

METHOD FOR TRANSMITTING MESSAGES IN AN ELEVATOR GROUP CONTROL
SYSTEM

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BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an elevator car including a large number of elevator controllers, a separate group controller for executing an operation of the elevator car, and a common network associated with the elevator controllers and the group controller, and more particularly a method for transmitting messages which increase the communication speed and capacity of the messages.

2. Description of the Prior Art

In an elevator communication system, all communication data originated from a separate group controller is not transmitted to a plurality of elevator controllers at almost same time. If all data is transmitted from the group controller to elevator controllers within a predetermined period, a large burden may cause a jam in the processing of the communication data. Accordingly, transmission efficiency is regarded as a major factor in the quality of such a control apparatus.

FIG. 1 is a simplified block diagram of a conventional elevator communication system.

Referring to FIG.1, the elevator communication system consists of a plurality of elevator controllers 12A-12K to execute elevator-related signaling and controlling the execution of necessary operations, a group controller 11 to execute group-related signaling and dispatching functions, and a common network NET to associate with the elevator controller 12A-12K and the

group controller 11.

FIG. 2 is a block diagram illustrating a communication control circuit in the conventional elevator communication system.

As illustrated in FIG. 2, a group communication controller 12, employed in the group controller 11 illustrated in FIG. 1, includes a plurality of communication controllers 21A-21K, and a plurality of elevator communication controllers 22A-22K employed in elevator controller 12A-12K respectively via exclusive communication lines in parallel fashion(1:1).

The operation of the elevator communication system described as above, will be explained with reference to FIGs. 3 through 6.

For instance, if a passenger who is standing on the 8th floor selects a hall call such as "down" via a control panel (not shown) provided in one of the elevator controllers, the corresponding elevator communication controller recognizes an inputting-signal of hall call and transmits the data to the corresponding elevator communication controllers.

Next, after passing a predetermined time, the group communication controller retransmits the transmitted data again to execute the operation as ordered.

In the retransmission operation, the communication data which is transmitted from the group communication controller to elevator communication controller, consist of 1) data number and 2) data as illustrated in FIG. 3. The data number represents an index indicating a data record for the data transmission, while the data indicate a region where the actual data is stored. For example, in case that a data number "3" is determined as an

execution of calling the elevator car from 1 to 8 floor, the elevator communication controller executes the recording operation and records the data number "3" on a region of the data number and "the hall call from 1 to 8 floor" on a region of the data, and subsequently transmits them to the corresponding group communication controller which is linked with the elevator communication controller via the exclusive communication cable. In a table of FIG. 3, the data number "0" and data "0" indicate a retransmission data.

FIG. 4 illustrates a transmission data storage table in the conventional communication system. Such table has been used to merely transmit the changed data after comparing the present data with the previous data stored in the elevator communication controller 22A.

FIG. 5 is a flow chart showing how the transmission data is created in the communication system.

Referring to FIG. 5, the retransmission data is determined in step S1 and the data number is initialized by "1" in step S2, wherein the number "1" is an index indicating a record of the transmission data storage table as illustrated in FIG. 4. For instance, if the data number is "2", a comparative data is "data 2" of the table illustrated in FIG. 4.

Next, a test S3 determines if any changed data is created with respect to all communication data. If the test S3 is affirmative, the overall program is returned to through a transfer point T1. But if test S3 is negative, a test S4 is executed to determine if the test S4 is affirmative, the communication data is as fully filled as much as the number of

the record defined by the communication data table of FIG. 3. That is to say, if a communication buffer for the record is not fully filled, the program is returned to through a transfer point T2.

But if the test S4 is negative, a test S5 is executed to check if the present data is identical to the data recorded in the transmission table. If it is affirmative, the relative data number and the actual data are recorded on the record region which will be transmitted in step S6. Subsequently, the data number is increased by "1" to process the next data in step S7. But if the test S5 is negative, a step S7 will also be executed.

FIG. 6 is a flow chart showing how the retransmission data is created in the conventional control apparatus.

The flow chart illustrated in FIG. 6 is a subroutine for determining the retransmission data in step ST1 of FIG. 5. In FIG. 6, a test S1 determines if the retransmission data number stored in the control apparatus is a maximum data number, i. e., if the number is bigger than a record number recorded in the transmission data storage table of FIG. 4. If the test is affirmative, the retransmission data number is initialized by 1 in step ST2. However, if the test is negative, the data of the transmission data table indicating by the retransmission data number is recorded on the communication record in step ST3. Subsequently the data number is increased by "1" to process the next data in step ST4.

According to the conventional creating process for the retransmission as described above, it is noted that if the record number recorded on the transmission table is 48 and the

transmission period for the communication record is 32 ms, the maximum time it takes to retransmit the data record 1, wherein the data record has already been transmitted, is 1,536 ms ($T = 48 \times 32 \text{ ms}$).

Accordingly, even though the number of changed data is created as 4, the retransmitted data will be 8 which is predetermined as the number of the data, since the data number which can be recorded on the communication record is determined as "8" at the beginning time.

For that reason, there are drawbacks that the transmission time is delayed, thereby putting a large burden on communication processing.

Further, in case that the elevator cars connected to the group controller are 5 and the communication period is 32 ms, the time it takes to transmit the record for 5 elevator cars is 160 ms ($T = 5 \times 32 \text{ ms}$), since the group controller has been communicated with each elevator car via the exclusive cables in parallel fashion (1:1).

Accordingly, in the conventional elevator communication system, when the records are transmitted, the unnecessary region where no information is recorded is also transmitted together because the record length is already predetermined. Further, if several elevator cars need to transmit the records at almost the same time, there is a drawback of a heavy burden in the communication process since each elevator car does not recognize the present operations of each elevator controller.

SUMMARY OF THE INVENTION

Therefore, the present invention has been devised to solve

the problems involved in the prior art, and is provided to a method for transmitting messages in an elevator communication system which can circularly select one of a plurality of elevator cars within predetermine period and order and subsequently transmit the messages created from the elevator cars, wherein the messages having changed data in the record are only transmitted.

In an aspect of the present invention, there is provided a method for transmitting messages in an elevator communication system having a plurality of elevator controllers, a group controller for controlling the elevator controller selectively, and a network associated with the group controller and the elevator controllers to transmit/receive a data and retransmit the transmitted data at a predetermined period by storing the transmitted data on a transmission data storage table, circularly selecting a plurality of elevator cars by the group communication controller which is started at a predetermined period, the method comprising the steps of : circularly selecting a plurality of elevator cars by the group communication controller which is started at the predetermined period; comparing a data stored in the transmission data storage table with a present data of the selected elevator car, and recording a changed data with a highest priority on a communication record which will be transmitted into the elevator communication controller; determining the priority of the selected data as a low priority in the transmission data storage table; assigning the number of retransmission data for each elevator car which will be recorded on the communication record using the priority information of the transmission data storage table of the selected elevator cars and

the number of the data for each priority; arranging the transmission data storage table of the each elevator car by a highest order; obtaining the data in sequence as much as the number of the retransmission data assigned by the arranged transmission data storage table, and recording the data on the communication record; arranging the priority of the retransmission data recorded on the communication record; and redetermining the changed data as a highest priority in the transmission data storage table.

BRIEF DESCRIPTION OF THE DRAWINGS

The above object and other features of the present invention will become more apparent by describing the preferred embodiment thereof with reference to the accompanying drawings, in which:

FIG. 1 is a simplified block diagram of a conventional elevator communication system.

FIG. 2 is a simplified block diagram illustrating a communication control circuit in a conventional elevator communication system.

FIG. 3 is a communication data table in a conventional elevator communication system.

FIG. 4 is a transmission data storage table in a conventional elevator communication system.

FIG. 5 is a flow chart showing how a transmission is performed in a conventional elevator communication system.

FIG. 6 is a flow chart showing how a transmission data created in a conventional elevator communication system.

FIG. 7 is a simplified block diagram of an elevator communication system applying a method for transmitting messages

according to the present invention.

FIG. 8 is a communication data table according to the present invention.

FIG. 9 is a transmission data storage table according to the present invention.

FIG. 10 is a flow chat illustrating how a communication data is created in accordance with the present invention.

FIG. 11 is a flow chart illustrating how the retransmission data is created in accordance with the present invention.

FIG. 12 is a flow chart illustrating how the number of retransmission records is determined in accordance with the present invention.

FIG. 13 is a communication data table created for the case of an operation of two elevator cars.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiment of the present invention will now be explained with reference to the accompanying drawings.

FIG. 7 is a simplified block diagram of an elevator communication system applying a method for transmitting messages according to the present invention.

Referring to FIG. 7, a plurality of elevator communication controllers 72A-72K provided in each elevator controller are associated with a common bus line of a group communication controller 71 provided in a separate group controller. Accordingly, the group communication controller 71 circularly selects one of the elevator communication controllers within a predetermined period and a predetermined order.

FIG. 8 is a communication data table which is used for

transmitting messages created from the group communication controller.

FIG 8 illustrates a construction of the communication data including an elevator number 8A, the number of data 8B, and the number of retransmission data 8C. Such data combination can be recorded with maximum numbers predetermined thereto, since the corresponding elevator messages created from the group communication controller 71 is stored on one record and can be also transmitted to the group communication controller 71. The elevator number 8A represents an original number given to an elevator car which is transmitting a message such as the transmission data, the number of data 8B, which is the number of data for the corresponding elevators from a data region which will be described hereinafter, and the number of the retransmission data 8C, which is the number of the retransmission data for the corresponding elevator cars recorded in a data region which will be described hereinafter. Accordingly, if the number of all elevator cars are summed to the retransmission data, the number N of the record will be obtained. Further, the data number 8D represents an index for defining a meaning of the data while the data 8E represents a region where the data are recorded. Therefore, the total number of the records is obtained by summing the total number of the data and the total number of the retransmission data. FIG. 13 is a communication data table used in the case where two elevators are operated.

FIG. 9 illustrate the transmission data storage table according to the present invention. Such table is used as a storage region for the transmission data in the communication

system, and is used to decrease the network load by minimizing the number of the transmission data. Accordingly, when the communication data is created, the present data used in the transmission data table and the control apparatus differ from the data stored previously on the data region 8E.

In FIG. 9, a data number 9A represents an index for determining a data meaning, 9B, which is a storage region for the transmission data, the number of the transmission 9C which is a storage region of the number of the corresponding transmitted data within the predetermined period, and a priority 9D which is a region storing the priority for retransmitting the data. As a result, the highest priority data is retransmitted first. If the same priority occurs, the data which had been attempted to be transmitted more times have the highest priority.

Now, the routine illustrated in the flow chart of FIG. 10 will be explained to show how the communication data is created.

First, initialization is caused by power-on-reset and the group communication controller circularly selects the original number for each elevator communication controllers within the predetermined period and predetermined period order in step SA1. Thus, the group controller circularly selects one of the elevator car numbers one by one. For instance, if there are 5 elevator cars associated with the control apparatus which are numbers such as 1, 2, 3, 4, and 5, messages for the cars 1, 2, and 3 will be recorded in the first communication data. In a similar manner, messages for the elevator cars 4, 5, and 1 will be recorded in the second, messages for the elevator cars 2, 3, and 4 are recorded in the third, and the like. Next, the number of the

transmission data is determined by "0" in step SA2. A test SA3 determines if the communication data is created with respect to the all the selected elevator cars in step SA1. If the test is affirmative, step SA12 will be executed to determine the number of the transmission data.

On the other hand, if test SA3 is negative, then initialization of the data number indicating the record number of the transmission data storage table illustrated in FIG. 9, is executed by "1" in step SA4.

Next, a test SA5 determines if the test for all data recorded in the transmission data storage table of FIG. 9, is finished. If test SA5 is affirmative, the routine is returned to step SA3 to repeatedly execute steps SA1 and SA2. On the other hand, if test SA5 is negative, a test SA6 will be executed to determine if a communication buffer is fully filled with the data record. If the test is affirmative, step SA 12 will be executed because the data can not be reduced further. But if the test SA6 is negative, a test SA7 will be executed.

Test SA7 determines if the data is changed in accordance with a result of comparing the present data with the data stored in the transmission data storage table illustrated in FIG. 9. If the data is not changed, a step SA11 is executed directly, while if test SA7 is affirmative, indicating that the data transmission operation should be executed because the communication data is being processed in the communication system and the data recognized in the corresponding elevator communication controller differ each other.

Accordingly, the corresponding data number and the data are

recorded in a communication data region, and subsequently the changed data is also recorded on the transmission data table illustrated in FIG. 9 in step SA8. After step SA8, the number of the data is increased by "1" to determine if the communication data is fully filled with the buffer in step SA9.

Subsequently, the priority for the present data is arranged as a priority 100 which is given to the transmission data which will be now transmitted in step SA10, and the number of the data is increased so as to be compared with the next data in step SA11. Next, step SA11 returns to step SA5 and continuously executes steps SA3 through SA11 repeatedly.

Accordingly, as a result of the repeated steps, the test SA3 determines if the communication data is created with respect to all elevator cars. If the test is affirmative, a step SA12 is executed to record the number of the transmission data on the region 8B of the number of data on the communication data table illustrated in FIG.8, and the retransmission data is additionally added in step SA13 and the routine returns.

On the other hand, the retransmission data is determined by executing a subroutine illustrated in FIG. 11.

First, in step SB!, the retransmission data for each elevator car is determined in a manner which will be described hereinafter with respect to FIG. 12. At this time, the priority of the data will be determined as below.

Priority 1 : previously transmitted data

Priority 2 : transmitted data within the predetermined period

Priority 3 : not-transmitted data within the predetermined

period

Priority 4: retransmitted data within the predetermined period

Priority 100 : transmission data at present

If the number of the retransmission data for each elevator cars is determined by the routine illustrated in FIG. 12, a test SB2 determines if the number of retransmission data is determined with respect to all elevator cars. If the test is affirmative, the number of the retransmission data for each elevator car is recorded on the region 8C for the number of the retransmission data of the communication data table illustrated in FIG. 8, and then a step SB9 is executed to arrange a highest priority in the manner that the priority 100 of the present transmission data should be changed to the priority 1 so that the retransmission is executed with the highest priority in the next period. In this case, overall elevator cars are limited to that selected in step SA1 illustrated in FIG. 10.

But if test SB2 is negative, the retransmission data is arranged based on the priority of the transmission data storage table for processing elevator cars in step SB3, and the retransmission data number is initialized to "1" in step SB4. Next, a test SB5 determines if the retransmission data number is bigger than the number of the retransmission data -which is obtained in step SB1 illustrated in FIG 11. At this time, If the test is affirmative, the program is returned to test SB2 and test SB2 through 4 and test SB5 are repeatedly continued with respect to the next elevator car.

But if test SB5 is negative, the data indicated by the

retransmission data number is recorded on the storage region of the record data in step SB6 and the retransmission number is increased by "1" in step in SB6A. At this stage, the data having the highest priority is recorded on the data record in step 7 since the transmission data table is updated by the highest priority in accordance with the execution of step SB3.

Next, the priority for the corresponding data record in step SB7 is changed to the priority 4, representing the retransmitted data within the predetermined period as the selected data record which can be transmitted together with the communication data so that the data record is not selected when the next communication data is transmitted.

Meanwhile, the number of the retransmission data record will be obtained by executing a subroutine illustrated in FIG. 12.

Referring to FIG. 12, first, the number of available retransmission data record is initialized in step SC1, and the priority is also initialized by the priority 1 in step SC2. Next, a test SC3 determines if the number of the retransmission data record is determined with respect to all priorities. If the test is affirmative, the program is returned. But if test SC3 is negative, the number of records for the corresponding priorities being in process are collected in step SC4, wherein the priority of the transmission data storage table illustrated in FIG. 9 is used.

Subsequently, a test SC5 determines if the number of the available data is bigger than a sum of the numbers of the corresponding records. If the test is affirmative, the number of the data records which is identical to the processing priority

in accordance with the execution of searching the transmission data storage table for selected elevator cars in step SA1 illustrated in FIG. 10, is determined as the number of the data for the corresponding elevators. Thus, the total number of the data can be obtained by summing the number of the data and the corresponding records in step SC6.

Next, the priority is increased by "1" in step SC7, and a value, which is obtained by subtracting the number of the available data record assigned by step SC6 from the number of the available data, is used as the number of new available data.

But if the test SC5 is negative, indicating that the number of the record for the processing priority is bigger than that of the available data, the rate-assignment is executed in accordance with the number of the total data which is obtained by summing the number of the data and the rate of the corresponding records in step SC9.

For instance, in the case that the number of available retransmission data region is 8 and the selected elevator cars are two elevator cars 1 and 2, the number of the retransmission data record for each elevator car illustrated table 2 will be obtained from the given table 1.

Table 1

Elevator No.	Priority 1	Priority 2	priority 3
1	3	6	8
2	3	3	12

Table 2

Elevator No.	Priority 1	Priority 2	Priority 3	Total
1	3	2	0	5
2	2	1	0	3

Referring to table 2, when the priority 1 is determined, the total number 5 is smaller than the number 8 of the retransmission data region, so assignment will be executed as it is.

Similarly, when the priority 2 is determined, the total number 9 is bigger than the number 3 of the retransmission data region : i.e., 3, so assignment will be executed in accordance with equation (1).

$$\text{elevator 1} : 3 \times 6/9 = 2$$

$$\text{elevator 2} : 3 \times 3/9 = 1 \quad \dots\dots\dots \text{equation (1)}$$

Further, in the case that the number of the records which are available to record on the communication records is 8 and the number of the changed data is 4, only 4 data records are used for the region of the retransmission records.

Accordingly, it is noted that the time it takes to transmit messages having 48 records is 384 ms ($32 \text{ ms} \times 48/4$), while it takes 1,536 ms in the prior art.

Further, assume that the number of the elevator cars associated with the communication system is 5, the communication period is 32 ms, and the data records created from the plurality of elevator cars are circularly transmitted within the predetermined period, for example, 32 ms, and the

predetermined order using one data record. In this case, if messages for two elevator cars are transmitted at almost same time, the time it takes to transmit messages of the total 5 of elevator cars is 80 ms ($T = 32 \text{ ms} \times 2.5$)

Thus, because of the transmitting method for selecting corresponding elevator circularly, messages for the elevator cars 1 and 2 will be recorded in the data 1, and similarly messages for the cars 3 and 4 in the data 2, messages for the cars 5 and 1 in the data 3, etc.,.

As described above, the retransmission data record region including the communication data are made of a minimum number of the transmission data after recognizing that the data is changed by causing in each elevator car as well as messages for elevator cars will be transmitted by circularly selecting corresponding elevator in the predetermined order.

Therefore, the transmission speed and capacity are highly increased and the total efficiency in processing communication data is largely improved.

Many modifications and variations of the present invention are possible in light of the above teachings. Therefore, it is to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.



What is claimed is:

1. A method for transmitting messages in an elevator communication system having a plurality of elevator controllers, a group controller for controlling the elevator controller selectively, and a network associated with said group controller and said elevator controllers to transmit/receive a data and retransmit the transmitted data at a predetermined period by storing said transmitted data on a transmission data storage table, circularly selecting a plurality of elevator cars by said group communication controller which is started at a predetermined period, the method comprising the steps of :

circularly selecting a plurality of elevator cars by said group communication controller which is started at the predetermined period;

comparing a data stored in said transmission data storage table with a present data of said selected elevator car, and recording a changed data with a highest priority on a communication record which will be transmitted into said elevator communication controller;

determining the priority of said selected data as a low priority in said transmission data storage table;

assigning the number of retransmission data for each elevator car which will be recorded on said communication record using the priority information of said transmission data storage table of said selected elevator cars and the number of the data for each priority;

arranging said transmission data storage table of said



each elevator car by a highest order;

obtaining the data in sequence as much as the number of said retransmission data assigned by said arranged transmission data storage table, and recording said data on said communication record;

arranging the priority of said retransmission data recorded on said communication record; and redetermining said changed data as a highest priority in said transmission data storage table.

2. The method of claim 1, wherein said priority of retransmission data is determined by the following order: previously transmitted data, transmitted data within a predetermined period, not transmitted data within a predetermined period, retransmitted data within a predetermined, and present transmission data.

3. The method of claim 1, wherein said transmission data include an elevator number, the number of communication data, and the number of retransmission data.

4. The method of claim 1, wherein said transmission data storage table comprises data numbers, data, transmission times, and priority of said retransmission data.

5. The method of claimed in claim 1, wherein said step for selecting said changed data comprising the steps of;

checking if the data is changed based on an order of the data numbers of said elevator cars which are circularly selected;

recording said changed data on said communication record;
and



recording the number of the data recorded on said communication record if said communication record is fully filled.

6. The method of claimed in claim 1, wherein said selection for said selected data is repeatedly performed to all elevator cars which are circularly selected.

7. The method of claimed in claim 1, wherein said step for assigning the number of said retransmission data comprises the steps of:

determining a communication record region where said retransmission data will be recorded;

collecting the number of the data having the corresponding priority for each elevator car using the priority recorded on said transmission data storage table;

assigning said retransmission data on the communication record as much as the number of the data having the corresponding priority of the corresponding priority rate for each elevator car; and redetermining said communication record region.

8. The method of claimed in claim 7, wherein said communication record region uses all remaining regions excluding a region where said selected data is recorded.