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(54) Benævnelse: **Fremgangsmåde og styresystem til styret betjening af bevægelige dele**

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DESCRIPTION

[0001] The present invention relates to a method and a control system for controlled operation of movable members by communication of operating commands from centralized and/or distributed control means to operator units for movement of said movable members.

[0002] Whereas a preferred useful application of the invention relates to natural ventilation of one ormoreventilation zones in a building by operation of passive ventilation members like e.g. openable window or façade sections, adjustable ventilation dampers, grids and similar devices, the invention may be applied in general to control of a variety of types of movable members.

Background of the invention

[0003] Published international patent application WO 00/39506 provides a general disclosure of a computer controlled method and system for controlled natural ventilation of ventilation zones in a building by adjustment of passive ventilation devices, typically in the form of openable window sections in building facades or other forms of openable façade sections such as adjustable ventilation dampers, grids and similar devices. The control strategy followed in this prior art method involves periodically repeated estimation of the ventilation demand of a zone from a physical parameter such as the volume of the zone, a target value for the indoor temperature of the zone and measurement of actual indoor and out door temperatures, correction of the estimated demand in dependence of additional indoor climatic variables such as CO_2 content to determine an adjustment factor for each ventilation device belonging to the zone and individual correction of adjustments factors thus determined in dependence of additional outdoor climatic variable such as wind load and direction and/or a user actuated adjustment of a ventilation device.

[0004] In published international patent application WO 02/01116 a further development of this method to provide comfort optimization for human occupants in the ventilation zone is disclosed.

[0005] The ventilation devices employed in such a method or system will as mentioned typically comprise openable windows or other openable façade sections comprising a wing or sash part arranged in a stationary main frame structure to be movable between a closed position and a ventilation position, whereby movement of the wing or sash part is performed by means of at least one electrical operator unit such as a conventional chain operator.

[0006] For a relatively simple and small ventilation device a single operator unit may be sufficient for the controlled operation of such awing orsash part, butfrequently a number of operator units will be required for a single ventilation device, e.g. for the movement of a rather heavy wing or sash part and/or for locking and unlocking the wing or sash part in its closed position with respect to the main frame structure in addition to movement of the wing or sash part between its closed position and the ventilation position.

[0007] In automatic control systems for natural ventilation of large building comprising a plurality of ventilation zones, a large number of windows placed all over the building may be operated in this way by electrical operator units receiving operating commands from centralized control means incorporating computer means for the determination of control parameters such as a target ventilation position for individual operators in dependence of various climatic parameters, such as air temperature and humidity, CO_2 content and wind load as well as external noise from traffic or the like and communication of corresponding control commands to the operator units associated with ventilation devices by remote control. Thereby, a ventilation device such as a window may be moved several times between different positions, which may not always correspond to the closed position or a maximum ventilation position.

[0008] For proper exercise of building climate control it is important therefore that exact information of the actual or current positions of all ventilation devices such as windows is made continuously available to the centralized control means.

[0009] In prior art electrical window control systems provision of such position information has traditionally been based, however, on relatively simple estimation of the ing or sash position from operation parameters such as the duration and magnitude of the current to a drive motor in an operator unit, using the closed position of the wing or sash part as zero reference. Evidently, use of such an estimation strategy in automatic window control systems would require closing of windows every once in a while in order not to loose track of their position. Otherwise errors in the estimates from the repeated opening and closing movements might accumulate leading to incorrect estimates of the window position.

[0010] In a computer-controlled window system for a building disclosed in EP-A2-0 397 179 electrical operation of the locking/unlocking and opening/closing functions of a plurality of windows is accomplished by microprocessors assigned to individual windows or groups of windows. For each window the actual condition of its locking means as well as the actual position of the sash member are communicated to the microprocessor associated with the window from sensor devices arranged at the window and for the overall system these sensor signals are communicated for all windows from the microprocessors to a common central monitoring unit for optical indication of the current condition of each window. Command signals for operation of individual windows or joint operation of a group of windows served by the same microprocessor are communicated to the respective microprocessors eitherfrom portable orstationary local remote control units or, via a data bus, from the common central unit. In response to such command signals the function of the microprocessor vis-a-vis a single window is limited to sequential operation of separate motors for the locking/unlocking and the opening/closing functions of the window.

[0011] In addition to this relatively limited use of the sensor signals communicated from the individual windows for control purposes the use of several separate sensor devices at each window to provide sensor inputs to the microprocessors requires a corresponding amount of physical wiring between a microprocessor and each window served thereby with resulting complications and costs of installation.

[0012] EP 0 994 560 discloses a method according to the preamble of claim 1.

Summary of the disclosure

[0013] On this background it is the object of the invention to provide a method and a system for the computerized control of natural ventilation, that provides for reduced cabling while improving reliability of data communication.

[0014] This object is achieved, according to the method defined in claim 1.

[0015] Preferred and advantageous implementations of the method are stated in dependent claims 2 to 7.

[0016] A preferred performance of the method comprises in response to an operating command for opening or closing of said single ventilation member communicated from said centralized and/or distributed control means a control command including a target position and a target speed of operation is communicated from said interface means to each operator unit, and that in dependence of position and/or status information received from the operator units new individual control commands including modifications of said target speed as needed to provide synchronized concurrent operation of said operator units is subsequently communicated by said interface means to individual operator units of said sub-group.

[0017] The object above is also achieved by a control system according to the invention as defined in claim 8.

[0018] Preferred and advantageous embodiments of such a ventilation system are stated in dependent claims 9 to 13.

Brief description of the drawings

[0019] In the following the invention will be described in greater detail based on an exemplary embodiments, and with reference to the schematic drawings, on which

Fig. 1 is a simplified basic control diagram for a control system for natural building ventilation embodying the invention,

Fig. 2 is a schematic diagram of an interface unit in the ventilation system shown in fig. 1,

Fig. 3 is a schematic block diagram of an operator unit communicating with an interface unit as shown in fig. 2, and

Fig. 4 is a graphic representation of a preferred structure of various communication telegrams between an interface unit as shown in fig. 2 and an operator unit as shown in fig. 3.

[0020] In the control system illustrated in fig. 1 by way of a simplified block diagram sub-groups 1 and 2 of operator units 3 are connected with a centralized control means 4 comprising a ventilation system computer and a centralized power supply unit 5 via

an interface unit 6.

[0021] In the illustrated example sub-group 1 comprises two operator units 3 for movement of a single passive ventilation member such as an openable window comprising a wing or sash part arranged to be movable with respect to a stationary frame structure, whereas subgroup 2 comprises a single operator unit 3 associated with another single ventilation member, whereby movement of the two ventilation members is controlled by the interface unit 6.

[0022] A further interface unit 7 is connected with the central control means 4 and the central power supply unit 5 for the control and coordination of four sub-groups 8 to 11 of operator units, which in the example illustrated comprise a number of operator units 3 serving the opening and closing of movable window wing or sash parts as described above, whereas one of the sub-groups 8 comprises in addition a special operator unit 12 used for the operation of a locking mechanism for locking and unlocking the wing or sash part of a window with respect to the stationary frame part as known perse, e.g. from EP-A2-0 397 179 mentioned above.

[0023] Thereby, interface units 6 and 7, each of which may each be assigned e.g. to a single room of a building incorporating a natural ventilation system, may control and coordinate the operation of a relatively large number of operator units 3 or 12 organized in sub-groups each associated with a single passive ventilation member. As shown for the sub-group 8 the operator units 3 and 12 may be operated sequentially for opening/closing and locking/unlocking of a window wing or sash part with respect to a stationary frame, respectively. All other operator units 3 of sub-groups 1, 2 and 8 to 11 may be of the same type and be operated concurrently for opening/ closing of a window wing or sash part.

[0024] Each of operator units 3 may comprise a chain operator of a type known per se with a chain connected with the window wing or sash part engaged by a chain or sprocket wheel driven by a reversible electric motor via suitable transmission means for movement of the wing or sash part in an opening direction or closing direction, respectively.

[0025] In the system shown in fig. 1 data communication between the central control means 4 and each of interface units 6 and 7 is effected via a serial communication bus 14 such as an EIB (European Installation Bus) and power supply to the interface units 6 and 7 from the central power supply unit 5 is effected on a power line 15. Moreover, in the illustrated example each sub-group of operator units may in addition to operation by command from the central control means be operated by a distributed local control means 16 such as a portable or stationary remote control device individually assigned to the sub-group and the single passive ventilation member associated therewith.

[0026] As shown in fig. 2 each of interface units 6 and 7 comprises a power supply unit (PSU) 17 connected with the power line 15. In a preferred embodiment the power supply unit 17 receives DC power supply from the central power supply unit 5 shown in fig. 1. The power supply unit 17 of the interface unit may simply be voltage adapting circuitry for the various voltages needed by different parts of the interface unit itself, on one hand, and for the operation of the operator units 3 or 12, respectively, of the sub-groups of operator units served by the interface unit, on the other hand. Alternatively, the power supply unit 17 may also include galvanic separation for the various consuming parts. Thus, the DC supply current from the central powersupply unit 5 is used both to supply a microprocessor 18 in the interface unit and all of the electrical window operator units 3 and 12, respectively, as well as other circuitry.

[0027] Each operator unit 3 is connected with the interface unit 6 or 7 by three conductors comprising two power supply lines and a single communication line. The three conductors may be connected to the interface unit 1 using standard terminals 19, 20, 21, such as screw terminals. The external DC supply current is preferably fed directly to the two terminals 19, 20 connected with the power supply lines.

[0028] As will appear, the interface unit 6,7 is built around the microprocessor 18, which may communicate with the EIB bus 14 by means of a bus interface 22. For additional storing capacity the interface unit 6 or 7 may further comprise an optional EEPROM 23 connected with the microprocessor 18. For reprogramming of the EEPROM 23 the interface unit 6 or 7 may further include a PC interface 24 for connection of the interface unit 1 to a personal computer (not shown). Alternatively the EEPROM 23 may be reprogrammed from the central control means 4. Typically EEPROM 23 may contain control parameters for the operator units 3, such as target speed, target position, maximum opening time, etc.

[0029] For controlling the operation of the ventilation members associated with the sub-groups of operator units served by the interface unit, the microprocessor 18 may communicate with each of operator units 3 via terminal 21 and the single communication line connected therewith. The control effected by his communication may either be automatic, i.e. caused by commands from the central control means 4, or selective, by a command communicated from distributed local means 16 as shown

in fig. 1.

[0030] In case of automatic operation the interface unit 6 or 7 receives instructions to open or close the window from the central control means 4 via the data bus 14.

[0031] In case of selective operation, opening or closing is effected by communication from the distributed local control means 16, which may comprise a number of keypads, each via a keypad interface 25.

[0032] For the individual control of the various sub-groups of operator units 3, 12 the interface unit 6 or 7 comprises a number of operator drivers 26. In the illustrated preferred embodiment each of drivers 26 may control a sub-group comprising up to four operator units 3 for opening and closing of a window wing or sash part and, in addition, up to two operator units 12 for locking/ unlocking of the wing or sash part in the closed position of a window.

[0033] Data communication and power supply from the interface unit to all operator units 3 and 12, respectively, served thereby is effected via a single common cable 27 as shown in fig. 1, which as mentioned incorporates two power supply lines 27a and 27b and a single data communication line 27c, connected with terminals 19,20 and 21, respectively. Preferably, the operator units 3, 12 of the same sub-group are connected in parallel to the common cable 27. Individual cabling for each operator unit of a sub-group is also possible, however, but will involve substantially more resources, e.g. more cable length.

[0034] The structure of the cabling with the cable 27 including three lines only, i.e. two power supply lines and a single communication line has been found to provide a good compromise between complexity of communication, which would increase with two lines only, and cabling costs, which would increase with additional lines.

[0035] In the illustrated preferred embodiment the DC power supplied from the interface unit 6 to the operator units 3 comprises balanced positive and negative voltages and the data communication on the single communication line 27c is effected at the reference voltage level $(V^+ - V^-)/2$ of the positive voltage V^+ and the negative voltage V^-. Thereby, common mode noise is suppressed and the data communication is made independent of voltage drops caused by the motor current. In result, the communication will be less prone to errors.

[0036] As an example, if the minimum voltage requirement of the electrical drive motor of each of operator units 3 as used in the preferred embodiment is 18V, the voltages on the two power supply lines 27a and 27b for each sub-group of operator units from the interface unit 6,7 should preferably be at least +10 V and -10 V, respectively. In view of the accumulated voltage drop on the power supply line 15 from the central power supply unit 5 to the interface unit 6,7 and the power supply lines 27a and 27b from the interface unit 6,7 to operator unit 3 an appropriate level of the DC power supply delivered by the central power supply unit would be 24 V in order to allow for a desirable maximum length of the power supply lines, e.g. up to 50 meters.

[0037] With this power supply the communication line 27c for each sub-group of operator units 3 may be operated well within the balanced supply voltages of +10 V and -10 V, respectively. Typically, the voltage difference between high and low states on the communication line could be 4 V to provide a treasonable compromise between the need for noise immunity, which might not be satisfactory at lower voltages, and the demands on communication line drivers, which would increase at higher voltages.

[0038] For compliance with stringent safety regulations requiring all ventilation members of a natural ventilation system to be operable for opening and/or closing in emergency situations caused e.g. by smoke or excessive heat developed during a fire, even in case of interruption of the power supply from the central power supply means, the interface unit 6 comprises, in the illustrated preferred embodiment a separate interface 28 for communication with an emergency and hazard control system, which as schematically shown in fig. 1 may comprise a hazard control unit 29 and emergency power supply means 30, such as a battery.

[0039] A suitable emergency and hazard control system is disclosed in applicants international patent application WO 03/001123, published 3 January 2003, the disclosure of which is incorporated herein by reference.

[0040] Each of the electrical window operator units 3 controlled by an interface unit 6 or 7 is designed, in general, as an autonomous unit comprising all electronic circuitry needed to receive instructions to move a window from one position to another, control the current for the energizing motor for the window movement, and continuously generate position and/or status information with respect to the actual position of the windows.

[0041] As an example, fig. 3 shows a block diagram illustrating electronic components and circuitry of an embodiment of an

electrical window operator unit 3 suitable for use in method and system according to the invention.

[0042] In the illustrated embodiment the operator unit, representing a unit 3 as shown in fig. 1 for opening and closing of a movable member such as a wing or sash part of an openable window between a closed position with respect to the stationary window frame and an open ventilation position, comprises a microprocessor 31 controlling the pulse width modulation of a PWM modulated driver stage 32 for a reversible electric dive motor of the unit (not shown) via two direction lines 32a and 32b controlling the polarity of the output motor current and thereby the sense of rotation of the drive motor. The operator unit 3 further includes a position detector 37 for generation of a position signal representative for the actual position of the movable member operated by the unit 3, such as the wing of sash part of an openable window. To accomplish this the detector may be adapted for detection e.g. of impulses from tacho means or similar means for detection of rotary movement of a rotary shaft of the drive motor or a transmission between the drive motor and the motion transfer member such as an operator chain connecting the movable member with its associated frame structure.

[0043] Various information needed for the communication between the interface unit 6,7 and the operator unit 3 is stored in memory means provided in the operator unit 3, e.g. in the form of an EEPROM 33. The information stored in the memory means 33 may comprise identification data comprising a unique factory-set serial number assigned to each individual operator unit 3 under control of the central ventilation system computer 4 as well as a shortened communication ID, which may be loaded during initial set-up of the system and need only be distinctive for each operator of the sub-group or sub-groups served by the same interface unit 6,7. Typically the stored information will further include parameter information essential to the function of the operator unit.

[0044] As communication interface means for conduct of the exchange of communications with the interface unit 6/7 the operator unit 3 comprises a receiver 34 and a transmitter 35 connected between the single communication line 27 c and the microprocessor 31.

[0045] Further connected with the microprocessor 31 is in the illustrated embodiment a measuring circuit 36 for measuring the momentary motor current. Thereby, detection of an increase in the motor current indicating blocking of the motor, caused e.g. by the movable member operated by the operator unit 3 having reached an end position or having been stopped in its movement by an obstacle may be processed in the microprocessor 31 and communicated to the interface unit 1, which in response may take appropriate action and may communicate appropriate commands back to the microprocessor 31 in the actual operator unit 3 as well as to other operator units belonging to the same sub-group and being associated with the same movable member as the actual operator unit.

[0046] As mentioned the transfer member for effecting movement of the movable member such as a wing or sash part of an openable window between its closed position and a ventilating position may typically comprise a chain having one end connected with a coupling fixture secured to the movable member or the corresponding stationary frame member thereof and the other end engaged by a sprocket wheel accommodated in the operator unit, which is secured to the other of the movable member and the stationary frame member, said sprocket wheel being driven by the electric drive motor of the operator unit via a suitable transmission.

[0047] As mentioned the actual position of the movable member may be obtained by means of a position signal obtained in the position detector 37. The position signal may be provided e.g. by atacho arrangement responding to rotation of any rotary member in the transmission between the drive motor and the transfer member for detection of the current speed of movement of the movable member. From the position detector 37 this position signal may be communicated to the microprocessor 31 together with a signal representing the current direction of movement of the movable member for generation of an overall position signal representing the current position of the movable member with a resolution of approximately 1 mm, by comparing the current speed and direction data with the position signal generated from the latest preceding position signal.

[0048] In the normal course of operation the current speed and direction of the drive motor of the operator unit 3 will be determined by the microprocessor 31 by controlling the pulse width modulation in the PWM driver stage 32 in response to target position and target speed data included in a command received from the interface unit 6/7 as well as the current speed data provided by the position detector 37. This control process is autonomous in the sense that the interface unit will as such only become involved in this control, if need arises to readjust the target speed early communicated to an operator unit on the basis of the position and/orstatus information communicated to the interface unit from all operator units 3 belonging to the same sub-group of operator unit serving the same movable member.

[0049] Whereas the explanation given so far of the structure of the operator unit has been exclusively directed to an operator unit for opening and closing of a movable member it should be noted that to a substantial extent the diagram in fig. 3 will apply

also an operator unit 12 as shown in fig. 1 for locking and unlocking a movable member such as window wing or sash part with respect to its stationary frame structure. Thus, an operator unit of this type will comprise a microprocessor, a memory and communication interface means as shown in fig. 3 as well as a reversible drive motor for operation of a locking mechanism such as a conventional pasquil mechanism and a measuring circuit for sensing the motor corrent. The drive motor would not need, however, to be adjustable in speed, but could be a conventional reversible DC motor. Moreover, as the position information required by the interface unit 6,7 may in some cases be limited to the actual locking status of a movable member, i.e. an indication of the movable member being either in a locked or an unlocked position, the structure and function of the position detector 37 in fig. 4 may be adapted accordingly.

[0050] For both types of operator units the communication with the interface unit 6,7 is preferably conducted as an asynchronous serial transmission on the single communication line 27c.

[0051] As illustrated in the simplified graphic representation in fig. 4 each communication is effected in the form of a telegram comprising 5 bytes B1 to B5 each containingten bits including one start bit and one stop bittogether with eight data bits. Moreover each communication is initiated by the interface unit 6,7 and is directed towards one ormore of the operator units in communication with it.

[0052] In order to allow communication of sufficient data to all operator units of a single sub-group connected with the same single communication line 27c, which as mentioned may comprise a maximum of four operator units 3 for opening and closing of a movable member together with one or two operator units 12 for locking and unlocking, in a timely fashion, the transmission rate for the asynchronous transmission is preferably selected to 9600 Baud. As this transmission rate equals 104 µs per bit the length of the telegrams or data packets can be kept small, e.g. of the order of 5 ms, and with appropriate pauses between successive telegrams, which should generally be longer than the telegrams, it is possible in this way to communicate e.g. target position and target speeds to all four operator units 3 of a single sub-group within a total time frame of 140 ms.

[0053] The selection of a relatively low transmission rate is preferred to limit demands on communication drivers and the microprocessors in the interface unit and the operator unit and reduce the risk of transmission errors, since a time frame of 140 ms for a total communication sequence for a sub-group of operator units would enable relatively simple and safe communication recovery in case of a communication error. Moreover the relatively long pauses between successive telegrams will facilitate detection of the start of each telegram in the operator units and will also provide for sufficient time in the operator units as well as the interface unit for the performance of other tasks allocated to them.

[0054] With the preferred transmission rate of 9600 Baud it will be possible to transmit communications over cable lengths up to about fifty meters with use of suitable communication drivers in the interface unit.

[0055] In the physical conduct of a transmission the interface unit may generate a 10 mA pull-up signal for the communication line 27c. Subsequently, low signal values on the communication line 27c may be generated both by the interface unit 6,7 or the operator unit 3 by means of a 20 mA pull-down current from either of these. These current levels enable the drive of input and cable capacitances. In order to provide short circuit protection and for limiting the voltage swing between high and low states, the output current is reduced, when the communication line is out of the ordinary operation range.

[0056] The initiation of each telegram transmission from the interface unit has the significant advantage that the available processing resources of the interface unit would not have to be spent on constantly monitoring the communication lines 27c for the various sub-groups of operator units for incoming communication.

[0057] In the graphic representation in fig. 4 three examples of five byte telegrams, that may be communicated from the interface unit 6,7 on a communication line, are illustrated at a), b) and c), respectively. In all three examples two of the five bytes, namely the second and the last byte B2 and B5 are used for CRC check sum control to allow detection of communication errors. In each byte of a telegram the start bit is set by the interface unit, whereby the workload on the microprocessors of the interface unit will be reduced.

[0058] The telegram example illustrated at a) in fig. 4 is a "read word" type telegram, which is used in connection with a command transmitted to an operator unit requesting the unit to return information in the form of a complete data word including 16 bits, which in the telegram will occupy two bytes. Examples of the use of this type of command would be a command containing a request to the operator to return information about the current position of the movable member as stored in the memory 33 of the operator, which request must be contained in the first byte B1 of the telegram. Moreover this command may be used in connection with initial set-up the system configuration. As already mentioned the operator units are provided in this situation with

a unique factory-set serial number code stored in the memory 33. By means of a single communication to the operator units of all sub-groups connected with it, the interface unit 6,7 may by use of the telegram type illustrated at a) request each operator unit to return its factory-set serial number code, which may be a 16 bit word. On the basis of the serial numbers thus returned from all operator units the interface unit may allocate to each of the operator units connected with it a shortened individual communication ID including a number of bits, e.g. four bits for a maximum number of sixteen operator units, which will fit within a single byte of all telegrams to be communicated subsequently. The allocation of such communication ID's may take place by bit-wise arbitration of the factory-set serial numbers returned from the operator units to the interface unit.

[0059] The use of a shortened individual command ID is a significant advantage for economizing the communication.

[0060] The telegram example illustrated at b) in fig. 4 is a "read byte" type command for use, when an identified operator unit should be requested to return information of a quantity fitting in a single byte of the telegram. In this case the request with identification of the type of information to be returned will be contained in the first data byte of the telegram, i.e. the third byte B3.

[0061] Finally the telegram example illustrated atc) in fig. 4 is a "write" type command, which is typically used, when the interface unit 6,7 communicates target position and target speed information to an operator unit.

[0062] When two or more operator units 3 of the same sub-group are used concurrently for movement of a single movable member, the control of such operator units 3 is coordinated in accordance with the invention and is, thus synchronised to avoid unnecessary mechanical stress on the window or overload on the motor and mechanical parts in the operator units 3.

[0063] In this respect, an interface unit 6,7 will receive position information from the operator units 3, e.g. by way of a "read word" type command illustrated in fig. 4 a) at regular intervals. If the position information reveals that one of operator units 3 of the sub-group is lacking behind, the interface unit 6,7 will transmit a new lower target speed to the other operator units 3 of the sub-group, whereby allowing the operator unit 3 lacking behind to catch up with the others.

[0064] Within the framework of the invention the interface unit 6,7 may retrieve other important status information from operator units 3 connected with it. Such information could include momentary motor current, whereby in response to a sudden increase in motor current in an operator unit, the interface unit may instruct the microprocessor of the operator unit to reduce the duty cycle of the motor current and coordinate this measure with other operator units of the same sub-group to keep all the involved operator units 3 synchronized.

REFERENCES CITED IN THE DESCRIPTION

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Patentkrav

1. Fremgangsmåde til styret betjening af bevægelige dele ved kommunikation af betjeningskommandoer fra centrale og/eller decentrale styremidler (4,16) til operatørenheder (3) til bevægelse af nævnte bevægelige dele, hvilken fremgangsmåde omfatter

- koordinering af en samtidig betjening af betjeningsenheder i en undergruppe (1,2, 8-11) af betjeningsenheder (3) knyttet til en enkelt bevægelig del via et interface (6,7) forbundet mellem nævnte undergruppe og nævnte centrale og/eller decentrale styremidler (4,16),
- hvor nævnte koordinering omfatter kommunikation af en betjeningskommando til nævnte enkelte bevægelige del fra nævnte centrale og/eller decentrale styremidler (4,16) til nævnte interface (6,7),
- generering af aktuel positions- og/eller statusinformation i hver betjeningsenhed (3) af ovennævnte undergruppe,
- kommunikation af nævnte positions- og/eller statusinformation fra betjeningsenheden (3) til nævnte interface (6,7), og
- anvendelse af nævnte positions- og/eller statusinformation ved nævnte interface (6,7) til kommunikation af koordinerede individuelle styrekommandoer til betjeningsenheder (3) i den nævnte undergruppe (1,2,8-11) som reaktion på den nævnte betjeningskommando til den enkelte bevægelige del,

hvori kommunikation mellem alle betjeningsenheder i undergruppen og nævnte interface sker på en enkelt kommunikationslinje (27c), **kendetegnet ved, at**

- kommunikation mellem interface (6,7) og hver betjeningsenhed (3) i en undergruppe (1,2,8-11) udføres som asynkron datakommunikation på nævnte enkelte kommunikationslinje (27c),
- at elektrisk effekt til betjeningsenhederne (3) i en undergruppe (1, 2, 8-11) tilføres fra mindst en central strømforsyningsenhed (5) via interfacet (6,7), der betjener undergruppen, hvilken elektriske effekt tilføres betjeningsenhederne (3) i form af balancerede positive og negative jævnstrømsspændinger på to forsyningslinjer (27a, 27b), og
- at den asynkrone datakommunikation på den enkelte kommunikationslinje (27c) udføres ved et referencespændingsniveau af de positive og negative jævnstrømsspændinger.

2. Fremgangsmåde ifølge krav 1, **kendetegnet ved, at** kommunikation mellem interface (6,7) og hver betjeningsenhed (3) i en undergruppe (1,2,8-11) igangsættes fra nævnte interface.

3. Fremgangsmåde ifølge krav 1 eller 2, **kendetegnet ved, at** kommunikation mellem interface (6,7) og hver betjeningsenhed i en undergruppe (1,2,8-11) udføres i form af et kommunikationstelegram, der indeholder et begrænset antal bytes, hvoraf mindst en indeholder identifikationsdata til betjeningsenheden.

4. Fremgangsmåde ifølge et hvilket som helst af kravene 1-3, **kendetegnet ved, at** betjeningskommandoer til betjening af hver enkelt bevægelig del kommunikeres fra nævnte centrale styremiddel (4) til nævnte interface (6,7), der betjener undergruppen (1,2,8-11) af betjeningsenheder (3,12) knyttet til nævnte bevægelige del via en fælles kommunikationsbus (14).

5. Fremgangsmåde ifølge et hvilket som helst af kravene 1-3, **kendetegnet ved, at** en betjeningskommando til betjening af en bevægelig del kommunikeres til nævnte interface (6,7) fra et decentralt styremiddel (16).

6. Fremgangsmåde ifølge et hvilket som helst af kravene 1-5, **kendetegnet ved, at** som reaktion på kommunikation af en betjeningskommando til den enkelte bevægelige del fra nævnte centrale og/eller decentrale styremidler (4,16) genererer nævnte interface (6,7) en styrekommando omfattende en positionsmål og hastighedsmål for betjeningen og kommunikerer nævnte styrekommando til hver betjeningsenhed (3) i nævnte undergruppe (1,2,8-11), og at der afhængig af positions- og/eller statusinformation modtaget fra betjeningsenhederne (3,12) efterfølgende kommunikeres nye individuelle styrekommandoer indbefattende ændringer i nævnte hastighedsmål, der er nødvendige for at sørge for en synkroniseret samtidig betjening af nævnte betjeningsenheder (3), via nævnte interface (6,7) til individuelle betjeningsenheder (3) i nævnte undergruppe (1,2,8-11).

7. Fremgangsmåde ifølge et hvilket som helst af kravene 1-6, **kendetegnet ved** det yderligere skridt at koordinere via nævnte interface (6,7) den samtidige betjening af betjeningsenheder i en undergruppe til bevægelse af den bevægelige del knyttet dertil med fortløbende betjening af en yderligere be-

tjeningsenhed (12) i undergruppen til fastlåsning og oplåsning af nævnte bevægelige del i dets lukkede position.

8. Styresystem til betjening af bevægelige dele, hvilket system omfatter betjeningsenheder (3) til bevægelse af nævnte bevægelige dele og centrale og/eller decentrale styremidler (4,16) til kommunikation af betjeningskommandoer til nævnte betjeningsenheder,
hvori der for mindst en bevægelig ventilationsdel sørges for en undergruppe (1,2,8-11) af tilknyttede betjeningsenheder (3), og
et interface (6,7) fælles for betjeningsenhederne (3) i undergruppen (1,2,8-11) er forbundet mellem hver betjeningsenhed (3) i undergruppen (1,2,8-11) og nævnte centrale og/eller decentrale styremidler (4,16) til koordineret samtidig betjening af de tilknyttede betjeningsenheder (3,12),
hvor hver tilknyttet betjeningsenhed (3) omfatter midler til generering af aktuelle positions- og/eller statusinformation for nævnte bevægelige del,
kendetegnet ved, at
- nævnte interfaceenhed (6,7) omfatter mikroprocessormidler indrettet til at modtage nævnte betjeningskommandoer fra nævnte centrale og/eller decentrale styremidler (4,16) og nævnte aktuelle positions- og/eller statusinformation, og
- til at kommunikere koordinerede individuelle styrekommandoer til betjeningsenhederne (3) i undergruppen som reaktion på nævnte betjeningskommando og nævnte positions- og/eller statusinformation,
- hvori al kommunikation mellem nævnte interfaceenhed (6,7) og alle betjeningsenheder (3) i nævnte undergruppe (1,2,8-11) sker på en enkelt kommunikationslinje,
- hvori interfaceenhedens (6,7) mikroprocessormidler er indrettet til kommunikation af styrekommandoer til betjeningsenhederne (3) og nævnte positions- og/eller statusinformation fra betjeningsenhederne ved asynkron datakommunikation via nævnte enkelte kommunikationslinje (27c),
- hvori interfaceenheden (6,7) omfatter midler til at levere strøm til hver betjeningsenhed (3) i undergruppen (1,2,8-11) som balancerede positive og negative jævnstrømsspændinger på nævnte strømforsyningsledninger (27a,27b), og
- hvori interfaceenheden (6,7) omfatter midler til at udføre nævnte datakommunikation på nævnte enkelte kommunikationslinje (27c) ved et referencespændingsniveau for nævnte positive og negative jævnstrømspændinger.

9. Styresystem ifølge krav 8, **kendetegnet ved, at** interfaceenheden (6,7) er forbundet med nævnte centrale styremiddel (4) via en kommunikationsbus (14) fælles for et antal interfaceenheder (6,7).

10. Styresystem ifølge krav 8 eller 9, **kendetegnet ved, at** interfaceenheden (6,7) er forbundet med mindst et decentralt styremiddel (16), der specifikt er tildelt nævnte enkelte bevægelige del.

11. Styresystem ifølge et hvilket som helst af kravene 8-10, **kendetegnet ved, at** interfaceenheden (6,7) er forbundet med mindst en central strømforsyningsenhed (5) til at levere strøm til betjeningsenhederne (3) i undergruppen (1,2,8-11) og er forbundet med hver af nævnte betjeningsenheder (3) via to strømforsyningsledninger (27a,27b).

12. Styresystem ifølge et hvilket som helst af kravene 8-11, **kendetegnet ved, at** hver betjeningsenhed (3) i undergruppen (1,2,8-11) omfatter midler til at sætte et positionsmål til bevægelse af nævnte bevægelige del i det enkelte ventilationselement og midler til at indstille et hastighedsmål til bevægelse af nævnte bevægelige del imod nævnte positionsmål, og at mikroprocessormidlerne i interfaceenheden (6,7) er indrettet til at indbefatte positionsmål- og/eller hastighedsmåldata i styrekommandoer kommunikeret til nævnte betjeningsenheder (3,12).

13. Styresystem ifølge et hvilket som helst af kravene 8-12, **kendetegnet ved, at** mindst en undergruppe foruden nævnte betjeningsenheder (3) til bevægelse af det enkelte bevægelige element knyttet til undergruppen omfatter en yderligere betjeningsenhed (12) til fastlåsning og oplåsning af nævnte bevægelige del i dets lukkede position, hvor en fortløbende betjening af nævnte yderligere betjeningsenhed (12) er koordineret med nævnte samtidige betjening af betjeningsenhederne (3) til bevægelse af nævnte enkelte bevægelige del.

DRAWINGS

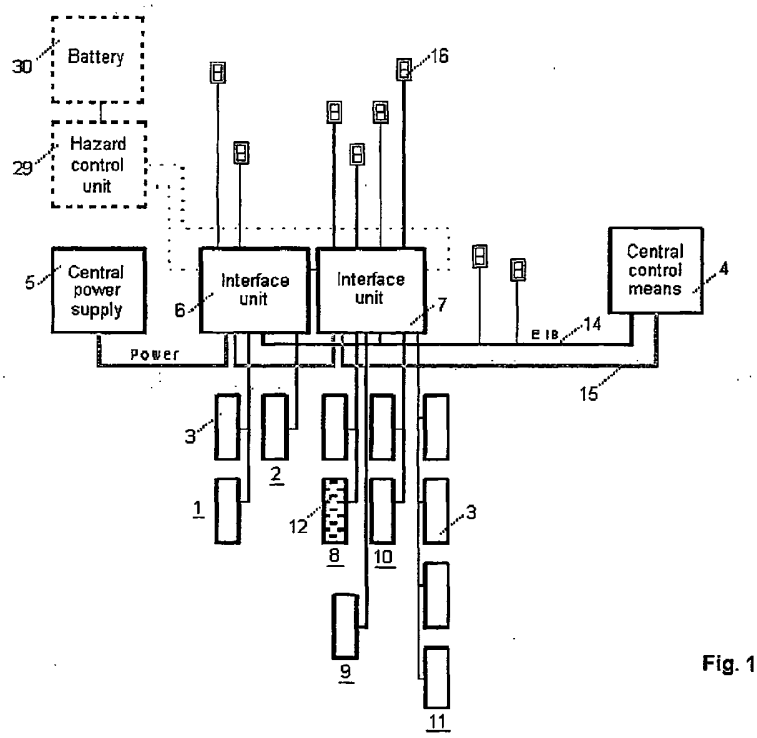


Fig. 1

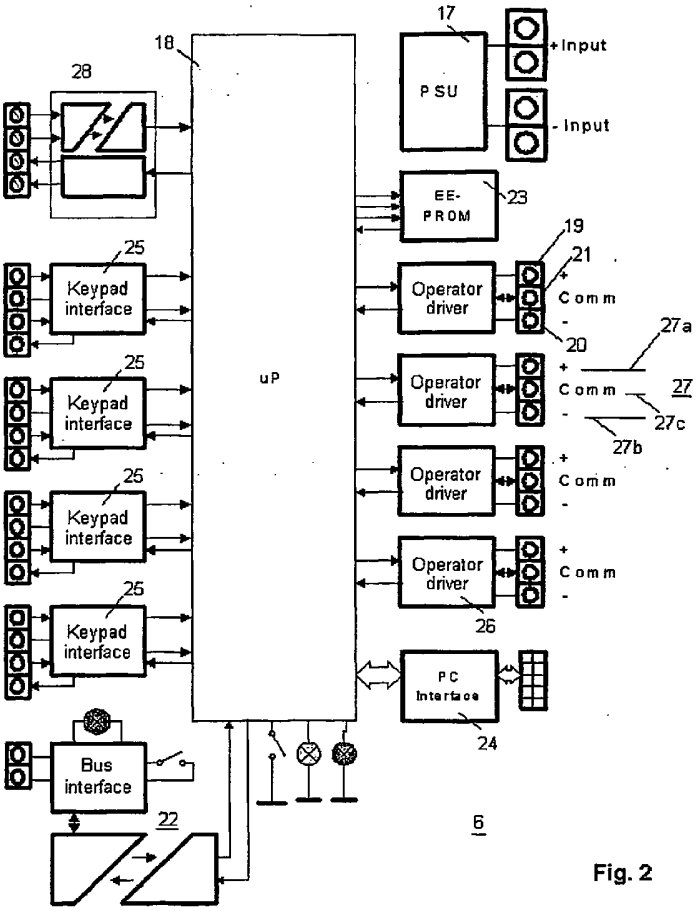

18
28
17
PSU
+ Input
- Input
EE-
PROM
23
19
21
Comm
20
27a
27
27c
27b
25
Keypad
interface
uP
Operator
driver
26
PC
Interface
24
Bus
interface
22
6

Fig. 2

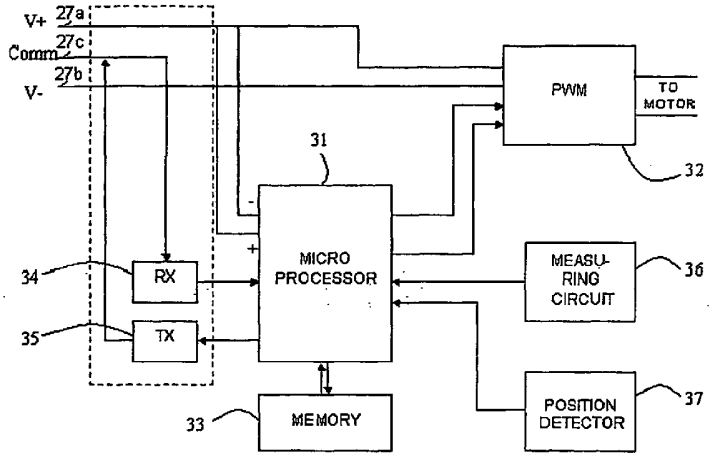

V+
27a
Comm
27c
27b
V-
PWM
TO MOTOR
31
32
MICRO PROCESSOR
MEASU-RING CIRCUIT
36
34
RX
35
TX
33
MEMORY
POSITION DETECTOR
37

Fig. 3

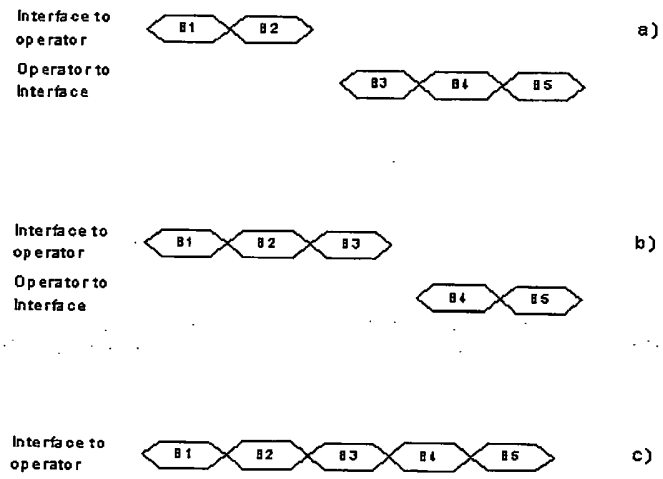

Interface to operator
B1
B2
a)
Operator to Interface
B3
B4
B5
Interface to operator
B1
B2
B3
b)
Operator to Interface
B4
B5
Interface to operator
B1
B2
B3
B4
B5
c)

Fig. 4