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(54) Video transmission

(57) A method of transmitting data especially video data in a secure manner comprises splitting each line of a video field into various frequency limited components, time compressing the lower frequency components and transmitting the components, in known order in a certain time period, together with sync information. Noise may be added and colour information may be accommodated. It is important to note that no increase in bandwidth arises and a reduction of bandwidth is quite possible.

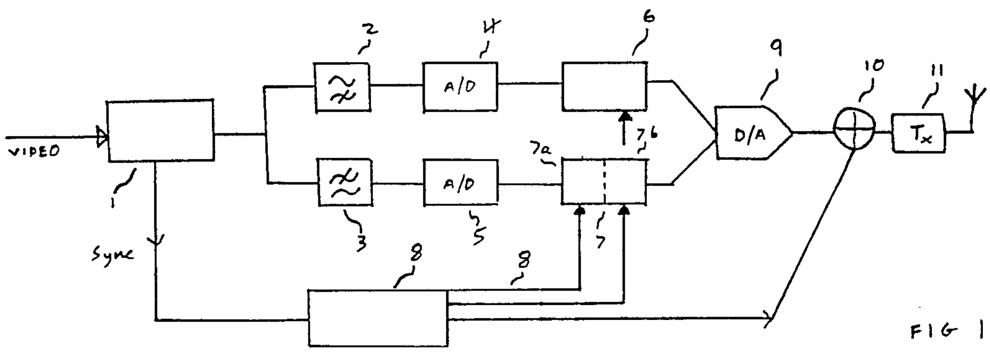

FIG 1

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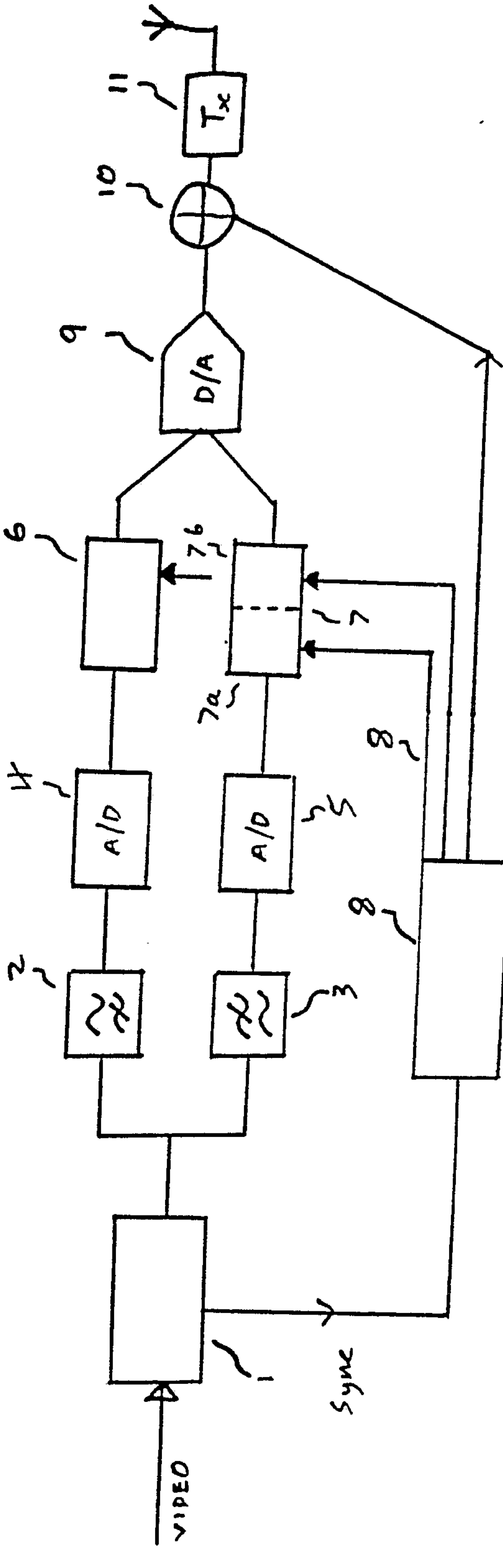

FIG 1

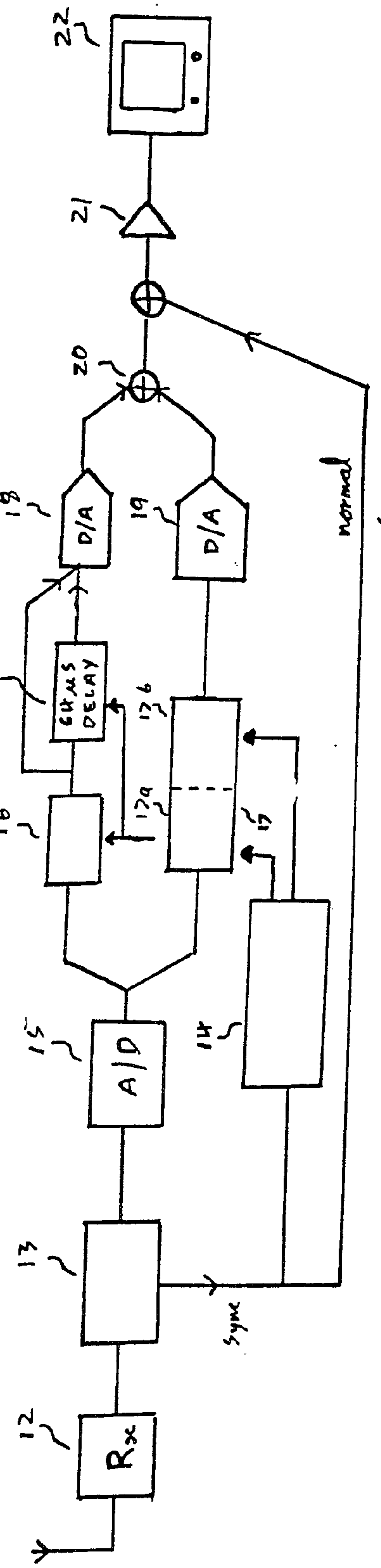

FIG 3

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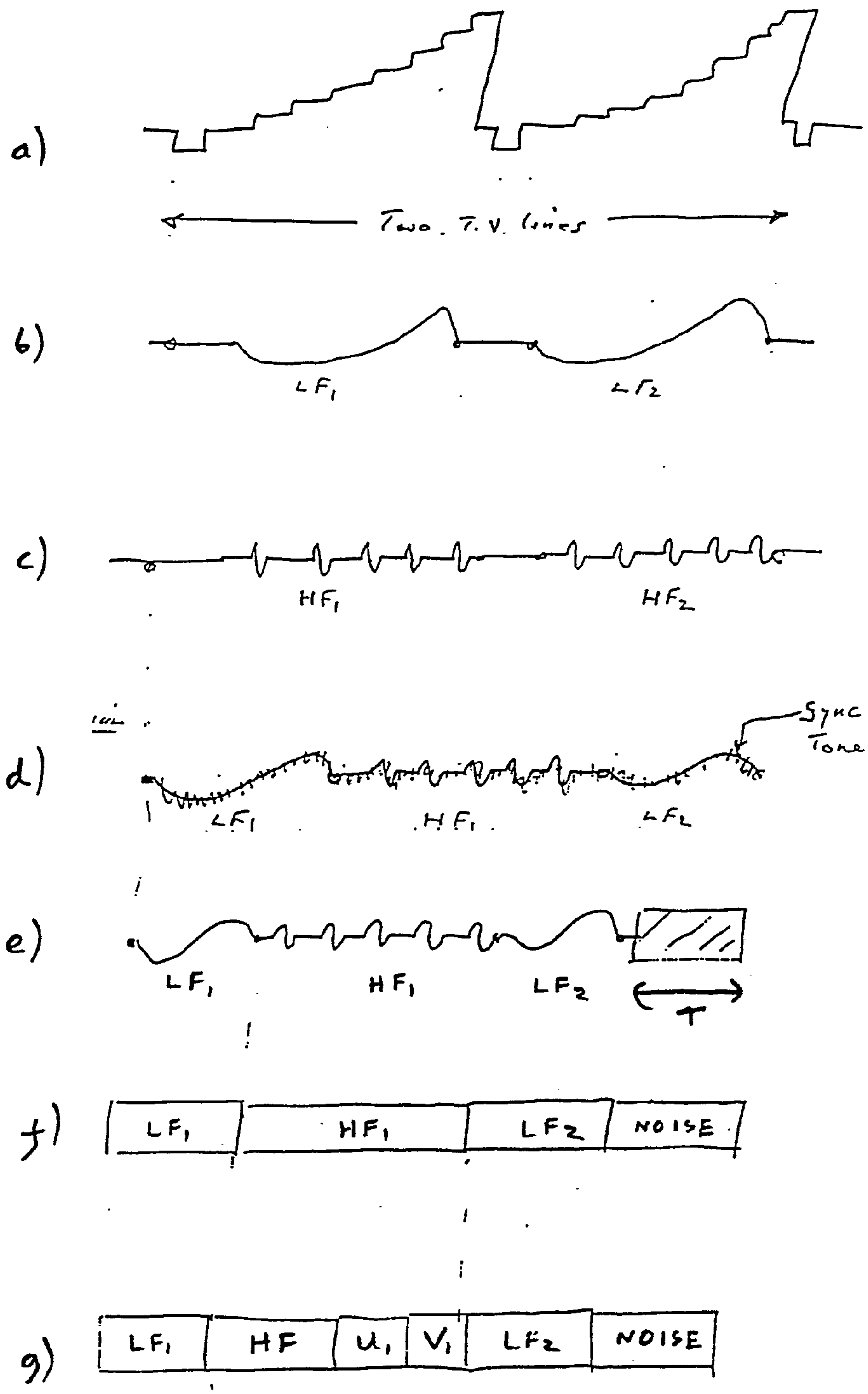

FIG 2

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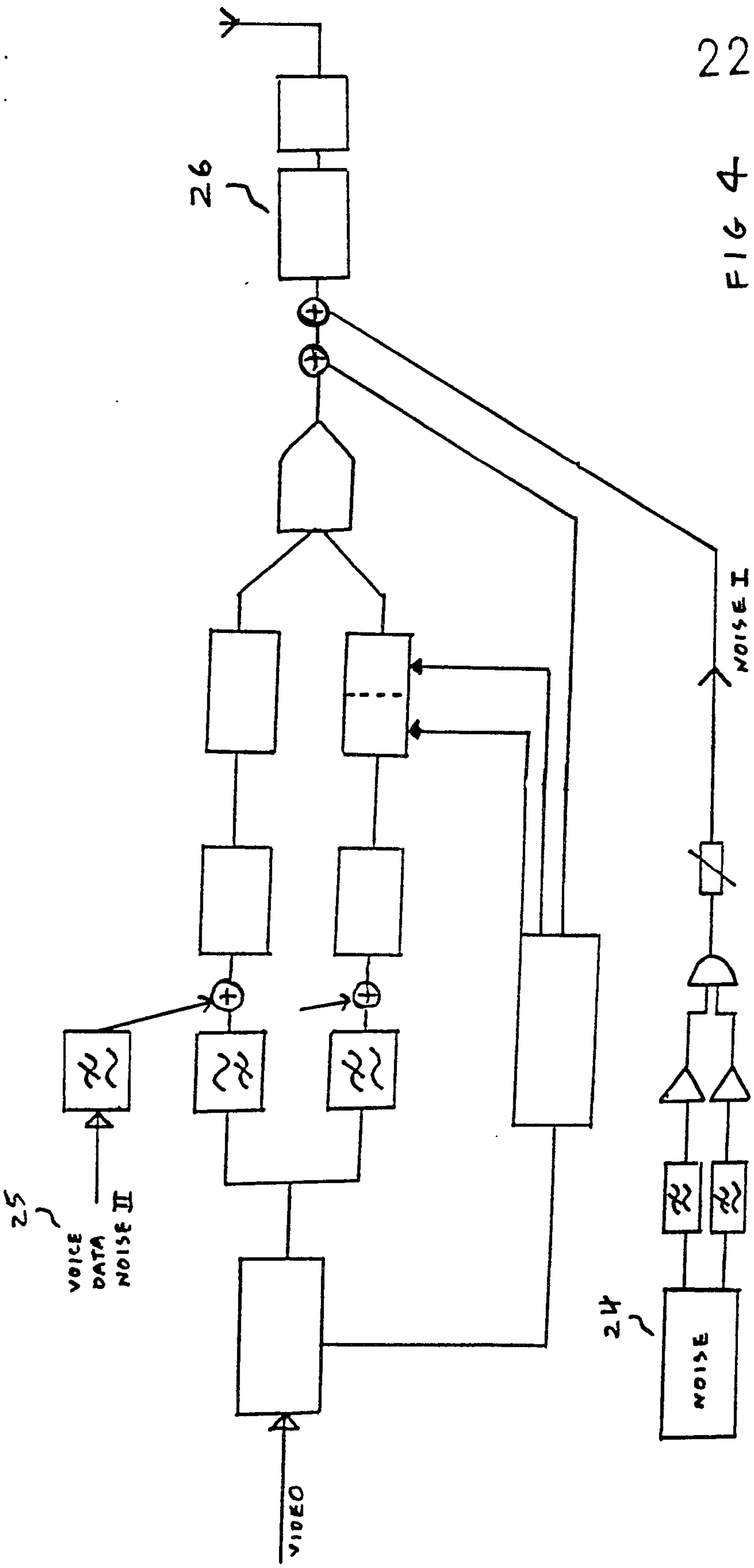

FIG 4

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Video Transmission

This invention relates to video transmission and in particular it relates to the secure transmission of video data to protect viewing of the data from unauthorised users.

It is often required to transmit video data such as television signals in a secure manner such that the data can only be used by an authorised person who possesses the apparatus or the know-how to process the received signals in a manner that when displayed they are understandable. Many methods of scrambling data are available but most of these can be relatively easily unscrambled and tend to impart some degree of useful information, even in their scrambled form, from which the scrambling algorithms can be determined.

According to the present invention there is provided a method for transmitting information, comprising; splitting blocks of the information into a plurality of frequency band components, time compressing at least one of the components and transmitting the components in chosen order within a chosen time period.

The method may accordingly be used with, for example, FM or AM radio data, but most preferably, the data is video data, in which case in a preferred embodiment each line of a video field is split into a low frequency part and a high frequency part; the low frequency part is time compressed and the low frequency part, the high frequency part and the low frequency part from a subsequent video line of that field are transmitted in chosen order within the chosen time period.

The method of the invention need not be restricted to only two frequency components and, by using bandpass filters for example, several components can be derived and transmitted.

Preferably, the chosen time period is the time available for the transmission of two lines of video data.

If a tone containing sync information is also added to the transmitted signal then all the information contained in the original video signal is transmitted, albeit in an unrecognisable and meaningless form to the unauthorised viewer, as will be shown further below.

In preferred embodiments, the low frequency part contains signal components in the frequency range DC to 1 MHz and the high frequency part contains components in the range 1 MHz to 5 MHz, although these ranges could vary depending upon requirements and the type of video to be transmitted.

Advantageously, to further improve security, the order of transmission of the high and low frequency parts is pseudo-randomly varied with each line.

A noise signal or other data may be added to the transmitted signal by further compression of the low frequency data.

For the transmission of colour video data, chrominance information may be added by compressing the HF part of the data to make space available for the U and V colour different signals, where U and V are well-known terms providing information from which the colour components of the data can be ascertained.

The invention further provides video processing apparatus comprising; means for splitting each line of video data into respectively a low frequency part and a high frequency part and for storing said parts; means for storing the low frequency part of a subsequent line of that field; means for time compressing at least the low frequency parts, and means for transmitting, within a chosen time period and in any desired order, the high frequency part and both low frequency parts.

Preferably, the apparatus includes means for transmitting other data, or noise, at appropriate times within the chosen time period. The data may be added in antiphase before compression and in this case the apparatus may require an equalisation network.

Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings in which;

Figure 1 shows a video encoder according to the present invention;

Figure 2 shows how an encoded signal is built up by the apparatus of Figure 1;

Figure 3 shows a video decoder; and

Figure 4 shows a further embodiment of a video encoder.

Referring to Figure 1 there is shown a video encoder including an input for a standard video signal to an amplifying and processing unit 1. The unit 1 extracts sync from the signal and also splits the signal into two components which are fed respectively to high pass filter 2 and low pass filter 3. The high pass filter is arranged to pass signals of between 1MHz to 5MHz and the low pass filter passes signals between DC and 1MHz. The signals are fed through respective A-D converters 4 and 5 and held in line stores 6 and 7. Line store 6 is used to store one line of high frequency video data and store 7 is split into two individual line stores 7a and 7b such that 7a stores one line of low frequency data and 7b stores the following received line. The sync signal generated by unit 1 is fed to a clock and tone sync generator 8 which is used to generate read and write clock signals for the store and also to generate a sync tone. The outputs from stores 6 and 7 are fed, at appropriate times as will be described below, to a D/A converter 9 and from there to a mixer 10 where the sync tone from unit 8 is added. The resulting encoded signal is then fed to a transmitter 11 and transmitted in the normal way.

An example of a typical video signal is shown in Figure 2a which shows two television lines of a simple staircase waveform. Figure 2b shows the low frequency component which is passed by filter 3. Figure 2c shows the signal filtered out by the high pass filter 2 and it is seen that this signal is representative of the modulated high frequency signal. The high frequency information from the first received video field, HF_1, is stored in line store 6. Line store 7 stores the low frequency information from this first received field LF_1 and waits until a second video field is received, when it stores a second set of low frequency data, LF_2 in second line store 7b. The sync which has been extracted by processing unit 1 is used by timing unit 8 to control the timing of this storage process, using conventional techniques.

The apparatus is arranged such that an output is provided as shown in Figure 2d, wherein signals LF_1 and LF_2 are compressed and transmitted sequentially, sandwiching between them signal HF_1 which remains uncompressed. Due to the straight-forward nature of the low frequency information it is easy to compress this data without loss of information. Compression of the LF component may be achieved by reading from store 7 at twice (or another multiple) the rate at which it was written to. Figure 2d also shows a low amplitude sync tone which is added to the transmitted signal. It is immediately seen that the transmitted signal comprising LF_1, HF_1 and LF_2, with LF_1 and LF_2 compressed, bears little resemblance to the actual video waveform shown in Figure 2a. Thus any eavesdropper or unauthorised viewer will find the data meaningless unless he possesses the correct decoding apparatus. All the information carried in the video waveform of Figure 2a is included in the transmitted signal and the loss of the higher frequency data HF_2 from the second TV line is not crucial because there is little signal loss between lines of HF.

Figure 3 shows a decoder for decoding signals such as that of Figure 2d. The transmitted signal is received by receiver 12 and processed by a unit 13 which extracts the sync tone and applies this to a clock generator 14. After A-D conversion 15 the signal is stored in respective line stores 16, 17a and 17b. The timing of this storage is determined by clock generator 14 and is arranged such that the higher frequency information, HF_1 is stored in line store 16 and the low fequency information from 2 consecutively received lines is stored in line stores 17a and 17b respectively. The timing of this is easy to achieve since the HF and LF data is transmitted sequentially, as shown in Figure 2d and thus the authorised user, by knowing the exact nature of this transmission and the extracted sync signals will know which part of the received data to store in which line store. At appropriate times the HF and LF data is fed through D-A converters 18 and 19, mixed at 20 and subsequently amplified 21 and displayed 22 if necessary.

A 64 microsecond delay 23 is provided in the HF line since the signal HF 2, representative of the high frequency component of the second received TV line is not of course transmitted. Thus when the second line is required to be displayed the signal HF_1 is fed through the delay 23 and applied to replace signal HF_2.

Since the low frequency data is, as described above, a relatively simple waveform it is possible to compress this even further and Figure 2e shows the situation where the low frequency information LF_1 and LF_2 is compressed four times (in Figure 2d it is compressed two times) and thus, in the time slot normally taken up by two TV lines the two compressed low frequency signals and the high frequency signal may be transmitted, leaving a gap T which may be used for any other information. Conveniently this gap may be filled with noise which serves to make the data transmission even more secure. This noise may be full bandwidth, i.e. DC to 5MHz and is preferably added in a digital form as is shown in Figure 4 in which a noise generator 24 is used to provide, by means of high pass filters and an OR (or exclusive OR) gate a digital noise signal (noise I) which is added to the data at an appropriate time T during transmission.

Furthermore, since the HF component contains no low frequency information it is possible to insert band limited signals into the HF period of the transmitted signal such that they may be extracted upon reception.

Figure 4 shows schematically the insertion of such signals 25 into the HF component of the signal. The signals may comprise voice or other data and further noise (noise II) may be added in this component to further improve security, although the most effective noise contribution for improving security is Noise I from source 24. Figure 4 also shows the addition of pre-emphasis 26 to the signal before transmission which helps with signal recovery as well as reducing low frequency pictorial information to unauthorised viewers. It will be appreciated that a corresponding de-emphasis unit will need to be used in the receiver.

The system is equally usable with colour television or video signals and the chrominance information necessary for such signals may be added as shown schematically in Figure 2g. In this arrangement the HF information will require to be compressed in order to make space available for the U and V colour difference signals. HF compression may be achieved in a colour TV system since the HF information of a colour signal is less than that for a monochrome one. Similarly to the HF information, at the receiver the U and V information will require to be interpolated for the second received video field. Methods of extracting chrominance information from video signals are well known to those skilled in the art.

In order to increase security yet further the components of the signal can be pseudo-randomly varied merely by altering the timing of storage and recovery of the component information.

Yet further information may be added to the signal, such as additional voice data, further noise or other data by injecting at the LF_1 and HF_1 signals before compression in antiphase. If the signals are added on even TV lines say, then there must be a 64 microsecond delayed version of that information added on the odd lines.

Preferably, the filters used to provide the LF and HF information at the sending unit have a slow amplitude-frequency response. A value of about 6dB per octave is appropriate. Similarly the receivers at the receiving end should also have slow response characteristics.

If single pole filters are used at both the sender and receiver then some form of equalisation is required in order to retain phase fidelity. If filters are required only at one end of a system then equalisation is not required. Three pole filters may be used but this increases the complexity of equalisation.

The technique described above can be used with other established approaches to security such as lateral or vertical scanning inversion, time element shifting, either laterally or vertically, or line rotation. In order to reduce DC step errors involved with line rotation the rotation point can be in the HF signal portion of the transmitted signal.

The techniques may also be used with signals other than video, such as FM or AM radio transmission in which instead of clearly defined lines, artificial "blocks" of data will need to be established. Apart from this difference, the transmission and reception of the data is similar to that described above, although different frequency ranges are involved and an increase of bandwidth is necessary.

If data other than video is transmitted then it will be appreciated that the second HF block cannot be omitted and must be transmitted.

Although the above described embodiments utilise only two frequency components, there is no theoretical limit to the number of components and separation filters used. Six components have been successfully transmitted and reassembled with negligible error but even more division could be achieved. Thus the invention also has wider uses for transmitting commercial data between banks for instance, where large quantities of independent information can be securely transmitted and received.

CLAIMS

1. A method for transmitting information, comprising: splitting blocks of the information into a plurality of frequency band components, time compressing at least one of the components and transmitting the components in chosen order within a chosen time period.

2. A method as claimed in claim 1 wherein the blocks are lines of video data.

3. A method as claimed in claim 2 wherein each line of a video field is split into a low frequency part and a high frequency part; the low frequency part is time compressed and the low frequency part, the high frequency part and the low frequency part from a subsequent video line of that field are transmitted in chosen order within the chosen time period.

4. A method as claimed in claim 2 or 3 wherein the chosen time period is the time available for the transmission of two lines of video data.

5. A method as claimed in any of claims 2 to 4 wherein a tone containing sync information is added to the transmitted signal.

6. A method as claimed in any of claims 2 to 5 wherein the low frequency part contains signal components in the frequency range DC to 1 MHz and the high frequency part contains components in the range 1 MHz to 5 MHz.

7. A method as claimed in any of claims 2 to 6 wherein noise or other information is added to the transmitted

signal within the chosen time period.

8. A method as claimed in claim 7 wherein at least some of said noise or other information is added to one or more of the frequency components, before compression, in antiphase.

9. A method as claimed in any of claims 2 to 7, adapted for use with colour video signals, wherein the high frequency part is compressed and chrominance information is added to the transmitted signal within the chosen time period.

10. A method as claimed in any of claims 1 to 8 wherein the order of transmission of the components is pseudo-randomly varied with each block of information.

11. Video processing apparatus, comprising; means for splitting each line of video data into respectively a low frequency part and a high frequency part and for storing said parts; means for storing the low frequency part of a subsequent line of that field; means for time compressing at least the low frequency part, and means for transmitting, within a chosen time period and in any desired order, the high frequency part and both low frequency parts.

12. Video processing apparatus as claimed in claim 10 including means for transmitting other data, noise, and/or chrominance information at appropriate times within the chosen time period.

13. Apparatus as claimed in claim 12 adapted to add at

least some of said other data, noise or other chrominance information to one or more of the frequency components, before compression, in antiphase and including an equalisation network.

14. A method for processing video data substantially as hereinbefore described with reference to Figure 2 of the accompanying drawings.

15. Video processing apparatus substantially as hereinbefore described with reference to, and as illustrated by, any one of Figures 1, 3 and 4 of the accompanying drawings.

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