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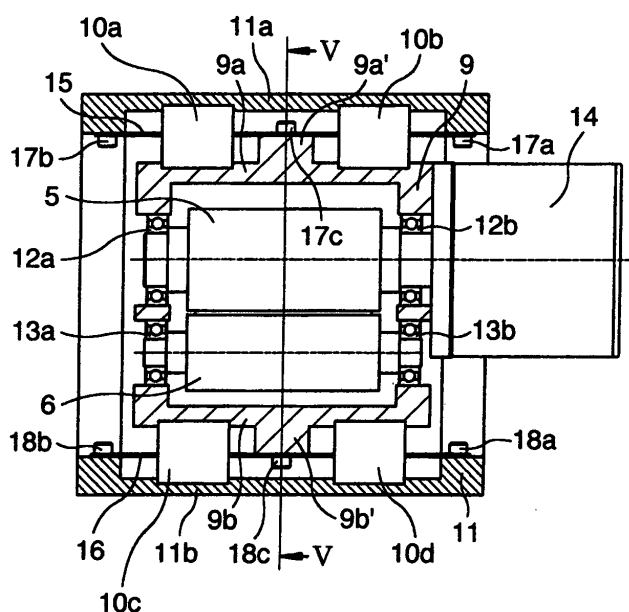
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(54) **Material feeding apparatus**

(57) A material feeding apparatus has a vibration absorbing construction, in which an impulse and vibrations from a press apparatus (4), etc. are hard to transmit to a material feeding equipment (5, 6), etc., and includes an inner housing (9) that accommodates therein the material feeding equipment, and an outer housing (11) connected to the inner housing through a vibration absorbing member (10a, 10b, 10c, 10d). A vibration restricting member (15, 16) is provided between the housings to restrict the degree of freedom of vibrations, which are transmitted

to the inner housing through the vibration absorbing member when an impulse force acts on the outer housing, only in a vertical direction. The vibration restricting member includes an upper plate member (15), upper and lower surfaces of which are interposed between a top wall of the outer housing and a top wall of the inner housing, and a lower plate member (16), upper and lower surfaces of which are interposed between a bottom wall of the outer housing and a bottom wall of the inner housing.

FIG.2



Description

Background of the Invention

[0001] The present invention relates to a material feeding apparatus that feeds a material such as a sheet material, a wire material, etc. intermittently to a work machine such as a press apparatus, etc. a predetermined quantity by a predetermined quantity, and more particularly to a material feeding apparatus suited to feeding of a material for small-sized parts used in electronic component industry to a press apparatus at high speed with high accuracy.

[0002] Generally, small-sized electronic parts such as connectors, terminals, etc. are manufactured by using a material feeding apparatus to intermittently feed a material wound round a coiler to a press apparatus a predetermined quantity by a predetermined quantity to subject the same to press working (see, for example, JP-A-2004-142876).

[0003] In order to subject such small-sized electronic parts to press working at high speed with high accuracy, it is necessary to make a press apparatus operable at high speed with high accuracy and to enable a material feeding apparatus to feed a material at high speed with high accuracy.

[0004] Conventionally, apparatuses that intermittently feed a material such as a sheet material, a wire material, etc. to a work machine such as a press apparatus, etc. include a roll feeder that interposes a material between a main roll and a sub-roll to convey the same, a gripper feeder that interposes a material between a stationary gripper and a moving gripper being movable in a direction toward and away from the stationary gripper to convey the same, etc. (see, for example, United States Patent No. 5,720,421 and JP-A-2000-135530).

[0005] Also, there are known some roll feeders constructed such that a main roll is rotationally driven by a servomotor to enable a synchronized operation with a press apparatus (see, for example, United States Patent No. 5,720,421).

[0006] Conventionally, it is said that an impulse force of 10G to 20G acts in press working in a press apparatus, and when a material feeding apparatus is mounted to a press apparatus, it is necessary to firmly clamp a material feeding apparatus and a press apparatus in order to reduce influences by the impulse force. Accordingly, there is a fear that vibrations caused by an impulse force generated on a press apparatus are transmitted directly to a material feeding apparatus and such vibrations cause degradation in accuracy of feeding of a material and breakage in a location, in which a mounted state of a cover, etc. is unstable. Conventionally, in order to avoid such disadvantage, a portion possibly undergoing breakage is mounted to an apparatus, such a press apparatus, etc., in which vibrations are generated, through a vibration absorbing member (cushioning member) such as rubber, etc. (see, for example, JP-U-6-76744).

[0007] The vibration absorbing member in the related art is suitably provided in a location not affecting an accuracy of feeding of a material, for example, between a mount such as a cover, etc. and a press apparatus but not suited to use in a location, in which accuracy of feeding of a material is adversely affected.

[0008] In, for example, the roll feeder, described above, in which a main roll is rotationally driven by a servomotor, rotation of the servomotor has direct influences on material feeding accuracy. Accordingly, there is a fear that when the servomotor and a press apparatus are clamped directly together, vibrations caused by an impulse force generated on the press apparatus act directly on the servomotor to cause degradation in accuracy of feeding of a material and breakage of the servomotor, an electric signal transmitting circuit associated therewith, etc.

[0009] In order to avoid such disadvantage, it is conceivable to provide for elasticity in a mount portion between the servomotor and a press apparatus through the medium of a vibration absorbing member. However, when a mount portion of the servomotor possesses more elasticity than needed, there is a fear of degradation in accuracy of feeding of a material, so that it is difficult to take an effective countermeasure against vibrations.

Summary of the Invention

[0010] It is an object of the invention to provide a material feeding apparatus that dissolves the problem described above and has a vibration absorbing construction, in which an impulse and vibrations from outside are hard to transmit to a material feeding equipment, etc.

[0011] In order to solve the problem described above, the invention provides a material feeding apparatus comprising an inner housing that accommodates therein a material feeding equipment, an outer housing surrounding the inner housing and connected to the inner housing through a vibration absorbing member, and a vibration restricting member provided between the inner housing and the outer housing to restrict the degree of freedom of vibrations, which are transmitted to the inner housing through the vibration absorbing member when an impulse force acts on the outer housing, in one direction.

[0012] In the invention, the housing is double-structured so that vibrations caused by an impulse force acting on the outer housing are damped by the vibration absorbing member (or a cushioning member) such as a vibration proof rubber, etc. and transmitted to the inner housing. Accordingly, it is possible to effectively prevent breakage of the material feeding equipment accommodated in the inner housing, an electric signal transmitting circuit associated therewith, etc.

[0013] When vibrations generate, the vibration absorbing member such as a vibration proof rubber, etc. tends to be

freely displaced in X-axis direction (left and right direction), Y-axis direction (vertical direction), and Z-axis (longitudinal direction), which axes are perpendicular to one another, and tends to be freely displaced in directions, which twist round the respective axes. In the invention, however, the vibration restricting member restricts the degree of freedom of vibrations, which are transmitted to the inner housing through the vibration absorbing member from the outer housing, in one direction. Accordingly, since the material feeding equipment accommodated in the inner housing vibrates only in a vertical direction, it is possible to stably perform material feeding at high speed with high accuracy.

[0014] When the material feeding apparatus is fixed to a press apparatus to be used, a direction of vibrations caused by an impulse generated on the press apparatus is mainly vertical, and a direction, in which a material fed to the press apparatus by the material feeding apparatus is fed, is horizontal. Accordingly, the vibration restricting member preferably restricts the degree of freedom of vibrations transmitted to the inner housing in a vertical direction. With such arrangement, even when vibrations are transmitted to the material feeding equipment accommodated in the inner housing, a direction of the vibrations is vertical and an accuracy, with which a material is fed in a horizontal direction, is little affected.

[0015] In this case, preferably, the vibration absorbing member includes an upper vibration absorbing member interposed between a top wall of the outer housing and a top wall of the inner housing and a lower vibration absorbing member interposed between a bottom wall of the outer housing and a bottom wall of the inner housing, and the vibration restricting member includes an upper plate member, upper and lower surfaces of which are interposed between the top wall of the outer housing and the top wall of the inner housing, and a lower plate member, upper and lower surfaces of which are interposed between the bottom wall of the outer housing and the bottom wall of the inner housing.

Brief Description of the Drawings

[0016]

Fig. 1 is a schematic, front view showing the alignment relationship among a material feeding apparatus according to an embodiment of the invention, a press apparatus, and a coiler;

Fig. 2 is an axial, cross sectional view showing the material feeding apparatus;

Fig. 3 is a cross sectional view as viewed from laterally in Fig. 2;

Fig. 4 is a cross sectional view showing the alignment relationship between an outer housing and an inner housing shown in Fig. 2 and seen in a direction of an arrow IV-IV in Fig. 5;

Fig. 5 is a cross sectional view as seen in a direction of an arrow V-V in Figs. 1 and 2;

Fig. 6 is a cross sectional view as seen in a direction of an arrow VI-VI in Fig. 4;

Figs. 7A, 7B, and 7C are cross sectional views as seen in a direction of an arrow VII-VII in Fig. 4 and showing three different alignments of vibration absorbing members, vibration restricting members, and a lower plate member mount; and

Figs. 8A, 8B, and 8C are cross sectional views illustrating a state, in which vibration restricting members restrict vibrations in degree of freedom.

Description of the Preferred Embodiments

[0017] Fig. 1 shows the alignment relationship among a material feeding apparatus 1, a press apparatus 4, and a coiler 3. The material feeding apparatus 1 fixed to the press apparatus 4 is constructed so that a material 2 wound round the coiler 3 is interposed by a main roll 5 and a sub-roll 6, which constitute a material feeding equipment, and fed a predetermined quantity by a predetermined quantity intermittently to the press apparatus 4. The press apparatus 4 includes metal molds 7, 8 for press working such as punching or the like. Vibrations caused by an impulse force generated on the press apparatus 4 at the time of press working are mainly directed in a vertical direction as indicated by an arrow A in Fig. 1.

[0018] As shown in Figs. 2 to 6, a housing of the material feeding apparatus 1 is double-structured to include an inner housing 9 and an outer housing 11 surrounding the inner housing 9 and connected to the inner housing 9 through vibration absorbing members (or cushioning members) 10a, 10b, 10c, 10d formed from a vibration proof rubber or the like, and the main roll 5 and the sub-roll 6, which constitute a material feeding equipment, is accommodated in the inner housing 9. The main roll 5 is supported rotatably in the inner housing 9 with bearings 12a, 12b therebetween, the sub-roll 6 is supported rotatably in the inner housing 9 with bearings 13a, 13b therebetween, and a servomotor 14 is connected to the main roll 5.

[0019] The material feeding apparatus 1 is constructed such that the main roll 5 and the sub-roll 6 interpose therebetween the material 2 and the servomotor 14 rotationally drives the main roll 5 in an intermittent manner to convey the material 2 in a direction of an arrow B in Fig. 3 to feed the material 2 a predetermined quantity by a predetermined quantity to the press apparatus 4 in an intermittent manner.

[0020] In addition, a material feeding apparatus of a type, in which a pair of rolls interpose and convey a material, is

usually provided with a mechanism that operates in synchronism with the operation of a press apparatus to release an interposing force, applied to the material by the pair of rolls, just before press working, and a mechanism that adjusts a clearance between the pair of rolls according to the thickness of the material. It suffices to appropriately adopt a known construction for these mechanisms.

[0021] Provided between the inner housing 9 and the outer housing 11 is a vibration restricting member that restricts the degree of freedom of vibrations, which are transmitted to the inner housing 9 through the vibration absorbing members 10a to 10d when an impulse force acts on the outer housing 11, in one direction.

[0022] In the embodiment shown in the figure, the vibration restricting member includes an upper plate member 15, upper and lower surfaces of which are interposed between a top wall 11a of the outer housing 11 and a top wall 9a of the inner housing 9, and a lower plate member 16, upper and lower surfaces of which are interposed between a bottom wall 11b of the outer housing 11 and a bottom wall 9b of the inner housing 9 and which is arranged in parallel to the upper plate member 15.

[0023] Also, in the embodiment shown in the figure, the vibration absorbing members 10a to 10d comprise upper vibration absorbing members 10a, 10b interposed between the top wall 11a of the outer housing 11 and the top wall 9a of the inner housing 9, and lower vibration absorbing members 10c, 10d interposed between the bottom wall 11b of the outer housing 11 and the bottom wall 9b of the inner housing 9.

[0024] The upper plate member 15 is interposed between neighborhoods of both axial ends of an inner surface of the top wall 11a of the outer housing 11 and an outer surface of an upper plate member mount 9a' formed in the vicinity of an axial center of the top wall 9a of the inner housing 9 and fixed to the top wall 11a of the outer housing 11 and the top wall 9a of the inner housing 9 by bolts 17a, 17b, 17c.

[0025] The lower plate member 16 is interposed between neighborhoods of both axial ends of an inner surface of the bottom wall 11b of the outer housing 11 and an outer surface of a lower plate member mount 9b' formed in the vicinity of an axial center of the bottom wall 9b of the inner housing 9 and fixed to the bottom wall 11b of the outer housing 11 and the bottom wall 9b of the inner housing 9 by bolts 18a, 18b, 18c.

[0026] The upper vibration absorbing members 10a, 10b extend through the upper plate member 15 and are mounted between the top wall 11a of the outer housing 11 and the top wall 9a of the inner housing 9. Also, the lower vibration absorbing members 10c, 10d extend through the lower plate member 16 and are mounted between the bottom wall 11b of the outer housing 11 and the bottom wall 9b of the inner housing 9.

[0027] Figs. 7A to 7C show the alignment relationship among the lower plate member 16, the lower vibration absorbing members 10c, 10d, and the lower plate member mount 9b' of the bottom wall 9b of the inner housing 9. As shown in Fig. 7A, the lower plate member mount 9b' is formed to have a smaller length than a width W of the inner housing 9 to enable providing the lower vibration absorbing members 10c, 10d one by one on respective sides of the lower plate member mount 9b'. Also, as shown in Fig. 7B, the lower plate member mount 9b' can have substantially the same length as the width W of the inner housing 9 to stabilize flexural deformation of the lower plate member 16 when vibrations apply. Fig. 7C shows a modification of the construction shown in Fig. 7A, in which lower vibration absorbing members 10c, 10d are provided two by two on respective sides of the lower plate member mount 9b'.

[0028] The upper plate member 15, the upper vibration absorbing members 10a, 10b, and the upper plate member mount 9a' of the top wall 9a of the inner housing 9 can be arranged in the same manner as that, in which the lower plate member 16, the lower vibration absorbing members 10c, 10d, and the lower plate member mount 9b' of the bottom wall 9b of the inner housing 9 shown in Figs. 7A to 7C are arranged. However, a state, in which the respective members are arranged in the vicinity of tops of the inner and outer housings, and a state, in which the respective members are arranged in the vicinity of bottoms of the housings, are not necessarily required to be made the same. For example, it is also possible to adopt the arrangement shown in Fig. 7A for an arrangement of the upper plate member 15, the upper vibration absorbing members 10a, 10b, and the upper plate member mount 9a' and to adopt the arrangement shown in Fig. 7C for an arrangement of the lower plate member 16, the lower vibration absorbing members 10c, 10d, and the lower plate member mount 9b'. In this manner, by making vibration absorbing members different in number between the top and the bottom of the housing, a difference in natural frequency is generated to enable increasing the whole apparatus in resonance frequency and creating a situation, in which resonance is hard to generate.

[0029] Figs. 8A to 8C show a state, in which the degree of freedom in vibration is restricted by the provision of the upper plate member 15 and the lower plate member 16, which comprise a vibration restricting member.

[0030] Fig. 8A shows a construction, in which an outer housing 11 and an inner housing 9 are connected to each other through vibration absorbing members 10a to 10d and there are not provided any upper plate member 15 and any lower plate member 16 between the housings 11, 9. In this case, when vibrations are generated on the outer housing 11, the vibration absorbing members 10a to 10d and the inner housing 9 connected to the outer housing 11 therethrough are freely displaced in X-axis direction (left and right direction), Y-axis direction (vertical direction), and Z-axis (longitudinal direction), which axes are perpendicular to one another. Also, these members are freely displaced in directions, which twist round the respective axes, that is, directions indicated by arrows a, b, c in Figs. 8A to 8C.

[0031] With a construction, shown in Fig. 8B, obtained by adding an upper plate member 15 to the construction shown

in Fig. 8A, displacement in a direction, which twists round the Y-axis direction, that is, a direction indicated by the arrow b in Fig. 8A is restricted. Also, in a construction, shown in Fig. 8C, obtained by adding a lower plate member 16, which is in parallel to the upper plate member 15, to the construction shown in Fig. 8B, a direction of displacement is made only a vertical direction being a direction, in which flexural deformation of the upper plate member 15 and the lower plate member 16 is caused, so that vibrations are restricted only in Y-axis direction.

[0032] The material feeding apparatus, according to the embodiments, shown in the drawings produces the following meritorious effects.

(1) Vibrations caused by an impulse force acting on the outer housing 11 are damped by the vibration absorbing members 10a to 10d and transmitted to the inner housing 9. Accordingly, it is possible to effectively prevent breakage of a material feeding equipment accommodated in the inner housing 9, an electric signal transmitting circuit associated therewith, etc.

(2) The upper plate member 15 and the lower plate member 16, which comprise a vibration restricting member, restrict the degree of freedom of vibrations, which are transmitted to the inner housing 9, to one direction, that is, a vertical direction. Accordingly, since a material feeding equipment accommodated in the inner housing 9 vibrates only in a vertical direction, it is possible to stably perform material feeding at high speed with high accuracy.

(3) When vibrations mainly in a vertical direction indicated by the arrow A in Fig. 1 are generated by an impulse generated in the press apparatus 4, the inner housing 9 and a material feeding equipment accommodated therein vibrate in the vertical direction. Here, as shown in Fig. 1, where L indicates a distance between centers of the main roll 5 and the sub-roll 6 and the metal molds 7, 8 and S indicates an amplitude of the inner housing 9 and a material feeding equipment, influences (that is, an error in feeding) ΔL , which vibrations of the amplitude S have on a direction of feeding of the material 2, are represented by the following formula and very minute. Accordingly, it is possible to accurately feed the material 2 to the press apparatus 4.

$$\Delta L = L (1 - \cos (\tan^{-1} S / 2L))$$

(4) The vibration restricting member is very simple in construction to use only the upper plate member 15 and the lower plate member 16, and the provision of the vibration restricting member does not make the material feeding apparatus large in size. Also, since there is no sliding contact portion and lubrication is not necessary, there is no need of maintenance over a long term.

[0033] While the material feeding apparatus, according to the embodiments, shown in the drawings comprises a roll feeder using a main roll and a sub-roll, it is of course possible to adopt a gripper system having a stationary gripper and a moving gripper, or the like, as a mechanism that feeds a material.

Claims

1. A material feeding apparatus comprising an inner housing (9) that accommodates therein a material feeding equipment (5, 6), an outer housing (11) surrounding the inner housing and connected to the inner housing through a vibration absorbing member (10a, 10b, 10c, 10d), and a vibration restricting member (15, 16) provided between the inner housing and the outer housing to restrict the degree of freedom of vibrations, which are transmitted to the inner housing through the vibration absorbing member when an impulse force acts on the outer housing, in one direction.
2. The material feeding apparatus according to claim 1, **characterized in that** the vibration restricting member (15, 16) restricts the degree of freedom of vibrations transmitted to the inner housing (9) in a vertical direction.
3. The material feeding apparatus according to claim 2, **characterized in that** the vibration absorbing member (10a, 10b, 10c, 10d) includes an upper vibration absorbing member (10a, 10b) interposed between a top wall (11a) of the outer housing (11) and a top wall (9a) of the inner housing (9) and a lower vibration absorbing member (10c, 10d) interposed between a bottom wall (11b) of the outer housing (11) and a bottom wall (9b) of the inner housing (9), and the vibration restricting member (15, 16) includes an upper plate member (15), upper and lower surfaces of which are interposed between the top wall (11a) of the outer housing (11) and the top wall (9a) of the inner housing (9), and a lower plate member (16), upper and lower surfaces of which are interposed between the bottom wall

(11b) of the outer housing (11) and the bottom wall (9b) of the inner housing (9).

4. The material feeding apparatus according to claim 1, 2 or 3, **characterized in that** the outer housing (11) is fixed to a housing of a press apparatus (4).
5. The material feeding apparatus according to claim 1, 2, 3 or 4, **characterized in that** the material feeding equipment comprises a main roll (5) and a sub-roll (6), which interpose therebetween a material to convey the same, and the main roll is driven by a servomotor (14).

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FIG.1

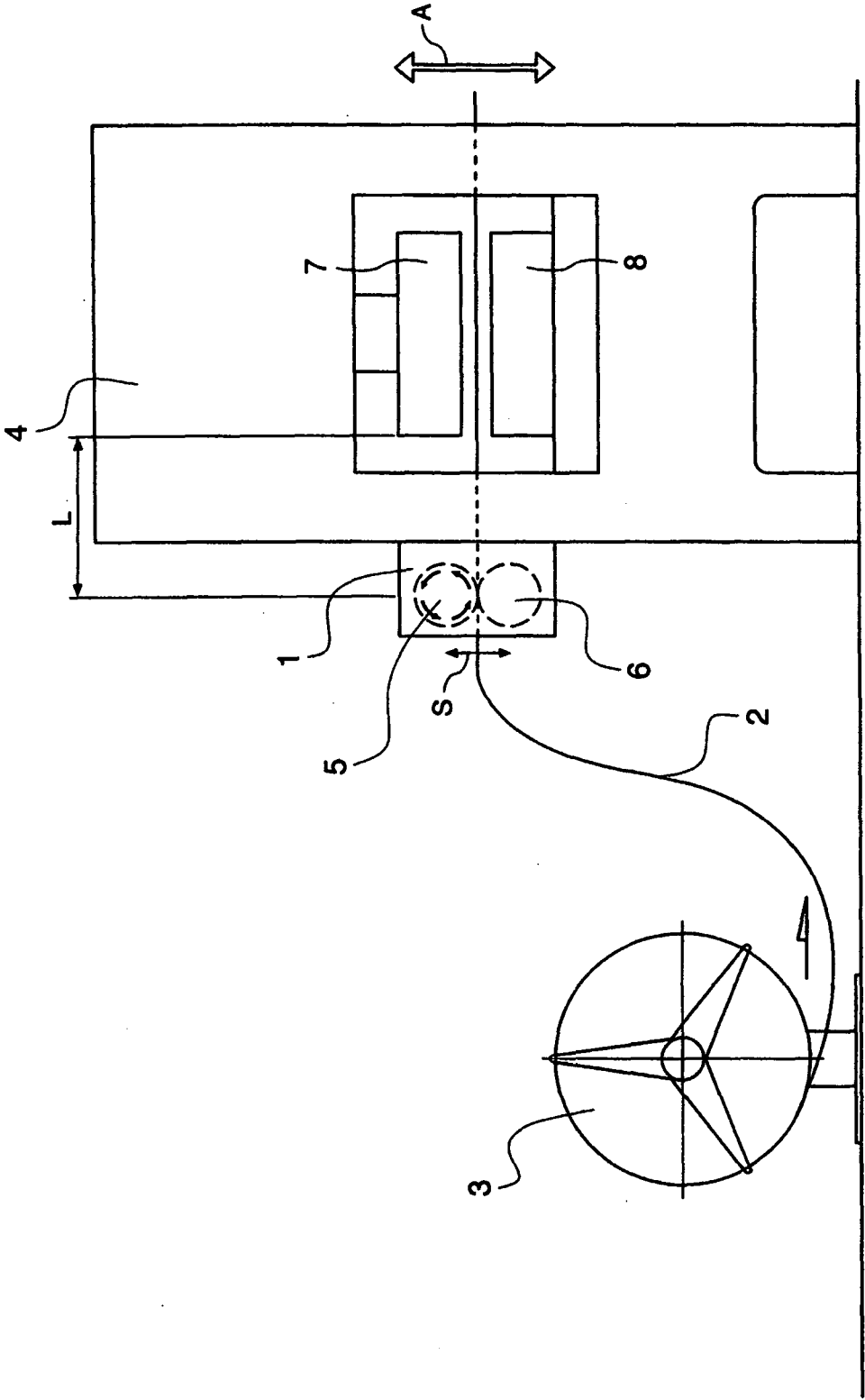


FIG.2

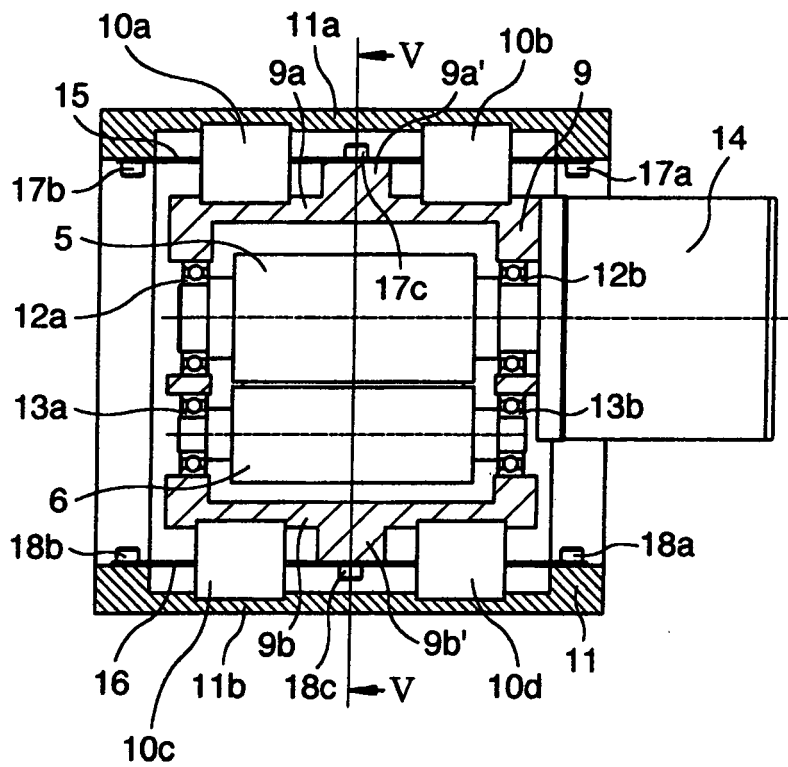


FIG.3

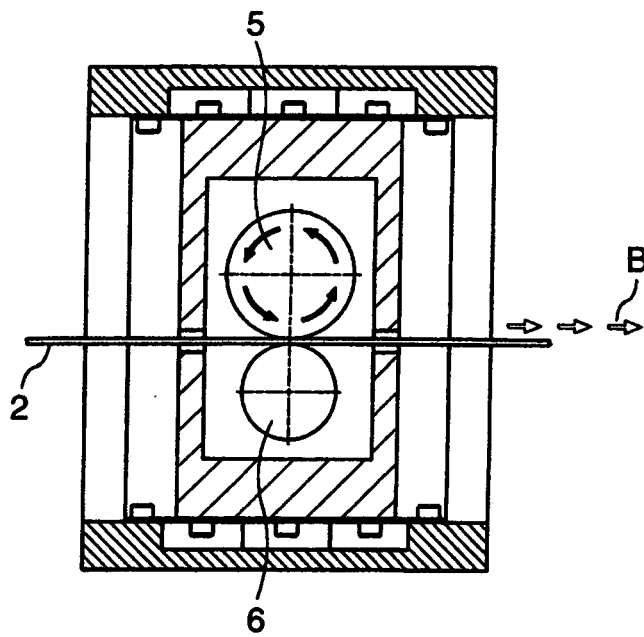


FIG.4

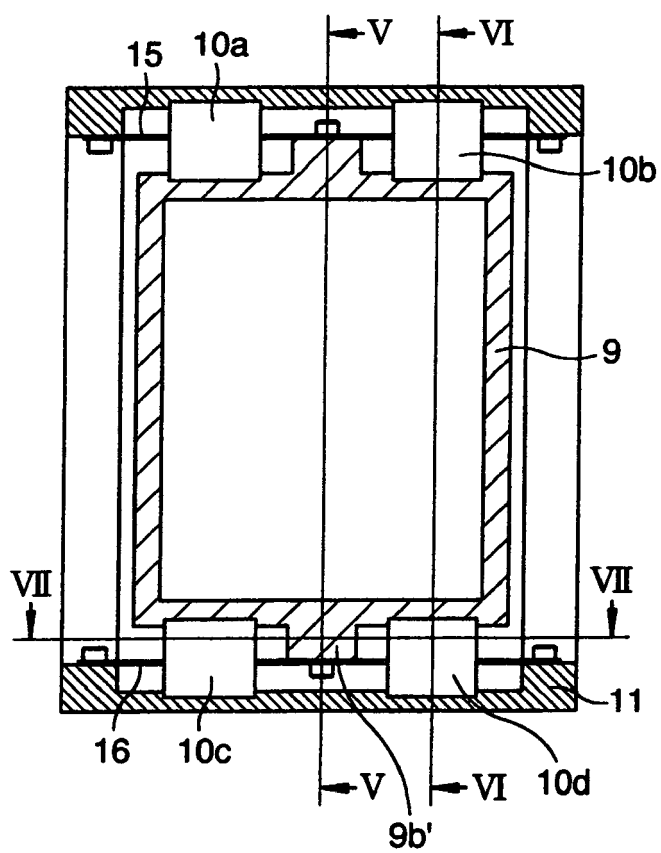


FIG.5

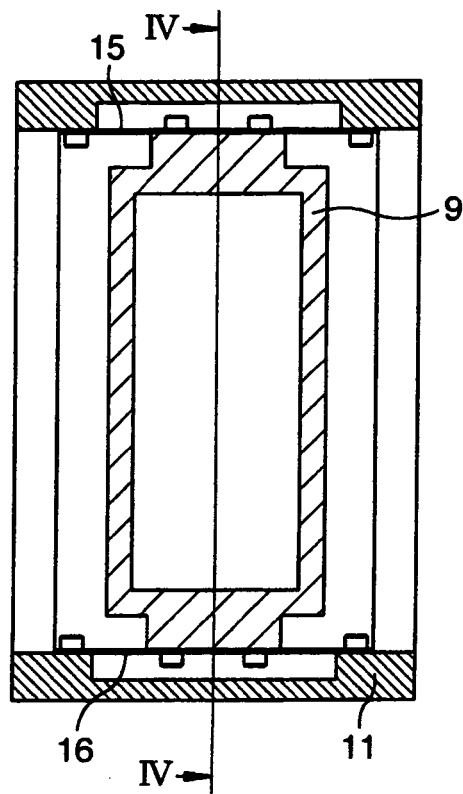


FIG.6

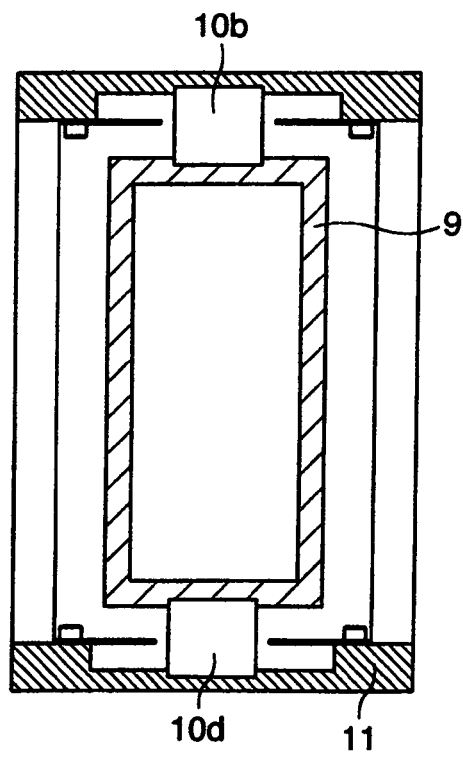


FIG.7B

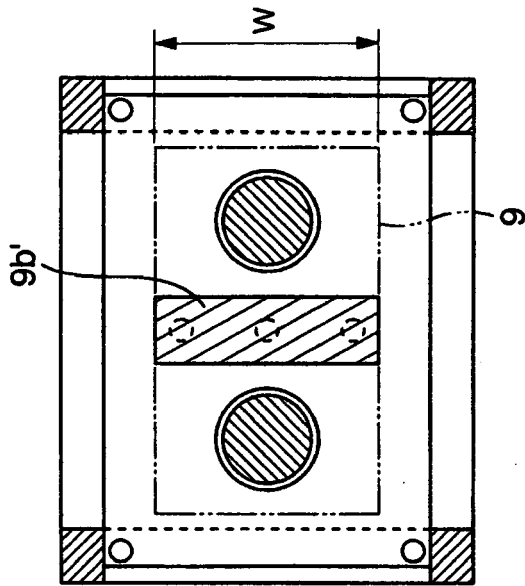


FIG.7A

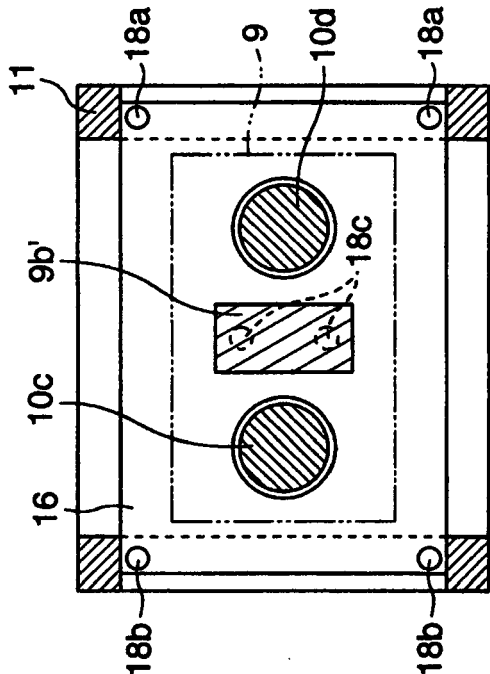


FIG.7C

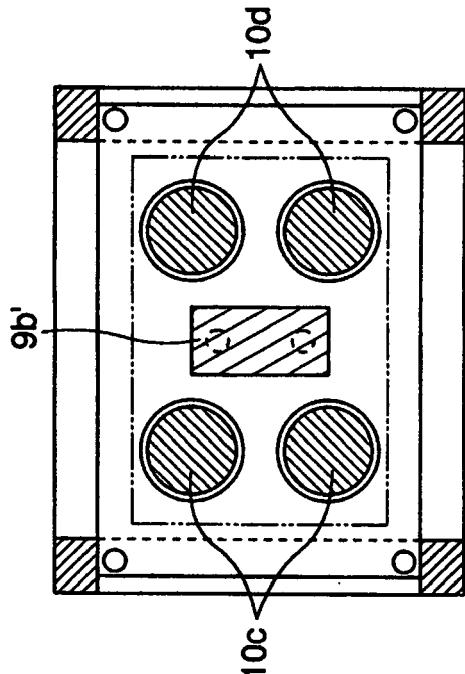
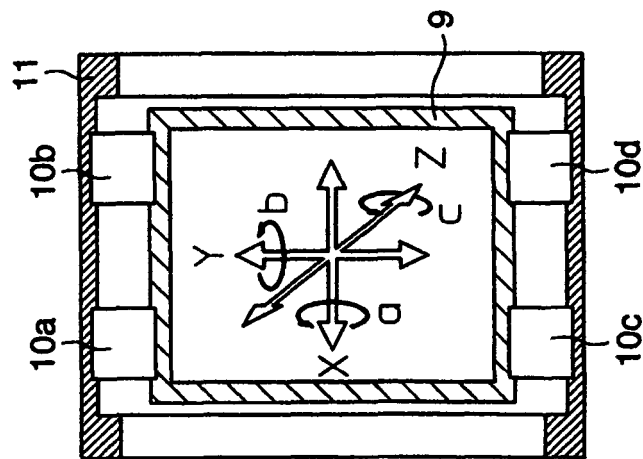
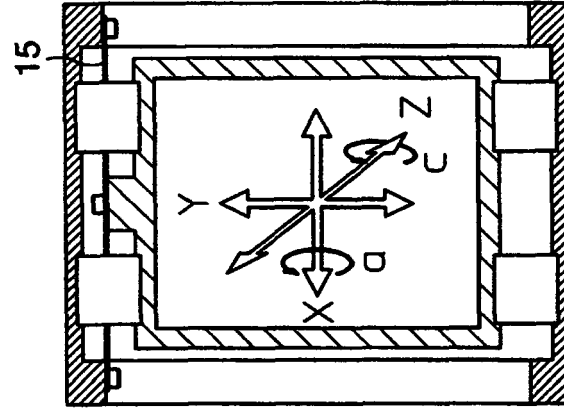


FIG.8A



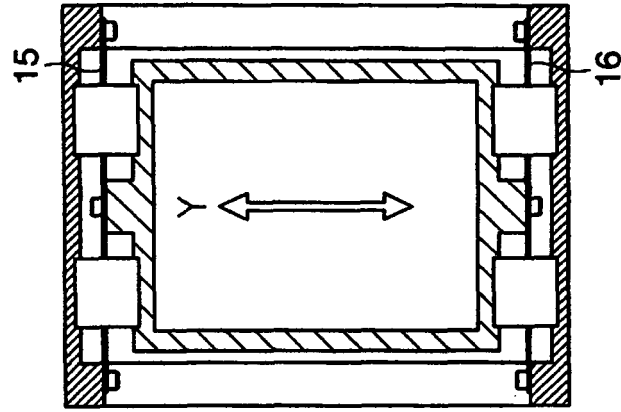
DEGREE OF FREEDOM
(X, Y, Z, a, b, c)

FIG.8B



DEGREE OF FREEDOM
(X, Y, Z, a, ~~b~~, c)

FIG.8C



DEGREE OF FREEDOM
(~~X~~, Y, ~~Z~~, ~~a~~, ~~b~~, ~~c~~)



EUROPEAN SEARCH REPORT

Application Number
EP 08 25 3510

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2003/200877 A1 (BLEI KLAUS [DE]) 30 October 2003 (2003-10-30) * paragraph [0005] * * paragraph [0007] - paragraph [0008] * * paragraph [0013] * * paragraph [0019] - paragraph [0020]; figure 1 * -----	1,2,4,5	INV. B21C47/34 B21D43/09 B21D43/11 B65H20/04 B65H20/18
			TECHNICAL FIELDS SEARCHED (IPC)
			B21C B21D B65H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 18 March 2009	Examiner Ritter, Florian
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3
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 25 3510

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18-03-2009

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US 2003200877 A1	30-10-2003	DE 10218716 A1	13-11-2003

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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