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Recording head and substrates therefor having pads.

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Description

FIELD OF THE INVENTION AND RELATED ART

The present invention relates to a recording head and a substrate therefor having pads usable with various recording apparatus, more particularly to a recording head using thermal energy for forming an image, further particularly to an ink jet recording head using heat generating elements for generating energy for ejecting ink and a substrate for such a recording head, or to a thermal recording head having heat generating elements for transferring ink or for coloring heat sensitive paper and a substrate for such a recording head.

In such recording heads, a number of heat generating elements are formed at a high density on a substrate of a semiconductor device to permit a high density image formation, and in addition, driver circuits for driving the heat generating elements (electrothermal transducers) are also formed on the substrate in the form of integrated circuit, so that the size of the recording head is reduced.

When the recording head has as many as 128 - 1720 heat generating elements, plural driving circuits in the form of integrated circuit which will hereinafter be called "driver IC means" may be required.

Corresponding to the one or more driver IC on the head substrate, signal lines for connecting the heat generating elements and the driver IC means or for connecting the plural driver IC means are provided. After the driver IC means is formed on the substrate during the manufacturing process, bonding or contact pads of the driver IC means and bonding or contact pads of the signal lines are properly connected by, for example, flip chip system.

The head substrate manufacturing process may include an inspection step in which the electrical open-circuit/short-circuit is inspected in the connections between the heat generating elements and the wiring therefore.

The inventor performed the inspection step before the completion of the contact pads, more particularly, after the pad bases made of aluminum or other wiring material were formed, before the pad bases were matured into contact pads. After the inspection, the pad bases were coated with metal plating to be completed as the contact pads.

However, after the inspection was performed repeatedly in which probe pins were frequently contacted to the pad bases made of aluminum or the like, the following problems were found.

(1) Figure 1A illustrates a first problem. On the substrate 9, there are a protection layer 8, a pad base 7 and contact pad 5. As shown in Figure 1A, the pad base 7 formed on the substrate 8 is partly projected by the probe pin to such an extent that there occurs a case wherein the contact pad 5 provided by the subsequent metal plating step is not flat. Such a contact pad is subjected to improper electric connection when the contact is performed in the flip chip system.

(2) Figure 1B illustrates another problem. The projection of the pad base 7 is sometimes not completely coated by the metal plating. If the subsequent manufacturing step is performed with such pads, the pad base 7 may be corroded depending on the nature of the subsequent steps, with the possible result of change in the line resistance or disconnection.

SUMMARY OF THE INVENTION

According to the present invention a recording head substrate comprising a plurality of electrothermal transducers for generating thermal energy used for the recording; electric lines for electrically connecting the plural electrothermal transducers and a driver circuit for driving the electrothermal transducers; bonding pads connectable with the driving circuit; is characterised by additional pads electrically connected to the electric lines, disposed at positions not influential to driving current for the electrothermal transducers.

According to the present invention a recording head comprising ink discharging portions having ink discharging outlets for discharging ink; a plurality of electrothermal transducers for generating thermal energy contributable to discharging of the ink, electric lines for electrically connecting said plural electrothermal transducers and a driver circuit for driving the electrothermal transducers; bonding pads for connection with the driver circuit; is characterised by: additional pads connected with said electric lines and disposed at positions not influential to driving currents to said electrothermal transducers.

How the invention may be carried out will now be described by way of example only and with reference to the accompanying drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1A and 1B are somewhat schematic sectional view illustrating the problems with conventional recording head substrate, to be solved by the present invention.

Figure 2 is a somewhat schematic perspective view of an ink jet recording head to which the present invention is applicable.

Figures 3 and 4 are somewhat schematic top plan view and an enlarged view of an example of wiring on a substrate for the recording head shown in Figure 2.
Figure 5 is a block diagram illustrating a control system for ink jet recording apparatus using the recording head according to this embodiment.

Figure 6 is a somewhat schematic perspective view illustrating the major mechanical structure of the same.

Figure 7 is an enlarged view of a major portion of a recording head substrate according to a second embodiment of the present invention.

Figure 8 is an enlarged view of a major part of a recording head substrate according to a third embodiment of the present invention.

Figures 9A, 9B, 9C, 9D and 9E show somewhat schematic top plan views of the pads on the substrates according to further embodiments of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In a preferred embodiment of the present invention, adjacent a line electrically connecting an electrothermal transducer and a driver circuit for driving the same, a connecting or contact or bonding pad having a width larger than the line, and an additional pad having a width larger than the width of the line. The additional pad is in the form of an extension from the bonding pad or in the form of a branch from the bonding pad. The position or configuration of the pad are not limited to those which will be described in detail hereafter, if the deformation or change in the properties of the additional pad itself does not influence the driving current supplied to the electrothermal transducer.

First Embodiment

Referring to Figure 2, there is shown an exemplary ink jet recording head for forming an image using thermal energy for forming ink droplets, to which the present invention is applicable. The recording head is a so-called full-multi-type in which several hundreds or several thousands ejection outlets are aligned to cover substantially the entire width of the recording material.

The heat generating element is, in this embodiment, in the form of a heat generating resistor 4 which produces heat in response to electric power supply to produce state change in the ink (film boiling) to form a bubble to eject the ink. The heat generating resistors 4 are formed on the substrate 1 together with the electric wiring through a thin film resistor forming process similar to the manufacturing process for forming integrated semiconductor devices. A liquid passage constituting portion 2A is effective to define a liquid passage 3 communicating with the heat generating element 4 and the ejection outlet 2. The passage 3 is defined by a top board 6, a bonding layer 6A and wall member 6B. The substrate 1 is further provided thereon with a heat accumulation layer 1A and a protection layer 1B. A common chamber 15 communicates with all of the liquid passages 3, and contains the ink supplied from an unshown ink supply source.

Figure 3 shows the wiring on the substrate 1 of Figure 2 made of semiconductor material or insulative material. A common electrode Vih is used to apply a voltage to the plural heat generating resistors 4 (R1 - Rm) as a recording signal. Each signal lines are indicated by references S1 - Sn and S1’ - Sn’. They are connected to input/output contacts disposed adjacent an edge of the recording head substrate 1 and are disposed in parallel adjacent to the recording side of plural driver IC means (IC1 - ICn). Through the signal lines, various signals are transmitted, such as recording data (DATA) clock signals for signal transfer (SCLK), latching signals (LAT), strobe signals for divided driving of the IC means (STRB), transfer clock signals for the divided driving of the IC means (ECLK) and the like. Conductive members Ghi are disposed at opposite sides of each of the driver circuit IC means, and to the conductive members Ghi, the ground potential for the recording current is applied. Contacts for applying voltage VDD for driving the driver IC means IC1 - ICm are disposed between adjacent conductive members Ghi.

Figure 4 is an enlarged view of a portion where the driver IC means are formed, of the substrate shown in Figure 3. The areas 10 by the broken lines indicates the areas where the driver IC means (IC1 - ICn) including a shift register, latching circuit and driving element are formed. In the area 10, the lines connecting with the plural heat generating resistors 20 are disposed. Plural grounding contacts for the driver IC means are disposed as indicated by a reference numeral 30 to commonly function as the grounding contacts for the driver IC means sandwiching them, and therefore, they occupy large areas. One of lines constituting a pair, connected to the heat generating resistor is connected to the grounding contact line by a switching element in the driver IC means in accordance with an image signal, and therefore, is grounded, upon which the current flows from the common electrode Vih biased to a positive potential through the heat generating resistor 1, the line 20 and the grounding line 30. By this electric power supply, the heat generating resistor 1 generates heat to project an ink.

The lines 40 corresponds to the signal lines S1 - Sn and S1’ - Sn in Figure 3. Designated by a reference numeral 45 is a bonding pad for the electric connection between the driving IC means and the substrate 1 through a flip chip bonding
process, for example. Designated by a reference numeral 46 is an inspection pad for inspecting open-circuit/short-circuit of the wiring. The inspection pad is disposed corresponding to each of lines 20 (the lines for the heat generating elements) for connecting the heat generating resistor 4 and the driver IC means. Similarly, in this embodiment, a plurality of the driver IC means are provided which are connected by the signal lines 40, and therefore, the inspection pad is provided for each of the signal lines 40. The inspection pad 46 is formed as an extension of the bonding pad, that is, it is formed at a position in a connecting path between the heat generating resistor 4 on the electric circuit and the driver IC means, the position being such that it does not adversely affect the driving current or the like flowing through the driver IC means.

By the provision of the inspection pads 46 in addition to the bonding pads 45, the probe pins are not contacted to the bonding pads 45. Therefore, the problem of the disturbance in the recorded image attributable to the improper electric connection, the wiring resistance change, the electric disconnection or the like which may otherwise be caused for the reasons described in the foregoing in conjunction with Figures 1A and 1B, can be avoided. More particularly, even if the situations described in conjunction with Figures 1A and 1B occur on the inspection pad or pads 46, the bonding pads 45 are free from the problems, and the inspection pads 46 are not directly concerned with the electric connection of the driver IC means and the signal transmission.

The inspecting operations may be performed prior to the completion of the bonding pad using the pad basis (aluminum or the like) of the inspection pads 46, or may be performed after the pads bases are coated by metal plating or the like. In any case, the bonding pads 45 are not contacted by the probing pin for the inspecting operation, and therefore, they are free from the damage by the contact. Since the inspection pads 46 are used only for the inspection before the completion of the bonding pads, and therefore, the metal plating thereof is not inevitable.

Figure 5 shows an example of a control system of the recording head having the above structure, reference numeral 202 designates the recording head.

One head driver IC means is provided for each predetermined number of heat generating elements 4 (Rm) (blocks). It comprises a shift register for aligning the data signals DATA for one recording line so that one bit thereof corresponds to one of the heat generating elements 4, a latching circuit for latching the bit data corresponding to the latch signal LAT, a switch for on-off-controlling the electric power supply to the heat generating element 4 on the basis of the bit data in accordance with the strobe signal. An image memory means 50 functions to store image data IDATA supplied from a host device H functioning as the image data supply source directly or through a main controller 60 of the recording apparatus. A recording signal generator 70 is responsive to a drive timing signal T from the main controller 60 to read out the image data developed in the image memory means 50, and produces the data signal DATA, the clock signals SCLK, ECLK and the latch signal LAT. In addition, it produces a strobe signal STRB or the like for the divided drive of the head driver IC means IC1 - ICn. A head driver power source 80 functions to apply a voltage to the common electrode Vtn during the recording operation.

Using the recording head and the control system described in the foregoing, a full-line printer capable of full-color recording operation, as shown in Figure 6, for example.

Referring to Figure 6, the printer includes a pair of rollers (conveying means) 201A and 201B for constituting a nip therebetween to feed the recording material R in a subordinate scanning direction Vs. Four recording heads 202BK, 202Y, 202M and 202C are each full-multi-type recording heads having ejection outlets disposed in the range substantially covering the entire width of the recording medium R, are effective to record in the black, yellow, magenta and cyan colors, respectively. As shown in Figure 6, the recording heads are disposed in the order of the black, yellow, magenta and cyan from the upstream side with respect to the direction of the recording material feed. They constitute a recording head assembly functioning as the recording means. An ejection recovering means 200 is faced to the recording heads 202BK, 202Y, 202M and 202C in place of the recording material R during the ejection recovery operation. It comprises a cap, an ink absorbing material, and a wiping blade or the like.

Second and Third Embodiments

The position of the inspection pad is not limited to that shown in Figure 4. It may be disposed at such a position that a virtual electric current path relating to the electric signal is not formed, in consideration of the wiring of the head. The inspection pad may be formed in the form of a branch.

As shown in Figure 7, the inspection pads 45 for the signal lines 40 may be deviated from the centers of the lines.

As shown in Figure 8, the inspection pads 45 relating to the lines 20 for connecting the driver IC means and the heat generating resistors may be disposed at the position deviated from the center of the lines.
By arranging the inspection pads staggered, or by arranging the inspection pads and the bonding pads alternately and staggered, erroneous inspection operation can be reduced, and the density of the wiring in the recording head can be increased with sufficient reliability.

The present invention can be used in the recording head which is operated under severe conditions including large current flowing therethrough as in the above-described full-line-type recording head, and therefore, the present invention is applicable to a recording head having plural heat generating resistors as in a thermal head. The recording head may be of a serial scanning type.

Other Embodiments

Figures 9A, 9B, 9C, 9D and 9E are somewhat schematic top plan view illustrating other embodiments, in which one combination of the bonding pad 45 and the inspection pad 46 is shown. In Figures 9A, 9B and 9D, the inspection pad 46 is in the form of an extension from the bonding pad 45, but the configuration of the pads are different.

In Figures 9C and 9A, the inspection pad 46 is branched in relation to the bonding pad 46, but the configurations of the pads and the configuration at the branching portions are different.

One or more of the above-described configurations of the connecting lines and the pads and the size and the material of them may be combined.

The description will be made as to the manufacturing method of the recording head.

First, a monocrystalline silicon substrate is prepared. A glass plate is usable in place thereof. The surface thereof is oxidized by heat to provide SiO₂ layer is formed as the heat accumulation later. Then, a heat generating resistance layer made of HfB₂ is formed by sputtering, and an electric conductive layer made of aluminum for the electrodes is formed thereon by sputtering. The layers are patterned into a thin film resistors to form an array of 4700 heat generating elements. Simultaneously, the inspection pad basis and the bonding pad basis are also formed in the form described in the foregoing.

Thereafter, a inspection mask is formed using positive photoresist.

A prober is used, and the probe pins are contacted to the inspection pads to inspect the electric connection of the wiring (open-short).

When short circuit is found, it is cut using a laser beam to increase the yield.

The surface of the aluminum layer exposed through the throughholes are coated with gold plating to provide the bonding pad.

Then, the open/short circuit inspection is performed again, and only the good substrate is passed to the next step.

Using positive resist, a dissolvable solid layer is formed to the portions which are to constitute the plural ink passages and which are to constitute a common chamber with which the plural ink passages communicate. In place of the positive resist, a position dry film resist is usable. The substrate on which the solid layer is formed is coated with photosensitive resin, and a top board is jointed thereon. Unnecessary parts and the solid layer of the photosensitive resin is removed so that ink ejection outlets, ink passages and the common chambers are formed.

The photosensitive layer is removed using triethane. The solid layer is removed using NaOH solution (alkaline) organic solvent is usable in place of it to remove the solid layer.

When alkaline NaOH water solution is used the aluminum of the electrode or the leads are easily corroded. Therefore, the situation shown in Figure 1B should particularly be avoided. So, the present invention is particularly effective in that case.

The driver IC means are mounted at proper positions and the bonding pads and the pins of the driver IC are connected by flip chip process (soldering).

The driving IC means are mounted at proper positions, and pins of the driver IC means and the bonding pads are contacted by flip chip process.

The use of the solid layer and photosensitive resin layer is described in Japanese Laid-Open Patent Application No. 253457/1987, and therefore, the detailed description thereof is omitted for simplicity.

The top board may be made of metal, ceramic material, plastic resin material in place of the glass. The materials of the heads are not limited hereinbefore.

Four of such recording heads are combined for black, yellow, cyan and magenta colors to provide the recording head assembly to be mounted into the recording apparatus.

As described in the foregoing, the pads made of conductive material capable of inspecting the open-circuit-short-circuit of at least the wiring connecting the heat generating resistors and the driver IC means, are provided at such a position that they do not adversely influence the driving current. Accordingly, the following advantages are provided:

(1) The surface of the bonding pad can be maintained flat, so that the improper connection between the driver IC means and the bonding pads can be minimized.

(2) Even if a trouble occurs on the inspection pad or the like, the wiring resistance change or the disconnection of the wiring do not occur since the inspection pads are disposed at positions not influential to the driving currents.
Accordingly, the yield can be improved, and in addition the reliability of the recording head and the reliability of the recording apparatus using the same are improved.

The present invention is particularly effective, when the current voltages applied are relatively large, or when the size of the product is relatively large (as in the case of liquid crystal panel as well as the recording head) so as to provide the space for the additional pads.

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 the scope of the following claims.

Claims

1. A recording head substrate (1), comprising:
   a plurality of electrothermal transducers (4) for generating thermal energy used for the recording;
   electric lines (20) for electrically connecting the plural electrothermal transducers (4) and a driver circuit (IC1) for driving the electrothermal transducers;
   bonding pads (45) connectable with the driving circuit; and characterised by
   additional pads (46) electrically connected to the electric lines, disposed at positions not influential to driving current for the electrothermal transducers.

2. A substrate according to Claim 1, having a plurality of driver circuits mounted on said substrate and signal lines (51 - 55) for electrically connecting the plural driving circuits (IC1 to ICn), bonding pads (45) for the signal lines for connection with the driver circuits, and further additional pads (46) which are electrically connected with the signal lines and disposed at positions not influential to signal transfer current of the driver circuits.

3. A substrate according to Claim 1, wherein said additional pads (46) are used for inspection of electric connections.

4. A substrate according to Claim 1, wherein said additional pads (46) are in the form of extensions from said bonding pads (45).

5. A substrate according to Claim 1, wherein said additional pads (46) are in the form of branches from the electric lines.

6. A substrate according to Claim 1, wherein said additional pads (46) are staggered.

7. A substrate according to Claim 1, wherein said additional pads (46) and said bonding pads (45) are arranged alternately and are staggered.

8. A substrate according to Claim 1, wherein said additional pads (46) for the driver circuit (IC1) are formed as an extension of said bonding pads (45), and wherein said further additional pads (46) for the signal lines (51 - 55) are in the form of branches from the signal lines.

9. A substrate according to Claim 1, wherein said pads (46) are gold-plated.

10. A method of inspecting electric connection in a recording head substrate according to Claim 1, wherein the inspection is performed using said additional pads (46).

11. A recording head, comprising:
   ink discharging portions (6, 6A, 6B) having ink discharging outlets (2) for discharging ink;
   a plurality of electrothermal transducers (4) for generating thermal energy contributable to discharging of the ink, electric lines (20) for electrically connecting said plural electrothermal transducers and a driver (IC1) circuit for driving the electrothermal transducers (4);
   bonding pads (45) for connection with the driver circuit; and characterised by:
   additional pads (46) connected with said electric lines (20) and disposed at positions not influential to driving currents to said electrothermal transducers.

12. A method of manufacturing the recording head according to Claim 11, wherein electric connections of the lines (20) are inspected using the additional pads (46), and thereafter, ink ejection outlets (2) are formed, and then, the driving circuit is connected to said bonding pads (45).

13. A substrate according to Claim 1, wherein each of the additional pads (46) is formed at a position branched out of a line electrically connected between said electrothermal transducer (4) and the associated one of said bonding pads (45), and said bonding pads (45) and said additional pads (46) are covered by the driver circuit (IC1) which is in the form of a chip.

14. A method according to Claim 12, wherein the said bonding pads (45) and the driver circuit
(IC1) which is in the form of a chip, are connected through a flip chip process.

15. A method according to Claim 14, wherein the inspection is effected before said bonding pads (45) and the driving circuit (IC1) which is in the form of a chip, are connected through a flip chip process.

16. A method according to Claim 12, wherein said electric lines (20) are disposed between end portions for connecting said bonding pads (45) and said electrothermal transducers (4) between the substrate (1) and the driving circuit chip (IC1).

17. A substrate according to Claim 13, wherein said driving circuit is connected with said bonding pads (45) through a flip-chip system.

Patentansprüche

1. Aufzeichnungskopf-Substrat (1) mit:
   einer Vielzahl elektrothermischer Meßgrößenumformer (4) zum Erzeugen von zum Aufzeichnen verwendeter thermischer Energie; elektrischen Leitungen (20) zum elektrischen Verbinden der vielen elektrothermischen Meßgrößenumformer (4) und einer Treiberschaltung (IC1) zum Ansteuern der elektrothermischen Meßgrößenumformer;
   mit der Treiberschaltung verbindbaren Bonding-Anschlußflächen (45); gekennzeichnet durch
   mit den elektrischen Leitungen elektrisch verbundene zusätzliche Anschlußflächen (46), die in den Ansteuerstrom der elektrothermischen Meßgrößenumformer nicht beeinflussenden Positionen angeordnet sind.

2. Substrat nach Anspruch 1 mit einer Vielzahl von auf dem Substrat angeordneten Treiberschaltungen und Signalleitungen (51 - 55) zum elektrischen Verbinden der vielen Treiberschaltungen (IC1 bis ICn), Bonding-Anschlußflächen (45) für die Signalleitungen zur Verbindung mit den Treiberschaltungen, und weiteren zusätzlichen Anschlußflächen (46), die mit den Signalleitungen elektrisch verbunden sind und in den Signalausübertragungssstrom der Treiberschaltungen nicht beeinflussenden Positionen angeordnet sind.

3. Substrat nach Anspruch 1, bei dem die zusätzlichen Anschlußflächen (46) zur Überprüfung elektrischer Verbindungen verwendet werden.

4. Substrat nach Anspruch 1, bei dem die zusätzlichen Anschlußflächen (46) Verlängerungen der Bonding-Anschlußflächen (45) sind.

5. Substrat nach Anspruch 1, bei dem die zusätzlichen Anschlußflächen (46) Verzweigungen von den elektrischen Leitungen sind.

6. Substrat nach Anspruch 1, bei dem die zusätzlichen Anschlußflächen (46) versetzt sind.

7. Substrat nach Anspruch 1, bei dem die zusätzlichen Anschlußflächen (46) und die Bonding-Anschlußflächen (45) alternierend und versetzt angeordnet sind.

8. Substrat nach Anspruch 1, bei dem die zusätzlichen Anschlußflächen (46) für die Treiberschaltung (IC1) als eine Verlängerung der Bonding-Anschlußflächen (45) ausgebildet sind, und bei dem die weiteren zusätzlichen Anschlußflächen (46) für die Signalleitungen (51 - 55) als Verzweigungen der Signalleitungen ausgebildet sind.

9. Substrat nach Anspruch 1, bei dem die Anschlußflächen (46) goldbeschichtet sind.


11. Aufzeichnungskopf mit:
   Tintenausstoßabschnitten (6, 6A, 6B) mit Tintenausstoßöffnungen (2) zum Ausstoßen von Tinte;
   einer Vielzahl von elektrothermischen Meßgrößenumformern (4) zum Erzeugen von zum Ausstoßen der Tinte beitragender thermischer Energie, elektrischen Leitungen (20) zum elektrischen Verbinden der vielen elektrothermischen Meßgrößenumformer (4) und einer Treiberschaltung (IC1) zum Ansteuern der elektrothermischen Meßgrößenumformer (4);
   Bonding-Anschlußflächen (45) zur Verbindung mit der Treiberschaltung; gekennzeichnet durch:
   mit den elektrischen Leitungen (20) verbundene und in den Ansteuerströme der elektrothermischen Meßgrößenumformer nicht beeinflussenden Positionen angeordneten zusätzlichen Anschlußflächen (46).

12. Verfahren zum Herstellen des Aufzeichnungskopfes nach Anspruch 11, bei dem die elektrischen Verbindungen der Leitungen (20) unter
Verwendung der zusätzlichen Anschlußflächen (46) überprüft werden, und danach die Tintentausstoßöffnungen (2) ausgebildet werden, und dann die Treiberschaltung mit den Bonding-Anschlußflächen verbunden wird.


14. Verfahren nach Anspruch 12, bei dem die Bonding-Anschlußflächen (45) und die als Chip ausgebildete Treiberschaltung (IC1) durch ein Flip-Chip-Verfahren verbunden werden.

15. Verfahren nach Anspruch 14, bei dem die Überprüfung durchgeführt wird, bevor die Bonding-Anschlußflächen (45) und die als Chip ausgebildete Treiberschaltung (IC1) durch ein Flip-Chip-Verfahren verbunden werden.

16. Verfahren nach Anspruch 12, bei dem die elektrischen Leitungen (20) zwischen Endabmessungen zum Verbinden der Bonding-Anschlußflächen (45) und der elektrothermischen Meßgrößenumformer (4) zwischen dem Substrat (1) und dem Chip der Treiberschaltung (IC1) angeordnet sind.

17. Substrat nach Anspruch 13, bei dem die Treiberschaltung mit den Bonding-Anschlußflächen (45) durch eine Flip-Chip-Einrichtung verbunden ist.

Revendications

1. Substrat (1) de tète d'enregistrement, comprenant:
   une pluralité de transducteurs électrothermiques (4) pour engendrer de l’énergie thermique utilisée pour l'enregistrement;
   des lignes électriques (20) pour connecter électriquement la pluralité de transducteurs électrothermiques (4) et un circuit de commande (IC1) pour la commande des transducteurs électrothermiques;
   des pastilles de connexion (45) pouvant être connectées avec le circuit de commande; et caractérisé par
   des pastilles supplémentaires (46) connectées aux lignes électriques, disposées en des positions n'ayant pas d'influence sur le courant de commande pour les transducteurs électrothermiques.

2. Substrat selon la revendication 1, ayant une pluralité de circuits de commande montés sur ledit substrat et des lignes de signaux (51-55) pour connecter électriquement la pluralité de circuits de commande (IC1 à ICn), les pastilles de connexion (45) pour les signaux de ligne pour la connexion avec les signaux de commande, et d'autres pastilles supplémentaires (46) qui sont connectées électriquement avec les lignes de signaux et disposées en des positions n'ayant pas d'influence sur le courant de transfert des signaux des circuits de commande.

3. Substrat selon la revendication 1, dans lequel lesdites pastilles supplémentaires (46) sont utilisées pour la vérification des connexions électriques.

4. Substrat selon la revendication 1, dans lequel lesdites pastilles supplémentaires (46) se présentent sous la forme de prolongements desdites pastilles de connexion (45).

5. Substrat selon la revendication 1, dans lequel lesdites pastilles supplémentaires (46) se présentent sous la forme de branchements à partir des lignes électriques.

6. Substrat selon la revendication 1, dans lequel lesdites pastilles supplémentaires (46) sont étagées.

7. Substrat selon la revendication 1, dans lequel lesdites pastilles supplémentaires (46) et lesdites pastilles de connexion (45) sont disposées de manière alternative et sont étagées.

8. Substrat selon la revendication 1, dans lequel lesdites pastilles supplémentaires (46) pour le circuit de commande (IC1) se présentent sous la forme d'un prolongement desdites pastilles de connexion (45), et dans lequel lesdites pastilles supplémentaires (46) pour les lignes de signaux (51-55) se présentent sous la forme de branchements à partir des lignes de signaux.

9. Substrat selon la revendication 1, dans lequel lesdites pastilles (46) sont plaquées or.

10. Procédé de vérification de connexions électriques dans un substrat de tête d'enregistrement selon la revendication 1, dans lequel la vérification est effectuée en utilisant lesdites
11. Tête d'enregistrement, comprenant:
   des parties (6, 6A, 6B) de décharge d'encre ayant des sorties (2) de décharge d'encre pour décharger de l'encre;
   une pluralité de transducteurs électrothermiques (4) pour engendrer de l'énergie thermique qui peut contribuer à la décharge de l'encre, des lignes électriques (20) pour connecter électriquement ladite pluralité de transducteurs électrothermiques et un circuit de commande (IC1) pour la commande des transducteurs électrothermiques (4);
   des pastilles de connexion (45) pour la connexion avec le circuit de commande; et caractérisée par:
   des pastilles supplémentaires (46) connectées avec lesdites lignes électriques (20) et disposées en des positions n'ayant pas d'influence sur les courants de commande desdits transducteurs électrothermiques.

12. Procédé de fabrication de la tête d'enregistrement selon la revendication 11, dans lequel des connexions électriques des lignes (20) sont vérifiées en utilisant les pastilles supplémentaires (46), puis, des sorties d'éjection (2) sont formées, et enfin, le circuit de commande est connecté auxdites pastilles de connexion (45).

13. Substrat selon la revendication 1, dans lequel chacune des pastilles supplémentaires (46) est formée en une position débranchée d'une ligne connectée électriquement entre ledit transducteur électrothermique (4) et la plage de connexion associée parmi lesdites pastilles de connexion (45), et lesdites pastilles de connexion (45) et lesdites pastilles supplémentaires (46) sont recouvertes par le circuit de commande (IC1) qui se présente sous la forme d'une puce.

14. Procédé selon la revendication 12, dans lequel lesdites pastilles de connexion (45) et le circuit de commande (IC1) qui se présente sous la forme d'une puce, sont connectés par l'intermédiaire d'un procédé de puces à bosses.

15. Procédé selon la revendication 14, dans lequel la vérification est effectuée avant que lesdites pastilles de connexion (45) et le circuit de commande (IC1) qui se présente sous la forme d'une puce, soit connectés par l'intermédiaire d'un procédé de puces à bosses.

16. Procédé selon la revendication 12, dans lequel lesdites lignes électriques (20) sont disposées entre les parties d'extrémité pour connecter lesdites pastilles de connexion (45) et lesdits transducteurs électrothermiques (4) entre le substrat (1) et la puce du circuit de commande (IC1).

17. Substrat selon la revendication 13, dans lequel ledit circuit de commande est connecté avec lesdites pastilles de connexion (45) par l'intermédiaire d'un système de puces à bosses.
FIG. 6