Description

The present invention relates to a method for recovering recorded information from a plurality of spiralling and substantially circular recorded video information tracks or concentric circular recorded video information tracks formed in a record disc.

Prior art apparatus directs beam of light at a selected one of a plurality of spiralling and substantially circular information tracks or concentric circular information tracks on a rotatable recording disc. The intensity of the beam is modulated by the recorded information which includes a unique address signal for each track, and the apparatus detects the modulated beam to produce a playback signal indicative of the recorded information.

The known apparatus includes means for selecting a particular target track to be scanned, together with a carriage motor and a movable mirror for moving the reading beam radially toward the target track with coarse and fine movements, respectively. The apparatus further includes means for monitoring the playback signal to detect periodically the track identifying code, or address, of the track currently being scanned. Such current address is compared to the target track identifying code, or address, and the apparatus applies prescribed sequential drive signals to the carriage motor, depending on the remaining distance to the target track. The speed of the carriage motor is stepped successively downwardly as the reading beam reaches predetermined distance thresholds during carriage translation. During the last stage of carriage translation, the movable mirror increments the beam radially by one track spacing during each revolution of the disc, thereby "playing" into the target track.

Although the information recovery system described above has proven effective in rapidly moving a reading beam toward a selected target track to recover information recorded thereon, the system does not operate satisfactorily.

Another failing of the prior art closely related to the above-mentioned player operational functions is the inability to freeze frame a selected information track. In this connection, in a known machine as disclosed in EP-A-35288, a freeze frame or still frame as it is known is obtained by repeating two consecutive fields one of which is identified by having a selected horizontal line of information in the vertical interval to represent an all white signal for that line, thereby defining a "white flag". Appropriate detecting circuits are employed to recognize the presence of a white flag, and upon such detection cause the tracking mirror to reposition the beam, during vertical interval, one frame backwards so as to repeat that frame indefinitely. Although the vertical retrace blanking pulse is delayed in order to produce a window for the white flag pulse which initiates a track jump, the player does not use sufficient other information to effect freeze frame operation, and the player may latch onto the next readable white flag and freeze frame the frame associated therewith and not the selected one. There is a need for a player system to be able to freeze frame without the presence of a white flag or the accurate recognition of a selected frame identifying code. The provision of repetitive jumps is disclosed in FR-A-2225804.

It is an object of the invention to provide a method of recovering recorded information from a videodisc which reduces the limitations of the prior art.

According to the present invention, there is provided a method for recovering recorded information from a plurality of spiralling and substantially circular recorded video information tracks or concentric circular recorded video information tracks formed in a record disc, wherein each of the tracks includes two fields of information, with an interval occurring between each two adjacent fields, and for repetitively reproducing any two adjacent fields of information, in a stop-motion mode, comprising the steps of: rotating the disc; impinging an incident reading beam of radiation upon the rotating disc to produce a modulated beam of reflected radiation indicative of the recorded information; moving said reading beam and the disc radially relative to each other, to thereby cause said reading beam to impinge upon successive ones of the tracks; employing a tracking servo means to maintain alignment of said reading beam with said successive ones of the tracks; recovering said modulated beam; using said recovered modulated beam to reproduce the video information recorded in said successive ones of the tracks; recovering a vertical synchronization signal coincident with each occurrence of said reading beam impinging upon a location on an information track corresponding to a point in the interval between adjacent fields of information; generating a stop-motion enable signal to thereby initiate the stop-motion mode; generating a field step enable signal; detecting each said vertical synchronization signal occurring subsequent to said field step enable generating step; alternately passing and blocking said detected vertical synchronization signals, using each said passed signal to generate a jump pulse; and applying each said generated jump pulse to said tracking servo means, wherein said tracking servo means is responsive to each said generated jump pulse for incrementally jumping said reading beam backwards to impinge upon the immediately preceding adjacent information track, to thereby effectuate the stop-motion mode; wherein said alternately passing and blocking step comprises a series of alternately executed passing and blocking sub-steps, said method being characterized by the further steps of generating a field-step-forward enable signal; and, bypassing the next said passing sub-step which would otherwise be executed subsequent to said generating a field-step-forward enable signal step, in response to said generating a field-step-forward enable signal step.

The invention also extends to a method for recovering recorded information from a plurality of spiralling and substantially circular recorded video information tracks or concentric circular recorded video information tracks formed in a record disc, wherein each of the tracks includes two fields of information, with an interval occurring between each two adjacent fields, and for repetitively reproducing any two adjacent fields of information, in a stop-motion mode, comprising the steps of: rotating the disc; impinging an incident reading beam of radiation upon the rotating disc to produce a modulated beam of ected radiation indicative of the recorded information; moving said reading beam and the disc radially relative to each other, to thereby cause said reading beam to impinge upon successive ones of the tracks; employing a tracking servo means to maintain alignment of said reading beam with said successive ones of the tracks; recovering said modulated beam; using said recovered modulated beam to reproduce the video information recorded in said successive ones of the tracks; recovering a vertical synchronization signal coincident with each occurrence of said reading beam impinging upon a location on an information track corresponding to a point in the interval between adjacent fields of information; generating a stop-motion enable signal to thereby initiate the stop-motion mode; generating a field step enable signal; detecting each said vertical synchronization signal provided subsequent to said field step enable generating step; alternately passing and blocking said detected vertical synchronization signals, using each said passed signal to generate a jump pulse; and applying each said generated jump pulse to said tracking servo means, wherein said tracking servo means is responsive to each said generated jump pulse for incrementally jumping said reading beam backwards to impinge upon the immediately preceding adjacent information track, to thereby effectuate the stop-motion mode; wherein said alternately passing and blocking step comprises a series of alternately executed passing and blocking sub-steps, said method being characterized by the further steps of generating a field-step-reverse enable signal and, in response to said field-step-reverse enable signal, bypassing the next said blocking sub-step which would otherwise be executed subsequent to said generating a field-step-reverse enable signal step.

A method of the invention enables the provision of a stop-motion function, that is the ability to freeze frame a selected information track, when the white flag or frame address code information of the selected frame to be viewed is obliterated. Further, independent of the fact that a picture frame is comprised of two (and sometimes three) adjacent and consecutive fields, a method of the invention has the ability to recover and recognize the vertical synchronization pulses contained in the recorded information on the disc, generate a stop-motion by utilizing the next vertical synchronization pulse in time after generating the enable signal to pulse the tracking servo of the disc player one track in reverse, and for additionally pulsing the tracking servo one track in reverse for every predetermined multiple of two vertical synchronization pulses detected. The predetermined multiple is one, i.e. the tracking servo is pulsed on every other vertical sync pulse.

In effecting stop-motion by the manner just described, the first field displayed in each group of two fields in the stop-motion mode could be an even field or an odd field, since the jump-back of the tracking servo is initiated by the next vertical sync pulse occurring in time after being enabled by an arbitrarily positioned, usually manually inserted, enabling signal. A method of the invention permits playing from the stop-motion position by producing a one-field-step-advance or one-field-step-reverse motion while maintaining stop-motion playback of the information tr k after being stepped. This is accomplished by either disabling the effect of the next vertical synchronization pulse in time after initiation of the field-step enable signal or by permitting an extra vertical sync pulse to "kick" the tracking servo after the field-step mode signal is generated.

Brief Description of the Drawings

Figure 1 is a general block diagram of the components of a video disc player for performing the method of the invention;

Figure 2 is a more detailed block diagram of the portion of Figure 1 illustrating the tracking and track jumping of the videodisc player;

Figure 3 is an illustration of the relationship between an open loop tracking error signal and the radial cross-section of tracks on a videodisc;

Figure 4 is a block diagram showing the details of the components of a videodisc player involved in performing a stop-motion effect;

Figure 5 is a pictorial representation of the path taken by a read beam when stepping one field at a time in reverse direction and then still framing;

Figure 6 is a pictorial representation of the path taken by a read beam of a videodisc player when stepping one field at a time in the forward direction and then still framing.

Figure 7 shows a preferred form of circuitry for carrying out the step forward and step reverse one field at a time function; and

Figure 8 is a timing chart showing the various signal relationships involved in carrying out the field step function of the disc player.

Detailed Description of the Preferred Embodiments

Referring now to the drawings, and particularly to Figure 1, there is shown apparatus for moving a reading beam of light 11 in a radial direction relative to a rotating recording disc 13, to recover information from a selected target track on the disc. The disc includes a plurality of closely spaced, circular and concentric recording tracks, and each track records a video signal

representing one or more video frames, with a unique frame or track address signal located in each vertical interval (i.e., two address signals per frame).

The apparatus includes a spindle motor 15 for rotating the recording disc 13 at a prescribed constant angular velocity, and an optical system 17 and an objective lens 19 for focusing the reading beam 11 onto a selected track of the rotating disc. The reading beam is reflected by the disc to produce a reflected beam 21 having an intensity that is modulated in accordance with the recorded information. The objective lens and optical system direct this reflected beam to a detector 23 which detects and demodulates the modulated intensity of the beam to produce a baseband video signal correspondiing to the recorded information. This video signal is coupled over line 25 to both a monitor 27 and an address recovery and estimator circuit 29. The monitor provides a real-time display of the video signal recovered from the target track, and the address recovery circuit detects the address signals in the successive vertical intervals of the video signal, using conventional techniques. The address recovery circuit then updates an address register 30 with each detected track address signal.

The apparatus further includes a coarse positioning system and a fine positioning system for controllably moving the reading beam 11 radially relative to the disc 13, toward the selected target track on the disc. The coarse positioning system includes a carriage motor 31 and appropriate gearing 33 for moving the beam at a selected one of two relatively high radial velocities (e.g., 100 and 500 tracks per disc revolution). The fine positioning system includes a movable mirror (not shown) located in the optical system 17 for controllably adjusting the beam's point of impingement on the disc over a relatively small range (e.g., about 50 tracks in either direction).

When a user desires to recover information recorded on a selected target track on the disc 13, he or she inputs a special target address code signal on line 35, indicating the target track's address. A function generator 37 compares this target address signal with the address signal currently being stored by the address register 30. In accordance with a prescribed algorithm, the function generator determines the radial separation between the current track and the target track, and outputs appropriate control signals to controllably drive the carriage motor 31 and the movable mirror of the optical system 17 so as to move the reading beam 11 toward the target track. These control signals are sequenced such that the beam reaches the target track in a time substantially less than that achieved by prior apparatus of this kind.

The carriage motor 31 is driven at a prescribed velocity (or sequence of velocities) until the reading beam 11 has been moved to within a prescribed number of tracks of the target track, after which the movable mirror of the optical system 17 is conditioned to incrementally jump the beam from one track to the next a plurality of times during each half revolution of the disc 13.

More particularly, the coarse positioning system further includes a track scan driver 39 and a carriage motor tachometer 41 for controllably driving the carriage motor 31 in the prescribed fashion. The function generator 37 outputs a plurality of velocity commands for coupling over lines 43a-d to the track scan driver, which, in turn, controllably adjusts a dc drive signal coupled over line 45 to the carriage motor. The tachometer feeds back to the track scan driver over line 47 a carriage tachometer signal indicating the carriage motor's angular velocity, to enhance control of that velocity. Also, a dc tracking error signal is coupled to the track scan driver over line 49 to controllably move the carriage motor so as to reduce any steady state deflection of the movable mirror of the optical system 17.

Referring again to Figure 1, the fine positioning system further includes a tracking servo in the form of a tracking controller 67 for producing a radial correction signal for coupling over line 69 to the movable mirror of the optical system 17. Depending on the operating mode of the apparatus, this signal either maintains the reading beam 11 aligned with a selected target track, or incrementally jumps the beam from track to track while approaching the target track. The tracking controller receives a plurality of track jump commands supplied on lines 71, 73 and 75 from the function generator 37, along with a tracking error signal supplied on line 77 from the detector 23.

When the apparatus is operating in a mode in which the reading beam 11 is to be maintained in alignment with a selected track, the tracking controller 67 merely amplifies the tracking error signal and couples it directly to the movable mirror of the optical system 17, to form a conventional closed loop tracking servo for controllably aligning the beam with the track. On the other hand, when the apparatus is in a search mode in which the beam is to be moved incrementally from track to track, the tracking error signal is uncoupled from the movable mirror, and a prescribed sequence of pulses is coupled in its place.

The tracking controller 67 is depicted in greater detail in Figure 2. It includes a disable switch circuit 79, an amplifier 81, and a power driver 83, for amplifying the tracking error signal supplied on line 77 and outputting it as the radial correction signal for coupling over line 69 to controllably position the movable mirror of the optical system 17 (Figure 1). The tracking error signal is coupled through the disable circuit 79 at all times except during the search mode of operation or when jumping multiple tracks in a jump mode to be discussed later. The output of the disable circuit is coupled over line 85 to the negative input terminal of the amplifier 81, and the output of the amplifier is, in turn, coupled over line 87 to the power driver 83, which outputs the radial correction signal. The signal output on line 85 by the

disable circuit is also coupled to a low-pass filter 89 to produce the dc tracking error signal for coupling on line 49 to the track scan driver 39 (Figure 1).

At the beginning stage of each search mode of operation in which the carriage motor 31 moves the reading beam 11 rapidly toward a target track, the tracking error signal experiences wide variations in level as the beam crosses the successive tracks. With reference to Figure 3, which is a fragmentary cross-sectional view of the disc 13 showing three recording tracks along a disc radius, it will be observed that the open-loop tracking error signal is a large amplitude ac signal having a level of zero at the center line 91 of each track. The disable circuit 79 uncouples the tracking error signal from the amplifier 81 at this time, to ensure that the apparatus does not attempt to controllably align the reading beam 11 with any track as it moves radially toward the target track.

In the search mode of operation, the coarse positioning system, which includes the carriage motor 31, operates whenever the distance between the target track and the present track exceeds a prescribed threshold, and the fine positioning system, which includes the movable mirror of the optical system 17, operates whenever this distance does not exceed the threshold. When the coarse positioning system is operating, a tracking disable command is coupled over line 71 from the function generator 37 to the tracking controller 67. This signal is coupled through an OR gate 93, and in turn over line 95 to the disable circuit 79, to uncouple the tracking error signal from the amplifier 81. The radial correction signal output by the tracking controller 67 on line 69 therefore has a level of zero, and the movable mirror remains stationary.

After the reading beam has been moved to a position within a prescribed number of tracks of the target track, the function generator 37 (Figure 1) no longer outputs velocity commands to the track scan driver 39, and the carriage motor 31 is no longer driven at a relatively high speed. A prescribed time delay thereafter, the function generator terminates the tracking disable command previously coupled over line 71 to the tracking controller 67, so that the tracking error signal is again coupled through the tracking controller to form the tracking servo loop for controllably aligning the reading beam 11 with whatever recording track the beam arrives at. Thereafter, the tracking controller outputs a prescribed sequence of pulses to jump the reading beam incrementally from track to track until it reaches the target track.

To effect the incremental jumping, the tracking controller 67 includes a kick generator 97, a zero crossing detector 99, a jumps-down counter 101, and a flip-flop 103. When the incremental jumping is to be initiated, a binary code indicating the number of tracks (e.g., 11 tracks) to be jumped during the next half revolution of the disc 13 is supplied on lines 73 from the function generator 37 and entered into the jumps-down counter. Simultaneously, a jump command signal supplied on line 75 from the function generator is coupled to the set direct input terminal of the flip-flop. This sets the Q output signal into the logical "1" state, and this signal is coupled over line 105 to the OR gate 93, and in turn over line 95 to the disable circuit 79, to open the tracking servo loop.

The $\overline{Q}$ output signal of the flip-flop 103 is coupled over line 107 to the kick generator 97, which responds by outputting a single pulse signal for coupling over line 109 to the positive input terminal of the amplifier 81. This pulse signal is coupled through the amplifier and power driver 83 to the movable mirror of the optical system 17, to accelerate the reading beam 11 in the direction of the target track.

After the reading beam has been accelerated in the direction of the target track by the kick generator 97, the zero crossing detector 99 monitors the open loop tracking error signal (Figure 3b) supplied on line 77 and outputs a clock pulse each time it detects a track crossing by the beam. These successive clock pulses are coupled over line 111 to the clock terminal of the jumps-down counter 101, to decrement the stored count, accordingly. When the count reaches zero, the counter outputs a reset pulse for coupling over line 113 to the reset direct terminal of the flip-flop 103.

The reset pulse coupled over line 113 to the reset direct terminal of the flip-flop 103 returns the $\overline{Q}$ output signal to the logical "1" state, which triggers the kick generator 97 to output a pulse of opposite polarity to that of the original pulse, thereby decelerating the movable mirror. The reset pulse simultaneously returns the Q output signal of the flipflop to the logical "0" state, so that the tracking servo loop is no longer disabled by the disable circuit 79 and the loop can again function to controllably align the reading beam 11 with the track then being scanned. During this time, the dc tracking error signal is coupled on line 49 to the track scan driver 39, to controllably move the carriage motor 31 so as to reduce the deflection of the movable mirror.

For a low number of tracks to jump, e.g., ten or less, the reading beam 11 preferably traverses the prescribed number of tracks during the vertical interval. Since the monitor screen is then blanked, a noiseless jump will have been effectuated.

The kick generator 97 can include two monostable multivibrator or one-shot circuits, one triggered by a positive-going transition and the other by a negative-going transition. The kick generator can further include appropriate gating circuits to ensure that the successive pulses it produces have the correct polarity to move the reading beam 11 in the direction of the target track. These gating circuits are responsive to the forward and reverse direction commands supplied on lines 43c and 43d, respectively.

In an alternative embodiment, the tracking controller 67 radially accelerates and decelerates the reading beam 11 such that it moves by just one track spacing each time.

After the reading beam 11 finally reaches the target track, the apparatus can operate, for example, in a stop-motion mode, to scan the track repeatedly and display the recovered video signal. If the successive tracks are arranged in a spiral pattern, the apparatus must jump the beam backward by one track spacing during each disc revolution, preferably during a vertical interval.

Single Field Step Mode

In order to understand the operation of the field step mode, it is necessary to review the operation of the stop-motion mode of a player.

Referring to Figure 4, there is shown a block diagram of the stop motion subsystem employed in the videodisc player. The video signal from the FM detector and demodulator 23 is applied to an input buffer stage 271. The output signal from the buffer 271 is applied to a DC restorer 273. The function of the DC restorer 273 is to set the blanking voltage at a constant uniform level. Variations in signal recording and recovery result in video signals with different blanking levels. The output from the DC restorer 273 is applied to a white flag detector circuit 257. The function of the white flag detector 257 is to identify the presence of an all white level video signal existing during an entire line of one or both fields contained in the vertical interval of a frame of video information, although the white flag may take other forms. One such form would be a special number stored in a line. Alternatively, the white flag detector can respond to the address indicia found in each video frame for the same purpose. Other indicia can also be employed. However, the use of an all white level signal during an entire line interval in the picture frame of information has been found to be the most useful and reliable.

The vertical sync signal recovered from the video is applied to a delay circuit 253. The output from the delay circuit 253 is supplied to a vertical window generator 255. The function of the window generator 255 is to generate an enabling signal for application to the white flag detector 257 to coincide with that line interval in which the white flag signal has been stored. The output signal from the generator 255 gates the predetermined portion of the video signal from the FM detector and generates an output white flag pulse whenever the white flag is contained in the portion of the video signal under surveillance. The output from the white flag detector 257 is applied to a stop motion pulse generator 265 through gate 259 and stop motion mode selector 261. The gate 259 has as a second input signal, the stop motion mode enabling signal from the function generator 37 (Figure 1).

The differential tracking error from the detector and demodulator 23 is applied over line 77 (Figure I) to a zero crossing detector and delay circuit 269. The function of the zero crossing detector circuit 269 is to identify when the lens crosses the mid points 91 between two adjacent tracks as shown with reference to line (a) of Figure 3. This mid point is the point at which the differential tracking error shown in line (b) of Figure 3 corresponds to the mid point 91 between adjacent tracks.

The output of the zero crossing detector and delay circuit 269 is applied to the stop motion pulse generator 265. The stop motion pulse generated in the generator 265 is applied to a plurality of locations, the first of which is as a loop interrupt pulse to the tracking controller servo. A second output signal from the stop motion pulse generator 265 is applied to a stop motion compensation sequence generator 267. The function of the stop motion compensation sequence generator 267 is to generate a compensation pulse waveform for application to the radial tracking mirror in optical system 17 to cooperate with the actual stop motion pulse sent directly to the tracking mirror servo. The stop motion compensation pulse is thus also sent to the tracking servo.

Briefly, the stop motion pulse to the tracking servo causes the radial tracking mirror to leave the track on which it is tracking and jump to the next sequential track. A short time later, the radial tracking mirror receives a stop motion compensation pulse to remove the added inertia and direct the tracking mirror into tracking the next adjacent track without skipping one or more tracks before selecting a track for tracking.

In order to insure the optimum cooperation between the stop motion pulse from the generator 265 and the stop motion compensation pulse from the generator 267, a loop interrupt pulse is sent to the tracking servo to remove the differential tracking error signal from being applied to the tracking error amplifiers in tracking controller 67 during the period of time that the mirror is purposely caused to leave one track under direction of the stop motion pulse from the generator 265 and to settle upon a next adjacent track under the direction of the stop motion compensation pulse from the generator 267.

Using the arrangement described above, and assuming stop motion selector 261 passes the output from white flag detector 257 to gate 259, a stop motion effect is realized by causing the player to play two fields in repeated fashion, the first field starting after detection of a white flag occurring during the vertical interval following the second field, and the second field having no white flag preceding it. Accordingly, any time a stop motion command is given the player, the first and second fields of a selected frame will be displayed. A frame advance command to the player would result in the player skipping to the next frame, i.e., skipping two fields such that first field displayed is again initiated by a white flag during the vertical interval, following the second field and the second field without an initial white flag.

As explained earlier, it is often desirable to step through a video display field by field, and this is not possible with the initiation of a stop motion function being coincident with the detection of a white flag which occurs every other field. Accordingly, the present invention provides for the possibility of stepping through one field at a time

independent of the occurrence of the white flag. Stop motion selector 261, rather than taking its input from white flag detector 257 can alternatively take its input from single field step generator 263. In such a case, when gate 259 is enabled by a stop motion command, i.e., when it receives the gate stop motion mode enabling signal, the next vertical sync pulse from the tangential servo passing through delay 253 will be effective in the single field step generator 263 to pass through the mode selector 261 and initiate stop motion of the display. Accordingly, independent of the position of the white flag in the coming video, in the single field step selected mode, any two adjacent fields will be displayed, the single field step generator 263 ensuring that every other vertical sync pulse from the initial one will cause the tracking servo to drive the reading beam in reverse by one track.

Figures 5 and 6 show, respectively, the paths taken by the reading beam along a spiral path in the reverse and forward single field step modes. In Figure 5 a disc portion 277, greatly exaggerated for purposes of explanation, has a spiral track thereon, with a portion 279 indicating the path of a reading beam in a normal stop motion mode. From this diagram, it can be appreciated that fields C and D are being traversed repeatedly. Assuming the beam is traversing field C when a field step reverse command is given, the arrow at 281 can be followed to illustrate that a jump back must occur at the next vertical interval and then every other vertical interval thereafter in order to have the read beam traverse repeatedly field C and B. It should be recognized that with a normal frame step reverse command, the fields traversed by the read beam would be A and B, while in the single field step reverse mode, the fields being traversed are B and C.

Assuming now that the single field step command was given while the reading beam is traversing field D, the arrow at 283 can be followed to show the need for a jump back at the next vertical interval, followed by a further jump back at the next vertical interval, and thereafter jumping back every other vertical interval. Accordingly, when the command is given during field D, jump back pulses must be sent to the tracking servo for each of the next two vertical interval times.

Turning now to Figure 6, the single field step forward mode is illustrated. Again, a normal stop motion function is illustrated by the line indicating traversal of the reading beam along fields C and D in a continuous repeating manner. This is shown at 285 in the drawing. Assuming that the jump forward command is given during the traversal of field C, arrow 287 shows that the second next vertical sync pulse should not cause a step reverse, as would normally be the case in order to follow path 285, and this will permit the read beam to continue past that second next vertical interval to traverse field E, after which the next vertical sync and every other vertical sync thereafter will produce repeated playing of fields D and E. Should the command to step a single field forward be given during the traversal of field D, arrow 289 can be followed to show that the next vertical sync pulse in time should be eliminated and that the next vertical sync pulse and every other sync pulse thereafter be used to effectuate a kick back of the tracking servo to again produce repeated playing of fields D and E.

A more detailed description of the circuitry and function of the single field step generator 263 can be found by reference to Figure 7. The circuit of Figure 7 will be explained with the aid of the waveforms diagram of Figure 8.

In the normal frame stop motion mode, when a stop command is given, flip-flop 261 takes a "0" set, and the $\bar{Q}$ output enables AND gate 290, while the 1 output, being a logical "0", inhibits AND 286. The enablement of AND gate 290 permits the white flag from white flag detector 257 (Figure 4) on line 303 to pass through OR gate 275, and arrive at AND gate 259 which, when enabled by the gate stop motion mode signal on line 302, initiates action of stop motion pulse generator 265 on line 304. In this mode, each white flag (one per frame) on line 303 causes a kickback of the tracking servo to repeat the previous two fields in the normal stop motion mode.

When a field step reverse or field step forward pulse is generated, for example manually by the user pushing an appropriate push button, a pulse passes through OR gate 287 to set flip-flop 261 which disables AND gate 290 and enables AND gate 286. Thus, the normal frame step reverse mode is defeated by the disablement of AND gate 290.

As explained in connection with Figures 5 and 6, the first three lines of Figure 8 indicate that a vertical sync pulse causes a kickback of the tracking servo for every two vertical sync pulses occurring, and the sequence of fields played is C, D, C, D, etc. If a step reverse command occurs during field C, Figure 8 shows, at line 5, letter D, that an extra kickback pulse must occur at the next vertical sync time and every other vertical sync time thereafter. This is accomplished in the circuit of Figure 7 by the setting of extra jump back flip-flop 288 whose Q output passes through OR gate 284 and, when coincident with jump back time pulse on line 276 which ensures that the jump back will occur during the vertical interval and at the proper time during the vertical interval, AND gate 285 passes a true signal through AND gate 286 (previously enabled by flip-flop 261), through OR gate 275, and through AND gate 259 to the stop motion pulse generator. Since the jump back time pulse on line 276 is time related to the vertical sync pulse time, this path of signal flow indicates that the next vertical interval after the initiation of the field step reverse command, i.e., at letter D, will indeed cause the tracking servo to kickback one track. The output of AND gate 285, going true, enables AND gate 289 to reset flip-flop 288. However, the other input to AND gate 289 from the "0" side of flip-flop 283, prevents resetting flip-flop 288. The "0" side of flip-flop 283 is

true, because flip-flop 283 has been set by AND gate 282 by the vertical sync pulse on line 280 which, having set flip-flop 281, allows jump back flip-flop 283 to toggle to its true state. Thus, after initiation of the field step reverse command during field C, OR gate 284 receives a true signal on both inputs to effect the kickback at the next vertical sync time. This can be observed by reference to the fifth line of Figure 8, letter D. The next vertical sync pulse in time (at E), however, does not kick the tracking servo, since the first vertical sync pulse toggled flip-flop 283 to the false state, and this enables AND gate 289 to reset flip-flop 288 such that both inputs to OR gate 284 are false, and thus the second vertical sync pulse has no effect on the tracking servo. This may be observed by reference to the fifth line of Figure 8 at letter E.

Having reset flip-flop 288, it will not be set again until the next field step reverse command by the user on line 278a is given. However, since flip-flop 283 is a toggle flip-flop, the next vertical sync pulse in time, occurring at letter F in Figure 8, will set flip-flop 283 to the true state, and the Q output of flip-flop 283 passes through OR gate 284 to again create a stop motion pulse. The continued toggling action of flip-flop 283 for each vertical sync pulse will ensure that, from this point on, every other vertical sync pulse will produce a stop motion pulse, and the objective set forth in connection with the description of Figure 5 for a step reverse pulse occurring during field C will have been accomplished.

Line 6 of Figure 8 then shows the resultant order of fields being displayed, and it can be seen that after the field step reverse command, fields B, C, B, C, B, etc. are being displayed, as is desired.

In the event that the field step reverse command occurs during field D (see line 7 of Figure 8), the O side of toggle flip-flop 283 will be true enabling AND gate 289. At the next vertical sync time (at C), toggle flip-flop 283 will flip to its true state, and through OR gate 284 a stop motion pulse will be generated at jump back time in the manner previously described. At the same time, the output of AND gate 285 will be sent to the second input of AND gate 289, and as a result flip-flop 288 will be reset, as well as toggle flip-flop 283. Thus, although flip-flop 283 was reset by toggle action on the previous vertical sync pulse, it is now reset again on the next vertical sync pulse through the path just described, i.e., through OR gate 284, AND gate 285, and AND gate 289. Thus, when a subsequent vertical sync pulse occurs, at letter D in Figure 8, another stop motion pulse will be generated due to toggle flip-flop 283 going true again. As a result, two kick back pulses in a row, at times C and D in Figure 8, will have occurred to produce the sequence of fields being played as shown in line 6 of Figure 8.

To accomplish a field step forward function, it is only necessary that the effect of the next vertical sync pulse in time be eliminated, therefore producing a sequence changing from the recycling of fields C and D to the recycling of fields D and E, and this is true whether the field step forward command occurred during the playing of field C or field D. To accomplish the field step forward function, an "inhibit one cycle" flip-flop 281 is employed. When the field step forward command is received over line 278b, flip-flop 281 is reset to the O state, and the Q output goes low to inhibit AND gate 282 and AND gate 285, thereby precluding passage of the next vertical sync pulse in time (at D for lines 10-12, and at C for lines 13-15 of Figure 11) to the jump back toggle flip-flop 283, and to preclude the next jump back time pulse on line 276 to create a stop motion pulse. However, the second next vertical sync pulse in time (at E and D, respectively) will again set flip-flop 281, and its output going true will again enable gate 282 to pass the vertical sync pulses occurring thereafter, will enable AND gate 285, and permit stop-motion action to resume. Accordingly, after elimination of one vertical sync pulse for each field step forward command, the toggle flip-flop 283 proceeds to produce a kickback of the tracking servo for every other vertical sync pulse in the manner described earlier. The waveforms of lines 7 through 15 of Figure 8 should be, therefore, self-explanatory.

Claims

1. A method for recovering recorded information from a plurality of spiralling and substantially circular recorded video information tracks or concentric circular recorded video information tracks formed in a record disc, wherein each of the tracks includes two fields of information, with an interval occurring between each two adjacent fields, and for repetitively reproducing any two adjacent fields of information, in a stop-motion mode, comprising the steps of: rotating the disc; impinging an incident reading beam of radiation upon the rotating disc to produce a modulated beam of reflected radiation indicative of the recorded information; moving said reading beam and the disc radially relative to each other, to thereby cause said reading beam to impinge upon successive ones of the tracks; employing a tracking servo means to maintain alignment of said reading beam with said successive ones of the tracks; recovering said modulated beam; using said recovered modulated beam to reproduce the video information recorded in said successive ones of the tracks; recovering a vertical synchronization signal coincident with each occurrence of said reading beam impinging upon a location on an information track corresponding to a point in the interval between adjacent fields of information; generating a stop-motion enable signal to thereby initiate the stop-motion mode; generating a field step enable signal; detecting each said vertical synchronization signal occurring subsequent to said field step enable generating step; alternately passing and blocking said detected vertical synchronization signals, using each said passed signal to generate a jump pulse;

true, because flip-flop 283 has been set by AND gate 282 by the vertical sync pulse on line 280 which, having set flip-flop 281, allows jump back flip-flop 283 to toggle to its true state. Thus, after initiation of the field step reverse command during field C, OR gate 284 receives a true signal on both inputs to effect the kickback at the next vertical sync time. This can be observed by reference to the fifth line of Figure 8, letter D. The next vertical sync pulse in time (at E), however, does not kick the tracking servo, since the first vertical sync pulse toggled flip-flop 283 to the false state, and this enables AND gate 289 to reset flip-flop 288 such that both inputs to OR gate 284 are false, and thus the second vertical sync pulse has no effect on the tracking servo. This may be observed by reference to the fifth line of Figure 8 at letter E.

Having reset flip-flop 288, it will not be set again until the next field step reverse command by the user on line 278a is given. However, since flip-flop 283 is a toggle flip-flop, the next vertical sync pulse in time, occurring at letter F in Figure 8, will set flip-flop 283 to the true state, and the Q output of flip-flop 283 passes through OR gate 284 to again create a stop motion pulse. The continued toggling action of flip-flop 283 for each vertical sync pulse will ensure that, from this point on, every other vertical sync pulse will produce a stop motion pulse, and the objective set forth in connection with the description of Figure 5 for a step reverse pulse occurring during field C will have been accomplished.

Line 6 of Figure 8 then shows the resultant order of fields being displayed, and it can be seen that after the field step reverse command, fields B, C, B, C, B, etc. are being displayed, as is desired.

In the event that the field step reverse command occurs during field D (see line 7 of Figure 8), the O side of toggle flip-flop 283 will be true enabling AND gate 289. At the next vertical sync time (at C), toggle flip-flop 283 will flip to its true state, and through OR gate 284 a stop motion pulse will be generated at jump back time in the manner previously described. At the same time, the output of AND gate 285 will be sent to the second input of AND gate 289, and as a result flip-flop 288 will be reset, as well as toggle flip-flop 283. Thus, although flip-flop 283 was reset by toggle action on the previous vertical sync pulse, it is now reset again on the next vertical sync pulse through the path just described, i.e., through OR gate 284, AND gate 285, and AND gate 289. Thus, when a subsequent vertical sync pulse occurs, at letter D in Figure 8, another stop motion pulse will be generated due to toggle flip-flop 283 going true again. As a result, two kick back pulses in a row, at times C and D in Figure 8, will have occurred to produce the sequence of fields being played as shown in line 6 of Figure 8.

To accomplish a field step forward function, it is only necessary that the effect of the next vertical sync pulse in time be eliminated, therefore producing a sequence changing from the recycling of fields C and D to the recycling of fields D and E, and this is true whether the field step forward command occurred during the playing of field C or field D. To accomplish the field step forward function, an "inhibit one cycle" flip-flop 281 is employed. When the field step forward command is received over line 278b, flip-flop 281 is reset to the O state, and the Q output goes low to inhibit AND gate 282 and AND gate 285, thereby precluding passage of the next vertical sync pulse in time (at D for lines 10-12, and at C for lines 13-15 of Figure 11) to the jump back toggle flip-flop 283, and to preclude the next jump back time pulse on line 276 to create a stop motion pulse. However, the second next vertical sync pulse in time (at E and D, respectively) will again set flip-flop 281, and its output going true will again enable gate 282 to pass the vertical sync pulses occurring thereafter, will enable AND gate 285, and permit stop-motion action to resume. Accordingly, after elimination of one vertical sync pulse for each field step forward command, the toggle flip-flop 283 proceeds to produce a kickback of the tracking servo for every other vertical sync pulse in the manner described earlier. The waveforms of lines 7 through 15 of Figure 8 should be, therefore, self-explanatory.

Claims

1. A method for recovering recorded information from a plurality of spiralling and substantially circular recorded video information tracks or concentric circular recorded video information tracks formed in a record disc, wherein each of the tracks includes two fields of information, with an interval occurring between each two adjacent fields, and for repetitively reproducing any two adjacent fields of information, in a stop-motion mode, comprising the steps of: rotating the disc; impinging an incident reading beam of radiation upon the rotating disc to produce a modulated beam of reflected radiation indicative of the recorded information; moving said reading beam and the disc radially relative to each other, to thereby cause said reading beam to impinge upon successive ones of the tracks; employing a tracking servo means to maintain alignment of said reading beam with said successive ones of the tracks; recovering said modulated beam; using said recovered modulated beam to reproduce the video information recorded in said successive ones of the tracks; recovering a vertical synchronization signal coincident with each occurrence of said reading beam impinging upon a location on an information track corresponding to a point in the interval between adjacent fields of information; generating a stop-motion enable signal to thereby initiate the stop-motion mode; generating a field step enable signal; detecting each said vertical synchronization signal occurring subsequent to said field step enable generating step; alternately passing and blocking said detected vertical synchronization signals, using each said passed signal to generate a jump pulse;

and applying each said generated jump pulse to said tracking servo means, wherein said tracking servo means is responsive to each said generated jump pulse for incrementally jumping said reading beam backwards to impinge upon the immediately preceding adjacent information track, to thereby effectuate the stop-motion mode; wherein said alternately passing and blocking step comprises a series of alternately executed passing and blocking sub-steps, said method being characterized by the further steps of generating a field-step-forward enable signal; and, bypassing the next said passing sub-step which would otherwise be executed subsequent to said generating a field-step-forward enable signal step, in response to said generating a field-step-forward enable signal step.

2. A method for recovering recorded information from a plurality of spiralling and substantially circular recorded video information tracks or concentric circular recorded video information tracks formed in a record disc, wherein each of the tracks includes two fields of information, with an interval occurring between each two adjacent fields, and for repetitively reproducing any two adjacent fields of information, in a stop-motion mode, comprising the steps of: rotating the disc; impinging an incident reading beam of radiation upon the rotating disc to produce a modulated beam of reflected radiation indicative of the recorded information; moving said reading beam and the disc radially relative to each other, to thereby cause said reading beam to impinge upon successive ones of the tracks; employing a tracking servo means to maintain alignment of said reading beam with said successive ones of the tracks; recovering said modulated beam; using said recovered modulated beam to reproduce the video information recorded in said successive ones of the tracks; recovering a vertical synchronization signal coincident with each occurrence of said reading beam impinging upon a location on an information track corresponding to a point in the interval between adjacent fields of information; generating a stop-motion enable signal to thereby initiate the stop-motion mode; generating a field step enable signal; detecting each said vertical synchronization signal provided subsequent to said field step enable generating step; alternately passing and blocking said detected vertical synchronization signals, using each said passed signal to generate a jump pulse; and applying each said generated jump pulse to said tracking servo means, wherein said tracking servo means is responsive to each said generated jump pulse for incrementally jumping said reading beam backwards to impinge upon the immediately preceding adjacent information track, to thereby effectuate the stop-motion mode; wherein said alternately passing and blocking step comprises a series of alternately executed passing and blocking sub-steps, said method being characterized by the further steps of generating a field-step-reverse enable signal and, in response to said field-step-reverse enable signal, bypassing the next said blocking sub-step which would otherwise be executed subsequent to said generating a field-step-reverse enable signal step.

Patentansprüche

1. Verfahren zum Wiedergewinnen von gespeicherten Informationen von einer Mehrzahl von spiralig und im wesentlichen kreisförmig gespeicherten Videoinformationsspuren oder konzentrischen, kreisförmig gespeicherten Videoinformationsspuren, ausgebildet in einer Speicherplatte, in der jede der Spuren zwei Felder von Informationen enthält, mit einem Zwischenraum zwischen zwei benachbarten Feldern, und zur wiederholten Reproduktion zwei beliebiger benachbarter Informationsfelder in einem Bewegungsstopp-Betrieb, mit den Schritten: Drehen der Platte; Auftreffen eines einfallenden Lesestrahles auf die rotierende Platte, um einen modulierten Reflexionsstrahl zu erzeugen, der die gespeicherten Informationen repräsentiert, Bewegen des Lesestrahles und der Scheibe radial relativ zueinander, um hierdurch den Lesestrahl zu veranlassen, auf abfolgende Spuren aufzutreffen; Anwenden einer Nachführ-Servoeinrichtung zum Aufrechterhalten der ausgerichteten Übereinstimmung des Lesestrahles mit den aufeinanderfolgenden Spuren; Wiedergewinnen des modulierten Strahles; Verwenden des wiedergewonnenen, modulierten Strahles, um die Videoinformationen zu reproduzieren, die in den aufeinanderfolgenden Spuren gespeichert sind; Wiedergewinnen eines Vertikal-Synchronisationssignales, das mit jedem Auftreten des Lesestrahles zusammenfällt, der auf eine Stelle auf einer Informationsspur auftrifft, die einem Punkt in dem Intervall zwischen benachbarten Informationsfeldern entspricht; Erzeugen eines einen Bewegungsstopp ermöglichenden Signales, um hierdurch einen Bewegungsstopp-Betrieb zu initiieren; Erzeugen eines einen Feldschritt ermöglichenden Signales; Erfassen jedes Vertikalsynchronisationssignales, das im Anschluß an dem den Feldschritt ermöglichenden Erzeugungsschritt auftritt; alternierendes Durchlassen und Blockieren des erfaßten Vertikalsynchronisationssignales, wobei jedes durchgelassene Signal verwendet wird, um einen Sprungimpuls zu erzeugen; und Anlegen jedes der erzeugten Sprungimpulse an die Nachführ-Servoeinrichtung, wobei die Nachführ-Servoeinrichtung in Abhängigkeit von jedem erzeugten Sprungimpuls arbeitet, um inkremental den Lesestrahl rückspringend zu verlagern, so daß dieser auf die unmittelbar vorangehend benachbarte Informationsspur auftrifft, um hierdurch den Bewegungsstopp-Betrieb zu bewirken; wobei der Schritt des alternierenden Durchganges und Blockierens enthält eine Reihe von alternierend ausgeführten Durchgangs- und Blokkierungs-Unterschritten, wobei das Verfahren gekennzeichnet ist durch die weiteren Schritte der Erzeugung eines einen Vorwärts-Feldschritt ermöglichenden Signales; und des Überspringens des nächsten Durchgangs-Unterschrittes,

der sonst im Anschluß an den Schritt der Erzeugung eines einen Vorwärts-Feldschritt ermöglichenden Signales abgearbeitet würde, in Abhängigkeit von dem Schritt der Erzeugung eines einen Vorwärts-Feldschritt ermöglichenden Signales.

2. Verfahren zum Wiedergewinnen von gespeicherten Informationen von einer Mehrzahl von spiralig und im wesentlichen kreisförmig gespeicherten Videoinformationsspuren oder konzentrischen, kreisförmig gespeicherten Videoinformationsspuren, ausgebildet in einer Speicherplatte, in der jede der Spuren zwei Felder von Informationen enthält, mit einem Zwischenraum zwischen zwei benachbarten Feldern, und zur wiederholten Reproduktion zwei beliebiger benachbarter Informationsfelder in einem Bewegungsstopp-Betrieb, mit den Schritten: Drehen der Platte; Auftreffen eines einfallenden Lesestrahles auf die rotierende Platte, um einen modulierten Reflexionsstrahl zu erzeugen, der die gespeicherten Informationen repräsentiert; Bewegen des Lesestrahles und der Scheibe radial relativ zueinander, um hierdurch den Lesestrahl zu veranlassen, auf abfolgende Spuren aufzutreffen; Anwenden einer Nachführ-Servoeinrichtung zum Aufrechterhalten der ausgerichteten Übereinstimmung des Lesestrahles mit den aufeinanderfolgenden Spuren; Wiedergewinnen des modulierten Strahles; Verwenden des wiedergewonnenen, modulierten Strahles, um die Videoinformationen zu reproduzieren, die in den aufeinanderfolgenden Spuren gespeichert sind; Wiedergewinnen eines Vertikal-Synchronisationssignales, das mit jedem Auftreten des Lesestrahles zusammenfällt, der auf eine Stelle auf einer Informationsspur auftrifft, die einem Punkt in dem Intervall zwischen benachbarten Informationsfeldern entspricht; Erzeugen eines einen Bewegungsstopp ermöglichenden Signales, um hierdurch einen Bewegungsstopp-Betrieb zu initiieren; Erzeugen eines einen Feldschritt ermöglichenden Signales; Erfassen jedes Vertikalsynchronisationssignales, das im Anschluß an dem den Feldschritt ermöglichenden Erzeugungsschritt auftritt; alternierendes Durchlassen und Blockieren des erfaßten Vertikalsynchronisationssignales, wobei jedes durchgelassene Signal verwendet wird, um einen Sprungimpuls zu erzeugen; und Anlegen jedes der erzeugten Sprungimpulse an die Nachführ-Servoeinrichtung, wobei die Nachführ-Servoeinrichtung in Abhängigkeit von jedem erzeugten Sprungimpuls arbeitet, um inkremental den Lesestrahl rückspringend zu verlagern, so daß dieser auf die unmittelbar vorangehend benachbarte Informationsspur auftrifft, um hierdurch den Bewegungsstopp-Betrieb zu bewirken; wobei der Schritt des alternierenden Durchganges und Blockierens enthält eine Reihe von alternierend ausgeführten Durchgangs- und Blokkierungs-Unterschritten, wobei das Verfahren gekennzeichnet ist durch die weiteren Schritte der Erzeugung eines einen Gegen-Feldschritt ermöglichenden Signales und, in Abhängigkeit von dem den Gegen-Feldschritt ermöglichenden Signal, ein Überspringen des nächsten Blockierungs-Unterschrittes, welcher sonst im Anschluß an den Schritt der Erzeugung eines einen Gegen-Feldschritt ermöglichenden Signales abgearbeitet würde.

Revendications

1. Un procédé pour restituer une information enegistrée d'une pluralité de pistes d'informations vidéo enregistrées en spirale et sensiblement circulaires ou de pistes d'informations vidéo enregistrées circulaires formées dans un disque d'enregistrement, où chacune des pistes comprend deux trames d'information, avec un intervalle se produisant entre deux trames adjacentes, et pour reproduire de façon répétitive n'importe quelle des deux trames adjacentes d'information, en un mode mouvement-arrêt, comprenant les étapes de: faire tourner le disque; amener en collision un faisceau de lecture incidente de rayonnement sur le disque en rotation pour produire un faisceau modulé de rayonnement réfléchi représentatif d'informations enregistrées; déplacer le faisceau de lecture et le disque radialement l'un par rapport à l'autre, pour amener de la sorte le faisceau de lecture à frapper une succession de pistes; utiliser un moyen d'asservissement de suivi pour maintenir un alignement du faisceau de lecture avec les pistes successives; restituer le faisceau modulé; utiliser le faisceau modulé restitué pour reproduire l'information vidéo enregistrée dans les pistes successives; restituer un signal de synchronisation verticale coïncidant avec chaque apparition du faisceau de lecture frappant un emplacement d'une piste d'information correspondant à un point dans l'intervalle entre trames adjacentes d'information; produire un signal de validation de mouvement-arrêt pour initialiser de la sorte le mode mouvement-arrêt; produire un signal de validation de progression de trames; détecter chaque signal de synchronisation verticale se produisant subséquente à l'étape de production de validation de progression de trames; laisser passer et bloquer alternativement les signaux de synchronisation verticale détectés, en utilisant chaque signal passé pour produire une impulsion de saut; et appliquer chaque impulsion de saut produite au moyen d'asservissement du suivi, où le moyen d'asservissement de suivi répond à chaque impulsion de saut produite pour sauter de façon incrémentale le faisceau de lecture en arrière pour frapper la piste d'information adjacente immédiatement précédente, pour effectuer de la sorte le mode mouvement-arrêt; où l'étape de passage et de blocage alternatif comprend une série de sous-étapes de passage et de blocage exécutées alternativement, le procédé étant caractérisé par les autres étapes de produire un signal de validation de progression de trame en avant; et court-circuiter la sous-étape de passage suivante qui sera autrement exécutée subséquemment à la production d'une étape d'un signal de validation de progression de trame en avant, en réponse à la production de l'étape du signal de validation de trame de progression en avant.

2. Un procédé pour restituer une information

enregistrée d'une pluralité de pistes vidéo d'informations enregistrées en spirale et sensiblement circulaires ou de pistes d'informations vidéo enregistrées circulaires formées dans un disque d'enregistrement, où chacune des pistes comprend deux trames d'information, avec un intervalle se produisant entre deux trames adjacentes, et pour reproduire de façon répétitive n'importe quelle des deux trames adjacentes d'information, en un mode mouvement-arrêt, comprenant les étapes de: faire tourner le disque; amener un faisceau de lecture incident de rayonnement à frapper le disque en rotation pour produire un faisceau modulé de rayonnement réfléchi représentatif de l'information enregistrée; déplacer le faisceau de lecture et le disque radialement l'un par rapport à l'autre, pour amener de la sorte le faisceau de lecture à frapper les pistes successives; utiliser un moyen d'asservissement du suivi pour maintenir un alignement du faisceau de lecture avec les pistes successives; restituer le faisceau modulé; utiliser le faisceau modulé restitué pour reproduire l'information vidéo enregistrée dans les pistes successives; restituer un signal de synchronisation verticale coïncident avec chaque apparition du faisceau de lecture frappant un emplacement d'une piste d'information correspondant à un point dans l'intervalle entre trames adjacentes d'information; produire un signal de validation de mouvement-arrêt pour initialiser de la sorte le mode mouvement-arrêt; produire un signal de validation de progression de trames; détecter chaque signal de synchronisation verticale produit subséquent à l'étape de production de validation de progression de trame; faire passer et bloquer alternativement les signaux de synchronisation verticale détectés, en utilisant chaque signal passé pour produire une impulsion de saut; et appliquer chaque impulsion de saut produite au moyen d'asservissement de suivi, où le moyen d'asservissement de suivi répond à chaque impulsion de saut produite pour sauter de façon incrémentale le faisceau de lecture en arrière pour frapper la piste d'information adjacente immédiatement précédente, pour effectuer de la sorte le mode mouvement-arrêt; où l'étape de passage et de blocage alternés comprend une série de sous-étapes de passage et de blocage exécutées alternativement, le procédé étant caractérisé par les autres étapes de produire un signal de validation de trame de progression en arrière et, en réponse au signal de validation de trame de progression en arrière, court-circuiter la sous-étape de blocage suivante qui serait autrement exécutée subséquemment à la production d'une étape de signal de validation de trame de progression en arrière.

* C L M S *