

The invention relates to a method for copying magnetic tapes, in particular, audio- or video- or data- magnetic tapes. The invention also relates to an apparatus for carrying out the method.

In conventional methods of copying, items of useful information located on an already recorded information carrier are reproduced by a playback device, transferred via a transmission path to a recording device and recorded on an information carrier upon which the recording is to be made. In the ideal case, the same items of useful information as in the original are contained on the information carrier which is to be recorded upon after the conclusion of the recording transfer process. Some possible additional items of information, which are recorded in addition to the actual useful information, for the internal control of the reproducing mechanism for certain recording standards - for example, for the VHS standard - are not affected by the copying process.

Such items of control information are generated in the device during the recording process and serve for switching over between a plurality of scanning heads of a rotating head disc during a subsequent reproduction for the purposes of synchronisation in video recorders for example. The synchronisation pulses are recorded in an extended track parallel to the edge of the tape called a regulating or control track ("CTL") and consist in essence, of sharp transitions from a North to a South or from a South to a North magnetisation whereby it suffices to constantly observe two respective similar types of successive transitions, for example from North to South magnetisation, between which, for example, there elapses a defined time period of 40 msec during the recording. The respective other transitions, thus in the said example, the transitions from South to North magnetisation, are not necessary for the purposes of synchronisation and consequently may be varied between certain limits as regards their relative locations within the time window comprising the said 40 msec without thereby interfering with the original purpose of the synchronisation by means of the control track.

The variation of the relative locations of the South/North transitions may thus be used for a digital coding for example. This has been made use of in the VHS standard in order to be able to place magnetic marks on the magnetic tape - for instance, for finding the exact frame at specific locations of a recording. Thereby, two types of marking may be distinguished, firstly, so-called VISS markings (VHS-Index-Search-System), which represents an unalterable item of digital information, and

so-called VASS markings (VHS-Address-Search-System), which contain an individual address in digitally coded form.

Especially when recording items that are relatively short in proportion to the total length of the tape as items of useful information, the simultaneous placing of a mark when starting a recording is of advantage for finding the exact starting point of such an item during the reproduction operation. If a recorded tape which is additionally provided with such marks is now copied however, then with copying processes in accordance with the state of the art, merely the useful information but not the information concerning the markings is copied over since the latter is recorded in a region which was only provided for internal control purposes of the apparatus during the reproduction operation i.e. purposes that are not directly influenceable by the user.

A method in accordance with the first part of Claim 1 is known from Patent Abstracts of Japan, Vol 12, No 220 (P-720) in which an integration of voltages obtained by key conditions occurs at the end having the reproducing video recorder. Insofar as a predetermined threshold level is exceeded during the integration, a signal relating to the control track is transmitted to the recording video recorder. Consequently, with the known method using integration, it is not possible to copy over addresses consisting of several bits contained in the control track of the tape that is to be copied.

The object of the invention is, when copying magnetic tapes, to also transmit additional information contained in a control track during the copying.

This object is achieved by the features given in claim 1. This object is also achieved by the features given in claim 7.

Preferably, the recording takes place in the next attainable time window conjointly with the recording of the control track.

The transmission of the item of digital information "0" or "1" may take place via one of the so-called Scart-connecting cables, whereby a level of 0 or 5 volt may correspond to the items of digital information "0" or "1".

It is provided that initially, at the reproducing device end, the items of digital information are intermediately stored in a buffer store for a length of time sufficient for an address consisting of a plurality of bits to be completely written in; this complete address can then be transmitted via serial

interfaces and an infra-red path arranged therebetween, to the recording device where it is then re-recorded in a digitally coded form by the control track.

It may be further provided that such an address be transmitted from the reproducing to the recording device via a D2B-bus. This D2B-bus has been specified in a publication referred to as "Project No 84.12.05001" (published June 1988) by the Internationalen Elektrotechnischen Kommission (IEC). For the transmission of index or address data, a serial transmission i.e. bit for bit, may be provided. However, it could also be provided that the D2B-bus be used for a transmission of the data in accordance with the previously described infra-red transmission format. Relative to a continuous serial transmission, the latter offers the advantage that it only loads the bus for a short time and consequently it is to be preferred to a continuous serial transmission.

It is self evident that any other data bus connection may be used instead of the D2B-bus.

Further features, advantages and details of the invention are explained hereinafter by means of the drawing. Therein

Fig. 1 shows in a schematic manner, a representation of a digital coding usable for a control track of a VHS video recorder,

Fig. 2 the formulation of an address code,

Fig. 3 a schematic representation of an infra-red transmission format,

Fig. 4 in a block circuit diagram, an embodiment of an apparatus in accordance with the invention for carrying out the copying method,

Fig. 5 a detail of the apparatus in Fig. 4 and

Fig. 6 a flow diagram for the program sequence in the detail illustrated in Fig. 5.

A time window referenced 100% and extending over 40 msec for the 625 line, 50 Hz, PAL television transmission method in the VHS standard is schematically illustrated in Fig. 1 from one positive flank (corresponding to a North/South magnetic transition for instance) to the next positive flank. If the negative flank (i.e. corresponding to a South/North magnetic

transition) occurring between the two positive flanks is located in the region $60\% \pm 5\%$ (Fig. 1a), then the digital value "0" is thereby coded, whereas if the negative flank is located in the region from $27.5\% \pm 2.5\%$ (Fig. 1b), then the digital value "1" is thereby coded.

It is schematically illustrated in Fig. 2 how an address code recorded in the control track of a VHS magnetic tape is built up. Such an address code consists of four headers which each consist of eleven bits. A data word is inserted between each two headers wherein each of these data words consists of four BCD digits which for their part once again consist of four bits. Thereby, the headers are built up as follows: a first bit "0" followed by nine bits "1" and then a bit "0". Consequently, a header consists of altogether eleven bits. The following applies for the data words: in the recording direction of the four bits forming a BCD digit one begins with the highest valued bit. The place value of the four BCD digits is defined as the thousandth, hundredth, tenth or unit in correspondence with the recording direction. The commencing "0" of the first header in the recording direction serves as the reference position.

An infra-red transmission format for the transmission of an address contained in the control track is illustrated in Fig. 3. This address consists, as was described for Fig. 2, of four BCD digits so that the digit range from 0000 to 9999 is available. Each of these digits is referenced "DATA" in Fig. 3, nevertheless they could take different values. A command word CMD placed in front of the BCD digits provides information regarding which types of data are being sent or received. The transmitter ICs having the reference M50467 from the company Mitsubishi Electric Corporation, 2 - 3, marunouchi, Tokyo, Japan could for example serve as integrated circuits for the transmitters for such an infra-red transmission path, which transmitters generate a format corresponding to the transmission format illustrated in Fig. 3.

An embodiment of an apparatus in accordance with the invention for carrying out the copying method is shown in Fig. 4 in a block circuit diagram.

A first video recorder VCR1 is operative in the reproducing mode, a second video recorder VCR2 is operative in the recording mode. The two video recorders VCR1, VCR2 are connected to one another by a cable 20 which may be a SCART or a video cable. Pictures and sound are transmitted from one (VCR1) to the other (VCR2) video recorder in the conventional manner via this cable 20. Furthermore, the video recorders VCR1, VCR2 are both

connected to a D2B-bus 30 via which they can exchange with each other data and commands corresponding to the standard laid down by the IEC.

If, in the first video recorder VCR 1, items of digital data contained in the control track are recognised as data items corresponding to VISS or VASS marks by a recording/reproducing head ("CTL-head") associated with the control track and a coding/decoding electronic circuit associated with the latter during the play back of the tape, then these are transmitted via, for example, the D2B-bus 30 to the second video recorder VCR2 where they are then recorded at the next possible opportunity by the control track in digitally coded form by means of its CTL-head and the coding/decoding electronic circuit associated with the latter during the current recording process.

The transmission of the digitally coded data in the control track may also take place in the form of complete data words; this then occurs for example in accordance with the infra-red transmission format described in connection with Fig. 3.

It is of course unavoidable during the transmission process that, compared with the original, a temporal displacement of the relevant markings occurs on the copy between the useful picture/sound information on the one hand and the VISS or VASS marks recorded on the copy. However, this delay occurring during copying of the markings is relatively small. In dependence on the method of transmission as well as on the occupied or free state of the transmission path, the order of magnitude of this displacement can lie for instance in the range of one second or of a couple of seconds.

Compared with conventional copying methods in which such markings cannot even be transmitted at the same time but rather the relevant locations have first got to be painstakingly sought in the copy and then a mark has to be manually inserted in the copy via a keyboard, such a small temporal displacement can be accepted without further ado. Nevertheless, should, in exceptional circumstances, the displacement be considered to be inconvenient then it can be provided that in a reproducing mode relating to the control track of the copy, the markings are automatically sought for and newly recorded on the control track with a displacement corresponding to a predetermined or given temporal amount. It may suffice thereby, that the "old" markings are merely overwritten without them needing to be specially erased.

Additionally, any other data bus may be used instead of the D2B-bus. For example, the still free pins of the SCART cable 20 may be assigned for this purpose.

Based upon the example of the video recorder VCR1 provided for the reproduction in Fig. 4, Fig. 5 shows the manner in which the data contained in the control track of the tape 50 that is to be copied, such as the data corresponding to the VISS or VASS markings for instance, can be read and processed if necessary and passed on.

In the reproducing mode, the recording/reproducing head ("CTL-head") 51 of the recorder VCR1 associated with the control track of the tape 50 reads the data contained in the control track. Via leads 52, this data reaches a so-called servo processor $\mu P1$ which suitably further processes the items of control information contained therein in accordance with the relevant recording norm - here for instance, in accordance with the VHS norm - whereby, for example, the control for the accurate tracking of the video heads of the video recorder VCR1 is ensured. The data items concerning the tape marks are further extended from the servo processor $\mu P1$ via a serial interface 53 to a so-called keyboard processor $\mu P2$ which reads and processes the data.

The keyboard processor $\mu P2$ controls, for example, a display unit with which the markings can be displayed - for instance, as decimal digits or as alphanumeric symbols. In addition, the storing of the tape marks - for example, in the recording mode available to the video recorder VCR2, although not here - can be controlled by the keyboard processor $\mu P2$. Furthermore, the data items concerning the tape marks are processed in the keyboard processor $\mu P2$ in accordance with the protocol to be transmitted (D2B-bus or an otherwise provided bus system).

Finally, the keyboard processor $\mu P2$ also controls the transfer of the codes concerning the tape marks to or from a D2B interface via a lead 54 which is connected to the D2B-bus 30 via leads 55 (Fig. 4).

The codes are passed on via this D2B-bus 30 to the video recorder VCR2 provided for the recording (Fig. 4). They are recorded - in a corresponding but inverse manner relative to the video recorder VCR1 - together with the control data items generated by the control processor therein on the control track of the tape provided for the copy in the video recorder VCR2 by means of the CTL-head of the video recorder VCR2.

Once again, D2B interface and D2B-bus are mentioned as aforesaid as being representative of any suitable bus system. For this for instance, the I2C bus system, RS232 interface connections or the like could be provided.

A flow diagram for a program running in the keyboard processor $\mu P2$ based upon the example of the video recorder VCR1, which is provided here as a reproducing device, is illustrated in Fig. 6. It is self evident that a correspondingly adapted program is provided for the recording mode as is illustrated for the video recorder VCR2 in Fig. 4. It is further self evident that the video recorders VCR1 and VCR2 are preferably equipped for both reproducing and recording modes.

At the starting point of the program illustrated in Fig. 6, the state of the operating keyboard of the video recorder VCR1 is first read. Thereafter, it is checked as to whether the track read by the CTL-head contains data items ("CTL DATA?") which represent tape marks. If this is not the case, then one jumps back to the starting point. Otherwise, these data items are stored as tape marks and displayed on a display unit.

Subsequently, it is checked as to whether an external interface - for instance, signalling the presence of a further video recorder - is connected via the bus output of the video recorder VCR1. If this is not the case, then a jump back to the starting point takes place. Otherwise, it is checked as to whether a transmission mode relating to the external device is selected ("transfer to External selected?"). If this is not the case, then a jump back to the starting point takes place.

Otherwise, the data items for the transmission protocol are generated and finally transmitted via the D2B interface of the video recorder VCR1 to the D2B-bus leads. The program starts anew with a jump back to the starting point.



Claims

1. Method for copying magnetic tapes, in particular, audio- or video- or data- magnetic tapes, wherein additional items of digital information contained in a control track of the tape which is being copied (50) that are detected when copying the magnetic tapes from a first, reproducing tape device (VCR1), are transmitted via a transmission path (20; 30) to a second, recording tape device (VCR2) and are recorded there in a digitally coded form onto the control track during a corresponding time window, characterised in that, initially, at the reproducing device end, the items of digital information are intermediately stored in a buffer store for a length of time sufficient for an address consisting of a plurality of bits to be completely written in, that thereafter this address is completely transmitted via serial interfaces (D²B-interfaces) to the recording device (VCR2) where it is then re-recorded in a digitally coded form by the control track.
2. Method in accordance with Claim 1, characterised in that, if necessary, the transmission of the address takes place via an infra-red path arranged between the serial interfaces (D²B-interfaces).
3. Method in accordance with Claim 1 or 2, characterised in that, this recording takes place in the next attainable time window conjointly with the recording of the control track.
4. Method in accordance with any of the preceding Claims, characterised in that, the transmission of an item of digital information "0" or "1" takes place via so-called Scart-connecting cables (20):
5. Method in accordance with Claim 4, characterised in that, the level of approximately 0 or approximately 5 volt corresponds to the items of digital information "0" or "1".
6. Method in accordance with any of the preceding Claims, Claims, characterised in that, an address is transmitted from the reproducing (VCR1) to the recording device (VCR2) via a D2B-bus (30).
7. Apparatus for copying magnetic tapes, in particular, audio- or video- or data- magnetic tapes, wherein additional items of digital information contained in a control track of the tape which is being copied (50) that are detected when copying the magnetic tapes from a first, reproducing tape device (VCR1), are transmitted via a transmission path (20; 30) to a second

recording tape device (VCR2) and are recorded there in a digitally coded form onto the control track during a corresponding time window, characterised in that, at the reproducing device end, there is provided a buffer store in which the items of digital information are initially intermediately stored for a length of time sufficient for an address consisting of a plurality of bits to be completely written in, and that serial interfaces (D²B-interfaces) are provided via which this address is thereafter completely transmitted to the recording device (VCR2) where it is then re-recorded in a digitally coded form by the control track.

