

Description

This invention relates to drive circuits for driving wire dot print heads which are adapted to print characters, figures, etc. in the form of a group of dots.

In print heads of the wire dot type, a print wire strikes a platen under the action of the magnetic attractive force of an electro-magnetic coil to perform printing. After printing, the print wire and its associated lever are repulsed by the platen and returned to an initial position or, alternatively, are returned by a return spring. The print head is provided with a damper member made of a high visco-elasticity material such as rubber in order to stop rebounding when the print wire returns to the initial position.

Such a damper member can sufficiently damp the rebounding of the print wire at room temperature, so that the combination of the print wire and its associated lever together can be stopped in the initial position (see the solid curve 2 in Figure 6).

However, when high print density data is printed or the surrounding temperature becomes very low, the damper member loses its visco-elasticity. As a result, the rebounding of the print wire and associated lever cannot be damped sufficiently (see the dotted curve 4 in Figure 6). Consequently, the lever, having impinged on the damper member during return to the initial position, cannot be decelerated sufficiently, so that the print wire again strikes the platen to perform ghost printing, or the print wire becomes caught in an ink ribbon.

To overcome such defects, JP-A-61-222761 and JP-A-63-317370 have proposed the provision of re-energising the electro-magnetic coil for a short period after the completion of printing to cancel any excessive return force returning the print wire to the initial position.

However, since the repulsive force of the lever varies depending on the elasticity of the damper member and in turn the elasticity of the damper member depends on its temperature, when the temperature of the print head is outside pre-determined upper and lower limits, other print wires in the print head tend to move and may strike the platen.

The present invention seeks to provide a drive circuit for driving a wire dot print head, which circuit can return each print wire properly to an initial position irrespective of the temperature of the print head, thereby to prevent undesired movement of the print wires and permitting high speed printing.

According to the present invention, there is provided a drive circuit for driving a wire dot print head including a driving coil, a lever for causing a print wire to strike a platen under the action of the driving coil, a spring member for urging the lever to an initial position, and a damper member for absorbing kinetic energy of the lever when it returns to the initial position, characterised by comprising circuit means for causing

current to flow through the driving coil when the lever is returning to the initial position when the temperature of the print head is outside a set temperature range, so that, in operation, a braking force is applied to the lever.

According to one embodiment of the present invention the circuit means comprises a DC drive power circuit connected to one end of the driving coil, a switching means connected to the other end of the driving coil, and an output gate whose output is connected to the switching means one of whose input terminals is connected to receive a print data signal and the other of whose input terminals is connected to receive a signal from a reference timing signal generating means.

The reference timing signal generating means may be composed of a drive pulse signal generating circuit arranged to be actuated by a print timing pulse to deliver a pulse having a given period to drive the lever and a braking pulse signal generating means arranged to deliver, when the temperature of the print head is outside the set temperature range, a pulse having a pre-determined interval during the return of the lever to the initial position.

In another embodiment of the present invention, the circuit means comprises a DC drive power circuit connected to one end of the driving coil, a switching means connected to the other end of the driving coil, the switching means being arranged to be turned on/off in response to a print data signal, a diode reverse connected with respect to the DC drive power circuit, and a spark suppression circuit connected between the DC drive power circuit and, through the diode, the drive coil, the arrangement being such that, in operation, the conduction potential of the spark suppression circuit is controlled in response to the temperature of the print head.

The spark suppression circuit may include a plurality of diodes forward connected with respect to the DC drive power circuit, one or more of said diodes being short-circuited when the temperature of the print head is outside the set temperature range.

The drive circuit may include temperature sensitive means for sensing the temperature of the print head.

In the invention is illustrated, merely by way of example, in the accompanying drawings, in which:-

Figure 1 is a sectional view of one embodiment of a wire dot print head to which a drive circuit according to the present invention is applied;

Figure 2 is a block diagram of a first embodiment of a drive circuit according to the present invention used in driving the wire dot print head shown in Figure 1;

Figure 3 is a waveform diagram illustrating the operation of the drive circuit shown in Figure 2, in which section 1 corresponds to the case where the temperature of the print head is within a set

temperature range, and section II corresponds to the case where the temperature is outside the set temperature range;

Figure 4 is a block diagram of a second embodiment of a drive circuit according to the present invention;

Figure 5 is a waveform diagram illustrating the operation of the drive circuit shown in Figure 4, in which section I corresponds to the case where the temperature of the print head is within a set temperature range, section II corresponds to the case where the temperature is lower than a lower limit of the set temperature range, and section III corresponds to the case where the temperature is higher than an upper limit of the set temperature range; and

Figure 6 is a graph showing the motion of a print wire of the wire dot print head shown in Figure 1.

Figure 1 shows one embodiment of a wire dot print head 4 driven by a drive circuit according to the present invention. The print head 4 is capable of high dot density printing and includes two head units 20, 21 fixed to a nose member 22 in superposed arrangement. In each of the print head units 20, 21, respective cup-shaped casings 23, 24 made of magnetic material and serving as a core, are formed with core portions 17 equi-distantly arranged in the circumferential direction. Each core portion 17 is provided with a driving coil 5. A lever 6 is rotatably supported via a pin 25 fixed to the respective casings 23, 24. Each lever 6 has a print wire 7 fixed thereto, the print wires being guided in the nose member 22. A return spring 12 is provided for urging the print wire 7 in a direction away from a platen 16.

A damper member 13 made of rubber or other resilient material is provided on the side of the spring 12 opposite the platen so that the lever 6 lies between the damper member 13 and the spring 12. The damper member 13 is arranged to absorb any impulse arising when the lever 6, having performed a printing operation, returns to an initial position (shown in Figure 1) under the action of the return spring 12 thereby preventing a rebounding of the lever 6. A temperature sensor 8, such as a thermistor, is provided for detecting the temperature of the print head to deliver a temperature signal. The temperature sensor 8 is accommodated inside the casing 23 as illustrated.

The foregoing components are accommodated in the casing 23 by a holder 14 forming a unitary body. A terminal board 9 is provided for connection of the driving coil 5 to an external circuit. A guide board 10 guides the print wires 7.

In the print head 4, when a driving pulse is supplied to the driving coil 5, the lever 6 is attracted by the magnetic force of the driving coil 5 against the biasing force of the spring 12, so that the print wire 7 moves towards the platen 16. As a result, the print wire 7 strikes an ink ribbon 11 and printing paper 15

lying between the platen 16 and the print head 4 to create a dot on the printing paper 15. When the driving pulse is terminated after a given period, the lever 6 is moved back to the initial position by the spring 12, and any resulting impulse is absorbed by the damper member 13 so that the lever 6 stops at the initial position.

Figure 2 shows a drive circuit according to the present invention for driving the print head 4 shown in Figure 1. Each driving coil 5 is connected at one end to a DC drive power circuit 30 and at the other end to ground through a switching transistor 32, and a spark suppression circuit is connected across each driving coil. Each spark suppression circuit is a series combination of a reverse connected diode 34 and a forward connected voltage regulation diode 36, the connections being with respect to the DC power circuit 30.

The base electrode of each switching transistor 32 is connected to a corresponding output of an output circuit 42 consisting of a plurality of AND gates 40. Each AND gate 40 has one input terminal connected to receive a print data signal D and its other input terminal connected to receive a signal from a reference timing signal generating circuit 50.

The reference timing signal generating circuit 50 consists of a drive pulse signal generating circuit 51, an AND gate 52, an interval setting circuit 53, a brake pulse signal generating circuit 54, and an OR gate 55. The drive pulse signal generating circuit 51 is adapted, upon receipt of a printing timing pulse A, to deliver a drive pulse signal C of, for example, 230 micro-seconds, this period being necessary to drive the print wire 7. The AND gate 52 receives the drive pulse signal C at one input terminal and its other input terminal receives a signal B from a temperature detecting circuit 56. The AND gate 52 produces an output when a high level signal (hereinafter referred to as "an H-level signal") is supplied from the temperature detecting circuit 56. The interval setting circuit 53 has set therein an interval T_1 of, for example, 60 micro-seconds, this interval corresponding to the time necessary for the print wire 7 to return to the initial position using the print timing pulse A as a reference point. The brake pulse signal generating circuit 54 is actuated at the time a pulse signal E from the interval setting circuit 53 falls thereby to deliver a brake pulse signal F of interval T_2 .

This interval T_2 is set to, for example, 50 micro-seconds in order that the lever 6 and the print wire 7, having returned to the initial position, can be satisfactorily decelerated to such an extent that there is no rebound even when the temperature of the print head 4, or the temperature of the damper member 13, is outside a set temperature range. The output terminals of the drive pulse signal generating circuit 51 and the brake pulse signal generating circuit 54 are connected to respective input terminals of the OR gate 55

whose output is connected to the input terminal of the output circuit 42.

The temperature detecting circuit 56 is a window comparator which receives a signal from the temperature sensor 8 for detecting the temperature of the print head and delivers a low level signal (hereinafter referred to as "a L-level signal") when the detected temperature is within the set temperature range of, for example, 5°C to 70°C or an H-level signal when it is outside the set temperature range.

The operation of the drive circuit shown in Figure 2 will now be described with reference to Figure 3.

If the temperature of the print head is within the set temperature range (section I in Figure 3), when the print timing pulse A is delivered, the drive pulse signal generating circuit 51 delivers the drive pulse signal C which, after passing through the OR gate 55, acts to open the AND gate 40 of the output circuit 12.

On the other hand, the print data signal D for selection of a print wire to be driven is delivered in timed relation to the delivery of the print timing pulse. In response to the above, the respective AND gate 40 of the print wire which has to perform a printing operation delivers a pulse synchronised to the drive pulse signal C to turn ON the switching transistor 32 connected to the AND gate 40, so that current is supplied from the DC drive power circuit 30 to the driving coil 5. As a result, the driving coil 5 is energised to attract the lever 6, so that the print wire 7 is moved towards the platen 16.

On the other hand, the drive pulse signal C is applied to the AND gate 52 but, since the temperature of the print head 4 is within the set temperature range, the temperature detecting circuit 56 is delivering a L-level signal, hence, the AND gate 52 delivers no H-level signal that is output. Consequently, the interval setting circuit 53 and the brake pulse signal generating circuit 54 are in a non-operating state.

The print wire 7 strikes the platen 16 and is returned by the lever 6 under the action of the return spring 12 and when it reaches the initial position the resulting impulse is absorbed by the damper member 13 and so it comes to rest.

On the other hand, if the temperature of the print head 4 is higher than the upper limit of the set temperature range (section II in Figure 3), the temperature detecting circuit 56 delivers an H-level signal B. Thus, when the print timing pulse A is delivered, the drive pulse signal generating circuit 51 delivers the drive pulse signal C. As a result, a current I_d is caused to flow through the driving coil 5 as in the case where the temperature of the print head is within the set temperature range, so that the print wire 7 strikes the platen 16.

After passing through the AND gate 52, which is in the open state due to the H-level signal from the temperature detecting circuit 56, the drive pulse C is applied to the interval setting circuit 53, so that the

latter is actuated.

After the print wire strikes the platen 16 it returns to the initial position under the action of the return spring 12 as described above. When the interval T_1 set in the interval setting circuit 53 has elapsed, the brake pulse signal generating circuit 54 delivers the brake pulse signal F. At this moment, since the print data signal D is still held, the switching transistor 32 relating to the print wire 7 that has just performed a printing operation, is again turned ON by the brake pulse signal F from the AND gate 40. As a result, a current I_b is caused to flow from the DC drive power circuit 30 through the driving coil 5, thereby energising the latter. Consequently, the lever 6 as it returns to the initial position is attracted by the driving coil 5 in opposition to the action of the return spring 12 and contacts the damper member 13 while being damped (see the one-dot chain curve 3 in Figure 8).

Therefore, even when the visco-elasticity of the damper member 13 is lowered due to being subjected to a temperature higher than the upper limit of the set temperature range, the lever 6 does not rebound, but is pressed against the damper member 13 and comes to rest.

Although in the drive circuit of Figure 2 the brake pulse signal F is applied only when the temperature of the print head is higher than the upper limit of the set temperature range, the rebound of the lever and associated print wire can be reliably prevented also when the temperature of the print head is lower than the lower limit of the set temperature range by causing the temperature detecting circuit 56 to deliver the H-level signal B when the temperature of the print head is lower than the lower limit of the set temperature range.

Figure 4 shows a second embodiment of a drive circuit according to the present invention for driving the print head shown in Figure 1. As shown, each driving coil 5 for actuating respective levers 6 is connected at one end to a DC drive power circuit 60 and at the other end to ground through a respective switching transistor 61. The end of each driving coil 5 connected to the switching transistor 61 is also connected through a spark suppression circuit 62 to the DC drive power circuit 60. The spark suppression circuit 62 is composed of a plurality of series connected voltage regulation diodes 64, 65, 66 and forward connected with respect to the DC drive power circuit 60. One end of the series connected diodes 64, 65, 66 is connected to the DC drive power circuit 60, the other end is connected to connections between the driving coils 5 and the switching transistors 61 through respective diodes 63 reverse connected with respect to the DC drive power circuit 60. Two switching transistors 67, 68 of the spark suppression circuit 62 are connected across the diodes 64, 65, respectively. A spark potential suppression setting circuit 70 receives a signal from the temperature sensor 8 and delivers

no H-level signal from first and second output terminals 70a, 70b thereof when the sensed temperature is within a set temperature range, delivers an H-level signal from the first output terminal 70a when the temperature of the print head is lower than the lower limit of the set temperature range, and delivers H-level signals from both first and second output terminals 70a, 70b when the temperature of the print head is higher than the upper limit of the set temperature range. The first output terminal 70a and the second output terminal 70b are connected to the base electrode of the switching transistor 66 and the base electrode of the switching transistor 68 respectively. Reference numerals 72, 73 indicate inverters.

The operation of the drive circuit of Figure 4 will be described with reference to the waveform diagram of Figure 5. Waveform D shows the print data signal, waveform SP shows conduction potential of the spark suppression circuit and waveform H shows the driving coil current.

When the print data signal D is applied to the switching transistor 61 of the print wire to be actuated (section I in Figure 5), the driving coil 5 is supplied with a DC current I_a from the DC drive power circuit 60 and energised thereby, so that the lever 6 is attracted to cause the print wire to strike the platen 16.

On the other hand, when the print data signal D turns off, the driving coil 5 releases its electro-magnetic energy to generate a counter electro-motive force. In an early stage, since the potential of the counter electro-motive force is in excess of the conduction potential V_1 of the spark suppression circuit 62, a flywheel current I_{b1} is generated in the driving coil 5, which assists the motion of the lever 6 towards the platen 16.

When the print wire has struck the platen 16, the counter electro-motive forces becomes less than the conduction potential V_1 set in the spark potential suppression setting circuit 70, so that a flyback current I_{b1} terminates quickly.

The lever 6 begins to return towards the damper member under the action of the return spring 12.

In this case, since the temperature of the print head 4 is maintained within the set temperature range, ensuring a sufficient visco-elasticity for the damper member 13, even when the flywheel current I_{b1} terminates quickly, the damper member 13 absorbs the impulse of the lever 6 having returned to the initial position under the action of the return spring 12, thereby preventing the lever 6 and the print wire 7 from rebound.

On the other hand, when the temperature of the print head is very low (section II in Figure 5), the spark potential suppression setting circuit 70 delivers an H-level signal from the first output terminal 70a to make the switching transistor 67 conductive thereby short circuiting the diode 64. As a result, the conduction potential V_2 of the spark suppression circuit 62 is low-

ered by the Zener voltage of the voltage regulation diode 64.

In this state, when the print data signal D is applied to the switching transistor 61 of the print wire to be actuated, the driving coil 5 is supplied with DC current from the DC drive power circuit 60 and energised thereby, so that the lever 6 is attracted to cause the print wire 7 to strike the platen 16.

On the other hand, when the print data signal D turns off, the driving coil 5 releases its electro-magnetic energy to generate the counter electro-motive force. In an early stage, since the potential of the counter electro-motive force is in excess of the conduction potential V_2 of the spark suppression circuit 62, a flywheel current I_{b2} is generated in the driving coil 5, which assists the motion of the lever 6.

When the print wire has struck the platen as described above, the lever 6 begins to return towards the initial position under the action of the return spring 12.

However, in this case, since the conduction potential V_2 of the spark suppression circuit 62 is reduced by the Zener voltage of the voltage regulation diode 64, as compared with the case where the temperature of the print head is within the normal temperature range, the flywheel current is still flowing through the driving coil 5 even as the lever 6 returns to the initial position. Therefore, the driving coil 5 maintains its attractive force to urge the lever 6 towards the platen 6, so that the movement of the lever 6 towards the damper member 13 is braked.

Therefore, even when the visco-elasticity of the damper member 13 has been lowered due to an extreme decrease of temperature of the print head, the damper member can absorb the impulse of the lever 6 which has been decelerated by the attractive force of the driving coil 5, so that the lever 6 and the print wire 7 come to rest in the initial position without rebound.

On the other hand, when the temperature of the print head 4 increases beyond the set temperature range due to high density printing or the like (section III in Figure 5), the spark potential suppression setting circuit 70 delivers H-level signals from the first output terminal 70a and the second output terminal 70b to make the switching transistors 67, 68 conductive thereby short circuiting the diodes 64, 65. As a result, the conduction potential V_3 of the spark suppression circuit 62 lowers by the sum of the Zener voltages of the voltage regulation diodes 64, 65, as compared with the case where the temperature of the print head is within the set temperature range.

In this case, when the print data signal D is applied to the switching transistor 61 of the print wire to be actuated, the driving coil 5 is supplied with DC current from the DC drive power circuit 60 and energised thereby, so that the lever 6 is attracted to cause the print wire 7 to strike the platen 16.

On the other hand, when the print data signal D turns off, the driving coil 5 releases its electro-magnetic energy to generate a counter electro-motive force. In an early stage, since the potential of the counter electro-motive force is in excess of the conduction potential of the spark suppression circuit 62, a flywheel current I_{f3} is generated in the driving coil 5, which assists the motion of the lever 6. After the print wire has struck the platen 16 as described above, the lever 6 moves towards the initial position under the action of the return spring 12.

However, in this case, since the conduction potential V_3 of the spark suppression circuit 62 is reduced by the sum of the Zener voltages of the two voltage regulation diodes 64, 65 as compared with the case where the temperature of the print head is within the set temperature range, the flywheel current I_{f3} is still flowing through the driving coil 5 even as the lever 6 returns to the initial position. Therefore, the driving coil 5 maintains its attractive force for a relatively long period to urge the lever 6 towards the platen, so that the return action of the lever 6 is braked over a relatively long period.

Therefore, when the visco-elasticity of the damper member 13 has been lowered due to an increase in temperature, the damper member absorbs the impulse of the lever 6 which has been decelerated by the attractive force of the driving coil 5 so that the lever 6 and the print wire 7 come to rest in the initial position without rebound.

Although in the description of the drive circuit of Figure 4 the conduction potential is changed to a greater extent when the temperature of the print head is higher than the upper limit of the set temperature range than when the temperature is lower than the lower limit of the set temperature range, a similar effect can be obtained if the conduction potential is changed to the same extent in both cases if the material of the damper member permits.

Further, although in the drive circuit of Figure 4 the ratio of decrease of the visco-elasticity of the damper member when the temperature of the print head exceeds the upper limit of the set temperature range is assumed to be larger than when it is lower than the lower limit, as will be appreciated, where the ratio decrease is larger when the temperature of the print head is lower than the lower limit of the set temperature range, the conduction potential may be set to a lower level.

Claims

1. A drive circuit for driving a wire dot print head including a driving coil (5), a lever (6) for causing a print wire (7) to strike a platen (16) under the action of the driving coil, a spring member (12) for urging the lever (6) to an initial position, and a

damper member (13) for absorbing kinetic energy of the lever when it returns to the initial position, characterised by comprising circuit means (30, 32, 40, 50; 60, 61, 62, 63) for causing current to flow through the driving coil when the lever (6) is returning to the initial position when the temperature of the print head is outside a set temperature range, so that, in operation, a braking force is applied to the lever (6).

2. A drive circuit as claimed in claim 1 characterised in that the circuit means comprises a DC drive power circuit (30) connected to one end of the driving coil (5), a switching means (32) connected to the other end of the driving coil, and an output gate (40) whose output is connected to the switching means (32) one of whose input terminals is connected to receive a print data signal (D) and the other of whose input terminals is connected to receive a signal from a reference timing signal generating means (50).
3. A drive circuit as claimed in claim 2 characterised in that the reference timing signal generating means (50) is composed of a drive pulse signal generating circuit (51) arranged to be actuated by a print timing pulse (A) to deliver a pulse (C) having a given period to drive the lever (6) and a braking pulse signal generating means (54) arranged to deliver, when the temperature of the print head is outside the set temperature range, a pulse (F) having a pre-determined interval during the return of the lever to the initial position.
4. A drive circuit as claimed in claim 1 characterised in that the circuit means comprises a DC drive power circuit (60) connected to one end of the driving coil (5), a switching means (61) connected to the other end of the driving coil, the switching means being arranged to be turned on/off in response to a print data signal (D), a diode (63) reverse connected with respect to the DC drive power circuit, and a spark suppression circuit (62) connected between the DC drive power circuit (60) and, through the diode, the drive coil, the arrangement being such that, in operation, the conduction potential of the spark suppression circuit (62) is controlled in response to the temperature of the print head.
5. A drive circuit as claimed in claim 4 characterised in that the spark suppression circuit (62) includes a plurality of diodes (64, 65, 66) forward connected with respect to the DC drive power circuit (60), one or more of said diodes being short-circuited when the temperature of the print head is outside the set temperature range.

On the other hand, when the print data signal D turns off, the driving coil 5 releases its electro-magnetic energy to generate a counter electro-motive force. In an early stage, since the potential of the counter electro-motive force is in excess of the conduction potential of the spark suppression circuit 62, a flywheel current I_{fs} is generated in the driving coil 5, which assists the motion of the lever 6. After the print wire has struck the platen 16 as described above, the lever 6 moves towards the initial position under the action of the return spring 12.

However, in this case, since the conduction potential V_3 of the spark suppression circuit 62 is reduced by the sum of the Zener voltages of the two voltage regulation diodes 64, 65 as compared with the case where the temperature of the print head is within the set temperature range, the flywheel current I_{fs} is still flowing through the driving coil 5 even as the lever 6 returns to the initial position. Therefore, the driving coil 5 maintains its attractive force for a relatively long period to urge the lever 6 towards the platen, so that the return action of the lever 6 is braked over a relatively long period.

Therefore, when the visco-elasticity of the damper member 13 has been lowered due to an increase in temperature, the damper member absorbs the impulse of the lever 6 which has been decelerated by the attractive force of the driving coil 5 so that the lever 6 and the print wire 7 come to rest in the initial position without rebound.

Although in the description of the drive circuit of Figure 4 the conduction potential is changed to a greater extent when the temperature of the print head is higher than the upper limit of the set temperature range than when the temperature is lower than the lower limit of the set temperature range, a similar effect can be obtained if the conduction potential is changed to the same extent in both cases if the material of the damper member permits.

Further, although in the drive circuit of Figure 4 the ratio of decrease of the visco-elasticity of the damper member when the temperature of the print head exceeds the upper limit of the set temperature range is assumed to be larger than when it is lower than the lower limit, as will be appreciated, where the ratio decrease is larger when the temperature of the print head is lower than the lower limit of the set temperature range, the conduction potential may be set to a lower level.

Claims

1. A drive circuit for driving a wire dot print head including a driving coil (5), a lever (6) for causing a print wire (7) to strike a platen (16) under the action of the driving coil, a spring member (12) for urging the lever (6) to an initial position, and a damper member (13) for absorbing kinetic energy of the lever when it returns to the initial position, characterised by comprising circuit means (30, 32, 40, 50; 60, 61, 62, 63) for causing current to flow through the driving coil when the lever (6) is returning to the initial position when the temperature of the print head is outside a set temperature range, so that, in operation, a braking force is applied to the lever (6).
2. A drive circuit as claimed in claim 1 characterised in that the circuit means comprises a DC drive power circuit (30) connected to one end of the driving coil (5), a switching means (32) connected to the other end of the driving coil, and an output gate (40) whose output is connected to the switching means (32) one of whose input terminals is connected to receive a print data signal (D) and the other of whose input terminals is connected to receive a signal from a reference timing signal generating means (50).
3. A drive circuit as claimed in claim 2 characterised in that the reference timing signal generating means (50) is composed of a drive pulse signal generating circuit (51) arranged to be actuated by a print timing pulse (A) to deliver a pulse (C) having a given period to drive the lever (6) and a braking pulse signal generating means (54) arranged to deliver, when the temperature of the print head is outside the set temperature range, a pulse (F) having a pre-determined interval during the return of the lever to the initial position.
4. A drive circuit as claimed in claim 1 characterised in that the circuit means comprises a DC drive power circuit (60) connected to one end of the driving coil (5), a switching means (61) connected to the other end of the driving coil, the switching means being arranged to be turned on/off in response to a print data signal (D), a diode (63) reverse connected with respect to the DC drive power circuit, and a spark suppression circuit (62) connected between the DC drive power circuit (60) and, through the diode, the drive coil, the arrangement being such that, in operation, the conduction potential of the spark suppression circuit (62) is controlled in response to the temperature of the print head.
5. A drive circuit as claimed in claim 4 characterised in that the spark suppression circuit (62) includes a plurality of diodes (64, 65, 66) forward connected with respect to the DC drive power circuit (60), one or more of said diodes being short-circuited when the temperature of the print head is outside the set temperature range.



6. A drive circuit as claimed in any preceding claim characterised by including temperature sensitive means (8) for sensing the temperature of the print head.

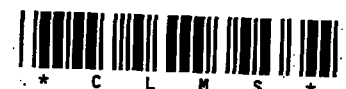
Patentansprüche

1. Antriebsschaltung zum Antreiben eines Nadel-Druck-Kopfes umfassend eine Antriebsspule (5), einen Hebel (6), zum Bewirken, daß eine Druckernadel (7) unter der Wirkung der Antriebsspule auf eine Walze (16) aufschlägt, ein Federelement (12) zum Drängen des Hebels (6) in eine Anfangsposition und ein Dämpfungselement (13) zum Absorbieren kinetischer Energie des Hebels, wenn er in die Anfangsposition zurückkehrt, dadurch gekennzeichnet, daß sie Schaltungsmittel (30, 32, 40, 50; 60, 61, 62, 63), umfaßt zum Bewirken, daß Strom durch die Antriebsspule fließt, wenn der Hebel (6) in die Anfangsposition zurückkehrt, wenn die Temperatur des Druckerkopfs außerhalb eines festgesetzten Temperaturbereichs liegt, so daß im Betrieb eine Bremskraft auf den Hebel (6) ausgeübt wird.
2. Antriebsschaltung nach Anspruch 1, dadurch gekennzeichnet, daß das Schaltungsmittel eine Gleichstromantriebsversorgungsschaltung (30) umfaßt, die mit einem Ende der Antriebsspule (5) verbunden ist, ein mit dem anderen Ende der Antriebsspule verbundenes Schaltmittel (32) und ein Ausgangsgatter (40), dessen Ausgang mit dem Schaltmittel (32) verbunden ist, wobei einer von dessen Eingangsanschlüssen verbunden ist, um ein Druckdatensignal (D) zu empfangen und der andere von dessen Eingangsanschlüssen verbunden ist, um ein Signal von Referenztaktsignalgebermitteln (50) zu empfangen.
3. Antriebsschaltung nach Anspruch 2, dadurch gekennzeichnet, daß das Referenztaktsignalgebermittel (50) aus einer Antriebsimpulssignalgeberschaltung (51) besteht, die angeordnet ist, um von einem Druckerzeitimpuls (A) betätigt zu werden, um einen eingegebenen Zeitperiode aufweisenden Impuls (C) abzugeben, um den Hebel (6) anzutreiben, und Bremsimpulssignalgebermittel (54), die angeordnet sind, während der Rückkehr des Hebels in die Anfangsposition einen ein vorbestimmtes Intervall aufweisenden Impuls (F) abzugeben, wenn die Temperatur des Druckerkopfs außerhalb des festgesetzten Temperaturbereichs liegt.

4. Antriebsschaltung nach Anspruch 1, dadurch gekennzeichnet, daß das Schaltungsmittel eine Gleichstromantriebsversorgungsschaltung (60) umfaßt, die mit einem Ende der Antriebsspule (5) verbunden ist, ein Schaltmittel (61), das mit dem anderen Ende der Antriebsspule verbunden ist, wobei das Schaltmittel angeordnet ist, um in Antwort auf ein Druckerdatensignal (D) EIN/AUS-geschaltet zu werden, eine relativ zu der Gleichstromantriebsversorgungsschaltung in Sperrrichtung geschaltete Diode (63), und eine Funkenunterdrückungsschaltung (62), die zwischen die Gleichstromantriebsversorgungsschaltung (60) und über die Diode die Antriebsspule geschaltet ist, wobei die Anordnung derart ist, daß im Betrieb das Leitungspotential der Funkenunterdrückungsschaltung (62) in Antwort auf die Temperatur des Druckerkopfs gesteuert ist.
5. Antriebsschaltung nach Anspruch 4, dadurch gekennzeichnet, daß die Funkenunterdrückungsschaltung (62) eine Mehrzahl von Dioden (64, 65, 66) umfaßt, die in Bezug auf die Gleichstromantriebsversorgungsschaltung (60) in Durchlaßrichtung geschaltet sind, wobei eine oder mehrere der Dioden kurzgeschlossen sind, wenn die Temperatur des Druckerkopfs außerhalb des festgesetzten Temperaturbereichs liegt.
6. Antriebsschaltung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß sie temperaturfühlende Mittel (8) zum Fühlen der Temperatur des Druckerkopfs umfaßt.

Revendications

1. Circuit de commande pour la commande d'une tête d'impression par points à aiguilles, comprenant une bobine de commande (5), un levier (6) pour amener une aiguille d'impression (7) à frapper un cylindre (16) sous l'action de la bobine de commande, un élément formant ressort (12) pour pousser le levier (6) vers une position initiale, et un élément amortisseur (13) pour absorber l'énergie cinétique du levier lorsqu'il retourne à la position initiale, caractérisé en ce qu'il comprend un moyen de circuit (30, 32, 40, 50, 60, 61, 62, 63) pour amener le courant à circuler dans la bobine de commande lorsque le levier (6) revient à la position initiale lorsque la température de la tête d'impression se situe hors d'une plage de températures fixée, de telle manière que, en fonctionnement, une force de freinage est appliquée au levier (6).



2. Circuit de commande selon la revendication 1, caractérisé en ce que le moyen de circuit comprend un circuit de puissance de commande en courant continu (30) relié à une extrémité de la bobine de commande (5), un moyen commutateur (32) relié à l'autre extrémité de la bobine de commande, et une porte de sortie (40) dont la sortie est reliée au moyen commutateur (32) dont l'une des bornes d'entrée est connectée pour recevoir un signal de données à imprimer (D), l'autre de ses bornes d'entrée étant connectée pour recevoir un signal venant d'un moyen générateur de signaux de cadencement de référence (50). 5 10
3. Circuit de commande selon la revendication 2, caractérisé en ce que le moyen générateur de signaux de cadencement de référence (50) se compose d'un circuit générateur de signaux impulsionsnels d'attaque (51) propre à être mis en fonction par une impulsion de cadencement d'impression (A) pour fournir une impulsion (C) ayant une période donnée pour commander le levier (6), et un moyen générateur de signaux impulsionsnels de freinage (54) propre à fournir, lorsque la température de la tête d'impression se situe hors de la plage de températures fixée, une impulsion (F) ayant un intervalle prédéterminé pendant le retour du levier vers la position initiale. 15 20 25
4. Circuit de commande selon la revendication 1, caractérisé en ce que le moyen de circuit comprend un circuit de puissance de commande en courant continu (60) relié à une extrémité de la bobine de commande (5), un moyen commutateur (61) relié à l'autre extrémité de la bobine de commande, le moyen commutateur étant propre à être débloquent/bloqué en réponse à un signal de donnée à imprimer (D), une diode (63) montée dans le sens inverse par rapport au circuit de puissance de commande en courant continu, et un circuit pare-étincelles (62) monté entre le circuit de puissance de commande en courant continu (60) et, par l'intermédiaire de la diode, la bobine de commande, la disposition étant telle que, en fonctionnement, le potentiel de conduction du circuit pare-étincelles (62) est commandé en réponse à la température de la tête d'impression. 30 35 40 45
5. Circuit de commande selon la revendication 4, caractérisé en ce que le circuit pare-étincelles (62) comprend une pluralité de diodes (64, 65, 66) montées dans le sens direct par rapport au circuit de puissance de commande en courant continu (60), l'une ou plusieurs desdites diodes étant mises en court-circuit lorsque la température de la tête d'impression se situe hors de la plage de températures fixée. 50 55
6. Circuit de commande selon l'une quelconque des revendications précédentes, caractérisé en ce qu'il comprend un moyen thermosensible (B) pour détecter la température de la tête d'impression.

