EUROPEAN PATENT SPECIFICATION

(54) Recording apparatus and method having a temperature overrise protection function

Aufzeichnungsgerät und Verfahren zum Schutz vor Temperatur-Überschreitung

Appareil d’enregistrement et méthode pour protéger contre le dépassement de température

(84) Designated Contracting States:
- AT
- BE
- CH
- DE
- DK
- ES
- FR
- GB
- GR
- IE
- IT
- LI
- LU
- NL
- PT
- SE


(43) Date of publication of application:
31.01.1996 Bulletin 1996/05

(73) Proprietor: CANON KABUSHIKI KAISHA
Tokyo (JP)

(72) Inventors:
- Otsuka, Naoji, c/o Canon K.K.
  Ohta-ku, Tokyo (JP)
- Suzuki, Tetsuo, c/o Canon K.K.
  Ohta-ku, Tokyo (JP)
- Yano, Kentaro, c/o Canon K.K.
  Ohta-ku, Tokyo (JP)
- Takahashi, Kiichiro, c/o Canon K.K.
  Ohta-ku, Tokyo (JP)
- Iwasaki, Osamu, c/o Canon K.K.
  Ohta-ku, Tokyo (JP)
- Kanematsu, Daigoro, c/o Canon K.K.
  Ohta-ku, Tokyo (JP)

(74) Representative:
Beresford, Keith Denis Lewis et al
BERESFORD & Co.
High Holborn
2-5 Warwick Court
London WC1R 5DJ (GB)

(56) References cited:
- EP-A- 0 374 762
- EP-A- 0 496 525
- US-A- 4 910 528

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).
Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to recording apparatus and method, and more particularly to temperature override protection, in the recording apparatus.

Related Background Art

[0002] A recording apparatus used in a printer, a copying machine and a facsimile machine is constructed to record an image comprising a dot pattern on a recording medium such as a paper or a plastic thin sheet in accordance with recording information. Such recording apparatus may be classified by its recording system as ink jet system, wire dot system, thermal transfer system and laser beam system. Of those, the ink jet system recording apparatus discharges ink droplets (recording liquid) from discharge ports (outlets or orifices) provided in a head and deposits them on a recording medium to record an image. The ink jet system has become widely used because it satisfactorily meets the general requirements of high speed recording, high resolution recording, high grade recording and low noise recording.

[0003] To meet the above requirements, a higher head drive frequency and a larger number of recording elements are used, increasing the energy applied to the recording head significantly.

[0004] This increase is particularly significant in the ink jet system in which ink droplets are discharged by generating bubbles in ink by using thermal energy. For example, in the recording apparatus, a member for mounting a recording head, an ink tank, and a member for supplying ink all serve to emit heat by energy application, and, when the drive frequency is doubled, while the volume and surface area of those members are kept fixed, relatively double the energy would be applied. When the number of discharge ports is doubled, double the energy would also be applied. In actuality, when the number of recording elements or discharge ports is increased, the volume near the discharge ports increases but the volume of other parts and the surface area thereof do not significantly increase. Thus, in the above case, approximately four times the energy would be applied to the substantially constant volume and surface area.

[0005] In this case, for the ink jet system using the thermal energy, several tens percent of the applied energy is emitted from the recording head in the form of the kinetic energy used to discharge the ink and heat generation by the discharged ink. Thus, approximately two times the temperature rise is generated in the recording head by the application of the four times the energy.

[0006] However, the temperature rise in such a recording head raises the following two problems.

[0007] A first problem is due to the fact that the temperature of the recording head rises high by the approximately two times temperature rise.

[0008] For example, when recording is made at a relatively high recording duty in an environment at a temperature of 30 °C, the temperature in the apparatus rises approximately 10 °C by the temperature rise of a power supply, a motor and a driver in the recording apparatus. In this case, if a recording head with a relatively low drive frequency and a relatively small number of discharge ports is used, the temperature rise will be approximately 25 °C for full printing or 100% duty recording, but when the drive frequency is doubled and the number of discharge ports of the recording head is doubled, the temperature rise will be double, that is, approximately 50 °C. By summing the environment temperature and the temperature rises, the temperature of the recording head is approximately 65 °C for the low drive frequency with the small number of discharge ports while it is approximately 90 °C for the high drive frequency with the large number of discharge ports.

[0009] When the temperature of the recording head reaches approximately 90 °C, failure of discharge is apt to occur. Further, in an apparatus in which the recording head is exchangeable or it may be touched by a user, it is necessary to pay attention to prevent the user from touching the recording head while the recording head is at a high temperature.


[0011] As explained above, the recording head temperature may reaches 90 °C depending on the recording status. In this case, even if four times energy is applied to the recording head, the temperature rise thereof is approximately two times because several tens percent of energy is ejected out of the recording head as the thermal and kinetic energy when ink is discharged.

[0012] However, although this is the case when ink is normally discharged, if ink is not supplied to the recording head because the ink tank is empty and so no ink can be discharged or if bubbles stay in the ink supply path to block the supply of ink, a so-called empty heat state arises in which the recording head is driven without ink. In this case, since four times energy is supplied and no ink is discharged in the above example, the energy which would have been used for the discharge of ink causes an abrupt rise in the temperature of the recording head so that the temperature of the recording head reaches one hundred and several tens °C. As a result, plastic parts of the recording head exceed a thermal deformation temperature and they may be deformed, adhered portions may be torn off by the abrupt thermal expansion or ink near the heater is burnt making the heater inoperable.

[0013] The break mode which is inherent to the ink jet system is different from a break mode in the conventional thermal transfer system or wire dot system in which
the temperature rises gently because of recording to cause a break due to the temperature overrise determined by the heat capacity of the recording head unit. The existence of such a break mode makes the solution by various countermeasures for the conventional break mode difficult.

[0014] Document US-A-4 910 528 discloses a recording apparatus and a recording method according to the preambles of claims 1 and 18, respectively.

SUMMARY OF THE INVENTION

[0015] It is an object of the present invention to provide recording apparatus and method which allows a user to be prevented from touching a recording head which is at a high temperature.

[0016] In order to achieve the above object the present invention provides a recording apparatus according to claim 1. The present invention also provides a recording method according to claim 18.

[0017] In accordance with the present invention, when the recording head reaches a relatively high temperature above a predetermined temperature, the exchange of the recording head is inhibited. Preferably, when the recording head reaches a high temperature, a drive duty of the recording head is reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Fig. 1 shows a block diagram of a control scheme of an ink jet recording apparatus in accordance with one embodiment of the present invention.

Fig. 2 shows a record range for determining a recording duty in the embodiment of the present invention.

Fig. 3 shows a perspective view of the ink jet recording apparatus of the embodiment of the present invention.

Fig. 4 shows a perspective view illustrating a cartridge exchange inhibit mode of the apparatus.

Fig. 5 shows a perspective view of a head cartridge used in the apparatus.

Fig. 6 shows a sectional view of a recording head structure used in the apparatus.

Fig. 7 shows a flow chart of a head protect control main routine in the embodiment of the present invention.

Fig. 8 is comprised of Fig. 8A and Fig. 8B shows a flow chart of a head protect sequence of the routine.

Fig. 9 shows a flow chart of a temperature overrise protect control timer clear routine in the head protect sequence.

Fig. 10 shows a flow chart of an update routine of the temperature overrise protect control timer.

Fig. 11 shows a flow chart of a record routine of the temperature overrise protect mode, and

Fig. 12 shows a flow chart of the cartridge exchange sequence.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] Referring to the accompanying drawings, embodiments of the present invention will be explained.

[0020] Before the prevention of the break of the recording head by the temperature overrise of the ink jet printer and the user protection sequence in exchanging the recording head in accordance with one embodiment of the present invention, a schematic construction of the printer is explained.

[0021] Fig. 1 shows a block diagram of a control scheme of the printer in accordance with the embodiment of the present invention.

[0022] Respective elements in Fig. 1 are first explained. Numerals 10, 11, 13, 14, 15, 16, 17, 18, 19, and 20 denote an interface, a gate array, a ROM, a head driver for driving a recording head, a sheet feed motor driver for driving a feed motor, and a motor driver for driving a carrier motor, respectively.

[0023] In the above arrangement, when record data is sent from a host unit, not shown, through the interface 10, the record data is temporarily stored in the DRAM 13 by the gate array 11. The stored data is then converted by the gate array 11 from a form of raster data to a form of print image data to record by the recording head 18 and it is again stored in the DRAM 13. The data stored in such a form is DMA transferred to the head driver 15 through the gate array 11 by a start of record signal. Thus, ink is selectively discharged from discharge ports of the recording head 18 to record an image. A hardware counter for counting the recorded dots in recording is arranged on the gate array 11 so that the number of recorded dots is counted at a high speed. The carriage 20 is driven through the motor driver 17 and it drives the recording head 18 along a main scan direction in synchronism with a discharge timing of the recording head 18.

[0024] In the recording sequence, the MPU 14 interrupts the gate array 11 at 10 msec interval to read the count of the counter for the recorded dots. Thus, the number of dots recorded in a unit time, that is, a recording duty is detected. More specifically, as shown in Fig. 2, assuming that a recording head having a 128-discharge port width (A in the figure) is used and the recording is made at a drive frequency of 6.25 KHz, the carriage is advanced by 63 dots in 10 msec if the resolution is same for the main scan direction and the sub-
polyethylene which has a good molding property, is a molding material such as polysulfon, and a plexiglass plate is formed by precise plastic molding. A common liquid chamber and it is of relatively complex shape. A plurality of liquid paths 209 and corresponding discharge ports 210 are arranged peripherally to the common liquid chamber 208. Ink is supplied to the respective liquid paths 209 depending on the state they are in. The common liquid chamber 208 and a plurality of liquid paths 209. The common liquid chamber 208 is a thin film heater formed on the base plate 200. An ink discharging heater 204 and a diode temperature sensor 206 are formed on the heater board 203 by a semiconductor film forming process. A grooved top plate 207 is press-fitted to the heater board 203 by a semiconductor film forming process. A contact plane 201 and a diode temperature sensor 206 are formed on the base plate 200.

In the present embodiment, a black ink tank 223A and a black ink tank 223B having a high resistance to chemicals and a high resistance to high temperature are provided. Numerals 205 denotes bubbles generated in the ink by the heat generated by a discharging heater 204 and ink droplets 211 are discharged thereby from discharge ports 210.

A sequence of the present embodiment for the temperature rise of the head of the printer is now explained.

The head cartridge 104 comprises the recording head 18 and an ink tank 203. The recording head 18 is formed by joining an aluminum base plate 200 and a top plate 207 as shown in Fig. 6. A contact plane 201 is arranged on one side of the base plate 200 and it is electrically connected to a matrix wiring in the ink jet recording head through a flexible cable 213. Numerals 223 denote an ink tank which comprises, in the present embodiment, a black ink tank 223A and a black ink tank 223B having cyan, magenta and yellow chambers separated therein, and the ink tank is exchangeable.

In the printer of the present embodiment, various controls to the recording head are basically conducted by timer interruption. The head control routine is also basically conducted by the interruption to the CPU. Namely, the head protect control main routine is conducted by the interruption at the interval of 50 msec. The present process is started by the 50 msec interval interruption in a step S1, and the signal value is read from the diode temperature sensor 206 of the recording head 18 in a step S2. In a step S3, the signal value is AD converted to generate a digital signal Tdi°C. In a step S4, a room temperature compensation value for the detection value of the diode temperature sensor 206 of the recording head 18 is read. This may be done only when the room temperature compensation is required by storing various values generated in various known methods in a memory and reading it. In a step S5, the compensation value is added to the temperature data to produce a current recording head temperature. In a step S6, the process shifts to a subroutine of a head protect sequence which will be described in detail in conjunction with Figs. 8A and 8B.

In a step S7, whether the temperature of the recording head 18 is above 50°C or not is determined. If it is above, it is flagged in a step S9 to shift the process to a head exchange inhibit process when a head exchange request is entered by the key operation. If the decision in the step S7 is negative, a head exchange inhibit mode flag is reset in a step S8, and in a step S10, the sequence of the present embodiment for the temperature overrise control is executed in various known methods in a memory and reading it. In a step S11, the compensation value is added to the temperature data to produce a current recording head temperature. In a step S12, the process shifts to a subroutine of a head protect sequence which will be described in detail in conjunction with Figs. 8A and 8B.

In a step S7, whether the temperature of the recording head 18 is above 50°C or not is determined. If it is above, it is flagged in a step S9 to shift the process to a head exchange inhibit process when a head exchange request is entered by the key operation. If the decision in the step S7 is negative, a head exchange inhibit mode flag is reset in a step S8, and in a step S10, the head protect control main routine is conducted by the interruption at the interval of 50 msec. The present process is started by the 50 msec interval interruption in a step S1, and the signal value is read from the diode temperature sensor 206 of the recording head 18 in a step S2. In a step S3, the signal value is AD converted to generate a digital signal Tdi°C. In a step S4, a room temperature compensation value for the detection value of the diode temperature sensor 206 of the recording head 18 is read. This may be done only when the room temperature compensation is required by storing various values generated in various known methods in a memory and reading it. In a step S5, the compensation value is added to the temperature data to produce a current recording head temperature. In a step S6, the process shifts to a subroutine of a head protect sequence which will be described in detail in conjunction with Figs. 8A and 8B.

In a step S7, whether the temperature of the recording head 18 is above 50°C or not is determined. If it is above, it is flagged in a step S9 to shift the process to a head exchange inhibit process when a head exchange request is entered by the key operation. If the decision in the step S7 is negative, a head exchange inhibit mode flag is reset in a step S8, and in a step S10, the head protect control main routine is conducted by the interruption at the interval of 50 msec. The present process is started by the 50 msec interval interruption in a step S1, and the signal value is read from the diode temperature sensor 206 of the recording head 18 in a step S2. In a step S3, the signal value is AD converted to generate a digital signal Tdi°C. In a step S4, a room temperature compensation value for the detection value of the diode temperature sensor 206 of the recording head 18 is read. This may be done only when the room temperature compensation is required by storing various values generated in various known methods in a memory and reading it. In a step S5, the compensation value is added to the temperature data to produce a current recording head temperature. In a step S6, the process shifts to a subroutine of a head protect sequence which will be described in detail in conjunction with Figs. 8A and 8B.

Fig. 7 shows a flow chart of a head protect control main routine of the present embodiment.

Whether the temperature of the recording head 18 is above 50°C or not is determined. If it is above, it is flagged in a step S9 to shift the process to a head exchange inhibit process when a head exchange request is entered by the key operation. If the decision in the step S7 is negative, a head exchange inhibit mode flag is reset in a step S8, and in a step S10, whether the head temperature is above 75°C or not is determined. If it is above, a content of a temperature overrise counter is incremented in a step S11. The content of the temperature overrise counter is incremented each time the head temperature is determined to be above 75°C at 50 msec interval interruption. If it is incremented four times continuously, the count-up is detected in a step S13 and a branch is made to carry out the temperature overrise protect operation (steps S14 to S16). This is a hysteresis loop to determine that the temperature is above 75°C only when the state of above 75°C for longer than 0.2 sec is detected. In this manner, the activation of the protect operation by an instantaneous noise or an instantaneous temperature rise is prevented.

If the temperature is below 75°C in the decision
of the step S10, the temperature overrise counter is reset in a step S12.

[0040] In a step S13, if the count of the counter is 4 or larger indicating the temperature overrise, the process proceeds to a step S14 to set a flag to move to a temperature overrise protect mode. In a step S15, a temperature overrise protect control timer for controlling a time to conduct the temperature overrise protect operation is set. In the present embodiment, this time is set to 20 seconds. Then, in a step S16, the temperature overrise counter is reset.

[0041] In a step S17, whether the temperature of the head is above 100°C or not is determined. If it is above 100°C, an abnormal temperature counter is incremented in a step S18. In the same principle as that for the temperature overrise counter, the temperature overrise is detected in a step S20 if the temperature is above 100°C four times continuously, and a temperature overrise error flag is set in a step S21. In a step S22, if the temperature is above 100°C, 24 times continuously, it is determined as an error of the diode temperature sensor and a head diode sensor error flag is set in a step S23. The counter is incremented at a 50 msec interval interruption 24 times, and when 20 times or one second elapses from the determination of the temperature overrise error, the diode temperature sensor error is detected.

[0042] By repeating the series of steps described above, the decision is made in the flow chart of 50 msec interruption for the respective states of the recording head, the corresponding heads are set and the corresponding processes are conducted in the corresponding sub-routines.

[0043] Fig. 9 shows a flow chart of a power-on interruption process as an exceptional process.

[0044] When power is turned on, the interruption of a step S30 is started as an initial operation and the temperature overrise protect control timer is cleared in a step S31.

[0045] Fig. 10 shows a flow chart of an update routine of the temperature overrise protect control timer.

[0046] The interruption of the control is conducted at 1 sec interruption timing in a step S40. The content of the protect control timer is read in a step S41, and if it is not 0 sec, it is determined that the counting is in process and the temperature overrise protect timer is decremented in a step S42. If the content of the temperature overrise protect control timer is 0 in the step S41, the temperature overrise protect mode flag is reset in a step S43 and the process returns in a step S44. Through this process, the temperature overrise protect is released in 20 seconds.

[0047] Fig. 11 shows a flow chart of a sub-routine of the recording in the temperature overrise protect mode.

[0048] When the temperature overrise is detected and the recording is to be made, this sub-routine is started. For each one line of recording, a carriage is moved to a home position in a step S61 the process waits for 3.5 seconds in a step S62, and it returns in a step S63. Through this process, the substantial recording duty is reduced as converted to a mean duty per unit time to prevent the temperature rise. The method to reduce the substantial recording duty is not limited to the above but other known processes may be used. For example, the number of discharge ports to be used may be reduced and the divisional recording may be conducted, or the drive frequency may be reduced for recording.

[0049] As described above, when the temperature of the recording head exceeds 50°C by the rise of the temperature of the recording head, the head exchange mode is rendered valid and the recording is continued. When the recording is continued at the high recording duty and the temperature rises to 75°C, the dot exchange inhibit mode as well as the temperature overrise protect operation are rendered valid to prevent the recording head from being broken or the record failure from taking place. When the head temperature further rises or the temperature rises unexpectedly to exceed 100°C, the temperature overrise error is rendered valid to set the system to the error mode to stop the recording. When the temperature still further rises, it is determined that the diode temperature sensor has failed and the diode sensor error is set. In this manner, the printer is controlled in multi-stage by the temperature detected for the recording head. Thus, the protection for the temperature overrise is attained without reducing the recording throughput as much as possible. The significance of the setting of the respective determination temperatures is explained below.

[0050] In the so-called bubble jet system in the present embodiment, as shown in Fig. 6, a pulse current is supplied to a heater 204 to instantaneously heat the ink to cause a film boil state and the ink in the liquid path 209 is pushed out by the air bubbles 205 generated thereby to form the discharged ink droplets 211. In discharging the ink, an electrical energy supplied to the heater 204 is not 100% converted to a kinetic energy but most of the energy are dissipated as a thermal energy. Approximately one half of the heat is emitted out of the recording head together with the discharged ink droplets and the remaining one half is stored in the recording head. Namely, it is conducted through the entire recording head including the heater board 203, the base plate 200 and the grooved top plate 207 and even the ink tank so that the heats are dissipated from those members to the air as the heat is conducted.

[0051] When the heat is stored in this manner, the temperature rise is particularly remarkable on the rear side of the aluminum base plate 200 which has a relatively high thermal conductivity. When the drive frequency is low and the number of discharge ports is small, the temperature by the temperature rise does not cause a problem by itself, but when the applied energy increases, that part becomes very high temperature. In the recording head used in the present embodiment, the temperature rise is approximately 40°C in the ink discharge
Accordingly, once the recording is started, the recording sequence is explained. In a step S9, if a flag to inhibit the cartridge exchange is set, the recording operation is continued if the recording is in process but when the user terminates the recording or attempts to interrupt the recording and enter the cartridge exchange mode, the flag is rendered valid. Specifically, when the cartridge exchange key is operated, the exchange sequence is started (step S80) and whether an inhibit mode flag is set or not is determined in a step S71. If it is set, the inhibit of the cartridge exchange is displayed in a step S72. Alternatively, it may be informed to a user by a buzzer. Simultaneously therewith, as shown in Fig. 4, the head cartridge is moved to the position covered by the barrier member 103 near the home position in a step S73 to make the lock lever 105 inoperable to prevent the carriage from being detached from the cartridge and prevent the user from touching the high temperature part. The present embodiment is characterized by the provision of both the means to inform to the user that the head exchange is not permitted and the mechanical code control means to prevent the head exchange.

A predetermined phase excitation of the carriage motor is also conducted to electrically fix the carriage. As the means to prevent the exchange by the user, the lock lever itself may be locked to render the lock lever unmovable instead of providing the barrier member 103.

When the user attempts to forcibly pull out the carriage from the rear of the barrier member 103 to release the lock lever 105 to take out the cartridge, the carriage motor is driven to immediately return the carriage to the home position to disable the exchange of the cartridge. In this case, in order to determine whether the carriage is forcibly moved or not, the pull-out of the carriage from the barrier 103 to the position which allows the release of the lock lever 105 may be determined by the detection state of the home position sensor and a state as to whether a drive signal is then applied to the carriage drive motor or not.

Alternatively, when the carriage position is controlled by a linear encoder or a rotary encoder, the movement may be determined at the point when the encoder detects the movement. A counter emf generated when the carriage motor is driven may be detected to determine the movement of the carriage. The determination may be made by one of various methods and when the forced movement of the carriage is detected, the carriage is moved as shown by an arrow in Fig. 4 to move the head cartridge to the rear of the barrier member 103 or other equivalent cover or member to inhibit the exchange of the cartridge or the recording head.

On the other hand, if it is determined in the step S71 that the inhibit mode flag is not set, the carriage is moved to the exchange position in a step S74 to allow the exchange by the user.

The setting of the determination temperature for the temperature overrise protect mode is now explained.

In the temperature overrise protect mode, a delayed recording flag is set to set a waiting time for each line of recording (see steps S13 and S14 in Fig. 8A). The further rise of the temperature is suppressed by the protect mode. The delayed recording or the operation to suppress the temperature rise may be conducted by other known methods instead of setting the waiting time between scans such as by reducing the number of discharge ports used per scan or reducing the drive frequency.

The recording head used in the present embodiment has the plastic molded grooved top plate 207 compress-fitted to the heater board 203. When the diode temperature sensor 206 detects the temperature of above 120°C, the grooved top plate 207 exceeds its thermal deformation point and it is deformed. For other structure, a break limit point is determined for the recording head by a difference between linear thermal expansion coefficients.

In order to keep the temperature below this temperature, the control may be made if a maximum error of the sensor system, a response frequency of the sensor system, a maximum delay time required for the control to interrupt and a maximum temperature rise during that period are known. In general, since the instant of sending the record data to the recording head for recording is so rapid that the sending of the record data to the recording head each time by the control of the MPU is too late, and the MPU merely sends a trigger signal to start the recording to the gate array which reads the bit image developed on the RAM in the DMA mode to send the signal to the recording head for recording. Accordingly, once the recording is started, the recording is proceeded without the intervention of the MPU so that...
the recording may not be readily stopped immediately. Further, when the recording operation is stopped by the interruption, the next operation must start from the stopped portion and means and control therefor are needed.

[0065] From the above, it is advantageous in the control that the stopping of the recording operation and the setting of the waiting time are done at the completion of one scan of recording. Accordingly, if a maximum temperature of rise in one scan is known, the determination temperature for the temperature overrise protect mode may be set to the limit operation temperature less the maximum temperature rise in one scan. Specifically, the temperature is set to be further lower than the above temperature by a maximum error of the temperature detection circuit. Thus, when the limit operating temperature is lower than 120°C, the maximum temperature rise in recording 8-inch width in one scan is 25°C and the maximum error of the sensor system is 20°C, the determination temperature for the temperature overrise protect mode is 120 - 25 - 20 = 75°C.

[0066] As a result, when the temperature immediately before the recording is 74°C, for example, the delayed recording is not started and the temperature of the recording head is below 119°C even if the sensor error is maximum. On the other hand, if the temperature immediately before the recording is 120°C, the delayed recording is started and the recording is started after the head temperature has dropped by the record waiting so that the head temperature does not exceed 120°C. When the divided recording is used for the delayed recording, the maximum temperature is suppressed to several °C and the overall temperature rise so far is gradually decreased so that the head temperature does not exceed 120°C.

[0067] In this manner, in the present embodiment, the maximum temperature rise in one scan is previously acquired and the control is conducted by using the limit operating temperature less the maximum temperature rise as the reference temperature. More preferably, above temperature less the maximum error of the sensor system is used as the reference for the control so that the instant stop of the recording is prevented.

[0068] The temperature of 100°C as the determination reference for the temperature overrise error mode is determined in the following manner. Namely, when the recording head is heated with no ink around the discharge heater of the recording head, when the high duty recording such as full painting by black is continued without noticing the empty heat state, when the control temperature value exceeds 100°C due to variance of heat dissipation, or when the control temperature exceeds 100°C when the sensor error is maximum, it is highly likely that the actual temperature of the recording head is above the limit temperature of 120°C. Accordingly, when the control temperature exceeds 100°C, it is determined as an error and the recording is immediately stopped (see step S20 of Fig. 8B).

[Embodiment 2]

[0069] The recording head of the Embodiment 1 allows the recording of 8-inch width per line. In the Embodiment 2 of the present invention, the temperature control for a large recording apparatus which allows the recording of 16-inch width.

[0070] In a relatively large printer having the recording width if 16 inches, the number of discharge ports increases and the maximum temperature rise in one scan is approximately 45°C as opposed to 25°C for the 8-inch width. In this case, in accordance with the setting of the determination reference temperature explained in the Embodiment 1, the reference temperature is 120 - 45 - 20 = 55°C. In this case, when the recording is conducted at the environment temperature of 30°C with the temperature rise in the apparatus being 10°C, the temperature rise of the recording head itself is permitted only for 55 - 30 - 10 = 15°C. Thus, even for the recording of a text, the recording head readily reaches the determination reference temperature by the temperature rise of its own and the process is shifted to the delayed recording mode which is the temperature overrise protect mode. As a result, the throughput is significantly reduced.

[0071] In the present embodiment, in order to solve this problem, at least one point at which the discharge control may interrupt is provided in one line of 16-inch width and a maximum temperature rise in one scan in the recording width between the points is previously measured.

[0072] For example, it is assumed that the maximum temperature rise when the 16-inch width is fully recorded in one scan is 45°C. It is also assumed that the temperature rise of the recording head is 75°C by the continuation of the high duty recording. In this case, if one scan is recorded by using all the discharge ports in the 16-inch width, the temperature rise thereby is 45°C, and the total temperature rise is 75 + 45 = 120°C. Thus, at the end of the scan, the grooved top plate may be fused and broken. Accordingly, for the 16-inch recording width, the control point to allow the stop of the ink discharge is provided at the 8-inch point so that the temperature rise is suppressed to 75 + 25 = 100°C. If it is known that the temperature rises 25°C in one scan of the 8-inch width, it may be determined that the discharge need not be stopped at the 8-inch point if the temperature rise by the recording of the 8-inch width is lower than 120 - 25 = 95°C. In actual, if the temperature rise is lower than the control temperature of 75°C which is the temperature of 95°C less the maximum error of 20°C of the sensor system, the recording of the 16-inch width may be permitted.

[0073] When the discharge is stopped at the 8-inch point, the sheet is not fed in the next scan and the remaining portion is recorded. Since the position at which the discharge is stopped is predetermined, the control is not very complex. In the present embodiment, the stop
point is only one although a plurality of point may be
advantageously provided.

[0074] The present invention is particularly suitable
for use in an ink jet recording head and an recording
apparatus in which an electro-thermal transducer, a la-
sor beam or the like is used to cause a change of state
of the ink to eject or discharge the ink, because the high
density of pixels and high resolution of recording are at-
tained.

[0075] The typical construction and the operational
principles are preferably the ones disclosed in USP
4,723,129 and USP 4,740,796. The principle and the
structure are applicable to a so-called on-demand type
recording system and a continuous type recording sys-
tem. Particularly, however, it is suitable for the on-de-
mand type because the principle is such that at least
one driving signal is applied to an electro-thermal trans-
ducer disposed on a liquid (ink) retaining sheet or liquid
passage, the driving signal being large enough to pro-
such a quick temperature rise beyond a departure from
nucleation boiling point, by which the thermal en-
ergy is provided by the electro-thermal transducer to
produce film boiling on the heating portion of the record-
ing head, whereby a bubble can be formed in the liquid
(ink) corresponding to each of the driving signals. By the
heating, development and contraction of the bub-
bles, the liquid (ink) is ejected through an discharge port
to produce at least one droplet. The driving signal is pref-
erably in the form of pulse because the development
and the contraction of the bubbles can be effected in-
stantaneously, and therefore the liquid (ink) is ejected
with fast response. The driving signal is preferably such
as those disclosed in USP 4,463,359 and USP
4,345,262. In addition, the temperature rise rate of the
heating surface is preferably such as those disclosed in
USP 4,313,124.

[0076] The structure of the recording head may be
those shown in USP 4,558,333 and USP 4,459,600 in
which 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 electro-thermal transduc-
er disclosed in the above-mentioned patents. In addi-
tion, the present invention is applicable to the structure
No. 59-123670 in which a common slit is used as the
discharge port for a plurality of electro-thermal transduc-
ers, and the structure disclosed in Japanese Laid-Open
Patent Application No. 59-138461 in which an opening
for absorbing a pressure wave of thermal energy is
formed corresponding to the discharge port. This is be-
cause the present invention is effective to preform the
recording with certainty and high efficiency irrespective
of the type of the recording head.

[0077] In addition, the present invention is applicable
to a serial type recording head in which the recording
head is fixed on a main assembly, to a replaceable chip
type recording head which is connected electrically with
the 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.

[0078] The provision of the recovery means and/or
the auxiliary means for the preliminary operation are
preferable because they further stabilize the effects of
the present invention. As for such means, there are capping
means for the recording head, cleaning means therefor, pressuring or sucking means, preliminary heating
means which may be an electro-thermal transducer,
an additional heating element or a combination thereof.
Also, means for effecting preliminary discharge (not for
the recording) may stabilize the recording operation.

[0079] As regards the variation of the recording head
mountable, it may be a single for a single color or plural
for a plurality of inks having different colors or densities.
The present invention is effectively applicable to an ap-
paratus having at least one of a monochromatic mode
mainly with black, a multi-color mode with different color
inks and/or full color mode using the mixture of colors,
which may be an integrally formed recording unit or a
combination of a plurality of recording heads.

[0080] Furthermore, in the foregoing embodiment, the
ink is liquid. Alternatively, ink which is solidified below a
room temperature and liquefied at a room temperature
may be used. Since the ink is controlled within a tem-
perature range of not lower than 30°C and not higher
than 70°C to stabilize the viscosity of the ink to provide
the stable discharge in a conventional recording appar-
ratus of this type, the ink may be such that it is liquid
within the temperature range when the recording signal
is applied. The present invention is applicable to other
type 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. Other ink is solidified when it is left, to
prevent the evaporation of the ink. In any case, the ap-
plication of the recording signal producing thermal en-
ergy, the ink is liquefied, and the liquefied ink may be
discharged. Other ink may start to be solidified at the
time when it reaches the recording sheet.

[0081] The present invention is also applicable to the
ink which is liquefied by the application of the thermal
energy. Such ink may be retained in liquid state or solid
state in holes or recesses formed in a porous sheet as
No. 54-56847 and Japanese Laid-Open Patent Applica-
tion No. 60-71260. The sheet is faced to the electro-ther-
mal transducers. The most effective one of the inks de-
scribed above is the film boiling system.

[0082] The ink jet recording apparatus may be used
as an output terminal of an information processing ap-
paratus such as a computer or the like, as a copying
machine combined with an image reader or the like, or
as a facsimile machine having information sending and
receiving functions.

[0083] In accordance with the present invention,
when the recording head reaches a relatively high tem-
perature above the predetermined temperature, the ex-
A recording apparatus according to claim 2, where-

- the recording head reaches a high temperature, the drive duty of the recording head is reduced.

[0084] As a result, the safe recording apparatus which prevents the user from touching the high temperature member is provided. Further, the recording throughput is not reduced significantly.

[0085] Further, when the temperature of the recording head reaches the limit operating temperature less the maximum temperature rise in at least one line, the control is made to reduce the energy per unit time applied to the recording head for recording to prevent the break of the recording head.

[0086] While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth and the present invention is intended to cover such modifications or changes as may come within the scope of the claims.

Claims

1. A recording apparatus for recording on a recording medium by using an exchangeable recording head (18), comprising:

- acquire means (14, s2) for acquiring temperature information of the recording head (18);
- determination means (14, s5, s7) for determining whether a head temperature value derived based on the temperature information of said recording head acquired by said acquire means is above a predetermined value or not; and
- control means (14) for controlling the recording apparatus in dependence upon the output of said determination means;

characterised in that said control means comprises mode setting means (14, s9) for setting a mode to inhibit an exchange operation of said recording head (18) when said determination means determines that the temperature of said recording head (18) is above the predetermined value.

2. A recording apparatus according to claim 1, wherein said recording apparatus is operable for recording on the recording medium while moving said recording head (18), and wherein said inhibit mode is operable to lock said recording head by a lock mechanism (105) to prevent said recording head from being removed, in response to an indication (s70) of the exchange of the recording head (18).

3. A recording apparatus according to claim 2, wherein in response to said indication (s70), said inhibit mode is operable to move and to hold said recording head (18) beyond said area behind a cover member (103).

4. A recording apparatus according to claim 2 or 3, further comprising means (20) for moving said recording head (18) out of said area when said inhibit mode has been set and in response to a determination that the recording head has been moved into said area.

5. A recording apparatus according to claim 4, wherein said means (20) comprises a home position sensor or an encoder or a means for detecting a counter emf of a motor during non-activation, for determining whether the recording head (18) has been moved into said area.

6. A recording apparatus according to claim 4 or 5, wherein said means (20) comprises a motor and means for supplying a DC current or more DC current to said motor (20) for moving said recording head (18) out of said area when said recording head (18) is attempted to be moved into said area.

7. A recording apparatus according to claim 1, wherein said recording apparatus is operable for recording on the recording medium while moving said recording head (18), and wherein said inhibit mode is operable to lock said recording head by a lock mechanism (105) to prevent said recording head from being removed, in response to a determination means (14, s72) for informing a user that the inhibit mode has been set.

8. A recording apparatus according to any of claims 1 to 7, further comprising means (14, s72) for informing a user that the inhibit mode has been set.

9. A recording apparatus according to claim 1, wherein said control means further comprises second determination means (14, s10) for determining whether the derived head temperature value is above a second predetermined value and means (14) for reducing an energy per unit time applied to the recording head (18) during one line of recording, when said second determination means (14, s10) determines that the derived head temperature value is above the second predetermined value.

10. A recording apparatus according to claim 9, wherein the second predetermined value is larger than the first predetermined value.

11. A recording apparatus according to claim 9, wherein in said reducing means (14) is operable (i) to reduce a drive frequency of said recording head (18) during the recording; (ii) to record by multi-path during the recording; (iii) to provide a rest period during the recording; or (iv) to perform a combination of (i), (ii) or (iii), when said second determination means de-
terminates that the derived head temperature is above said second predetermined value.

12. A recording apparatus according to any of claims 1 to 11, wherein said recording head (18) is arranged to generate bubbles in ink by utilising a thermal energy and to discharge the ink as the bubbles are generated.

13. A recording apparatus according to claim 12 further comprising suction means for sucking the ink.

14. A recording apparatus according to any of claims 1 to 13, further comprising a carriage to mount said recording head (18) thereon.

15. A facsimile machine comprising a recording apparatus according to any of claims 1 to 14.

16. A copying machine comprising a recording apparatus according to any of claims 1 to 14.

17. A word processor comprising a recording apparatus according to any of claims 1 to 14.

18. A recording method for recording on a recording medium by using an exchangeable recording head (18), comprising the steps of:

   acquiring (s2) temperature information of the recording head (18);
   determining (s5, s7) whether a head temperature value derived based on the temperature information of said recording head acquired in said acquiring step is above a predetermined value or not; and
   controlling the recording apparatus in dependence upon the output of said determining step;

   characterised in that said controlling step comprises the step of setting (s9) a mode to inhibit an exchange operation of said recording head (18) when said determining step determines that the temperature of said recording head (18) is above said predetermined value.

19. A recording method according to claim 18, wherein the recording is made while moving said recording head, and wherein said inhibit mode moves and holds said recording head beyond an area in which a user can exchange said recording head (18), in response to an indication (s70) of the exchange of the recording head (18).

21. A recording method according to claim 19 or 20, further comprising the step of moving said recording head (18) out of said area when said inhibit mode has been set and when it is determined that the recording head (18) has been moved into said area.

22. A recording method according to claim 21, wherein a home position sensor or an encoder or a means for detecting a counter emf of a motor during non-activation is used to determine whether the recording head (18) has been moved by force into said area.

23. A recording method according to claim 21 or 22, wherein a motor is used to move said recording head (18) and wherein a DC current or more DC current is supplied to said motor when said recording head is attempted to be moved into said area.

24. A recording method according to claim 18, further comprising the step of informing a user that the inhibit mode has been set.

25. A recording method according to any of claims 18 to 24, further comprising the second step of determining whether or not the derived head temperature value is above a second predetermined value, and the step of reducing an energy per unit time applied to the recording head (18) during one line of recording, when said second determination step determines that the derived head temperature is above the second predetermined value.

26. A recording method according to claim 25, wherein the second predetermined value is larger than the first predetermined value.

27. A recording method according to claim 25 or 26, wherein said control step (i) reduces a drive frequency of said recording head during the recording; (ii) records by multi-path during the recording; (iii) provides a rest period during the recording; or (iv) performs a combination of (i), (ii) or (iii), when said second determining step determines that the derived head temperature is above said second predetermined value.

Patentansprüche

1. Aufzeichnungsgerät zum Aufzeichnen auf einem Aufzeichnungsmedium unter Verwendung eines austauschbaren Aufzeichnungskopfes (18) mit:

   einer Erfassungseinrichtung (14, s2) zum Erfassen einer Temperaturinformation des Aufzeichnungskopfes (18);
   einer Bestimmungseinrichtung (14, s5, s7) zum
Bestimmen, ob ein Kopftemperaturwert, der auf der Grundlage der Temperaturinformation des Aufzeichnungskopfes abgeleitet wird, die von der Erfassungseinrichtung gewonnen wird, oberhalb eines vorbestimmten Wertes ist oder nicht; und
der Steuereinrichtung (14) zum Steuern des Aufzeichnungsgerätes in Abhängigkeit von dem Ausgabesignal der Bestimmungseinrichtung; dadurch gekennzeichnet, daß


1. Aufzeichnungsgerät gemäß Anspruch 1, wobei das Aufzeichnungsgerät zum Aufzeichnen auf dem Aufzeichnungsmedium betreibbar ist, während der Aufzeichnungskopf (18) bewegt wird, und wobei der Behinderungsmodus betreibbar ist, um einen Austauschvorgang des Aufzeichnungskopfes (18) zu behindern, wenn die Bestimmungseinrichtung bestimmt, daß die Temperatur des Aufzeichnungskopfes (18) oberhalb des vorbestimmten Wertes ist.

2. Aufzeichnungsgerät gemäß Anspruch 1, wobei das Aufzeichnungsgerät zum Aufzeichnen auf dem Aufzeichnungsmedium betreibbar ist, während der Aufzeichnungskopf (18) bewegt wird, und wobei der Behinderungsmodus betreibbar ist, um den Aufzeichnungskopf (18) über einen Bereich, in dem ein Anwender den Aufzeichnungskopf (18) im Ansprechen auf eine Anzeige (s70) des Austauschens des Aufzeichnungskopfes (18) austauschen kann, hinaus zu bewegen und zu halten.

3. Aufzeichnungsgerät gemäß Anspruch 2, wobei im Ansprechen auf die Anzeige (s70) der Behinderungsmodus betreibbar ist, um den Aufzeichnungskopf (18) über den Bereich hinter ein Abdeckelement (103) zu bewegen und zu halten.

4. Aufzeichnungsgerät gemäß Anspruch 2 oder 3, das des weiteren folgendes aufweist:
eine Einrichtung (20) zum Bewegen des Aufzeichnungskopfes (18) aus dem Bereich heraus, wenn der Behinderungsmodus eingestellt worden ist und im Ansprechen auf eine Bestimmung, das der Aufzeichnungskopf in den Bereich bewegt worden ist.

5. Aufzeichnungsgerät gemäß Anspruch 4, wobei die Einrichtung (20) einen Ausgangssensor oder eine Kodiereinrichtung oder eine Einrichtung aufweist, um ein Zählglied eines Motors während einer Nichtbetätigung erfassen, um zu bestimmen, ob der Aufzeichnungskopf (18) in den Bereich bewegt worden ist.

6. Aufzeichnungsgerät gemäß Anspruch 4 oder 5, wobei die Einrichtung (20) einen Motor und eine Einrichtung zum Liefern eines Gleichstromes oder mehrerer Gleichströme zu dem Motor (20) zum Bewegen des Aufzeichnungskopfes (18) aus dem Bereich heraus, wenn versucht wird, den Aufzeichnungskopf (18) in den Bereich zu bewegen, aufweist.

7. Aufzeichnungsgerät gemäß Anspruch 1, wobei das Aufzeichnungsgerät für ein Aufzeichnen auf dem Aufzeichnungsmedium betreibbar ist, während der Aufzeichnungskopf (18) bewegt wird, und wobei der Behinderungsmodus betreibbar ist, um den Aufzeichnungskopf durch einen Einrastmechanismus (105) im Ansprechen auf eine Anzeige (s70) des Austausches des Aufzeichnungskopfes (18) zu verrasten, um zu verhindern, daß der Aufzeichnungskopf entfernt wird.

8. Aufzeichnungsgerät gemäß einem der Ansprüche 1 bis 7, das des weiteren folgendes aufweist:
eine Einrichtung (14, s72) zum Informieren des Anwenders, das der Behinderungsmodus eingestellt worden ist.

9. Aufzeichnungsgerät gemäß Anspruch 1, wobei die Steuereinrichtung des weiteren eine zweite Bestimmungseinrichtung (14, s10), um zu bestimmen, ob der abgeleitete Kopftemperaturwert oberhalb eines zweiten vorbestimmten Wertes ist, und eine Einrichtung (14) aufweist, um eine Energie pro Zeiteinheit, die auf den Aufzeichnungskopf (18) während einer Aufzeichnungszeile aufgebracht wird, zu verringern, wenn die zweite Bestimmungseinrichtung (14, s10) bestimmt, daß der abgeleitete Kopftemperaturwert oberhalb des zweiten vorbestimmten Wertes ist.

10. Aufzeichnungsgerät gemäß Anspruch 9, wobei der zweite vorbestimmte Wert größer als der erste vorbestimmte Wert ist.

11. Aufzeichnungsgerät gemäß Anspruch 9, wobei die Verringerungseinrichtung (14) betreibbar ist, um
(i) eine Antriebsfrequenz des Aufzeichnungskopfes (18) während des Aufzeichnens zu verringern;
(ii) ein Aufzeichnen mit Mehrfachbahn während des Aufzeichnens auszuführen;
(iii) eine Ruhezeitspanne während des Aufzeichnens vorzusehen; oder
(iv) eine Kombination aus (i), (ii) oder (iii) auszuführen, wenn die zweite Bestimmungseinrichtung bestimmt, daß die abgeleitete Kopftemperatur oberhalb des zweiten vorbestimmten Wertes ist.

12. Aufzeichnungsgerät gemäß einem der Ansprüche
1 bis 11, wobei
der Aufzeichnungskopf (18) so eingerichtet ist, daß er Blasen in der Tinte unter Anwendung von Wärmeenergie erzeugt und die Tinte ausstößt, wenn die Blasen erzeugt werden.

13. Aufzeichnungsgerät gemäß Anspruch 12, das des weiteren eine Saugeinrichtung zum Saugen der Tinte aufweist.


15. Faxgerät mit einem Aufzeichnungsgerät gemäß einem der Ansprüche 1 bis 14.


17. Textverarbeitungseinrichtung mit einem Aufzeichnungsgerät gemäß einem der Ansprüche 1 bis 14.

18. Aufzeichnungsverfahren zum Aufzeichnen auf einem Aufzeichnungsmedium unter Anwendung eines austauschbaren Aufzeichnungskopfes (18) mit den folgenden Schritten:

- Erfassen (s2) einer Temperaturinformation des Aufzeichnungskopfes (18);
- Bestimmen (s5, s7), ob ein Kopftemperaturwert, der auf der Grundlage der Temperaturinformation des Kopfes abgeleitet wird, die bei dem Erfassungsschritt erfaßt wird, oberhalb eines vorbestimmten Wertes ist oder nicht; und
- Steuern des Aufzeichnungsgerätes in Abhängigkeit von dem Ausgabesignal des Bestimmungsschrittes;

dadurch gekennzeichnet, daß

- der Steuerschritt einen Schritt eines Einstellens (s9) eines Modus zum Verhindern eines Austauschvorgangs des Aufzeichnungskopfes (18), wenn der Bestimmungsschritt bestimmt, daß die Temperatur des Aufzeichnungskopfes (18) oberhalb des vorbestimmten Wertes ist, aufweist.

19. Aufzeichnungsverfahren gemäß Anspruch 18, wobei

das Aufzeichnen ausgeführt wird, während der Aufzeichnungskopf bewegt wird, und wobei der Behinderungsmodus den Aufzeichnungskopf über einen Bereich, in dem ein Anwender den Aufzeichnungskopf (18) austauschen kann, im Ansprechen auf eine Anzeige (s70) des Austauschens des Aufzeichnungskopfes (18) bewegt und hält.

20. Aufzeichnungsverfahren gemäß Anspruch 19, wobei

im Ansprechen auf die Anzeige (s70) der Behinderungsmodus den Aufzeichnungskopf (18) über den Bereich hinter ein Abdeckelement (103) bewegt und hält.

21. Aufzeichnungsverfahren gemäß Anspruch 19 oder 20, das des weiteren den folgenden Schritt aufweist:

Bewegen des Aufzeichnungskopfes (18) aus dem Bereich heraus, wenn der Behinderungsmodus eingestellt worden ist und wenn bestimmt worden ist, daß der Aufzeichnungskopf (18) in den Bereich bewegt worden ist.

22. Aufzeichnungsverfahren gemäß Anspruch 21, wobei

ein Ausgangspositionssensor oder eine Kodiereinrichtung oder eine Einrichtung, durch die ein Zähglied emf von einem Motor während einer Nichtbetätigung erfaßt wird, verwendet wird, um zu bestimmen, ob der Aufzeichnungskopf (18) zwangsweise in den Bereich bewegt worden ist.

23. Aufzeichnungsverfahren gemäß Anspruch 21 oder 22, wobei

ein Motor verwendet wird, um den Aufzeichnungskopf (18) zu bewegen, und wobei ein Gleichstrom oder mehrere Gleichströme zu dem Motor geliefert werden, wenn versucht wird, den Aufzeichnungskopf in den Bereich zu bewegen.

24. Aufzeichnungsverfahren gemäß Anspruch 18, das des weiteren den folgenden Schritt aufweist:

Informieren (s72) eines Anwenders darüber, das der Behinderungsmodus eingestellt worden ist.


26. Aufzeichnungsverfahren gemäß Anspruch 25, wobei

der zweite vorbestimmte Wert größer als der erste vorbestimmte Wert ist.

27. Aufzeichnungsverfahren gemäß Anspruch 25 oder 26, wobei

der Steuerschritt (i) eine Antriebsfrequenz des
Aufzeichnungskopfes während des Aufzeichnens verringert; der Steuerschritt (ii) durch ein Mehrfachbahn­aufzeichnen während des Aufzeichnens aufzeichnet; der Steuerschritt (iii) eine Ruhezeitspanne während des Aufzeichnens vorsieht; oder der Steuerschritt (iv) eine Kombination aus (i), (ii) oder (iii) ausführt, wenn der zweite Bestimmungsschritt bestimmt, daß die abgeleitete Kopftemperatur oberhalb des zweiten vorbestimmten Wertes ist.

Revendications

1. Appareil d'enregistrement pour enregistrer sur un support d'enregistrement en utilisant une tète (18) d'enregistrement pouvant être changée, comprenant :

   un moyen (14, s2) d'acquisition destiné à acquérir de l'information de température de la tète (18) d'enregistrement ;
   un moyen (14, s5, s7) de détermination destiné à déterminer si une valeur de température de tête, obtenue sur la base de l'information de température de ladite tête d'enregistrement, acquise par ledit moyen d'acquisition, est supérieure, ou non, à une valeur prédéterminée ; et
   un moyen (14) de commande destiné à commander l'appareil d'enregistrement en fonction de la sortie dudit moyen de détermination ;

   caractérisé en ce que ledit moyen de commande comprend un moyen (14, s9) d'établissement d'un mode destiné à établir un mode pour interdire une opération de changement de ladite tête (18) d'enregistrement lorsque ledit moyen de détermination détermine que la température de ladite tête (18) d'enregistrement est supérieure à la valeur prédéterminée.

2. Appareil d'enregistrement selon la revendication 1, dans lequel ledit appareil d'enregistrement peut fonctionner pour enregistrer sur le support d'enregistrement et dans lequel ledit moyen d'interdiction peut être activé pour déplacer et maintenir (s73) ladite tête (18) d'enregistrement au-delà d'une zone dans laquelle un utilisateur peut changer ladite tête (18) d'enregistrement, en réponse à une indication (s70) du changement de la tête (18) d'enregistrement.

3. Appareil d'enregistrement selon la revendication 2, dans lequel, en réponse à ladite indication (s70), ledit mode d'interdiction peut être activé pour déplacer et maintenir ladite tête (18) d'enregistrement au-delà de ladite zone, derrière un élément (103) de recouvrement.

4. Appareil d'enregistrement selon la revendication 2 ou 3, comprenant en outre un moyen (20) destiné à déplacer ladite tête (18) d'enregistrement hors de ladite zone lorsque ledit mode d'interdiction a été établi et en réponse à une détermination du fait que la tête d'enregistrement a été déplacée dans ladite zone.

5. Appareil d'enregistrement selon la revendication 4, dans lequel ledit moyen (20) comprend un capteur de position de repos ou un codeur ou un moyen servant à déterminer une force contre-électromotrice d'un moteur pendant une non-activation, pour déterminer si la tête (18) d'enregistrement a été déplacée dans ladite zone.

6. Appareil d'enregistrement selon la revendication 4 ou 5, dans lequel ledit moyen (20) comprend un moteur et un moyen servant à délivrer du courant continu ou davantage de courant continu audit moteur (20) pour déplacer ladite tête (18) d'enregistrement hors de ladite zone lorsque l'on tente de déplacer ladite tête (18) d'enregistrement dans ladite zone.

7. Appareil d'enregistrement selon la revendication 1, dans lequel ledit appareil d'enregistrement peut fonctionner pour enregistrer sur le support d'enregistrement tout en déplaçant ladite tête (18) d'enregistrement, et dans lequel ledit mode d'interdiction peut être activé pour verrouiller ladite tête d'enregistrement à l'aide d'un mécanisme (105) de verrouillage pour empêcher le retrait de ladite tête d'enregistrement, en réponse à une indication (s70) du changement de la tête (18) d'enregistrement.

8. Appareil d'enregistrement selon l'une quelconque des revendications 1 à 7, comprenant en outre un moyen (14, s72) destiné à informer un utilisateur que le mode d'interdiction a été établi.

9. Appareil d'enregistrement selon la revendication 1, dans lequel ledit moyen de commande comprend en outre un second moyen (14, s10) de détermination destiné à déterminer si la valeur de température de tête obtenue est supérieure à une seconde valeur prédéterminée et un moyen (14) destiné à réduire une énergie par unité de temps appliquée à la tête (18) d'enregistrement pendant une ligne d'enregistrement, lorsque ledit second moyen (14, s10) de détermination détermine que la valeur de température de tête obtenue est supérieure à la seconde valeur prédéterminée.
10. Appareil d'enregistrement selon la revendication 9, dans lequel la seconde valeur prédéterminée est supérieure à la première valeur prédéterminée.

11. Appareil d'enregistrement selon la revendication 9, dans lequel ledit moyen (14) de réduction peut fonctionner : (i) pour réduire une fréquence d'attaque de ladite tête (18) d'enregistrement pendant l'enregistrement ; (ii) pour effectuer un enregistrement à trajets multiples pendant l'enregistrement ; (iii) pour fournir une période de repos pendant l'enregistrement ; ou (iv) pour effectuer une combinaison de (i), (ii) ou (iii), lorsque ledit second moyen de détermination détermine que la température de tête obtenue est supérieure à ladite seconde valeur prédéterminée.

12. Appareil d'enregistrement selon l'une quelconque des revendications 1 à 11, dans lequel ladite tête (18) d'enregistrement est agencée pour générer des bulles d'encre en utilisant de l'énergie thermique et pour décharger l'encre lors de la production des bulles.

13. Appareil d'enregistrement selon la revendication 12, comprenant en outre un moyen d'aspiration destiné à aspirer l'encre.

14. Appareil d'enregistrement selon l'une quelconque des revendications 1 à 13, comprenant en outre un chariot pour porter ladite tête (18) d'enregistrement.

15. Télécopieur comprenant un appareil d'enregistrement selon l'une quelconque des revendications 1 à 14.


17. Matériel de traitement de texte comprenant un appareil d'enregistrement selon l'une quelconque des revendications 1 à 14.

18. Procédé d'enregistrement pour enregistrer sur un support d'enregistrement en utilisant une tête (18) d'enregistrement pouvant être changée, comprenant les étapes, dans lesquelles :
- on acquiert (s2) de l'information de température de la tête (18) d'enregistrement ;
- on détermine (s5, s7) si une valeur de température de tête, obtenue sur la base de l'information de température de ladite tête d'enregistrement, acquise lors de ladite étape d'acquisition, est supérieure, ou non, à une valeur prédéterminée ; et
- on commande l'appareil d'enregistrement en fonction de la sortie de ladite étape de détermination ;

caractérisé en ce que ladite étape de commande comprend l'étape dans laquelle on établit (s9) un mode pour interdire une opération de changement de ladite tête (18) d'enregistrement lorsque ladite étape de détermination détermine que la température de ladite tête (18) d'enregistrement est supérieure à ladite valeur prédéterminée.

19. Procédé d'enregistrement selon la revendication 18, dans lequel l'enregistrement se fait tout en déplaçant ladite tête d'enregistrement, et dans lequel ledit mode d'interdiction déplace et maintient ladite tête d'enregistrement au-delà d'une zone dans laquelle un utilisateur peut changer ladite tête (18) d'enregistrement, en réponse à une indication (s70) du changement de la tête (18) d'enregistrement.

20. Procédé d'enregistrement selon la revendication 19, dans lequel, en réponse à ladite indication (s70), ledit mode d'interdiction déplace et maintient ladite tête (18) d'enregistrement au-delà de ladite zone, derrière un élément (103) de recouvrement.

21. Procédé d'enregistrement selon la revendication 19 ou 20, comprenant en outre l'étape dans laquelle on déplace ladite tête (18) d'enregistrement hors de ladite zone lorsque ledit mode d'interdiction a été établi et lorsque l'on a déterminé que la tête (18) d'enregistrement a été déplacée dans ladite zone.

22. Procédé d'enregistrement selon la revendication 21, dans lequel on utilise un capteur de position de repos ou un codeur, ou un moyen servant à détecter une force contre-électromotrice d'un moteur pendant une non-activation pour déterminer si la tête (18) d'enregistrement a été déplacée de force dans ladite zone.

23. Procédé d'enregistrement selon la revendication 21 ou 22, dans lequel on utilise un moteur pour déplacer ladite tête (18) d'enregistrement, et dans lequel du courant continu ou davantage de courant continu est délivré audit moteur lorsque l'on tente de déplacer ladite tête d'enregistrement dans ladite zone.

24. Procédé d'enregistrement selon la revendication 18, comprenant en outre l'étape (s72) consistant à informer un utilisateur du fait que le mode d'interdiction a été établi.

25. Procédé d'enregistrement selon la revendication 18 à 24, comprenant en outre la seconde étape de détermination du fait que la valeur de température de tête obtenue est supérieure ou non, à une seconde valeur prédéterminée, et
l'étape de réduction d'une énergie par unité de temps appliquée à la tête (18) d'enregistrement pendant une ligne d'enregistrement, lorsque ladite seconde étape de détermination détermine que la température de tête obtenue est supérieure à la seconde valeur prédéterminée.

26. Procédé d'enregistrement selon la revendication 25, dans lequel la seconde valeur prédéterminée est supérieure à la première valeur prédéterminée.

27. Procédé d'enregistrement selon la revendication 25 ou 26, dans lequel ladite étape de commande (i) réduit une fréquence d'attaque de ladite tête d'enregistrement pendant l'enregistrement ; (ii) effectue un enregistrement à trajets multiples pendant l'enregistrement ; (iii) fournit une période de repos pendant l'enregistrement ; ou (iv) effectue une combinaison de (i), (ii) ou (iii), lorsque ladite seconde étape de détermination détermine que la température de tête obtenue est supérieure à ladite seconde valeur prédéterminée.
FIG. 7

S1

interrupt (50m sec)

S2

read value of sensor 206

S3

convert into digital value Tdi (°C)

S4

read correction value Tadjust (=0°C at default)

S5

sum Tdi and Tadjust to obtain current temp thead (°C) of head

S6

execute head protect sequence

S7

return
FIG. 8A

HEAD PROTECT SEQUENCE → S6

THεad ≥ 50°C ?

YES

S8 NO

HEAD EXCHANGE INHIBIT MODE RELEASE FLAG → RESET

S9

HEAD EXCHANGE INHIBIT MODE TRANSFER FLAG → SET

S10

THεad ≥ 75°C ?

YES

S11

TEMP OVER-RISE COUNTER → +1

S12 NO

TEMP OVER-RISE COUNTER → RESET

S13

TEMP OVER-RISE COUNTER ≥ 4 ?

YES

S14

TEMP OVER-RISE PROTECT MODE TRANSFER FLAG → SET

S15

TEMP OVER-RISE PROTECT CONTROL TIMER → SET (20 SEC)

S16

TEMP OVER-RISE COUNTER → RESET

A
FIG. 8B

A

S17

Thead ≥ 100°C ?

YES

S18

ABNORMAL TEMP COUNTER → +1

S20

ABNORMAL TEMP COUNTER ≥ 4 ?

NO

S21

ABNORMAL TEMP ERROR FLAG → SET

NO

S22

ABNORMAL TEMP COUNTER ≥ 24 ?

YES

S23

DIODE SENSOR ERROR FLAG → SET

S24

RETURN
FIG. 9

SOFT POWER-ON → S30

TEMP OVER-RISE PROTECT CONTROL TIMER → CLEAR → S31

RETURN → S32

FIG. 10

INTERRUPT (1 SEC) → S40

TEMP OVER-RISE PROTECT CONTROL TIMER = 0 ? → S41

NO

YES → S43

TEMP OVER-RISE PROTECT MODE RELEASE FLAG → RESET

RETURN → S44

TEMP OVER-RISE PROTECT CONTROL TIMER → -1 → S42
**FIG. 11**

- RECORDING IN TEMP OVER-RISE PROTECT MODE
  - S60
- MOVE CARRIAGE TO HOME POSITION
  - S61
- WAIT FOR 3.5 SEC
  - S62
- RETURN
  - S63

**FIG. 12**

- CARTRIDGE EXCHANGE
  - S70
- INHIBIT MODE FLAG SET?
  - S71
- YES
- MOVE CARRIAGE TO EXCHANGE POSITION
  - S74
- NO
- DISPLAY INHIBITION OF CARTRIDGE EXCHANGE
  - S72
- MOVE CARTRIDGE TO REFUGE POSITION
  - S73
- RETURN
  - S75