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(54) **Magnetic head for magnetic display**

Magnetkopf für magnetische Anzeige

Tête magnétique pour panneau d'affichage magnétique

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(73) Proprietor: **STAR MICRONICS CO., LTD.**
Shizuoka-shi, Shizuoka-ken 422-8001 (JP)

(72) Inventors:
• **Urushibata, Kiyoshi**
Shizuoka-shi, Shizuoka 422 (JP)
• **Moritake, Fuminori**
Shizuoka-shi, Shizuoka 422 (JP)

(74) Representative: **Hale, Peter et al**
Kilburn & Strode
20 Red Lion Street
London WC1R 4PJ (GB)

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Description

[0001] The present invention relates to a magnetic head for recording and displaying a still image on a magnetic display medium on the basis of printing information sent from an external host.

[0002] Hitherto, there has been known a magneto-sensitive magnetic display sheet as a display medium which can be colored or decolored in response to directions and strengths of magnetic fields (e.g. Japanese Unexamined Patent Publications JP-A 48-56393 (1973), JP-A 2-146082 (1990)).

[0003] Because on such a magnetic display sheet simple letters and graphics can be drawn just by touching a surface of the magnetic display sheet with a magnet incorporated magnetic pen and as well the magnetic display sheet can be used many times by erasing such letters and graphics, the magnetic display sheet is being put into practical use as a simple notepad.

[0004] Lately, an electronic information display apparatus for recording and displaying a still image on the magnetic display sheet by generating dot matrix type magnetic fields from a recording head on the basis of printing information sent from an external host has been developing. Since the electronic information display apparatus allows display contents to be arbitrarily changed by remote control of the external host, a great variety of information may be given and, for example, advertised widely to pedestrians by installing it at public facilities, train stations, shops and the like. Additionally, because the electronic information display apparatus requires no works for changing posters and contributes in conservation of resources such as papers, the electronic information display apparatus is considered promising as a future bulletin board.

[0005] In such electronic information display apparatus, a magnetic head is used to generate the dot matrix recording magnetic fields on the basis of printing signals (see Japanese Unexamined Patent Publication JP-A 63-259678 (1988), Japanese Examined Patent Publication JP-B2 5-35876 (1993), JP-B2 6-14264 (1994), Japanese Unexamined Patent Publication JP-A 7-281621 (1995) and others). The magnetic head is composed of a plurality of magnetic cores arranged in a row or a plurality of rows, a plurality of electromagnetic coils mounted around each magnetic core, a yoke for forming air gaps for leaking magnetic fluxes around each magnetic core.

[0006] Fig. 6A is a structural drawing showing one example of a magnetic head for magnetic display and Fig. 6B is an explanatory drawing showing an operating state thereof. A magnetic head 1 has a yoke 10 in which a box-shaped front yoke 11 is magnetically coupled with a plate-like rear yoke 12. A plurality of holes 13 are formed in a predetermined arrangement on a printing face 14 of the front yoke 11 and edges of magnetic cores 20 are inserted into the corresponding holes 13. The roots of the magnetic cores 20 are in contact with the

rear yoke 12 and electromagnetic coils 30 are disposed around the magnetic cores 20. A circuit member 60 for individually wiring the plurality of electromagnetic coils 30 is provided on the back of the rear yoke 12 and connected to a driving circuit (not shown) for driving the electromagnetic coils 30.

[0007] In Fig. 6B, the magnetic head 1 is arranged such that the printing face 14 closely contacts with a magnetic display sheet 50. In the magnetic display sheet 50, microcapsules 52 which develop colors in response to magnetism are coated and fixed between a substrate 51 made of a transparent material and a protecting sheet 55. The microcapsules 52 contain magnetic particles 53 of black iron oxide (FeO) or the like and a white opaque solution 54 containing non-magnetic particles.

[0008] Next, a principle of magnetic recording will be explained. When the magnetic head 1 is approached to the magnetic display sheet 50 and the electromagnetic coils 30 are energized based on a printing signal, magnetic fields are generated. The magnetic fields thus generated pass through the magnetic circuit composed of the magnetic core 20 and the yoke 10 and cause dot-like leakage magnetic fluxes, which pass through the magnetic display sheet 50, at air gaps between the holes 13 and the edges of the magnetic cores 20.

[0009] When the recording magnetic fields are generated, the magnetic particles distributed within the microcapsules 52 are drawn toward the substrate 51 side and due to the pressure of the magnetic particles, the white opaque solution 54 moves toward the protection sheet 13 side. Then, seeing from the side of the substrate 51 of the magnetic display sheet 50, the part to which the recording magnetic field has been applied is observed as if dots are developed nearly black.

[0010] Thus, one magnetic core 20, one electromagnetic coil 30 and one hole 13 compose a writing unit 40 for recording one dot. Furthermore, letters, symbols and the like can be recorded just like a dot printer by applying magnetic fields in a dot matrix fashion while moving the magnetic head 1 relatively with the magnetic display sheet 50.

[0011] In erasing the letters and the like, an erasing magnetic head (not shown) is approached to the back side of the magnetic display sheet 50, i.e. to the side where the protection sheet 55 is located. Then, the magnetic particles 53 distributed within the microcapsules 52 are drawn to the protection sheet 55 side and due to the pressure thereof, the white opaque solution 54 moves to the substrate 51 side. Then, seeing from the surface side of the magnetic display sheet 50, the part to which the erasing magnetic field has been applied appears to be nearly white. The letters and the like may be erased uniformly by applying the erasing magnetic field to the sheet over the width thereof.

[0012] In such magnetic head 1, since no consideration has been made as to the directions of the magnetic fields generated by the plurality of magnetic cores 20,

the directions of the magnetic fields are all the same. Then, because the magnetic fields generated by the plurality of such magnetic cores 20 pass through the yoke 10 in common, a ghost image has been apt to be generated by a writing unit by which no recording magnetic field is supposed to be applied as the number of writing units 40 which are driven at the same time increases.

[0013] Figs. 7A through 7D show examples of arrangement of the writing unit 40 on the printing face 14, wherein Figs. 7A and 7B show that of nine rows and one column, Fig. 7C shows that of eight rows and two columns disposed in a staggered fashion, and Fig. 7D shows that of six rows and six columns disposed in an inclination fashion. Here, in order to facilitate the understanding, among the plurality of writing units 40, those represented by a mark "○" belong to a group which generates magnetic fields simultaneously at certain timing and those represented by a mark "○" belong to a group which generates no magnetic field at such timing.

[0014] Figs. 8A through 8D are explanatory drawings showing printing examples corresponding to each of the arrangements shown in Figs. 7A through 7D. Here, in order to facilitate the understanding, dots represented by a mark "●" indicate that they have been magnetically printed. In Fig. 8A, when printing is carried out while scanning the magnetic head of an arrangement of nine rows and one column as shown in Fig. 7A in the horizontal direction, the writing units 40 of "◎" shown in Fig. 7A are driven simultaneously at timing when the magnetic head is located at columns L1 and L2. Then, since consecutive eight units among the nine writing units 40, except the middle one, are driven, magnetic fluxes are slightly leaked from the middle writing unit 40 and the hatched middle dots develop color slightly, causing a so-called ghost image. Meanwhile, because the number of writing units 40 simultaneously driven is as small as four when the magnetic head is not located at the columns L1 and L2 and the writing units simultaneously driven are not consecutive, no ghost image appears yet.

[0015] In Fig. 8B, when printing is carried out while scanning the magnetic head of an arrangement of nine rows and one column shown in Fig. 7B in the horizontal direction, the writing units 40 represented by the mark '◎' in FIG. 7B are simultaneously driven at timing when the magnetic head is located at columns L3 and L4. Then, since seven consecutive writing units among the nine writing units 40, except those at the both ends, are driven, the hatched dots at the both ends are also slightly colored, causing a ghost image. Meanwhile, since the number of the writing units 40 which are driven at the same time is one when the magnetic head is not located at the columns L3 and L4, no ghost image appears.

[0016] In FIG. 8C, when printing is carried out by scanning the magnetic head of an arrangement of eight rows and two columns in a staggered fashion in the horizontal direction as shown in Fig. 7C, those in the column A represented by the mark "◎" in Fig. 7C are simulta-

neously driven at timing when they are positioned at column L5. Then, magnetic flux leakage from the writing units 40 in the column B in Fig. 7C occurs and the column of the hatched dots appear as a ghost image.

[0017] In case the magnetic head move further and is driven at timing when the writing units in the column B are positioned at column L5, a print result that dots are overlapped in part each other as shown in Fig. 8C is obtained. At the same time a ghost image (not shown) appears at position corresponding to column A as well.

[0018] In Fig. 8D, when printing is carried out while scanning the magnetic head of an arrangement of inclined six rows and six columns as shown in Fig. 7D, the writing units 40 represented by the mark "◎" are simultaneously driven. Then, magnetic flux leakage from the four writing units 40 at the center in Fig. 7D occurs, causing the hatched dots to appear as a ghost image.

[0019] Thus, when the writing units 40 to be simultaneously driven in the magnetic head 1 having the plurality of writing units 40 form a specific pattern in arrangement and number, dots which are supposed not to be printed are printed as a ghost image. It is noted that there exist printing patterns which cause a ghost image other than those shown in Figs. 8A through 8D.

[0020] Fig. 9 is an explanatory drawing showing a ghost image generating mechanism. Fig. 9 is a cross-sectional view taken along a line C-C in Fig. 7C and shows a state when the writing units in the column A are in operation and the writing units in the column B are out of operation. When the electromagnetic coils 30 in the column A are energized and a magnetic field is generated in the magnetic core 20 of the column A, most of the magnetic field passes through the front yoke 11 and returns again to the magnetic core 20 in the column A. Further, part of the magnetic field passes through the magnetic core 20 in the column B which is out of operation.

[0021] When the number of the writing units 40 in the column A to be simultaneously driven is as small as one or two, magnetic flux leakage to the magnetic core 20 in the column B is less and the ghost magnetic field at the edge of the magnetic core will not cause the magnetic display sheet 50 to develop color because the sectional area of the magnetic path of the front yoke 11 per writing unit is sufficient.

[0022] However, when the number of writing units 40 in the column A to be simultaneously driven increases and they are consecutively arranged, the sectional area of the magnetic path of the front yoke 11 per writing unit becomes insufficient, the magnetic flux leakage to the magnetic core 20 in the column B increases and the ghost magnetic field at the edge of the magnetic core causes the magnetic display sheet 50 to develop color.

[0023] The more the number of the writing units 40 to be simultaneously driven and the less the pitch in the arrangement of the writing units 40 is, the more such ghost magnetic field increases.

[0024] Further, even if the number of the writing units

to be simultaneously driven is the same, the ghost magnetic field increases when the writing units 40 to be driven are consecutive, depending on the degree of consecutiveness.

[0025] The invention is defined in the accompanying independent claim. Some preferred features are recited in the dependent claims.

[0026] It is an object of the present invention to provide a magnetic head for magnetic display, capable of suppressing generation of ghost images to realize high quality magnetic printing.

[0027] In one form the invention provides a magnetic head for magnetic display comprising a yoke having a printing face which faces to a magnetic display medium; a plurality of air gap holes formed on the printing face; a plurality of magnetic cores whose edges are inserted to the air gap holes of the yoke for generating dot-like recording magnetic fields by magnetically coupling with the yoke; and a plurality of electromagnetic coils for selectively supplying the magnetic fields to each of the magnetic cores on the basis of a printing signal, wherein among the plurality of magnetic cores, there exist first magnetic cores for generating a recording magnetic field in a first direction and second magnetic cores for generating a recording magnetic field in a second direction opposite to the first direction.

[0028] Because there exist the first magnetic cores and the second magnetic cores whose directions of the recording magnetic fields are opposite from each other and the first magnetic cores and the second magnetic cores excited by the electromagnetic coil form a path of magnetic fluxes by themselves, magnetic saturation in the yoke may be relaxed. Owing to that, magnetic fluxes leaked to non-excited magnetic cores are remarkably reduced and it becomes possible to reliably prevent generation of ghost images which may be caused by the magnetic cores out of operation.

[0029] It is noted that the direction of the recording magnetic field may be controlled by changing a winding direction of the electromagnetic coil and a direction of current.

[0030] In the invention it is preferable that the first and the second magnetic cores are arrayed in such a manner that a predetermined number of consecutive first magnetic cores and a predetermined number of consecutive second magnetic cores are alternately arranged.

[0031] An area where the directions of magnetic fields within the yoke becomes the same and the flux density becomes high may be distributed to the whole of the head and the magnetic saturation within the yoke may be relaxed by alternately arranging a predetermined number of consecutive first magnetic cores and a predetermined number of consecutive second magnetic cores over and over. Therefore, the amount of magnetic flux leakage to a non-excited magnetic core decreases and the generation of ghost image may be reliably prevented.

[0032] Furthermore, in the invention it is preferable

that the first and the second magnetic cores are arrayed in such a manner that a predetermined number of consecutive first magnetic cores and a predetermined number of consecutive second magnetic cores are two-dimensionally alternately arranged along row and column directions.

[0033] An area where the directions of magnetic fields within the yoke becomes the same and the flux density becomes high may be distributed to the whole of the head and the magnetic saturation within the yoke may be relaxed by alternately arranging a predetermined number of consecutive first magnetic cores and a predetermined number of consecutive second magnetic cores two-dimensionally over and over. Therefore, the amount of magnetic flux leakage to a non-excited magnetic core decreases and the generation of ghost image may be reliably prevented.

[0034] High quality magnetic printing may be thus realized while suppressing the occurrence of ghost image.

[0035] Other and further objects, features, and advantages of the invention will be more explicit from the following detailed description taken with reference to the drawings wherein:

Figs. 1A through 1D are explanatory drawings showing one example of magnetic head for magnetic display of the invention;

Figs. 2A through 2D are drawings showing examples in which eight rows and two columns of writing units or nine rows and two columns of writing units are arranged in a zigzag fashion;

Figs. 3A through 3D are drawings showing examples in which writing units are arranged by reducing a row pitch by distributing the writing units in the row direction;

Figs. 4A through 4E are drawings showing examples in which the arrangements in Figs. 3A through 3D are expanded in the column direction;

Figs. 5A and 5B are circuit diagrams showing various examples of electromagnetic coil driving circuits;

Fig. 6A is a structural drawing showing one example of magnetic head for magnetic display and Fig. 6B is an explanatory diagram showing an operation state thereof;

Figs. 7A through 7D are drawings showing examples of arrangement of writing units on a printing face;

Figs. 8A through 8D are explanatory drawings showing printing examples corresponding to each arrangement shown in Figs. 7A through 7D; and Fig. 9 is an explanatory drawing showing a ghost generating mechanism.

[0036] Now referring to the drawings, preferred embodiments of the invention are described below.

[0037] Figs. 1A through 1D are explanatory drawings showing examples of magnetic heads for magnetic display.

play of the invention. All of them are seen from a printing face of a magnetic head. In Figs. 1A through 1D, writing units 40 each comprising a magnetic core, an electro-magnetic coil and others are arranged in nine rows and one column and form a magnetic circuit together with common front and rear yokes as shown in Fig. 6. These writing units 40 are divided into two groups: those marked with "●" are writing units in which a direction of a recording magnetic field in the magnetic core 20 directs to the magnetic display sheet from the printing face (Hereinafter referred to as "forward direction") and those marked with "x" are writing units in which a direction of the recording magnetic field in the magnetic core 20 directs to the printing face from the magnetic display sheet (Hereinafter referred to as "backward direction").

[0038] Fig. 1A shows an example in which the forward writing units 40 and the backward writing units 40 are alternately arranged per each. Fig. 1B shows an example in which the forward writing units 40 and the backward writing units 40 are alternately arranged per two of them from the top. Fig. 1C shows an example in which the forward writing units 40 and the backward writing units 40 are alternately arranged per three of them from the top. Fig. 1D shows an example in which the forward writing units 40 and the backward writing units 40 are arranged in a cycle in which one backward writing unit 40 is arrayed after arraying two forward writing units 40. It is noted that the number of consecutive writing units which indicates the number of writing units which are consecutively arrayed and whose magnetic field generating directions are the same is preferably three or less. A ghost tends to appear when the number is four or more, though it also depends on the structure and material of the magnetic head.

[0039] No ghost image will appear by alternately arranging a predetermined number of consecutive forward writing units and a predetermined number of consecutive backward writing units 40 because the concentration of flux within the yoke is relaxed and an amount of magnetic flux leakage to magnetic cores out of printing is reduced.

[0040] For example, when magnetic printing is carried out, while scanning the magnetic display sheet, by the magnetic head having the arrangement as shown in Fig. 1A with the printing pattern of the column L1 shown in Fig. 8A, while the four magnetic cores from the upper and lower ends are excited at the same time. However, because the direction of the recording magnetic field is reversed each other per each, the magnetic cores having different polarities form a closed magnetic circuit by themselves, so that the magnetic fluxes within the yoke will not leak to the magnetic cores not excited at the middle.

[0041] Further, because the magnetic cores whose magnetic field direction is the same are separated by a certain distance by alternately arranging them, the magnetic saturation within the yoke may be relaxed. Due to that, magnetic flux which passes through the non-excited

ed magnetic core may be considerably reduced.

[0042] Still more, because a spatial magnetic flux near the edge of the non-excited magnetic cores is also reduced as the forward magnetic field and the backward magnetic field superpose each other, the ghost magnetic field may be also reduced considerably.

[0043] It is noted that although an example in which the nine writing units 40 are arranged vertically in nine rows and one column in the explanation described above, it is also possible to arrange them horizontally in one row and nine columns. Further, the total number of the writing units 40 and the number of writing units in consecutive arrangement are not also limited to those described above. The forward writing units and the backward writing units may be also replaced from each other.

[0044] Figs. 2A through 2D show examples in which the writing units 40 are staggered in eight rows and two columns and nine rows and two columns. All of them are seen from the printing face of the magnetic head. Similarly to those in Figs. 1A through 1D, the writing units 40 are divided into two groups: those marked with "●" are writing units in which a direction of a recording magnetic field is the forward direction and those marked with "x" are writing units in which a direction of the recording magnetic field is the backward direction. Fig. 2A shows an example in which the forward writing units 40 and the backward writing units 40 are alternately arranged per each with respect to each column. Fig. 2B shows an example in which the forward writing units 40 and the backward writing units 40 are alternately arranged per two of them with respect to each column. Fig. 2C shows an example in which the forward writing units 40 and the backward writing units 40 are alternately arranged per three of them with respect to each column. Fig. 2D shows an example in which the forward writing units 40 and the backward writing units 40 are arranged such that combinations of two and one thereof are arrayed alternately.

[0045] No ghost image will appear by alternately arranging a predetermined number of consecutive forward writing units 40 and a predetermined of consecutive backward writing units 40 because the concentration of flux at the yoke is relaxed and an amount of magnetic flux leakage to magnetic cores out of printing is reduced.

[0046] When magnetic printing is carried out, while scanning the magnetic display sheet, by the magnetic head having the arrangement, for example, as shown in Fig. 2A, with the printing pattern of, for example, the column L5 as shown in Fig. 8C, while one column of magnetic cores are excited at the same time. However, because the directions of the recording magnetic fields of the one column of magnetic cores are alternately reversed one by one, the magnetic cores having different polarities form a closed magnetic circuit by themselves, so that the magnetic fluxes within the yoke will not leak to the non-excited magnetic cores in the other columns.

[0047] Further, because the magnetic cores whose magnetic field directions are the same are separated at a certain distance from each other by alternately arranging them, the magnetic saturation within the yoke may be relaxed. Due to that, magnetic flux which passes through the non-excited magnetic core may be considerably reduced.

[0048] Still more, because spatial magnetic fluxes near the edges of the non-excited magnetic cores are also reduced as the forward magnetic field and the backward magnetic field superpose each other, the ghost magnetic field may be also reduced considerably.

[0049] It is noted that although an example in which the 16 or 18 writing units 40 are arranged in eight rows and two columns or in nine rows and two columns in the explanation described above, it is also possible to arrange them horizontally in two rows and eight columns or two rows and nine columns. Further, the total number of the writing units 40 and the number of writing units in consecutive arrangement are not also limited to those described above. The forward writing units and the backward writing units may be also replaced from each other.

[0050] Figs. 3A through 3D show examples in which the writing units 40 are arranged in two rows and eight columns or two rows and nine columns by distributing them in the row direction to reduce the row pitch. The printed dots are overlapping partially in the column direction. Similarly to those in Figs. 1A through 1D, the writing units 40 are divided into two groups: those marked with "●" are writing units in which a direction of a recording magnetic field is the forward direction and those marked with "x" are writing units in which a direction of the recording magnetic field is the backward direction. Fig. 3A shows an example in which the forward writing units 40 and the backward writing units 40 are alternately arranged per each with respect to each column. Fig. 3B shows an example in which the forward writing units 40 and the backward writing units 40 are alternately arranged per two of them with respect to each column. Fig. 3C shows an example in which the forward writing units 40 and the backward writing units 40 are alternately arranged per three of them with respect to each column. Fig. 3D shows an example in which the forward writing units 40 and the backward writing units 40 are arranged such that combinations of two forward writing units and one backward writing unit are arrayed.

[0051] No ghost image will appear by arranging the forward and backward writing units in such a manner that a predetermined number of consecutive forward writing units and a predetermined number of consecutive backward writing units 40 are alternately arrayed, because the concentration of flux within the yoke is relaxed and an amount of magnetic flux leakage to magnetic cores out of printing is reduced.

[0052] Further, because the magnetic cores whose magnetic field directions are the same are separated at

certain distances from each other by alternately arranging them, the magnetic saturation within the yoke may be relaxed. Due to that, magnetic flux which passes through the non-excited magnetic core may be considerably reduced.

[0053] Still more, because the spatial magnetic fluxes near the edges of the non-excited magnetic cores are also reduced by superposing of forward magnetic fields and backward magnetic fields, ghost magnetic fields may be also reduced considerably.

[0054] It is noted that although an example in which the 16 or 18 writing units 40 are arranged in two rows and eight columns or in two rows and nine columns in the explanation described above, it is also possible to arrange them in eight rows and two columns or nine rows and two columns. Further, the number of the writing units 40 and the numbers of rows and columns for consecutive arrangement are not limited to those described above. The forward writing units and the backward writing units may be also replaced with each other.

[0055] Figs. 4A through 4E show examples in which the arrangements in Figs. 3A through 3D are expanded in the column direction. The writing units 40 are divided into two groups: those marked with "●" are writing units in which recording magnetic fields have the forward direction and those marked with "x" are writing units in which the recording magnetic fields have the backward direction. Fig. 4A shows an example in which the forward writing units 40 and the backward writing units 40 are arranged in such a manner that one forward writing unit and one backward writing unit are alternately arrayed over and over with respect to each column and each row in the writing units 40 of six rows and six columns. Fig. 4B shows an example in which the forward writing units 40 and the backward writing units 40 are alternately arranged per two of them with respect to each column and per one with respect to each row in the writing units 40 of six rows and six columns. Fig. 4C shows an example in which the forward writing units 40 and the backward writing units 40 are alternately arranged per three of them with respect to each column and per one with respect to each row in the writing units 40 of six rows and six columns. Fig. 4D shows an example in which the forward and backward writing units 40 are arranged in such a manner that combinations of two forward writing units and one backward writing unit are arrayed with respect to each row in the writing units 40 of eight rows and six columns. Fig. 4E shows an example in which the forward and backward writing units 40 are alternately arranged per two with respect to each row and each column in the writing units 40 of six rows and six columns.

[0056] No ghost image will appear by alternately arranging a predetermined number of consecutive forward writing units and a predetermined number of consecutive backward writing units 40 as described above because the concentration of fluxes at the yoke is relaxed and an amount of magnetic flux leakage to magnetic cores out

of printing is reduced.

[0057] When magnetic printing is carried out, while scanning the magnetic display sheet, by the magnetic head of an arrangement, for example, as shown in Fig. 4A, with the printing pattern, for example, as shown in Fig. 8D, while all the magnetic cores except four mag-

[0058] However, because the directions of the recording magnetic fields are reversed per each, the magnetic cores having different polarities form a closed magnetic circuit by themselves, so that the magnetic fluxes within the yoke will not leak to the non-excited magnetic cores in the other columns.

[0059] Further, because the magnetic cores whose magnetic field directions are the same are separated at certain distances from each other by alternately arranging them, the magnetic saturation within the yoke may be relaxed. Due to that, magnetic fluxes which pass through the non-excited magnetic core may be considerably reduced.

[0060] Still more, because the spatial magnetic fluxes near the edges of the non-excited magnetic cores are also reduced by superposing of the forward magnetic fields and backward magnetic fields, the ghost magnetic field may be also reduced considerably.

[0061] It is noted that although an example in which the 36 or 48 writing units 40 are arranged in eight rows and six columns or in six rows and six columns in the explanation described above, the total number of the writing units 40 and the number of writing units in consecutive arrangement are not limited to those described above. The forward writing units and the backward writing units may be also replaced with each other.

[0062] Figs. 5A and 5B are circuit diagrams showing various examples of driving circuits of the electromagnetic coil. In Fig. 5A, a plurality of (four in this example) electromagnetic coils 30a through 30d are mounted to each magnetic core. With respect to a winding direction of the coil wire rod, the electromagnetic coils 30a and 30c are wound counterclockwise along an upward direction and the electromagnetic coils 30b and 30d are wound clockwise along an upward direction, respectively. Lower lead wires of the electromagnetic coils 30a and 30c and upper lead wires of the electromagnetic coils 30b and 30d are connected in common to an anode of a DC power source E. Upper lead wires of the electromagnetic coils 30a and 30c and lower lead wires of the electromagnetic coils 30b and 30d are connected in common to a cathode of the DC power source E via corresponding switching devices SWa through SWd, respectively. The switching devices SWa through SWd are composed of transistors, thyristers and relays and are driven selectively by a control circuit such as a micro-processor on the basis of printing signals supplied from the external host.

[0063] For example, when all of the switching devices SWa through SWd are energized, current flows through the electromagnetic coils 30a through 30d, the electro-

magnetic coils 30a and 30c generate downward magnetic fields and the electromagnetic coils 30b and 30d generates upward magnetic fields. The directions of the recording magnetic fields may be set alternately by alternately reversing the directions of the currents flowing through the wire rods of the electromagnetic coils as described above.

[0064] While Fig. 5B is similar to Fig. 5A, Fig. 5B and Fig. 5A are different in that the winding directions of the coil wire rods of the electromagnetic coils 30a through 30d are all counterclockwise along the upward direction.

[0065] For example, when all of the switching devices SWa through SWd are energized, current flows through the electromagnetic coils 30a through 30d, the electromagnetic coils 30a and 30c generate downward magnetic fields and the electromagnetic coils 30b and 30d generate upward magnetic fields. The directions of the recording magnetic fields may be set alternately by alternately reversing the directions of the currents flowing through the wire rods of the electromagnetic coils as in such circuit structure. Because the arrangement in Fig. 5B will do just by one type of electromagnetic coil, the part cost and assembling cost may be reduced.

[0066] Further, such wiring may be implemented on a circuit board which is closely disposed on the magnetic head or on a electromagnetic coil driving circuit separated from the magnetic head.

[0067] It is noted that although the winding directions of the coil wire rods have been all counterclockwise in the above explanation, it is possible to wind all clockwise.

[0068] The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and the range of equivalency of the claims are therefore intended to be embraced therein.

Claims

1. A magnetic head for a magnetic display (1) comprising:

- a yoke (10) having a printing face (14);
- a plurality of air gap holes (13) formed on the printing face (14);
- a plurality of magnetic cores (20) arranged in relation to the air gap holes (13) of the yoke (10) to generate a dot-like recording magnetic field by magnetically coupling with the yoke (10); and
- a plurality of electromagnetic coils (30) for selectively energising each of the magnetic cores (20) in a magnetic field,

wherein among the plurality of magnetic cores (20), there exist first magnetic cores for generating a recording magnetic field of one polarity and second magnetic cores for generating a recording magnetic field of the other polarity.

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2. The magnetic head of claim 1, wherein the first and second magnetic cores are arrayed in such a manner that a predetermined number of consecutive first magnetic cores and a predetermined number of consecutive second magnetic cores are alternately arranged.

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3. The magnetic head of claim 2, wherein the first and the second magnetic cores are arrayed in a such a manner that a predetermined number of consecutive first magnetic cores and a predetermined number of consecutive second magnetic cores are two-dimensionally alternately arranged along row and column directions.

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4. The magnetic head of claim 1, 2 or 3, wherein an end of each magnetic core protrudes into a respective air gap hole to generate the dot-like recording magnetic field at or near the printing face.

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Patentansprüche

1. Magnetkopf für eine magnetische Anzeige (1), mit:

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einem Joch (10) mit einer Druckfläche (14); mehreren Luftspaltlöchern (13), die in der Druckfläche (14) ausgebildet sind; mehreren Magnetkernen (20), die relativ zu den Luftspaltlöchern (13) des Jochs (10) angeordnet sind, um ein punktförmiges Aufzeichnungsmagnetfeld durch magnetische Kopplung mit dem Joch (10) zu erzeugen; und mehreren elektromagnetischen Spulen (30) zum wahlweisen Erregen jedes der Magnetkerne (20) in einem Magnetfeld, wobei unter den mehreren Magnetkernen (20) erste Magnetkerne zum Erzeugen eines Aufzeichnungsmagnetfeldes mit einer Polarität und zweite Magnetkerne zum Erzeugen eines Aufzeichnungsmagnetfeldes der anderen Polarität vorhanden sind.

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2. Magnetkopf nach Anspruch 1, wobei die ersten und zweiten Magnetkerne in der Weise angeordnet sind, daß eine vorgegebene Anzahl aufeinanderfolgender erster Magnetkerne und eine vorgegebene Anzahl aufeinanderfolgender zweiter Magnetkerne abwechselnd angeordnet sind.

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3. Magnetkopf nach Anspruch 2, wobei die ersten und zweiten Magnetkerne in der Weise angeordnet

sind, daß eine vorgegebene Anzahl aufeinanderfolgender erster Magnetkerne und eine vorgegebene Anzahl aufeinanderfolgender zweiter Magnetkerne zweidimensional in Zeilen- und Spaltenrichtungen abwechselnd angeordnet sind.

4. Magnetkopf nach Anspruch 1, 2 oder 3, wobei ein Ende jedes Magnetkerns in ein entsprechendes Luftspaltloch vorsteht, um das punktförmige Aufzeichnungsmagnetfeld an der Druckfläche oder in deren Umgebung zu erzeugen.

Revendications

1. Tête magnétique (1) pour un panneau d'affichage, comprenant :

une culasse (10) ayant une face d'impression (14),
une série de trous entrefers (13) faits sur la face d'impression (14),
une série de noyaux magnétiques (20) placés par rapport aux trous entrefers (13) de la culasse (10) de façon à produire un champ magnétique d'enregistrement du genre point par couplage magnétique avec la culasse (10), et
une série de bobines électromagnétiques (30) pour l'excitation de chacun des noyaux magnétiques (20) dans un champ magnétique, dans laquelle il existe, parmi la série de noyaux magnétiques (20), des premiers noyaux magnétiques pour la production d'un champ magnétique d'enregistrement d'une polarité et des deuxièmes noyaux magnétiques pour la production d'un champ magnétique d'enregistrement de l'autre polarité.

2. Tête magnétique selon la revendication 1, dans laquelle les premiers et deuxièmes noyaux magnétiques sont rangés de manière telle qu'un nombre déterminé de premiers noyaux magnétiques consécutifs et un nombre déterminé de deuxièmes noyaux magnétiques consécutifs alternent.

3. Tête magnétique selon la revendication 2, dans laquelle les premiers et les deuxièmes noyaux magnétiques sont rangés de manière telle qu'un nombre déterminé de premiers noyaux magnétiques consécutifs et un nombre déterminé de deuxièmes noyaux magnétiques consécutifs alternent bidimensionnellement dans des directions de rangs et de colonnes.

4. Tête magnétique selon l'une des revendications 1 à 3, dans laquelle une extrémité de chaque noyau magnétique entre dans un trou entrefer respectif pour produire le champ magnétique d'enregistre-

ment du genre point sur la face d'impression ou près de celle-ci.

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FIG. 1A

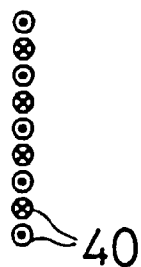


FIG. 1B



FIG. 1C



FIG. 1D



FIG. 2A

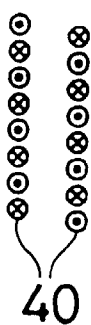


FIG. 2B

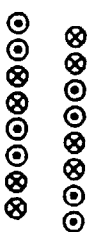


FIG. 2C

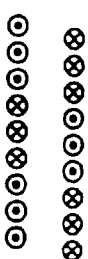


FIG. 2D



FIG. 3A

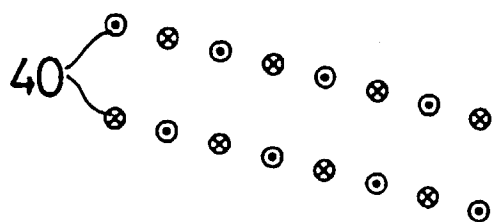


FIG. 3B

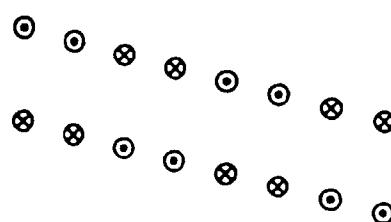


FIG. 3C

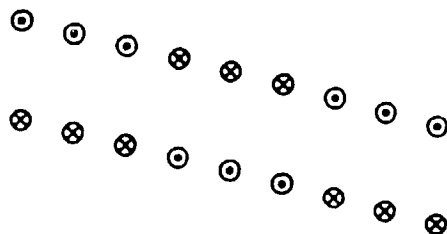


FIG. 3D

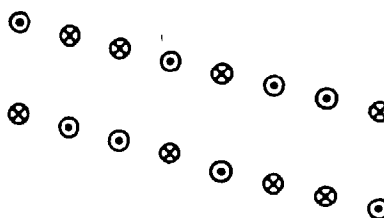


FIG. 4A

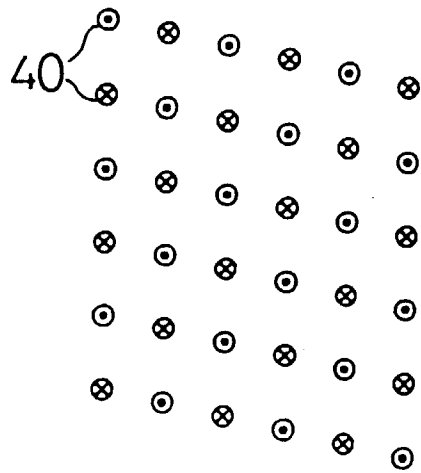


FIG. 4B

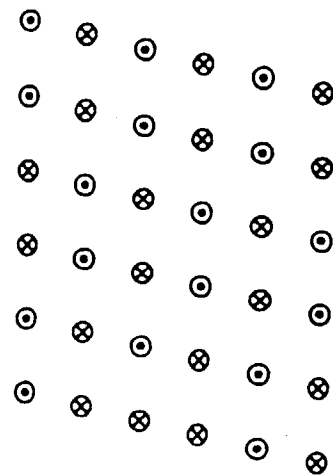


FIG. 4C

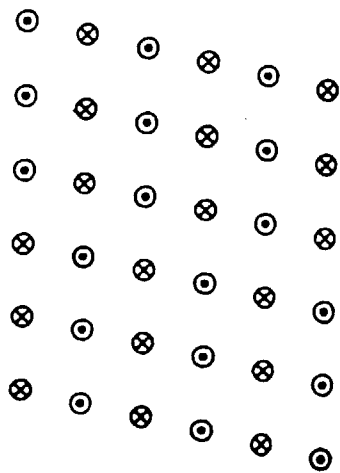


FIG. 4D

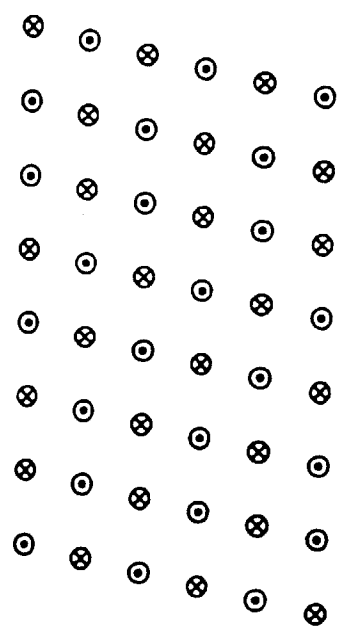


FIG. 4E

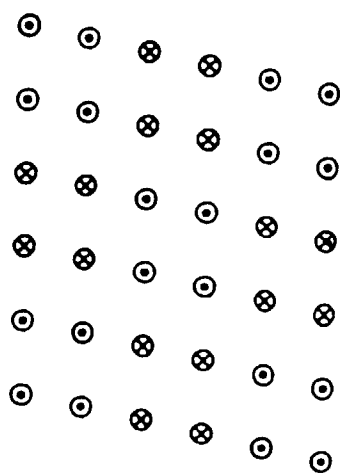


FIG. 5A

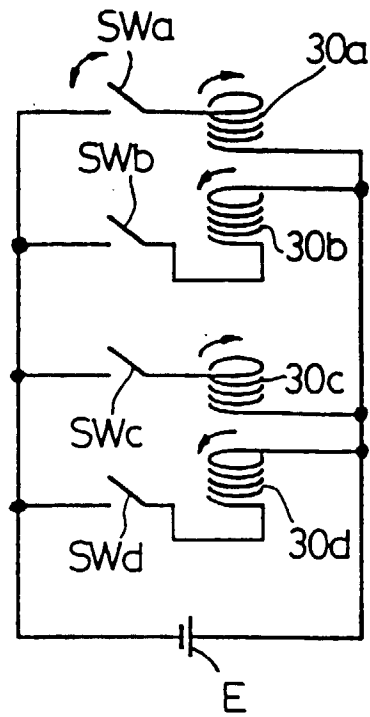


FIG. 5B

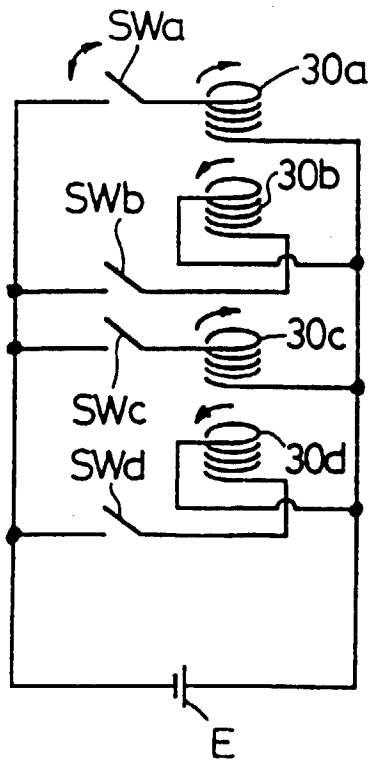


FIG. 6A

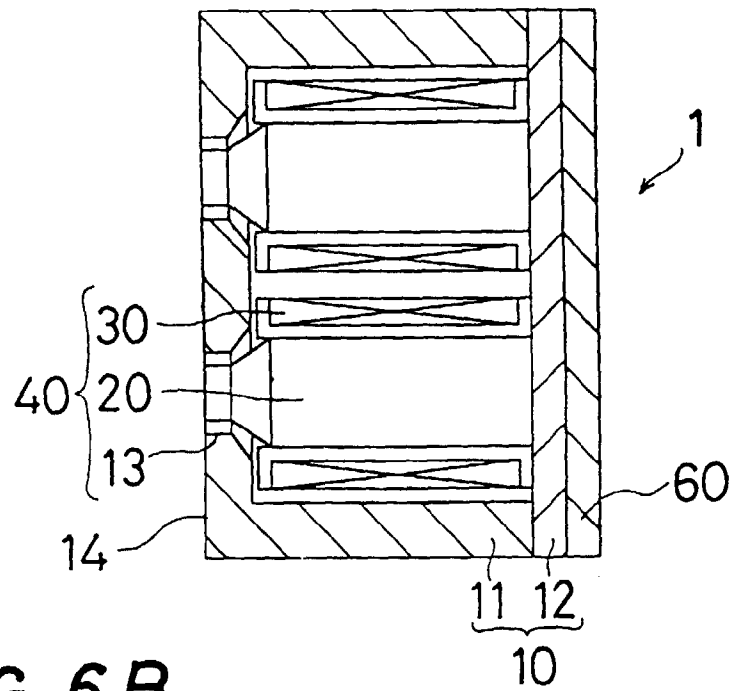


FIG. 6B

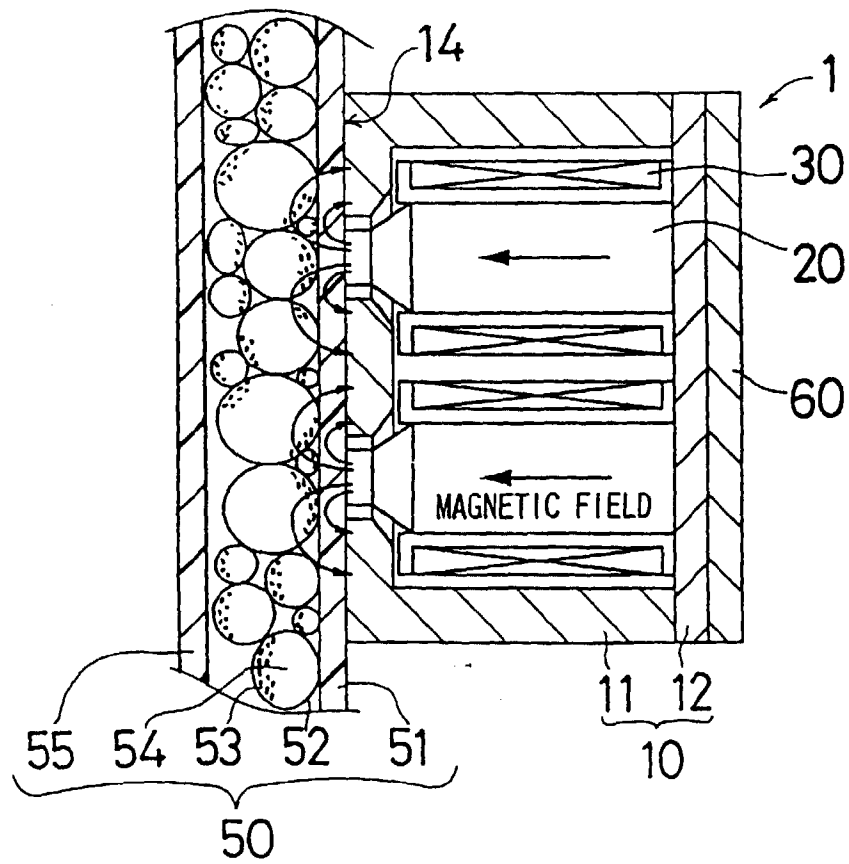


FIG. 7A

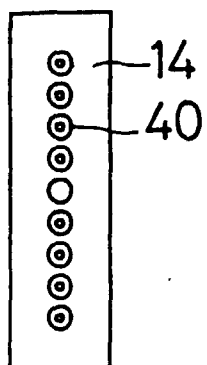


FIG. 7B

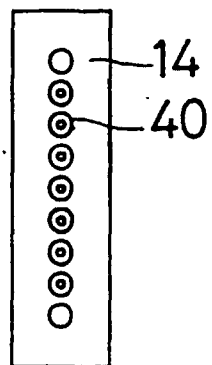


FIG. 7C

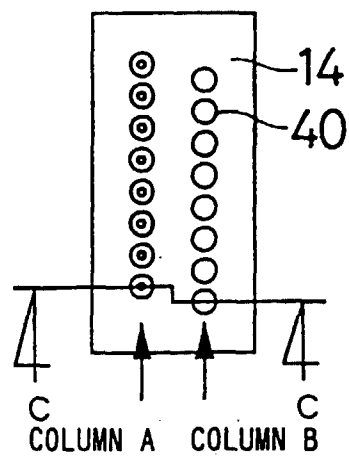


FIG. 7D

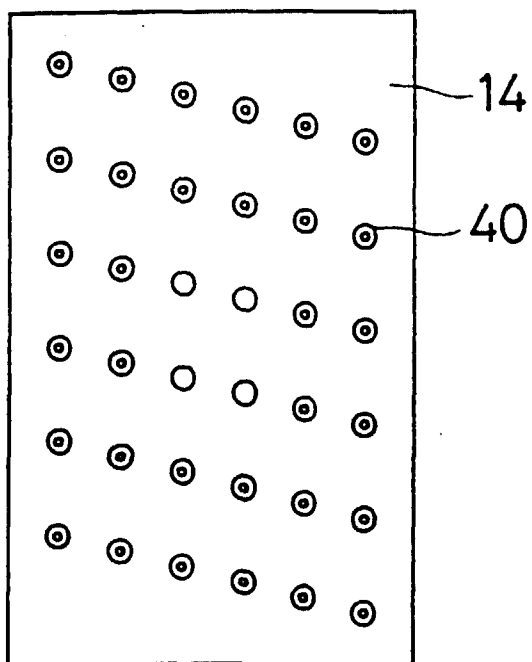


FIG. 8A

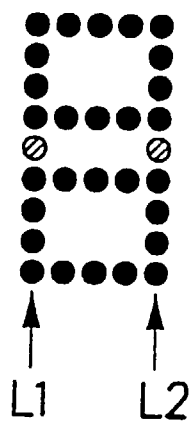


FIG. 8B

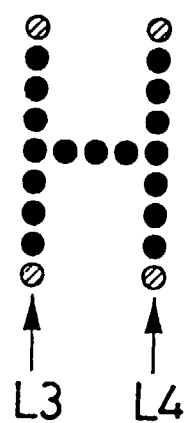


FIG. 8C

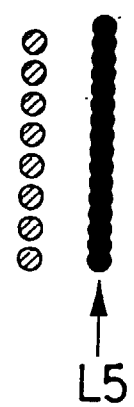


FIG. 8D

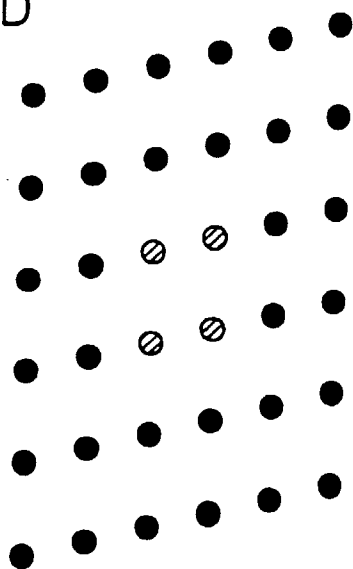


FIG. 9

