

PATENT SPECIFICATION

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(54) VIDEO SIGNAL REPRODUCING APPARATUS

(71) We, SONY CORPORATION, a corporation organised and existing under the laws of Japan, of 7-35 Kitashinagawa-6, Shinagawa-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

- 5 This invention relates to video signal reproducing apparatus. 5
With a video tape recorder (VTR) of the helical scanning type, if the magnetic tape is transported at a low speed or is stopped, while the magnetic head is rotated at the frame frequency, slow motion or still reproduction can be carried out. This is useful, for example, for editing, and in fact to find a required editing point it may be desired to transport the tape 10 step-wise frame by frame. In this case, however, since the parallel oblique video tracks recorded on the video tape differ in inclination angle to the scanning traces of the magnetic head during the slow motion or still reproducing mode, the head scans a portion of the guard band between adjacent video tracks. This results in guard band noise at a mid portion of a reproduced picture. 10
15 According to the present invention there is provided a video signal reproducing apparatus having a tape transport means including a slow motion and still reproduction mode and a signal reproducing means for reproducing a video signal recorded in parallel tracks oblique to the length of a magnetic tape, and further comprising: 15
20 a drive motor coupled to said tape transport means;
a motor driving circuit for driving said drive motor; and control circuit means operable by a user when the slow motion and still reproduction mode has been selected for supplying stepping pulses to said motor driving circuit, one cycle of said stepping pulses serving to transport said magnetic tape by a predetermined distance, which distance is shorter than one pitch of said tracks measured in the direction parallel to the length of said magnetic tape. 20
25 The invention will now be described by way of example with reference to the accompanying drawings, in which:
Figures 1A and 1B show a part of a video tape on which oblique video tracks are formed; Figure 2 is a block diagram showing an embodiment of VTR according to the invention; and 25
30 Figures 3A to 3E are waveform diagrams for explaining the operation of the VTR of Figure 2. 30
In an ordinary VTR of the helical scanning type, if the video tape is transported at a low speed or is stopped, while the magnetic head is rotated at the frame frequency, slow motion or still reproduction can be obtained. For editing, it may be required to transport the tape 35 step-wise track by track, that is, field by field. 35
However, as shown in Figure 1A, a video track 2 recorded on a video tape 1 differs in inclination angle from a scanning trace 3 of a magnetic head in the slow motion or still reproduction mode, so the head may scan a mid portion or guard band 3A between adjacent video tracks 2. The head also scans parts of both of the adjacent video tracks 2, with the result that guard band noise is contained in the reproduced video signal, and hence a noise band 40 appears at the mid portion of a reproduced picture. 40
In order to avoid this defect, it is necessary for the tape 1 to be transported by a distance corresponding to a fraction of the pitch p of the video tracks 2 measured in the direction of the tape length to shift the portion 3A where the head bridges the adjacent video tracks 2 to an end portion of the video tracks 2, as shown in Figure 1B, and accordingly to move the noise 45

band to the vertical blanking period or an end portion of a reproduced picture.

An embodiment of VTR according to the invention, with which the above operation to move the noise band to the vertical blanking period or to an end portion of the reproduced picture can easily be performed, will now be described with reference to Figure 2.

5 Rotary magnet heads 11 and 12 are arranged at an angular spacing of 180° and are rotated by a motor 21 at the frame frequency (30 Hz for NTSC) under control of a servo circuit 20. In the servo circuit 20, the vertical synchronising pulse is fed from an external synchronising board (not shown) to an input terminal 22, this vertical synchronising pulse is then fed to a frequency divider circuit 23 to be divided into a signal of 30 Hz which is one-half of the frequency of the pulse signal applied thereto, and the frequency-divided signal is then fed to a phase comparator circuit 24. A pulse generator 26 is provided in association with, for example, a rotary shaft 25 of the motor 21 to which the heads 11 and 12 are attached. The pulse generator 26 produces one pulse at each rotation of the heads 11 and 12, and this pulse is fed through a shaping amplifier 27 to the phase comparator 24. The compared output signal therefrom is fed through a driving amplifier 28 to the motor 21 to control the latter. Thus, the rotation of the heads 11 and 12 is synchronised with the vertical synchronising pulse supplied to the terminal 22. 15

The tape 1 is obliquely wound on the cylindrical surface of a head drum associated with the heads 11 and 12, and over an angular range of about 180° . A capstan 14 and a pinch roller 15 are provided to transport the tape 1. 20

In the embodiment of Figure 2, there is provided a servo circuit 30, which operates as a phase locked loop (PLL) upon recording to record a video signal on the tape 1, which is transported in accordance with the vertical synchronising pulse fed to the terminal 22. That is, there is provided a variable frequency oscillator (VFO) 31 which produces an oscillatory signal, the free-running frequency of which is, for example, 210 Hz. This oscillatory signal is supplied to a frequency divider circuit 32 to be frequency-divided by seven to form a signal of frequency of 30 Hz. This frequency-divided signal is fed through a recording side contact R of a recording and playback mode changing switch 33 to a phase comparator circuit 34 which is also supplied with the output signal from the frequency divider 23. The compared output from the phase comparator 34 is fed to the VFO 31 as its control signal. Thus, the frequency and phase of the oscillatory signal from the VFO 31 are synchronised with the vertical synchronising signal fed to the terminal 22. 25

The oscillatory signal from the VFO 31 is fed through a recording side contact R of a recording and playback mode changing switch 36 to a hexadic counter 37 to be converted into symmetrical, rectangular waveform three-phase signals of frequency $1/6$ that of the oscillatory signal. One of the three-phase signals is supplied directly to and the other two thereof are supplied through a switching circuit 38 to amplifiers 41, 42 and 43, respectively. The output signals from the amplifiers 41 to 43 are fed to a Δ -connection of a three-phase hysteresis motor 45 for driving the capstan 14. Thus, the motor 45 is rotated in synchronism with the vertical synchronising pulse fed to the terminal 22 and hence tape 1 is transported in synchronism with the synchronising pulse signal. 35

A video signal is fed from an input terminal 5 through a recording amplifier 6, which includes a frequency modulator and so on, and through a recording side contact R of a recording and playback mode changing switch 7 to the heads 11 and 12. Thus, the video signal is recorded on the tape 1 such that one field of the video signal forms one oblique magnetic track as shown in Figure 1. At the same time, the frequency-divided signal from the frequency divider 23 is supplied through a recording amplifier 51 and a recording side contact R of a recording and playback mode changing switch 52 to a magnetic head 13 which then records the frequency-divided signal on the tape 1 along the edge portion as a control pulse upon playback. 40

On ordinary playback, the servo circuit 30 acts as a PLL servo circuit to carry out the tracking servo control. That is, the control pulse is reproduced by the head 13 from the tape 1 and fed through a playback side contact P of the switch 52, a reproducing amplifier 54 and a play back side contact P of the switch 33 to the phase comparator 34, which phase-compares the control signal with the frequency-divided signal from the frequency divider 23. The compared output signal from the phase comparator 34 is fed to the VFO 31 as its control signal and the oscillation signal therefrom is fed through a normal playback side contact N of a playback mode changing switch 35 and a playback side contact P of the switch 36 to the counter 37. Then, the three-phase signals from the counter 37 are supplied through switching circuit 38 and the amplifiers 41 to 43 to the motor 45. As a result, the motor 45 is servo-controlled such that the phase difference between the vertical synchronising pulse applied to the terminal 22 and the control pulse from the head 13 is made constant, and hence the heads 11 and 12 scan the video tracks 2 on the tape 1 correctly. 50

The video signal reproduced by the heads 11 and 12 from the tape 1 is supplied through a playback side contact P of the switch 7 and through a playback amplifier 8, which includes a 55

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limiter, frequency demodulator and so on, to an output terminal 9.

With the embodiment of Figure 2, the editing point of tape 1 is determined with the aid of a control circuit 60. In the control circuit 60, there are provided an operating switch 61 which serves to transport tape 1 by a step corresponding to $1/3.5$ of the track pitch p in the forward direction, every time the switch 61 is momentarily operated, an operating switch 62 which serves to transport tape 1 in the backward direction in the similar manner to that of switch 61, and a control signal generator circuit 63. The control signal generator 63 produces a control signal S_a , which is '1' when the switch 61 or 62 is ON as shown in Figure 3A, and also a signal S_f which is '1' only when the switch 62 is ON. The control circuit 60 further includes monostable multivibrators 64 and 65 for generating trigger pulses, and each of which has a clear terminal CL. When the monostable multivibrators 64 and 65 are supplied, at their clear terminals CL, with a signal 'O', their time constant capacitors (not shown) are reset and hence their output terminals Q are made 'O' irrespective of the mode at that time. An output terminal Q of the monostable multivibrator 64 is connected to the input terminal of the monostable multivibrator 65, while an output terminal $\bar{Q}$ of the monostable multivibrator 65 is connected through an AND circuit 66 for gating to the input terminal of the monostable multivibrator 64.

In the control circuit 60, there are further provided inverters 67, 68 and 69 which serve to provide a delay circuit between the control signal generator 63 and the monostable multivibrators 64 and 65. The signal S_a from the control signal generator 63 is fed to the clear terminal CL of the monostable multivibrator 64, also to the clear terminal CL of the monostable multivibrator 65 through inverters 67 and 68, and further through the inverters 67 and 69 to the input terminal of the AND circuit 66.

When the switches 61 and 62 are OFF, the signal S_a from the signal generator 63 is 'O' before time t_1 , as shown in Figure 3A, and an output signal S_b from the inverter 68 is also 'O' before time t_1 , as shown in Figure 3B. Accordingly, the output signal from the AND circuit 66 is 'O', and the monostable multivibrators 64 and 65 are made clear by signals S_a and S_b with the result that their output signals S_c and S_d at their output terminals Q are '1', respectively, as shown in Figures 3C and 3D.

When a desired editing point is to be determined, the switch 61 or 62 is made ON. That is, when the switch 61 is made ON at time t_1 (Figure 3), the signal S_a becomes '1' with the result that the monostable multivibrator 64 is released from the clear state. Thereafter, the signal S_b from the inverter 68 becomes '1' so that the monostable multivibrator 65 is also released from the clear state. In this case, since the signal S_b from the inverter 69 becomes '1', the output signal S_d from the monostable multivibrator 65 is fed through the AND circuit 66 to the monostable multivibrator 64 from about t_1 . Thus, the monostable multivibrator 64 is triggered by the signal S_d at the rising edge and also the multivibrator 65 is triggered by the signal S_c at the rising edge. Accordingly, the monostable multivibrators 64 and 65 start their oscillation from about time t_1 and hence the signals S_c and S_d therefrom are varied at every reversing period T_c and T_d , for example 0.2 seconds, of the monostable multivibrators 64 and 65, as shown in Figures 3C and 3D, respectively.

At this time, the monostable multivibrator 64 produces, at the output terminal Q, a signal S_e which is of reverse phase to the signal S_c produced at the terminal Q of the multivibrator 64, as shown in Figure 3E. This signal S_e is supplied through a slow-still playback side contact S of the switch 35 and a contact P of the switch 36 to the counter 37. Accordingly, the motor 45 is rotated in response to the signal S_e , so that the tape 1 is transported by the motor 45 at a speed corresponding to the frequency of the signal S_e . Therefore, for each cycle of the oscillatory signal of frequency 210 Hz supplied by the VFO 31, the tape 1 is transported by a distance:

$$\frac{60p}{210} = \frac{p}{3.5}$$

In other words, in the slow motion and still reproduction modes of operation, the tape 1 is transported step-wise in steps of $1/3.5$ of the track pitch p .

When a required picture is reproduced at, for example, time t_2 , the switch 61 is put OFF. Then, the signals S_a and S_b become 'O', so that the signal S_d is not supplied to the multivibrator 64, which then stops oscillation, and the multivibrators 64 and 65 are cleared by the signals S_a and S_b , respectively. As a result, the output signals S_c and S_d from the multivibrators 64 and 65 become '1' from time t_2 , while the signal S_e from the output terminal Q of the multivibrator 64 becomes 'O'. Thus, the transportation of tape 1 is stopped from time t_2 and hence the apparatus is brought into the still reproduction mode.

If any noise band appears on a reproduced picture during the still reproduction mode, the switch 61 is put ON momentarily, in particular for less than 0.2 seconds, which is the period T_c , to make the signal S_a '1' in time period T_a ($T_a < T_c$) from time t_3 as shown in Figure 3A.

Then, at this time the multivibrator 64 is triggered and the output signal Sc becomes 'O', but the signal Sb becomes 'O' at time t_4 where the period Ta is terminated. Thus, the multivibrator 64 is cleared and hence the output signal Sc again becomes '1' at time t_4 . Although the signal Sc becomes '1' at time t_4 , at this time the multivibrator 65 is cleared by the signal Sb

with the result that the signal Sd remains '1'. That is, when the switch 61 is made ON for a period Ta ($T_a < T_c$), the signal Sc becomes 'O' in the period Ta and at the same time the signal Se becomes '1' in the same period Ta. Accordingly, since one cycle of the signal Se is obtained between times t_3 and t_4 , the motor 45 is rotated in response to the signal Se and hence the tape 1 is transported by $p/3.5$, with the result that the noise band on the reproduced picture is

moved up or down.
If the noise band is still a problem despite the above operation, the switch 61 is put ON again at time t_5 later than time t_4 for a period Ta. Thus, the tape 1 is again transported by a similar fraction of the track pitch p , and the noise band is further moved up or down. By repeating the above operation the noise band can be moved to a position where it is

inconspicuous.
As shown in Figure 3 after time t_6 , if the switch 61 is successively operated the tape 1 can be transported at a speed corresponding to the operating speed of the switch 61.

Further, if the switch 62 is put ON, the signal Se is generated from the multivibrator 64 similarly to when the switch 61 is operated. In this case the switching circuit 38 is changed over by the signal Sf from the signal generator 63 and two signals of the three-phase signals supplied from the counter 37 to the motor 45 are inter-changed, so that the rotational direction of the motor 45 is reversed and hence the tape 1 is transported in the reverse direction.

It is also possible for the apparatus for achieving the above operation to be made as an accessory for a VTR, so that when coupled to the VTR, the VTR can be controlled remotely.

WHAT WE CLAIM IS:-

1. A video signal reproducing apparatus having a tape transport means including a slow motion and still reproduction mode and a signal reproducing means for reproducing a video signal recorded in parallel tracks oblique to the length of a magnetic tape, and further comprising:

a drive motor coupled to said tape transport means;

a motor driving circuit for driving said drive motor; and

control circuit means operable by a user when the slow motion and still reproduction mode has been selected for supplying stepping pulses to said motor driving circuit, one cycle of said stepping pulses serving to transport said magnetic tape by a predetermined distance, which distance is shorter than one pitch of said tracks measured in the direction parallel to the length of said magnetic tape.

Apparatus according to claim 1, wherein said control circuit means includes a control signal generator having a first terminal, actuating means connected to said control signal generator and capable of being selectively set into an 'on' state, said control signal generator providing from said first terminal a first signal whenever said actuating means is set into said 'on' state, and pulse forming means for providing said stepping pulses in response to said first signal.

3. Apparatus according to claim 2, wherein said pulse forming means includes first and second monostable multivibrators, each having an input terminal, a clear terminal, an output terminal, and an inverse output terminal; a logic circuit; and delay circuit means coupled between the first terminal of said control signal generator and said first and second multivibrators for supplying said first signal to said multivibrators; the first signal being supplied to the clear terminal of said first multivibrator, the first signal being supplied to the clear terminal of the second multivibrator and to said logic circuit, the inverse output terminal of said second multivibrator being connected with said logic circuit, said logic circuit providing a signal to the input terminal of said first multivibrator whenever there is coincidence between said first signal and the output from said inverse output terminal of said second multivibrator, the inverse output terminal of said first multivibrator being connected to the input terminal of said second multivibrator, and the output terminal of said first multivibrator providing said stepping pulses.

4. Apparatus according to claim 1, wherein said drive motor has an associated supply means for providing current to said motor, and said stepping pulse supplying control circuit means comprises a digital counter.

5. Apparatus according to claim 4 wherein said motor is a multiple-phase motor, and said supply means includes a plurality of amplifiers, each said amplifier providing a current to said motor.

6. Apparatus according to claim 5 wherein said control circuit means includes a control signal generator and reverse actuating means connected to said control signal generator and capable of being selectively set into an 'on' state, said control signal generator providing a reversing signal when said reverse actuating means is set into said 'on' state thereof, and said

supply means further includes switching means connected with two of said amplifiers for interchanging the currents of said two amplifiers in response to the reversing signal from said control signal generator, thereby reversing the direction of rotation of said motor in response to said reversing signal.

- 5 7. A video signal reproducing apparatus substantially as hereinbefore described with reference to the accompanying drawings. 5

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COMPLETE SPECIFICATION

2 SHEETS

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the Original on a reduced scale
Sheet 1

FIG. 1A

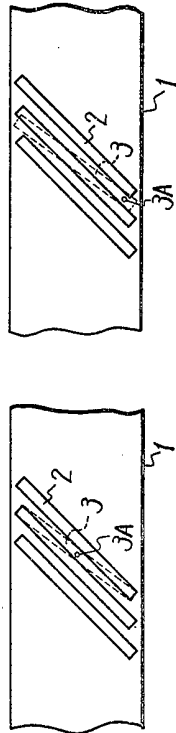
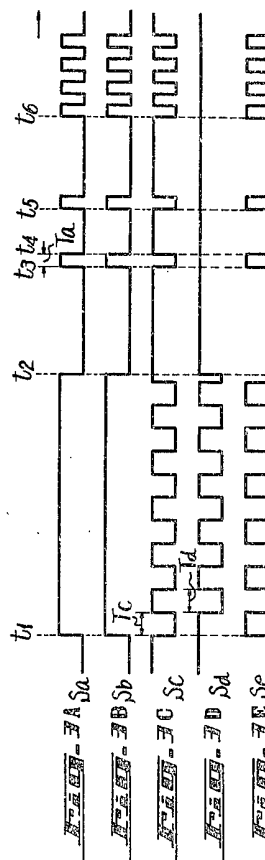
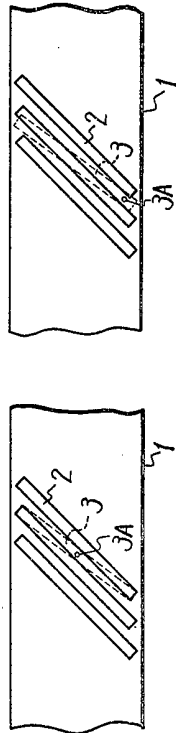


FIG. 1B



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2 SHEETS

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Sheet 2

