OPTICAL INFORMATION RECORDING MEDIUM AND APPARATUS FOR RECORDING/REPRODUCING INFORMATION USING THE SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an optical information recording medium and apparatus for recording/reproducing information in and from the medium. More particularly, the present invention relates to an optical information recording medium in the form of a card having tracks to obtain a tracking signal and a clock signal, and also relates to apparatus for recording/reproducing information using the recording medium.

2. Description of the Prior Art

In the art there have been known and used various kinds of recording media in which information can be recorded utilizing light and from which the recorded information can be read out optically. These known optical recording media have various forms such as disk, card, tape, etc. Among them the card-shaped optical recording medium (hereinafter referred to simply as an optical card) has many advantages. It is small in size and light in weight for its large recording capacity. Man can carry it very conveniently. For these advantages the optical card is expected to have an increasing demand.

Recording of information on the optical card is carried out by scanning the card by a beam of light modulated in accordance with information imparted thereto and condensed to a very small spot. With the scanning, the information is recorded as lines of record pits (information track) which are optically detectable. In order to perform the optical recording correctly without any trouble such as crossing of information tracks according to the recording method, it is essential to precisely control the position at which the modulated beam is projected. In this optical recording method, the beam projection position must be controlled in a direction normal to the direction of scanning (this control is referred to as auto-tracking). In addition, it is necessary to generate a clock signal useful for the correction of possible variations in scanning speed.

Concerning the above-mentioned optical card, we, the inventors of the present invention, have received some technical disclosure from the Drexler Technology Corporation. From the technical disclosure we have known that such optical cards have already been proposed which have tracks previously formed on the card to obtain a tracking signal and a clock signal. For the sake of explanation, a first example of such optical cards as disclosed is shown in the accompanying drawings, FIGS. 1A and 1B.

FIG. 1A is a schematic plan view of the prior art optical card.

The optical card **31** has clock tracks 32_1, 32_2, 32_3, 32_4, . . . in the form of broken lines previously formed by recording clock signals. The clock tracks are arranged at regular intervals on the optical card so as to provide recording zones 34_1, 34_2, 34_3, . . . between the clock tracks.

FIG. 2 is an enlarged view of the surface of the optical card **31** showing how to record information on the optical card.

In recording some information, three beams are projected from an optical recording head. The projected beams are focused to form very small spots S_1, S_2 and S_3 on the card. With the relative movement between the optical card and the optical recording head, these spots scan the card surface in the direction of arrow a. Of the three spots the middle spot S_2 is used to record information. At the step shown in FIG. 1B, the spot S_2 has just recorded a piece of information as a record pit **35** in the record zone 34_1. The remaining two spots S_1 and S_3 are used to generate a tracking signal and a clock signal in the following manner.

The spots S_1 and S_3 are reflected on the card surface. One of the reflected lights, that of the spot S_1 or that of the spot S_3 is guided to a detector provided in the optical recording head. From the reflected light the detector detects a tracking signal by a known method such as push-pull. In accordance with the tracking signal, the spots S_1, S_2 and S_3 are moved together in the direction of arrow b normal to the scanning direction a so that the spot S_1 can always trace the clock track 32_1 correctly. This control of the spot positions enables the forming of the record pits **35** correctly along the clock track 32_1 and prevents information tracks from crossing each other. Simultaneously with the detection of the tracking signal, the reflected light of S_3 or S_1 reproduces the clock signal which is used as a clock for recording signals.

The reproduction of the recorded information can be carried out in a similar manner to the above.

The above-shown optical card, however, has disadvantages. Generally, the recording or reproducing transfer speed of the optical card is low and, therefore, the frequency of change of the tracking signal due to the noncontinuity of the clock track lies near the servo area of the auto-tracking. Because of this fact the auto-tracking is adversely affected by the change of the tracking signal. This is an important drawback of the above-shown prior art optical card.

In the above-mentioned technical disclosure there has been shown also an optical card developed to solve the above problem. This optical card is shown in FIGS. 2A and 2B as a second example of the prior art.

FIG. 2A is a schematic plan view of the optical card. The optical card **41** has clock tracks 42_1, 42_2, 42_3, . . . tracking tracks 43_1, 43_2, 43_3, . . . previously formed on the card. Between the clock tracks and the tracking tracks there are provided record zones 44_1, 44_2, . . . In other words, one clock track is along one side of one record zone and one tracking track is along the other side of the record zone. The clock track is again in the form of broken line. But, in this second example, the tracking track is formed as unbroken line.

FIG. 2B is an enlarged view of the record side surface of the optical card **41** showing how to record information on the card.

The method of recording on the optical card is basically the same as that of the first example shown in FIG. 1. Again, three spots scan the card surface in the direction of arrow a. The middle spot S_2 is used to record information as a record pit **45**. However, in this example, the spot S_3 traces the tracking tracks 43_1, 43_2, . . . to generate a tracking signal. The first spot S_1 is projected on the clocks 42_1, 42_2, . . . to obtain the necessary clock signal.

As obviously seen, the second example enables to detect the tracking signal independently of the clock signal thereby assuring correct autotracking.