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MONITORING UNIT FOR
POWER-DRIVEN MOVABLE RACK SYSTEM

This invention relates to a unit for continuously monitoring operating status of a power-driven movable rack system and alerting any abnormality or trouble occurring therein.

In a storehouse, a plurality of movable racks are used to store articles. Such movable racks are moved under control of a power-driven movable rack system, which comprises a main control panel and a plurality of decentralized control panels. The main control panel is usually mounted on one of the movable racks, and the decentralized control panels are mounted on the other movable racks. The decentralized control panels are selectively operated to move a plurality of movable racks so as to form passageways therebetween. Such a power-driven movable rack system is exemplified in Japanese Patent Laid-Open Publication Hei 3-23162 (1991).

In a conventional power-driven movable rack system, a number of colored lamps turn on or blink to signal information concerning the operating status of the movable racks or troubles occurring therein, or

light emitting diodes are used to give numerical indication of such information. In either case, such an indication tends to cover only basic matters and is given to a limited number of destinations, and is not suitable to give a large amount of detailed information. Furthermore, the foregoing information is usually processed in each decentralized control panel, and not is processed under centralized control of the main control panel.

With a recent situation in the labor, unskilled workers tend to replace with skilled workers to attend storehouse facilities. In addition, to reduce the number of personnel, management of such facilities is extensively automated and simplified. Demands for safer and more reliable operation is making the storehouse facilities much complicated and sophisticated.

It is very difficult to restore these facilities without long interruption and without economic loss once abnormality or trouble occurs therein.

According to the present invention, there is provided a monitoring unit for use with a power-driven movable rack system in which a plurality of movable racks are selectively moved in response to an open command from a control unit so as to form a passageway therebetween, the monitoring unit comprising;

a communication means for transferring operating status information and abnormality information to a particular movable rack from the other movable racks;

a display unit for indicating the operating status information and abnormality information of the power-driven movable rack system, and

a control means for making the display unit indicate the operating status information and abnormality information of the movable racks which are received from the communication means.

In a preferred embodiment, the display unit is of a touch-panel type, and the control means causes the display unit to give hierarchical indications of various pieces of information of the movable racks in an interactive mode.

The communication means may be of a multiple communication type in which two communication lines are used to transfer the information wherein the logic circuit converts a signal format of the information from the communication means so that the information can be received by the control means.

The information may be supplied to the controller in a simple manner without using a sophisticated communication system including a micro-computer and an expensive high-speed controller.

Embodiments of the invention are now described, by way of example only, with reference to the accompanying drawings, in

which:

Fig. 1 is a block diagram of a monitoring unit according to an embodiment of the present invention;

Fig. 2 is a rear elevation of a power-driven movable rack system to which the monitoring unit of Figure 1 is applied;

Fig. 3 is a block diagram showing a circuit configuration of the power-driven movable rack system of Figure 2;

Fig. 4 is a block diagram showing a part of the power-driven movable rack system;

Fig. 5 is a block diagram showing a part of the power-driven movable rack system to which the present invention is applied.

Fig. 6 is a block diagram showing a circuit configuration of the power-driven movable rack system of Fig. 5.

Fig. 7 is a block diagram showing an interface circuit of the power-driven movable rack system of Fig. 5.

Fig. 8 is a block diagram of a communication control circuit for the power-driven movable rack system of Fig. 5.

Fig. 9 is a timing chart of signals for the power-driven movable rack system of Fig. 5.

Fig.10 is a timing chart of other signals for the power-driven movable rack system.

Fig.11 shows display screens given by an electronic display unit.

Fig.12 shows an example of display screen indicating the operating status.

Fig.13 shows an example of display screen indicating an abnormal condition.

Fig.14 shows an example of display screen indicating a trouble.

Fig.15 shows an example of display screen indicating trouble data.

Fig.16 is a block diagram showing the configuration of the main control panel and decentralized control panels in the power-driven movable rack system.

Fig. 17 is a flow chart of a processing routine of the power-driven movable rack system.

Fig. 18 is a rear elevation of another movable rack system to which the invention is applied.

As shown in Fig. 1, the monitoring unit comprises: a communication means 1 for transferring operating status information and abnormality information to a particular movable rack from the other movable racks; a display unit 2 for indicating the operating status information and abnormality information of the power-driven movable rack system, and a control means 3 for making the display unit indicate the operating status information and abnormality information of the movable racks which are received from the communication means 2.

In a first aspect of the invention, the information concerning the operating status, or abnormality or trouble of the movable rack system is indicated on the display unit 2

based on the information transferred between the movable racks via the communication means 1. The workers can recognize the status of the movable rack system by observing the indications on the display unit 2. Therefore, even unskilled workers can take care of the movable rack system safely and efficiently.

In Fig. 2, there is shown a light weight power-driven movable rack system to which a monitoring unit of this invention is applicable. The movable rack system comprises a stationary rack 11, a main movable rack 12, and movable racks 13_1 to 13_n . These racks are arranged in a row. The main movable rack 12 includes a main control panel 14 and an electronic display 16 which constitutes part of the monitoring unit. The movable racks 13_1 to 13_n include decentralized control panels 15_1 to 15_n respectively. The stationary rack 11 is positioned on the left hand side in the rack system. The movable racks 12 and 13_1 to 13_n are movable to the right away from the stationary rack 11.

Fig. 3 shows the circuit configuration of the power-driven movable rack system.

The main control panel 14 includes a decentralized control panel 18 for decentralized control of the movable rack 12, a controller 19, a communication control circuit 20, and an interface circuit 21. The

controller 19 comprises a main control circuit 17 for centralized control of the movable racks 12 and 13₁ to 13_n. The decentralized control panel 15₁ includes a decentralized control circuit 22₁ for the decentralized control of the movable rack 13₁, and an interface circuit 23₁. Similarly, the decentralized control panel 15_n includes a decentralized control circuit 22_n for the decentralized control of the movable rack 13_n, and an interface circuit 23_n. The electronic display 16, the communication control circuit 20, and the interface circuits 21, 23₁ to 23_n constitute the monitoring unit.

Each of the main control panel 14, the decentralized control circuits 18 and 22₁ to 22_n includes circuit boards which are usually used for conventional movable rack systems.

Various monitoring data the decentralized control panels 18, and 22₁ to 22_n, i.e. data concerning the operating status of the movable racks 12, and 13₁ to 13_n, or abnormality or trouble thereof, are output, in parallel, to the interface circuits 21, and 23₁ to 23_n, respectively. These interface circuits perform parallel-serial conversion of the data. The data are then delivered to the communication control circuit 20 via two transmission lines 24. The communication control circuit 20 converts the data into two voltage-

pulse signals, which are suitable to the input processing by the controller 19, and are input to the controller 19. Thus, the data are supplied to the controller 19 in a simple manner without using a sophisticated communication control system including in a micro-computer, and without using an expensive and high-speed controller. This means that software load for the communication control can be reduced. The controller 19 is applicable not only to the monitoring functions but also to the communication control.

The controller 19 lets the electronic display 16 indicate the operating status of the movable racks 12 and 13₁ to 13_n, or abnormality or trouble data in response to the input signals from the communication control circuit 20 and the data from the main control panel 14.

Fig. 4 shows in detail a connection between the decentralized control panel 18 and the interface circuit 21, and a connection between the interface circuit 21 and the communication control circuit 20. The data concerning the operating status of the main movable rack 12 or abnormality or trouble therein are output in parallel, and are subject to the parallel-serial conversion by the interface circuit 21, and are output to the communication control circuit 20 via the

two transmission lines 24.

Each of the interface circuits 21, and 23₁ to 23_n includes a plurality of communication elements 25₁ to 25_n. The communication elements 25₁ to 25_n are communication elements "Bitnet" NBH001 manufactured by Nippon Protec System Co., Ltd., and serially convert the data a, b, ... concerning the operating status, or abnormality or trouble of the movable racks 12 and 13₁ to 13_n. These data are input in parallel from the decentralized control circuits 18 and 22₁ to 22_n. The converted data are then supplied to the transmission lines 24. The number of the communication elements 25₁ to 25_n depends upon the number of data received in parallel from the decentralized control circuits 18 and 22₁ to 22_n.

Fig. 8 shows the configuration of the communication control circuit 20.

The communication control circuit 20 includes a dedicated interface module "BN1000-OB1" 26 manufactured by Nippon Protec System Co., Ltd., mono-stable multi-vibrators 27 and 28, an AND gate 29, and a NOT gate 30.

Fig. 9 is a timing chart of signals in the communication control circuit 20. The interface module 26 is activated by an /ENABLE signal which is a control signal from the controller 19 so as to transmit

the data, and outputs a SENS signal and a /SYNCH signal in response to the data (concerning the ON or OFF state of contacts 1 to n, for example) transmitted via the communication lines 24. The SENS signal is a positive pulse signal which is produced based on the data received via the transmission lines 24. The SENS signal has a pulse width of 300 μ s when there are no data, e.g. the contact is off, while it has a pulse width of 120 μ s when there are data, e.g. the contact is on. The /SYNCH signal is a negative pulse signal which is produced at an interval of 500 μ s in synchronization with the data received via the communication lines, and has a pulse width between 120 μ s and 300 μ s.

The SENS signal and the /SYNCH signal from the interface module 26 are ANDed by the AND gate 29. The mono-stable multi-vibrator 27 is triggered at the rising edge of an output signal of the AND gate 29, and provides the controller 19 with a SENS' signal having a 250- μ s pulse width.

The /SYNCH signal from the interface module 26 is reversed by the NOT gate 30. The mono-stable multi-vibrator 28 is triggered at the rising edge of an output signal from the NOT gate 30, and provides the controller 19 with a SYNCH' signal having a 250 μ s pulse width.

The SENS' signal and the SYNCH' signals from the mono-stable multi-vibrators 27 and 28 are in the format which is directly receivable in the controller 19. In other words, the data carried via the transmission lines 24 are converted by the communication control circuit 20 into signals which are receivable in the controller 19. The data from the transmission lines 24 are converted into a signal having a 50% duty ratio so that the controller 19 can reliably receive the signal, since the duty ratio of the /SYNCH signal is not stable due to variable performance of the communication elements 25₁ to 25_n.

The SENS' signal and the SYNCH' signal are independently input to an interrupt port. As shown in Fig. 10, the controller 19 is activated for interrupt processing at the rising edges of the SENS' and SYNCH' signals. When an interrupt by the SENS' signal is performed during an interrupt by the SYNCH' signal, the controller 19 recognizes the absence of data. Otherwise, the controller 19 recognizes the presence of data. The controller 19 interprets respective data in this manner, and recognizes them by incrementing the data number each time the interrupt by the SYNCH' signal is performed.

It is also possible that the controller 19 recognizes the presence or absence of the data based

on a low or high level of the SENS' signal when the controller 19 is activated for the interrupt processing at the falling edge of the SYNCH' signal. Furthermore, although the communication control circuit 20 outputs the SENS' signal having the 250 μ s pulse width when the presence of the data is recognized, the communication control circuit 20 may output the SENS' signal when the absence of the data is recognized.

Fig. 11 shows a flow of messages given on the electronic display 16 under control of the controller 19.

The electronic display 16 has screens, which are roughly classified into four types. They are an operating status screen 31, abnormality alerting screens 32 and 33, trouble alerting screens 34, 35, 36 and 37, and auxiliary screens 38 and 39. All of the screens give hierarchal indications of various data. The electronic display 16 is of a touch panel type, in which touch switches shown thereon are operated to input signals to the controller 19.

The controller 19 automatically switches the operating status screen 31 to the trouble alerting screen 34 or the abnormality alerting screen 34 when there is an abnormality or trouble. The other screens will be switched to lower order screens when their associated touch switches are operated on the screens.

The number of screens may be increased so as to give more detailed data on lower order screens.

Figs. 12 to 15 show examples of screens of the electronic display 16. As shown in Fig. 12, the electronic display 16 normally shows the operating status screen 31, from which an operation mode of the movable rack system can be recognized. Fig. 13 shows an example 32a of the abnormality alerting screen 32. Fig. 14 shows the trouble alerting screen 34. Fig. 15 is the trouble data screen 35. The electronic display 16 indicates the information graphically or by characters so that the workers can easily understand the operating status of the movable rack system, and abnormality or trouble therein.

Fig. 6 shows a circuit configuration of another example of the movable rack system to which the present invention is applied. Fig. 5 shows a part of the circuit.

In this embodiment, the decentralized control circuit 18 containing the interface 21 is represented by reference numeral 18a. The other decentralized control circuits 22_1 to 22_n including interface circuits 23_1 to 23_n are represented by reference numerals $22a_1$ to $22a_n$, respectively.

Fig. 16 shows the configuration of the main control circuit, and the decentralized control circuits

22₁ to 22_n.

The main control circuit 17 includes an open command and passageway locking circuit 36, a rightward movement commanding circuit 37, an all-rack-move command detecting circuit 38, a double command detecting circuit 39, an abnormality detecting circuit 40, an all-rack-stop commanding circuit 41, and an operation signal generating circuit 42.

The decentralized control circuits 22₁ to 22_n include the following components, respectively. For example, the decentralized control circuit 22₁ includes an open command and passageway locking circuit 43₁, a leftward move commanding circuit 44₁, a rightward move commanding circuit 45₁, an all-rack-move command detecting circuit 46₁, a double command detecting circuit 47₁, an abnormality detecting circuit 48₁, a stop limit detecting circuit 49₁, a motor control circuit 50₁, a moving rack detecting circuit, 51₁, and a motor driver 52₁. Similarly, the decentralized control circuit 22_n includes an open command and passageway locking circuit 43_n, a leftward move commanding circuit 44_n, a rightward move commanding circuit 45_n, an all-rack-move command detecting circuit 46_n, a double command detecting circuit 47_n, an abnormality detecting circuit 48_n, a stop limit detecting circuit 49_n, a motor control circuit 50_n, a

moving rack detecting circuit 51_n , and a motor driver 52_n .

The main control circuit 17 includes a stop switch 55_0 . The decentralized control circuits 22_1 to 22_n include stop switches 55_1 to 55_n , respectively. These switches 55_0 to 55_n are usually closed, and are connected in series between the earth and the all-rack-stop commanding circuit 41. The depression of at least one of the stop switches 55_0 to 55_n produces a stop signal, which is input to the all-rack-stop commanding circuit 41. Then, the all-rack-stop commanding circuit 41 outputs a stop signal to the motor control circuits 50_1 to 50_n , and the open command and passageway locking circuits 36, and 43_1 to 43_n .

In the following description, the circuits and members assigned with the reference numerals having a suffix "n" are used as a typical example, since the respective circuits and member with the suffixes 1 to n operate similarly.

The all-rack-stop command circuit 41 receives an output signal from any of the double command detecting circuit 39 and 47_1 to 47_n , and the abnormality detecting circuit 40 or 48_n , and outputs the stop signal pulse to any of the motor control circuits 50_1 to 50_n and any of the open command and passageway locking circuits 36 and 43_1 to 43_n .

The open command and passageway locking circuits 36 and 43₁ to 43_n are activated and output open command signals when the open command switches 54₀ to 54_n are depressed.

Passageway width limiting switches 53₀ to 53_n are disposed between the open command and passageway locking circuits 36 and 43₁ to 43_n, and a power source.

The open command and passageway locking circuit 36 or 43_n provides the locking signal to the motor control circuit 50₁ or 50_n and the leftward move commanding circuit 44₁ or 44_n when at least one of the passageway width limiting switches 53₁ to 53_n is turned off. Specifically, the passageway width limiting switches 53₀ to 53_n are designed to be turned off when passageways become as wide as predetermined between the movable racks and when swing arms disposed between the racks 11, 12 and 13₁ to 13_n turn to a predetermined angle, respectively.

The open command and passageway locking circuit 36 provides the open command signal to the rightward move commanding circuit 37 when the open command switch 54₀ is turned on. Then, the rightward move commanding circuit 37 provides the rightward move signal to the rightward move commanding circuit 45₁ of the decentralized control circuit 22₁, and the motor

control circuit 50₁. When the open command switch 54_n is turned on, the open command and passageway locking circuit 43_n provides the open command signal to the leftward move commanding circuit 44_n, and the rightward move commanding circuit 45_n.

When receiving the open command signals from the open command and passageway locking circuit 43_n, the rightward move commanding circuit 45_n of the decentralized control circuit 22_n provides the rightward move commanding signal to the rightward move commanding circuits 45_n of the decentralized control circuit 22_n, and the motor control circuit 50_n. For example, when receiving the open command signal from the open command and passageway locking circuit 43₁, the leftward move command circuit 44₁ of the decentralized control circuit 22₁ provides the leftward move command signal to the motor control circuit 50₁.

After receiving the open command signals from the open command and passageway locking circuit 43_n, the leftward move commanding circuit 44_n of the decentralized control circuit 22_n provides the leftward move signal to the motor control circuit 50_n and the leftward move commanding circuit 44_n of the decentralized control circuit 22_n. The leftward move commanding circuit 44_n stops transmitting the leftward

move commanding signal in response to the locking signal from the open command and passageway locking circuit 43_n.

When detecting the command signals for forming a passageway which are supplied from the main control circuit 17 and the decentralized control circuit 22_n, the all-rack-move command detecting circuit 38 or 46_n provides an output signal to the operation signal generating circuit 42. The double command detecting circuits 39 and 47_n detect that the command signals are dually issued in the main control circuit 17 and in any of the decentralized control circuits 22₁ to 22_n, and provide the output signals to the all-rack-stop commanding circuit 41.

The abnormality detecting circuit 40 detects an abnormal condition in the movable rack 12, and provides an output signal to the all-rack-stop commanding circuit 41. Each of the abnormality detecting circuits 48₁ to 48_n detects an abnormal condition in each of the movable racks 13₁ to 13_n, and provides the output signal to the all-rack-stop commanding circuit 41.

The stop limit detecting circuits 49₁ to 49_n detect that any of the adjacent movable racks 12, and 13₁ to 13_n are in contact with one another, and provide output signals to the motor control circuit 50₁ to 50_n, respectively. Each of the motor drivers 52₁

to 52_n rotates a plurality of motors forwardly or backwardly, thereby moving the movable racks 12 and 13_1 to 13_n to the left or right.

Receiving the rightward move command from the rightward move commanding circuit 37, the motor control circuit 50_1 activates the motor driver 52_1 , which rotates the motors forwardly so as to move the movable racks 12 to the right. Similarly, after receiving the rightward move command from the rightward move commanding circuit 45_n , the motor control circuit 50_n activates the motor driver 52_n , which rotates the motors forwardly so as to move the movable rack 13_n to the right.

In response to the leftward move command from the leftward move command circuit 44_n , the motor control circuit 50_n activates the motor driver 52_n , which allows the reverse rotation of the motors, and resultant leftward movement of the movable rack 12 or 13_n .

Receiving the locking signal from the open command and passageway locking circuit 36 or 43_n , the motor control circuit 50_1 or 50_n controls the motor driver 52_1 or 52_n so that the motors are stopped and that the movable rack 12 or 13_n is locked. In response to the output signal from the all-rack-stop commanding circuit 41 and the stop limit detecting

circuit 49₁ or 49_n, the motor control circuit 50₁ or 50_n controls the motor driver 52₁ or 52_n so as to stop the motors and the movable rack 12 or 13_n.

The moving rack detecting circuits 51₁ to 51_n detect that any of the movable racks 12 and 13₁ to 13_n are being moved by the motors, and signal the presence of the moving racks to the operation signal generating circuit 42, which outputs operation signals to the open command and passageway locking circuits 36 and 43_n according to the presence of the moving racks and output signals from the all-rack-move command detecting circuits 38 and 46_n. The open command and passageway locking circuits 36 and 43_n output locking signals when some of the passageway width limiting switches 53₀ to 53_n are turned off by the operation signal from the operation signal generating circuit 42.

Assume that all of the stationary rack 11 and the movable racks 12, 13₁ to 13_n are in close contact with one another and that there is no passageway between the racks. When the open command switch 54₀ is turned on under this condition, the open command and passageway locking circuit 36 provides the open command signal to the rightward move commanding circuit 37, which provides the rightward move command signal to the rightward move commanding circuit 45₁ and the

motor control circuit 50₁. The rightward move commanding circuit 45₁ provides the rightward move command signal to the rightward move commanding circuit 45₂ and the motor control circuit 50₂. In the similar manner, the rightward move commanding circuit 45₂ provides the rightward move command signal to the rightward move commanding circuit 45₃, and the motor control circuit 50₃. The rightward move commanding circuit 45₃ provides the rightward move command signal to the circuit 45₄, and the motor control circuit 50₄.

The motor control circuits 50₁ to 50_n control the motor drivers 52₁ to 52_n, respectively. The motor drivers 52₁ to 52_n rotate the motors forwardly so as to move the movable racks 12 and 13₁ to 13_n to the right. Thus, a passageway is formed between the stationary rack 11 and the movable rack 12, thereby offering a working space. When this passageway becomes wide as predetermined, the passageway width limit switch 53₀ is turned off. Then, the open command and passageway locking circuit 36 provides the locking signal to the motor control circuit 50₁ and the leftward move commanding circuit 44₁. In response to the locking signal, the motor control circuit 50₁ controls the motor driver 52₁, which stops the motor so as to lock the movable rack 12. Thereafter, the mov-

able rack 12 remains locked and immovable even when the open command switch 54_0 is turned on.

To form another passageway under this condition, an open command switch for the passageway is turned on. For example, when the open command switch 54_1 is pushed, the open command and passageway locking circuit 43_1 provides the rightward move command signal to the leftward move commanding circuit 44_1 and the rightward move commanding circuit 45_1 . Having received the locking signal, the leftward move commanding circuit 44_1 does not issue the leftward move command although it receives the open command signal. In response to the open command signal, the rightward move commanding circuit 45_1 provides the rightward move command signals to the rightward move commanding circuit 45_2 and the motor control circuit 50_2 . Similarly, the rightward move commanding circuit 45_2 provides the rightward move command signal to the rightward move commanding circuit 45_3 , and the motor control circuit 50_3 . The rightward move commanding circuit 45_3 transfers the signal to the rightward move commanding circuit 45_4 and the motor control circuit 50_4 .

The motor control circuit 50_2 controls the motor driver 52_2 . The motor control circuit 50_3 controls the motor driver 52_3 . The motor drivers 52_2 and 52_3

respectively rotate the motors forwardly so as to move the movable racks 13_1 and 13_2 rightwardly. Thus, the rightward movement of these racks forms a passageway between the main movable rack 12 and the movable rack 13_1 .

When the passageway becomes as wide as predetermined, the passageway width limit switch 53_1 is turned off. The open command and passageway locking circuit 43_1 provides the locking signal to the motor control circuit 50_2 and the leftward move commanding circuit 44_2 . Then, the motor control circuit 50_2 controls the motor driver 52_2 , which stops the motor so as to lock the movable rack 13_1 . The movable rack 13_1 remains immovable even when the open command switch 54_1 is turned on.

Selective operation of the open command switches 54_0 to 54_n allows selective movement of the movable racks 12 and 13_1 to 13_n , so that passageways can be formed between these movable racks as desired.

Referring to Fig. 17, there is shown a flowchart of the main routine of the controller 19.

When it is activated, the controller 19 performs initialization and input processing. Specifically, for the input processing, the controller 19 receives the data concerning the operating status, abnormality or trouble of the movable racks 12 and 13_1 to 13_n from

the decentralized control circuits 18 and 22₁ to 22_n via the interface circuits 21, 23₁ to 23_n and the communication control circuit 24. In other words, the controller 19 receives the data concerning the power supply voltage and a motor overcurrent from the decentralized control circuits 18 and 22₁ to 22_n, the output signals from the double command detecting circuits 47₁ to 47_n, the output signals from the stop limit detecting circuits 49₁ to 49_n, the operation status data, abnormality and trouble data, i.e. power supply voltage, from the main control circuit 17, output signal from the double command detecting circuit 39, and output signal from the all-rack-stop commanding circuit 41.

Then, the controller 19 performs self-diagnostic check, and calls a self-diagnostic error screen on the electronic display 16 when an error is detected.

Otherwise, the controller 19 checks whether or not there is a trouble in any of the movable racks 12, and 13₁ to 13_n. When there is a trouble, the controller 19 calls the trouble screen 34 on the electronic display 16 so as to give a trouble indication thereon. Otherwise, the controller 19 calls the start screen for a preset period of time, e.g. 10 seconds, prior to activation of the power-driven movable rack system.

When activating the power-driven movable rack

system, the controller 19 checks whether the power supply has been turned on based on the received power supply voltage data during the input processing. If the power supply is off, the controller 19 lets the electronic display unit 16 indicate the non-activation of the power supply. When the power supply is on, the controller 19 checks the presence or absence of any trouble. If there is a trouble, the controller 19 has the display 16 show the trouble on the trouble alerting screen 32. Otherwise, the controller 19 calls the operating status screen 31, so that the operation status of the movable rack system will be indicated on the display 16.

When a touch switch on the display 16 is operated by the user, a signal associated with the operated switch is input to the controller 19. On the operating status screen 31 of Fig. 12, there are shown a touch switch 56 "MANUAL" and a touch switch 57 "SYSTEM". Furthermore, the display 16 is of a type in which display screen can be programmed and designed as desired, and can reduce load applied to the controller 19. The display screens can be designed as desired.

When the "MANUAL" switch 56 is operated on the display unit 16, the controller 19 receives a signal associated with the operated switch, calls the instruction manual screen 39 on the display 16. Activa-

tion of the "SYSTEM" switch 57 inputs its signal associated to the controller 19, which calls the monitoring condition setting screen 38 on the display 16.

This screen 38 has a plurality of touch switches. In response to a signal associated with a switch operated on the screen 38, the controller 19 establishes the monitoring conditions accordingly.

When one of the touch switches on the screens 34 to 36 is operated, the controller 19 receives a signal associated with the switch, and calls a screen of a lower or higher order than the screen currently given on the display 16. The abnormality alerting screens 32 and 33 are called in response to the operation of their associated switches on the display 16.

This invention is also applicable to a movable rack system including heavy movable racks. Fig. 18 shows an example of such a heavy movable rack system. The stationary rack 11a, the main movable rack 12a, and the decentralized movable racks 13a₁ to 13a_n are horizontally arranged in a row. The stationary rack 11a is positioned at the leftist side, and the movable racks are positioned at the right side of thereof so as to be movable. The main movable rack 12a includes the main control panel 14a, and the other movable racks include decentralized control panels 15a₁ to 15a_n, respectively. The main movable rack 12a also

includes the electronic display 16a as the monitoring unit.

CLAIMS



1. A monitoring unit for use with a power-driven movable rack system in which a plurality of movable racks are selectively moved in response to an open command from a control unit so as to form a passageway therebetween, the monitoring unit comprising,

a communication means for transferring operating status information and abnormality information to a particular movable rack from the other movable racks;

a display unit for indicating the operating status information and abnormality information of the power-driven movable rack system, and

a control means for making the display unit indicate the operating status information and abnormality information of the movable racks which are received from the communication means.

2. A monitoring unit according to claim 1, wherein the display unit is of a touch-panel type, and the control means causes the display unit to give hierarchical indications of various information of the movable racks in an interactive mode.

3. A monitoring unit according to claim 1 or 2, wherein the communication means is of a multiple communication type in which two communication lines are used to transfer the information, and wherein a logic circuit converts a signal format of the information



from the communication means so that the information can be received by the control means.

4. A monitoring unit substantially as herein described with reference to the accompanying drawings.