

DESCRIPTION

Bearing for pinch roller and pinch roller using the bearing

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Technical Field

The present invention relates to a pinch roller and bearing for the pinch roller for use in a tape driving apparatus in a magnetic recording and playback unit such as a videotape recorder, audiotape recorder and the like, and furthermore to a pinch roller and bearing for the pinch roller able to be inexpensive in manufacturing and feed a tape stably.

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Background Art

Hitherto, there is used a pinch roller in a tape driving apparatus in a magnetic recording and playback unit. Such a pinch roller is requested to have a capability to feed surely and stably a tape running interposed between a capstan motor shaft and the roller. In order to satisfy such a request, the pinch roller is provided with a bearing having a self-aligning ability to conform movably to a deflection of the capstan motor shaft. Instead of a ball bearing previously used as this bearing, nowadays a metal bearing and resin bearing prevails. As such a bearing, there are presented the bearings in Japanese Utility Model publication No. HEI 8-9447 and Japanese Laid-open Patent Publication No. HEI 7-65443. However, while it makes it possible to reduce the manufacturing costs in these bearings, there exist the following problems.

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In the metal bearing described in the problem Japanese Utility Model publication No. HEI 8-9447, there is a problem that the pinch roller shaft mounted on the bearing is worn or seized because of the hardness of the metal material. The abrasion of the shaft makes the clearance between the bearing and the pinch roller shaft so larger as to prevent the pinch roller from rotating smoothly. Furthermore, the fine powder caused by the abrasion is adhered to the apparatus and tape to exert bad influences thereon.

Meanwhile, the resin bearing described in the Japanese Laid-open Patent Publication HEI 7-65443 is, as shown therein, formed as below with the aim to obtain a self-aligning ability. The inner diameter of the bearing comprises the straightway center portion forming a clearance between the shaft and the bearing and the crowning portion expanding gradually and radially along the direction of from both the ends of the center portion to the end surfaces of the bearing. Since both the end portions expands radially, if the injection molding die is formed of a split mold and provided with a structure in which the nests are extracted from both the sides of the die, the resin bearing is easily molded. However, in view of ensuring a high accuracy of the dimension, it is not preferable as a manufacturing mold to use such a structure that the nests are extracted from both the sides. Consequently, there should be employed the die structure which allows an unitedly molded nest to be taken out forcedly from one side only. If the above nest is removed forcedly, it is apprehended that the resulting

bearing is split or broken because a harder resin is used for the bearing. Moreover, since a resin bearing is totally large in thickness, it is feared that the accuracy of dimension gets worse due to the shrinkage after its molding.

5 Although there never happens such shrinkage when the resin bearing is formed by cutting a solid resin material, the manufacturing cost is raised because of the increased manufacturing steps. Further, it is difficult to use a mass production system so that the manufacturing cost becomes
10 higher.

Hence, an object of the present invention is to provide a bearing for a pinch roller which overcomes such disadvantages of the prior bearings for a pinch roller and avoids an abrasion and seizing of the shaft, and the pinch roller using the bearing.

15 Another object of the present invention is to provide a bearing which is excellent in accuracy of dimension and molded easily without being broken and split, and a pinch roller using the bearing.

 An even further object of the present invention is to
20 provide a bearing which enables reducing an abrasion of a pinch roller shaft and feeding a tape stably, and the pinch roller using the bearing.

Disclosure of the Invention

25 The present invention comprises a shaft for mounting a pinch roller on a frame, a sleeve provided with a rubber roller therearound and a bearing interposed between the shaft and

sleeve. The bearing comprises an inner cylinder and outer cylinder, the inner cylinder and outer cylinder being interconnected with each other through an interconnecting rib, and there is provided between the inner cylinder and outer
5 cylinder a space with an opening toward at least one end surface. Since the space generates an elastic action, there never occurs any breaks or splits in the molded bearing when a nest is forcibly extracted in an injection molding steps.

Further, in the present invention, a bearing for a pinch
10 roller comprises an inner cylinder and outer cylinder, and a space between the inner cylinder and outer cylinder is formed to open toward at least one end surface. By such a space, the bearing for a pinch roller is given elasticity. The inner diameter of the inner cylinder is made linearly straightway in
15 the center portion thereof, and the diameter expands gradually and radially from the center portion of the straightway to both the end surfaces to take a taper or circular arc shape.

The inner cylinder and outer cylinder are so formed as to be interconnected with each other at either end portion
20 through a radially extending interconnecting rib and provide the space with an opening at the other end surface.

In a case, the inner cylinder and outer cylinder are so formed as to be interconnected with each other at the center portion through a radially extending interconnecting rib and
25 provide the space with openings at both the end surfaces of the inner and outer cylinders. In another case, the inner cylinder and outer cylinder are so formed as to be interconnected with

each other by no less than two radially extending interconnecting ribs disposed in the axial direction and provide the space with openings at both the end surfaces of the inner and outer cylinders.

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Brief Description of the Drawings

Fig. 1 is a perspective view illustrating a preferable pinch roller to which the present invention relates.

10 Fig. 2 is a vertical cross sectional view illustrating the first embodiment of the present invention.

Fig. 3 is a vertical cross sectional view illustrating the second embodiment of the present invention.

Fig. 4 is a perspective view illustrating a pinch roller in the third embodiment of the present invention.

15 Fig. 5 is a cross sectional view taken along with the line A-A in Fig.4.

Fig. 6 is a cross sectional view taken along with the line B-B in Fig.4

20 Fig. 7 is a cross sectional view illustrating an arrangement in which a pinch roller equipped with a bearing of the present invention is mounted on a pinch roller shaft.

Fig. 8 is a cross sectional view illustrating a bearing of comparative examples.

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Best Mode for Carrying out the Invention

In order to explain the present invention in detail, a description is made according to the embodiments illustrated below.

Fig. 1 and Fig. 2 show the first embodiment of a

preferable bearing of the present invention. In a bearing 1, an outer cylinder 5 is disposed through the intermediary of a space 7 formed outside an inner cylinder 3 in the axial direction, and the outer cylinder 5 and the inner cylinder 3 is
5 interconnected by a radially extended interconnecting rib 9 provided at one end surface. The space has an opening at the opposite end surface to the end surface with the interconnecting rib 9 to thereby take generally an U-shaped form in section. The space expands radially toward the opening so that a molding
10 die is easily extracted. Further, the inner diameter of the inner cylinder expands radially along the direction of from the center portion to both the end surfaces so as to have a self-aligning ability. Namely, the central portion 3a has a diameter whose size allows to form a certain clearance between
15 a pinch roller shaft and the central portion 3a to take a straightway form. Still further, the inner diameter of the inner cylinder expands gradually and radially along the direction of from both the ends of the center portion 3a to both the end surfaces to take sectionally taper or circular arc
20 shapes therein.

When the inner surface of the inner cylinder 3 is formed to be taper or circular arc as described above, it may deflect angularly from the pinch roller shaft to thus acquire a self-aligning ability. Consequently, the pinch roller are
25 able to easily conform a deflection of a capstan motor shaft to enable keeping a steady contact with a rubber roller. The bearing is elasticized by its own structure with a space.

Resultingly, there never broken or split the molded product when the nest is extracted forcedly toward one end portion in the injection molding process. As compared with a bearing without any space, which has a constant wall thickness defined by the inner diameter of the inner cylinder 3 and outer diameter of the outer cylinder 5, the bearing in the above embodiment is provided with a thinner wall by the corresponding amount to the space 7 so as to reduce an amount of shrinkage after the molding and secure a high circularity. The space 7 provides the bearing 1 with elasticity and hence any partial pressure is not applied to the bearing so that an abrasion of the pinch roller and the bearing itself is prevented.

Fig. 3 depicts the second embodiment of the present invention in which a bearing 10 comprises the inner cylinder 3 and outer cylinder 5 which are interconnected in the center portion by a radially extending interconnecting rib 9a and a space 7a which is disposed in the axial direction and provided with openings at both the end surfaces. When the interconnecting rib 9a is positioned in the center portion as above, both the end portions are equal to each other in elasticity. Other constitutions, functions and advantages are the same as those of the first embodiment, and then the same numerals are used for the same parts whose explanations are obviated.

Fig. 4 to Fig. 5 show the third embodiment of the present invention in which the bearing 20 is obtained by providing the bearing 1 of the first embodiment additionally with a axially

expending interconnecting rib 9b and thus interconnecting the inner cylinder 3 and outer cylinder 5. Accordingly, a plurality of spaces 7b are formed in the axial direction at one surface. The spaces 7b each have its opening at the opposite surface to the interconnecting rib 9b, and the width of each space is enlarged gradually toward its opening so that the molding die may be easily extracted. In case that the interconnecting rib 9b disposed in the axial direction is employed, the strength of the bearing is raised. The number of the interconnecting ribs 9b are not limited specifically, however, preferably the ribs 9b are positioned at equal intervals. Other constitutions, functions and advantages are the same as those of the first embodiment and so the same reference numerals are attached to the same parts whose explanations are omitted.

The bearing for the pinch roller according to the present invention is never limited to the above embodiments, and it is possible to appropriately determine the positions of the axially extending interconnecting ribs and the number of the axially extending interconnecting ribs for interconnecting the inner cylinder and outer cylinder. With respect to such an interconnecting rib, there can be used any one or both of the radially extending interconnecting rib and the axially extending interconnecting rib. It is admitted to use the axially extending interconnecting ribs 9b only without using the radially extending interconnecting rib, or it is enabled to employ the combination of the interconnecting ribs 9a and 9b.

Next, a pinch roller relating to the present invention is described based upon Fig. 7. Fig. 7 is a cross sectional view illustrating that the pinch roller using a bearing relating to the present invention is incorporated into a pinch roller shaft. The pinch roller 21 is formed by mounting a rubber roller 23 whose outer periphery is previously polished on the outer periphery of a metal sleeve 25. The bearing 1 is positioned appropriately within the inner periphery of the sleeve 25. The stepped pinch roller shaft 29 secured to a frame 27 is inserted into the bearing 1, and the bearing is fixed thereon by an end cap 30. In the axial direction of the shaft, the washers 31 of synthetic resin are interposed between the under surface of the bearing 1 and the step of the shaft 29 and between the upper surface of the bearing 1 and the end cap 30, respectively. There are provided predetermined axial clearances between the washer 31 and the step and between the other washer 31 and the end cap 30, respectively. Fig. 7 illustrates the bearing having the structure shown in Fig. 1, however, any bearings in the embodiments are available.

The pinch roller 21 with the above constitution is installed in an appropriate position of a tape driving apparatus in a video tape recorder and the like using the frame 27, and the rubber roller 23 is disposed in parallel to a capstan motor shaft not illustrated. In operation, the rubber roller 23 is biased by the capstan motor shaft to feed a tape intervening between itself and the capstan motor shaft. The bearing is provided with a space therein and further it is given a

self-aligning ability because the inner diameter thereof is enlarged gradually toward both the end portions to sectionally take a taper or circular arc shape. Hence, the bearing conforms movably to any deflection of the capstan motor shaft,
5 accordingly a stable feeding of tape is ensured and further it is not apprehended that any abrasion is caused by a partial pressure.

As apparent from the above description, according to a bearing for a pinch roller of the present invention having
10 such a structure that the inner cylinder and outer cylinder are interconnected with each other and a space is provided in the bearing so as to have an opening at at least one end surface of the bearing, if a nest for the molding of the bearing is extracted forcibly from the one end surface when molded, the
15 molded product is never broken or split because of the elastic action of the bearing. An amount of shrinkage of the bearing after the molding is so little that an accuracy of dimension of the bearing is maintained. As mentioned above, the bearing is easily manufactured without a fear of reducing a function
20 as a pinch roller and which enables decreasing a manufacturing cost of the pinch roller. According to the above structure of the bearing, it is possible to reduce an amount of abrasion of the pinch roller shaft and feed a tape stably.

25 Embodiments 1 to 3

Next, in embodiments and comparative examples to handle a pinch roller provided with a bearing of the present

invention and another pinch roller provided with a conventional bearing respectively, an abrasion (life) test is conducted individually. A bearing used in the test is made of polyacetal-based resin, the bearings of the structures shown in Fig. 1, Fig.2 and Figs. 4 to 6 are each used in the embodiments 1, 2 and 3, respectively.

The each size of the bearings is equally 3 mm in inner diameter, 7 mm in outer diameter, 7 mm in length and 0.9 mm in the height of the space between the inner cylinder and outer cylinder. The metal bearing shown in Fig.8 is employed as a bearing of the comparative examples. There is used in comparative example 1 a pinch roller with the metal bearing of Fig. 8(a) whose inner diameter is enlarged gradually toward both the end portions, and there is used in comparative example 2 another pinch roller with the polyacetal-based resin bearing of Fig. 8(b) whose inner diameter is straightway. The each size of the bearings is equally 3 mm in inner diameter, 7 mm in outer diameter and 6 mm in length.

The test procedure is according to the following conditions. A biasing force of the pinch roller against a capstan motor shaft is set to be 1.5 Kgf, and a rotational speed of the capstan motor shaft is determined to be 1270 r.p.m., which is around seven times as large as that of playback mode in a video tape recorder, and the direction of rotation of the capstan motor shaft is reversed at intervals of fifteen minutes. The experimental results are shown in Table 1.

Table 1

	Running time equivalent to 100 hrs. in actual unit	Running time equivalent to 1500 hrs. in actual unit	Running time equivalent to 3000 hrs. in actual unit
Comparative example A	6.5 μm	8.0 μm	20.0 μm
Comparative example A	0 μm	0.5 μm	1.0 μm
Embodiment 1	0 μm	0 μm	0 μm
Embodiment 2	0 μm	0 μm	0 μm
Embodiment 3	0 μm	0 μm	0 μm

As seen from the above table, a little abrasion occurs in each of comparative examples, however, there is never happen any abrasion in the embodiments. The reason that no abrasion appears in the embodiments is likely because the bearing becomes so elastic due to formation of a space therein that it is not only able to conform to any deflection of a capstan motor shaft but also not subjected to any partial pressure.



CLAIMS

1. A bearing for a pinch roller comprising an inner cylinder and an outer cylinder, wherein a space is formed
5 between the inner cylinder and outer cylinder and provided with an opening at at least one end surface of the cylinders.

2. A bearing for a pinch roller according to claim 1, wherein the inner cylinder and outer cylinder are
10 interconnected with each other by a radially extending interconnecting rib and/or an axially extending interconnecting rib.

3. A bearing for a pinch roller according to claim
15 1, wherein the inner cylinder and outer cylinder are interconnected with each other at one end portion thereof by a radially extending interconnecting rib and the space is provide with an opening at the other end surface of the cylinders.

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4. A bearing for a pinch roller according to claim 1, wherein the inner cylinder and outer cylinder are interconnected with each other at the center portion thereof by a radially extending interconnecting rib and the space is
25 provide with openings at both the end surfaces of the cylinders.

5. A bearing for a pinch roller according to claim 1,



wherein the inner cylinder and outer cylinder are interconnected with each other by no less than two axially extending interconnecting ribs and the space is provided with openings at both the end surfaces of the cylinders.

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6. A bearing for a pinch roller according to claim 1, wherein the inner cylinder and outer cylinder are interconnected with each other at one end portion thereof by a radially extending interconnecting rib and are further
10 interconnected with each other by no less than two axially extending interconnecting ribs and the space is provided with openings at both the end surfaces of the cylinders.

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7. A bearing for a pinch roller according to any one of claims 1 to 6, wherein the inner diameter of the inner cylinder is straightway at the center portion thereof and is enlarged radially and gradually along the direction of from the center portion toward both the end portions to thereby take sectionally a taper or circular arc shape.

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8. A pinch roller comprising a shaft to be fixed to a frame, a sleeve having a rubber roller on the outer periphery thereof and a bearing disposed between the shaft and the sleeve, wherein the bearing comprises an inner cylinder and outer
25 cylinder and a space is formed between the inner cylinder and outer cylinder and provided with an opening at at least one end surface to thereby give the bearing elasticity.



9. A pinch roller according to claim 8, wherein the inner cylinder and outer cylinder are interconnected with each other by a radially extending interconnecting rib and/or an
5 axially extending interconnecting rib.

10. A pinch roller according to claim 8 or 9, wherein the inner diameter of the inner cylinder is straightway at the center portion thereof and is enlarged radially and gradually
10 along the direction of from the center portion toward both the end portions to thereby take sectionally a taper or circular arc shape.