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Description

The present invention relates to a method of, and apparatus for, generating a unique index mark from the commutation signal of a d.c. brushless motor.

In the case of a 2-phase brushless d.c. motor a commutation signal as shown in Fig. 1*a* is produced every revolution. In a rotating disc memory a unique index mark is required which occurs once per revolution. In order to obtain such a mark it is known to divide the commutation signal as shown in Fig. 1*a* by 2. However as shown in Figs. 1*b* and 1*c*, two different index signals may be produced, therefore the index mark is not unique.

This provides a problem in the situation where a disc defect exists on a track. If that track is reformatted for any reason the defective part of the track may not be assigned the same address as before if the index pulse is not unique because the address format scheme normally uses the index as a first address mark. This could lead to user difficulties. A related problem exists for certain host systems which make use of the index mark during the reading of data as a guide that addresses are correctly positioned around a track. Clearly a unique index is required here also.

Unique index marks may be provided by discrete transducers, for example, inductive, capacitive, optical transducers. However these involve additional expense and assembly and the reliability decreases with additional components. Such devices have been known to fail after a relatively short time, which is a disadvantage.

It is also known in general terms, see e.g. US—A—3 329 944, to provide timing signals on the record surface, but these signals have to be accurately located at particular positions on the surface.

The invention, as defined in the appended claims, provides a unique index mark on each revolution by synchronising the commutation signals with data signals written on a predetermined proportion of one disc track.

An embodiment of the present invention will now be described by way of example with reference to the accompanying drawings in which:—

Fig. 1*a* is a commutation signal from a 2-phase brushless d.c. motor.

Figs. 1*b* and 1*c* are two index signals derived from the signal of Fig. 1.

Fig. 2 is a schematic diagram of the apparatus according to the present invention.

Fig. 3*a*, 3*b* is a diagram showing the relationship between the signal from the disk and the detector output respectively of the apparatus shown in Fig. 2.

Referring now to the drawings, a commutation signal 1 from a 2-phase brushless d.c. motor (not shown) is connected to an input 2a of a multivibrator or flip-flop 2, (Fig. 2). There are two pulses 1*a* and 1*b* generated per revolution (Fig. 1*a*). A signal synchronised to index "high" 1*d* is recorded on one half 3*a* of a track "−2" (not shown) on the disk surface which is not used for data recording. In normal computer disk files, the first track is known as track 0, the second track as track 1 and so on to the maximum towards the disk centre. In normal operating tracks occurring before track 0 (i.e. external tracks) are not normally accessible and are denoted as track "−1" (in this case a guard track), track "−2" and so on towards the disk periphery. The other half 3*b* of the track is left erased. This is shown diagrammatically in Fig. 3. The synchronising signal recorded on the one half of the track is called a 'data burst'. The data burst is a pattern of unformatted data written on the track. The synchronising signal may also be written on track "−3". A sensing head 4 for reading the track is connected to a detection comparator 5 the output 5*a* which in turn is connected to a microprocessor 6. The output 6*a* of the microprocessor is connected to a set input 2*b* on the flip-flop 2. The output 2*c* of the flip-flop provides the index mark 7 to the general signal processing circuitry which handles the transfer of data.

In use, at power-up of the device the microprocessor 6 steps the heads to the track "−2" on which the synchronising signal was previously recorded and looks for a data burst on head 4. The detection comparator 5 finds the data burst, the output of the comparator 5 being at logic zero when the burst is detected and being at logic "1" when erasure is detected. The output of the comparator 5 causes output of the microprocessor 6*a* which is the set input 2*b* of the flip-flop 2, to force the output 2*c* of the flip-flop "high", setting the initial condition. The microprocessor 6 sets the output of this flip-flop 2 such that it is synchronised with the detected data burst. Thus in our example, the waveform 1*b* always results thereafter, the high to low transitions being caused as before by the commutation signals 1 into the flip-flop 2. This results in a unique index mark. Failure to find the data burst on track "−2" due to inadvertent erasure say, results in the microprocessor seeking automatically to track "−3", and repeating the search. If no data burst is found the microprocessor flags an error code which indicates a fault condition in the operation. Track "−1" acts as a guard track. The microprocessor also has a physical hard-wire link which, if cut causes the system to override index selection since the application may not be suited to index marking.

A suitable technique for using and detecting the synchronising signal is to write a pattern consisting of say, 10 individual data blocks each of short duration relative to the time that index 1*d* is high. Detection consists of counting the number of these blocks in each half revolution of the disk timed from the index edge and comparing the difference over several revolutions. The microprocessor can then indentify the half revolution of the disk in which the synchronising signal was recorded.

The data burst does not require to extend in

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time over half revolution. In fact, a delay is incorporated at the start and before the end of a half revolution to avoid tolerence problems where there may be uncertainty between the data burst and the index signals.

Modifications may be made to the apparatus hereinbefore described without departing from the scope of the invention. For example the microprocessor may be replaced by digital logic components, and either index signal can be selected so long as the same signal is selected every revolution. Additionally, a brushless d.c. motor having 3 or more phases can be used, since the index signal is synchronised with the data burst. In this situation the proportion of data burst on the tracks "−2", "−3" requires to be correlated with the number of phases of the d.c. motor. For example, if a 3-phase motor was used ½ of the tracks "−2", "−3" would have a data burst signal, and if 4-phases were used ½ of the tracks "−2", "−3" would have a data burst signal.

Advantages of the present invention include; there is no requirement to generate a unique index signal by a discrete transducer which is usually inductive, capacitive or optical, hence the present invention is more economic in terms of component and assembly cost; the present invention has increased reliability since fewer components are used, and the apparatus according to the present invention is adapted to be interfaced with or to use the same microprocessor of the stepper motor control circuit disclosed in European Patent Application No 82302197.7. A further advantage of the invention is that this technique is subject to the same fault detection as all data transfers of the circuit.

Claims

1. A method of generating a unqiue index mark from the commutation signal (1) of a d.c. brushless motor driving the disc(s) of a rotating disc memory, in which method magnetic timing signals are provided on at least one track on the disc, and the commutation signal (1) from the motor is sensed to provide index signals (1a, 1b); characterised by:

providing said timing signals in the form of magnetic signals stored on a proportion (3a) of said at least one track with the remaining proportion (3b) of said at least one track being erased, the proportions (3a, 3b) and the number of index signals (1a, 1b) being determined by the number of phases of the motor, and

sensing said magnetic signals and correlating them with said commutation signals to provide an index mark (7) as a unique output signal, the correlation providing the same unique index mark every revolution of the motor.

2. Apparatus, for use in conjunction with a rotating disc memory having one or more discs driven by a d.c. brushless motor, for generating a unique index mark from the commutation signal of the motor, the apparatus including commutation signal sensing means for sensing the commutation signal (1) from said motor and providing index signals (1a, 1b), characterised by:

disc signal sensing means (4) for sensing magnetic signals stored on a proportion (3a) of at least one track on the disc, the remaining proportion (3b) of that track being erased, said proportions and the number of index signals (1a, 1b) being determined by the number of phases of the motor, and

index mark generating means (2) connected to said disc signal sensing means and to said commutation signal sensing means, and arranged to produce an output signal forming a unique index mark (7) on coincidence of inputs from said sensing means.

3. Apparatus according to claim 2, in which said disc signal sensing means (4) is a magnetic read/write head.

4. Apparatus according to claim 2 or claim 3, in which said index mark generating means (2) is a multivibrator.

5. Apparatus according to any of claims 2 to 4, in which the disc signal sensing means (4) is connected to the index mark generating means (2) via a microprocessor (6) which also controls track seeking.

Revendications

1. Procédé pour engendrer un point de repère unique à partir du signal de commutation (1) d'un moteur à courant continu sans balais d'entraînement du ou des disques d'une mémoire à disque tournant, des signaux magnétiques de synchronisation étant prévus dans ce procédé sur au moins une piste du disque et le signal de commutation (1) venant du moteur étant détecté pour fournir des signaux de repérage (1a, 1b), caractérisé en ce que des signaux de synchronisation sous la forme de signaux magnétiques sont stockés sur une fraction (3a) de ladite au moins une piste, la fraction restante (3b) de ladite au moins un piste étant effacée, les fractions (3a, 3b) et le nombre de signaux de repérage (1a, 1b) étant déterminés par le nombre de phases du moteur, et en ce que ces signaux magnétiques sont détectés et utilisés en corrélation avec les signaux de commutation de manière à fournir un point de repère (7) comme signal de sortie unique, la corrélation fournissant le même point de repère unique à chaque tour du moteur.

2. Appareil, utilisable en association avec une mémoire à disque tournant, comprenant un ou plusieurs disques entraînés par un moteur à courant continu sans balais, pour engendrer un point de repère unique à partir du signal de commutation du moteur, l'appareil comprenant des moyens de détection du signal de commutation, pour détecter le signal de commutation (1) venant du moteur et fournir des signaux de repérage (1a, 1b), caractérisé en ce qu'il comprend des moyens de détection (4) du signal de disque, pour détecter des signaux magnétiques stockés sur une fraction (3a) d'au moins une piste sur le disque, la fraction restante (3b) de cette

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time over half revolution. In fact, a delay is incorporated at the start and before the end of a half revolution to avoid tolerence problems where there may be uncertainty between the data burst and the index signals.

Modifications may be made to the apparatus hereinbefore described without departing from the scope of the invention. For example the microprocessor may be replaced by digital logic components, and either index signal can be selected so long as the same signal is selected every revolution. Additionally, a brushless d.c. motor having 3 or more phases can be used, since the index signal is synchronised with the data burst. In this situation the proportion of data burst on the tracks "−2", "−3" requires to be correlated with the number of phases of the d.c. motor. For example, if a 3-phase motor was used ½ of the tracks "−2", "−3" would have a data burst signal, and if 4-phases were used ¼ of the tracks "−2", "−3" would have a data burst signal.

Advantages of the present invention include; there is no requirement to generate a unique index signal by a discrete transducer which is usually inductive, capacitive or optical, hence the present invention is more economic in terms of component and assembly cost; the present invention has increased reliability since fewer components are used, and the apparatus according to the present invention is adapted to be interfaced with or to use the same microprocessor of the stepper motor control circuit disclosed in European Patent Application No 82302197.7. A further advantage of the invention is that this technique is subject to the same fault detection as all data transfers of the circuit.

Claims

1. A method of generating a unqiue index mark from the commutation signal (1) of a d.c. brushless motor driving the disc(s) of a rotating disc memory, in which method magnetic timing signals are provided on at least one track on the disc, and the commutation signal (1) from the motor is sensed to provide index signals (1a, 1b); characterised by:

providing said timing signals in the form of magnetic signals stored on a proportion (3a) of said at least one track with the remaining proportion (3b) of said at least one track being erased, the proportions (3a, 3b) and the number of index signals (1a, 1b) being determined by the number of phases of the motor, and

sensing said magnetic signals and correlating them with said commutation signals to provide an index mark (7) as a unique output signal, the correlation providing the same unique index mark every revolution of the motor.

2. Apparatus, for use in conjunction with a rotating disc memory having one or more discs driven by a d.c. brushless motor, for generating a unique index mark from the commutation signal of the motor, the apparatus including commutation signal sensing means for sensing the commutation signal (1) from said motor and providing index signals (1a, 1b), characterised by:

disc signal sensing means (4) for sensing magnetic signals stored on a proportion (3a) of at least one track on the disc, the remaining proportion (3b) of that track being erased, said proportions and the number of index signals (1a, 1b) being determined by the number of phases of the motor, and

index mark generating means (2) connected to said disc signal sensing means and to said commutation signal sensing means, and arranged to produce an output signal forming a unique index mark (7) on coincidence of inputs from said sensing means.

3. Apparatus according to claim 2, in which said disc signal sensing means (4) is a magnetic read/write head.

4. Apparatus according to claim 2 or claim 3, in which said index mark generating means (2) is a multivibrator.

5. Apparatus according to any of claims 2 to 4, in which the disc signal sensing means (4) is connected to the index mark generating means (2) via a microprocessor (6) which also controls track seeking.

Revendications

1. Procédé pour engendrer un point de repère unique à partir du signal de commutation (1) d'un moteur à courant continu sans balais d'entraînement du ou des disques d'une mémoire à disque tournant, des signaux magnétiques de synchronisation étant prévus dans ce procédé sur au moins une piste du disque et le signal de commutation (1) venant du moteur étant détecté pour fournir des signaux de repérage (1a, 1b), caractérisé en ce que des signaux de synchronisation sous la forme de signaux magnétiques sont stockés sur une fraction (3a) de ladite au moins une piste, la fraction restante (3b) de ladite au moins un piste étant effacée, les fractions (3a, 3b) et le nombre de signaux de repérage (1a, 1b) étant déterminés par le nombre de phases du moteur, et en ce que ces signaux magnétiques sont détectés et utilisés en corrélation avec les signaux de commutation de manière à fournir un point de repère (7) comme signal de sortie unique, la corrélation fournissant le même point de repère unique à chaque tour du moteur.

2. Appareil, utilisable en association avec une mémoire à disque tournant, comprenant un ou plusieurs disques entraînés par un moteur à courant continu sans balais, pour engendrer un point de repère unique à partir du signal de commutation du moteur, l'appareil comprenant des moyens de détection du signal de commutation, pour détecter le signal de commutation (1) venant du moteur et fournir des signaux de repérage (1a, 1b), caractérisé en ce qu'il comprend des moyens de détection (4) du signal de disque, pour détecter des signaux magnétiques stockés sur une fraction (3a) d'au moins une piste sur le disque, la fraction restante (3b) de cette

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piste étant effacée, ces fractions et le nombre des signaux de repérage (1a, 1b) étant déterminés par le nombre de phases du moteur, et des moyens (2) pour engendrer un point de repère, reliés aux moyens de détection du signal de disque et aux moyens de détection du signal de commutation et prévus pour fournir un signal de sortie constituant un point de repère unique (7), lors de la coïncidence des entrées provenant desdits moyens de détection.

3. Appareil suivant la revendication 2, dans lequel les moyens (4) de détection du signal de disques comprennent une tête magnétique de lecture/écriture.

4. Appareil suivant la revendication 2 ou la revendication 3, dans lequel les moyens (2) d'obtention du point de repère comprennent un multivibrateur.

5. Appareil suivant l'une quelconque des revendications 2 à 4, dans lequel les moyens (4) de détection du signal de disque sont reliés aux moyens (2) d'obtention du point de repère par l'intermédiaire d'un microprocesseur (6) qui commande également la recherche de piste.

Patentansprüche

1. Verfahren zur Erzeugung einer eindeutigen Indexmarkierung aus dem Kommutationssignal (1) eines bürstenlosen Gleichstrommotors, der die Platte(n) eines Rotationsplattenspeichers antreibt, bei welchem Verfahren magnetische Zeitsignale auf mindestens einer Spur auf der Platte vorgesehen sind, und bei dem das Kommutationssignal (1) au dem Motor abgetastet wird, um Indexsignale (1a, 1b) zu erzeugen, gekennzeichnet durch

das Erzeugen der Zeitsignale in Form von auf einem Teilabschnitt (3a) der mindestens einen Spur gespeicherten magnetischen Signalen, wobei der ver bleibende Teilabschnitt (3b) der mindestens einen Spur gelöscht ist, und wobei die Teilabschnitte (3a, 3b) und die Anzahl der Indexsignale (1a, 1b) von der Anzahl der Motorphasen bestimmt wird, und

das Abtasten der magnetischen Signale und das Korrelieren der magnetischen Signale mit den Kommutationssignalen, um eine Indexmarkierung (7) als eindeutiges Ausgangssignal zu erzeugen, wobei die Korrelation bei jeder Umdrehung des Motors die gleiche eindeutige Indexmarkierung ergibt.

2. Vorrichtung zur Verwendung in Verbindung mit einem Rotationsplattenspeicher mit mindestens einer von einem bürstenlosen Gleichstrommotor angetriebenen Platte zur Erzeugung einer eindeutigen Indexmarkierung aus dem Kommutationssignal des Motors, mit einem Kommutationssignalaufnehmer zum Abtasten des Kommutationssignals (1) des Motors und zur Erzeugung von Indexsignalen (1a, 1b), gekennzeichnet durch

einen Plattensignalaufnehmer (4) zur Abtastung magnetischer auf einem Teilabschnitt (3a) mindestens einer Plattenspur gespeicherter Signale, wobei der verbleibende Teilabschnitt (3b) der Plattenspur gelöscht ist, und wobei die Teilabschnitte und die Anzahl der Indexsignale (1a, 1b) von der Anzahl der Motorphasen bestimmt ist, und

einen mit dem Plattensignalaufnehmer und mit dem Kommutationssignalaufnehmer verbundenen Indexmarkierungserzeuger (2), der ein Ausgangssignal erzeugen kann, das eine eindeutige Indexmarkierung (7) bei Koinzidenz der Eingangssignale aus den Aufnehmern bildet.

3. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß der Plattensignalaufnehmer (4) ein magnetischer Schreib/Lesekopf ist.

4. Vorrichtung nach Anspruch 1 oder 3, dadurch gekennzeichnet, daß der Indexmarkierungserzeuger (2) ein Multivibrator ist.

5. Vorrichtung nach einem der Ansprüche 2 bis 4, dadurch gekennzeichnet, daß der Plattensignalaufnehmer (4) mit dem Indexmarkierungserzeuger (2) über einen Mikroprozessor (6) verbunden ist, der auch die Spursuche steuert.

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