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602685
Patents Act 1952

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Sydney

CONVENTION APPLICATION FOR A STANDARD PATENT

I/WE, SEW-EURODRIVE GmbH & CO, a limited liability company of
Industriestr. 42, D-7520 Bruchsal, German Federal Republic

hereby apply for the grant of a Standard Patent for an invention
entitled Brake for a motor

which is described in the accompanying complete specification.

This application is made under the provision of Part XVI of the
Patents Act 1952 and is based on an application for a patent or
similar protection made

in German Federal Republic

on 19 April 1986

No. (P36 13 294.2)

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Our address for service is:

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LODGED AT SUB-OFFICE
16 APR 1987
Sydney

Dated this 16th day of April

1987

SEW-EURODRIVE GMBH & CO.

APPLICATION ACCEPTED AND AMENDMENTS

ALLOWED 3.8.90

By:

Registered Patent Attorney

TO: The Commissioner of Patents,
COMMONWEALTH OF AUSTRALIA

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Commonwealth of Australia
The Patents Act 1952
DECLARATION IN SUPPORT

In support of the (Convention) Application made by: SEW-EURODRIVE GmbH & CO. of Industriestr, 42, D-7520 Bruchsal, German Federal Republic.

for a patent for an invention entitled: Brake for a motor

I (~~was~~) Reinhard Engel, Managing Director
of and care of the applicant company do solemnly and sincerely declare as follows:

~~a) I am (was) the applicant(s) for the patent~~

~~or~~

b) I am (~~was~~) authorised by the applicant(s) for the patent to make this declaration on its behalf.

Delete the following if not a Convention Application.

The basic application(s) as defined by section 141 (~~142~~) of the Act was (~~were~~) made

on 19 April 1986 in German Federal Republic

~~or~~

~~or~~

~~or~~

~~or~~

by the present applicant company

The basic application(s) referred to in this paragraph is (~~are~~) the first application(s) made in a Convention country in respect of the invention the subject of the application.

~~a) I am (was) the actual inventor(s) of the invention.~~

~~or~~ Walter TRÜMLER, of Kleinbachstr. 21, D-7500 Karlsruhe 41,
German Federal Republic;

b) Josef SCHMIDT, of Dettenheimer Weg 2, D-7523 Graben-Neudorf,
German Federal Republic

~~is (are)~~ the actual inventor(s) of the invention and the facts upon which
the applicant company
is (~~are~~) entitled to make the application are as follows:

The applicant is a person who would, if a patent were granted upon an application made by the actual inventor, be entitled to have the patent assigned to it.

Declared at Karlsruhe this 2nd day of April 19 87

Signed  Status Managing Director
of SEW-EURODRIVE GmbH & Co.

Declarant's Name Reinhard Engel

F. B. RICE & CO PATENT ATTORNEYS

This form is suitable for any type of Patent Application. No legalisation required.

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ELECTROMAGNETIC BRAKE FOR A.C. MOTOR

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(57) Claim

1. A brake for a motor, comprising an electromagnet arranged to actuate an armature arranged to apply a braking force to the motor, the electromagnet comprising a coil which is subdivided by an intermediate circuit tap into two partial coils, an accelerating coil and a holding coil, a rectifier circuit arranged to rectify current through the coils, and a freewheeling circuit within which said holding coil is connected.

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Complete Specification for the invention entitled:

Brake for a motor

The following statement is a full description of this invention
including the best method of performing it known to us:-

The invention relates to a brake for a motor, particularly an alternating current motor with an electromagnet and a rectifier circuit. In such electromagnetic brakes, in which an armature disk or plate is generally moved counter to the tension of springs on switching on, high magnetomotive forces or potential differences must be built up on switching on in order to move the armature disk and in particular to achieve a momentary response or operation of the brake. Following the application of the brake the air gap between the armature disk and the electromagnet becomes smaller and consequently the magnetic resistance is reduced, so that lower potential differences and therefore lower holding currents are required for maintaining the brake.

It has already been proposed (US patent 3 614 565) to initially subject the magnet for a short time following the switching on of the motor current to the action of a high voltage and therefore a correspondingly high current and then to reduce the current through the magnet coil by means of a control circuit to a low holding value. This can be more rapidly decreased following disconnection, so that the brake can than relatively rapidly be released again.

The problem of the present invention is to so further develop a brake according to the preamble, that the dynamic characteristics can be improved in a simple manner.

The present invention provides a brake for a motor, comprising an electromagnet arranged to actuate an armature arranged to apply a braking force to the motor, the electromagnet comprising a coil which is subdivided by an intermediate circuit tap into two partial coils, an accelerating coil and a holding coil, a rectifier circuit arranged to rectify current through the coils, and a freewheeling circuit within which said holding coil is connected.



The dynamic characteristics of the brake are advantageously improved in that the freewheeling circuit of the coil is only formed by a partial coil thereof.

Preferably, a switch means is connected in series
5 with the accelerating coil and in parallel with the holding coil, and a control means is arranged to operate said switch means to divert current away from said holding coil so that said accelerating coil accelerates actuation of the brake armature.

10 As a result of the inventive brake construction the dynamic characteristics of a brake are advantageously improved, which can be constructed more cost-favourably, because less copper has to be used for the winding, less iron for a coil armature and also less expensive iron can
15 be used. This more than compensates for the slightly increased costs of the switching electronics, where a switch means is placed in series with the accelerating coil, which merely switch one coil into and out of the circuit. As a result of the inventive construction, the
20 brake is advantageously subject to less wear and has a higher brake lining life, because the lining becomes worn due to the rapid application of the brake through the high starting current in the case of electromagnetic production of the lifting force. The short starting time is attained
25 by the small time constant of the accelerator coil. A high current flows for a short-time, but because of the smaller number of turns the current does not cause an over-saturation. In addition, during starting, the motor is heated less due to the rapid removal of the brake.

30 As stated above, preferably, for switching the branches or partial coils of the brake, one partial coil as the accelerating coil is in series with a switch which is in parallel to the other partial coil and which can be switched by an associated control element. This inventive
35 further development provides the possibility of applying



the voltage to only one part of the coil during the switching on of the brake and consequently the current only flows through one part of the coil with a high value adequate for applying the armature disk, whereas for
5 maintaining purposes the voltage decreases over the entire coil, so that as a result of the increased resistance there is automatically a lower holding current. The control element is preferably constructed as a time switch, to which is also connected in series one of the
10 partial coils as a dropping resistor.

For as long as the switch, which is preferably constructed as an electronic switch, such as a thyristor is connected, the rectified current flows across one coil part, namely the accelerating coil part, as well as the
15 thyristor. Blocking the thyristor leads to a current flow through both partial coils and the increased resistance reduces the current passage. On switching off the motor, accompanied by the application of the brake, a freewheeling circuit with a freewheeling diode is
20 associated in conventional manner with the coil or one of its branches in order to decrease the magnetic energy of the coil following disconnection. In order to permit rapid application, in known manner the freewheeling circuit can be made high impedance in that an electronic
25 switch is blocked, so that following disconnection the current flows across a resistor arranged in parallel to the switch and e.g. a varistor. The latter switch has hitherto been switched in known manner by the voltage at the motor. Following the disconnection of the motor, the
30 latter produces a generator voltage, which delays the blocking of said switch.

In order to obtain immediate switching and therefore an improvement to the dynamic behaviour of the brake, even on disconnecting the motor and on applying the brake,
35 according to a preferred development it is proposed that a



current transformer is located in the brake motor power supply and is connected to a control circuit for a switch arranged in the brake coil circuit. Thus, according to this preferred embodiment of the invention, for switching
5 the magnet the motor current and not the voltage is used as the control signal for opening the freewheeling circuit of the brake. Unlike the voltage, said motor current is also interrupted immediately after interrupting the supply to the motor, e.g. by switching a contactor, so that the
10 disconnection times are further reduced. According to a further development, the control circuit has a Schmitt trigger circuit and with the circuit breaker is associated in antiparallel form a diode, which provides an additional protection for the switch, particularly a field effect
15 transistor against confusion of the poles.

The present invention further provides a brake for a motor, comprising a current transformer having a first arm which is arranged to be connected to an electricity power supply associated with said motor and a second arm which
20 is connected to a control circuit for a switch means, said switch means being arranged to be connected in an electromagnet control circuit for controlling an electromagnet arranged to operate an armature to apply a braking force to said motor, and said control circuit for
25 said switch means being responsive to said current transformer to operate said switch means.

This aspect of the invention may be utilised with the inventive brake circuitry discussed above, but could be used with known electromagnetic coil brake arrangements.

30 As an alternative to the per se known direct current-side high impedance switching of the freewheeling circuit, the invention further proposes countercurrent energizing, so that a preferred embodiment of the invention is characterized in that with the freewheeling circuit is associated a counterenergizing branch with a
35



- 3b -

switch for countercurrent application purposes. Thus, the residual induction voltage of the motor following the disconnection thereof is used to



supply countercurrent to the brake. It is also pointed out that, should the motor have no residual voltage after disconnection, so that no countercurrent action can be provided, this would correspond to an a.c. voltage-side disconnection, in which the brake would in any case be rapidly applied due to its inventive construction. An a.c. voltage-side disconnection of a lifting magnet coil supplied with direct current is known per se, but the switch for carrying out switching belongs to a contactor used for
10 switching on and off the mains voltage, whereby it is prejudicial that a motor contactor must have an additional switch contact for the brake coil and therefore additional connecting lines from the contactor to the circuit arrangement for the brake coil, so that d.c. side disconnections have been proposed as a result of the residual voltage of the motor and which have the aforementioned disadvantages. According to a further development, the invention proposes an a.c. side isolation in that on
20 decreasing the switching signal across a current transformer located in the brake motor power supply, said switch is connected on the a.c. side in the power supply of the brake coil. The switch is a circuit breaker and in particular a triac.

Further advantages and features of the invention can be gathered from the claims and the following description of preferred embodiments of the inventive brake and with reference to the attached drawings, wherein show :

Fig 1, a first embodiment of the invention.

Fig 2, a diagrammatic representation of brake and motor with
30 the circuit according to fig 1.

Fig 3, a circuit for further improving the dynamics.

Fig 4, another embodiment like that of fig 1. with better removal dynamics by accelerator function

Fig 4a, a specific circuit for controlling and monitoring of the embodiment of Fig. 4.

Fig 5, another embodiment similar to that of Fig. 3

Fig.6, an alternative to the circuit according to Fig 3, particularly for the embodiment of Fig 1.

Fig 7, a preferred fitting possibility for a switch

according to figs 3 or 6.

According to fig ¹/₂, the inventive brake 1 has an electromagnet 2 with two partial coils 3, 4, as is shown diagrammatically in fig 1. An intermediate tap 6 is provided between the two partial coils 3, 4. The overall coil 2 is preferably constructed in such a way that the two partial coils are wound in radially superimposed manner and are led out at an appropriate point of the intermediate tap. Partial coil 3 has approximately $\frac{1}{2}$ to $\frac{1}{3}$ of the resistance of partial coil 4. There is also a one-way rectifier circuit 7 with two rectifier diodes V1, V2, whereof diode V1 is positioned parallel to partial coil 4 in the form of a freewheeling diode. Varistors R1 and R2, as overvoltage protection means are connected in parallel to diodes V1, V2. There is finally a third varistor R3, which will be explained with reference to fig 2 and which on disconnecting the brake is in series with the high impedance freewheeling circuit of the brake coil, as is shown by a comparison with fig 2.

The function of the embodiment of fig 1 is as follows. For one half-wave of the alternating current network, the current flows across both partial coils 3, 4 and diode V2. For the other half-wave diode V2 is blocked, whilst a freewheeling circuit is freed across diode V1 and across which the energy of the coil is reduced. This in itself leads to an improvement in the dynamics of brake 1 compared with conventional brakes with the same production of heat and in particular the release time is reduced.

Fig 2 shows a motor 21 to be braked with connections L1, L2, L3 for phases R, S, T of an a.c. voltage network. In connection lines L1, L2, L3 is provided a motor contactor K1, via which the motor 21 can be connected to the mains. From two connections, in this L2, L3, leads 22, 23 pass to the brake of fig 1. The freewheeling circuit of lifting magnet 2 also contains a switch 24 switchable by the disconnection of the mains via contactor K1. Switch 24 can be switched in per



se known manner by the voltage drop on switching off the motor across contactor K1 or by means of the control circuit 26 described relative to fig 3 by a motor current in the manner represented in fig 2. Switch 24 is shunted by varistor R3 contained in fig 1. With the disconnection of motor 21 from the mains, via contactor K1, the switch 24 shunted by varistor R3 is opened and consequently the freewheeling current flowing across the freewheeling diode V1 is reduced to a value limited by varistor R3, so that the
10 lifting magnet leads to an even faster application of brake 1.

As stated, according to the invention, switch 24 in the freewheeling circuit of the lifting magnet forms part of a control circuit 26, as shown in fig 3. Circuit 26 of fig 3 is preferably constructed as an additional device in a separate casing. The casing can be designed in the manner described with reference to fig 7.

The additional device with circuit 26 has four leads. With two leads 31, 32 it is connected into one of the connecting
20 lines of the motor and in the embodiment according to fig 2 into line L3. Circuit 26 has as an essential element a current transformer T1, so that it deals with the motor current and not the voltage applied to motor 21. The additional device is switched in the freewheeling circuit of the lifting magnet by output terminals 33, 34 associated with electronic switch 24, which is a field effect transistor (FET) in the represented embodiment. To switch 24 can be connected an antiparallel-associated diode V8, in order to provide further protection against pole confusion during
30 wiring. A field effect transistor (FET) has already incorporated such a diode (as parasitic element). Control circuit 26 has a bridge rectifier 37 with two diodes V4, V5 and two Zehner diodes Z1, Z2 (the latter for voltage limitation purposes), as well as a Schmitt trigger D1, which is formed by a correspondingly wired integrated component 4093. A filter R4, R5, C1 is provided, in order to filter out the ripple of the signal of current transformer T1 rectified by the rectifier. Schmitt trigger D1 is

supplied by means of diodes V6 and capacitor C2 ensuring that there is always an adequate supply voltage for the Schmitt trigger. V7 is a protection diode. If the motor is now switched off, in that contactor K1 is opened then leads 22, 23 of brake 1 (fig 2) become dead, so that the brake should be released. However, such a rapid release is delayed by the generator voltage formed on disconnecting the motor. In addition, a freewheeling current is formed in the brake coil on disconnection and delays and application of brake 1. On
10 disconnecting the motor across contactor K1, the power supply in leads L1 to L3 is immediately interrupted, so that via the control circuit 26 in lead L3, on dropping below the lower breakover voltage of the Schmitt trigger, switch 24 is immediately transferred into the blocked state, so that (fig. 2) the freewheeling current of brake coil 2 must flow against the varistor voltage and the magnetic energy is withdrawn from the brake system, what makes the brake be apply even faster.

As soon as the motor is switched on again, i.e. is connected to the mains and consequently current flows, switch 26 is
20 again connected through.

Fig 4 shows another embodiment of the inventive brake. This construction is based on fig 1, so that reference should be made thereto in connection with coinciding features. A thyristor Th is connected to the intermediate tap 6 and in series with partial coil 3, so that the latter can be switched as an accelerating coil. The thyristor Th is switched and in particular started by a time switch 12, which has a not shown RC network, which applies the starting signal for a desired time to thyristor Th. A monitoring unit 13 is
30 provided for retriggering time switch 12 in the case of undervoltages, the use of said unit being a function of the dimensioning of the brake and will be explained in further detail hereinafter. Unit 13 operates in preferred manner according to the principle of relative voltage measurement, so that the function thereof is independent of the supply voltage. Compared with the construction according to fig 1,

the dimensioning of the coil and the partial coils 6 is such that without switching the current flowing through the complete coil 2, it is no longer possible to apply the brake. Thus, in this construction, the same coil as in fig 1 can be used in the case of a "heavier" brake for a more powerful motor.

The function of the circuit shown in fig 4 is as follows. On applying mains voltage and therefore switching on motor 21, thyristor Th is switched through as an electronic switch, so

10 that as a result of the small internal resistance compared with the complete coil 2 a high current flows through accelerating coil 3 and this brings about a high magnetic flux and consequently a rapid application action and a short response time. Following the response or operation of the brake magnet, the high magnetic flux is no longer necessary, because the air gap between armature and magnet coil and therefore the magnetic resistance is reduced. Thus, lower holding forces and consequently lower magnetic potential differences and lower holding current are required. Thus,

20 after response or operation, the thyristor Th is blocked by time switch 12, so that mains current flows across the entire coil, i.e. both partial coils 3, 4 and is rectified by the oppositely directed diodes ~~8, 9~~^{V₁, V₂} forming the rectifier. Due to the higher resistance of coil 3, 4, there is a lower holding current, which permits a lower energy consumption and a faster disconnection.

The above-described brake can be switched in the same way as a conventional brake (fig 5) like that of fig 1, in the manner shown in fig 2 for additional fast disconnection by

30 means of a freewheeling circuit connected in high impedance manner by varistor 3.

For the rapid energizing or disconnection of the brake coil, a counter energizing can be provided, as indicated in broken line form in fig 4. For this purpose, a further thyristor Th' is connected in antiparallel to thyristor Th and with the



additional transistor is associated not shown switching electronics corresponding to electronics 12. Thyristor Th' switches the negative mains half-wave to accelerating coil 3. The voltage comes from the motor, so that a time control is not needed. Countercurrent application leads to rapid demagnetization of the system and therefore to rapid brake application. Thyristor Th' can be started in an appropriate manner, e.g. by a current sensor T1 according to fig 3. The circuit replaces the control line and the switching contact a

10 "direct current-side isolation", e.g. according to fig 2.

As stated hereinbefore, as a functioning of the dimensioning of the brake in the case of a voltage "break", it may be the case that the holding force of the complete brake coil (both partial coils) is no longer adequate for holding the brake, so that the latter is applied. When the voltage is restored, it must be ensured that the brake is applied again and, as a function of the brake dimensioning, may not be achievable by the brake, in the case of a current flow through the complete coil (blocked thyristor Th). In this case, the thyristor Th

20 must be momentarily switched through, so that there is an increased current flow through partial coil 3 which, as on switching on, leads to the re-application of the brake. A specific circuit for this is shown in fig 4a. Monitoring circuit 13 is supplied from the mains across a dropping resistor 101 of e.g. approximately 180 K and brake coil 2. The relative voltage is taken on the one hand at a capacitor 102 with 0.33 μ F and on the other hand at time switch 12 with e.g. 220 K $\wedge$ 0.1 μ F. In the case of a rise in the voltage (of a half-wave), due to the voltage difference which occurs a

30 double transistor arrangement 103 (which can be looked upon as a thyristor) and then a FET 104 is switched in such a way that thyristor Th is initially connected through, so that only accelerating coil 3 is applied between the mains terminals. If the voltage applied is then compensated across time switch 12, then the starting pulse is removed from thyristor Th, so that the latter is blocked. If voltage ^{drops} ~~occurs~~, discharging takes place, so that on rising again



there is again a voltage difference. The further elements are used for matching in the particular case.

If FET 104 is connected through, there is no signal at thyristor Th2 accordingly the Thyristor Th can trigger on at positive half wave.

If FET 104 is blocked the trigger signal is present at the thyristor Th2. Which signal makes the thyristor Th2 conductive with the positive half wave and accordingly withdraws the trigger voltage from the Thyristor Th. In the case of a voltage difference at the time switch 12 and the capacitor 102 is not connected through the double transistor 10(thyristor) definite, where by the transistor 104 becomes conductive (self conductive FET) and the Thyristor Th can trigger on. Thus the voltage at capacities C1 and C2 equalize, the double transistor 103 blocks and so does the Transistor 104 which stops the accelerator function. After reducing the voltage difference to below a given limit, the thyristor must be switched, so that the FET blocks.

Corresponding to fig 2, fig 5 shows the circuit of a conventional brake through the current of motor 21 by means of a circuit 26 according to fig 3 for the direct current-side isolation for the high impedance switching of 20 the freewheeling circuit. Once again are shown motor 21 with connections L1, L2, L3 for phases R, S, T of an a.c. voltage mains and motor contactor K1 located in connections L1, L2, L3 by means of which motor 21 can be connected to the mains. From connection L2 and L3, once again leads 22, 23 lead to a circuit arrangement 41 which, as stated, in the embodiment according to fig 5 is a conventional circuit. Circuit 24 shown in fig 5 has a rectifier with two zero diodes in one-way connection. For controlling the high disconnection speeds of large inductors additional wiring with varistor R3 30 is provided. If with the disconnection of motor 21 from the mains switch 24 shunted by varistor R3 in the freewheeling circuit having a freewheeling diode the coil of brake 42 is opened, then the freewheeling current flowing across the freewheeling diode is reduced to a value limited by varistor R3, so that the lifting magnet permits a corresponding rapid application of brake 1. Thus, the circuit of fig 5 is known to the extent that it control circuit 41.

However, switch 24 in the freewheeling circuit and lifting magnet forms part of the control circuit of fig 3 40 connected with its leads 31, 32 in connecting line L3 of

motor 21, so that in this case switch 24 is inventively switched by the motor current.

The circuit according to fig 3 is preferably constructed as an additional device in a separate casing. The latter can be constructed by standard components, such as a conventional screwing part and a blind plug, so that the additional device can be fitted by screwing in the thread of a cable bushing on the motor terminal box, so that there is no need use a larger terminal box.

- 10 The inventive intermediate tap 6 on brake coil 2 and the arrangement of the freewheeling circuit across partial coil 4 with freewheeling diode V1 makes it possible, in place of the hitherto preferred d.c. side isolation, an identical result by a.c. side isolation, whilst involving lower costs. For this purpose a circuit 51 according to fig 6 is provided, whose connections 52, 53, as in the circuit according to fig 3, are connected in a lead L3 to motor 21. By means of outputs 54, 56, the circuit is connected on the a.c. side into one of the supply lines 22, 23 of brake coil 2 (fig 2).
- 20 Circuit 51 once again has a current transformer T11, followed by a rectifier with diodes V11, V12 and voltage limiting zenex diodes V13, V14. A capacitor 10, 11 is provided for bringing the brief voltage drop of the alternating signal. The voltage smoothed by current transformer T11 and capacitor C11 is supplied to the control input of a triac V15, with which a varistor R11 is connected in parallel. On switching off the motor power supply, across current sensor T11 the supply for brake coil 2 is immediately interrupted by blocking triac V15 or the varistor R11 is reduced to a value
- 30 not adequate for holding the brake. As a result of this inventive construction, the own lines hitherto disadvantageously necessary in the case of alternating current-side isolation are rendered superfluous.

Fig 7 shows a construction for receiving additional circuits, particularly with current sensors, like those of figs 3 and

6, without larger terminal boxes having to be provided.

Apart from its cover 62, a conventional terminal box 61 has a number of cable bushings 63 having an internal thread and closed by externally threaded blind plugs 64 when not in use. Into such an opening 63 is screwed an additional casing 66 with a threaded attachment 67, which is frontally closed with a cover 68. In the represented embodiment the additional casing is a reducer or extender which is at the front of sealingly screwed an adapted blind plug, whilst interposing seals, such as an O-ring (not shown). There is a clamping plate 71 ,
10 brake rectifier 72, a clamping block 73, whilst the actual cabling is not shown in detail.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. A brake for a motor, comprising an electromagnet arranged to actuate an armature arranged to apply a braking force to the motor, the electromagnet comprising a coil which is subdivided by an intermediate circuit tap into two partial coils, an accelerating coil and a holding coil, a rectifier circuit arranged to rectify current through the coils, and a freewheeling circuit within which said holding coil is connected.
2. A brake in accordance with claim 1, wherein a switch means is connected in series with said accelerating coil and in parallel with the holding coil, and a control means is arranged to operate said switch means to divert current away from said holding coil, whereby said accelerating coil is arranged to accelerate actuation of said armature.
3. A brake in accordance with any of claims 1 or 2, wherein the rectifier circuit is protected from over-voltages by an overvoltage protection means.
4. A brake in accordance with claim 3, wherein the rectifier circuit comprises a plurality of diodes and said overvoltage protection means comprises an overvoltage protection element connected in parallel to each diode.
5. A brake in accordance with any of claims 2 to 4, wherein said control means for said switch means is connected in series with at least one of said partial coils, whereby said at least one partial coil is arranged to act as a dropping resistor for said control means.
6. A brake in accordance with any one of claims 2 to 5, wherein said control means comprises a time switch.
7. A brake in accordance with any preceding claim, wherein said motor is associated with an electricity power supply, and wherein said electromagnetic circuit further comprises a current transformer, having a first arm which is arranged to be connected to said power supply and a second arm which is connected to a control circuit for a



further switch means, said further switch means being connected to said partial coils, said control circuit being responsive to said current transformer to operate said further switch means.

8. A brake in accordance with claim 7, wherein said control circuit includes a Schmitt trigger connected to operate said further switch means in response to said current transformer.

9. A brake in accordance with any of claims 7 or 8, wherein a diode is connected in anti-parallel manner with said further switch means.

10. A brake in accordance with any of claims 7 to 9, wherein a voltage limiting means is connected in parallel with said further switch means.

11. A brake in accordance with any of claims 7 to 10, wherein said further switch means is operably arranged to connect said partial coils to or disconnect from a power supply.

12. A brake in accordance with any one of claims 1 to 6, wherein a counter energising circuit is connected to said partial coils, comprising a counter current switch arranged for counter current energising.

13. A brake for a motor, comprising a current transformer having a first arm which is arranged to be connected to an electricity power supply associated with said motor and a second arm which is connected to a control circuit for a switch means, said switch means being arranged to be connected in an electromagnet control circuit for controlling an electromagnet arranged to operate an armature to apply a braking force to said motor, and said control circuit for switch means being responsive to said current transformer to operate said switch means.

14. A brake in accordance with claim 13, wherein said control circuit includes a Schmitt trigger connected to operate said switch means in response to said current



transformer.

15. A brake in accordance with any of claims 13 or 14, wherein a diode is connected in anti-parallel manner with said switch means.

16. A brake in accordance with any of claims 13, 14 or 15, wherein a voltage limiting means is connected in parallel with said switch means.

17. A brake in accordance with any one of claims 13 to 16, wherein said switch means is operably arranged to connect said electromagnetic control circuit to a power supply.

18. A brake for a motor, substantially as described herein with reference to Figure 1 of the drawings, or Figures 1 and 2, or Figures 1, 2 and 3, or Figure 4, or Figure 4A, or Figure 5, or Figures 1, 2 and 6.

DATED this 25th day of July 1990

SEW-EURODRIVE GmbH & CO.
Patent Attorneys for the
Applicant:

F.B. RICE & CO.



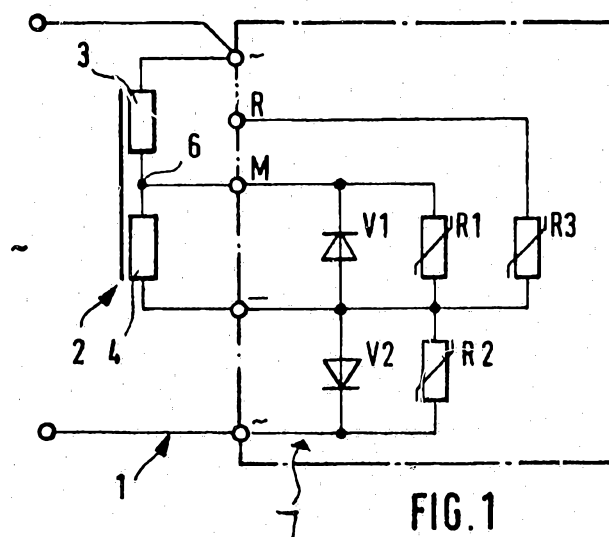


FIG. 1

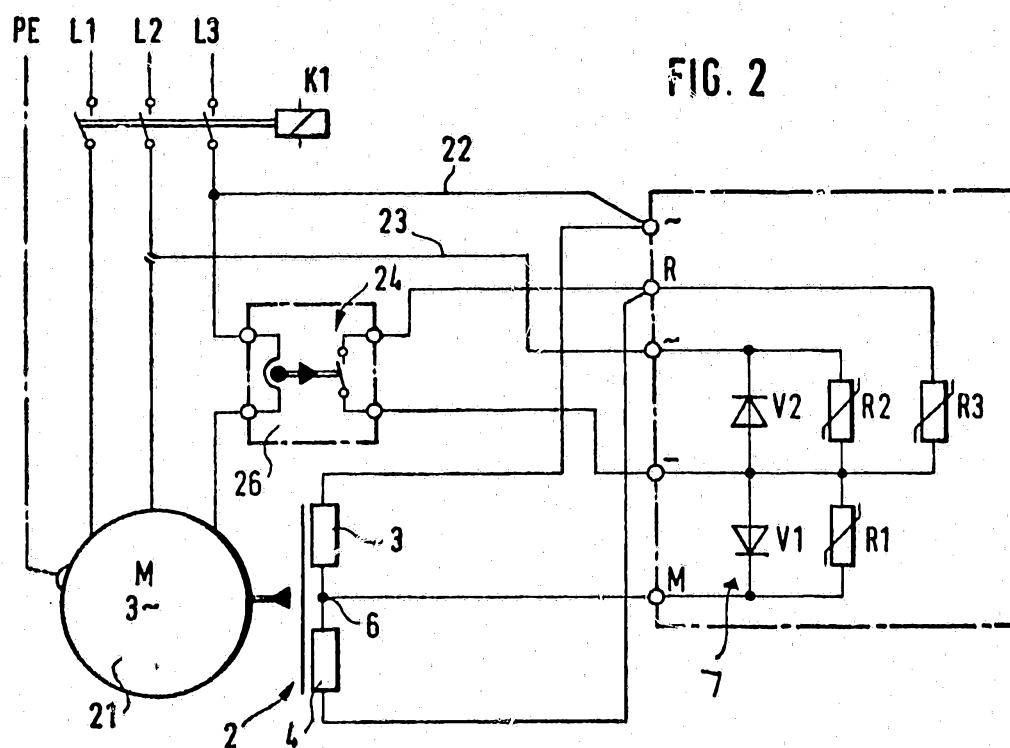


FIG. 2

71-768187



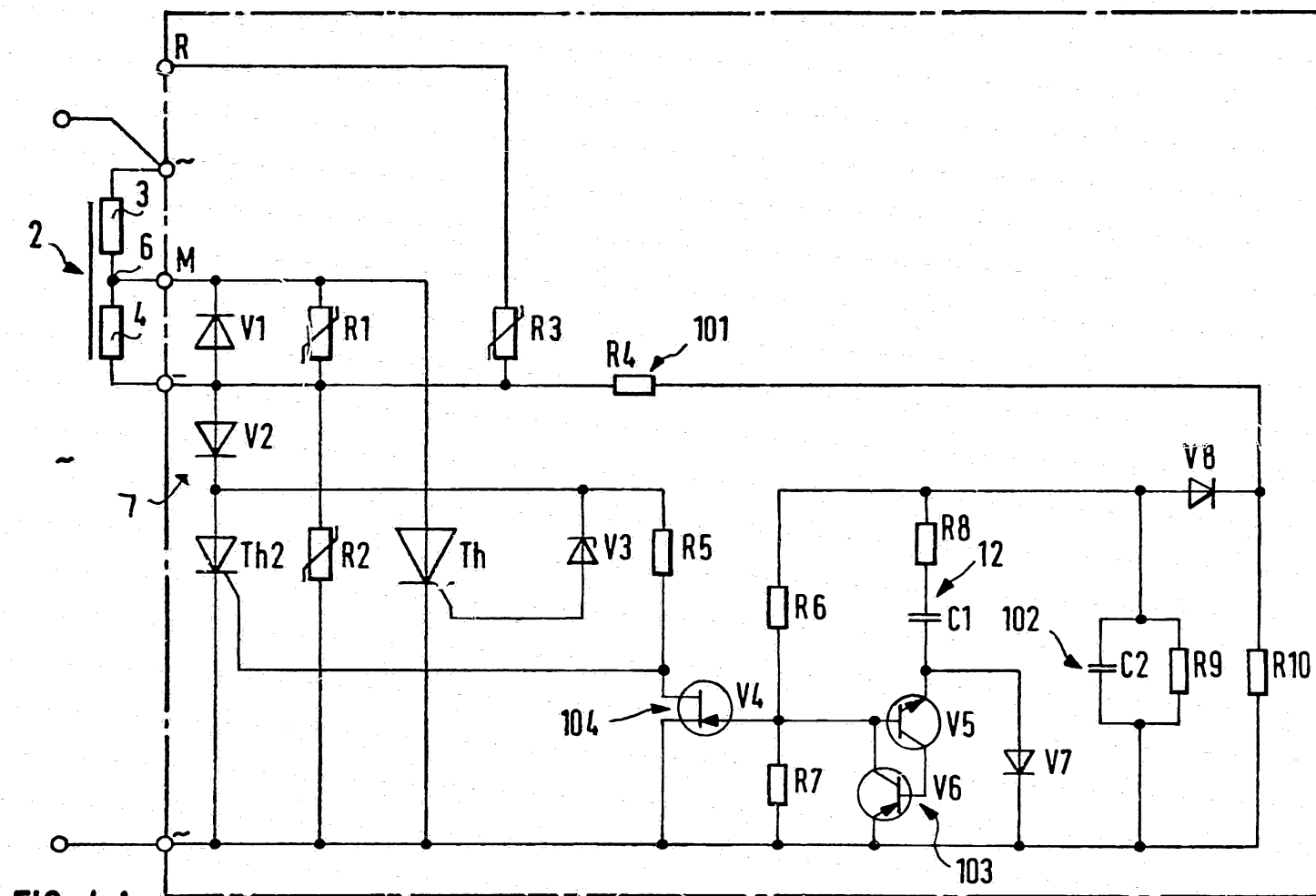
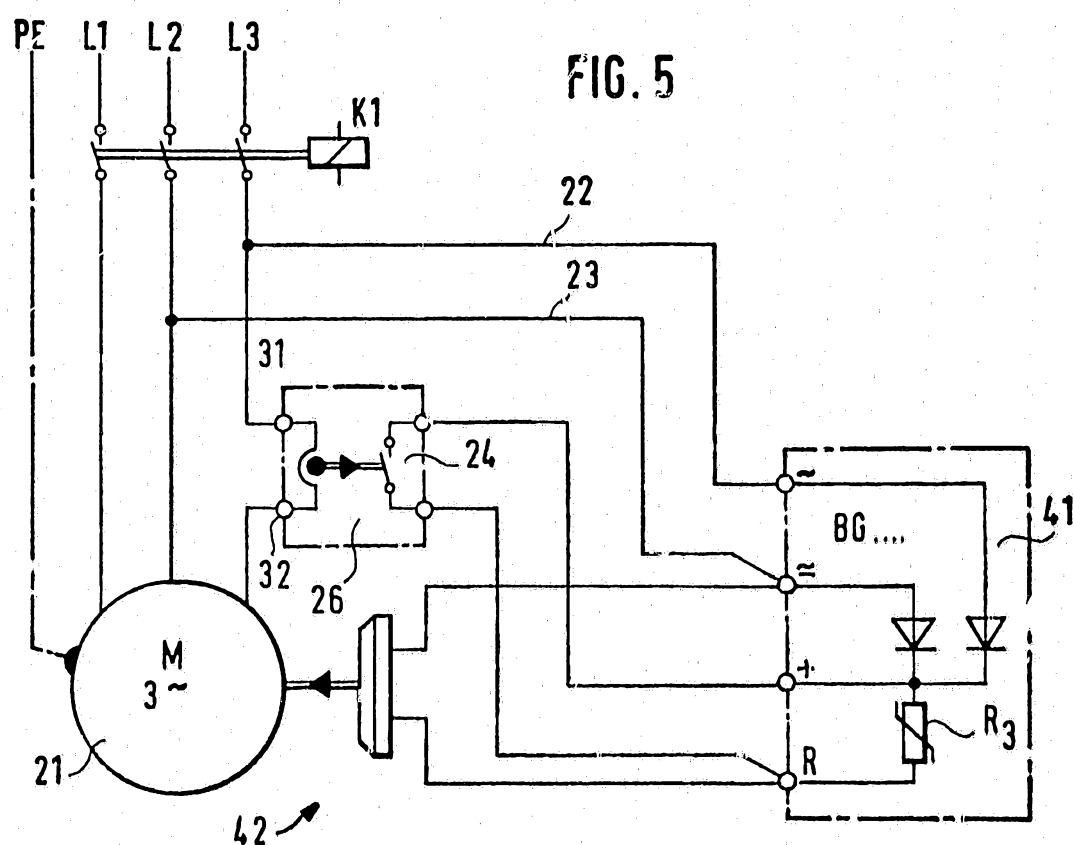


FIG. 4 A



5 5 7

7179

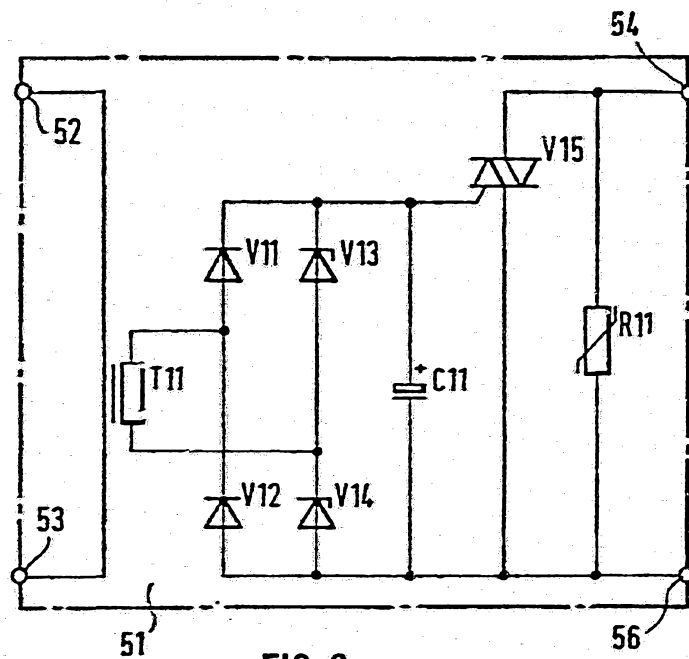


FIG. 6

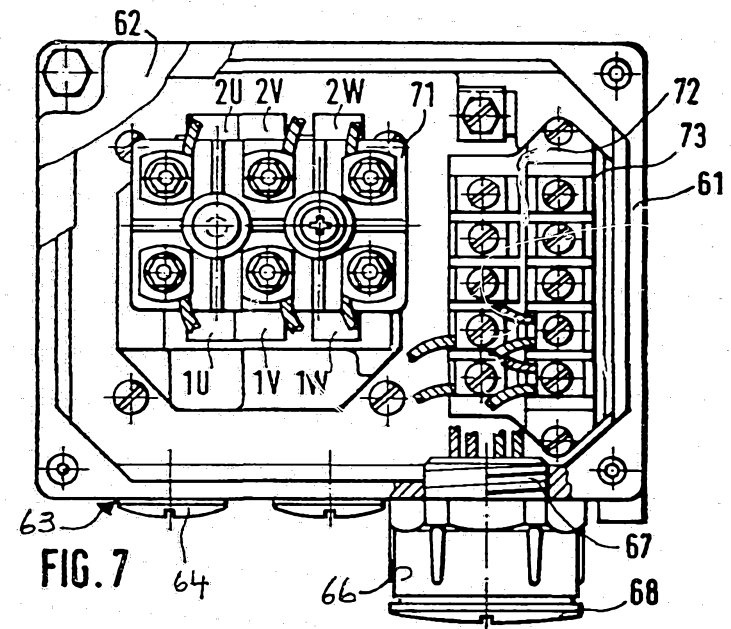
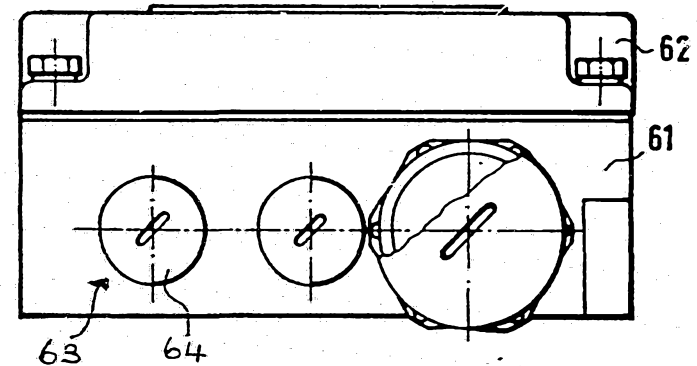


FIG. 7