

Description

This invention relates to video signal recording and/or reproducing apparatus.

In a standard 2-head video tape recorder (VTR), a pair of rotary magnetic heads having opposite azimuth gap angles are mounted on a rotary drum at an angular spacing of 180°, and a magnetic tape is wrapped around the rotary drum over a tape wrapping angle of substantially 180°. In the recording mode of such a VTR, as shown in Figure 1 of the accompanying drawings, recording tracks TA and TB are alternately formed in close side-by-side relation on a magnetic tape 1 by the pair of rotary magnetic heads HA and HB having different azimuth gap angles, and such tracks extend obliquely across the tape 1. A recording track conforming to the standard format can be formed by recording one field of a video signal in each recording track.

In order to reduce the diameter of the rotary drum of the standard VTR for permitting miniaturizing of the VTR, it has been previously proposed, as shown in Figure 2 of the accompanying drawings, to mount four rotary magnetic heads, HD1, HD2, HD3 and HD4 on a rotary drum 2 with an equal angular distance of 90° between the heads, and with the diameter of the drum 2 reduced to 2/3 the diameter of the rotary drum of the standard VTR. In this case, the tape 1 is wrapped around the drum 2 with a tape wrapping angle of substantially 270°, as shown in full lines, and the rotational speed of the drum 2 is increased to one and 1/2 times the speed used in the case of the 2-head VTR.

If the azimuth gap angles of the first and third heads HD1 and HD3 are a positive angle (for example, +7°) and the azimuth gap angles of the second and fourth heads HD2 and HD4, which are located at angular spacings of 90° from the first and third heads HD1 and HD3, are a negative angle (for example, -7°), each time the drum 2 rotates three times, the heads HD1, HD2, HD3 and HD4 sequentially scan four oblique recording tracks TA, TB, TA and TB thereby to form a track pattern having the same format as is shown in Figure 1.

This will be described more fully with reference to Figure 3 of the accompanying drawings, in which a recording track TA1 is formed by the first head HD1 having the azimuth gap angle of the HA head; a recording track TB2 is formed by the second head HD2 having the azimuth gap angle of the HB head; a recording track TA3 is formed by the third head HD3 having the azimuth gap angle of the HA head; and a recording track TB4 is formed by the fourth head HD4 having the azimuth gap angle of the HB head. These four tracks TA1, TB2, TA3 and TB4, or four recording tracks corresponding thereto, are scanned by the heads HD1, HD2, HD3 and HD4 once each time the drum 2 is rotated three times.

When the recording pattern of Figure 3 with the

same format as the standard recording pattern of Figure 1 is formed on the tape 1 by the four heads HD1, HD2, HD3 and HD4 mounted on the drum 2 of reduced diameter, it will be apparent that the azimuth gap angles of the first and third heads HD1 and HD3 are the same, and the azimuth gap angles of the second and fourth heads HD2 and HD4 are the same. For that reason, if the heads HD1, HD2, HD3 and HD4 are made to track the recording tracks, in the reproducing mode, by a so-called control pulse (CTL) tracking servo system, there is no assurance that the tracks TA1, TB2, TA3 and TB4 recorded by the heads HD1, HD2, HD3 and HD4 will be tracked by the same heads HD1, HD2, HD3 and HD4 during reproducing. In other words, the tracking servo may lock onto a condition in which the rotary phase of the drum 2 is displaced by an angular amount corresponding to two tracks, so that, for example, the tracks TA1, TB2, TA3 and TB4 are tracked by the heads HD3, HD4, HD1 and HD2, respectively, in that order.

In a CTL tracking servo system, a CTL signal (control signal) of logic level "1" or "0" is recorded in a track along a longitudinal edge of the magnetic tape and changes its logic level at each track in accordance with the recording azimuth gap angle at each track in accordance with the recording azimuth gap angle of the respective one of the tracks TA1, TB2, TA3 and TB4. In the reproducing mode, the CTL signal is reproduced and used as the basis for tracking-control, so that the recording tracks are reproduced by magnetic heads having the same azimuth gap angles.

Moreover, in an 8mm VTR, the control pulse (CTL pulse) is not recorded in a longitudinal track along an edge of the tape, so that it becomes impossible to select the reproducing heads on the basis of a reproduced CTL pulse.

If a recording track is reproduced by a magnetic head different from the magnetic head used to record the track, variations in the angles between the heads HD1, HD2, HD3 and HD4 mounted on the drum 2 may cause so-called head mounting angle interference in the reproduced picture, that is, may cause reproduction of a skewed picture.

In this connection, if head mounting angles θ_{12} , θ_{23} , θ_{34} and θ_{41} (Figure 2) between the heads HD1, HD2; HD3; HD3, HD4; and HD4, HD1, respectively, contain head mounting angular errors α_1 , α_2 , α_3 and α_4 , the head mounting angles θ_{12} , θ_{23} , θ_{34} and θ_{41} may be respectively expressed by:

$$\theta_{12} = 90^\circ + \alpha_1 \quad (1)$$

$$\theta_{23} = 90^\circ + \alpha_2 \quad (2)$$

$$\theta_{34} = 90^\circ + \alpha_3 \quad (3)$$

$$\theta_{41} = 90^\circ + \alpha_4 \quad (4)$$

When the tracks TA1, TB2, TA3 and TB4 recorded by the heads HD1, HD2, HD3 and HD4 mounted on the drum 2 with such mounting angle errors α_1 to α_4 are respectively reproduced by the same heads,

the periods of the horizontal synchronizing signals contained in the reproduced signals obtained by switching from one to another of the heads HD1, HD2, HD3, HD3 and HD4, in turn, are coincident with those of the horizontal synchronizing signals inserted during recording. When each recording tracks is reproduced by the same recording head as was used to form that recording track, the apparatus is said to be operating in a head self-recording and/or reproducing mode, and the so-called head mounting angle interference or skewing will not appear in the reproduced picture.

However, if the recording tracks are reproduced by heads different from the recording heads used to form the respective recording tracks, when the reproducing heads are switched, the periods of the horizontal synchronizing signals contained in the reproduced signals are displaced by amounts corresponding to the respective ones of the head mounting angle errors α_1 to α_4 . As a result, as shown in Figure 4 of the accompanying drawings, when the reproduced picture or image includes a straight line 5A, for example, extending in the vertical direction of a picture screen 4, the occurrence of so called head mounting angle interference causes a skewed picture in which the portions of the reproduced picture at opposite sides of the straight line 5A are expanded laterally, as shown by a dashed line 5B1 or 5B2.

In the reproducing circuit of the known VTR, the horizontal synchronizing signal contained in the reproduced signal is automatic frequency control (AFC) controlled thereby to attempt to match its period with that of predetermined reference synchronizing signal. However, in the reproducing mode, each time the heads are switched the period of the reproduced horizontal synchronizing signal may nevertheless be displaced for the lock-in time of the AFC loop. In other words, as shown in Figure 4, the AFC control operation is not so effective at the upper portion of the picture screen 4, so that skewing of the picture occurs at such upper portion.

Moreover, when the recording track formed by a head is not reproduced by the same head, in addition to the above-described skewing of the picture, flicker may appear on the reproduced picture, for example, due to uneven rotation in each revolution of a motor, uneven amplitude of the head output, and scattering or variations of the frequency characteristics of the several heads.

French patent specification FR-A-2 536 619 (GB-A-2 132 403) discloses a recording/reproducing apparatus having the features of the pre-characterizing part of claim 1. Four-frequency automatic track following is disclosed in our European patent specification EP-A2-0 089 816.

In order to overcome the above mentioned disadvantages the present invention provides a video recording and/or reproducing apparatus comprising:

first, second, third and fourth magnetic heads of which said first and third heads each have a first azimuth gap angle and said second and fourth heads each have a second azimuth gap angle;

a rotary drum on which said first, second, third and fourth heads are mounted in the order stated with substantially equal angular spacings therebetween, said first, second, third and fourth heads being operative, in a recording mode of the apparatus, for recording information on a recording medium in first, second, third and fourth recording tracks, respectively, so as to change azimuth gap angles from track to track;

said magnetic heads being operative, in a reproducing mode of the apparatus, for reproducing said information from said recording tracks;

first switching means operative in said reproducing mode for switching between outputs of said first and third magnetic heads;

second switching means operative in said reproducing mode for switching between outputs of said second and fourth magnetic heads;

third switching means for switching outputs from said first and second switching means in synchronism with rotation of said rotary drum;

means for generating a phase indicating pulse at each revolution of said drum and a pulse derived from said phase indicating pulse by dividing it by three to provide a pulse for each three revolutions of said drum; and

switching control means for generating control signals for said first, second and third switching means on the basis of a rotary phase of said rotary drum; said magnetic tape being wrapped about said rotary drum with a wrap angle of at least 270°;

characterized by:

means operative in said recording mode for superimposing first, second, third and fourth pilot signals having respective different frequencies on said information recorded by said first, second, third and fourth heads, respectively;

means for extracting said tracking pilot signals from reproduced signals obtained from said magnetic heads through said third switching means;

selector means for selecting, in dependence on control signals from said switching control means, a reference pilot signal from among four reference pilot signals generated with frequencies the same as those of said first, second, third and fourth pilot signals, respectively;

tracking error detecting means for producing a tracking error signal by comparing a pilot signal extracted from the reproduced signal obtained through said third switching means with the selected reference pilot signal;

means responsive to said tracking error signal for causing said first, second, third and fourth magnetic heads, in said reproducing mode, to track the record-

ing tracks in which the information and superimposed pilot signals were recorded by said first, second, third and fourth magnetic heads, respectively, in said recording mode; and

means for generating a plurality of clock pulses at respective angular displacements of said drum during each revolution thereof;

said switching control means generating control signals for controlling said means for superimposing said pilot signals in response to predetermined counts of said clock pulses with respect to the pulse derived from said phase indicating pulse.

The invention will now be described by way of example, with reference to the accompanying drawings, throughout which like parts are referred to by like references, and in which:

Figure 1 is a diagrammatic representation of a recording pattern on a magnetic tape;

Figure 2 is a schematic plan view of a rotary drum assembly in a video signal recording and/or reproducing apparatus of a type to which this invention may advantageously be applied;

Figure 3 is a diagrammatic representation of the recording pattern, and the relationship between the magnetic heads and recording tracks formed thereby with the rotary drum assembly of Figure 2;

Figure 4 is a diagrammatic illustration of a video picture to which reference will be made in explaining so-called head mounting angle interference;

Figure 5 is a block diagram of an embodiment of video signal recording and/or reproducing apparatus according to the present invention;

Figure 6 is a diagrammatic view showing the pattern of recording tracks recorded on a magnetic tape by the apparatus of Figure 5;

Figure 7A is an enlarged diagrammatic view showing in greater detail the track pattern of Figure 6 and the pilot signals recorded therein, and Figure 7B is a corresponding graphic representation of changes in a tracking error signal in an automatic track following system and to which references will be made in explaining a problem to be overcome by the embodiment of the present invention;

Figure 8A to 8F4 are respective signal waveforms showing signals appearing at respective portions of the apparatus of Figure 5;

Figure 9 is a block diagram showing details of a switching control circuit included in the apparatus of Figure 5; and

Figures 10A to 10I are respective signal waveforms to which reference will be made in explaining the operation of the circuit of Figure 9.

The embodiment of video signal recording and/or reproducing apparatus 11 shown in Figure 5 comprises a recording and/or reproducing circuit 12 which is

connected through rotary transformers RT1, RT2, RT3 and RT4 to rotary magnetic heads HD1, HD2, HD3 and HD4, respectively.

In the recording mode of the apparatus 11, the recording and/or reproducing circuit 12 superimposes pilot signals PL1, PL2, PL3 and PL4 having frequencies f_1 , f_2 , f_3 and f_4 , respectively, upon video signals recorded in the recording tracks TA1, TB2, TA3 and TB4 (Figure 6) by the heads HD1, HD2, HD3 and HD4, respectively, with each track having one field of the video signal recorded therein. In the reproducing mode, the heads HD1, HD2, HD3 and HD4 are controlled properly to trace the corresponding recording tracks TA1, TB2, TA3 and TB4 by an automatic tracking follow (ATF) processing circuit 13 employing the 4-frequency ATF system. More particularly, the ATF processing circuit 13 may employ a 4-frequency ATF system as disclosed in detail in our European patent specification EP-A-0 089 816.

In this embodiment, the frequencies f_1 , f_2 , f_3 and f_4 of the pilot signals PL1, PL2, PL3 and PL4 are selected such that the pilot signals recorded in adjacent tracks will have frequency differences Δf_A and Δf_B given by:

$$\Delta f_A = |f_1 - f_2| = |f_3 - f_4| = 16 \text{ kHz} \quad (5)$$

$$\Delta f_B = |f_2 - f_3| = |f_4 - f_1| = 46 \text{ kHz} \quad (6)$$

Accordingly, upon reproduction, it is possible to detect, by the appearance of the frequency difference Δf_A or Δf_B in the reproduced signal, whether the operative one of the heads HD1 to HD4 is displaced in the rightward or leftward direction (Figure 6) from the desired tracking position.

Referring now to Figures 7A and 7B, in which variations of a tracking error signal S_{ER} are shown for various displacements of a rotary magnetic head, for example, the head HD1, from the recording track TA1 which was recorded by that same head HD1, it will be seen that, if the head HD1 is properly tracking the track TA1, the cross-talk of the pilot signals PL2 and PL4 from the tracks TB2 and TB4 at the left-hand side and the right-hand side of the track TA1 are balanced, so that the tracking error signal S_{ER} becomes zero. On the other hand, if the head HD1 is displaced rightwardly from the centre of the track TA1 towards the adjacent recording track TB2 at the right-hand side of the track TA1, the cross-talk of the pilot signal PL2 from the recording track TB2 is increased, so that the magnitude of the component having the frequency difference Δf_A is increased on the basis of Equation 5. Thus, the magnitude of the tracking error signal S_{ER} is increased in the negative direction as the head HD1 moves towards a position centred on the track TB2.

If the head HD1 is further displaced towards the right in Figure 7A from the position at which the head HD1 is centred with respect to the track TB2, the component of the pilot signal PL2 from the track TB2 is decreased relative to the cross-talk component of the pilot signal PL3 from the track TA3, so that the mag-

nitude of the tracking error signal S_{ER} is gradually decreased to zero.

If the head HD1 is further displaced rightwardly to a position at which the head HD1 is centred with respect to the track TA3 adjoining the track TB2, no signal component of the frequency differences Δf_A and Δf_B is produced. If the head HD1 is further displaced rightwardly, the cross-talk signal component of the pilot signal PL4 from the adjacent track TB4 at the right-hand side of the track TA3 is produced, so that the tracking error signal S_{ER} is increased in the positive direction. If the head HD1 is still further rightwardly displaced from the position at which the head HD1 is centred with respect to the track TB4, the cross-talk of the pilot signal PL4 from the recording track TB4 is decreased, so that the tracking error signal S_{ER} is gradually decreased to zero.

When the head HD1 is properly tracking the next track TA1 adjacent to the track TB4, no tracking error signal S_{ER} is produced.

As described above, if the heads HD1, HD2, HD3 and HD4 are properly tracking the corresponding tracks TA1, TB2, TA3 and TB4, respectively, or the track-displacement is 0, 4TP, 8TP, ..., (where TP is the width of each track), ..., a stable tracking condition can be maintained. If, on the other hand, the track-displacement is 2TP, 6TP, ..., for example, the head HD1 is centred with respect to the track TA3, the tracking servo system is in an unstable oscillation condition. In the apparatus 11, this unstable oscillation condition is avoided, that is, the heads are controlled by using a pilot detecting circuit to just track the corresponding recording tracks at stable positions corresponding to track-displaced amounts 0, 4TP, 8TP, ...

Consequently, the head HD1 is made properly to track only the corresponding track TA1 in accordance with the ATF servo operation of the ATF processing circuit 13. The other heads HD2, HD3 and HD4 are similarly made properly to track only the corresponding tracks TB2, TA3 and TB4 respectively. As a result, when the heads HD1, HD2, HD3 and HD4 scan the tape 1 in the reproducing mode, the heads HD1, HD2, HD3 and HD4 are servo-controlled so as properly to track the corresponding tracks TA1, TB2, TA3 and TB4, respectively.

The recording and/or reproducing circuit 12 is arranged so as to perform the 4-frequency tracking control on the basis of the above operating principle. The arrangement and operation of the recording and/or reproducing circuit 12 will now be described with reference to Figure 5, in which a switching control circuit 21 is shown to receive a switching pulse SWP (Figure 8A) which changes its logic level between "L" (low level) and "H" (high level) each time the drum 2 is rotated to a position at which one of the heads HD1, HD2, HD3 and HD4 starts scanning the tape 1. The switching control circuit 21 further receives a rotation

detecting pulse PG (Figure 8B) which rises once during each revolution of the drum 2 and a rotation frequency signal pulse FG which corresponds to the rotational speed of the drum 2.

The switching pulse SWP and the rotation detecting pulse PG indicate timings at which the heads HD1, HD2, HD3 and HD4 are switched in synchronism with the rotation of the drum 2. As illustrated in Figures 8A and 8B, the period T1 of the switching pulse SWP which rises immediately after the occurrence of a rotation detecting pulse PG represents the scanning period of the first head HD1. Likewise, the subsequent periods T2, T3 and T4, in which the switching pulse SWP changes its logic level alternately, correspond to the periods in which the second, third and fourth heads HD2, HD3 and HD4, respectively, are scanning the tape 1.

The switching control circuit 21 produces, in response to the switching pulse SWP, a first selecting signal SEL1 which changes its level in time with the switching pulse SWP, as shown in Figure 8C1. The switching control circuit 21 also produces a second selecting signal SEL2 shown in Figure 8C2, and which results from frequency-dividing the first selecting signal SEL1 by two. The first and second selecting signals SEL1 and SEL2 are both supplied to a pilot signal selecting circuit 22.

The pilot signal selecting circuit 22 selects, during each of the periods T1, T2, T3 and T4, a respective one of the pilot signals PL1, PL2, PL3 and PL4 of frequencies f_1 , f_2 , f_3 and f_4 derived from a pilot signal generating circuit 23 on the basis of the first and second selecting signals SEL1 and SEL2, and supplies the selected pilot signal as a reference pilot signal RPL (Figure 8D).

In the recording mode, the switching control circuit 21 supplies recording control or gating signals S_{RC1} , S_{RC3} and S_{RC4} (Figures 8F1, 8F2, 8F3 and 8F4) to gated recording amplifying circuits REC1, REC2, REC3 and REC4, respectively. As shown in Figures 8F1, 8F2, 8F3 and 8F4, the recording control or gating signals S_{RC1} , S_{RC2} , S_{RC3} and S_{RC4} are concurrent with, and have pulse widths which are slightly wider than the head scanning periods T1, T2, T3 and T4, respectively.

The gated recording amplifying circuits REC1, REC2, REC3 and REC4 supply recording signals VD1, VD2, VD3 and VD4 through rotary transformers RT1, RT2, RT3 and RT4 to the heads HD1, HD2, HD3 and HD4, respectively, during the intervals when the respective heads are scanning tracks on the tape 1. The recording signals VD1, VD2, VD3 and VD4 include the corresponding pilot signals PL1, PL2, PL3 and PL4 superimposed upon information signals, such as, composite video signals VD, each of which is formed of a luminance signal, a chrominance signal and an audio frequency modulated (FM) signal.

Accordingly, the heads HD1, HD2, HD3 and HD4

record, in the tracks TA1, TB2, TA3 and TB4, respectively, the video signals and the pilot signals PL1, PL2, PL3 and PL4, respectively, as earlier described in connection with Figure 6.

In the reproducing mode, the switching control circuit 21 generates first and second switching signals SW1 and SW2 and supplies them to switching circuits W1 and W2. The first switching signals SW1 (Figure 8E1) is formed by frequency-dividing the switching pulse SWP by two, and the second switching signal SW2 is formed by delaying the phase of the first switching signals SW1 by a delay corresponding to the scanning period T1, as shown in Figure 8E2.

The switching circuit W1 receives reproduced signals S_{PB1} and S_{PB3} from the first and third heads HD1 and HD3 having the positive azimuth gap angles, through playback amplifying circuits PB1 and PB3, respectively. The switching circuit W1 supplies the reproduced signal S_{PB1} to a switching circuit W3 when the first switching signal SW1 is high "H". Conversely, switching circuit W1 supplies the reproduced signal S_{PB3} to the switching circuit W3 when signal SW1 is low "L".

In like manner, the switching circuit W2 receives reproduced signals S_{PB2} and S_{PB4} from the second and fourth heads HD2 and HD4 having the negative azimuth gap angles, through playback amplifying circuits PB2 and PB4, respectively. The switching circuit W2 supplies the reproduced signal S_{PB2} to the switching circuit W3 when the second switching signal SW2 (Figure 8E2) is high "H", while the reproduced signal S_{PB4} is supplied to the switching circuit W3 when signal SW2 is low "L".

The switching pulse SWP (Figure 8A) is supplied to the switching circuit W3 as a switching signal, whereby the first and third reproduced signals S_{PB1} and S_{PB3} supplied from the first switching circuit W1 to the switching circuit W3 during the head scanning periods T1 and T3, respectively, in each of which the switching pulse SWP is high "H", are supplied through the switching circuit W3 as portions of a reproduced video signal VIDEO.

On the other hand, the switching circuits W3 passes, as other portions of the reproduced video signal VIDEO, the reproduced video signals S_{PB2} and S_{PB4} from the second switching circuit W2 during the head scanning periods T2 and T4 in which the switching pulse SWP is low "L".

As a result, the reproduced signals S_{PB1} , S_{PB2} , S_{PB3} and S_{PB4} obtained from the first, second, third and fourth heads HD1, HD2, HD3 and HD4, respectively, during the scanning periods T1, T2, T3 and T4 are sequentially supplied through the switching circuit W3 as the reproduced video signal VIDEO. Such reproduced video signal VIDEO is supplied to a video processor circuit (not shown) and also to a low-pass filter 24.

The reproduced video signal VIDEO contains the

signal components of the pilot signals PL1, PL2, PL3 and PL4 recorded in the tracks TA1, TA2, TA3 and TA4, respectively, as already described in connection with Figures 7A and 7B. The frequencies f_1 , f_2 , f_3 and f_4 of the pilot signals PL1, PL2, PL3 and PL4 are selected to be sufficiently low so that the pilot signals PL1, PL2, PL3 and PL4 are extracted or passed by the low-pass filter 24 as a reproduced pilot signal PPL and supplied to a multiplying circuit MUL.

The reference pilot signal RPL from the pilot signal selecting circuit 22 is also supplied to the multiplying circuit MUL which produces a multiplied output signal S_{MUL} , converts it to DC level signals, and compares these DC level signals S_{ER} (Figure 7B) indicating the right or left displacement of the rotary magnetic head. The tracking error signal S_{ER} is supplied to a capstan servo circuit 25 which controls the rotational speed of a capstan motor 26 in that the tracking error signal S_{ER} becomes zero. Thus, a rotary magnetic head is made properly to track the corresponding recording track.

With the arrangement described above, in the recording mode of the recording and/or reproducing circuit 12, the recording amplifying circuits REC1, REC2, REC3 and REC4 are sequentially operated by the recording control signals S_{RC1} (Figure 8F1), S_{RC2} (Figure 8F2), S_{RC3} (Figure 8F3) and S_{RC4} (Figure 8F4) during the scanning periods T1, T2, T3 and T4, respectively, in response to the switching pulse SWP (Figure 8A) indicative of the rotary phase of the drum 2 and the rotation detecting pulse PG (Figure 8B). In consequence of the foregoing, the recording signals VD1, VD2, VD3 and VD4, with the pilot signals PL1, PL2, PL3 and PL4 (Figure 8D) respectively superimposed thereon, are sequentially recorded in the tracks TA1, TA2, TA3 and TA4 on the tape 1 by the heads HD1, HD2, HD3 and HD4, respectively, with each such track having a different azimuth gap angle from the adjacent tracks.

Thus, as described and shown in Figure 6, the tracks TA1, TA2, TA3 and TA4 are sequentially recorded in the form of a recording pattern with no guardbands by the heads HD1, HD2, HD3 and HD4, which recording pattern satisfies the standard tape format.

When the thus recorded tape 1 is reproduced, the switching circuits W1, W2 and W3 in the recording and/or reproducing circuit 12 are respectively switched by the switching signals SW1 (Figure 8E1), SW2 (Figure 8E2) and SWP (Figure 8A) so that the switching circuit W3 permits the reproduced signals S_{PB1} , S_{PB2} , S_{PB3} and S_{PB4} reproduced by the heads HD1, HD2, HD3 and HD4 during the scanning periods T1, T2, T3 and T4, respectively to be supplied there-through in sequence as the reproduced video signal VIDEO.

If the heads HD1, HD2, HD3 and HD4 are displaced from the positions at which they properly track

the corresponding tracks TA1, TB2, TA3 and TB4 because the rotary phase of the drum 2 is displaced relative to the tape 1, the ATF processing circuit 13 generates the corresponding tracking error signal S_{ER} which, in the capstan servo circuit 25, suitably controls the capstan motor 26 to cause the heads HD1, HD2, HD3 and HD4 properly to track the corresponding tracks TA1, TB2, TA3 and TB4, respectively.

If the first head HD1 scans any one of the tracks TB2, TA3 and TB4, that is, any track except the track TA1 on which the pilot signal PL1 is recorded, the ATF processing circuit 13 generates the tracking error signal S_{ER} which causes a change in the speed at which the tape 1 is driven so that the head HD1 again properly tracks the track TA1.

In like manner, tracking error signals S_{ER} are sequentially supplied for the second, third and fourth heads HD2, HD3 and HD4 which are thereby made properly to track the corresponding tracks TB2, TA3 and TB4 on which the corresponding pilot signals PL2, PL3 and PL4 are recorded.

By reason of the circuitry described above, even if errors occur in the angular distances between the heads HD1, HD2, HD3 and HD4 mounted on the drum 2, the AFT tracking servo is effected so that, in the reproducing mode, the heads HD1, HD2, HD3 and HD4 are always made properly to track the tracks TA1, TB2, TA3 and TB4, respectively, that were recorded by the corresponding heads HD1, HD2, HD3 and HD4. Thus, it becomes impossible to prevent a skewed picture from appearing on the picture screen 4 (Figure 4) in response to the reproduced video signal VIDEO.

Although the first and third heads HD1 and HD3 record the video signals at the same positive azimuth gap angle, even if the third head HD3 scans the track TA1, as shown in dash-lines in Figure 7A, and thereby picks up the pilot signal PL1 recorded in the track TA1 by the first head HD1, the tracking error signal S_{ER} generated during the scanning period T3 of the third head HD3 indicates the scanning of a track displaced by the width of two tracks from the desired scanning position with the result that it becomes possible effectively to avoid stable tracking of the track TA1 by the head HD3.

Similarly, the first head HD1 can be prevented from stably tracking the track TA3, and the second head HD2, or the fourth head HD4, can be prevented from stably tracking the track TB4 (or the track TB2, respectively, having the same azimuth gap angle.

An arrangement of the switching control circuit 21 that may be used in the recording and/or reproducing circuit 12 (Figure 5) will be described more fully with reference to Figure 9.

In Figure 9, the drum 2 on which the four heads HD1 to HD4 are mounted is shown to be rotated by a shaft S of a motor DM, and a rotary disc R is attached to the motor shaft S. On the rotary disc R, there are

provided a single magnet MG which generates one magnetic flux in the coil of a fixed head PG' each time the motor DM rotates the drum 2 and the disc R through a single revolution. A relatively large number, for examples thirty-six magnets (not shown) are equally angularly spaced on the disc R so as to generate thirty-six magnetic fluxes in a fixed head FG' each time the motor DM rotates the disc R through one revolution. In practice, a large number of magnets may be provided on the disc R for cooperation with the head FG', thereby to increase the frequency of the resulting pulse signal. The head PG' and the head FG' produce the pulse signals PG and FG (Figures 10A and 10B). The pulse PG indicates the reference rotary phase of the drum 2, whereas the pulse FG becomes a clock pulse corresponding in frequency to the rotational speed of motor DM and is used in the succeeding circuit.

The pulse PG is supplied to a counter 100, in which it is counted down or divided by three to provide a pulse $1/3$ PG (Figure 10C). The pulse $1/3$ PG is generated each time the drum 2 turns through three revolutions. The pulse $1/3$ PG from the counter 100 is supplied to an input terminal PS of a presettable counter 101. The counter 101 is preset to zero each time it receives the pulse $1/3$ PG at the input terminal PS. The presettable counter 101 receives the pulse FG' at its clock terminal C and generates the pulses SWP and SEL1 (Figure 10D). The pulses SWP and SEL1 rise at the arrival of the first pulse PG just after the presettable counter 101 is reset to zero, fall at the arrival of the tenth pulse FG, and then rise again at the arrival of the nineteenth pulse FG from the first pulse FG to the counter 101. As shown in Figure 10D, such configuration of the pulses SWP and SEL1 is repeated. The pulses SWP and SEL1, which correspond to the similarly identified signals shown in Figure 8A and Figure 8C1, indicate the times at which the heads HD1 to HD4 are sequentially used or made operative in the recording and/or reproducing modes. The switching pulse SWP is supplied to a clock terminal C of a D-type flip-flop circuit 102 which thereby generates an output at the leading or trailing edge of the switching pulse SWP. Thus, the flip-flop circuit 102 generates, at its output terminal Q, pilot signal selecting and head selecting pulses or signals SEL2 and SW1 (Figure 10E and Figures 8C2 and 8E1). Moreover, the pulse $1/3$ PG is supplied to a reset terminal R of the flip-flop circuit 102, whereby the phases of the pulses SEL1 are employed for selecting one of the pilot signals PL1 to PL4. The switching pulse SWP is inverted by an inverter 103 into the pulse SWP (Figure 10F). The inverted SWP is supplied to a clock terminal C of a D-type flip-flop circuit 104. Since the pulse $1/3$ PG is supplied to a reset terminal R of the flip-flop circuit 104, an output pulse SW2 (Figure 10G) synchronized with the pulse $1/3$ PG can be produced at the output terminal Q of the flip-flop circuit

104. The pulse SW2 and the pulse SW1 serve as the head switching pulses of Figures 8E2 and 8E1 and of Figures 10G and 10E.

Moreover, the pulse 1/3 PG is supplied to a preset input terminal PS of a presettable counter 105, and the pulse FG is supplied to a clock terminal C thereof. Accordingly, the counter 105 is preset to "000000" by each pulse 1/3 PG, and then counts the pulse FG sequentially until it generates a 6-bit parallel output. The output from the counter 105 is supplied to encoders 106 to 109. The encoder 109 generates the pulse S_{RC1} (Figure 10H) which rises when the counter 105 counts the thirty-sixth pulse FG, or is set to "100100" in the binary code notation, and which falls when the presettable counter 105 counts the eleventh pulse FG or is set to "001011".

The encoder 107 generates the pulse S_{RC2} (Figures 10I) which rises when the counter 105 counts the ninth pulse FG, or the counter 105 is set to "001001", and which falls when the counter 105 counts the twentieth pulse FG, or the counter 107 is set to "010001". Similarly, the encoders 108 and 106 generate the pulses S_{RC3} and S_{RC4} , respectively, which rise, or attain logic level "H", when the counter 105 counts the eighteenth pulse FG and twenty-ninth pulse FG, respectively, and which fall when the counter 105 counts the twenty-seventh pulse FG and the first pulse FG, respectively. The pulses S_{RC1} and S_{RC4} are respectively supplied to the recording amplifiers REC1 to REC4 as the gating signals for controlling recording as described before.

The switching control circuit 21 is not limited to the circuit arrangement described above but may be modified or replaced by, for example, a microcomputer controlled in accordance with a program to produce input and output signals similar to those described above.

While the video signal has been described above as being recorded and reproduced by four rotary magnetic heads HD1 and HD4, it is to be appreciated that a tape recorded by an 8mm VTR, for example, of the 2-head type now available on the market, can be reproduced by a 4-head VTR utilizing the described reproducing circuit. The foregoing is made possible by the fact that the recording pattern of the signals recorded on the magnetic tape by the embodiment has sufficient compatibility with the recording pattern of the signals recorded by an 8mm VTR of 2-head type.

While the invention has been specifically described as applied to a VTR having the format in which the video signal is recorded in the recording tracks TA1 to TB4 formed by scanning the tape 1 wrapped around the drum 2 with a wrap angle of substantially 270° by means of the heads HD1 to HD4 extending over an angular range of 270° on the drum, the invention is not limited to such a VTR but may be applied to VTRs having various other formats.

For example, the invention can be applied to a

VTR (corresponding to what may be called an 8mm VTR) having a format in which, as shown by a dashed line in Figure 2, the wrapping angle of the tape 1 around the drum 2 is extended to more than 270° , and in which a pulse code modulated audio signal with its time base compressed is recorded in each oblique track on the tape 1 over an angular range of θ_{pcm} (for example, about 45°) which is the angle by which the wrapping angle exceeds 270° .

While the invention has been described as applied to a VTR, the present invention is not limited to a VTR but can be applied to a wide variety of information recording and/or reproducing apparatus for recording and/or reproducing information containing a predetermined timing signal, such as, a horizontal synchronizing signal.

By way of summary, it will be seen that, in accordance with this invention, when the recording tracks are formed on the magnetic tape so as to have a recording pattern characteristic of the so-called double azimuth 4-head system in which four rotary magnetic heads are used and the azimuth gap angles of the rotary magnetic heads are changed alternately, the rotary magnetic heads are made properly to track the recording tracks in the reproducing mode of a 4-frequency ATF tracking system in such a fashion that the several recording tracks are reproduced by the same rotary magnetic heads as were used for recording in the respective tracks. For this reason, even when an error occurs in the angular distances between the four rotary magnetic heads mounted on the rotary drum, it is possible to prevent disturbance of the period of the timing signal or horizontal synchronizing signal upon switching from one to another of the reproducing rotary magnetic heads. Thus, it is easily possible to realize a video signal recording and/or reproducing apparatus which can reproduce the information recorded with high definition.

Claims

1. A video recording and/or reproducing apparatus comprising: first, second, third and fourth magnetic heads (HD1, HD2, HD3, HD4) of which said first and third heads (HD1, HD3) each have a first azimuth gap angle and said second and fourth heads (HD2, HD4) each have a second azimuth gap angle;
a rotary drum (2) on which said first, second, third and fourth heads (HD1, HD2, HD3, HD4) are mounted in the order stated with substantially equal angular spacings therebetween, said first, second, third and fourth heads (HD1, HD2, HD3, HD4) being operative, in a recording mode of the apparatus, for recording information (VIDEO) on a magnetic tape (1) in first, second, third and fourth recording tracks (TA1, TA2, TA3, TA4), re-



104. The pulse SW2 and the pulse SW1 serve as the head switching pulses of Figures 8E2 and 8E1 and of Figures 10G and 10E.

Moreover, the pulse 1/3 PG is supplied to a preset input terminal PS of a presettable counter 105, and the pulse FG is supplied to a clock terminal C thereof. Accordingly, the counter 105 is preset to "000000" by each pulse 1/3 PG, and then counts the pulse FG sequentially until it generates a 6-bit parallel output. The output from the counter 105 is supplied to encoders 106 to 109. The encoder 109 generates the pulse S_{RC1} (Figure 10H) which rises when the counter 105 counts the thirty-sixth pulse FG, or is set to "100100" in the binary code notation, and which falls when the presettable counter 105 counts the eleventh pulse FG or is set to "001011".

The encoder 107 generates the pulse S_{RC2} (Figures 10I) which rises when the counter 105 counts the ninth pulse FG, or the counter 105 is set to "001001", and which falls when the counter 105 counts the twentieth pulse FG, or the counter 107 is set to "010001". Similarly, the encoders 108 and 106 generate the pulses S_{RC3} and S_{RC4} , respectively, which rise, or attain logic level "H", when the counter 105 counts the eighteenth pulse FG and twenty-ninth pulse FG, respectively, and which fall when the counter 105 counts the twenty-seventh pulse FG and the first pulse FG, respectively. The pulses S_{RC1} and S_{RC4} are respectively supplied to the recording amplifiers REC1 to REC4 as the gating signals for controlling recording as described before.

The switching control circuit 21 is not limited to the circuit arrangement described above but may be modified or replaced by, for example, a microcomputer controlled in accordance with a program to produce input and output signals similar to those described above.

While the video signal has been described above as being recorded and reproduced by four rotary magnetic heads HD1 and HD4, it is to be appreciated that a tape recorded by an 8mm VTR, for example, of the 2-head type now available on the market, can be reproduced by a 4-head VTR utilizing the described reproducing circuit. The foregoing is made possible by the fact that the recording pattern of the signals recorded on the magnetic tape by the embodiment has sufficient compatibility with the recording pattern of the signals recorded by an 8mm VTR of 2-head type.

While the invention has been specifically described as applied to a VTR having the format in which the video signal is recorded in the recording tracks TA1 to TB4 formed by scanning the tape 1 wrapped around the drum 2 with a wrap angle of substantially 270° by means of the heads HD1 to HD4 extending over an angular range of 270° on the drum, the invention is not limited to such a VTR but may be applied to VTRs having various other formats.

For example, the invention can be applied to a

VTR (corresponding to what may be called an 8mm VTR) having a format in which, as shown by a dashed line in Figure 2, the wrapping angle of the tape 1 around the drum 2 is extended to more than 270° , and in which a pulse code modulated audio signal with its time base compressed is recorded in each oblique track on the tape 1 over an angular range of θ_{PCM} (for example, about 45°) which is the angle by which the wrapping angle exceeds 270° .

While the invention has been described as applied to a VTR, the present invention is not limited to a VTR but can be applied to a wide variety of information recording and/or reproducing apparatus for recording and/or reproducing information containing a predetermined timing signal, such as, a horizontal synchronizing signal.

By way of summary, it will be seen that, in accordance with this invention, when the recording tracks are formed on the magnetic tape so as to have a recording pattern characteristic of the so-called double azimuth 4-head system in which four rotary magnetic heads are used and the azimuth gap angles of the rotary magnetic heads are changed alternately, the rotary magnetic heads are made properly to track the recording tracks in the reproducing mode of a 4-frequency ATF tracking system in such a fashion that the several recording tracks are reproduced by the same rotary magnetic heads as were used for recording in the respective tracks. For this reason, even when an error occurs in the angular distances between the four rotary magnetic heads mounted on the rotary drum, it is possible to prevent disturbance of the period of the timing signal or horizontal synchronizing signal upon switching from one to another of the reproducing rotary magnetic heads. Thus, it is easily possible to realize a video signal recording and/or reproducing apparatus which can reproduce the information recorded with high definition.

Claims

1. A video recording and/or reproducing apparatus comprising: first, second, third and fourth magnetic heads (HD1, HD2, HD3, HD4) of which said first and third heads (HD1, HD3) each have a first azimuth gap angle and said second and fourth heads (HD2, HD4) each have a second azimuth gap angle;
a rotary drum (2) on which said first, second, third and fourth heads (HD1, HD2, HD3, HD4) are mounted in the order stated with substantially equal angular spacings therebetween, said first, second, third and fourth heads (HD1, HD2, HD3, HD4) being operative, in a recording mode of the apparatus, for recording information (VIDEO) on a magnetic tape (1) in first, second, third and fourth recording tracks (TA1, TA2, TA3, TA4), re-



spectively, so as to change azimuth gap angles from track to track;
 said magnetic heads (HD1, HD2, HD3, HD4) being operative, in a reproducing mode of the apparatus, for reproducing said information (VIDEO) from said recording tracks (TA1, TA2, TA3, TA4);
 first switching means (W1) operative in said reproducing mode for switching between outputs of said first and third magnetic heads (HD1, HD3);
 second switching means (W2) operative in said reproducing mode for switching between outputs of said second and fourth magnetic heads (HD2, HD4);
 third switching means (W3) for switching outputs from said first and second switching means (W1, W2) in synchronism with rotation of said rotary drum (2);
 means (PG') for generating a phase indicating pulse (PG) at each revolution of said drum (2) and a pulse (1/3 PG) derived from said phase indicating pulse (PG) by dividing it by three to provide a pulse for each three revolutions of said drum; and
 switching control means (21) for generating control signals (SW1, SW2, SWP) for said first, second and third switching means (W1, W2, W3) on the basis of a rotary phase of said rotary drum (2);
 said magnetic tape being wrapped about said rotary drum (2) with a wrap angle of at least 270°; characterized by:
 means (22, 23) operative in said recording mode for superimposing first, second, third and fourth pilot signals (PL1, PL2, PL3, PL4) having respective different frequencies (f1, f2, f3, f4) on said information (VIDEO) recorded by said first, second, third and fourth heads (HD1, HD2, HD3, HD4), respectively;
 means (24) for extracting said tracking pilot signals (PL1, PL2, PL3, PL4) from reproduced signals obtained from said magnetic heads (HD1, HD2, HD3, HD4) through said third switching means (W3);
 selector means (22) for selecting, in dependence on control signals from said switching control means (21), a reference pilot signal (RPL) from among four reference pilot signals generated with frequencies the same as those of said first, second, third and fourth pilot signals (PL1, PL2, PL3, PL4), respectively;
 tracking error detecting means (13) for producing a tracking error signal (SER) by comparing a pilot signal extracted from the reproduced signal obtained through said third switching means (W3) with the selected reference pilot signal (RPL);
 means (25) responsive to said tracking error signal for causing said first, second, third and fourth magnetic heads (HD1, HD2, HD3, HD4), in said reproducing mode, to track the recording tracks (TA1, TA2, TA3, TA4) in which the information and

superimposed pilot signals (PL1, PL2, PL3, PL4) were recorded by said first, second, third and fourth magnetic heads (HD1, HD2, HD3, HD4), respectively, in said recording mode; and
 means (FG') for generating a plurality of clock pulses (FG) at respective angular displacements of said drum (2) during each revolution thereof;
 said switching control means (21) generating control signals for controlling said means for superimposing said pilot signals in response to predetermined counts of said clock pulses with respect to the pulse (1/3 PG) derived from said phase indicating pulse (PG).

2. Apparatus according to claim 1 wherein said switching control means (21) includes a first counter (100) receiving said phase indicating pulse (PG) and dividing the latter by three and presetable counter means (101) preset to zero by said pulse (1/3 PG) for each three revolutions and being operative to count said clock pulses (FG) to provide a head switching signal (SWP) which changes its level as each of said magnetic heads (HD1, HD2, HD3, HD4) commences scanning of a respective recording track (TA1, TA2, TA3, TA4) on said magnetic tape (1), said head switching signal (SWP) being applied to said third switching means (W3) for controlling the latter, first and second D-type flip-flops (102, 104) for providing output pulses to control said first and second switching means (W1, W2), respectively, said first D-type flip-flop (102) having a clock input receiving said head switching signal (SWP), and inverting means (103) through which said second D-type flip-flop (104) receives said head switching signal (SWP) at a clock input thereof, said first and second D-type flip-flops (102, 104) having respective reset inputs receiving said pulse (1/3 PG) for each three revolutions.
3. Apparatus according to claim 2 wherein said selector means (22) receives said head switching signal (SWP, SEL1) and said output pulse (SEL2) from said first D-type flip-flop (102) for selecting said reference pilot signal (RPL) on the basis thereof.
4. Apparatus according to any one of claims 1 to 3 further comprising first, second, third and fourth gated amplifier means (REC1, REC2, REC3, REC4) connected to said first, second, third and fourth magnetic heads (HD1, HD2, HD3, HD4), respectively, for supplying said information (VIDEO) and superimposed pilot signal (PL1, PL2, PL3, PL4) thereto in said recording mode; and wherein said switching control means (21) is operative, in said recording mode, to provide first, second, third and fourth gating signals (S_{RC1},



S_{RC2} , S_{RC3} , S_{RC4}) to said first, second, third and fourth gated amplifiers (REC1, REC2, REC3, REC4), respectively, for ensuring that said first, second, third and fourth pilot signals (PL1, PL2, PL3, PL4) are recorded by said first, second, third and fourth magnetic heads (HD1, HD2, HD3, HD4) respectively, in the recording tracks (TA1, TA2, TA3, TA4) scanned thereby.

5. Apparatus according to claim 4 wherein said first, second, third and fourth heads (HD1, HD2, HD3, HD4) scan first, second, third and fourth recording tracks (TA1, TA2, TA3, TA4), respectively, during each three successive revolutions of said drum (2); and wherein said switching control means (21) includes further presettable counter means (105) preset by said pulse (1/3 PG) for each three revolutions of said drum (2) and being operative to count said clock pulse (FG), and encoding means (106, 107, 108, 109) responsive to predetermined counts of said presettable counter means (105) for providing said gating signals (S_{RC1} , S_{RC2} , S_{RC3} , S_{RC4}) to said gated amplifier means (REC1, REC2, REC3, REC4).
6. Apparatus according to any one of the preceding claims wherein said magnetic tape (1) is wrapped about said rotary drum (2) with a wrap angle substantially exceeding 270° , and said information (VIDEO) recorded by each of said first, second, third and fourth heads (HD1, HD2, HD3, HD4), respectively, includes video information which is supplied to the respective one of said recording tracks (TA1, TA2, TA3, TA4) corresponding to a wrap angle of 270° so that an over scan portion remains in each of said recording tracks (TA1, TA2, TA3, TA4) for receiving recorded audio information (AUDIO).

Patentansprüche

1. Videoaufzeichnungs- und/oder Wiedergabegerät mit:
 - einem ersten, zweiten, dritten und vierten Magnetkopf (HD1, HD2, HD3, HD4), von denen der erste und dritte Kopf (HD1, HD3) jeweils einen ersten Azimuth-Spaltwinkel und der zweite und vierte Kopf (HD2, HD4) jeweils einen zweiten Azimuth-Spaltwinkel besitzen;
 - einer Rotationstrommel (2), auf welcher der erste, zweite, dritte und vierte Kopf (HD1, HD2, HD3, HD4) in der Ordnung befestigt ist, die im wesentlichen mit gleichen dazwischen liegenden Winkelabständen festgelegt ist, wobei der erste, zweite, dritte und vierte Kopf (HD1, HD2, HD3, HD4) in einem Aufzeichnungsmodus des Geräts zum Aufzeichnen einer Information (VI-

DEO) auf einem Magnetband in einer ersten bzw. zweiten, dritten und vierten Aufzeichnungsspur (TA1, TA2, TA3, TA4) Azimuth-Spaltwinkel von Spur zur Spur ändern können;

wobei die Magnetköpfe (HD1, HD2, HD3, HD4) in einem Wiedergabemodus des Geräts die Information (VIDEO) aus den Aufzeichnungsspuren (TA1, TA2, TA3, TA4) wiedergeben können;

einer ersten Schalteinrichtung (W1), die im Wiedergabemodus zwischen Ausgangssignalen des ersten und dritten Magnetkopfs (HD1, HD3) umschalten kann;

einer zweiten Schalteinrichtung (W2), die im Wiedergabemodus zwischen Ausgangssignalen des zweiten und vierten Magnetkopfs (HD2, HD4) umschalten kann;

einer dritten Schalteinrichtung (W3) zum Umschalten von Ausgangssignalen der ersten und zweiten Schalteinrichtung (W1, W2) synchron mit einer Rotation der Rotationstrommel (2);

einer Einrichtung (PG') zum Erzeugen eines Phasenzeigepulses (PG) bei jeder Umdrehung der Trommel (2) und eines Impulses (1/3 PG), der vom Phasenzeigepuls (PG) durch dessen Dividieren durch drei hergeleitet wird, um einen Impuls für eine jede dritte Umdrehung der Trommel zu liefern; und

einer Schaltsteuereinrichtung (21) zum Erzeugen von Steuersignalen (SW1, SW2, SWP) für die erste, zweite und dritte Schalteinrichtung (W1, W2, W3) auf der Grundlage einer Rotationsphase der Rotationstrommel (2);

wobei das Magnetband um die Rotationstrommel (2) mit einem Umschlingungswinkel von wenigstens 270° gewickelt ist;

gekennzeichnet durch

Einrichtungen (22, 23), die im Aufzeichnungsmodus ein erstes bzw. zweites, drittes und viertes Pilotsignal (PL1, PL2, PL3, PL4), die entsprechende verschiedene Frequenzen (f_1 , f_2 , f_3 , f_4) haben, auf der Information (VIDEO) überlagern können, die durch den ersten bzw. zweiten, dritten und vierten Kopf (HD1, HD2, HD3, HD4) aufgezeichnet ist;

eine Einrichtung (24) zum Extrahieren der Spurpilotsignale (PL1, PL2, PL3, PL4) aus den reproduzierten Signalen, die von den Magnetköpfen (HD1, HD2, HD3, HD4) über die dritte Schalteinrichtung (W3) erhalten werden;

eine Auswahlrichtung (22) zum Auswählen in Abhängigkeit von Steuersignalen aus den Schaltsteuermitteln (21) eines Referenzpilotsignals (RPL) unter vier Referenzpilotsignalen, das mit den gleichen Frequenzen wie die des ersten, bzw. zweiten, dritten und vierten Pilotsignals (PL1, PL2, PL3, PL4) erzeugt wurde;

eine Spurfehlerermittlungseinrichtung (13)



zum Liefern eines Spurfehlersignals (SER) durch Vergleich eines vom reproduzierten Signal extrahierten Pilotsignals, das über die dritte Schalteinrichtung (W3) mit dem ausgewählten Referenzpilotsignal (RPL) erhalten wurde;

eine Einrichtung (25), die auf das Spurfehlersignal antwortet, zur Veranlassung des ersten, zweiten, dritten und vierten Magnetkopfs (HD1, HD2, HD3, HD4) im Wiedergabemodus, die Aufzeichnungsspuren (TA1, TA2, TA3, TA4), in denen die Information und die Überlagerungspilotsignale (PL1, PL2, PL3, PL4) durch den ersten bzw. zweiten, dritten und vierten Magnetkopf (HD1, HD2, HD3, HD4) im Aufzeichnungsmodus aufgezeichnet wurden, zu verfolgen; und

eine Einrichtung (FG') zum Erzeugen von mehreren Taktimpulsen (FG) bei entsprechenden Winkelversetzungen der Trommel (2) während jeder Umdrehung von ihr;

wobei die Schaltsteuereinrichtung (21) Steuersignale erzeugt zum Steuern der Einrichtung zur Überlagerung der pilotsignale in Abhängigkeit von vorgegebenen Zählwerten der Taktimpulse in bezug auf den Impuls (1/3 PG), der vom Phasenzangeimpuls (PG) hergeleitet wurde.

2. Gerät nach Anspruch 1, dadurch gekennzeichnet, daß die Schaltsteuereinrichtung (21) einen ersten Zähler (100) aufweist, der den phasenzangeimpuls (PG) empfängt und diesen durch drei teilt, und eine voreinstellbare Zählereinrichtung (101), die durch diesen Impuls (1/3 PG) für eine jede dritte Umdrehung auf Null voreingestellt wird, und welche die Taktimpulse (FG) zählen kann, um ein Kopfschaltsignal (SWP) zu liefern, das seinen Pegel ändert, wenn jeder der Magnetköpfe (HD1, HD2, HD3, HD4) mit einem Abtasten einer entsprechenden Aufzeichnungsspur (TA1, TA2, TA3, TA4) auf dem Magnetband (1) beginnt, daß das Kopfschaltsignal (SWP) an die dritte Schalteinrichtung (W3) zur Steuerung des letzteren, ersten und zweiten D-Flipflops (102, 104) angelegt wird, um Ausgangsimpulse zu liefern, um die erste bzw. zweite Schalteinrichtung (W1, W2) zu steuern, daß das erste D-Flipflop (102) einen Takteingang hat, der das Kopfschaltsignal (SWP) empfängt, und eine Invertereinrichtung (103), über die das zweite D-Flipflop (104) das Kopfschaltsignal (SWP) an seinem Takteingang empfängt, wobei das erste und zweite D-Flipflop (102, 104) entsprechende Reseteingänge hat, die den Impuls (1/3 PG) für eine jede dritte Umdrehung empfängt.
3. Gerät nach Anspruch 2, dadurch gekennzeichnet, daß die Auswahleinrichtung (22) das Kopfschaltsignal (SWP, SEL1) und den Ausgangsim-

puls (SEL2) vom ersten D-Flipflop (102) zur Auswahl des Referenzpilotsignals (RPL) auf dessen Grundlage empfängt.

4. Gerät nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß es weiter eine erste bzw. zweite, dritte und vierte torgesteuerte Verstärkereinrichtung (REC1, REC2, REC3, REC4) aufweist, die mit dem ersten bzw. zweiten, dritten und vierten Magnetkopf (HD1, HD2, HD3, HD4) verbunden ist, um die Information (VIDEO) und das überlagerte Pilotsignal (PL1, PL2, PL3, PL4) im Aufzeichnungsmodus dorthin zu liefern; und daß die Schaltsteuereinrichtung (21) im Aufzeichnungsmodus ein erstes bzw. zweites, drittes und viertes Torsteuerungssignal (SRC1, SRC2, SRC3, SRC4) zum ersten bzw. zweiten, dritten und vierten torgesteuerten Verstärker (REC1, REC2, REC3, REC4) liefern kann, um sicherzustellen, daß das erste bzw. zweite, dritte und vierte Pilotsignal (PL1, PL2, PL3, PL4) durch den ersten bzw. zweiten, dritten und vierten Magnetkopf (HD1, HD2, HD3, HD4) in den Aufzeichnungsspuren (TA1, TA2, TA3, TA4) aufgezeichnet wird, die dadurch abgetastet werden.
5. Gerät nach Anspruch 4, dadurch gekennzeichnet, daß der erste bzw. zweite, dritte und vierte Kopf (HD1, HD2, HD3, HD4) eine erste bzw. zweite, dritte und vierte Aufzeichnungsspur (TA1, TA2, TA3, TA4) während einer jeden dritten aufeinanderfolgenden Umdrehung der Trommel (2) abtastet; und daß die Schaltsteuereinrichtung (21) weiter eine voreinstellbare Zählereinrichtung (105) aufweist, die durch den Impuls (1/3 PG) für eine jede dritte Umdrehung der Trommel (2) voreingestellt wird und die den Taktimpuls (FG) zählen kann, und eine Verschlüsselungseinrichtung (106, 107, 108, 109) zum Liefern von Torsteuerungssignalen (SRC2, SRC2, SRC3, SRC4) zur torgesteuerten Verstärkereinrichtung (REC1, REC2, REC3, REC4) aufgrund vorbestimmter Zählwerte der voreinstellbaren Zählereinrichtung (105).
6. Gerät nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das Magnetband (1) um die Rotationstrommel (2) mit einem Umschlingungswinkel gewickelt ist, der 270° wesentlich übersteigt, und daß die Information (VIDEO), die durch den ersten bzw. zweiten, dritten und vierten Kopf (HD1, HD2, HD3, HD4) aufgezeichnet wurde, eine Videoinformation enthält, die zu einer entsprechenden der Aufzeichnungsspuren (TA1, TA2, TA3, TA4) entsprechend einem Umschlingungswinkel von 270° geliefert wird, so daß ein Überabtastbereich (Overscanbereich) in jeder der Aufzeichnungsspuren (TA1, TA2, TA3, TA4) zum Empfang einer aufgezeichneten Audiöinfor-



mation (AUDIO) verbleibt.

Revendications

1. Un appareil d'enregistrement et/ou de reproduction vidéo comprenant : des première, seconde, troisième et quatrième têtes magnétiques (HD1, HD2, HD3, HD4), desquelles lesdites première et troisième têtes (HD1, HD3) ont chacune un premier angle d'ouverture d'azimut, et lesdites seconde et quatrième têtes (HD2, HD4), ont chacune un second angle d'ouverture d'azimut ;

un tambour rotatif (2) sur lequel lesdites première, seconde, troisième têtes (HD1, HD2, HD3, HD4) sont montées dans l'ordre énoncé, avec des espacements angulaires sensiblement égaux entre elles, lesdites première, seconde, troisième et quatrième têtes (HD1, HD2, HD3, HD4) étant opérantes, dans un mode d'enregistrement de l'appareil, pour enregistrer de l'information (VIDEO) sur une bande magnétique (1), dans des première, seconde, troisième et quatrième pistes d'enregistrement (TA1, TA2, TA3, TA4), respectivement, de façon à changer des angles d'ouverture d'azimut de piste à piste ;

desdites têtes magnétiques (HD1, HD2, HD3, HD4) étant opérantes, dans un mode de reproduction de l'appareil, pour reproduire ladite information (VIDEO) à partir desdites pistes d'enregistrement (TA1, TA2, TA3, TA4) ;

des premiers moyens de commutation (W1) opérant dans ledit mode de reproduction pour commutation entre des sorties desdites première et troisième têtes magnétiques (HD1, HD3) ;

des seconds moyens de commutation (W2) opérant dans ledit mode de reproduction, pour commutation entre des sorties desdites seconde et quatrième têtes magnétiques (HD2, HD4) ;

des troisièmes moyens de commutation (W3) pour commuter des sorties à partir desdits premier et second moyens de commutation (W1, W2), en synchronisme avec la rotation dudit tambour rotatif (2) ;

des moyens (PG') pour générer une impulsion d'indication de phase (PG) à chaque révolution dudit tambour (2) et une impulsion (1/3 PG) dérivée de ladite impulsion d'indication de phase (PG), en la divisant par trois afin de procurer une impulsion pour chaque trois révolutions dudit tambour ;

et des moyens de commande de commutation (21) pour générer des signaux de commande (SW1, SW2, SWP) pour lesdits premier, second et troisième moyens de commutation (W1, W2, W3), sur la base d'une phase rotative dudit

tambour rotatif (2) ;

ladite bande magnétique étant enroulée autour dudit tambour rotatif (2) avec un angle d'enroulement d'au moins 270° ;

caractérisé par :

des moyens (22, 23) actifs dans ledit mode d'enregistrement, pour superposer des premier, second, troisième et quatrième signaux pilotes (PL1, PL2, PL3, PL4) ayant des fréquences différentes respectives (f1, f2, f3, f4) sur ladite information (VIDEO) enregistrée par lesdites première, seconde, troisième et quatrième têtes (HD1, HD2, HD3, HD4), respectivement ;

des moyens (24) pour extraire lesdits signaux pilotes de suivi de piste (PL1, PL2, PL3, PL4) à partir de signaux reproduits obtenus à partir desdites têtes magnétiques (HD1, HD2, HD3, HD4), par l'intermédiaire desdits troisièmes moyens de commutation (W3) ;

des moyens de sélecteur (22) pour sélectionner, en fonction de signaux de commande, à partir desdits moyens de commande de commutation (21), un signal pilote de référence (RPL) parmi quatre signaux pilotes de référence générés avec des fréquences identiques à celles desdits premier, second, troisième et quatrième signaux pilotes (PL1, PL2, PL3, PL4), respectivement ;

des moyens (13) de détection d'erreurs de suivi de piste pour produire un signal (SER) d'erreur de suivi de piste, en comparant un signal pilote extrait à partir du signal reproduit, obtenu au moyen desdits troisièmes moyens de commutation (W3), avec le signal pilote de référence (RPL) sélectionné ;

des moyens (25) réagissant au signal d'erreur de suivi de piste, pour amener lesdites première, seconde, troisième et quatrième têtes magnétiques (HD1, HD2, HD3, HD4), dans ledit mode de reproduction, à suivre les pistes d'enregistrement (TA1, TA2, TA3, TA4), dans lesquelles l'information et les signaux pilotes (PL1, PL2, PL3, PL4) superposés étaient enregistrés par lesdites première, seconde, troisième et quatrième têtes magnétiques (HD1, HD2, HD3, HD4), respectivement, dans ledit mode d'enregistrement ; et

des moyens (FG') pour générer une pluralité d'impulsions d'horloge (FG), à des déplacements angulaires respectifs dudit tambour (2), durant chaque révolution de celui-ci ;

lesdits moyens (21) de commande de commutation générant des signaux de commande pour commander lesdits moyens pour superposer lesdits signaux pilotes, en réponse à des comptes prédéterminés desdites impulsions d'horloge, par rapport à l'impulsion (1/3 PG) dérivée à partir de ladite impulsion (PG) d'indication



de phase.

2. Appareil selon la revendication 1, dans lequel lesdits moyens (21) de commande de commutation incluent un premier compteur (100) recevant ladite impulsion (PG) d'indication de phase et divisant cette dernière par trois, et des moyens (101) de compteur préréglables, préréglés à zéro par ladite impulsion (1/3 PG) pour chaque trois révolutions et étant opérant afin de compter lesdites impulsions d'horloge (FG), afin de procurer un signal (SWP) de commutation de tête, qui change son niveau à chacune desdites têtes magnétiques (HD1, HD2, HD3, HD4), commence l'exploration d'une piste d'enregistrement (TA1, TA2, TA3, TA4) respective sur ladite bande magnétique (1), ledit signal (SWP) de commutation de tête étant appliqué auxdits troisièmes moyens de commutation (W3) pour commander ces derniers, des premier et second circuits bistables (102, 104) de type D pour procurer des impulsions de sortie, afin de commander lesdits premiers et seconds moyens de commutation (W1, W2), respectivement, ledit premier circuit bistable (102) de type D ayant une entrée d'horloge recevant ledit signal (SWP) de commutation de tête, et des moyens d'inversion (103), au moyen desquels ledit second circuit bistable (104) de type D reçoit ledit signal (SWP) de commutation de tête à une entrée d'horloge de celui-ci, lesdits premier et second circuits bistables (102, 104) de type D ayant des entrées de restauration respectives recevant ladite impulsion (1/3 PG) pour chaque trois révolution.
3. Appareil selon la revendication 2, dans lequel lesdits moyens (22) de sélecteur reçoivent ledit signal (SWP, SEL1) de commutation de tête et ladite impulsion (SEL2) de sortie à partir dudit premier circuit bistable (102) de type D, pour sélectionner ledit signal pilote de référence (RPL) sur la base de ceux-ci.
4. Appareil selon une quelconque des revendications 1 à 3 comprenant de plus des premiers, seconds, troisièmes et quatrièmes moyens d'amplificateur déclenchés (REC1, REC2, REC3, REC4) reliés auxdites première, seconde, troisième et quatrième têtes magnétiques (HD1, HD2, HD3, HD4), respectivement, pour fournir ladite information (VIDEO) et le signal pilote (PL1, PL2, PL3, PL4) superposé à celle-ci dans ledit mode d'enregistrement; et dans lequel, lesdits moyens (21) de commande de commutation sont opérants, dans ledit mode d'enregistrement, afin de procurer des premier, second, troisième et quatrième signaux de déclenchement (S_{RC1} , S_{RC2} , S_{RC3} , S_{RC4}) auxdits premier, second, troisième et

quatrième amplificateurs (REC1, REC2, REC3, REC4) déclenchés, respectivement, pour garantir que lesdits premier, second, troisième et quatrième signaux pilotes (PL1, PL2, PL3, PL4) sont enregistrés par lesdites première, seconde, troisième et quatrième têtes magnétiques (HD1, HD2, HD3, HD4), respectivement, dans les pistes d'enregistrement (TA1, TA2, TA3, TA4) explorées par celles-ci.

5. Appareil selon la revendication 4, dans lequel lesdites première, seconde, troisième et quatrième têtes (HD1, HD2, HD3, HD4) explorent les première, seconde, troisième, quatrième pistes d'enregistrement (TA1, TA2, TA3, TA4), respectivement, durant chaque trois révolutions successives dudit tambour (2); et dans lequel lesdits moyens (21) de commande de commutation incluent de plus des moyens de compteur (105) préréglables, préréglés par ladite impulsion (1/3 PG) pour chaque trois révolution dudit tambour (2), et étant opérant afin de compter ladite impulsion d'horloge (FG), et des moyens de codage (106, 107, 108, 109), réagissant à des comptes prédéterminés desdits moyens (105) de compteur préréglables, pour procurer lesdits signaux de déclenchement (S_{RC1} , S_{RC2} , S_{RC3} , S_{RC4}) auxdits moyens (REC1, REC2, REC3, REC4) d'amplificateur déclenché.
6. Appareil selon l'une quelconque des précédentes revendications, dans lequel ladite bande magnétique (1) est enroulée autour dudit tambour rotatif (2), avec un angle d'enroulement excédant sensiblement 270°, et ladite information (VIDEO) enregistrée par chacune desdites première, seconde, troisième et quatrième têtes (HD1, HD2, HD3, HD4), respectivement, inclut l'information vidéo qui est fournie respectivement à l'une desdites pistes d'enregistrement (TA1, TA2, TA3, TA4) correspondant à un angle d'enroulement de 270°, de sorte qu'une partie de surexploration reste dans chacune desdites pistes d'enregistrement (TA1, TA2, TA3, TA4), pour recevoir de l'information audio (AUDIO) enregistrée.