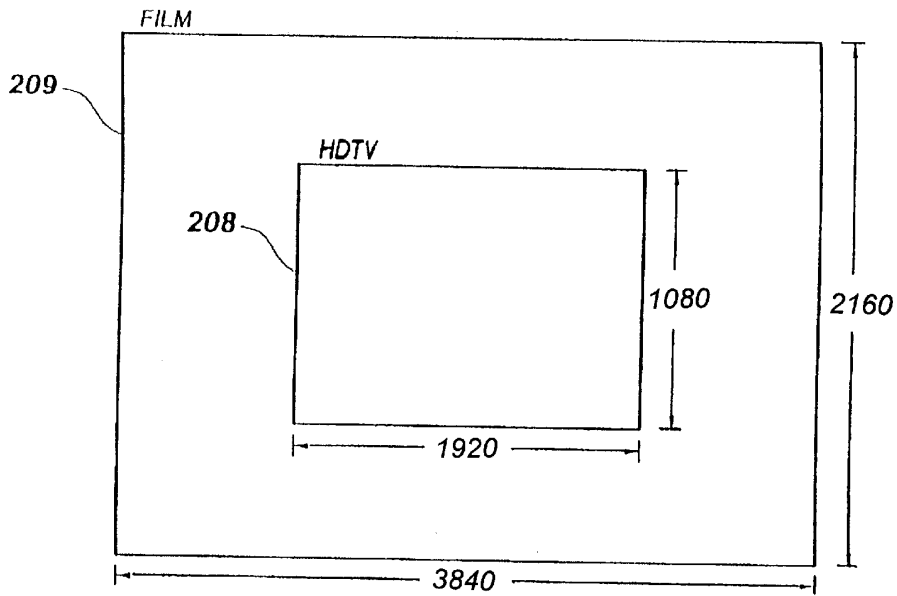


Figure 1d

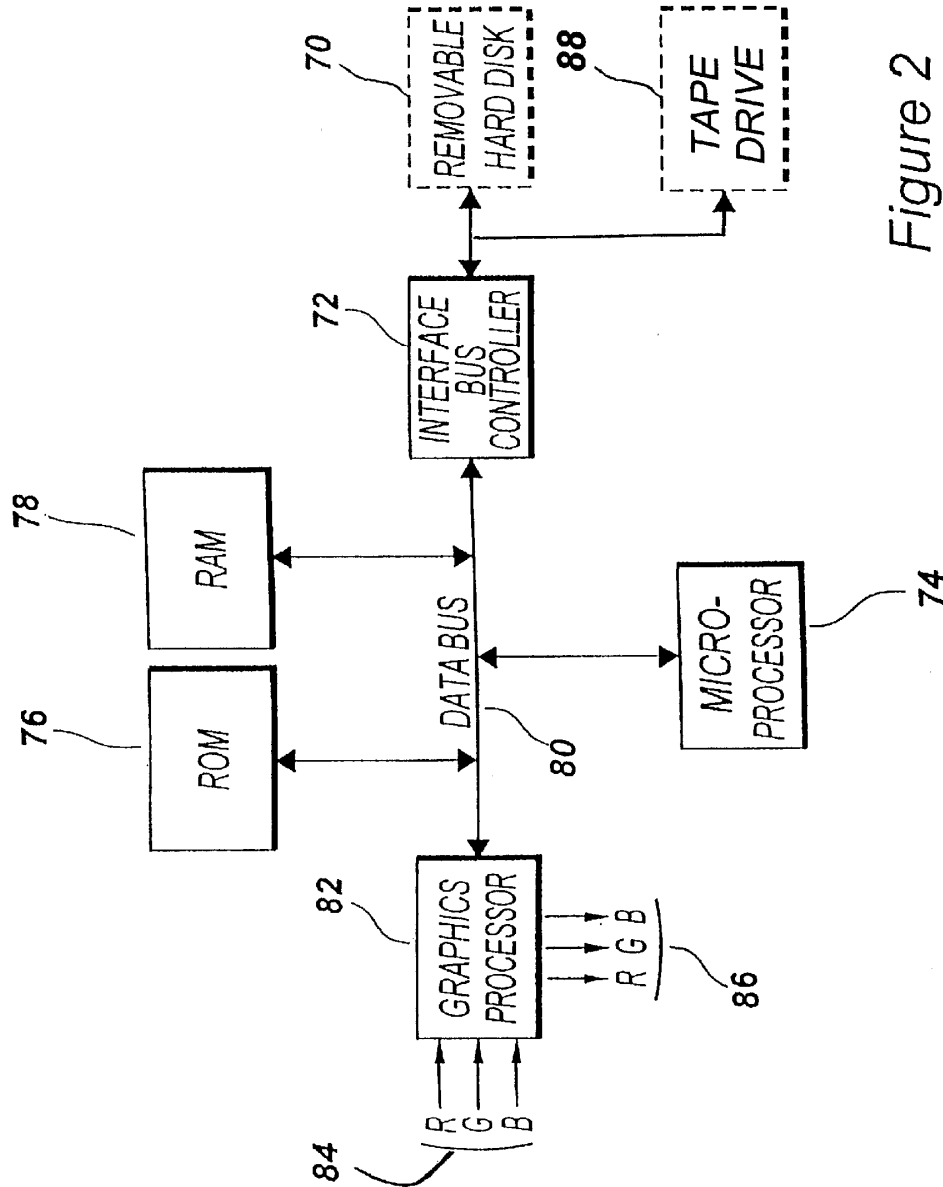


Figure 2

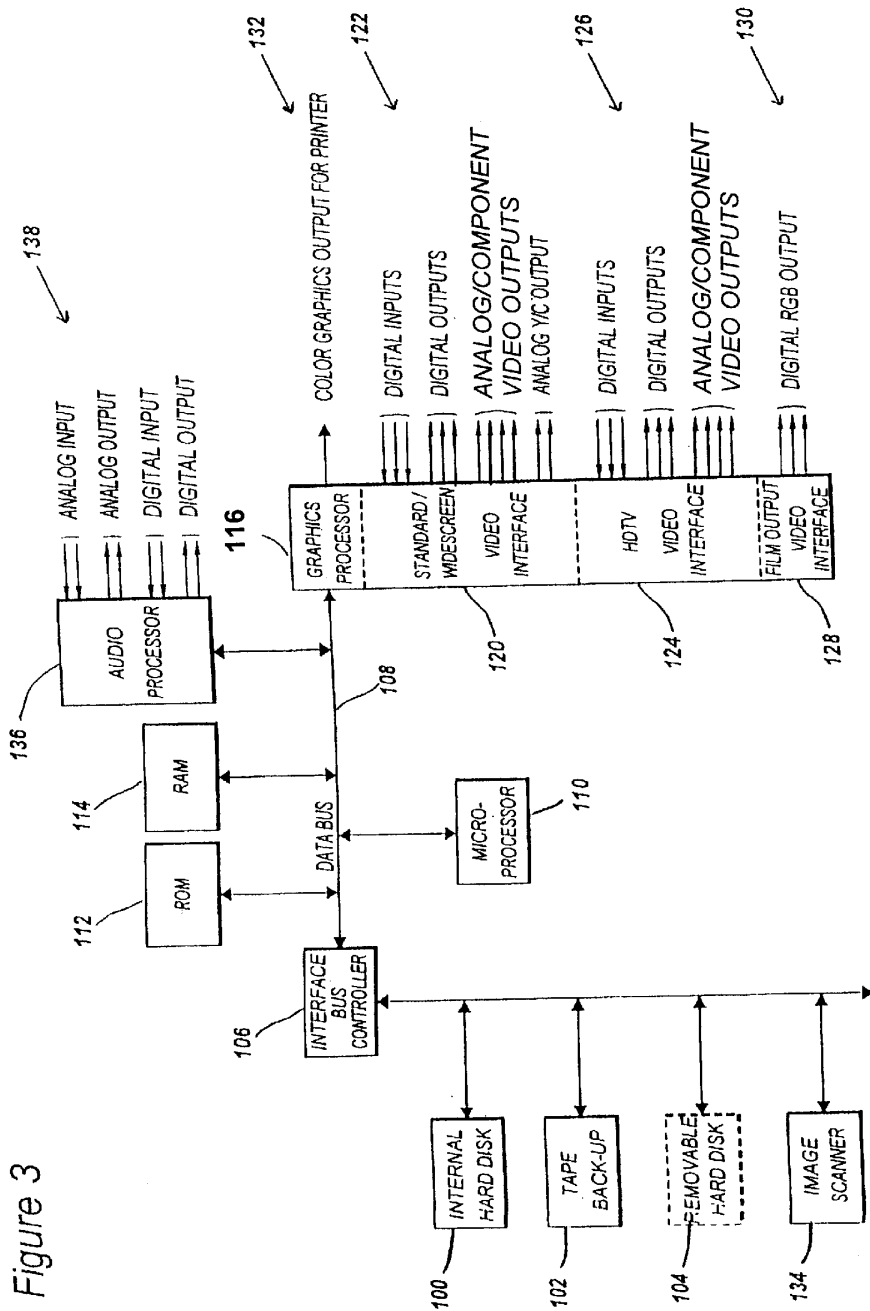


Figure 3

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