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(54) CHECKING CORRECT CORRELATION OF TWO DATA STRIPS

(71) We, KARL VOCKENHUBER, of 118 Pötzleinsdorferstrasse, Vienna 18, Austria and RAIMUND HAUSER, of 2 Goldeggasse, Vienna 4, Austria, both of Austrian Nationality, 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:—

Very unreliable means have hitherto been used for detecting the correct correlation of two separate data media, more particularly cinema films and the associated recording tape. In the older method the reel or cassette for supporting the appropriate data medium was inscribed. It was then possible that the inscription on the audio medium or image medium could not be read because of the darkness which was required during the performance in the room in which the performance was given so that it was very likely to lead to a performance in which tapes which are not related to each other were played back. Moreover, the inscription on the reel or on the cassette became very unclear and not readily readable in the course of time or became completely detached from the medium.

An improvement was obtained in recent times with a synchronizing method between film and sound known as the "PIP" method by the correlation between the two tapes being indicated on the image medium as well as on the sound medium by means of marks. To this end the marks on the sound medium control the operating frequency of a claw device for the drive of the image medium, and the driving speed may for example be "zero" in order to project a stationary image or to show a scene with "slow motion" effect where the speed amounts to a fraction of the driving speed in normal projection. If a recording tape that was not related to the film was erroneously played back, the fact that uncoordinated data media were being played back was noted sooner or later only by reference to the contrast between the sound and the film. In some circumstances it was possible that the wrong

correlation of the data media could not be detected at all, more particularly in films with a minimum scene content and musical sound background. However, this could have a very detrimental effect more particularly if the sound background intended for the film was to have been particularly informative.

In accordance with the present invention there is provided a method of checking the correlation of two independently driven data carriers to be run at the same time, comprising the steps of:

providing a first data carrier with a visible starting mark and with a code mark detectable in any early phase of its run;

providing the second data carrier with a visible starting mark and with a correlation marking spaced from the latter starting mark by a distance corresponding to the separation of the marks on the first data carrier;

starting the run of both the data carriers substantially concurrently from predetermined positions on the carriers indicated by the visible starting marks;

stopping or reducing the speed of the second data carrier to detect any correlation marking thereon in response to detection of a code mark on said first data carrier;

resuming the run of said second data carrier only upon detection of a correlation marking immediately after the second carrier is slowed down or stopped.

In its simplest form, said first data carrier is a sound tape, said second data carrier is a film strip arranged to be stopped in response to the detection of a code mark on the sound tape and the correct correlation marking on the film strip is a title of the film. The operator of the apparatus may then determine correct correlation by checking whether or not the title is displayed when the film is stopped. The frames preceding and following the title frame of the film may carry markings not noticeable when the film is projected at normal speed to indicate the absence of

correlation if the film should be stopped on one of these frames.

Preferably, however, said first data carrier is a sound tape, said second data carrier is a film strip and the correlation marking on the film strip lies outside the frames of the film so as not to be displayed during film projection.

In such an embodiment of the invention, the film may be displayed using a film projector having a detector for detecting correlation markings on the film strip and a correct correlation sensing device including a threshold switch responsive to the period during which a correlation marking is detected exceeding a predetermined threshold period whereby the sensing device only responds to the correlation marking when the film has been slowed down or stopped thus indicating that correct correlation is present.

Synchronising control markings may be placed on the sound tape to control synchronous movements of the tape and film after correlation has been established.

The invention will now be described in more detail, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 illustrates diagrammatically a film projector whose film is to be co-ordinated or correlated with a tape recorder providing the sound accompaniment to the projected film;

Figure 2 shows in sketches A, B, C, marks provided on a section of the film strip and on a section of the sound tape to enable their movements to be co-ordinated when first fitted to the projector and tape recorder respectively;

Figure 3 shows in sketches A and B sections of a film strip and a sound tape again provided with co-ordinating marks;

Figure 4 diagrammatically illustrates a film traction claw whose motion is cam controlled, and also a circuit used in a modification and for detecting the presence or absence of a co-ordinating mark on a film when temporarily stopped by cessation of the claws movement in response to a co-ordination mark on the sound tape;

Figure 5 is a section through the claw and associated cams of Figure 4 and is taken on the line and in the direction indicated by the arrows V—V in that Figure, and also represented schematically is a circuit for preventing film traction by the claw when a co-ordination mark is read from the sound tape; and,

Figure 6 shows diagrammatically a second way of responding to correct co-ordination of the film strip and sound tape.

The numeral 1 in Figure 1 refers to a diagrammatic view of a film projector while the recorded acoustic background for the film which is supported in a cassette 3 of the pro-

jector 1 is produced by means of a recording tape 4 in a tape recorder 2. A reading device 5 on the tape recorder 2 transmits a signal via a connecting lead 6 to the film projector 1 as soon as a control mark on the recording tape 4 passes by the reading device 5.

A control mark of this kind is shown for example in Figure 2B and is referenced 7. In order to detect the correct coordination of the two data media it is necessary that both data media are started from a first position of a sequence of positions which are coordinated to each other. To facilitate adjustment of this position the film in Figure 2A is provided with a start mark 9 and the recording tape in Figure 2B is provided with a start mark 11.

The film 8 is then transported at a speed at which indicating and/or control marks of the first kind 12 as well as those of the second kind 13 cannot be evaluated. In the simplest case such as that shown in Figure 2A the indicating marks of the first kind 12 comprise light transmitting leaders or scene images while the indicating and/or control marks of the second kind 13 are formed by a single film image which shows the film title when it is projected. The simplest evaluation in this embodiment is performed by the operator of the apparatus. This is done by stopping the film drive if a control signal is delivered via the lead 6 to the projector 1 when the control mark 7 reaches the reading device 5 of the tape recorder 2. If the film image which is then disposed in the image window displays the film title it means that the two strips are correctly coordinated to each other. If instead the leader or an image of the first or succeeding scenes is projected (that is to say an indicating mark of the first kind) the operator will immediately know that the mark 7 has produced stoppage at the wrong time, and that the two strips are not co-ordinated to each other or have been wrongly inserted. In all these eventualities there will be no synchronization when the two strips are played back.

Figure 2C shows the manner in which the indicating marks may be applied to the film in order to enable the coordination to be unequivocally evaluated. The images 12¹ are provided with the symbol "NO" so that these images project the non-coordination of the two data media "marks" 12¹ when the mark 7 triggers the stoppage of the data medium. As may be seen by reference to Figure 2C, each of the symbols "NO" occupies a different position on the image 12¹ in the image cut-out. When the film is projected at a speed which is higher than an initially defined detection limit it is not possible to indicate the coordination because the inertia of the eye is not able to

follow the "NO" marks which change their position suddenly. Evaluation relating to the coordination of the strips is possible only when the mark 7 produces a change-over in the transport speed of the film because the speed is then so arranged as to permit reading of the marks 12¹, 13¹. The mark 13¹ which refers to correct coordination may again in the simplest case represent the film title and it is particularly advantageous if the previously mentioned second speed is "zero" so that the mark 12¹, 13¹ which will be disposed in the image window, depending on the coordination of the two strips, will be projected when it is stationary.

In the embodiment of Figures 3A and 3B it is necessary for both data media 8¹ and 10¹ to be started from a coordinated position. To this end it is not necessary for the transport speeds of the two data media to be identical, it is merely essential that an indicating and/or control mark on the image medium 8¹ which is coordinated to a control mark on the audio medium 10¹ simultaneously passes the appropriate evaluation station. In the example illustrated in Figures 3A and 3B the audio medium 10¹ is provided with control marks 14 which are associated with each image zone 12¹ and thus characterize indexing of the film 8¹ at the normal image frequency. If no control mark 14 is provided on the audio medium 10¹ it means that the film is to be projected when stationary. When the film 8¹ is correctly coordinated to the recording tape 10¹ a control mark 15 on the film can be used to provide a response from an evaluation device associated with the film, simultaneously with the absence of the first control mark 14. The time during which the affected image is to be projected when stationary corresponds to the time before the moment when the audio medium, which continues to be transported, again switches a mark 14 into the reading station 5. This section of the audio medium is designated with the numeral 16 in Figure 3B. Re-engagement of the film drive as controlled by the mark 14 is maintained until the next section 16 on the recording tape initiates a stationary projection, for example the film image with the control mark 17. This kind of encoding does not merely enable the coordination of the two data media to be recognised very soon after the beginning of the performance but also achieves synchronization of the entire length of the two strips. Synchronization is usually obtained by the control marks 14 being adapted to influence a magnet for the claw control as for example in the known "PIP" system. It will be appreciated that the images themselves can be utilized in the place of the control marks 15 and 17 in order to detect the coordination, for example in order to

project the film title when stationary. The code marks on the film could then be formed as described for example by reference to Figure 2C. However, it is also feasible for the intervals 16 to be made substantially shorter, such an interval being followed by one or possibly more control markers 14 in sequence. Such a sequence of control marks and intervals would take the form of "slow motion" effect when the film 8¹ is projected and can of course also be utilized for evaluation with respect to the coordination or synchronization of the two strips.

The numeral 21 in Figures 4 and 5 refers to a claw spindle of a projector and which is driven in the anti-clockwise direction by a motor (not shown). The spindle 21 is provided with a boss 22 which supports a three-part shutter blade 23 and a disc cam 24. The disc cam is provided with a radial cam 25 and an axial cam 26. The disc cam 24 is disposed opposite to a claw frame 27 which is vertically slidably and pivotally supported on two balls 28 and 29. The claw frame 27 has two claw teeth 30, 31 which cooperate with perforations of the film 8 and transport it in accordance with the motion of the claw frame. The claw frame 27 is provided with a cam follower 32 which is pressed simultaneously against both cams of the disc cam 24 by the springs 33 and 34. The cam follower 32 causes the claw frame 27 to be vertically reciprocated in accordance with the characteristics of the radial cam 25 while the axial cam 26 causes the claw frame to be pivoted, the claw teeth 30, 31 being either engaged with the perforation of the film 8 or being disengaged therefrom. A cup magnet 35 which is energized by a pulse transmitter 36 shown in Figure 5 is disposed opposite the claw frame which is constructed of ferromagnetic material. A variable resistor 37 which is shown associated with the pulse transmitter 36 provides an adjustable time constant element of the pulse transmitter. The resistor 37 which is adjusted in its static state so as to produce no pulse in the transmitter 36, can be controlled by the reading device 5 through an amplifier 38. The recording tape 10 is moved past the reading device 5 by a drive roller 39 and a pinch roller 40.

A heat filter 42 is provided which may be moved into the optical projection path together with the energization of the cup magnet 35 during prolonged projection of a film frame.

If the film 8 and the recording tape 10 are started by the coordinated marks 9, 11 the said film 8 will be transported in known manner through the claw mechanism while the electromagnet 35 is not energized. Immediately before the actual indexing motion of the claw the axial cam 26 will cause the claw teeth 30 and 31 to engage

with the perforation of the film. During the succeeding phase the claw frame is downwardly displaced by the radial cam 25, the claw teeth 30 and 32 transporting the film 8 through the film gate in the same sense. On completion of the transport stroke the axial cam 26 pivots the claw frame so that the claw teeth 30 and 31 are disengaged from the perforation of the film 8. The claw frame is subsequently returned by the radial cam into the original starting position in readiness to commence a second cycle of movement.

If the control mark 7 on the recording tape 10 reaches the reading station 5 a signal is transmitted via the amplifier 38 to the resistor 37 to cause an adjustment thereof which is such that the pulse transmitter 36 delivers a pulse to the cup magnet 35 to hold it energized and thus prevent the claw frame engaging the film perforations. The film image which has just been indexed into an image window 41 of the film gate will then be projected while stationary. The title of the film 8 will be projected if the two data media are correctly coordinated to each other otherwise the leader or a scene image 12 or a negative indicating mark 12¹ will be projected in accordance with Figure 2C.

The following modification makes evaluation of coordination by the operator unnecessary as such evaluation takes place automatically. Referring to Figure 4 marks 13¹ which are scanned by a reading device are provided on the film 8 in place of or together with the coding of the strip coordination via the film image itself.

In the reading device there is provided a light source 43 to illuminate an edge track on the film 8 to which the mark 13¹ is applied. A photocell 44 is disposed on the opposite side of the film and the output of the photocell is connected to an amplifier 45. The output of the amplifier 45 is connected to a relay 46 with a delayed drop-out action and through an RC element 57 to a threshold switch 58 which receives the output of the RC element 57 and controls operation of a relay 59. A changeover contact 47 is operated by the relay 59 while the relay 46 controls an on-off contact 60 in a lamp circuit 61. Either a red lamp 48 or a green lamp 49 can be connected to a voltage supply in the lamp circuit 61. In its inoperative state the contact 47 connects the red lamp 48 to one terminal of the voltage supply so that it is illuminated until the connection to the voltage source is interrupted by the contact 60 in series with the other terminal.

Coordination of the two strips is evaluated by amplification in 45 of the brief voltage pulse which is produced in the photocell 44 when the light-transmissive

mark 13¹ passes between the light source 43 and the photocell 44. The resultant signal initially causes the red lamp 48 to be illuminated via the contact 47 and by the contact 60 which is closed by the relay 46. The output signal from the amplifier 45 is also supplied to the RC element 57 which functions as a signal integrator during the period the contact 60 is closed. The delayed output signal from the RC element 57 passes to the threshold switch 58. Since the voltage pulse signal produced by the mark 13¹ is relatively short owing to the film passing quickly between the light source 43 and the photocell 44 the charge in the capacitor of the RC element 57 is insufficient to operate the threshold switch 58 and the relay 59 will not be energized. The red lamp 48 remains switched on only until the delay winding in the relay 46 causes the relay contact 60 to open.

If the drive for the film 8 is stopped by the appearance of the control mark 7 on the recording tape and if the mark 13¹ of the film 8 simultaneously is located between the light source 43 and the photocell 44 it means that the two strips are correctly coordinated to each other. The output pulse signal produced and amplified by the photocell 44 now causes the red lamp 48 to be switched on again but this time it also causes the relay 59 to be energized. Since the duration of the pulse produces a sufficiently large charge in the capacitor of the RC element 57 due to the film with the mark 13¹ being stopped between the light source 43 and the photocell 44, the threshold switch 58 triggers operation of the relay 59 which is also then energized. The change-over contact 47 which is controlled by the relay 59 changes to the circuit branch with the green lamp 49 which is thus illuminated. This indicates the correct coordination of the two strips. The green lamp is again switched off by the "delay opening" winding of the relay 60 after the film is moved on. After the voltage across the RC element 57 has decayed, the relay contact 47 is again connected to the branch with the red lamp 48 by virtue of the fact that the relay 59 is monostable and spring biased to this state. A mode selector switch may also be used in place of the lamps 49 and 48.

A film transport device constructed as shown in Figure 6 corresponds substantially to the device illustrated in Figures 4 and 5 and its parts are therefore correspondingly referenced and it will not be described again in detail. Only the kind of evaluation regarding the coordination of the two strips is different. If a control mark 54 or 56 on the recording tape 10¹ biases the associated reading device 5 a lamp 52, which is disposed in the zone of the film path, is illuminated. Behind the film 8¹ and situated

opposite to the lamp 52 is a photocell 50 the output of which is connected via a threshold switch 58 to an "EX-NOR" gate 62.

5 The second input of the network 62 comprises a conductor 63 which is branched off from the lamp circuit. The output of the "EX-NOR" network 62 is connected with a switch 64 for switching off the projector circuit.

10 If a control mark 53 on the film biases the associated reading device simultaneously with a control mark 54 on the recording tape an equivalent signal will be supplied to the gate 62 via the conductor 63 as well as via the photocell 50, due to the illumination of the lamp 52, and the switch 64 will remain closed. This indicates the correct co-ordination of the strips. If the strips are not coordinated the lamp 52 is illuminated only if no mark 53 is present on the film at a position opposite the lamp. Owing to the low light transmissivity of the film edge track in the absence of a mark 53 the voltage produced in the photocell 50 under these conditions is insufficient to operate the threshold switch 58 and to supply a signal to the gate 62. However, since the gate is supplied with an input signal via the conductor 63 the switch 64 which is controlled by the gate 62 is opened and de-energizes the drive circuit for the projector motor. Coding the co-ordination of the two strips can be rendered very versatile by applying further code marks 55 on the film or applying code marks 56 to the recording tape.

Finally it should be mentioned that the detecting device for coordinating the two data media in the projector and in the tape recorder may also be associated with an indicating device which indicates faulty operation of coordinated strips if the strips are not started by the same mark. As already mentioned the two strips would then not run in synchronism.

WHAT WE CLAIM IS:—

1. A method of checking the correlation of two independently driven data carriers to be run at the same time, comprising the steps of:

55 providing a first data carrier with a visible starting mark and with a code mark detectable in any early phase of its run;

60 providing the second data carrier with a visible starting mark and with a correlation marking spaced from the latter starting mark by a distance corresponding to the separation of the marks on the first data carrier;

starting the run of both the data carriers substantially concurrently from predetermined positions on the carriers indicated by the visible starting marks;

65 stopping or reducing the speed of the

second data carrier to detect any correlation marking thereon in response to detection of a code mark on said first data carrier;

70 resuming the run of said second data carrier only upon detection of a correlation marking immediately after the second carrier is slowed down or stopped.

2. A method as claimed in Claim 1, in which said first data carrier is a sound tape, said second data carrier is a film strip which is stopped in response to detection of a code mark on the sound tape and the correct correlation marking on the film strip is a title of the film.

3. A method as claimed in Claim 1, in which said first data carrier is a sound tape, said second data carrier is a film strip and the correlation marking on the film strip lies outside the frames of the film so as not to be displayed during film projection.

4. A method as claimed in any preceding claim, in which synchronising control markings control synchronous movement of the two data carriers after correct correlation has been established.

5. A film projector when used in carrying out the method claimed in Claim 3, or Claim 4 when appended to Claim 3, having a detector for detecting correlation markings on the film strip, and a correct correlation sensing device including a threshold switch responsive to the period during which a correlation marking is detected exceeding a predetermined threshold period, whereby the sensing device only responds to a correlation marking when the film has been slowed down or stopped thus indicating that correct correlation is present.

6. A projector as claimed in Claim 5 for carrying out the method claimed in Claim 4 when appended to Claim 3, in which a film drive mechanism having two operational states is arranged to drive the film and is adapted to be switched into a synchronous drive state, in which state it is arranged to be controlled by the synchronising control markings on the tape, only when such synchronising markings are resumed after the correct correlation sensing device has indicated that correct correlation is present between the sound tape and the film strip.

7. A method as claimed in Claim 1 and substantially as hereinbefore particularly described with reference to and as illustrated in the accompanying drawings.

8. A film projector as claimed in Claim 5 and substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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opposite to the lamp 52 is a photocell 50 the output of which is connected via a threshold switch 58 to an "EX-NOR" gate 62.

The second input of the network 62 comprises a conductor 63 which is branched off from the lamp circuit. The output of the "EX-NOR" network 62 is connected with a switch 64 for switching off the projector circuit.

If a control mark 53 on the film biases the associated reading device simultaneously with a control mark 54 on the recording tape an equivalent signal will be supplied to the gate 62 via the conductor 63 as well as via the photocell 50, due to the illumination of the lamp 52, and the switch 64 will remain closed. This indicates the correct co-ordination of the strips. If the strips are not coordinated the lamp 52 is illuminated only if no mark 53 is present on the film at a position opposite the lamp. Owing to the low light transmissivity of the film edge track in the absence of a mark 53 the voltage produced in the photocell 50 under these conditions is insufficient to operate the threshold switch 58 and to supply a signal to the gate 62. However, since the gate is supplied with an input signal via the conductor 63 the switch 64 which is controlled by the gate 62 is opened and de-energizes the drive circuit for the projector motor. Coding the co-ordination of the two strips can be rendered very versatile by applying further code marks 55 on the film or applying code marks 56 to the recording tape.

Finally it should be mentioned that the detecting device for coordinating the two data media in the projector and in the tape recorder may also be associated with an indicating device which indicates faulty operation of coordinated strips if the strips are not started by the same mark. As already mentioned the two strips would then not run in synchronism.

WHAT WE CLAIM IS:—

1. A method of checking the correlation of two independently driven data carriers to be run at the same time, comprising the steps of:

providing a first data carrier with a visible starting mark and with a code mark detectable in any early phase of its run;

providing the second data carrier with a visible starting mark and with a correlation marking spaced from the latter starting mark by a distance corresponding to the separation of the marks on the first data carrier;

starting the run of both the data carriers substantially concurrently from predetermined positions on the carriers indicated by the visible starting marks;

stopping or reducing the speed of the

second data carrier to detect any correlation marking thereon in response to detection of a code mark on said first data carrier;

resuming the run of said second data carrier only upon detection of a correlation marking immediately after the second carrier is slowed down or stopped.

2. A method as claimed in Claim 1, in which said first data carrier is a sound tape, said second data carrier is a film strip which is stopped in response to detection of a code mark on the sound tape and the correct correlation marking on the film strip is a title of the film.

3. A method as claimed in Claim 1, in which said first data carrier is a sound tape, said second data carrier is a film strip and the correlation marking on the film strip lies outside the frames of the film so as not to be displayed during film projection.

4. A method as claimed in any preceding claim, in which synchronising control markings control synchronous movement of the two data carriers after correct correlation has been established.

5. A film projector when used in carrying out the method claimed in Claim 3, or Claim 4 when appended to Claim 3, having a detector for detecting correlation markings on the film strip, and a correct correlation sensing device including a threshold switch responsive to the period during which a correlation marking is detected exceeding a predetermined threshold period, whereby the sensing device only responds to a correlation marking when the film has been slowed down or stopped thus indicating that correct correlation is present.

6. A projector as claimed in Claim 5 for carrying out the method claimed in Claim 4 when appended to Claim 3, in which a film drive mechanism having two operational states is arranged to drive the film and is adapted to be switched into a synchronous drive state, in which state it is arranged to be controlled by the synchronising control markings on the tape, only when such synchronising markings are resumed after the correct correlation sensing device has indicated that correct correlation is present between the sound tape and the film strip.

7. A method as claimed in Claim 1 and substantially as hereinbefore particularly described with reference to and as illustrated in the accompanying drawings.

8. A film projector as claimed in Claim 5 and substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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