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(54) **COPY PREVENTION METHOD AND APPARATUS FOR DIGITAL VIDEO SYSTEM**

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Filed: **Feb. 3, 2000**

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(58) **Field of Classification Search** **380/201, 380/228; 705/53, 56, 57, 58, 51**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,753,228 A	8/1973	Nickolas et al.
4,420,829 A	12/1983	Carlson
4,554,461 A	11/1985	Oho et al.
4,694,489 A	9/1987	Frederiksen
4,736,422 A	4/1988	Mason
4,796,220 A	1/1989	Wolfe
4,802,215 A	1/1989	Mason
4,817,140 A	3/1989	Chandra et al.

(Continued)

FOREIGN PATENT DOCUMENTS

EP 0 267 039 A2 5/1988

(Continued)

OTHER PUBLICATIONS

Derfler, F. J. et al., "How Networks Work".

(Continued)

Primary Examiner — Pierre E Elisca

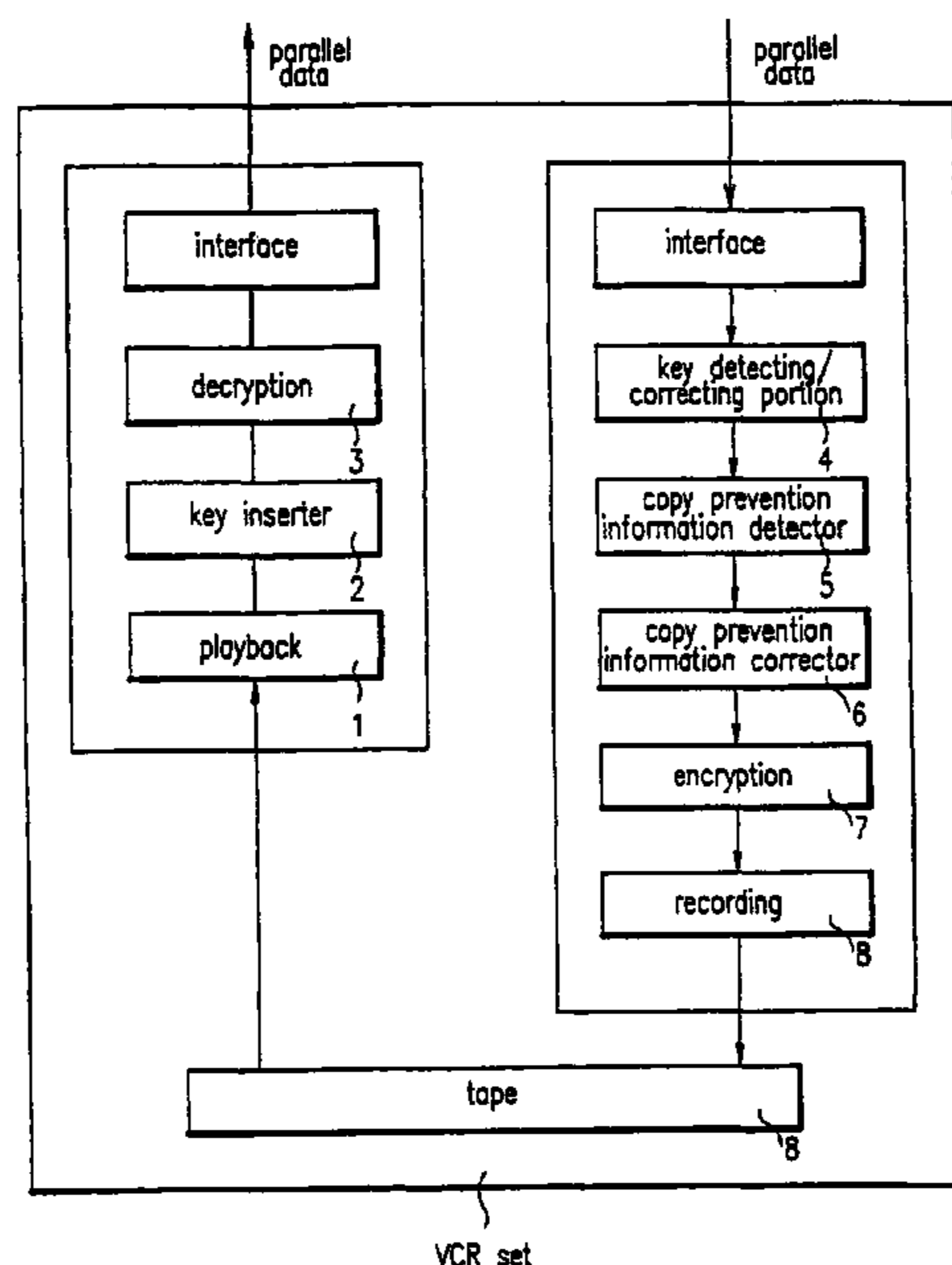
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(57)

ABSTRACT

A copy prevention method and apparatus for a digital video system is disclosed including the steps of: (a) adding a header area of a header start code and key field to a reproduced bit stream; (b) decrypting and transmitting the bit stream to which the header area is added; (c) detecting a key field of the decrypted and transmitted bit stream and detecting copy prevention information; and (d) encrypting the bit stream according to information detected from step (c) and recording it on a tape.

42 Claims, 7 Drawing Sheets



U.S. PATENT DOCUMENTS

4,871,140 A 10/1989 Hoskinson et al.
4,890,319 A 12/1989 Seth-Smith et al.
RE33,189 E 3/1990 Lee et al.
4,916,738 A 4/1990 Chandra et al.
4,924,513 A 5/1990 Herbison et al.
4,937,679 A 6/1990 Ryan
4,965,680 A 10/1990 Endoh
4,975,952 A 12/1990 Mabey et al.
4,999,806 A 3/1991 Chernow et al.
5,003,590 A 3/1991 Lechner et al.
5,014,274 A 5/1991 Higurashi et al.
5,034,981 A 7/1991 Leonard et al.
5,034,985 A 7/1991 Keough
5,054,064 A * 10/1991 Walker et al. 380/239
5,057,947 A 10/1991 Shimada
5,058,162 A * 10/1991 Santon et al. 705/51
5,073,925 A 12/1991 Nagata et al.
5,109,413 A 4/1992 Comerford et al.
5,134,656 A 7/1992 Kudelski
5,138,659 A 8/1992 Kelkar et al.
5,144,658 A 9/1992 Takahashi
5,159,633 A 10/1992 Nakamura
5,182,680 A 1/1993 Yamashita et al.
5,193,176 A 3/1993 Brandin
5,231,546 A 7/1993 Shimada
5,233,650 A 8/1993 Chan
5,243,650 A 9/1993 Roth et al.
5,260,999 A 11/1993 Wyman
5,265,164 A 11/1993 Matyas et al.
5,289,276 A 2/1994 Siracusa et al.
5,303,294 A 4/1994 Kimoto et al.
5,315,448 A * 5/1994 Ryan 360/60
5,323,244 A 6/1994 Yamaguchi et al.
5,377,266 A 12/1994 Katta et al.
5,381,481 A 1/1995 Gammie et al.
5,392,351 A 2/1995 Hasebe et al.
5,406,625 A 4/1995 Kotaka et al.
5,418,853 A * 5/1995 Kanota et al. 380/203
5,442,541 A 8/1995 Hube et al.
5,469,272 A 11/1995 Kubota et al.
5,477,276 A 12/1995 Oguro
5,504,816 A 4/1996 Hamilton et al.
5,506,903 A 4/1996 Yamashita et al.
5,513,260 A * 4/1996 Ryan 380/200
5,530,756 A 6/1996 Bourel et al.
5,546,461 A 8/1996 Ibaraki et al.
5,563,946 A 10/1996 Cooper et al.
5,574,787 A 11/1996 Ryan
5,576,843 A 11/1996 Cookson et al.
5,579,120 A 11/1996 Oguro
5,588,058 A 12/1996 Le Berre
5,590,306 A 12/1996 Watanabe et al.
5,629,980 A 5/1997 Stefik et al.
5,638,513 A 6/1997 Ananda
5,646,992 A * 7/1997 Subler et al. 705/53
5,659,613 A 8/1997 Copeland et al.
5,673,357 A 9/1997 Shima
5,689,559 A 11/1997 Park

5,689,561 A * 11/1997 Pace 705/55
5,703,859 A 12/1997 Tahara et al.
5,715,403 A 2/1998 Stefik
5,757,909 A 5/1998 Park
5,757,910 A 5/1998 Rim
5,761,302 A 6/1998 Park
5,778,064 A 7/1998 Kori et al.
5,790,664 A 8/1998 Coley et al.
5,799,081 A 8/1998 Kim et al.
5,832,084 A 11/1998 Park
5,862,115 A 1/1999 Matsui et al.
5,881,038 A 3/1999 Oshima et al.
5,898,695 A 4/1999 Fujii et al.
5,907,443 A 5/1999 Hirata
5,910,987 A 6/1999 Ginter et al.
5,925,127 A 7/1999 Ahmad
5,956,505 A 9/1999 Manduley
6,009,401 A 12/1999 Horstmann
6,028,932 A 2/2000 Park
6,052,242 A 4/2000 Hirata
RE36,763 E 7/2000 Kanota et al.
6,236,971 B1 5/2001 Stefik et al.
6,430,290 B1 8/2002 Van Willigen et al.
7,069,250 B2 6/2006 Meadow et al.
7,114,745 B2 10/2006 Schütz et al.

FOREIGN PATENT DOCUMENTS

EP 0 498 617 A2 8/1992
EP 0 519 320 A2 12/1992
EP 0519320 12/1992
EP 0 580 367 A2 1/1994
EP 0 581 227 A 2 2/1994
EP 0 589 459 A1 3/1994
EP 0589459 8/1997
JP 6-70282 3/1994
JP 6-162690 6/1994
JP 6-199288 7/1994
JP 6-339110 12/1994

OTHER PUBLICATIONS

Gralla, P., "How The Internet Works".
Muller, N. J., "Desktop Encyclopedia of the Internet".
White, R., "How Computers Work".
Systems Working Committee, "MPEG-2 Systems Working Draft",
International Organization for Standardization, ISO/IEC/JTC1/
SC29/WG11N0601, 114 pages, Nov. 1993.
Wasilewski, "MPEG-2 systems specification: Blueprint for network
interoperability", Communications Technology, 8 pages, Feb. 1994.
Strunk, Jr. et al., "The Elements of Style", Third Edition, MacMillan
Publishing Co., Inc., 59 pages, 1979.
ISO/IEC 13818-1, "Information Technology—Generic Coding of
Moving Pictures and Associated Audio: Systems" International Stan-
dard. Nov. 13, 1994, 1-144 (all pages).
ISO/IEC 13818-2, "Information Technology—Generic Coding of
Moving Pictures and Associated Audio Information: Video". Inter-
national Standard. 1995, pp. 1-243 (all pages).

* cited by examiner

FIG. 1
prior art

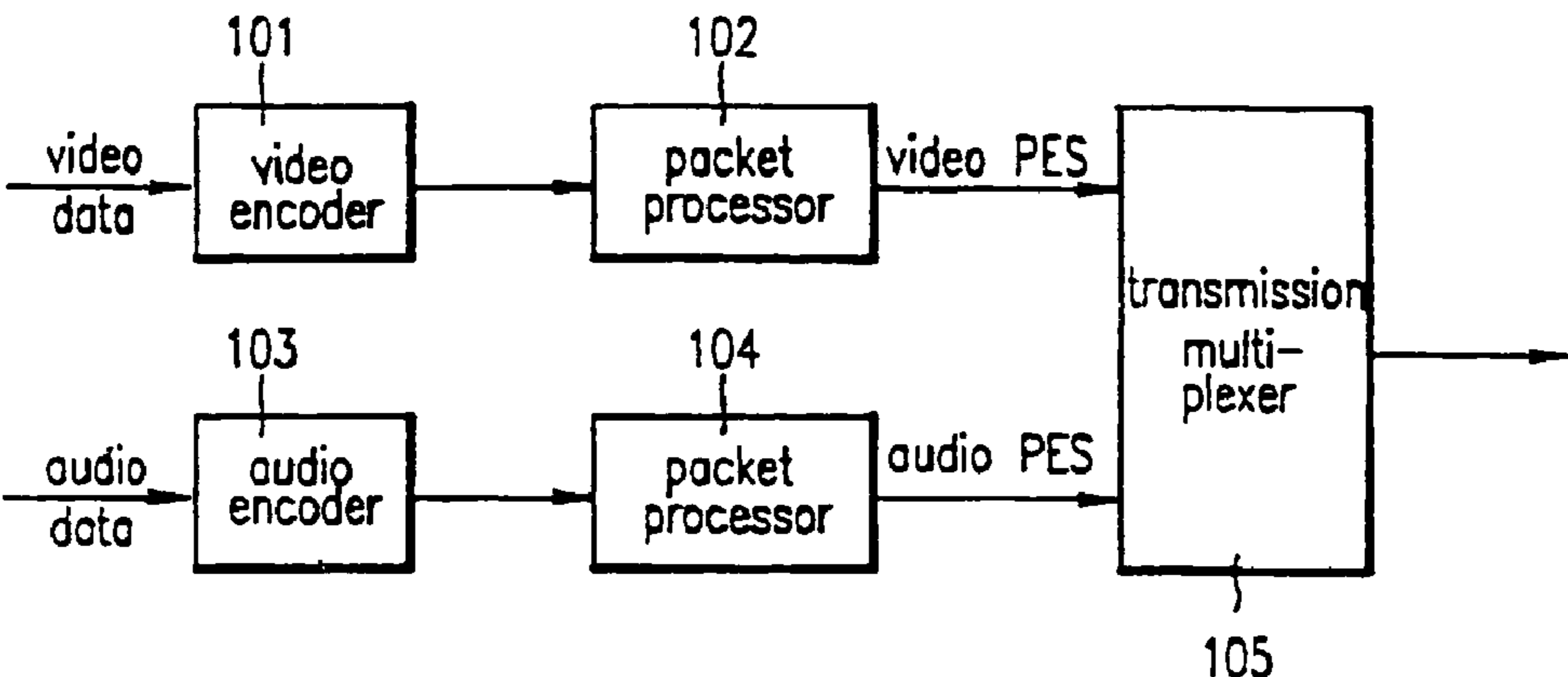
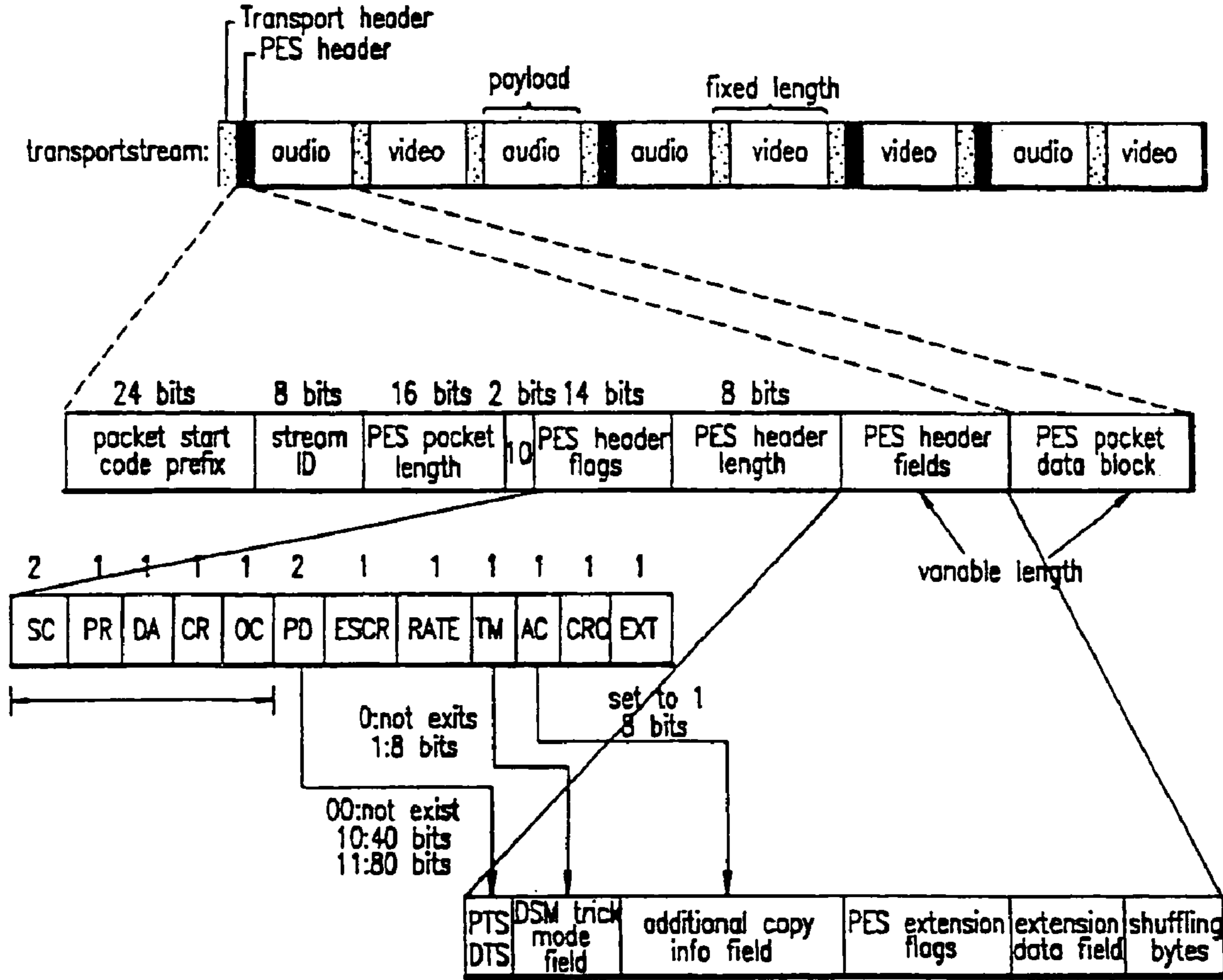
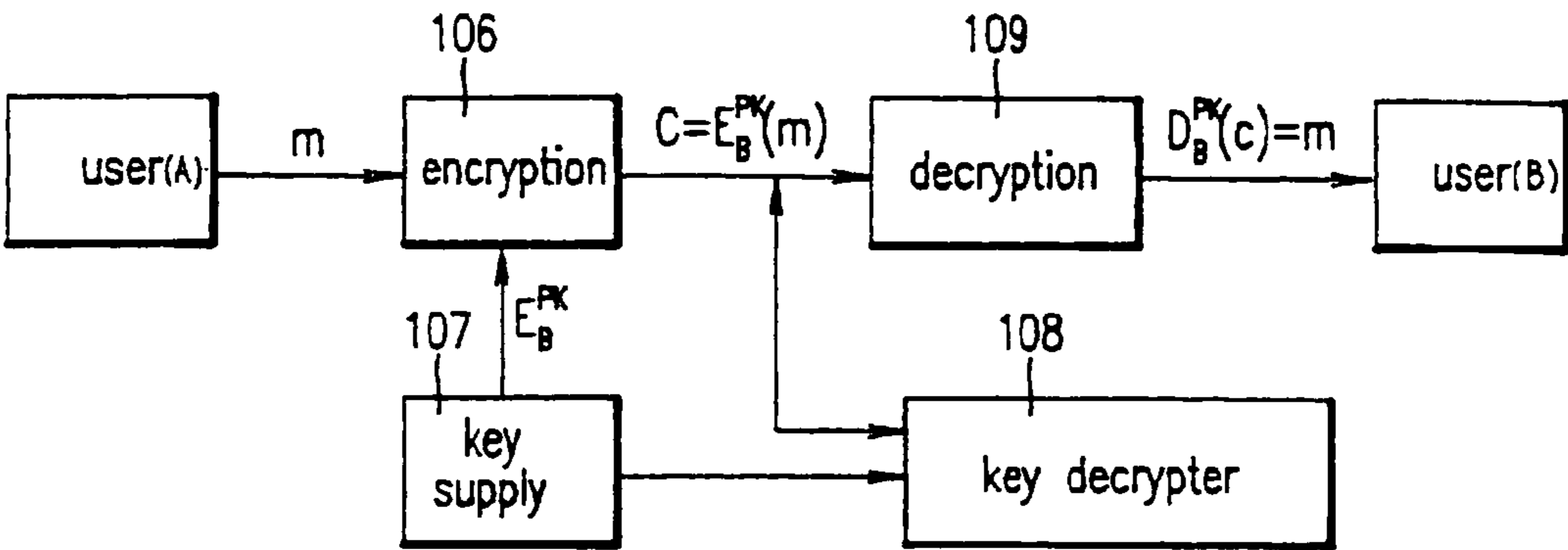


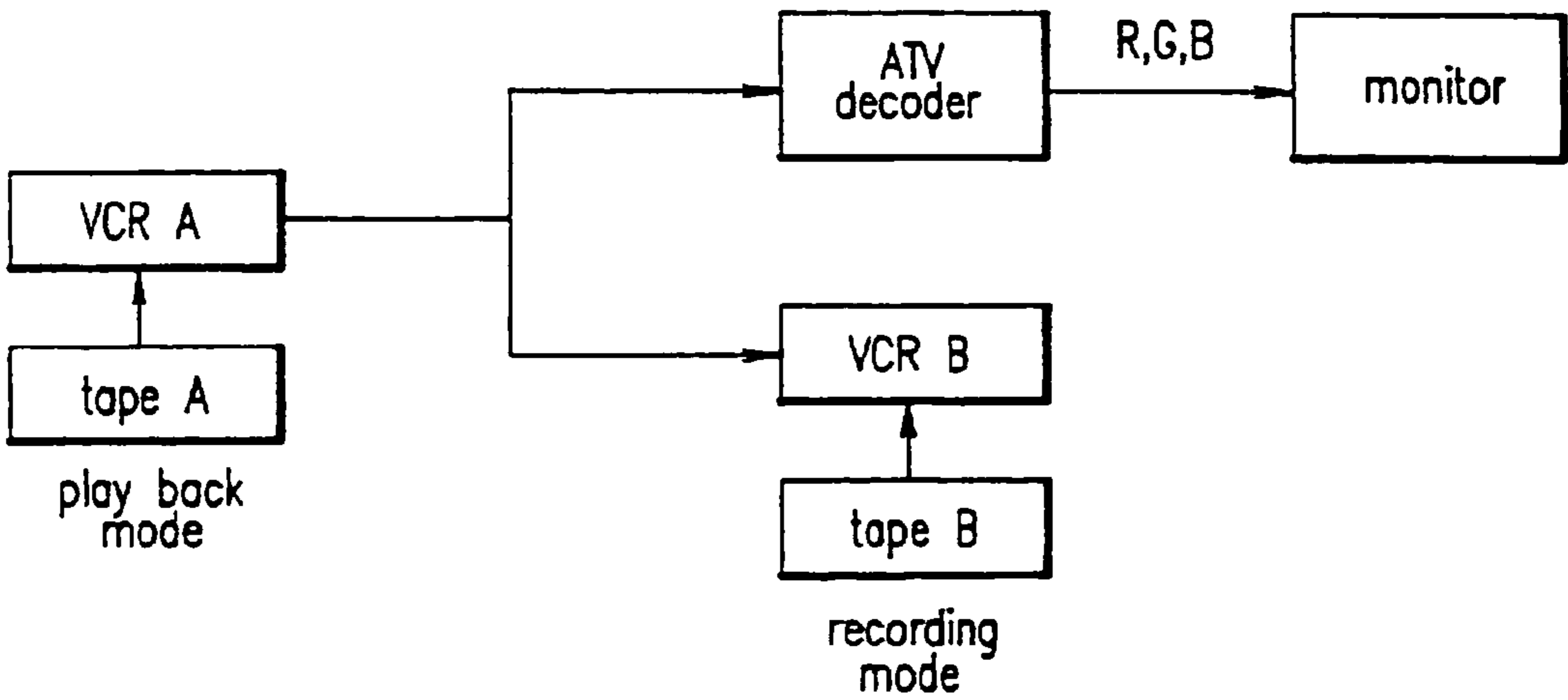
FIG. 2



F I G.3
prior art



F I G.4



F I G.5

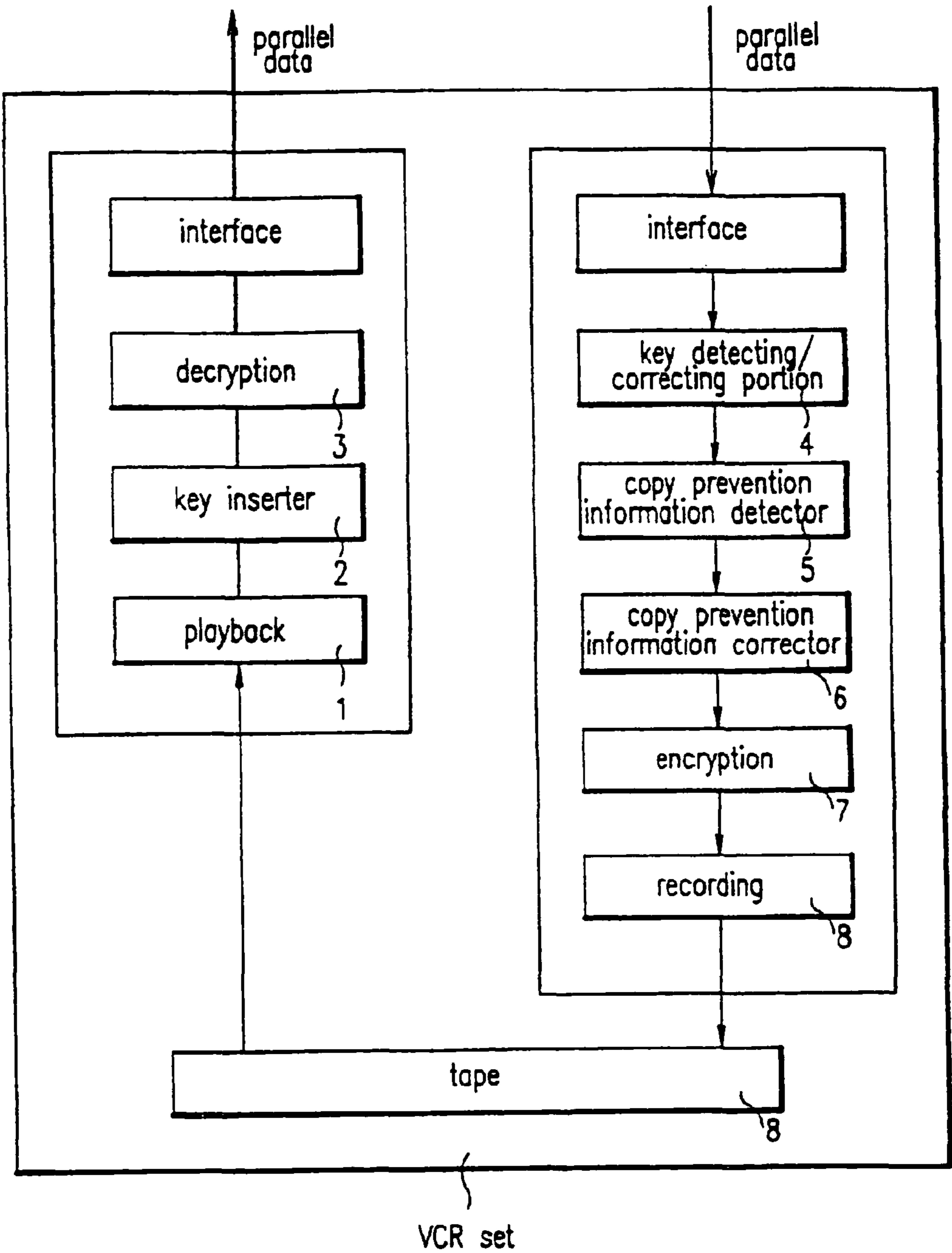


FIG. 6

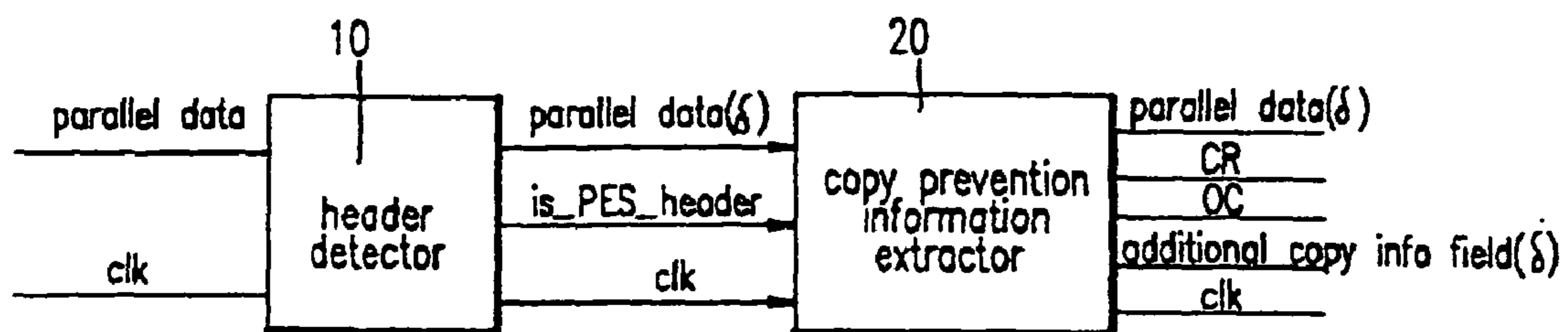
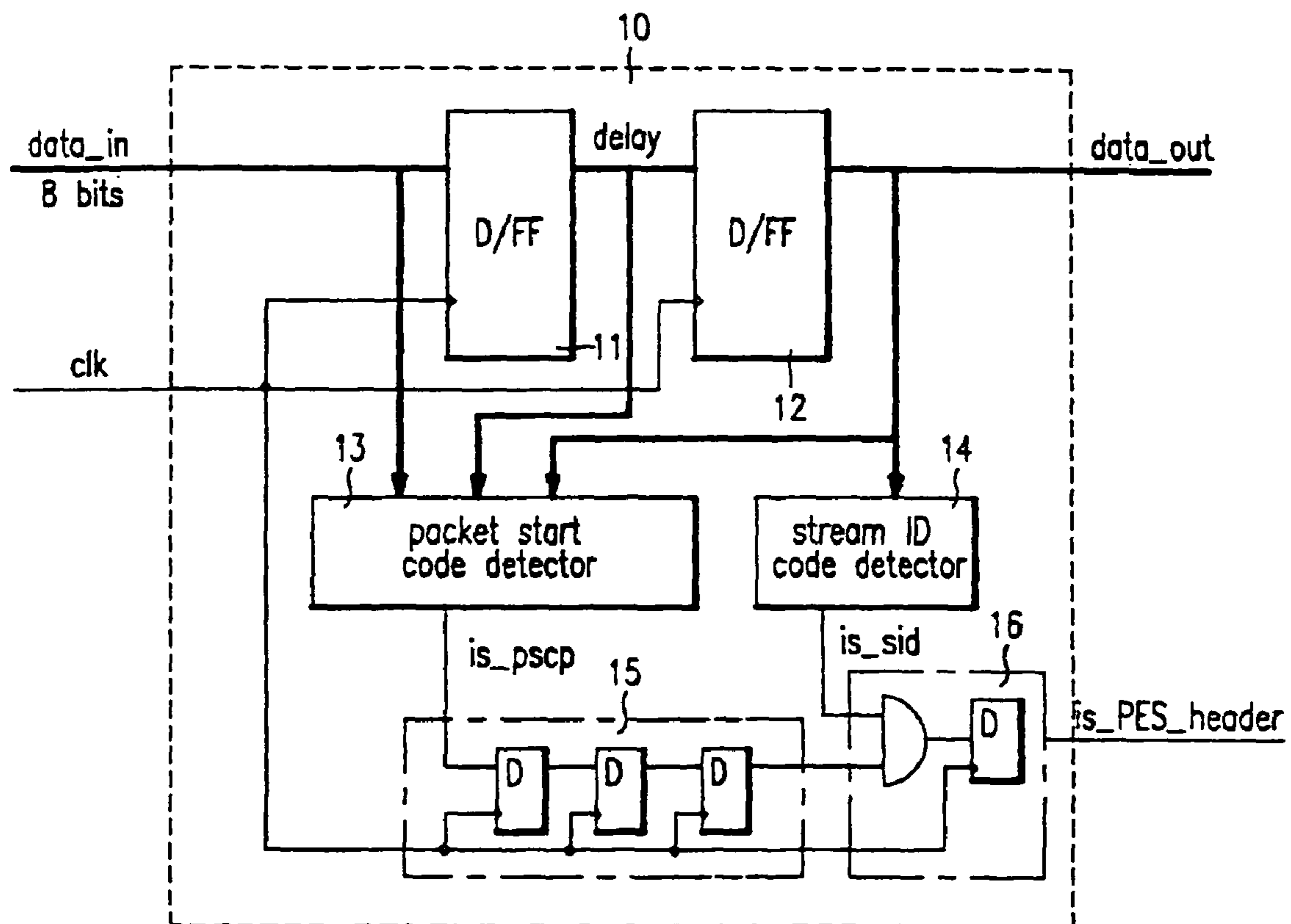
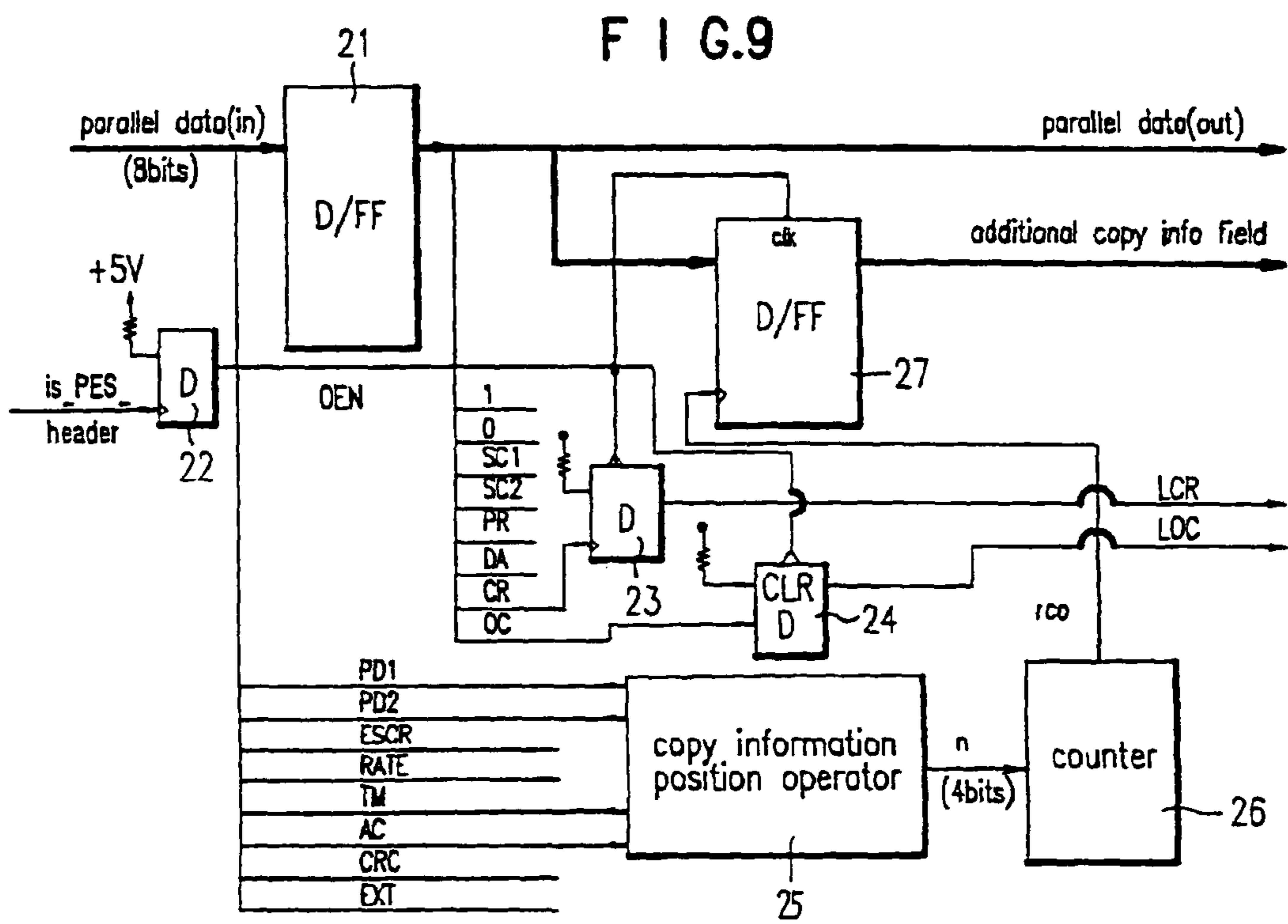
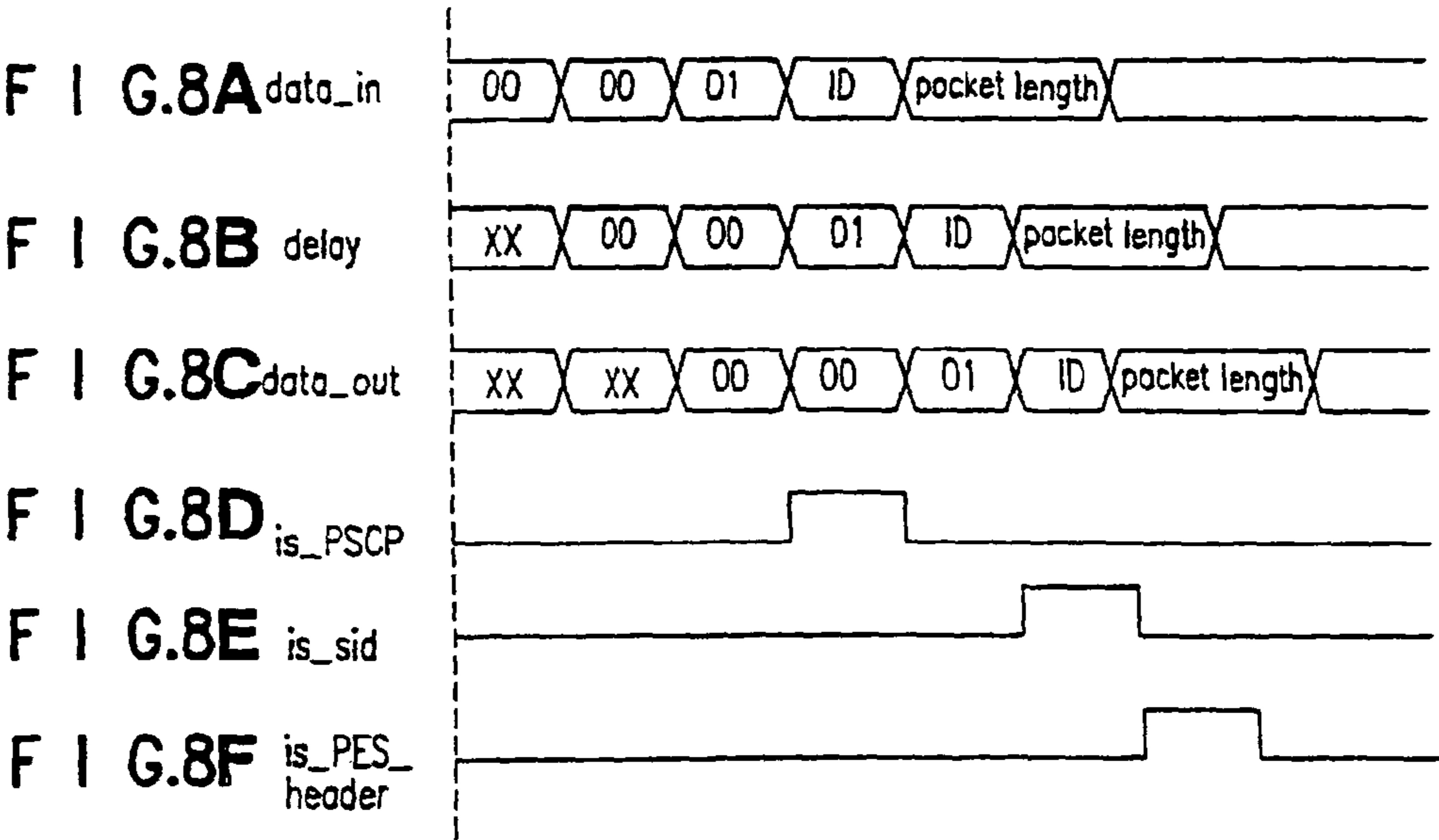
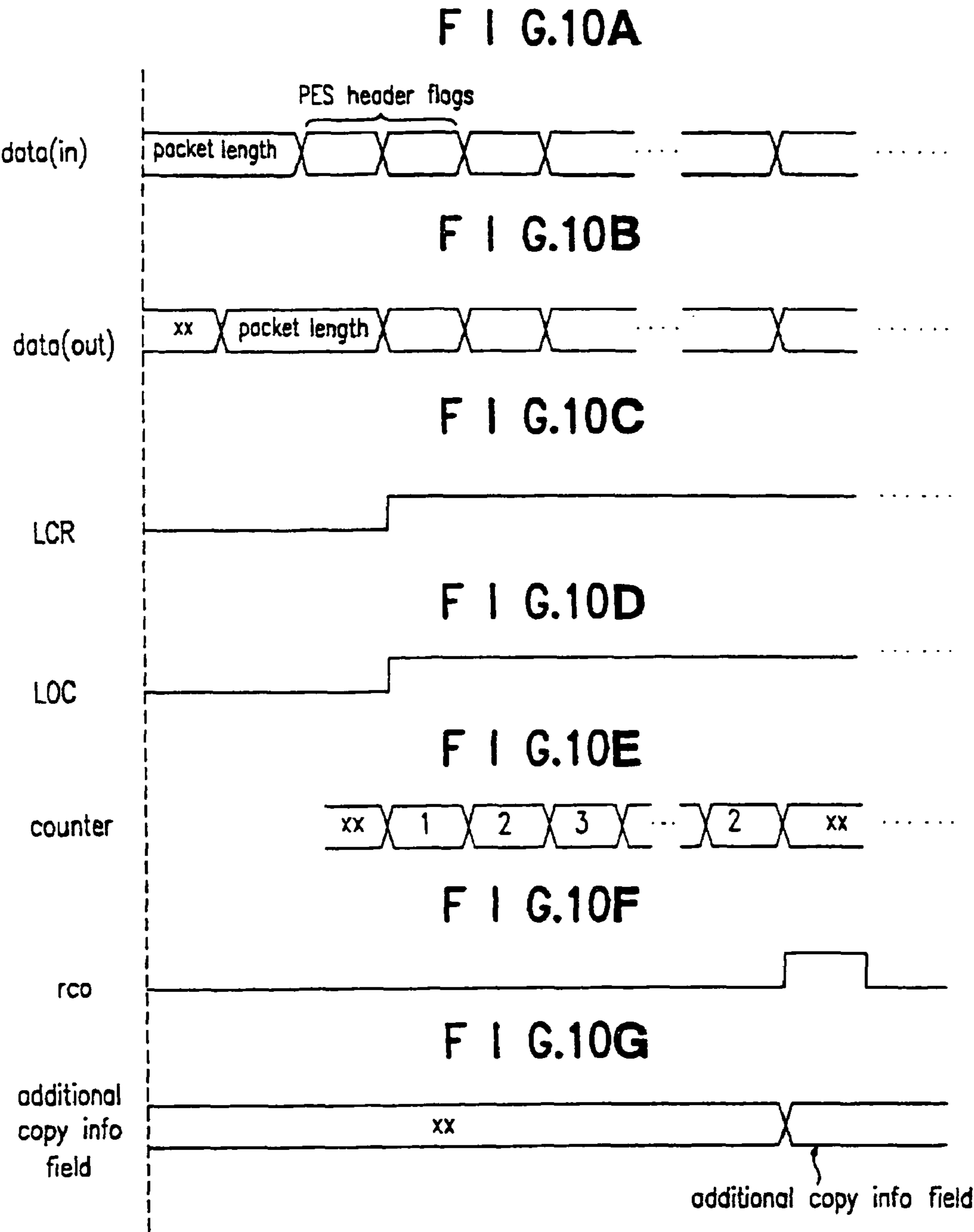


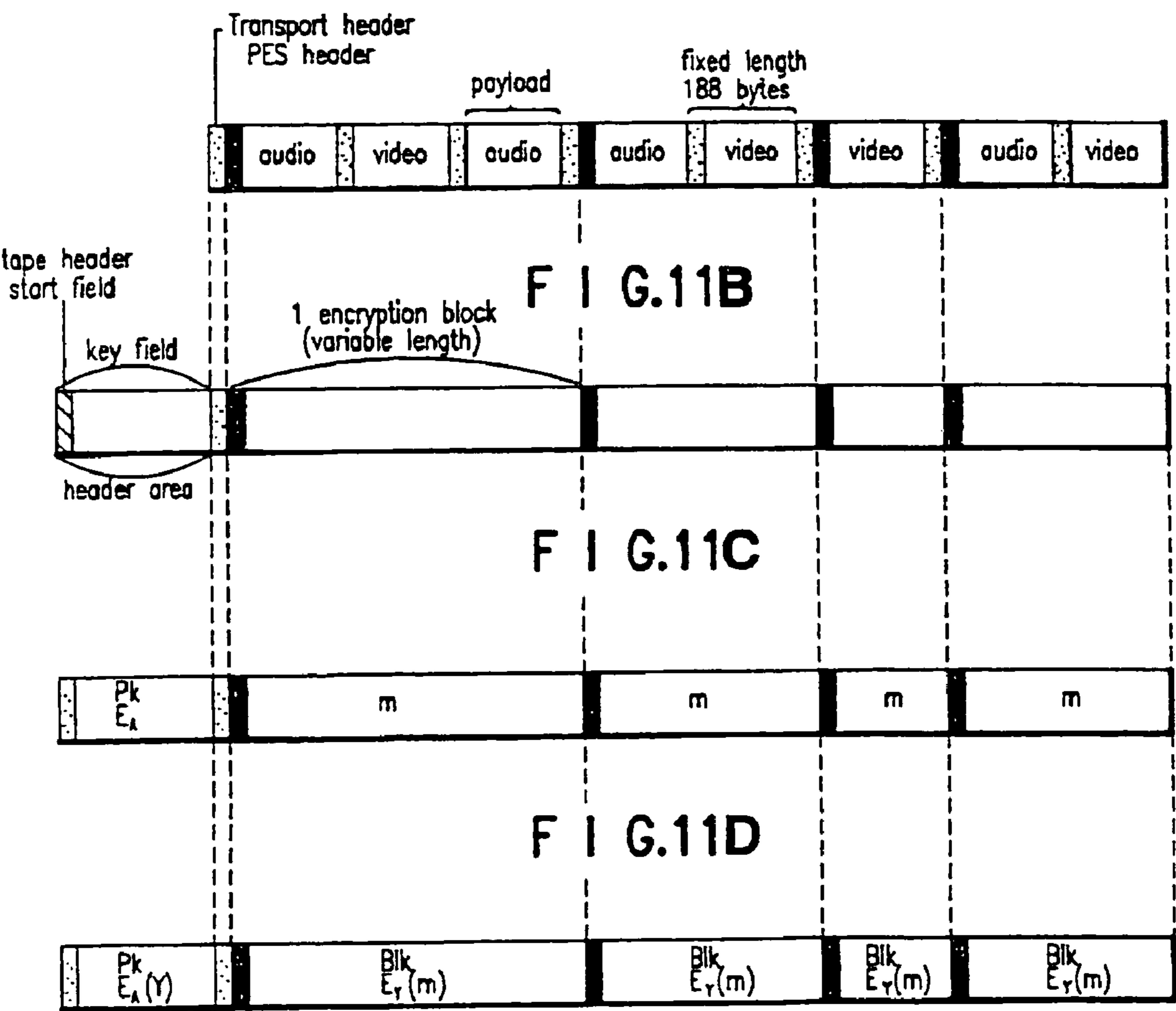
FIG. 7







F I G.11A



COPY PREVENTION METHOD AND APPARATUS FOR DIGITAL VIDEO SYSTEM

Matter enclosed in heavy brackets [] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This is a divisional reissue application of Ser. No. 10/737,672 filed Dec. 17, 2003 now U.S. Pat. No. Re. 39,319. This reissue application is related to another divisional reissue application filed on Nov. 5, 2004 of U.S. Pat. No. 6,347,144, and also related to application Ser. No. 10/737,971, filed Dec. 17, 2003.

[This is] Notice: *More than one reissue applications have been filed for the reissue of U.S. Pat. No. 6,347,144. The reissue applications are application Ser. Nos. 10/737,671, 10/737,672 (now U.S. Pat. No. Re. 39,319), Ser. No. 11/040,606 (now U.S. Pat. No. Re. 41,074), and Ser. No. 11/040,607 which are all reissues of U.S. Pat. No. 6,347,144; Ser. No. 10/981,797 (the present application), Ser. Nos. 10/737,672, 10/909,248 and 10/981,798 which are all divisionals of Ser. No. 10/737,672; Ser. No. 12/139,161 which is a continuation of Ser. No. 10/909,248; and Ser. Nos. 12/405,011 and 12/405,053 which are both divisionals of Ser. No. 10/981,798. U.S. Pat. No. 6,347,144 resulted from application Ser. No. 09/497,465, which is a continuation of application Ser. No. 09/053,288, filed Apr. 1, 1998, now U.S. Pat. No. 6,028,932, which is a continuation of Ser. No. 08/562,042, filed Nov. 22, 1995, now U.S. Pat. No. 5,761,302, issued Jun. 2, 1998.*

BACKGROUND OF THE INVENTION

The present invention relates to a copy prevention technology for a digital video system, and more particularly, to a copy prevention method and apparatus for a digital VCR to which encryption is introduced to display a picture only in a VCR internally containing a corresponding encryption code, thereby preventing tape from being copied.

General copy prevention methods for analog VCR are presented in U.S. Pat. Nos. 4,819,098, 4,571,642 and 4,577,216.

First, U.S. Pat. NO. 4,819,098 discloses a method in which an interference signal is inserted into a video waveform in an automatic gain control circuit (AGC) of a VCR. Here, the inserted signal does not affect the AGC of its monitor but has the AGC of the VCR record an accurate level of signal on a video tape.

In U.S. Pat. No. [4,571,642] 4,577,216, there is presented a method in which a phase noise or other corrected signal is inserted into the [chrome] *chroma* burst of a video waveform.

However, all the conventional technologies insert a distributing signal to an analog signal using the difference between a circuit of a monitor and a corresponding circuit of a VCR. Some VCRs may perform copy normally despite of copy prevention. Some monitors cannot display images of the original video tape. A conventional copy prevention introduced to an analog VCR system is hard to be applied to digital storage media (DSM).

Specifically, in a satellite receiver or high-definition TV decoder, as shown in FIG. 2, an MPEG bit stream received by a digital VCR is constructed to transmit a transport header, packetized elementary stream [(PEG)] (*PES*) header and audio and video data respectively or simultaneously.

The PES header contains a PES header flag area of 14 bits which is a field for DSM such as digital VCR, and a PES

header field having a variable length. The PES header flag area includes 1-bit copyright (CR) flag, 1-bit original-or-copy (OC) flag, 2-bit PD flag, 1-bit TM flag, and 1-bit AC flag.

The PES header field varies in length, and part thereof is set by the [PC] *PD*, TM and AC flags. A PTS/DTS area is not present if the value of the PD flag is "00". It is 40 bits if the value "10". If the value is "11", the area is 80 bits. A DSM trick mode field is not present if the TM flag is "0". If the flag is "1", the field is 8 bits. An additional copy information field is 8 bits if the AC flag is "1".

When recording is carried out by the satellite receiver or high-definition TV decoder and compressed video data is encoded in encoder 101, it is converted into a packet form in packet processing portion [122] 102 as shown in FIG. 1. If the compressed audio data is encoded in audio encoder 103, it is converted into a packet form in packet processing portion 104.

When the outputs of packet processing portions 102 and 104 are multiplexed in transmission multiplexer 105, a fixed transmission stream shown in FIG. 2 is output to a digital VCR. In this case, for copy prevention, a public-key encryption is applied which is suggested in U.S. Pat. No. 4,200,770. This solves disadvantages in key management or key distribution when a conventional block-cipher or stream cipher algorithm such as data encryption standard (DES) encrypts or decrypts only with a secret key.

This public-key encryption system has all users U hold unique encryption algorithm E^{PK}_U and description algorithm D^{PK}_U . Here, encryption algorithm E^{PK}_U for the public-key is opened as a public-key to key supply portion 107. Decryption algorithm D^{PK}_U for secret key is kept in secret. The characteristics of E^{PK}_U and D^{PK}_U are as follows.

First, with respect to all users U and message m transmitted, $D^{PK}_U(E^{PK}_U(m))=m$.

Second, encryption algorithm E^{PK}_U and decryption algorithm D^{PK}_U do not require complicated calculation.

Third, it is impossible to find $D^{PK''}_U$ satisfying $D^{PK''}_U(E^{PK}_U(m))=m$ from encryption algorithm E^{PK}_U .

In the encryption system having the above characteristics, as shown in FIG. 3, when user A transmits message m to user B, encrypter 106 receiving public-key algorithm E^{PK}_U for user B's public-key from key supply portion 107 encrypts message m ($E^{PK}_U(m)=c$) and transmits the result to decrypter 109 via a public channel. Here, the public channel indicates a channel in which transmitted data is not kept in secret.

Key decrypter 108 receiving the key information from key supply portion 107 outputs an algorithm D^{PK}_B corresponding to encryption algorithm E^{PK}_B , decrypter 109 decrypts ($D^{PK}_B(c)=m$) the output of encrypter 106 with decryption algorithm D^{PK}_B , and then transmits to user B. In other words, only user B can decrypt decryption algorithm D^{PK}_B corresponding to encryption algorithm E^{PK}_B .

A concept developed from the public-key encryption is presented in U.S. Pat. No. 4,405,829. This public-key encryption system is called RSA system. A method in which the RSA public-key encryption is efficiently calculated via batch processing is presented in U.S. Pat. No. 4,964,164.

However, this public-key encryption is inappropriate for high-velocity encryption. A CA system is intended to [present] prevent illegal [view] viewing. However, there is no method of protecting a program distributed through a digital storage medium, such as a digital VCR.

SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to provide an illegal copy prevention method and apparatus for a digital

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video system in which, in copy tape, *with* encrypted key information is transmitted and recorded so that a copied tape is reproducible only in a VCR having a corresponding encrypted key information, thereby **[prevented copy]** *preventing copying*.

To accomplish the object of the present invention, there is provided a copy prevention method for a digital video system comprising the steps of (a) adding a header area of a header start code and key field to a reproduced bit stream; (b) decrypting and transmitting the bit stream to which the header area is added; (c) detecting a key field of the decrypted and transmitted bit stream and detecting copy prevention information; and (d) encrypting the bit stream according to information detected from step (c) and recording it on tape.

For the object of the present invention, there is provided a copy prevention apparatus for a digital video system comprising: a reproduction block for adding key information to a reproduced bit stream, and decrypting and transmitting it; and a recording block for searching key information of the bit stream transmitted from the reproduction block **[is]** to extract copy prevention information, and encrypting and recording the bit stream according to the extracted copy prevention information.

The reproduction block comprises: reproduction means for reproducing data recorded on tape; key insertion means for adding key information to the bit stream of the reproduction means; and decryption means for decrypting the output of the key insertion means and transmitting it to a recording-side VCR.

The recording block comprises: key detecting/correcting means for detecting key information from the transmitted bit stream of a reproducing-side VCR; copy prevention information detecting means for searching the key information detected from the key detecting/correcting means to detect copy prevention information; encrypting means for encrypting the bit stream according to the copy prevention information of the copy prevention information detecting means; and recording means for recording the bit stream encrypted in the encrypting means.

The copy prevention information detecting means comprises: a PES header detecting portion for detecting a PES header from parallel data output from the key detecting/correcting means; and a copy prevention information extractor enabled by a PES header detection signal of the PES header detecting portion to detect an additional copy information field.

BRIEF DESCRIPTION OF THE ATTACHED DRAWINGS

FIG. 1 is a block diagram of a conventional packet processing apparatus;

FIG. 2 shows an example of a general transmission stream;

FIG. 3 is a block diagram of a conventional public-key encryption system;

FIG. 4 shows connections of systems of the present invention;

FIG. 5 is a block diagram of a copy prevention apparatus for a digital video system of the present invention;

FIG. 6 is a block diagram of the copy prevention information detector of FIG. 5;

FIG. 7 is a circuit diagram of the PES header detector of FIG. 6;

FIGS. 8A-8F are waveform diagrams of input/output at the **[respect]** *respective* portions of FIG. 7;

FIG. 9 is a circuit diagram of the copy prevention information extractor of FIG. 4;

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FIGS. 10A-10G are waveform diagrams of input/output at the respective portions of FIG. 9; and

FIGS. 11A-11D show examples of a bit stream of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, a preferred embodiment of the present invention will be described below with reference to the attached drawings.

Referring to FIG. 5, a copy prevention apparatus of the present invention comprises a reproducing portion 1 for reproducing data recorded on tape, a key inserting portion 2 for adding a tape header start code and key field at the front end of a bit stream of reproducing portion 1, a decrypting portion 3 for decrypting the output of key inserting portion 2 and transmitting it as parallel data, a key detecting/correcting portion 4 for detecting a key field from the parallel data transmitted from decrypting portion 3, a copy prevention information detecting portion 5 for detecting a PES header from the key field detected and extracting copy prevention information, a copy prevention information correcting portion 6 for correcting the output of copy prevention information detecting portion 5 if necessary, an encrypting portion 7 for encrypting the output of copy prevention information correcting portion 6, and a recording portion 8 for recording the output of encrypting portion 7 on tape.

As shown in FIG. 6, copy prevention information detecting portion **[6]** 5 comprises a PES header detecting portion 10 for searching the parallel data in synchronization with a clock *clk* to detect the PES header, and a copy prevention information extractor 20 enabled by the PES header signal of PES header detecting portion 10 to detect the copy prevention information field.

Referring to FIG. 7, PES header detecting portion 10 comprises first and second flipflops 11 and 12 for sequentially delaying the parallel data according to clock **[elk]** *clk*, a packet start code detector 13 for searching the parallel data and the output of first and second flipflops 11 and 12 to detect the packet start code of the PES header, a stream ID detector 14 for searching the output of second flipflop 12 to detect the stream ID of the PES header, a delay 15 for sequentially delaying the output is-pscp of packet start code detector 13 according to clock *clk*, and a detection signal generator 16 for logically multiplying the outputs of delay 15 and stream ID detector 14 and outputting a PES header detection signal is-PES-header.

As shown in FIG. 9, copy prevention information extractor 20 comprises a D-flipflop 21 for holding the parallel data output from PES header detector 10, a D-flipflop 22 for holding PES header detection signal is-PES-header of PES header detector 10, a D-flipflop 23 cleared by the output of D-flipflop 22 and holding voltage (+5V) by a CR signal of the output of D-flipflop 21 and outputting a signal LCR, a D-flipflop 24 cleared by the output of D-flipflop 22 and holding voltage (+5V) by an OC signal of the output of D-flipflop 21 and outputting a signal **[LOR]** *LOC*, a copy prevention information position operator 25 for searching the parallel data of PES header detector 10 and calculating the position of an additional copy information field, a counter 26 for counting the output of copy information position operator 25, and a D-flipflop 27 for holding the additional copy information field of the output of D-flipflop 21.

The operation and effect of the present invention will be explained below. Generally, in case of reproducing or copy recording data on **[tapa]** *tape*, connections between systems are made as shown in FIG. 4.

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With those connections, an MPEG bit stream reproduced from VCR A is input to a satellite receiver or high-definition TV so that it cannot be recognized whether the stream is displayed on a screen or input to VCR B and recorded on another video tape.

For this reason, according to the present invention, in case that the bit stream reproduced from VCR A is copied from VCR B, information on copy prevention is transmitted to VCR B from VCR A. VCR B analyzes this information which is recorded with the bit stream.

Here, the insertion position of the copy prevention information contained in a GA bit stream is very limited because it must not affect decoding of the decoder of the satellite receiver or high-definition TV so that an image is displayed normally on a monitor. The copy prevention information may be inserted into the front end of the MPEG bit stream or inside the PES header.

When the MPEG bit stream is decoded in units [or] of group of picture (GOP), the respective GOPs are classified by their [cop] GOP start codes. This is useful in transmitting initialization data to a recording-side VCR because decoding is never affected even when a slight amount of data is added to the front end of the MPEG bit stream.

The case of inserting the copy prevention information into the PES header is useful in repeated transmission of information because copy prevention of a recording medium such as DSM is decided using CR and OC flaps of the PES header and additional copy information field. In this case, there are a variety of copy preventing methods.

First, when a mode of "No Copy" is detected from the additional copy information field of the PES header, VCR B is not able to enter its recording mode.

Second, when a mode of "Copy Permitted" is detected in order to implement a copy prevention such as DAT mode, VCR B records but "No Copy" mode is recorded in the additional copy information field to interrupt recopying from a copying tape. This means that a secondary source *tape can be made*, but a third source tape cannot.

Third, for "Back-up Copy", tape B copied from VCR B is reproducible normally only is VCR A. According to this method, reproducing-side VCR A encrypts the bit stream with its own inherent key and records it on tape so that only reproducing-side VCR A decrypts the MPEG bit stream recording on the tape. For every VCR set, a unique key is provided, encrypted by VCR's key and recorded on tape B. However, the VCR set for recording tape B is VCR B and tape B is encrypted by VCR A's key so that VCR A's key needs to be transmitted to VCR B with GA bit stream.

Accordingly, when the key information of VCR A is transmitted as a header in advance prior to the bit stream in the "Back-up Copy", it is recorded at the front end of tape B, which satisfies the insertion position of the copy prevention information mentioned before.

Here, as shown in FIG. 2, the position of the additional copy information field is varied within the PES header according to whether presentation time stamp (PTS)/Decoding time stamp (DTS) and DSM trick mode field are present or not. This varied position must be compensated. Here, information transmitted through the additional copy information is a copy prevention method to be performed by recording-side VCR B.

In case of recording the bit stream shown in FIG. 11A in the method of "Back-up Copy", the formal of the bit stream recorded on tape is determined as shown in FIG. 11B.

Here, a header area added to the front of the MPEG bit stream is formed with a tape header start code, that is, the header identifier code, and a key field for storing key infor-

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ation. In case of encrypting the MPEG bit stream in units of GOP, encryption blocks are classified by the packet start code prefix and stream ID of the PES header. The encryption block is a basic unit of encryption and can change whether encryption is performed in units of the encryption block, and encryption algorithm and key selection. Here, the encryption blocks must not be encrypted until the additional copy information field of the PES header. Encryption is performed until the end of the encryption block after the additional copy information field. The first "transmission header" is not encrypted.

The operation of performing the "back-up Copy" mode by adding the header will be described below.

First, in copying, when recording data of tape A is encrypted, reproducing-side VCR A decrypts it using the key information of the key field so as to make message m. Its key information is added to the header and transmitted in the format of FIG. 11C.

Recording-side VCR B records the key information transmitted from reproducing-side VCR A on the header of copying tape B and then records the encrypted bit stream. Here, when the key information is transmitted from reproducing side to recording side, for security, a public-key encryption may be employed to the system because the information may be exposed to a pirate.

Such public-key encryption system ensures the secret of data even though the public-key is exposed but cannot be processed in real-time due to a great amount of calculation. Therefore, this system is not improper when the MPEG bit stream is encrypted directly. The "Back-up Copy" can be implemented when the MPEG bit stream is encrypted using a block-cipher algorithm or stream-cipher algorithm such as DES and a key used is encrypted in the public-key encryption.

In this case, every VCR u incorporates encryption algorithm E^{PK}_u corresponding to the public-key and decryption algorithm D^{PK}_u corresponding to the secret key. Encryption algorithm E^{PK}_u takes a power key of VCR u, and decryption algorithm D^{PK}_u an internal key of VCR u.

Here, the internal key may be opened to the public. Reproducing-side VCR A transmits the internal key on the key field of the header because another VCR encrypts using the internal key. Recording-side VCR B randomly selects a key Y used in the block-cipher algorithm such as DES and encrypts it with the public-key encryption system using an external key E_{PKA} . The result is recorded on the key field of copying tape B.

Sequentially, the data is divided into encryption blocks and encrypted and recorded in the block-cipher algorithm using key Y. In this method, the bit stream of FIG. 11D is recorded on copying tape B.

When copying tape B is reproduced in reproducing-side VCR A, key Y can be restored by decryption $D^{PK}_A[E^{PK}_A(Y)]$ in which data is decrypted properly. In other VCRs, key Y cannot be found, which disables the decryption of the bit stream.

[As] An embodiment of the present invention, shown in FIG. 5, for performing such an operation will be described below.

When playback starts for tape copying, reproducing portion 1 detects data recorded on tape as shown in FIG. 11A, and amplifies it by a predetermined level. As shown in FIG. 11B, key inserting portion 2 adds a header having a tape header start code and key field in the GA bit stream of reproducing portion 1 shown in FIG. 11A. Copy prevention information is loaded on the additional copy information field of the PES header to form a format shown in FIG. 11C. Here, decrypting

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portion 3 decrypts the bit stream formed in key inserting portion 2 and transmits it as parallel data to the recording-side VCR via an interface.

When the bit stream of FIG. 11C is transmitted to the recording-side VCR via the interface, key detecting/correcting portion 4 detects the key field added to the bit stream and corrects the key field if necessary.

Copying prevention information detecting portion 5 searches the PES header area to detect the additional copy information field. Here, though a slight amount of information is recorded in the additional copy information field, redundancy is provided in several areas of the bit stream to increase reliability of information transmitted.

Copy prevention information detecting portion 5 extracts the value of AC flag from the PES header flag in order to calculate the position of the additional copy information field because it varies within the PES header. Here, when copy prevention information correcting portion 6 corrects the output of copy prevention information detecting portion 5, encrypting portion 7 performs encryption using the block-cipher algorithm such as DES. Here, copy prevention information correcting portion 6 performs correction while the input data is stored in a RAM. Accordingly, encrypting portion 7 records the encrypted bit stream on tape in recording portion 8. Because the key information of the reproducing-side VCR is added on the copying tape, only a VCR having this key information can reproduce tape normally.

As shown in FIG. 6, in copy prevention information detecting portion 5, PES header detecting portion 10 searches the output of key detecting/correcting portion 4 and outputs a header detection signal is-PES-header. After header detection signal is-PES-header is input, copy prevention information extractor 20 detects the additional copy information field and OC and CR flags.

PES header detector 10 for detecting the PES header is formed as shown in FIG. 7. When bit stream data_in is input as shown in FIG. 8A, first flipflop 11 synchronized to clock clk is delayed for a predetermined time to output the bit stream delayed as shown in FIG. 8B. Second flipflop 12 delays the output of first flipflop 11 by a predetermined time and outputs the bit stream delayed as shown in FIG. 8C.

Here, packet start code detecting portion 13 searches the bit stream shown in FIG. 8A and the output of first and second flipflops 11 and 12 shown in FIGS. 8B and 8C in order to detect the packet start code of the PES header. When detection signal is-pscp is output as shown in FIG. 8D, delay 15 in which flipflops are coupled at multi-stages delays it sequentially according to clock clk.

Meanwhile, stream ID code detector 14 searches the output of second flipflop 12 and detects the stream ID area of the PES header. Then, detection signal is-sid shown in FIG. 8E is output to detection signal generator 16. Detection signal generator 16 logically multiplies the outputs of delay 15 and stream ID code detector 14, and the flipflops hold the output of the AND gate according to clock clk so that PES header detection signal is-PES-header is output to copy prevention information extractor 20 as shown in FIG. 8F.

Here, copy prevention information extractor 20 for detecting the copy prevention information is formed as shown in FIG. 9. When the parallel data output from PES header detector 10 and shown in FIG. 10A is held and output as shown in FIG. 10B, D-flipflop 22 synchronized to PES header detection signal is-PES-header of PES header detector 10 shown in FIG. 8F holds voltage +5V so that a HIGH signal is output to the clear ports of D-flipflops 23, 24 and 27 to release the clear states.

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D-flipflop 23 is synchronized to the CR flag or the output of D-flipflop 21 shown in FIG. 10B to hold voltage Vcc so that a HIGH signal LCR is output as shown in FIG. 10C. D-flipflop 24 is synchronized to the OC flag of the output of D-flipflop 21 to hold voltage Vcc so that a HIGH signal LOC is output as shown in FIG. 10D.

Copy prevention position detector 25 searches the PD, TM and AC flags of the parallel data of PES header detector 10 shown in FIG. 10A to calculate the position of the additional copy information field, which is output to counter 26 as shown in FIG. 10E. Counter 26 receiving the 4-bit value performs counting so that a HIGH signal is output as shown in FIG. 10F at a predetermined counting value.

D-flipflop 27 synchronized to HIGH output rco of counter 26 holds the additional copy information field from the parallel data of D-flipflop 21 shown in FIG. 10B. The field is output as shown in FIG. 10C.

As described above, in the copy prevention method and apparatus for a digital video system of the present invention, a key information is recorded with a bit stream so that a VCR having the key information reproduces tape normally, thereby preventing illegal copy of tape. In addition, for key information transmission, the public-key encryption is introduced to disable a pirate to release the copy prevention, increasing reliability of copy prevention.

What is claimed is:

[1. A copy prevention method for a digital video system comprising the steps of:

- (a) receiving a digital data stream reproduced from a digital medium;
- (b) detecting an encryption key, which is a portion of said received digital data stream;
- (c) decrypting said encryption key using key information;
- (d) decrypting said received digital data stream based on said decrypted encryption key; and
- (e) transmitting said decrypted digital data stream to at least one of a monitor and a digital recorder.]

[2. A copy prevention method for a digital video system as claimed in claim 1, wherein said key information is predetermined by said digital video system.]

[3. A copy prevention method for a digital video system as claimed in claim 1, wherein said decrypting step (d) is operated in units of predetermined block of said received digital data stream.]

[4. A copy prevention apparatus for a digital video system comprising:

- receiving means for receiving a digital data stream reproduced from a digital medium;
- a key detector to detect an encryption key, which is a portion of said received digital data stream;
- a decryption unit to decrypt said encryption key using key information and to decrypt said received digital data stream based on said decrypted encryption key; and
- a controller to control transmission of said decrypted digital data stream to at least one of a monitor and a digital recorder.]

[5. A copy prevention apparatus for a digital video system as claimed in claim 4, wherein said key information is predetermined by said digital video system.]

[6. A copy prevention apparatus for a digital video system as claimed in claim 4, wherein said decryption unit is operated in units of predetermined block of said received digital data stream.]

[7. A copy prevention method for a digital video system comprising the steps of:

- (a) receiving a digital data stream reproduced from a digital medium;

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- (b) detecting an encryption key, which is a portion of said received digital data stream;
- (c) decrypting said encryption key using key information;
- (d) decrypting said received digital data stream based on said decrypted encryption key.]

[8. A copy prevention method for a digital video system as claimed in claim 7, wherein said key information is predetermined by said digital video system.]

[9. A copy prevention method for a digital video system as claimed in claim 7, wherein said decrypting step (d) is operated in units of predetermined block of said received digital data stream.]

[10. A copy prevention apparatus for a digital video system comprising:

- receiving means for receiving a digital data stream reproduced from a digital medium;
- a key detector to detect an encryption key, which is a portion of said received digital data stream;
- a decryption unit to decrypt said encryption key using key information and to decrypt said received digital data stream based on said decrypted encryption key.]

[11. A copy prevention apparatus for a digital video system as claimed in claim 10, wherein said key information is predetermined by said digital video system.]

[12. A copy prevention apparatus for a digital video system as claimed in claim 10, wherein said decryption unit is operated in units of predetermined block of said received digital data stream.]

[13. A copy prevention method for a digital video system comprising the steps of:

- (a) receiving a digital data stream reproduced from a digital medium;
- (b) detecting an encryption key, which is a portion of said received digital data stream;
- (c) decrypting said encryption key using predetermined key information;
- (d) decrypting said received digital data stream based on said decrypted encryption key.]

[14. A copy prevention method for a digital video system as claimed in claim 13, wherein said decrypting step (d) is operated in units of predetermined block of said received digital data stream.]

[15. A copy prevention apparatus for a digital video system comprising:

- receiving means for receiving a digital data stream reproduced from a digital medium;
- a key detector to detect an encryption key, which is a portion of said received digital data stream;
- a decryption unit to decrypt said encryption key using predetermined key information and to decrypt said received digital data stream based on said decrypted encryption key.]

[16. A copy prevention apparatus for a digital video system as claimed in claim 15, wherein said decrypting unit is operated in units of predetermined block of said received digital data stream.]

[17. A copy prevention method for a digital data system, comprising the steps of:

- (a) receiving first key information;
- (b) encrypting second key information using said first key information;
- (c) encrypting digital data streams using said second key information; and
- (d) recording at least said encrypted second key information and said encrypted digital data streams on a digital medium.]

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[18. The method of claim 17, wherein said (b) randomly selects said second key information.]

[19. The method of claim 17, wherein said step (c) encrypts said digital data streams in blocks.]

[20. A copy prevention apparatus for a digital data system, comprising the steps of:

- an encryption unit receiving first key information, encrypting second key information using said first key information, and encrypting digital data streams using said second key information; and
- a controller controlling recording of at least said encrypted second key information and said encrypted digital data streams on a digital medium.]

[21. The apparatus of claim 20, wherein said encryption unit randomly selects said second key information.]

[22. The apparatus of claim 20, wherein said encryption unit encrypts said digital data streams in blocks.]

[23. A recording medium having a data structure for controlling operation of copy prevention function in a digital data processing device, comprising:

- a digital data area storing digital data encrypted using first key information; and
- a key information area storing said first key information encrypted using second key information, said first key information operatively controlling the decryption of said encrypted digital data in a digital data process device.]

[24. A copy prevention method for a digital data system, comprising:

- receiving first key information, said first key information for encrypting digital data;
- encrypting said first key information using second information; and
- transferring said encrypted first key information.]

[25. The method of claim 24, wherein said encrypting step public key encrypts said second key information.]

[26. The method of claim 24, wherein said transferring step records said encrypted first key information on a digital medium.]

[27. The method of claim 24, wherein said transferring step transmits said encrypted first key information.]

[28. A copy prevention apparatus for a digital data system, comprising:

- an encryption unit receiving first key information, said first key information for encrypting digital data, and encrypting said first key information using second key information; and
- a controller controlling a transfer of said encrypted first key information.]

[29. The apparatus of claim 28, wherein said encryption unit public key encrypts said first key information.]

[30. The apparatus of claim 28, wherein said controller controls recording said encrypted first key information on a digital medium.]

[31. The apparatus of claim 28, wherein said controller controls transmitting said encrypted first key information.]

[32. A content protection method for a digital data system including a controller and an encryption device, the method comprising:

- receiving first key information by the encryption device within the digital data system, the first key information for encrypting digital content, the digital content including one or more data segments, the one or more data segments including a header portion and a data portion, wherein at least the data portion is encrypted using the first key information and the header portion includes classification information to classify the data portion;

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encrypting, via the controller controlling the encryption device, the first key information using second key information that is different than the first key information; and transferring the encrypted first key information with the controller.

33. The method of claim 32, wherein the second key information is a public key, such that said encrypting step encrypts the first key information using the public key.

34. The method of claim 32, wherein said transferring step includes recording the encrypted first key information on a digital storage medium.

35. The method of claim 32, wherein said transferring step also transmits the encrypted digital content.

36. An apparatus for content protection, comprising:
an encryption device programmed to receive first key information, the first key information for encrypting digital data, and programmed to encrypt the first key information using second key information that is different than the first key information, wherein the digital data includes one or more data segments, the one or more data segments including a header portion and a data portion, wherein at least the data portion is encrypted using the first key information and the header portion is not encrypted and the header portion includes classification information to classify the data portion; and a controller, coupled to the encryption unit, and programmed to control the encryption operation and control a transfer of the encrypted first key information.

37. The apparatus of claim 36, wherein the second key information is a public key, such that said encryption device is programmed to encrypt the first key information using the public key.

38. The apparatus of claim 36, wherein said controller is programmed to control recording of the encrypted first key information and encrypted digital data on a digital storage medium.

39. The apparatus of claim 36, wherein said controller is also programmed to control a transmitting of the encrypted digital data.

40. A content protection method within a digital data system including a controller and a generating device, the method comprising:

generating, via the controller controlling the generating device, protected digital content, the protected digital content including one or more data segments, the one or more data segments including a header portion and a data portion, wherein at least the data portion is protected and the header portion includes classification information to classify the protected digital content; and transmitting, via the controller, the protected digital content and first key information used to generate the protected digital content,

wherein the first key information is required to process the protected digital content in a receiving part and is encrypted using second key information different than the first key information.

41. The method of claim 40, further comprising:
encrypting the first key information using the second key information prior to said transmitting step.

42. The method of claim 41, wherein the second key information is a public key, such that the first key information is encrypted using the public key.

43. The method of claim 40, wherein the generating step includes encrypting the digital content by a block-cipher algorithm or a stream-cipher algorithm.

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44. A content protection method for a digital data system including a controller, a recording device and an encryption device, the method comprising:

receiving first key information by the encryption device within the digital data system, the first key information for encrypting digital data, the digital data including a header portion and a data portion;

encrypting, via the controller controlling the encryption device, the first key information using second information;

encrypting, via the controller controlling the encryption device, the digital data using the first key information, wherein only the data portion is encrypted; and

recording, via the controller controlling the recording device, the encrypted first key information and the encrypted digital data on a digital medium, wherein the header portion includes classification information to classify the encrypted data portion on a digital medium.

45. The method of claim 44, wherein the second information is a public key, such that the first key information is encrypted using the public key.

46. The method of claim 44, wherein the header portion and the data portion comprise a packet.

47. The method of claim 44, wherein the first key information is randomly generated.

48. A content protection method for a digital data system including a controller, a receiving circuit and a decryptor, the method comprising:

(a) receiving encrypted digital content and encrypted first key information by the receiving circuit within the digital data system, the first key information being previously used for encrypting the digital content, the digital content including a header portion and a data portion, wherein only the data portion is encrypted;

(b) decrypting, via the controller controlling the decryptor, the first key information using second information; and

(c) decrypting, via the controller controlling the decryptor, the encrypted digital content using the decrypted first key information,

wherein the header portion includes classification information to classify the digital content, and

the step (a) includes classifying the digital content based on the classification information by the controller.

49. The method of claim 48, wherein the second information is a public key such that the first key information is decrypted by the public key.

50. The method of claim 48, wherein said step (c) decrypts the encrypted digital content only when the first key information is normally decrypted in step (b).

51. A content protection method within a digital data system for content protection including a controller and a receiving circuit, the method comprising:

receiving protected digital content and key information which is required to process the protected digital content by the receiving circuit, wherein the protected digital content includes one or more data segments, the one or more data segments including a header portion and a data portion, wherein at least a portion of the header portion is non-protected; and

processing, via the controller, the protected digital content, based on the received key information, wherein the header portion includes classification information to classify the digital content, and the receiving step includes classifying the digital content based on the classification information by the controller.

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52. The method of claim 51, wherein the received key information is encrypted, and

wherein the processing step includes processing the encrypted key information by the processor.

53. The method of claim 52, wherein the protected digital content is processed only when the encrypted key information is normally decrypted.

54. The method of claim 53, wherein the encrypted key information is decrypted using second key information.

55. An apparatus for content protection, comprising:

a receiving device to receive encrypted digital content and key information, wherein the encrypted digital content includes one or more data segments, the one or more data segments including a header portion and a data portion, wherein at least a portion of the header portion is non-encrypted;

a key detecting device to detect the key information; and a controller to control a decryption process of the digital content based on the detected key information,

wherein the header portion includes classification information to classify the digital content, and the controller is to classify the digital content based on the classification information.

56. The apparatus of claim 55, wherein the key information is first key information, and wherein said key detecting device is to decrypt the first key information using second key information.

57. The apparatus of claim 56, wherein said controller is to decrypt the data portion of each data segment using the decrypted first key information.

58. The apparatus of claim 55, wherein said controller is to decrypt the data portion of each data unit using the detected first key information.

59. The apparatus of claim 55, wherein the first key information was encrypted and predetermined by a digital data system.

60. An apparatus for content protection, comprising:

a generating device to generate protected digital content, the protected digital content including one or more data segments, the one or more data segments including a header portion and a data portion, wherein at least the data portion is protected and the header portion includes classification information to classify the protected digital content; and

a controller to transmit the protected digital content and first key information used to generate the protected digital content,

wherein the first key information is required to process the protected digital content in a receiving part and is encrypted using second key information different than the first key information.

61. The apparatus of claim 60, further comprising:

an encryption device to encrypt the first key information using the second key information prior to said transmission.

62. The apparatus of claim 61, wherein the second key information is a public key.

63. The apparatus of claim 61, wherein the controller is to control the encryption device to protect the digital content by a block-cipher algorithm or a stream-cipher algorithm.

64. An apparatus for content protection, comprising:

a receiving device to receive first key information, the first key information for encrypting digital data, the digital data including a header portion and a data portion;

an encryption device to encrypt the first key information using second information, and encrypt the digital data using the first key information, wherein only the data portion is encrypted;

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a recording device to record the encrypted first key information and the encrypted digital data on a digital medium; and

a controller, coupled to the encryption device and the recording device, to control the encryption operation and the recording operation,

wherein the header portion includes classification information to classify the encrypted data portion, and wherein the controller is to classify the encrypted data portion based on the classification information.

65. The apparatus of claim 64, wherein the second information is a public key, and the encryption device is to encrypt the first key information using the public key.

66. The apparatus of claim 64, wherein the header portion and the data portion comprise a packet.

67. The apparatus of claim 64, wherein the first key information is randomly generated.

68. An apparatus for content protection, comprising:

a receiving device to receive encrypted digital content and encrypted first key information, the first key information being previously used for encrypting the digital content, the digital content including a header portion and a data portion, wherein only the data portion is encrypted;

a decryption device to decrypt the first key information using second information and decrypt the encrypted digital content using the decrypted first key information; and

a controller, coupled to the receiving unit and the decryption unit, to control the decryption operation,

wherein the header portion includes classification information to classify the digital content, and

wherein the controller is to classify the digital content based on the classification information received from the receiving device.

69. The apparatus of claim 68, wherein the second information is a public key.

70. The apparatus of claim 68, wherein said controller is to control the decryption device to decrypt the encrypted digital content only when the first key information is normally decrypted.

71. An apparatus for content protection, comprising:

a receiving device to receive protected digital content and key information required to process the protected digital content, wherein the protected digital content includes one or more data segments, the one or more data segments including a header portion and a data portion, wherein at least the header portion is non-protected;

a processor to process the protected digital content, using the received key information; and

a controller, coupled to the receiving device and the processor, to control the processing of the protected digital content,

wherein the header portion includes classification information to classify the digital content, and

wherein the controller is to classify the digital content based on the classification information received from the receiving unit.

72. The apparatus of claim 71, wherein the received key information is an encrypted key information.

73. The apparatus of claim 72, wherein the controller is to control the processor to process the protected digital content only when the encrypted key information is normally decrypted.