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(54) **Lift control system**

(57) A control system for a lift system having a lift car and a lift motor to move said car between a plurality of floors, wherein the control system comprises a plurality of control nodes, one of said control nodes comprising a lift controller, said control nodes being commu-

nicatively connected by a communication means, said lift controller being operable in response to messages received from others of said control nodes by said communication means to operate said lift motor, wherein the communication means comprises a serial connection.

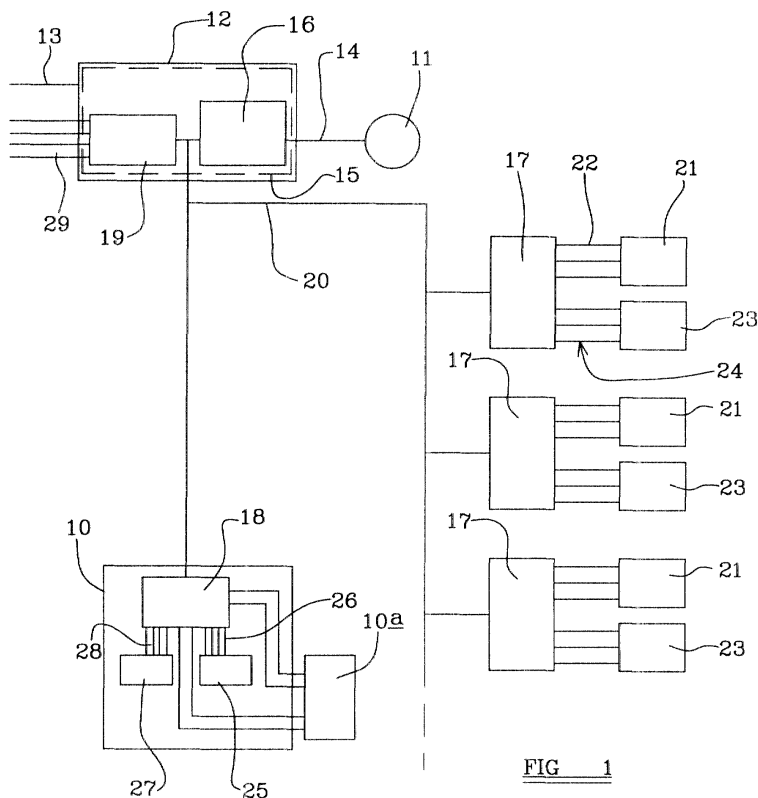


FIG 1

Description

Description of Invention

[0001] This invention relates to a lift control system.

[0002] A lift system conventionally comprises a car, a lift motor operable to raise or lower the car and a lift control system to operate the lift motor to raise or lower the car. Conventionally, a manually operable control is provided in the car and at each of a plurality of floors served by the lift, and each such control is connected by an individual pair of wires to the lift control system. Such a wiring configuration is particularly complex, and in the case of controls provided in the lift car, a trailing cable must be attached to the car to carry the connecting wires from the controls to the lift control system. Where the lift has a very large number of controls this leads to a particularly heavy wiring cable being attached to the car and because such a trailing cable is continuously flexing, an expensive cable type is required to prevent the cable fracturing.

[0003] According to a first aspect of the present invention, we provide a control system for a lift system having a lift car and a lift motor to move said car between a plurality of floors, wherein the control system comprises a plurality of control nodes, one of said control nodes comprising a lift controller, said control nodes being communicatively connected by a communication means, said lift controller being operable in response to messages received from others of said control nodes by said communication means to operate said lift motor, wherein the communication means comprises a serial connection.

[0004] Said serial connection may comprise a two wire serial link.

[0005] One of said control nodes may comprise a car node adapted to be provided in said lift car.

[0006] At least one of said control nodes may comprise a landing node adapted to be disposed at one of said plurality of floors.

[0007] At least one of said control nodes may comprise an input means and be operable to transmit a message via said communication means in response in an input received from said input means.

[0008] At least one of said control nodes may comprise an output means and may be operable to send an output on said output means in response to a message received via said communication means.

[0009] Said at least one landing node may comprise an input means comprising a lift call means and may be operable to transmit a message to said lift controller in response to said lift call means being operated.

[0010] Said at least one landing node may comprise an output means comprising a display means and said landing node may be operable to illuminate said display means in response to a message received by said landing node.

[0011] Said car node may comprise an input means

comprising a floor selection means, said car node being operable to transmit a message to said lift controller via said communication means in response to operation of said floor selection means.

[0012] Said car node may comprise an output means comprising a display means and said car node may be operable to illuminate said display means in response to a message received from said lift controller via said communication means.

[0013] One of said control nodes may comprise an ancillary node, wherein said ancillary node comprises at least one input connected to a monitoring means, and wherein said ancillary node may be operable to transmit a message via said serial connection to said lift controller in response to an input received from said monitoring means.

[0014] Each message transmitted by said serial connection may comprise a first header part and a second data part, wherein the first part identifies the control node for which the message is intended, and the second part may comprise information to be transmitted to said control node.

[0015] Each control node may be responsive only to a message wherein the first part identifies said control node.

[0016] The lift control system may comprise a motor controller to control said lift motor wherein said lift controller may be provided integrally with said motor controller.

[0017] Said control nodes may comprise a plurality of inputs, each of said inputs being connected in parallel to said control node.

[0018] Said control nodes each may comprise a microprocessor.

[0019] Said lift controller may comprise a microprocessor comprising a computer memory and a lift control program.

[0020] According to a second aspect of the invention, we provide a lift system comprising a lift car, a lift motor operable to move said lift car between a plurality of floors and a lift control system, wherein the lift control system comprises a control system according to the first aspect of the invention.

[0021] The invention will now be described by way of example only with reference to the accompanying drawings wherein

Figure 1 is a diagrammatic view of a lift control system according to the present invention,

Figure 2 is a diagram of a message structure of the lift control system of Figure 1, and

Figure 3 is a flow chart of a method of operation of the lift control system of Figure 1.

[0022] Referring now to Figure 1, a lift control system according to the present invention is provided in a lift system comprising a lift car 10 comprising motor-operated doors 10a to serve a plurality of floors and a lift

motor 11 operable to move said lift car between said plurality of floors. A motor controller 12 is provided connected to an electricity supply 13 and connected to said motor 11 by an electrical connection 14.

[0023] Provided in the motor controller 12 is a lift control unit 15 comprising a control node comprising a lift controller 16. At each of a plurality of floors served by said lift car 10 there is provided a further control node comprising a landing node 17, whilst a further control node comprising a car node 18 is provided in the lift car 10. The lift control unit 15 is further provided with an ancillary node 19. The lift controller 16, landing nodes 17, car node 18 and ancillary node 19 are interconnected by a communication means comprising a serial connection 20. The serial connection 20 in the present example comprises a two-wire serial link.

[0024] Connected to each of said landing nodes 17 is an input means 21 comprising in this example lift call buttons which are manually operable to summon said lift car 10 to the floor at which said landing node is provided. The input means 21 is connected by parallel connections 22 to the landing node 17. The landing node 17 is further provided with output means 23, comprising in the present example an illuminated display, which is connected by parallel connections 24 to said landing node 17. Any or all of said landing nodes 17 may be similarly provided with input means and/or output means as required.

[0025] The car node 18 is similarly provided with input means 25, comprising a floor selection means which is manually operable to indicate the floor to which the lift car 10 is required to be moved, connected by parallel connections 26 to said car node 18. The car node 18 is further be provided with output means 27 comprising an illuminated display connected in parallel by parallel connections 28 to said car node 18. Said car node 18 is also comprises an output means operable to control the doors 10a of said lift car 10, for example by controlling suitable motors to open and close said doors 10a and input means comprising sensors responsive to the position of lift doors 10a.

[0026] The ancillary node 19 comprises a plurality of parallel input means 29 connected to appropriate safety sensors or other inputs, for example safety monitor circuits, locks, disabling inputs to prevent operation of the lift motor, or any other input as desired.

[0027] The electrical supply 13 in the present example comprises a three-phase 415 volt alternating current supply, and the electrical connection 14 to the motor 11 similarly comprises a three-phase 415 volt alternating current supply controlled by the motor controller 12.

[0028] The control nodes 16, 17, 18, 19 communicate with one another via the serial connection 20 using an appropriate serial communication protocol. In the present example, the CAN protocol is used, developed for use in the automotive industry but generally used in other applications. Of course, any suitable communications protocol may be used as desired.

[0029] When a control node 16, 17, 18, 19 wishes to transmit a message via the serial connection 20, a message is sent having the structure shown in Figure 2. Each message consists of a first, header part 30 and a second data part 31. The header part 30 identifies the control node 16, 17, 18, 19 to which the message is directed. The second data part 31 comprises the message to be sent to the control node 16, 17, 18, 19 identified in the first header part 30, which may be information to be transmitted or instructions to carry out an operation. Each control node is responsive only to those messages in which that control node is identified in the first, header part 30. To confirm the validity of the message, the message may comprise a third part 32 comprising a checksum based on the preceding message to ensure that the message is correctly transmitted. In the CAN protocol, the first, header part comprises 11 data bits and the second, data part 31 may comprise up to 8 bytes (64 bits) of information.

[0030] Each of the landing control nodes 17, car node 18 and ancillary node 19 comprise a microprocessor which acts as a serial-to-parallel and parallel-to-serial information converter with on-board intelligence to perform the conversion appropriately. The lift controller 16 comprises a microprocessor on which a lift control program is provided and a computer memory. The lift control program is operable to transmit control instructions on the serial connection 20 to the landing nodes 17 and car node 18 and control supply of electricity on connection 14 to the motor 11 in response to the information transmitted on the serial connection 20 by the landing nodes 17, car node 18 and ancillary node 19.

[0031] The method of operation of the lift control program is shown in Figure 3. In the present example, the lift control program is written in the proprietary programming language SYPT, although it will be apparent that the program may be written in any desired language. The control program comprises a main program responsive to messages received on the serial connection 20 to operate the lift system, and a pair of background programs, one of which monitors the lift car position by feedback from a motor encoder and the other of which continuously transmits and receives messages from the serial connection 20.

[0032] In the present example, the lift position is determined by counting the number of pulses generated by the motor encoder ('the encoder count') as the motor is operated. At the lowest floor, the encoder count is taken to be zero. With the lift car is raised, the encoder count increments and when the lift car is lowered, the encoder count decrements. The encoder count thus gives the lift car position relative to the lowest floor. Of course, any appropriate method of monitoring the lift car position may be provided as desired.

[0033] To identify when the lift car is at floor level, suitable floor switches may be provided (not shown). In the present example, one or two magnetically responsive floor switches may be provided on the lift car and a mag-

net may be mounted at the landing floor level. When the floor switches are close to the magnet, the switches are actuated and a signal sent to the lift controller that the lift car is at floor level.

[0034] Referring to Figure 3, the lift control system is first initialised. The computer memory provided in the lift controller 16 is cleared, all outputs 23, 25 will be switched off and the operation of the motor 11 is inhibited. Communication via the serial connection 20 with the control nodes 17, 18, 19 is established, and the lift car is moved to a default floor, usually the lowest floor.

[0035] When the lift control system is initialised, the encoder count and floor switches may be calibrated. This is performed by moving the lift car once throughout its range of movement. The lift car is located at its default floor, the lowest floor, and the encoder count is set to zero. The lift car is then raised and when a magneto floor switch is operated, the encoder count corresponding to that floor is stored. The lift control system thus can identify when a lift is at floor level both by virtue of the floor switches and by operating the lift motor until the encoder count corresponds to the stored value for that floor.

[0036] After the control system is initiated, the lift control system is set to a quiescent state. The CAN protocol is a so called event-driven protocol, that is the lift controller 16 does not perform an operation until it receives a message from a control node 17, 18, 19. This in contrast to other known serial communications system wherein it is necessary for the controller to poll each control node to check whether any information is available. An event driven system as in the present example is advantageous for a lift control system as there may be long periods where any given control node is not active, for example when a lift is not used or when the lift is not called to a particular floor.

[0037] When a lift call button on a landing node input means 21 is pressed, the appropriate landing node 17 detects the button has been pressed by the appropriate connection 22 and transmits a message on the serial connection 20. The header of the message identifies that the message is intended for the lift controller 16, whilst the second data part 31 of the messages identifies the floor to which the car is being called and, optionally, the direction in which the car is desired to travel. The landing node 17 then illuminates the relevant output means 23 via the parallel connection 24, for example an illuminated halo around the lift call button. The lift control program in the lift controller 16 will identify the position of the call and initialise the lift motor 11. The lift motor 11 is then operated to raise or lower the car 10 until the car reaches the desired floor. When the car 10 approaches the floor to which it has been called, the lift controller 16 operates the lift motor 11 to slow the car 10, for example in response to the encoder count approaching the stored value corresponding to the desired floor. The program then monitors the lift position data received from the background tasks, and when the lift is at floor level as detected by a floor switch or from the

encoder count, the lift controller 16 stops operation of the lift motor 11 and transmits a message via the serial connection 20 to the car node 18 to open the car doors 10a. The car node 18 operates the appropriate parallel output connection to operate the doors 10a. The lift controller 16 further transmits a message to the landing node 17 to extinguish the output means 23.

[0038] When the doors are opened, the car node 18 detects the door position via an input means comprising an appropriate sensor, and transmits an appropriate message to the lift controller 16. A predetermined time period is allowed to elapse, whereupon the lift controller 16 transmits a message to the car node 18 to close the doors 10a. The car node 18 then operates the appropriate output to operate the doors and transmits an appropriate message to the lift controller 16 once the doors are detected as being in their closed position. The software program then loops back to its quiescent stage to await a message. If a person has entered the lift car 10, they will operate the input means 25, for example by pressing a button corresponding to the desired floor. The car node 18 will detect the input from the input means 25 and will transmit an appropriate message to the lift controller 16, which will then function as set out in Figure 3.

[0039] Typical messages transmitted from the car node 18 to the lift controller 16 may comprise lift control signals directing the lift car to a particular floor, whether the doors 10a are fully open or closed, floor switch information and appropriate messages where other controls are provided, for example an attendant call control or a priority key switch, and such a control has been actuated. Typical messages transmitted from the controller 16 to the car node 18 may include instructions to illuminate or extinguish the display means 27, open or close the doors 10a, or to cancel and inhibit all car calls from the input means 25.

[0040] Typical messages from the landing nodes 17 to the lift controller 16 will comprise reports on existing and new calls, for example when a plurality of buttons are pressed on the input means 21, and where further controls are provided, for example a security key switch or a fireman's switch, when such a control has been operated. The landing node may also transmit information on the status of the input means 21, for example if a lift call button is stuck in. The control means 16 may transmit appropriate messages to the landing nodes 17 such as instructions to extinguish the display means 23 and to cancel and inhibit all lift calls received from the input means 25.

[0041] Although the system is event driven, the lift control means 16 may further from time to time poll individual control nodes 17, 18, 19 to ensure that they are operating correctly.

[0042] In the present example, the motor controller comprises a UG77 controller supplied by Global Controls Inc. and the lift control unit 15 is provided on a microprocessor board provided integrally with said motor

controller 12. The control nodes 17, 18, 19 each comprise microprocessor which has a control program written in the language C held in a flash memory.

[0043] The ancillary control node 19 is provided in the present example because there are insufficient input on the lift controller 16. It may be envisaged that, where sufficient inputs are provided, the inputs 29 could be connected directed to the lift controller 16 and the ancillary control node 19 could be omitted.

[0044] In the present specification "comprise" means "includes or consists of" and "comprising" means "including or consisting of".

[0045] The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

Claims

1. A control system for a lift system having a lift car and a lift motor to move said car between a plurality of floors, wherein the control system comprises a plurality of control nodes, one of said control nodes comprising a lift controller, said control nodes being communicatively connected by a communication means, said lift controller being operable in response to messages received from others of said control nodes by said communication means to operate said lift motor, wherein the communication means comprises a serial connection.
2. A control system according to Claim 1 wherein said serial connection comprises a two wire serial link.
3. A control system according to Claim 1 or Claim 2 wherein one of said control nodes comprises a car node adapted to be provided in said lift car.
4. A control system according to any one of the preceding claims wherein at least one of said control nodes comprises a landing node adapted to be disposed at one of said plurality of floors.
5. A control system according to any one of the preceding claims wherein at least one of said control nodes comprises an input and is operable to transmit a message via said communication means in response in an input received by said input means.
6. A control system according to any one of the preceding claims wherein at least one of said control nodes comprises an output means and is operable to send an output on said output means in response to a message received by said via said communication means.
7. A control system according to Claim 5 or Claim 6 where dependent on Claim 4 wherein said at least one landing node comprises an input means comprising a lift call means and is operable to transmit a message to said lift controller in response to said lift call means being operated.
8. A control system according to any one of Claims 5 to 7 where dependent on Claim 4 wherein said at least one landing node comprises an output means comprising a display means and said landing node is operable to illuminate said display means in response to a message received by said landing node.
9. A control system according to any one of Claims 4 to 8 where dependent directly or indirectly on Claim 3 wherein said car node comprises an input means comprising a floor selection means, said car node being operable to transmit a message to said lift controller via a said communication means in response to operation of said floor selection means.
10. A control system according to any one of claims 3 to 9 wherein said car node comprises an output means comprising a display means, said car node being operable to illuminate said display means in response to a message received from said lift controller via said communication means.
11. A control system according to any one of the preceding claims wherein one of said control nodes comprises an ancillary node, wherein said ancillary node comprises at least one input connected to a monitoring means, and wherein said ancillary node is operable to transmit a message via said communication means to said lift controller in response to an input received on said monitoring means.
12. A control system according to any one of the preceding claims wherein each message transmitted by said serial connection comprises a first header part and a second data part, wherein the first part identifies the control node for which the message is intended, and the second part comprises information to be transmitted to said control node.
13. A control system according to Claim 12 wherein each control node is responsive only to a message wherein the first part identifies said control node.
14. A control system according to any one of the preceding claims comprising a motor controller to control said lift motor and wherein said lift controller is provided integrally with said motor controller

15. A control system according to any one of the preceding claims wherein at least one of said control nodes comprises a plurality of inputs, each of said inputs being connected in parallel to said control node.

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16. A control system according to any of the preceding claims wherein said control nodes each comprise a microprocessor.

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17. A control system according to Claim 16 wherein said lift controller comprises a microprocessor comprising a computer memory and a lift control program.

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18. A lift system comprising a lift car, a lift motor operable to move said lift car between a plurality of floors and a lift control system, wherein the lift control system comprises a control system according to any one of Claims 1 to 18.

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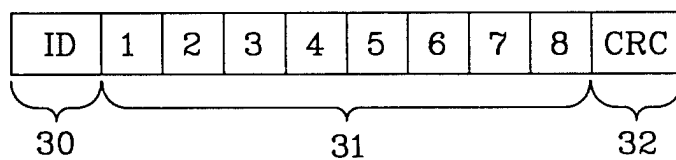
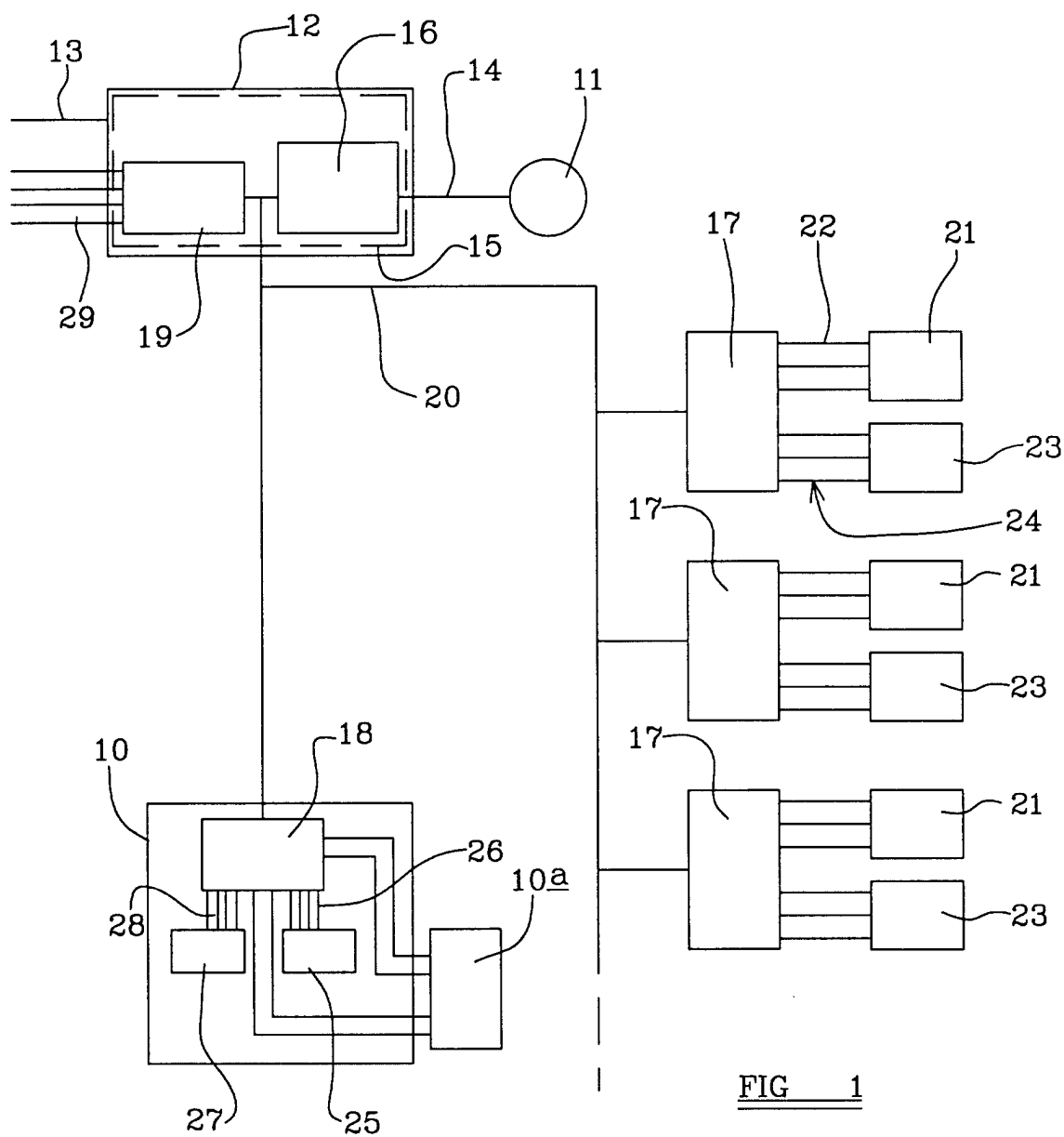
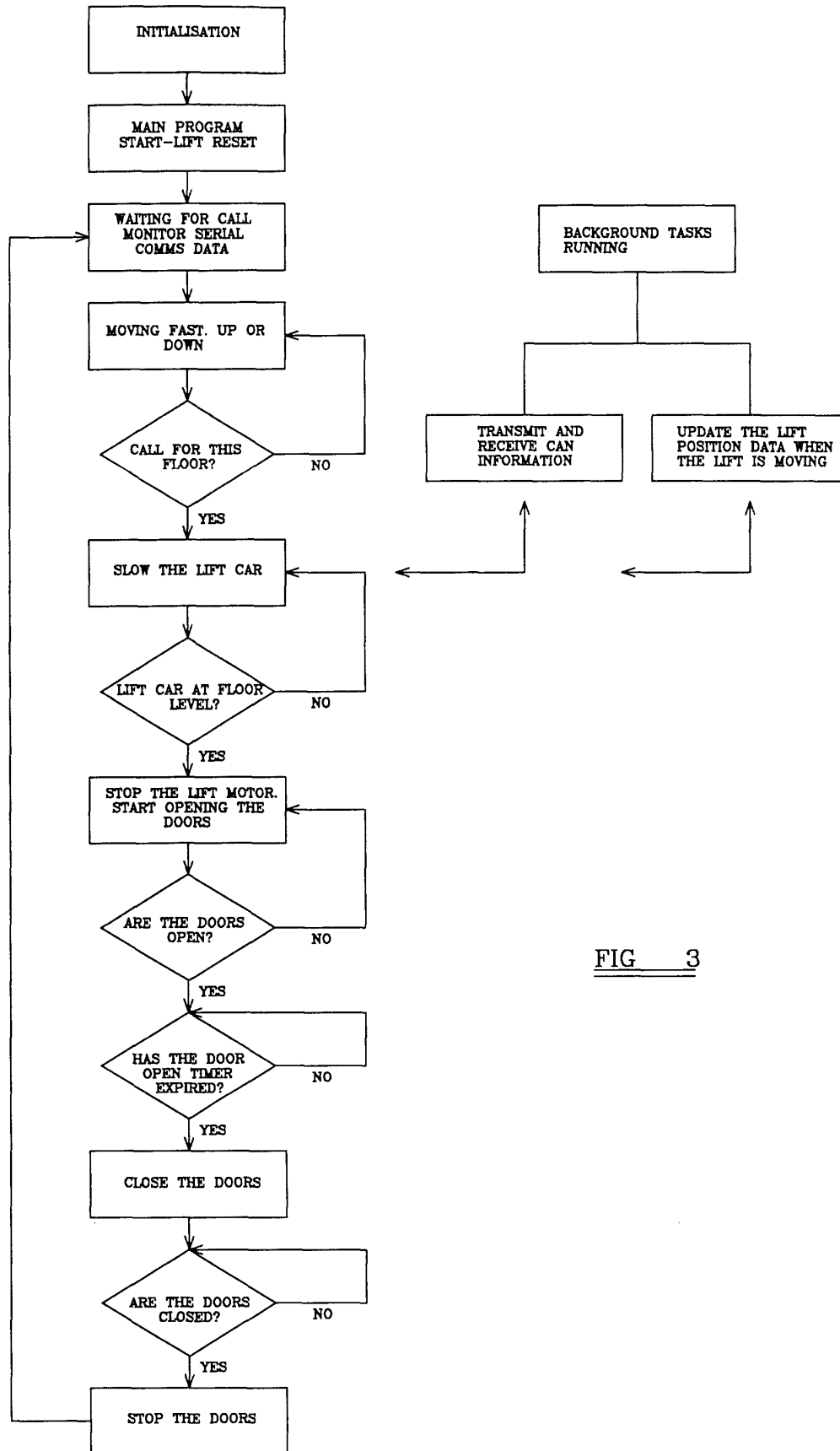


FIG 2

FIG 3