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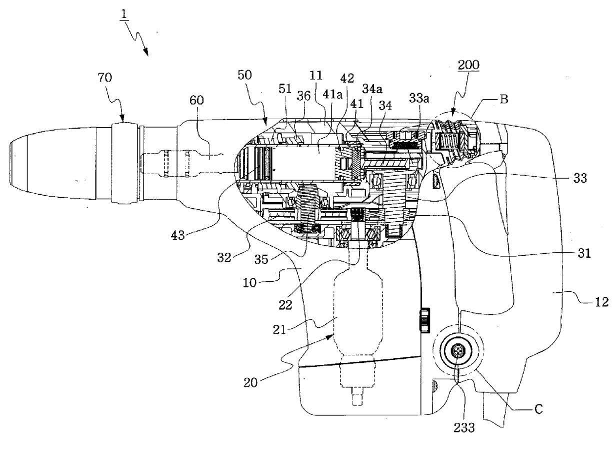
(54) **Power tool**

(57) Disclosed therein is a power tool, which can effectively reduce vibration of high intensity and vibration of low intensity. The power tool includes: first and second vibration reducing means (100,200) disposed within a tool body (10) and a hand-grip part (12) in order to reduce vibration generated when crushing work or perforating work is carried out while a striking motion and a rotating motion are performed simultaneously or while only the striking motion is performed. The first vibration reducing means (100) is disposed on at least one side of the tool body (10), and includes: a guide pin (120); elastic members (130) resiliently mounted on the outer circumferential surface of the guide pin (120) and expanding and contracting along a vibration direction; and a counter weight (140) that the elastic members (130) are inserted and supported into both sides thereof and the guide pin (120) passes therethrough, the counter weight (140) moving along the guide pin (120) while expanding and contracting the elastic members (130) in order to reduce the vibration. The second vibration reducing means (200) is disposed inside the upper portion of the power tool where the tool body (10) and the hand-grip part (12) are in contact with each other and are joined with each other in a slidably movable manner, and includes a vibration damping part (220) disposed between the tool body (10) and the hand-grip part (12) for absorbing the vibration.

【Fig. 1】



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a power tool such as a hammer drill, and more particularly, to a power tool, which can effectively reduce vibration of high intensity and vibration of low intensity generated when the power tool is used.

Background Art

[0002] In general, a hammer drill out of various kinds of power tools is a tool for crushing or perforating concrete or stones by converting a rotary power of a motor into a reciprocating motion and a hitting power of a bit, wherein the hitting power is generated by pneumatic pressure generated by a piston and the bit is rotated by a power transmission device.

[0003] Such a hammer drill includes a tool body having a motor housing, a crank housing and a tool holder, and a hand-grip part.

[0004] Moreover, the motor housing of the tool body houses a motor for generating the rotary power by electric energy. The crank housing includes a motion transformation unit for converting a rotational motion of the motor into a reciprocating motion and a hitting unit for generating the hitting power after generating pneumatic pressure. The tool holder that allows a user to detachably mount a working tool is located on a front face of the hitting unit.

[0005] The hand-grip part includes a handle that allows the user to store tools therein and a handle joining portion for connecting the tool body with the handle. Furthermore, the handle has a switch for turning on and off the hammer drill.

[0006] When the user pulls the switch of the handle, electric energy is applied to the electronic motor, and the motor housed in the motor housing generates a rotary power. The rotary power of the motor is transferred to the motion transformation unit of the crank housing. The motion transformation unit stored in the crank housing converts the rotary power of the motor into a linearly reciprocating motion to thereby generate a linearly reciprocating motion of the piston stored in the hitting unit.

[0007] The hitting unit includes a cylinder extending in a direction that is at right angles to a rotary shaft of the motor. The piston is slidably disposed inside the cylinder. The piston carries out a reciprocating motion along the inner circumference of the cylinder. A striker is slidably disposed along the inner circumference of the cylinder and in front of the piston. An air chamber is formed between the piston and the striker inside the cylinder. Air pressure inside the air chamber repeats increase and decrease by the linearly reciprocating motion of the piston to thereby provide the striker with the hitting power.

[0008] The tool holder is located in front of the striker, and an anvil is mounted inside the tool holder. The anvil slidably operates on the inner circumferential surface of the tool holder. The tool holder is located coaxially with the cylinder. When the striker moves forward and collides with the rear end of the anvil, the hitting power is transferred to the anvil. The working tool is mounted in front of the anvil by the tool holder, and the hitting power applied to the anvil collides with the rear end of the working tool, and then, is applied to the working tool. Accordingly, an object is crushed by the hitting power applied to the working tool.

[0009] By the above process, vibration is generated by the reciprocating motion and mutual collision of the piston, the striker, the anvil and the working tool, and it is difficult to work smoothly and the user becomes more and more fatigued because the generated vibration is transferred to the user through the hand-grip part.

[0010] In order to overcome the problems of the general electric hammer drill, various kinds of power tools having vibration reduction means have been proposed. For instance, U.S. Patent No. 7,252,157 (hereinafter, called 'cited reference 1') discloses a power tool including a vibration reducer disposed in a crank housing.

[0011] The vibration reducer in the cited reference 1 is disposed on a side of a striker and communicates with the striker by means of an air path. A sealed space is formed by the striker and the vibration reducer. The vibration reducer includes a counter weight and two coil compression springs. The counter weight performs a reciprocating motion that is parallel to a reciprocating motion of a piston. The two springs are respectively located at both ends of the counter weight.

[0012] Because of the sealed space formed by the striker and the vibration reducer, when the piston moves forward during the operation of the power tool, the counter weight moves backward. On the contrary, when the piston moves backward, the counter weight moves forward. As described above, the counter weight performs the reciprocating motion in interlock with the reciprocating motion of the piston.

[0013] However, the vibration reducer has a problem in that a vibration reducing effect is decreased according to vibration intensity transferred to the tool body of the power tool. In other words, because the force of the springs disposed at both ends of the counter weight is set in such a way as to be fit to a strong power of vibration, the vibration reducer cannot effectively cope with a weak power of vibration. Moreover, the power tool according to the cited reference 1 has further problems in that the counter weight cannot be operated smoothly due to friction between the counter weight and the vibration reducer and in that it costs a lot to construct the vibration reducer.

[0014] For another instance, U.S. Patent Laid-open No. 2006/0219418 (hereinafter, called 'cited reference 2') discloses a power tool including a vibration damping part disposed between a tool body and a grip.

[0015] In the cited reference 2, the vibration damping part connects the tool body and the grip with each other, and is located coaxially with a striker or slightly above an axis of the striker. Furthermore, the vibration damping part can slide in the same direction as the movement direction of the tool body that vibration is generated.

[0016] The vibration damping part has a rubber buffer or a coil spring as an elastic element and uses friction produced between a grip rod and a guide as a damping element. The power tool attenuates vibration, which is transferred from the tool body to the grip, through the elastic element and the damping element of the vibration damping part.

[0017] However, the vibration damping part has a problem in that it cannot effectively prevent vibration transferred from the tool body because the tool body and the grip are not completely decoupled due to the friction between the tool body and the grip. Additionally, the power tool according to the cited reference 2 has another problem in that the vibration damping part cannot attenuate the vibration smoothly due to the physical property of each elastic element when the coil compression spring or the rubber buffer is exclusively used.

SUMMARY OF THE INVENTION

[0018] The power tools having the vibration reducing parts disclosed in the prior arts can effectively attenuate vibration of high intensity but cannot effectively attenuate vibration of low intensity, and hence, they cannot completely remove the user's fatigue due to the vibration.

[0019] Accordingly, the present invention has been made to solve the above-mentioned problems occurring in the prior arts, and it is an object of the present invention to provide a power tool, which can effectively reduce vibration generated during the use of the power tool by reducing all of the high intensity of vibration and the low intensity of vibration.

[0020] To accomplish the above object, according to the present invention, there is provided a power tool including: first and second vibration reducing means disposed within a tool body and a hand-grip part in order to reduce vibration generated when crushing work or perforating work is carried out while a striking motion and a rotating motion are performed simultaneously or while only the striking motion is performed, wherein the first vibration reducing means is disposed on at least one side of the tool body, and includes: a guide pin; elastic members resiliently mounted on the outer circumferential surface of the guide pin and expanding and contracting along a vibration direction; and a counter weight that the elastic members are inserted and supported into both sides thereof and the guide pin passes therethrough, the counter weight moving along the guide pin while expanding and contracting the elastic members in order to reduce the vibration, and wherein the second vibration reducing means is disposed inside the upper portion of the power tool where the tool body and the hand-grip part are in contact with each other and are joined with each other in a slidably movable manner, and comprises: a vibration damping part disposed between the tool body and the hand-grip part for absorbing the vibration.

[0021] Moreover, the first vibration reducing means includes a case for supporting the guide pin and accommodating and sealing the elastic members and the counter weight.

[0022] Furthermore, the counter weight includes insertion grooves formed on both sides thereof in a circumferential direction for inserting a part of each of the elastic member thereinto.

[0023] Additionally, the guide pin includes rings disposed at both end portions thereof for preventing movement of the guide pin and serving a buffering function when the counter weight collides with the case due to the counter weight's movement by large amplitude.

[0024] In addition, the hand-grip part includes a holder spaced apart from the side of the tool body within the hand-grip part for supporting the vibration damping part.

[0025] Moreover, a sleeve that extends from the inside of the hand-grip part in such a way that the tool body is slidably movable when vibration is generated is joined to the inner side of the tool body with an interval between the sleeve and the tool body, so that the tool body and the hand-grip part are joined by means of a fastening member.

[0026] Furthermore, the vibration damping part includes a buffering member serving a buffering function and an elastic member resiliently mounted inside the buffering member.

[0027] Additionally, the vibration damping part further includes support plates for supporting both ends of the elastic member.

[0028] In addition, a cover that expands and contracts according to movement of the tool body when the vibration is generated is joined to the first vibration reducing means, which is disposed on the upper portion where the tool body and the hand-grip part are joined.

[0029] Moreover, the power tool further includes another second vibration reducing means disposed on the lower portion where the tool body and the hand-grip part are joined, wherein the lower side of the tool body and the lower side of the hand-grip part are joined with each other with an interval therebetween to thereby prevent the vibration.

[0030] Furthermore, the second vibration reducing means disposed on the lower portions of the tool body and the hand-grip part includes: a buffering member fit into the lower side of the hand-grip part; and fastening member passing through the buffering member and joined to the buffering member.

[0031] Additionally, the buffering member passes through the lower side of the hand-grip part and joined to the lower side of the tool body in a state where the buffering member is in contact with the lower side of the tool body.

[0032] In addition, the second vibration reducing means further includes a tube disposed between the buffering member and the fastening member for keeping a fastening force.

[0033] As described above, the power tool according to the present invention can reduce not only the vibration of high intensity generated during working by the first vibration reducing means that is disposed at both sides of the tool body but also the vibration of low intensity by the second vibration reducing means that is disposed at the upper portion and the lower portion behind the first vibration reducing means, whereby it can remarkably reduce the user's fatigue by the vibration and enhance work efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] The above and other objects, features and advantages of the present invention will be apparent from the following detailed description of the preferred embodiments of the invention in conjunction with the accompanying drawings, in which:

[0035] FIG. 1 is a sectional view of a general structure of a power tool according to a preferred embodiment of the present invention;

[0036] FIG. 2 is a plan view of the power tool;

[0037] FIG. 3 is an enlarged sectional view of the part A of FIG. 2;

[0038] FIG. 4 is a perspective view of first vibration reducing means of FIG. 3;

[0039] FIG. 5 is a perspective view, in section, showing an assembled state of the first vibration reducing means of FIG. 3;

[0040] FIG. 6 is an enlarged sectional view of the part B of FIG. 1, showing a structure of second vibration reducing means of the power tool;

[0041] FIG. 7 is a perspective view of a vibration damping part of FIG. 4; and

[0042] FIG. 8 is a plan sectional view of the part C of FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0043] Reference will be now made in detail to the preferred embodiment of the present invention with reference to the attached drawings.

[0044] According to a preferred embodiment of the present invention, a hammer drill 1, which is a power tool, will be described.

[0045] FIG. 1 is a sectional view of a general structure of a power tool according to a preferred embodiment of the present invention, and FIG. 2 is a plan view of the power tool, in partly section.

[0046] As shown in the drawings, the hammer drill 1 according to the present invention includes: driving means 20 disposed inside a tool body 10, power transmission means 30 for transmitting driving power to the driving means 20, and a striking part 40 and a rotating part 50 for carrying out striking and rotational motions by the power transmission means 30.

[0047] The driving means 20 includes a motor 21 driven when electricity is applied thereto, and the power transmission means 30 includes: first and second gears 31 and 32 joined to a shaft 22 of the motor 21 for rotating by receiving driving power generated from the motor 21; a crank shaft 33 rotatably joined to the center of the first gear 31; a connecting rod 34 eccentrically joined to an end portion 33a of the crank shaft 33 for converting a rotary power of the crank shaft 33 into a linear motion; a transmission gear 35 joined to the center of the second gear 32 to transmit a rotary power; and a bevel gear 36 joined to an upper end portion of the transmission gear 35 for rotating by receiving the driving power.

[0048] Moreover, the striking part 40 includes: a cylinder 41 that the bevel gear 36 is joined to the outer circumference; a piston 42 disposed inside the cylinder 41 and connected with the connecting rod 34 via a shaft 34a while performing a linear motion; and a striker 43 arranged on the opposite side of the piston 42 where an air chamber 41a is mounted inside the cylinder 41, the striker 43 striking an anvil 60 while the air chamber 41a is compressed according to a movement of the piston 42.

[0049] Furthermore, the rotating part 50 includes a clutch 51 engaging with the bevel gear 36 and intermittently transmitting the rotary power of the bevel gear 36 to the cylinder 41 to rotate the cylinder 41.

[0050] In other words, while the power transmission of the bevel gear 36 is stopped when the engagement between the clutch 51 and the bevel gear 36 is released by a cam (not shown), the rotary power of the bevel gear 36 is transmitted to the clutch 51 to rotate the clutch 51 when the clutch 51 engages with the bevel gear 36, and at the same time, the cylinder 41 rotates to provide the rotary power to the anvil 60.

[0051] The above structure of the power tool is the same as the power tools according to prior arts, and hence, a detailed description of the structure will be omitted.

[0052] Here, the hammer drill 1 according to the present invention includes first vibration reducing means 100 and second vibration reducing means 200 disposed within the tool body 10 of the hammer drill 1 in order to reduce vibration transferred to the hammer drill 1 when a striking motion and a rotating motion are carried out simultaneously by a tool holder part 70 having the anvil 60 and a bit joined to the tool holder part 70 or when crushing work or perforating work on concrete or stones is performed while the striking motion is carried out, and accordingly, the hammer drill 1 according to the present invention can effectively reduce vibration.

[0053] As shown in FIGS. 2 and 3, the first vibration reducing means 100 of the present invention may be disposed on at least one side of a crank housing 11 inside the tool body 10, but it is preferable that the first vibration reducing means 100 are disposed on both sides of the crank housing 11.

[0054] Referring to FIG. 3, the first vibration reducing means 100 includes: a case 110; a guide pin 120 crossing the inside of the case 110; an elastic member 130 resiliently mounted on an outer circumferential surface of the guide pin 120; and a counter weight 140 that the elastic members 130 are inserted and supported into both sides thereof and through which the guide pin 120 passes.

[0055] As shown in FIGS. 4 and 5, the case 110 is in a cylindrical shape and divided into first and second case members 111 and 112, and has a retaining projection 111a formed on an upper end of the first case member 111 and a retaining ring 112a formed on an upper end of the second case member 112 so that the retaining projection 111a and the retaining ring 112a are coupled with each other.

[0056] In addition, the first and second case members 111 and 112 of the case 110 respectively have connection pieces 111b and 112b formed on end portions of the other side thereof and the connection pieces 111b and 112b are assembled by means of fastening members 113 and 114, such as screws or bolts.

[0057] Because the first vibration reducing means 100 is sealed by the case 110, it is highly unlikely that foreign matters, such as dust, are introduced into the first vibration reducing means 100, and hence, the counter weight 140 disposed within the case 110 can be operated smoothly when the hammer drill according to the present invention is used in a construction site.

[0058] Moreover, rings 121 made of rubber are fit on both end portions of the guide pin 120 to prevent movement of the guide pin 120 and to prevent a damage of the case 110 by serving as a buffer when the counter weight 140 collides with the case 110 due to the counter weight's movement by large amplitude.

[0059] Furthermore, two elastic members 130 are disposed within both sides of the counter weight 140, and it is preferable that the elastic members 130 are coil springs 131 and 132.

[0060] The counter weight 140 is formed in a cylindrical shape and has insertion grooves 141 and 142 formed at both sides thereof for allowing the insertion of the elastic members 130. The insertion grooves 141 and 142 have a predetermined depth and a spiral groove structure in a circumferential direction to allow a smooth insertion of the coil springs 131 and 132.

[0061] Additionally, the counter weight 140 performs a reciprocating motion along the guide pin 120, but does not cause a change in amplitude of the counter weight 140 by friction because a contact area between the counter weight 140 and the guide pin 120 is smaller than those of the prior arts.

[0062] The striker 43 of the hammer drill 1 performs a reciprocating motion in order to perforate or crush an object (concrete, stones, or the likes), and in this instance, vibration energy produced from the tool body 10 is transferred to the first vibration reducing means 100 in a transverse direction of the tool body 10 (from the left to the right in the drawings), to thereby reduce the vibration of the tool body 10 in the resonant frequency band.

[0063] In this instance, the resonant frequency of the first vibration reducing means 100 can be controlled by mass of the counter weight 140 and spring constant of the coil springs 131 and 132, which are the elastic members 130, inside the case 110 of the first vibration reducing means 100. That is, the vibration of the tool body 10 can be reduced by attuning natural frequency of the tool body 10 produced by the reciprocating motion of the striker 43 with resonant frequency of the first vibration reducing means 100.

[0064] In addition, the counter weight 140 is made of, for instance, brass and can be controlled in mass by changing its shape and size. Moreover, the counter weight 140 is guided along the guide pin 120, and hence, can be constructed of simple components without needing expensive components, such as a cylinder.

[0065] In the meantime, the hammer drill 1 according to the present invention can attenuate the vibration of the high intensity by the first vibration reducing means 100 and attenuate the vibration of the low intensity by the second vibration reducing means 200 because the first vibration reducing means 100 cannot effectively reduce the vibration of the low intensity as the counter weight 140 of the first vibration reducing means 100 is not operated smoothly when the vibration of the low intensity is generated.

[0066] As shown in FIGS. 6 and 8, in order to prevent the vibration transferred to a hand-grip part 12 joined to one side of the tool body 10, the second vibration reducing means 200 of the present invention are respectively disposed on the upper portion of the tool body 10 and the lower portion of the hand-grip part 12.

[0067] In more detail, the structure of the upper portion of the hand-grip part 12 will be described. As shown in FIG. 6, the hand-grip part 12 includes a holder 210 spaced apart from the side 10a of the tool body 10 within the hand-grip part 12. A vibration damping part 220 is disposed between the side 10a of the tool body 10 and the holder 210.

[0068] Moreover, a pair of insertion tubes 10b are protrudingly formed on the side 10a of the tool body 10 at a predetermined interval from each other, and the hand-grip part 12 has sleeves 12a that extend from the inside thereof in such a way as to pass through the holder 210 and are slidably joined to the insertion tubes 10b through slide holes 10c formed in the insertion tubes 10b.

[0069] The sleeves 12a, which pass through the holder 210, are joined to the holder 210. In other words, the sleeves 12a are joined integrally with the holder 210.

[0070] Furthermore, the sleeves 12a are joined inside the slide holes 10c of the insertion tubes 10b at an interval (d1) between the sleeves 12a and the slide holes 10c, and are joined and fastened to the hand-grip part 12 by means of fastening members 211, such as bolts or screws.

[0071] Additionally, a cover 13 is joined to the sides of the insertion tubes 10b and the sleeves 12a to thereby prevent penetration of dust during working, to protect the inside of the hammer drill, and to allow the movement of the tool body 10 relative to the hand-grip part 12 according to the vibration generated during the operation of the hammer drill 1.

[0072] That is, the cover 13 is formed in a zigzag type (or bellows type) and is made of rubber material or sponge to provide elasticity.

[0073] Accordingly, when the hammer drill 1 is operated and generates vibration, because there is the interval (d1), the sleeves 12a slide smoothly without any friction between the insertion tubes 10b of the tool body 10 and the sleeves 12a, and hence, the hammer drill 1 can reduce the vibration while the tool body 10 moves even though the vibration generated from the striking part 40 is transferred.

[0074] Meanwhile, as shown in FIG. 7, the vibration damping part 220 includes a buffering member 221 made of rubber, an elastic member 222 resiliently mounted inside the buffering member 221, and support plates 223 made of metal and adapted to support both ends of the elastic member 222.

[0075] Moreover, the support plates 223 are flat plates and inserted into the buffering member 221 and fixed to both sides of the buffering member 221 to support both ends of the elastic member 222 and not to damage the inner wall surface of the buffering member 221 by the elastic member 222.

[0076] The elastic member 222 is a coil spring and is arranged in such a way as to serve a buffer function in a direction that the vibration by striking is transferred.

[0077] The second vibration reducing means 200 disposed on the upper portion of the hand-grip part 12 is located at the same position as the striking part 40 or slightly above the striking part 40, and serves to connect the tool body 10 of the hammer drill 1 and the hand-grip part 12 with each other and to reduce the vibration.

[0078] FIG. 8 is an enlarged plan sectional view of the part C of FIG. 1, showing the lower portion of the hand-grip part 12. FIG. 8 illustrates second vibration reducing means 20 with another structure disposed on the lower portion of the hand-grip part 12.

[0079] In detail, buffering parts 230 are disposed at both sides of the lower portion of the tool body 10 (in FIG. 8, the buffering parts are shown at upper and lower portions), and each includes: a buffering member 231 inserted into a lower side 12b of the hand-grip part 12; a tube 232 passing through the buffering member 231 and fit to a lower side 10d of the tool body 10; and a fastening member 233, such as a screw or a bolt, passing through the tube 232 and fastened to the tube 232.

[0080] Furthermore, it is preferable that the buffering member 231 is made of rubber to provide an effective buffering function.

[0081] Additionally, the tube 232 is made of steel, and may be inserted into the buffering member 231 and molded integrally with the buffering member 231. In addition, the tube 232 can firmly keep a fastening force of the fastening member 233 joined into the tube 232 because the tube 232 is made of steel.

[0082] A joining hole 10e is formed in the lower side 10d of the tool body 10, to which the buffering member 231 of the buffering part 230 is inserted, and the fastening member 233 is joined and fixed to the joining hole 10e.

[0083] Moreover, the lower side 12b of the hand-grip part 12 is inserted into the lower side 10d of the tool body 10 at an interval (d2) between the lower side 12b and the lower side 10d. Accordingly, when the vibration is transferred from the tool body 10, the tool body 10 can move in a state where the hand-grip part 12 is fixed without any friction due to the interval (d2) between the tool body 10 and the hand-grip part 12, and the tube 232 and the fastening member 233 can move while pushing the buffering member 231 at the same time when the tool body 10 moves by the vibration because the buffering member 231 is joined on the inner face of the lower side 12b of the hand-grip part 12. Accordingly, the vibration by striking can be relieved without being directly transferred to the hand-grip part 12.

[0084] However, the buffering member 231 is in contact with the lower side 10d of the tool body 10 after passing through the lower side 12b of the hand-grip part 12. Therefore, it can prevent a lateral movement of the hand-grip part 12 from the tool body 10.

[0085] If the buffering member 231 is arranged apart from the lower side 10d of the tool body 10 at a predetermined interval, it can provide a vibration-reducing effect by the tool body 10, which moves according to the vibration, because there is no friction when the tool body 10 moves, but the hand-grip part 12 may be moved laterally, and hence, it is preferable that the buffering member 231 is in contact with the lower side 10d of the tool body 10.

[0086] However, because the buffering member 232 is made of rubber or sponge with elasticity, when the tool body 10 moves by the vibration, friction may be produced between the bottom surface of the buffering member 232 and the lower side 10d of the tool body 10, and it may disrupt the movement of the tool body 10, but the buffering member 232 does not absolutely disrupt the movement of the tool body 10 because it is made of an elastic material with no rigidity.

[0087] In the second vibration reducing means 200 disposed on the upper portion where the tool body 10 and the hand-grip part 12 are joined with each other, the interval (d1) formed between the insertion tube 10b of the tool body 10 and the sleeve 12a extending from the hand-grip part 12 is equal to or larger than the interval (d2) formed between the lower side 10d of the tool body 10 and the lower side 12b of the hand-grip part 12, which are disposed on the lower portion.

[0088] If the interval (d1) of the upper portion is smaller than the interval (d2) of the lower portion, in an aspect of the structure of the hammer drill 1, because the striking part 40 for generating vibration is arranged on the upper portion, it is difficult to effectively reduce the vibration because the main vibration is transferred to the upward direction of the tool body 10.

[0089] Of course, if the intervals (d1) and (d2) have sufficient lengths, it can provide an excellent vibration reducing effect because there is no possibility to cause friction, but it is required to keep proper lengths of the intervals (d1) and (d2) because the hand-grip part 12 may be moved laterally.

[0090] Therefore, if the interval (d1) of the upper portion to which the main vibration is transferred is greater than the interval (d2) of the lower portion, it can minimize the lateral movement of the hand-grip part 12 and provide more vibration reducing effect than the case that the intervals (d1) and (d2) have the same length.

[0091] In other words, in order to provide good vibration reducing effect and prevent the lateral movement of the hand-grip part 12, the interval (d2) of the lower portion is set to the minimum length and the interval (d1) of the upper portion is set to a length to effectively reduce the vibration and prevent the lateral movement of the hand-grip part 12.

[0092] Also the case that the intervals (d1) and (d2) have the same length can reduce the vibration and prevent the lateral movement of the hand-grip part 12, but because the vibration is mainly transferred to the upper portion of the tool body 10, it is preferable that the interval (d1) of the upper portion is set to the maximum length for allowing a smooth sliding motion with no friction and the interval (d2) of the lower portion is set to the minimum length for allowing the sliding.

[0093] In the case that the intervals (d1) and (d2) have the same length, if the interval (d1) of the upper portion is set according to the interval (d2) of the lower portion, it may disrupt the smooth sliding motion of the tool body 10 due to the vibration transferred to the upper portion, or if the interval (d2) of the lower portion is set according to the interval (d1) of the upper portion, it allows the smooth sliding motion but causes the lateral movement. Therefore, it is preferable that the interval (d1) of the upper portion is greater than the interval (d2) of the lower portion.

[0094] When the hammer drill 1 is operated and vibration is generated by a striking motion of the striker 43, the vibration of the tool body 10 is transferred to the first vibration reducing means 100 to thereby first reduce the vibration. Additionally, the counter weight 140 disposed within the case 110 moves along the guide pin 120 by the vibration, and in this instance, because the coil springs 131 and 132 of the elastic member 130 are respectively inserted and resiliently mounted in the insertion grooves 141 and 142 formed at both sides of the counter weight 140, the coil springs 131 and 132 serve a buffering function according to the movement of the counter weight 140 to thereby reduce the vibration.

[0095] Such a first vibration reducing means 100 is effective when vibration of high intensity is generated, but in the case that vibration of low intensity is generated, the movement of the counter weight 140 of the first vibration reducing means 100 is decreased, and hence, it cannot effectively reduce the vibration and the vibration may be transferred to the hand-grip part 12 as it is. In this instance, the second vibration reducing means 200 disposed at the upper portion and the lower portion where the tool body 10 and the hand-grip part 12 are joined with each other can effective reduce the vibration of low intensity.

[0096] That is, as shown in FIG. 6, the buffering member 221 that is mounted on the upper portion of the tool body 10 and disposed between the side 10a of the tool body 10 and the holder 210 can reduce the vibration, and the elastic member 222 resiliently mounted inside the buffering member 221 can additionally reduce the vibration.

[0097] Furthermore, as shown in FIG. 7, because the lower portion of the hand-grip part 12 is joined with the lower side 10d of the tool body 10 through the buffering part 230, the vibration can be reduced.

[0098] Because the buffering part 230 has the buffering member 231 that is made of rubber and passes through the hand-grip part 12 and the lower side 10d of the tool body 10, the buffering member 231 absorbs the movement of the tool body 10 to thereby reduce the vibration even though the vibration is transferred.

[0099] Additionally, because the lower side 10d of the tool body 10 is fit to the lower side 12b of the hand-grip part 12 with the interval (d2), the tool body 10 slides smoothly in the same direction as the vibration direction by striking in a state where the hand-grip part 12 is fixed, so that it can effectively prevent the vibration.

[0100] If the lower side 10d of the tool body 10 and the hand-grip part 12 are joined and fixed integrally, the vibration generated from the tool body 10 is transferred to the hand-grip part 12 as it is, and hence, a user feels fatigue due to the vibration transferred to the user's hand and work efficiency is deteriorated. However, as described above, the lower side 10d of the tool body 10 and the lower side 12b of the hand-grip part 12 are joined with the interval (d2), and hence, the tool body 10 can move coping with the vibration and the vibration is not transferred to the user's hand.

[0101] While the present invention has been described with reference to the particular illustrative embodiment, it is not to be restricted by the embodiment but only by the appended claims. It is to be appreciated that those skilled in the art can change or modify the embodiment without departing from the scope and spirit of the present invention.

Claims

1. A power tool comprising: first and second vibration reducing means (100, 200) disposed within a tool body (10) and a hand-grip part (12) in order to reduce vibration generated when crushing work or perforating work is carried out while a striking motion and a rotating motion are performed simultaneously or

while only the striking motion is performed,
wherein the first vibration reducing means (100) is disposed on at least one side of the tool body (10), and comprises:

a guide pin (120);
elastic members (130) resiliently mounted on the outer circumferential surface of the guide pin (120) and expanding and contracting along a vibration direction; and
a counter weight (140) that the elastic members (130) are inserted and supported into both sides thereof and the guide pin (120) passes therethrough, the counter weight (140) moving along the guide pin (120) while expanding and contracting the elastic members (130) in order to reduce the vibration, and
wherein the second vibration reducing means (200) is disposed inside the upper portion of the power tool where the tool body (10) and the hand-grip part (12) are in contact with each other and are joined with each other in a slidably movable manner, and comprises:
a vibration damping part (220) disposed between the tool body (10) and the hand-grip part (12) for absorbing the vibration.

2. The power tool according to claim 1, wherein the first vibration reducing means (100) comprises a case (110) for supporting the guide pin (120) and accommodating and sealing the elastic members (130) and the counter weight (140).

3. The power tool according to claim 1, wherein the counter weight (140) comprises insertion grooves (141, 142) formed on both sides thereof in a circumferential direction for inserting a part of each of the elastic member (130) thereinto.

4. The power tool according to claim 1, wherein the guide pin (120) comprises rings (121) disposed at both end portions thereof for preventing movement of the guide pin (120) and serving a buffering function when the counter weight (140) collides with the case (110) due to the counter weight's movement by large amplitude.

5. The power tool according to claim 1, wherein the hand-grip part (12) comprises a holder (210) spaced apart from the side of the tool body (10) within the hand-grip part (12) for supporting the vibration damping part (220).

6. The power tool according to claim 1, wherein a sleeve (12a) that extends from the inside of the hand-grip part (12) in such a way that the tool body (10) is slidably movable when vibration is generated is joined to the inner side of the tool body (10) with an interval between the sleeve (12a) and the tool body (10), so that the tool body (10) and the hand-grip part (12) are joined by means of a fastening member (113).

7. The power tool according to claim 1, wherein the vibration damping part (220) comprises a buffering member (221) serving a buffering function and an elastic member (130) resiliently mounted inside the buffering member (221).

8. The power tool according to claim 1 or 7, wherein the vibration damping part (220) further comprises support plates (223) for supporting both ends of the elastic member (130).

9. The power tool according to claim 1, wherein a cover (13) that expands and contracts according to movement of the tool body (10) when the vibration is generated is joined to the first vibration reducing means (100), which is disposed on the upper portion where the tool body (10) and the hand-grip part (12) are joined.

10. The power tool according to claim 1, further comprising another second vibration reducing means (200) disposed on the lower portion where the tool body (10) and the hand-grip part (12) are joined, wherein the lower side (10d) of the tool body (10) and the lower side (12b) of the hand-grip part (12) are joined with each other with an interval therebetween to thereby prevent the vibration.

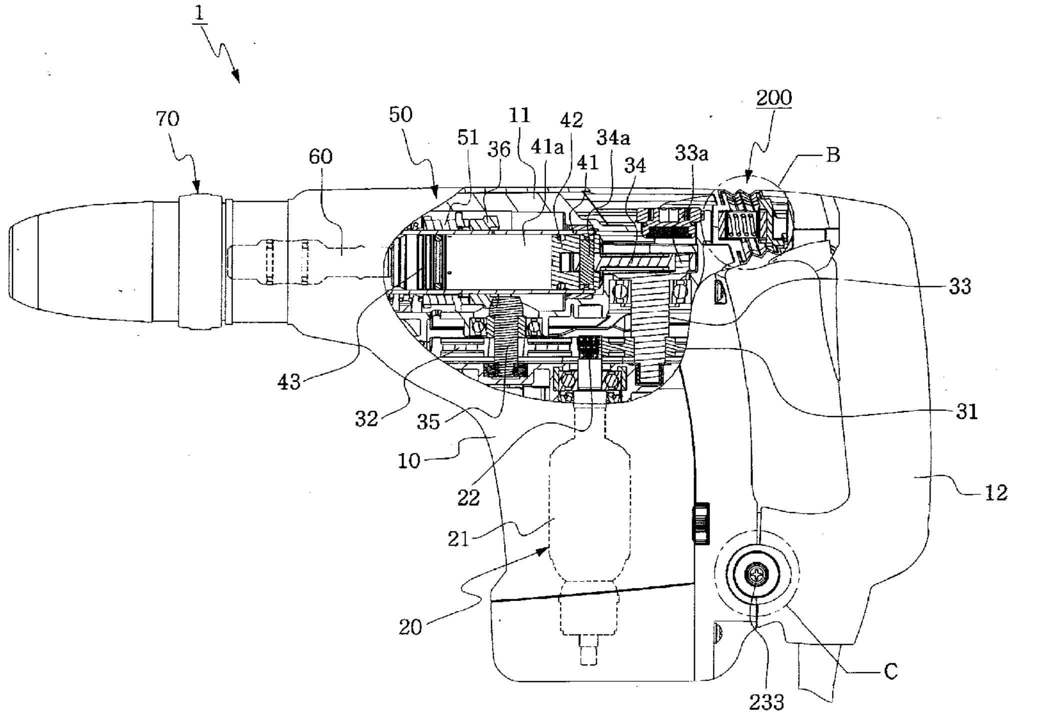
11. The power tool according to claim 10, wherein the second vibration reducing means (200) disposed on the lower portions of the tool body (10) and the hand-grip part (12) comprises:

a buffering member (221) fit into the lower side (12b) of the hand-grip part (12); and
fastening member (113) passing through the buffering member (221) and joined to the buffering member (221).

12. The power tool according to claim 11, wherein the buffering member (221) passes through the lower side (12b) of the hand-grip part (12) and joined to the lower side (10d) of the tool body (10) in a state where the buffering member (221) is in contact with the lower side (10d) of the tool body (10).

13. The power tool according to claim 11 or 12, wherein the second vibration reducing means (200) further comprises a tube (232) disposed between the buffering member (221) and the fastening member (113) for keeping a fastening force.

【Fig. 1】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42
41
34a
34
33a
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B
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32
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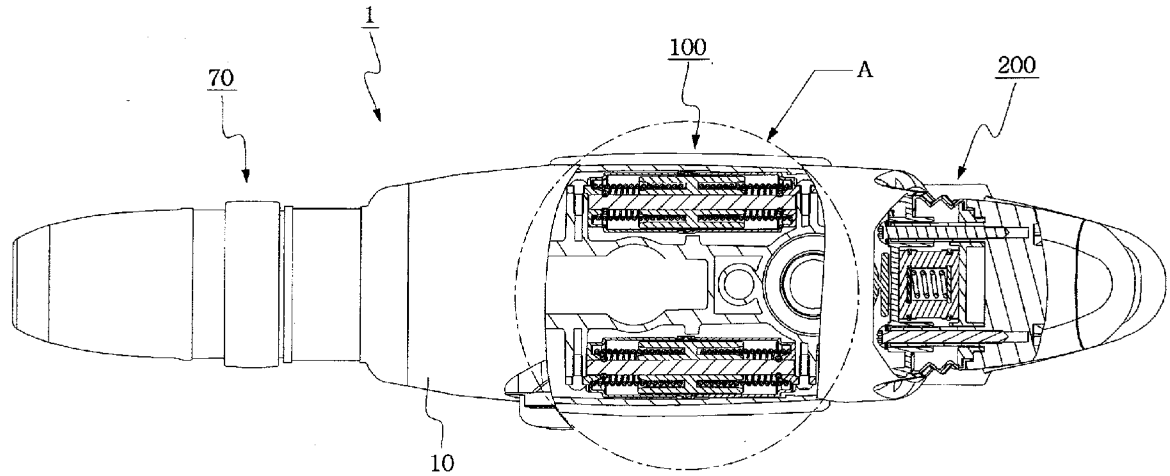
31
10
22
12
21
20
C
233

【Fig. 2】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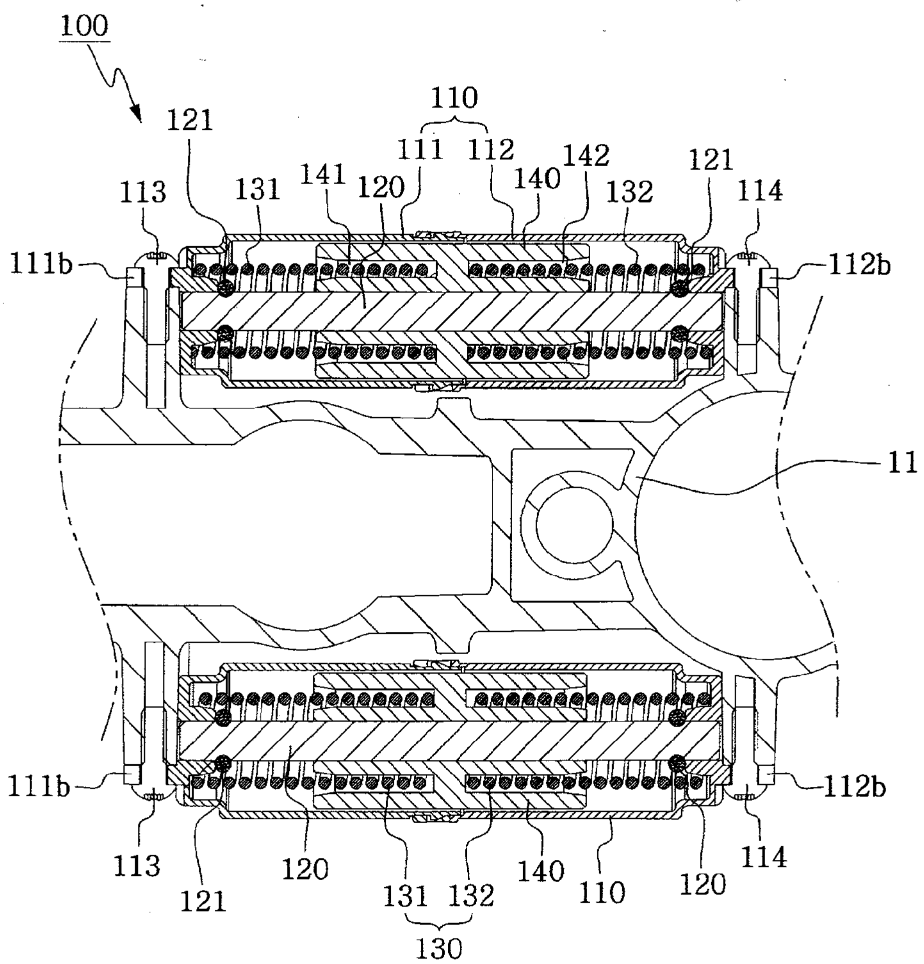
200
10

【Fig. 3】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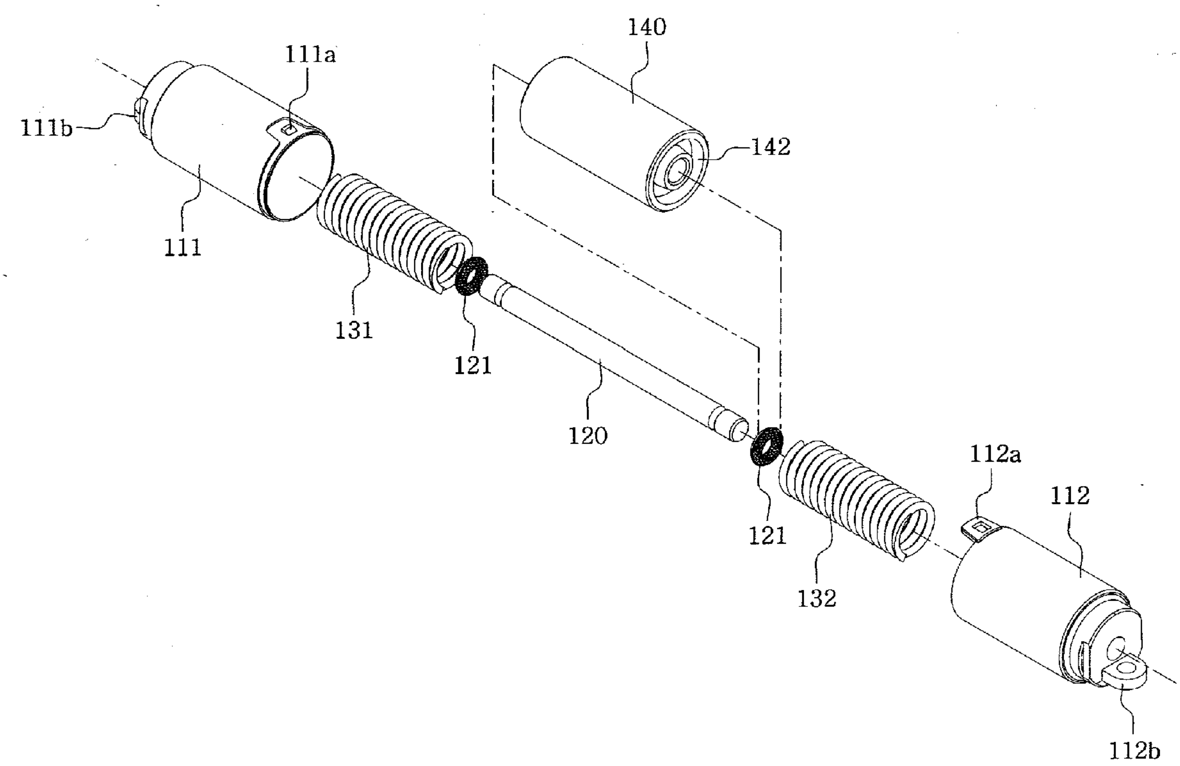
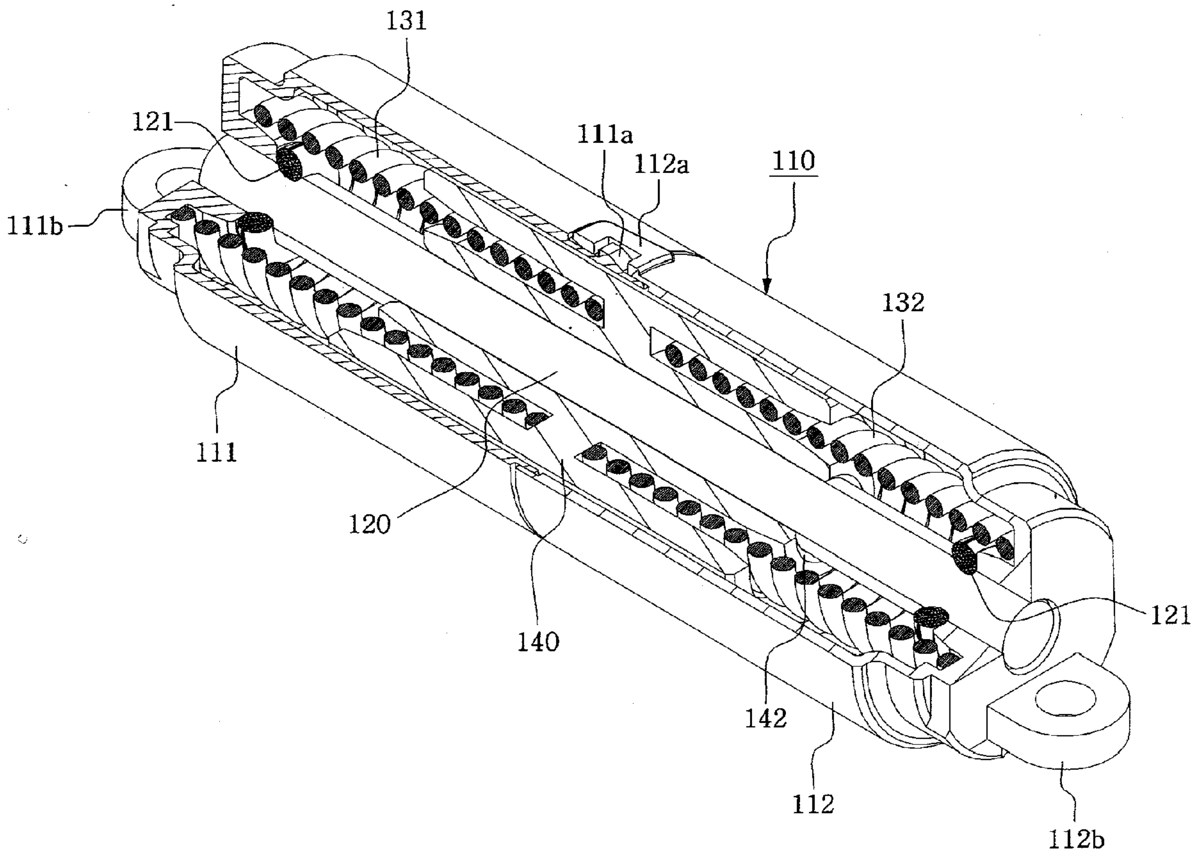
120
114

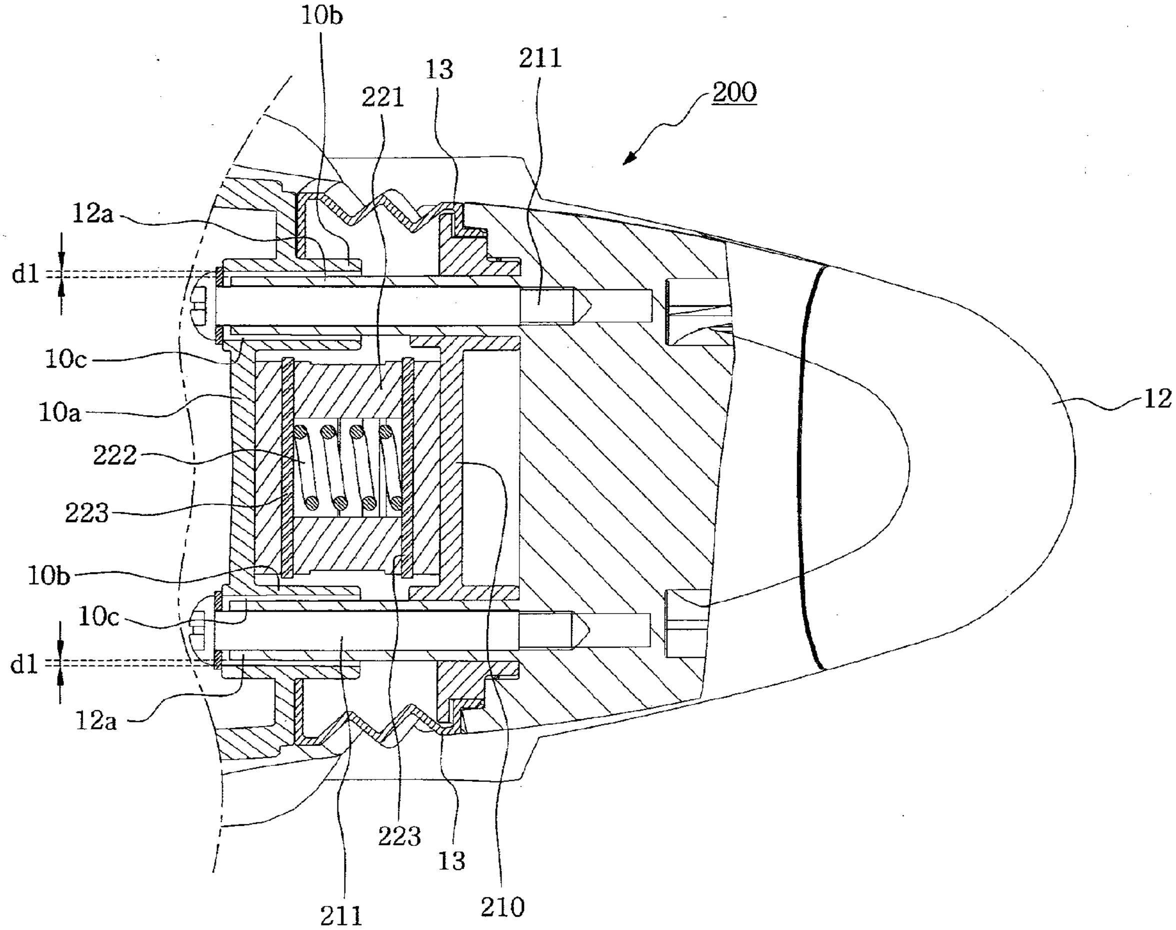
【Fig. 4】



【Fig. 5】



【Fig. 6】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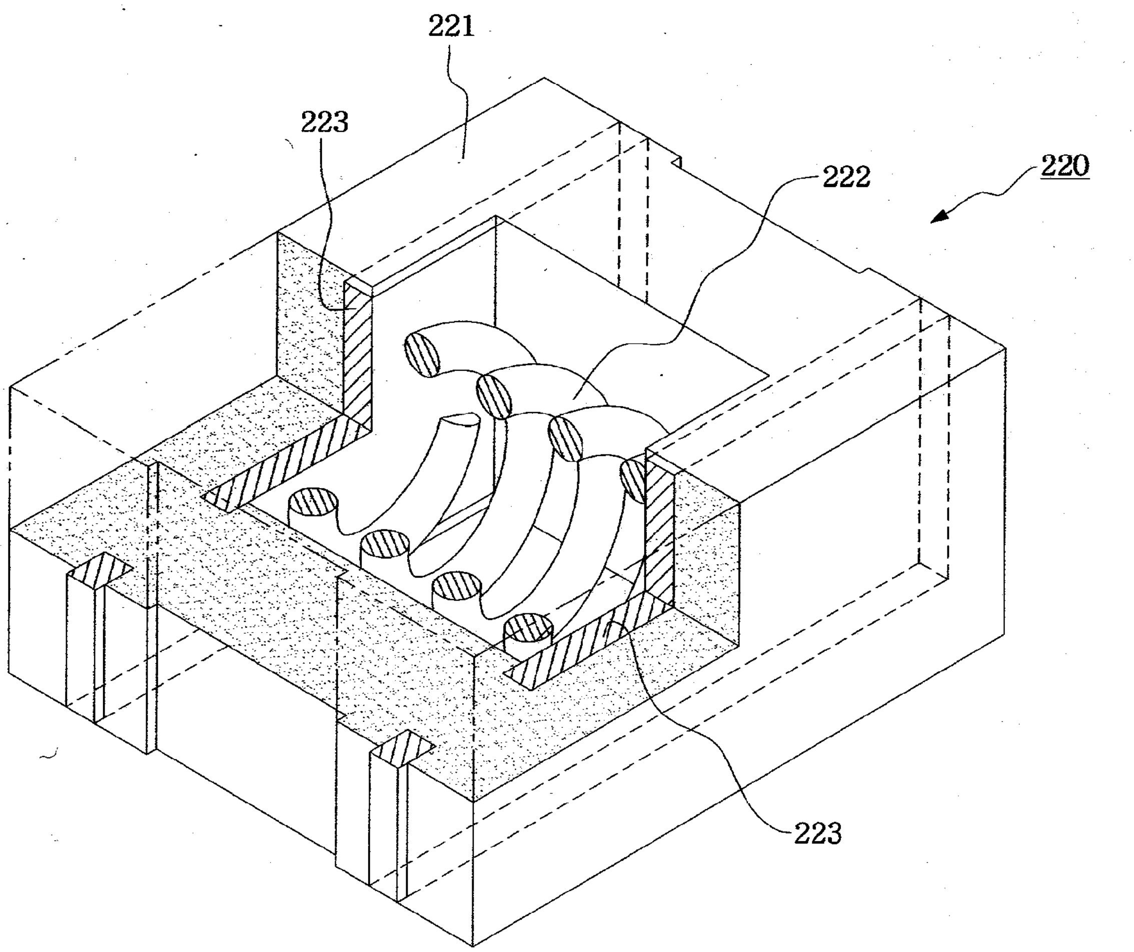
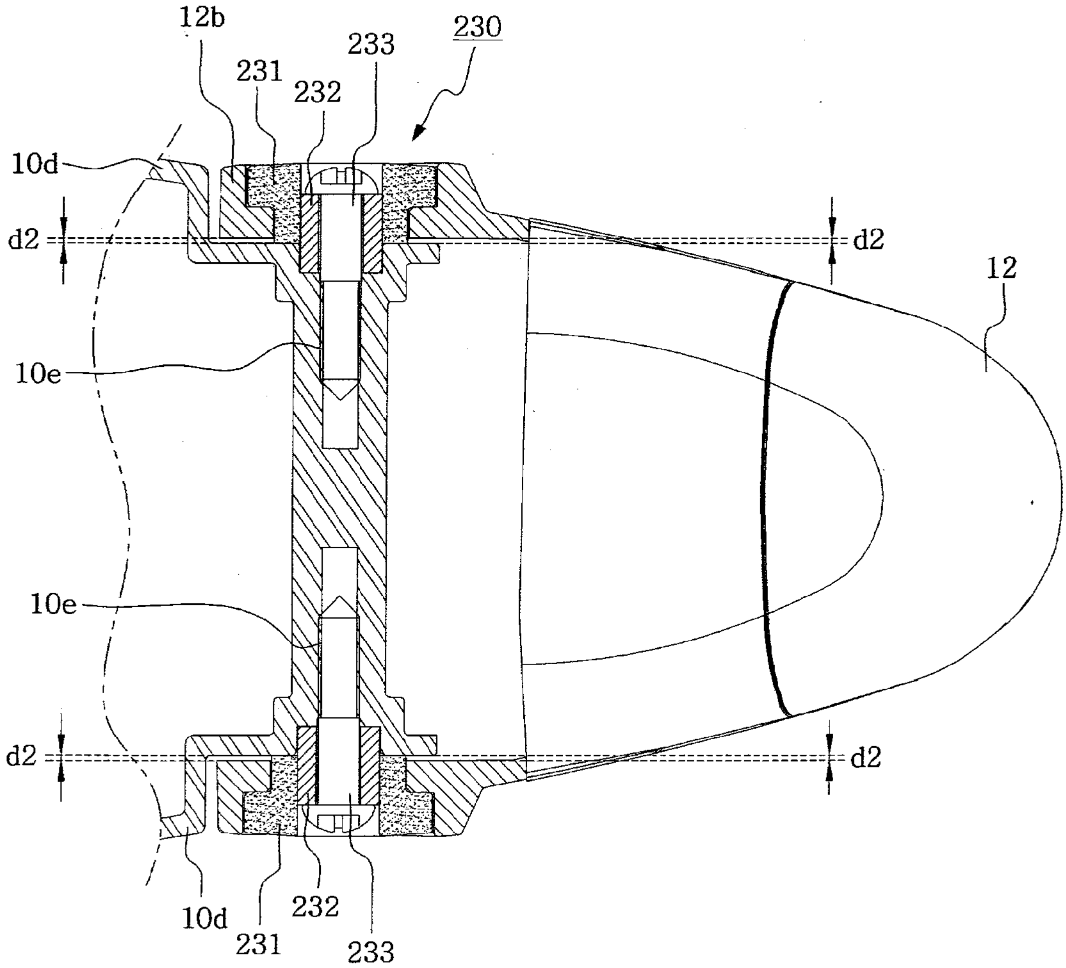
211
221
200
12a
d1
10c
10a
12
222
223
10b
10c
d1
12a
223
13
211
210

【Fig. 7】



【Fig. 8】



REFERENCES CITED IN THE DESCRIPTION

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