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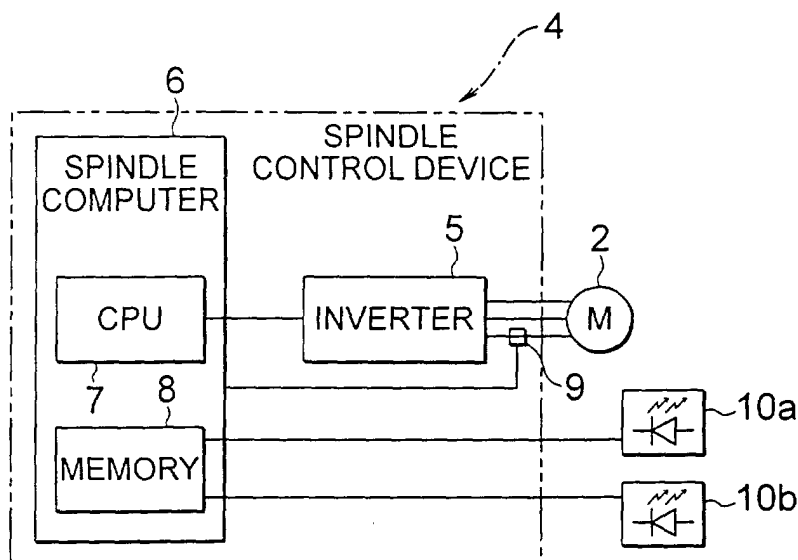
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(54) Operation control system for single spindle driving spinning machines

(57) In an operation control system for single spindle driving spinning machines: a spindle computer provided in each spindle drives controls a motor provided in the corresponding spindle; a frame computer, which is provided in each spinning machine which is connected with

a plurality of spindle computers provided in the spinning machine through communication means, controls operation of the corresponding spinning machine; and a host computer connected with a plurality of frame computers through communication means keeps operation condition of each frame under control.

FIG. 2



Description

BACKGROUND OF THE INVENTION

Field of the Invention:

[0001] The present invention relates to an operation control system for a plurality of single spindle driving spinning machines, each spinning machine being of the type in which the machine is mounted with a large number of spindles and in which the spindles are independently driven by motors provided in the spindles, respectively.

Description of the Related Art:

[0002] For the purpose of making it possible to set a large number of spindles in a spinning frame, or to increase the rotational speed of the spindles, a single spindle driving spinning machine has been recently proposed which has, instead of only one motor for driving all spindles in a spinning frame, a plurality of spindle driving motors for driving the spindles, respectively. As a method of controlling spindle driving motors in the single spindle driving spinning machine, a method of driving and controlling spindle driving motors by one inverter is disclosed in Japanese Patent Application Laid-open No. 10-226930. Further, a method of independently driving and controlling respective spindle driving motors by individual inverters is disclosed in Japanese Patent Application Laid-open No. 11-181636, along with an arrangement in which information about a broken-state of thread in each spindle is handled in a control device provided in a frame.

[0003] A spinning machine in which a large number of spindles are driven by one motor cannot perform operation of the frame, due to its construction, in a state in which a specific spindle is at rest. Thus, the degree of freedom in an operation control of the frame is low. On the contrary, in the case of a single spindle driving spinning machine, spindles can be driven independently, and thus it is possible to perform the operation of the frame in a state that a specific spindle is at rest. Accordingly, the degree of freedom in an operation control of the frame is high. Conventionally, in such a spinning machine for driving a single spindle, a proposal has been made concerning an operation control of each frame based on, for example, information about a broken-state of thread, but no proposal has been made concerning an operation control of a plurality of frames with efficiency.

SUMMARY OF THE INVENTION

[0004] The present invention has been made in view of the above, and an object of the present invention is therefore to provide an operation control system for single spindle driving spinning machines, which enables an

operation of a plurality of single spindle driving spinning machines with efficiency.

[0005] According to the present invention, there is provided an operation control system for single spindle driving spinning machines, each of which is of the type in which the machine is mounted with a plurality of spindles and the spindles are independently driven by motors provided in the spindles, respectively, characterized in that the system comprises: a plurality of spindle computers which are provided in correspondence with the plurality of spindles and each of which drives and controls a motor provided in the corresponding spindle; a plurality of frame computers which are provided correspondingly to the plurality of spinning machines and each of which is connected with the plurality of spindle computers provided in the corresponding spinning machine through communication means and controls operation of the corresponding spinning machine; and a host computer which is connected with the plurality of frame computers through the communication means and which keeps an operation conditions of each frame under control.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

Fig. 1 is a front view of a spindle in an embodiment; Fig. 2 is a block diagram showing a spindle control device in the embodiment; Fig. 3 is a block diagram showing a structure of an operation control system for single spindle driving spinning machines in accordance with the embodiment; and Fig. 4 is a block diagram showing a structure of an operation control system in accordance with another embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0007] Hereinafter, an embodiment of a ring spinner according to the present invention will be described.

[0008] As shown in Fig. 1, each spindle 1 of the spinner is provided with a driving spindle motor 2. A synchronization motor is used as the spindle motor 2. A spindle control device 4 is provided in a housing 3 of the spindle motor 2, and a power supply converted from a commercial power supply into a direct current by an AC/DC converter (not shown) is supplied to the spindle control device 4.

[0009] A display portion 10a for displaying a broken-state of thread and a display portion 10b for notifying abnormality are provided in each housing 3. These display portions 10a and 10b are disposed on a front surface of the housing 3 in parallel. Orange LEDs are used in the display portion 10a, and red LEDs are used in the display portion 10b. Further, the housing 3 is equipped

with a switch 11 for instructing the spindle motor 2 to start/stop.

[0010] As shown in Fig. 2, the spindle control device 4 is provided with an inverter 5 and a spindle computer 6 for controlling a spindle. The spindle computer 6 is provided with a CPU 7 and a memory 8. Any one of three feeders for connecting the inverter 5 with the spindle motor 2 is provided with a current sensor 9 for measuring a current supplied to the spindle motor 2. The CPU 7 inputs an output of the current sensor 9 through an A/D converter and an interface, which are not shown in the figure. The CPU 7 obtains a rate of change of current in accordance with an output signal from the current sensor 9, and when the rate of change of current exceeds a set value, the CPU 7 judges occurrence of a broken-state of thread, and then stops supply of power to the spindle motor 2 of the corresponding spindle and also turns on the display portion 10a for displaying the broken-state of thread. Further, the spindle motor 2 is provided with a sensor (not shown) for detecting its rotational speed. In the case where the rotational speed of the spindle motor 2, which is detected by the sensor, largely deviates from a predetermined value, the CPU 7 judges that an abnormality has occurred, and then stops the spindle motor 2 and also turns on the display portion 10b for notifying abnormality.

[0011] As shown in Fig. 3, all the spindles of the spinning frame is divided into a plurality of groups, one group consisting of 48 spindles, for example. All the spindle computers 6 in each of the groups are connected with a section control unit 12 dedicated to one of the groups through a communication line 13, respectively. The section control unit 12 is connected with a frame control device 14 that unifies all the spindles through the communication line 13. A multi drop connection using a serial interface is adopted for the communication line 13, and RS-485 is used, for example, as the serial interface. The section control unit 12 relay the transfer of signals between the spindle computers 6 and the frame control device 14, which are connected with the section control unit 12.

[0012] The frame control device 14 is provided with a frame computer 15 and an input device 16. The frame computer 15 is provided with a CPU 18, a ROM 19, a RAM 20, and an input/output interface 21, and the input device 16 is connected with the CPU 18 through the input/output interface 21. Further, a display 17 and a counter 22 for totalizing rpm of a front roller (not shown) are respectively connected with the CPU 18 through the input/output interface 21. The CPU 18 calculates the actual length of thread wound around a bobbin of each of the spindles (referred to as actual spinning length) based on the count value of the counter 22.

[0013] Program data and various data necessary for carrying out the program are stored in the ROM 19. The program data includes corresponding data on spinning conditions such as various fiber materials, spinning count and the number of twists, rotational speed of a

spindle at the time of steady operation, rotational speed of motors of a draft driving system and a lifting driving system, and the like. The RAM 20 temporarily stores the data input from the input device 16, the calculation processing result at the CPU 18, and the like.

[0014] The CPU 18 inputs data on the broken-state of thread and abnormality of each spindle in a predetermined cycle from each-of the spindle computers 6, and then calculates the actual spinning length of each spindle based on the data and a detection signal from the counter 22 and also totalizes the number of times of the broken-state of thread every spindle. The RAM 20 is provided with a storage region for storing the number of times of the broken-state of thread and a storage region for storing the actual spinning length, which correspond to each spindle.

[0015] The CPU 18 totalizes the number of times of broken-state of thread and stores the number in the storage region that corresponds to the spindle in which the broken-state of thread occurs. Further, the CPU 18 stores the difference between the count value of the counter 22 at the time of a stop due to the broken-state of thread or abnormality and the count value of the counter 22 at the time of restarting of spinning for each spindle. When the actual spinning length is calculated, the spinning length corresponding to the stored difference of the count value is subtracted from the spinning length obtained from the count value of the counter 22 at that time, thereby obtaining the actual spinning length at that time. In the case where spinning is not restarted until the time of the calculation of the actual spinning length, the spinning length until the time of the stop corresponds to the actual spinning length. The CPU 18 totalizes the number of times of the broken-state of thread of each spindle from the start of operation of the frame until the stop of doffing (during one doff), and the integrated value is reset to zero every one doff. The frame computer 15 can display various items of control information (for example, a number and a position of the spindle with the broken-state of thread and the spindle with abnormality) on the display 17 by the operation of the input device 16.

[0016] Each of the frame computers 15 is connected with a host computer 24 through a local area network (LAN) 23. The host computer 24 is provided with a CPU 25, a ROM 26, and a RAM 27. The host computer 24 is connected with an input device 28 and with a color display 29 through an input/output interface (not shown). The host computer 24 is supplied with control data on information on broken-state of thread, actual spinning length, or existence/non-existence of abnormality, or rpm of motor, current, voltage, load state or the like from the frame computer 15. The information on broken-state of thread includes information on whether each spindle is in the broken-state of thread at present or not, and information on the total number of times of broken-state of thread.

[0017] When the number of times of broken-state of

thread exceeds a predetermined number of times $N\alpha$ set in advance in a predetermined period (during one doff in this embodiment) in a certain spindle, the CPU 25 outputs a starting prohibition command signal for prohibiting starting of the spindle motor 2 of the spindle to the corresponding spindle computer 6 through the frame computer 15. The predetermined number of times $N\alpha$ differs depending on the spinning conditions, and is set to several times, for example. When inputting the starting prohibition command signal, the spindle computer 6 turns on the display portion 10b of the corresponding spindle and also does not start the spindle motor 2 until a starting prohibition cancellation command signal is input even if the switch 11 is turned on or a starting signal is input from the frame computer 15.

[0018] The host computer 24 can display various items of control information on the color display 29 by the operation of the input device 28 and also can output the starting prohibition cancellation command signal to the frame computer 15. The CPU 18 of the frame computer 15 outputs a starting cancellation command signal to the spindle computer 6 of the corresponding spindle based on the starting prohibition cancellation command signal.

[0019] Further, the host computer 24 transmits data for the frame operation on, for example, the number of stop spindle in the adjustment of production and the spinning conditions at the time of changing the spinning conditions. In addition, the host computer 24 can print various items of control data, a daily report, and the like from a printer not shown in the figure.

[0020] Next, the operation of the system structured as described above will be described. Prior to the operation of the spinning machine, the spinning conditions such as the fiber material, the spinning count, and the number of twists are input to each of the frame computers 15 from the host computer 24. Note that these spinning conditions may be input from the input device 16 of the frame computer 15. When the operation of the spinning machine is started, the speed command of the spindle motor 2 is output to the respective spindle computers 6 of the respective spindles from the frame computer 15, and each of the spindle computers 6 controls the spindle motor 2 to a predetermined rotational speed through the inverter 5 based on the command from the frame computer 15.

[0021] Each of the spindle computers 6 judges existence/non-existence of a broken-state of thread and existence/non-existence of abnormality of the corresponding spindle in a predetermined cycle. When the spindle computer 6 acknowledges the broken-state of thread, it stops the spindle motor 2 and also turns on (drives) the display portion 10a. On the other hand, when the spindle computer 6 acknowledges the abnormality, it stops the spindle motor 2 and also turns on (drives) the display portion 10b. The spindle computer 6 outputs the existence/non-existence of the broken-state of thread and abnormality to the section control unit 12.

[0022] The CPU 18 of the frame computer 15 inputs data on the existence/non-existence of a broken-state of thread and the existence/non-existence of abnormality from the spindle computers 6 of the respective spindles through the section control unit 12 in a predetermined cycle. Further, the frame computer 15 calculates the actual spinning length of each spindle. Then, the frame computer 15 outputs control information such as information on a broken-state of thread to the host computer 24 during the operation in accordance with the command from the host computer 24. After the stop due to the state of a full spool, the frame computer 15 outputs data on the count value of the total number of times of broken-state of thread and the actual spinning length of each spindle during one doff to the host computer 24 before resetting the data to zero.

[0023] The host computer 24 retrieves the spindle in which the total number of times of broken-state of thread exceeds the predetermined number of times $N\alpha$ based on the control data during the operation of the frame, judges that the corresponding spindle is a spindle in bad condition, and outputs a starting prohibition command to the spindle computer 6 of the spindle through the frame computer 15. Further, the host computer 24 calculates efficiency of each spindle and efficiency of each frame in accordance with the actual spinning length of each spindle based on the control data every one doff.

[0024] The host computer 24 notifies each of the frame computers 15 of the number of the spindle to be stopped in carrying out a planned stop to stop a part of the frames and spindles for the adjustment of production. In this case, the spindle or frame with inefficiency is given priority in stopping.

[0025] After the repairing processing of the spindle in bad condition is completed by a maintenance worker, this is reported to a manager. The manager operates the input device 28 of the host computer 24 and outputs the starting prohibition cancellation command signal to the spindle having been subjected to the repairing processing through the frame computer 15. Thus, the drive and control of the spindle motor 2 of the spindle is possible again. The manager displays the spindle in a starting prohibition state on a screen of the color display 29 in canceling the starting prohibition. Then, the manager selects the spindle in which the starting prohibition should be cancelled and clicks the display of the spindle on the screen. Then, the starting prohibition cancellation command to the spindle is output to the frame computer 15 to which the spindle belongs, and the display of the spindle on the screen is cancelled.

[0026] When spinning is continued to reach the state of a full spool, the operation of the frame is stopped. Then, a doffing operation is started by a doffing device (not shown). The integrated value of the number of times of the broken-state of thread and the actual spinning length of each spindle, which are stored in the RAM 20, are reset to zero by a starting signal of the doffing operation. Note that, when the starting prohibition cancella-

tion command signal is output to the spindle in bad condition in which repairing is completed, the total number of times of the broken-state of thread of the spindle is reset to zero based on the command signal.

[0027] This embodiment has the following effects.

a) In the single spindle driving spinning machine, the spindle computers 6 provided in the respective spindles and the frame computer 15 are connected through the communication line 13. Each of the frame computers 15 and the host computer 24 that controls the operation conditions of each of the frames are connected through the LAN 23. Therefore, the transfer of data may be carried out easily among the respective computers. Thus, division of the control is attained, thereby enabling the control with efficiency.

b) The broken-state of thread of each spindle is judged by each of the spindle computers 6, and the judgement results are output to the frame computer 15. Then, the control data is output to the host computer 24 from the respective frame computers 15. Therefore, it is possible to reduce collection time for data on the broken-state of thread, and thus monitoring at higher speed is possible.

c) The respective spindle computers 6 are connected with the frame computer 15 through the section control units 12. Therefore, when the frame computer 15 acquires data of each spindle on broken-state of thread and the like by a polling method, the frame computer 15 conducts polling plural times corresponding to the number of the section control units 12, thereby making it possible to input data of all the spindles. Thus, the data collection time can be further reduced.

d) The host computer 24 inputs the control data from the respective frame computers 15, thereby making it possible to control the operation conditions of all the frames and controlling the judgement of the spindle in bad condition, the stop of the spindle in bad condition, and the like with efficiency.

e) The frame computer 15 calculates the actual spinning length of each spindle based on the data on the broken-state of thread from the respective spindle computers 6 and the detection signal from the counter 22 of the frame. Therefore, the host computer 24 inputs the data from the respective frame computers 15, and thus the output and production efficiency of each spindle and each frame can be kept under control with more precision.

f) The frame computer 15 is connected with the host computer 24 through the LAN 23, and the cancellation of the starting prohibition command is possible by the command from the host computer 24. Therefore, the worker does not have to cancel the starting prohibition for each spindle at his discretion, and there is no fear that the control of the host computer 24 is hindered.

[0028] The present invention is not limited to the above embodiment, and may be embodied as described below, for example.

[0029] Without the provision of the section control units 12, the spindle computers 6 of the respective spindle control devices 4 may be connected with the frame computer 15 of the frame control device 14 through a LAN 30 as shown in Fig. 4. Ethernet is used as the LAN 30. In this structure, the data transfer is not carried out between the frame computer 15 and the spindle computers 6 by conducting polling by the frame computer 15, and data output is possible from the respective spindle computers 6 to the frame computer 15. As a result, it is possible to further reduce the time that the frame computer 15 requires for acquiring the data on existence/non-existence of a broken-state of thread or abnormality of all the spindles.

[0030] As for the command for the same operation of the spindle computers 6 such as the starting prohibition command, the starting prohibition command signal may be common to the spindle computers 6 irrespective of the difference of reasons for the starting prohibition.

[0031] Further, one or both of the frame computer 15 and the host computer 24 may compare the total number of times of broken-state of thread and the predetermined number $N\alpha$ in one doff and judge the spindle in which the total number exceeds the predetermined number $N\alpha$ is a spindle in bad condition. Thus, the starting prohibition command may be output to the spindle computer 6 of the spindle.

[0032] A method of detecting broken-state of thread of each spindle is not limited to a method of detecting a supply current to the spindle motor 2 by the current sensor 9, and a sensor for detecting broken-state of thread of another method may be used.

[0033] The display condition may be changed, for example, the broken-state of thread and the abnormality may be notified by using a combination of continuously turning on a light and switching a light on and off by using one display portion, instead of providing separately the display portion 10b for notifying abnormality and the display portion 10a for displaying broken-state of thread. Thus, the number of components is reduced, and the manufacturing cost can be reduced.

[0034] The period for totalizing the number of times of broken-state of thread for judging whether a spindle is a spindle in bad condition or not may be set in a plurality of doffs, working hours of a shift worker, or days instead of one doff as one unit.

[0035] The present invention is not limited to the ring spinner, and may be applied to a ring throwing machine for driving a single spindle, and the like.

Claims

1. An operation control system for a plurality of single spindle driving spinning machines, each spinning

machine being of the type in which the machine has a plurality of spindles and the spindles are independently driven by motors provided in the spindles, respectively, said operation control system comprising:

a plurality of spindle computers provided in correspondence with the plurality of spindles, respectively, each of which drives and controls a motor provided in the corresponding spindle; 5
a plurality of frame computers provided in correspondence with the plurality of spinning machines, respectively, each of which is connected with the plurality of spindle computers provided in the corresponding spinning machine through a communication means and controls an operation of the corresponding spinning machine; and 10
a host computer which is connected with the plurality of frame computers through another communication means and which keeps operation conditions of each frame under control. 15 20

2. An operation control system according to claim 1 wherein 25

each of the spindle computers outputs data on the state of the corresponding spindle to the corresponding frame computer; 30
each of the frame computers outputs speed command to the corresponding spindle computers, also handles data input from the respective spindle computers and outputs the data to the host computer; and 35
the host computer handles the data input from each of the frame computers.

3. An operation control system according to claim 1 wherein 40

each of the spinning machines is provided with a counter for totalizing rpm of a front roller; and 45
each of the frame computers calculates an actual spinning length of each spindle based on data on a broken-state of thread from the corresponding spindle computers and a detection signal from the counter.

4. An operation control system according to claim 1 wherein the plurality of spindles mounted on each of the spinning machines are divided into a plurality of groups, section control units are provided in correspondence with the respective groups, and a plurality of spindle computers of each of the groups are connected with the corresponding frame computer through the corresponding section control unit. 50 55

5. An operation control system according to claim 4

wherein

each of the spindles is provided with a display portion for displaying a broken-state of thread and a display portion for notifying abnormality; and
each of the spindle computers judges existence/non-existence of the broken-state of thread and existence/non-existence of the abnormality of the corresponding spindle in a predetermined cycle, when detecting the broken-state of thread, stops the corresponding motor and also turns on the display portion for displaying the broken-state of thread of the corresponding spindle, and when detecting the abnormality, stops the corresponding motor and also turns on the display portion for notifying the abnormality of the corresponding spindle.

FIG. 1

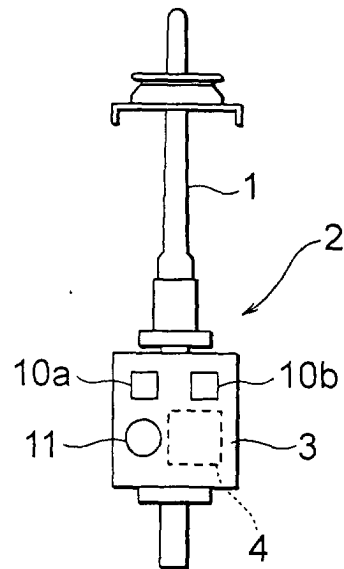


FIG. 2

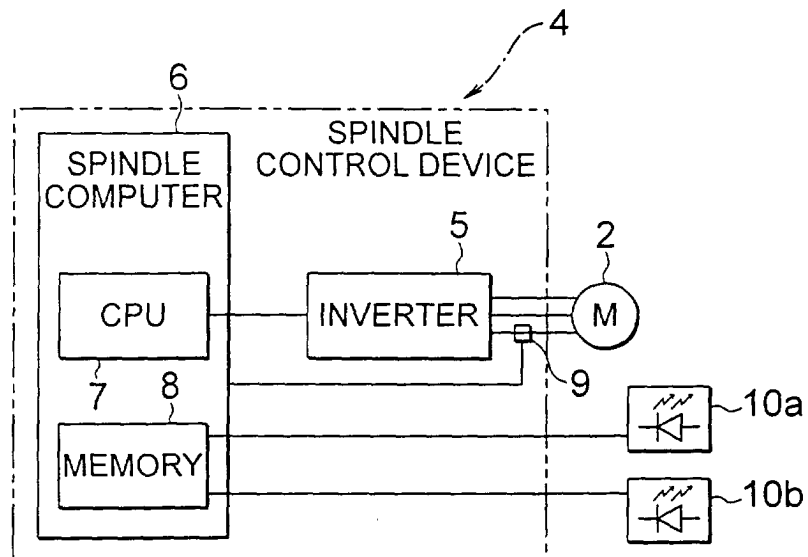


FIG. 3

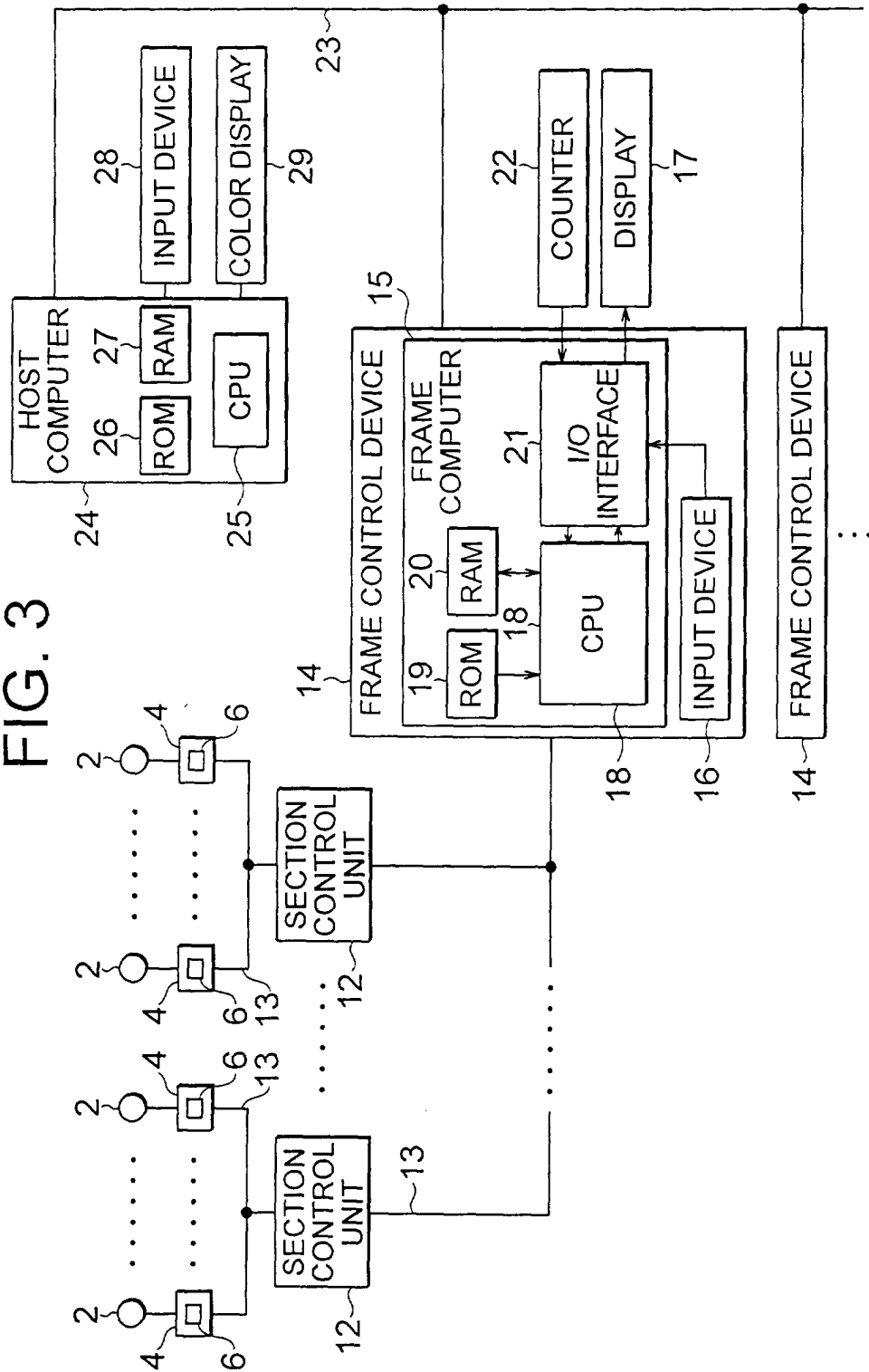


FIG. 4

