Description

This invention relates generally to improvements in video recorder-playback machines, and more specifically to an improved arrangement of optical components in a video recorder-playback machine of the type including optical laser beams for recording and playback of video information from a video information disc.

Video recorder-playback machines in general are known in the art and include appropriate means for recording and/or playing back a video information signal utilizing a selected medium for storage of the signal. For example, in one type of machine, the video signal is recorded magnetically for storage and/or retrieval upon a length of so-called video tape. In another type of system, the video signal is recorded upon an information disc for retrieval by means of a stylus, in a manner analogous to that of sound reproduction from phonographic records. In still another type of system, the video signal is used to frequency modulate a beam of amplified light, such as a laser beam, with sufficient power for physically altering the surface characteristics of a light sensitive coating on a video information disc and thereby record the signal upon the disc. During playback, a lower power light beam is reflected from the disc and the resulting signal is demodulated to reproduce the recorded signal. In all of these types of systems, the video information signal can be combined with an appropriate audio signal either for recording or playback purposes to yield a composite audio-video signal of the type commonly used for television transmissions and the like. For conveience, however, the signal will be referred to herein as a video information signal.

Video recorder-playback machines utilizing amplified light beams for recording and playback purposes offer significant advantages in that all physical contact of the recording and playback elements with the storage medium, namely, the information disc, is avoided. This prevents wear and deterioration of the machine elements and the disc, resulting in a high quality stored video signal which can be played back repeatably over a long period of time with unimpaired video resolution.

In video recorder-playback machines using amplified light beams for signal recording and playback, separate laser generator units are provided for generating the high power record optical beam and the low power playback optical beam, respectively. These laser generator units thus comprise a "write" laser and a "read" laser and are mounted on the machine in optical alignment with an optical record-playback head including a focusing lens for focusing the beams upon the video information disc. Typically, the record-playback head is driven in a radial direction with respect to the disc simultaneously with rotation of the disc whereby the video information is recorded upon and played back from a spiral pattern of information tracks on the disc. Importantly, for maximum information storage together with maximum recording and playback time for each disc, it is desirable to form the information tracks to have a narrow width such as on the order of about 0.5 microns, and a narrow center-to-center radial spacing such as on the order of about 1.5 microns. Accordingly, a precise optical alignment between the laser generator units and the record-playback head is critical for proper focusing of the record and playback beams to a spot image within the information tracks in order to maximize signal resolution and minimize cross talk between tracks.

In the prior art (US—A—4 225 873), the "write" laser and the "read" laser are commonly mounted upon a fixed base of the recorder-playback machine. A plurality of redirecting mirrors and optical conditioning lenses are provided for aligning the generated record and playback optical beams with the movable record-playback head. However, these systems require a relatively large number of mirrors, etc. which must be adjusted manually to the proper position for achieving the necessary precise alignment of the beams with the record-playback head. This results in a system which is relatively complex, bulky, expensive, and difficult to maintain in proper adjustment. Accordingly, such systems have not found commercial acceptance in production quantities.

A few prior art playback machines have been proposed wherein the relatively small "read" laser is mounted in fixed optical alignment with a playback head for movement together upon an optics carriage. While these types of arrangements advantageously simplify alignment of the playback optical beam with the head, such arrangements heretofore have been limited for use only in playback machines. Alternately stated, these arrangements have not been adapted for use in a recorder-playback machine wherein additional alignment of the record-playback head with a record beam generated by a "write" laser is also required.

The Japanese patent application No. 51—36835 as disclosed in Patent Abstracts of Japan, Vol. 2, No. 6, page 9921E77 shows the usage of an acousto-optic (AO) modulator and a comparison device. There is, however, only suggested a comparison between the modulating signal source and the signal developed from the modulated light beam. No comparison is made with the described device for comparing the modulated signal with a signal retrieved during playback of the record.

It is an object of the invention to provide recorder-playback machines, the operating parameters of the modulator of which can be more finely tuned on the one hand, and which on the other hand provides the possibility to gather valuable information at the detection of an error as to which portion of the error the modulator itself contributed.

As a solution the invention provides a recorder-playback machine for recording and playing back

nformation from an information storage disc, comprising: a "write" laser (16), secured to a machine base and operative to generate a first light beam directed along a first path (11) for use in recording information upon the disc (14); a "read" laser (80) operative to generate a second light beam directed along a second path for use in recovering information from the disc (14); means (18) for supporting the disc for rotation; an optical record-playback head (34) for focusing said first and second beams upon said disc; optical means (32, 53) for directing said first and second light beams through said head toward said disc; means (38) for moving said head being mounted on a carriage radially with respect to said disc (14) generally in parallel with a portion (28, 11, 32) of said first path; modulator means (17) positioned along said first path upstream of said head for interrupting said first light beam to produce a modulated light beam representative of the information to be recorded; said optical means (32) including means (53) for directing said second light beam through said head for focusing of said second light beam by said head upon the disc at a point slightly downstream from the point of focus of said first light beam

— a first light responsive means (77) along said second path responsive to said second light beam, after being reflected from the disc along said second path of said read laser mounted on said carriage, for generating an electrical signal used in playing back the information from the disc, and for monitoring the recording characterized by the read laser being mounted on said carriage

— said modulator means (17) comprising means (24) for splitting said first light beam into said modulated light beam for passage along said first path (11), and an auxiliary light beam comprising the complement of said modulated light beam (11) and directed out of said first path along a third path (9);

— a second light responsive means (94) along said third path for generating an electrical signal in responsive means (94 along said third path for generating an electrical signal in response to said auxiliary light beam for use in monitoring the characteristics of said modulated light beam;

— comparator means (98) for comparing the electrical signal generated by said light responsive means (94) along said third path with the electrical signal generated by said light responsive means (77) along said second path.

Further developments of the invention are subjects of claims 2 and 3. A machine according to the first part of claim 1 is known from US—A—4225873.

The divisional applications EP—A—181427 and EP—A—181428 are derived from this application.

In the invention, the "read" laser is secured in optical alignment with the record-playback head for focusing of the playback optical beam upon the disc at a point slightly downstream of the point of focus of the record optical beam upon the disc. This enables the machine to be operated simultaneously in both the record and playback modes whereby the resolution of the video information being recorded can be monitored continuously as recording progresses.

The "write" laser generates an amplified continuous beam of collimated light which is passed through a modulator such as an acousto-optic modulator for frequency modulation to diffract the light beam into a modulated optical signal beam comprising the record optical beam, and a complementary optical beam diffracted angularly out of optical alignment with the record-playback head on the optics carriage. This complementary optical signal can form the input to a light responsive detection device for driving an electronic demodulator which reconverts the complementary optical beam to an electrical signal representative of the video information. Since this electrical signal is derived from the complement of the record optical beam, monitoring of this electrical signal reveals the quality of the record optical beam as recording progresses. This complementary signal can be compared with the video information played back from the disc to provide an accurate indication of recording quality during the recording process.

The following detailed description, taken in conjunction with the accompanying drawings, illustrates, by way of example, the principles of the invention.

The accompanying drawings illustrate the invention. In such drawings:

Fig. 1 is a fragmented perspective view illustrating, partially in exploded form, a video recorder-playback machine;

Fig. 2 is a schematic diagram illustrating the arrangement of optical components in the machine; and

Fig. 3 is an enlarged exploded perspective view of a portion of the machine illustrating the optics carriage and assembly thereof.

As shown in the exemplary drawings, the present invention is embodied in a video recorder-playback machine 10 utilizing laser-generated record and playback optical beams for recording and playback of video information from a video information disc 14. The information disc 14 is removably supported within the machine upon a spindle assembly 18 for controlled rotation of the disc at a relatively high speed during the recording and playback operations. Concurrently with disc rotation, the record and/or playback optical beams are precisely focused upon the disc 14 by an optical record-playback head 34 mounted on a mobile optics carriage 30 driven for movement in a radial direction with respect to the disc. A clamp assembly 20 cooperates with the spindle assembly 18 to clamp the disc 14 in a precisely centered position for accurate, high speed disc rotation without substantial radial eccentricities or rotational slippage.

The record-playback machine 10 of this invention comprises an improvement over the prior art in that a simplified arrangement is provided for precise alignment of the record and playback

optical beams with respect to the record-playback head 34. The machine 10 is designed for quick and easy assembly of the optical components with the record and playback optical beams in the desired alignment without requiring significant or complicated adjustments. Moreover, the alignment arrangement is relatively compact in size and is uniquely adapted for simultaneous operation of the machine in both a record mode and a playback mode to allow monitoring of the recorded information during the recording process. In addition, the machine is adapted to provide an auxiliary record optical beam for use in monitoring the quality of the record beam during the recording process, and, if desired, for use in comparing the record beam quality with the resolution of the information as recorded.

As shown in Figs. 1 and 2, the video recorder-playback machine 10 includes a machine base 12 which provides support for a relatively high power laser generator unit 16, or "write" laser, such as an argon ion laser for use in recording prescribed video information upon the disc 14. The "write" laser 16 emits a highly amplified collimated beam of light which is incident upon a pair of angularly disposed mirrors 21 of a mirror mount assembly 22 secured to the machine base 12. These two mirrors 21 redirect the amplified light beam to a modulator subassembly 17 for appropriately interrupting the amplified light beam to yield a record optical beam representative of the desired video information.

The modulator subassembly 17 comprises a plate 13 suitably secured to the machine base 12 and carrying an electronically driven modulator 24, such as an acousto-optic modulator. The modulator 24 is aligned for passage of the amplified light beam reflected by the mirrors 21, with a condensing lens 23 mounted on the subassembly plate 13 being positioned between the modulator 24 and the mirrors 21 to focus the light beam for passage through the modulator.

The modulator 24 is driven by a suitable frequency modulated electronic signal supplied via an input lead 26 wherein the electronic signal is representative of the desired video information. The modulator 24 responds to the electronic signal to diffract a portion of the amplified beam of light as illustrated by the arrow 9 in Fig. 2, and thereby pass without diffraction a corresponding modulated record optical beam as illustrated by the arrow 11 in Fig. 2. This resultant record optical beam 11 is therefore representative of the prescribed video information, and the diffracted beam 9 comprises the modulated complement of the record optical beam and is thus also representative of the prescribed video information. Conveniently, in many instances, the electronic signal comprises a composite audio-video signal of the type commonly used in television transmissions and which, when supplied to the modulator 24, yields an optical signal beam representative of the composite audio and video information. However, for sake of clarity and ease of description, all further reference herein will be to video information.

The modulated record optical beam from the modulator 24 passes through a second condensing lens 19, which is also carried by the subassembly plate 13, for incidence upon a pair of mirrors 25 of a second mirror mount assembly 28 secured to the machine base 12. These latter mirrors 25 function to reflect the modulated second optical beam 11 to the mobile optics carriage 30 for further reflection and focusing of the beam by the optical record-playback head 34 to the surface of the video information disc 14. More specifically, the optics carriage 30 carries an additional condensing lens 27 which focuses the record optical beam upon a dichroic mirror 32 which is mounted on the carriage 30 in an angularly disposed position for reflection of the beam 11 in an upward direction through the record-playback head 34.

The record-playback head 34 carries a focusing lens 36 for focusing the record optical beam 11 to a precise spot image on the underside of the video information disc 14. In this regard, the record-playback head 34 includes means responsive to the distance between the focusing lens 36 and the disc 14 for maintaining the focusing lens 36 at a prescribed distance from the disc, and thereby maintain a precise focus of the record optical beam upon the disc.

The optics carriage 30 is movably positioned by a carriage drive assembly 38 along a linear path in a radial direction with respect to the disc 14. In this manner, the focusing lens 36 of the record-playback head 34 is movably positioned with respect to the disc 14 along a radius of the disc to control the point of focusing of the record optical beam upon the disc. As illustrated, the carriage drive assembly 38 comprises a precision lead screw 48 supported for rotation by a bracket 50 which can be secured to a frame 40 and to the machine base 12 by a plurality of bolts 42. The lead screw 48 threadably receives a lead screw nut 52 coupled via a non-rotational coupling indicated at 54 to a sleeve-type push block 46 positioned freely about the lead screw 48 and secured to an upright wall 44 of the optics carriage 30.

The lead screw 48 is oriented in a direction generally parallel with the required radial direction of movement of the optics carriage 30. A relatively slow speed reversible motor 56 and a relatively high speed reversible motor 58 are connected to the lead screw 48 through a selective clutch unit 60, and this clutch unit is operated to control driving of the lead screw 48 about its own axis either at a relatively slow or relatively fast speed of rotation.

As illustrated in Fig. 1, the optics carriage 30 is driven by the lead screw 48 in a radially outward direction with respect to the disc 14 whenever the lead screw 48 is rotated to cause the lead screw nut 52 to push against the push block 46. When the lead screw is rotated in an opposite direction, the lead screw nut 52 travels along the

screw in an opposite direction. To assure that the optics carriage 30 follows in the opposite, or radially inwardly direction with respect to the disc 14, the carriage 30 is secured by pins 62 to a linear track member 64 which is urged with respect to the disc 14 in the radially inward direction by a constant tension band spring 66 wound about a barrel 68 secured to the frame 40. The track member 64 is slidably mounted on a track guide 70 secured to the frame 40 and shaped to accommodate linear movement of the optics carriage 30 in both the radially inward and the radially outward directions.

The video information disc 14 is rotatably driven about a vertical axis by the spindle assembly 18 simultaneously with linear movement of the optics carriage 30. More specifically the disc 14 is vertically supported upon a rotatable drive spindle 72 including an upwardly extending annular shoulder 74 for supporting the disc, and an upper shaft portion 76 received through a central opening 15 formed in the disc. The drive spindle 72 is carried within an upright spindle housing 78 which is secured to the machine base 12 and supports the spindle 72 for relatively high speed rotation, such as on the order of about 1800 rpm, about its vertical axis. A drive motor (not shown) is drivingly coupled to the spindle 72 for rotating the spindle at the relatively high speed of rotation. The clamp assembly 20 is receivable over the upper shaft portion 76 of the spindle 72 for locking the disc in a precisely centered position for high speed rotation.

In operation, the record optical beam is focused upon the underside of the video information disc 14 by the radially traversing focusing lens 36 on the optics carriage 30 simultaneously with high speed rotation of the disc. By appropriately controlling the relationship between radial traversal and rotational speed, the record optical beam is focused upon the disc along a spiraling pattern of closely spaced tracks. Importantly, the disc 14 includes a photosensitive coating, such as a layer of thin metal or a photoresist material, adapted to be physically altered by the high power record optical beam whereby the optical beam is physically recorded upon the disc as a pattern of discontinuities representative of the prescribed video information. In practice, the closely spaced tracks have a width on the order of about 0.5 microns and a center-to-center spacing of about 1.5 microns.

The high power record optical beam is quickly and easily aligned optically with the record-playback head 34 with little or no adjustment of the optical components. More specifically, the track member 64 constrains the optics carriage 30 for movement along a precise linear path, and this path can be predetermined in direction and location with respect to the machine base 12 by appropriate sizing and positioning of the drive assembly 38 upon the frame 40 with respect to the base 12. The mirror mount assemblies 22 and 28 of the machine base 12 function to redirect the high power record optical beam first through the modulator 24 and then along this precise linear path for incidence upon the angularly disposed dichroic mirror 32, regardless of the radial position of the optics carriage 30. Conveniently, the "write" laser 16 together with the mirror mount assemblies 22 and 28 and the modulator subassembly 17 can be mounted on the base 12 in precise, predetermined locations by means of pre-formed mounting holes or the like in the base so that the record optical beam is appropriately and automatically aligned optically with the record-playback head 34 upon installation of the components on the machine base 12. If additional adjustment of the direction of the record optical beam is desired, one or both of the mirror mount assemblies 22 and 28 can be formed to include adjustable mirrors to allow precise and rapid adjustment of the record optical beam for incidence upon dichroic mirror 32 of the mobile optics carriage 30.

As illustrated in Figs. 1 and 2, a relatively low power laser generator unit 80, or "read" laser such as a helium-neon laser is provided for generating a playback optical beam for use in retrieving or playing back the recorded video information for the disc 14. This "read" laser 80 emits an amplified and collimated optical beam of light having a frequency different from the record optical beam for reflection off the disc 14 whereby the reflected beam comprises a modulated playback beam which is alternately reflected and non-reflected in accordance with the recorded video information. This modulated playback beam is of sufficiently low power to avoid physical alteration of the photo-sensitive coating on the disc 14.

The "read" laser 80 is mounted directly upon the optics carriage 30 for movement with the record-playback head 34. In this manner, the "read" laser 80 is mounted in a fixed position with respect to the head 34 to eliminate substantially adjustment or optical alignment with the head 34. Importantly, however, the optics carriage 30 comprises a compact subassembly for the machine adapted to carry the "read" laser 80 without interfering with the "write" laser 16 and the record optical beam generated thereby.

More specifically, as shown in detail in Fig. 3, the optics carriage 30 comprises a relatively small horizontal platform 31 upon which are mounted a pair of upwardly concave brackets 33 by means of a plurality of pins 35 received into prepositioned locator holes 37 in the platform 31. Curved retainer straps 39 in turn are received over the "read" laser 80 and are secured by screws 41 to the brackets 33 to mount the "read" laser 80 upon the brackets 33. If desired, cushion strips 43 of a felt material or the like are interposed between the straps 39 and the laser 80 to prevent movement of the laser 80 within the brackets 33 as a result of vibrations or the like. Accordingly, the "read" laser 80 is securely and accurately positioned upon the optics carriage 30.

A relatively small mirror mount assembly 82 is secured in close association with the "read" laser

80 by pins 47 received into pre-formed locator holes 49 in the platform 31. This mirror mount assembly 82 includes a first mirror 45 and a second mirror 51 accurately positioned for reflection of the light beam emitted by the "read" laser along a path in parallel with the direction of movement of the optics carriage 30, as illustrated by the beam 81 in Fig. 2. Accordingly, the light beam 81 from the "read" laser 80 is reflected along a path in parallel with the record optical beam 11 generated by the "write" laser 16, with the record optical beam 11 being spaced above the beam 81 from the "read" laser 80 as shown in Fig. 2.

A focusing subassembly 83 is secured to the upright wall 44 of the optics carriage 30, and includes a condensing lens 84 positioned along the path of the light beam 81 from the "read" laser 80. As illustrated in Fig. 3, focusing subassembly 83 is sized for reception into a complementary shaped recess 85 in the carriage wall 44, and a screw 86 is provided for securing the subassembly 83 within the recess 85. Conveniently, however, this screw 86 is received through an elongated slot 87 formed in the subassembly 83 whereby the precise position of the subassembly 83 within the recess 85 is adjustable within the limits provided by the slot 87.

The condensing lens 84 of the focusing subassembly 83 focuses the light beam 81 from the "read" laser 80 for passage through a polarizing beam splitter cube 88 and further through a quarterwave plate 89, both of which are mounted in fixed positions upon the subassembly 83. The beam 81 passes further to an angularly disposed reflection mirror 53 for reflection of the beam 81 upwardly through the dichroic mirror 32 and further to the record-playback head 34. Importantly, the reflection mirror 53 is carried by a bracket 55 secured to the carriage wall 44 within a recess 57 by screws 59, and the dichroic mirror is carried by another bracket 61 in a position directly above the reflection mirror 53 and secured to the carriage wall 44 within a recess 63 by screws 65. Accordingly, the dichroic mirror 32 is positioned for reflection of the record optical beam 11 in an upward direction to the record-playback head 34, and for simultaneous passage of the beam 81 from the "read" laser 80 in an upward direction to the record-playback head 34.

The "read" laser beam 81 is thus focused upon the video information disc 14 by the record-playback head 34, and this beam 81 is reflected and non-reflected from the surface of the disc 14 according to the surface configuration of the disc. The reflected portion of the light beam 81 comprises a modulated optical playback beam which is reflected downwardly back through the dichroic mirror 32 to the reflection mirror 53. The reflection mirror 53 in turn reflects the playback optical beam back through the quarterwave plate 89 which functions to prevent passage of light of other frequencies, such as the frequency of the record optical beam, and which allows free passage of the playback optical beam to the polarizing beam splitter cube 88.

The polarizing beam splitter cube 88 includes a mirrored back surface 90 for redirecting the returning playback optical beam in a transverse direction to a 50—50 beam splitter cube 91 mounted on the focusing subassembly 83 alongside the polarizing cube 88. This 50—50 beam splitter cube 91 reflects one portion of the playback optical beam to an aperture 71 in a plate 73, and another portion of the beam is directed to a small redirecting mirror 75 on the focusing subassembly. The redirecting mirror 75 is angularly positioned to reflect the incident portion of the beam toward the aperture 71, but at an angle with respect to the first portion of the beam. A photodetector 77, such as a light sensitive diode, is positioned behind the aperture 71, and responds to the incident light to generate an electrical signal representative of the prescribed video information carried by the playback optical beam. This electrical signal can be supplied to an appropriate frequency modulation discriminator 79 for reprocessing and demodulation to yield an electrical signal for supply to an appropriate video display device 92, such as a television receiver, for playback of the recorded video information. Conveniently, the photodetector 77 can also be used to determine and to provide an electrical signal for the adjustment of the position of the focusing lens 36 of the record-playback head 34 with respect to the disc 14.

The various optical components on the optics carriage 30 are precisely arranged for focusing of the beam 81 from the "read" laser 80 upon the disc 14 without substantial alignment adjustments. That is, the components are secured in position upon the carriage 30 and with respect to each other for proper alignment upon assembly. Moreover, the components are positioned for proper operation and optical alignment with the record optical beam 11 without any interference between the record and playback optical beams.

The reflection mirror 53 is carried by the bracket 55 for reflection of the "read" laser beam 81 at a slight angle with respect to the record optical beam. This angle is chosen so that the beam 81 is focused upon the disc 14 slightly downstream, say about a few microns, of the focal point of the record optical beam 11. Thus, the two beams are not focused upon precisely the same spot on the disc 14, whereby the machine can be operated in both the record and playback modes at the same time to provide a substantially simultaneous playback of the recorded information. This allows the resolution of the recorded information to be monitored during the recording process. This is particularly advantageous when the machine is operated to produce a "master" disc 14 for use in the large scale manufacture of production disc replicas in that the simultaneous playback of the recorded information provides an immediate indication of the quality of the recording.

As illustrated in Fig. 2, the machine also includes means for monitoring the quality of the record optical beam during the recording process. More specifically, the diffracted beam 9 from the modulator 24 comprises the complement of the record

optical beam 11, and this complement or auxiliary beam 9 can be directed by a mirror 93 to a photodetection device 94, such as a light sensitive diode. This photodetection device 94 generates an electrical signal representative of the video information in generally the same manner as the photodetector 77 on the optics carriage 30, resulting in an electronic signal for connection as the input to an appropriate frequency modulator discriminator 95. The discriminator 95 demodultes the signal to yield an appropriate electrical information signal suitable for supply to a display device 96 such as a television receiver and thereby allow monitoring of the quality of the record optical beam during the recording process.

The monitored record signal and the monitored playback signal are compared during the recording process to provide an accurate indication of the quality of the video recording on the disc 14. This comparison is made by a comparator 98 coupled to the outputs of the demodulators 79 and 95, with an appropriate time delay device 99 introduced into the circuit to delay slightly the output from the demodulator 95 and thereby account for the slight downstream focusing of the beam 81 from the "read" laser 80 upon the disc 14. This comparison is also particularly useful in applications where the machine is used for making master information discs which are then used in the subsequent replication of discs in production quantities. A comparison of the qualities of the signals allows close monitoring of the various video signals whereby substantial imperfections can be detected and the recording process restarted with a new disc without having to complete the recording process before the recorded signal is checked.

Claims

1. A recorder-playback machine for recording and playing back information from an information storage disc, comprising: a "write" laser (16), secured to a machine base and operative to generate a first light beam directed along a first path (11) for use in recording information upon the disc (14); a "read" laser (80) operative to generate a second light beam directed along a second path for use in recovering information from the disc (14); means (18) for supporting the disc for rotation; an optical record-playback head (34) for focusing said first and second beams upon said disc; optical means (32, 53) for directing said first and second light beams through said head toward said disc; means (38) for moving said head being mounted on a carriage radially with respect to said disc (14) generally in parallel with a portion (28, 11, 32) of said first path; modulator means (17) positioned along said first path upstream of said head for interrupting said first light beam to produce a modulated light beam representative of the information to be recorded; said optical means (32) including means (53) for directing said second light beam through said head for focusing of said second light beam by said head upon the disc at a point slightly downstream from the point of focus of said first light beam; and a first light responsive means (77) along said second path responsive to said second light beam, after being reflected from the disc along said second path of said read laser, for generating an electrical signal used in playing back the information from the disc, and for monitoring the recording characterized by the "read" laser (80) being mounted on said carriage

— said modulator means (17) comprising means (24) for splitting said first light beam into said modulated light beam for passage along said first path (11), and an auxiliary light beam comprising the complement of said modulated light beam (11) and directed out of said first path along a third path (9);

— a second light responsive means (94) along said third path for generating an electrical signal in response to said auxiliary light beam for use in monitoring the characteristics of said modulated light beam;

— comparator means (98) for comparing the electrical signal generated by said second light responsive means (94) along said third path with the electrical signal generated by said first light responsive means (77) along said second path.

2. A recorder-playback machine as set forth in claim 1, characterized in that said means for splitting said beam comprises means (24) for diffracting said light beam issuing from said modulator, the diffracted beam portion defining said auxiliary light beam.

3. A recorder-playback machine as set forth in claim 1, characterized in that said modulator means (17) comprises an acousto-optic modulator (24).

Patentansprüche

1. Ein Aufzeichnungs-Wiedergabegerät zum Aufzeichnen und zur Wiedergabe von Information aus einer Informationsspeicherplatte, in dem enthalten sind: ein "Schreib"-Laser (16), der an einer Maschinenbasis befestigt ist und ein erstes Lichtstrahlenbündel erzeugt, das längs eines ersten Pfades (11) verläuft, um bei der Aufzeichnung von Information auf der Platte (14) verwendet zu werden; ein "Lese"-Laser (80), der ein zweites Lichtstrahlenbündel erzeugt, das längs eines zweiten Pfades verlaüft, um bei der Wiedergabe von Information von der Platte (14) verwendet zu werden; Vorrichtungen (18), um die Platte drehbar zu haltern; ein optischer Aufzeichnungs-Wiedergabekopf (34), um die genannten ersten und zweiten Lichtstrahlenbündel auf der genannten Platte zu fokussieren; optische Vorrichtungen (32, 53), mit denen die genannten ersten und zweiten Lichtstrahlenbündel durch den genannten Kopf auf die genannte Platte gerichtet werden; Vorrichtungen (38), um den auf einem Schlitten montierten genannten Kopf in radialer Richtung bezüglich der genannten Platte (14) und im allgemeinen parallel zu einem Teil (28, 11, 32) des genannten ersten Pfades zu ver-

ptical beam 11, and this complement or auxiliary beam 9 can be directed by a mirror 93 to a photodetection device 94, such as a light sensitive diode. This photodetection device 94 generates an electrical signal representative of the video information in generally the same manner as the photodetector 77 on the optics carriage 30, resulting in an electronic signal for connection as the input to an appropriate frequency modulator discriminator 95. The discriminator 95 demodultes the signal to yield an appropriate electrical information signal suitable for supply to a display device 96 such as a television receiver and thereby allow monitoring of the quality of the record optical beam during the recording process.

The monitored record signal and the monitored playback signal are compared during the recording process to provide an accurate indication of the quality of the video recording on the disc 14. This comparison is made by a comparator 98 coupled to the outputs of the demodulators 79 and 95, with an appropriate time delay device 99 introduced into the circuit to delay slightly the output from the demodulator 95 and thereby account for the slight downstream focusing of the beam 81 from the "read" laser 80 upon the disc 14. This comparison is also particularly useful in applications where the machine is used for making master information discs which are then used in the subsequent replication of discs in production quantities. A comparison of the qualities of the signals allows close monitoring of the various video signals whereby substantial imperfections can be detected and the recording process restarted with a new disc without having to complete the recording process before the recorded signal is checked.

Claims

1. A recorder-playback machine for recording and playing back information from an information storage disc, comprising: a "write" laser (16), secured to a machine base and operative to generate a first light beam directed along a first path (11) for use in recording information upon the disc (14); a "read" laser (80) operative to generate a second light beam directed along a second path for use in recovering information from the disc (14); means (18) for supporting the disc for rotation; an optical record-playback head (34) for focusing said first and second beams upon said disc; optical means (32, 53) for directing said first and second light beams through said head toward said disc; means (38) for moving said head being mounted on a carriage radially with respect to said disc (14) generally in parallel with a portion (28, 11, 32) of said first path; modulator means (17) positioned along said first path upstream of said head for interrupting said first light beam to produce a modulated light beam representative of the information to be recorded; said optical means (32) including means (53) for directing said second light beam through said head for focusing of said second light beam by said head upon the disc at a point slightly downstream from the point of focus of said first light beam; and a first light responsive means (77) along said second path responsive to said second light beam, after being reflected from the disc along said second path of said read laser, for generating an electrical signal used in playing back the information from the disc, and for monitoring the recording characterized by the "read" laser (80) being mounted on said carriage

— said modulator means (17) comprising means (24) for splitting said first light beam into said modulated light beam for passage along said first path (11), and an auxiliary light beam comprising the complement of said modulated light beam (11) and directed out of said first path along a third path (9);

— a second light responsive means (94) along said third path for generating an electrical signal in response to said auxiliary light beam for use in monitoring the characteristics of said modulated light beam;

— comparator means (98) for comparing the electrical signal generated by said second light responsive means (94) along said third path with the electrical signal generated by said first light responsive means (77) along said second path.

2. A recorder-playback machine as set forth in claim 1, characterized in that said means for splitting said beam comprises means (24) for diffracting said light beam issuing from said modulator, the diffracted beam portion defining said auxiliary light beam.

3. A recorder-playback machine as set forth in claim 1, characterized in that said modulator means (17) comprises an acousto-optic modulator (24).

Patentansprüche

1. Ein Aufzeichnungs-Wiedergabegerät zum Aufzeichnen und zur Wiedergabe von Information aus einer Informationsspeicherplatte, in dem enthalten sind: ein "Schreib"-Laser (16), der an einer Maschinenbasis befestigt ist und ein erstes Lichtstrahlenbündel erzeugt, das längs eines ersten Pfades (11) verläuft, um bei der Aufzeichnung von Information auf der Platte (14) verwendet zu werden; ein "Lese"-Laser (80), der ein zweites Lichtstrahlenbündel erzeugt, das längs eines zweiten Pfades verläuft, um bei der Wiedergabe von Information von der Platte (14) verwendet zu werden; Vorrichtungen (18), um die Platte drehbar zu haltern; ein optischer Aufzeichnungs-Wiedergabekopf (34), um die genannten ersten und zweiten Lichtstrahlenbündel auf der genannten Platte zu fokussieren; optische Vorrichtungen (32, 53), mit denen die genannten ersten und zweiten Lichtstrahlenbündel durch den genannten Kopf auf die genannte Platte gerichtet werden; Vorrichtungen (38), um den auf einem Schlitten montierten genannten Kopf in radialer Richtung bezüglich der genannten Platte (14) und im allgemeinen parallel zu einem Teil (28, 11, 32) des genannten ersten Pfades zu ver-

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schieben; Modulatorvorrichtungen (17), die längs des genannten ersten Pfades stromaufwärts vom genannten Kopf angeordnet sind, um das genannte erste Lichtstrahlenbündel zu unterbrechen und ein moduliertes Lichtstrahlenbündel zu erzeugen, das die aufzuzeichnende Information darstellt; wobei die genannten optischen Vorrichtungen (32) Vorrichtungen (53) enthalten, mit denen das genannte zweite Lichtstrahlenbündel durch den genannten Kopf gerichtet wird, um das genannte zweite Lichtstrahlenbündel durch den genannten Kopf auf der Platte an einem Punkt zu fokussieren, der geringfügig stromabwärts vom Brennpunkt des genannten ersten Lichtstrahlenbündels liegt; und eine erste lichtempfindliche Vorrichtung (77) längs des genannten zweiten Pfades, die auf das genannte zweite Lichtstrahlenbündel anspricht, nachdem dieses von der Platte längs des genannten zweiten Pfades des genannten Leselasers reflektiert wurde, um ein elektrisches Signal zu erzeugen, das bei der Wiedergabe der Information aus der Platte verwendet wird und zum Überwachen der Aufzeichnung, dadurch gekennzeichnet, daß

— der "Lese"-Laser (80) auf dem genannten Schlitten montiert ist;

— die genannten Modulatorvorrichtungen (17) Vorrichtungen (24) enthalten, um das genannte erste Lichtstrahlenbündel in das genannte modulierte Lichtstrahlenbündel aufzuspalten, das längs des genannten ersten Pfades (11) verläuft, und ein Hilfslichtstrahlenbündel, das das Komplement des genannten modulierten Lichtstrahlenbündels (11) enthält und aus dem genannten ersten Pfad längs eines dritten Pfades (9) ausgelenkt wird;

— eine zweite lichtempfindliche Vorrichtung (94) längs des genannten dritten Pfades, um eine elektrisches Signal als Antwort auf das genannte Hilfslichtstrahlenbündel zu erzeugen, das bei der Überwachung der Charakteristiken des genannten modulierten Lichtstrahlenbündels verwendet wird;

— Vergleichsvorrichtungen (98) zum Vergleichen des elektrischen Signals, das von der genannten zweiten lichtempfindlichen Vorrichtung (94) längs des dritten Pfades erzeugt wird, mit dem elektrischen Signal, das von der genannten ersten lichtempfindlichen Vorrichtung (77) längs des genannten zweiten Pfades erzeugt wird.

2. Ein Aufzeichnungs-Wiedergabegerät nach Anspruch 1, dadurch gekennzeichnet, daß die genannten Vorrichtungen zum Aufspalten des genannten Strahlenbündels Vorrichtungen (24) enthalten, mit denen das genannte aus dem genannten Modulator austretende Lichtstrahlenbündel gebeugt wird, wobei der gebeugte Teil des Lichtstrahlenbündels das genannte Hilfslichtstralenbündel definiert.

3. Ein Aufzeichnungs-Wiedergabegerät nach Anspruch 1, dadurch gekennzeichnet, daß die genannten Modulatorvorrichtungen (17) einen akustooptischen Modulator (24) enthalten.

Revendications

1. Enregistreur/lecteur pour l'enregistrement et la lecture d'une information d'un disque de stockage de l'inforamtion, comprenant: un laser "écriture" (16) fiké à une base de la machine et servant à produire un premier faiceau de lumière dirigé le long d'un premier trajet (11) pour une utilisation pour l'enregistrement de l'information sur le disque (14); un laser "lecture" (80) servant à produire un second faisceau de lumière dirigé le long d'un second trajet pour une utilisation pour la récupération de l'information du disque (14); un moyen (18) pour supporter le disque pour sa rotation; une tête optique d'enregistrement/lecture (34) pour focaliser lesdits premier et second faisceaux sur ledit disque; un moyen optique (32, 53) pour diriger lesdits premier et second faisceaux de lumière par ladite tête vers ledit disque; un moyen (38) pour déplacer ladite tête étant monté sur un chariot radialement par rapport audit disque (14) généralement parallèlement à une partie (28, 11, 32) dudit premier trajet; un moyen modulateur (17) placé le long dudit premier trajet en amont de ladite tête pour interrompre ledit premier faisceau de lumière et produire un faisceau modulé de lumière représentatif de l'information à enregistrer ledit moyen optique (32) comprenant un moyen (53) pour diriger ledit second faisceau de lumière par ladite tête pour focalisation dudit second faisceau de lumière par ladite tête sur le disque en un point légèrement en aval du point de focalisation dudit premier faisceau de lumière; et un premier moyen photosensible (77) le long dudit second trajet répondant audit second faisceau de lumière, après réflexion par le disque le long dudit second trajet dudit laser de lecture pour produire un signal électrique utilisé pour la lecture de l'information du disque et pour surveiller l'enregistrement, caractérisé en ce que le laser "lecture" (80) est monté sur ledit chariot, ledit moyen modulateur (17) comprenant un moyen (24) pour diviser ledit faisceau de lumière en ledit faisceau modulé de lumière pour passage le long dudit premier trajet (11), et un faisceau auxiliaire de lumière formant le complément dudit faisceau modulé de lumière (11) et dirigé hors dudit premier trajet le long d'un troisième trajet (9);

un second moyen photosensible (94) le long dudit troisième trajet pour produire un signal électrique en réponse audit faisceau auxiliare de lumière pour une utilisation pour surveiller les caractéristiques dudit faisceau modulé de lumière;

un moyen comparateur (98) pour comparer le signal électrique produit par ledit second moyen photosensible (94) le long dudit troisième trajet au signal électrique produit par ledit premier moyen photosensible (77) le long dudit second trajet.

2. Enregistreur/lecteur selon la revendication 1, caractérisé en ce que ledit moyen pour diviser ledit faisceau comprend un moyen (24) pour diffracter ledit faisceau de lumière sortant dudit

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modulateur, la partie diffractée du faisceau définissant ledit faisceau auxiliare de lumière.

3. Enregistreur/lecteur selon la revendication 1, caractérisé en ce que ledit moyen modulateur (17) comprend un modulateur acousto-optique (24).

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