

TITLE OF THE INVENTION

HEAD CONTACT TYPE MAGNETIC DISK MEMORY DEVICE HAVING A NOVEL MAGNETIC HEAD SLIDER

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to a magnetic disk memory device, and more particularly, to a head contact type magnetic disk memory device having a novel magnetic head slider for performing a stable head contacting to a disk surface with keeping a low loading during recording and reproducing operations.

Description of the Related Art

Recently, a head contact type magnetic disk memory device has been developed in order to increase a recording density into a magnetic disk. The head contact type magnetic disk memory device includes a magnetic head slider for sliding on a surface of a magnetic disk for contacting a magnetic head to the disk surface during recording and reproducing operations.

Usually, the magnetic head slider has a slider surface facing to

a disk surface. During recording and reproducing operations, the slider surface receives air pressures caused by fluid dynamic pressure effects due to relative motions between the head slider and the rotating disk surface. In order to utilize the air pressures during the rotation of the magnetic disk, a portion of the head slider is designed so as to contact to the disk surface by the air pressures during recording and reproducing operations. Usually, a back end portion of the slider surface along a forwarding direction of the head slider keeps contact to the disk surface.

As illustrated in Fig. 17, in general, the magnetic head slider 100 has three degrees of freedom, i.e., a translation direction 101, a rolling direction 103, and a pitching direction 102. Accordingly, a rigidity of a fluid film formed in a gap between a disk surface and a magnetic head slider due to the fluid dynamic pressure effects must be designed so as to keep a stable contact to the disk surface against disturbances appeared along the three degrees of freedom.

Figure 18 explains as to the inertia force influences affected on the surface of the magnetic head slider due to swells or vibrations of the magnetic disk or impact forces. In Figure 18, a white circle G_n indicates the center of gravity G_n of the magnetic head slider 100 alone, and a black circle G_p indicates a pivot position where the equivalent masses of the suspensions are intensively affected. Generally, an application point of the inertia forces is located at a center gravity G that is decided by the mass distribution of the

magnetic head slider 100 and an equivalent mass of the suspension at the pivot position G_p . Thus, the center of gravity G is positioned on a line connecting the center of gravity G_n and the pivot position G_p .

Thus, the inertia force f_g is divided into to a fluid force fluctuation d_{fn} at a point 105 and a contact force fluctuation d_{fc} at a point 104. Assuming that a distance between a contacting point 104 and the center of gravity G_n is l_n , and a distance between a contacting point 104 and the center of gravity G (the point 105) is l_g , the following formula is acquired:

$$d_{fc} = (l_n - l_g)/l_n \times f_g$$

Thus, in order to reduce the contact force fluctuation d_{fc} , it is required to increase the distance l_n as large as possible. Thus, it needs to increase a distance between the fluid force operating position 105 and the contacting part 104 of the head slider. It is also needed to decrease the distance l_g between the fluid force operating position and the center of gravity G as short as possible.

In order to meet the both needs, a configuration of the magnetic head slider has conventionally proposed as illustrated in Figures 19A and 19B. Thus, the head slider 100 includes a positive pressure generating part 106 is provided at a flow-in side end of the slider so as to generate flowing-in fluids during the rotation of the magnetic disk.

Further, a contact pad 107 is provided at a flow-out side of the fluid so as to increase a distance between the fluid force operating position and the contact part and also to decrease a distance between the fluid force operating position and the center of gravity G.

As illustrated in Figure 19B, both the positive pressure generating part 106 and the contact pad 107 is positioned at a top surface A of the head slider. Namely, the surface A of the slider is the closest to the facing disk surface. Each of the surfaces A, B and C of the head slider has a different height against a disk surface.

The head contact type magnetic disk memory devices are usually installed in handheld devices, such as note-type personal computers. To apply the head contact type magnetic disk memory device in a handheld computer, it is strongly needed to perform a stable head loading and unloading operations with restrict fluctuations of the contact force of the magnetic head caused by shocks to the computer. Thus, it is keenly requested to keep a stable contact of the head slider to the magnetic disk with a low load. Further, it is needed for the computer use to enhance the suppression of fluctuations of the contacting forces of the slider caused by the changes of the atmospheric pressures.

SUMMARY OF THE INVENTION

Therefore, there is a need for providing a head contact type magnetic disk device having a novel magnetic head slider that can perform a stable head contacting to a magnetic disk with a low load in order to restrict the variations of the contacting forces of the head slider due to shocks and/or the atmospheric pressures.

In order to achieve the above-mentioned objectives, the invention provides a magnetic head slider having an air flowing inlet side, an air flowing outlet side, and a plurality of surfaces between the inlet side and the outlet side for constituting fluid force generating parts for the magnetic head slider due to dynamic pressure effects of the air flowing accompanying rotation of the magnetic recording medium. Each of the plurality of surfaces has a different height level for respectively defining a different distance to a surface of the magnetic recording medium. The magnetic head slider comprising: a contact pad for supporting a magnetic head for recording and reproducing data to and from a magnetic recording medium so as to make the magnetic head contact to the surface of the magnetic recording medium, the contact pad is provided around the air flowing outlet side with keeping at a top level in the plurality of different height levels; a positive pressure pad area provided around the air flowing inlet side for generating positive pressure during rotation of the magnetic recording medium, the positive pressure pad area is positioned so as to keep the same top level of the contact pad; and a squeeze pad area for suppressing fluctuations of contacting forces between the magnetic head and the magnetic disk medium, the

squeeze pad area is provided along the air flowing direction at an middle height level between the top level and the low level of the surfaces so as to across the low level of the surfaces.

The magnetic head slider according to the invention can obtain the squeeze effect with generation of positive pressure suppressed, so that the contact change of the magnetic head due to stable head slider loading and vibration by an impact can be suppressed, thus the stable contact force of the magnetic head to the information recording medium can be kept.

Further, the magnetic head slider consistent with the invention is characterized in that it additionally has a first negative pressure control area installed so as to divide the positive pressure generation area.

According to the magnetic head slider of the invention, since a fluid flows in from forth of the first negative pressure control area in the direction of the flow due to rotation of the information recording medium, the generation of negative pressure behind the positive pressure generation area is suppressed and the contact force of the magnetic head can be obtained free of dependence on the position of the magnetic head in the radial direction of the information recording medium.

Furthermore, the magnetic head slider of the invention is

characterized in that it additionally has a second negative pressure control area installed so as to divide the positive pressure generation area and the squeeze pad area.

According to the magnetic head slider consistent with the invention, air flowing can be introduced from the second negative pressure control area and the generation of negative pressure behind the positive pressure generation part in the direction of the flow due to rotation of the information recording medium can be suppressed.

Further, the magnetic head slider consistent with the invention is characterized in that it additionally has a third negative pressure control area installed so as to be held between the second negative pressure control area and the positive pressure generation area.

According to the magnetic head slider consistent with the invention, the degrees of freedom of design of the second negative pressure control area are extended and the introduction of air can be controlled more accurately.

Furthermore, the magnetic head slider consistent with the invention is characterized in that the squeeze pad area is arranged on a slant to the direction of the flow due to rotation of the recording medium.

According to the magnetic head slider consistent with the

invention, for example, simultaneously with a change in the positive pressure in the squeeze pad area at the time of reduction in the atmospheric pressure, the back negative pressure in the direction of the fluid flow due to rotation of the information recording medium is changed, so that the change is suppressed and the contact force of the magnetic head can be prevented from changing.

Further, the magnetic head slider consistent with the invention is characterized in that a forward area and a backward area constituting the squeeze pad area are arranged on a slant in different directions respectively from the direction of the flow due to rotation of the information recording medium.

The magnetic head slider consistent with the invention can suppress generation of positive pressure, increase the area of the squeeze pad area, control a change in the contact force at the time of reduction in the atmospheric pressure smaller, and obtain a larger squeeze effect at the same time.

Furthermore, the magnetic disk device consistent with the invention has a magnetic head slider having a loaded magnetic pole element for recording and reproducing data on a recording medium installed so as to freely rotate, characterized in that the magnetic head slider has a slider part having a surface on which fluid force generated by a dynamic pressure effect of the flow due to rotation of the information recording medium operates and a contact part for

supporting the magnetic pole element so that the surface of the magnetic pole element opposite to the information recording medium comes in contact with the information recording medium and a plurality of areas into which the fluid force operating surface of the slider part is divided via a plurality of level differences have a positive pressure generation area belonging to the top level together with the contact part which is installed between the contact part and them at least across the area belonging to the low level on the inlet side of the flow due to rotation of the information recording medium and a squeeze pad area belonging to the middle level between the top level and the low level which is installed along the direction of the flow due to rotation of the information recording medium so as to cross the area belonging to the low level between the positive pressure generation area and the contact part.

Further, the magnetic disk device consistent with the invention is characterized in that it additionally has a second negative pressure control area installed so as to divide the positive pressure generation area and the squeeze pad area.

Furthermore, the magnetic disk device consistent with the invention is characterized in that it additionally has a second negative pressure control area installed so as to divide the positive pressure generation area and the squeeze pad area.

Further, the magnetic disk device consistent with the invention

is characterized in that it additionally has a third negative pressure control area installed so as to be held between the second negative pressure control area and the positive pressure generation area.

Furthermore, the magnetic disk device consistent with the invention is characterized in that the squeeze pad area is arranged on a slant to the direction of the flow due to rotation of the recording medium.

Further, the magnetic disk device consistent with the invention is characterized in that the forward area and backward area constituting the squeeze pad area are arranged on a slant in different directions respectively to the direction of the flow due to rotation of the information recording medium.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the present invention and many of the attendant advantages thereof will be obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings.

Figure 1 is a perspective view of a magnetic disk device having a magnetic head slider consistent with the invention.

Figure 2 is an enlarged perspective view of the magnetic head slider in the magnetic disk device illustrated in Figure 1.

Figure 3 is a plain view of the magnetic head slider consistent with the invention that is facing to a magnetic disk.

Figure 4 illustrates a correlation between each parts of the magnetic head slider that is respectively shaded in Figure 3 and each of respective heights of the parts from a disk surface.

Figure 5 is a plan view illustrating a second embodiment of the magnetic head slider configuration consistent with the invention.

Figure 6 is a plan view illustrating a third embodiment of the magnetic head slider configuration consistent with the invention.

Figure 7 is a perspective view illustrating a fourth embodiment of the magnetic head slider configuration consistent with the invention.

Figure 8 is a plan view of the magnetic head slider illustrated in Figure 7.

Figures 9A-9D are drawings for explaining the postures of the magnetic head slider illustrated in Figure 7 when the slider receives a fluid dynamic pressure.

Figure 10 shows the squeeze pad effect in a translation direction for the magnetic head slider shown in Figure 7.

Figure 11 shows the squeeze pad effect in a pitching direction for the magnetic head slider shown in Figure 7.

Figure 12 shows the squeeze pad effect in the rolling direction for the magnetic head slider shown in Figure 7.

Figure 13 is a plan view illustrating a fifth embodiment of the magnetic head slider configuration consistent with the invention.

Figures 14A, 14B explain the squeeze pad effect by the magnetic head slider shown in Figure 13.

Figure 15 is a plan view illustrating a sixth embodiment of the magnetic head slider configuration consistent with the invention.

Figures 16A, 16B explain the squeeze pad effect by the magnetic head slider shown in Figure 15.

Figure 17 is a perspective view of a magnetic head slider drawing for explaining postures due to a fluid dynamic pressure.

Figure 18 explains an effect of inertia force operating on the magnetic head slider by an impact.

Figures 19A, 19B illustrate configurations of a conventional magnetic head slider.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to the same or the like parts.

As illustrated in Figure 1, a magnetic disk device 100, which is applicable to a magnetic head slider 1 consistent with the invention, includes a base body 12 (an upper cover is not shown), a plurality of magnetic disks 13, which is stacked along a spindle motor 16, and a carriage 15 for rotating the magnetic head slider 1 along a radius direction of the disk medium 13 in order to locate a magnetic head to the recording or reproducing tracks of the disk medium 13.

As illustrates in Figure 2, the magnetic head slider 1 is mounted on an edge portion of the carriage 15 for supporting a magnetic head element (not shown) facing to a surface of the disk medium.

With reference to Figures 3 and 4, a first embodiment of a construction of the magnetic head slider 1 consistent with the

invention would be explained. Figure 3 illustrates the configuration of the magnetic head slider 1 which is viewed from the surface side of the magnetic disk. Figure 4 explains correlation in a plurality of different height to a surface of the magnetic disk, in which each slashed lines indicates a different height of the slider surface facing to the magnetic disk.

Thus, the magnetic head slider 1 includes an air flowing inlet side edge 2 and an air flowing outlet side edge 3 accompanying the rotation of the magnetic disk. The magnetic head slider 1 further includes a contact pad 5 provided around the air flowing outlet side edge 3 and a positive pressure generating area 7 provided around the air flowing inlet side edge 2. As illustrated in the same slashed lines in Figure 3, both the magnetic head slider 1 and the positive pressure generating area 7 are provided at the top level surface A in the slider surface, as illustrated in Figure 4. The contact pad 5 supports the magnetic head 4 so as to contact a surface of the magnetic head 4 facing to the magnetic disk 13 to the facing magnetic disk surface.

Further, the magnetic head slider 1 includes an U-shaped squeeze pad 8 positioned at a middle height level B in the slider surface as illustrated in Figure 3. The U-shaped squeeze pad 8 includes two side-edge parts extended along the rotational direction of the magnetic disk, i.e., the air flowing direction during the rotation of the magnetic disk 13. The U-shaped squeeze pad 8 is

provided so as to encircle the low surface area 6 positioned between the contact pad 5 and the positive pressure generating pad area 8.

Thus, as illustrated above, both the contact pad 5 and the positive pressure generating area 7 are provided on a surface positioned at the top level A in the head slider surface, and the U-shaped squeeze pad area 8 is provided on a surface positioned at the middle level B in the head slider surface so as to locate between the top level A and the low level C.

These differences in the height levels in the slider surface in order to provided the different elements at a different height level, i.e., both the contact pad 5 and the positive pressure generating area 7 positioned at the top level surface A, the U-shaped squeeze pad 8 at the middle level surface B, and the surface area 6 at the low level surface C, are designed so as to constitute a fluid force generating part for the head slider 1 due to the dynamic pressure effect of the air flowing during the rotation of the magnetic disk 13.

As illustrated in Figure 4, the middle level surface B in the slider surface is rather closer to the top level surface A than the low level surface C in the slider surface. By providing the squeeze pad 8 in the magnetic head slider 1 at a lather near position to the facing surface of the magnetic disk 13, the magnetic head slider 1 can suppress the fluctuations of the contact force between the magnetic disk surface and the magnetic head surface by utilizing the

generated squeeze effect by the squeeze pad 8. Thus, the squeeze pad 8 generates repulsion forces against the sliding air film force between the magnetic disk 13 and the magnetic head slider 1.

Generally, when a surface of the slider head is positioned close to the disk surface, a positive pressure is generated to the slider head. Accordingly, when a lot of surfaces are positioned at a closer to the disk surface, a large amount of positive pressure causes to disturb a stable contacting force of the head slider to the disk surface.

However, the configuration of the magnetic head slider 1 consistent with the invention can avoid the generation of the large amount of the positive pressure since the squeeze pad 8 is provided at the middle level surface B of the head slider so as to obtain the squeeze effect. Thus, the configuration of the magnetic head slider 1 consistent with the invention can obtain the squeeze effect with restricting the generated positive pressure.

Accordingly, it becomes possible to perform a stable loading and unloading of the head slider 1. Further, it becomes possible to restrict the contacting variations caused by shocks added to the magnetic disk device. Accordingly, it becomes possible to maintain a stable contacting force of the magnetic head 4 against the magnetic disk.

According to the configuration of the U-shaped squeeze pad 8 in

the magnetic head slider 1 of the first embodiment generates a negative pressure in the surface area 6 surrounded by the positive pressure generating part 7 and the squeeze pad 8. The negative pressure is highly depended upon the air flowing speed. Accordingly, the positioning differences of the magnetic head 4 in a radial direction of the magnetic disk 13 causes to generates fluctuations in the contacting force of the magnetic head 4 to the magnetic disk 13 along the radial direction of the disk. Consequently, it is preferable to restrict the generation of the negative pressure in order to keep a stable contact to the disk with a smaller contacting force.

(Second Embodiment)

Figure 5 explains a first improvement of the configuration of the magnetic head slider 1 illustrated in Figure 3. As illustrated in Figure 5, in this configuration of the magnetic head slider 1, the positive pressure generating area is divided into two parts 7a and 7b, and the squeeze pad also divided into two parts 20a and 20b so as to form a first negative pressure controlling area 6c between the divided two pair of parts 7a-20a, and 7b-20b. Consequently, the squeeze pad is also provided at the middle level B in the form of the divided two parts 8a and 8b. Thus, in this magnetic head slider 1, the first negative pressure controlling area 6c is provided between the divided squeeze pads 20a and 20b so as to divide the positive pressure generating area along the air flowing direction, i.e., a direction from the air flowing-inlet end 2 to the air flowing-outlet end 3, during the rotation of the magnetic disk 13.

Accordingly, the configuration of this magnetic head slider 1 having the first negative pressure controlling area 6c can restrict the generation of the negative pressure at the behind the positive pressure generation areas 7a and 7b. Consequently, it can obtain a stable contacting force for the magnetic head 4 along a radial direction of the magnetic disk.

As illustrated in Figure 5, the first negative pressure controlling area 6c is constructed so as to have a pair of tapered air flowing controlling walls 9a and 9b along the air flowing direction during the rotation of the magnetic disk. Thus, the tapered air flowing controlling walls 9a and 9b are provided so as to make the negative pressure controlling area 6c gradually narrower along the direction to the air flowing outlet side.

Consequently, it becomes possible to restrict the generation of the negative pressure at the behind the positive pressure generating parts 7a and 7b by compressing the air flowing at the behind the positive pressure generation parts 7a and 7b.

(Third Embodiment)

As illustrated in Figure 6, according to this embodiment, the magnetic head slider 1 includes a second negative pressure controlling areas 6d and 6e provided between each of the divided positive pressure generating areas 7a and 7b and the divided squeeze

pads 8c and 8d. Thus, the respective second negative pressure control areas are provided so as to divide the positive pressure generation areas and the squeeze pad along the air flowing direction generated during the rotation of the magnetic disk. Furthermore, each of the second negative pressure control areas 6d and 6c is formed to have a tapered air flowing-in controllers 10a and 10b in order to adjust the air flowing-in rate.

According to this configuration of the magnetic head slider, it becomes more possible to restrict the generation of the negative pressure behind the positive pressure generating areas 7a and 7b by introducing air flowing through the second negative pressure controlling areas 6d and 6e.

(Fourth Embodiment)

Figures 7 and 8 illustrate the fourth embodiment of the magnetic head slider 1 that includes a third negative pressure controlling areas 20c and 20d behind the positive pressure generation sections 7a and 7b along air flowing direction. Thus, the third negative pressure controlling areas 20c and 20d are formed so as to put between the positive pressure generation sections 7a and 7b and the second negative pressure controlling areas 6d and 6d at the same height level B to the positive pressure generating parts 7a and 7b. Further, each the second negative pressure controlling areas 6d and 6e is formed to have a tapered air flowing-in control structures 10c and 10d for adjusting the air flowing-in rate, respectively.

According to these structures of the head slider, the degrees of freedom of designing the second negative pressure control areas 6d and 6e is expanded. Consequently, it becomes possible to more accurately control the air flowing-in. Thus, it becomes possible for the magnetic head slider 31 to obtain more stable contact force of the magnetic head 4 against the air flowing speed.

Figures 9A-9D to 12 explain the fluid dynamic pressure operation of the magnetic head slider consistent with the invention. As illustrated in Figure 9A, the magnetic head slider has three degrees of freedom, i.e., a translation direction 101, a pitching direction 102 and a rolling direction 103. Furthermore, the magnetic head slider receives counter forces or counter torque from the air film in correspondence with variations of the posture of the head slider.

Figure 9B shows the fluid dynamic pressure operation of the counter force C_{zz} in correspondence with variations of speed V_z along the translation direction 101. Figure 9C shows the fluid dynamic pressure operation of the counter torque C_{pp} in correspondence with variations of speed $V_{\theta p}$ along the pitching direction 102. And Figure 9D shows the fluid dynamic pressure operation of the counter torque C_{rr} in correspondence with variations of speed $V_{\theta r}$ along the rolling direction 103.

Figures 10 - 12 show the squeeze pad effect due to the counter force or counter torques acting to the magnetic head slider when the

magnetic head slider is vibrated with a unit of amplitude at each of frequencies along the translation direction 101, the pitching direction 102, and the rolling direction 103, respectively. The transverse axis in each Figures 10-12 indicates a vibration frequencies (1 Hz to 1 MHz). The ordinate axis in Figure 10 indicates counter forces [mN/mm] acting on the head slider with a unit of amplitude at each vibration times along the translation direction 101. The ordinate axis in each Figures 11 and 12 indicates counter torques [mNmm/rad] acting on the head slider with a unit of amplitude at each vibration times along the pitching direction 102, and the rolling direction 103, respectively.

In Figures 10-12, circle dots show the data for the magnetic head slider consistent with the invention and triangle dots show the data of the conventional magnetic head slider such as shown in Figure 19. As shown in Figures, the magnetic head slider consistent with the invention receives larger counter forces or counter torques for suppressing the vibration than the conventional magnetic head slider. Thus, it shows that the structure of the magnetic head slider consistent with the invention can keep its posture in a more stable form than the conventional head slider structure.

(Fifth Embodiment)

Figure 13 illustrates a fifth embodiment of the magnetic head slider consistent with the invention. The magnetic head slider 1 includes a shorter squeeze pad areas 8e and 8f than the squeeze pad

areas illustrated in the first to fourth embodiments along the rotational direction of the disk. Thus, as illustrated in Figure, the squeeze pad areas 8e and 8f are slanted against a perpendicular direction to the rotational direction of the disk.

In such the squeeze pad structures shown in the first to fourth embodiments may increase the contact forces when the atmospheric pressure reduces since the squeeze pad area keeps the contacting posture of the head slider with compressing the air by its length along the air flowing direction due to rotation of the magnetic disk. Consequently, the contact force increases when the atmospheric pressure reduces since that the positive pressure behind the squeeze pad area decreases when the atmospheric pressure reduces. Thus, the vibration of the slider posture can be made smaller even when the atmospheric pressure reduces.

On the other hand, the magnetic head slider shown in Figure 13 includes the squeeze pad areas 8e and 8f that are in a slanted shorter form along the rotational direction of the disk. Consequently, the squeeze pad areas 8e and 8f can generate the negative pressures at the behind of them. The negative pressure cancels the positive pressure generated in the squeeze pad areas 8e and 8f. Furthermore, the structure of this embodiment can prevent the contact force of the magnetic head slider from vibrating by restricting the vibration with changing the negative pressure behind the squeeze pad areas 8e and 8f when the atmospheric pressure

reduces.

Figures 14A and 14B compare the fluid dynamic pressure operations of the magnetic head sliders in the forth and the fifth embodiments. As shown in Figure 14A, the head slider consistent with the fourth embodiment receives the force that is comprised of the suspension load F , the fluid force f_h , the contact force f_c of the magnetic head and the positive pressure f_p generated in the squeeze pad areas. When the pressure reduces, the positive pressure f_p becomes smaller. Consequently, the contact force f_c increases largely.

On the other hand, as shown in Figure 14B, the head slider relating to the fifth embodiment, the squeeze pad has a slant form so as to generate both the positive pressure f_p and the negative pressure f_n behind the squeeze pad. When the positive pressure f_p varies due to reduction of the atmospheric pressure, the negative pressure f_n also varies so as to cancel the varies of the positive pressure. Thus, it can keep the resultant force operating in the squeeze pad areas similar to that before the reduction of the atmospheric pressure. Consequently, it becomes possible to restrain the variation of the contact force f_c when the atmospheric pressure reduces. Therefore, the magnetic head slider consistent with this embodiment can surely prevent the contact force of the magnetic head from vibrating.

(Sixth Embodiment)

Figure 15 illustrates a sixth embodiment of the magnetic head slider consistent with the invention. The magnetic head slider includes the squeeze pad areas that are shorter than the squeeze pad areas of the first to fourth embodiments along the rotational direction of the disk. Thus, as illustrated in Figure, one of the squeeze pads has a forward area 8g and a backward area 8h that inclined in a different direction along the rotational direction of the disk with each other. Similarly, the other of squeeze pads has a forward area 8i and a backward area 8j that are inclined in a different direction along the rotational direction of the disk.

According to this construction, the magnetic head slider can increase the squeeze pad areas in order to obtain a larger squeeze effect. Further it can suppress generation of the positive pressure so as to control the variation of the contact force when the atmospheric pressure reduces.

Figures 16A and 16B compare the fluid dynamic pressure operations of the magnetic head sliders in the forth and the sixth embodiments. As explained in Figure 14A, the head slider illustrated in Figure 16A receives the force that is comprised of the suspension load F , the fluid force f_h , the contact force f_c of the magnetic head and the positive pressure f_p generated in the squeeze pad areas. When the pressure reduces, the positive pressure f_p becomes smaller. Consequently, the contact force f_c increases largely.

On the contrary, the magnetic head slider illustrated in Figure 16B includes the V-shaped squeeze pad areas that have the forward slant areas 8g and 8i, and the backward slant areas 8h and 8j. Thus, the forward slant area and the backward slant area are inclined in a different direction along the rotational direction of the disk so that the squeeze pad areas generate a couple of the negative pressures f_{n1} and f_{n2} behind a couple of the positive pressures f_{p1} and f_{p2} so as to cancel them. Consequently, the magnetic head slider of this embodiment can reduce the variations of the contact force f_c of the magnetic head when the atmospheric pressure reduces.

As explained above, a magnetic head slider consistent with the invention can suppress fluctuations of contacting forces of the magnetic head to a magnetic disk surface due to variations of the atmospheric pressures or afforded impacts to the magnetic disk memory device. Consequently, a stable head loading in a head contact type magnetic disk memory device is realized.

WHAT IS CLAIMED IS:

1. A magnetic head slider having an air flowing inlet side, an air flowing outlet side, and a plurality of surfaces between the inlet side and the outlet side for constituting fluid force generating parts for the magnetic head slider due to dynamic pressure effects of the air flowing accompanying rotation of the magnetic recording medium, each of the plurality of surfaces has a different height level for respectively defining a different distance to a surface of the magnetic recording medium,

the magnetic head slider comprising:

a contact pad for supporting a magnetic head for recording and reproducing data to and from a magnetic recording medium so as to make the magnetic head contact to the surface of the magnetic recording medium, the contact pad is provided around the air flowing outlet side with keeping at a top level in the plurality of different height levels;

a positive pressure pad area provided around the air flowing inlet side for generating positive pressure during rotation of the magnetic recording medium, the positive pressure pad area is positioned so as to keep the same top level of the contact pad; and

a squeeze pad area for suppressing fluctuations of contacting forces between the magnetic head and the magnetic disk medium, the squeeze pad area is provided along the air flowing direction at an middle height level between the top level and the low level of the surfaces so as to across the low level of the surfaces.



2. The magnetic head slider according to claim 1, wherein the squeeze pad area has an U-shaped configuration including two side-edge parts extended along the rotational direction of the magnetic disk medium so as to encircle the low level of the surfaces.

3. The magnetic head slider according to claim 1 or 2, wherein the positive pressure generation area is divided into two parts by a first negative pressure control area.

4. The magnetic head slider according to claim 1, 2 or 3, wherein both the positive pressure generation area and the squeeze pad area are collectively divided into two parts by a second negative pressure control area.

5. The magnetic head slider according to claim 4, wherein each of the collectively divided parts of the positive pressure generation area and the squeeze pad area is further collectively divided by a third negative pressure control area.

6. The magnetic head slider according to claim 1, wherein the squeeze pad area is arranged on a slant along the air flowing direction flow due to rotation of the magnetic recording medium.

7. The magnetic head slider according to claim 1, wherein the squeeze pad area includes a forward area and a backward area



along the air flowing direction, each of the forward area and the backward area of the squeeze pad is arranged on a different slant direction respectively along the air flowing direction due to rotation of the magnetic recording medium.

8. A magnetic disk memory device, comprising:

a magnetic head for recording and reproducing data to and from a disk medium;

a magnetic head slider for supporting the magnetic head so as to contact to a surface of the disk medium; and

a carriage for rotating the magnetic head slider along a radius direction of the disk medium in order to locate the magnetic head to a target recording or reproducing track of the disk medium;

wherein the magnetic head slider having an air flowing inlet side, an air flowing outlet side, and a plurality of surfaces between the inlet side and the outlet side for constituting fluid force generating parts for the magnetic head slider due to dynamic pressure effects of the air flowing accompanying rotation of the magnetic recording medium, each of the plurality of surfaces has a different height level for respectively defining a different distance to a surface of the magnetic recording medium, comprising:

a contact pad for supporting a magnetic head for recording and reproducing data to and from a magnetic recording medium so as to make the magnetic head contact to the surface of the magnetic recording medium, the contact pad is provided around the air flowing



outlet side with keeping at a top level in the plurality of different height levels;

a positive pressure pad area provided around the air flowing inlet side for generating positive pressure during rotation of the magnetic recording medium, the positive pressure pad area is positioned so as to keep the same top level of the contact pad; and

a squeeze pad area for suppressing fluctuations of contacting forces between the magnetic head and the magnetic disk medium, the squeeze pad area is provided along the air flowing direction at an middle height level between the top level and the low level of the surfaces so as to across the low level of the surfaces.

9. The magnetic disk memory device according to claim 8, wherein the squeeze pad area has an U-shaped configuration including two side-edge parts extended along the rotational direction of the magnetic disk medium so as to encircle the low level of the surfaces.

10. The magnetic disk memory device according to claim 8 or 9, wherein the positive pressure generation area is divided into two parts by a first negative pressure control area.

11. The magnetic disk memory device according to claim 8, 9 or 10, wherein both the positive pressure generation area and the squeeze pad area are collectively divided into two parts by a second negative pressure control area.



12. The magnetic disk memory device according to claim 11, wherein each of the collectively divided parts of the positive pressure generation area and the squeeze pad area is further collectively divided by a third negative pressure control area.

13. The magnetic disk memory device according to claim 8, wherein the squeeze pad area is arranged on a slant along the air flowing direction flow due to rotation of the magnetic recording medium.

14. The magnetic disk memory device according to claim 8, wherein the squeeze pad area includes a forward area and a backward area along the air flowing direction, each of the forward area and the backward area of the squeeze pad is arranged on a different slant directions respectively along the air flowing direction due to rotation of the magnetic recording medium.

