OPTICAL PICK-UP APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to an optical pick-up apparatus. More specifically, this invention relates to an optical pick-up apparatus for recording/reproducing information onto/from an optical disk, optomagnetic disk, etc.

A conventional optical pick-up apparatus includes an objective lens for focusing write/read beams onto an optical disk. The focused beam is sent onto the surface of the optical disk and moved into a tracking direction of the optical disk. For this control, the objective lens is provided in the apparatus in a way that it is movable in a focusing direction, or a direction along the optical axis of the objective lens. The optical lens is also movable in a tracking direction orthogonal to the focusing direction.

There are several conventional ways of movably carrying the objective lens in the optical pick-up apparatus, such as a spring-type and reciprocating type apparatus. Japanese Patent Laid-Open No. 63-104227 discloses an optical pick-up apparatus of four wire-type of movably carrying the objective lens in the apparatus which is advanced compared to those types.

Such an optical pick-up apparatus of four wire-type will be described with reference to Figs. 1 and 2.

In the figures, fixed on a cylindrical movable member 1 are an objective lens 2 and a balancer 3 provided so as to balance the objective lens 2. The movable member 1 is carried between two pair of upper and lower wires 5. Two wires of each pair cross each other and are placed in the apparatus as surrounded by four pillars 4. A focusing coil 6 is wound around an outer surface of the movable member 1. Further, a tracking coil 7 is wound around a part of the focusing coil 6. The focusing and tracking

coils 6 and 7 generate magnetic flux crossing each other. A pair of yokes 8 are provided outside the coils 6 and 7. A pair of yokes 9 are inserted into slots formed in the movable member 1. Each yoke 8 is provided with a magnet 10.

Control of currents passing through the coils 6 and 7 causes interaction of magnetic flux generated by these coils and magnet 10. This interaction moves the objective lens 2 in the focusing direction (up and down directions in Fig. 1) and the tracking direction.

An optical pick-up apparatus requires several fine characteristics to access an optical disk by moving an objective lens. Such characteristics are access stability of the objective lens movably supported by wire springs, dynamic balance, shock dumping, wire elasticity, servo accuracy, etc.

Several Japanese Patents or Utility Models disclose optical pick-up apparatuses with better characteristics, such as dynamic balance and shock dumping. Among them are: Japanese Utility Model Laid-Open No. 3-14721 (four spring members fixed on a balancer and an objective lens facing the balancer via magnet), Japanese Patent Laid-Open No. 2-232824 (jelly dumping material provided at a part holding a pin for supporting a lens holder), Japanese Patent Laid-Open No. 3-54736 (silicon rubber filled in a hole of a fixed plate) and Japanese Patent Laid-Open No. 3-212826 (a dumper case with silicon rubber suspended by a wire).

Further, there are Japanese Patents or Utility Models of optical pick-up apparatuses with uniquely shaped wires or uniquely suspended wires against resonant frequencies. Among them are: besides Japanese Utility Model Laid-Open No. 3-14721, Japanese Patent Laid-Open No. 60-197942 (V-shaped wires), Japanese Patent Laid-Open No. 62-137732 (wires crossing each other), Japanese Patent Laid-Open No. 63-119029 (wires twisted together), Japanese Patent Laid-Open No. 63-27118 (wires like a hollow pipe) and Japanese Patent Laid-Open No. 1-243246 (an H-shaped

wire holding member, two wires being deformed in directions orthogonal to each other). Further, Japanese Patent Laid-Open No. 3-125336 discloses an optical pick-up apparatus with a flexible printed board for holding wires against a resonant frequency.

The optical pick-up apparatuses listed above have such drawbacks as follows:

The dumping mechanism provided on a fixing member with V-shaped wires exhibits low dumping effect. This mechanism requires a balancer but with difficulty in adjustment. Provision of a balancer on a location separated from a movable member or in a dumper case also separated therefrom exhibits low balancing effect and causes low productivity.

The wire suspension mechanism cannot control occurrence of free oscillation at the natural frequency or controls it only in a narrow range. Further, this mechanism has a difficulty in exhibiting different resonant frequencies in focusing and tracking.

Usage of wires, such as wires like a hollow pipe, increases production cost. The H-shaped wire holding member of Japanese Patent Laid-Open No. 1-243246 which may have a thin member provided close to the wire holding member causes low productivity. Further, this holding member controls resonant (or natural) frequency only in a very narrow range. Because one end of the holding member is fixed close to an objective lens. Further, the wires are provided parallel to each other.

Provision of a flexible printed board for holding wires has a difficulty in wire attachment to the printed board. For example, vertical attachment of suspended wires onto the printed board requires the operations: drilling small holes in the printed board and inserting the wires into the holes. The difficulty lies insertion of the same length wires at the same time or in order. This causes low operationability and hence increases production cost. This goes against a strong demand for lower production cost in

the pick-up industry with intense cost competition.

The inventors of the present invention have disclosed an optical pick-up apparatus in Japanese Patent Application No. 6-34119 to solve those problems. The optical pick-up apparatus has such configuration that a supporting member made of wire is fixed on a specific location and a dumper block is placed close to the supporting member. The apparatus has better dynamic balance, shorter access settling time and higher dumping effect. The access settling time is a period of time in which the vibration of an objective lens caused by lateral gravitational acceleration generated when the objective lens is moved in the tracking direction attenuates a specific level.

High-speed reproduction has been achieved with the improvement of a recording medium, such as CD-ROM, a reproducing apparatus, etc. The higher the reproduction speed, the higher the operation frequency in focusing and tracking. It has been revealed in the inventors' conventional apparatus that as shown in Fig. 3 resonance R1 occurs at a high frequency. While this apparatus exhibits preferable frequency characteristics in low and intermediate frequency bands at which the apparatus is usually operated. This makes longer the access settling time in a high frequency band.

SUMMARY OF THE INVENTION

A purpose of the present invention is to provide an optical pick-up apparatus with restriction on occurrence of resonance in a high frequency band.

Another purpose of the present invention is to provide an optical pick-up apparatus with better frequency characteristics in an intermediate frequency band.

In order to solve the problems, the present invention provides an optical pick-up apparatus comprising: an objective lens for focusing read/write beams onto a specific position on an optical disk; a movable member on

which the objective lens is mounted; means for moving the movable member to move the objective lens in a direction of the optical axis of the objective lens and another direction perpendicular to the optical axis direction; and an elastic member for connecting the objective lens and the movable member.

The optical pick-up apparatus may further comprise: a container provided on the movable member for containing the elastic member and the objective lens in a way that the elastic member is contained on the bottom of the container and the objective lens is located on the elastic member; and a protruding member formed in the container by which the elastic member is subjected to a predetermined thickness.

The elastic modulus of the elastic member may range from 0.5 to 5 kg/cm^2. The thickness of the elastic member may range from 0.05 to 0.2 mm. The elastic member is made of material including epoxy resin adhesive, urethane adhesive, or silicon adhesive.

Further, the present invention provides an optical pick-up apparatus comprising: an objective lens for focusing read/write beams onto a specific position on an optical disk; a movable member on which the objective lens is mounted; means for moving the movable member to move the objective lens in a direction of the optical axis of the objective lens and another direction perpendicular to the optical axis direction; a balance weight mount provided on the movable member so as to face the objective lens; and an elastic member for connecting the balance weight and the mount. The elastic member may be made of material including silicon adhesive.

Further, the present invention provide an optical pick-up apparatus comprising: an objective lens for focusing read/write beams onto a specific position on an optical disk; a movable member on which the objective lens is mounted; a holding member for swingably holding the

movable member by means of suspension wires; means for moving the movable member to move the objective lens in a direction of the optical axis of the objective lens and another direction perpendicular to the optical axis direction; and a dumper provided close to the suspension wires, for preventing vibration of the fixed member from occurrence while operation in the optical axis direction and the other direction. The dumper may be made of material including silicon rubber.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded view of a conventional optical pick-up apparatus;

Fig. 2 is a top view of the conventional apparatus shown in Fig. 1;

Fig. 3 is a graph representing the amplitude-frequency characteristics of another conventional optical pick-up apparatus disclosed by the inventor of the present invention;

Fig. 4 is a perspective view of suspension base attachment of the first preferred embodiment of an optical pick-up apparatus according to the present invention;

Fig. 5 is a top view of the first preferred embodiment;

Fig. 6 is a schematic front view of the apparatus shown in Fig. 4;

Fig. 7 is a fragmentary sectional view of the major portions of the apparatus shown in Fig. 5;

Fig. 8 is a fragmentary enlarged view of the view shown in Fig. 7;

Fig. 9 shows a modification of the major portions shown in Fig. 7;

Fig. 10 is a graph representing the amplitude-frequency characteristics of the first preferred embodiment;

Fig. 11 is an enlarged top view of major portions of the second preferred embodiment of an optical pick-up

apparatus according to the present invention;

Fig. 12 is a sectional view of the view along the line A - A in Fig. 11;

Fig. 13 shows a modification of the portions shown in Fig. 12;

Figs. 14A and 14B are graphs representing the output- and phase-frequency characteristics, respectively, of a conventional apparatus;

Figs. 15A and 15B are graphs representing the output- and phase-frequency characteristics, respectively, of the second preferred embodiment;

Fig. 16 is an enlarged top view of major portions of the third preferred embodiment of an optical pick-up apparatus according to the present invention;

Fig. 17 shows a modification of the container shown in Fig. 16;

Figs. 18A and 18B are graphs representing another output- and phase-frequency characteristics, respectively, of the conventional apparatus; and

Figs. 19A and 19B are graphs representing the output- and phase-frequency characteristics, respectively, of the third preferred embodiment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will be described with reference to the attached drawings.

As shown in Fig. 4, an optical pick-up apparatus as the first preferred embodiment includes a fixed base plate 11 with a range 12 that stands out from an edge of the base plate 11. A suspension base 14 is attached to the range 12 at the center inner surface of the suspension base 14. A fixing plate 13 is further attached to the suspension base 14. The fixing plate 13 and the suspension base 14 are fixed to the range 12 by a screw 22 with a washer W. The range 12 and fixing plate 13 consist of a fixing member 15.

The suspension base 14 has empty spaces 17a and 17b

as shown in Fig. 5. The empty spaces are formed at the edge of the suspension base 14 connected to the fixing plate 13 except at the middle portion of the edge. Further, the empty spaces 17a and 17b are slightly distant from the fixing plate 13. The empty spaces are respectively filled with dumpers 18a and 18b made of gel or rubber stable against temperature fluctuation. High dumping effect can be achieved by connecting the fixing plate 13 and suspension base 14 through the dumpers 18a and 18b.

Suspension wires 20a and 20b (totally four wires not shown though) are fixed on the fixing plate 13 as shown Fig. 5. One pair of the upper wire 20a and a lower wire 20c are laterally extended to hold a moving member 40 at ends of the wires as shown in Fig. 6. The moving member 40 is held by the flexible four suspension wires and can be moved by a slight force given at the ends of the wires. The wires 20a and 20b are provided to shape a capital letter "V" towards the fixing plate 13 as shown in Fig. 5. The suspension base 14 and moving member 40 have grooves 21a and 21b through which the wires 21a and 21b pass, respectively.

The moving member 40 has, as shown in Fig. 5, a lens holder 24 for holding the objective lens 23. Further, the moving member 40 has a holder plate 25 made of a printed board, for example, to which the ends of the wires 20a and 20b are connected at the positions close to the center of the holder plate 25. These positions are located so as to face the objective lens 23 over the imaginary wire-crossing point O on the moving member 40. The point O is the point at which the upper wires 20a and 20b (and the lower wires) cross each other when extended.

A pair of ring focusing coils 26a and 26b are provided symmetrically with the point O as the center on an imaginary line on the lens holder 24. The imaginary line is so placed that it is perpendicular to another imaginary line passing through the objective lens 23, the

point O and the fixing plate 13. A pair of tracking coils 27a and 27b are provided at the respective side faces of the focusing coils 26a and 26b. Two pairs of yokes 28a and 28b, and 28c and 28d stand from the base plate 11. Each yoke pair is provided such that the yokes stand inside and outside of the ring focusing coil so as to have the focusing and tracking coils placed therebetween. The yokes 28a and 28c are provided with magnets 29a and 29b, respectively.

In this configuration, control of a current flowing through the focusing coils moves the lens holder 24 in the direction depicted by the arrow X in Fig. 6, due to magnetic flux interaction. The direction X is the focusing direction, or the optical axis direction of the objective lens 23. Further, control of a current flowing through the tracking coils moves the lens holder 24 in the direction depicted by the arrow Y in Fig. 5. The direction Y is the tracking direction perpendicular to the focusing direction X of the optical disk D.

A portion 30 on the moving member 40 as shown in Fig. 5 functions a dumper block. The portion 30 and the objective lens 23 are separated from the point O by the same distance. The grooves 21a and 21b are formed to carry the respective suspension wires 20a and 20b placed therein so as to avoid interference with the dumper block 30. A subsidiary balancer 31 of mass-adjusted is provided in the center of the dumper block 30 to keep right and left mass balance in Fig. 5. As shown in Fig. 6, turning a bar screw 32 slides the fixing member 15 in its longitudinal direction, or the radius direction the disk D.

The apparatus of the first preferred embodiment employs a unique configuration for containing the objective lens 23 to restrict occurrence of resonance in a high frequency band. As shown in Figs. 7 and 8, a concave lens container 34 is formed in a fixing section 33 of the lens holder 24 to hold the objective lens 23. The lens container 34 has a through hole 35 at its center that goes

through downwards. The through hole 35 is shaped reverse-conical at its upper end. A ring boss 36 with a height L1 is formed on the bottom of the lens container 34 and at the periphery of the upper opening of the through hole 35.

The objective lens 23 is stuck firmly into the lens container 34 with an adhesive applied in the bottom of the container 34 or on the lower surface of the objective lens 23. With the adhesive, an elastic member layer 37 is placed in the fixing section 33. The adhesive is made of substance with an adequate elastic modulus, such as epoxy resin. The elastic layer 37 of such an adhesive restricts occurrence of resonance in a high frequency band.

The elastic modulus for restricting the occurrence of such resonance preferably ranges from 0.5 to 5 kg/cm^2. For further restriction on the resonance, it is preferable to have the elastic layer 37 with thickness ranging from 0.05 to 0.2mm. This thickness (height) can be the same height L1 of the boss 36 on the bottom of the lens container 34 by pressing the objective lens 23 downwardly when fixing the lens 23 in the container 34. A desired thickness of the elastic member layer 37 can be obtained by having the boss 36 with an adequate thickness L1.

When fixing the objective lens 23, an excess of the epoxy resin adhesive is not flown into fixing section 33. An accurate thickness of the elastic layer 37 thus can be obtained. The boss 36 can be obtained by molding. The elastic layer 37 can be made of an urethane adhesive, a silicon adhesive, etc., besides the epoxy resin adhesive.

When the elastic layer 37 is not required to be so accurate in thickness, a lens container 34a without a boss may be formed as shown in Fig. 9. In this case, an epoxy resin adhesive is applied in the bottom of the container 34a or on the lower surface of the objective lens 23 to have the elastic layer 37.

When the optical pick-up apparatus as configured above operates, the lens holder 24 moves in the focusing

(optical axis) and tracking directions to access the disk D. This motion is in response to currents flowing through the focussing and tracking coils. In this access operation, an excess of rotation can be greatly restricted by means of the dumper block 30 and the subsidiary balancer 31 that keep mass balance in right and left in Fig. 5. This improves dynamic balance in both the focusing (optical axis) and tracking directions and shortens the access settling time. Further, connection of the fixing plate 13 and suspension base 14 via the dumpers 18a and 18b restricts resonance while operating to greatly achieve high dumping effect.

In the first preferred embodiment, the objective lens 23 is attached to the lens holder 24 via the elastic layer 37 made of epoxy resin exhibiting dumping effect in a high frequency band. This arrangement restricts occurrence of resonance when accessing in the high frequency band to control quality factors (Q-factor) of electric components used in the optical pick-up apparatus. Provision of the boss 36 on the bottom of the lens container 34 provides the elastic layer 37 with an accurate and adequate thickness L1 to greatly restrict the resonance.

Figure 10 shows the amplitude-frequency characteristics (solid line) of the first embodiment. In a conventional apparatus, a resonance peak R1 (dot line in Fig. 10) occurs in a high frequency band. Contrast to this, the first embodiment provides the elastic layer 37 that cancels such a resonance peak to have the gentle characteristics curve (solid line) as shown.

The elastic layer 37 can be a thin disk elastic layer made of rubber, resin, etc., besides the adhesive explained above. Such a disk elastic layer can be provided at the lower part of the objective lens or the bottom of the lens container.

Next, the second preferred embodiment which will be explained below provides a balance weight elastically fixed

on a movable member to restrict resonance in a high frequency band. The balance weight is provided instead of the elastic layer of the first embodiment.

In the second embodiment, a balance weight container 45 is provided at the edge of a movable member 40 facing a fixing member 15, as shown in Fig. 11. A concave is formed in the balance weight container with thin bottom as shown in Fig. 12. Further, the balance weight container 45 is formed like a trapezoid at its top. Also, in Fig. 11, the container 45 is provided with four spacers 46 close to its corners. The spacers are actually provided in the bottom 45A of the balance weight container 45 as shown in Fig. 12. Each spacer has a tiny area and is very thin, such as 50 μm.

A trapezoidal balance weight 47 is placed over the four spacers 46. The balance weight 47 is a bit smaller than the bottom of the container 45A in area and weighs about 100 mg. The balance weight 47 is so placed in the concave that it does not touch the inner side faces of the container 45.

As shown in Fig. 12, there is a space between the lower surface of the balance weight 47 and the bottom 45A. The space is filled with an elastic connector 48 made of silicon adhesive to elastically fix the balance weight 47. This is the same situation as the case in which the balance weight 47 is placed on a thin elastic layer.

In stead of the elastic connector 48, elastic connectors 48a and 48b, as shown in Fig. 13, can be inserted between the balance weight 47 and the inner side faces of the container 45 to elastically fix the weight 47.

As described above, the balance weight 47 is so fixed in the container 45 via the elastic connector 48 (or the connectors 48a and 48b) that the weight 47 is slightly attached to the spacers 46. These arrangements can greatly restrict occurrence of resonance, particularly in a high frequency band, while the optical pick-up apparatus is operating. This makes possible high-speed access to an

optical disk.

Such resonance restriction effect will be explained with reference to Figs. 14A to 15B. Figs. 14A and 14B show the frequency-output and the frequency-phase characteristics, respectively, in the focusing direction in the conventional apparatus (Japanese Patent Application No. 6-34119). Figs. 15A and 15B show the frequency-output and the frequency-phase characteristics, respectively, in the second preferred embodiment.

In the conventional apparatus, the frequency-output characteristics gets worse in the high frequency band because the resonance P1 appears around 13kHz as shown in Fig. 14A. Further, the phase curve steeply varies around 13kHz as shown in Fig. 14B to get worse in the high frequency band.

Contrary to this, the second embodiment does not exhibit such resonance around 13kHz as shown in Fig. 15A. This greatly improve the frequency-output characteristics in the high frequency band. This improvement is also shown in Fig. 15B.

As shown in Figs. 12 and 13, the balance weight container 45 and the spacers 46 are provided as different parts in the second embodiment. The spacers 46 may be molded on the bottom of the container 45 when molding the movable member 40 with material, such as carbonate. The balance weight 47 is fixed in the container 45 via the spacers 46. This stabilizes the balance weight 47 in the container 45. The spacers 46 further may be shaped as it has a curved top, like a boss. This makes smaller the lower surface area of the balance weight 47 to touch the spacers 46. The balance weight 47 further may be molded with the spacers 46 as protrusions from the lower surface of the weight 47.

As described above, what is required in the second embodiment is that the balance weight 47 is partially fixed in the container 45 with the elastic connector 48 and via the spacers 46. Suppose that the balance weight 47 is

directly attached to the bottom of the container 45 without the spacers 46. This increases the lower surface area of the weight 47 and hence sufficient dumping effect for restricting resonance cannot be expected.

The first and second preferred embodiments are especially for restricting the occurrence of resonance in the high frequency band. The third embodiment below is, in addition to that, for restricting the occurrence of resonance in an intermediate frequency band. This is achieved by improvement of providing a dumper between a fixing plate and a suspension base.

The third preferred embodiment according to the present invention will be explained with reference to Figs. 16 to 19B.

As shown in Fig. 16. a suspension base 14 is fixed between a attaching plate 12 and a fixing plate 13 through a screw 22 at the center of the base 14. The suspension base 14 is so shaped that it is extended right and left (up and down directions in the figure). The base 14 is further shaped to have arms 14a and 14b separated from each other by a distance slightly more than the distance between arms of the fixing plate 13. The fixing plate 13 is roughly squared at its both ends to which adhered are ends of suspension wires 20a and 20b. The wires 20a and 20b hold a movable member 40 so that it can swing.

Each of the arms 14a and 14b is formed a square container 50 at its end. The container 50 encloses one of the square ends of the fixing plate 13 in at least two directions. One direction is that the movable member 40 is located in this direction (right and left in Fig. 16). The other direction is orthogonal to the former direction.

The suspension base 14 and the fixing plate 13 are so arranged that the inner square faces of each container 50 and the square faces of one end of the plate 13 are separated by a distance L4, such as 0.3 mm. Inserted into spaces therebetween are elastic and sticky two dumper pairs made of substance, such as silicon rubber. Each pair has

dumpers 51a and 51b.

As shown in Fig. 16, each dumper 51a is located between the side face of each container 50 and the side face of one end of the fixing plate 13. These side faces face each other in the direction of the movable member 40 (right and left in the figure). Each dumper 51b is located in the direction orthogonal to this direction. The dumpers 51a dump the compressing force (or vibration) applied in the direction of the movable member 40. While, the dumpers 51b dump the twisting force, or shearing force applied to the fixing plate 13 and the suspension base 14. By the dumpers 51a and 51b, the occurrence of resonance particularly in an intermediate frequency band is greatly restricted. This makes possible high-speed access to the optical disk. Further, the fixing plate 13 and the suspension base 14 are well fixed to each other by the dumpers 51a and 51b. One pair of dumpers 51a and 51b are not necessarily to be separated. They may be formed in one dumper like the dumper 18a or 18b as shown in Fig. 5. This arrangement also well restricts the occurrence of resonance in the intermediate frequency band.

Such resonance restriction effect will be explained with reference to Figs. 18A to 19B. Figs. 18A and 18B show the frequency-output and the frequency-phase characteristics, respectively, in the tracking direction in the conventional apparatus (Japanese Patent Application No. 6-34119). Figs. 19A and 19B show the frequency-output and the frequency-phase characteristics, respectively, in the third preferred embodiment.

In the conventional apparatus, the frequency-output characteristics gets worse in the intermediate frequency band because resonance appears three times at points P2 at frequencies of 220 to 1000 kHz as shown in Fig. 18A. Further, the phase curve steeply varies at three points P3 as shown in Fig. 18B to get worse in the intermediate frequency band.

Contrary to this, the third embodiment does not

exhibit such resonance at the frequencies of 220 to 1000 kHz as shown in Fig. 19A. Further, there is only one phase variation at a point P4 with no other variations as shown in Fig. 19B. It is revealed that the frequency-output and -phase characteristics are greatly improved in the intermediate frequency band.

In the third embodiment, both ends of the fixing plate 13 and each container 50 of the suspension base 14 are square-shaped. They may be formed in another shape if such arrangement can absorb the forces applied in the two orthogonal directions. Figure 17 shows another arrangement with a fixing member 13a and a suspension base 140. The fixing member 13a has an end with a curved surface. An arm 14c of the suspension base 140 has a container 50a with a curved surface. A long, narrow dumper 51 is inserted in the space between the ends of the fixing member 13a and the container 50a.

The arrangements of the first to third embodiments can be combined to have the advantages described above.

Further, as described above, each preferred embodiment has the following advantage:

The first embodiment has the arrangement in which the elastic member is provided at the lower surface of the objective lens. This restricts the occurrence of resonance in the high frequency band. This arrangement thus achieves high-speed access and shorter access settling time.

The second embodiment has the arrangement in which the movable member is provided with the balance weight and the elastic connector. This arrangement also restricts the occurrence of resonance in the high frequency band and hence achieves high-speed access.

The third embodiment has the arrangement in which the sticky dumpers are provided between both ends of the fixing plate and both ends of the suspension base. These dumpers absorb the forces applied at least two orthogonal directions. This arrangement restricts the occurrence of resonance particularly in the intermediate frequency band

and hence achieves high-speed access.

WHAT IS CLAIMED IS:

1. An optical pick-up apparatus comprising:

an objective lens for focusing read/write beams onto a specific position on an optical disk;

a movable member on which the objective lens is mounted;

means for moving the movable member to move the objective lens in a direction of the optical axis of the objective lens and another direction perpendicular to the optical axis direction; and

an elastic member for connecting the objective lens and the movable member.

2. An optical pick-up apparatus according to claim 1 further comprising:

a container provided on the movable member for containing the elastic member and the objective lens in a way that the elastic member is contained on the bottom of the container and the objective lens is located on the elastic member; and

a protruding member formed in the container by which the elastic member is subjected to a predetermined thickness.

3. An optical pick-up apparatus according to claim 1, wherein elastic modulus of the elastic member ranges from 0.5 to 5 kg/cm^2.

4. An optical pick-up apparatus according to claim 1, wherein the thickness of the elastic member ranges from 0.05 to 0.2 mm.

5. An optical pick-up apparatus according to claim 1, wherein the elastic member is made of material including epoxy resin adhesive.

6. An optical pick-up apparatus according to claim 1, wherein the elastic member is made of material including urethane adhesive.

7. An optical pick-up apparatus according to claim 1, wherein the elastic member is made of material including silicon adhesive.

8. An optical pick-up apparatus comprising:

an objective lens for focusing read/write beams onto a specific position on an optical disk;

a movable member on which the objective lens is mounted;

means for moving the movable member to move the objective lens in a direction of the optical axis of the objective lens and another direction perpendicular to the optical axis direction; and

a balance weight mount provided on the movable member so as to face the objective lens; and

an elastic member for connecting the balance weight and the mount.

9. An optical pick-up apparatus according to claim 8, wherein the elastic member is made of material including silicon adhesive.

10. An optical pick-up apparatus comprising:

an objective lens for focusing read/write beams onto a specific position on an optical disk;

a movable member on which the objective lens is mounted;

a holding member for swingably holding the movable member by means of suspension wires;

means for moving the movable member to move the objective lens in a direction of the optical axis of the objective lens and another direction perpendicular to the

* C L M S *

optical axis direction; and

a dumper provided close to the suspension wires, for preventing vibration of the fixed member from occurrence while operation in the optical axis direction and the other direction.

11. An optical pick-up apparatus according to claim 10, wherein the dumper is made of material including silicon rubber.

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ABSTRACT OF THE DISCLOSURE

An optical pick-up apparatushas has an objective lens that focuses read/write beams onto a specific position on an optical disk. The objective lens is mounted on a movable member. The movable member is controlled to move the objective lens in a direction of its optical axis and another direction perpendicular to the optical axis direction. The apparatus further has an elastic member provided for connecting the objective lens and the movable member. A balance weight mount may be provided on the movable member so as to face the objective lens. In this case, the elastic member connects the balance weight and the mount. A holder member may be provided for swingably holding the movable member by means of suspension wires for preventing vibration of the fixed member from occurrence while operation in the optical axis direction and the other direction.

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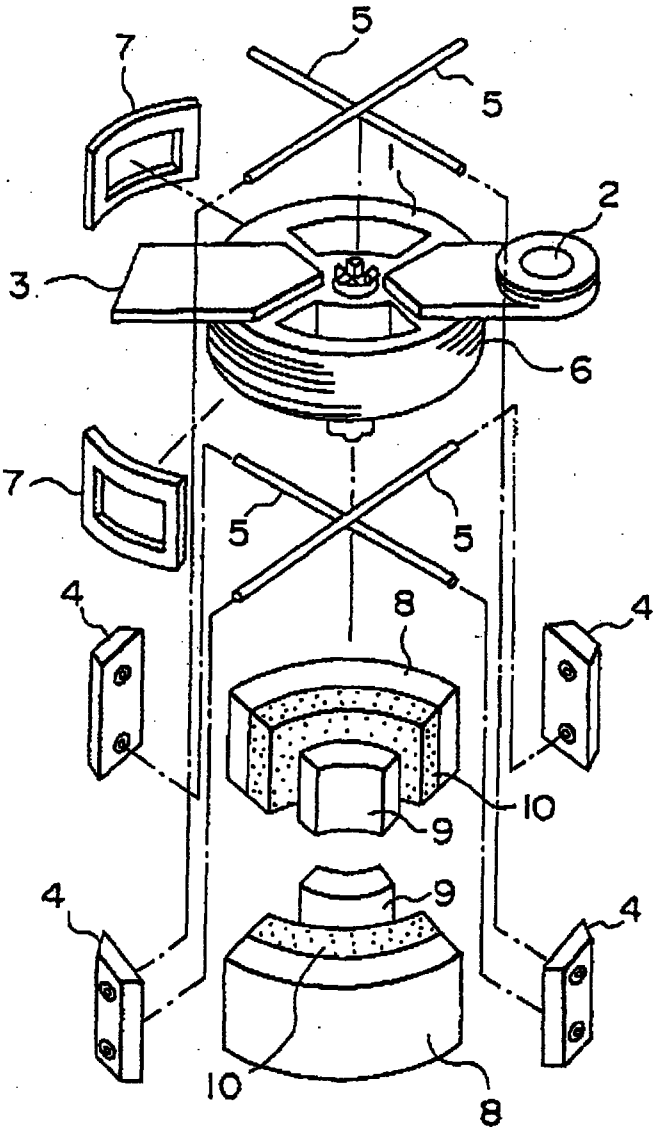


FIG. 1 PRIOR ART

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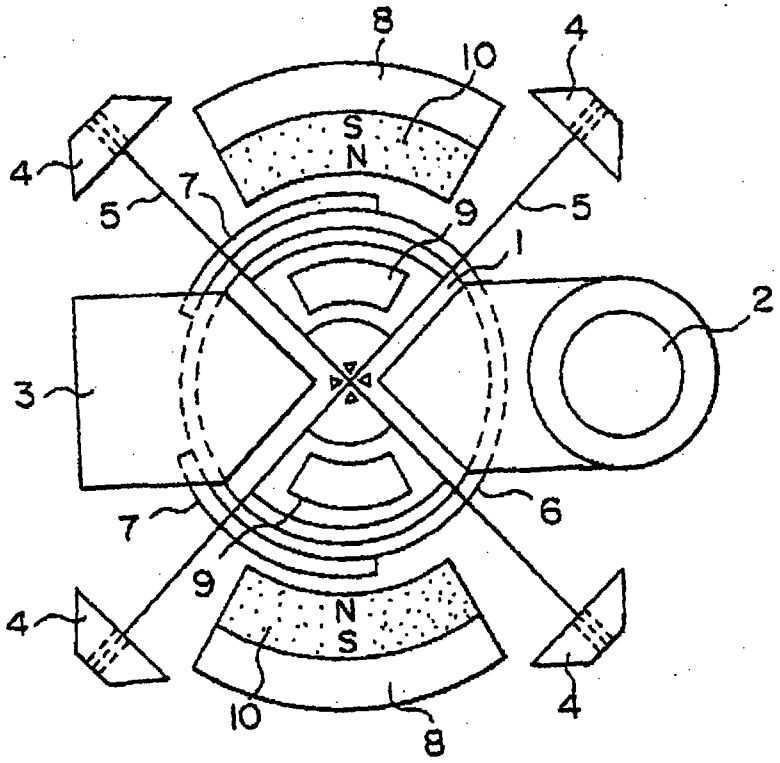


FIG. 2 PRIOR ART

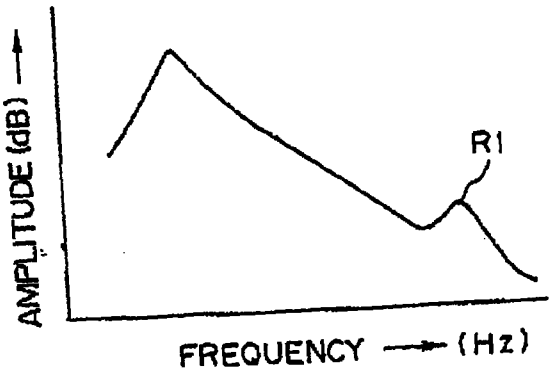


FIG. 3 PRIOR ART

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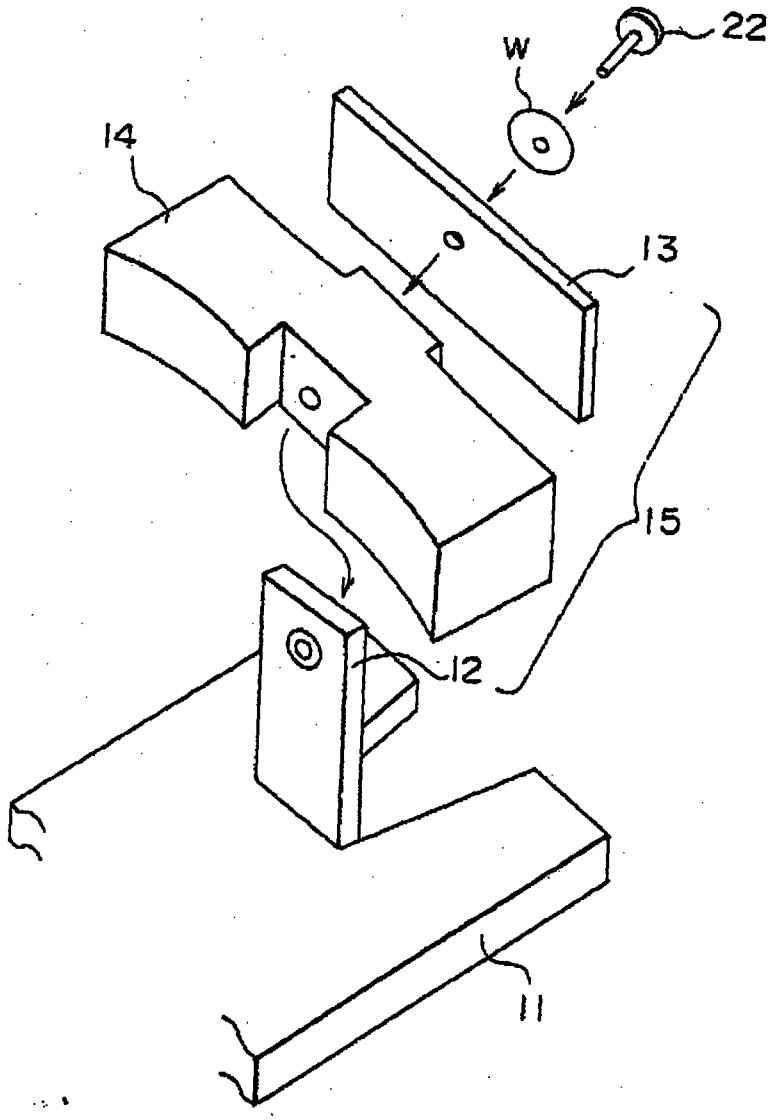


FIG. 4

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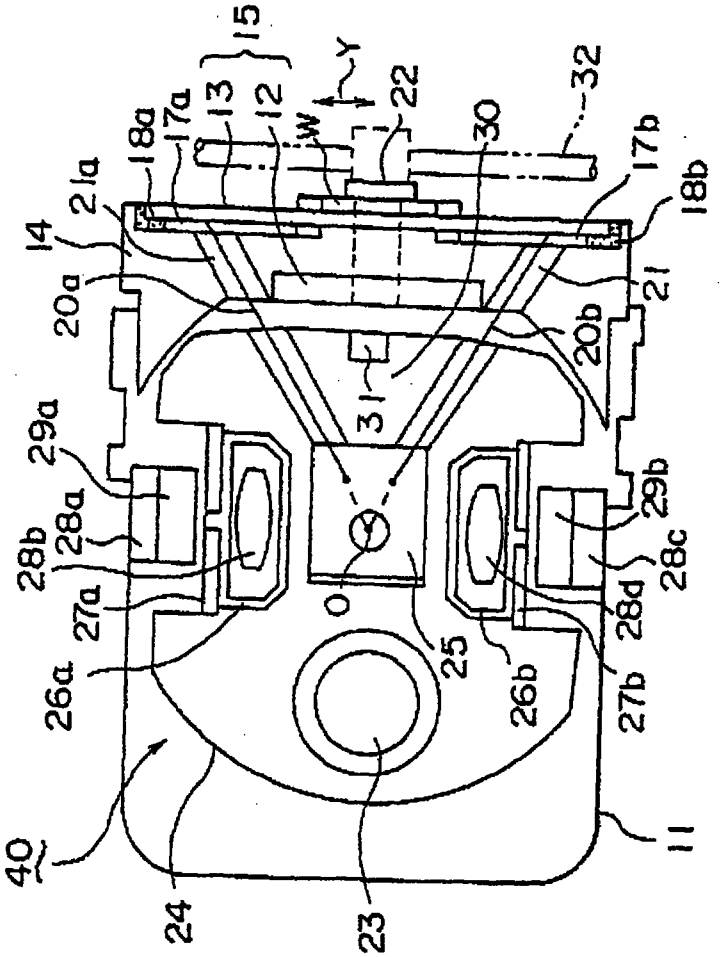


FIG. 5

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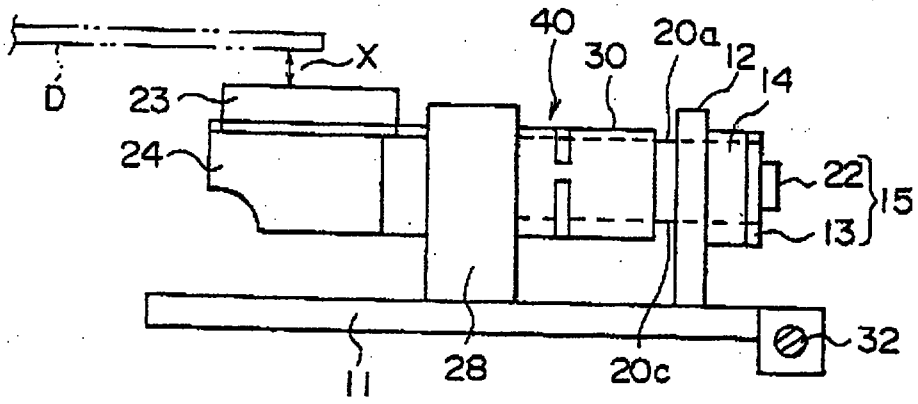


FIG. 6

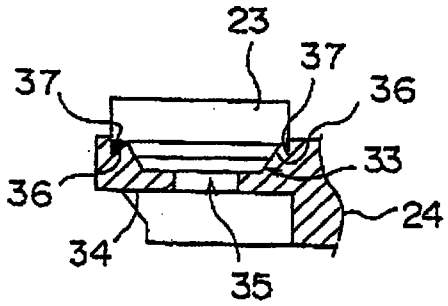


FIG. 7

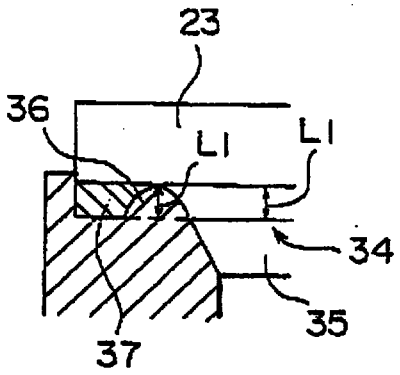


FIG. 8

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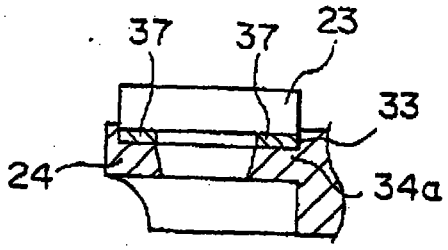


FIG. 9

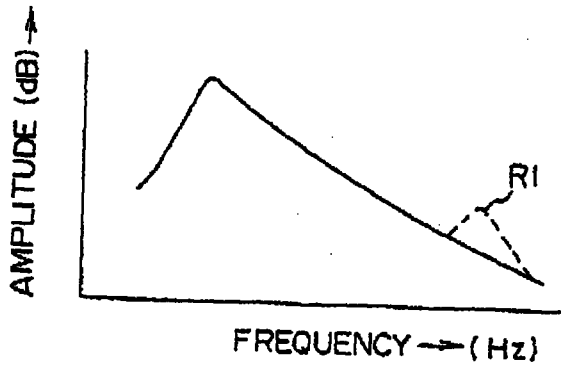


FIG. 10

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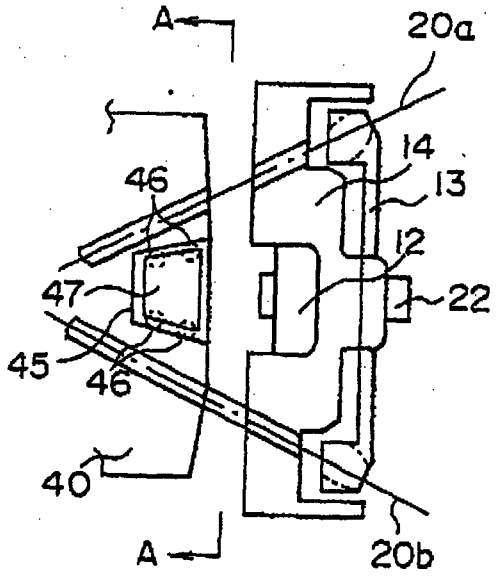


FIG. 11

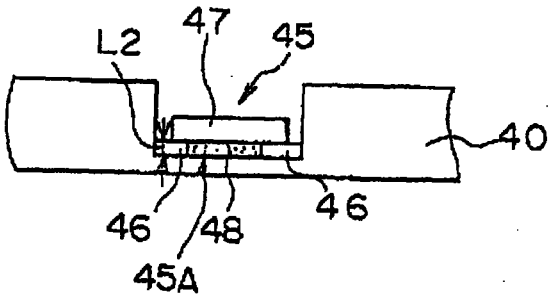


FIG. 12

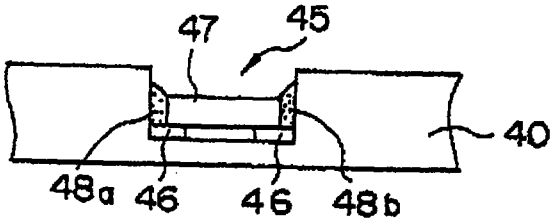


FIG. 13

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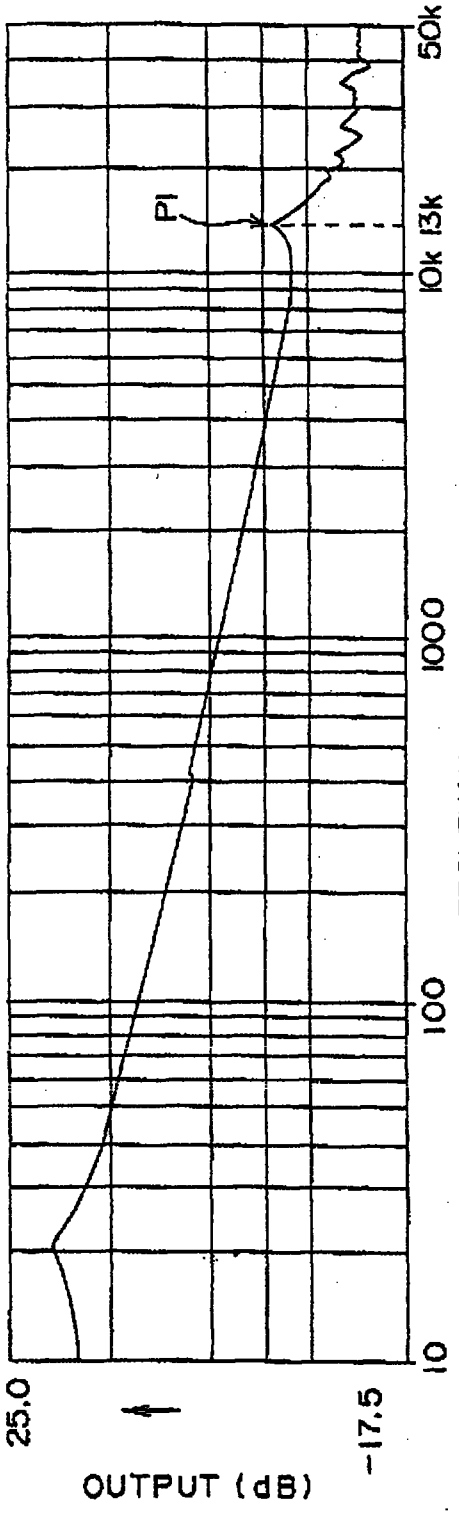


FIG.14A PRIOR ART

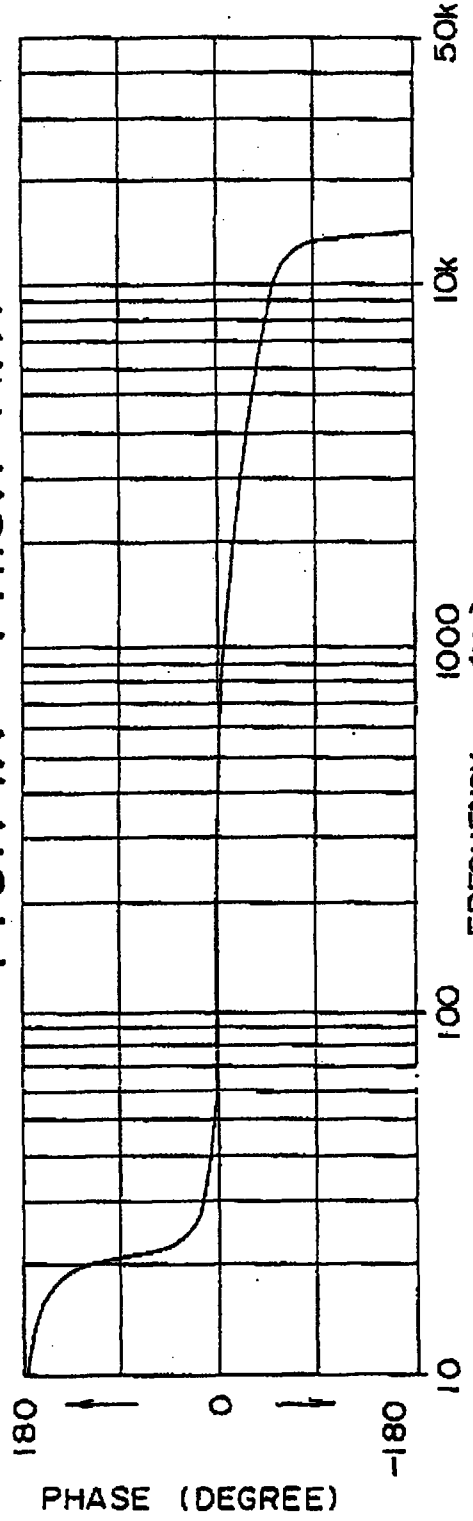


FIG.14B PRIOR ART

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REPLACED

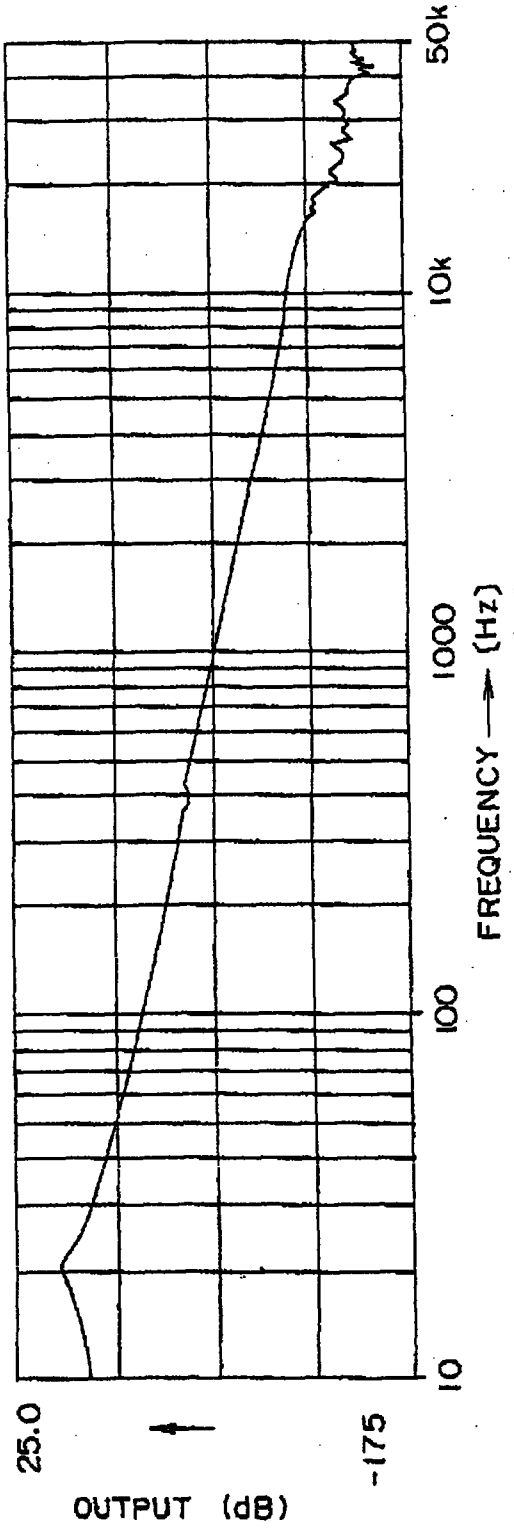


FIG. 15A

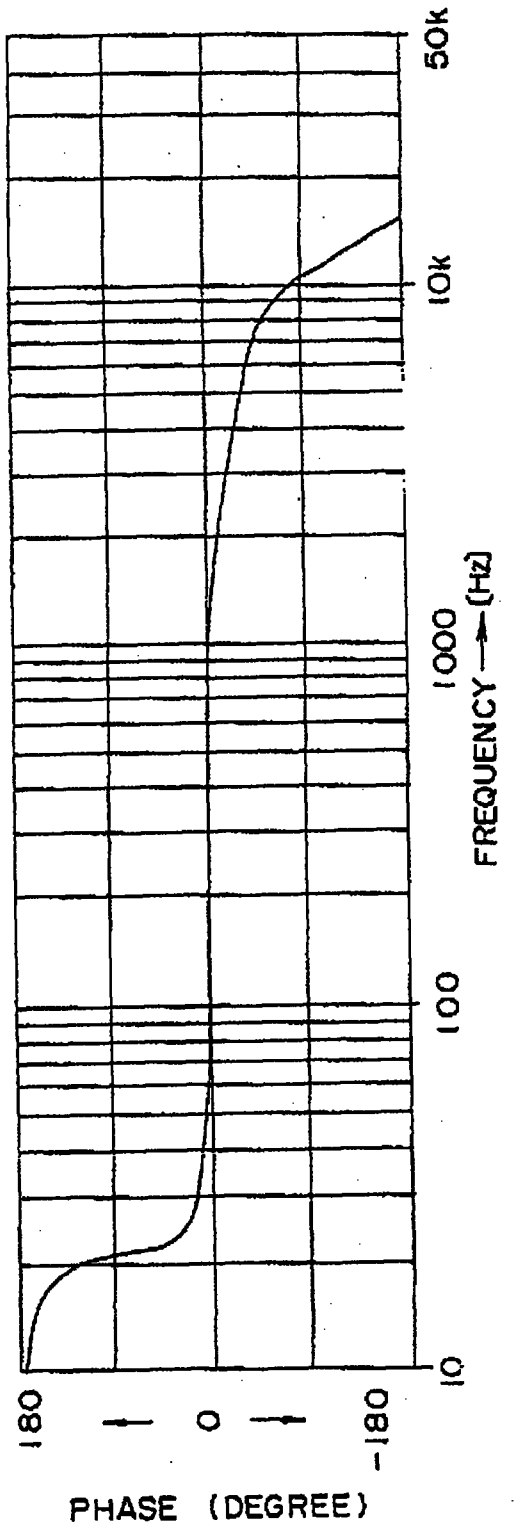


FIG. 15B

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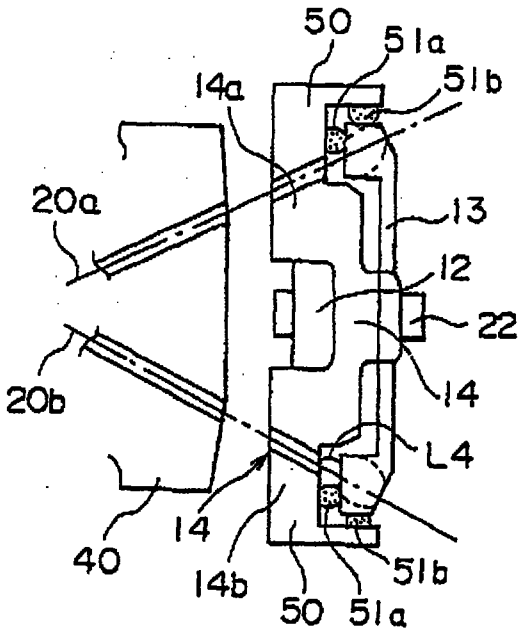


FIG. 16

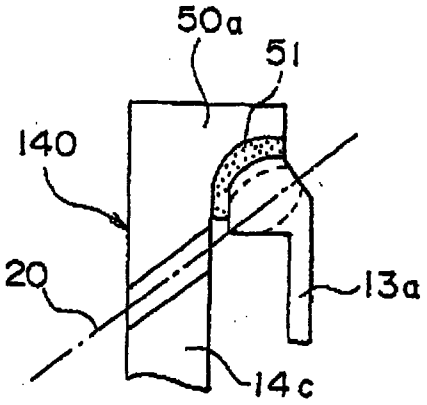


FIG. 17

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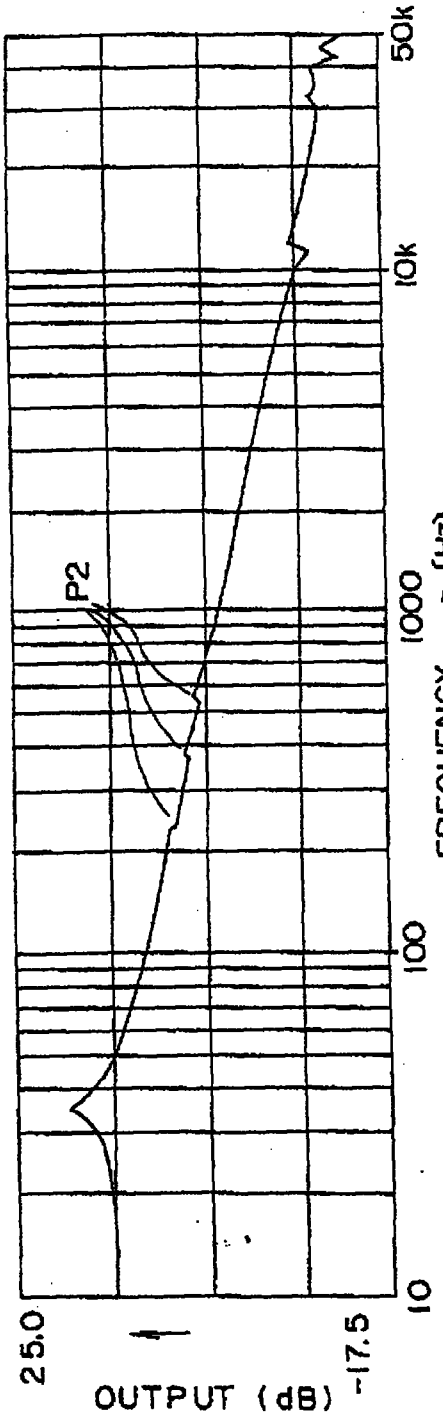


FIG. 18A PRIOR ART

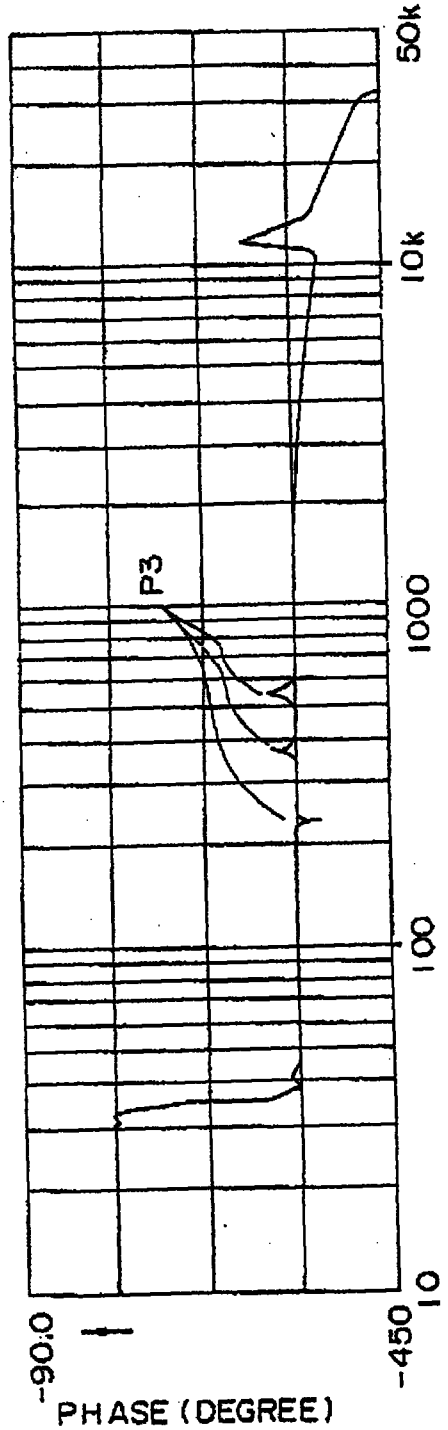


FIG. 18B PRIOR ART

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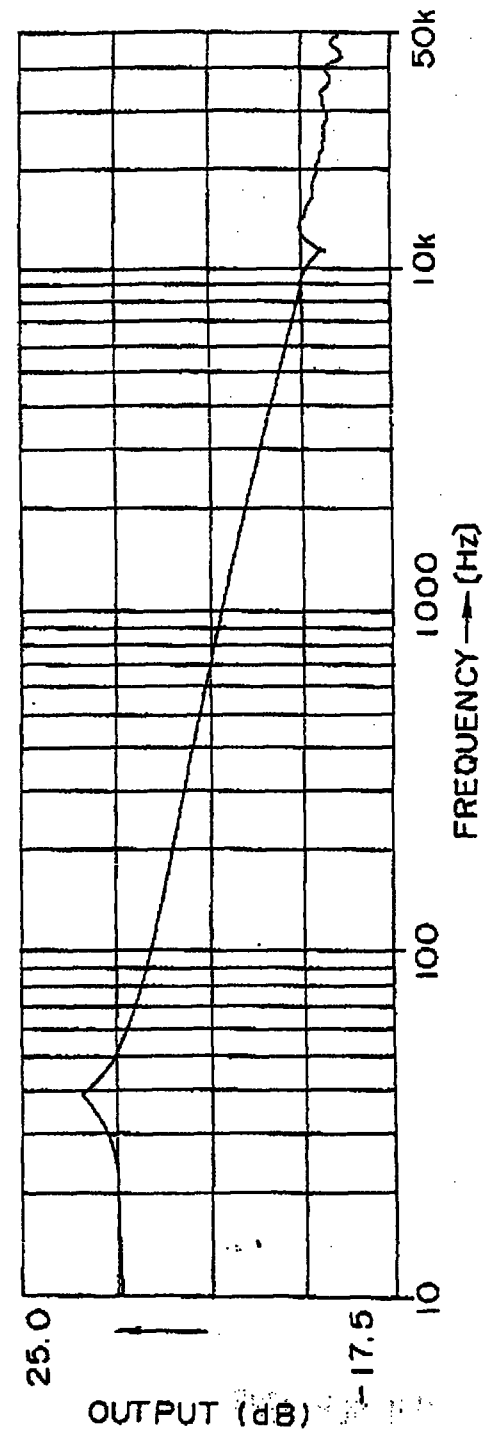


FIG. 19A

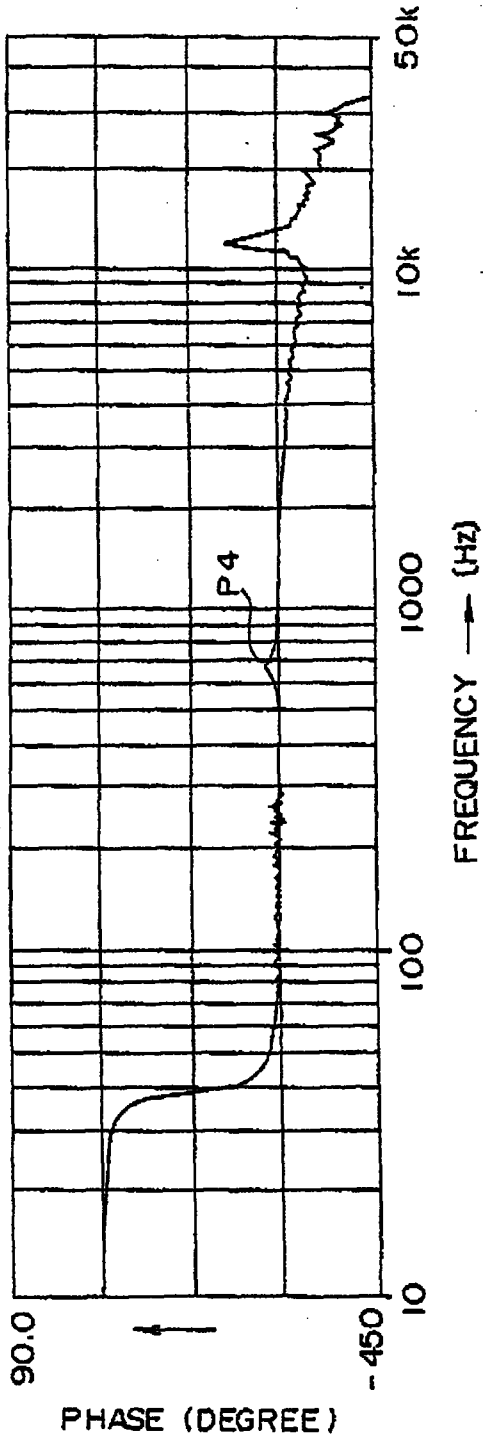


FIG. 19B