METHOD AND APPARATUS FOR MACHINE MAINTENANCE

Inventors: Allen W. Koehlinger; Laurence A. Chrouch, both of Cincinnati, Ohio

Assignee: R. A. Jones & Co., Inc.,

Filed: Oct. 23, 1970

Appl. No.: 83,318

U.S. Cl. 35/13, 53/78

Int. Cl. G09b 25/02, B65b 57/18

Field of Search 35/13, 10; 53/78

References Cited

UNITED STATES PATENTS
2,932,929 4/1960 Fahrenbach et al. 53/78 X

3,237,318 3/1966 Schager

Primary Examiner—Wm. H. Grieb
Attorney—Wood, Herron & Evans

ABSTRACT

Method and apparatus for locating and correcting faults in machinery comprising fault detector indicators at the fault area, a viewer for fault correcting instructions, means to correlate the indicators with the viewer. The apparatus further includes recorded audio instructions keyed to said indicators for aurally leading plant personnel through a maintenance operation. The apparatus further including a monitor for counting and timing the duration of the faults.

7 Claims, 4 Drawing Figures
METHOD AND APPARATUS FOR MACHINE MAINTENANCE

The term maintenance, when used herein, refers to all operations performed on the machinery to keep it functioning on a specific job or to change it over to a different size or type of job and thus includes clearing faults, correcting machinery which causes faults and changing the machine for different sizes.

The term operator refers to a person who attends the machine during its normal operation. The term mechanic refers to a person who, working with tools, makes changes in the machinery to correct its operation or to change it for different sizes of articles and containers.

The term plant personnel refers to any person involved in the operation of the machinery and includes operators and mechanics.

This invention relates to a method and apparatus for providing fault indicators and instructions at the site of a machine for facilitating the maintenance of the machine. The invention will be described particularly with reference to packaging machinery where articles and containers therefor, such as cartons, cases, plastic packages and the like, pass through the machine. Also, it should be understood that the invention can be adapted for other machinery having similar maintenance problems.

In existing packaging machinery one or more of the following functions are performed either automatically or by hand. Conveyors are provided for conveying the articles to be packed into the loading section of the machine. A mechanism is provided for packaging articles in film or for setting up containers from blanks and feeding them into the loading section where they are filled with one or more articles, sealed, and conveyed away. Microwaves and/or photoelectric detectors are located in critical areas of the several sections of the machine to detect a particular fault, as for example, a reduced supply of articles, container blanks improperly set up, and containers improperly filled. Each detector is normally connected to a respective indicator such as a lamp bulb and lens, the indicators being mounted on a panel board. The indicators may also be connected to switches which will interrupt the operation of the machine or a particular section of the machine.

In the operation of the machine, the occurrence of a fault will cause the illumination of the indicator, and the operator seeing the indicator light, will take steps to clear the fault.

The efficiency of the operation of the machine is rather directly related to the efficiency and skill of the plant personnel. Therein lies the problem. Presently, very considerable amounts of time and creative energy are being directed toward the training of skilled personnel. Much time is spent in the training of personnel as well as the creation of training tools. Attempts have been made to create training films for general training of the personnel as well as to make specific films related to specific machines so that the personnel can draw such films from a library for study either preparatory to operating the machine or in the event of the need to make a specific maintenance correction.

Some companies provide a training room in an operating area having a sample packaging line for use in training. The acquisition of an unproductive machine is of itself expensive but additionally, since in many plants no two packaging machines are alike, work on a mock line will not necessarily train personnel for actual production.

Another proposed solution has been to provide a complex panel board in an area of the plant, the panel board having indicators each being connected to a detector on each of the various machines in the plant. When an indicator is lit, a watchful secretary dispatches a mechanic to the line where the fault must be cleared.

Another approach to the solution of the problem is the provision of two or three mechanic training schools in the country just to train mechanics for packaging machinery.

But even when trained personnel are available, problems arise. Such personnel are given daily rest periods and regular vacations and during these periods may be replaced by more or less inexperienced help. Such relief operators or mechanics have proved to be very inefficient. In some instances, the unions require the personnel to be rotated at regular intervals so that as a person acquires the necessary experience with one machine he may be shifted to another and become an inexperienced person there.

The machine manufacturer, of course, publishes a manual but the manual is, in practice, never at hand when it is needed under operating conditions and further, time is required to identify and locate the section of the manual which might be applicable to the fault. Further, the plant personnel may not be familiar with the language in the manual and have difficulty in correlating it to the parts of the machine or, the personnel may not be sufficiently literate at all to cope with the written instructions.

Still another problem occurs with experienced plant personnel, namely, the need to communicate with the machinery manufacturer. It is not at all unusual for a machinery manufacturer to receive a call from the personnel of a plant and to have that personnel give the manufacturer a totally erroneous description of the fault or problem and even more specifically, to give the manufacturer an erroneous description of a part which is urgently needed for replacement purposes on the machine, making it difficult for the manufacturer to be of meaningful assistance.

Still another allied maintenance problem arises, namely, the problem of properly attributing the down time of a packaging line to the machine at fault and especially the section of the machine at fault. The packaging company knows that a line is down too much of the time and may attribute the problem to the wrong section of the machine or to the wrong machine. Very often identifying the problem is more time consuming than the correction of the problem once it is identified.

The objective of the present invention is to provide a totally new approach to the operation and maintenance of machinery, particularly packaging machinery, the new approach supplementing or even eliminating the need for extensive off the line training of plant personnel as well as providing a mechanism for accounting for the frequency and duration of faults of a machine thus pinpointing the major recurring problems on a particular machine so that they can be isolated more quickly and correctly.
More specifically, the invention provides a mechanism at the site of the machine having instruction data stored within the mechanism and having means for selecting the appropriate data, the means being correlated to the fault to be corrected. In one form of the machine a microfilm viewer is located at the site of the machine and has a selector adapted, when operated, to produce desired data on a viewing screen. The selector may be manually operated and correlated to indicia on the fault indicator lights or may be connected directly to the fault detector so as to produce the proper instructions when the fault occurs. Further, the data is cross-referenced to additional selectable data to permit a mechanic to be referenced to additional instructions when the general instructions are insufficient to clear the fault or its cause.

The invention further provides an aural system of instructions including a magnetic tape transducer or equivalent having earphones and connectable to outlets positioned adjacent the various sections of the machine to enable a mechanic to be led through the solving of a maintenance problem through aural instructions.

The invention further provides a monitor having means for counting and timing the duration of every detected fault. Preferably, a daily log is kept of the results produced by the monitor. Periodic examination of the log associated with any packaging line could very quickly isolate the major causes of down time and thereby enable the company to intelligently approach a solution to the problem of down time.

The monitor may be built into a console associated with the viewer and indicator panel board or alternatively, the monitor may be provided as a portable unit with means to connect it to existing machinery for the purpose of checking the efficiency of various machines in a line and isolating problem areas.

Intelligent utilization of the several features of the present invention greatly simplifies the operation and maintenance of machinery. No longer is it necessary to provide extensive training for plant personnel with special films, special training lines and/or extended training periods at the machinery manufacturer. Personnel with only minimal training have the tools at hand to make rapid identification of fault and selection of instructions for correcting the fault.

Further, by providing a rapid print-out mechanism associated with the instruction viewer, instructions can be carried to the fault area thereby enabling the personnel, very rapidly after the occurrence of the fault, to carry instructions related to its correction to the area of the fault and to proceed to correct it.

Still further, in communicating with the machinery manufacturer, the print-out can be used. For example, when a part is required, a print-out of a blueprint section showing part can be circed and mailed to the parts supplier.

The lubrication of the machine can be simplified for it requires simply the selection of the lubrication chart, obtaining a print-out of it and carrying out the lubrication process with the print-out at hand while checking the various lubricated areas. That lubrication chart can be handed to the foreman and become a part of the log of the machine.

The instructions on the viewer may refer the operator to additional instructions or may refer the operator to a particular magnetic tape cassette which the operator can insert in a player. Earphones can be plugged into jacks located at the relevant section of the machine.

The several features and objectives of the invention will become more readily apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a diagrammatic perspective view of a machine embodying the invention,

FIG. 2 is a diagrammatic top plan view of a machine embodying the invention,

FIG. 3 is a perspective view of a maintenance console used in the invention, and

FIG. 4 is a diagrammatic elevational view of an alternative monitor.

By way of illustration, the invention is shown as embodied in a tray packer, a tray packer being a machine for packaging 24 cans in a corrugated tray type case. It should be understood that that INVENTION is particularly applicable to other types of packaging machinery as well as having general application to machines wherein operating and maintenance problems of the type which the present invention solves are encountered. As shown in FIGS. 1 and 2, a tray packer 10 is connected to a console 11. The tray packer has an infeed section 13 for six-packs of cans 14 and a magazine 15 containing a stack of tray blanks 16. Adjacent the infeed section 13 is a metering section 17 where the six-packs are separated into groups of four making up a load for individual trays. Downstream of the metering section 17 is a transfer section 18 where overhead flight bars on endless conveyors sweep each group of four six-packs into the next section. Immediately downstream of the transfer section 18 is a barrel loader section 19 having a plurality of plunger 20 carried on an endless conveyor and having cam means associated with the conveyor to move each plunger 20 gradually toward the trays as they are conveyed past the barrel loader section.

Adjacent the magazine section 15 containing the stack of tray blanks 16 is a primary pusher 25 which ejects the lowermost tray from the stack in a downstream direction into a tamp section 26 immediately adjacent the magazine section 18. At the tamp section 26 is a vertically moveable tamp plunger 28 which cooperates with a receptacle 29 to partially form a tray from a blank 16. More particularly, a blank ejected by the primary pusher 25 moves into a space between the tamp plunger 28 and the receptacle whereupon the tamp plunger 28 presses the blank into the receptacle 29 thereby bending upwardly the leading and trailing side walls 30 and 31 with respect to the bottom wall 32 of the tray.

A secondary plunger 35 is associated with the tamp section 26 and is engageable with the partially formed tray to drive it out of the tamp section and onto a tray conveyor section 36. In the tray conveyor section, an endless conveyor carrying transport lugs conveys the partially formed trays past the barrel loader section 19 where those partially formed trays receive a load of four six-packs.

Immediately downstream of the tray conveyor section 36 is a tray forming section 37 which includes a flap closer 38. The flap closer 38 has rotating blades
which engage trailing glue flaps 40 of trailing end wall 31 and swing them through an angle of 90° to wrap them about the cans in the tray. The tray forming section also includes stationary plows 39 which engage the leading glue flaps 41 of leading end wall 30 and similarly fold them about the cans. A glue applicator 42 applies glue to the lateral portions of end walls 43 so that when the end walls are plowed up about the cans in the tray, the glue will adhere to the leading and trailing glue flaps 40 and 41 respectively, to form the tray. Stationary plows 45 are located downstream of the glue applicator 42 for the purpose of maintaining the flaps in contact with the end walls until the glue has set.

The foregoing describes in a general way the packaging machinery structure and the manner in which it operates to meter cans into groups, to transfer them to barrel loaders, to partially form trays, and to load the cans into the trays after which the trays are completely formed. In each of the sections, one or more problems may arise which require maintenance by an operator or skilled mechanic. Detectors are located at critical positions in each section to detect the presence of the problem. The detectors may take the form of microswitches or photoelectric devices to detect the presence or absence of proper alignment of articles on conveyors. The detectors may also take the form of pressure sensitive devices which are associated principally with the mechanisms for transferring articles and containers to detect the presence of a jam and to stop the machinery when such a jam is detected.

Eleven such detectors are indicated generally and designated by the letters A through K. Each detector, which will be described below, is connected to the console 11 illustrated in greater detail in FIG. 3. The console has a panel board 50, a viewer-printer 51 and a magnetic tape transducer 52. The panel board 50 has an indicator section 54 containing a vertically oriented series of signal lamps designated 54A through 54K, each signal lamp being connected to a respective detector A through K to illuminate the respective signal lamp when the detector is operated. The panel board also contains a monitor group indicated at 55 which in the illustrated embodiment, contains 11 counter and timer modules 55A through 55K which are also connected respectively to the detectors A through K. Two additional modules 56 and 57 are provided for monitoring total fault and down time of the packaging machine and the complete packaging line, respectively.

Each module contains a counter 58 which counts each operation of its respective detector and a timer 59 which totals the time of all detected faults from the time of the operation of the detector until the fault is cleared and the detector is returned to normal conditions. Reset mechanisms may be associated with each of the modules or one reset mechanism may be used to reset all modules in one operation.

The panel board 50 also includes a control panel 65 containing indicators and switches normally associated with a machine of this type which are used for the regular operation of the machine.

An alternative form of module is illustrated in FIG. 4. There, replacing or supplementing the individual counter 58 and timer 59, is a graphic recorder 60 which includes a calibrated paper disc 61 carried by a timer movement. Cooperating with the paper disc is a pen 62 connected to a detector to move the pen radially inwardly with respect to the disc upon the detection of a fault. The disc preferably is calibrated for an 8-hour shift and will provide a visual indication of the number of faults occurring during the eight-hour shift as well as their duration and time of occurrence. The paper discs can be replaced at the end of each shift, the used discs being retained as a part of the log of the machine to provide the statistical data needed to remedy faults which occur more frequently and are of longer duration than should normally be expected.

The viewer-printer 51 may be an instrument of known design as for example, the 400CT Series II Reader-Printer manufactured by 3M Company which has been somewhat modified for application to the present invention.

The viewer-printer has a storage section 67 containing a cartridge of instruction data on microfilm. Above the storage section is a screen 68 onto which any frame of instruction data may be projected for viewing. Behind the screen 68 is a printing mechanism adapted to make prints of the frame on the screen, the prints being ejected through slot 69.

The microfilm is indexed and is driven by a mechanism which responds to input from a pushbutton selector 71. For example, the cartridge may contain 9,999 frames any one of which can be selected by pushing, in sequence, the pushbuttons corresponding to the four digit number of the frame. Manual crank 72 is also provided to move the data, frame by frame, past the viewer. Instead of or in addition to the selector 71, the detectors may be connected, through a coding mechanism, to the storage section so as to cause the appropriate instruction to be selected and brought into position for projection on the screen 68 when a fault is detected.

To the right of the selector 71 is a scanning selector dial 73. Rotation of it in one direction causes the film to move in a first direction and rotation in the opposite direction causes the film to reverse its direction. The extent of the rotation determines the speed of the movement of the film past the projector.

To the left of the selector 71 is a dial 74 associated with the printer, the adjustment of which permits lighter or darker prints to be made. A pushbutton 75 initiates the operation of the printer.

The magnetic transducer 52 has a receptacle 76 adapted to receive a cartridge 77. A receptacle 78 is also provided for an earphone set 79. The earphone set has a coil cord 80 and jack 81 which permits it to be connected to the transducer via jack receptacles 82, 83 and 84 and 85 (as in FIG. 1) on one side of the machine 10 and comparable outlets on the other side of the machine. Thus, when the operator requires oral instructions for corrective or regular maintenance, the relevant cartridge can be selected, inserted in the transducer and the earphones can be plugged into any of the jack receptacles so as to bring the mechanic to a position adjacent the section where maintenance is required. Preferably the earphone is provided with a stop-start button 86 to control the operation of the transducer.

Mounted over the machine are three signal lights, 87, 88 and 89. An upstream signal light 87 is connected to detectors upstream of the instant machine, the middle
indicator light 88 is connected to the detectors of the instant machine and the downstream indicator light 89 is connected to indicators at the downstream of the instant machine. When a fault occurs, an operator can first glance at the overhead lights 87–89 to determine whether the problem lies with his machine or a machine up or down the line, and govern his acts accordingly.

In the illustrated exemplary embodiment, each detector is positioned at a critical location on the machine to detect a particular fault. That fault is given a four digit code number which appears alongside the respective signal lamp 54A–54K, and which corresponds to a microfilm frame containing at least the initial instructions for correction of the fault. That instruction frame contains the information required to solve the most probable and frequently occurring cause of the fault. The frame may also contain cross-references to other causes of the fault, along with a four digit code relating to each which guides the operator in selecting additional instruction frames for presentation to the viewer.

The following are detectors employed in the illustrated embodiment:

A. Prime — A microswitch detector which detects the absence of sufficient cans in the infeed conveyer section 13.
B. Misaligned Six-Pack — A microswitch detector which detects a six-pack longitudinally oriented (two abreast) instead of properly transversely oriented (three abreast).
C. Low Magazine — A microswitch detector which detects insufficient supply of blanks 16 in the magazine 15.
D. Primary Case Feed — A pressure sensitive detector which detects a jam in the ejecting of a blank from the magazine.
E. Secondary Case Feed — A pressure sensitive detector which detects a jam in the transfer of the partially formed tray from the tamp section to the transport conveyer section 36.
F. Tamp — A pressure sensitive detector which detects a jam in the formation of a tray in the tamp section.
G. Missing Case — A microswitch detector at the tamp section which detects the absence of a tray when the tamp plunger 28 descends for the proper formation of the tray.
H. Transfer — A pressure sensitive detector on the overhead flight bar conveyer of the transfer section 18 which detects a jam on the conveyer of incoming six-packs.
I. Missing Six-Pack — A pressure sensitive detector which detects the absence of one or more six-packs at the upstream end of the barrel loader section.
J. Barrel Loader — A pressure sensitive detector which detects a jam which prevents all four six-packs from being properly positioned in a barrel loader.
K. Flap Closer — A pressure sensitive detector which detects a jam or associated problem which prevents the proper operation of the flap closer to swing the trailing end flaps into position.

OPERATION

In considering the operation of the machine let it be assumed that initially the machine is running properly. Then a fault is detected.

When the machine stops, the operator can immediately look overhead at the indicator lamps 87, 88 and 89 and determine whether the machine has stopped due to a fault on his machine or on a machine upstream or downstream from the instant machine.

A jam might have occurred, for example, in the transfer mechanism 18 causing the detector H to be actuated which in turn would cause signal lamp 54H to be illuminated. The signal from the detector would also initiate the operation of the counter 58 and timer 59 on monitor module 55H associated with the specific fault as well as modules 56 and 57 associated with the line and machine respectively. In this case as well as many others, the detector will provide a signal to the main controls to stop the machine. The operator, seeing light 54H illuminated on the indicator panel 54 will note the code number 8001 and punch that number into selector 71 (unless the machine is connected for automatic operation of the viewer) to bring onto the screen instructions for clearing the fault.

The instructions may simply advise the operator of the sequence of steps to relieve the jam which initiated the operation of the detector. The instructions might further suggest several possibilities of improper operation of the machine which might have given rise to the jam and provide code numbers for these alternatives. The personnel can punch those code numbers into the selector 71 to obtain additional instructions for preventing further jams of the type being cleared. If the nature of the instructions is such that adjustments must be made at points remote from the viewer, a print-out of the instructions can be obtained by punching the button 75.

If the instructions are extensive and require several adjacent frames, the operator can turn to the adjacent frames by manipulating the hand crank 72.

Where conditions require oral instructions, an appropriate cartridge can be placed in the transducer 53, enabling the personnel to take the earphones 79 to the location of the adjustments to be made. The personnel plugs the earphones into a jack 83, for example, to listen to the instructions while concentrating on the work to be performed rather than having to refer back and forth from an instruction sheet to the machine.

When the maintenance operations have been performed, an appropriate start button is punched by the operator and the machine will resume normal operation. The resumption of the operation will stop the timer on the modules 55H, 56 and 57.

At the end of the shift, a foreman will go to the consoles of each machine in his charge and extract the information relating to numbers of faults and down time and enter that information in the log of the machine.

We claim:

1. In a packaging machine having a plurality of sections for handling articles and containers therefor, means for detecting faults in said sections, and a signal lamp associated with each said section, the improvement comprising:

   a viewer having storage means containing selectable data in the form of instructions relating to fault correction,
a manually operable selector for selecting data from said storage means and presenting said data in an immediately perceivable form at said machine, and indicia associated with each said signal lamp providing input for operating said selector, whereby, when a fault occurs, a signal lamp is illuminated and personnel operate said selector in accordance with the indicia associated with said lamp to present data in the form of instructions for correcting the fault.

2. A packaging machine according to claim 1 further comprising:
   print-out means in said viewer for providing a sheet of instructions, drawings and the like for use by the personnel away from the viewer.

3. A packaging machine according to claim 1 further comprising:
a counter connected to each detector and operable upon detection of each fault, whereby the number of faults occurring at each section over a preselected period may be determined.

4. A packaging machine according to claim 1 further comprising a timer connected to each of said detectors, said timer being operated at the time of each fault until said fault is cleared, whereby the total duration of faults on each section can be determined.

5. In a packaging machine having a plurality of sections for handling articles and containers therefor, means including indicators for detecting and indicating faults in said sections, the improvement comprising, a viewer having storage means containing selectable data relating to fault correction, means for selecting data from said storage means for visual presentation in said viewer, and means connecting said detecting means to said selecting means to provide automatic selection and presentation of data in said viewer.

6. In a packaging machine having a plurality of sections for handling articles and containers therefor, means including indicators for detecting and indicating faults in said sections, the improvement comprising, a viewer disposed adjacent said machine and having storage means containing selectable data relating to fault correction, and means for selecting data from said storage means for immediate visual presentation in said viewer, said selected data being correlated to the fault indicated by said detecting means.

7. A packaging machine according to claim 6 in which said data selecting means is manually operable and, in which said indicators are associated with indicia which correspond to the data to be selected.