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Abe et al.

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(54) **IMAGE RECORDING APPARATUS**

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B41J 19/00 (2006.01)

(52) **U.S. Cl.**
CPC ***B41J 25/006*** (2013.01); ***B41J 19/005*** (2013.01)

(58) **Field of Classification Search**
CPC B41J 25/006; B41J 19/005
See application file for complete search history.

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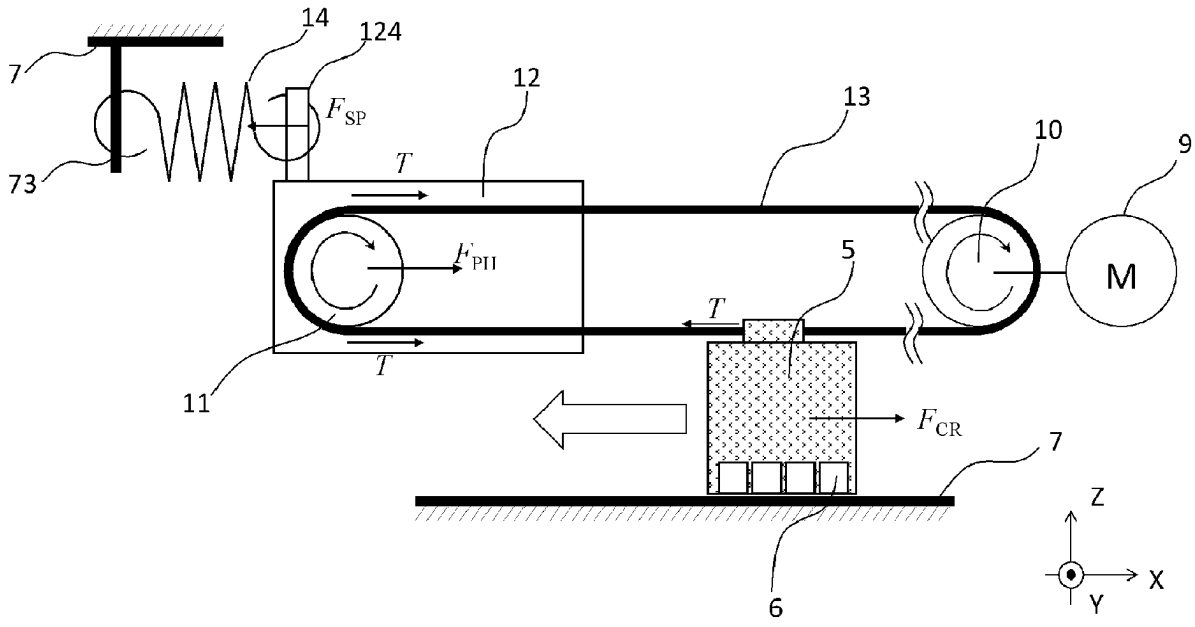
(57) **ABSTRACT**

An image recording apparatus includes a belt passed around a drive pulley and a driven pulley, a support member configured to support a recording head and fixed to the belt, a holder member, having a claw part, configured to hold the driven pulley, and a frame having a first opening for the claw part to penetrate. The holder member is attached to the frame such as to be movable relative to the drive pulley. The first opening has an enlarged opening portion allowing the claw part to pass through without engaging with the frame on one side closer to the drive pulley. At least a portion of the claw part is positioned within a part of the first opening excluding the enlarged opening portion in a state where the holder member is positioned in a predetermined location closer to the drive pulley.

10 Claims, 9 Drawing Sheets



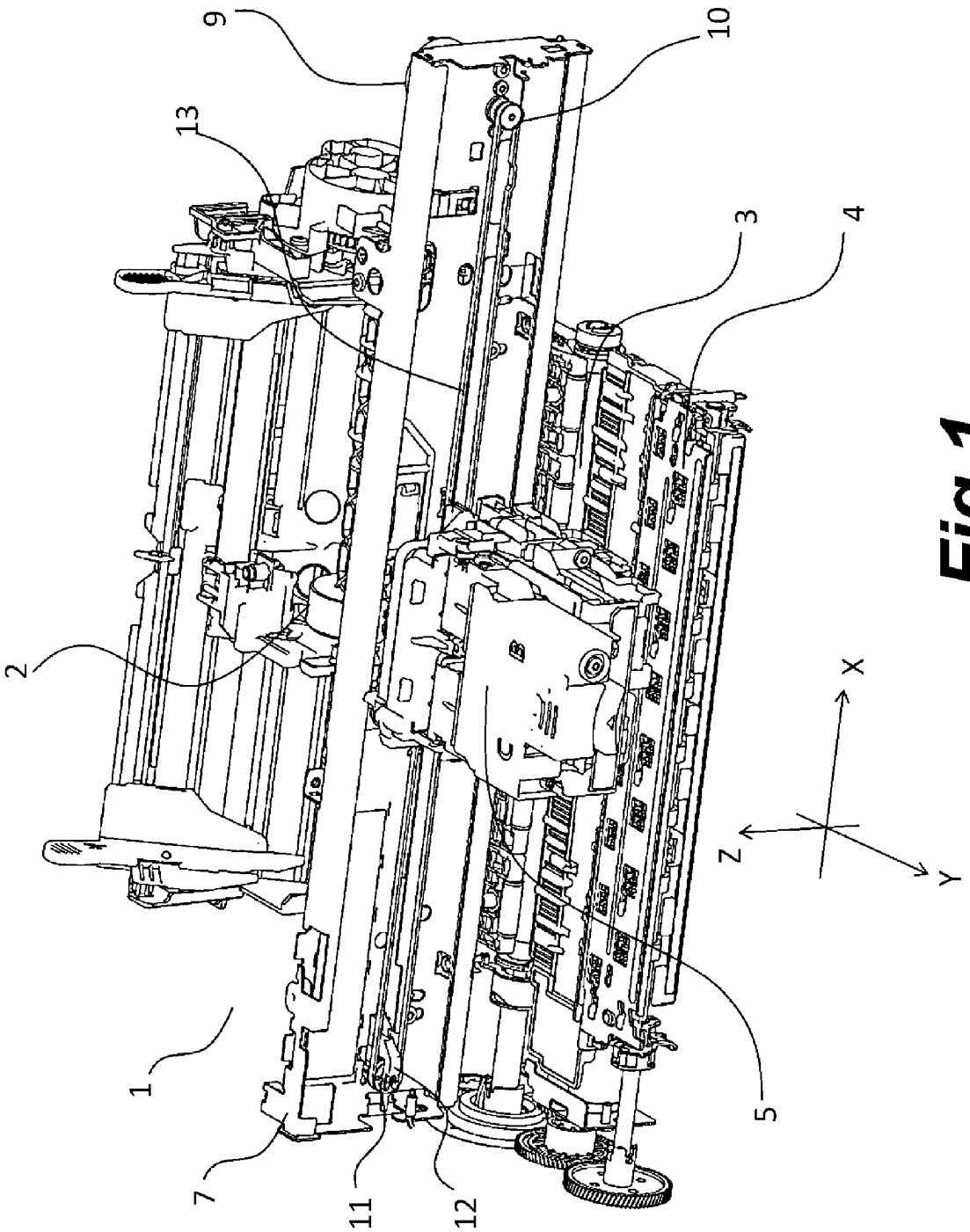


Fig.1

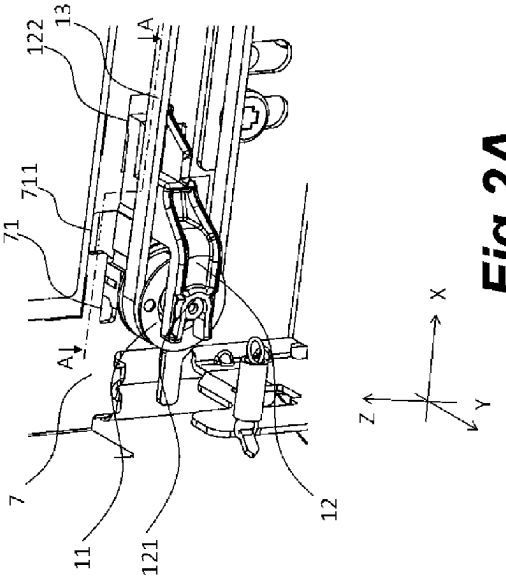


Fig.2A

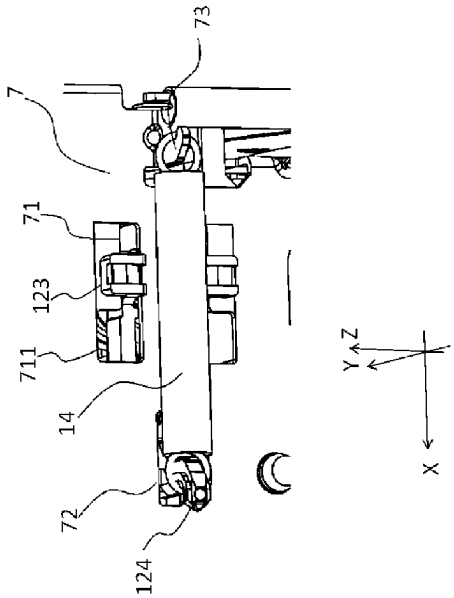


Fig.2B

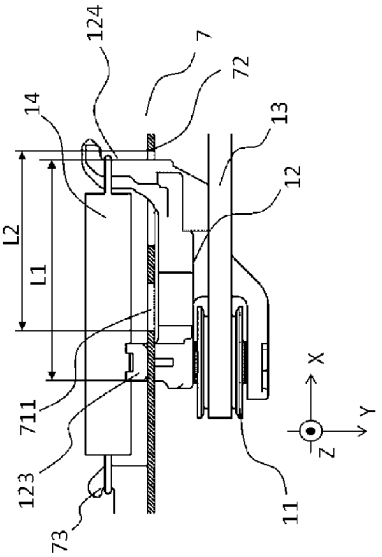


Fig.2C

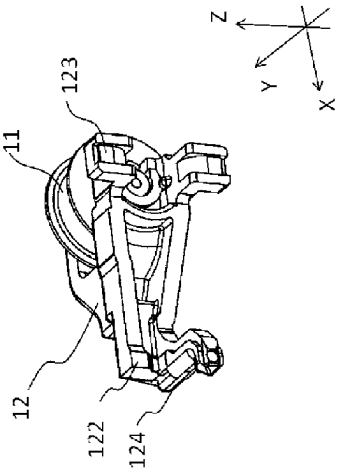


Fig.2D

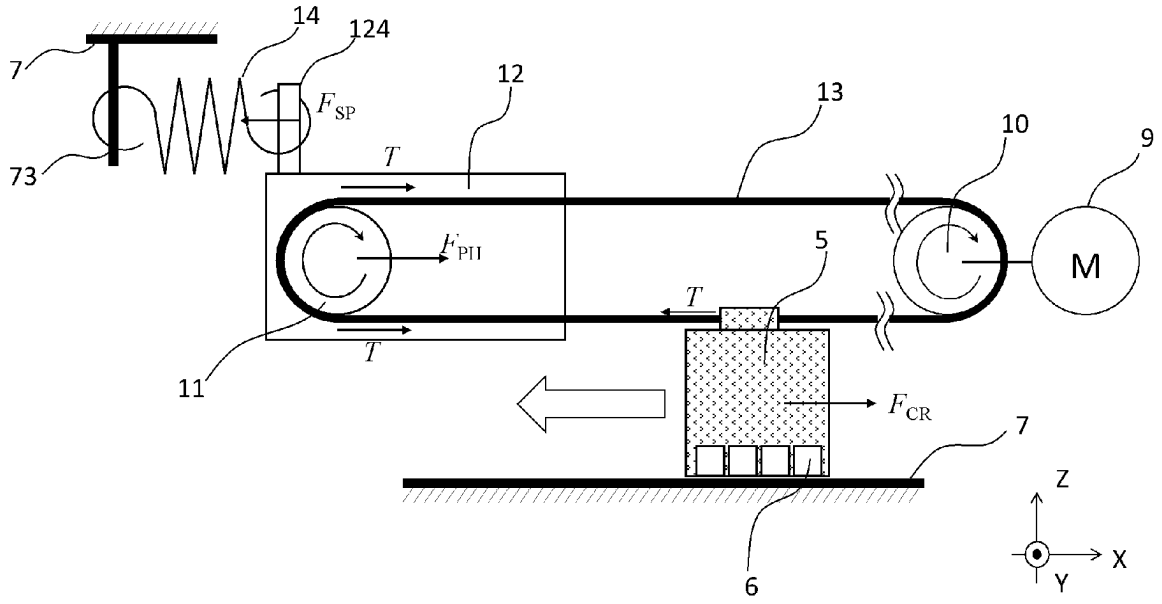
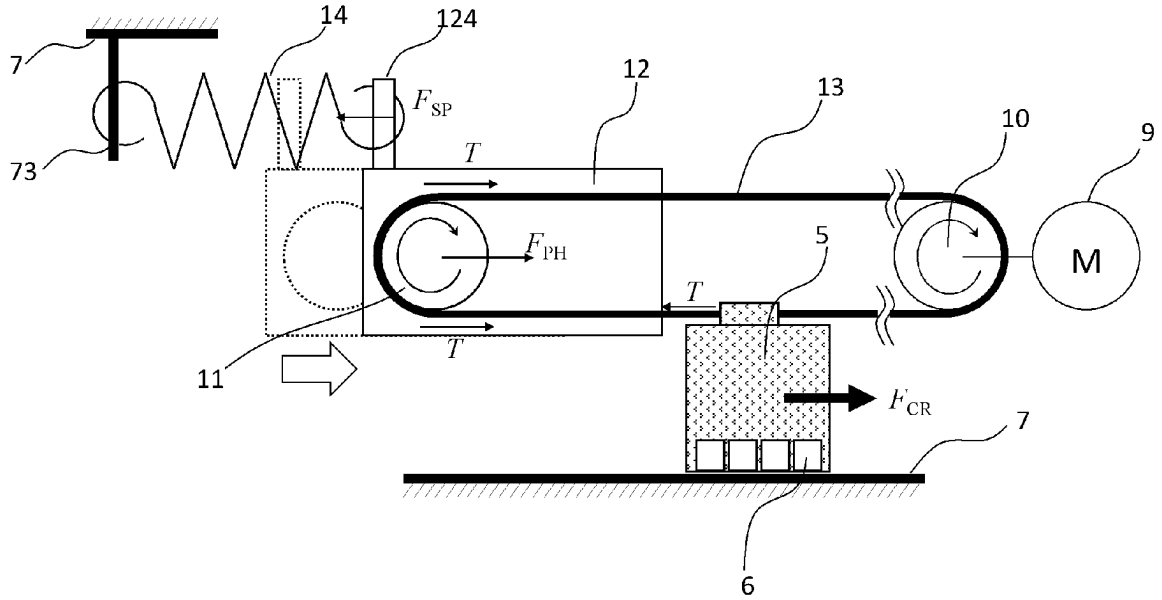

14
124
7
12
13
10
9
F_{SP}
73
T
F_{PH}
5
M
T
T
11
F_{CR}
7
Z
X
Y
6

Fig.3A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124
7
12
13
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T
T
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7
6

Fig.3B

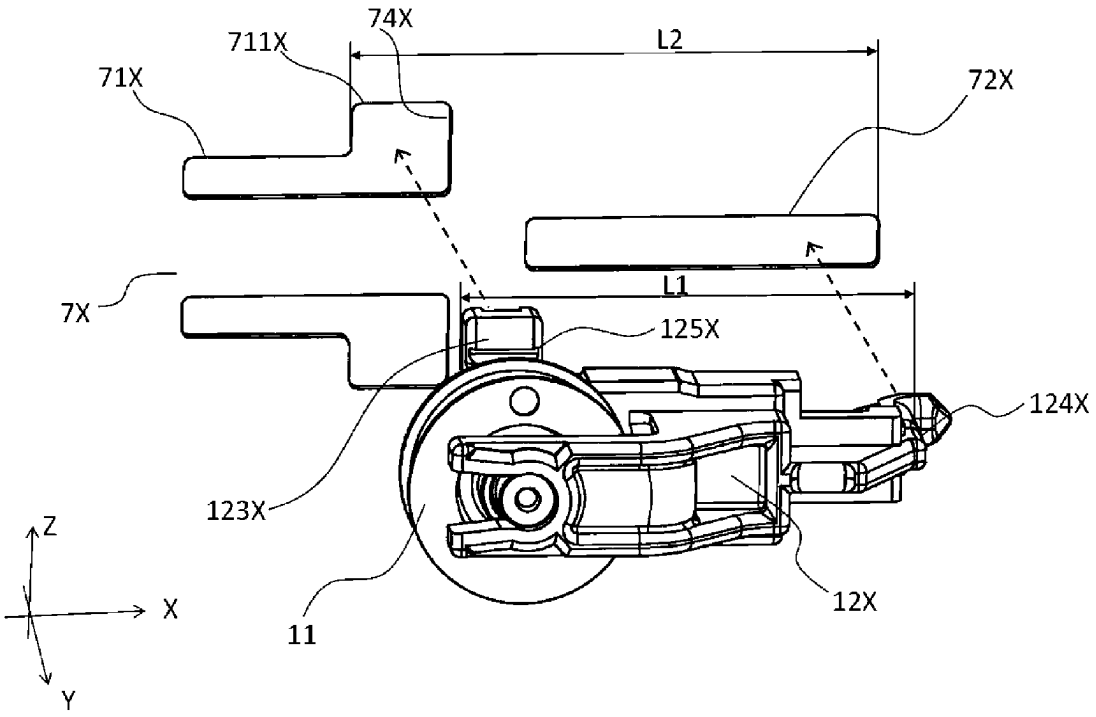
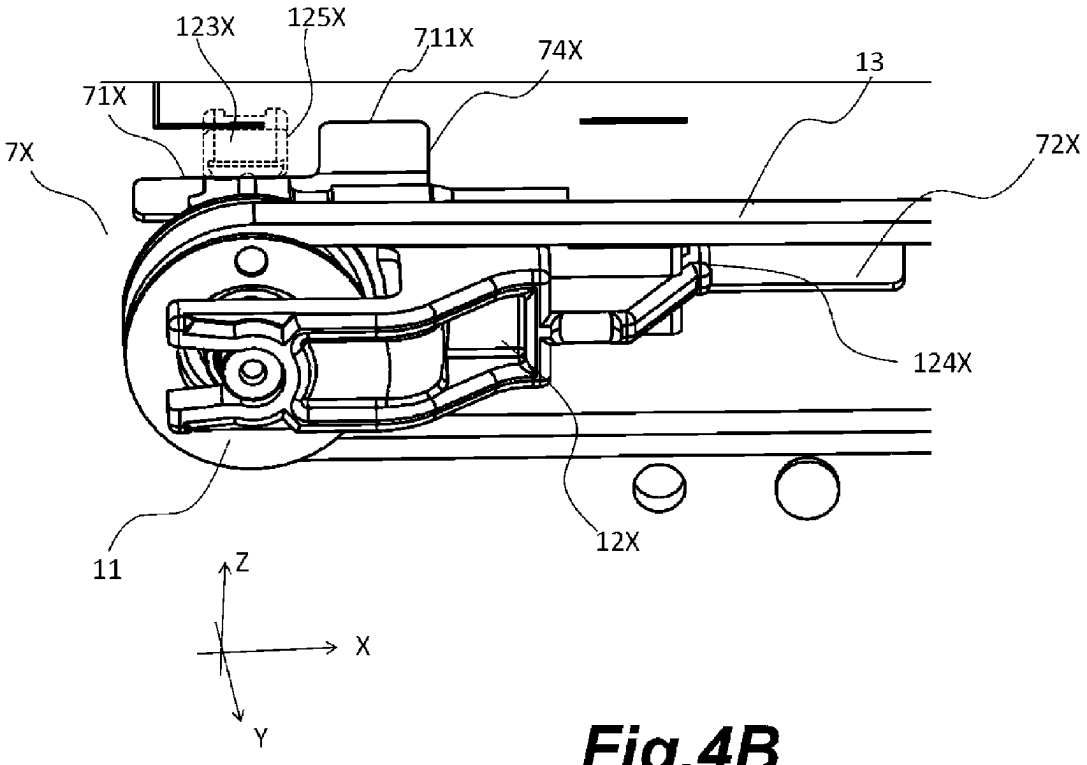

74X
711X
L2
71X
72X
7X
L1
125X
124X
123X
Z
X
Y
11
12X

Fig.4A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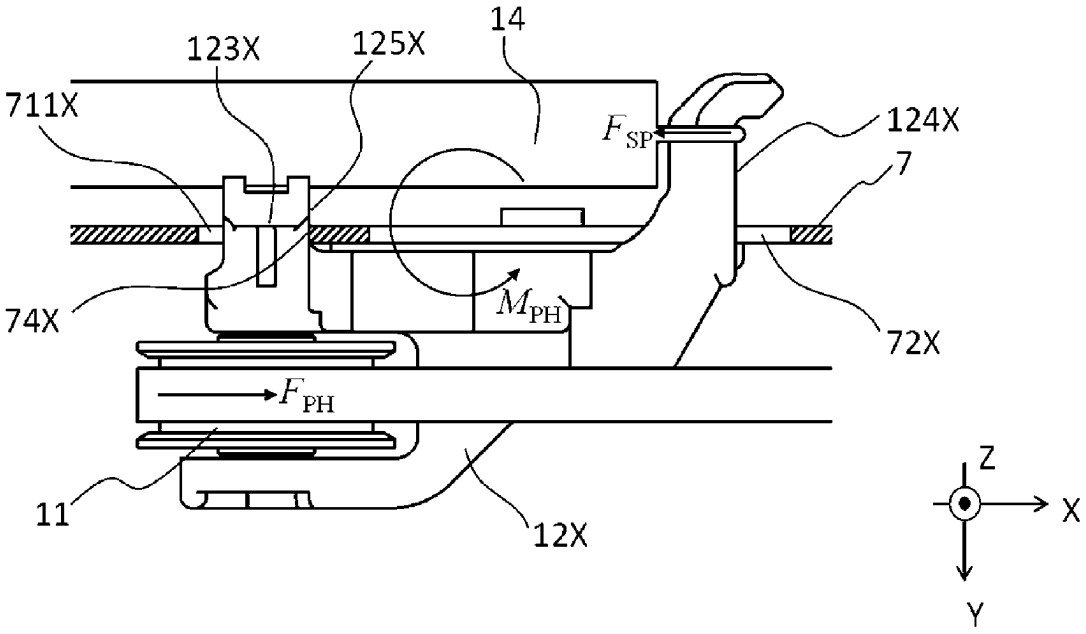
711X
74X
13
71X
7X
72X
124X
11
12X
Z
X
Y

Fig.4B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125X
711X
F_{SP}
124X
7
74X
M_{PH}
72X
F_{PH}
11
12X
Z
X
Y

Fig.5A

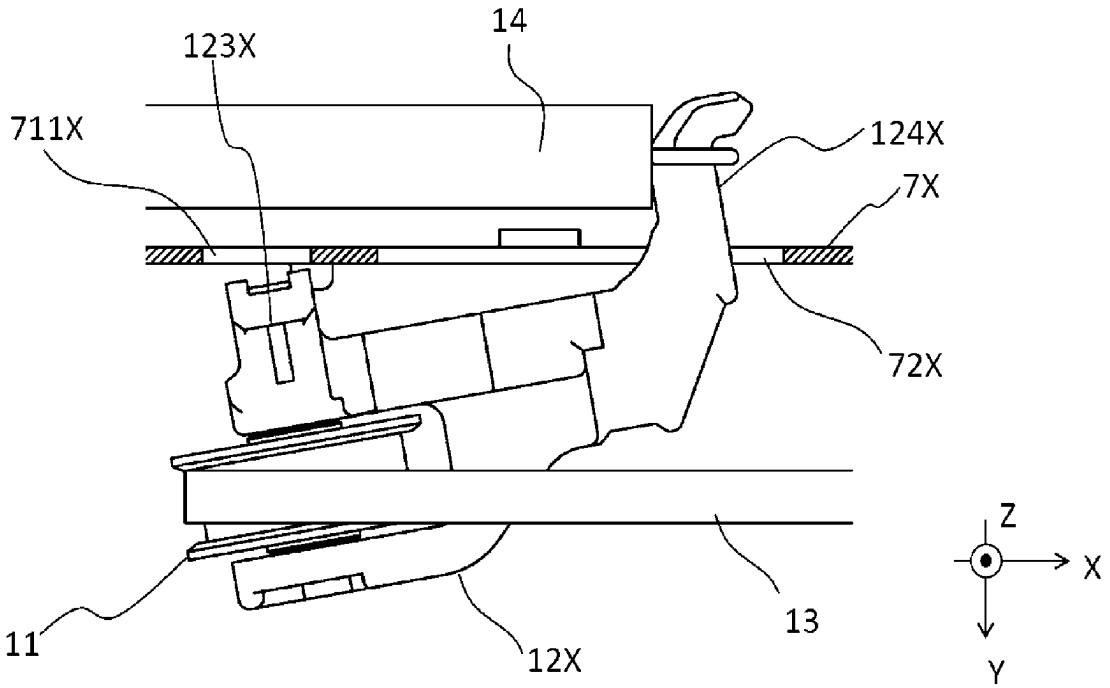
14
123X
711X
124X
7X
72X
11
12X
13
Z
X
Y

Fig.5B

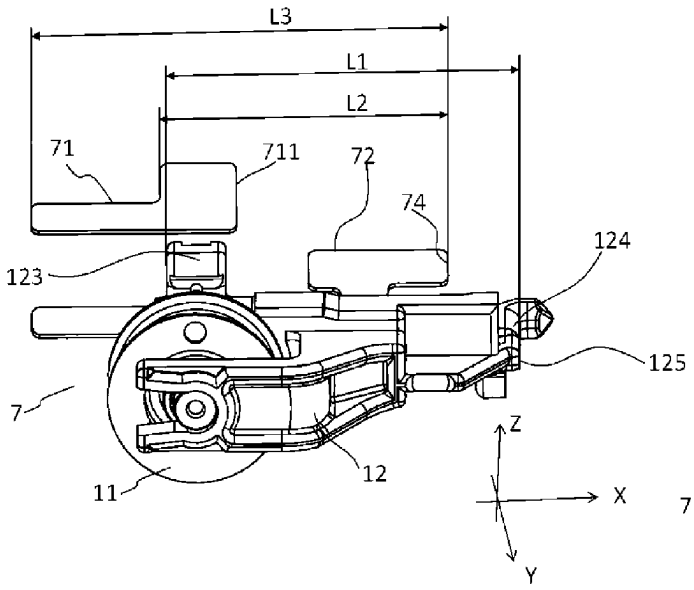

Fig.6A

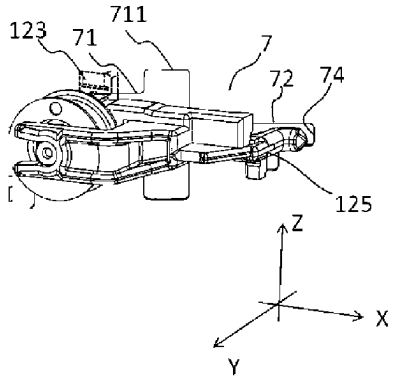

Fig.6D

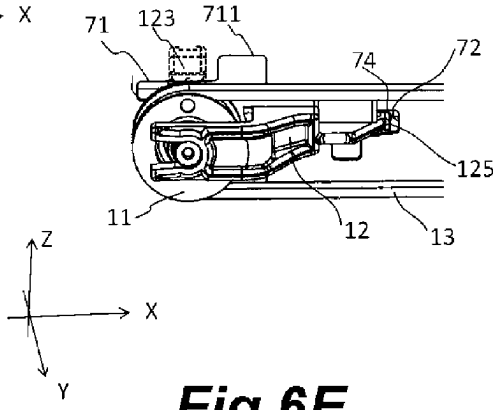

Fig.6E

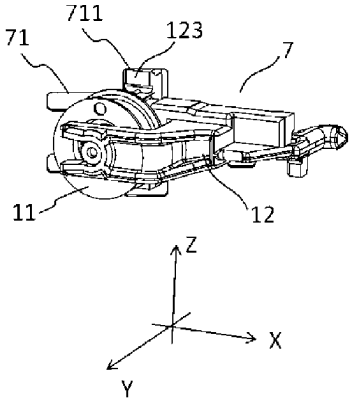

Fig.6B

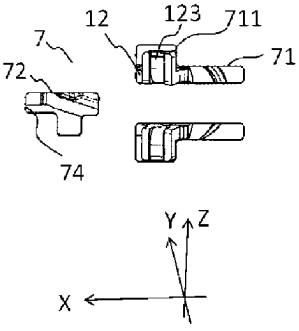

Fig.6C

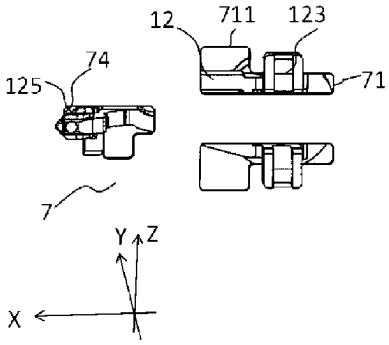

Fig.6F

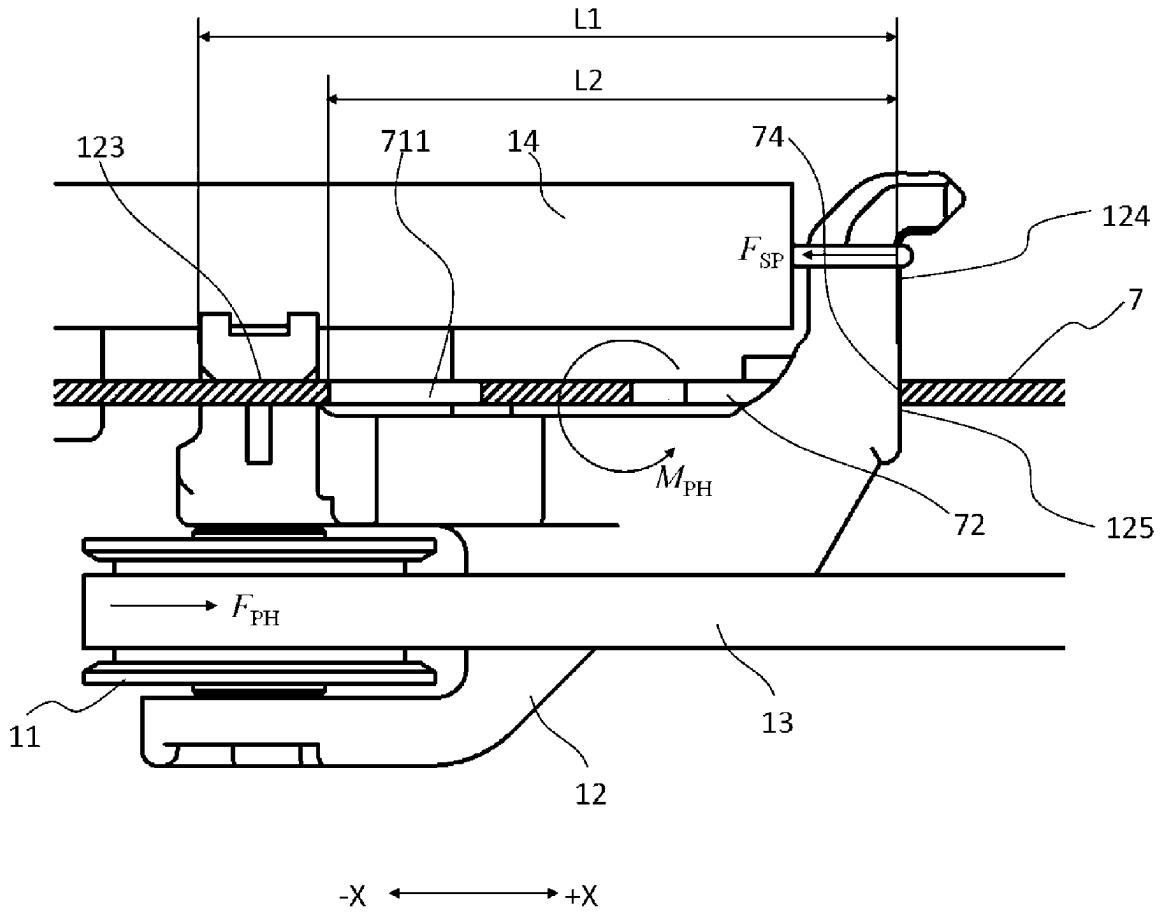

Fig.7

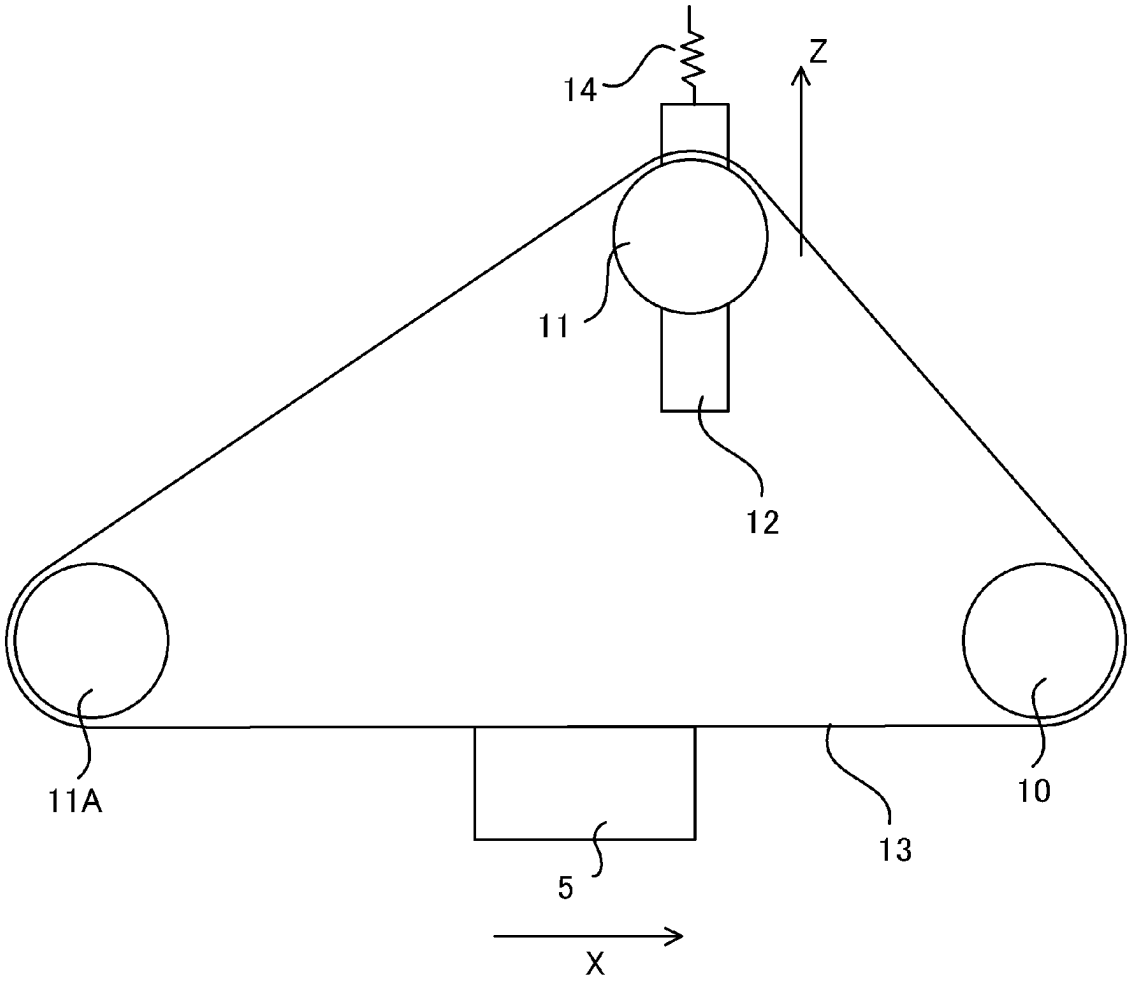

Fig.8

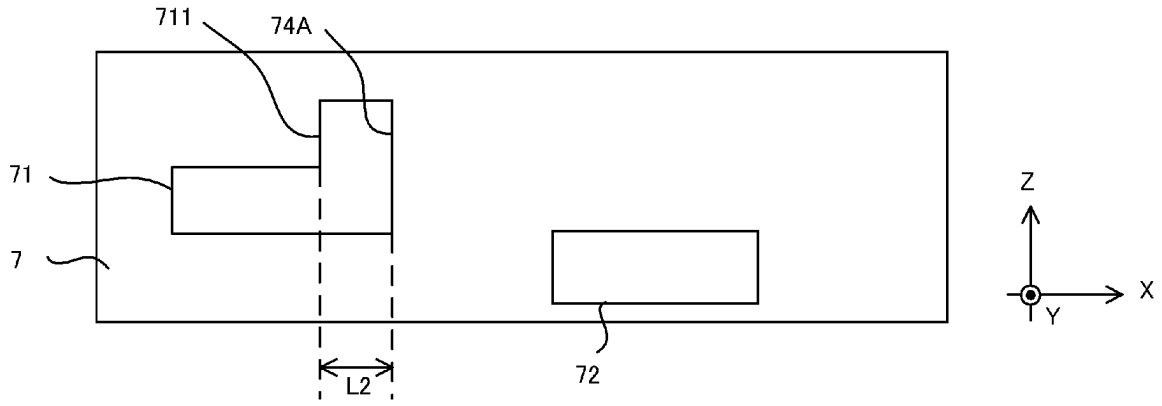

Fig.9A

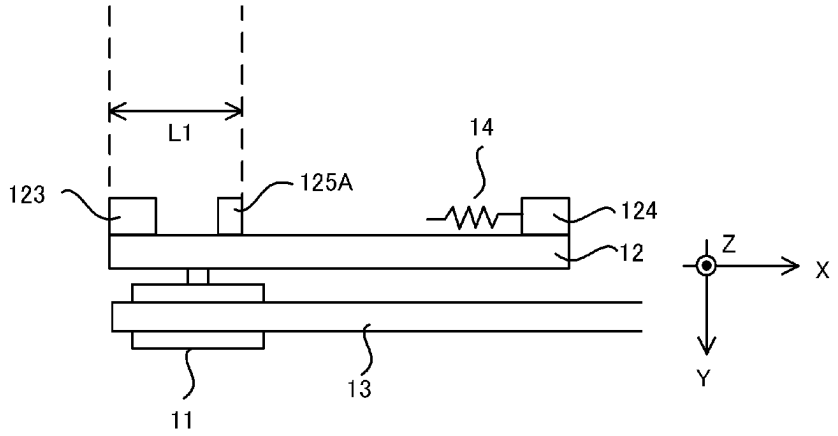

Fig.9B

IMAGE RECORDING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an image recording apparatus.

Description of the Related Art

A serial-type image recording apparatus performs recording by ejecting ink from a recording head mounted on a carriage onto a recording medium as the carriage is reciprocated in a direction intersecting with the transport direction of the recording medium. A belt-driven system is known as a mechanism for moving the carriage, which uses an endless belt passed around a motor-driven drive pulley and a driven pulley. In the belt-driven system, a holder member that holds the driven pulley is attached to a frame such as to be movable relative to the drive pulley. The tension of the belt is stabilized by a biasing member that is provided to apply a force for moving the holder member away from the drive pulley. A claw part of the holder member engages with the frame via an opening that extends along the direction of the movement of the holder member to prevent detachment of the holder member from the frame while allowing relative movement thereof. One structure for attaching the holder member to the frame features an enlarged opening portion provided at one end of the opening closest to the drive pulley and sized to allow passage of the claw part. In this configuration, the holder member is attached to the frame as follows: The claw part is first passed through the enlarged opening portion, after which the holder member is moved away from the drive pulley. With the claw part engaging with the opening, the biasing member is connected to the holder member, and the belt is passed around the drive pulley and driven pulley.

An extensive force applied to the holder member by the biasing member generates a large tension in the belt. As a result, more energy will be required for driving the carriage, which may necessitate a larger motor or lead to increased power consumption or reduced durability. On the other hand, if the force applied to the holder member by the biasing member is insufficient, sudden increases in the belt drive force, such as those caused by carriage acceleration, may cause the holder member to jerk towards the drive pulley. If the holder member is attached to the frame with the mounting structure described above, the claw part may pass through the enlarged opening portion and disengage from the frame when the holder member reaches its movement limit on the side closer to the drive pulley, in which case the holder member may detach from the frame.

Japanese Patent Application Publication No. 2006-198936 describes a technique for restricting the movement of a driven pulley towards a drive pulley. This is achieved by providing a component that limits the movement of a holder member of the driven pulley. Japanese Patent Application Publication No. 2006-21423 describes a technique for limiting the movement of a holder member of a driven pulley by a frictional force generated by applying pressure to the holder member towards a frame.

SUMMARY OF THE INVENTION

The configuration described in Japanese Patent Application Publication No. 2006-198936 requires additional components and increases costs. With the configuration described in Japanese Patent Application Publication No. 2006-21423, if the frictional force is not strong enough to handle a sudden increase in belt drive force, it may be difficult to control the movement of the holder member.

An object of the present invention is to prevent detachment of a holder member that holds a driven pulley from a frame in an image recording apparatus where a recording head is driven by a belt and where the holder member is attached to the frame such as to be movable relative to a drive pulley.

The present invention is an image recording apparatus comprising:

- a belt passed around a drive pulley and a driven pulley;
- a support member configured to support a recording head and fixed to the belt;
- a holder member, having a claw part, configured to hold the driven pulley; and
- a frame having a first opening through which the claw part is capable of penetrating, and to which the holder member is attached such as to be movable relative to the drive pulley,
- wherein the first opening having an enlarged opening portion allowing the claw part to pass through without engaging with the frame on one side closer to the drive pulley, and
- in a state where the holder member is positioned in a predetermined location closer to the drive pulley, at least a portion of the claw part is within a part of the first opening excluding the enlarged opening portion.

Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram illustrating the interior of an inkjet recording apparatus according to Embodiment 1;

FIG. **2**A to FIG. **2**D are diagrams illustrating the configuration of a holder member according to Embodiment 1;

FIG. **3**A and FIG. **3**B are diagrams explaining the behavior of the holder member according to Embodiment 1;

FIG. **4**A and FIG. **4**B are diagrams illustrating the configuration of a holder member according to a comparative example;

FIG. **5**A and FIG. **5**B are diagrams explaining the behavior of the holder member according to the comparative example when the holder member is positioned in a predetermined location closer to a drive pulley;

FIG. **6**A to FIG. **6**F are diagrams illustrating the configuration of the holder member according to Embodiment 1;

FIG. **7** is a diagram explaining the behavior of the holder member according to Embodiment 1 when the holder member is positioned in a predetermined location closer to a drive pulley;

FIG. **8** is a diagram explaining the pulley configuration and the direction of relative movement of the holder member according to Embodiment 2; and

FIG. **9**A and FIG. **9**B are diagrams illustrating the configuration of the frame and holder member according to Embodiment 3.

DESCRIPTION OF THE EMBODIMENTS

Embodiment 1

Embodiments of the present invention will be hereinafter illustrated with reference to the drawings. It should be noted

that the sizes, materials, shapes, and relative arrangement or the like of constituent components described in the embodiments should be altered suitably in accordance with the configuration and various conditions of an apparatus to which the invention is applied, and it is not intended to limit the scope of this invention to the following embodiments.

Inkjet Recording Apparatus

FIG. **1** is a perspective view illustrating the interior of an inkjet recording apparatus **1** (hereinafter referred to as recording apparatus) as one example of an image recording apparatus according to Embodiment 1 of the present invention. The recording apparatus **1** includes a feed part **2**, a transport part **3**, a discharge part **4**, a carriage **5**, and a frame **7** that guides the carriage **5**. The carriage **5** has a recording head **6** at a position opposite the transport part **3** (see FIG. **3**A and FIG. **3**B). Recording media (not shown) are stacked in the feed part **2**. The recording medium is transported to a position opposite the recording head **6** via the transport part **3**. The recording head **6** ejects ink as the carriage **5**, which is a support member that supports the recording head **6**, is reciprocated in a direction (main scanning direction or X direction) intersecting with the transport direction of the recording medium (sub scanning direction or Y direction) along the frame **7** to record an image on the recording medium. The recording medium on which an image was recorded is discharged to the outside of the recording apparatus **1** via the discharge part **4**. A toothed drive pulley **10** is installed at the end in the positive X direction of the frame **7**, and a drive member **9** such as a motor is connected to the drive pulley **10** to rotate the drive pulley **10**. A holder member **12** that holds a driven pulley **11** in a rotatable manner is mounted at the end in the negative X direction of the frame **7**. An endless toothed belt **13** is passed around the drive pulley **10** and driven pulley **11**, with the teeth of the drive pulley **10** engaging with the teeth of the belt **13**. The carriage **5** is secured to the belt **13**, and therefore the recording head **6** is fixed to the belt **13**. As the drive pulley **10** is rotated by the drive member **9**, the carriage **5** is pulled by the belt **13** and reciprocates in the X direction along the frame **7**.

Holder Member

FIG. **2**A to FIG. **2**D are diagrams illustrating the configuration of the holder member **12** according to Embodiment 1. FIG. **2**A is a diagram of the frame **7** as viewed from the side on which the holder member **12** is set (positive Y side, hereinafter referred to as the front side). FIG. **2**B is a diagram of the frame **7** as viewed from the opposite side from the front side (negative Y side, hereinafter referred to as the back side). FIG. **2**C is a cross-sectional view taken along A-A in FIG. **2**A. FIG. **2**D is a diagram of the holder member **12** as viewed from the back side.

The frame **7** supports the holder member **12** in a manner that allows the holder member **12** to move in the X direction relative to the frame **7**. Since the drive pulley **10** is installed on the frame **7** in Embodiment 1, the holder member **12** is supported by the frame **7** such as to be movable in the X direction relative to the drive pulley **10**. The frame **7** has a mounting portion **73** for mounting a biasing member **14** on the back side.

The frame **7** has a first opening **71** that opens from the front side on which the holder member **12** is supported through to the back side, and that extends in the direction of relative movement of the holder member **12** (i.e., the X direction). The first opening **71** includes an enlarged opening portion **711** at one end closest to the drive pulley **10**. The enlarged opening portion **711** is larger than the first opening **71** in the direction (i.e., the Z direction) intersecting with the direction in which the first opening **71** extends (i.e., the X direction), and is larger than a claw part **123** to be described later of the holder member **12**. Therefore, the claw part **123** of the holder member **12** can pass through the enlarged opening portion **711** without engaging with the frame **7**. As will be described later, the enlarged opening portion **711** allows the claw part **123** to penetrate (extend through) the frame **7** when assembling the holder member **12** to the frame **7**. The frame **7** also has a second opening **72** that extends in the direction of relative movement of the holder member **12** (i.e., the X direction) and opens from the front side through to the back side. The second opening **72** is provided closer to the drive pulley **10** than the first opening **71**.

The holder member **12** includes a bearing part **121**, a front side abutment part **122**, the claw part **123**, and an operating part **124**. The bearing part **121** rotatably holds the driven pulley **11**. The front side abutment part **122** makes contact with the frame **7** from the front side. The claw part **123** penetrates the first opening **71** and engages with the frame **7** by making contact with the frame **7** from the back side of the frame **7**. The operating part **124** penetrates the second opening **72**. The biasing member **14** is attached to the operating part on the back side of the frame **7** so that the force applied by the biasing member **14** acts on the operating part.

The biasing member **14** is attached to the mounting portion **73** and the operating part **124**. The biasing member **14** applies a force to cause the holder member **12** to move (in the negative X direction) away from the drive pulley **10**. While the biasing member **14** in Embodiment 1 is a tension spring, any other means other than tension springs may be used as long as a force can be applied to cause the holder member **12** to move away from the drive pulley **10**, such as compression springs, torsion coil springs, and other similar elastic members. The biasing member **14** need not necessarily be provided on the back side of the frame **7** as in Embodiment 1 and may be provided on the front side of the frame **7**. The biasing member **14** can apply a force to maintain tension in the belt **13**.

A high tension in the belt **13** causes the holder member **12** to move (in the positive X direction) closer to the drive pulley **10**, increasing the biasing force received from the biasing member **14**. A low tension in the belt **13** causes the holder member **12** to move (in the negative X direction) away from the drive pulley **10**, decreasing the biasing force received from the biasing member **14**.

The operation of the holder member **12** is described below with reference to FIG. **3**A and FIG. **3**B. FIG. **3**A is a schematic diagram illustrating the relationship of the forces on the holder member **12** when the carriage **5** moves in the negative X direction (away from the drive pulley **10**). The force F_{CR} required for moving the carriage **5** is the sum of resistance forces such as the friction between the carriage **5** and the frame **7** that guides the carriage **5** and air resistance, and inertia (acceleration). The pulling force is provided by the tension T of the belt **13** (therefore F_{CR}=T). The force applied to the holder member **12** by the belt **13** is the sum of the tension T of the belt **13** from the driven pulley **11** to the joint between the carriage **5** and the belt, and the tension T of the belt **13** from the driven pulley **11** to the drive pulley **10**. Therefore, the force applied to the holder member **12** by the belt **13** is F_{PH}=2T. The position of the holder member **12** in the X direction is defined by the balance between this force and the force F_{SP} the holder member **12** receives from the biasing member **14**. For example, an increase in resistance force such as when the carriage **5** collides against something, or an increase in inertia by rapid acceleration

increases F_{CR}, which increases F_{PH}, so that the holder member **12** moves in the positive X direction as shown in FIG. **3**B. This increases the force F_{SP} of the biasing member **14**, which is an elastic member, so that the holder member **12** moves as far as to a position where the increased F_{SP} balances the increased F_{PH}.

Comparative Example

A comparative example for comparison with Embodiment 1 is described below with reference to FIG. **4**A and FIG. **4**B and FIG. **5**A and FIG. **5**B. FIG. **4**A and FIG. **4**B are diagrams illustrating the configuration of the holder member **12**X according to the comparative example. FIG. **4**A is a diagram illustrating an assembling process of the holder member **12**X according to the comparative example. FIG. **4**B is a diagram illustrating the holder member **12**X according to the comparative example attached to the frame **7**X. FIG. **5**A and FIG. **5**B are diagrams explaining the behavior of the holder member **12**X according to the comparative example when the holder member is positioned in a predetermined location closer to the drive pulley **10**.

L1 denotes the distance along the direction of relative movement (i.e., the X direction) between the end (i.e., the end in the negative X direction) of the claw part **123**X farthest away from the drive pulley **10** and the end (i.e., the end in the positive X direction) of the operating part **124**X penetrating the frame **7**X and closest to the drive pulley **10**. L2 denotes the distance along the direction of relative movement (i.e., the X direction) between the end (i.e., the end in the negative X direction) of the enlarged opening portion **711**X farthest away from the drive pulley **10** and the end (i.e., the end in the positive X direction) of the second opening **72**X closest to the drive pulley **10**. In the configuration of the comparative example, L1<L2.

When attaching the holder member **12**X to the frame **7**X, the claw part **123**X and operating part **124**X can be passed respectively through the first opening **71**X and second opening **72**X of the frame **7**X at the same time. Namely, the holder member **12**X can be attached to the frame **7**X, with the back side of the holder member **12**X being kept parallel to the front side of the frame **7**X, by bringing the holder member closer to the frame **7**X in the direction perpendicular to the front side of the frame **7**X (i.e., the negative Y direction). After the claw part **123**X of the holder member **12**X is passed through the enlarged opening portion **711**, the holder member **12**X is moved (in the negative X direction) away from the drive pulley **10** so that the claw part **123**X engages with the frame **7**X via the first opening **71**X. In this state, the biasing member **14** is connected to the operating part **124**X, and the belt **13** is passed around the drive pulley **10** and driven pulley **11**. The holder member **12**X is thus attached to the frame **7**X.

FIG. **4**B shows the state with the belt **13** and biasing member **14** mounted after the holder member **12**X has been attached to the frame **7**X. The movement of the holder member **12**X (in the positive X direction) towards the drive pulley **10** is restricted by the end **125**X (i.e., the end in the positive X direction) of the claw part **123** closest to the drive pulley **10** making contact with the end **74**X (i.e., the end in the positive X direction) of the first opening **71**X closest to the drive pulley **10**. In the configuration of FIG. **4**A and FIG. **4**B, the end (i.e., the end in the positive X direction) **74**X of the first opening **71**X of the frame **7**X closest to the drive pulley **10** serves as a restricting part that restricts the movement of the holder member **12**X towards the drive pulley **10** by making contact with the holder member **12**X. Therefore, the end **74**X shall be hereinafter also referred to as the restricting part **74**X. The end (i.e., the end in the positive X direction) **125**X of the claw part **123**X of the holder member **12**X closest to the drive pulley **10** serves as a restricted part capable of making contact with the restricting part. Therefore, the end **125**X shall be hereinafter also referred to as the restricted part **125**X.

When the restricting part **74**X of the frame **7**X makes contact with the restricted part **125**X of the holder member **12**X, the holder member **12**X is positioned in a predetermined location closer to the drive pulley **10** (in the positive X direction). That is, the holder member **12**X is able to move (in the positive X direction) towards the drive pulley **10** until the restricting part **74**X of the frame **7**X makes contact with the restricted part **125**X of the holder member **12**X. Namely, the predetermined location is the movement limit of the holder member **12**X on the side closer to the drive pulley **10**. The holder member **12**X moves in the X direction as far as to a position where the force F_{PH} provided by the tension of the belt **13** balances the force F_{SP} received from the biasing member **14**.

Let us now assume that, in the comparative example, the force F_{CR} required for the drive of the carriage **5** has increased and the holder member **12**X has reached the predetermined location closer to the drive pulley **10** (in the positive X direction). Since L1<L2, the entire claw part **123**X is positioned at the enlarged opening portion **711**X, as shown in FIG. **5**A.

The force F_{PH} the holder member **12**X receives from the belt **13** and the force F_{SP} the holder member **12**X receives from the biasing member **14** are oriented oppositely in the X direction as shown in FIG. **5**A. Moreover, the acting point of the force F_{PH} the holder member **12**X receives from the belt **13** (i.e., the end in the negative X direction of the driven pulley **11**) is displaced in the Y direction from the acting point of the force F_{SP} the holder member **12**X receives from the biasing member **14** (i.e., the end in the positive X direction of the operating part **124**X). As a result, a rotational force M_{PH} acts on the holder member **12**X counterclockwise as viewed from the positive Z direction.

The counterclockwise rotational force M_{PH} applied to the holder member **12**X while the claw part **123**X is positioned completely within the enlarged opening portion **711**X may cause the claw part **123**X to move out of the enlarged opening portion **711**X in the positive Y direction as shown in FIG. **5**B, potentially resulting in detachment of the holder member from the frame **7**X. This means that, in the configuration of the comparative example, there is a possibility that the holder member **12**X may detach from the frame **7**X due to a counterclockwise rotational force M_{PH} applied to the holder member **12**X when the holder member **12**X reaches the predetermined location closer to the drive pulley **10** (in the positive X direction).

To prevent detachment of the holder member **12**X, it is necessary to prevent the holder member **12**X from reaching the predetermined location closer to the drive pulley **10**. One approach to achieving this is to ensure that the force F_{SP} applied by the biasing member **14** to the holder member **12**X is sufficiently large relative to the potential force F_{CR} required for the carriage **5** to be driven. However, this approach leads to several drawbacks, such as an increased load on the drive member **9**, which requires a larger motor, increased cost, higher power consumption, and larger housing, among others. Another alternative is to restrict the movement of the holder member **12**X towards the drive pulley **10** (in the positive X direction) using a fastening member such as a screw, after attaching the holder member

12X to the frame 7X. However, this approach results in an increase in the number of components and the number of assembling steps required.

Embodiment 1

FIG. 6A to FIG. 6F and FIG. 7 are diagrams illustrating the configuration of the holder member **12** according to Embodiment 1. FIG. 6A to FIG. 6F are diagrams illustrating an assembling process of the holder member **12** according to Embodiment 1. FIG. 6A, FIG. 6B, FIG. 6D, and FIG. 6E are diagrams of the holder member **12** as viewed from the front side, and FIG. 6C and FIG. 6F are diagrams of the holder member **12** as viewed from the back side. FIG. **7** is a diagram explaining the behavior of the holder member **12** according to Embodiment 1 when the holder member **12** is positioned in a predetermined location closer to the drive pulley **10**.

L1 denotes the distance along the direction of relative movement (i.e., the X direction) between the end (i.e., the end in the negative X direction) of the claw part **123** farthest away from the drive pulley **10** and the end (i.e., the end in the positive X direction) **125** (constituting a restricted part to be described later) of the operating part **124** penetrating the second opening **72** and closest to the drive pulley **10**. L2 denotes the distance along the direction of relative movement (i.e., the X direction) between the end (i.e., the end in the negative X direction) of the enlarged opening portion **711** of the frame **7** farthest away from the drive pulley **10** and the end (i.e., the end in the positive X direction) **74** (constituting a restricting part to be described later) of the second opening **72** closest to the drive pulley **10**. In Embodiment 1, L1>L2. L3 denotes the distance along the direction of relative movement (i.e., the X direction) between the end (i.e., the end in the negative X direction) of the first opening **71** of the frame **7** farthest away from the drive pulley **10** and the end (i.e., the end in the positive X direction) **74** (constituting a restricting part to be described later) of the second opening **72** closest to the drive pulley **10**. In Embodiment 1, L3>L1.

When attaching the holder member **12** to the frame **7**, the claw part **123** is first passed through the enlarged opening portion **711**, with the back side of the holder member **12** being inclined relative to the front side of the frame **7** as the holder member **12** is brought closer to the frame **7**, as shown in FIG. **6**B and FIG. **6**C. The holder member **12** is then moved (in the negative X direction) away from the drive pulley **10** so that the claw part **123** engages with the frame **7** via the first opening **71** as shown in FIG. **6**D. The holder member **12** is moved farther (in the negative X direction) away from the drive pulley **10** so that the entire operating part **124** is aligned with the position of the second opening **72** in the X direction. After that, the holder member **12** is rotated counterclockwise as viewed from the positive Z direction so that the operating part **124** penetrates the second opening **72**, as shown in FIG. **6**E and FIG. **6**F. In this state, the biasing member **14** is connected to the operating part **124**, and the belt **13** is passed around the drive pulley **10** and driven pulley **11**. The holder member **12** is thus attached to the frame **7**.

The movement of the holder member **12** (in the positive X direction) towards the drive pulley **10** is restricted by the end (i.e., the end in the positive X direction) **125** of the operating part **124** penetrating the second opening **72** and closest to the drive pulley **10** making contact with the end **74** of the second opening **72** closest to the drive pulley **10**. The end **74** of the second opening **72** closest to the drive pulley **10** thus serves as a restricting part that restricts the movement of the holder member **12** towards the drive pulley **10** by making contact with the holder member **12**. Therefore, hereinafter the end **74** shall also be referred to as the restricting part **74**. The end **125** of the operating part **124** penetrating the second opening **72** and closest to the drive pulley **10** serves as a restricted part capable of making contact with the restricting part. Therefore, hereinafter the end **125** shall also be referred to as the restricted part **125**. In Embodiment 1, the restricting part **74** is a portion of the second opening **72**.

When the restricting part **74** of the frame **7** makes contact with the restricted part **125** of the holder member **12**, the holder member **12** is positioned in a predetermined location closer to the drive pulley **10** (in the positive X direction). That is, the holder member **12** is able to move (in the positive X direction) towards the drive pulley **10** until the restricting part **74** of the frame **7** makes contact with the restricted part **125** of the holder member **12**. Namely, the predetermined location is the movement limit of the holder member **12** on the side closer to the drive pulley **10**. The holder member **12** moves in the X direction as far as to a position where the force F_{PH} provided by the tension of the belt **13** balances the force F_{SP} received from the biasing member **14**.

Let us now assume that, in Embodiment 1, the force F_{CR} required for the drive of the carriage **5** has increased and the holder member **12** has reached the predetermined location closer to the drive pulley **10** (in the positive X direction). At this position, the restricted part **125** makes contact with the restricting part **74**. However, since L1>L2, at least a portion of the claw part **123** is positioned within a part of the first opening **71** that is not the enlarged opening portion **711**. In other words, the end (i.e., the end in the negative X direction) of the claw part **123** farthest away from the drive pulley **10** is located farther from the drive pulley **10** than the end (i.e., the end in the negative X direction) of the enlarged opening portion **711** farthest away from the drive pulley **10**. In Embodiment 1, the claw part **123** is entirely positioned in a part that is not the enlarged opening portion **711** as shown in FIG. **7**. Therefore, according to Embodiment 1, the claw part **123** is unlikely to disengage from the frame **7** even when the holder member **12** reaches the predetermined location closer to the drive pulley **10** (in the positive X direction).

The force F_{PH} the holder member **12** receives from the belt **13** and the force F_{SP} the holder member **12** receives from the biasing member **14** are oriented oppositely in the X direction. Moreover, the acting point of the force F_{PH} the holder member **12** receives from the belt **13** (i.e., the end in the negative X direction of the driven pulley **11**) is displaced in the Y direction from the acting point of the force F s p the holder member **12** receives from the biasing member **14** (i.e., the end in the positive X direction of the operating part **124**). As a result, a rotational force M_{PH} acts on the holder member **12** counterclockwise as viewed from the positive Z direction.

In the case of Embodiment 1, the claw part **123** is unlikely to disengage from the frame **7** when the holder member **12** reaches the predetermined location closer to the drive pulley **10** (in the positive X direction), so that the claw part **123** does not pass through the enlarged opening portion **711** even when the counterclockwise rotational force M_{PH} is applied to the holder member **12**. Thus detachment of the holder member **12** from the frame **7** is prevented.

According to Embodiment 1, as described with reference to FIG. **6**D and FIG. **6**E, the holder member **12** is rotated

counterclockwise as viewed from the positive Z direction when attaching the holder member **12** to the frame **7**. In other words, the holder member **12** needs to be rotated clockwise as viewed from the positive Z direction when removing the holder member **12** from the frame **7**. As mentioned above, the rotational force M_{PH} that acts on the holder member **12** due to the tension of the belt **13** and the biasing force of the biasing member **14** is counterclockwise as viewed from the positive Z direction. Therefore, the rotational force M_{PH} that acts on the holder member **12** due to the tension of the belt **13** and the biasing force of the biasing member **14** does not cause the holder member **12** to detach from the frame **7**. According to Embodiment 1, detachment of the holder member **12** from the frame **7** is prevented by this feature, too.

Embodiment 2

In Embodiment 1, the belt **13** passes around the drive pulley **10** and driven pulley **11**, and the holder member **12** moves parallel to the direction of carriage **5** (recording head **6**) movement (both in the X direction) relative to the drive pulley **10** (frame **7**). The pulley configuration is not limited to this example described above. The holder member **12** may be designed to move in a direction that intersects with the direction of carriage **5** (recording head **6**) movement relative to the drive pulley **10**.

FIG. **8** is a diagram depicting Embodiment 2, which features a different pulley configuration and direction of movement of the holder member relative to the drive pulley compared to Embodiment 1. FIG. **8** is a schematic diagram illustrating the configuration of the drive pulley, driven pulley, and belt in an image recording apparatus of Embodiment 2. The same reference numerals and names will be used for the components common to Embodiment 1 and a detailed description thereof will be omitted.

Embodiment 2 further includes at least one fixed driven pulley **11**A that remains stationary and does not move relative to the drive pulley **10** (frame **7**). The belt **13** passes around the drive pulley **10**, driven pulley **11**, and fixed driven pulley **11**A in this configuration. The holder member **12** that holds the driven pulley **11** such as to be movable relative to the drive pulley **10** moves in a direction that intersects with the direction of movement of the carriage **5** (recording head **6**). Embodiment 2 provides one example in which the carriage **5** moves in the X direction, while the holder member **12** moves in the Z direction relative to the drive pulley, as shown in FIG. **8**. Namely, the holder member moves towards the drive pulley **10** in the negative Z direction, and away from the drive pulley **10** in the positive Z direction. The biasing member **14** applies a force to cause the holder member **12** to move (in the positive Z direction) away from the drive pulley **10**, which generates tension in the belt **13**.

Embodiment 2 also features the same relationship between the restricting part **74** of the frame **7** and the restricted part **125** of the holder member **12** as Embodiment 1, despite the different pulley configuration and direction of movement of the holder member relative to the drive pulley. Namely, when the holder member **12** is positioned in a predetermined location closer to the drive pulley **10** (in the negative Z direction), at least a portion of the claw part **123** is positioned within a part of the first opening **71** that is not the enlarged opening portion **711**. This prevents detachment of the holder member **12** from the frame **7** even when the holder member **12** moves (in the negative Z direction) towards the drive pulley **10** to the predetermined location.

Embodiment 3

The previously described Embodiment 1 provided one example in which the end (i.e., the end in the positive X direction) of the second opening **72** closest to the drive pulley **10** is the restricting part **74**, while the end (i.e., the end in the positive X direction) of the operating part **124** penetrating the frame **7** and closest to the drive pulley **10** is the restricted part **125**. The configuration of the restricting part and restricted part is not limited to the example described above. The claw part **123**, operating part **124**, or a different portion of the holder member **12** may be designed as the restricted part, and the first opening **71**, second opening **72**, or a different portion of the frame **7** may be designed as the restricting part.

FIG. **9**A and FIG. **9**B are diagrams depicting Embodiment 3, which features a different configuration of the restricting part and restricted part compared to Embodiment 1. FIG. **9**A is a diagram of a part of the frame **7** as viewed from the front side (from the positive Y direction), and FIG. **9**B is a diagram of the holder member **12** as viewed from the positive Z direction.

In Embodiment 3, the end (i.e., the end in the positive X direction) of the enlarged opening portion **711** of the first opening **71** of the frame **7** closest to the drive pulley **10** constitutes the restricting part **74**A, while a restricted part **125**A is provided to the holder member **12** to make contact with the restricting part **74**A. In this configuration, L1 denotes the distance along the direction of relative movement (i.e., the X direction) between the end (i.e., the end in the negative X direction) of the claw part **123** of the holder member **12** farthest away from the drive pulley **10** and the restricted part **125**A. L2 denotes the distance along the direction of relative movement (i.e., the X direction) between the end (i.e., the end in the negative X direction) of the enlarged opening portion **711** of the frame **7** farthest away from the drive pulley **10** and the restricting part **74**A. In this configuration, L1>L2. In Embodiment 3, the restricting part **74**A is a portion of the first opening **71**.

FIG. **9**A and FIG. **9**B illustrate a state of the holder member **12** positioned in the predetermined location closer to the drive pulley **10** (in the positive X direction) where the restricting part **74**A of the frame **7** makes contact with the restricted part **125**A of the holder member **12**. In this state, since L1>L2, at least a portion of the claw part **123** is positioned within a part of the first opening **71** that is not the enlarged opening portion **711**, as shown in FIG. **9**A and FIG. **9**B. Therefore, in the configuration of FIG. **9**A and FIG. **9**B, the claw part **123** is unlikely to disengage from the frame **7** even when the holder member **12** reaches the predetermined location closer to the drive pulley **10** (in the positive X direction).

The present invention, as illustratively described in some embodiments above, prevents detachment of a holder member that holds a driven pulley from a frame in an image recording apparatus where a recording head is driven by a belt and where the holder member is attached to the frame such as to be movable relative to a drive pulley.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2022-102964, filed on Jun. 27, 2022, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. An image recording apparatus comprising:

a belt passed around a drive pulley and a driven pulley;

a support member configured to support a recording head and fixed to the belt;

a holder member, having a claw part and an operating part, configured to hold the driven pulley;

a frame having a first opening through which the claw part is capable of penetrating from a front side to a back side of the frame and a second opening through which the operating part is capable of penetrating from the front side to the back side of the frame, and to which the holder member is attached such as to be movable relative to the drive pulley; and

a biasing member that applies a force to the operating part on the back side of the frame in a direction away from the drive pulley,

wherein the first opening having an enlarged opening portion allowing the claw part to pass through without engaging with the frame on one side closer to the drive pulley, and

wherein, in a state where movement of the holder member toward the drive pulley is restricted by the frame, at least a portion of the claw part is engaged with the frame and is positioned within a part of the first opening excluding the enlarged opening portion.

2. The image recording apparatus according to claim **1**, wherein,

in a state where the movement of the holder member toward the drive pulley is restricted by the frame, one end of the claw part farthest away from the drive pulley is positioned farther from the drive pulley than one end of the enlarged opening portion located farthest away from the drive pulley.

3. The image recording apparatus according to claim **1**, wherein

the frame includes a restricting part that restricts the movement of the holder member towards the drive pulley by making contact with the holder member,

the holder member includes a restricted part capable of making contact with the restricting part,

the holder member is configured so that the movement thereof toward the drive pulley is restricted in a state where the restricting part of the frame makes contact with the restricted part of the holder member,

the frame and the holder member satisfy a relationship of L1>L2, where L1 denotes a distance between one end of the claw part farthest away from the drive pulley and the restricted part along a direction of movement of the holder member relative to the drive pulley, and

L2 denotes a distance between one end of the enlarged opening portion farthest away from the drive pulley and the restricting part along the direction of movement of the holder member relative to the drive pulley.

4. The image recording apparatus according to claim **3**, wherein

the frame and the holder member satisfy a relationship of L3>L1, where L3 denotes a distance between one end of the first opening farthest away from the drive pulley and the restricting part along the direction of movement of the holder member relative to the drive pulley.

5. The image recording apparatus according to claim **1**, wherein

the second opening is positioned closer to the drive pulley than the first opening.

6. The image recording apparatus according to claim **3**, wherein

the restricting part is a portion of the first opening.

7. The image recording apparatus according to claim **3**, wherein

the restricting part is a portion of the second opening.

8. The image recording apparatus according to claim **1**, further comprising

at least one fixed driven pulley that remains stationary relative to the drive pulley, wherein

the belt is also passed around the fixed driven pulley.

9. The image recording apparatus according to claim **1**, wherein

the holder member moves relative to the drive pulley in parallel to a moving direction of the support member.

10. The image recording apparatus according to claim **8**, wherein

the holder member moves relative to the drive pulley in a direction intersecting with a moving direction of the support member.

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