

The invention relates to a recording and/or reproduction device for rotating recording media which can be scanned in a contactless manner.

Such devices, e.g. CD-players or video disc players, are equipped with a loading and unloading mechanism, in which the recording medium, a CD-disc or a video-disc, is placed by hand and from which it can be taken out again by hand. After insertion the CD-disc is moved automatically into the playing position. By means of a so-called STOP-key, the user can at any time interrupt the playing of the CD-disc. The CD-disc is stopped and automatically moved into the removal position, to allow the user to take it out of the unloading mechanism, e.g. in order to be able to insert other CD-discs.

In Funkschau 10, May 1985 there is disclosed on pages 50 to 54 a test report on to CD-players of the so-called drawer type. The loading and unloading mechanism of this type is constructed as a drawer, which is moved out of the front of the CD-player for the insertion and for the removal of a CD-disc. The CD-players reviewed in the above report are also equipped with the above-mentioned STOP-key.

Before the CD-disc is moved from the playing position into the removal position, however, the disc should be slowed down by the motor of the disc drive to a stop if possible, in order to avoid damage to its sensitive surface during the process of unloading.

The rotational speed of a CD-disc is not constant, however, because a CD-player uses a system that in contrast to a CAV-system, the short term for constant-angular-velocity, does not keep the angular velocity but the orbital path velocity constant, as with the CLV-system, the short term for constant-linear-velocity.

Therefore it can happen that the CD-disc is still revolving during the process of unloading, either in the playing direction or even backwards, according to whether it has been braked by the motor of the disc drive too little or too strongly. As mentioned above the sensitive surface of a CD-disc can easily be damaged, when still revolving during the automatic unloading process.

In order to make sure that the CD-disc is actually at a stop at the beginning of the unloading process, there should be provided a short waiting period between the braking of the CD-disc and the unloading process as a time safety margin, in order to allow the CD-disc to run down. This measure does however have the drawback, that the unloading process is delayed.

From FR-A-2470506 it is known to apply a braking signal having a constant value to the motor of the disc drive in

order to stop the disc of a disc player, e.g. a video disc player. A measurement device measures the rotational speed of the disc during braking. As soon as the disc is slowed to a predetermined rotational speed, e.g. zero, the braking process is terminated.

It is therefore an object of the invention to construct a recording and/or reproduction device for rotating recording media which can be scanned in a contactless manner such that for removal the rotating recording medium is braked to a stop quickly and reliably.

The invention solves this object in that the necessary braking energy for stopping the rotating recording medium is generated in dependence upon the diameter of the recording medium.

There is shown in

Figure 1 an arrangement for generating brake pulses in dependence upon the rotational speed of the recording medium.

Figure 2 a part of a first embodiment.

Figure 3 the first embodiment with a light barrier.

Figure 4 a second embodiment.

Figure 5 pulse diagrams for the second embodiment.

The braking of the rotating recording medium can be achieved e.g. by means of one or more braking pulses, which are applied to the motor of the disc drive. The duration and/or the amplitude of the braking pulses depend upon the rotational speed of the recording medium, which can be detected e.g. by using a marking and a photo-sensor. With CD-players and video disc players moreover, there is the possibility of calculating the rotational speed of the disc from the subcode, which contains the information about the so-called cumulative playing time. A certain rotational speed of the CD-disc or the video disc appertains to each cumulative playing time, which is also frequently designated as the A-time.

The rotational speed is calculated according to the following formula:

$$n = w_1 - (w_1 - w_2) A/T,$$

w_1 is the initial rotational speed, w_2 the final rotational speed, T the total playing time of the disc and A the so-called cumulative playing time. With a CD-disc the initial rotational speed when reading the innermost data track is 500 revolutions per minute. During the playing of a CD-disc the

initial rotational speed of 500 revolutions per minute when reading the innermost data track drops linearly to a final rotational speed of 215 revolutions per minute, which is specified for reading the outermost data track. With a CDV-disc, which contains a video part in addition to an audio part, the initial rotational speed for the video part is 2700 revolutions per minute, while the CDV-disc rotates at only 2000 revolutions per minute when reading the outermost data track of the video part. Thus, with a CDV-disc the rotational speed can be either between 500 and 200 revolutions per minute or between 2700 and 2000 revolutions per minute, depending on whether the audio part or the video part is being played. Despite these great differences in rotational speed the CDV-disc should also be braked to a stop for removal.

In Figure 1 an arrangement is now shown, in which the braking pulses for the motor of the disc drive are generated in dependence upon the momentary rotational speed of a CD-disc.

From a CD-disc CD, driven by a motor M, data are read by an optical scanning device AV and supplied to a decoder D. At its first output A1 the decoder D delivers the audio signal. At its second output A2 the decoder D delivers the control signals for the controller FT of the focus- and track-control circuit. The third output A3, at which the decoder D delivers the control signal for the rotational speed of the disc, is connected via a switch S1 to the speed controller MR of the motor M. The fourth output A4 of the decoder D, at which the subcode can be taken off, is connected to an evaluating circuit SC, the output of which is connected to the input of a counter Z1.

The evaluating circuit SC delivers counting pulses for the counter Z1, which corresponds with the cumulative playing time. If the CD-disc is played from the very beginning, the evaluating circuit SC sets the counter state of the counter Z1 to zero and subsequently delivers counting pulses so that the momentary counter state is always a measure for the cumulative playing time and therefore also for the momentary rotational speed of the disc.

If however the CD-disc is not played from its beginning, but e.g. starting at the seventh music title, then the evaluating circuit SC recognises by means of the subcode the cumulative playing time; that is the period after which the seventh music title starts calculated when playing from the beginning. The evaluating circuit SC now loads the counter Z1 to the counter state, which corresponds with the cumulative playing time for the seventh music title. Upon track jumping from one music title to another the evaluating circuit SC up-dates the counter position each time. The counter state is therefore always proportional to the rotational speed of the CD-disc.

The outputs of the counter Z1 are connected to the inputs of a ROM R1, the outputs of which are connected to a shift register SR. The output of the shift register SR is connected via a switch S2 to the rotational speed controller MR of the motor M. The stop input of the counter Z1 can be connected to the positive terminal of a voltage source via a switch S3.

As long as the CD-disc is being played, switch S1 is closed, however the switches S2 and S3 are open. If now the user wants to remove a loaded CD-disc from the CD-player, simultaneously with pressing of the so-called STOP-key the switches S2 and S3 are closed, while switch S1 is opened. By closing of switch S3 the counter Z1 is stopped. Its counter state now serves as address for the ROM R1, in which different bit-samples are stored. Now by means of the shift register SR the bit-sample appertaining to the counter state is supplied to the controller MR of the motor M as a single braking pulse or as a sequence of several braking pulses, in order to bring the CD-disc quickly and reliably to a stop with the correctly injected braking energy. The bit-samples stored in the ROM R1, which determine the length and number of the braking pulses, can be ascertained empirically for example.

With a second embodiment of the invention a second ROM R2 is provided. By means of a change-over switch US the output of the counter Z1 is connectable to the input of the first ROM R1 or the second ROM R2, as Figure 2 shows. The outputs of both ROMs, ROM R1 and ROM R2, are connected to the inputs of an OR-gate O, at the output of which the braking pulses for the rotational speed controller MR of the motor M of the disc drive can be taken off. With a CD-player the bit-samples of a normal CD disc are stored e.g. in the first ROM R1, and in the second ROM R2 the bit-samples of the mini-CD. The change-over switching from the first to the second ROM and vice versa can be effected manually or automatically. The diameter of the CD-disc CD can be determined, as shown in Figure 3, e.g. using a light barrier consisting of an optical transmitter OS and an optical receiver OE.

In order to brake to a stop a so-called mini-CD, which has a smaller diameter than a normal CD-disc, and presupposing an equal rotational speed less braking energy is necessary than with the larger normal CD-disc due to the lower mass.

In the third embodiment, which is shown in Figure 4, besides the rotational speed there is therefore also considered the mass of the disc. For this purpose a test braking pulse is supplied to the motor M, which is dimensioned so that the CD-disc CD is indeed braked, but the data reproduction is not adversely effected thereby. The rotational speeds are measured before and after the test brake pulse and compared with each other. The comparison now serves for determination

of the duration of the brake pulses.

In Figure 4 the CD-disc CD is driven as in the first embodiment by the motor M, the rotational speed of which is controlled by the rotational speed controller MR. The optical scanning device AV supplies the data signal to the decoder D, at the output A1 of which the audio signal can be taken off, the output A2 of which is connected to the controllers FT of the focus- and track-control circuit, the output A3 of which is connected via the switch S1 to the rotational speed controller MR and the output A4 of which is connected to the evaluating circuit SC. The outputs of the evaluating circuit SC are connected to the counter Z1 and a counter Z2. By means of switch S2 a positive voltage can be applied to the stop-input of the counter Z1. The outputs of counter Z1 are connected to a memory SP1 and a mono-flop M1. The outputs of the counter Z2 are connected to the inputs of a memory SP2, the output of which is connected to a difference former DF. The outputs of the memory SP1 are also connected to the difference former DF and with the ROM R1, the outputs of which are connected to the shift register SR. The output of the difference former DF is connected to the input of a comparator V, the first output of which is connected to a mono-flop M2 and the second output of which is connected to a mono-flop M3. The output of the mono-flop M2 is connected to the first input, the output of the mono-flop M3 to the second input of a NOR-gate N and an OR-gate O1. The output of the NOR-gate N is connected to the first input of an AND-gate U. The output of the mono-flop M1 is connected to the first input of an OR-gate O2, the stop-input of the counter Z2 and via converter I to the second input of the AND-gate U, at the third input of which is a clocking signal T. The output of the AND-gate U is connected to the clocking input of the shift register SR, the output of which is connected to the third input of the OR-gate O1. The output of the OR-gate O2, the second input of which is connected to the output of the AND-gate U, is connected to the rotational speed controller MR.

With reference to the pulse-diagrams shown in Figure 5, the second embodiment of the invention, shown in Figure 4, is explained below.

During the playing operation the counter state of the counter Z1 is continuously updated, as in the first embodiment, by the evaluating circuit, so that it is always proportional to the momentary rotational speed of the disc. When the user presses the STOP-key, as indicated in Figure 5a, the switch S1 is simultaneously opened, the switch S2 however is closed. Thus the counter Z1 is stopped and its counter state taken over by the memory SP1. The rotational speed before the test braking pulse is thus stored in the memory SP1. Because the mono-flop M1 is moreover set for the time t_1 , the motor M receives now a test braking pulse for the period t_1 , as is

shown in Figure 5b. Simultaneously the shift-register SR is blocked due to the inverter I and the AND-gate U. When the mono-flop M1 resets to its stable state after the time t_1 , the counter Z2 is stopped, the counter state of which however, corresponds to the reduced rotational speed as a result of the test braking pulse. The counter state of the counter Z2 is taken over by the memory SP2. In the difference former DF the difference of the counter states of both counters Z1 and Z2 is formed and compared in the comparator V with a predetermined threshold value X. The time needed by the difference former DF for forming the difference of both counter states and by the comparator V for the comparison, is designated in Figures 5c and 5d with t_z .

If the difference is above the threshold value X, the mono-flop M2 is set, otherwise the mono-flop M3, the time constant t_3 of which is chosen smaller than the time constant t_2 of the mono-flop M2. Due to the setting of the mono-flop M2 or the mono-flop M3 the shift register SR is released, so that now as in the first embodiment a braking pulse or several braking pulses are delivered to the motor M. After the time t_2 or t_3 the mono-flop M2 or M3 resets into the stable starting position, whereby the AND-gate U again blocks the shift register SR.

In Figure 5c is shown the output signal of the mono-flop M2, in Figure 5d that of the mono-flop M3. IN Figure 5e a braking pulse B is shown, which is supplied when the mono-flop M3 is set. Figure 5f shows several braking pulses B1, which are supplied by the shift register SR, as long as the mono-flop M2 is set. It is possible while the mono-flop M2 or M3 is set, to supply either only an elongated braking pulse or several braking pulses of shorter duration.

Instead of one comparator V several comparators may be provided to form several intervals. By means of the comparators it will be determined, in which interval lies the difference formed by the difference former DF. For each interval a mono-flop is provided. By always setting that mono-flop in the interval of which the difference falls, differing braking pulses are produced.

The second counter Z2 can also be left out in the third embodiment. After the memory SP1 has taken over the counter state of the counter Z1 before the braking pulse, the counter Z1 continues counting. At the end of the test braking pulse the memory SP2 takes over the new counter state of the counter Z1, which corresponds with the rotational speed reduced by the test braking pulse.

A combination of the arrangement shown in Figure 1 and the first embodiment constitutes a fourth embodiment. The momentary counter state of the counter Z1, which is proportional to the momentary rotational speed of the disc,

is compared with a predetermined threshold value. If the counter state is below this threshold value or in other words, if the rotational speed is below a threshold value, the braking pulse or the braking pulses are produced by the ROM R1 and the shift register SR, as shown in Figure 1.

However, if the counter state of the counter Z1 is greater than or equal to the threshold value - the rotational speed is then also greater than or equal to a threshold value -, first a test braking pulse is supplied and then one or more braking pulses are produced by the mono-flop M2 or M3, according to the embodiment shown in Figure 2.

The invention is suitable e.g. for CD-players, video disc players, CDV-players, DRAW-disc-players or magneto-optical devices.



CLAIMS

1. A recording and/or reproduction device for rotating recording media which can be scanned in a contactless manner, wherein the braking energy required for stopping the rotating recording medium is produced in dependence upon the rotational speed of the recording medium, characterised in that the braking energy required for stopping the rotating recording medium is also produced in dependence upon the diameter of the recording medium.

2. A recording and/or reproduction device according to claim 1, characterised in that a test braking pulse is supplied to the motor (M) of the disc drive, which is dimensioned so that it indeed reduces the rotational speed of the recording medium (CD), but does not disturb the reproduction of data, that the rotational speed is measured before the test braking pulse and after the test braking pulse and that the braking pulse is produced in dependence upon a comparison of the rotational speed before the test braking pulse with the rotational speed after the test braking pulse.

3. A recording and/or reproduction device according to claim 1 or 2, characterised in that in the case of a CD-player, a video disc player or a CDV-player, the rotational speed of the disc is obtained from the subcode recorded thereon.

4. A recording and/or reproduction device according to claim 3, characterised in that a counter (Z1) adds the playing time obtained from the subcode, so that the momentary counter state is always proportional to the momentary rotational speed of the recording medium (CD), that for stopping the recording medium (CD) the counter (Z1) is stopped and its counter state serves as the address for a first ROM (R1), in which bit-samples are stored, which are supplied as braking pulses by a shift register (SR) to the motor (M) of the disc drive.

5. A recording and/or reproduction device according to claim 4, characterised in that the counter state of the counter (Z1) serves as the address for a second ROM (R2), when it exceeds a predetermined threshold value, that the bit-samples stored in the second ROM (R2) are supplied as braking pulses by the shift register (SR) to the motor (M) of the disc drive.

6. A recording and/or reproduction device according to claim 2 or 3, characterised in that a counter (Z1) adds the playing time obtained from the subcode, so that its momentary counter state corresponds always to the momentary rotational speed of the recording medium (CD), that its counter state is taken over by a first memory (SP1), when the test braking



pulse is produced by setting of a first mono-flop (M1), that at the end of the test braking pulse, when the first mono-flop (M1) resets, the counter state of the counter (Z1) is taken over by a second memory (SP2), that the counter states prevailing in both memories (SP1, SP2) are subtracted in a difference former (DF), that a second mono-flop (M2) is set, when the difference of the counter states is below a predetermined threshold value (X), that a third mono-flop (M3) is set, when the difference of the counter states is greater than or equal to the predetermined threshold value (X), and that either the second or the third mono-flop (M2, M3) releases a shift register (SR), reads bit-samples out of a ROM (R1) and supplies them as braking pulses to the motor (M) of the disc drive.

7. A recording and/or reproduction device according to claim 2 and 3, characterised in that a first and a second counter (Z1, Z2) adds the playing time obtained from the subcode, so that the momentary counter states always correspond to the momentary rotational speed of the recording medium (CD), that the counter state of the first counter (Z1) is taken over by a first memory (SP1), when the test braking pulse is produced by setting of a first mono-flop (M1), that at the end of the test braking pulse, when the first mono-flop (M1) resets, the counter state of the second counter (Z2) is taken over by a second memory (SP2), that the counter states prevailing in both memories (SP1, SP2) are subtracted in a difference former (DF), that a second mono-flop (M2) is set, when the difference of the counter states is below a predetermined threshold value (X), that a third mono-flop (M3) is set, when the difference of the counter states is greater than or equal to the predetermined threshold value (X), and that either the second or the third mono-flop (M2, M3) releases a shift register (SR), reads the bit-samples out of a ROM (R1) and supplies them as braking pulses to the motor (M) of the disc drive.

8. A recording and/or reproduction device as claimed in claim 4 or 5 and 6 or 7, characterised in that the braking pulses are produced according to claim 6 or 7, when the counter state of the counter (Z1) is below a predetermined threshold value, that the braking pulses however are produced according to claim 8 or 9, when the counter state of the counter (Z1) is greater than or equal to the predetermined threshold value.