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PATENTS ACT 1990

PATENT REQUEST: STANDARD PATENT

I/We, the Applicant(s)/Nominated Person(s) specified below, request I/We be granted a patent for the invention disclosed in the accompanying standard complete specification.

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[54] Invention Title:

Ink Jet Recording Head, Ink Jet Recording Head Cartridge and Recording Apparatus Using Same

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NOTICE OF ENTITLEMENT

I, Giichi MARUSHIMA
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being authorised by the Applicant(s)/Nominated Person(s) in respect of an Application entitled:

Ink Jet Recording Head, Ink Jet Recording Head Cartridge and Recording Apparatus Using Same

state the following:-

1. The Applicant(s)/Nominated Person(s) has/have, for the following reasons, gained entitlement from the actual inventor(s):-

The Applicant/Nominated Person, by virtue of a Contract of Employment between the actual inventors as employees and the Applicant/Nominated Person as employer, is a person entitled to have the patent assigned to it if a patent were granted on an application made by the actual inventors.

2a.* The Applicant(s)/Nominated Person(s) is/~~are~~ the applicant(s) of the basic application(s) listed* on the Patent Request/~~*In the Declaration under Article 8 of the PCT~~.

~~2b.* The Applicant(s)/Nominated Person(s) is/are entitled to rely on the basic application(s) listed* on the Patent Request/*In the Declaration under Article 8 of the PCT as follows:-~~

3.* The basic application(s) listed* on the Patent Request/~~*In the Declaration under Article 8 of the PCT~~ is/~~are~~ are the application(s) first made in a Convention Country in respect of the invention.

~~4a.* The Applicant(s)/Nominated Person(s) is/are the depositor(s) of the deposit(s) listed in the Schedule hereto.~~

~~4b.* The Applicant(s)/Nominated Person(s) has/have the consent of , of~~

~~the depositor(s) of the deposit(s) listed in the Schedule hereto, to rely on that/those deposit(s).~~

DATED this 4th day of December ~~1992~~

CANON KABUSHIKI KAISHA
Giichi MARUSHIMA
Managing Director

* Delete if not applicable.

S-T

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INK JET RECORDING HEAD, INK JET RECORDING HEAD CARTRIDGE AND RECORDING APPARATUS USING SAME

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(56) Prior Art Documents
US 4635080
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(57) Claim

1. An ink jet recording head for ejecting ink through an ejection outlet for effecting recording, and receiving ink from an ink container comprising:

a supporting member having a given surface and a facing surface opposite from said given surface;

a recording element disposed on said given surface, said recording element having an energy generating means for applying energy to the ink so that the ink is ejected in accordance with a record signal;

an ink passage disposed on said recording element and corresponding to said energy generating means;

an ink supply member for connection with said ink container, said supply member having an ink supply port at a position more remote from the facing surface than from the given surface of said supporting member;

a wiring member including:

a first electric connection part, disposed on said given surface, and connected to said recording element, and

a second electric connection part connectable to an outside of said recording head to transmit the record signal to said recording element;

wherein said second electric connection part is disposed on the facing surface of said supporting member.

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COMPLETE SPECIFICATION

FOR A STANDARD PATENT

ORIGINAL

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Invention Title: Ink Jet Recording Head, Ink Jet Recording Head Cartridge and Recording Apparatus Using Same

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

INK JET RECORDING HEAD, INK JET RECORDING HEAD CARTRIDGE AND RECORDING APPARATUS USING SAME

FIELD OF THE INVENTION AND RELATED ART

The present invention relates to a small size ink jet recording head and an ink jet recording head cartridge which are detachably mountable to a recording apparatus, and to a recording apparatus using the same.

Recently, various recording systems have been developed. Among them, an ink jet recording system in which ink is ejected through ejection outlet in accordance with record signal, is widely used because of the advantage of the small size and the low noise.

The recording head used in such an ink jet recording apparatus is in the form of a detachably mountable recording head cartridge from the standpoint of easy maintenance and service life or the like.

The recording head cartridge detachably mountable to the recording apparatus and the recording apparatus are electrically connected by electric connection contacts (connectors) for transmitting signals for driving the recording head from the recording apparatus. When the recording head is mounted on the recording apparatus, the contacts are electrically connected.

However, in the case of detachably mountable recording head cartridge, there is a liability that the ink leaked through the ejection outlet contaminates the contacts with the result of insufficient electric connection.

In order to solve the problem, U.S. Patent No. 4,635,080 discloses that the contacts are disposed on a surface which is different from an ejection side surface having the ejection outlets of a recording head cartridge having an integral ink container.

The recent demand for the small size of the recording apparatus, requires reduction of the size of the recording head cartridge. In this case, the ink capacity of an ink container constituting the recording head cartridge also decreases. In addition, the difference of the service life from that of the recording head constituting the head cartridge. Therefore, from the standpoint of cost and from the standpoint of re-use of the recording head, the recording head cartridge in which the ink container and the recording head is separable, is considered.

The ink is supplied from the ink container to the recording head through an ink supply port. In addition, the driving signal is supplied by the electric connection between the electric contacts of the recording head and the recording apparatus.

Figures 14 and 15 shows an example of an ink

jet recording head not using the present invention. The ink jet recording head is of a type in which electrothermal transducers are used as energy generating means, and the ink droplets are ejected by bubble creation in the ink by the thermal energy produced by the electrothermal transducers. These figures show a recording head which is connectable to and separable from an ink container. A supporting plate 1 has a top surface to which energy base plate and wiring base plate 9 are bonded. The energy base plate (heater board) is mainly made of Si or the like having on a surface thereof heat generating portion (heaters) of electrothermal transducers effective to generate thermal energy. The base plate 9 (wiring board) is made mainly of glass or epoxy resin material and effective to transmit the electric signals from the main assembly of the recording apparatus to the heater board 2. The heater board 2 and the wiring board 9 are electrically connected by wire bonding 7.

The top surface of the wiring board 9 is provided with contact pads (electric contacts) 4 electrically connected with a flexible wiring board of the main assembly of the recording apparatus.

The ink is supplied from an ink container or recording apparatus side through an ink supply member 6 to a common liquid chamber and ejection nozzles constituted by the bonding between the heater board 2

and a top plate 5, and the ink is ejected through the ejection outlets 8.

However, in such a recording head, an ink joint between an ink supply member 6 and an ink container or an ink supplying portion of the apparatus, and a portion having the contact pads 4 of the wiring board 9, are disposed on the same side of the supporting plate 1. Therefore, when the recording head is connected or disengaged, the ink leaked from the ink joint may contacts the contact pads with the result of insufficient or improper electric connection.

Recently, the further reduction of the size is desired. Since the number of pads and the area of each of the pads are more or less limited, and therefore, it is difficult to further reduce the area occupied by the contact pads. In addition, the area of the recording head supporting plate is determined by the areas of the heater board portion, the wire bonding portion and the contact pad portion. For these reasons, the reduction of the size is not easy.

SUMMARY OF THE INVENTION

Accordingly, it is a principal object of the present invention to provide an ink jet recording head, an ink jet recording head cartridge and a recording apparatus using the same in which the

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According to an aspect of the present invention, there is provided an ink jet recording head for ejecting ink through an ejection outlet for effecting recording, and receiving ink from an ink container comprising:

a supporting member having a given surface and a facing surface opposite from said given surface;

a recording element disposed on said given surface, said recording element having an energy generating means for applying energy to the ink so that the ink is ejected in accordance with a record signal;

an ink passage disposed on said recording element and corresponding to said energy generating means;

an ink supply member for connection with said ink container, said supply member having an ink supply port at a position more remote from the facing surface than from the given surface of said supporting member;

a wiring member including:

a first electric connection part, disposed on said given surface, and connected to said recording element, and

a second electric connection part connectable to an outside of said recording head to transmit the record signal to said recording element;

wherein said second electric connection part is disposed on the facing surface of said supporting member.

According to another aspect of the present invention, there is provided an ink jet head cartridge, comprising:

an ink jet recording head for ejecting ink through an ejection outlet for effecting recording, including:

a supporting member having a given surface and a facing surface opposite from said given surface;

a recording element disposed on said given surface, said recording element having an energy generating means for applying energy to the ink so that the ink is ejected in accordance with a record signal;

an ink passage disposed on said recording elements and corresponding to said energy generating means;

an ink supply member for connection with said ink container, said supply member having an ink supply port at a position more remote from said facing surface than from said given surface of said supporting member;

a wiring member including

a first electric connection part, disposed on said given surface, and connected to said recording element, and

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a second electric connection part connectable to an outside of said recording head to transmit the record signal to said recording element;

wherein said second electric connection part is disposed on the facing surface of said supporting member;

said ink jet recording head cartridge further comprising an ink container connected to said ink supply member of said ink jet recording head to supply the ink to said recording head.

According to a further aspect of the present invention, there is provided an ink jet recording apparatus, comprising:

an ink jet recording head for ejecting ink through an ejection outlet for effecting recording, including:

a supporting member having a given surface and a facing surface opposite from said given surface;

a recording element disposed on said given surface, said recording element having an energy generating means for applying energy to the ink so that the ink is ejected in accordance with a record signal;

an ink passage disposed on said recording element and corresponding to said energy generating means;

an ink supply member for connection with ink container, said supply member having an ink supply port which is located at a position more remote from said facing surface than from said given surface;

a wiring member including

a first electric connection part, disposed on said given surface, and connected to said recording element, and

a second electric connection part connectable to an outside of said recording head to transmit the record signal to said recording element;

wherein said second electric connection part is disposed on the facing surface of said supporting member;

wherein said recording apparatus further comprises carrying means for carrying said ink jet recording head and an electric connection contactable with said second electric connection part of said ink jet recording head on said carrying means.

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These and other objects, features and advantages of the present invention will become more apparent upon a consideration of the following description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a sectional view of an ink jet recording head according to an embodiment of the present invention.

Figure 2 is a sectional view of an ink jet recording head according to another embodiment of the present invention.

Figure 3 is a top and bottom perspective view of the ink jet recording head.

Figure 4 is a sectional view of an ink jet recording head according to a further embodiment of the present invention.

Figures 8A, 8B and 8C are bottom, top and bottom perspective view of the ink jet recording head according to an embodiment of the present invention.

Figure 9 is a sectional view of an ink jet recording apparatus according to a further embodiment of the present invention.

Figure 10 is a sectional view of an ink jet recording head cartridge according to a further

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embodiment of the present invention.

Figure 11 is a perspective view of a major part of an example of an ink jet recording apparatus according to an embodiment of the present invention.

Figure 12 is a perspective view of an information processing apparatus according to an embodiment of the present invention.

Figure 13 is a block diagram of a major part of electrical circuit of the information processing apparatus having the recording apparatus of this invention.

Figure 14 is a sectional view of an ink jet recording head not using the present invention.

Figure 15 is a perspective view of an ink jet recording head not using the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figures 1 and 3, an ink jet recording head according to an embodiment of the present invention is shown. Figure 1 is a sectional view of an ink jet recording head, and Figure 3A is a top side perspective view of the ink jet recording head, and Figure 3B is a bottom side perspective view of the ink jet recording head.

Referring to Figure 1, the entire structure of the ink jet recording head of this embodiment will be described. It comprises an energy base plate

(heater board constituting recording elements) 2 and a flexible wiring board (wiring member) 3. The heater board 2 is made mainly of Si or the like and has on its surface heat generating portion (heaters) of electrothermal transducers for producing thermal energy for ejecting the ink. The flexible wiring board 3 is made of polyimide or polyester resin and has electric contacts (contact pads) 4 for transmitting electric signals from the main assembly of the recording apparatus to the heater board 2. The heater board 2 and the wiring board 3 are on the supporting member 1 made of aluminum or the like. The heater board 2 and the wiring board 3 are electrically connected by wire bonding 7.

Between the supporting member 1 and the flexible wiring member 3 and at the backside of the connecting portion of the wire bonding, there is a first reinforcing plate 301 made of glass and epoxy resin or the like, which is bonded. The flexible portion of the flexible wiring member 3 without the reinforcing plate, is bent by approx. 180 degrees in this embodiment. A second reinforcing plate 302 of glass or epoxy resin material is bonded to the flexible wiring member 3 corresponding to the contact pads 4 at the backside of the supporting member 1. The contact pads 4 of the flexible wiring member 3 are contacted to contact pads of a flexible wiring member

of the main assembly of the recording apparatus, so that the electric signals are transmitted from the recording apparatus side to the recording element side.

The ink is supplied from the main assembly of the recording apparatus through an ink supply port 6a of an ink supply member 6 to the inside of the top plate 5 constituting the common chamber and the ink passage wall, and is heated by the heaters on the heater board 2, so that the ink is ejected through ejection outlets 8.

The description will be made as to the major parts of the recording head manufacturing. An adhesive such as epoxy resin adhesive or silicone resin adhesive SE9145, SE4410 (available from Toray Dow Corning Silicon Co.), is applied through screen printing or the like on a necessary part on a surface of a supporting member which has been cleaned. The supporting member may be made of ceramic or glass material or the like. However, it is preferable to use metal such as aluminum or the like.

Then, a heater board 2 constituting the recording elements is positioned and bonded to an end portion of the surface coated with the adhesive, and a part of the wiring member 3 of polyimide or polyester material is positioned using an unshown positioning member and is bonded on the other end portion of the

same surface of the supporting member so that the portion thereof having the contact pads effective to establish electric connection with the main assembly, overhang beyond the supporting member.

Thereafter, the connecting portion between the heater board 2 and the wiring member 3, are connected by wire bonding. By bonding the top plate on the heater board, an ink passage or common liquid chamber is formed to provide recording elements. An ink supply member 6 is connected to the top plate, and the sealing is effected using silicone resin sealing material or the like.

The overhung portion having the contact pads is folded by 180 degrees, and the folded portion is bonded to the backside of the supporting member or plate 1.

In Figure 3B, designated by a reference numeral 9 is a positioning hole for positioning the wiring board 3 to be folded and bonded. The supporting plate 1 is provided with a corresponding positioning hole or recess at a proper position. By alignment of the holes, the correct positioning is established. However, the positioning may be effected not using the opening of the wiring board 3. It is possible with the use of the configurations of the wiring board and the supporting plate (proper engagement relation, for example). The same

positioning is desirable in the connection between the wiring board 3 and the heater board 2.

Since the contact pad is disposed opposite from a side having the heater board 2, both of the surfaces of the supporting plate 1 are used efficiently. In addition, the area of the supporting plate 1 can be reduced, thus permitting size reduction of the recording head. Also, the contact pads are disposed opposite from the ink joint portion, the contamination of the contact pads with ink can be avoided, and the influence to the electric connection can be also avoided.

Embodiment 2

In the foregoing embodiment 1, the wiring bonding is used for the connection between the heater board 2 and the flexible wiring board 3. Another connecting system is usable.

In Figure 2 embodiment, the heater board 2 and the flexible wiring member 3 are connected, using TAB. In this embodiment, the area required by the connection can be further reduced, as compared with the wire bonding method, and therefore, the area of the supporting plate can be further reduced. Then, the size of the ink jet recording head can be further reduced.

In the embodiment of Figures 1 - 3, the flexible wiring member 3 is folded by approx. 180

degrees. However, the angle is not limited to 180 degrees.

In Figure 4, a supporting plate 11 for supporting the heater board 2 and the flexible wiring member 3 is made of molded material or the like which can be freely designed in the configuration.

In this embodiment, the folding angle is between 90 - 180 degrees since the angle is smaller than that in the foregoing embodiment, and therefore, the stress in the bent portion of the flexible wiring member 3 is smaller with the result of higher reliability. In addition, the latitude of design relating to the position of the contact pads and the folding angle.

Embodiment 4

Referring to Figure 5, there is shown a further embodiment, in which a heater board 2 made mainly of Si and having a surface electrothermal transducer element layer (energy generating element) for generating energy used for ejection of an ink, is disposed on a part of a supporting plate 1 made of metal such as aluminum or the like. The wiring member 3 made mainly of aluminum is effective to transmit electric signals from the main assembly of the recording apparatus to the heater board 2. It comprises a connecting portion for connection with the heater board 2 and contact pads 4 for connection with

the recording apparatus. The connecting portion is disposed on the same surface of the supporting plate 1 as that having the heater board 2. The contact pads 4 are disposed on the opposite side of the supporting plate. The heater board 2 and the wiring member 3, are connected by wire bonding.

The other structure of the recording head and the manufacturing steps of the recording head, are the same as in the foregoing embodiments, and therefore, the detailed description thereof are omitted for simplicity.

The base material of the wiring member 3 may be any metal (including alloy) if it can be bent by not less than 90 degrees. Preferably, it is metal such as aluminum or copper. There is a liability that the wiring member of metal is cracked with the result of disconnection in the wiring, if it is bent with a radius not more than approx. 2.5 times the thickness of the wiring member. Therefore, the thickness is preferably as small as possible from the standpoint of the folding. However, from the standpoint of configuration maintenance and the flatness of the contact surface, a certain degree of thickness is required.

The preferable range of the thickness in this embodiment is 0.1 - 0.5 mm.

As described in this embodiment, by bending

the metal wiring member, the contact pads are disposed on a surface opposite from the heater board 2, and therefore, the surfaces of the supporting plate 1 can be efficiently used. In addition, the area of the supporting plate 1 can be reduced so that the size of the recording head can be reduced.

Since the contact pads are disposed on the opposite side of the ink joint portion, the contamination of the contact pads with the ink can be prevented.

Since the basic material of the wiring member is metal, the static electricity from human body or the like, upon the mounting or exchanging the ink jet recording head, is discharged through the metal portion of the wiring member to the ground, and therefore, it is not discharged to the heater board, thus preventing damage of the ink jet recording head due to the static electricity.

Since the wiring member is of metal, the heat can be transmitted to the apparatus through the contact portion, and when the recording head and the ink container are jointed, the heat can be transferred to the cartridge, so that the uniform temperature can be provided in the neighborhood of the recording head.

Embodiment 5

Figure 6 shows another embodiment. In the foregoing fourth embodiment, the wiring member 3 of

metal is bonded to the backside of the supporting member 1. In Figure 6 embodiment, it is not bonded to the backside, but is slightly spaced from the backside of the supporting member 1, using the properly of the metal material.

Upon the contact between the main assembly of the apparatus and the contact pads of the flexible wiring board, the clearance provides cushion effect, and the reliability of the electric connection is increased.

Even if there is a clearance, it can be properly supported by bonding a part because of the use of the metal, and therefore, there is no need of bonding onto the backside. This is effective to omit the bonding process in the manufacturing, and the manufacturing becomes easier.

Embodiment 6

In the foregoing embodiments, the arrangement, on the supporting member, of the element board having the energy generating means for ink ejection and the wiring board. More particularly, the contact pads are disposed on the side opposite from the side of the supporting plate having the element board.

In this embodiment, by further improving the folding of the wiring member and the wiring, the electric connection between the element board and the

apparatus can be more reliable.

The structure and the manufacturing method in this embodiment are the same except for those described in the following. In this embodiment, as shown in Figures 7 and 8, an end of the supporting member corresponding to the wiring member folding region, is formed into folding supporting portion 1a in the form of a curvature (circular). Along the curved surface, the wiring board is bent.

Because of the folding portion supporting end, the wiring member can be smoothly folded, and in addition, the contact pads can be correctly positioned to the predetermined positions on the supporting member with stability.

Because of the provision of the folding portion supporting end, the wiring member is prevented from being bent too acutely, and therefore, the possibility of the damage to the wiring in the folding region, can be reduced.

When the wiring pattern in the region where the wiring board is bent, is parallel with the folding direction, as shown in Figure 8C, the possibility of the damage to the wiring is smaller.

Embodiment 7

In the foregoing embodiment, the folding portion supporting end of the supporting member 1 is in the form of a round surface. In another

embodiment, the end configuration has two or more appex lines (1b) to assist proper bending of the wiring member 3.

The same advantageous effects as in the previous embodiment, can be provided. However, the present embodiment is advantageous in that the formation of the folding portion supporting portion is easy since what is required is only to cut the surfaces.

In the foregoing embodiments, the recording head is of a type in which ink droplets are ejected by creasing a bubble in the ink by thermal energy. The present invention, however, is applicable to another type of recording head in which the ink droplets are ejected with the use of piezoelectric elements or the like.

Embodiment 8

Figure 10 shows a further embodiment in which the ink jet recording head and a detachably mountable ink container 10, are connected. As described in the foregoing embodiment, since the size of the recording head can be reduced, the size of the ink container can be reduced. Where a metal member is used as the wiring member, and the ink container can contain the ink above the wiring board, the heat can be transmitted to the ink container from the recording head through the wiring member.

Referring to Figure 11, the description will be made as to an ink jet recording apparatus loaded with an ink jet recording head and an ink jet recording head cartridge in accordance with the embodiments of the present invention. Figure 11 is a schematic perspective view illustrating a major part of the example of the ink jet recording apparatus.

In Figure 11 an ink jet recording head cartridge 320 is a cartridge type having integral ink container and detachably mountable to an ink jet recording apparatus. It comprises a plurality of ink ejection outlets faced to a recording surface of a recording material (not shown) on a platen 324. A carriage 316 for carrying the ink jet recording head cartridge 320 is operatively coupled with a part of a driving belt 318 for transmitting driving force from a driving motor 317. The carriage 316 is slidingly guided on two guiding shafts 329A and 329B. Thus, the ink jet recording head cartridge 320 is reciprocable over the entire width of the recording material.

A recovery device 326 functions to prevent, and recover from, improper ink ejection from the recording head, and is disposed at a position faced to a predetermined position within a movable range of the ink jet recording head cartridge 320, hole position, for example. The recovery device 326 caps ejection outlets of the ink jet recording head by the driving

force from the motor 322 through the transmission mechanism 323. In interrelation with the capping operation for the ejection outlets of the ink jet recording head by the cap 326A of the recovery device 326, the ink is sucked through the ejection outlets by suitable sucking means (not shown) in the recovery device 326, or the ink is pressured by suitable pressure means (not shown) provided in an ink supply passage to the ink jet recording head where the ink is supplied from the apparatus to the recording head. By doing so, the ink is forcedly ejected through the ejection outlets to remove foreign matter such as high viscosity ink or the like in the ejection outlets. A blade 330 is disposed to a side of the recovery apparatus 326 and is made of silicone rubber. It functions as a wiping member and is cantilevered on a blade supporting member 330A. Similarly to the recovery device 326, it is operated by the motor 322 and the transmission mechanism 323 to be contacted to the ejection outlet side surface of the ink jet recording head. At proper timing during recording operation of the ink jet recording head, after recovery operation of the recovery device 326, the blade 330 is projected into the movable range of the ink jet recording head, and together with the movement of the ink jet recording head, the dew, wet or foreign matter can be removed from the ejection side surface.

The recording sheet feeding means, the carriage, the recovery device, the recording head or the like movements in the ink jet recording head, are controlled on the basis of instructions and signals produced from control means including CPU, for example, of the main assembly of the apparatus.

The description will be made as to an information processing apparatus having recording apparatus, particularly the electric circuits therefor.

Figure 12 is a perspective view of an outer appearance of the information processing apparatus 604 incorporating the recording apparatus of this invention. It comprises a printer portion 601, a keyboard portion 602 provided with keys for inputting characters, numericals and the like and keys for various instructions, and display portion 603 provided with a display device.

Figure 13 is a block diagram of the electric circuit of the information processing apparatus. As shown in this Figure, the electric circuit comprises a main controller 501, a CPU in the form of a microcomputer, for example, for executing programmed steps, RAM 503 containing an area for developing text data or image data and a working area, ROM 504 for storing program corresponding to the steps, font data or other fixed data, a timer 505 for producing

executing cycle of the CPU 502 and for producing proper timing for the recording operation of the printer 601, and an interface 506 for supplying the signal from CPU 502 to the peripheral devices.

It further comprises a printer 601 controller 507, a head driver 508 for supplying the record signals or the electric power to the head cartridge 101, motor drivers 509a and 509b for supplying necessary signals and the electric power for the drive of the carrier motor 402a and the feeding motor 402b, respectively, a carriage sensor 510 for detecting the position of the carriage 102 and for discriminating whether the carriage 102 is at the home position or not, a paper sensor 511 for detecting presence or absence of the recording material to prevent the recording outside the recording material 6 when the recording material 6 is not properly set or when the record has already covered the end of the page.

Designated by a reference numeral 605 is an external memory device in the form of FDD, HDD, RAM card or the like. A reference numeral 512 designates an external interface for communication with another information processing apparatus or for controlling peripheral machines by direct connection with an internal bus.

Although not shown in the block diagram of Figure 7, there is provided a power source for

supplying the electric power to the electric circuit. It may be in the form of a chargeable battery, disposable battery or AC voltage converter.

The present invention is particularly suitably usable in an ink jet recording head and recording apparatus wherein thermal energy by an electrothermal transducer, laser beam or the like is used to cause a change of state of the ink to eject or discharge the ink. This is because the high density of the picture elements and the high resolution of the recording are possible.

The typical structure and the operational principle are preferably the ones disclosed in U.S. Patent Nos. 4,723,129 and 4,740,796. The principle and structure are applicable to a so-called on-demand type recording system and a continuous type recording system. Particularly, however, it is suitable for the on-demand type because the principle is such that at least one driving signal is applied to an electrothermal transducer disposed on a liquid (ink) retaining sheet or liquid passage, the driving signal being enough to provide such a quick temperature rise beyond a departure from nucleation boiling point, by which the thermal energy is provided by the electrothermal transducer to produce film boiling on the heating portion of the recording head, whereby a bubble can be formed in the liquid (ink) corresponding

to each of the driving signals. By the production, development and contraction of the the bubble, the liquid (ink) is ejected through an ejection outlet to produce at least one droplet. The driving signal is preferably in the form of a pulse, because the development and contraction of the bubble can be effected instantaneously, and therefore, the liquid (ink) is ejected with quick response. The driving signal in the form of the pulse is preferably such as disclosed in U.S. Patents Nos. 4,463,359 and 4,345,262. In addition, the temperature increasing rate of the heating surface is preferably such as disclosed in U.S. Patent No. 4,313,124.

The structure of the recording head may be as shown in U.S. Patent Nos. 4,558,333 and 4,459,600 wherein the heating portion is disposed at a bent portion, as well as the structure of the combination of the ejection outlet, liquid passage and the electrothermal transducer as disclosed in the above-mentioned patents. In addition, the present invention is applicable to the structure disclosed in Japanese Laid-Open Patent Application No. 123670/1984 wherein a common slit is used as the ejection outlet for plural electrothermal transducers, and to the structure disclosed in Japanese Laid-Open Patent Application No. 138461/1984 wherein an opening for absorbing pressure wave of the thermal energy is formed corresponding to

the ejecting portion. This is because the present invention is effective to perform the recording operation with certainty and at high efficiency irrespective of the type of the recording head.

The present invention is applicable to a serial type recording head wherein the recording head is fixed on the main assembly, to a replaceable chip type recording head which is connected electrically with the main apparatus and can be supplied with the ink when it is mounted in the main assembly, or to a cartridge type recording head having an integral ink container.

The provisions of the recovery means and/or the auxiliary means for the preliminary operation are preferable, because they can further stabilize the effects of the present invention. As for such means, there are capping means for the recording head, cleaning means therefor, pressing or sucking means, preliminary heating means which may be the electrothermal transducer, an additional heating element or a combination thereof. Also, means for effecting preliminary ejection (not for the recording operation) can stabilize the recording operation.

As regards the variation of the recording head mountable, it may be a single corresponding to a single color ink, or may be plural corresponding to the plurality of ink materials having different

recording color or density. The present invention is effectively applicable to an apparatus having at least one of a monochromatic mode mainly with black, a multi-color mode with different color ink materials and/or a full-color mode using the mixture of the colors, which may be an integrally formed recording unit or a combination of plural recording heads.

Furthermore, in the foregoing embodiment, the ink has been liquid. It may be, however, an ink material which is solidified below the room temperature but liquefied at the room temperature. Since the ink is controlled within the temperature not lower than 30 °C and not higher than 70 °C to stabilize the viscosity of the ink to provide the stabilized ejection in usual recording apparatus of this type, the ink may be such that it is liquid within the temperature range when the recording signal is the present invention is applicable to other types of ink. In one of them, the temperature rise due to the thermal energy is positively prevented by consuming it for the state change of the ink from the solid state to the liquid state. Another ink material is solidified when it is left, to prevent the evaporation of the ink. In either of the cases, the application of the recording signal producing thermal energy, the ink is liquefied, and the liquefied ink may be ejected. Another ink material may start to be

solidified at the time when it reaches the recording material.

The ink jet recording apparatus may be used as an output terminal of an information processing apparatus such as computer or the like, as a copying apparatus combined with an image reader or the like, or as a facsimile machine having information sending and receiving functions.

As described in the foregoing, since the contact pads and the heater board are disposed on different surfaces, and therefore, surfaces of a supporting plate can be efficiently used, and the area of the supporting plate can be reduced, thus permitting reduction of the recording head size.

Since the contact pads are disposed on the side opposite from the ink joint portion, the contact pads are protected from contamination with the ink.

By the use of the metal for the basic material of the wiring member, the static electricity from the human body or the like can be discharged to the ground through the metal portion of the wiring member when the ink jet recording head is mounted or exchanged. Therefore, the electricity does not flow into the heater board, thus preventing damage of the ink jet recording head by the static electricity. By spacing the contact pad portion of the metal wiring board from the supporting member with a small

clearance, the cushion effects are provided upon the contact between the contact pads of the flexible wiring board and the main assembly of the apparatus, thus increasing the connection reliability. In this case, the bonding process can be avoided.

In an aspect of the present invention, since an end of a supporting member corresponding to the folding portion of the wiring board is formed into folding portion, supporting portion, or since the wiring pattern is generally parallel with the bending direction, and therefore, the contact pads can be disposed to the side opposite from the side having the heater board, without damage such as wire disconnection. In addition, the wiring disconnection during use can be prevented. By closely bonding it to the backside of the supporting member 1, the positioning of the contact pads relative to the supporting plate 1, can be stabilized.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the purposes of the improvements or the scope of the following claims.

The claims defining the invention are as follows:

1. An ink jet recording head for ejecting ink through an ejection outlet for effecting recording, and receiving ink from an ink container comprising:

a supporting member having a given surface and a facing surface opposite from said given surface;

a recording element disposed on said given surface, said recording element having an energy generating means for applying energy to the ink so that the ink is ejected in accordance with a record signal;

an ink passage disposed on said recording element and corresponding to said energy generating means;

an ink supply member for connection with said ink container, said supply member having an ink supply port at a position more remote from the facing surface than from the given surface of said supporting member;

a wiring member including:

a first electric connection part, disposed on said given surface, and connected to said recording element, and

a second electric connection part connectable to an outside of said recording head to transmit the record signal to said recording element;

wherein said second electric connection part is disposed on the facing surface of said supporting member.

2. A recording head according to claim 1, wherein said wiring member comprises a metal member as a base member thereof.

3. A recording head according to claim 1, wherein said wiring member has a folded portion and a part of said supporting member corresponds to a folded portion of said wiring member and supports the folded portion.

4. A recording head according to claim 1, 2 or 3, wherein said wiring member is folded by not less than 90 degrees.

5. A recording head according to claim 3, wherein the folded portion of the wiring member has a wiring pattern, said wiring pattern being generally parallel a wiring pattern in the folded portion of the wiring member is generally parallel with a folding direction of the folded portion.

6. A recording head according to claim 1, 2 or 3, wherein said energy generating means comprises an electrothermal transducer for producing thermal energy.

7. An ink jet head cartridge, comprising:

an ink jet recording head for ejecting ink through an ejection outlet for effecting recording, including:

a supporting member having a given surface and a facing surface opposite from said given surface;

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a recording element disposed on said given surface, said recording element having an energy generating means for applying energy to the ink so that the ink is ejected in accordance with a record signal;

an ink passage disposed on said recording elements and corresponding to said energy generating means;

an ink supply member for connection with said ink container, said supply member having an ink supply port at a position more remote from said facing surface than from said given surface of said supporting member;

a wiring member including

a first electric connection part, disposed on said given surface, and connected to said recording element, and

a second electric connection part connectable to an outside of said recording head to transmit the record signal to said recording element;

wherein said second electric connection part is disposed on the facing surface of said supporting member;

said ink jet recording head cartridge further comprising an ink container connected to said ink supply member of said ink jet recording head to supply the ink to said recording head.

8. A cartridge according to claim 7, wherein said wiring member comprises a metal member as a base member thereof.

9. An ink jet head cartridge according to claim 7, wherein said wiring member has a folded portion and a part of said supporting member corresponds to a folded portion of said wiring member and supports the folded portion.

10. A cartridge according to claim 7, 8 or 9, wherein said wiring member is folded by not less than 90 degrees.

11. An ink jet head cartridge according to claim 7, 8 or 9, wherein the folded portion of the wiring member has wiring pattern, said wiring pattern being generally parallel a wiring pattern in the folded portion of the wiring member is generally parallel with a folding direction of the folded portion.

12. An ink jet head cartridge according to claim 7, 8 or 9, wherein said energy generating means comprises an electrothermal transducer for producing thermal energy.

13. An ink jet recording apparatus, comprising:

an ink jet recording head for ejecting ink through an ejection outlet for effecting recording, including:

a supporting member having a given surface and a facing surface opposite from said given surface;

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a recording element disposed on said given surface, said recording element having an energy generating means for applying energy to the ink so that the ink is ejected in accordance with a record signal;

an ink passage disposed on said recording element and corresponding to said energy generating means;

an ink supply member for connection with ink container, said supply member having an ink supply port which is located at a position more remote from said facing surface than from said given surface;

a wiring member including

a first electric connection part, disposed on said given surface, and connected to said recording element, and

a second electric connection part connectable to an outside of said recording head to transmit the record signal to said recording element;

wherein said second electric connection part is disposed on the facing surface of said supporting member;

wherein said recording apparatus further comprises carrying means for carrying said ink jet recording head and an electric connection contactable with said second electric connection part of said ink jet recording head on said carrying means.

14. An apparatus according to claim 13, wherein said wiring member comprises a metal member as a base member thereof.

15. An apparatus according to claim 13, wherein said wiring member has a folder portion and a part of said supporting member corresponds to a folded portion of said wiring member and supports the folded portion.

16. An apparatus according to claim 13, 14 or 15, wherein said wiring member is folded by not less than 90 degrees.

17. An apparatus according to claim 15, wherein the folded portion of the wiring member has a wiring pattern said wiring pattern being generally parallel a wiring pattern in the folded portion of the wiring member is generally parallel with a folding direction of the folded portion.

18. An apparatus according to claim 13, 14 or 15, wherein said energy generating means comprises an electrothermal transducer for producing thermal energy.

19. A cartridge according to claim 7, 8 or 9, wherein said ink jet recording head and said ink container are separable.

20. A cartridge according to claim 7, wherein said ink container contains the ink.

21. A cartridge according to claim 19, wherein said container contains the ink.

22. An ink jet head according to claim 1, wherein said first electric connection part and said recording element are connected by wire bonding.

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23. An ink jet head cartridge substantially as described herein with reference to any one of Figs. 1, or Figs. 2, 3A and 3B, or Fig. 4, or Figs. 5, 6 and 7, or Figs. 8A-8C, or Fig. 10 of the drawings.

24. An ink jet recording apparatus substantially as described herein with reference to any one of Figs. 9, 11, 12 and 13 of the drawings.

DATED this First Day of May 1995

Canon Kabushiki Kaisha

Patent Attorneys for the Applicant

SPRUSON & FERGUSON

AUSTRALIAN PATENT OFFICE

Ink Jet Recording Head, Ink Jet Recording Head Cartridge
and Recording Apparatus Using Same

ABSTRACT OF THE DISCLOSURE

An ink jet recording head for ejecting ink through an ejection outlet for effecting record includes a supporting member (1); a recording element (2) having an energy generating element for applying energy to the ink to eject it in accordance with a record signal; a wiring member (3) including electric connection part (7) relative to the recording element (2) and a second electric connection part (4) relative to an outside of the recording head to transmit the record signal to the recording element (2); wherein the first electric connection part (7) is disposed on one face of the supporting member (1), the second electric connection part (4) is disposed on another surface of the supporting member (1).

Figure 1

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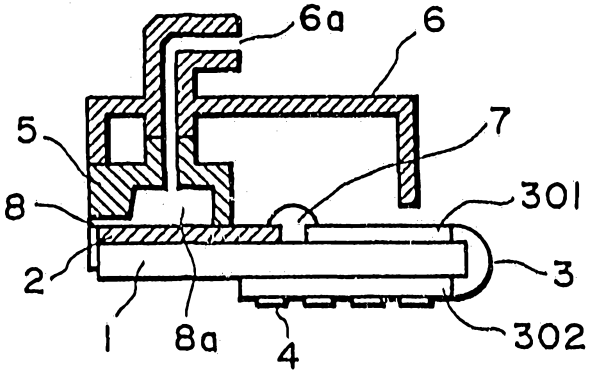


FIG. 1

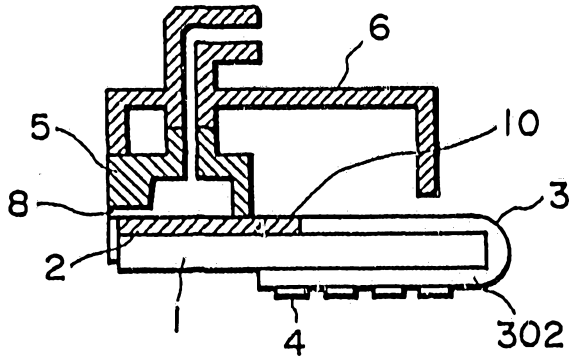


FIG. 2

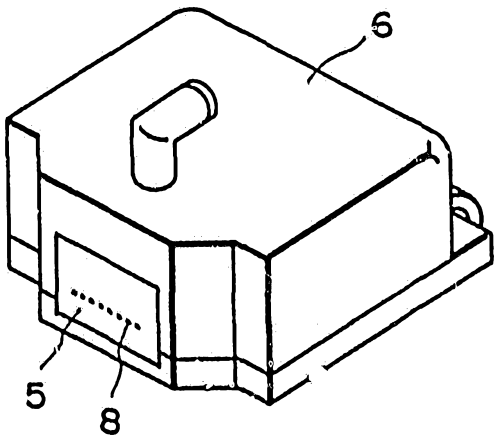


FIG. 3A

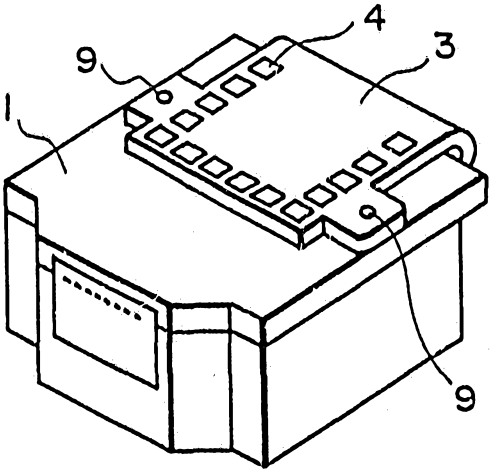


FIG. 3B

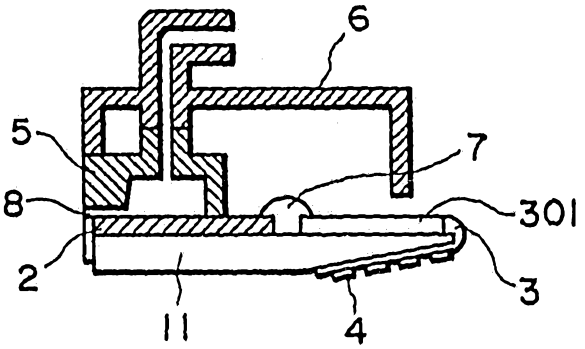


FIG. 4

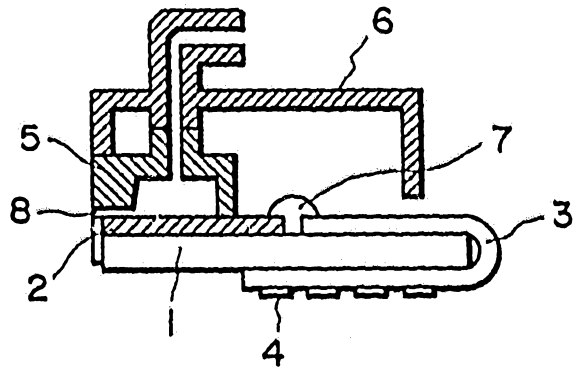


FIG. 5

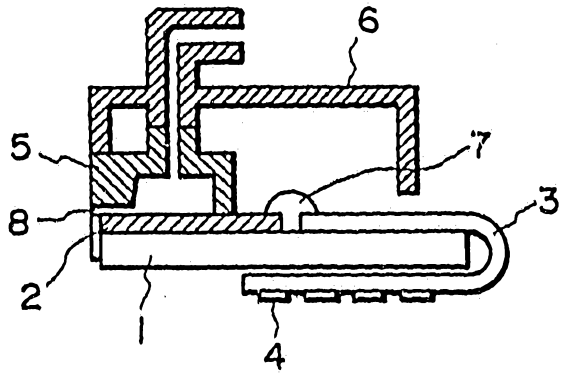


FIG. 6

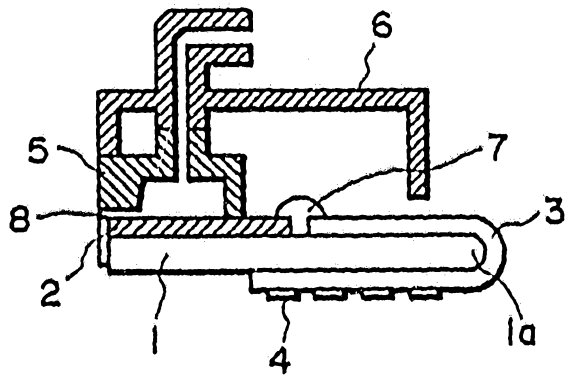


FIG. 7

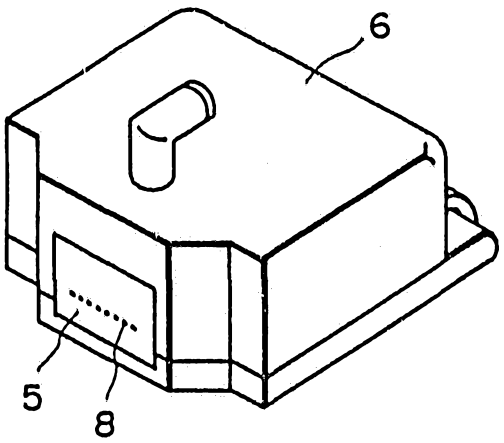


FIG. 8A

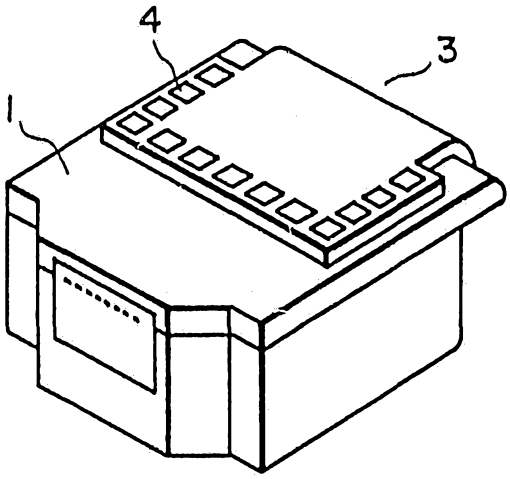


FIG. 8B

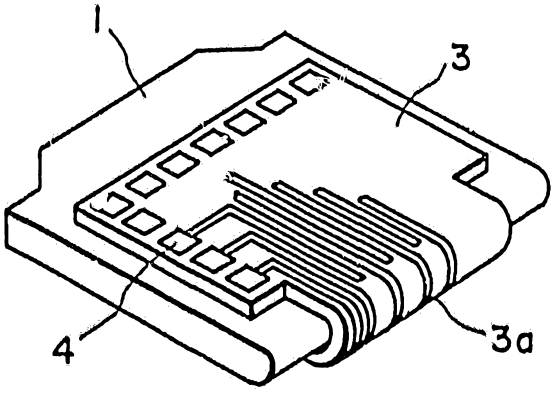


FIG. 8C

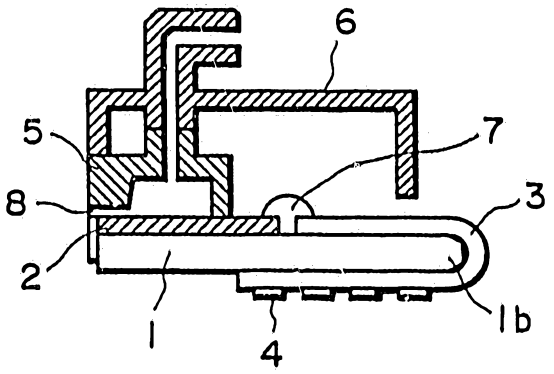


FIG. 9

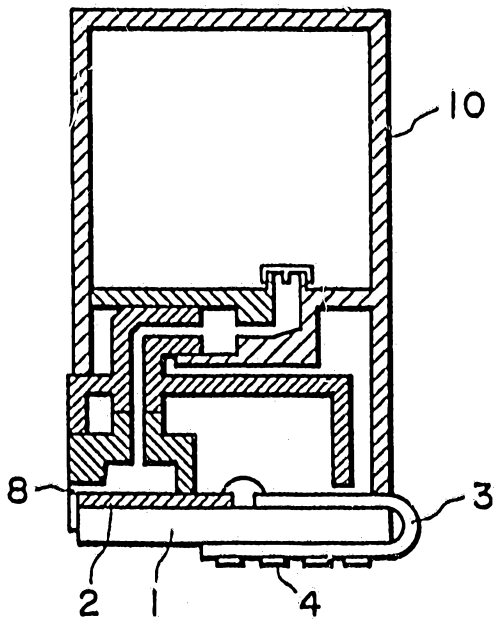


FIG. 10

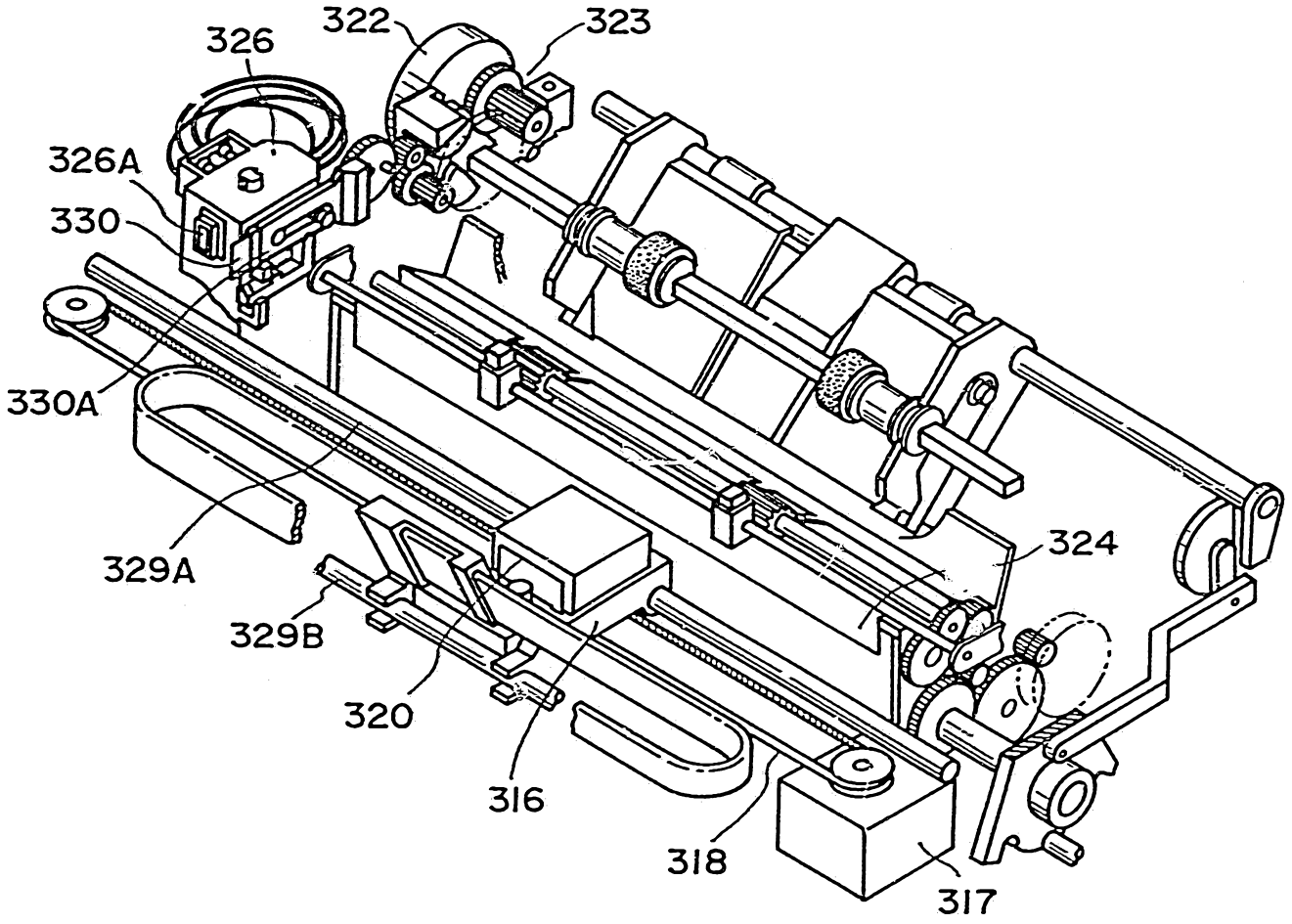


FIG. 11

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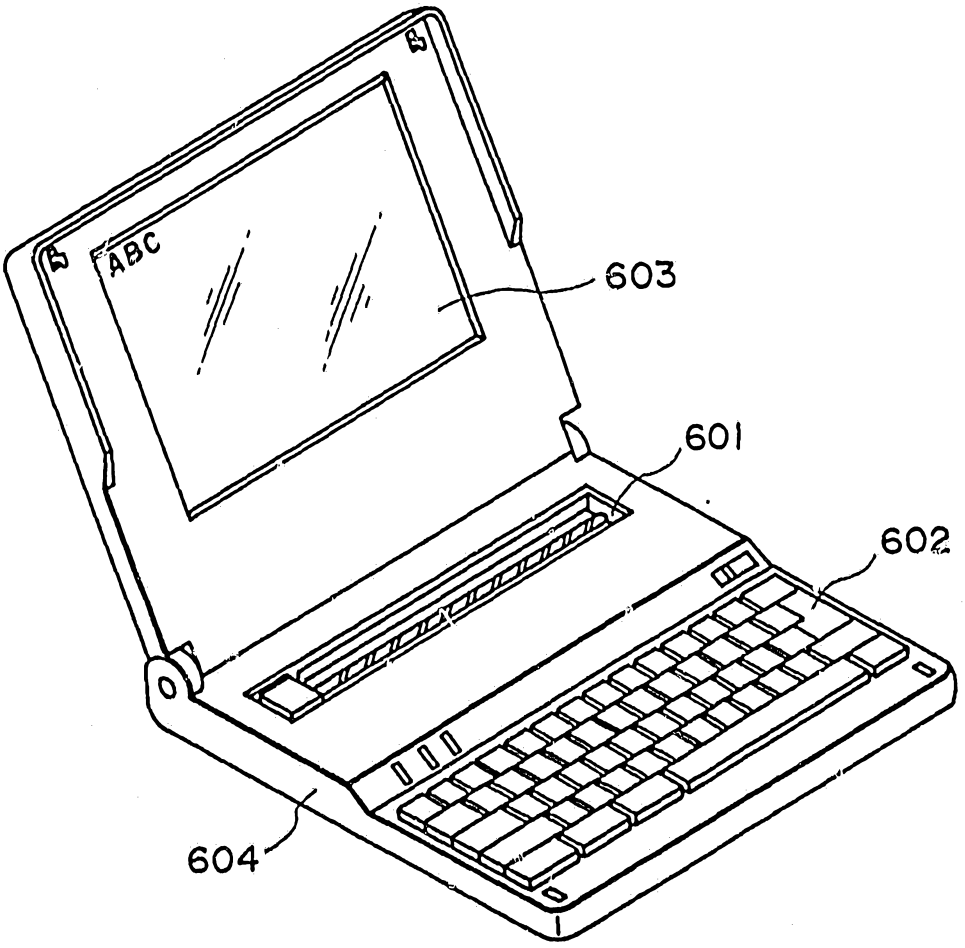


FIG. 12

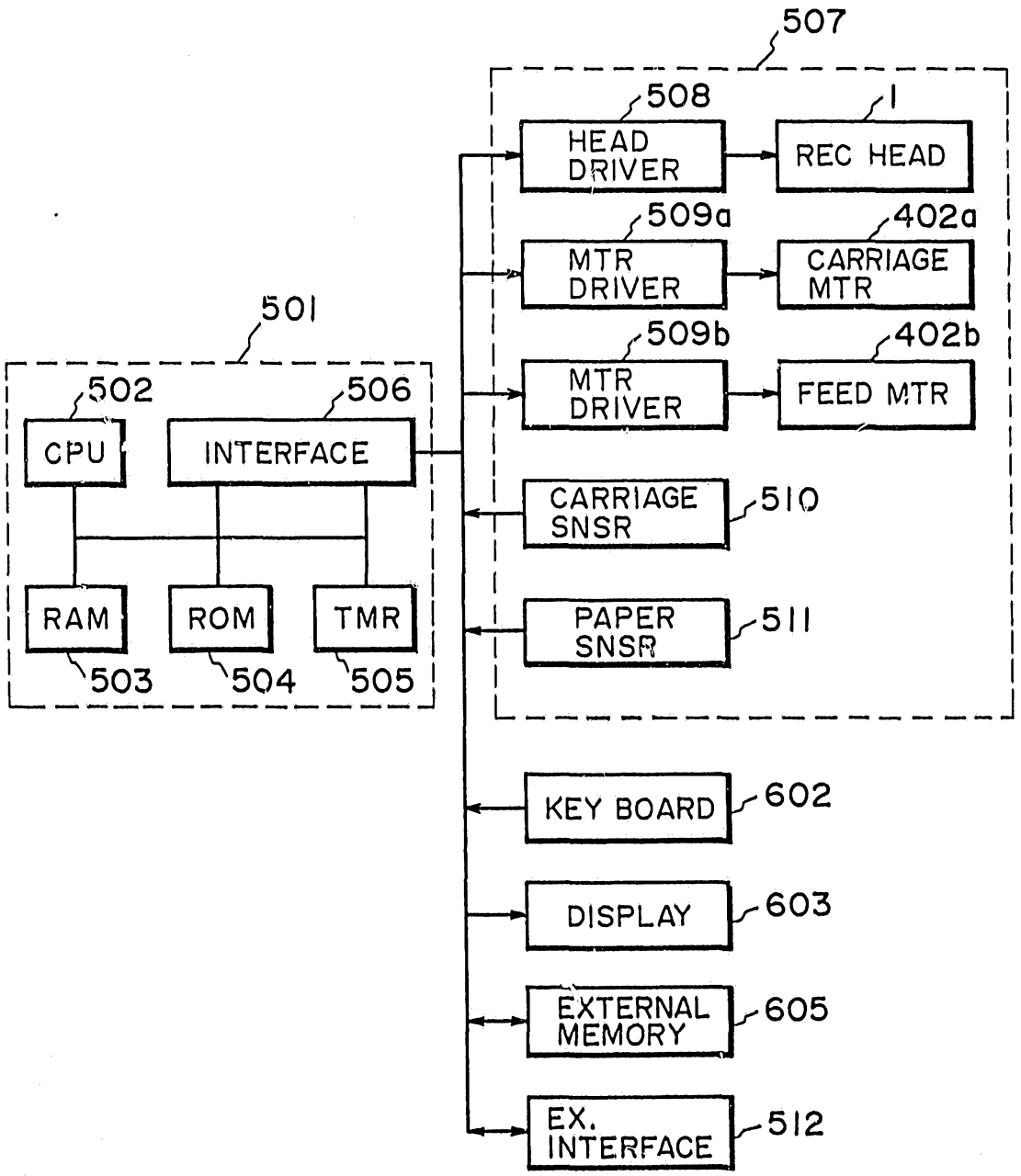

507
508
HEAD DRIVER
1
REC HEAD
509a
MTR DRIVER
402a
CARRIAGE MTR
501
509b
MTR DRIVER
402b
FEED MTR
502
506
CPU
INTERFACE
CARRIAGE SNSR
510
PAPER SNSR
511
RAM
ROM
TMR
503
504
505
KEY BOARD
602
DISPLAY
603
EXTERNAL MEMORY
605
EX. INTERFACE
512

FIG. 13

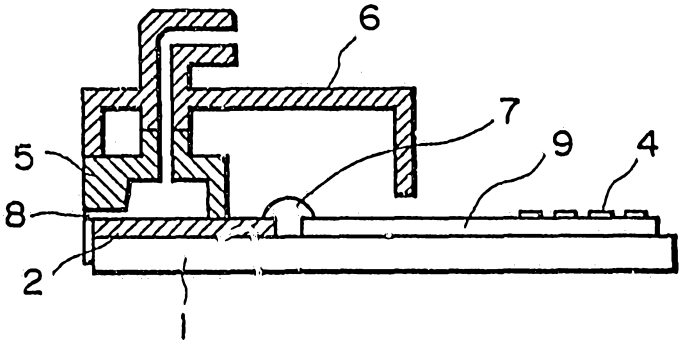


FIG. 14

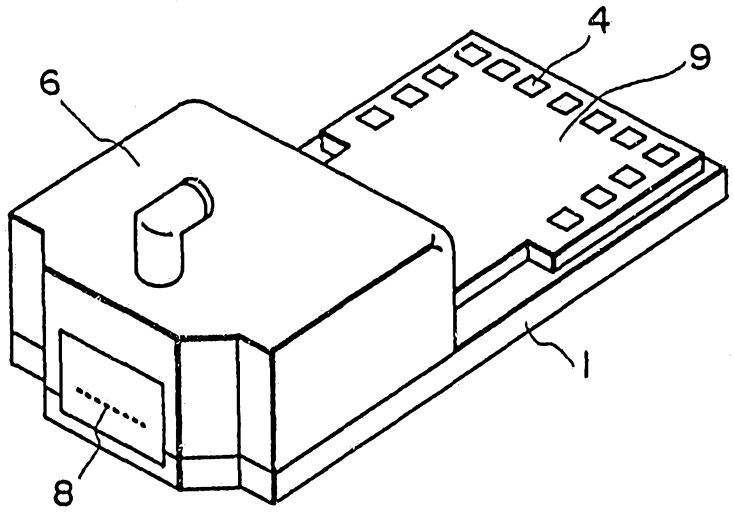


FIG. 15