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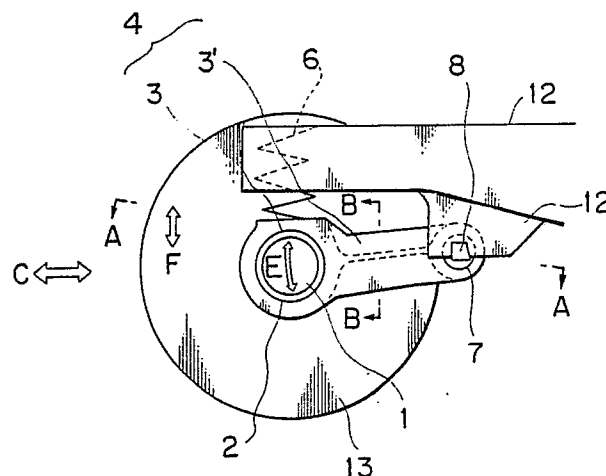
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54 Axle box suspension.

57 There is provided an axle box suspension having an axle spring according to the present invention, wherein an axle box body is formed by providing an axle anchor rod at one end of the axle box, and the axle anchor rod is shaft-coupled to a truck frame through a resilient element, so that longitudinal, lateral and vertical swivel movement between the axle and the truck frame can be allowed by deforming the resilient element and the axle anchor rod without rattle, thereby the running stability of the vehicle is greatly improved. Further, since the axle box suspension does not have slides and gaps, a wear and a deterioration due to years of driving are eliminated, whereby replacement of the components will be obviated and maintenance thereof will be much more facilitated. Moreover, excellent advantages such as simplified structure, space-saving of the whole axle box suspension, reduction in its weight are provided.

FIG. 1



AXLE BOX SUSPENSION

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an axle box suspension for supporting the axle of a truck by an axle anchor rod integrally formed with the axle box to a truck frame in a railway vehicle or car or the like.

Description of the Prior Art

An axle anchor rod type axle box suspension for mounting the axle of a railway vehicle to a truck frame is already disclosed, for example, in Japanese Patent Laid-Open No 58-63568 and No.58-118447. Figs. 10A and 10B show its conventioned example. In the drawings, numeral 13 denotes a wheel, which is mounted on the same axle 1 as that of a wheel (not shown) provided at the opposite side of the vehicle. Such two axles are mounted in the vicinities of both the ends of a truck frame 12, thereby constructing one truck. Numeral 3 denotes an axle box which contains a bearing 2 and so on of the axle 1. At the right side of the drawing of the axle box 3 is provided an axle anchor rod 3' formed integrally with the axle box, and rotatably slidably supported by a pin 8' wound with a resilient element 7a to the truck frame 12. At the left of the drawing of the axle box 3 is connected one end of a link 11 by a pin 10, and the other end of the link 11 is coupled to the truck frame 12 through the resilient element 7b. Numeral 6 denotes an axle spring, which buffers relative upward and downward movements between the truck frame 12 and the axle 1.

In this axle box suspension, the upward and downward vibrations occurred between the truck frame 12 and the wheel 13 are allowed by rotatably sliding the pins 8' and 10.

An axle anchor rod type axle box suspension shown in Figs. 11A and 11B eliminates a sliding section, in which an axle anchor rod 3' is coupled to a truck frame 12 by a pin 8' wound with a resilient element 7a. Since the axle anchor rod 3' is of a cantilever beam, two sets of resilient elements 7a and pins 8' must be provided as shown in Fig. 11B so as to resist against an external force applied in an axle direction.

Further, in order to prevent the reduction of a wheel load (or a derailment caused at its final stage of the reduction) due to an external force in an axle

direction and an irregularity of tracks of rails, a bearing supporting resilient element 7c is wound between a bearing 2, the axle box 3 and a bearing retainer 5.

The performance required for a recent railway vehicle includes high speed running performance, easiness of maintenance and a reduction in a vehicle weight to reduce a damage imposed on the rails, and so on.

However, as designated by the conventional example in Figs. 10A and 10B in the prior art, when the vehicle is coasting, the performance of absorbing a vibration in an axle direction of the vehicle is deteriorated due to slides and gaps between the pin 8' and the resilient element 7a, between the pin 8' and the truck frame 12, and between the pin 10 and the link 11, so that the running stability of the vehicle is reduced, and that running ability at high speed is also greatly reduced. Further, there arise more problems such as deterioration in the running performance of the vehicle due to the aging wears of the slide sections and the gap sections and complications in its maintenance due to lubrication and replacement of the components thereof.

On the other hand, in the conventional example shown in Figs. 11A and 11B, there are not slides and gaps in the axle box suspension, but its axle anchor rod is increased in size and in weight, and a space for mounting the same is broadened. Further, as shown in a sectional view of the axle anchor rod 3' in Fig. 12, since the axle anchor rod 3' has a large twisting rigidity in a rotating direction 1, (i.e., in a running direction) and a wide interval in the axle direction of the resilient elements 7a, the twisting rigidity between the axle anchor rod 3' and the truck frame 12 is large. Accordingly, it is necessary to also provide the resilient element 7c at the bearing 2 so as to prevent the reduction of the wheel load (or the derailment) which is possibly caused when the track is twisted due to the irregularity in the track or a reduction in the cant (the difference of the heights between an inside rail and an outside rail at a curve), thereby problems such as a complicated construction and an increase in the weight of the axle box 3 are caused.

SUMMARY OF THE INVENTION

This invention is made to solve the above-described problems of the prior art, and an object of the invention is to provide a light-weight axle box suspension which has a high running stability at a high speed and a reduction in its maintenance

work.

In order to achieve the above-described object, there is provided according to one aspect of the present invention an axle box suspension for a railway vehicle comprising an axle anchor rod formed at one side of an axle box, an axle spring engaged between an axle box body and a truck frame, the axle anchor rod being integrally coupled to the truck frame through a shaft and a resilient element. As a result, twisting rigidity of the vehicle in the running direction of the vehicle is imposed on both the axle anchor rod and the resilient element.

There is also provided according to another aspect of the present invention an axle box suspension for a railway vehicle comprising an axle box body formed integrally at one side of an axle box with an axle anchor rod and at the other side of a supporting arm, and an axle spring engaged between the axle box body and a truck frame, the axle anchor rod being integrally coupled to the truck frame through a first resilient element, the supporting arm being coupled to the truck frame through a second resilient element in such a manner that the twisting rigidity of the second resilient element in the running direction of the vehicle is sufficiently smaller than the composite twisting rigidity of the axle anchor rod and the first resilient element in the same direction.

The operation of this invention will be described with reference to Figs. 1 and 2.

The axle box body 4 is formed integrally with the axle box 3 and the axle anchor rod 3', and is mounted at the truck frame 12 through the resilient element 7 in such a manner that there is no slide and gap.

The relative vertical movements between the axle 1 and the truck frame 12, which is equivalent to a swivel movement of the axle box body 4 around the shaft 8, is allowed by the deformation of the resilient element 7 provided between the axle anchor rod 3' and the truck frame 12.

Since the axle anchor rod 3' allows a twist in the running direction of the vehicle, and is coupled in series with the twisting rigidity of the resilient element 7, then the composite twisting rigidity between the axle box body 4 and the truck frame 12 is reduced, whereby the relative displacement of rolling between the axle 1 and the truck frame 12 can be easily allowed, so that the axle box and the axle can follow the longitudinal, lateral and vertical vibrations between the axle and the truck frame as a whole without rattling phenomenon.

Other objects and features of the invention will be more fully understood from the following detailed description and appended claims when taken with accompanying drawings.

Brief Description of the Drawings

Fig. 1 is a front view of an axle box suspension according to a first embodiment of this invention;

Fig. 2 is a sectional view taken along the line A-A of Fig. 1;

Fig. 3 is a sectional view taken along the line B-B of Fig. 1 or 6;

Fig. 4 is a front view of a second embodiment of this invention;

Figs. 5A and 5B are sectional views showing a modified example of the sectional shape of an axle anchor rod;

Fig. 6 is a front view of the first embodiment of the invention, wherein a second resilient element is adopted;

Fig. 7 is a sectional view taken along the line A'-A' of Fig. 6;

Fig. 8 is a front view of the second embodiment of the invention, wherein the second resilient element is adopted;

Fig. 9 is a top view of a third embodiment of the invention, wherein the second resilient element is adopted;

Figs. 10A and 10B are views of a conventional example of an axle box suspension, wherein Fig. 10A is a front view, and Fig. 10B is a sectional view taken along the line J-J of Fig. 10A;

Figs. 11A and 11B are view of other conventional example, wherein Fig. 11A is a front view, and Fig. 11B is a top view; and

Fig. 12 is a sectional view taken along the line H-H of Fig. 11A.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

There will now be described preferred embodiments of the present invention with reference to the drawings.

Referring to Figs. 1 to 3. An axle anchor rod 3' extending in the same direction as the running direction C of a truck is integrally provided at an axle box 3, which is supporting the axle 1 with a wheel 13, forming an axle box body 4. The axle box body 4 is mounted to a truck frame 12 through an axle spring 6, but the axle anchor rod 3' is shaft-coupled by a resilient element 7 and a shaft 8 at the axle anchor rod support of the truck frame 12.

The resilient element 7 is adhered to the shaft 8 and is force-fitted into the axle anchor rod 3', so that there is no slipping part in this structure. The shaft 8 and the truck frame 12 are coupled by a tapered shaft fitting or a bolt clamping, which also

makes the structure with no slipping parts. Accordingly, the axle box body 4 is allowed to swivel in a direction E around the shaft 8 as a center by means of the deformation of the resilient element 7. Thus, the axle 1 is allowed in vertical relative movements in a direction F to the truck frame 12 through the axle box body 4.

The resilient element 7 transmits a propulsion force and a brake force in a direction C (same as the running direction) and lateral force in a direction D (same as the axle direction) from the axle 1 to the truck frame 12 through the axle box 3 and the axle anchor rod 3'.

As described above, a displacement between the axle box body 4 and the truck frame 12 is allowed by means of the deformation of the resilient element 7. Since there is no slip and particularly no gap in a direction C (same as the running direction of the vehicle), the axle box suspension does not rattle, so that running stability is enhanced and the vehicle is enabled to run at high speed. Furthermore, since there is no sliding or slipping parts, the gap is not increased due to aging wear at the conventional one, the deterioration of the running performance can be prevented, so that the replacement of worn components is eliminated, and maintenance can be easily done. As compared with the conventional example, the link and the pins are eliminated, whereby weight of the axle box suspension can be reduced. Further, it is made easy to assemble because of its simple structure.

In the present invention, since the twisting rigidity of the resilient element 7 can be coupled in series with that of the axle anchor rod 3' in the present invention, the twisting rigidity between the axle box body 4 and the truck frame 12 can be reduced.

Fig. 3 is a sectional view of the axle anchor rod 3'. When the twisting rigidity of the axle anchor rod in a direction G (same as the running direction) in the drawing is designated by K1 as shown in Fig. 2 and the twisting rigidity of the resilient element 7 in the direction G is designated by K2, the composite twisting rigidity K of the axle anchor rod 3' and the resilient element 7 is obtained from the formula $1/K = 1/K1 + 1/K2$, and thus the combined twisting rigidity is smaller than K1 or K2.

Further, the K1 and the K2 are equalized substantially to the same degree thereby to reduce the composite twisting rigidity K of the K1 and the K2 with good balance without decrease of the strengths of the axle anchor rod 3' and the resilient element 7. As a result, the relative displacement is allowed in the rolling direction between the axle 1 and the truck frame 12. Therefore, the vehicle can follow the twist of the track due to an irregularity in the track or a reduction in the cant of the rails,

thereby preventing the reduction of the wheel load generated by the twist of the rails (if the reduction of the wheel load is increased, derailment will finally be caused).

Fig. 4 shows a second embodiment of the invention. An axle spring 6 is engaged between a truck frame 12 and an axle box 3. The other construction is the same as that of the previous embodiment.

The twisting rigidity of the axle anchor rod 3' is suitably selected by setting its sectional shape in combination with the twisting rigidity of the resilient element 7.

Figs. 5A and 5B show other examples of the sectional views of an axle anchor rod 3'. Thus, the twisting rigidity of the axle anchor rod 3' in a direction G in Fig. 3 can be selected by suitably setting the sectional shape of the axle anchor rod 3' as described above.

Figs. 6 and 7 show another embodiment of the invention. The axle box of in the embodiment as shown in Fig. 1 and Fig. 2 is of the cantilever, whereas the axle box of this embodiment is provided with the second resilient element 9. An axle box 3 supporting the axle 1 with a wheel 13 is provided with an axle anchor rod 3' and a supporting arm 3'' extending longitudinally in a running direction C of a truck to form an axle box body 4. The axle anchor rod 3' is shaft-coupled to an axle anchor rod supporting portion of the truck frame 12 by means of a first resilient element 7' and a shaft 8, and the supporting arm 3'' is coupled to a supporting portion of the truck 12 in such a manner that two second resilient elements 9 are held therebetween.

The first resilient element 7' is adhered to the shaft 8, while the second resilient element 9 is formed in a laminated layer structure so that the rigidity thereof in a direction F corresponding to a shearing direction may reduce. Thus, the axle 1 is allowed in vertical relative movements in a direction E in the drawings to the truck frame through the axle box body 4.

The first resilient element 7' transmits a propulsion force and a brake force in the direction C (same as the running direction of the vehicle) and lateral direction force of the direction D (same as the axle direction) from the axle 1 to the truck frame 12 through the axle box 3 and the axle anchor rod 3', while the second resilient element 9 mainly transmits the lateral force in the direction D.

Since the second resilient element 9 is formed in a laminated layer structure, it can mainly resist against a force applied in a direction D, and rigidity in vertical direction is smaller than that of the axle spring 6 in a direction F.

In this embodiment, since the twisting rigidities of the first resilient element 7' and the axle anchor

rod 3' are coupled in series, the composite twisting rigidity K of the axle anchor rod 3' and the first resilient element 7' is obtained from the formula $1/k = 1/K1 + 1/K2$, and the composite twisting rigidity is reduced to smaller than K1 and K2.

The twisting rigidity of a second resilient element 9 supported by the supporting arm 3'' at the other end of the axle box body 4 is dynamically in parallel with K. When this twisting rigidity is designated by K3, the total twisting rigidity between the axle box body 4 and the truck frame 12, i.e., the total twisting rigidity Kt between the axle 1 and the truck frame 12 becomes $Kt = K + K3$. Since the relation $K \gg K3$ can be obtained by forming the structure of the second resilient element in a laminated layer structure, the K3 can be ignored, so that the total twisting rigidity Kt between the axle 1 and the truck frame 12 becomes $Kt = K$, and the influence of the second resilient element 9 to the twisting rigidity is reduced to very small.

As described above, even in this embodiment, the composite twisting rigidity can be reduced.

Fig. 8 shows a second embodiment of the invention, wherein a second resilient element is adapted. An axle spring 6 is engaged between a truck frame 12 and an axle box 3. The other construction is the same as that of the embodiment shown in Fig. 7.

Fig. 9 shows a third embodiment of the invention. A second resilient element 9 interposed between a truck frame 12 and an axle supporting arm 3'' is employed as one set, and the other construction is the same as that of the above embodiment in Fig. 6.

Advantageous Feature of the Present Invention

There is provided an axle box suspension having an axle spring according to the present invention, wherein an axle body is formed by providing an axle anchor rod at one end of the axle box, and the axle anchor rod is shaft-coupled to a truck frame through a resilient element, so that longitudinal, lateral and vertical swivel movement between the axle and the truck frame can be allowed by deforming the resilient element and the axle anchor rod without rattle, thereby the running stability of the vehicle is greatly improved. Further, since the axle box suspension does not have slides and gaps, a wear and a deterioration due to years of driving are eliminated, whereby replacement of the components will be obviated and maintenance thereof will be much more facilitated. Moreover, excellent advantages such as simplified structure, space-saving of the whole axle box suspension, reduction in its weight are provided.

Claims

1. An axle box suspension for mounting axles of a railway vehicle to a truck frame thereof comprising;

an axle box body including an axle box and an axle anchor rod; said axle box supporting said axle with a bearing provided therearound, and said axle anchor rod integrally formed with said axle box and extending to one side therefrom;

an axle spring engaged between said axle box body and said truck frame;

said axle anchor rod being coupled to said truck frame through a shaft and a resilient element, thereby sharing a twisting rigidity of said vehicle in the running direction thereof between said axle anchor rod and said resilient element.

2. An axle box suspension as claimed in claim 1, wherein said shaft is provided in such a manner that there occurs no slipping phenomenon among said shaft, said truck and said resilient element.

3. An axle box suspension as claimed in claim 1 or 2, wherein the twisting rigidities of said axle anchor rod and said resilient element are equalized to substantially the same degree.

4. An axle box suspension as claimed in claims 1 to 3, wherein said axle anchor rod allows the displacement of said truck frame in the running direction of said vehicle, the displacement thereof in a swiveling direction around said shaft as a central position and the displacement thereof in an axle direction.

5. An axle box suspension for mounting axles of a railway vehicle to a truck frame thereof comprising;

an axle box body including an axle box, an axle anchor rod and a supporting arm; said axle box storing said axle with a bearing provided therearound, said axle anchor rod integrally formed with said axle box and extending to one side therefrom, while said supporting arm integrally formed with said axle box and extending to the other side thereof;

an axle spring engaged between said axle box body and said truck frame;

said axle anchor rod being coupled to said truck frame through a shaft and a first resilient element, while said supporting arm being coupled to said truck frame by means of a second resilient element provided therebetween, wherein the twisting rigidity of said second resilient element to the running direction of said vehicle is sufficiently smaller than the composite twisting rigidity of said axle anchor rod and said first resilient element in the same direction.

6. An axle box suspension as claimed in claim 5, wherein said shaft is provided in such a manner that there occurs no slipping phenomenon neither

among said shaft, said truck and said first resilient element, nor among said shaft, said truck and said second resilient element.

7. An axle box suspension as claimed in claims 5 to 7, wherein said axle anchor rod allows the displacement of said truck frame in the running direction of said vehicle, the displacement thereof in a radiating direction at said shaft as a central position and the displacement thereof in an axle direction.

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FIG. 1

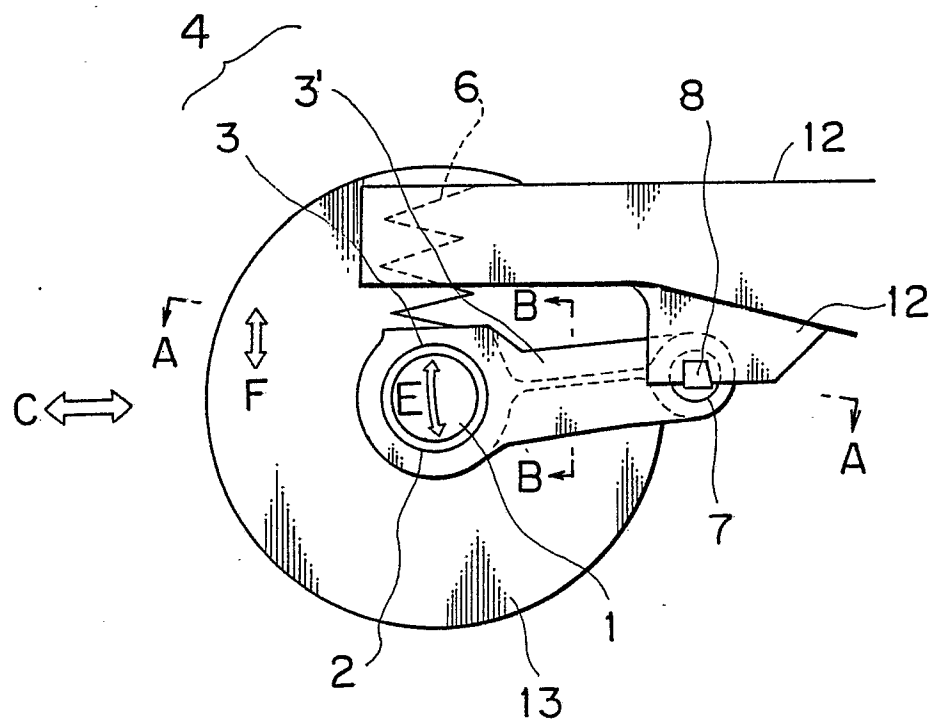


FIG. 2

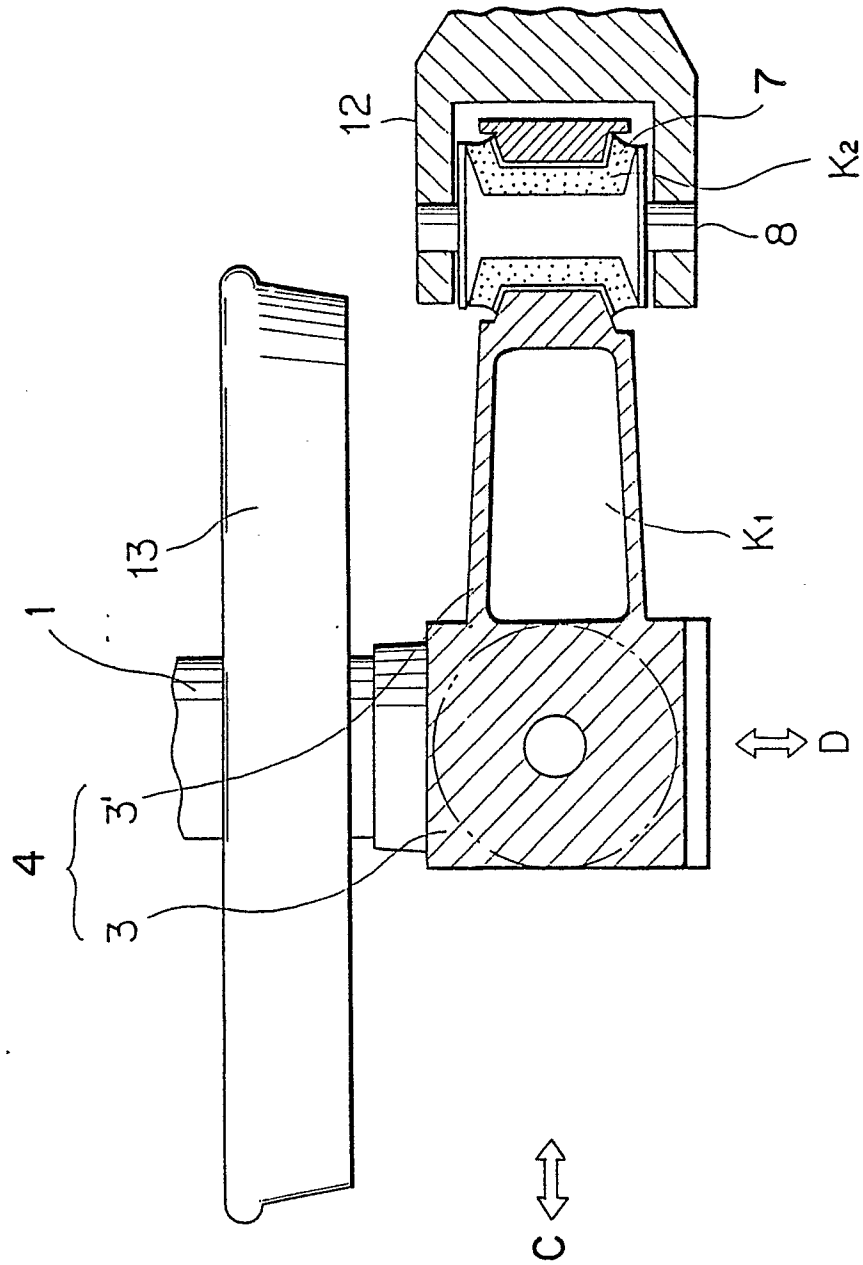


FIG. 3

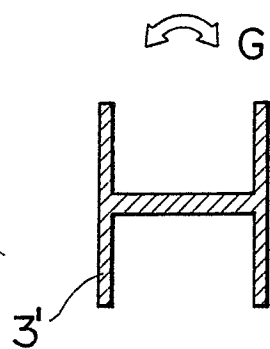


FIG. 4

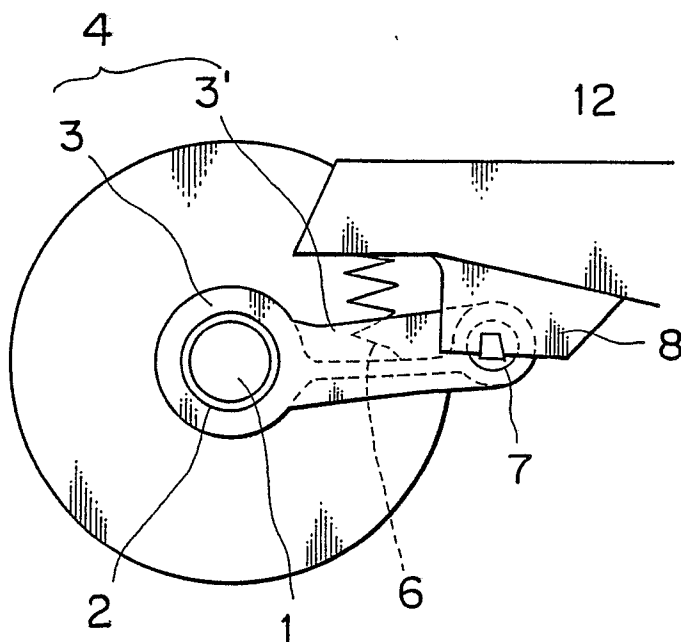


FIG. 5A

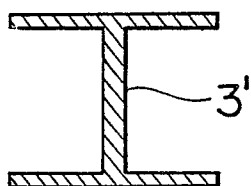


FIG. 5B

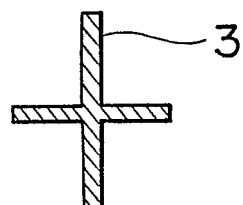


FIG. 6

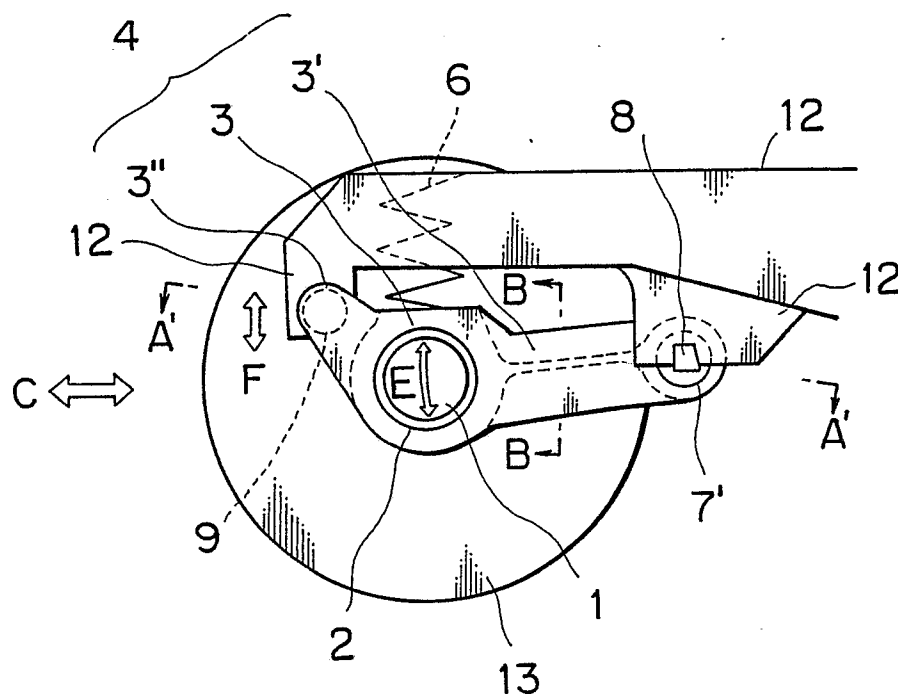


FIG. 7

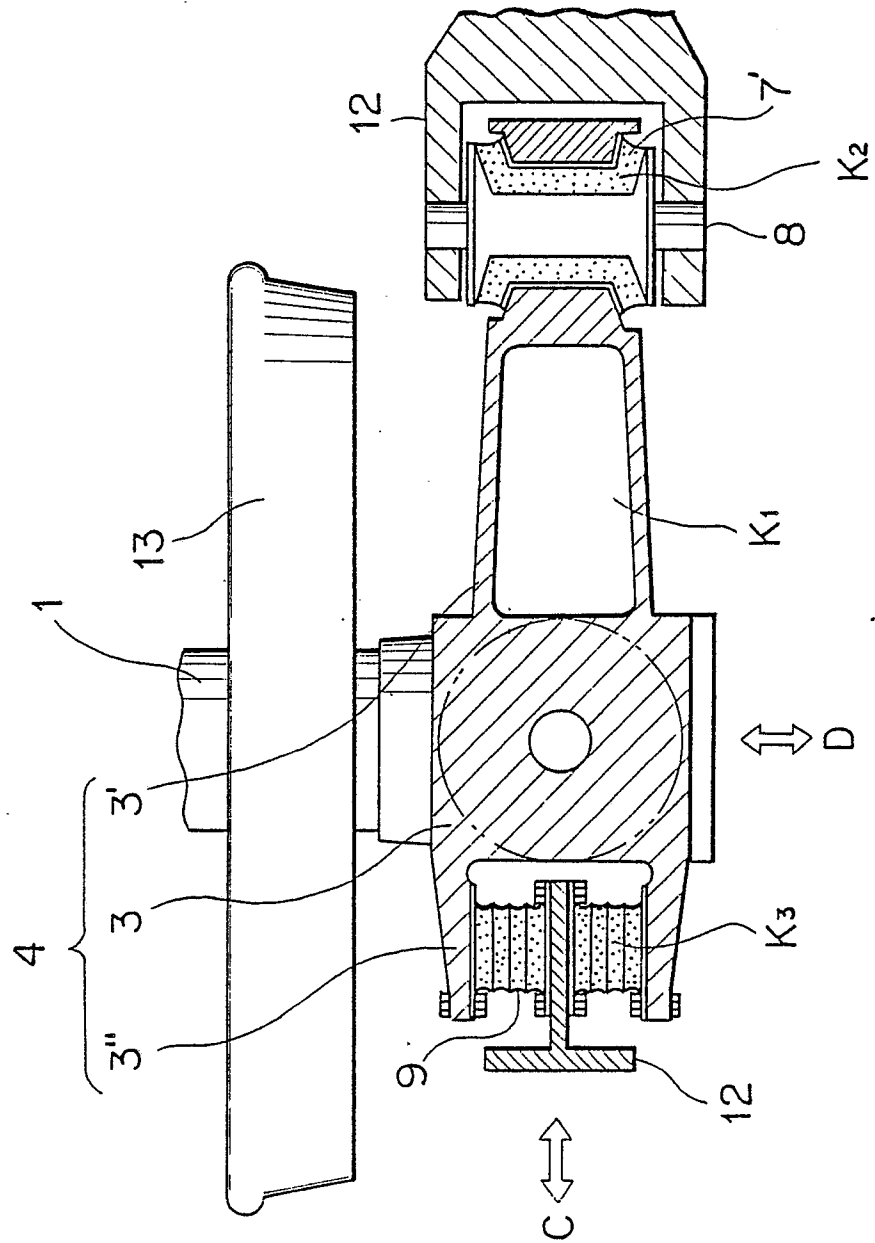


FIG. 8

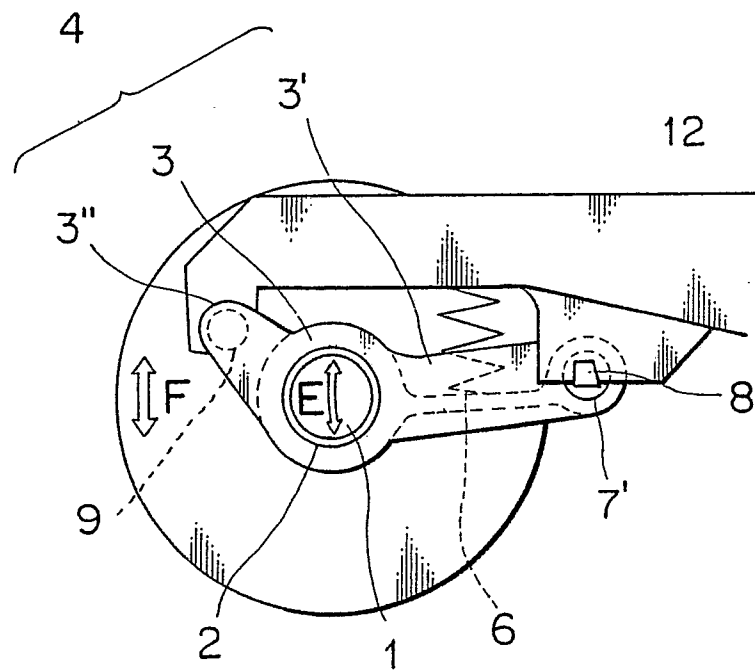


FIG. 9

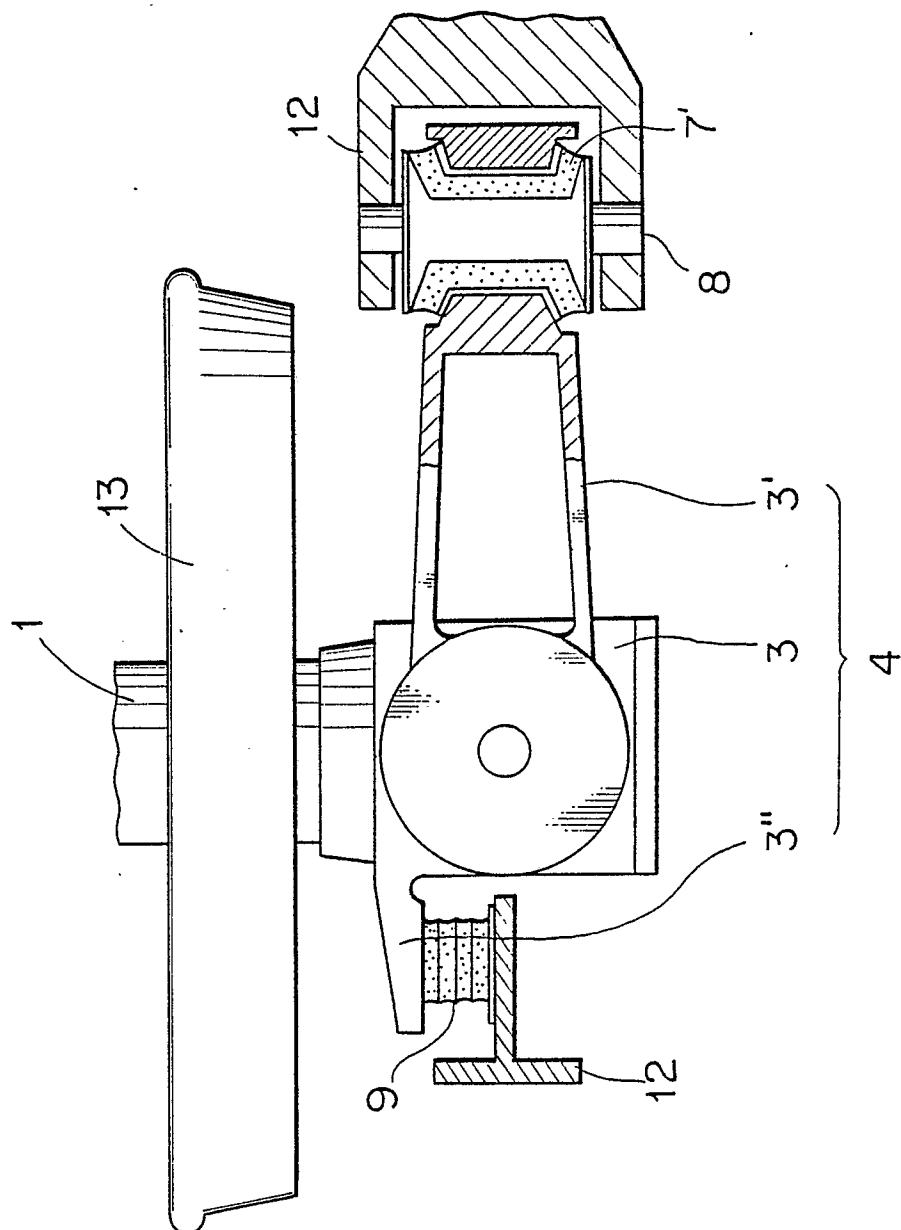


FIG. 11A
PRIOR ART

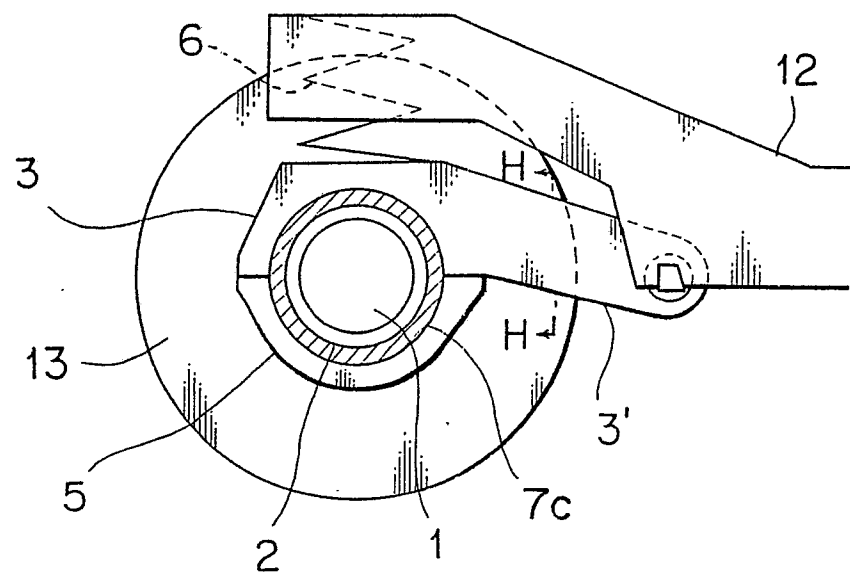


FIG. 11B
PRIOR ART

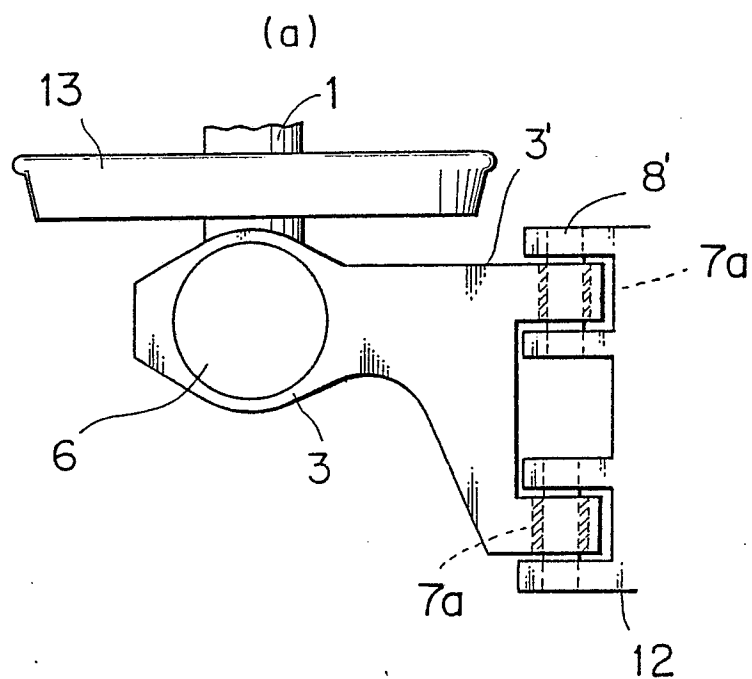


FIG. 12
PRIOR ART

