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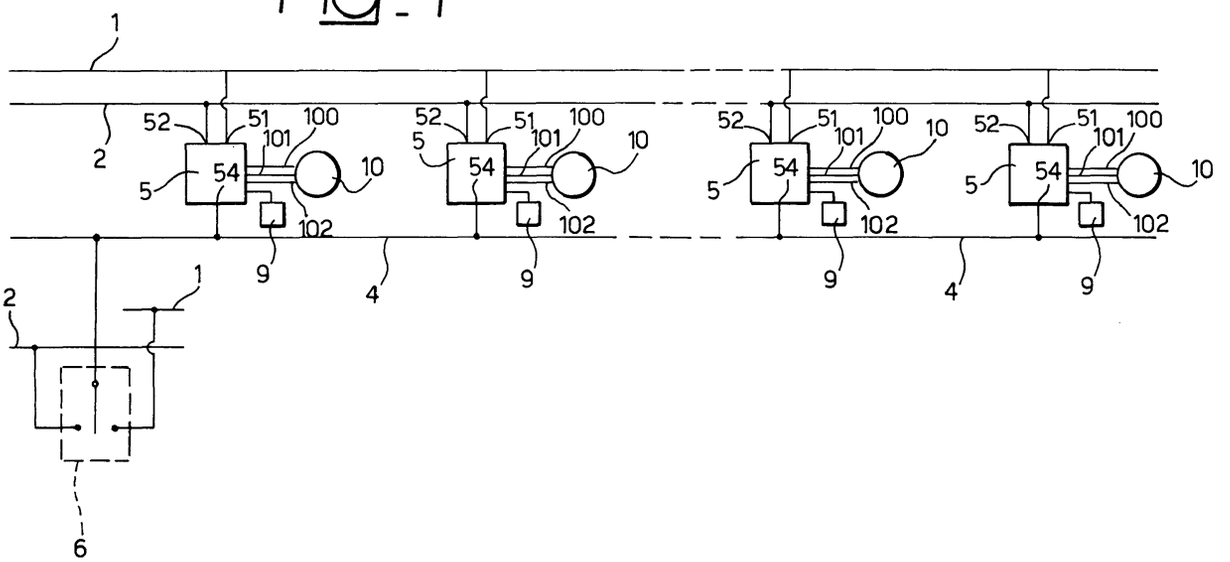
(54) Device for controlling several electrical motors simultaneously, for instance for powering curtains, shutters and the like

(57) A plurality of electric motors (10), such as motors for actuating blinds, roller shutters, rolling gates, roller blinds or the like are connected to a first supply line (1) and to a second supply line (2). The connection is made by means of a switching network (7), which has a control terminal (54) selectively connectable (6) to the one supply line (1) and to the other supply line (2). The switching network is able to provide connection of the motors (10) in two different configurations, corresponding to opposite directions of rotation, according to whether the aforesaid control terminal (54) is connected to the one supply line (1) or else to the other supply line (2). A bus line (4) comprising just one wire connects the connection devices (5) associated to the various motors. At least one selector switch (6) is provided for connecting selectively the bus line (4) to the first supply line (1) and to the second supply line (2).

Fig. 1



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Description

[0001] The present invention relates to techniques for the connection of electric motors and has been developed with particular attention paid to their possible use for connecting electric motors used for actuating roller shutters, roller blinds, rolling gates and similar devices.

[0002] For this particular type of use the choice of using asynchronous motors, typically of a squirrel-cage type, has spread increasingly over the years, basically for reasons of simplicity, reliability, and contained cost.

[0003] The said motor is essentially of the "three-wire" type and thus has three terminals, one common to both of the windings and the other two being associated, respectively, to each of the coils or windings, with the additional provision of a phase shifter aimed at causing the motor to turn in one direction or else in the other according to the connection configuration.

[0004] Once again in the same applicational context, there is an increasingly widespread use of blinds, roller shutters, roller blinds and similar devices set in an array, for example where there is a very extensive window or large window panes on the front of a building.

[0005] In such conditions of installation, the aim is to enable the motors in question to be actuated in a combined and co-ordinated way, for example to cause all the blinds associated to a certain window pane to be raised or lowered simultaneously.

[0006] The above mode of use comes up, however, against the fact that the motors of the type described previously are not suited for connection in parallel.

[0007] In the installation of blinds, roller shutters or roller blinds designed for operating in a co-ordinated way according to the modality described previously, recourse has thus traditionally been had to a configuration in which the motors of the various blinds have respective supply cables coming under a control unit for their actuation, where there are the respective relays for connection to the electric supply network all interlocked to an on-off/changeover switch functioning as main control switch.

[0008] The disadvantages of this solution are evident.

[0009] In first place, the need to connect each motor to the control unit entails the laying of an appreciable quantity of connection cables. This latter solution is particularly inconvenient when the blinds are installed in an environment, such as a domestic environment, in which there can no longer be purposely provided chased channels. In any case, even when it is possible to resort to a solution using chases, the number of channels required is rather high.

[0010] The above solution is, moreover, intrinsically rigid in its configuration: if, for any reason, the aim is to displace the point of main control of an array of blinds, it is practically necessary to re-wire the system completely, with all the drawbacks that have already been described.

[0011] In order to reduce the drawbacks linked to the above solution, there has been a continued development over the last few years of solutions of decentralized control, which substantially amount to a bus architecture: on each motor there is made available a point of supply of the electrical network, as well as a corresponding pair of relays connected to a bus, which enables (remote) control of the various motors via the relays. The said bus is typically a three-wire bus, which entails, at least in the majority of cases, the provision of an appropriate channel, with all the drawbacks already outlined previously.

[0012] There therefore exists the need to provide a further improved solution, which will overcome such drawbacks definitively.

[0013] The purpose of the present invention is to provide just such a solution.

[0014] According to the present invention, this purpose is achieved thanks to a device which has the characteristics recalled specifically in the ensuing claims. The invention also regards the corresponding method of use or installation, as well as the installation thus provided.

[0015] The said installation is characterized, as regards its more immediately appreciable aspect, in that, for actuation of the various motors, it is only necessary, in addition to the provision of the electrical supply network, to use a single wire functioning as a bus, by means of which it is possible to control - in the two directions and in a co-ordinated way - rotation of the various motors.

[0016] The invention will now be described, purely by way of non-limiting example, with reference to the annexed drawings, in which:

- Figure 1 is a general representation, in the form of a block diagram, of a system built according to the invention;
- Figure 2 is a further block diagram, which illustrates the general structure of one of the devices used in the system represented in Figure 1;
- Figure 3 illustrates, at an even greater level of detail, various possible examples of embodiment of the device represented in Figure 1; and
- Figure 4 illustrates the structure of one of the parts represented as a block in Figure 3.

[0017] In Figure 1, the numeric references 10 designate various motors used for actuating blinds, roller blinds or roller shutters, not specifically illustrated in the attached drawings but of a known type.

[0018] The characteristics of the above motors, capable of taking on also the form of "tubular" motors incorporated in the actuation roller of the roller blind or the like, are altogether known in the art.

[0019] As already indicated previously, these are typically asynchronous motors, which have, for their supply, a first terminal 100, which is common to both of the windings of the motor, and two additional terminals, des-

ignated, respectively, by 101 and 102, each associated with one of the aforesaid windings.

[0020] The motors in question are designed to be supplied through an a.c. electrical network comprising typically a first line 1, a second line 2, as well as a third line having the function of earth line.

[0021] In the representation of the figures of the attached drawings, which is deliberately simplified for reasons of clarity of illustration, the connections for the earth line to the various motors 10 have been largely omitted.

[0022] The supply lines 1 and 2 are typically made up of:

- respectively, the "neutral" and the "phase" of a normal 220-V domestic distribution network; or
- two "phases" drawn from a 380-V three-phase supply line for industrial use.

[0023] Consequently, in general terms, the line 1 and the line 2 are chosen in the group consisting of the neutral and the phase of a single-phase supply line and two phases of a three-phase supply line.

[0024] Of course, the terms used above are to be considered as including the corresponding solutions of embodiment which envisage the supply of the electrical power in waveforms of a digital type, i.e., square waveforms. This may occur, for example, in the framework of safety systems supplied by standby batteries designed to cause, in certain conditions (for example, in the presence of a strong wind, detected by an anemometer), the blinds to be brought, in any case, into the rolled-up or retracted position even in the absence of the mains supply voltage.

[0025] In general, the purpose that it is intended to achieve, in the framework of the system represented in Figure 1, is that of being able to connect the motors 10 selectively to the electrical distribution network according to two different configurations of connection:

- the first, with the supply voltage applied between the terminal 100 and the terminal 101, with consequent rotation of the motors 10 in a first direction; and
- the second, with the supply voltage applied between the terminal 100 and the terminal 102, with rotation of the motors 10 in a second direction, opposite to the former one.

[0026] According to the invention, the above purpose is achieved thanks to a single bus line, designated by 4, which connects corresponding control devices 5 associated to the various motors 10.

[0027] The line 4 comes under a selector switch 6 located in any position of the system, hence without any need for it to be located in the proximity of one of the motors 10 and with the possibility of changing said location selectively.

[0028] In addition to a neutral position (corresponding to the fact that the motors 10 are deactivated), the selector switch 6 can be selectively brought into connection either with the line 1 or with the line 2.

[0029] In the diagrams of Figures 1 and 2, there has been highlighted the fact that the aforesaid connection of the selector switch 6 can be obtained also in a remote position with respect to the positions in which the various motors 10 designed to be connected to the lines 1 and 2 by means of the actuation devices 5 are located.

[0030] Figure 2 shows that, in the framework of each device 5, it is possible to distinguish:

- three terminals, designated by 51, 52 and 54 and respectively designed to be connected to the line 1, to the line 2, and to the bus 4; and
- a switching network 7, which is controlled by the aforesaid input terminals and enables two operating states.

[0031] In the first operating state, the switching network 7 furnishes, in regard to the motor 10 associated to the corresponding device 5, the first connection configuration, of which mention was made previously, ensuring rotation of the motor in a first direction.

[0032] Instead, when the switching network 7 is in the second operating state, it ensures the second condition of connection of the associated motor 10, causing the motor 10 to turn in the direction opposite to the former one.

[0033] In practice:

- when the selector switch 6 is shifted from the inactive condition into its first active position, in the framework of each of the devices 5, the terminal 54, coming under the bus 4, is connected to the line 1; and
- instead, when the selector switch 6 is shifted from the inactive condition into its second active position, in the framework of each of the devices 5, the terminal 54, coming under the bus 4, is connected to the line 2.

[0034] "Connected to the line 1" and "connected to the line 2" are meant to include the possibility of said connection being obtained either in a direct way or via a protection device, such as a resistor or the like.

[0035] When the terminal 54, functioning as a control terminal of the switching network 7, is connected to the terminal 51, the two terminals in question are in practice brought to the same voltage, whilst between the terminal 54 and the terminal 52 there is set up a voltage difference basically corresponding to the voltage difference existing between the lines 1 and 2.

[0036] Conversely, when the terminal 54 is connected to the terminal 52, the said two terminals are practically at the same voltage, whilst between the terminal 51 and the terminal 54 there is set up a voltage difference equal

to the one currently existing between the line 1 and the line 2.

[0037] The switching network 7 is basically a network designed to transfer to the motors the supply voltage drawn between the lines 1 and 2 in a way that is different according to the condition of connection established between the terminals 51, 52 and 54, for example so as to cause - without prejudice to the connection to the line 1 of the common terminal 100 of all of the motors 10 - the line 2 to be selectively connectable to the terminal 101 or else to the terminal 102, so as to determine rotation of the motors in one direction or else in the opposite direction.

[0038] The selector switch 6 is usually provided with symbols which indicate, respectively, the raising and the lowering of blinds, roller shutters, roller blinds or the like, controlled by the motors 10, thus enabling the correspondence between symbols present on the selector switch 6 and directions of movement obtained with the actuation of the motors 10 to be achieved.

[0039] The switching network 7 is suited for being made in different ways.

[0040] The foregoing is said considering the fact that, as has already been mentioned previously, the control of "three-wire" asynchronous a.c. motors (terminals 100, 101 and 102) presumes a fixed connection of the common terminal 100, e.g., to the neutral of the 220 V (line 1), and connection of a phase (line 2) alternatively to one or to the other coil (terminal 101 or terminal 102) according to the required direction of rotation.

[0041] It is not possible to connect motors of this type in parallel on account of current return in the coils themselves.

[0042] The solution here described has been purposely studied for connecting a number of motors on the same line, which is designed for a technically non-functioning connection in parallel.

[0043] In particular, Figure 3 illustrates, proceeding from left to right, the possible evolution of the switching network 7 from a basic solution (the one represented further to the left) to the solution of the currently preferred embodiment (the one represented further to the right - also with further reference to Figure 4).

[0044] It is, on the other hand, evident that the said representation (in which the three motors 10 are visible in the figure have associated switching networks 7 with different structures) has a merely illustrative character: in practice, the implementation of the solution here described envisages that all of the motors 10 will have associated thereto a switching network 7 having the same structure.

[0045] The working diagram, or basic diagram, represented further to the left envisages that the terminals 51, 52 and 54 are associated with the excitation windings of the two relays A and B, the power contacts of which are designated, respectively, by aI and bI.

[0046] In detail, in the example of embodiment here illustrated (which, it is emphasized, is purely an example):

- the relay A has the excitation winding connected between the terminal 52 (line 2) and the terminal 54 (bus line 4), and the power contact aI acting between the line 2 and the terminal 101 of the motor 10; and
- the relay B has the excitation winding connected between the terminal 51 (line 1) and the terminal 54 (bus line 4), and the power contact bI acting between the line 2 and the terminal 102 of the motor 10.

[0047] In resting conditions, the two excitation windings of the two relays A and B are in any case connected in series together between the lines 1 and 2. They are consequently both excited and attract the power contacts aI and bI so as to keep them open: the motor 10 is consequently not supplied and is stationary.

[0048] If, during actuation, the selector switch 6 is shifted into the position that connects the bus line 4 to the line 2, the excitation winding of the first relay A is short-circuited; its contact aI closes, and the motor receives current in the coil coming under the terminal 101, so turning in one direction.

[0049] If, instead, the selector switch 6 is shifted into the position that connects the bus line 4 to the line 1, it is the excitation winding of the second relay B that is short-circuited; its contact bI closes, and the motor receives current in the coil coming under the terminal 102, so turning in a direction opposite to the former one.

[0050] Albeit altogether satisfactory from the functional point of view, the basic solution just described presents certain critical aspects.

[0051] In the first place, from an examination of the working diagram just described, it may be noted that if one of the relays A or B were to have the excitation coil burnt out (i.e., in conditions such as no longer to attract the corresponding power contact), there would be the non-desired supply of the motor 10. This in itself would not lead to any damage to the motor 10: in systems of the type described, the motor is in fact usually provided with a so-called "limit-switch" circuit such as to cause, once the end-of-travel has been reached (e.g., blind all the way up or all the way down), the motor to be in any case deactivated.

[0052] The problem could, instead, arise in the case where, in the aforesaid conditions, the selector switch 6 were to be actuated so as to cause the rotation of the motor 10 in a direction opposite to the one in which the motor has just been moving: in this case, the motor would be supplied through both of the terminals 101 and 102, which would ruin it irremediably.

[0053] For this reason, in the currently preferred embodiment, it is envisaged that the power contacts aI and bI of the relays A and B are connected by means of a switch contact 104, as illustrated in the central part and in the right-hand part of Figure 3.

[0054] In practice, the line 104 connects the two power contacts aI and bI in series together in such a way that, in order to have voltage reaching the motor 10, it will be necessary to have the condition of one relay attracted and one relay dropped out. If the contacts are both dropped out (and likewise when the contacts are both attracted), the motor 10 does not receive any voltage.

[0055] In practice, this solution is readily implementable by configuring the power contacts aI and bI as switches with the central switching elements connected together by the line 104 and:

- an "attracted" condition, in which the central switching elements are connected to the terminal 101 and to the terminal 102 of the motor 10 respectively; and
- a "dropped" condition, in which the central switching elements are connected to the line 2 (supply phase).

[0056] In addition to this, in the basic-connection solution, represented in the left-hand part of Figure 3, in a resting situation there are the two relays A and B with the excitation windings connected in series at a voltage of 220 V, hence with a voltage drop of 110 V on each relay. In the operating situation, in other words with the excitation winding of one of the relays A or B short-circuited, the voltage drop of 220 V is therefore applied integrally on the excitation coil of the other relay.

[0057] This mode of operation consequently entails the use of relays with excitation coils that are able to operate both at 110 Vac and at 220 Vac without any heating. These relays are usually rather costly.

[0058] It is, on the other hand, evident that the solution here described draws particular advantage from the possibility of using relays which, albeit presenting a good degree of reliability and being able to remain constantly energized, are of very contained dimensions and very low cost. From this point of view, the optimal choice is represented by the relays used in the automotive sector, namely ones of small size, ones that do not heat up and that are very reliable

[0059] To function, these relays require a d.c. voltage typically comprised in the 20-V to 24-V range.

[0060] In the currently preferred embodiment, the relays A and B are consequently built according to the diagram of Figure 4, which (except for the different configuration of connection at input and at output) applies both to the relay A and to the relay B.

[0061] In the said diagram, the reference 105 designates a relay of an automotive type, as described previously. Upstream of the relay there is present an RC cell 106, the capacitor of which, with its impedance, reduces the current available and hence the voltage (starting condition, motor stationary) from 110 Vac to approximately 21/22 Vac.

[0062] The cell 106 moreover comprises a resistor in series for absorbing, when required, the discharge current of the capacitor.

[0063] A double diode bridge 107 cascaded to the RC cell 106 rectifies the voltage and transforms it into d.c. voltage. A Zener diode 108 set between the diode bridge 107 and the relay 105 has the job of clipping the d.c. voltage applied to the relay 105 to the maximum value of 24 V.

[0064] When the selector switch 6 is actuated, according to the relay unit (A or B) each time involved, the voltage on the capacitor passes from 110 V to 220 V, and the d.c. output of the bridge 107 passes to approximately 40 V. The Zener diode 108 clips the voltage from 40 Vdc to 24 Vdc.

[0065] In this way, the relay 105 is subjected to two voltage conditions: 21/22 V (resting conditions - motor deactivated) and 24/25 V (for the period in which the motor 10 is activated). Both of the voltages indicated fall within the normal range of operation of this type of relay.

[0066] The overall resulting solution (the one illustrated further to the right in Figure 3) is altogether compatible with the normal provision, associated to each motor 10, of a respective single-control selector switch 9, connected directly to the motor.

[0067] The said selector switch 9 must not be actuated simultaneously with the general selector switch 6. In order to prevent any damage to the motor 10 that could derive from this event it is sufficient to have the relays A and B with two switch contacts that break the common contact of the individual selector switch 9 when they are active.

[0068] Persons skilled in the art will of course understand that functions altogether equivalent to the ones described herein can be achieved with different technical means.

[0069] For example, it is possible to use a single relay, which incorporates in a single element the functions of the two relays A and B just described.

[0070] Another solution is to resort to a rotary contactor, which provides the two different configurations of connection of the motor 10 in two different positions of rotation selectively controllable by means of the terminals 51, 52 and 54.

[0071] The same solution can be implemented also with solid-state switches, after a prior possible conversion into digital form of the signals taken between the terminals 51, 52, 54.

[0072] The installation of a system of the type illustrated in Figure 1 entails simply the availability, for the various motors 10, of the supply lines 1 and 2 and of the bus 4 (plus, obviously, the earth connection, here not illustrated), as well as the association to each motor 10 of a device 5 of the type of the one illustrated in Figures 2 and 3.

[0073] As has been indicated previously, the main actuating push-button, designated by 6, associated with the bus 4, can be located in any position, with the further possibility of changing selectively said location without this entailing a reconfiguration of the system as a whole.

[0074] Of course, without prejudice to the principle of the invention, the details of implementation and the embodiments may vary widely with respect to what is described and illustrated herein, purely by way of non-limiting example, without thereby departing from the scope of the present invention, as defined in the annexed claims.

Claims

1. A device for connecting selectively to a first supply line (1) and to a second supply line (2) an electric motor (10), which has at least one first supply terminal (101) and one second supply terminal (102), it being possible to make the connection of said terminals (101, 102) of the motor to said supply lines (1, 2) in a first configuration and in a second configuration so as to determine selectively rotation of the motor (10) in a first direction and in a second direction of rotation, said device being **characterized in that** it comprises a switching network (7), which has a control terminal (54) selectively connectable (6) to the one (1) and the other (2) of said first supply line (1) and said second supply line (2), said switching network being able to provide connection of said terminals (101, 102) of the motor (10) to said supply lines (1, 2) in said first configuration and said second configuration according to whether said control terminal (54) is connected to the one (1) or else the other (2) of said first supply line (1) and second supply line (2).

2. The device according to Claim 1, **characterized in that** said first supply line (1) and said second supply line (2) are chosen between the neutral and the phase and two phases of an electric supply network.

3. The device according to Claim 1 or Claim 2, **characterized in that** said switching network (7) comprises a first switch element (A) and a second switch element (B) capable of forming said first configuration and said second configuration of connection, said first switch (A) and said second switch (B) being associated, in an actuation relationship with said control terminal (54).

4. The device according to Claim 3, **characterized in that** said first switch element and said second switch element are in the form of a first relay (A) and a second relay (B).

5. The device according to Claim 4, **characterized in that** said first relay (A) and said second relay (B) each comprise:

   - an excitation winding associated with said control terminal (54); and
   - a power contact (aI, bI), which is controlled by said excitation winding and is able to produce the supply of the motor (10).

6. The device according to Claim 5, **characterized in that**, in said first relay (A) and said second relay (B), said excitation winding is able to be short-circuited, producing the supply of the motor (10) by means of the corresponding power contact (aI, bI), when said control terminal (54) is connected (6) to the one and to the other of said supply lines (1, 2).

7. The device according to Claim 5 or Claim 6, **characterized in that** said first relay (A) and said second relay (B) have the respective power contacts (aI, bI) in series to one another in such a way that the supply of said motor (10) entails the condition of one relay attracted and one dropped out.

8. The device according to Claim 7, **characterized in that** the power contacts (aI, bI) of said first relay (A) and of said second relay (B) are configured as selector switches with the central switching elements connected together (104) and having:

   - an attracted position, in which said central switching element is connected to a respective terminal (101, 102) of the motor (10); and
   - a dropped-out position, in which said central switching element is connectable to one between said first supply line (1) and said second supply line (2).

9. The device according to any one of the preceding Claims 4 to 8, **characterized in that** said relays are d.c. relays (105), which have associated thereto a rectification network (105).

10. The device according to any one of the preceding Claims 4 to 9, **characterized in that** said relays are low-voltage relays, which have associated thereto a voltage-scaling network (106).

11. The device according to Claim 10, **characterized in that** said voltage-scaling network (106) is an RC cell.

12. The device according to Claim 10 or Claim 11, **characterized in that** said relays have associated thereto a protection diode (108) with a function of limitation of the voltage applied to the excitation winding of the relays.

13. The device according to any one of Claims 4 to 12, **characterized in that** said relays (A, B) are relays of an automotive type.

14. The device according to Claim 3, **characterized in that** said first and second switch elements are integrated in a single device.

15. The device according to Claim 1, **characterized in that** said switching network (7) comprises a rotary contactor.

16. The device according to any one of the preceding claims, **characterized in that** said switching network (7) comprises at least one semiconductor switch.

17. A method for using a device according to any one of the preceding claims, **characterized in that** it comprises the operations of:

- installing a plurality of said motors (10), providing said first supply line (1) and said second supply line (2);
- associating to each of the motors (10) of said plurality a respective said device (5), by arranging said respective device (5) between said first supply line (1) and said second supply line (2) and the respective motor (10), so that said switching network (7) of said respective device (5) is able to provide selectively, in regard to said respective motor (10), said first condition and said second condition of connection;
- connecting the control terminals (54) of the plurality of devices (5) associated to said plurality of motors (10) by means of a bus line (4); and
- associating to said bus line (4) a control element (6) that is able to connect selectively said bus line (4) to said first supply line (1) and said second supply line (2).

18. A system comprising:

- a plurality of electric motors (10);
- a first electric supply line (1) and a second electric supply line (2);
- for each of said motors (10), a connection device (5), which has a control terminal (54) that can be connected selectively (6) to said first electric supply line (1) and said second electric supply line (2); said control terminal (54) being able to provide selectively a first configuration and a second configuration of connection of said motors to said first supply line (1) and said second supply line (2), said first configuration and said second configuration of connection determining the rotation of said motors (10) in a first direction and a second direction of rotation, respectively;
- a bus line (4) comprising just one wire, which connects the connection devices (5) associated to said plurality of motors (10); and
- at least one switch (6) for selectively connecting said bus line (4) to said first supply line (1) and to said second supply line (2) so as to determine selectively the common and co-ordinated actuation of said motors (10) in a first direction and in a second direction of rotation.

19. The system according to Claim 18, **characterized in that** said connection devices (5) are according to any one of Claims 1 to 16.

20. The system according to Claim 18 or Claim 19, **characterized in that** said motors (10) are motors that cannot be connected in parallel together.

21. The system according to any one of Claims 18 to 21, **characterized in that** said motors (10) are motors for actuating blinds, roller shutters, rolling gates, or the like.

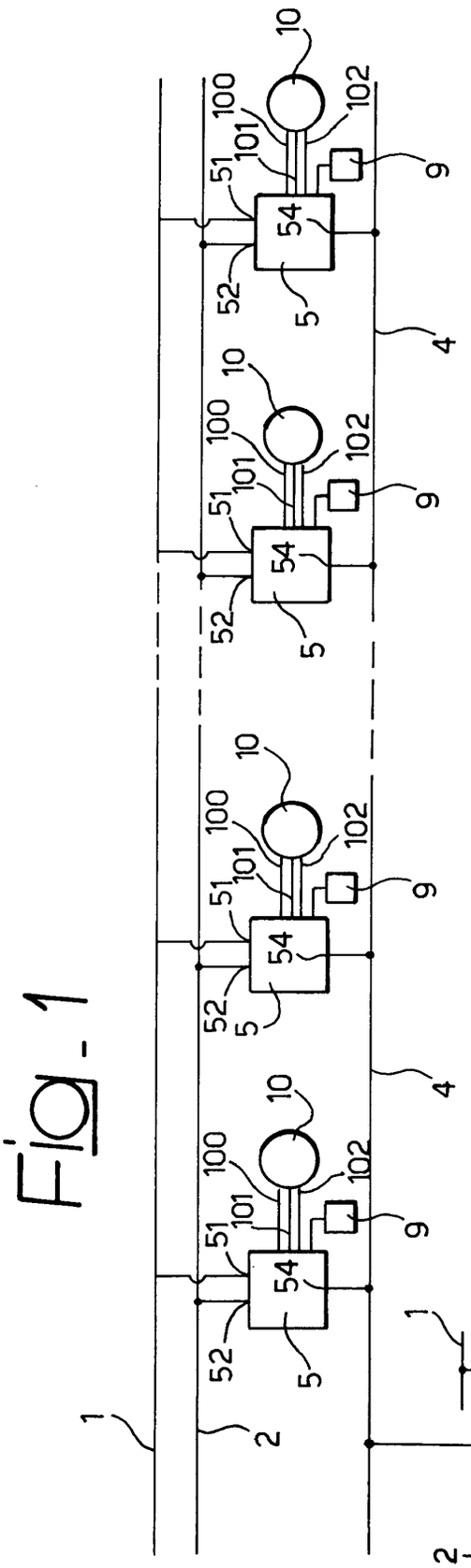

Fig. 1

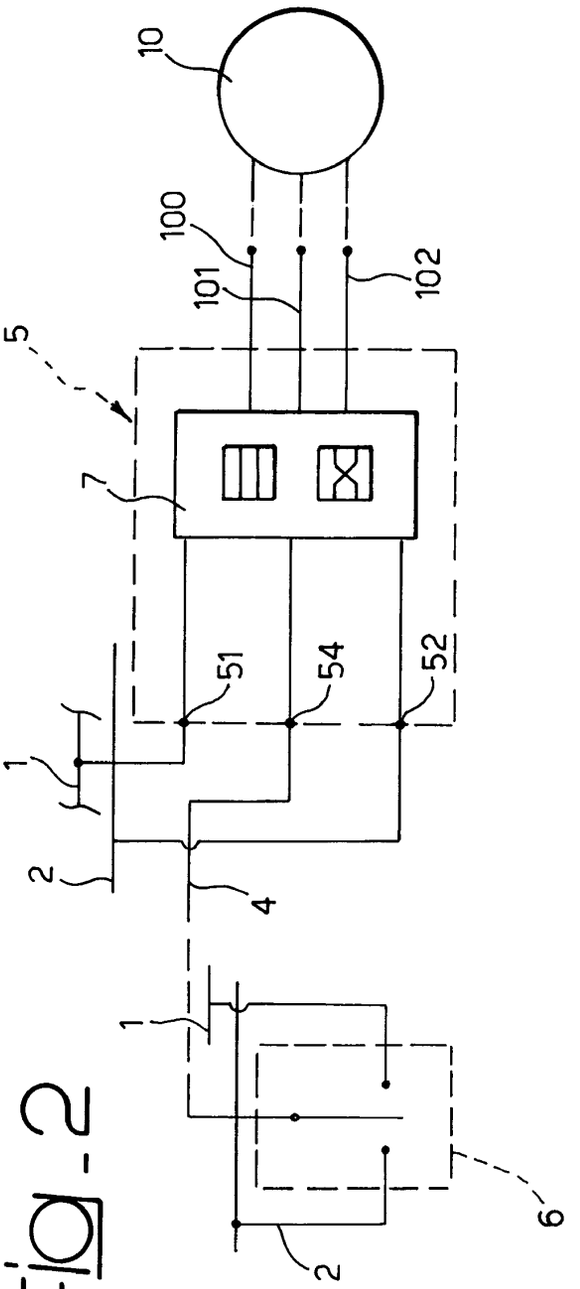

Fig. 2

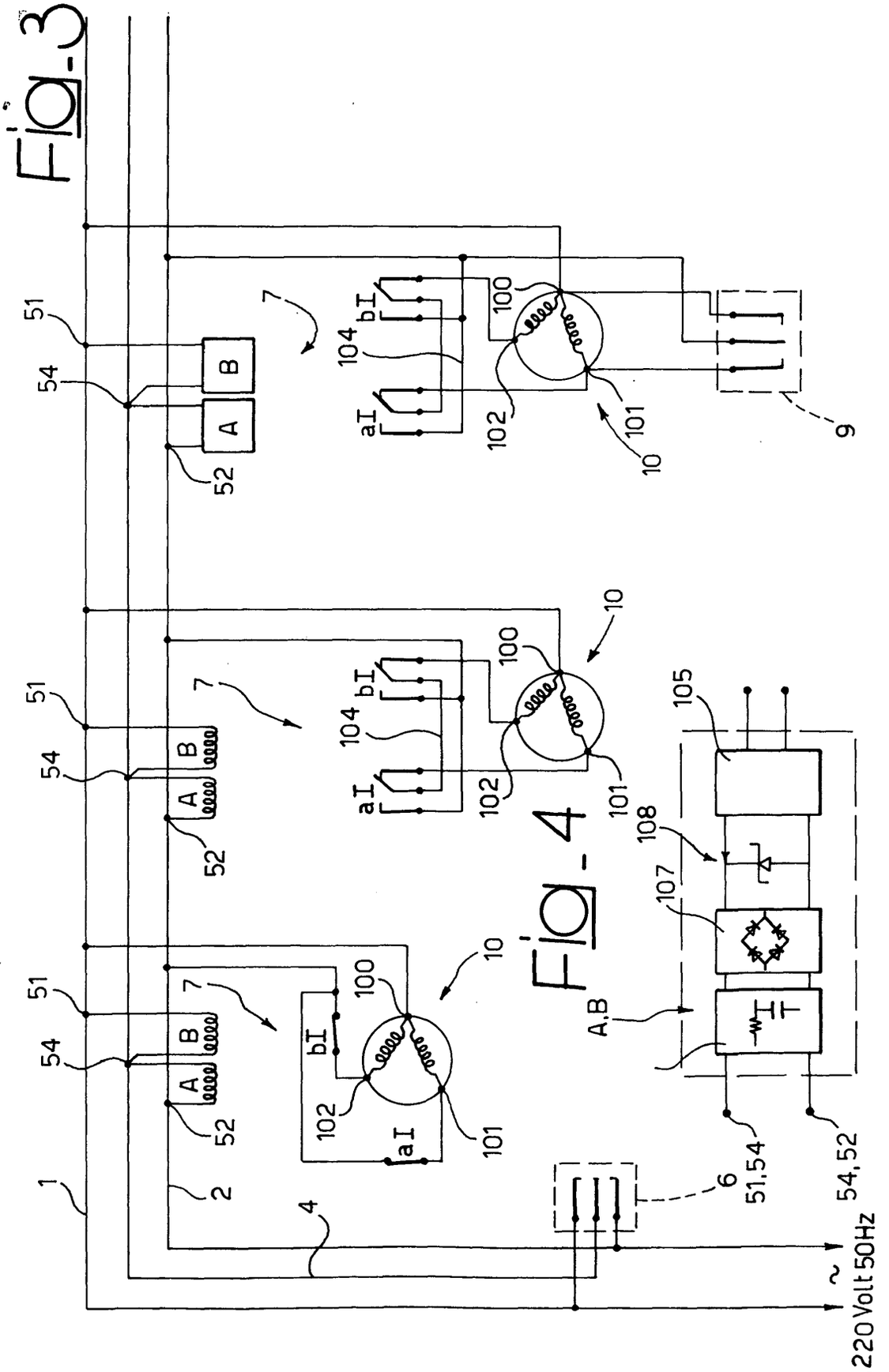
Fig-3
Fig-4
1
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54,52
220 Volt 50Hz

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 42 5233

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	DE 43 38 339 A (KLENK GOTTLIEB) 11 May 1995 (1995-05-11) * column 3, line 20 - line 22 * * figures 1,2 * -----	1,17,18	H02P7/74 E06B9/68

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H02P
E06B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	17 September 2003	Foussier, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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