

Recording and reproduction of items of information using ROM-RAM storage media

The invention relates to a method and a device for the recording and reproduction of items of information in connection with storage systems which contain both a read only memory or a so-called ROM as well as a read-write memory, a so-called RAM. The storage system may be an optical storage system in the form of a magneto optic disc or a tape like storage system as well as being constituted by any other ROM-RAM storage medium.

It is generally known to use optical, magnetic as well as magneto optic storage systems for the recording and reproduction of items of information.

Optical storage systems such as for example the compact disc, usually referred to as a CD, have depressions, so-called pits, in a spiral track which represent the items of information or data items stored on the CD. These depressions are fixedly implanted on or in the CD so that the CD is to be assigned to the category of permanent stores or read-only memories. For the reproduction of the items of information stored on the CD which is referred to as an optical disc, the CD is accelerated by a rotational speed and scanned by a light beam whereby the speed of the turntable is regulated by data signals that are contained in the information signal read from the disc. The disc is scanned at a higher rotational speed close to its centre than at the edge in order to ensure a virtually constant reading speed despite the spiral shape of the information track.

Magnetic storage systems, which are generally known as audio or video tapes, are used as a rule as stores having freely selectable access or both as write and read stores. The information carrier, the magnetic tape, is conducted at a virtually constant speed past a recording or reproduction head. Moreover, the magnetic disc such as is used for computers is known as a magnetic storage system. The data items are inserted in so-called sectors with the magnetic discs for computers.



In order to be able to use the advantages of magnetic storage systems, the ability to be always written anew, it is already known to use a magneto optic recording process in connection with a so-called MOD. Whereas recording can only be effected once with the CD-WORM, the MOD makes it possible to have a multiplicity of erasings and recordings with a disc of this type. The magneto optic disc or MOD, which does not have depressions or pits, can be erased and rerecorded almost as often as desired. The items of information are stored in domains having different directions of magnetisation and are read out with polarised light. For the production of the correlation between the recording or reproduction of items of information and the rotational speed of the optical disc, a method and a device for the recording and reproduction of items of information are known c.f. DE-OS 29 23 581 A1, in which the spiral information track is wobbled during recording of a train of information in a direction running orthogonally thereto in synchronism with synchronisation signals which are disposed in the train of information at regular time intervals. The spiral information track thereby appears as a wavy line and in this respect exhibits a substantial difference to the information track of the CD. The wobbling of the information track is necessary in particular for the regulation of the rotational speed of the optical disc during the recording of items of information. However, due to the wobble frequency, increased demands are made on the scanning or reproduction system guiding the light or laser beam and the recording as well as the reproduction are thereby adversely influenced. In order to achieve an exact tracking by means of a simple tracking control loop despite the wobbling information tracks on the record carrier, an optical scanning device is known which is characterised in that the spacing between the diffraction beams of +1 and -1 order, which generate the tracking error signal, on the record carrier amounts to a whole number multiple of the wavelength appertaining to the centre frequency with which the data tracks are wobbled about their central position c.f. DE-OS 39 23 330 A1.





Means are required for generating the wobble signal as well as for decoding and fading it out during the reproduction. The recorded information signal also contains clock signals which are used for the control of the reproduction after the reproduction position has been located.

Furthermore, in the endeavour to increase the storage capacity of the information carrier, an optical record carrier having a transparent layer is known c.f. DE-OS 37 32 875 A1 which represents a combination of a CD and an MOD. Since on the one hand items of information or data items are stored in the pits and on the other hand items of information can be stored and erased nearly as often as desired by magnetisation of the light reflecting magnetic layer analogously to the MOD, the storage capacity is increased by at least a factor of 2. The record carrier, which is also referred to as a RO/AM disc or ROM-RAM storage medium, can be both recorded as well as read in an advantageous manner by an optical scanning device c.f. DE-OS 37 32 874 A1.

Thus, it is the object of the invention to increase the usable storage capacity of a ROM-RAM storage medium despite different recording and reproduction processes to one in excess of the capacity attainable from the sum of the different processes and to avoid the disadvantages caused by the wobbling of the ROM information track with a simultaneous reduction of the cost.

This object is achieved in accordance with the invention by a method and a device in which data items read out from the ROM region of the ROM-RAM storage medium are made use of at least for the recording of items of information in the RAM region of a ROM-RAM storage medium and preferably also for the reproduction of items of information. The extraction of data items from the ROM region of the ROM-RAM storage medium for the provision of this assistance, in particular from the point of view of determining a position and for the production of a correlation between the recording or reproduction and the record carrier, is implemented by a device for the recording and reproduction of items of information whereby the ROM-RAM storage medium includes



a RAM information track which has a course coinciding with the ROM information track. This means that the RAM information track is overlaid by the ROM information track and, in contrast to a wobbled information track, does not have any deviation or wobble running orthogonally to the direction of the track. Nevertheless, a recording and reproduction of items of information are made possible since data items, which are present in the ROM region of the ROM-RAM storage medium and which are preferably read out during the recording, are made use of in an advantageous manner instead of the wobble signal in order to control especially the rotational speed of the record carrier and to locate the position of the recording. To this end, the methods and devices known in connection with the reproduction, coding and synchronisation of ROM storage media can be used. In addition, the data items present in the ROM region can be used to advantage for the reproduction of the items of information stored in the RAM region.

In an advantageous manner, a magneto optic disc, which has both pit structures as well as magnetic domains such as for example a RO/AM disc, is suitable as the ROM-RAM storage medium whereby however, the usage is not limited to such types of record carrier but tape like or extensive record carriers may also be used. The recording and reproduction of items of information is carried out by a recording and reproduction device with which the ROM-RAM storage medium, which is preferably formed by a magneto optic record carrier having a spiral information track, is scanned and written.

The use of the data items present in the ROM region for the control of the recording medium during recording and/or reproduction of items of information permits, in an advantageous manner, the recording of items of information in the RAM region without wobble so that the disadvantages caused by the wobble are avoided. Nevertheless, due to different reading techniques, RAM and ROM items of information stored together in one information track can be reproduced by only one scanning device whereby, in comparison with the MOD, a greater storage capacity is available for the items of information or data items that can



be recorded in the RAM region since it is not necessary to provide data items in the RAM region for the determination of the position and the synchronisation. As a consequence, the usable storage capacity is increased over and above the sum of the storage capacities of the combined stores. In addition to which, the expense required for the recording and reproduction device is reduced since the means needed for the decoding of the wobble signal for the MOD are not required.

It is pointed out that the ROM region contains both control as well as user data items and the RAM region contains user storage areas which overlies the user data items written in the ROM region.

The invention will be explained hereinafter in more detail by means of an embodiment in the drawings. Therein

Fig. 1 shows an information track of a ROM-RAM storage medium,

Fig. 2 a block circuit diagram of a recording and reproduction device,

Fig. 3 a basic sketch of a device for the recording and reproduction of items of information.

For the recording and reproduction of items of information, there is used a record carrier M which is a ROM-RAM storage medium that is formed by a magneto optic disc which, as an information carrier in correspondence with Fig. 1, has both pits P known in connection with the CD as well as magnetic domains D known in connection with the MOD whereby somewhat surprisingly however, the magnetic domains D are arranged in the direction coinciding with the information track of the pits P. In order to be able to record items of information despite the non-wobbled RAM information track which is formed by the magnetic domains D, the data items present in the ROM region of the ROM-RAM storage medium or in the ROM information track of the record carrier are made use of for locating the recording position and/or for the production of the correlation between the information that is to



be recorded or reproduced and the rotational speed or advancing speed of the record carrier or of a recording head. The RAM information track can be selectively at least partly or completely freed of data regarding positional matters and synchronisation so that, by comparison, additional storage capacity is made available. An only partial relief of the RAM storage region is foreseen exclusively for a self-synchronisation required during the reproduction of the RAM signal.

In addition, the costs for a device for the recording and reproduction of items of information, whose block circuit diagram is illustrated in Fig. 2, are reduced. The ROM-RAM storage medium or the record carrier M is driven by a drive mechanism SPM which is controlled by a speed control device SPC. The control signal for the speed control device SPC is derived exclusively from a ROM signal ROM-RS which is detected from the record carrier M by a scanning unit R. The scanning unit R makes both the ROM signal ROM-RS and the RAM signal RAM-RS available which are then respectively supplied if required to other systems OS via a signal processing stage SCD.

An item of information which is to be recorded on the record carrier M or a write signal RAM-WS is transmitted via a write control unit RAM-WC and via a write unit RAM-W to the record carrier M or is stored on the record carrier M. It is apparent from the block circuit diagram in accordance with Fig. 2 that the data items present in the ROM region of the record carrier M, which is formed as a ROM-RAM storage medium, are made use of for the recording of the write signal RAM-WS whereby the expensive speed regulation necessary for MOD recording and reproduction devices is no longer applicable so that the costs are substantially reduced. This is made possible, in particular, in that data items can be simultaneously read from the record carrier during the recording. The permanently available ROM signal ROM-RS is used as the controlling magnitude for the rotational speed of the record carrier M and also, the current position of the scanning unit R relative to the record carrier M can be derived in known manner from the ROM signal ROM-RS.



The recording and the reproduction of items of information will be explained with the aid of a basic sketch of an appropriate device illustrated in Fig. 3. For the recording of items of information on the record carrier M which is a ROM-RAM storage medium in the form of a magneto optic disc that has both pits P as well as magnetic domains D in an information track, the item of information to be recorded or the write signal RAM-WS is supplied to a coil W generating a magnetic field with which the direction of magnetisation of the domains D disposed in the magnetic layer of the record carrier M is influenced or altered. To this end, the magnetic layer is heated above the Curie temperature of the magnetic layer by a laser beam generated by a laser diode LD so that the direction of magnetisation determined by the magnetic field of the coil W is maintained in the record carrier M after the cooling below the Curie temperature and the information is stored on the record carrier M. For the heating of the magnetic layer, the laser diode LD is controlled via a laser driver LDD by a system control SC which is mentioned here, exclusively in this connection, without going into further detail as to its full tasks. The temperature necessary for the heating of the magnetic layer is produced at the focal point of the laser beam on the record carrier M by means of a collimating lens CL and an objective lens OL. For the control of the rotational speed during the recording and for the determination of the position of the recording, there serves a ROM signal which is also read from the record carrier M during the recording and which is detected by means of a photodiode PD3 with the laser or light beam generated by the laser diode LD from the pits P arranged on the record carrier M with a first polarisation beam splitter PBS1 arranged in the beam path of the laser beam, a second convex lens CV2 and a beam splitter BM. The ROM signal ROM-RS detected by the photodiode PD3 is then processed by a current - voltage converter A1 into an information signal which can be further processed or into the actual ROM signal ROM-RS-1.

This ROM signal ROM-RS-1, which also contains items of information regarding the current position and the rotational



speed of the record carrier, is then supplied via a switch S1 to a speed control device SPC which applies the control voltage necessary for the required rotational speed of the record carrier M to the turntable motor SPM. Following this, the ROM signal ROM-RS-1 detected from the record carrier M is made use of for the recording of items of information on the ROM-RAM storage medium or on the record carrier M. In this operational mode, the switch S2 is preferably open and, for appropriate further processing of the ROM signal ROM-RS-1, the items of information stored in the ROM track of the record carrier M may be reproduced during the recording and even though the RAM information track and the ROM information track are superimposed in correspondence with Fig. 1.

An additional influencing of the RAM signal RAM-WS is not required so that the disadvantages associated therewith do not arise and the otherwise usual expense for the control of the record carrier M for the recording of a RAM signal RAM-WS is avoided since the means provided for the reproduction of the ROM signal or of the items of information stored in the pits P can be used in an advantageous manner. Since the RAM signal RAM-WS is freed from auxiliary information for locating the position of the recording and for the control of the speed, there is moreover, additional store space available.

As regards the reproduction of items of information recorded on a ROM-RAM storage medium several modes of operation are possible.

If, for example, the items of information stored in the pits P or in the ROM region should be exclusively reproduced, then this can occur in the manner previously described whereby the laser beam or the laser diode LD is controlled in such a way that the magnetic layer is not heated in order to prevent a destruction of the items of information possibly already stored in the RAM region.

In order to exclusively reproduce items of information stored in the RAM region or in the magnetic domains D, polarised light is



used in known manner and there are provided in particular, a first $\lambda/2$ plate P1 arranged between the collimator lens CL and the first polarisation beam splitter PBS1 in the beam path of the laser beam, a second polarisation beam splitter PBS2 arranged between the first polarisation beam splitter PBS1 and the second convex lens CV2, a second $\lambda/2$ plate P2, a third polarisation beam splitter PBS3, a first convex lens CV1, a third convex lens CV3 and a first and a second photodiode PD1, PD2.

The RAM signal, which is read from the record carrier M, then appears as the difference signal of the signals detected by the first and second photodiode PD1, PD2. In this operating mode, the switch S2 is closed and the control of the record carrier M occurs with the ROM signal ROM-RS-2 which is then tapped off between the laser driver LDD and the laser diode LD and supplied via the first switch S1 to the speed control device PSC as well as being made available at a corresponding terminal ROM-RS-2 for the reproduction in parallel with the RAM signal. In this operating mode, the laser driver LDD or the laser diode LD is controlled by a regulating signal detected, via a servo amplifier A2, the switch S2 and a capacitor C1 together with the current - voltage converter A1, by a photodiode PD3. Thereby, the capacitor C1 is specially provided for isolating a dc component of the regulating signal.

The cylindrical lens ZL and the fourth photodiode PD4 provided in the basic sketch in accordance with Fig. 3 are specially provided for the tracking and focussing of the scanning beam.

Although the method and the device for the recording and reproduction of items of information has only been described on the basis of a ROM-RAM storage medium in the form of a magneto optic disc having a spiral information track which exhibits both pits P and magnetic domains D, the application is not however limited to such a type of record carrier.



Claims

1. Method for the recording and reproduction of items of information using a ROM-RAM storage medium, characterised in that, a recording of items of information in the RAM region of a ROM-RAM storage medium is carried out with the aid of data items read out from the ROM region of the ROM-RAM storage medium and/or a reproduction of items of information stored in the RAM region of the ROM-RAM storage medium is carried out with the aid of data items read out from the ROM region of the ROM-RAM storage medium.
2. Method in accordance with Claim 1, characterised in that, the recording of items of information in the RAM region of the ROM-RAM storage medium is carried out simultaneously during a read out from the ROM region of the ROM-RAM storage medium and with the aid of data items that are simultaneously read out.
3. Method in accordance with any of the Claims 1 to 2, characterised in that, a recording and reproduction of items of information is carried out with a ROM-RAM storage medium having a RAM information track coinciding with the ROM information track.
4. Method in accordance with any of the Claims 1 to 3, characterised in that, at least for the recording of items of information, use is made of data items present at the recording position in the ROM region of a ROM-RAM storage medium.
5. Method in accordance with any of the Claims 1 to 4, characterised in that, the ROM-RAM storage medium is a magneto optic record carrier (M) having both pits (P) and magnetic domains (D) and, at least for a recording of items of information, use is made of data items contained in the ROM region of the ROM-RAM storage medium formed by pits (P).
6. Method in accordance with any of the Claims 1 to 5, characterised in that, the ROM-RAM storage medium is a RO/AM disc and data items simultaneously read out from the ROM region



of the RO/AM disc at least during a recording of items of information are used for the control of the speed of rotation of the RO/AM disc.

7. Method in accordance with any of the Claims 1 to 6, characterised in that, a ROM information track superimposed on the RAM information track is used for the recording and/or reproduction of items of information using a ROM-RAM storage medium and the making use of the data items contained in the ROM region for a determination of the position and/or for the production of a correlation between the recording or reproduction and the record carrier (M) is carried out with a recording and reproduction device.

8. Device for the recording and reproduction of items of information using a ROM-RAM storage medium, characterised in that, the ROM-RAM storage medium has a RAM information track which has a course coinciding with the ROM information track and at least one recording and reproduction device is provided for the recording and reproduction of items of information.

9. Device in accordance with Claim 8, characterised in that, the ROM-RAM storage medium is a disc shaped magneto optic record carrier having a spiral information track which has both pits (P) and magnetic domains (D).

10. Device in accordance with Claim 8, characterised in that, for the location of the recording position and/or for the control of the speed of the record carrier (M) or a corresponding recording unit, the recording and reproduction device has means provided exclusively for the reproduction of the ROM signals (ROM-RS) stored on the record carrier (M).

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