2128798

"APPARATUS FOR OPTICALLY READING AND/OR RECORDING INFORMATION"

The invention relates to an apparatus for optically reading and/or recording information on a rotary optical disc.

Such an apparatus is known which comprises a frame, an objective mounted on an objective carrier which is movable over the frame along a radial path relative to the disc, and a drive unit for driving the objective carrier along said radial path, which unit comprises an electric motor and transmission means between the electric motor and the objective carrier.

An apparatus of this known construction is described in United States Patent Specification 4,152,728. This known apparatus is a video-disc player in which the objective, a gas laser and all optical and opto-electronic elements required in the optical path between the laser and the objective are together mounted on a radially movable carriage. Driving is effected by means of an electric motor arranged on the carriage. The transmission means comprise a plurality of gear wheels which co-operate with the electric motor and a toothed rack which is ridigly mounted on the frame of the video-disc player. The drive unit of this known video disc player is capable of moving the carriage in the radial direction at the required speed during reading of the video disc and is also capable of returning the carriage to its initial position or a selected position at a higher speed.

Video-disc players as well as optical-disc recorders require a drive unit which is capable of moving the objective carrier along its path at a high speed. In the case of video-disc players this requirement is prompted by the fact that new uses are envisaged for video-disc players. For example, during demonstrations or lectures it may be desirable to have the possibility of rapidly locating specific picture sequences, which may be effected under control of a computer. Furthermore, it becomes possible to design very sophisticated T.V. games using a special game computer or a so-called personal computer, if under control of the computer pictures recorded on a video disc can be displayed on a picture screen in the desired sequence and at the desired instant.

In optical recorders the speed of access to the information recorded on the optical disc and also the speed with which the information can be recorded at a specific location of the disc are essential for the potential uses of such apparatus. For some uses the waiting times which occur should be minimal. The waiting time is determined by four factors, namely: the speed of rotation of the disc, the maximum acceleration of the objective carrier in its path of movement, the accuracy with which the objective carrier can be positioned, and the speed with which the desired track on the optical disc is located after a movement of the objective carrier.

From the above it follows that rapid accelerations and decelerations in the movements of the objective carrier are required in order to obtain a small waiting time, which means that the objective carrier must have a small mass, a robust construction and a sufficiently powerful drive unit. Moreover, a large waiting-time ratio is desired, which ratio is the average ratio between the time during which the objective carrier is accelerated or decelerated by the drive unit and the time during which the drive unit is required to be stationary for the purpose of cooling. The aforementioned known video-disc player comprises a drive unit which neither meets nor has been designed to meet these requirements.

It is an object of the invention to provide an apparatus in which rapid accelerations and decelerations in the movements of the objective carrier can be achieved with large waiting-time ratio.

According to the invention there is provided an apparatus for optically reading and/or recording information on a rotary optical disc which apparatus comprises a frame, an objective mounted on an objective carrier which is movable over the frame along a radial path relative to the disc, and a drive unit for driving the objective carrier along said radial path, the drive unit comprising two identical electric motors which rotate in opposite directions, transmission means between the electric motors and the objective carrier, and two identical balancing masses which are disposed on opposite sides of the path of the objective carrier and which are

movable along paths parallel to the path of the objective carrier, the balancing masses being coupled to the two electric motors and the objective carrier by the transmission means in such a way that the balancing masses move synchronously with but in the opposite direction to the objective carrier.

An apparatus in accordance with the invention may have a powerful drive unit, for example, one comprising two d.c. commutator motors, by means of which rapid accelerations of the objective carrier can be achieved without the frame being subjected to reactive forces or reaction moments.

A particularly light and simple construction is obtained in a preferred embodiment of the invention wherein the objective carrier and the balancing masses are moved through equal distances by the transmission means, and each of the balancing masses has a mass equal to half the sum of the masses of the objective carrier, the objective and other parts which are connected to and move with the objective carrier.

The following is an example of the forces which may occur. The aforesaid sum of the masses of the objective carrier, the objective and other parts which are connected to and move with the objective support, hereinafter referred to as "the total effective mass of the objective carrier", may be of the order of 100 grammes in the case of a suitable light-weight apparatus in which the objective carrier carries only the objective and the electro-dynamic means necessary for driving the objective. If the acceleration is 10 g, this means that a force of the order of magnitude of 100 Newtons is exerted on the objective carrier. Should this force act on the frame of the apparatus, this would result in the frame being subjected to a strong and undesired shock, which could even result in a displacement of the entire apparatus over the surface on which it is placed. Obviously, this last-mentioned effect depends on the weight of the apparatus and the coefficient of friction between the surface on which the apparatus is placed and the supporting feet of the apparatus.

A simple and reliable drive unit is obtained in an embodiment

of the invention wherein the transmission means comprise two first timing pulleys fixed on the shafts of the electric motors, two second timing pulleys which are mounted for free rotation on the frame and an endless timing belt comprising a first section which passes round one of said first pulleys and one of said second pulleys in driving engagement therewith, and a second section which passes round the other first pulley and the other second pulley in driving engagement therewith, the first pulleys being arranged on opposite sides of the path of movement of the objective carrier at one end of the path, the second pulleys being arranged on opposite sides of said path at the other end thereof, and parts of said belt sections which extend between the first and the second pulleys being connected to the objective carrier.

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

Figure 1 is a schematic underneath view of an apparatus constructed in accordance with the invention,

Figure 2 is a perspective view, taken from below, of the drive unit of an optical recorder of the construction show in Figure 1, and

Figure 3 is a perspective view, taken from above, of the objective carrier and part of the transmission means of the optical recorder shown in Figure 2.

The apparatus shown in Figure 1 comprises a frame 1 and an objective 2 arranged on an objective carrier 3. An optical disc 4 can be rotated by means of an electric motor 5 arranged on the frame. The objective carrier 3 can be moved over the frame 1 along a path 6 in a radial direction with respect to the disc 4. The drive unit for driving the objective carrier along the path 6 comprises two identical electric motors 7A and 7B which rotate in opposite directions. The drive unit also includes transmission means comprising two first toothed timing pulleys 8A and 8B which are disposed on opposite sides of the path 6 of the objective carrier at one end thereof, and two second toothed timing pulleys

9A and 9B which are disposed on opposite sides of the path 6 at the other end thereof. The first pulleys 8A and 8B are fixed on the shafts 10A and 10B (shown schematically) of the motors 7A and 7B. The second pulleys 9A and 9B are mounted for free rotation on the frame 1.

Dispersed on opposite sides of the path of the objective carrier are two identical balancing masses 11A and 11B which belong to the drive unit and which are movable along paths parallel to the path 6 of the objective carrier. The balancing masses 11A and 11B move synchronously with the objective carrier 3 but in the opposite direction thereto. For example, if the objective carrier 3 is moved in the direction indicated by the arrow 12 by rotation of the pulleys 8A and 8B in opposite directions 13A and 13B by means of the motors 7A and 7B, the balancing masses 11A and 11B move in the directions indicated by the arrows 14A and 14B. To achieve this movement of the balancing masses the drive unit comprises an endless toothed timing belt 15 having two sections 15A and 15B which run side-by-side and which pass round the toothed pulleys 8A, 9A and 8B, 9B respectively in driving engagement therewith. Each belt section comprises two parts which extend parallel to one another between the two respective pulleys 8A, 9A or 8B, 9B and which are also parallel to the two parts of the other belt section. To the part of the belt section 15A which is remote from the belt section 15B the balancing mass 11A is attached, and to the part of the belt section 15B which is remote from the belt section 15A the balancing mass 11B is attached. The part of the belt section 15A which is adjacent the belt section 15B is connected to the objective carrier 3 at two opposite sides thereof, and the part of the belt section 15B which is adjacent the belt section 15A is also connected to the objective carrier at said two opposite sides thereof. The two motors 7A and 7B, the objective carrier 3 and the two balancing masses 11A and 11B are thus coupled to each other by the transmission means 8A-B, 9A-B and 15 for synchronizing said movements.

In the embodiment shown in Figure 1 the objective carrier and

the balancing masses 11A and 11B move through equal distances. Furthermore, the balancing masses 11A and 11B each have a mass equal to half the total effective mass of the objective carrier 3. Thus, the simple drive unit shown provides full compensation for all mass forces, so that no resulting mass forces are exerted on the frame 1 during the movement of the objective carrier 3 along its path 6. Alternatively, the balancing masses may have a combined mass which differs from the total effective mass of the objective carrier 3, in which case they are moved through a different distance from that through which the objective carrier moves. For example, if the mass of the balancing masses is larger the distance through which they move may be shorter. However, this has the disadvantage that the mass of the complete drive unit becomes larger, which means a greater weight, whilst moreover the transmission means becomes more intricate. Alternatively, the balancing masses may be given a smaller mass and may be moved through a greater distance than the objective carrier. However, this has the advantage that the drive unit must have larger dimensions and becomes more intricate. The use of the two identical motors which rotate in opposite directions ensures that no resulting turning moment is exerted on the frame.

In Figures 2 and 3 the parts which are schematically represented in Figure 1 are designated by the same reference numerals as in Figure 1.

The entire frame 1 is made of aluminium and is formed with a slot 16 in which the objective carrier 3 is movable. This carrier is provided with a number of ball-bearings rollers 17 which run on inclined guide surfaces 18 on the wall of the slot 16 to provide a parallel guidance for the objective carrier 3. By means of coils 19 and permanent magnets 20 the objective 2 is movable through a small distance relative to the objective carrier 3. This enables a track on the optical disc 4 to be followed by the objective, electronic servo-circuits ensuring that the light beam is kept in focus on the information surface of the optical disc and the focussed light spot remains in the track. The drawing does not

(17)

show those parts of the optical path which are required in addition to the objective, because they are irrelevant to the present invention. They may be mounted rigidly on the frame 1 or on other stationary parts to be connected to the frame. The timing belt is fixed to the objective carrier by bolts 21 disposed on two opposite sides of the objective carrier. The balancing masses 11A and 11B each comprise parts which are disposed on opposite sides of the respective part of the respective section 15A or 15B of the timing belt 15 and which are interconnected by clamping bolts. On its lower end the electric motor 7B carries a position encoder 22 which supplies to the control circuitry for controlling the movements of the objective carrier a position signal which is a measure of the nominal position of the objective carrier 3 relative to the frame 1.

(18)

CLAIMS:

1. An apparatus for optically reading and/or recording information on a rotary optical disc, which apparatus comprises a frame, an ojective mounted on an objective carrier which is movable over the frame along a radial path relative to the disc, and a drive unit for driving the objective carrier along said radial path, the drive unit comprising two identical electric motors which rotate in opposite directions, transmission means between the electric motors and the objective carrier, and two identical balancing masses which are disposed on opposite sides of the path of the objective carrier and which are movable along paths parallel to the path of the objective carrier, the balancing masses being coupled to the two electric motors and the objective carrier by the transmission means in such a way that the balancing masses move synchronously with but in the opposite direction to the objective carrier.

2. An apparatus as claimed in Claim 1, wherein the objective carrier and the balancing masses are moved through equal distances by the transmission means, and each of the balancing masses has a mass equal to half the sum of the masses of the objective carrier, the objective and other parts which are connected to and move with the objective carrier.

3. An apparatus as claimed in Claim 2, wherein the transmission means comprise two first timing pulleys fixed on the shafts of the electric motors, two second timing pulleys which are mounted for free rotation on the frame, and an endless timing belt comprising a first section which passes round one of said first pulleys and one of said second pulleys in driving engagement therewith, and a second section which passes round the other first pulley and the other second pulley in driving engagement therewith, the first pulleys being arranged on opposite sides of the path of movement of the objective carrier at one end of the path, the second pulleys being arranged on opposite sides of said path at the other end thereof and parts of said belt sections which extend between the first and the second pulleys being connected to the objective

* C L M S *

carrier at two opposite sides thereof.

4. An apparatus for optically reading and/or recording information on a rotary optical disc, substantially as herein described with reference to Figures 1 to 3 of the accompanying drawings.

---

* C L M S *