

MAGNETIC DISPLAY DEVICE

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a magnetic display device for displaying a drawing or the like on a display sheet magnetically.

Earlier Development

Conventionally, a magnetic display device having a construction to enable displaying a drawing or the like on a magnetic display sheet by using a magnetic pen is known. Such a magnetic display device comprises a main body and a magnetic pen which are provided separately to each other. A user can display a drawing or the like on a magnetic display sheet by holding the magnetic pen by a hand and rubbing the magnetic pen onto the magnetic display sheet.

Another magnetic display device in which a magnetic pen disposed under a magnetic display is moved in X (sideways) and Y (forward and backward) directions by rotating two knobs, is also known, as shown in USP. 3,760,505. In the magnetic display device, a drawing or the like is displayed on the magnetic display sheet by operating the two knobs

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properly.

However, the conventional magnetic display device has the following problems.

According to the former magnetic display device, it is difficult to draw a clear straight line because the user draws manually with holding a magnetic pen by a hand. Although it is possible to draw a clear straight line by using a ruler and moving the magnetic pen along a side of the ruler, it is complicated to move the magnetic pen with holding the ruler. In particular, it is difficult to move the magnetic pen by using a hand with pressing down the ruler by using the other hand.

According to the latter magnetic display device, in the case that it is necessary to move both the two knobs at the same time, e.g., in the case of drawing an oblique line, it is difficult to image a practical oblique line to be drawn according to the amount of rotational movements of the knobs, although there is a relationship between the amount of rotational movement of each knob and the amount of the movement of the magnetic pen. Therefore, in particular, it is hard for a child to handle it.

SUMMARY OF THE INVENTION

The invention was developed in view of the above problems.

An object of the invention is to provide a magnetic display device which enables drawing a straight line and the like easily.

That is, in accordance with one aspect of the present invention, the magnetic display device having a construction to enable displaying a drawing or the like by using a magnetic pen on a magnetic display sheet, comprises: a first movement body which is provided under the magnetic display sheet and is movable in one direction along a lower surface of the magnetic display sheet; a first operating member which is attached to the first movement body, for moving the first movement body in the one direction; a second movement body holding a magnetic pen, which is provided on the first movement body and is movable in another direction different from the one direction; and a second operating member which is connected to the second movement body for moving the second movement body in the another direction.

Preferably, the magnetic display device having a construction to enable displaying a drawing or the like by using a magnetic pen on a magnetic display sheet,

comprises: a first movement body which is provided under the magnetic display sheet and is movable in one linear direction along a lower surface of the magnetic display sheet; a first operating member which is attached to the first movement body, for moving the first movement body in the one linear direction by operating the first operating member in the one linear direction; a second movement body holding a magnetic pen, which is provided on the first movement body and is movable in an approximately perpendicular direction to the one linear direction; and a ball-shaped second operating member which is connected to the second movement body and can swing at a predetermined position on the first operating member, for moving the second movement body in the approximately perpendicular direction by swinging the second operating member.

In the magnetic display device, the first movement body can be linearly moved in one direction by operating the first operating member, and the second movement body can be linearly moved in another direction on the first movement body. Therefore, according to the magnetic display device, it is possible to draw a straight line in the movement direction for the first movement body or in the movement direction for the second movement body easily. Further, according to the magnetic display device, it is possible to imagine the current position of the magnetic

pen in the movement direction for the first movement body by seeing the position of the first operating member. Therefore, it is possible to draw a desired oblique straight line and the like easily by only adjusting the position of the magnetic pen in the direction perpendicular to the movement direction by using the second operating member.

Preferably, the magnetic display device further comprises a wrapping connector driving mechanism with a rope, chain, belt or the like, which is connected to the magnetic pen on the way thereof and is driven by a rotation-operation of the second operating member.

According to the magnetic display device having such a structure, it is possible to make the construction thereof simple because transfer of the magnetic pen is carried out by using the wrapping connector driving mechanism.

Preferably, the magnetic display device further comprises a pen top moving member for contacting a top of the magnetic pen with a lower surface of the magnetic display sheet or separating the top of the magnetic pen from the lower surface.

According to the magnetic display device having such a structure, it is possible to draw discontinuous

straight lines or discontinuous curved lines because the top of the magnetic pen can be moved to be brought into contact with or apart from the magnetic display sheet by using the pen top moving button.

The pen top moving member is preferably located near the first operating member, and comprises a pen top moving button which can swing the magnetic pen around an axis approximately parallel to the lower surface of the magnetic display sheet. Preferably, the pen top moving button is located at a position where it is able to handle by an index finger or a middle finger when placing a hand on the ball-like operating member.

According to the magnetic display device, it is possible to perform contact with or separation from the magnetic display sheet, of the top of the magnetic pen easily because it is performed by pressing down the pen top moving button.

Preferably, the pen top moving button can swing around a first shaft and the magnetic pen can swing around and together with a second shaft, and a swing of the pen top moving button in one direction brings about a swing of the second shaft through a connecting member. The line of the first shaft

preferably coincides with a line of the second shaft. The second shaft preferably has a polygonal section, e.g., a triangle section or a square section, and passes through the magnetic pen so that the magnetic pen is not rotatable with respect to and is movable along the second shaft.

The magnetic display device may further comprises an eraser independent of a body the magnetic display device, for erasing a desired portion of a drawing or the like which is displayed on the magnetic display sheet.

According to the magnetic display device, it is possible to demagnetize to erase the desired portion of a drawing or the like which has been displayed on the magnetic display sheet.

Preferably, the eraser can practically erase a desired portion of a drawing or the like which was displayed on the magnetic display sheet, by a single going and returning linear movement.

According to the magnetic display device, it is possible to erase the desired portion of a drawing or the like on the magnetic display sheet conveniently by a single going and returning linear movement.

The magnetic display sheet may comprise: a

large number of micro capsules provided close together in plan, each of which includes a mixture of an oily liquid, ferromagnetic powder with a light absorptive property and non-magnetic powder with a light reflective property in a suspension state; and an upper protective sheet with light transmissive property, for covering an upper portion of the large number of micro capsules.

According to the magnetic display device, it is possible to display even a fine line clearly because of using the magnetic display sheet which comprises a large number of micro capsules.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus are not intended as a definition of the limits of the present invention, and wherein;

FIG. 1 is a plan view of a magnetic display device according to an embodiment of the invention;

FIG. 2 is an exploded perspective view of the magnetic display device according to the embodiment;

FIG. 3A is a vertical sectional view for showing a construction of a magnetic display sheet in the magnetic display device according to the embodiment, and FIG. 3B is a sectional view of a capsule shown in FIG. 3A;

FIG. 4 is a vertical sectional view of a magnetic pen in the magnetic display device according to the embodiment;

FIG. 5A is a perspective view showing the portion in the vicinity of the first and second operating members in the magnetic display device according to the embodiment, and FIG. 5B is a perspective view showing the engagement of the pen top moving button and the connecting member in detail.

PREFERRED EMBODIMENT OF THE INVENTION

FIG. 1 is a plan view of a magnetic display device according to an embodiment of the present invention. FIG. 2 is an exploded perspective view of the magnetic display device. The magnetic display device 1 comprises a lower frame 2 and an upper frame 3. In the upper frame 3, a rectangular window 4 which is covered by an exposed magnetic display sheet 5 is formed. The lower frame 2 is

larger than the upper frame 3 so that the portion of this side of the lower frame 2 exposes when assembling the upper frame 3 on the lower frame 2. The portion of this side of the lower frame 2 forms a table 6. On the table 6, a first operating member 7 which can be reciprocally moved in right and left directions (X-direction) is provided. On the first operating member 7, a second operating member 8 comprising a ball-like operating member which can be operated to rotate backward and forward (in Y-direction) is provided. Further, on the first operating member 7, a pen top moving button 9 for separating the top of the magnetic pen 18, which can be operated to swing in right and left directions (X-direction) around a first shaft 9a is provided in front of the second operating member 8. A plate-like eraser 11 is attached to the upper frame 3 through a rope 10.

In the magnetic display device 1, when operating to move the first operating member 7 in right and left directions (in X-direction) with pushing down the left side portion of the pen top moving button 9, a straight line extending in X-direction is displayed on the magnetic display sheet 5. Even if operating to move the first operating

member 7 in X-direction with pushing down the right side portion of the pen top moving button 9, nothing are displayed on the magnetic display sheet 5.

On the other hand, in the magnetic display device 1, when operating to rotate the second operating member 8 forward or backward (in Y-direction) with pushing down the left side portion of the pen top moving button 9, a straight line extending in Y-direction is displayed on the magnetic display sheet 5. Even if operating to rotate the second operating member 8 in Y-direction with pushing down the right side portion of the pen top moving button 9, nothing are displayed on the magnetic display sheet 5.

Further, in the magnetic display device 1, when operating to move the first operating member 7 and the second operating member 8 at the same time with pushing down the left side portion of the pen top moving button 9, an oblique line is displayed on the magnetic display sheet 5. Even if operating to move the first operating member 7 and the second operating member 8 at the same time with pushing down the right side portion of the pen top moving button 9, nothing are displayed on the magnetic display sheet 5.

Next, the detail of the magnetic display device 1 will be explained as follows.

The magnetic display sheet 5 comprises a large number of micro capsules 51, as shown in FIG. 3A. Each of the micro capsules 51 includes an oily liquid, ferromagnetic powder 51a having a light absorptive property, and non-magnetic powder 51b having a light reflective property, in a suspension state, as shown in FIG. 3B. The large number of micro capsules 51 are sandwiched between protective sheets 52 and 53. The ends of the protective sheets 52 and 53 are adhered to each other, e.g., by high frequency welding or the like. The lower protective sheet 52 has magnetic transmissive property. The upper protective sheet 53 has light transmissive property.

To the first operating member 7, a first movement body 12 is attached as a body, as shown in FIG. 2. The first movement body 12 is extending along the lower surface of the magnetic display sheet 5. The first movement body 12 can move along a guide 13 which extends in X-direction linearly.

A square shaft (second shaft) 14 which extends in a direction perpendicular to the guide, i.e., in Y-direction is attached to the first movement body 12. At portions of the first movement body 12, next to and

distant from the first operating member 7, bearing portions 15 and 16 are provided to support both ends of the square shaft 14, respectively, so that the square shaft 14 is rotatable around the shaft line thereof. The square shaft 14 passes through the arms 17a and 17a of a second movement body 17. The second movement body 17 is rotatable with respect to the square shaft 14 and is movable along the shaft line thereof. The square shaft 14 also passes through a magnetic pen 18 between the arms 17a and 17a. The square shaft 14 is fitted into a hole formed in the magnetic pen 18 so that the magnetic pen 18 is not rotatable and is movable along the shaft line, with respect to the square shaft 14. The section of the shaft 14 is not necessarily a square. It may be any shape to enable rotation of the magnetic pen 18 having a through hole with a similar shape according to the rotation of the shaft 14, for example, a triangle, a pentagon, an ellipse, a star-shape, and the like.

The core 18a of the magnetic pen 18 is preferably made of magnet material. For example, it may be made of neodymium system which contains an alloy of neodymium, iron and boron, magnet material containing an alloy of rare-earth element of samarium and cobalt, rare-earth magnet material

containing praseodymium, or the like. Use of such a magnet material for the core the magnetic pen enables a clear display even by a fine line. The core 18a of the magnetic pen 18 is energized upward by a spring 18b, as shown in FIG. 4.

The square shaft 14 is fitted in a connecting member 20 also, as shown in FIG. 5. The connecting member 20 comprises a rising portion 20a and a horizontal portion 20b. The horizontal portion 20b extends to the lower position of the pen top moving button 9.

On the other hand, the pen top moving button 9 can swing around a shaft 9a which extends in the direction perpendicular to the guide 13 in parallel with the magnetic display sheet 5. The line of the shaft 9a coincides with the line of the square shaft 14. On the lower surface of the pen top moving button 9, a forked member 9b is attached to hold the connecting member 20 by sandwiching an end of the horizontal portion 20b thereof. Accordingly, when pressing down the right side portion of the pen top moving button 9, the magnetic pen 18 comes to incline to right, through rotation of the connecting member 20 and of the square shaft 14. As a result, the top of the pen 18 is moved apart from the lower surface of the magnetic display sheet 5. On the

contrary, when pressing down the left side portion of the pen top moving button 9, the magnetic pen 18 comes to stand up, through reverse rotation of the connecting member 20 and of the square shaft 14. As a result, the top of the pen 18 is moved to contact the top of the pen with the lower surface of the magnetic display sheet 5.

The ball-like operating member 8 can rotate reciprocally in the direction perpendicular to the guide 13, as shown in FIG. 5. A gear 8a is attached to the left side of the ball-like operating member 8. A gear 31 having a pulley 30 as a body is engaged with the gear 8a. Around the pulley 30, a rope 32 is wound. An end of the rope 32 is connected with an end of the spring 33, and the other end of the spring 33 is connected with the second movement body 17, as shown in FIG. 2. The other end of the rope 32 is wound around a pulley 34 which is arranged at the top end of the first movement body 12, and is thereafter connected with the second movement body 17. Accordingly, when rotating the ball-like operating member 8 in the direction perpendicular to the guide 13, also the second movement body 17 comes to move in the same direction. The reason for connecting the spring 33 to the rope 32 is to provide no slack to the rope.

Lastly, the plate-like eraser 11 will be explained, as follows.

A permanent magnet is incorporated in the eraser 11. The material thereof may be the same as or also different from the core of the magnetic pen 18. It is preferable to increase the number of lines of magnetic force of the material to easily erase a drawing or the like formed on the magnetic display sheet 5.

Next, the function of the invention will be explained.

When operating to move the first operating member 7 in X-direction, the first movement body 12 moves also in X-direction. At this time, when the left side portion of the pen top moving button 9 is pressed down, the magnetic pen 18 stands up, so that the top of the pen is brought into contact with the lower surface of the magnetic display sheet 5. Accordingly, the locus of the magnetic pen 18 is displayed on the magnetic display sheet 5. On the contrary, when the right side portion of the pen top moving button 9 is pressed down, the magnetic pen 18 inclines to right, so that the top of the pen is moved apart from the lower surface of the magnetic display sheet 5. Accordingly, the locus of the

magnetic pen 18 is not displayed on the magnetic display sheet 5.

When operating the second (ball-like) operating member 8 in the direction perpendicular to the guide, the pulley 30 is rotated through the gears 8a and 31. The rotation of the pulley 30 gives a movement to the rope 32 through the frictional force between them. Thereby, the second movement body 17 which is connected with the rope 32 is moved in Y-direction. At this time, when the left side portion of the pen top moving button 9 is pressed down, the magnetic pen 18 stands up, so that the top of the pen is brought into contact with the magnetic display sheet 5. Accordingly, the locus of the magnetic pen 18 is displayed on the magnetic display sheet 5. On the contrary, when the right side portion of the pen top moving button 9 is pressed down, the magnetic pen 18 inclines to right, so that the top of the pen is moved apart from the magnetic display sheet 5. Accordingly, the locus of the magnetic pen 18 is not displayed on the magnetic display sheet 5.

When operating both the first operating member 7 and the second operating member 8 at the same time, a composite movement having both X-direction and Y-direction components is given to the magnetic pen 18.

At this time, when the left side portion of the pen top moving button 9 is pressed down, the magnetic pen 18 stands up, so that the top of the pen is brought into contact with the magnetic display sheet 5. Accordingly, the locus of the magnetic pen 18, that is, an oblique line, a curved line or the like, is displayed on the magnetic display sheet 5 on the basis of the composite movement of the magnetic pen 18. On the contrary, when the right side portion of the pen top moving button 9 is pressed down, the magnetic pen 18 inclines to right, so that the top of the pen is moved apart from the magnetic display sheet 5. Accordingly, the locus of the magnetic pen 18 is not displayed on the magnetic display sheet 5.

According to the magnetic display device 1 of the embodiment, it is possible to draw a clear straight line such as a continuous straight line in X or Y direction, or an oblique line, or a continuous curved line, by operating the first operating member 7 or the second operating member 8. According to the magnetic display device 1 of the embodiment, it is further possible to simplify the construction of the device because of using a rope transmission mechanism for moving the magnetic pen 18.

According to the magnetic display device 1 of

the embodiment, it is possible to draw discontinuous straight lines or discontinuous curved lines because the top of the magnetic pen 18 can be moved apart from the magnetic display sheet 5 by using the pen top moving button 9. Further, contact with or separation from the magnetic display sheet 5, of the top of the magnetic pen 18 can be performed easily because it is performed by pressing down the pen top moving button 9.

According to the magnetic display device 1 of the embodiment, it is possible to erase a desired portion of a drawing which is displayed on the magnetic display sheet 5. In the magnetic display device 1, it is possible to display even a clear fine line because of being able to use the magnetic display sheet 5 which comprises a large number of small micro capsules 51.

Although some embodiments of the invention have been explained as described above, it should also be understood that the present invention is not limited to the embodiments and that various changes and modifications may be made to the invention without departing from the gist thereof.

The entire disclosure of Japanese Patent Application No. Tokugan hei-10-297078 filed on

October 19, 1998 including specification, claims, drawings and summary are incorporated herein by reference in its entirety.

Some representative effect of the invention will be explained, as follows.

In the magnetic display device, the first movement body can be linearly moved in one direction by operating the first operating member, and the second movement body can be linearly moved in another direction on the first movement body. Therefore, according to the magnetic display device, it is possible to draw a straight line in the movement direction for the first movement body or in the movement direction for the second movement body easily. Further, according to the magnetic display device, it is possible to imagine the current position of the magnetic pen in the movement direction for the first movement body by seeing the position of the first operating member. Therefore, it is possible to draw a desired oblique straight line and the like easily by only adjusting the position of the magnetic pen in the direction perpendicular to the movement direction by using the second operating member.

What is claimed is:

1. A magnetic display device having a construction to enable displaying a drawing or the like by using a magnetic pen on a magnetic display sheet, comprising:

a first movement body which is provided under the magnetic display sheet and is movable in one linear direction along a lower surface of the magnetic display sheet,

a first operating member which is attached to the first movement body, for moving the first movement body in the one linear direction by operating the first operating member in the one linear direction,

a second movement body holding a magnetic pen, which is provided on the first movement body and is movable in an approximately perpendicular direction to the one linear direction, and

a ball-shaped second operating member which is connected to the second movement body and can swing at a predetermined position on the first operating member, for moving the second movement body in the approximately perpendicular direction by swinging the second operating member.

2. The magnetic display device as claimed in claim 1: further comprising a wrapping connector driving



mechanism with a rope, chain, belt or the like, which is connected to the magnetic pen on the way thereof and is driven by a rotation-operation of the second operating member.

3. The magnetic display device as claimed in claim 1 or 2: further comprising a pen top moving member for contacting a top of the magnetic pen with a lower surface of the magnetic display sheet or separating the top of the magnetic pen from the lower surface.

4. The magnetic display device as claimed in claim 3: wherein the pen top moving member is located near the first operating member, and comprises a pen top moving button which can swing the magnetic pen around an axis approximately parallel to the lower surface of the magnetic display sheet.

5. The magnetic display device as claimed in claim 4: wherein the pen top moving button can swing around a first shaft and the magnetic pen can swing around and together with a second shaft, and a swing of the pen top moving button in one direction brings about a swing of the second shaft through a connecting member.



6. The magnetic display device as claimed in claim 5, wherein a line of the first shaft coincides with a line of the second shaft.

7. The magnetic display device as claimed in claim 5, wherein the second shaft has a polygonal section and passes through the magnetic pen so that the magnetic pen is not rotatable with respect to and is movable along the second shaft.

8. The magnetic display device as claimed in claim 1: further comprising an eraser independent of a body the magnetic display device, for erasing a desired portion of a drawing or the like which is displayed on the magnetic display sheet.

9. The magnetic display device as claimed in claim 8: wherein the eraser can practically erase a desired portion of a drawing or the like which was displayed on the magnetic display sheet, by a single going and returning linear movement.

10. The magnetic display device as claimed in claim 1: wherein the magnetic display sheet comprises:
a large number of micro capsules provided



close together in plan, each of which includes a mixture of an oily liquid, ferromagnetic powder with a light absorptive property and non-magnetic powder with a light reflective property in a suspension state; and

an upper protective sheet with light transmissive property, for covering an upper portion of the large number of micro capsules.

11. A magnetic display device having a construction to enable displaying a drawing or the like by using a magnetic pen on a magnetic display sheet, comprising:

a first movement body which is provided under the magnetic display sheet and is movable in one direction along a lower surface of the magnetic display sheet,

a first operating member which is attached to the first movement body, for moving the first movement body in the one direction,

a second movement body holding a magnetic pen, which is provided on the first movement body and is movable in another direction different from the one direction, and

a second operating member which is connected to the second movement body for moving the second movement body in the another direction.

