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(54) VIDEO DISC PLAYBACK

(71) We, N.V. PHILIPS' GLOEILAMPENFABRIEKEN, a limited liability Company, organised and established under the laws of the Kingdom of the Netherlands, of Emmasingel 29. Eindhoven, the Netherlands 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:

The invention relates to system for playing back a programme recorded on a disc-shaped record carrier, which system comprises a read apparatus for scanning the record carrier, said record carrier being provided with a spiral information track in which the programme is recorded as a television signal in a sequence of two fields per turn of the track, and consecutive scenes of the programme on the record carrier being constituted by consecutive sets of fields, each set comprising either two of three fields, in accordance with a regularly repeated pattern of sets, and the read apparatus being provided with control means for realizing a still-picture mode, in which mode the same two consecutive fields are repeatedly read by the repeated scanning of the same turn of the track.

Currently disc-shaped record carriers command much interest as a storage-medium for video information. This applies in particular to disc-shaped record carriers on which this video information is recorded in optically coded form. For reading these record carriers a read apparatus is employed which uses an optical scanning system. With the aid of a beam of radiation a scanning spot is projected onto the record carrier and information which is contained in this radiation beam after interaction with the record carrier is detected and converted into a television signal which is suitable for reproduction *via* a standard television receiver. Control systems, which may *inter alia* comprise deflection means interposed in the radiation beam, ensure that the scanning spot always coincides with the spiral information track on the record carrier. Such read apparatus, in particular the control system used therein, is *inter alia* described in Patent Specification No. 1,429,882 which is incorporated herein by reference.

The major advantage of using an optical coding on the record carrier in conjunction with an optcal scanning system is that scanning is entirely contactless, so that the risk of damage to the record carrier is minimised irrespective of movements of the scanning spot over the record carrier. During read-out this, *inter alia*, provides the possibility of using a still-picture mode, which possibility is comprehensively described in the above Patent Specification. In this still-picture mode the scanning spot is moved back radially by one track pitch after every revolution of the record carrier with the aid of the deflection means, so that continually the same turn of the spiral track is scanned. As exactly two fields are recorded in one turn of the track, which fields together constitute the interlaced television image, one specific picture of the recorded television signal is reproduced continuously in the still-picture mode.

Said record carriers are primarily intended to be provided with a programme by the factory and thus to be made available to the consumer as prerecorded record carriers. The most likely programme material for this type of prerecorded record carriers is constituted by film material because this is available in large quantities and in a wide repertory. If a film programme is to be used for the manufacture of record carriers destined for the American market, a complication results from the difference between the standards for the reproduction of film images and those for the reproduction of television pictures.

The standard mainly used for film *inter alia* implies that 24 film frames per second are

recorded and reproduced. In order to convert such a film into a video signal which is suitable for recording on said disc-shaped record carriers, each film frame is scanned in accordance with a pattern of interlaced fields. However, in accordance with the United States television standard, 30 pictures per second must be reproduced, so that it is not possible to transform one film frame into one television picture because then the playback speed of the recorded programme would then not be correct. The necessary adaptation can be obtained in known manner by programming the film scanner so that consecutve film frames are alternately converted into a set of two fields and a set of three fields. This means that two film frames are converted into five fields or four film frames into 10 fields or 5 television pictures, which correspond to a 24/30 conversion from the film standard into the television standard. In order to obtain this transformation it is not necessary *per se* to convert consecutive film frames into alternate sets of two and three fields. It is also possible to use a different sequential pattern. For example, as an alternative four consecutive film frames may be converted into consecutive sets of two, three, three and two fields. Any pattern with a period which is so short as not to be observed by the human eye may in principle be used.

If a read apparatus for disc-shaped record carriers is operated in the still-picture mode it is found that the reproduction quality is not always satisfactory when record carriers are used on which a television programme is recorded which is obtained in the manner described above. Often the television picture which is reproduced in the still-picture mode exhibits blurring and in the case of certain programmes it is even completely unacceptable.

It is an object of the invention to improve this situation and the invention is characterized in that to at least one of the fields which together constitute a pair of consecutive sets of television fields on the record carrier an indication signal is added and that the read apparatus is provided with detection means for detecting this indication signal and with selection means which are coupled to said detection means and which co-operate with the control means, which selection means as a function of the detected indication signal in conjunction with the control means, is adapted to select the two fields to be reproduced in the still-picture mode in such a way that the two fields reproduced belong to the same set of fields.

The invention is based on the recognition that in the still-picture mode of the known read apparatus two interlaced fields may be reproduced which stem from two consecutive film frames. As the scenes recorded in two consecutive film frames generally differs slightly, in particular in the case of fast-moving scenes in the recorded programme, the fields stemming from these individual film frames will also differ. If these fields are then combined into a television image by interlacing, a blurred picture results.

This is largely avoided by the steps in accordance with the invention in that first of all during the recording of the video signal on the record carrier an indication signal is added to each pair of consecutive sets of fields. By providing the read apparatus with detection means for detecting this indication signal it is achieved that information is available in respect of the field which is being read at that instant during the still-picture mode. This information can be employed for programming the control means *via* selection means controlled by this indication signal in such a way that, in this mode, the two fields reproduced always stem from the same film frame.

Preferably an indication signal is added to each set of fields on the record carrier, because in that case the selection means can be very simple.

The added indication signal may also serve as an address signal, *i.e.* it may contain such a code that the indication signal after detection not only has the above-mentioned function in the still-picture mode, but that after decoding of the code which is contained in each individual indication signal, it also provides a frame number associated with each film frame which may, for example, be displayed on the television screen simultaneously with the reproduced television picture or *via* a separate display.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which

Figures 1 and *2* schematically represent the manner in which a film programme is recorded on a disc-shaped record carrier,

Figure 3 schematically shows the read apparatus for such a disc-shaped record carrier.

Figure 4 in tabulated form shows the possible locations for the indication signal in consecutive sets of fields.

Figure 5 shows a form of the selection means which may be used in the read apparatus of Figure 3.

Figure 6 shows the signals appearing therein in the various scanning modes, and

Figure 7 schematically represents the scanning sequence of the sets of fields thus obtained.

Figure 8 finally shows an alternative form of the selection means.

Figure 1a schematically shows how a programme recorded on film is reproduced. Each of the film frames I through IV is consecutively reproduced for 1/24 of a second. If such a film programme is to be converted into a television signal, it is necessary to ensure that, per second, this television signal sequentially represents the information content of 24 consecutive film frames, preferably in an as regular as possible manner. To obtain a television signal in accordance with United States standards, which signal contains 60 fields per second, a conversion is necessary of which a possibility is represented in *Figure 1b*

Figure 1b schematically represents the reproduction of a television signal which consists of 30 television pictures per second. Each television picture, as is known, consists of two interlaced fields. Within a time interval of 1/6 of a second in which 4 film frames (I through IV) are reproduced it is therefore necessary to reproduce 5 television pictures of 10 fields (1 through 10). In order to achieve this the film frames are converted in known manner into a television signal, which changes from film frame to film frame, with aid of film scanning equipment. The first film frame I is scanned in accordance with two fields 1 + 2 resulting in a television picture S_1 (*Figure 1c*) consisting of these two interlaced fields 1 + 2. The second film frame II is first of all scanned in accordance with two fields 3 + 4, resulting in a television picture S_2 consisting of these two interlaced fields 3 + 4, but subsequently this film frame II is again scanned in accordance with a field 5, Thus, in the television signal this film frame II is ultimately represented by three fields 3, 4 and 5. The next film frame III again yields two fields 6 + 7, film frame IV three fields 8, 9 and 10, etc.

The Figure readily shows that in the time interval (1/6 of a second) which is necessary for reproducing 4 film frames exactly 10 fields are reproduced, or 5 television pictures. Owing to the alternate sets of two and three fields per film frame the sequence of the original scenes recorded on the film will be slightly disturbed during normal reproduction, but because it is disturbed with a frequency of 12 Hz this is hardly perceptible to the human eye.

Instead of the conversion illustrated in Figure 1 it is readily possible to select a conversion in accordance with the film frames I and IV each result into two fields and the film frames II and III each in three fields. Moreover, a pattern of sets may be chosen which is divided among more than four film frames, each pattern comprising an equal number of sets of two and of three fields.

If during read out of a disc-shaped record carrier the still-picture mode is selected it is found that in certain cases an unacceptable picture, in particular a blurred picture, is produced. It is found that such a blurred picture in the still-picture mode may be attributed to the selected conversion of film frames into television signals. This is illustrated by means of Figure 2 in combination with Figure 1.

As previously stated, the video signal is recorded in a spiral track on the disc-shaped record carrier, each turn of the track comprising two fields. Figure 2 shows such a spiral track T. This track is scanned by a rotation of the record carrier in the direction P, namely from the inside towards the outside in the example shown. Assuming that recording of field 1 begins on the radius R, the fields 1 through 10 will occupy the indicated track portions, *i.e.* the odd fields the track portions to the right of the radius R and the even fields the track portions to the left of the opposite radius to R. A sequence of odd and an even field always constitutes one track circumference, corresponding to one television picture S_1, S_2,...S_5.

In the still-picture mode of the playback apparatus one turn of the track is scanned continuously in that the scanning spot is moved back radially over a distance equal to the track pitch of the spiral track upon each revolution of the record carrier, said movement being referred to hereinafter as track jump. Obviously, such a track jump is not effected at an arbitrary instant, but always during the vertical flyback of the reproduced television signal, in order not to disturb the displayed picture. Furthermore, it is common practice for the track jump to coincide with the beginning of the odd fields by detection of the vertical synchronizing signal, so that in the still-picture mode pictures are reproduced which always consist of an odd followed by an even field, *i.e.* consecutive pictures S_1, S_2, S_3 etc. in the present example the track jump is therefore always effected at the location of the uninterrupted part of the diameter along R.

In the still-picture mode the scanning spot for example follows the path indicated by the dashed line, so that the picture S_1 consisting of the fields 1 and 2 is reproduced. This is found to be an entirely correct picture. If in the still-picture mode the scanning spot follows the path indicated by the dashed-dot line, the picture S_3 consisting of the fields 5 + 6 is reproduced. In Figure 1 it can be seen that the two fields 5 and 6, which in interlaced form constitute said picture S_3, stem from two different film frames, namely the frames II and III respectively. These two fields will consequently represent different scenes which in the still-picture mode are then alternately reproduced for 1/60 sec, resulting in an unacceptable picture.

The picture S_3, consisting of the fields 5 + 6 is therefore not suitable for reproduction in the still-picture mode. The same applies to the picture S_4, consisting of the fields 7 + 8, as

can readily be seen in Figure 1.

In accordance with the invention indication signals are added to the recorded video signal in order to prevent these problems in the still-picture mode of the read apparatus. These indication signals are detected during read-out and together with the selection means, which are responsive to these indication signals, they ensure that in the still-picture mode only combinations of two fields which stem from the same film frame are reproduced.

To explain the operation of the system in accordance with the invention Figure 3 schematically shows an embodiment of an optical read apparatus. This read apparatus largely corresponds to that shown and comprehensively described in the said Patent Specification No. 1,429,882.

The disc-shaped record carrier 11 is driven in a rotary sense 13 about its centre 12 and comprises a spiral information track T. The optical scanning system comprises a radiation source 14 which produces a radiation beam 15. This radiation beam is focussed to a scanning spot 19 *via* the semi-transparent mirror 16, the mirror 17 and the lens 18. After reflection the radiation beam is again incident on the mirror 17 and the semi-transparent mirror 16 by which it is partly reflected to a detector 20. This detector first of all serves to detect the video information contained in the radiation beam and make it available at a terminal 21.

Moreover, it is assumed that the radiation beam which is incident on the detector 20 contains information relating to the radial position of the scanning spot 19 relative to the information track, which results in a control signal at the terminal 22. Systems for obtaining this information relating to the radial position of the scanning spot are known in a multitude of variants. As it is irrelevant for the present invention which system is used for this purpose, reference is merely made, by way of example, to the possibilities described in the said Patent Specification. The control signal which is available at the terminal 22 is applied to a drive means 27 *via* a control amplifier 25 and the switch 26, which drive means can rotate the rotatably journalled (point 28) mirror 17 in the direction 33. Thus a closed control system is obtained for controlling the radial position of the scanning spot 19, so that it is ensured that the scanning spot 19 always coincides with the information track T.

In the still-picture mode of the read apparatus the scanning spot 19 should radially be moved back by one track pitch of the spiral track at every revolution of the record carrier 11. In order to achieve this the control loop of the radial tracking system is briefly rendered inoperative once per revolution of the record carrier, in that for example this loop is interrupted by the change-over of the switch 26. During this short time a signal source 32 then supplies a suitable control signal (jump signal) to the drive means 27 *via* the switch 26, so that the mirror 17 is rotated in such a way that the scanning spot 19 is rapidly moved by one track pitch in the radial direction. Subsequently, the control loop is again closed by means of the switch 26, so that during the rest of the revolution of the record carrier the information track is normally followed.

The control signal for the switch 26 and the signal source 32 is supplied by a selection circuit 31, which has two inputs which are connected to two separate detection circuits 29 and 30. Both detection circuits receive the television signal which is taken from the terminal 21 of the detector 20 and which is decoded with the aid of a decoding device 23, from which signal they extract the vertical synchronizing signals F (detector 29) and the indication signals B (detector 30). The detection of the two signals jointly defines the instant in the still-picture mode at which the control loop of the radial tracking system is interrupted and the jump signal is applied to the drive means 27 of the mirror 17, in other words the instant at which the track jump of the scanning spot is performed.

By a suitable choice of the position of the indication signal within a set of fields on the record carrier in conjunction with a suitable design of the selection circuit, it is then possible to ensure that in the still-picture mode always two fields are reproduced which stem from one and the same film frame. In respect of the position of the indication signal within the sets of fields on the disc in conjunction with the design of the selection circuit there are a number of possibilities. The most significant possibilities are schematically shown in Figure 4 in the form of a table.

In Figure 4 in the upper part of the table fields are indicated along a time axis *t*, showing that the fields 1 and 2 stem from film frame I, fields 3, 4 and 5 from film frame II, and fields 6 and 7 from film frame III. In the rows 1 through 6 several possibilities for the location of the indication signal are given, which location is further specified in column B. Column Z indicates at which instant the track jump occurs.

For the sake of clarity possibility 1 is considered first. As is indicated in the table by crosses an indication signal is added to the first field (r_1) of each set (I, II, etc.) of fields, *i.e.* to the fields 1, 3, 6, 8 etc. It is evident that this indication signal is included in the non-visible part of the television signal, *i.e.* in the vertical blanking period, namely after the vertical synchronizing signal. The selection circuit in the playback apparatus may now be designed

so that the control signal which causes the track jump in the still-picture mode is produced by the second vertical synchronizing signal (represented by F_2 in column Z) after detection of the indication signal. If the still-picture mode is switched on and subsequently the indication signal associated with field 1 is detected, the vertical synchronizing signal which appears after read-out of field 2 will cause the track jump of the scanning spot, which means that the fields 1 + 2 are reproduced as a still picture.

If switching to the still-picture mode is effected one picture later, which will be explained subsequently, the scanning spot keeps following the information track until the next indication signal (field 3) is detected, after which the second vertical synchronizing signal which is detected after this again initiates the track jump, so that the fields 3 + 4 are then reproduced as a still-picture. As is apparent from the table it is thus ensured that the number of possibilities for reproduction in the still-picture mode is limited to combinations of fields which belong to the same set of fields.

Figure 5 schematically shows an example of the selection circuit which is based on procedure 1 in accordance with Figure 4. The selection circuit comprises an input terminal 40 for the vertical synchronizing pulses F which are detected from the read-out television signals by the detector 29 (Figure 3). These vertical synchronizing pulses F are applied to the clock input *t* of two JK-flip-flops 48 and 49. The J and the K inputs of the JK flip-flop 48 are respectively connected to the Q_1 and $\overline{Q_1}$ outputs of a flip-flop 47, whilst the J and K inputs of the JK flipflop 49 are respectively connected to the Q_2 and the $\overline{Q_2}$ outputs of the JK flip-flop 48. The flip-flop 47 has a set input S which is connected to a circuit 46. This circuit 46 receives the field pulses F at its input from which it derives pulses L which viewed in time are situated between the field pulses and, as the case may be, an indication signal associated with a relevant field. For this it is thus assumed that the indication signal is situated some time after the vertical synchronizing signal. For this purpose the circuit 46 may for example consist of a monostable multivibrator which is triggered by the trailing edge of a field pulse. The selection circuit further more comprises two AND-gates 50 and 51. The AND-gate 50 comprises three inputs which are respectively connected to the Q_2 output of JK flip-flop 48, the $\overline{q_3}$ output of JK flip-flop 49, and the output of circuit 46. The AND-gate 51 comprises three inputs which are respectively connected to the output of the circuit 46, the output Q_3 of the JK flip-flop 49 and a control terminal 44. The outputs X and Y of these two AND-gates 50 and 51 are connected to the inputs of an OR-gate 52, whose output Z is connected to an output terminal 45. This output terminal 45 constitutes the output of the selection circuit and consequently corresponds to the output of the circuit 31 in Figure 3.

The selection circuit of Figure 5 furthermore comprises an input terminal 41 to which the indication signals B detected by the detector 30 (Figure 3) are applied. This indication signal B is applied *via* an inverter 53 to the clock input T of a JK flip-flop 54. The J-input of said JK flip-flop is connected to an input terminal 42, which *via* an inverter 55 is connected to the K-input of JK flip-flop 54. The outputs Q_4 and $\overline{Q_4}$ of JK flip-flop 54 are connected to the J and K input respectively of a JK flip-flop 56, whose clock input T also receives the inverted indication signals (pulses). The output Q_5 of JK flip-flop 56 and the output $\overline{Q_4}$ of the JK flip-flop 54 are connected to the inputs of an OR-gate 57. The circuit finally comprises another AND-gate 58 with three inputs which are respectively connected to an input terminal 43, the input terminal 41 and the output of the OR-gate 58. The output W of this AND-gate is connected to the reset inputs R of the flip-flops 47, 48 and 49.

The scanning mode of the read apparatus is determined by the logic levels of the control signals C, D and A at the respective control terminals 43, 44 and 42. In the following table the combinations of logic levels of these control signals in the corresponding scanning modes are indicated.

C	D	A	Mode
0	0	-	normal forward
0	1	-	backward
1	-	0	still-picture
1	0	0→1→0	one picture forward
1	1	0→1→0	one picture backward

As long as the signal C is a logic 0 either normal scanning of the recorded video signal is obtained (D = 0) or the recorded programme is scanned backwards (D = 1). Signal A is then irrelevant. If signal C is a logic 1 and signal A a logic 0 the still-picture mode is switched on irrespectively of signal D. If the signal A is a logic 1 for a certain time, one

picture is scanned in the forward direction (D = 0) or one picture is scanned in the backward direction (D = 1).

The operation of the selection circuit of Figure 5 will now be described in more detail with reference to the timing diagrams in Figures 6a, 6b and 6c, which give the signals at the various points of the circuits in the various scanning modes.

Hereinafter the signals at the various points Q_1 through Q_5, L, X, Y, Z etc. will be designated by the same reference letters as the points themselves. The signal Q_1 thus means the signal at the output Q_1 of the flip-flop 47 etc. Furthermore Figure 7 schematically shows the corresponding scanning sequence of a number of consecutive pictures recorded on the record carrier. The vertically plotted units represent a sequence of fields recorded on the disc, *i.e.* together a part of the spiral track. The first two fields for example stem from a film frame n-3, the following three fields from a film frame n-2 etc. To each set of fields an indication signal B has been added to the first field, which is indicated in the Figure by the number of the relevant film frame. The time axis has been plotted horizontally, so that the diagram shown gives the scanning sequence of the recorded fields.

It is assumed that the control signal C at the control terminal 43 is a logic "0". This means that the output signal W of the AND-gate 58 is always "0", so that the flip-flops 47, 48 and 49 receive no reset pulses. The first pulse L at the set input S of the flip-flop 47 will make the signal Q_1 "1", a subsequent field pulse F at the clock input T of JK flip-flop 48 will make the signal Q_2 "1", and the next field pulse F at the clock input T of the JK flip-flop 49 will make the signal Q_3 "1". This situation is continuously maintained as long as the signal C at the control input 43 remains "0", *i.e.* as long as the flip-flops 47, 48 and 49 receive no reset pulses. It is assumed that this situation exists at the instant t_0 in the time diagram of Figure 6a so that all outputs Q_1, Q_2 and Q_3 supply a "1" signal. This means that the signal X at the output of the AND-gate 50 is always "0", because the signal $\overline{Q_3}$ is "0". The signal Y at the output of the AND-gate 51 depends on the control signal D at the control terminal 44. It is assumed that this control signal D is "0", so that Y is also "0". This also means that a signal Z at the output of the OR-gate 52 is always "0". Consequently, at the output terminal 45 of said selection circuit no command pulse appears which, *via* the switch 26 shown in Figure 3 and signal source 32, can cause a track jump of the scanning spot. This means that the spiral track on the record carrier is scanned continuously, so that consecutively the fields corresponding to the film frames (n-3) and (n-2) are read.

At the instant t_1 (Figure 6a) the control signal C at the terminal 43 is switched to "1". As it is assumed that the control signal A at the control terminal 42 is already "0" at least from the instant t_0, the signals Q_4 and Q_5 are both "0". As the signal $\overline{Q_4}$ is consequently "1", the next indication pulse B at the output W of the AND-gate 58 results in a pulse which resets the three flip-flops 48 and 49, so that the signals Q_1, Q_2 and Q_3 become zero. The signal Q_1 becomes "1" again owing to the next pulse of the signal L from the circuit 46. The signal Q_2 becomes "1" owing to the field pulse F which then follows. The two signals Q_1 and Q_2 become "0" again owing to the next pulse W from the AND-gate 58 to appear. The signal Q_3 remains always "0" under these conditions.

Within the time interval between the instant that the signal Q_2 becomes "1" owing to the appearance of a field pulse F and the instant that said signal becomes "0" again owing to the occurrence of a reset pulse W for the flip-flops 47 through 49, a pulse L from the circuit 46 appears. This pulse is transferred *via* the AND-gate, because the two other inputs of this gate receive a "1" signal, so that at the output X of this AND-gate and thus at the output Z of the OR-gate 52 a pulse appears. This pulse causes a track jump of the scanning spot, so that the same turn of the track, *i.e.* the same two fields, are read again. This is repeated as long as the control signals C, D and A retain the specified values. During this time the read apparatus consequently remains in the still-picture mode.

At the instant t_2 (Figure 6a and 6b respectively) the control signal A at the control terminal 42 becomes "1" for a certain time (at least for three field periods). At the trailing edge of the next indication pulse B_n the signal Q_4 from flip-flop 54 becomes "1". This indication pulse B_n also results in a reset pulse (signal W from the AND-gate 58) for the flip-flops 47 through 49. The next indication pulse B_n, however, does not have this effect, because at the instant at which the next indication pulse B_n occurs, both the signal $\overline{Q_4}$ from the flip-flop 54 and the signal Q_5 from flip-flop 56 are "0", so that the output signal of the OR-gate 57 is "0" and the AND-gate 58 is consequently closed. At the trailing edge of this indication pulse B_n Q_5 becomes "1" again, so that after this instant the OR-gate 57 again supplies an "1" to the AND-gate 58.

Owing to the absence of a reset pulse W for the flip-flops 47 through 49 which coincides with the indication pulse B_n not only the signals Q_1, Q_2 from the flip-flops 47 and 48 respectively become "1", but also the signal Q_3 from the flip-flop 49. As long as this signal Q_3 is "1", *i.e.* the signal Q_3 is "0", the AND-gate 50 is closed. As AND-gate 51 is also closed by the control signal D, output terminal 45 cannot supply a command pulse, so that

no track jump is effected. Consequently the scanning spot keeps following the spiral track until the indication pulse B_{n+1} associated with the next film frame is detected. As at this instant Q_5 is still "1", this indication pulse B_{n+1} *via* the AND-gate 58 provides a reset pulse W for the flip-flops 47 through 49, as a result of which in a similar way as in the time interval t_1-t_2 the desired command pulses (Z) are obtained with the aid of the flip-flops 47 through 49 and the gates 50 through 52, so that now the fields corresponding to the film-frame (n+1) are reproduced in the still-picture mode.

For switching one picture backwards the control signal A is switched to "1" for a certain time at the instant t_3, and simultaneously the control signal D becomes "1". In a similar way as when switching one picture forwards one of the reset pulses (W) for the flip-flops 47 through 49 is suppressed, so that after the signals Q_1 and Q_2 have become "1", the signal Q_3 also becomes "1". AND-gate 50 is closed during the time that the signal Q_3 is "1", *i.e.* signal $\overline{Q_3}$ is "0". The AND-gate 51, however, is open during this time, so that the signal Y consists of a pulse train corresponding to the signal L from the circuit 46. *Via* the OR-gate 52 this pulse train is transferred to the output terminal 45, so that after each field period a track jump of the scanning spot is initiated. This continues until another indication pulse B_n is detected. This indication pulse belongs to the preceding film frame and results in a reset pulse W, so that the still-picture mode is restored completely.

If the recorded programme is to be played back in a backward direction, the control signal C should become "0" whilst the control signal D is "1", as is indicated at the instant t_4. The signal W consequently remains "0", so that no reset pulses are applied to the flip-flops 47 through 49. After some field pulses F all signals Q_1, Q_2 and Q_3 are consequently "1". This means that the AND-gate 50 is closed. The AND-gate 51, however, completely transfers the pulse train L to the output terminal 45, so that after each field period a track jump is initiated.

A fast forward scanning mode can be achieved by just reversing the polarity of the control signal for the drive means 27 (Figure 3), which signal is supplied by the signal source 32 and which is destined for effecting the track jump, due to which, a forward track jump will be effected after read-out of one field, *i.e.* two fields are skipped.

With the example of the selection circuit shown in Figure 5 it is thus possible to switch on the various scanning modes by the application of the various control signals, whilst ensuring that in the still-picture mode only the first two fields stemming from one film frame are reproduced. Obviously, many variants of this circuit are possible. It is to be noted that the embodiment shown is based on the requirement that in addition to provisions for the still-picture mode the necessary provisions are taken from the other scanning modes. If only a still-picture mode is required, the selection circuit may of course be considerably simpler.

Reverting now to the table of Figure 4, the remaining possibilities of adding the indication signal to the television signal and deriving a command signal therefrom for initiating the track jump will be discussed now. In the case of the possibility given in row 2 the indication signal, in a similar way as under 1, is always added to the first field of a set. The command signal for initiating the track jump, however, is now not derived from the vertical synchronizing signal but from the indication signal B itself. Thus the track jump is effected immediately after detection of the indication signal.

In the case of possibility 3 the indication signal is added to the second field of each set, whilst the command-signal for initiating the track jump is derived from the next vertical synchronizing signal. Thus, always the first and second field of a set are reproduced in the still-picture mode entirely in accordance with possibility 1.

In the case of possibilities 4 and 5 only the second and third field of a set consisting of 3 fields are reproduced in the still-picture mode, the positions of the indication signals B and the command signals Z being apparent from the table.

Under 6 a special possibility is given, one indication signal being added to each combination of two consecutive sets, namely to the first field of second set. If in the still-picture mode the indication signal B is now used as a command signal Z for initiating the track jump, two fields of the first set are reproduced. However, if the second vertical synchronizing signal F_2 after detection of the indication signal is employed as a command signal Z, two fields of the second set are reproduced. By switching between these two methods of obtaining the command signal, consecutive film frames are reproduced in the still-picture mode.

For illustration Figure 8 shows an example of the selection circuit required for this. The section which should supply the second vertical synchronizing signal after the detection of an indication signal B as a command signal, may be substantially identical to the corresponding section of the circuit of Figure 5 and comprises the flip-flops 47, 48 and 49, the AND-gate 50 and a circuit 46. The output signal X of the AND-gate 50 is applied to an AND-gate 62. This AND-gate 62 furthermore receives a signal from a control terminal 65, which is "1" in the still picture mode, and a signal from a control terminal 60. If this

last-mentioned signal is also "1" the signal X *via* the AND-gate 62 and the OR-gate 64 thus functions as a command signal Z for initiating the track jump, *i.e.* the second vertical synchronizing signal F_2 after detection of an indication signal B. However, if the control signal at the control terminal 60 is "0", the AND-gate 62 is closed. The command signal Z is then constituted by the indication signal B itself which is then transferred *via* an AND-gate 63 which also receives the control signal from terminal 60 *via* an inverter 61 and the signal at the control terminal 65. Depending on the control signal at the control terminal 60 either the scene corresponding to the first set of fields or the second set of fields is reproduced.

In respect of the position of the indication signal within a field period and the shape of this signal the following is to be noted. As previously stated this indication signal is always recorded during the vertical blanking period in order not to disturb the picture to be reproduced. A certain picture line after the vertical synchronizing signal may then be reserved for the indication signal. In order to minimize the risk of interference, steps can be taken to ensure that the detection of an indication signal is possible only in the relevant portion of the field period, for which purpose a gate circuit can be included before the detector.

For the addition of an address signal it is for example possible to use a bi-phase signal with the signal values corresponding to white and black of the television signal as logic levels. A number of bits may then serve as indication signal, whilst the remaining bits may represent the picture number.

Finally, it is to be noted that the invention is by no means limited to the embodiments shown. Both in respect of the scanning sequence at the transitions between the various scanning modes of the read apparatus and in respect of the design of the selection circuit many variants are possible.

WHAT WE CLAIM IS;-

1. A system for playing back a programme recorded on a disc-shaped record carrier, which system comprises a read apparatus for scanning the record carrier, said record carrier being provided with a spiral information track in which the programme is recorded as a television signal in a sequence of two fields per turn of the track and consecutive scenes of the programme on the record carrier being constituted by consecutive sets of fields, each set comprising either two or three fields, in accordance with a regularly repeated pattern of sets, and the read apparatus being provided with control means for realizing a still-picture mode, in which mode the same two consecutive fields are repeatedly read by the repeated scanning of the same turn of the track, characterized in that to at least one of the fields which together constitute a pair of consecutive sets of fields on the record carrier an indication signal is added and that the read apparatus is provided with detection means for detecting this indication signal and with selection means which are coupled to said detection means and which co-operate with the control means, which selection means, as a function of the detected indication signal in conjunction with the control means, is adapted to select the two fields to be reproduced in the still-picture mode in such a way that the two fields reproduced belong to the same set of fields.

2. A system as claimed in Claim 1 characterized in that the consecutive sets of fields comprise alternately two and three fields.

3. A system as claimed in claim 1 or Claim 2, characterized in that an indication signal is added to one field of each set of fields.

4. A system as claimed in Claim 3, characterized in that the indication signal is always added to the first or second field of a set and the selection means are such that in the still-picture mode always the first and the second fields of a set are reproduced.

5. A system as claimed in any of the preceding Claims, characterized in that the indication signal moreover serves as an address signal for the associated set and that the read apparatus comprises a decoding unit for decoding said address signal.

6. A read apparatus for use in a system as claimed in any of the preceding Claims.

7. A record carrier for use in a system as claimed in any of Claims 1 through 5.

8. A read apparatus substantially as described with reference to Figures 3 and 5 or Figures 3 and 8 of the accompanying drawings.

9. A system substantially as described with reference to Figures 4, 6 and 7 of the accompanying drawings.

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