

Description

The invention relates to a control circuit for an electric printing machine drive motor or the like which contains a first power control element, containing semi-
5 conductors, for driving the motor in a first torque direction and a second power control element, containing semiconductors, for driving the motor in the other torque direction.

Such control circuits are known, for example,
10 from German Offenlegungsschrift 30 20 139. In this document, a reversible converter circuit is shown which allows both forward operation and reverse operation. The isolating device 98 shown is a device for isolating the ignition pulse. However, an electric isolation of the
15 power control element as such from the remaining system is not possible by means of the isolating device 98. It is also known to replace pure discrete components, for example power thyristors, which are provided with screw mountings or screw connections, in the case of a repair.

20 Driving the motor in the first torque direction is understood to mean that the motor either runs in this direction and outputs mechanical power during this process or that the motor runs in the other direction but is electrically decelerated by an electrically generated
25 torque acting in the first torque direction. This analogously applies to the second torque direction. The known control circuits make it possible electrically to decelerate the drive motor, and as a result the entire printing machine, at least when the motor is running in
30 the said first direction which in this case is to be designated as forward direction or forward running for the sake of simplicity.

A motor can be electrically decelerated in various manners, for example by resistance braking or by
35 regenerative braking. To avoid inconveniences, for example due to the space requirement of braking resistors and/or due to the development of heat on these during the

decelerating process, the regenerative braking is frequently preferred in which the motor outputs electrical energy to the system during the deceleration. The regenerative braking is also preferred in the invention but the invention is not restricted thereto.

In the current state of the art, a direct-current motor which is fed from an alternating-current system (this is also understood to be a system with multi-phase alternating current), is generally used as drive motor for a high-quality printing machine, particularly an offset printing machine. The illustrative embodiment described here also uses such an arrangement.

If the power control element supplying the armature current during the forward running of the motor fails as consequence of a defect in one of the semiconductors, which cannot be completely eliminated even when high-quality semiconductors are used, the printing machine or any other machine driven by the drive motor cannot be used until the damage is repaired when the conventional control circuits are used. In general, the reverse run of the drive motor of a printing machine is only used for adjustment work which is associated, for example, with a change of printing plates. If the power control element used for the reverse run fails due to a semiconductor failure, forward operation is normally also no longer possible. Electrical deceleration is also no longer possible in this case. Naturally, such a machine will also come to a standstill without electrical deceleration due to the braking torque exerted by the driven printing machine after the energy supply to the motor has been disconnected.

The invention is based on the object of shortening the stand still times which occur in the event of failure of a semiconductor. According to the invention, this object is achieved by providing an isolating device in order to electrically disconnect, at least in the event of failure of a particular power control element, the latter from the remaining circuit

and instead to connect the remaining circuit to the other power control element.

5 In the text which follows, the said particular power control element is to be designated as the power control element intended for the forward run of the motor for the sake of simplicity. When this control element fails, in which case, in conventional control circuits, there must first be a repair before the machine can be operated again, the defective power control element is
10 electrically disconnected in accordance with the invention and, instead, the other power control element is connected which is now available for the forward run of the machine. Although it is now no longer possible to decelerate the machine electrically, it will still come
15 to a standstill without electrical deceleration when the energy supply is disconnected, as mentioned above.

In the simplest case, the isolating device can be implemented in such a manner that the control connections and the load connections (high-power connections) of the
20 two power control elements are connected by means of sufficiently long flexible cables or rigid busbars and by means of screw-type clamping connections to the remaining control circuit, the power system and the electrical lines which lead to the electric motor. In the event of
25 failure of the power control element for the forward run, all connections to and from the two power control elements are isolated and the functional power control element is electrically connected instead of the defective power control element.

30 Even if screw-type clamping connections are used, that is to say without fast manually operated electric switches or automatic breakers, the standstill of the machine can be kept relatively short and lasts, for example, only a few minutes. After the switch-over,
35 either the defective power control element can be removed and repaired on site, or it is sent to the manufacturer for repair or an exchange part is ordered. Because of the high reliability of semiconductor elements, it is highly

probable that it will be possible to maintain the emergency operation just described until repair is possible.

5 If the power control element needed for electrical deceleration, which is also needed for reverse running, fails in a control circuit for a printing machine, only this power control element is electrically disconnected.

10 Disconnection of at least the high-power lines is appropriate since a permanent short circuit must be expected in the case of a defective semiconductor.

15 So that one power control element can be used instead of the other one without problems, it is advantageous if, in accordance with an embodiment of the invention, the two power control elements are essentially constructed to be identical.

20 It is advantageous if, in accordance with an embodiment of the invention, each power control element is constructed as a unit which can be easily removed from the control circuit. The defective power control element can then be removed from the control circuit and the control circuit can continue to operate with the single power control element still functional after the switching-over described above. The power control element
25 removed from the control circuit can now be repaired on site without time pressure, or can be sent to the manufacturer for repair.

30 As already mentioned initially, the power control elements in an embodiment of the invention are controllable converters and in one embodiment of the invention, each power control element contains an alternating-current bridge circuit, particularly a bridge circuit for three-phase alternating current.

35 The switching-over to emergency operation in the event of failure of one of the power control elements can be done particularly quickly if, in accordance with an embodiment of the invention, switches are provided for switching over the power control elements. In a simple

case, these can be manually operable so that the printing machine or any other machine driven by the drive motor is ready for operation again within a few seconds after it has been found that one of the power control elements has failed. It is also possible to provide controllable breakers which are automatically operated in the event of failure of one of the power control elements so that in this case no standstill times at all are produced.

The manner in which the failure of one of the power control elements is found and/or indicated and/or the automatic breakers just mentioned are operated in such a case is not the subject-matter of the present invention.

In an embodiment of the invention, an additional possibility for deceleration is provided in the event of failure of the particular power control element. The advantage is that the motor and the printing machine coupled to it can be stopped particularly rapidly in the event of the failure of the particular power control element.

The additional possibility for deceleration can be implemented in various manners. Thus, an additional brake is provided in one embodiment and the control device can be switched over in such a manner that it generates, at least in the event of failure of the particular power control element when a state occurs which initiates the electrical deceleration of the motor, a control signal for operating the brake.

In this event, the control circuit is switched over in such a manner that, instead of the drive signals for the power control element originally provided for the electrical deceleration, drive signals are now generated for the brake additionally provided and reach the latter, if necessary, after appropriate amplification, for example by means of a contactor. If the power control element for the other torque direction, which is usually needed for the electrical deceleration, fails in this embodiment, only this power control element is

electrically disconnected and the control circuit is switched over as described above in order to utilise the brake additionally provided as an operating brake.

When the particular power control element fails,
5 the brake additionally provided, which is thus used as operating brake as long as there has not been any repair, is here used for decelerating the motor. If the control circuit is in a correct state, in contrast, the brake additionally provided is not needed for the deceleration
10 process and is therefore protected from premature wear. The brake additionally provided can then be used as a safety device in order to block the printing machine, for example during maintenance work, so that it cannot be set in motion even if the drive motor is switched on. In
15 addition, the brake additionally provided can be used as safety device in the event of voltage failure of the electrical system supplying the motor. In this case, the brake can be brought into its braking position, for example by means of a spring, whereas it is held in its
20 disengaged position when the mains voltage is present. The brake additionally provided can be, for example, an electromechanical brake or an hydraulically or pneumatically operated brake which, however, must be electrically controllable in some manner.

25 The switching-over described above, which activates the brake additionally provided instead of the electrical braking operation, can also be used analogously in other embodiments of the invention in which the additional braking possibility is implemented
30 by the fact that the excitation of the motor is reversible, or that the direction of the armature current is switchable in another embodiment of the invention.

Further features and advantages of the invention are obtained from the following description of an
35 embodiment of the invention, with reference to the drawing which shows details essential to the invention, and from the claims. The individual features can be implemented each individually by themselves or several of

them in arbitrary combination in an embodiment of the invention.

Fig. 1 shows a block diagram of a printing machine main drive with an illustrative embodiment of a control circuit,

Fig. 2 shows a diagrammatic view of the connection of two bridge circuits.

Figure 1 diagrammatically shows the control circuit needed for operating a motor 1 which is constructed as direct-current shunt motor. This control circuit is connected with three poles to a three-phase system with connecting lines 2. Current transformers 3 are inserted into two of the connecting lines 2. The connecting lines 2 lead to a first bridge circuit 6 containing six thyristors 5 and to a second bridge circuit 7 connected in antiparallel with the bridge circuit 6, which is of the same construction as the bridge circuit 6. The bridge circuit 6 is used for generating from the alternating current direct current which feeds the motor 1 during its forward run, and the bridge circuit 7 is used for feeding the motor 1 during its reverse run or, when the motor is running forward in electrical deceleration mode, to feed energy back into the alternating-current system from the motor 1. The control lines leading to the thyristors are not shown for the purpose of simplifying the drawing.

As long as the two bridge circuits 6 and 7 are capable of operation, the direction of running and the nominal speed of the motor 1, which drives an offset printing machine, are predetermined by the position of a potentiometer 10, the tap of which is supplied to an input of a subtraction circuit 11, the other input of which is supplied with the output signal of a speed transmitter, a tacogenerator in the illustrative embodiment, which is connected to the motor 1 and supplies a voltage proportional to the speed. The output signal of the subtraction circuit 11 is supplied to the input of a speed controller 13 which drives a current

controller 14 depending on whether a deviation of the speed of the motor 1 from the direction of rotation and speed determined by the voltage predetermined by the potentiometer 10 exists and whether the motor speed is less than or greater than the nominal speed. The current controller 14 drives a control circuit 15 which generates the firing pulses for the thyristors of one of the bridge circuits 6 or 7 in the correct phase so that the amounts of the actual current value from the current measuring device 20, 3 and of the nominal current value at the output of the speed controller 13 are equally large at the comparator 19. Only one of the bridge circuits 6 or 7 is in operation in each case and the current reversing logic 18, with the aid of the pulse change-over switch 16, ensures that the pulses generated by the control circuit 15 are in each case supplied to the required bridge circuit 6 or 7, respectively, depending on the direction of the output variable of the speed controller 13 (torque direction). Switching-over occurs in each case after the current flow has ended in the currently active bridge circuit.

Since the current controller 14 only determines the amount of the current, the polarity reverser 17 ensures that the polarity of the nominal current value from the output of the speed controller 13 is also switched over with the switching-over of the firing pulses. The operation of a direct-current motor with two three-phase bridges hitherto described is known.

If the bridge circuit 6 fails due to a short circuit or an interruption of one of the semiconductors, namely the thyristors 5, the bridge circuit 6 is isolated from the circuit and the bridge circuit 7 is connected in the same manner as the bridge circuit 6 is connected. The bridge circuit 7 is then used for feeding the motor 1 for the forward run. For switching-over the control circuit, a change-over switch 21 is provided which supplies a switch-over signal to the setpoint transmitter 10 which influences the latter in such a manner that a reverse run

of the motor 1 can no longer be predetermined by the setpoint transmitter 10. In addition, the switch-over signal of the change-over switch 21 reaches an input of a drive logic 22 for an electromagnetic brake 23. In addition, the output signal of the change-over switch is supplied to another input of the current reversing logic 18, and a third output of this current reversing logic is connected to the other input of the drive logic 22.

If the change-over switch 21 is operated, the current reversing logic continuously keeps the pulse change-over switch 16 in such a position that it drives the bridge circuit needed for the forward run of the motor 1. If the setpoint transmitter 10 generates an output signal which is characteristic of a speed of the motor 1 which is below its actual speed by a predetermined amount, the negative output voltage of the speed controller 13, which is supplied to the current reversing logic 18, causes an output signal to be output to the drive logic 22 which causes the brake 23 to decelerate the motor 1. At the same time, the current reversing logic 18 influences the polarity reverser 17 in such a manner that it supplies the current controller 14 with a signal which causes the latter to act in such a manner that the semiconductors of the bridge circuit supplying the motor 1 are no longer controlled to conduct so that no electrical power is absorbed from the three-phase system.

Depending on the magnitude of the output signal assuming two values, of the drive logic 22, the electromagnetic brake is either in the disengaged (detached) state or in the braking state.

In Figure 2, two heat sinks 24 are provided at a distance from one another and mounted on a carrier 26 of a switchgear cabinet. On each heat sink 24, three thyristor modules 28 are mounted which in each case form two rectifier links. The thyristor modules in each case exhibit two control connections 29, an alternating-current connection 30 which leads to the anode of one

rectifier link and to the cathode of the other rectifier link of the thyristor module, and two direct-current connections 31 and 32 to which the positive and, respectively, negative direct voltage for the motor is connected. The three thyristor modules 28 of each heat sink 24 form a three-phase bridge circuit exhibiting a total of six rectifier links. The two bridge circuits are connected to one another by means of busbars mounted by means of screw-type clamping connections in the manner described and busbars 35 lead to the alternating-current system, whereas busbars 37 lead to the electric motor 1. Each of the two bridge circuits can be completely disconnected from the busbars 35 and 37 by detaching the screw-type clamping devices. If it is assumed that the lower bridge circuit in Figure 2 is the bridge circuit 7 of Figure 1 and if this bridge circuit fails, the bridge circuit 8 can simply replace the bridge circuit 7, after complete disconnection of the busbars 35 and 37 from this bridge circuit 7, by interchanging the direct-current connections at the bridge circuit 8.

The heat sinks 24 are mounted in the rack 26 by means of screws and can be easily removed after detaching the screws.

The invention can be used for the motor or the motors for the main drive of a printing machine, but also for other motors of a printing machine, for example stack lifting motors which raise or lower the stack of paper sheets to be supplied in sheet printing machines, continuously or step by step.

Patent Claims

1. Control circuit for an electric printing machine drive motor (1) or the like, which exhibits a first power control element (6), containing semiconductors (5), for driving the motor (1) in a first torque direction and a second power control element (7), containing semiconductors (5), for driving the motor (1) in the other torque direction, the power control elements (6, 7) in each case containing controllable alternating-current bridge circuits, characterised in that an isolating device is provided in order to electrically disconnect, at least in the event of failure of a particular power control element (6, 7), the latter from the remaining circuit and instead, to connect the remaining circuit to the other power control element (7) in such a manner that this power control element replaces the failed power control element (6).

2. Control circuit for an electric printing machine drive motor (1) or the like, which exhibits a first power control element (6), containing semiconductors (5), for driving the motor (1) in a first torque direction and a second power control element (7), containing semiconductors (5), for driving the motor (1) in the other torque direction, the power control elements (6, 7) in each case containing controllable alternating-current bridge circuits, characterised in that a mechanical isolating device is provided in order to electrically disconnect, at least in the event of failure of a particular power control element (6), the latter from the remaining circuit and instead, to connect the remaining circuit to the other power control element (7) in such a manner that this power control element replaces the failed power control element (6).

3. Control circuit according to Claim 2, characterised in that mechanical switches are provided for electrically disconnecting a failed power control element (6, 7) and for switching-over the connection



between the control circuit and the power control elements (6, 7).

