

The invention relates to a method for starting an electronically commutated direct-current motor with a plurality of cyclically activated coils by means of signals delivered per revolution by a sampler for commutation.

It is always difficult to identify and evaluate the correct running direction and phase position of the rotation in motors of this kind. It is, for example, known to use a plurality of samplers to identify the running direction and phase position. The samplers increase the cost of the arrangement (DE-A-2538835 and US-A-4297622). Also known are arrangements with just one sampler which evaluate differently coded sampling signals in order to identify the running direction and phase position of the rotation. However this solution only operates at a certain minimum motor speed in order to enable the different coding to be correctly evaluated. Yet this means that there will be a considerable delay in starting the motor if the phase position and direction of rotation do not correspond with the activation.

It is also known to make a motor of the type initially described rotate in the correct direction by firstly bringing it into a predetermined position. The indexing of the commutation is stopped during this positioning period. Commutation from this predetermined starting position of the motor does not commence until the positioning has been completed.

It is important for the motor to start in the correct direction as quickly as possible, particularly in the case of motors for driving the head drum of video recorders, before the magnetic tape threading operation takes place.

The object of the invention is to indicate a method which results in a reduction in expenditure in terms of circuitry for operating the motor from any desired starting direction of rotation. This object is solved by the features indicated in the claim.

The invention is explained in the following with regard to an embodiment and on the basis of the drawings, in which

Figure 1 is a diagrammatic view of the structure of a motor with a two-pole magnet as rotor,

Figure 2 shows diagrams for illustrating the operating mode of the arrangement according to Figure 1,

Figure 3 shows the sequence of movements in the starting phase of the motor.

Figure 1 shows that the motor comprises three uniformly distributed winding sections, each of the winding sections consisting of two like stator windings 1, 1'; 2, 2'; 3, 3', which are disposed opposite one another and are connected in series both electrically and magnetically. A south magnetic pole is associated with the magnetizable pole of the stator windings 1, 2, 3 which is disposed opposite the rotor of the motor, while a north magnetic pole is associated with the pole of the stator windings 1', 2', 3' which is disposed opposite the rotor. The stator windings 1', 2', 3' are electrically connected to the reference potential (earth) of a voltage U. The rotor consists of the two-pole magnet 4, at the circumference of which uniformly distributed marks M1, M2 and M3, which cooperate with a sampler 5, are disposed. The pulses m1 - m3 obtained from the sampler 5 (Figure 2) are delivered to an evaluation circuit 6, which cyclically switches a voltage U to the outputs A1 - A3 each time a pulse arrives. The outputs A1 - A3 are connected to the stator windings 1, 2 and 3 of the motor. The cyclic activation produces a rotating field for the magnet 4.

For the purpose of illustrating the operation of the method, it is assumed that the position of the magnet 4 is particularly unfavourable for starting and activation when the motor is switched on. The motor is put into operation at the instant t1, and it is assumed that the output A3 acts on

the stator winding 3 with the voltage U. The magnet 4 will therefore initially start counterclockwise for a period T_3 , 1. At the instant t_2 the mark M3 reaches the sampler 5 and produces a commutating pulse K1, 1 (Figure 2) through the cyclic indexing of the evaluation circuit 6. The winding section consisting of the stator windings 1, 1' is thereby energised, so that the motor is initially braked, as indicated by the broken line extending counterclockwise. As soon as the magnet 4 has turned with its north pole over the stator winding 1, it is accelerated until the instant t_3 by the winding section consisting of the stator windings 1, 1'. After the period T_1 , 1 the mark M2 reaches the sampler 5 and produces a pulse m2, which connects the winding section consisting of the stator windings 2, 2'. The magnet 4 is again braked, as the stator attracts it with its windings 2, 2', so that the magnet 4 changes direction to clockwise at the instant t_4 . At the instant t_5 the mark M2 again reaches the sampler 5 and produces a pulse m2, which connects the next following winding section consisting of the stator windings 3, 3'. This time this section lies in the direction of rotation which has now been taken up, so that the motor is driven in the nominal direction of rotation. After a period T_3 , 2 the winding section consisting of the stator windings 1, 1' is acted upon by the mark M3 at the instant t_6 . This concludes the starting phase of the motor, so that it is cyclically indexed by the known commutation by means of the pulses K1 - K3.

The sequence of movements of the starting phase of the motor will be explained by means of Figure 3. The individual phases of Figure 1 are represented in the individual movement steps a to h. The winding section which is activated at the time is indicated by N - S. It can be seen that the direction of rotation is changed from the instant t_4 and that the winding sections consisting of the stator windings 1, 1'; 2, 2'; 3, 3' are activated in the correct sequence from the beginning of the starting process.

The invention was described with regard to the example of a motor with three winding sections. The method for starting may, however, also be applied to a motor with more than three winding sections without departing from the scope of the invention.

The marks M for commutating may also be coded so that they can be distinguished from other marks used for other information.



Claim

Method for starting an electronically commutated direct-current motor with a permanent magnet rotor (4), three or more like winding sections (1, 1'; 2, 2'; 3, 3'), which can be cyclically activated and are uniformly distributed in the stator to produce a rotating field, and marks (M1; M2; M3) at the rotor circumference, which are also uniformly distributed, for producing a commutating step sequence necessary for the number of winding sections, which marks cooperate with a single non-rotatable sampler (5) for obtaining like pulse-type signals (m1; m2; m3) for the purpose of controlling the commutation of the winding sections via an evaluation circuit (6), the latter energising any desired winding section each time the motor is switched on and then, upon receiving the pulse-type signals, indexing the commutation of the winding sections in the sequence corresponding to the nominal direction of rotation predetermined by the evaluation circuit, irrespective of the starting direction of rotation of the motor.