

Description

This invention relates to a method of, and an apparatus for, retracting the head and braking the drive motor of a record disk file, upon a loss of power.

During a power down or power interruption condition, the disk file must perform two primary functions. One primary function is to retract the head (or heads) of the disk file to an area of the disk pack designated as a head landing area. This is to prevent the head from landing in a data area and destroying data. Once the head is in the head landing area, it must be forcibly held up against the head stop so it doesn't drift back over into the data area due to the forces created by the still spinning disk and the mechanical bias from the actuator cable. The head must be held up against the head stop long enough to allow time for a latch to secure the head in place. Therefore, sufficient power must be provided to the head retract circuit upon a loss of power to move the head into a safe, locked position, no matter where the head was before the power loss occurred. The worst case situation that must be accounted for is when the head is near the outer edge of the disk and rapidly accelerating outwards. Much power is required just to reverse the direction of the head, let alone move it back to a safe, locked position.

A second function that must be performed upon the loss of power is to brake the spindle drive motor to a stop. This is done to reduce the wear cycles on the head when it is dragging in contact with the media, after it has been locked in place.

Previous designs have used a separate dedicated generator winding in the brushless DC spindle drive motor or a large, dedicated capacitor to provide power to retract the head. The separate dedicated generator winding has the advantage of generating retract power for several seconds, necessary to reliably overcome the worst case situation described above. Using a separate generator winding has the disadvantages of using extra space and extra output lines, as well as extra cost. As disk drives become more compact and less expensive, these disadvantages loom large.

Capacitor storage also is disadvantageous, because a large capacitor is required to perform the necessary functions reliably. Large, dedicated capacitors add significantly to the cost and space requirements of the disk drive, and as a practical matter cannot provide retract power for more than a short period of time.

For the braking of the spindle motor, previous designs have used relays to short the windings of the brushless DC motor to brake the motor regeneratively. Using relays is costly and unreliable.

One prior art approach to solving the above problems was to allow the motor to coast after loss of power, use the EMF from all the windings to retract the head, and then, after a delay long enough to ensure the heads are in place, short out all the windings of the motor using the FET driver circuit to regeneratively brake the motor. Complex, expensive circuitry was required to implement this approach. Using all the windings for both the retracting and braking operations requires delay circuitry, costly both in extra circuit components needed and in extra time needed to complete both operations.

US 4,371,903 discloses a further prior art approach in which upon occurrence of an emergency situation e.g. loss of power to the disk file, all the spindle motor windings are switched directly to the linear motor positioner coil to retract the head. The transfer of energy from motor to the linear coil causes the speed of rotation of the head to decrease. There is no regenerative braking of the spindle motor.

US-A-4 417 288 discloses a disk rotation control device for a multiphase spindle motor, where power is generated by one phase of the multiphase spindle motor to hold a mechanical brake shoe against the force of a spring in a state separated from a brake drum, while simultaneously the other phases are shorted to regeneratively brake the spindle motor. Head retracting is not performed by this device.

The invention seeks to provide a method of, and apparatus for retracting the head assembly and braking the spindle drive motor that do not have the disadvantages noted above.

The invention provides a method of retracting a head assembly of a disk file driven by a multiphase spindle motor having at least a first and a second phase for turning the spindle in normal operation, and of braking the motor upon loss of power to the disk file, the method comprising generating power with said first phase of the multiphase spindle motor to retract the head assembly; and simultaneously shorting said second phase of the multi-phase motor to regeneratively brake the motor.

In an apparatus embodying the invention, one phase of the multi-phase spindle motor, normally used to rotate the disk when power is on, is used to supply power to a capacitor storage circuit when power is lost. The capacitor storage circuit provides the power to the retract circuit, which retracts the head. The combination of the generator effect of the phase and the capacitor storage circuit provides power to the retract circuit for a time sufficient to reliably retract and lock the head regardless of the bias of the head prior to power loss.

Simultaneously with one phase being used to retract the head, the other phases are shorted together to provide regenerative braking.

In the preferred embodiment, the capacitor storage circuit is used as a line filter circuit when power is on. Therefore, the major circuit components used for retracting the head and braking the motor upon loss of power (capacitor storage circuit, motor windings, FET drivers) are all used for different purposes when power is on. This efficient use of the same circuitry for multiple purposes results in an efficient, reliable, compact, and relatively inexpensive approach to solving the problems mentioned above.

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

Figure 1 is a block circuit diagram of apparatus embodying the invention;

Figure 2 is a detailed diagram of the driver and control circuit, and the filter and storage circuit of Figure 1;

Figure 3 is a timing diagram of the operation of the circuitry of Figures 1 and 2 when power is on;

Figure 4 is a modelled circuit corresponding to the circuitry shown in Figure 2 upon a power loss condition;

Figure 5 is a detailed diagram of the power indication circuit of Figure 1; and

Figure 6 is a detailed diagram of the head retract circuit of Figure 1.

Figure 1 is an overall block diagram of apparatus embodying the invention. A spindle motor 10 is shown as a three phase delta wound six pole DC brushless motor in the preferred embodiment, although a Y-wound motor or another type of motor could easily be substituted. Windings 11, 12, and 13 of motor 10 configured in a delta format make up phases A, B, and C, as shown.

When power indication circuit 60 senses power is on, lines 61 - 66 instruct driver and control circuit 30 to alternately provide power and speed control information to phases A, B, and C of motor 10 via lines 14, 15, and 16, respectively. In this manner, rotary motion of motor 10 is created, and the disk (not shown) attached to motor 10 spins. Hall sensors 21 on motor 10 provide rotor position information to power indication circuit 60 via lines 17, 18 and 19. Power indication circuit 60 uses this information to sequence motor 10 properly for rotational motion. In addition, line 17 is used to provide speed information to speed regulation circuit 80, which processes this information and passes it on to power indication circuit 60. Filter and storage circuit 50 provides filtered power to control circuit 30 to power the phases of motor 10.

When power indication circuit 60 senses power has been lost, lines 61 - 66 instruct control circuit 30 to use phase A as a generator to provide power to storage circuit 50 for use by head retract circuit 90 to retract the head of the disk drive. Simultaneously with this instruction, lines 61 - 66 instruct control circuit 30 to short phases B and C, thereby providing regenerative braking to motor 10.

Figure 2 shows control circuit 30 and storage circuit 50 in greater detail. Lines 61, 62, and 63 are connected to the gates of P-channel FETs 32, 33, and 34, respectively. Likewise, lines 64, 65, and 66 are connected to the gates of N-channel FETs 36, 37, and 38, respectively. Diodes 42, 43, 44, 46, 47, and 48 are connected from drain to source of FETs 32, 33, 34, 36, 37, and 38, respectively. In the preferred embodiment, diodes 42, 43, 44, 46, 47, 48 are the internal body diodes of FETs 32, 33, 34, 36, 37, 38, respectively.

Storage circuit 50 is made up of diode 52, capacitors 53 and 54, and inductor 55.

Figure 3 shows a timing diagram of the operation of the circuitry shown in Figures 1 and 2 when power is on. Lines 17, 18 and 19 provide Hall rotational position information to power indication circuit 60. Indication circuit 60 uses this information to control the rotation of motor 10 via lines 61-66. Specifically, lines 61, 62, and 63 enable (switch on) FETs 32, 33, and 34 when they are low. As can be seen from Figure 3, lines 61, 62, 63 are low 1/3 of the time, and are 120 electrical degrees out of phase with each other.

When line 61 is low, FET 32 is enabled. This allows voltage +V, filtered by the LC filter of capacitors 53 and 54 and inductor 55, to pass through FET 32 and provide power to phase A of motor 10 via line 14. Similarly, when line 62 is low, FET 33 is enabled, and a filtered +V passes through FET 33 and provides power to phase B of motor 10 via line 15. When line 63 is low, FET 34 is enabled, and a filtered +V passes through FET 34 and provides power to phase C of motor 10 via line 16. This sequential providing of power to phases A, B, and C of motor 10 accounts for the rotational motion of motor 10.

Indication circuit 60 receives speed regulation information from speed regulation circuit 80 via line 81. Speed regulation circuit 80 analyzes Hall information from line 17 in conjunction with a timer to determine the period of one revolution of motor 10. The time of one revolution is compared to a set point count of the desired revolutions per minute. The error between the set point time and the actual time of one revolution is used to form a pulse width modulated signal on line 81, as shown in Figure 3.

Indication circuit 60 uses the pulse width modulated signal on line 81 to control the speed of motor 10. Specifically, lines 64, 65, and 66 enable

FETs 36, 37, and 38 when they are high. As can be seen from Figure 3, lines 64, 65, 66 are high 1/3 of the time, and are 120 electrical degrees out of phase with each other. Note also that line 64 is 90 electrical degrees out of phase with line 61, line 65 is 90 electrical degrees out of phase with line 62, and line 66 is 90 electrical degrees out of phase with line 63. Also note that lines 64, 65, and 66 are pulse width modulated based on information from line 81.

When line 64 is high, FET 36 is enabled. This allows the signal on line 64 to pass through FET 36 and provide speed control to phase A of motor 10 via line 14. Similarly, when line 65 is high, FET 37 is enabled, and the signal on line 65 passes through FET 37 and provides speed control to phase B of motor 10 via line 15. When line 66 is high, FET 38 is enabled, and the signal on line 66 passes through FET 38 and provides power to phase C of motor 10 via line 16. This periodic providing of speed control information to phases A, B, and C of motor 10 accounts for the maintenance of the proper speed of motor 10.

Therefore, as can be seen from Figure 3, indication circuit 60 provides information on lines 61-66 to control circuit 30 that controls the rotation and speed of motor 10 when power is on. The signals on lines 14, 15, and 16 that connect to phases A, B, and C respectively of motor 10 are shown in Figure 3.

When power indication circuit 60 senses a loss of power to the disk drive, the signals on lines 61-66 are considerably different from those for a normal power on condition shown in Figure 3. Specifically, lines 61, 62, and 63 are held high, thus turning off FETs 32, 33, and 34. Line 64 is held low, turning off FET 36. Lines 65 and 66 are both held high, turning on FETs 37 and 38.

Figure 4 shows the circuit of Figure 2, but with the FETs represented by switches in their proper position upon indication from indication circuit 60 of a loss of power condition. FETs 32, 33, 34, and 36, since they are off, are represented by open switches. FETs 37 and 38, since they are on, are represented by closed switches. Note that since FETs 37 and 38 are closed switches, diodes 47 and 48 present in Figure 2 are not depicted in the modelled circuit of Figure 4.

Figure 4 also shows +V as 0 volts, indicative of the power loss condition. Capacitors 53 and 54, previously charged in their role in the LC filter circuit when power was on, are forbidden from discharging to ground through reverse biased diode 52. Instead, capacitors 53 and 54 discharge through line 51, thereby providing an energization signal to retract circuit 90, and the heads begin to retract back to the head landing area.

Note that line 14 coming from phase A of motor 10 is connected to diodes 42 and 46. The positive back-EMF generated from phase A of motor 10 is forbidden by reverse biased diode 46 from discharging to ground. Instead, when the voltage of the discharging capacitors 53 and 54 drops one diode drop below the voltage on line 14, the voltage on line 14 goes through diode 42 and recharges capacitors 53 and 54. This recharging of capacitors 53 and 54 allows power to go to retract circuit 90 via line 51 for a period of time much longer than would have been possible with just capacitors 53 and 54 alone. This extended period of time ensures that retract circuit 90 has ample power to retract the head to the head landing area (even if the head was rapidly accelerating outwardly just before the power loss), hold the head at the landing area, and latch the head into place. Line 14 continues to recharge capacitors 53 and 54 as long as it is at a high enough voltage to forward bias diode 42.

Lines 15 and 16, coming from phases B and C respectively of motor 10, are both connected to shorting resistor 39 upon loss of power, as shown in Figure 4. Therefore, simultaneously with phase A generating power to recharge capacitors 53 and 54 to retract the head, phases B and C are shorted and regeneratively brake motor 10. Note also that the negative back-EMF from phase A goes through diode 46 and assists the regenerative braking process. Therefore, 5/6 of the motor is used for braking, and 1/6 is used to generate power for the retract circuit.

Figure 5 shows how power indication circuit 60 holds lines 61, 62, 63, 65, and 66 high while holding line 64 low upon indication of power loss. Power to inverter 71 is lost during power down, thereby turning off inverter 71. The output of the inverter, line 72, is then pulled up to the voltage of line 51 coming from capacitors 53 and 54 (Figure 2), thereby holding lines 61, 62, and 63 high.

Line 64 is pulled low through diode 73 when the voltage on line 74 drops to 0 volts due to a loss of power. Transistor 76, normally switched on when power is on, is turned off upon the loss of power, thereby allowing capacitor 77 to discharge through diodes 78 and 79 to lines 65 and 66, thereby holding lines 65 and 66 high.

Figure 6 shows retract circuit 90 in more detail. Line 91 drops on power loss to turn on the retract circuit. Line 92 holds the retract circuit on until the servo system is ready. When the retract circuit is on, power from line 51 energizes actuator coil 93, thus retracting the head.



Claims

1. A method of retracting a head assembly of a disk file driven by a multi-phase spindle motor (10) having at least a first and a second phase for turning the spindle in normal operation, and of braking the motor upon the loss of power to the disk file, the method comprising:
 - generating power with said first phase (A) of the multi-phase spindle motor to retract the head assembly said method being characterised by simultaneously shorting said second phase (B), (C) of the multi-phase motor to regeneratively brake the motor.
2. A method as claimed in claim 1, further comprising:
 - storing power in a storage circuit (50) to retract the head assembly; and
 - using the power generated with said first phase of the motor to recharge said storage circuit.
3. Apparatus for retracting a head assembly of a disk file driven by a multi-phase spindle motor having at least a first and a second phase for turning the spindle in normal operation (10) and for braking the motor upon the loss of power to the disk file, the apparatus comprising:
 - indication means (60) for indicating the presence or loss of power to the disk file;
 - head retract means (90) for retracting said head assembly;
 - control means (30) responsive to said indication means on loss of power to supply energy derived from said first phase (A) of the spindle motor to activate the head retract means, said apparatus being characterised by said control means (30) being simultaneously responsive to said indication means on loss of power to apply a load to said second phase (B), (C) of the spindle motor thereby to regeneratively brake the motor.
4. An apparatus as claimed in claim 3, further comprising:
 - storage means, connected to the control means and the head retract means, for storing the energy derived from said first phase of the motor.
5. An apparatus as claimed in claim 4, wherein the control means comprises:
 - a first plurality of switching devices (32,33,34) each having a first, second and third terminal, the first terminals being connected to the indication means, the second terminals being connected to the motor, and the third terminals being connected to the storage means; and
 - a second plurality of switching devices (36,37,38) each having a first, second and third terminal, the first terminals being connected to the indication means, the second terminals being connected to the motor, and the third terminals being connected to a ground signal level, the first and second plurality of switching devices and the windings of the spindle motor constituting a three phase bridge.
6. An apparatus as claimed in claim 5, wherein the first plurality of switching devices, upon an indication of the presence of power from the indication means, sequentially switch on and off to provide sequential power to each phase of the motor, thereby producing rotational motion of the motor.
7. An apparatus as claimed in claim 5, wherein one of the first plurality of switching devices is switched to a permanent ON state upon an indication of loss of power from the indication means, thereby providing an electrical path for the energy derived from said first phase of the motor to the storage means.
8. An apparatus as claimed in claim 5, wherein the second plurality of switching devices, upon an indication of the presence of power, from the indication means, sequentially switch on and off to provide speed control information to the motor.
9. An apparatus as claimed in claim 5, wherein at least two of the second plurality of switching devices are held on upon an indication of loss of power, from the indication means, thereby shorting out all phases except said first phase of the motor, thereby regeneratively braking the motor.
10. An apparatus as claimed in any of claims 4 to 9, wherein the storage means comprises a filter having a capacitor and an inductor.
11. An apparatus as claimed in claim 10, wherein the capacitor provides the energy to the retract means upon an indication of power loss and is recharged by said first phase of the motor.
12. An apparatus as claimed in claim 10 or claim 11, wherein the filter filters the sequential power upon an indication of the presence of power from the indicating means.



13. A record disk file having a head assembly, a multiphase spindle motor (10) and apparatus for retracting said head assembly and braking said motor as claimed in any of claims 3 to 12.

Patentansprüche

1. Ein Verfahren zum Abheben einer Wandlereinheit eines Plattenlaufwerks, das durch einen mehrphasigen Spindelmotor (10) mit mindestens einer ersten und zweiten Phase zum Drehen der Spindel im Normalbetrieb angetrieben wird, sowie ein Verfahren zum Bremsen des Motors bei Stromverlust beim Plattenlaufwerk, wobei das Verfahren folgendes umfaßt:

die Erzeugung von Strom mit der ersten Phase (A) des mehrphasigen Spindelmotors, um die Wandlereinheit abzuheben, wobei das Verfahren gekennzeichnet ist durch:

das gleichzeitige Kurzschließen der zweiten Phase (B, C) des mehrphasigen Motors, um den Motor regenerativ zu bremsen.
2. Ein Verfahren nach Anspruch 1, das weiterhin umfaßt:

das Speichern des Stroms in einem Speicherkreis (50), um die Wandlereinheit abzuheben; und

die Nutzung des von der ersten Phase des Motors erzeugten Stroms, um den Speicherkreis erneut aufzuladen.
3. Eine Vorrichtung zum Abheben einer Wandlereinheit eines Plattenlaufwerks, das durch einen mehrphasigen Spindelmotor (10) mit mindestens einer ersten und zweiten Phase zum Drehen der Spindel im Normalbetrieb angetrieben wird, sowie eine Vorrichtung zum Bremsen des Motors bei Stromverlust beim Plattenlaufwerk, wobei die Vorrichtung folgendes umfaßt:

ein Anzeigemittel (60), das das Vorhandensein von Strom oder Stromverlust beim Plattenlaufwerk anzeigt;

ein Wandlerabhebemittel (90), das die Wandlereinheit abhebt;

ein Steuermittel (30), das aufgrund der Informationen des Anzeigemittels bei Stromverlust den von der ersten Phase (A) des Spindelmotors kommenden Strom bereitstellt, um das Wandlerabhebemittel zu aktivieren, wobei die Vorrichtung durch das Steuermittel (30) gekennzeichnet ist, das gleichzeitig aufgrund der Informationen des Anzeigemittels bei Stromverlust eine Last auf die zweite Phase (B, C) des Spindelmotors anlegt, um damit den Motor regenerativ zu bremsen.
4. Eine Vorrichtung nach Anspruch 3, die weiterhin umfaßt:

ein mit dem Steuermittel und dem Wandlerabhebemittel verbundenes Steuermittel, das die von der ersten Phase des Motors kommende Energie speichert.
5. Eine Vorrichtung nach Anspruch 4, bei der die Steuermittel folgendes umfassen:

ein erstes Set von Schalteinrichtungen (32, 33, 34) mit einem ersten, zweiten und dritten Terminal, wobei die ersten Terminals mit dem Anzeigemittel verbunden sind, die zweiten Terminals mit dem Motor und die dritten Terminals mit dem Speichermittel; und

ein zweites Set von Schalteinrichtungen (36, 37, 38) mit einem ersten, zweiten und dritten Terminal, wobei die ersten Terminals mit dem Anzeigemittel verbunden sind, die zweiten Terminals mit dem Motor und die dritten Terminals mit dem Massesignal, wobei das erste und zweite Set der Schalteinrichtungen sowie die Wicklungen des Spindelmotors eine dreiphasige Brücke bilden.
6. Eine Vorrichtung nach Anspruch 5, bei der das erste Set der Schalteinrichtungen sequentiell ein- und ausgeschaltet wird, nachdem das Anzeigemittel das Vorhandensein von Strom angezeigt hat; dadurch wird jede Phase des Motors sequentiell mit Strom versorgt, wodurch die Drehbewegung des Motors verursacht wird.
7. Eine Vorrichtung nach Anspruch 5, bei der eine Schalteinrichtung des ersten Sets auf einen ständigen EIN-Zustand geschaltet wird, nachdem das Anzeigemittel einen Stromverlust angezeigt hat; dadurch wird ein elektrischer Pfad für die von der ersten Phase des Motors erzeugte Energie geschaffen, die zum Speichermittel geht.
8. Eine Vorrichtung nach Anspruch 5, bei der das zweite Set von Schalteinrichtungen sequentiell ein- und ausgeschaltet wird, nachdem das Anzeigemittel das Vorhandensein von Strom angezeigt hat; dadurch erhält der Motor Informationen zur Drehzahlregelung.
9. Eine Vorrichtung nach Anspruch 5, bei der mindestens zwei der Schalteinrichtungen des zweiten Sets aufrechterhalten werden, nachdem vom Anzeigemittel ein Stromverlust angezeigt wurde; dadurch werden alle Phasen mit Ausnahme der ersten Phase des Motors kurzgeschlossen, wodurch der Motor regenerativ gebremst wird.



10. Une Vorrichtung nach einem der Ansprüche 4 bis 9, bei der das Speichermittel einen Filter mit einem Kondensator und einem Induktor hat.

11. Eine Vorrichtung nach Anspruch 10, bei der der Kondensator nach der Anzeige eines Stromverlusts das Abhebemittel mit Strom versorgt, wobei der Kondensator von der ersten Phase des Motors wieder aufgeladen wird.

12. Eine Vorrichtung nach Anspruch 10 oder Anspruch 11, bei der der Filter die sequentielle Stromzufuhr filtert, nachdem das Anzeigemittel das Vorhandensein von Strom angezeigt hat.

13. Ein Aufzeichnungsplattenlaufwerk mit einer Wandlereinheit, einem mehrphasigen Spindelmotor (10) und einer Vorrichtung zum Abheben der Wandlereinheit und zum Bremsen des Motors nach einem der Ansprüche 3 bis 12.

Revendications

1. Un procédé de rétraction d'un ensemble tête d'un fichier disque commandé par un moteur de moyeu multi-phasé (10) ayant au moins une première et une seconde phase pour entraîner le moyeu en rotation normale et de freinage du moteur en cas de perte de puissance au fichier disque, le procédé comprenant:

- la génération de la puissance avec ladite première phase (A) du moteur de moyeu multi-phasé pour rétracter l'ensemble tête, ledit procédé étant caractérisé par: le court-circuit simultané de ladite seconde phase (B), (C) du moteur multi-phasé pour régénérativement freiner le moteur.

2. Un procédé selon la revendication 1, comprenant en outre:

- l'emmagasinage de puissance dans un circuit de mémoire (50) pour rétracter l'ensemble tête, et
- l'utilisation de la puissance générée avec ladite première phase du moteur pour recharger ledit circuit de mémoire.

3. Appareil pour rétracter un ensemble tête d'un fichier disque entraîné par un moteur de moyeu multi-phasé (10) ayant au moins une première et une seconde phases pour entraîner le moyeu en rotation normale et pour freiner le moteur en cas de perte de puissance au fichier disque, l'appareil comprenant:

- des moyens d'indication (60) pour indiquer la présence ou la perte de puissance

ce au fichier disque,

- des moyens de rétraction de tête (90) pour rétracter ledit ensemble tête,
- des moyens de commande (30) répondant auxdits moyens d'indication en cas de perte de puissance pour délivrer de l'énergie dérivée de ladite première phase (A) du moteur de moyeu afin d'activer les moyens de rétraction de tête, ledit appareil étant caractérisé en ce que lesdits moyens de commande (30) répondent simultanément auxdits moyens d'indication en cas de perte de puissance pour appliquer une charge à ladite seconde phase (B), (C) du moteur de moyeu afin de freiner ainsi régénérativement le moteur.

4. Un appareil selon la revendication 3, comprenant en outre:

- des moyens de mémoire connectés aux moyens de commande et aux moyens de rétraction de tête, pour emmagasiner l'énergie dérivée de ladite première phase du moteur.

5. Un appareil selon la revendication 4, dans lequel les moyens de commande comprennent:

- une première pluralité de dispositifs de commutation (32, 33, 34) comprenant chacun une première, une seconde et une troisième borne, les premières bornes étant connectées aux moyens d'indication, les secondes bornes étant connectées au moteur et les troisième bornes étant connectées aux moyens de mémoire, et
- une seconde pluralité de dispositifs de commutation (36, 37, 38) comportant chacun une première, une deuxième et une troisième bornes, les premières bornes étant connectées aux moyens d'indication, les deuxième bornes étant connectées au moteur et les troisième bornes étant connectées à la masse, la première et la seconde pluralité de dispositifs de commutation et les enroulements du moteur de moyeu formant un pont triphasé.

6. Un appareil selon la revendication 5 dans lequel la première pluralité de dispositifs de commutation, à l'indication de la présence de puissance par les moyens d'indication, sont conditionnés et déconditionnés séquentiellement pour délivrer de la puissance séquentielle à chaque phase du moteur, ce qui commande le mouvement rotatif du moteur.



7. Un appareil selon la revendication 5 dans lequel l'un de la première pluralité de dispositifs de commutation est commuté à un état de marche permanent à l'indication de perte de puissance par les moyens d'indication, ce qui forme ainsi un chemin électrique pour l'énergie dérivée de ladite première phase du moteur aux moyens de mémoire. 5
8. Un appareil selon la revendication 5 dans lequel la seconde pluralité de dispositifs de commutation, lors de l'indication de présence de puissance par les moyens d'indication, sont séquentiellement commutés sur marche et arrêt pour délivrer des informations de commande de vitesse au moteur. 10 15
9. Un appareil selon la revendication 5 dans lequel au moins deux de la seconde pluralité de dispositifs de commutation sont maintenus conditionnés lors d'une indication de perte de puissance par les moyens d'indication, ce qui court-circuite ainsi toutes les phases à l'exception de ladite première phase du moteur et régénérativement freine le moteur. 20 25
10. Un appareil selon l'une quelconque des revendications 4 à 9, dans lequel les moyens de mémoire comprennent un filtre comportant un condensateur et un inducteur. 30
11. Un appareil selon la revendication 10 dans lequel le condensateur délivre l'énergie aux moyens de rétraction lors d'une indication de perte de puissance et est rechargé par ladite première phase du moteur. 35
12. Un appareil selon la revendication 10 ou la revendication 11 dans lequel le filtre assure le filtrage de la puissance séquentielle lors d'une indication de présence de puissance par les moyens d'indication. 40
13. Un fichier disque d'enregistrement comprenant un ensemble tête, un moteur de moyeu multi-phasé (10) et un appareil pour rétracter ledit ensemble tête et freiner ledit moteur selon l'une quelconque des revendications 3 à 12. 45

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