

FIELD OF THE INVENTION

The present invention relates to an optical storage drive. In particular, this invention relates to an optical storage drive with a new and compact
5 power transmission system in the traverse or loader mechanisms of the optical storage drive.

BACKGROUND OF THE INVENTION

Optical storage drives are devices that store and retrieve data by means of light signal. The most well-known form of optical storage drive to date is
10 the Optical storage device Read-only-Memory (CD-ROM). The electricals and optical pickup ability of optical storage drives has progressed rapidly to produce faster, smaller and cheaper drives. Electronic features such as constant angular velocity (CAV) technology is available, which allows optical storage drives to run approximately two to three times faster than
15 drives using constant linear velocity (CLV) technology.

For driving the optical storage system, two subsystems are used. A traverse mechanism contains the spindle motor subsystem and the sled-axis for moving the optical pickup unit. The loader mechanism loads and unloads the optical storage device into the traverse mechanism. The
20 mechanics of the drive mechanism has evolved at a slower pace than the electronics and optics, preventing engineers from exploit fully the advances in electronic and optical pickups.

The compact optical storage drive design has to take into account the total area taken up by the traverse and loader mechanism, the optical

pickup unit, and the space for placement of the optical storage unit. For reducing the noise level, various power transmission systems and gears have to be considered, as different combinations give different noise levels. Although electrical features such as CAV and CLV play an important role in determining the speed of the optical storage drive, the power transmission system is also important. Presently, given the same electrical feature (i.e. CAV or CLV), the faster drives tend to be bigger, noisier and costlier while the slower drives tend to be smaller and quieter due to differences in the power transmission system.

Two types of gears are commonly used in the art. A spur gear set consists of a set of interacting wheel-shaped gear each having teeth etched along the perimeter of the wheel shape. Spur gear sets tend to be noisy, have backlash problem, and need at least two stages of belt or gear sets to achieve the desired gear ratio. Consequently, the gears take up a lot of space, resulting in noisy, bulky optical storage drive.

A worm gear set also consists of wheel-shaped gears with teeth etched along the perimeter. The gears are driven by an elongated pinion at one side. A high gear ratio can be achieved and backlash is not as problematic in worm gears. However, the optical storage drives using these gears are still very bulky due to the large space requirement of the worm gear design. There is therefore the need to design a cheaper, quieter and more compact optical storage drive which provides high performance.

OBJECT OF THE INVENTION

It is an object of the present invention to provide a fast optical storage drive.

It is another object of the present invention to provide quiet optical storage
5 drive.

It is an object of the present invention to provide a compact optical storage drive.

SUMMARY OF THE INVENTION

The present invention is an optical storage drive provided with a traverse mechanism coupled to a loader mechanism. The traverse mechanism is mounted to the interior of the loader mechanism, and allows
5 the optical pickup unit to read an optical storage device when the optical storage device is loaded into the optical storage drive. The loader mechanism includes a loader sled motor fixed onto a chassis, a tray for holding an optical storage device slidably attached to the chassis, and a loader hypoid gear set having a loader hypoid pinion, a loader hypoid
10 gear and a loader rack bar. The attachment end of the loader hypoid pinion is fixed onto the loader motor, and the loader rack bar is attached to the tray. Rotational movement of the loader motor is translated into linear movement via the loader hypoid gear set to cause the tray to slide forward or backward. The traverse mechanism is coupled to the interior of the
15 chassis, and includes a frame, an optical pickup unit (OPU) slidably connected to the frame, a turntable attached to the frame for turning the optical storage device on the tray, a spin motor for spinning the turntable, a sled motor fixed onto the frame, and a OPU hypoid gear set. The OPU hypoid gear set includes a OPU hypoid pinion fixed onto the sled motor, a
20 OPU hypoid gear fixed onto the frame, and a OPU rack bar attached to the optical pickup unit. The OPU hypoid gear set transmits the rotational movement of the sled motor into linear movement of the optical storage unit, whereby the optical storage unit can move across the radius of an optical storage device loaded onto the tray.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a hypoid gear set in the present invention.

Figure 2 is a top perspective view of a optical storage drive attached to the
5 hypoid gear set.

Figure 3 is a top, front perspective view in a traverse mechanism of a optical storage drive.

Figure 4 is a top, front perspective view of a loader mechanism of an optical storage drive.

10 Figure 5 is a front perspective view of a hypoid gear set (5A) and a worm gear set (5B).

DESCRIPTION OF THE INVENTION

The optical storage drive according to the present invention includes a traverse mechanism and a loading mechanism. The loading mechanism is provided with a loader gear set, which moves a tray forward for receiving an optical storage device to be read, and brings the tray back into the optical storage drive where the optical pickup unit reads the optical storage device. The optical pickup unit is preferably situated below the tray, and is controlled by a second OPU gear set. The optical storage device may be a compact disc (CD), a digital versatile disc (DVD), or any other optical storage device than may be read in an optical storage drive of the type described here.

Gears are used in optical storage drives to transfer the power from the sled motor to the optical pickup unit or the tray in the traverse or loader mechanisms respectively. The conventional way is to use spur gears or worm gears to achieve this function. Hypoid gears are a cross between spiral bevel gears and worm gears. The axes of a pair of hypoid gears are non-intersecting, and the distance between the axes is referred to as the offset. The offset, combined with other characteristics gives the hypoid gear system several advantages over the spur and worm gears, including smooth and quiet running, and higher gear ratio for a given space.

The present invention provides a hypoid gear set, as shown in Figure 1. The hypoid gear set of the present invention includes three parts, the wheel-shaped hypoid gear 20 and the hypoid pinion 22. The hypoid gear includes a typical wheel-shaped hypoid gear with hypoid teeth 24 provided on the outer region of its upper surface 26, and a spur gear 28,

of smaller diameter than the wheel-shaped hypoid gear, coaxially mounted in the center of the upper surface of the hypoid gear. One end of the hypoid pinion, pointing toward the edge of the hypoid gear (the attachment end 30) is fixed to a sled motor, such that the pinion would rotate upon the activation of the sled motor. Teeth 32 provided on the pinion are engaged with the hypoid teeth 24, causing the hypoid gear to turn. As the central spur gear is fixedly mounted as part of the hypoid gear, the central spur gear will also rotate. Ideally, the hypoid gear is produced by plastic injection molding, such that the spur gear and the wheel-shaped hypoid gear form one integral piece of hypoid gear. In order to translate the rotational movement into a linear movement, the rack bar is used to engage the central spur gear, as shown in subsequent drawings.

Figure 2 shows an example of how the hypoid gear of the present invention is used to drive an optical pickup unit. An elongated OPU rack bar 34 is fixedly attached to the optical pick up unit 36. The side of the OPU rack bar adjacent to the central spur gear is provided with a row of teeth 35 which are engaged with the teeth of the central spur gear 40 of the OPU hypoid gear. The attachment end 38 of the OPU hypoid pinion 37 is fixed into the sled motor 39. As the sled motor is activated, the rotational movement in the OPU hypoid pinion is translated to a linear movement of the optical pickup unit via the OPU hypoid gear and the OPU rack bar. The preferred gear ratio of the hypoid pinion to the hypoid gear in the traverse and loader mechanism is in a range between 6 : 1 and 10 : 1. The most preferred ratio is 10 : 1. The preferred diameter of the hypoid gear is 24 to 27mm. This is in contrast to spur gears, which have lower gear ratios in the range of 1:1 to 5:1. Worm gears can reach high gear

ratios easily, but are bulkier than hypoid gears due to the position of the pinion as discussed below.

Figure 3 illustrates the traverse mechanism of the present invention. It is to be understood that the following is a description of one embodiment of the present invention, and is not meant to limit the scope of this invention. A frame 56 with two shafts 58, couples the traverse mechanism onto the chassis of the loading mechanism. Brackets 59 extending from the optical pickup unit are fitted around the shafts, and allows the optical pickup unit to be slidably connected to the frame. Preferably, bushing is provided within the brackets to allow quiet and precise sliding of the optical pickup unit. A turntable 62 and its corresponding spin motor 64 are fixed onto the frame below the tray of the loading mechanism, and functions to spin the optical storage device placed on the tray. The optical pickup unit is also attached to the OPU rack bar 34 of a OPU hypoid gear set. The OPU hypoid gear 42 and the sled motor 39 are fixed onto the frame 56. When the sled motor rotates, the OPU hypoid gear set causes the OPU to slide along the shafts 58 in a quiet, precise and controlled manner.

Figure 4 illustrates how the present invention is used in the loader mechanism of an optical storage drive. In this example, the loader hypoid gear 68 and the loader motor 70 are fixed onto the chassis 72 of the loader. The loader rack bar 73 is fixed onto the tray 74. As the loader motor 70 is activated, the rotational movement is translated to linear movement of the tray 74 via the loader hypoid pinion, the loader hypoid gear, and the loader rack bar. As a result, the tray can be driven forward or

backward, depending on the direction of rotation of the loader motor. The frame 56 of the traverse mechanism fits into space 76 of the chassis.

With the aforementioned design, a very thin and compact gear system can be produced. Based on the same wheel diameter, the space required to operate the present invention is smaller than the space required for a worm gear system. As an example, figure 5 shows a comparison between a hypoid gear and a worm gear in term of space requirements. Based on the same wheel dimension, the hypoid gear set, including the hypoid gear 20 the hypoid pinion 22, and the sled motor 39, would have a length 48 and a height 50. When compared with the length 52 and height 54 of the worm gear set, the dimension of the hypoid gear set is smaller. As a result, one can save space while maintaining high efficiency and low noise levels.

**CLAIMS****I Claim:**

- 1 1. An optical storage drive comprising :
 - 2 a loader mechanism and a traverse mechanism, said loader mechanism
 - 3 having
 - 4 a loader motor fixed onto a chassis;
 - 5 a tray slidably attached to said chassis for receiving an optical storage
 - 6 device;
 - 7 a loader hypoid gear set including a loader hypoid gear fixed onto said
 - 8 chassis, having hypoid teeth on the upper surface and a spur gear
 - 9 with teeth mounted on the interior of the upper surface; a loader
 - 10 hypoid pinion having a teeth end and an attachment end, said
 - 11 attachment end coupled to said loader motor, and said teeth end
 - 12 engaged with said hypoid teeth of said hypoid gear; and a loader
 - 13 rack bar having a row of teeth on one longitudinal side, and further
 - 14 having a section of said row of teeth engaged with said teeth of said
 - 15 spur gear, said rack bar further fixed to said tray;
 - 16 whereby the loader hypoid gear set transmits rotational movement
 - 17 generated by said loader motor to linear movement causing said
 - 18 tray to slid backward and forwards according to the direction of
 - 19 rotation;
 - 20 said traverse mechanism having
 - 21 a frame coupled inside said chassis;



22 means for spinning an optical storage device, said means attached to said
23 frame;
24 an optical pickup unit slidably connected to said frame, for reading an
25 optical storage device;
26 a sled motor, fixed onto said frame; and
27 a OPU hypoid gear set, including an OPU hypoid gear fixed onto said
28 frame, having hypoid teeth on the upper surface and a spur gear
29 with teeth mounted on the center of the upper surface; an OPU
30 hypoid pinion having a teeth end and an attachment end, said
31 attachment end coupled to said sled motor, and said teeth end
32 engaged with said hypoid teeth of said OPU hypoid gear; and an
33 OPU rack bar having a row of teeth on one longitudinal side, having
34 a section of said row of teeth engaged with said teeth of said OPU
35 spur gear, said OPU rack bar further fixed to said optical pickup
36 unit,
37 whereby the OPU hypoid gear set transmits rotational movement
38 generated by said sled motor into linear movement causing said optical
39 pickup unit to slide along an axis across the radius of an optical storage
40 device positioned on said tray.



- 1 2. A loader mechanism of an optical storage drive comprising :
- 2 a loader motor fixed onto a chassis;
- 3 a tray slidably attached to said chassis for receiving an optical storage
- 4 device;
- 5 a loader hypoid gear set including a loader hypoid gear fixed onto said
- 6 chassis, having hypoid teeth on the upper surface and a spur gear
- 7 with teeth mounted on the interior of the upper surface; a loader
- 8 hypoid pinion having a teeth end and an attachment end, said
- 9 attachment end coupled to said loader motor, and said teeth end
- 10 engaged with said hypoid teeth of said hypoid gear; and a loader
- 11 rack bar having a row of teeth on one longitudinal side, and further
- 12 having a section of said row of teeth engaged with said teeth of said
- 13 spur gear, said rack bar further fixed to said tray;
- 14 whereby the loader hypoid gear set transmits rotational movement
- 15 generated by said loader motor to linear movement causing said
- 16 tray to slid backward and forwards according to the direction of
- 17 rotation.



1 3. An traverse mechanism of an optical storage drive comprising :
2 a frame;
3 means for spinning an optical storage device, said means attached to said
4 frame;
5 an optical pickup unit slidably connected to said frame, for reading an
6 optical storage device;
7 a sled motor, fixed onto said frame; and
8 a OPU hypoid gear set, including an OPU hypoid gear fixed onto said
9 frame, having hypoid teeth on the upper surface and a spur gear
10 with teeth mounted on the center of the upper surface; an OPU
11 hypoid pinion having a teeth end and an attachment end, said
12 attachment end coupled to said sled motor, and said teeth end
13 engaged with said hypoid teeth of said OPU hypoid gear; and an
14 OPU rack bar having a row of teeth on one longitudinal side, having
15 a section of said row of teeth engaged with said teeth of said OPU
16 spur gear, said OPU rack bar further fixed to said optical pickup
17 unit;
18 whereby the OPU hypoid gear set transmits rotational movement
19 generated by said sled motor into linear movement causing said
20 optical pickup unit to slide along an axis across the radius of an
21 optical storage device positioned on said tray.



- 1 4. A gear set according to claims 1 or 2 wherein the gear ratio of said
2 loader hypoid pinion to said loader hypoid gear ratio is in the range
3 of 10:1 to 6 : 1.
- 1 5. A gear set according to claims 1, 2 or 4 wherein the gear ratio of
2 said loader hypoid pinion to said loader hypoid gear ratio is 10 : 1.
- 1 6. gear set according to claims 1 or 3 wherein the gear ratio of said
2 OPU hypoid pinion to said OPU hypoid gear ratio is in the range of
3 10:1 to 6 : 1.
- 1 7. A gear set according to claims 1, 3 or 6 wherein the gear ratio of
2 said OPU hypoid pinion to said OPU hypoid gear ratio is 10 : 1.
- 1 8. A gear set according to claims 1 or 2 wherein said loader hypoid
2 gear has a diameter between 24 to 27mm.
- 1 9. A gear set according to claims 1 or 3 wherein said OPU hypoid
2 gear has a diameter between 24 to 27mm.