

REPORT AND SUMMARY

☒ Description of paper: 1 to page 15

☒ Claims: 13 to page 17

☒ Drawing(s): 13 to page 13/8

☒ Abstract: 4 to page 4

DATE OF INVENTION



EP 0 408 343 A2

2

ENCODING DEVICE AND DECODING DEVICE SUITABLE FOR DUBBING

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention is related to the encoding and decoding devices suitable for dubbing, in particular to their handling at the time of occurrence of uncorrectable symbol error.

Related Background Art

Digital VTR etc may be an example of the system to record and reproduce image and aural signals.

With the recording and reproducing device of such digital VTR, the analogue signals (aural signal and image signal) to be recorded are first converted into digital code and error correction encoding is executed by addition of parity bit for error correction by error correction encoding circuit (ECC encoding circuit) and recording it on a recording medium. On the other hand, in order to reproduce analogue signals from the digital data recorded on the recording medium of the recording and reproducing device, first the digital data are reproduced from the recording medium, the data are input into error correction decoding circuit (ECC decoding circuit), the symbol errors having been produced at recording and reproduction are corrected there as much as possible, error symbols which could not be corrected by ECC decoding circuit are interpolated (modified) by the publicly known method at the interpolation circuit (for example interpolated by the average value of the preceding and succeeding data), the output of interpolation circuit is converted into analogue signal and thus the original signals are reproduced.

In order to execute dubbing of signals digitally recorded on the recording medium as they are in digital mode by using two sets of recording and reproducing units with such construction, the digital data taken out of the interpolation circuit of recording and reproducing device at one side are entered into the ECC encoding circuit of the other recording and reproducing device at the other side and the signals are ECC-encoded and recorded in the recording medium. Like above, recorded signals can be dubbed as they are in the digital mode, without being reconverted into analogue signals.

On the other hand, another method for compression-encoding of image information which has been publicly known is the method like DPCM encoding by midtread type quantifier, wherein the

symbols once having been encoded are decoded into baseband digital signals and then encoded again to obtain the same symbols as before. When such encoding method is employed, deterioration due to encoding occurs only at the time of initial encoding and even when encoding and decoding are repeated thereafter in digital signals, deterioration does not accumulate and dubbing and editing in the baseband digital signal mode can be executed without accompanying deterioration.

However in the case of image information etc, it has been the general practice to modify by interpolation to deal with the uncorrectable error which generates at the time of reproduction of recorded information (at the transmission in broad sense) and if thus modified information is encoded again, encoding error generates at that time and it has been a problem. As the result due to the deterioration caused by modifying coupled with deterioration caused by encoding, accumulation of deterioration proceeds as encoding and decoding are repeated.

In addition, also at the reproduction of dubbing data by recording-reproducing device, the dubbed data are reproduced without being identified whether they are interpolated data or correct data and the data which are judged to be uncorrectable at the ECC decoding circuit of recording and reproducing device of the other side may be interpolated by using the data which had been recorded after being interpolated at the time of dubbing by the interpolation circuit and if so it results in the deterioration of picture quality and sound quality.

SUMMARY OF THE INVENTION

The objective of the present invention is to solve the problems as aforesaid.

Another objective of the present invention is to minimize the deterioration of dubbing data caused by the presence of information modified by interpolation.

With such objective, there is provided an encoding apparatus comprising:

(a) the first input means for inputting the primary information;

(b) the second input means for inputting flag information which indicates production or non-production of the past uncorrectable symbol error of the aforesaid primary information for each unit of the specified block of information amount;

(c) error correction encoding means for forming a parity symbol to correct the error of the pri-



mary information input by the aforesaid first input means and for adding said parity symbol to said primary information; and
(d) recording means for recording the primary information with addition of said parity symbol and said flag information on the same recording medium.

According to the present invention, there is also provided a decoding apparatus which reproduces the primary information added with parity symbol for correction of error from the recording medium on which the first flag information indicating said primary information and the production or non-production of uncorrectable past symbol error as one unit of the specified block of information amount is recorded, comprising:

- (a) reproducing means for reproducing said primary information added with said parity symbol and said flag information from said recording medium;
- (b) error correcting means for correcting the symbol error of the primary information reproduced by said reproducing means using the parity symbol reproduced by said reproducing means and for producing second flag information indicating the production of uncorrectable symbol error in said block unit; and
- (c) modifying means for modifying, in said block unit, said primary information having gone through the said error correcting means by said first flag information and said second flag information having been reproduced by said reproducing means.

Other objectives and the characteristic features of the present invention shall be made evident by the detailed explanation of the embodiment of the present invention in reference to the drawings to be stated hereunder.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is the block diagram to show the composition of the encoding device of an embodiment of the present invention;

Fig. 2 is the block diagram to show the composition of the decoding device of an embodiment of the present invention;

Figs. 3A - 3C are the drawings to indicate the system composition which employs the devices of Fig. 1 and Fig. 2;

Fig. 4A is the drawing to illustrate an example of composition of retouch flag producing circuit of Fig. 2;

Fig. 4B is the drawing to explain the performance of the decoding device of Fig. 2 by the retouch flag producing circuit of Fig. 4A;

Fig. 5A is the drawing to illustrate another exam-

ple of composition of retouch flag production circuit of Fig. 2;

Fig. 5B is the drawing to explain the performance of the decoding device of Fig. 2 by the retouch flag producing circuit of Fig. 5A;

Fig. 6 is the drawing to show the composition of dubbing system as an example of embodiment; Fig. 7 is the drawing to show the data format of recording and reproduction in the system of Fig. 6;

Fig. 8A is the drawing to show a concrete example of composition of 1 sync block of Fig. 7;

Fig. 8B is the drawing to show a concrete example of composition of 1 frame in Fig. 7;

Fig. 8C is the drawing to show another concrete example of composition of 1 frame in Fig. 7;

Fig. 9 is the block diagram to show the composition of dubbing system as an example of embodiment of the present invention;

Fig. 10 is the drawing to explain the characteristics of mid tread type DPCM; and

Fig. 11 is a conceptual drawing to show the propagation of the error at the uncorrectable part at the time of dubbing when line interpolation is used.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Hereunder is explained the embodiments of the present invention.

Fig. 1 is the block diagram to show the composition of the encoding device which is an embodiment of the present invention. Hereunder the supply source of digital*video signal shall be called master side and receiving unit shall be called slave side. Digital*video signal dv to be entered into the input terminal 10 is compressed by compression encoding circuit 12 and impressed on the modification information addition circuit 14.

Modification information cf which indicates whether modification had been conducted or not is supplied by the preceding stage encoding-decoding device to the modification information addition circuit 14 via input terminal 16 and modification information addition circuit 14 outputs the symbol to be output by the compression encoding circuit 12 after adding such modification information cf thereto. When the encoding circuit indicated in Fig. 1 is used not as the slave side but in the initial stage or when it is connected to other encoder type devices, modification information cf is not supplied to the input terminal 16. In such case, the modification information addition circuit 14 adds, instead of modification information cf, the information corresponding to the modification information which has not been modified in the past. When variable long symbol is used as data format, it may



be so arranged that modification information cf is added only when it is required.

The output of modification information addition circuit 14 is fed to the error correction encoding circuit 18 and after being coupled with parity symbol for error correction, it is modulated by modulation circuit 20, so that it fits the transmission route and it is delivered from the output terminal 22 to the transmission route. Transmission route includes, in addition to communication circuit, such recording media as magnetic disc, magnetic tape, etc.

Fig. 2 is the block diagram to show the composition of decoding device which is an embodiment of the present invention. Encoding data are input from transmission route into the input terminal 30, demodulation circuit 32 demodulates it and error correction decoding circuit 34 detects and corrects the error symbols at the transmission route. Error correction decoding circuit 34 outputs the error-corrected data to the modification information separation circuit 38 and outputs the uncorrectable flag ef to the modification flag producing circuit 38 in response to the production of uncorrectable data. Modification information separation circuit 36 separates the modification information cf added at the master side (for example modification information addition circuit 14) and the image data which have been compression-encoded and supplies the former to the modification flag production circuit 38 and the latter to the expansion decoding circuit 40. Expansion decoding circuit 40 decodes the compression-encoded image data and expands its information volume.

When the encoding system is such that the results of the first encoding and decoding are reproducible in the second and the succeeding repetitions of encoding and decoding (for example the DPCM encoding system utilizing midtread type quantifying characteristics), the output of expansion decoding circuit 40 of slave device is identical with the output of expansion decoding circuit of the master device corresponding to the said expansion decoding circuit 40.

Modification flag production circuit 38 produces, from the error flag ef of error correction circuit 34 and modification information cf given by the modification information separation circuit 36, a new modification flag cfe which represents the two flags ef and cf. Image modification circuit 42 modifies the output of expansion decoding circuit 40 according to the modification flag cfe and outputs it to the output terminal 44 as the digital video signal dve. Modification flag cfe is output at the output terminal 46 to the next stage encoding device as the modification information cf.

Next is explained an example of system composition of the case when the aforesaid device is

applied to the system composed of digital image recording and reproducing device or digital image transmission device, in reference to Figs. 3A - 3C. Fig. 3A shows the system composition of the case when two recording and reproducing devices at master side and slave side are connected and dubbing is conducted on the digital video signal. When the modification flag cf at the master side is recorded at the slave side and no error is produced at the slave side, the modifying action at the master side is reproduced and therefore as long as no error is produced at the master side data, deterioration at the slave side encoding is not added to the master side modification data and thus master output and slave output become identical.

Fig. 3B indicates an example of the system composition for recording the image data received from the transmission medium on the recording and reproducing device wherein recording and reproduction are done without deterioration of the modified data as in the foregoing example. Fig. 3C shows an example of system composition of the case where the digital output of recording and reproducing device is encoded by the transmission device and delivered to the transmission route. These are simply the examples of system composition while the actual connections are of course made via digital signal converter, etc.

Next the modifying action by modification flag cf is explained in concrete manner. According to the present invention, arbitrary modifying method may be employed depending on the encoding system and the characteristics of transmission error but here explanation shall be made taking an example of line interpolation method for DPCM encoding. In the case of DPCM encoding, when error is produced, it influences the decoded value at the later stage and it propagates in line direction. To prevent such propagation, reset values (PCM symbols which are not DPCM-encoded) are provided at the present distance. The block composed of the continuous data between such reset values is called line*block and the method to interpolate the line*block where error was produced by the data of the line*blocks above and below such error-containing line*block is known to be a highly effective modifying method in bringing visual improvement. In this case, the aforesaid modification flag cf is added for each line*block and error flag ef is also produced for each line*block.

Fig. 4A is the drawing to illustrate a concrete example of composition of modification flag producing circuit 38 of Fig. 2. Modification information cf is at the high level ("H") for the block for which retouching has been made in the past and at the low level ("L") for the block where no modification has been made. Error flag ef becomes "H" for the line*block which contains uncorrectable symbol er-



ror and "L" for the line*block which is free from such uncorrectable symbol error.

As illustrated in the drawing, when either of the modification information cf or error flag ef is "H", the output of OR-gate 50 becomes "H" and such output is synchronized with each line*block from expansion decoding circuit 40 by latch 51 and it is output as modification flag cfe.

Fig. 4B(a) indicates the output of expansion decoding circuit 40 at the master side. It is observed that error is produced at line*block B and error*flag ef has become "H". Fig. 4B(b) shows the output of image modification circuit 42 at master side. Modification is done by substituting (interpolating) the data of line*block B for the interpolation data B1 obtained by $B1 = (A + C)/2$ by modification flag cfe. Fig. 4B(c) shows the output of expansion decoding circuit 40 at slave side. Since the error caused by encoding and decoding at the slave side is added to B1 which has been modified at the master side, line*block B2 does not become equivalent to B1. In the conventional example, this B2 constitutes the output of the slave side device. Fig. 4B(a) shows the output of slave side image modification circuit 42. Modification flag cfe becomes "H" due to the modification information cf transmitted from the master side by line*block B1 and at the slave side also, interpolation of $B1 = (A + C)/2$ is done and thus the results obtained become identical to the master side output.

As it is easily understood from the above explanation, according to the aforesaid example of embodiment, even when encoding and decoding are repeated, deterioration due to modifying made on the way is not allowed to propagate. It is highly useful for dubbing, editing and transmission devices, etc.

Fig. 5A is the drawing to indicate another concrete example of composition of the modification flag producing circuit 38 of Fig. 2. In the Figure, 52, 53 and 54 form the circuit to delay the modification information cf and error flag ef for the period of 1 line. The modification information cf and error flag ef of the line block being noticed are output at the delay circuit 52 and 53. Normally "H" output is obtained at OR-gate 57 as long as either of modification information cf or error flag ef is "H" and this OR-gate 57 function in the same manner as OR-gate 50 of Fig. 4. However if the error flag ef is "H" at either of the line*block corresponding to the line before and after the line*block being noticed, modification (interpolation) of such line*block does not produce satisfactory modification information, since retouch information cf is "H".

When "H" error flag ef exists at either of the line*blocks corresponding to the line before and after the line*block being noticed, the output of

NOR-gate 55 becomes "L" and "L" is supplied to OR-gate 57 even when modification information cf is "H" and thus modification information cf is neglected. Latch 58 synchronizes the output of OR-gate 57 with the respective line*block given by expansion decoding circuit 40 and outputs it as modification flag cfe.

Also in this example, when error is produced as illustrated in Fig. 4B, similar processing performance is conducted. However, in the case of Fig. 4A, when error flag ef is detected in line*block C at the slave side, modification must be done by using the data of line*block D below the line*block C and modification of line*block B and C must be made from line*blocks A and D and therefore, deterioration due to modification becomes large. Therefore in this example of embodiment, it is so processed as shown in Fig. 5B. In Fig. 5B(a), error flag ef is hoisted at line*block C to indicate that it requires modification. However, out of the line*blocks B and D, the line*block B is already modified in the foregoing step and therefore, the data are $B2 = f(B1) = f[(A + C)/2]$ and modification flag cf is at "H".

In the present example of embodiment, when modification information cf is "H" for the line*block being noticed, and the error flag ef is "H" for other line*blocks required for retouching of the said line*block, the modification information cf is neglected. In other words, as shown in Fig. 5B(b), modification information cf for line*block B is neglected and modification is done by using the line*block B2 which has been modified by the master device and encoded, decoded and modified by the slave device and $C1 = (B2 + D)/2$ is used as the modification output. In this way the scope of modification can be made as narrow as possible even when error continues at master/slave.

Fig. 6 shows the system composition in the case when recorded signals are given digital-dubbing by the digital VTR of the present example of embodiment.

In Fig. 6, 300 and 400 represent the recording and reproducing device of digital VTR, etc. The numbers at the unit of 10 and 1 of each section show the identical part when used in the order of 300 and 400.

First the outline of the performance of recording-reproducing device used at digital dubbing is explained using the example of recording-reproducing device 300.

Aural signal and image signal are respectively input into voice input terminal 301 and image input terminal 302 and converted into digital signals by A/D converter 303 and 304. Time axis of thus converted image signals and aural signals are converted and multiplexed for time axis and via the switch 307, they are supplied to the error correc-



tion encoding circuit 308 (hereinafter described as ECC encoding circuit). At this circuit 308, parity bit for correction of error is added to such multiplex signal to produce the data to be recorded. For reproduction of recorded digital data, it is the general practice to do error correction-encoding for correction of error produced at the time of reproduction of recorded data.

Thus produced digital recorded data are input into recording circuit 309 and thereby recorded on the medium.

At reproduction side, the digital data having been reproduced from the medium by reproduction circuit 310 are corrected of the error having been produced at reproduction at the error correction decoding circuit (hereinafter called ECC decoding circuit) 311 as far as possible. ECC decoding circuit 311 outputs the digital data and interpolation flag (modification flag) of through with error correction and these output signals are entered into interpolation circuit 312 and the uncorrectable data are interpolated and modified by the publicly known method (for example by the average value of preceding and succeeding data) according to the modification flag of having been produced in response to the data which could not be corrected at the ECC decoding circuit 311. The outputs signal of interpolation circuit 312 are divided into voice data and image data at the separation circuit 313 and they are respectively converted into analogue data at A/D converter 314 and 315 and output at output terminal 316 and 317.

This recording-reproducing device is additionally provided with the digital input terminal 306 which is connected to ECC encoding circuit 308 in exchange for the multiplexing circuit 305 via switch 307 in order to execute digital dubbing and the digital data output terminal 318 which is connected to the output end of interpolation circuit 312.

In Fig. 6, at the time of digital dubbing, digital data is output from the digital data output terminal 318 of the recording and reproducing device to be input to a digital data input terminal 406 of the recording and reproducing device 400. At this time, in the recording and reproducing device 400, a switch 407 selects the digital data input terminal 406 and digital data input to the terminal 406 is ECC-encoded and then recorded. In this manner, the recording signal can be dubbed as digital data without conversion into an analog signal.

Fig. 7 shows an example of a recording format of one frame of TV signal applied to a recording and reproducing apparatus of embodiments of the present invention. The one frame comprises a plurality of sync blocks each of which include image data and audio data. "V" denotes a region of the image data, "A" denotes a audio data region and "P" denotes a parity bit region.

Due to the difference between sampling rates of the image and audio data, in the audio data which have less information amount than that of the image data, a fraction portion in which there is no data to be recorded may exist in practice.

The present embodiment pays attention to the presence of such fragmentary part and records at such part the data retouch information of corresponding to the retouch flag of used in the interpolation circuit 312.

The example of Fig. 7 assumes that such fragmentary part where no voice data are recorded as aforesaid are present for the amount equivalent to n sync block and here, the modification information of used for the aforesaid dubbing are entered at such part instead of voice data.

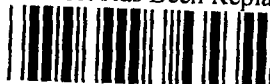
In this way the modification information of before the aforesaid dubbing is added to the dubbing data without providing an area in which the interpolation flag, in the recording format, that is, without increase of redundancy.

Next in Fig. 8A, explanation is made citing concrete values. In this example, the format at the time of recording of high vision signals after compression-encoding is explained.

High vision signal is sampled by brightness signal 48.6 MHZ and color difference signal 16.2 MHZ and through sub-sampling, DPCM encoding, pigment line sequentializing etc, data volume is condensed to 105,8184 Mbps. On the other hand, voice data are sampled by 48 KHZ, quantized by 16 bit and recorded in 4 channels to become the data of 3.072 Mbps.

When these data are punctuated for one frame and one sync block is composed of 1/3 line of image data (V), 4 channel 1 sample of voice data (A) and parity bit (P), the sync block composition as shown in Fig. 8A is obtained. One frame is composed of 3105 sync blocks of Fig. 8A as shown in Fig. 8B. At this time, the amount of data recorded on the voice data area as the voice data is the amount of those having 12800 symbols (1 symbol = 8 bit) per frame and out of the 24840 symbols (8 x 3 x 1035) corresponding to voice data area per frame, 12040 symbols (24840-12800) are the fragmentary part where data are not actually recorded.

On the other hand, interpolation flag (modification information) (F) at the time of dubbing only indicates if there remains error in one sync block composing the error correction symbol (which corresponds to 1 line block as aforesaid), and therefore one bit is required for one sync block. At this time, for one frame, it is enough if there exists recording area for 3105 bit = 388,125 symbols for interpolation flag (retouch information of) at the time of dubbing and therefore it fits well into the aforesaid fragmentary part where no voice



data is recorded.

When error correction potential is raised and error correction symbol is made into double symbol as shown in Fig. 8C, it requires only such additional area that will accept the entry of interpolation flag (modification information cf) at dubbing of 2550 symbols ($150 \times 3 \times 5$), i.e., 2250 bit = 281.25 symbols. In this case, the required recording area is only 669.375 symbols ($388.125 + 281.25$) even when interpolation flag in transversal direction and longitudinal direction are summed and it fits sufficiently into the fragmentary section of the aforesaid voice data.

As aforesaid, at the interpolation circuit 312 of VTR at reproduction side, the interpolation flag (modification information cf) at dubbing can be inserted into the dubbing data without providing a special recording area and at the interpolation circuit 412 at reproducing system of VTR on recording side, dubbing data are interpolated utilizing the flag (modification information cf) at the time of dubbing and thus deterioration of picture quality and sound quality of reproduced signals can be minimized.

To be more concrete, as illustrated in Fig. 4, at the recording side interpolation circuit 412, when the data which could not be corrected at reproduction of dubbing data is interpolated according to the new interpolation flag ef, for example when interpolation is made by the peripheral pixel data, the interpolation flag (modification information cf) at the time of dubbing of such peripheral pixel is checked and if pixel which had been interpolated at dubbing exists at the periphery, such pixel is not used for interpolation, thus enabling to do interpolation by the more accurate pixel and reduce deterioration of picture quality or sound quality.

Fig. 9 illustrates the dubbing system of another example of embodiment of the present invention, wherein primary reproducing VTR and secondary recording VTR are both digital VTR with identical construction.

First their performances at ordinary recording and reproducing time are explained.

At normal recording time, analogue image signals are entered at input terminal 110, sampled by the sampling clock with frequency more than twice of their maximum frequency, converted into 8 bit digital signals by the analogue/digital (A/D) conversion circuit 111 and entered into the compression (high efficiency) encoding circuit 112. At this circuit 112, input signals are given compression encoding wherein a representative value (specific data) not used for the value taken by the processing symbol unit (in this case 8 bit. 0 - 255) exists just like for example the midtread type DPCM having the characteristics as shown in Fig. 10 and this encoded signal is entered into the error correction encoding

circuit 114 via switch 113. Switch 113 is connected to terminal 102 except when it is connected to dubbing input terminal 101 for being used as the photographing (recording) side VTR at dubbing.

At the error correction encoding circuit 114, input signals receive error correction encoding having the correction ability matching the error rate of magnetic conversion system. For example, Read-Solomon double encoding may be made.

The output signal from error correction encoding circuit 114 is modulated by modulation circuit 115 so that it suits the transmission route and via the wide band recording amplifier which enables high speed digital recording and magnetic head 116, it is recorded on the magnetic tape 117.

At the normal reproduction time, the digital signals recorded on the magnetic tape 117 are reproduced by wide band reproduction amplifier and magnetic head 116, demodulated by demodulation circuit 118 and written into the main memory 119. Simultaneously the demodulated data are input into the error correction decoding circuit 120 and there syndrome calculation and error correction encoding and decoding calculation are conducted for each encoding block. When correction is judged to be possible at the said circuit 120, the reproduction data stored in the memory 119 are corrected and if correction is judged to be impossible, a flag information indicating that uncorrectable symbol is contained is entered in the interpolation flag memory 121. The unit 127 is the control unit to control writing and reading of the flag for the interpolation flag memory 121.

The data which have been duly corrected are read out of the memory 119 and entered into the flag judging circuit 122.

At the flag judging circuit 122, the code which is not used for compression encoding of the input signal is detected and if it is detected, flag information is entered at the address of interpolation flag memory 121 which corresponds to such data. Thereafter at the compression (high efficiency) decoding circuit 124, compression encoding signal such as DPCM is decoded and input into the interpolation circuit 125. At interpolation circuit 125, the image data coming from compression decoding circuit 124 are compared with the contents of interpolation flag memory 121 and when interpolation flag is recognized, image data are given such processing as line interpolation. The output signal of interpolation circuit 125 is converted into analogue image signal synchronizing with the sampling clock at the digital/analogue (D/A) conversion circuit 126 and output at the output terminal 127.

Next the performance at dubbing time is explained.

At the primary VTR, the line or symbol which has been judged uncorrectable as for the output



signal of demodulating circuit 118 are substituted for the specific code (data) which is not used at compression encoding by the error correction decoding circuit 120. Such specific code functions as the interpolation flag to be transmitted at dubbing. Flag judging circuit 122 performs flag detection as in the case of ordinary reproducing and enters the flag information into the interpolation flag memory. Image data passes through the said circuit 122 as they are. Output side dubbing terminal 123 of flag judging circuit 122 inputs the 8 bit image data and clock having passed through the flag judgment circuit 122 into the secondary VTR terminal 101 via flat cable.

At secondary VTR, switch 113' is connected to the dubbing input terminal 101' to input the signal from primary VTR. The signals having been input into the input terminal 201' receive error correction encoding, modulation and recording as in the case of ordinary recording.

By the aforesaid dubbing operation, at reproduction of the tape recorded by the secondary VTR, the interpolation flag caused by the error of electromagnetic conversion system of secondary VTR and the interpolation flag caused by the error of primary VTR which is detected by the flag judging circuit 122' are both entered into the interpolation flag memory 121' and the same interpolation processing is given to them at the interpolation circuit 121'. It is of course easy also to differentiate the said two interpolation flags and give appropriate interpolation processing to each of them separately.

According to the present invention, the only modification of the hardware of the ordinary VTR is the change of input terminal (13, 13', 23, 23') for digital dubbing, the memory (21, 21') working as the 8 bit comparator for flag judgment and the control unit (27, 27') for writing and reading of flag, thus the scale of addition of hardware being extremely small and the basic timing system and sequence at recording and reproduction being exactly same as those of the ordinary performance.

Claims

1. An encoding apparatus, comprising:

- (a) the first input means for inputting the primary information;
- (b) the second input means for inputting flag information which indicates production of non-production of the past uncorrectable symbol error of the aforesaid primary information for each unit of the specified block of information amount;
- (c) error correction encoding means for forming a parity symbol to correct the error of the pri-

mary information input by the aforesaid first input means and for adding said parity symbol to said primary information; and

(d) recording means for recording the primary information with addition of said parity symbol and said flag information on the same recording medium.

2. An apparatus according to claim 1, wherein said error correction encoding means contains the multiplex circuit which multiplexes said primary information and said flag information and outputs multiplex circuit, forms parity symbol to correct the error of said multiplex information and adds said parity symbol to said multiplex information.

3. An apparatus according to claim 2, wherein said primary information contains video information and audio information and said multiplex circuit selectively multiplexes the specified amount of said audio information and the specified amount of said flag information on the specified amount of said video information.

4. An apparatus according to claim 1, wherein said primary information is composed of a group of symbols of the specified bit which do not become the specific symbol pattern and said flag information recorded by said recording means is provided by making said primary information where uncorrectable symbol error has been produced in the past a specific symbol pattern.

5. Decoding apparatus which reproduces the primary information added with parity symbol for correction of error from the recording medium on which the first flag information indicating said primary information and the production or non-production of uncorrectable past symbol error as one unit of the specified block of information amount is recorded, comprising:

(a) reproducing means for reproducing said primary information added with said parity symbol and said flag information from said recording medium;

(b) error correcting means for correcting the symbol error of the primary information reproduced by said reproducing means using the parity symbol reproduced by said reproducing means and for producing second flag information indicating the production of uncorrectable symbol error in said block unit; and

(c) modifying means for modifying, in said block unit, said primary information having gone through the said error correcting means by said first flag information and said second flag information having been reproduced by said reproducing means.

6. An apparatus according to claim 5, wherein said retouching means contain the logic sum means to take the logic sum of the said first flag information and said second information and decide whether



signal of demodulating circuit 118 are substituted for the specific code (data) which is not used at compression encoding by the error correction decoding circuit 120. Such specific code functions as the interpolation flag to be transmitted at dubbing. Flag judging circuit 122 performs flag detection as in the case of ordinary reproducing and enters the flag information into the interpolation flag memory. Image data passes through the said circuit 122 as they are. Output side dubbing terminal 123 of flag judging circuit 122 inputs the 8 bit image data and clock having passed through the flag judgment circuit 122 into the secondary VTR terminal 101 via flat cable.

At secondary VTR, switch 113' is connected to the dubbing input terminal 101' to input the signal from primary VTR. The signals having been input into the input terminal 201' receive error correction encoding, modulation and recording as in the case of ordinary recording.

By the aforesaid dubbing operation, at reproduction of the tape recorded by the secondary VTR, the interpolation flag caused by the error of electromagnetic conversion system of secondary VTR and the interpolation flag caused by the error of primary VTR which is detected by the flag judging circuit 122' are both entered into the interpolation flag memory 121' and the same interpolation processing is given to them at the interpolation circuit 121'. It is of course easy also to differentiate the said two interpolation flags and give appropriate interpolation processing to each of them separately.

According to the present invention, the only modification of the hardware of the ordinary VTR is the change of input terminal (13, 13', 23, 23') for digital dubbing, the memory (21, 21') working as the 8 bit comparator for flag judgment and the control unit (27, 27') for writing and reading of flag, thus the scale of addition of hardware being extremely small and the basic timing system and sequence at recording and reproduction being exactly same as those of the ordinary performance.

Claims

1. An encoding apparatus, comprising:

- (a) the first input means for inputting the primary information;
- (b) the second input means for inputting flag information which indicates production of non-production of the past uncorrectable symbol error of the aforesaid primary information for each unit of the specified block of information amount;
- (c) error correction encoding means for forming a parity symbol to correct the error of the pri-

mary information input by the aforesaid first input means and for adding said parity symbol to said primary information; and

(d) recording means for recording the primary information with addition of said parity symbol and said flag information on the same recording medium.

2. An apparatus according to claim 1, wherein said error correction encoding means contains the multiplex circuit which multiplexes said primary information and said flag information and outputs multiplex circuit, forms parity symbol to correct the error of said multiplex information and adds said parity symbol to said multiplex information.

3. An apparatus according to claim 2, wherein said primary information contains video information and audio information and said multiplex circuit selectively multiplexes the specified amount of said audio information and the specified amount of said flag information on the specified amount of said video information.

4. An apparatus according to claim 1, wherein said primary information is composed of a group of symbols of the specified bit which do not become the specific symbol pattern and said flag information recorded by said recording means is provided by making said primary information where uncorrectable symbol error has been produced in the past a specific symbol pattern.

5. Decoding apparatus which reproduces the primary information added with parity symbol for correction of error from the recording medium on which the first flag information indicating said primary information and the production or non-production of uncorrectable past symbol error as one unit of the specified block of information amount is recorded, comprising:

(a) reproducing means for reproducing said primary information added with said parity symbol and said flag information from said recording medium;

(b) error correcting means for correcting the symbol error of the primary information reproduced by said reproducing means using the parity symbol reproduced by said reproducing means and for producing second flag information indicating the production of uncorrectable symbol error in said block unit; and

(c) modifying means for modifying, in said block unit, said primary information having gone through the said error correcting means by said first flag information and said second flag information having been reproduced by said reproducing means.

6. An apparatus according to claim 5, wherein said retouching means contain the logic sum means to take the logic sum of the said first flag information and said second information and decide whether





said retouching should be done or not according to the output of said logic sum.

7. An apparatus according to claim 6, wherein said retouching means decide whether or not said retouching should be done or not for either of the plural number of blocks required for such retouching, as for the block wherein said first flag information indicates the production of the past symbol error and when the second flag information indicates the production of symbol error, makes said decision only responding to the second flag.

8. An apparatus according to claim 5, wherein the multiplex information which multiplexes said first flag information and said primary information are recorded on said recording medium and said modifying means contain the separation circuit to separate said first flag information from the multiplex information reproduced by said reproducing means.

9. An apparatus according to claim 8, wherein said primary information is composed of the symbol group of specified bit which does not become a symbol pattern, said first flag information recorded on said recording medium is provided by making said primary information in which the uncorrectable symbol error was produced, a specific symbol pattern and said separation circuit contains the pattern to detect said specific symbol pattern.

10. A decoding apparatus to reproduce the primary information added with parity symbol for error correction from the recording medium on which said primary information is recorded, comprising:

(a) reproducing means for reproducing primary information added with said parity symbol from said recording medium;

(b) error correcting means for correcting the symbol error of the primary information reproduced by said reproducing means using the parity symbol reproduced by said reproducing means and for generating a flag which indicates the production of uncorrectable symbol error in one unit of block of specified information amount.

(c) modifying means for modifying, in the said block unit, said primary information which has gone through said error correction means using said flag; and

(d) output means for outputting modification information corresponding to said primary information having gone through said retouching means and said flag.

11. An apparatus according to claim 10, wherein flag information indicating production or non-production of uncorrectable past symbol error of said primary information together with said primary information in one unit of block is recorded on said recording medium and said retouching means decides whether or not retouching should be done

using said flag information reproduced by said reproducing means and the flag having been generated by said error correction means.

12. An apparatus according to claim 11, wherein said output means form said modification information according to said flag information and said flag.

13. An apparatus according to claim 10, wherein said output means have the multiplexing means to multiplex the said primary information having gone through said modifying means and said modification information and outputs the information multiplexed by said multiplexing means.

14. Dubbing system comprising:

(A) reproducing means for reproducing primary information added with the parity symbol for error correction from the recording medium on which said primary information is recorded, comprising:

(a) reproducing means for reproducing primary information added with said parity symbol from said recording medium;

(b) error correcting means for correcting the symbol error of the primary information reproduced by the said reproducing means using parity symbol reproduced by the said reproducing means and for producing a flag which indicates the production of uncorrectable symbol error in one unit of the block of specified information amount; and

(c) output means for outputting modification information corresponding to the said primary information having gone through said error correction means and said flag; and

(B) recording device, comprising:

(a) input means for inputting said primary information and said retouch information output by said reproducing device;

(b) error correction encoding means for forming the parity symbol for correction of primary information input by the said first input means and for adding said parity symbols to said primary information; and

(c) recording means for recording the primary information added with the said parity symbol and said modification information on the same recording medium.

15. A system according to claim 14, wherein said reproducing device contains the modifying means to modify said primary information having gone through said error correction means in said block unit using said flag and outputs said primary information having gone through the said modifying means.

16. A system according to claim 14, wherein said output means is provided with the multiplexing means to multiplex said primary information having gone through said correcting means and said



modifying means and thus form multiplex information and output said multiplex information, said input means containing the separation means to input said multiplex information and separate said modification information from said multiplex information.

5

17. A system according to claim 16, wherein said primary information is composed of specified bits of the symbol group which does not become a specific symbol pattern and said output means makes, as said modification information, said primary information where uncorrectable symbol error had been produced in the past a specific symbol pattern according to said flag.

10

18. A system according to claim 14, wherein said recording device further includes the reproduction means to reproduce the primary information added with said parity symbol and said modification information from said recording medium,

15

the second error correcting means for correcting the symbol error of the primary information reproduced by said reproducing means using the parity symbol reproduced by said reproducing means and for producing a second flag which indicates the production of uncorrectable symbol error in said block unit, and modifying means for modifying said primary information having gone through said error correction means in the aforesaid block units using said modification information and said second flag reproduced by the said reproduction means.

20

25

30

19. A system according to claim 18, wherein said modifying means contain the logic sum means which takes the logic sum of said modification information and said second flag and decides whether or not the modification should be done according to the output of said logic sum means.

35

20. Use in encoding or decoding apparatus of input means or error correcting means responsive to flag information that indicates for a primary information stream an uncorrectable symbol error in a region thereof.

40

45

50

55



This Sheet Has Been Replaced





EP 0 408 343 A2

FIG. 1

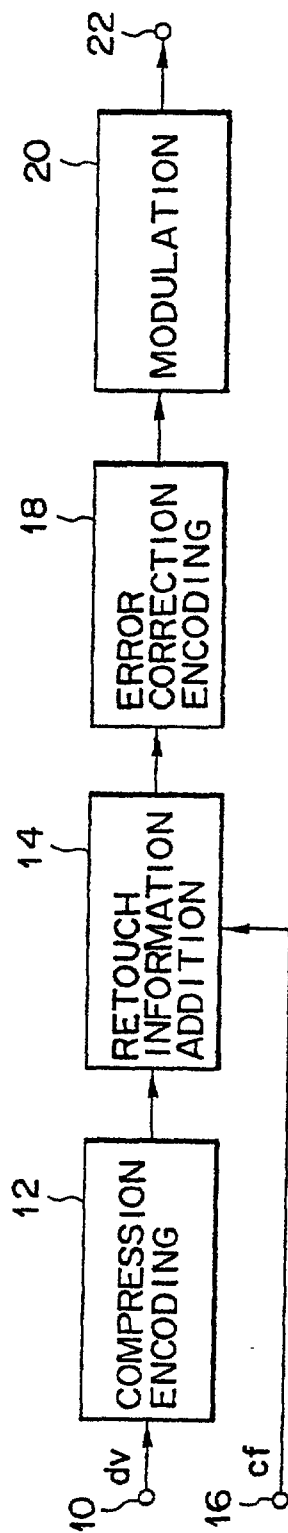
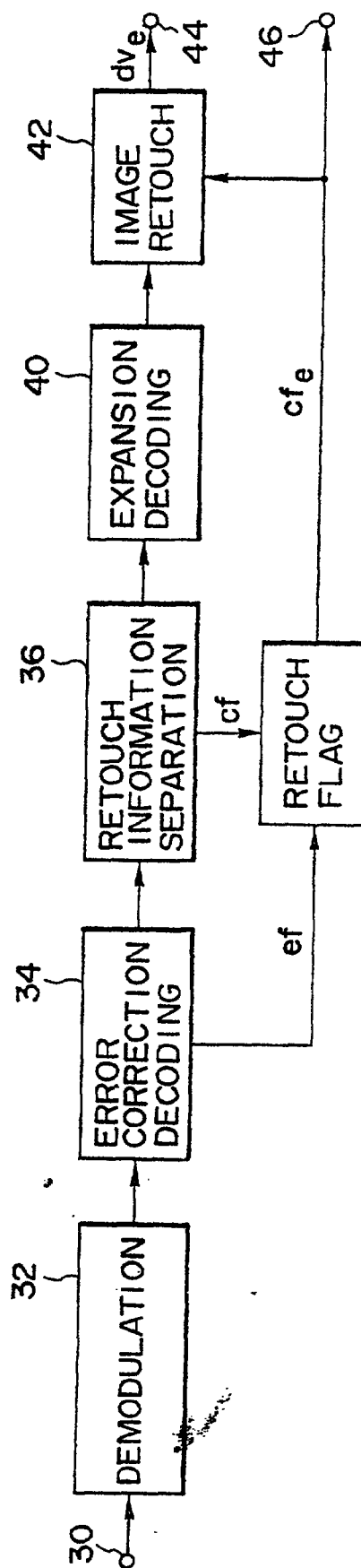


FIG. 2





EP 0 408 343 A2

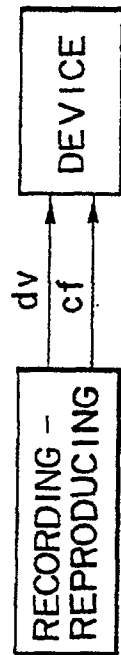


FIG. 3A

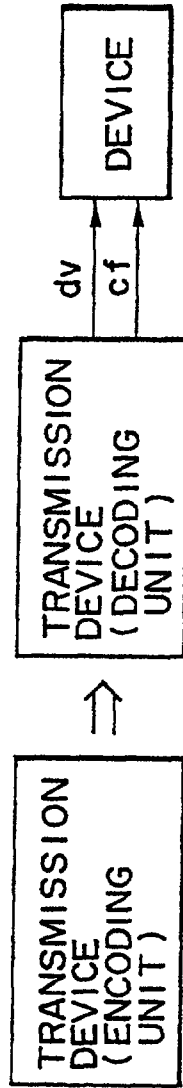


FIG. 3B

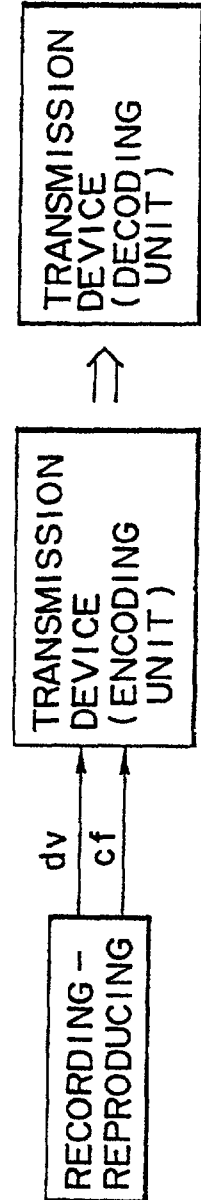


FIG. 3C



FIG. 4A

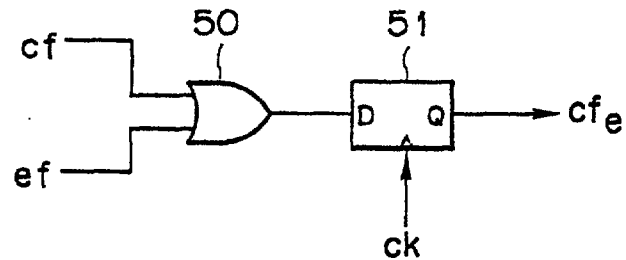
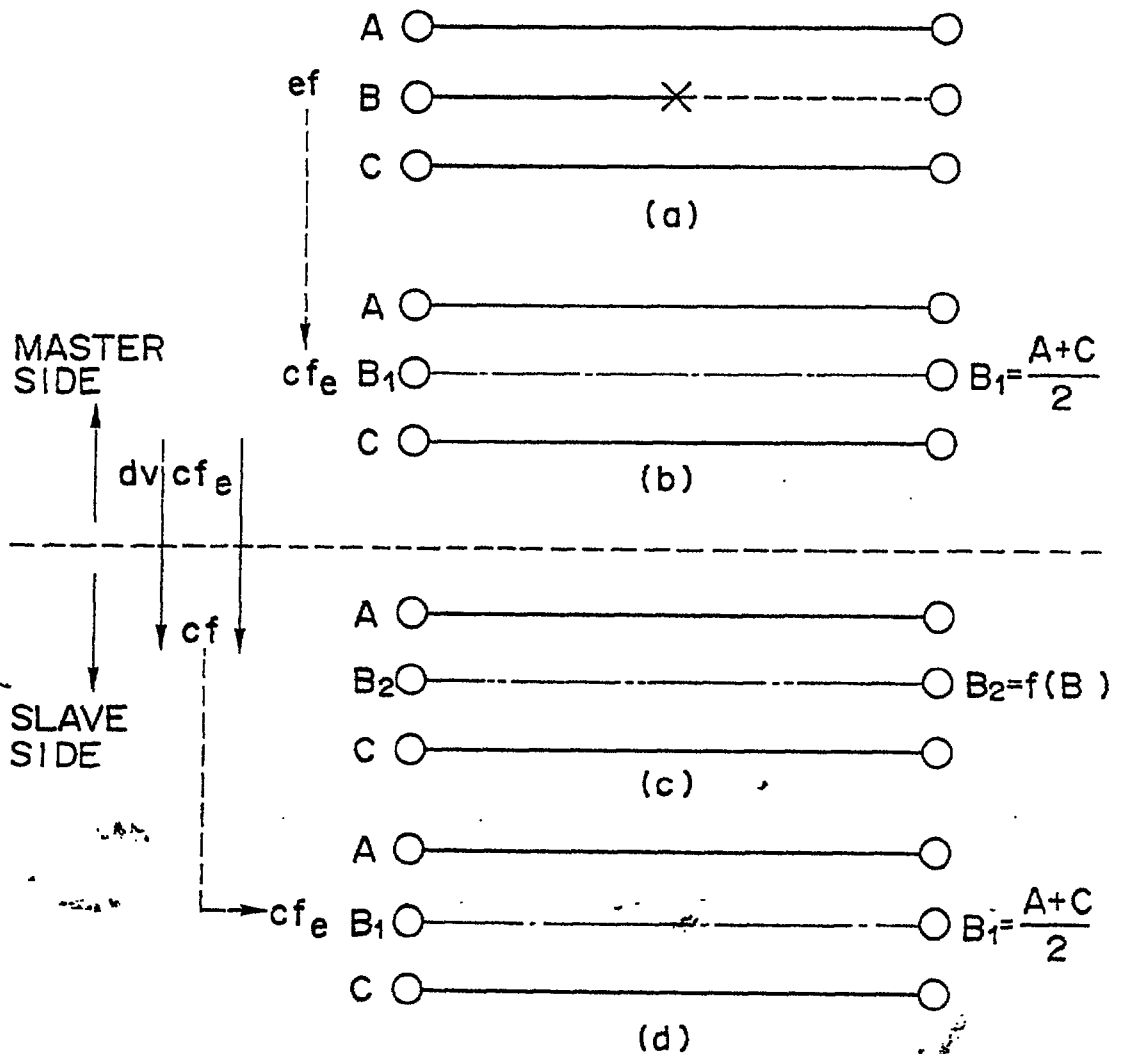


FIG. 4B



○ : RESET DATA

X : ERROR

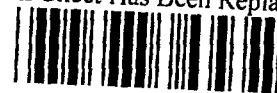


FIG. 5A

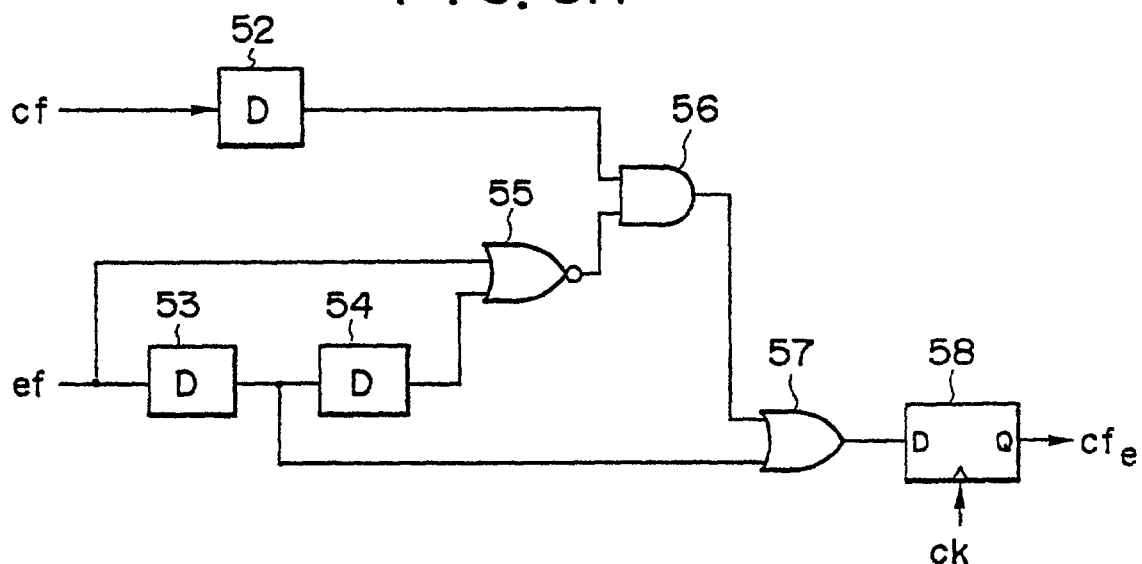


FIG. 5B

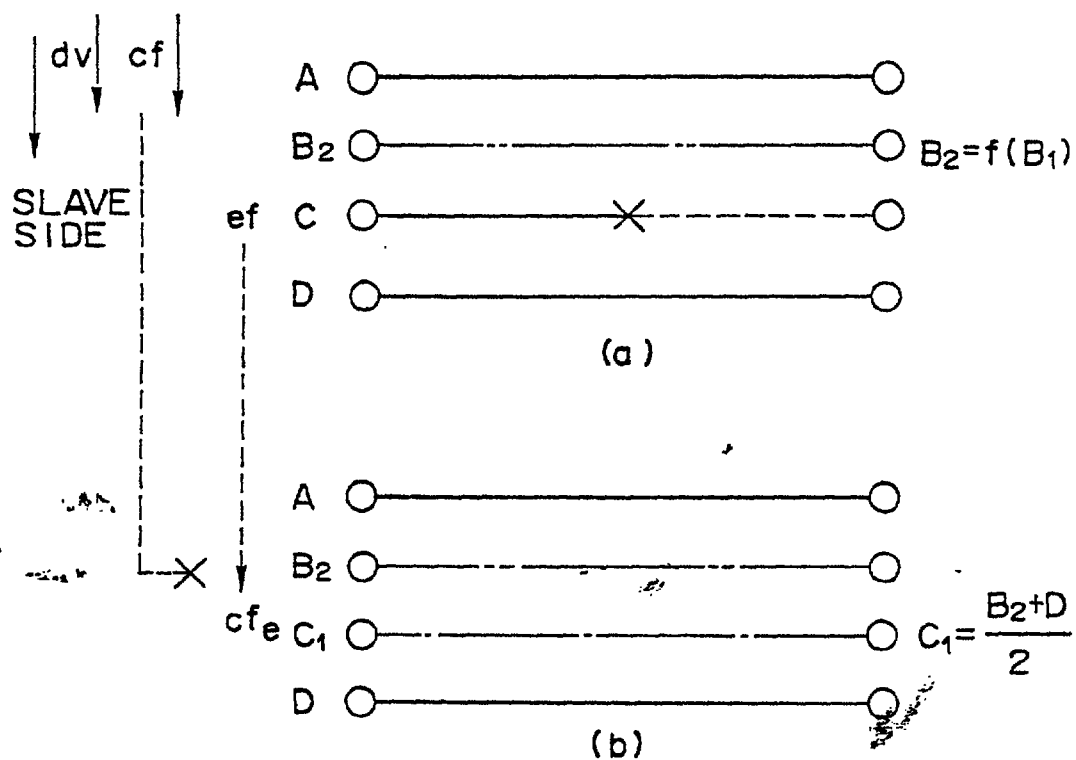
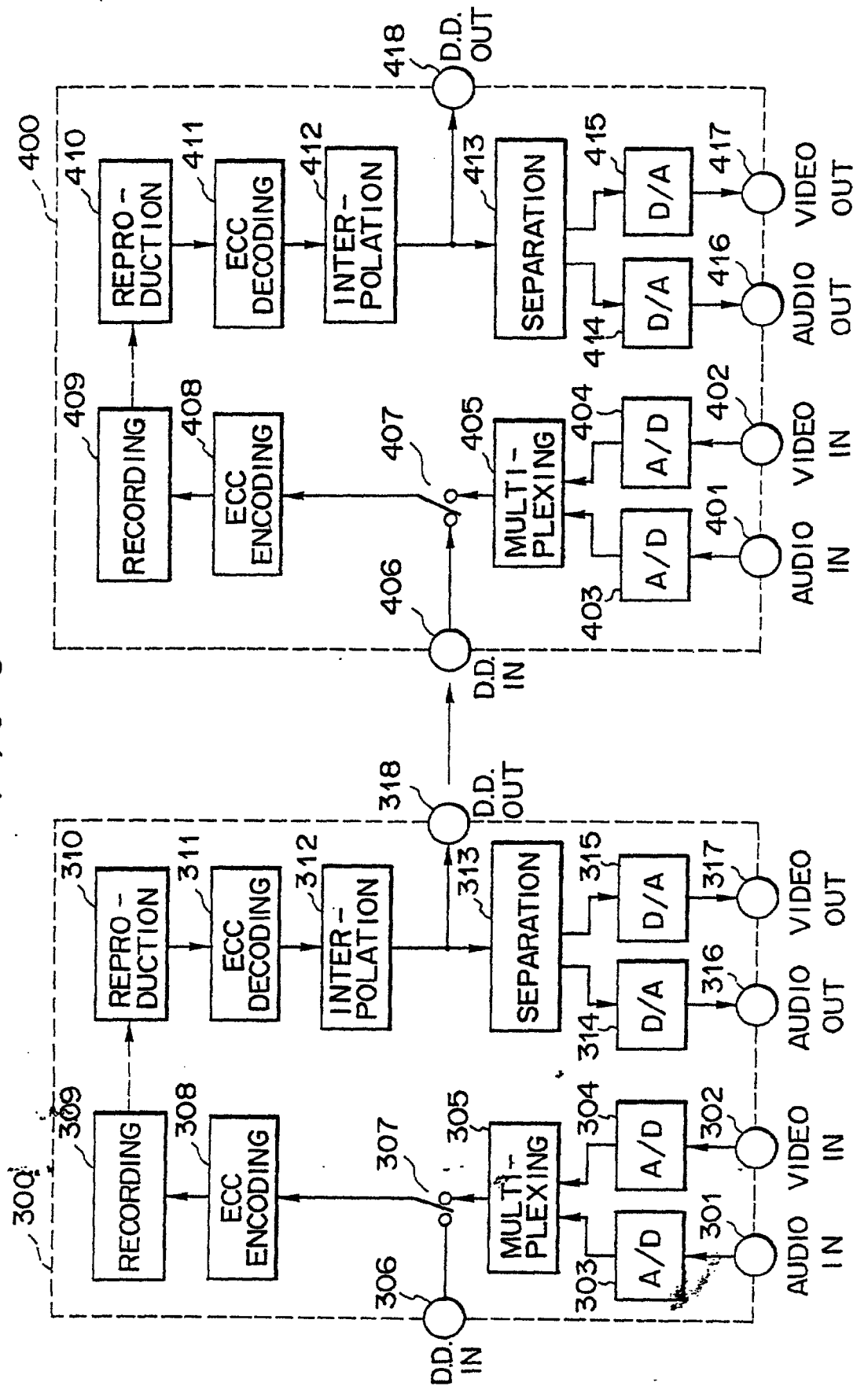




FIG. 6



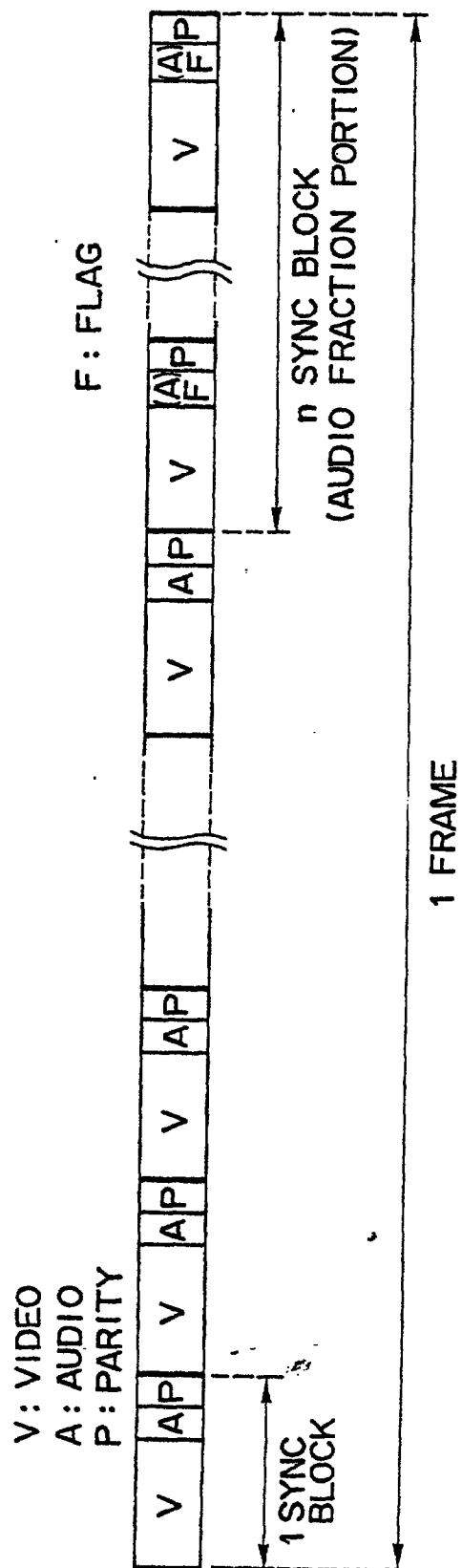
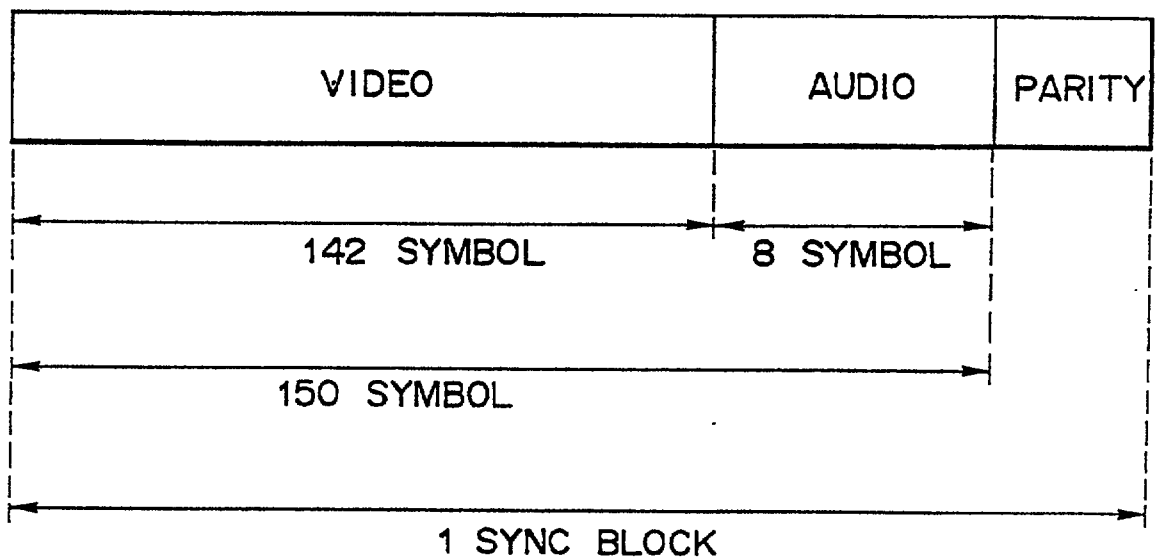


FIG. 8A



This Sheet Has Been Replaced





1035
LINES

[illegible]

```
V : VIDEO
A : AUDIO
P : PARITY
F : FLAG
```

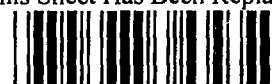
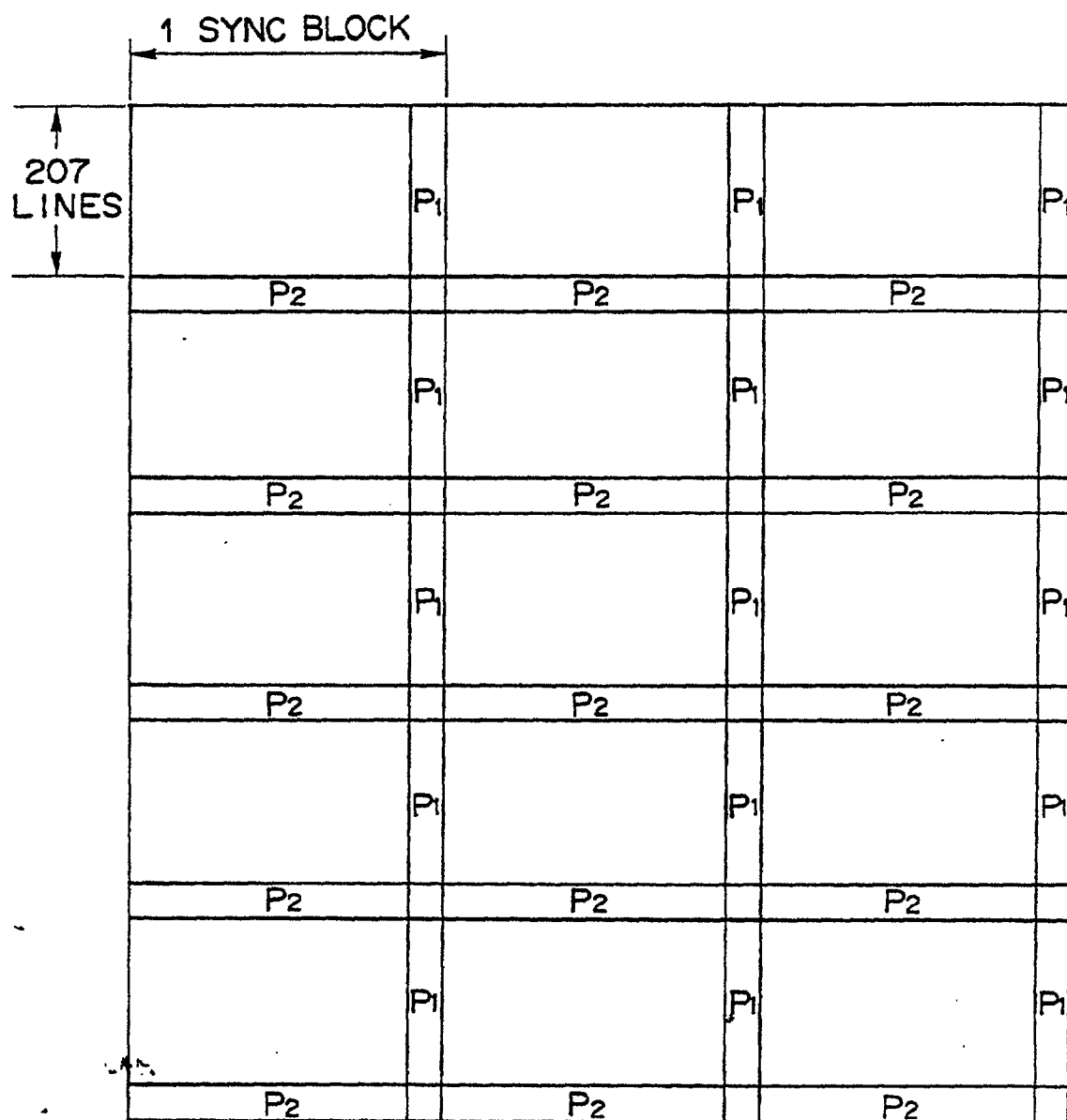


FIG. 8C



P₁ : TRANSVERSAL DIRECTION PARITY
P₂ : LONGITUDINAL DIRECTION PARITY

FIG. 9A

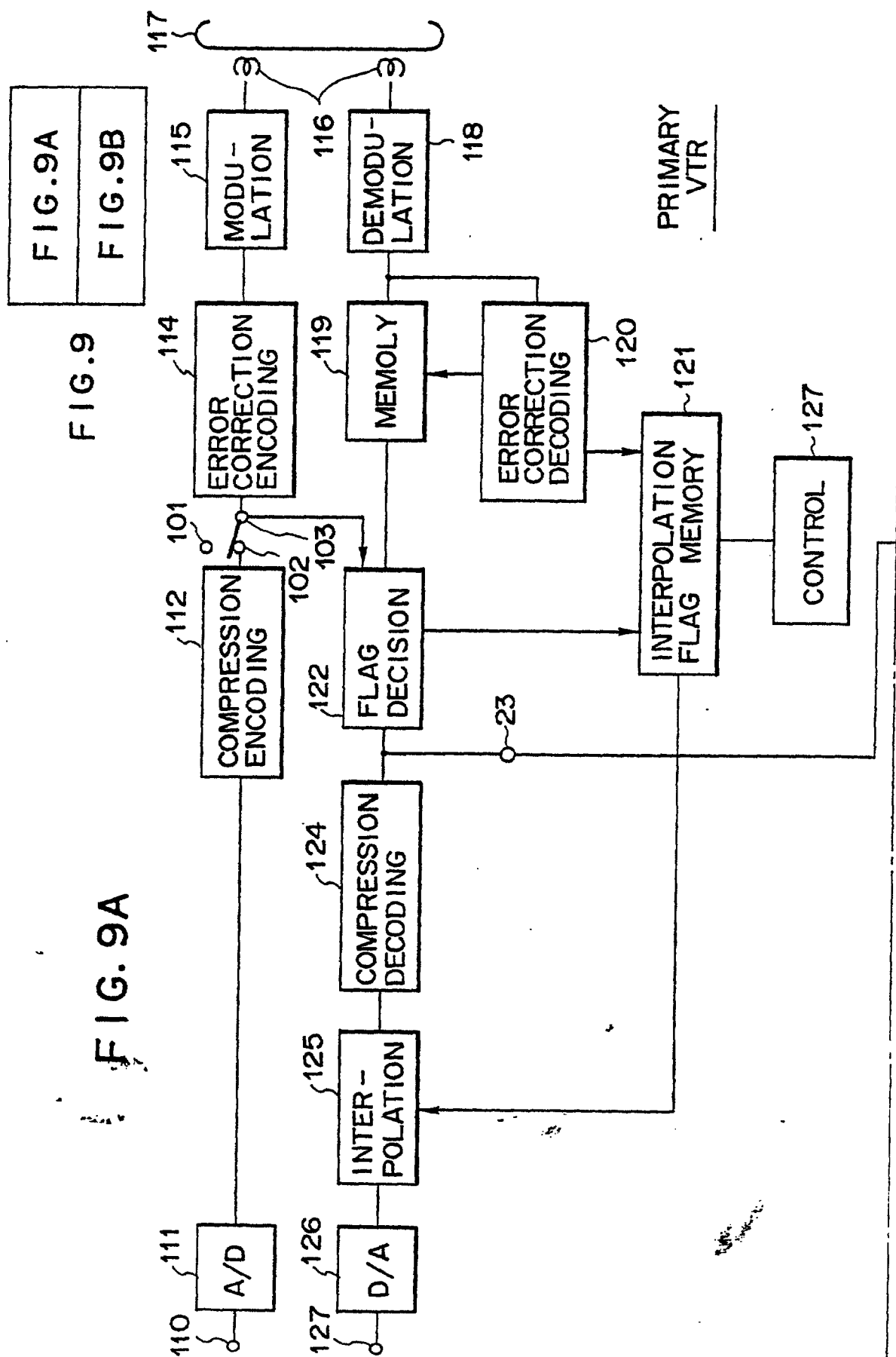




FIG. 9B

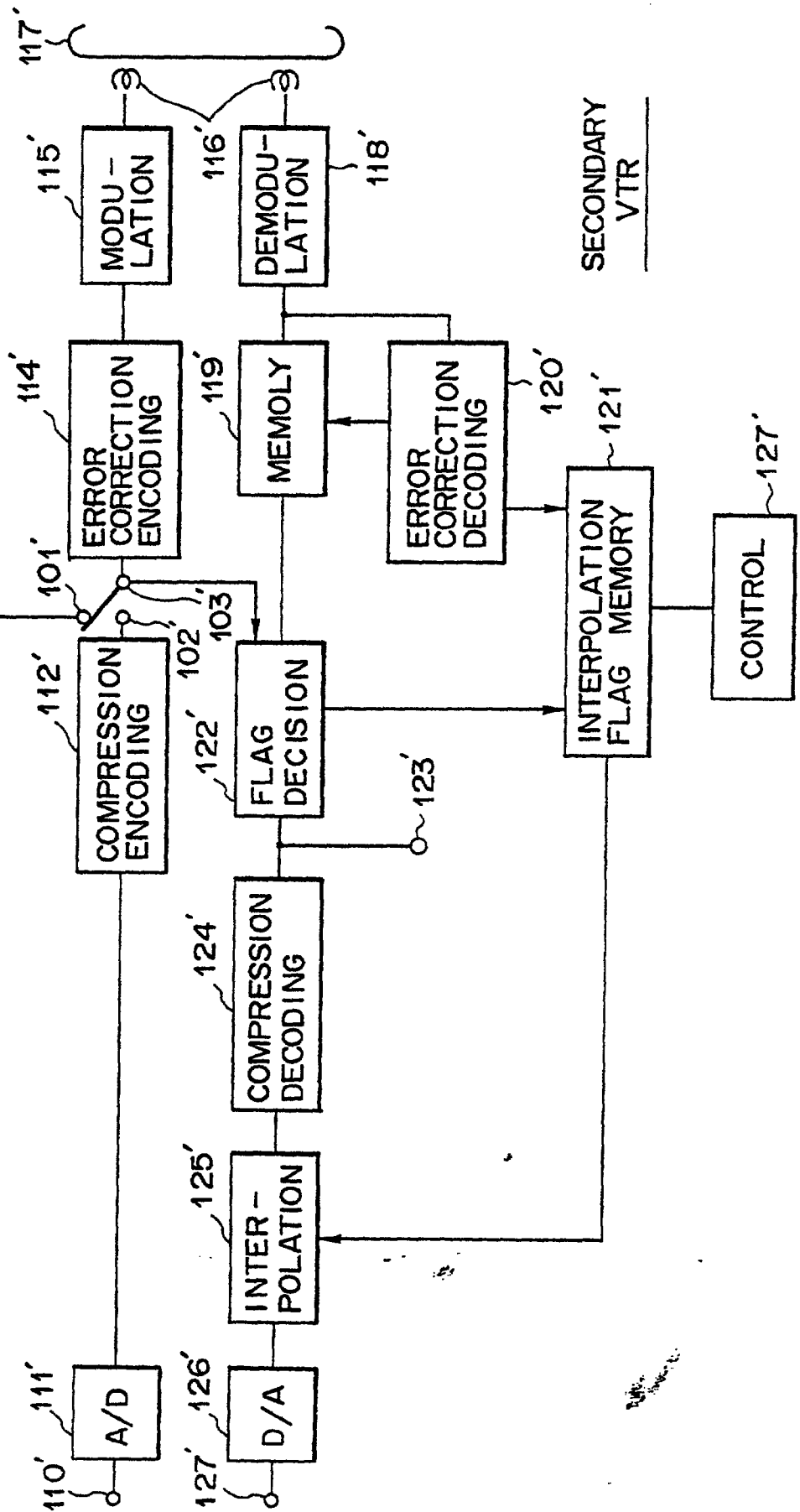




FIG. 10

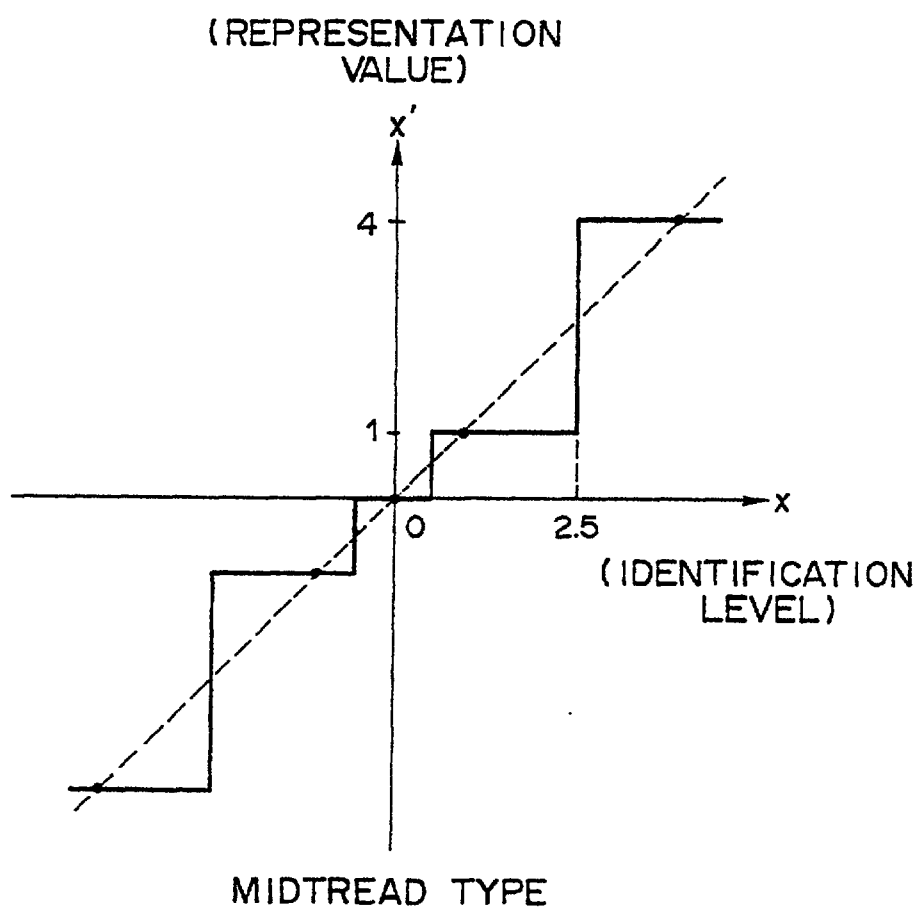
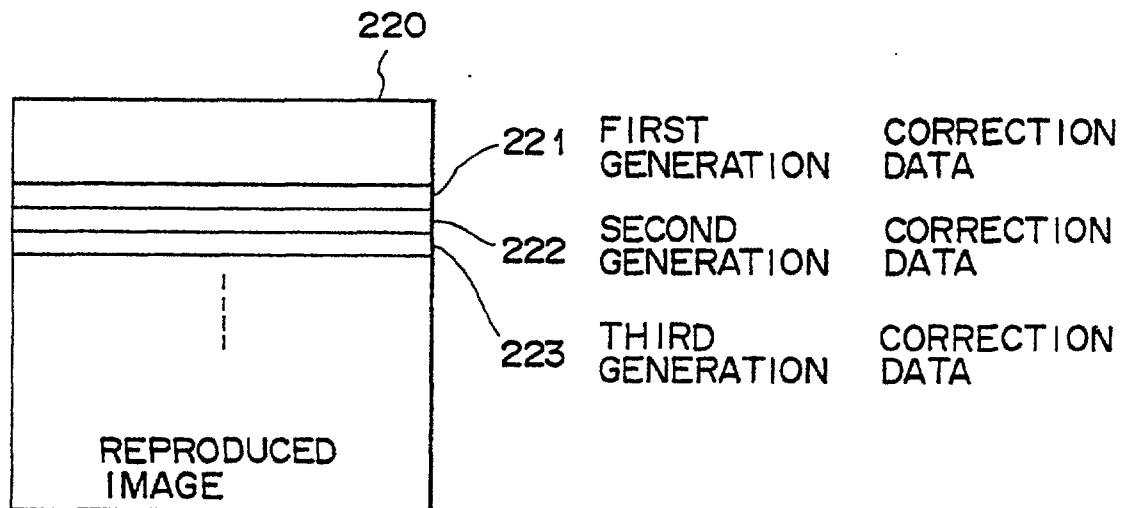
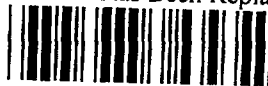




FIG. 11





Europäisches Patentamt
European Patent Office
Office européen des brevets



Publication number: **0 408 343 A3**

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: **90307592.7**

(51) Int. Cl.⁵: **G11B 20/18, G11B 5/86**

(22) Date of filing: **11.07.90**

(30) Priority: **13.07.89 JP 181159/89**
29.09.89 JP 252305/89
29.09.89 JP 252308/89
14.12.89 JP 324585/89

(43) Date of publication of application:
16.01.91 Bulletin 91/03

(84) Designated Contracting States:
DE ES FR GB IT NL

(88) Date of deferred publication of the search report:
17.07.91 Bulletin 91/29

(71) Applicant: **CANON KABUSHIKI KAISHA**
30-2, 3-chome, Shimomaruko, Ohta-ku
Tokyo(JP)

(72) Inventor: **Ishii, Yoshiki, c/o Canon K.K.**
30-2, 3-chome, Shimomaruko, Ohta-ku
Tokyo(JP)

Inventor: **Shikakura, Akihiro, Canon K.K.**
30-2, 3-chome, Shimomaruko, Ohta-ku
Tokyo(JP)

Inventor: **Shimuzu, Tetsuya, Canon K.K.**
30-2, 3-chome, Shimomaruko, Ohta-ku
Tokyo(JP)

(74) Representative: **Beresford, Keith Denis Lewis**
et al
BERESFORD & Co. 2-5 Warwick Court High
Holborn
London WC1R 5DJ(GB)

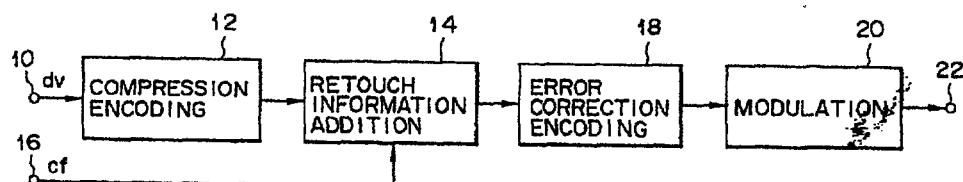
(54) **Encoding device and decoding device suitable for dubbing.**

(57) For the cases where recording medium recorded at slave side apparatus is reproduced it has been made possible to do identical modification processing to that conducted at master side apparatus, by reproducing, at master side apparatus, the primary information added with parity symbol for error correction from the recording medium on which the primary information is recorded, correcting the symbol error of primary information reproduced at the reproducing means using the reproduced parity symbol, producing the flag which indicates the production of unacceptable symbol error in one unit of

the block of specified information amount and thus outputting the modification information corresponding to the primary information and the flag and forming, at slave side, the parity symbol for correction of error of primary information output at the master side apparatus and recording the primary information added with parity symbol and modification information on the same recording medium. It has also become possible to conduct satisfactory modification processing when the symbol error is produced.

EP 0 408 343 A3

FIG. 1



STANDARD SHEET

✓ Description : page 1 to page 1

✓ Claim(s) : page 24 to page 34

✓ Drawing(s) : page 1 to page 1

✓ Abstract : page 25 to page 25

DATE OF RECEIPT

- 1 -

✓ 1 25

✓ 24 34

✓ 1/1 1/1

✓ 25 -

15/10/96

ENCODING DEVICE AND DECODING
DEVICE SUITABLE FOR DUBBING

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention is related to the encoding and decoding devices suitable for dubbing, in particular to their handling at the time of occurrence of uncorrectable symbol error.

Related Background Art

Digital VTR etc may be an example of the system to record and reproduce image and aural signals.

With the recording and reproducing device of such digital VTR, the analogue signals (aural signal and image signal) to be recorded are first converted into digital code and error correction encoding is executed by addition of parity bit for error correction by error correction encoding circuit (ECC encoding circuit) and recording it on a recording medium. On the other hand, in order to reproduce analogue signals from the digital data recorded on the recording medium of the recording and reproducing device, first the digital data are reproduced from the recording medium, the data are input into error correction decoding circuit (ECC decoding circuit), the symbol errors having been produced at recording and reproduction are corrected there as much as possible, error symbols which could not be

This is the replacement sheet

Date: 15 OCT 1996

corrected by ECC decoding circuit are interpolated (modified) by the publicly known method at the interpolation circuit (for example interpolated by the average value of the preceding and succeeding data), the output of interpolation circuit is converted into analogue signal and thus the original signals are reproduced.

In order to execute dubbing of signals digitally recorded on the recording medium as they are in digital mode by using two sets of recording and reproducing units with such construction, the digital data taken out of the interpolation circuit of recording and reproducing device at one side are entered into the ECC encoding circuit of the other recording and reproducing device at the other side and the signals are ECC-encoded and recorded in the recording medium. Like above, recorded signals can be dubbed as they are in the digital mode, without being reconverted into analogue signals.

On the other hand, another method for compression-encoding of image information which has been publicly known is the method like DPCM encoding by midtread type quantifier, wherein the symbols once having been encoded are decoded into baseband digital signals and then encoded again to obtain the same symbols as before. When such encoding method is employed, deterioration due to encoding occurs only at the time of initial encoding and even when encoding and decoding are repeated thereafter in digital signals, deterioration does not accumulate and

This is the replacement sheet

Date: 15 OCT 1996

dubbing and editing in the baseband digital signal mode can be executed without accompanying deterioration.

However in the case of image information etc, it has been the general practice to modify by interpolation to deal with the uncorrectable error which generates at the time of reproduction of recorded information (at the transmission in broad sense) and if thus modified information is encoded again, encoding error generates at that time and it has been a problem. As the result due to the deterioration caused by modifying coupled with deterioration caused by encoding, accumulation of deterioration proceeds as encoding and decoding are repeated.

In addition, also at the reproduction of dubbing data by recording-reproducing device, the dubbed data are reproduced without being identified whether they are interpolated data or correct data and the data which are judged to be uncorrectable at the ECC decoding circuit of recording and reproducing device of the other side may be interpolated by using the data which had been recorded after being interpolated at the time of dubbing by the interpolation circuit and if so it results in the deterioration of picture quality and sound quality.

SUMMARY OF THE INVENTION

The objective of the present invention is to solve the problems as aforesaid.

This is the replacement sheet

Date: 1 OCT 1996

Another objective of the present invention is to minimize the deterioration of dubbing data caused by the presence of information modified by interpolation.

With such objective, there is provided an encoding apparatus comprising:

(a) the first input means for inputting the primary information;

(b) the second input means for inputting flag information which indicates production or non-production of the past uncorrectable symbol error of the aforesaid primary information for each unit of the specified block of information amount;

(c) error correction encoding means for forming a parity symbol to correct the error of the primary information input by the aforesaid first input means and for adding said parity symbol to said primary information; and

(d) recording means for recording the primary information with addition of said parity symbol and said flag information on the same recording medium.

According to the present invention, there is also provided a decoding apparatus which reproduces the primary information added with parity symbol for correction of error from the recording medium on which the first flag information indicating said primary information and the production or non-production of uncorrectable past symbol error as one unit of the

This is the replacement sheet

Date 15 OCT 1996

specified block of information amount is recorded,
comprising:

(a) reproducing means for reproducing said primary information added with said parity symbol and said flag information from said recording medium;

(b) error correcting means for correcting the symbol error of the primary information reproduced by said reproducing means using the parity symbol reproduced by said reproducing means and for producing second flag information indicating the production of uncorrectable symbol error in said block unit; and

(c) modifying means for modifying, in said block unit, said primary information having gone through the said error correcting means by said first flag information and said second flag information having been reproduced by said reproducing means.

Other objectives and the characteristic features of the present invention shall be made evident by the detailed explanation of the embodiment of the present invention in reference to the drawings to be stated hereunder.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is the block diagram to show the composition of the encoding device of an embodiment of the present invention;

Fig. 2 is the block diagram to show the

This is a reproduction of the original document.

15 OCT 1996

composition of the decoding device of an embodiment of the present invention;

Figs. 3A - 3C are the drawings to indicate the system composition which employs the devices of Fig. 1 and Fig. 2;

Fig. 4A is the drawing to illustrate an example of composition of retouch flag producing circuit of Fig. 2;

Fig. 4B is the drawing to explain the performance of the decoding device of Fig. 2 by the retouch flag producing circuit of Fig. 4A;

Fig. 5A is the drawing to illustrate another example of composition of retouch flag production circuit of Fig. 2;

Fig. 5B is the drawing to explain the performance of the decoding device of Fig. 2 by the retouch flag producing circuit of Fig. 5A;

Fig. 6 is the drawing to show the composition of dubbing system as an example of embodiment;

Fig. 7 is the drawing to show the data format of recording and reproduction in the system of Fig. 6;

Fig. 8A is the drawing to show a concrete example of composition of 1 sync block of Fig. 7;

Fig. 8B is the drawing to show a concrete example of composition of 1 frame in Fig. 7;

Fig. 8C is the drawing to show another concrete example of composition of 1 frame in Fig. 7;

This is the replacement sheet

Date: 15 JUL 1976

Fig. 9 is the block diagram to show the composition of dubbing system as an example of embodiment of the present invention;

Fig. 10 is the drawing to explain the characteristics of mid tread type DPCM; and

Fig. 11 is a conceptual drawing to show the propagation of the error at the uncorrectable part at the time of dubbing when line interpolation is used.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Hereunder is explained the embodiments of the present invention.

Fig. 1 is the block diagram to show the composition of the encoding device which is an embodiment of the present invention. Hereunder the supply source of digital video signal shall be called master side and receiving unit shall be called slave side. Digital video signal dv to be entered into the input terminal 10 is compressed by compression encoding circuit 12 and impressed on the modification information addition circuit 14.

Modification information cf which indicates whether modification had been conducted or not is supplied by the preceding stage encoding-decoding device to the modification information addition circuit 14 via input terminal 16 and modification information addition circuit 14 outputs the symbol to be output by the compression

encoding circuit 12 after adding such modification information of thereto. When the encoding circuit indicated in Fig. 1 is used not as the slave side but in the initial stage or when it is connected to other encoder type devices, modification information cf is not supplied to the input terminal 16. In such case, the modification information addition circuit 14 adds, instead of modification information cf, the information corresponding to the modification information which has not been modified in the past. When variable long symbol is used as data format, it may be so arranged that modification information cf is added only when it is required.

The output of modification information addition circuit 14 is fed to the error correction encoding circuit 18 and after being coupled with parity symbol for error correction, it is modulated by modulation circuit 20, so that it fits the transmission route and it is delivered from the output terminal 22 to the transmission route. Transmission route includes, in addition to communication circuit, such recording media as magnetic disc, magnetic tape, etc.

Fig. 2 is the block diagram to show the composition of decoding device which is an embodiment of the present invention. Encoding data are input from transmission route into the input terminal 30, demodulation circuit 32 demodulates it and error correction decoding circuit

34 detects and corrects the error symbols at the transmission route. Error correction decoding circuit 34 outputs the error-corrected data to the modification information separation circuit 38 and outputs the uncorrectable flag ef to the modification flag producing circuit 38 in response to the production of uncorrectable data. Modification information separation circuit 36 separates the modification information cf added at the master side (for example modification information addition circuit 14) and the image data which have been compression-encoded and supplies the former to the modification flag production circuit 38 and the latter to the expansion decoding circuit 40. Expansion decoding circuit 40 decodes the compression-encoded image data and expands its information volume.

When the encoding system is such that the results of the first encoding and decoding are reproducible in the second and the succeeding repetitions of encoding and decoding (for example the DPCM encoding system utilizing midtread type quantifying characteristics), the output of expansion decoding circuit 40 of slave device is identical with the output of expansion decoding circuit of the master device corresponding to the said expansion decoding circuit 40.

Modification flag production circuit 38 produces, from the error flag ef of error correction circuit 34 and modification information cf given by the modification

This is the replacement sheet

Date: 15 OCT 1996

information separation circuit 36, a new modification flag cfe which represents the two flags ef and cf. Image modification circuit 42 modifies the output of expansion decoding circuit 40 according to the modification flag cfe and outputs it to the output terminal 44 as the digital video signal dve. Modification flag cfe is output at the output terminal 46 to the next stage encoding device as the modification information cf.

Next is explained an example of system composition of the case when the aforesaid device is applied to the system composed of digital image recording and reproducing device or digital image transmission device, in reference to Figs. 3A - 3C. Fig. 3A shows the system composition of the case when two recording and reproducing devices at master side and slave side are connected and dubbing is conducted on the digital video signal. When the modification flag cf at the master side is recorded at the slave side and no error is produced at the slave side, the modifying action at the master side is reproduced and therefore as long as no error is produced at the master side data, deterioration at the slave side encoding is not added to the master side modification data and thus master output and slave output become identical.

Fig. 3B indicates an example of the system composition for recording the image data received from the transmission medium on the recording and reproducing

device wherein recording and reproduction are done without deterioration of the modified data as in the foregoing example. Fig. 3C shows an example of system composition of the case where the digital output of recording and reproducing device is encoded by the transmission device and delivered to the transmission route. These are simply the examples of system composition while the actual connections are of course made via digital signal converter, etc.

Next the modifying action by modification flag cf is explained in concrete manner. According to the present invention, arbitrary modifying method may be employed depending on the encoding system and the characteristics of transmission error but here explanation shall be made taking an example of line interpolation method for DPCM encoding. In the case of DPCM encoding, when error is produced, it influences the decoded value at the later stage and it propagates in line direction. To prevent such propagation, reset values (PCM symbols which are not DPCM-encoded) are provided at the present distance. The block composed of the continuous data between such reset values is called line-block and the method to interpolate the line-block where error was produced by the data of the line-blocks above and below such error-containing line-block is known to be a highly effective modifying method in bringing visual improvement. In this case, the aforesaid modification flag cf is

THIS IS THE ORIGINAL COPY

15 OCT 1996

added for each line-block and error flag ef is also produced for each line-block.

Fig. 4A is the drawing to illustrate a concrete example of composition of modification flag producing circuit 38 of Fig. 2. Modification information cf is at the high level ("H") for the block for which retouching has been made in the past and at the low level ("L") for the block where no modification has been made. Error flag ef becomes "H" for the line-block which contains uncorrectable symbol error and "L" for the line-block which is free from such uncorrectable symbol error.

As illustrated in the drawing, when either of the modification information cf or error flag ef is "H", the output of OR-gate 50 becomes "H" and such output is synchronized with each line-block from expansion decoding circuit 40 by latch 51 and it is output as modification flag cfe.

Fig. 4B(a) indicates the output of expansion decoding circuit 40 at the master side. It is observed that error is produced at line-block B and error-flag ef has become "H". Fig. 4B(b) shows the output of image modification circuit 42 at master side. Modification is done by substituting (interpolating) the data of line-block B for the interpolation data B1 obtained by $B1 = (A+C)/2$ by modification flag cfe. Fig. 4B(c) shows the output of expansion decoding circuit 40 at slave side. Since the error caused by encoding and

This is the replacement sheet

Date: 15 OCT 1996

decoding at the slave side is added to B1 which has been modified at the master side, line-block B2 does not become equivalent to B1. In the conventional example, this B2 constitutes the output of the slave side device. Fig. 4B(a) shows the output of slave side image modification circuit 42. Modification flag cfe becomes "H" due to the modification information cf transmitted from the master side by line-block B1 and at the slave side also, interpolation of $B1 = (A+C)/2$ is done and thus the results obtained become identical to the master side output.

As it is easily understood from the above explanation, according to the aforesaid example of embodiment, even when encoding and decoding are repeated, deterioration due to modifying made on the way is not allowed to propagate. It is highly useful for dubbing, editing and transmission devices, etc.

Fig. 5A is the drawing to indicate another concrete example of composition of the modification flag producing circuit 38 of Fig. 2. In the Figure, 52, 53 and 54 form the circuit to delay the modification information cf and error flag ef for the period of 1 line. The modification information cf and error flag ef of the line block being noticed are output at the delay circuit 52 and 53. Normally "H" output is obtained at OR-gate 57 as long as either of modification information cf or error flag ef is "H" and this OR-gate 57 function

This is the replacement sheet

Date: 1975. 10. 10

in the same manner as OR-gate 50 of Fig. 4. However if the error flag ef is "H" at either of the line·block corresponding to the line before and after the line·block being noticed, modification (interpolation) of such line·block does not produce satisfactory modification information, since retouch information cf is "H".

When "H" error flag ef exists at either of the line·blocks corresponding to the line before and after the line·block being noticed, the output of NOR-gate 55 becomes "L" and "L" is supplied to OR-gate 57 even when modification information cf is "H" and thus modification information cf is neglected. Latch 58 synchronizes the output of OR-gate 57 with the respective line·block given by expansion decoding circuit 40 and outputs it as modification flag cfe.

Also in this example, when error is produced as illustrated in Fig. 4B, similar processing performance is conducted. However, in the case of Fig. 4A, when error flag ef is detected in line·block C at the slave side, modification must be done by using the data of line·block D below the line·block C and modification of line·block B and C must be made from line·blocks A and D and therefore, deterioration due to modification becomes large. Therefore in this example of embodiment, it is so processed as shown in Fig. 5B. In Fig. 5B(a), error flag ef is hoisted at line·block C to indicate that it requires modification. However, out of the

This is the original document

15 OCT 1996

line-blocks B and D, the line-block B is already modified in the foregoing step and therefore, the data are $B2 = f(B1) = f[(A+C)/2]$ and modification flag cf is at "H".

In the present example of embodiment, when modification information cf is "H" for the line-block being noticed, and the error flag ef is "H" for other line-blocks required for retouching of the said line-block, the modification information cf is neglected. In other words, as shown in Fig. 5B(b), modification information cf for line-block B is neglected and modification is done by using the line-block B2 which has been modified by the master device and encoded, decoded and modified by the slave device and $C1 = (B2+D)/2$ is used as the modification output. In this way the scope of modification can be made as narrow as possible even when error continues at master/slave.

Fig. 6 shows the system composition in the case when recorded signals are given digital-dubbing by the digital VTR of the present example of embodiment.

In Fig. 6, 300 and 400 represent the recording and reproducing device of digital VTR, etc. The numbers at the unit of 10 and 1 of each section show the identical part when used in the order of 300 and 400.

First the outline of the performance of recording-reproducing device used at digital dubbing is explained using the example of recording-reproducing device 300.

This is the replacement sheet

Date: 15 OCT 1996

Aural signal and image signal are respectively input into voice input terminal 301 and image input terminal 302 and converted into digital signals by A/D converter 303 and 304. Time axis of thus converted image signals and aural signals are converted and multiplexed for time axis and via the switch 307, they are supplied to the error correction encoding circuit 308 (hereinafter described as ECC encoding circuit). At this circuit 308, parity bit for correction of error is added to such multiplex signal to produce the data to be recorded. For reproduction of recorded digital data, it is the general practice to do error correction-encoding for correction of error produced at the time of reproduction of recorded data.

Thus produced digital recorded data are input into recording circuit 309 and thereby recorded on the medium.

At reproduction side, the digital data having been reproduced from the medium by reproduction circuit 310 are corrected of the error having been produced at reproduction at the error correction decoding circuit (hereinafter called ECC decoding circuit) 311 as far as possible. ECC decoding circuit 311 outputs the digital data and interpolation flag (modification flag) ef through with error correction and these output signals are entered into interpolation circuit 312 and the uncorrectable data are interpolated and modified by the publicly known

This is the replacement sheet

Date: 15 OCT 1980

method (for example by the average value of preceding and succeeding data) according to the modification flag ef having been produced in response to the data which could not be corrected at the ECC decoding circuit 311. The outputs signal of interpolation circuit 312 are divided into voice data and image data at the separation circuit 313 and they are respectively converted into analogue data at A/D converter 314 and 315 and output at output terminal 316 and 317.

This recording-reproducing device is additionally provided with the digital input terminal 306 which is connected to ECC encoding circuit 308 in exchange for the multiplexing circuit 305 via switch 307 in order to execute digital dubbing and the digital data output terminal 318 which is connected to the output end of interpolation circuit 312.

In Fig. 6, at the time of digital dubbing, digital data is output from the digital data output terminal 318 of the recording and reproducing device to be input to a digital data input terminal 406 of the recording and reproducing device 400. At this time, in the recording and reproducing device 400, a switch 407 selects the digital data input terminal 406 and digital data input to the terminal 406 is ECC-encoded and then recorded. In this manner, the recording signal can be dubbed as digital data without conversion into an analog signal.

Fig. 7 shows an example of a recording format

THIS IS THE PRELIMINARY REPORT

15 OCT 1996

of one frame of TV signal applied to a recording and reproducing apparatus of embodiments of the present invention. The one frame comprises a plurality of sync blocks each of which include image data and audio data. "V" denotes a region of the image data, "A" denotes a audio data region and "P" denotes a parity bit region.

Due to the difference between sampling rates of the image and audio data, in the audio data which have less information amount than that of the image data, a fraction portion in which there is no data to be recorded may exist in practice.

The present embodiment pays attention to the presence of such fragmentary part and records at such part the data retouch information cf corresponding to the retouch flag cf used in the interpolation circuit 312.

The example of Fig. 7 assumes that such fragmentary part where no voice data are recorded as aforesaid are present for the amount equivalent to n sync block and here, the modification information cf used for the aforesaid dubbing are entered at such part instead of voice data.

In this way the modification information cf before the aforesaid dubbing is added to the dubbing data without providing an area in which the interpolation flag, in the recording format, that is, without increase of redundancy.

This is the replacement sheet

Date: 15 OCT 1995

Next in Fig. 8A, explanation is made citing concrete values. In this example, the format at the time of recording of high vision signals after compression-encoding is explained.

High vision signal is sampled by brightness signal 48.6 MHz and color difference signal 16.2 MHz and through sub-sampling, DPCM encoding, pigment line sequentializing etc, data volume is condensed to 105,8184 Mbps. On the other hand, voice data are sampled by 48 KHZ, quantized by 16 bit and recorded in 4 channels to become the data of 3.072 Mbps.

When these data are punctuated for one frame and one sync block is composed of 1/3 line of image data (V), 4 channel 1 sample of voice data (A) and parity
15 bit (P), the sync block composition as shown in Fig. 8A is obtained. One frame is composed of 3105 sync blocks of Fig. 8A as shown in Fig. 8B. At this time, the amount of data recorded on the voice data area as the voice data is the amount of those having 12800 symbols (1 symbol = 8 bit) per frame and out of the 24840 symbols ($8 \times 3 \times 1035$) corresponding to voice data area per frame, 12040 symbols ($24840 - 12800$) are the fragmentary part where data are not actually recorded.

On the other hand, interpolation flag (modification
25 tion informaton) (F) at the time of dubbing only indicates if there remains error in one sync block composing the error correction symbol (which corresponds to 1

line block as aforesaid), and therefore one bit is required for one sync block. At this time, for one frame, it is enough if there exists recording area for 3105 bit = 388,125 symbols for interpolation flag (retouch information cf) at the time of dubbing and therefore it fits well into the aforesaid fragmentary part where no voice data is recorded.

When error correction potential is raised and error correction symbol is made into double symbol as shown in Fig. 8C, it requires only such additional area that will accept the entry of interpolation flag (modification information cf) at dubbing of 2550 symbols ($150 \times 3 \times 5$), i.e., 2250 bit = 281.25 symbols. In this case, the required recording area is only 669.375 symbols ($388.125 + 281.25$) even when interpolation flag in transversal direction and longitudinal direction are summed and it fits sufficiently into the fragmentary section of the aforesaid voice data.

As aforesaid, at the interpolation circuit 312 of VTR at reproduction side, the interpolation flag (modification information cf) at dubbing can be inserted into the dubbing data without providing a special recording area and at the interpolation circuit 412 at reproducing system of VTR on recording side, dubbing data are interpolated utilizing the flag (modification information cf) at the time of dubbing and thus deterioration of picture quality and sound quality of reproduced

signals can be minimized.

To be more concrete, as illustrated in Fig. 4, at the recording side interpolation circuit 412, when the data which could not be corrected at reproduction of dubbing data is interpolated according to the new interpolation flag ef, for example when interpolation is made by the peripheral pixel data, the interpolation flag (modification information cf) at the time of dubbing of such peripheral pixel is checked and if pixel which had been interpolated at dubbing exists at the periphery, such pixel is not used for interpolation, thus enabling to do interpolation by the more accurate pixel and reduce deterioration of picture quality or sound quality.

Fig. 9 illustrates the dubbing system of another example of embodiment of the present invention, wherein primary reproducing VTR and secondary recording VTR are both digital VTR with identical construction.

First their performances at ordinary recording and reproducing time are explained.

At normal recording time, analogue image signals are entered at input terminal 110, sampled by the sampling clock with frequency more than twice of their maximum frequency, converted into 8 bit digital signals by the analogue/digital (A/D) conversion circuit 111 and entered into the compression (high efficiency) encoding circuit 112. At this circuit 112, input signals are given compression encoding wherein a representative value

This is the replacement sheet

Date: 15 OCT 1996

(specific data) not used for the value taken by the processing symbol unit (in this case 8 bit 0 - 255) exists just like for example the midtread type DPCM having the characteristics as shown in Fig. 10 and this encoded signal is entered into the error correction encoding circuit 114 via switch 113. Switch 113 is connected to terminal 102 except when it is connected to dubbing input terminal 101 for being used as the photographing (recording) side VTR at dubbing.

At the error correction encoding circuit 114, input signals receive error correction encoding having the correction ability matching the error rate of magnetic conversion system. For example, Read-Solomon double encoding may be made.

The output signal from error correction encoding circuit 114 is modulated by modulation circuit 115 so that it suits the transmission route and via the wide band recording amplifier which enables high speed digital recording and magnetic head 116, it is recorded on the magnetic tape 117.

At the normal reproduction time, the digital signals recorded on the magnetic tape 117 are reproduced by wide band reproduction amplifier and magnetic head 116, demodulated by demodulation circuit 118 and written into the main memory 119. Simultaneously the demodulated data are input into the error correction decoding circuit 120 and there syndrome calculation and error correction

This is the replacement sheet

0510: 15 OCT 1990

encoding and decoding calculation are conducted for each encoding block. When correction is judged to be possible at the said circuit 120, the reproduction data stored in the memory 119 are corrected and if correction is judged to be impossible, a flag information indicating that uncorrectable symbol is contained is entered in the interpolation flag memory 121. The unit 127 is the control unit to control writing and reading of the flag for the interpolation flag memory 121.

The data which have been duly corrected are read out of the memory 119 and entered into the flag judging circuit 122.

At the flag judging circuit 122, the code which is not used for compression encoding of the input signal is detected and if it is detected, flag information is entered at the address of interpolation flag memory 121 which corresponds to such data. Thereafter at the compression (high efficiency) decoding circuit 124, compression encoding signal such as DPCM is decoded and input into the interpolation circuit 125. At interpolation circuit 125, the image data coming from compression decoding circuit 124 are compared with the contents of interpolation flag memory 121 and when interpolation flag is recognized, image data are given such processing as line interpolation. The output signal of interpolation circuit 125 is converted into analogue image signal synchronizing with the sampling clock at

FIG. 13 is a block diagram of the second embodiment.

15 OCT 1996

the digital/analogue (D/A) conversion circuit 126 and output at the output terminal 127.

Next the performance at dubbing time is explained.

At the primary VTR, the line or symbol which has been judged uncorrectable as for the output signal of demodulating circuit 118 are substituted for the specific code (data) which is not used at compression encoding by the error correction decoding circuit 120. Such specific code functions as the interpolation flag to be transmitted at dubbing. Flag judging circuit 122 performs flag detection as in the case of ordinary reproducing and enters the flag information into the interpolation flag memory. Image data passes through the said circuit 122 as they are. Output side dubbing terminal 123 of flag judging circuit 122 inputs the 8 bit image data and clock having passed through the flag judgment circuit 122 into the secondary VTR terminal 101 via flat cable.

At secondary VTR, switch 113' is connected to the dubbing input terminal 101' to input the signal from primary VTR. The signals having been input into the input terminal 201' receive error correction encoding, modulation and recording as in the case of ordinary recording.

By the aforesaid dubbing operation, at reproduction of the tape recorded by the secondary VTR, the interpolation flag caused by the error of electromagnetic

This is the replacement sheet

Date: 15 OCT 1996

conversion system of secondary VTR and the interpolation flag caused by the error of primary VTR which is detected by the flag judging circuit 122' are both entered into the interpolation flag memory 121' and the same interpolation processing is given to them at the interpolation circuit 121'. It is of course easy also to differentiate the said two interpolation flags and give appropriate interpolation processing to each of them separately.

According to the present invention, the only modification of the hardware of the ordinary VTR is the change of input terminal (13, 13', 23, 23') for digital dubbing, the memory (21, 21') working as the 8 bit comparator for flag judgment and the control unit (27, 27') for writing and reading of flag, thus the scale of addition of hardware being extremely small and the basic timing system and sequence at recording and reproduction being exactly same as those of the ordinary performance.



CLAIMS:

1. An encoding apparatus, comprising:
 - (a) the first input means for inputting the primary information;
 - (b) the second input means for inputting flag information which indicates production of non-production of the past uncorrectable symbol error of the aforesaid primary information for each unit of the specified block of information amount;
 - (c) error correction encoding means for forming a parity symbol to correct the error of the primary information input by the aforesaid first input means and for adding said parity symbol to said primary information; and
 - (d) recording means for recording the primary information with addition of said parity symbol and said flag information on the same recording medium.
2. An apparatus according to claim 1, wherein said error correction encoding means contains the multiplex circuit which multiplexes said primary information and said flag information and outputs multiplex circuit, forms parity symbol to correct the error of said multiplex information and adds said parity symbol to said multiplex information.
3. An apparatus according to claim 2, wherein





said primary information contains video information and audio information and said multiplex circuit selectively multiplexes the specified amount of said audio information and the specified amount of said flag information on the specified amount of said video information.

4. An apparatus according to claim 1, wherein said primary information is composed of a group of symbols of the specified bit which do not become the specific symbol pattern and said flag information recorded by said recording means is provided by making said primary information where uncorrectable symbol error has been produced in the past a specific symbol pattern.

5. Decoding apparatus which reproduces the primary information added with parity symbol for correction of error from the recording medium on which the first flag information indicating said primary information and the production or non-production of uncorrectable past symbol error as one unit of the specified block of information amount is recorded, comprising:

(a) reproducing means for reproducing said primary information added with said parity symbol and said flag information from said recording medium;

(b) error correcting means for correcting

This is the replacement sheet



Date:

15 OCT 1988



the symbol error of the primary information reproduced by said reproducing means using the parity symbol reproduced by said reproducing means and for producing second flag information indicating the production of uncorrectable symbol error in said block unit; and

(c) modifying means for modifying, in said block unit, said primary information having gone through the said error correcting means by said first flag information and said second flag information having been reproduced by said reproducing means.

6. An apparatus according to claim 5, wherein said retouching means contain the logic sum means to take the logic sum of the said first flag information and said second information and decide whether said retouching should be done or not according to the output of said logic sum.

7. An apparatus according to claim 6, wherein said retouching means decide whether or not said retouching should be done or not for either of the plural number of blocks required for such retouching, as for the block wherein said first flag information indicates the production of the past symbol error and when the second flag information indicates the production of symbol error, makes said decision only responding to the second flag.

This is the replacement sheet



Date.

15 OCT 1981



8. An apparatus according to claim 5, wherein the multiplex information which multiplexes said first flag information and said primary information are recorded on said recording medium and said modifying means contain the separation circuit to separate said first flag information from the multiplex information reproduced by said reproducing means.

9. An apparatus according to claim 8, wherein said primary information is composed of the symbol group of specified bid which does not become a symbol pattern, said first flag information recorded on said recording medium is provided by making said primary information in which the uncorrectable symbol error was produced, a specific symbol pattern and said separation circuit contains the pattern to detect said specific symbol pattern.

10. A decoding apparatus to reproduce the primary information added with parity symbol for error correction from the recording medium on which said primary information is recorded, comprising:

(a) reproducing means for reproducing primary information added with said parity symbol from said recording medium;

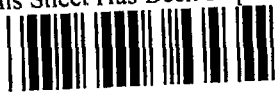
(b) error correcting means for correcting the symbol error of the primary information reproduced



* C L M S *

This is the replacement sheet

15 OCT 1996



by said reproducing means using the parity symbol reproduced by said reproducing means and for generating a flag which indicates the production of uncorrectable symbol error in one unit of block of specified information amount.

(c) modifying means for modifying, in the said block unit, said primary information which has gone through said error correction means using said flag; and

(d) output means for outputting modification information corresponding to said primary information having gone through said retouching means and said flag.

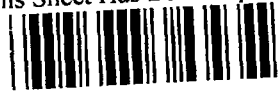
11. An apparatus according to claim 10, wherein flag information indicating production or non-production of uncorrectable past symbol error of said primary information together with said primary information in one unit of block is recorded on said recording medium and said retouching means decides whether or not retouching should be done using said flag information reproduced by said reproducing means and the flag having been generated by said error correction means.

12. An apparatus according to claim 11, wherein said output means form said modification information according to said flag information and said flag.



This is the replacement sheet

Date: 15 OCT 1995



13. An apparatus according to claim 10, wherein said output means have the multiplexing means to multiplex the said primary information having gone through said modifying means and said modification information and outputs the information multiplexed by said multiplexing means.

14. Dubbing system comprising:

(A) reproducing means for reproducing primary information added with the parity symbol for error correction from the recording medium on which said primary information is recorded, comprising:

(a) reproducing means for reproducing primary information added with said parity symbol from said recording medium;

(b) error correcting means for correcting the symbol error of the primary information reproduced by the said reproducing means using parity symbol reproduced by the said reproducing means and for producing a flag which indicates the production of uncorrectable symbol error in one unit of the block of specified information amount; and

(c) output means for outputting modification information corresponding to the said primary information having gone through said error correction means and said flag; and

(B) recording device, comprising:





(a) input means for inputting said primary information and said retouch information output by said reproducing device;

(b) error correction encoding means for forming the parity symbol for correction of primary information input by the said first input means and for adding said parity symbols to said primary information; and

(c) recording means for recording the primary information added with the said parity symbol and said modification information on the same recording medium.

15. A system according to claim 14, wherein said reproducing device contains the modifying means to modify said primary information having gone through said error correction means in said block unit using said flag and outputs said primary information having gone through the said modifying means.

16. A system according to claim 14, wherein said output means is provided with the multiplexing means to multiplex said primary information having gone through said correcting means and said modifying means and thus form multiplex information and output said multiplex information, said input means containing the separation means to input said multiplex information and separate said modification information from said multiplex information.





17. A system according to claim 16, wherein said primary information is composed of specified bits of the symbol group which does not become a specific symbol pattern and said output means makes, as said modification information, said primary information where uncorrectable symbol error had been produced in the past a specific symbol pattern according to said flag.

18. A system according to claim 14, wherein said recording device further includes the reproduction means to reproduce the primary information added with said parity symbol and said modification information from said recording medium,

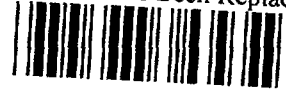
the second error correcting means for correcting the symbol error of the primary information reproduced by said reproducing means using the parity symbol reproduced by said reproducing means and for producing a second flag which indicates the production of uncorrectable symbol error in said block unit, and modifying means for modifying said primary information having gone through said error correction means in the aforesaid block units using said modification information and said second flag reproduced by the said reproduction means.

19. A system according to claim 18, wherein said modifying means contain the logic sum means which takes

This is the replacement sheet



Date: 15 OCT 1996



- 34 -

the logic sum of said modification information and said second flag and decides whether or not the modification should be done according to the output of said logic sum means.

20. Use in encoding or decoding apparatus of input means or error correcting means responsive to flag information that indicates for a primary information stream an uncorrectable symbol error in a region thereof.



This is the replacement sheet

Date: 15 OCT 1997

ABSTRACT

ENCODING DEVICE AND DECODING DEVICE SUITABLE
FOR DUBBING

For the cases where recording medium recorded at slave side apparatus is reproduced it has been made possible to do identical modification processing to that conducted at master side apparatus, by reproducing, at master side apparatus, the primary information added with parity symbol for error correction from the recording medium on which the primary information is recorded, correcting the symbol error of primary information reproduced at the reproducing means using the reproduced parity symbol, producing the flag which indicates the production of uncorrectable symbol error in one unit of the block of specified information amount and thus outputting the modification information corresponding to the primary information and the flag and forming, at slave side, the parity symbol for correction of error of primary information output at the master side apparatus and recording the primary information added with parity symbol and modification information on the same recording medium. It has also become possible to conduct satisfactory modification processing when the symbol error is produced.

FIGURE 1

This Sheet Has Been Replaced



Copy the replacement sheet

15 OCT 1996

FIG. 1

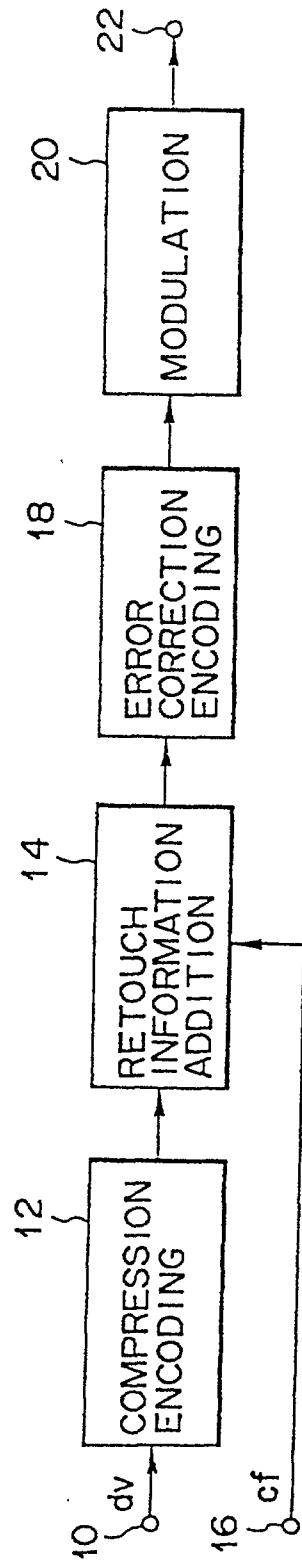
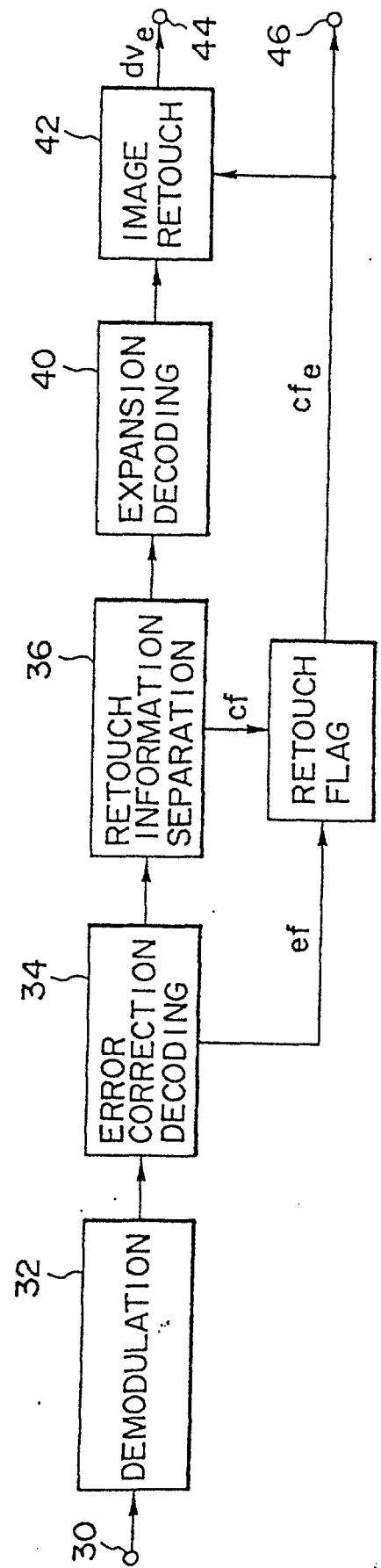


FIG. 2



This is the replacement sheet

Date: 15 OCT 1996

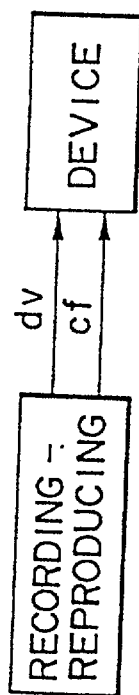


FIG. 3A

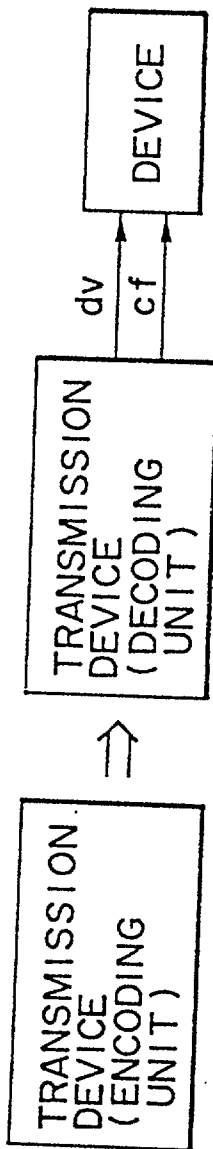


FIG. 3B

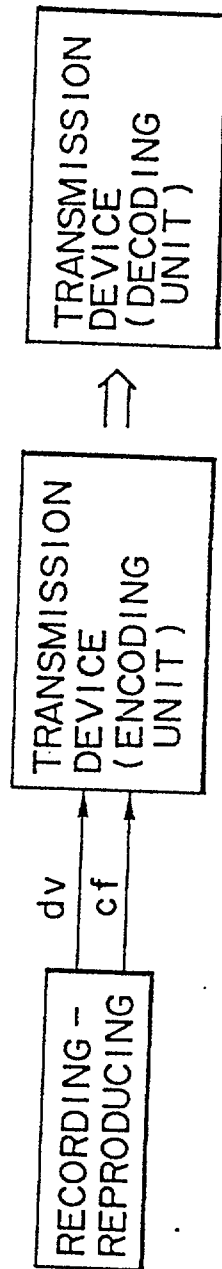


FIG. 3C

FIG. 4A

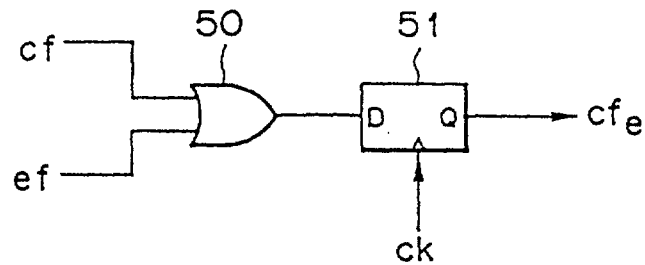
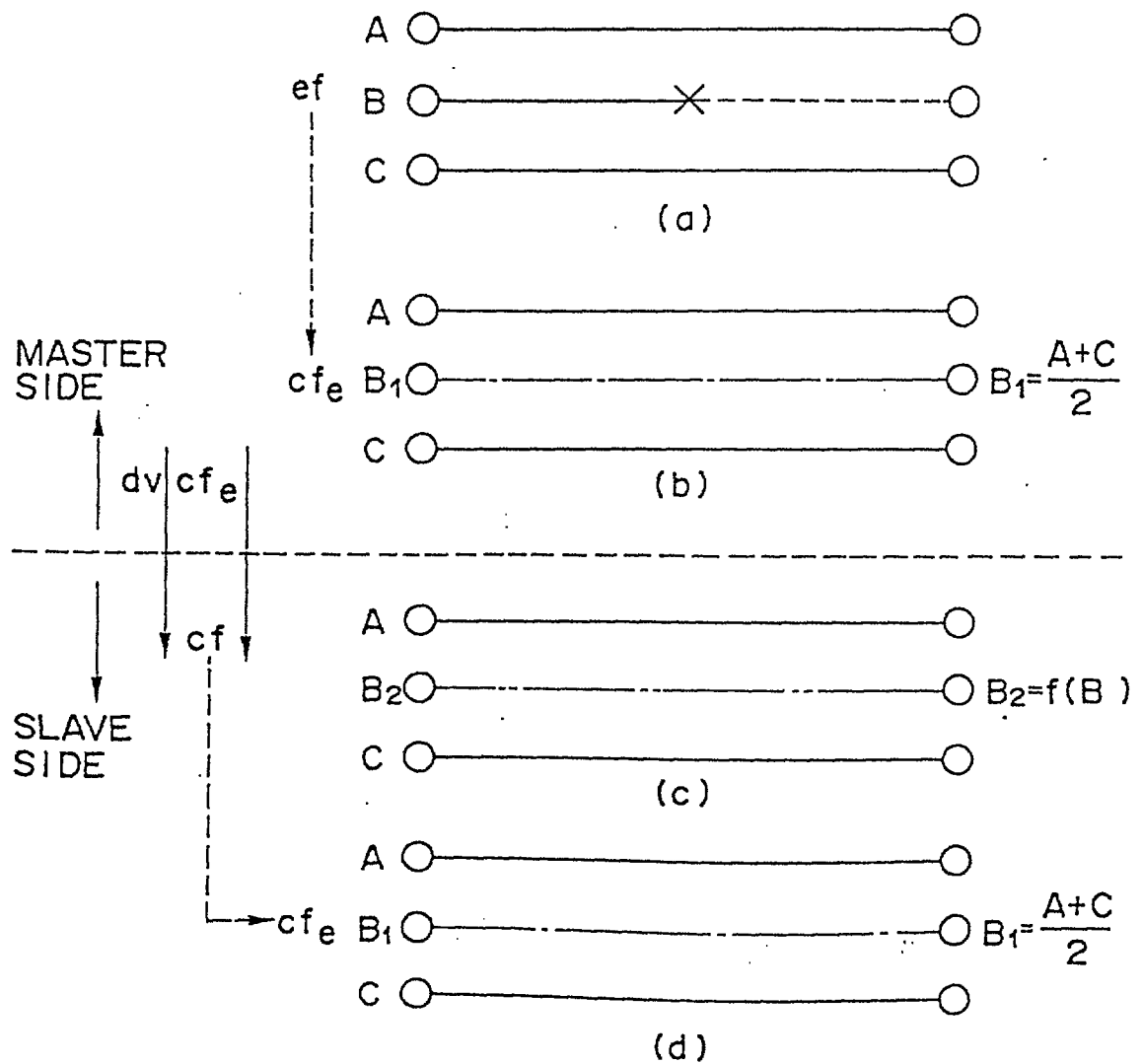


FIG. 4B



○ : RESET DATA

× : ERROR

THIS IS THE FIRST OF TWO PAGES

15 OCT 1996

FIG. 5A

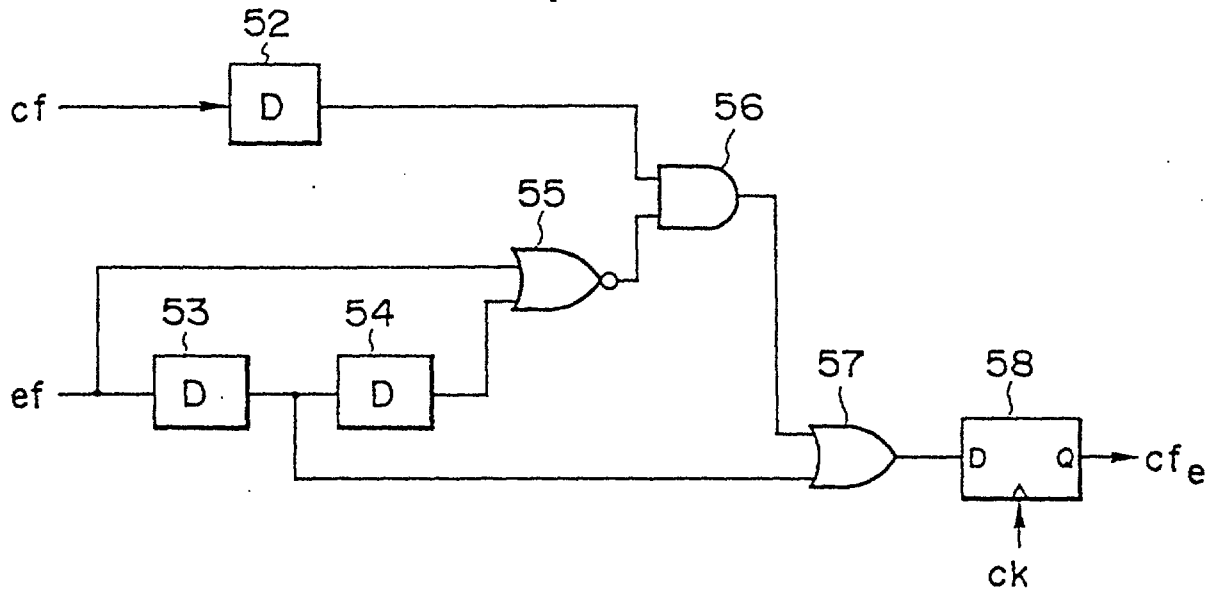
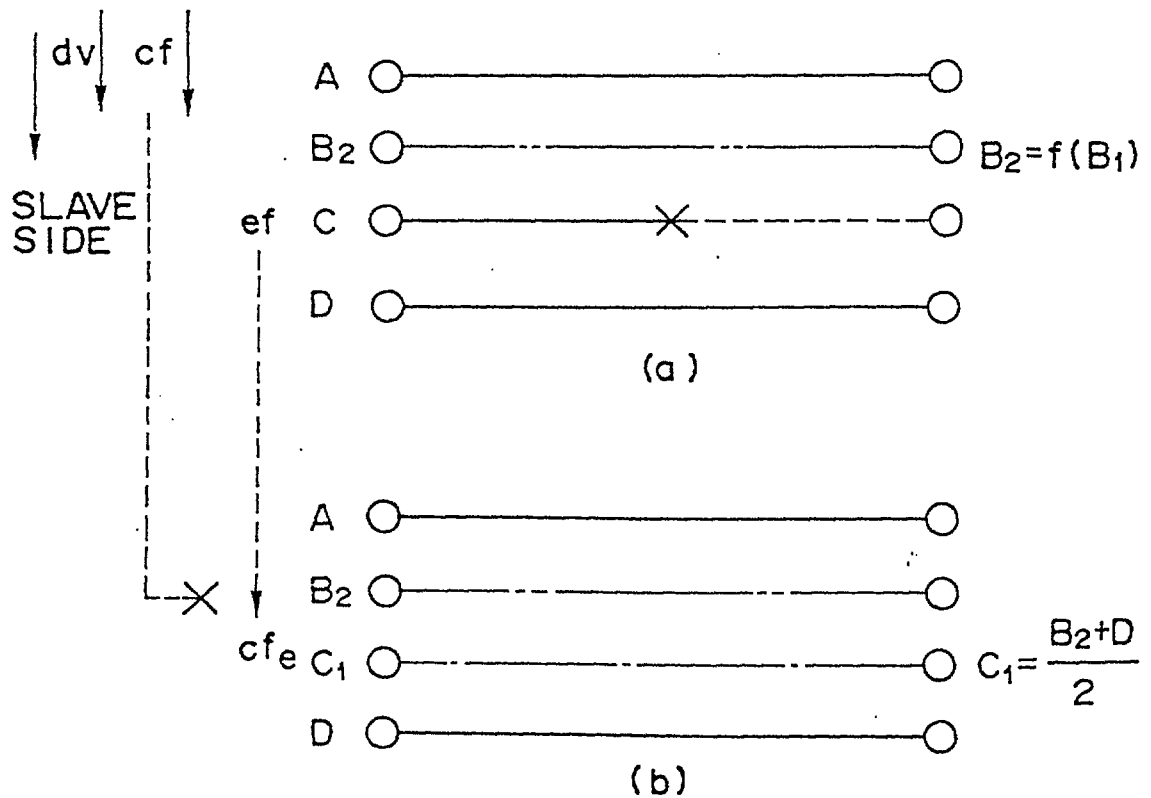


FIG. 5B



This is the replacement sheet

Date: 15 OCT 1996

FIG. 6

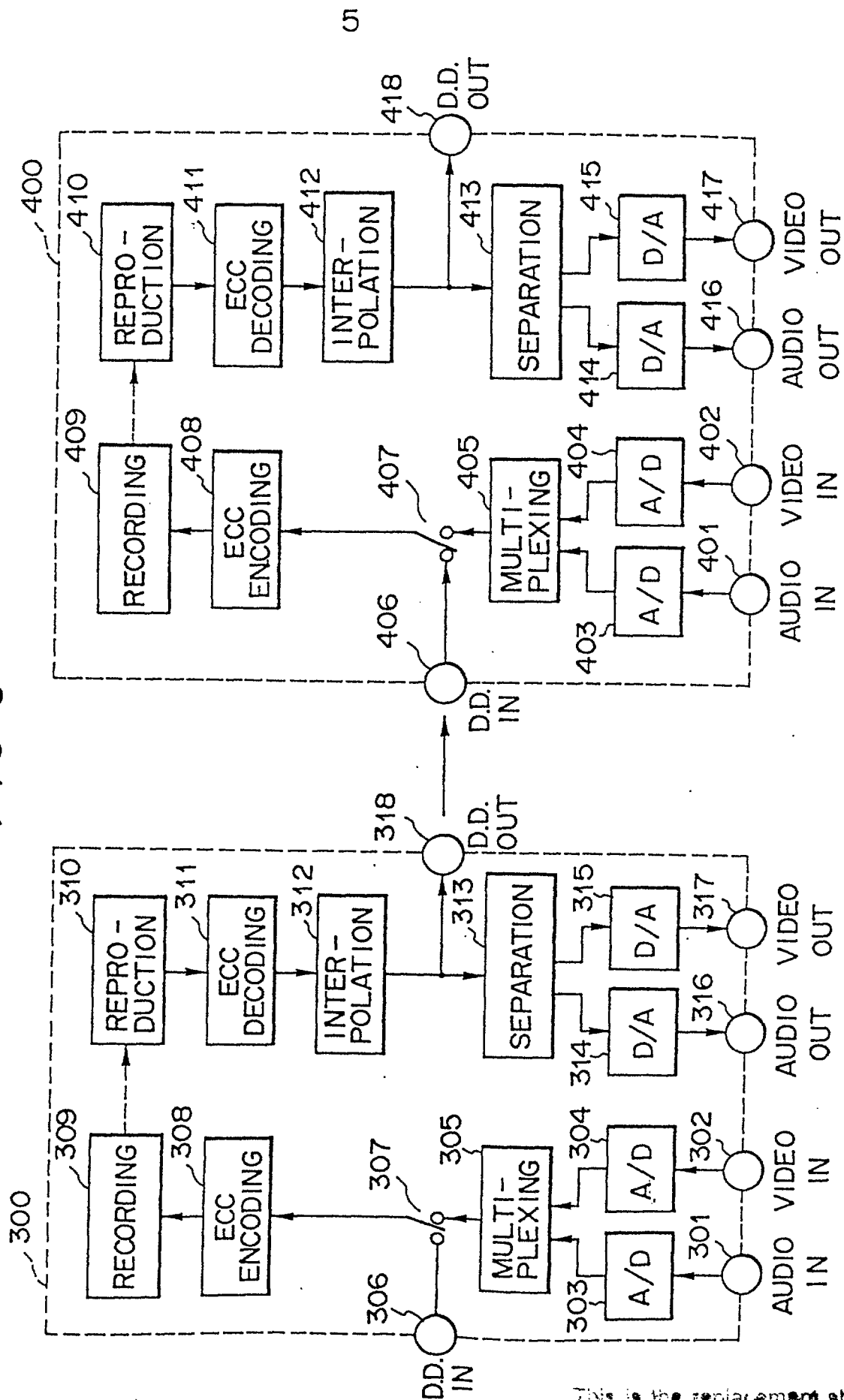


FIG. 7

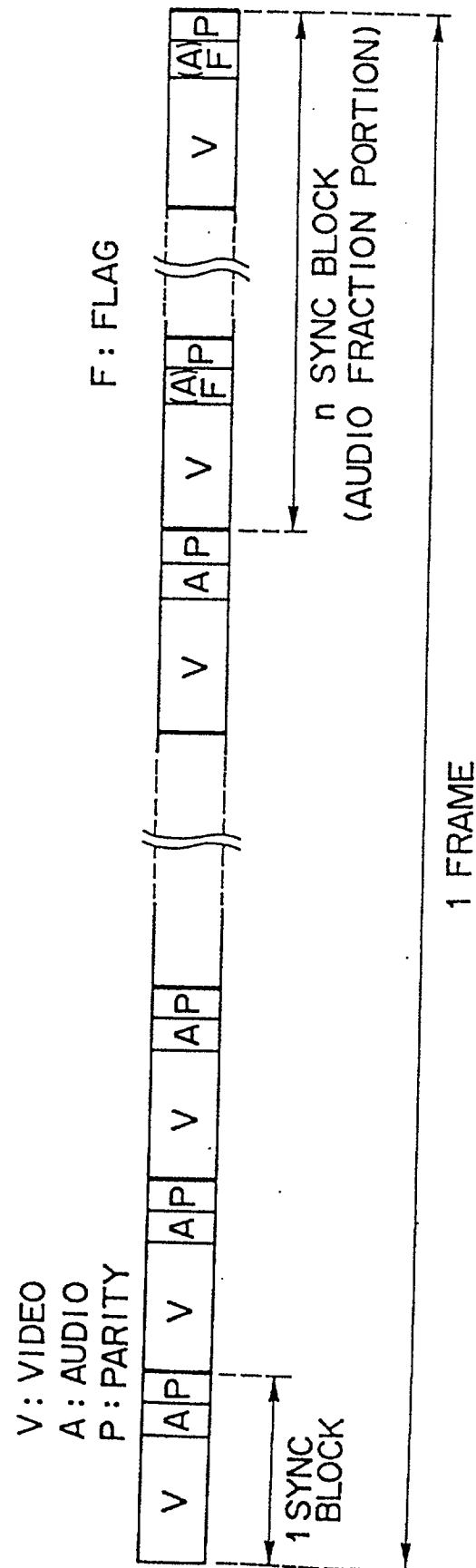
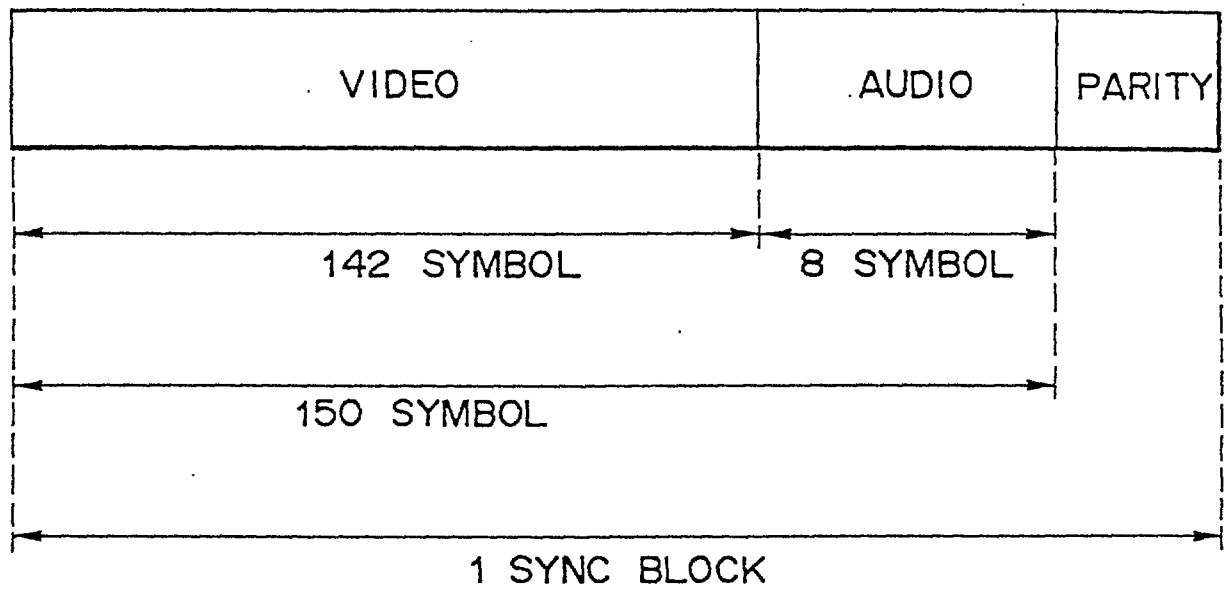


FIG. 8A



This is the replacement sheet

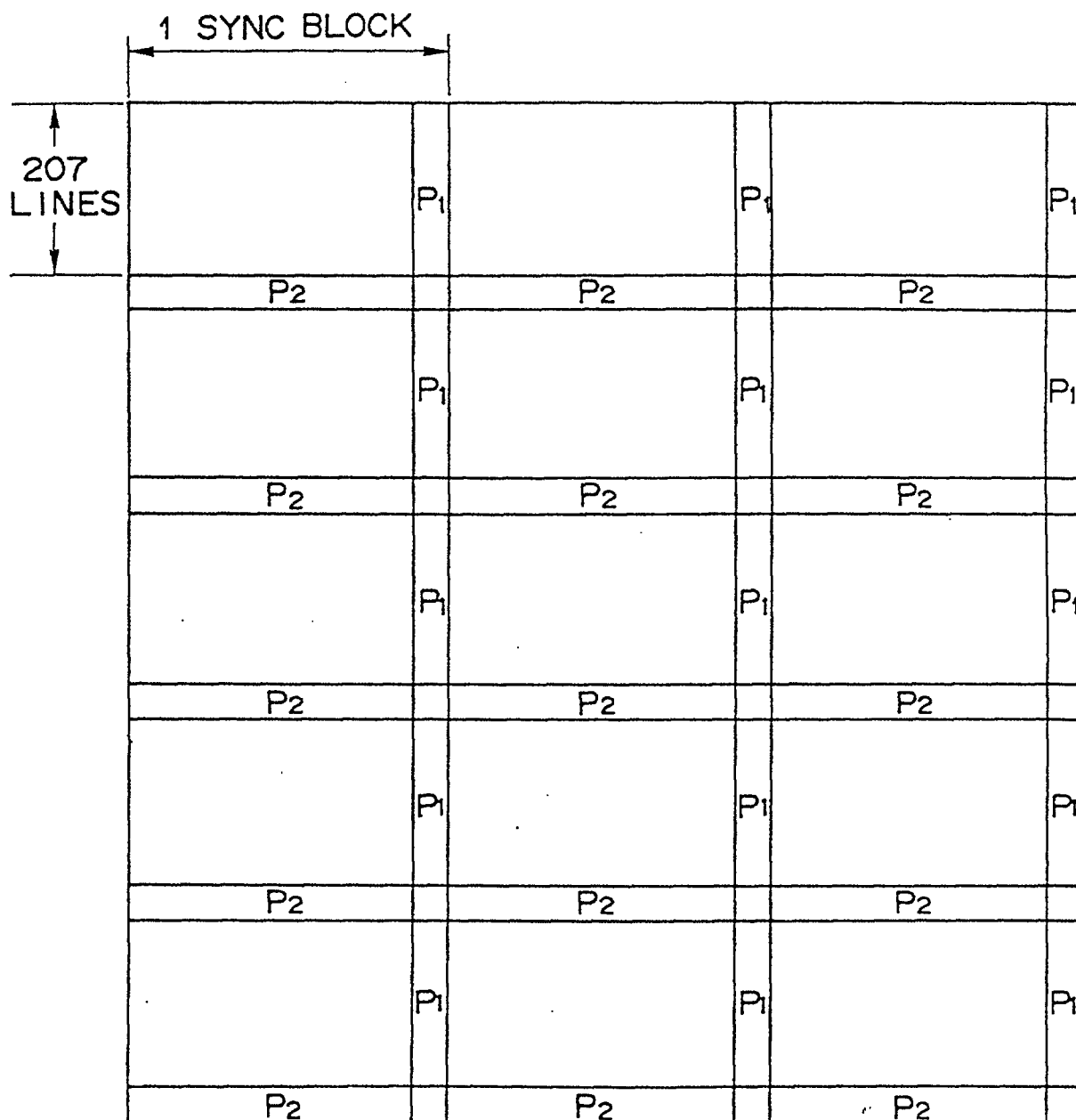
Date: 15 OCT 1996

1 SYNC BLOCK

```
V : VIDEO
A : AUDIO
P : PARITY
F : FLAG
```

[illegible]

FIG. 8C



P_1 : TRANSVERSAL DIRECTION PARITY
 P_2 : LONGITUDINAL DIRECTION PARITY

This is the replacement sheet

Date: 15 OCT 1996

FIG. 9.

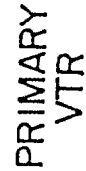


FIG. 9B

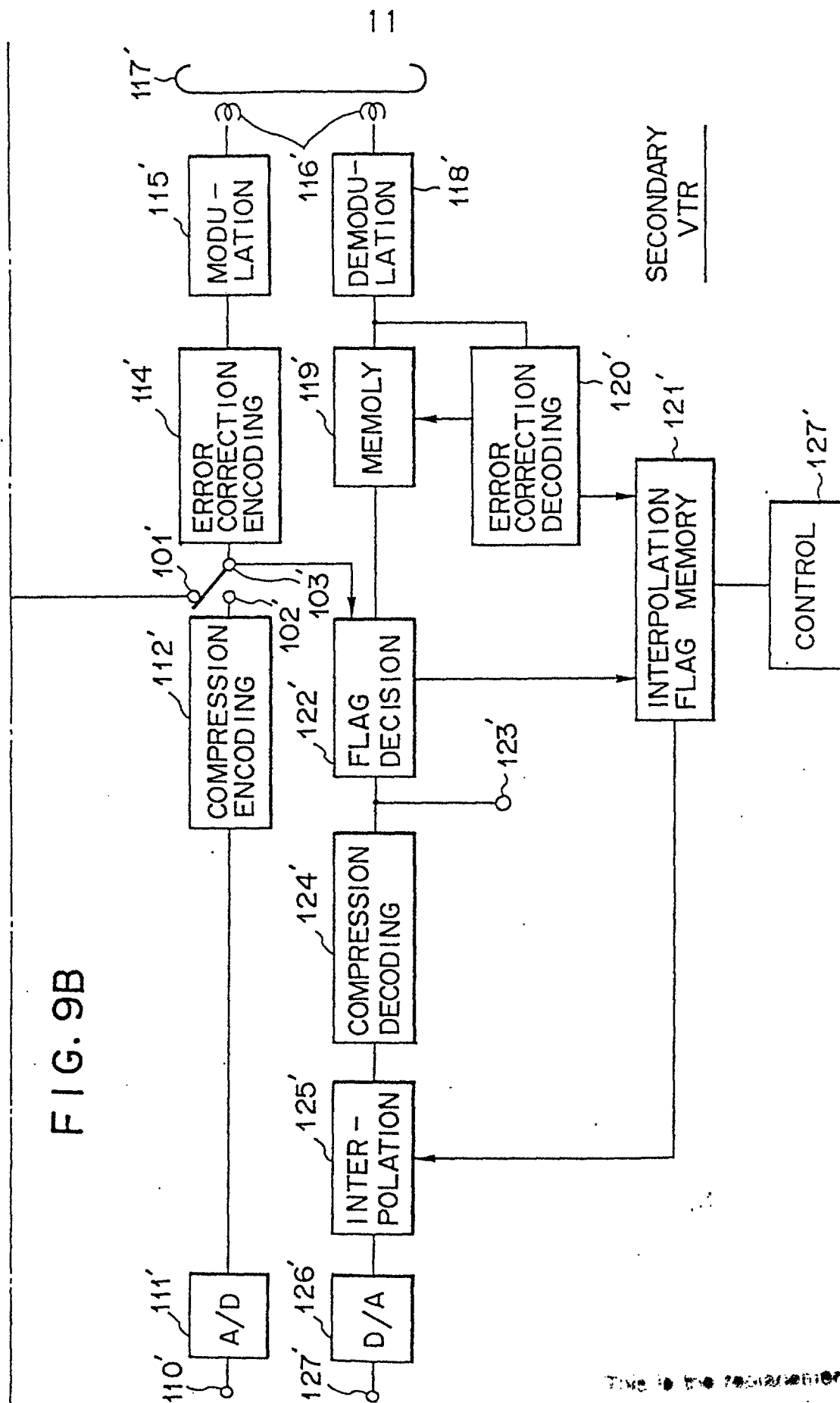
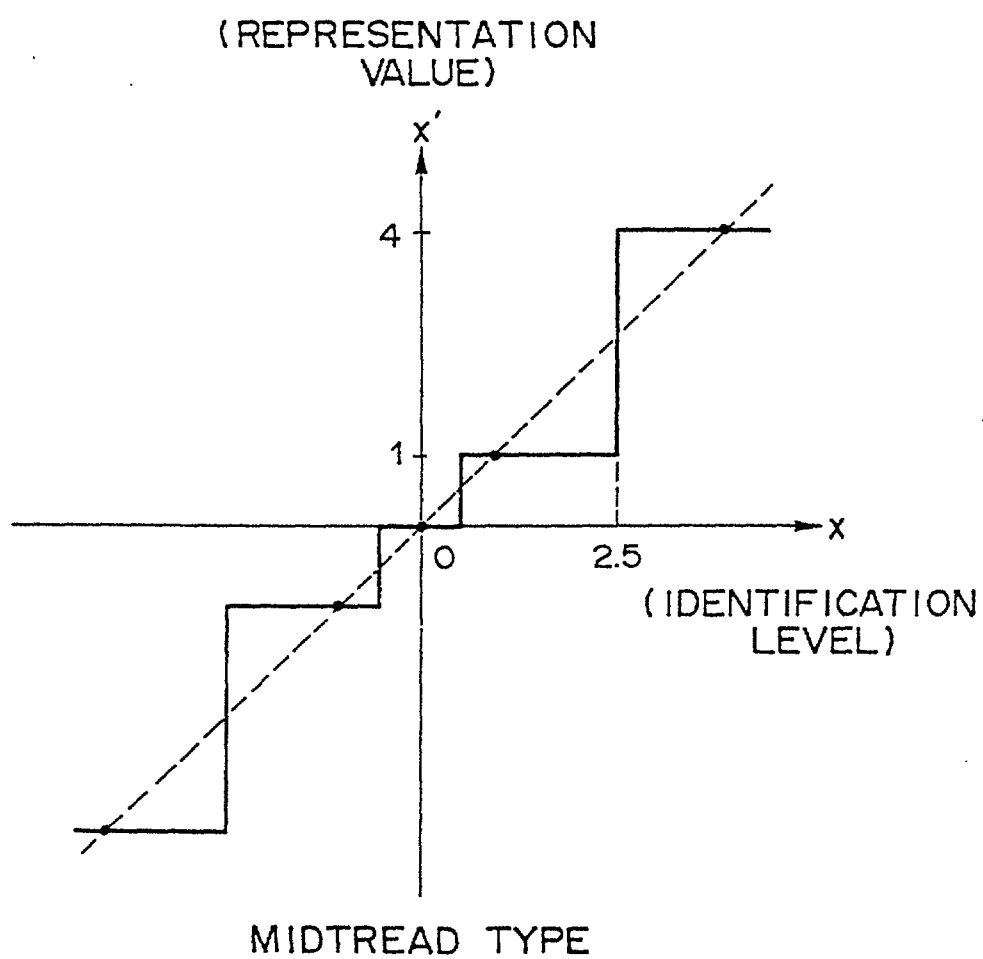


FIG. 9B is a block diagram of a video recording system.

FIG. 9B is a block diagram of a video recording system.

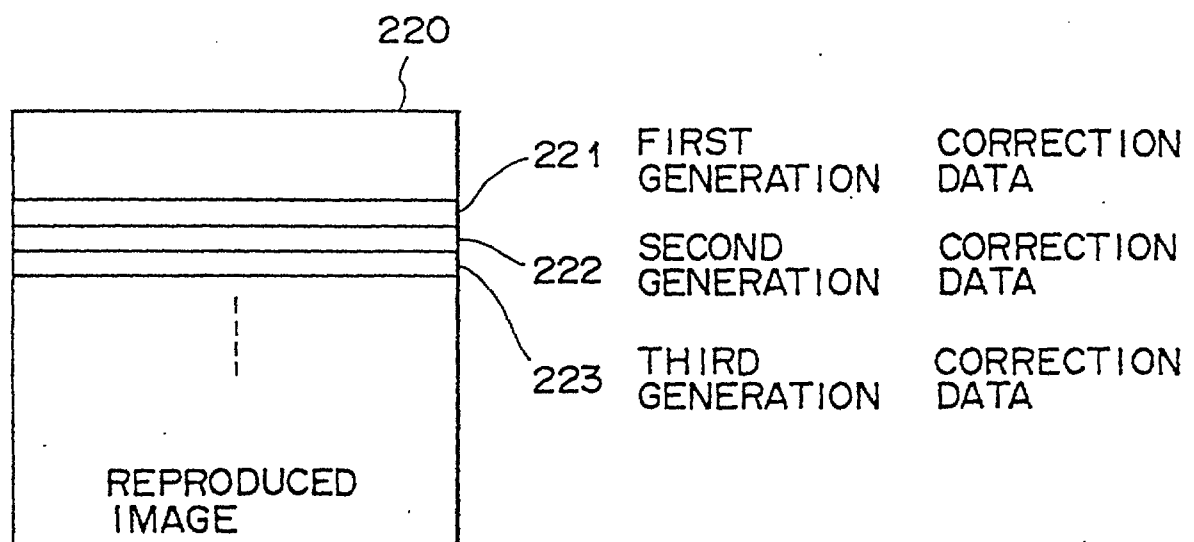
FIG. 10



This is the replacement sheet

Date: 15 OCT 1996

FIG. 11



This Sheet Has Been Replaced

-1-



Amendment of Claims

Replace claims now on file new claims 1 - 17 to read as follows:

1. A dubbing system comprising:
 - (a) a reproducing device comprising:
 - (i) reproducing means for reproducing primary digital data together with check symbols from a recording medium;
 - (ii) error correcting means for correcting errors in the reproduced primary digital data using the reproduced check symbols and for producing a flag to indicate occurrence of an uncorrectable error in a block of a predetermined number of symbols;
 - (iii) dubbing output means for outputting the reproduced error corrected primary digital data, as dubbing data;
 - (b) a recording device comprising:
 - (i) dubbing input means for receiving the dubbing data output by the dubbing output means of said reproducing device;
 - (ii) error correcting encoding means for generating new check symbols to assist correction of errors in subsequent reproduction of the received dubbing data; and
 - (iii) recording means for recording the dubbing data onto a recording medium, characterized in that: the dubbing data sent from the dubbing output means of said reproducing device to the dubbing input means of said recording device also comprises flag information produced by the error correction means of the reproducing device, and

1. CLAIMS

☒ Claim(s) on separate sheet(s) of paper

☒ Abstract(s) on separate sheet(s) of paper

☐ Drawing(s) on separate sheet(s) of paper

☐ Abstract on separate sheet(s) of paper

DATE OF MATTER: _____

2. DRAWINGS

☒ Drawing(s) on separate sheet(s) of paper

☐ Abstract on separate sheet(s) of paper

DATE OF MATTER: 11/6/97

This is the replacement sheet

16 JUN 1997

Date:



* C L M S *



-2-

the recording means of said recording device records said dubbing data, including said flag information in combination with new check symbols generated by the error encoding means of said recording device.

2. A dubbing system according to claim 1, wherein said reproducing device further includes concealing means for concealing by the block uncorrectable errors in said error corrected primary digital data and said dubbing output means outputs the error corrected and error concealed primary digital data.

3. A dubbing system according to claim 2 wherein the concealing means of the reproducing device is responsive both to said flag indicating an error uncorrectable by said error correcting means and to the flag information reproduced by said reproducing means, the flag information indicating where the recording being reproduced contains a previously uncorrected error.

4. A dubbing system according to claim 2 or 3 wherein, for normal reproduction, said reproduction device further comprises normal reproduction output means for outputting the error corrected and error concealed primary digital data.

5. A dubbing system according to any preceding claim, wherein said dubbing output means includes means for combining the error corrected primary digital data and the flag information before outputting the dubbing data primary information.

6. A dubbing system according to claim 5, wherein the



This is the replacement sheet

Date: 16 JUN 1997



primary digital data includes symbols each of a predetermined number of bits which never have a specified bit pattern and said flag information consists of an output of that specified bit pattern when an uncorrectable error has occurred.

7. A dubbing system according to any preceding claim, wherein said recording device comprises:

reproducing means for reproducing the information recorded on the recording medium;

error correction means for correcting an error in the information reproduced by said reproducing means and for producing a further flag indicative of a new occurrence of an uncorrectable error in a block of symbols; and

concealing means for concealing errors in the error corrected information in accordance with the flag information reproduced by said reproducing means and the further flag.

8. A dubbing system according to claim 7, wherein said concealing means includes logic sum means which provides logic sum of said flag information and said further flag and decides whether or not the concealment should be performed in accordance with the output of said logic sum means.

9. A dubbing system according to any of claims 1 to 8, the reproducing and recording device being a video tape player and recorder, respectively.

10. A reproducing device comprising:

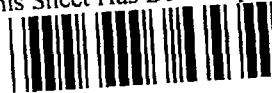
reproducing means for reproducing primary digital data together with check symbols from a recording medium;

error correcting means for correcting errors in

This is the replacement sheet



Date: 16 JUN 1997



-4-

the reproduced primary digital data using the reproduced check symbols and for producing a flag to indicate occurrence of an uncorrectable error in a block of a predetermined number of symbols; and

dubbing output means for outputting the reproduced error corrected primary digital data, as dubbing data;

wherein the dubbing data sent from the dubbing output means also comprises flag information produced by the error correction means.

11. A recording device comprising:

dubbing input means for receiving the dubbing data output by the dubbing output means of the reproducing device of said suitable dubbing apparatus;

error correcting encoding means for generating new check symbols to assist correction of errors in subsequent reproduction of the received dubbing data; and

recording means for recording the dubbing data onto a recording medium;

wherein the recording means records said dubbing data, including said flag information in combination with new check symbols generated by the error correcting encoding means.

12. An encoding device comprising:

input means for receiving primary data and flag information, said flag information being to indicate whether said primary data contains an uncorrectable error,

error correction encoding means for encoding the primary data and the flag information and adding check symbols, and

modulating means for generating signals to convey the error corrected primary data, the check symbols and the



* C L M S *

This is the replacement sheet

Date 16 JUN 1977



flag information via a transmission path.

13. An encoding device according to claim 12 wherein said flag information indicates concealed uncorrectable errors in the received primary information.

14. A decoding device comprising:
input means for receiving via a transmission path signals conveying primary digital data and check symbols,
error correcting means for correcting errors in said primary data using the received check symbols and for providing an error flag if correction was not possible,
separating means for extracting from the received signals, flag information indicating previously uncorrected errors present in said primary data, and
concealment means for concealing uncorrectable errors dependent upon the error flag (ef) and the flag information extracted from the received signals.

15. A decoding device according to claim 14, wherein said flag information indicates previously concealed uncorrected errors in the primary data, and wherein said concealment means operates to re-conceal said previously concealed errors in response to the flag information subject to the error flag indicating that said re-concealment is possible.

16. A dubbing method comprising the steps:
reproducing primary digital data together with check symbols from a first recording medium;
correcting errors in the reproduced primary digital data using the reproduced check symbols and
producing a flag to indicate occurrence of an uncorrectable

This is the replacement sheet



Date: 16 JUN 1977

error in a block of a predetermined number of symbols;

generating new check symbols to assist correction of errors; and

recording the error corrected primary digital data and the new check symbols onto a second recording medium,

characterized in that said flag information is recorded in combination with the primary data and the new check symbols.

17. A method according to claim 16, wherein said method further includes concealing by the block uncorrectable errors in said reproduced and error corrected primary digital data, and wherein the error corrected and error concealed primary digital data is recorded with said new check symbols and flag information.

This Sheet Has Been Replaced



* C L M S *

This is the replacement sheet

Date: 16 JUN 1997

REPLACEMENT SHEET

CLAIMS

1. A dubbing system comprising:
- (a) a reproducing device comprising:
- (i) reproducing means for reproducing primary digital data together with check symbols from a recording medium;
- (ii) error correcting means for correcting errors in the reproduced primary digital data using the reproduced check symbols and for producing a flag to indicate occurrence of an uncorrectable error in a block of a predetermined number of symbols;
- (iii) dubbing output means for outputting the reproduced error corrected primary digital data, as dubbing data;
- (b) a recording device comprising:
- (i) dubbing input means for receiving the dubbing data output by the dubbing output means of said reproducing device;
- (ii) error correcting encoding means for generating new check symbols to assist correction of errors in subsequent reproduction of the received dubbing data; and
- (iii) recording means for recording the dubbing data onto a recording medium, characterized in that: the dubbing data sent from the dubbing output means of said reproducing device to the dubbing input means of said recording device also comprises flag information produced by the error correction means of the reproducing device, and

✓ Aluminum 10/24 26 to 10/24 31
 ✓ Aluminum 10/24 22 to 10/24 -

12/15/99



This is the replacement sheet

Date: 14 MAY 1999

the recording means of said recording device records said dubbing data, including said flag information in combination with new check symbols generated by the error encoding means of said recording device.

2. A dubbing system according to claim 1, wherein said reproducing device further includes concealing means for concealing by the block uncorrectable errors in said error corrected primary digital data and said dubbing output means outputs the error corrected and error concealed primary digital data.

3. A dubbing system according to claim 2 wherein the concealing means of the reproducing device is responsive both to said flag indicating an error uncorrectable by said error correcting means and to the flag information reproduced by said reproducing means, the flag information indicating where the recording being reproduced contains a previously uncorrected error.

4. A dubbing system according to claim 2 or 3 wherein, for normal reproduction, said reproduction device further comprises normal reproduction output means for outputting the error corrected and error concealed primary digital data.

5. A dubbing system according to any preceding claim, wherein said dubbing output means includes means for combining the error corrected primary digital data and the flag information before outputting the dubbing data primary information.

6. A dubbing system according to claim 5, wherein the



This is the replacement sheet

Date: 14 MAY 1999

primary digital data includes symbols each of a predetermined number of bits which never have a specified bit pattern and said flag information consists of an output of that specified bit pattern when an uncorrectable error has occurred.

7. A dubbing system according to any preceding claim, wherein said recording device comprises:

reproducing means for reproducing the information recorded on the recording medium;

error correction means for correcting an error in the information reproduced by said reproducing means and for producing a further flag indicative of a new occurrence of an uncorrectable error in a block of symbols; and

concealing means for concealing errors in the error corrected information in accordance with the flag information reproduced by said reproducing means and the further flag.

8. A dubbing system according to claim 7, wherein said concealing means includes logic sum means which provides logic sum of said flag information and said further flag and decides whether or not the concealment should be performed in accordance with the output of said logic sum means.

9. A dubbing system according to any of claims 1 to 8, the reproducing and recording device being a video tape player and recorder, respectively.

10. A reproducing device comprising:

reproducing means for reproducing primary digital data together with check symbols from a recording medium;

error correcting means for correcting errors in



This is the replacement sheet

Pat. No. 2,800,000

the reproduced primary digital data using the reproduced check symbols and for producing a flag to indicate occurrence of an uncorrectable error in a block of a predetermined number of symbols; and

dubbing output means for outputting the reproduced error corrected primary digital data, as dubbing data;

wherein the dubbing data sent from the dubbing output means also comprises flag information produced by the error correction means.

11. A recording device comprising:

dubbing input means for receiving the dubbing data output by the dubbing output means of the reproducing device of said suitable dubbing apparatus;

error correcting encoding means for generating new check symbols to assist correction of errors in subsequent reproduction of the received dubbing data; and

recording means for recording the dubbing data onto a recording medium;

wherein the recording means records said dubbing data, including said flag information in combination with new check symbols generated by the error correcting encoding means.

12. An encoding device comprising:

input means for receiving primary data and flag information, said flag information being to indicate whether said primary data contains an uncorrectable error,

error correction encoding means for encoding the primary data and the flag information and adding check symbols, and

modulating means for generating signals to convey the error corrected primary data, the check symbols and the

This is the replacement sheet



Date: 14 MAY 1999

flag information via a transmission path.

13. An encoding device according to claim 12 wherein said flag information indicates concealed uncorrectable errors in the received primary information.

14. A decoding device comprising:

input means for receiving via a transmission path signals conveying primary digital data and check symbols,

error correcting means for correcting errors in said primary data using the received check symbols and for providing an error flag if correction was not possible,

separating means for extracting from the received signals, flag information indicating previously uncorrected errors present in said primary data, and

concealment means for concealing uncorrectable errors dependent upon the error flag (ef) and the flag information extracted from the received signals.

15. A decoding device according to claim 14, wherein said flag information indicates previously concealed uncorrected errors in the primary data, and wherein said concealment means operates to re-conceal said previously concealed errors in response to the flag information subject to the error flag indicating that said re-concealment is possible.

16. A dubbing method comprising the steps:

reproducing primary digital data together with check symbols from a first recording medium;

correcting errors in the reproduced primary digital data using the reproduced check symbols and producing a flag to indicate occurrence of an uncorrectable



This is the replacement sheet

Date 14 MAY 1999

error in a block of a predetermined number of symbols;

generating new check symbols to assist correction of errors; and

recording the error corrected primary digital data and the new check symbols onto a second recording medium,

characterized in that said flag information is recorded in combination with the primary data and the new check symbols.

17. A method according to claim 16, wherein said method further includes concealing by the block uncorrectable errors in said reproduced and error corrected primary digital data, and wherein the error corrected and error concealed primary digital data is recorded with said new check symbols and flag information.

This is the replacement sheet



Date: 14 MAY 1999

ABSTRACT

ENCODING DEVICE AND DECODING DEVICE SUITABLE
FOR DUBBING

For the cases where recording medium recorded at slave side apparatus is reproduced it has been made possible to do identical modification processing to that conducted at master side apparatus, by reproducing, at master side apparatus, the primary information added with parity symbol for error correction from the recording medium on which the primary information is recorded, correcting the symbol error of primary information reproduced at the reproducing means using the reproduced parity symbol, producing the flag which indicates the production of uncorrectable symbol error in one unit of the block of specified information amount and thus outputting the modification information corresponding to the primary information and the flag and forming, at slave side, the parity symbol for correction of error of primary information output at the master side apparatus and recording the primary information added with parity symbol and modification information on the same recording medium. It has also become possible to conduct satisfactory modification processing when the symbol error is produced.

FIGURE 1

This is the replacement sheet

Date: 14 MAY 1966