In VHS video recorders it is known for the analogue picture signal to be recorded along oblique tracks, a frame being recorded in each case on one oblique track. In such a recording method scanning at an increased running speed of the magnetic tape in order to achieve fast operation is relatively simple, because in each case successive frames lie one behind the other on the magnetic tape and thus pictures can be skipped without significant disturbances during scanning.

For the recording of digital picture signals on magnetic tape of small dimensions, e.g. 8 mm wide tape, it is known for the signal of a picture to be recorded in a plurality of successive tracks, e.g. 11 tracks. Each track, which forms an angle of 20° for example with respect to the edge of the tape, then contains one segment of the picture, i.e. a set of lines consisting for example of 60 lines. During scanning at an increased tape running speed and corresponding resetting of the heads, e.g. tilting the axis of rotation of the drum or an actuator, the speed of rotation of the head wheels writing the oblique tracks, the duration of scanning of a track, i.e. of one segment, and the duration of a scanned picture remain constant. Since on the other hand a specific number of tracks must be scanned in a short time, tracks must inevitably be omitted during scanning. Since a track does not contain a frame, but only a segment of a picture, certain segments of a picture are suppressed thereby. Therefore it is no longer readily possible to scan all segments of the same picture. This results in a discontinuity in reproduction which depends upon the factor of increase in the running speed and upon the picture content. In order to scan all segments of the same picture, the scanning would have to jump to and fro between certain areas of the tape. However, this is not possible in practice.

The object of the invention, in a video recorder of the type described above with an increased magnetic tape running speed, is to make it possible to reproduce the pictures selected according to the factor of the increase in the running speed with all their original segments.

This object is achieved by the invention described in Claim 1. Advantageous embodiments of the invention are described in the subordinate claims.

It is also known (GB-A-2 160 059) to provide a digital video recorder with four heads offset in pairs by 180° and with them to record data segments on a magnetic tape. The data segments are read with a demultiplexer in such a way as to facilitate a continuous reproduction of the data.

It is also known (EP-A-0 153 820) to divide a digital television signal into different segments and to recombine this signal after recording in a recorder to a uniform

continuous signal.

What is achieved with the solution according to the invention is that at an increased running speed of the magnetic tape, that is to say in fast operation, the selected pictures can be scanned with all their segments. It is true that depending upon the factor of the increase in the speed entire pictures are inevitably omitted. However, for example with a factor n = 3 picture No. 1 can be scanned with all its segments, than picture No. 4 with all its segments, etc. Preferably in a group of tracks initially all first segments of m pictures are recorded, m being equal to the maximum value of n. Then in a next group of tracks the second segments of the m pictures are correspondingly recorded, in a third group the third segments of the m pictures are recorded, etc. The modified sequence of the signals of the individual segments during recording and the corresponding inverse rearrangement of the scanned pictures during playback are effected by stores. During recording the signals of the segments are read in in the original sequence and read out in the modified sequence. During playback the scanned pictures are read into the stores in the modified sequence and read out with the original sequence which is necessary for the correct playback of the picture.

The invention is explained below with the aid of the drawings, in which:

Figure 1 shows the arrangement of the tracks on the magnetic tape,

Figure 2 shows the arrangement of the pictures and segments in a known recording method,

Figure 3 shows the difficulty occurring at an increased running speed,

Figure 4 shows the principle of recording according to the invention,

Figure 5 shows tables to explain Figure 4,

Figure 6 shows the storage during playback,

Figure 7 shows the storage during playback in normal operation and

Figure 8 shows the storage during recording.

In the description the following symbols are used:

n = factor of the increase in the running speed

V = fraction of the number of pictures which can be scanned during playback

z = number of tracks or segments per picture

m = number of tracks recorded within one group with segments having the same ordinal number of successive pictures.

In the example described the following values apply:

n = 1, 2, 3, 4, 6, 8, 12, 24
z = 11
m = 24 (maximum value of n)

In Figure 1 tracks 3 which run obliquely with respect to the edge of the tape 2 are recorded on the magnetic tape 1 at an angle of 20°. The tracks extend over a 4 mm wide half of the width of the tape which has an overall width of 8 mm. Pictures are recorded along the inclined tracks 3 with a rotating head wheel at a constant running speed V of the magnetic tape 1, each picture occupying z = 11 successive inclined tracks 3. 11 successive oblique tracks 3 each contain one segment S of a picture, e.g. one set of lines consisting of 60 lines.

Figure 2 shows this type of recording. During the first 11 tracks the segments S1 to S11 of the picture B1 are recorded, then the segments S1 to S11 of the picture B2, etc... Thus during normal operation, that is to say playback at normal speed Vo, the successive segments S1 to S11 of the successive pictures B are played back in the correct sequence.

If scanning is now carried out at triple speed V, that is to say V = 3 x Vo, then because the duration of scanning of a track and of a picture remains constant only every third tracks 3 and thus every third segment S can be scanned. the lower line in Figure 2 shows by the dashes that with n = 3 only the segments B1S1, B1S4, B1S7, B1S10 etc. can be scanned. Thus the segments B1S2, B1S3, B1S5, B1S6 etc. lying between them are lost during scanning. Thus the picture 1 can no longer be written with its original 11 segments B1S1 to B1S11. The following scanning is produced in total:

picture 1 segment 1, 4, 7, 10
picture 2 segment 2, 5, 8, 11
picture 3 segment 3, 6, 9.

With a value V of 12 x Vo, that is to say n = 12, the 11 segments originate from 12 pictures which succeed one another chronologically, so that the picture quality becomes poorer with increasing feed speed V.

Figure 3 shows that in the manner described for n = 3 only the segments B1S1, B1S4, B1S7, B1S10 can be scanned and the segments lying between them are lost. Thus the picture B1 can no longer be made available for playback with all its original segments S1 to S11.

Figure 4 shows the modified recording. First of all within one group G1 of 24 tracks all segments S1 of 24 successive pictures B1 - B24 are recorded. Within the next group G2 all segments S2 of the same successive pictures B1 to B24 are recorded. This is repeated up to the group G11, in which all segments S11 of the successive pictures B1 to B24 are recorded. At the end of the group G11 all segments S1 to S11 of all pictures B1 to B24 are recorded in modified sequence.

In the lines n = 2, n = 3, etc. which are drawn below, the short vertical dashes indicate which of the tracks, i.e. which segments S can be scanned and thus are available for playback of the picture. It can be seen that in each case the pictures which can be scanned according to the factor n can each be scanned with all their original segments S1 - S11. According to the n = 2 line in Figure 4, with n = 2 the segments B1S1, B3S1, etc. can be scanned. This applies correspondingly to the segments S2, S3 ... to S11 in the following groups G2, G3 ... to G11. Thus, in contrast to Figure 3, according to Figure 5 the selected pictures can be recovered with all their segments S1 to S11. Merely the number of pictures which can be scanned is smaller, which is unavoidable due to the increased running speed V. With n = 24 only the picture B1 can be scanned as the only one out of 254 pictures, but with all its original segments S1 to S11.

Figure 6 shows the organisation of the stores at a running speed V which is increased by the factor 2, i.e. 2 x Vo and n = 2, for playback. The individual segments pass in the sequence in which they were scanned according to Figure 4 from the recorder R into the storage area M1. They are then arranged in the storage area M1 in groups G1 to G11 according to Figure 4. The output of the segments is represented in the central column. The output from the storage area M1 is now achieved in such a way that the pictures are each available with their own segments S1 - S11 in the correct sequence, that is to say in the represented sequence B1S1, B1S2 ... to B1S11, then B3S1, B3S2 ... to B3S11. Since the last segment S11 of the first picture B1 can only be stored according to Figure 4 at the end of the storage areas M1, in order to achieve the correct sequence according to the central column at the top in Figure 6 the read-out can only begin at the end of reading in to the storage area M1.

While the storage area M1 is being read out, the following segments B25S1, B27S1 etc. coming from the recorder R are read in to a second storage area M2. These segments from

B25S1 to B47S11 are then read out again in the time period according to the right-hand column in the ordered sequence. During this time the following segments B49S1 to B71S11 are again read in to the free storage area M1 which is now free, etc... Thus the two storage areas M1 and M2 serve alternately for reading in the segments of a block B1, B2, B3 and for reading out the segments in the changed sequence which is necessary for playback of the picture.

Figure 7 shows the arrangement of the stores for normal operation, that is to say n = 1, for playback. In this case all the segments are scanned according to Figure 4 and read in to the appropriately dimensioned storage areas M in the sequence according to Figure 4. For playback of the picture the segments of a block B1, i.e. of a storage area M1, are again read out in the sequence necessary for playback of the picture, i.e. the sequence according to Figure 2. Thus during playback the stores for ordering the segments are also required in normal operation. During the read-out of the storage area M1 the following segments beginning at B25S1 are again read in to the storage area M1. In this case each storage location which becomes free can again be read in with the segment just coming from the recorder R. As soon as B1S1 is read out from the storage location of the storage area M1 for playback the segment B25S1 is read in to this storage location. Since according to Figure 6 at the top the segment B1S2 is then read out of the storage area M1, the next segment B26S1 coming from the recorder R can be read in to this storage location. Correspondingly the storage location with the segment B1S3 is read in, after reading out this segment, with the segment B27S1 coming from the recorder R. Thus a modified arrangement of the segments is produced in the storage locations of the store M1. This solution has the advantage that each storage location for a segment is again read in with a new segment immediately after reading out and no storage location remains empty unnecessarily.

Figure 8 shows the store for recording. The segments are initially read into the storage area M1 in their original sequence, that is to say B1S1, B1S2, B1S3 etc. during the block BL0. The read-out operation is carried out in such a way that a recording of the segments according to Figure 4 takes place. Here too, in each case after the read-out of a segment for the recording from a storage location the incoming segment of the signal is read in to the storage location. After the read-out of B1S1 in the block BL0 after the end of the read-in of the total block BL0, the incoming segment B25S1 is read in to this storage location. Correspondingly, after the succeeding read-out of the signal B2S1 the following signal B25S2 is read in to this storage location. In this way it is ensured that each storage location is read in again as quickly as possible after read-out and does not remain empty for an unnecessarily long time.

* C L M S *

Claims

1. Video recorder with oblique track recording, in which a plurality (z) of segments (S) of a picture (B) are recorded in a plurality (z) of oblique tracks (3), characterised in that the segments (S) of the time period of several successive rasters or pictures (B) are recorded in a sequence which is modified in such a way that at a running speed (V) of the magnetic tape (1) increased by a factor n with n greater than or equal to 2 (2, 4, ... 24) the rasters or pictures (B) selected during scanning according to the factor n can each be scanned with some or all of their segments (S).

2. Recorder according to Claim 1, characterised in that within a group (G1) of m (24) tracks (S) all first segments (S1) of m successive pictures (B) are recorded, within the next group (G2) all second segments (S2) of the m pictures (B) are recorded, etc.

3. Recorder according to Claim 2, characterised in that the value of m is equal to the maximum value of n.

4. Recorder according to Claim 1, characterised in that the sequence in the recording of the segments is modified so that the selected rasters or pictures (B) which can be scanned with some or all of their segments (S1 - S11) are equidistant in the original raster or picture sequence.

5. Recorder according to Claim 1, characterised in that during the recording the signals associated with the tracks (3) or segments (S) are read into stores (M) and are read out of the stores (M) in the modified sequence.

6. Recorder according to Claim 1, characterised in that during playback the signals of the individual tracks (3) or segments (S) scanned from the tape (1) are read into stores and are read out of the stores with a changed sequence which is necessary for the correct playback of the picture.

7. Recorder according to Claim 5 or 6, characterised in that the total storage duration of the stores (M) is equal to the product of the common even-numbered multiple (n) of the running speeds (V) and the picture duration.

8. Recorder according to Claim 2, characterised in that the signals from successive blocks of z groups (G) are read alternately into a first storage area (M1) and a second storage area (M2) and read-out from each storage area (M1, M2) begins at the end of reading in to this storage area.

9. Recorder according to Claim 5 or 6, characterised in that during recording and/or playback immediately after read-out of a segment (S) from a storage location of the

* C L M S *

store (M1) the segment (S) arriving in the signal or scanned by the recorder (R) is read into this storage location.