

SPECIFICATION

Cage position detecting apparatus

The present invention relates to a cage position detecting apparatus for an elevator which is controlled by a computer.

The detection of the cage position is indispensable for the operation of an elevator and is carried out by a floor selector.

Various floor selectors have been proposed.

Recently, it has been considered to utilize the operation of a computer. In this system, floor pass switches are placed on each floor to indicate the present position of the cage by an addition or subtraction operation for each floor which the cage passes.

The cage position signals obtained from the floor selectors are used for indicating the cage position with respect to the floors and for deciding when to stop the cage.

When there is a deviation between the detected cage position and the actual cage position, the elevator cannot be controlled properly. This can occur especially when the elevator operation is interrupted for servicing.

Even after the service interruption, it is impossible to operate the elevator normally. Thus, in such cases, the output of the floor selector has to be calibrated to the actual cage position. For example, when the output of the floor selector designates a final end floor (the top floor or the bottom floor), the cage is run to the final floor so as to make the stored position correct.

It is, however, difficult to avoid the costs resulting from the consumption of excess electric power and the requirement for a complicated circuit.

According to the present invention there is provided cage position detecting apparatus for storing the presumed present position of an elevator cage using a computer powered by a main power source, the apparatus having a first memory; an emergency power source operable to supply power to the first memory during an abnormal state such as a service interruption of the main power source; said first memory memorizing the presumed present position of the cage during said abnormal state; means for determining, after the abnormal state has ceased, whether the cage was running or stopped at the start of the abnormal state; a second memory storing data indicative of a predetermined floor; a detector for detecting when the cage is at said predetermined floor; and means operable

(i) to store the data of the second memory as the presumed present cage position when said detector indicates that the cage is at the predetermined floor;

(ii) to cause the cage to run to the predetermined floor if the stored presumed present position is said predetermined floor and said detector indicates that the cage is not at said predetermined floor;

(iii) after said abnormal state has ceased, to store the data in said first memory as the

presumed present cage position if said determining means determines that the cage was stopped at the start of the abnormal state; and (iv) after said abnormal state has ceased, to cause said cage to run to said predetermined floor if said determining means determines that the cage was running at the start of the abnormal state.

If desired, the first memory may also store data indicating whether or not the elevator cage was running at the start of the abnormal state.

Subsequently, this data is read out, and if the cage was not running prior to the abnormal state the memorized data for the cage position in the first memory is stored at the presumed present cage

position (referred to hereafter simply as the present cage position), whereas if the cage was running at the time of the abnormal state, the cage is forcibly run to the predetermined floor and the data in the second memory is then stored as the present cage position. Alternatively, the determining means can be arranged to determine that the cage was running if the cage was in an automatic operation mode and was situated between adjacent floors at the time of the abnormal state, and to determine that the cage was not running if the cage was in a manual operation mode, or if it was in an automatic operation mode and was situated at a floor at the start of the abnormal state.

Arrangements embodying the invention will now be described by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a block diagram of one embodiment of a cage position detector according to the invention;

Figure 2 is a block diagram of a further embodiment;

Figure 3 is a block diagram of a part of an elevator system having the cage position detecting apparatus shown in Figure 1;

Figure 4 is a more detailed diagram of the micro-processor system of the cage position detecting apparatus of Figure 1; and

Figure 5 is a block diagram showing further details of the embodiment of Figure 2.

Referring to Figure 1, a preferred embodiment of the present invention will be described.

In Figure 1, the reference numerals (101) to (105) designate the first to fifth floors of a building having an elevator system incorporating the apparatus of the invention; (101A) to (105A) designate cams placed at the first to fifth floors in the elevator hatchway; (106) designates a bottom floor detector comprising a switch which is placed at the bottom floor (first floor); (107) designates a top floor detector placed at the top floor (fifth floor); (108) to (111) designate cams placed between the first and second floors (101), (102), between the second and third floors (102), (103), between the third and fourth floors (103), (104) and between the fourth and fifth floors (104), (105); (112) designates an elevator cage; (113) designates a cam which is provided on the cage

(112) and actuates the bottom floor detector (106) at the bottom floor (101) and the top floor detector (107) at the top floor (105); (114) designates a floor detector comprising a switch which is actuated by the cams (101A) to (105A) when the cage (112) is at each of the first to fifth floors (101), (102), (103), (104), (105); (115) designates a floor pass detector which is actuated by the cams (108) to (111) when the cage (112) passes the floors; (116) designates a main rope for the cage; (117) designates a computer; (118) designates a central processing unit; (119) designates a read-only memory (ROM) which stores data representing the bottom floor position and the top floor position; (120) designates a writeable and readable memory (RAM) which stores the data representing the present cage position in a particular memory location; (121) designates a converter for converting the signal from the detectors into data for the computer (117); (122) designates a mode signal which is "H" during the automatic operation of the cage (112) and "L" during the manual operation; (123) designates lines for the address path and the data path; (124) designates a main power source; (125) designates an emergency power source; (126) designates a memory device for memorizing data representing the present position of the cage (112).

The operation of the embodiment will now be described.

The floor pass detector (115) is actuated by one of the cams (108) to (111) each time the cage (112) passes between floors and the output is received through the converter (121) so that the data representing the present position of the cage (112) is written by the central processing unit (118) in the RAM (120). During the ascent of the cage, the datum for one floor is added to the memorized data in the RAM (120). During the descent of the cage, the datum for one floor is subtracted from the memorized data in the RAM. This memorized data is used as the cage position signal for controlling the operation of the cage. This is well-known and will not be described in detail.

When the cage (112) stops at the bottom floor (101), the cam (113) actuates the bottom floor detector (106) whereby the bottom floor detector (106) outputs a signal. The output is received by the central processing unit (118) and the data representing the bottom floor position are read out from ROM (119) and written in the RAM (120) as the data for the present cage position. When the cage (112) stops at the top floor (105), the cam (113) actuates the top floor detector (107). In the same manner, the top floor detector (107) outputs a signal and the data representing the top floor position are read out from ROM (119) and written in the RAM (120) as the present cage position. Thus, even if the data for the present position of the cage (112) memorized in the RAM (120) are not correct when the cage (112) stops at the final floor, the data are corrected at that floor.

On the other hand, the memory device (126) is actuated by the emergency power source (125) to memorize the same data as that representing the cage position as memorized in the RAM (120).

After a service interruption when the main power source (124) is switched on again, the conditions of the various signals are detected for a predetermined period (1 second). When, for example, the floor detector (114) is not actuated by any cam (101A) to (105A) (i.e. the cage (112) was running at the time of the service interruption) and the operation state signal (122) is "H", the data are corrected by the central processing unit (118). The cage (112) is forcibly run to the bottom floor by a circuit (not shown). When the cage (112) stops at the bottom floor (101), the cam (113) actuates the bottom floor detector (106) whereby the data representing the bottom floor position are read out from ROM (119) to correct the contents of the RAM (120) and the data stored in the memory element (126) are also corrected. When the floor detector (114) is actuated by the cam (102A) at the time of the service interruption, (i.e. the cage (112) was stopped at the time of the service interruption) and the operation state signal (122) is "H", the data memorized in the memory device (126) are used as the cage position signal. Even if the data memorized in RAM (120) are changed by the service interruption, the memory element (126) maintains the data stored before the service interruption and accordingly, data representing the actual cage position can be obtained. In such a case, the forcible running of the cage (112) is not performed. When the operation state signal (122) is "L" (i.e. the cage (112) was in the manual operation mode at the time of the service interruption), the correction of the data in the RAM (120) and the memory element (126) and the forcible running of the cage (112) are not performed, because the speed of the cage is slow in the manual operation. Even if the service interruption occurred during the running of the cage, the deviation between the stored data for the cage position and the actual cage position would be very small.

Figure 2 shows a further embodiment of the present invention. The running signal (127) is "H" during running of the cage (regardless of whether the operation is automatic or manual) and is "L" when the cage is stopped. The signal is memorized in the memory device (126). The rest of the embodiment is the same as that of Figure 1.

The condition of the running signal (127) is memorized in the memory device (126). When the service interruption of the main power source (124) is terminated, the data of the memory element are read out. When the running signal (127) before the service interruption is "L", the stored cage position should be correct and accordingly, the data for the cage position memorized in the memory element (126) are used.

When the running signal (127) is "H", the stored cage position may be incorrect because the

service interruption occurred during the running of the cage. In such a case, the cage (112) is forcibly run to the final floor when the service interruption is terminated. The data for the final floor position memorized in ROM (119) are written in the memory device (126).

Referring to Figure 3, the embodiment of Figure 1 will be described in detail.

In Figure 3, the same references as those used in Figure 1 designate identical or corresponding parts and will not be described in detail.

Figure 4 is a block diagram of the position detector computer (117).

The position detector computer comprises a microprocessor system (200) such as 8085 manufactured by Intel Co., although another microprocessor system or digital computer could be used. The microprocessor (200) comprises an input port (201) (Intel 8212), a central processing unit (CPU) (202) (Intel 8085A) a timer for interruption period control (203) (Intel 8155), a read-only memory (ROM) (204) (Intel 2716), a writeable and readable memory (RAM) (205) (Intel 2114A) and the output port (206) (Intel 8212). The reference (207) designates a 5V stabilized power source to feed power to the devices of the microprocessor system (200); and (122) designates an operation state detector to output the automatic operation signal (AUTO) during automatic operation and to output the manual operation signal (MANUAL) during manual operation; (126') designates a latch circuit using CMOS circuits which is actuated by the emergency power source (125).

The operation of the embodiment will now be described.

The floor pass detector (115) is actuated by the cams (108) to (111) when the cage passes between the floors. The output is fed through the input port (201) into the microprocessor system (200). The data representing the present floor (FSY) are derived by the floor processing program memorized in ROM (204) and the data are memorized in RAM (205).

At each output of a signal from the floor pass detector (115), the datum for one floor is added to the data representing the present floor (FSY) memorized in RAM (205) during the ascent of the cage, whereas the datum for one floor is subtracted from the data representing the present floor (FSY) in RAM (205) during the descent of the cage. The memorized data are used as the cage position signal to control the cage.

When the cage (112) stops at the bottom floor (101), the bottom floor detector (106) is actuated by the cam (113) to output the bottom floor signal (BOT). The signal is fed into the microprocessor system (200) and the data for the bottom floor memorized in ROM (204) are read out and are written in RAM (205) as the data for the present floor (FSY).

When the cage (112) stops at the top floor (105), the top floor detector (107) is actuated by the cam (113) to output the top floor signal (TOP). In the same manner, the data for the top floor are

read out from ROM (204) and are written in RAM (205) as the data for the present floor (FSY).

When the cage (112) stops at the bottom floor or the top floor, even if the data for the present floor (FSY) memorized in RAM (205) are not correct, the data are corrected as described above.

When the cage (112) stops at the middle floor such as the third floor (103) and the data for the present floor (FSY) indicate the bottom floor, a calibration operation is performed by the deviation correcting program memorized in ROM (204). That is, the signal ZBT for forcibly running the cage (112) to the bottom floor is output to the control device (208). When the data for the present floor (FSY) memorized in RAM (205) indicate the top floor, the signal ZTP for forcibly running the cage (112) to the top floor is output by the correcting program to the control device (208). Thus, the cage (112) runs to the bottom floor (101) or the top floor (105). Until the cage (112) reaches the bottom floor (101) or the top floor (105), the correction of the data representing the present floor by the floor processing program is stopped. When the cage (112) stops at the bottom floor (101) or the top floor to output the signal (BOT) or (TOP) from the bottom floor detector (106) or the top floor detector (107) which is actuated by the cam (113), the data for the bottom floor (101) or the top floor (105) are written in RAM (205) as the data for the present floor (FSY), which thus indicate the correct cage position. The data for the present floor (FSY) are output through the output port (206) each time the data changes to memorize the data in the latch circuit (126').

When the service interruption of the stabilized power source (207) is terminated, the conditions of the various signals just after the recovery of the power source are detected. For example, if the floor detector (114) is not interlocked with any cam (101A) to (105A) and the automatic operation signal (AUTO) is output, it is deduced that the cage (112) was running at the time of the service interruption. There is a high possibility that the data for the present floor (FSY) memorized in the latch circuit (126') do not represent the actual cage position. Therefore, a correction operation is performed by the microprocessor system (200). The signal ZBT is output by the deviation calibrating program to the control device (208) to run forcibly the cage (112) to the bottom floor. When the cage (112) stops at the bottom floor (101), the cam (113) actuates the bottom floor detector (106) to output the signal (BOT). The data for the bottom floor are read out from ROM (204) to rewrite the data for the present floor (FSY) in RAM (205) and to correct the data in the latch circuit (126').

When the floor detector is actuated by any cam (102A) to (104A) at a middle floor and the automatic operation signal AUTO is output at the time the service interruption is terminated, it is deduced that the cage (112) was stopped at a middle floor at the time of the service interruption. Therefore, the data for the present

floor memorized in the latch circuit (126') are reliable data and the data are memorized in RAM (205) as the data for present floor (FSY) to use the data for the following operation of the cage.

5 The data for the present floor (FSY) coincide with the actual cage floor position, whereby the running of the cage (112) to the bottom floor for the correction of the data is not performed.

10 When the manual operation signal (MANUAL) is output at the time the service interruption is terminated, it is deduced that the cage (112) was in the manual operation mode at the time of the service interruption. In such a case, even if the service interruption occurred during the running of the cage, the cage speed in the manual operation mode is usually slow and the distance for the movement of the cage (112) is short, whereby the data for the present floor as memorized in the latch circuit (126') coincide with the actual cage position at the time the service interruption is terminated. Thus, the data of the latch circuit (126') are memorized in RAM (205) as the data for the present floor (FSY). It is unnecessary to run the cage forcibly to the bottom floor.

25 Referring to Figure 5, the embodiment of Figure 2 is further illustrated in detail.

30 The running condition detecting circuit (127) outputs the running signal (RUN) during the running of the cage (112) and does not output such signal when the cage is stopped. The condition of the running signal (RUN) is memorized together with the data for the present floor (FSY) of RAM (120) in the latch circuit (126').

35 When the stabilized power source is switched back on after the service interruption, the data of the latch circuit (126') are read out to find out whether the cage was running just before the service interruption by detecting the stored condition of the running signal (RUN). If the cage (112) was stopped at the time of the service interruption, there should be no deviation between the data for the floor memorized in the latch circuit (126') and the actual cage position. Therefore, the data are input and memorized in RAM (120) as the data for the present floor (FSY). If the cage (112) was running just before the service interruption, there is a possibility that the data for the floor memorized in the latch circuit (126') do not represent the actual cage position. After the service interruption, the cage (112) is forcibly run to the bottom floor (101) and the data for the bottom floor memorized in ROM (119) are memorized as the data for the present floor (FSY) in RAM (120) and are also memorized in the latch circuit (126'). The forcible running for the correction of the data does not have to be to the bottom floor but can instead be to the top floor to attain the same effect.

60 CLAIMS

1. Cage position detecting apparatus for storing the presumed present position of an elevator cage using a computer powered by a main power source, the apparatus having a first memory; an

65 emergency power source operable to supply power to the first memory during an abnormal state such as a service interruption of the main power source said first memory memorizing the presumed present position of the cage during said abnormal state; means for determining, after the abnormal state has ceased, whether the cage was running or stopped at the start of the abnormal state; a second memory storing data indicative of a predetermined floor; a detector for detecting when the cage is at said predetermined floor; and means operable:

70 (i) to store the data of the second memory as the presumed present cage position when said detector indicates that the cage is at the predetermined floor;

80 (ii) to cause the cage to run to the predetermined floor if the stored presumed present position is said predetermined floor and said detector indicates that the cage is not at said predetermined floor;

85 (iii) after said abnormal state has ceased, to store the data in said first memory as the presumed present cage position if said determining means determines that the cage was stopped at the start of the abnormal state; and
90 (iv) after said abnormal state has ceased, to cause said cage to run to said predetermined floor if said determining means determines that the cage was running at the start of the abnormal state.

2. Cage position detecting apparatus according to claim 1, wherein said determining means is operable to determine that the cage was running at the start of the abnormal state if the cage was in an automatic operation mode and was positioned between floors at said start of the abnormal state, and is operable to determine that the cage was stopped at the start of the abnormal state if the cage was in an automatic operation mode and was situated at a floor at the start of the abnormal state.

3. Cage position detecting apparatus as claimed in claim or claim 2, wherein said determining means is operable to determine that the cage was stopped at the start of the abnormal state if the cage was in a manual operation mode at the start of said abnormal state.

4. Cage position detecting apparatus according to claim 1, wherein the first memory is also operable to store data indicative of whether or not the cage was running at the start of the abnormal state.

5. Cage position detecting apparatus according to any preceding claim, wherein said predetermined floor is the top floor or the bottom floor.

6. Cage position detecting apparatus according to any preceding claim, wherein the detector is a switching device arranged to be actuated in response to the movement of the cage.

7. Cage position detecting apparatus according to claim 6, wherein the detector is a switch which is turned on and off by a cam provided on the cage.

floor memorized in the latch circuit (126') are reliable data and the data are memorized in RAM (205) as the data for present floor (FSY) to use the data for the following operation of the cage.

5 The data for the present floor (FSY) coincide with the actual cage floor position, whereby the running of the cage (112) to the bottom floor for the correction of the data is not performed.

10 When the manual operation signal (MANUAL) is output at the time the service interruption is terminated, it is deduced that the cage (112) was in the manual operation mode at the time of the service interruption. In such a case, even if the service interruption occurred during the running of the cage, the cage speed in the manual operation mode is usually slow and the distance for the movement of the cage (112) is short, whereby the data for the present floor as memorized in the latch circuit (126') coincide with the actual cage position at the time the service interruption is terminated. Thus, the data of the latch circuit (126') are memorized in RAM (205) as the data for the present floor (FSY). It is unnecessary to run the cage forcibly to the bottom floor.

25 Referring to Figure 5, the embodiment of Figure 2 is further illustrated in detail.

30 The running condition detecting circuit (127) outputs the running signal (RUN) during the running of the cage (112) and does not output such signal when the cage is stopped. The condition of the running signal (RUN) is memorized together with the data for the present floor (FSY) of RAM (120) in the latch circuit (126').

35 When the stabilized power source is switched back on after the service interruption, the data of the latch circuit (126') are read out to find out whether the cage was running just before the service interruption by detecting the stored condition of the running signal (RUN). If the cage (112) was stopped at the time of the service interruption, there should be no deviation between the data for the floor memorized in the latch circuit (126') and the actual cage position. Therefore, the data are input and memorized in RAM (120) as the data for the present floor (FSY). If the cage (112) was running just before the service interruption, there is a possibility that the data for the floor memorized in the latch circuit (126') do not represent the actual cage position. After the service interruption, the cage (112) is forcibly run to the bottom floor (101) and the data for the bottom floor memorized in ROM (119) are memorized as the data for the present floor (FSY) in RAM (120) and are also memorized in the latch circuit (126'). The forcible running for the correction of the data does not have to be to the bottom floor but can instead be to the top floor to attain the same effect.

60 CLAIMS

1. Cage position detecting apparatus for storing the presumed present position of an elevator cage using a computer powered by a main power source, the apparatus having a first memory; an

65 emergency power source operable to supply power to the first memory during an abnormal state such as a service interruption of the main power source said first memory memorizing the presumed present position of the cage during said abnormal state; means for determining, after the abnormal state has ceased, whether the cage was running or stopped at the start of the abnormal state; a second memory storing data indicative of a predetermined floor; a detector for detecting when the cage is at said predetermined floor; and means operable:

70 (i) to store the data of the second memory as the presumed present cage position when said detector indicates that the cage is at the predetermined floor;

80 (ii) to cause the cage to run to the predetermined floor if the stored presumed present position is said predetermined floor and said detector indicates that the cage is not at said predetermined floor;

85 (iii) after said abnormal state has ceased, to store the data in said first memory as the presumed present cage position if said determining means determines that the cage was stopped at the start of the abnormal state; and

90 (iv) after said abnormal state has ceased, to cause said cage to run to said predetermined floor if said determining means determines that the cage was running at the start of the abnormal state.

95 2. Cage position detecting apparatus according to claim 1, wherein said determining means is operable to determine that the cage was running at the start of the abnormal state if the cage was in an automatic operation mode and was positioned between floors at said start of the abnormal state, and is operable to determine that the cage was stopped at the start of the abnormal state if the cage was in an automatic operation mode and was situated at a floor at the start of the abnormal state.

100 3. Cage position detecting apparatus as claimed in claim or claim 2, wherein said determining means is operable to determine that the cage was stopped at the start of the abnormal state if the cage was in a manual operation mode at the start of said abnormal state.

105 4. Cage position detecting apparatus according to claim 1, wherein the first memory is also operable to store data indicative of whether or not the cage was running at the start of the abnormal state.

110 5. Cage position detecting apparatus according to any preceding claim, wherein said predetermined floor is the top floor or the bottom floor.

115 6. Cage position detecting apparatus according to any preceding claim, wherein the detector is a switching device arranged to be actuated in response to the movement of the cage.

125 7. Cage position detecting apparatus according to claim 6, wherein the detector is a switch which is turned on and off by a cam provided on the cage.



8. Cage position detecting apparatus according to any preceding claim, wherein the second memory is a nonvolatile read-only memory.

- 5 9. Cage position detecting apparatus according to any preceding claim, arranged such that, when the cage is run to the predetermined floor prior to storing the data of said second memory as the presumed present cage position, the stored presumed present position of the cage is unaltered until the cage stops at the predetermined floor.
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10. Cage position detecting apparatus according to any one of claims 1 to 8, arranged such that the stored presumed present position of the cage is altered during the running of the cage to the predetermined floor prior to storing the data of said second memory as the presumed present cage position.

- 15 11. Cage position detecting apparatus substantially as herein described with reference to Figures 1, 3 and 4 or Figures 2 and 5 of the accompanying drawings.
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