IMPROVEMENTS IN OR RELATING TO THE CONTROL OF PRODUCTION PROCESSES

The present invention relates to a method and system for controlling a production process, and to a reading device and individual storage devices for use with such a method or system.

There is a need to collect information about a production process, such as a manufacturing process. For example, information as to workers' attendance and information about the products during their production may be required. In some sophisticated manufacturing facilities, a computer is provided at each work station and these computers are networked or otherwise connected such that all of the information required can be fed to a main or control computer. However, such networked computer systems are expensive. Furthermore, a very large capital investment is needed in order to install such a system in an existing manufacturing facility.

It is an object of the present invention to provide a method and system for controlling a production process which does not require an expensive networked computer system.

According to a first aspect of the present invention there is provided a method of controlling a production process comprising the steps of providing a respective first programmed storage device for each individual involved, each said first storage device carrying information identifying the corresponding individual, and providing a respective second programmed storage device for products treated by the process, each said second storage device carrying information identifying the product, wherein at least one stand alone reading device capable of

reading the information on the first and second storage devices is provided, and wherein the method further comprises the step of causing the reading device to read first and second storage devices of individuals, and products associated with the process at a selected location and/or time, whereby said reading device collects information identifying the individuals, and products associated with the process at said location and/or time.

If, for example, each product in the course of manufacture, has a respective second programmed storage device, the reading device at a particular work station, for example, will collect information identifying the individual working at that work station and identifying each product which passes through that work station.

Preferably, the method further comprises the step of providing said reading device with information identifying the step(s) of the process.

Preferably, the or each reading device is provided with output means enabling the information it has collected to be output. For example, the output means may be arranged to write to first and second storage devices and/or to further storage devices.

Preferably, at least one reading device is associated with a respective work station. The information collected by each said reading device may be output on to a selected storage device which is preferably arranged to be read by a computer. It will be appreciated that in this manner, information collected at each work station by the respective reading devices may be fed to, and subsequently collated and acted upon, by the computer.

Preferably, the method further comprises the step of

causing the or each reading device to request the input of information.

For example, the or each said reading device may be arranged periodically to output an audio or visual warning that information is required.

The method may comprise the step of enabling each reading device to additionally receive information by way of input means, such as, for example, by way of push buttons, a key pad, a keyboard, a sensor or sensors, and/or a barcode reader.

In one preferred embodiment, an individual worker will be stationed at a particular work station provided with the respective reading device. The individual will have an associated first programmed storage device which will be inserted into, and retained within, the reading device whilst the individual is at the work station. The reading device will be arranged to read the storage device such that it collects information identifying the individual. Periodically, the reading device may output a warning signal, for example, may beep, requiring the individual to press a key or button to signify his continued attendance at the work station.

Additionally and/or alternatively, the method may comprise the step of causing the or each reading device to output data or information.

For example, the or each said reading device may display selected information from selected storage devices. The identification of the step(s) and/or product(s) at a particular work station, for example, may usefully be displayed. Instructions as to the process steps or actions on a product to be undertaken may usefully be displayed.

Thus, the individual worker at a particular work station may be provided with information and data to assist him to perform the necessary operations.

Preferably, the method may further comprise the step of providing each said reading device with information identifying process steps or actions.

In a preferred embodiment, a further, preprogrammed, storage device, for example, a job card or work order card may be provided for each reading device and may cause the reading device to display sequentially individual tasks to be performed.

The method may be used for controlling any production process, for example, a manufacturing process or a product processing or testing process. The second programmed storage devices preferably each identify a respective product which is being manufactured or processed by the production process. Thus, each reading device will collect information as to the attendance of the worker at the work station, and as to the identity of products passing through that work station. In addition, further programmed storage devices may carry information identifying individual steps in the process.

In a preferred embodiment, each said reading device is enabled to record real time.

As the reading device is enabled to read real time, it is a straightforward matter to collect information as to a worker's attendance. However, the method preferably comprises collecting information relating to the performance of the individual worker.

As each said second storage devices identifies a

respective product, the time of arrival and time of departure of each product at a particular work station may be collected by the corresponding reading device or on the storage device. Hence, the speed at which the worker deals with individual products can be determined. Similarly, the reading device may be arranged to collect information as to the time taken to complete a particular step or task.

The or each reading device may be provided with information identifying quality control procedures, the work order of the process, materials and/or parts to be utilised, and/or any other relevant information. For example, additional storage devices may be provided for carrying the information. These additional storage devices may be dedicated to one particular type of information or may carry multiple types. If required, the or each reading device may be enabled to write information from any of said first, second, further and additional storage devices to any of said first, second, further and additional storage devices.

According to a further aspect of the present invention there is provided a system for controlling a production process comprising a number of first storage devices, each said first storage device carrying information identifying a respective individual involved in the production process, a number of second storage devices, each said second storage device carrying information identifying products subject to the production process, at least one stand alone reading device capable of reading and storing information on said first and second storage devices, and output means enabling access to the stored information stored by said reading device.

In a preferred embodiment each said first storage device is associated with a respective individual, and each

said second storage device is associated with a respective product. Preferably, said reading device is arranged to collect information identifying the individuals, steps and products associated with the process at a selected location and/or time.

For example, each product in the course of manufacture has a respective second programmed storage device, and the reading device at a particular work station may collect information identifying the individual working at that work station and identifying each product which passes through that work station.

In an embodiment, said output means is arranged to write to first and second storage devices and/or to further storage devices.

Preferably, at least one reading device is associated with a respective work station. The information collected by each said reading device may be output on to a storage device. The system preferably further comprises a computer enabled to read information from said storage devices.

Preferably, the or each said reading device is provided with warning means arranged periodically to output an audio or visual warning that information is required.

Preferably, each reading device has input means, such as, for example, push buttons, a key pad, a keyboard, a sensor or sensors, and/or a barcode reader, whereby information may be input thereto.

In a preferred embodiment, each said reading device is enabled to record real time.

In a preferred embodiment each of the first, second

and further storage devices comprises a card or a disc enabled to carry data. Preferably, each said storage device is programmable and can be read by the reading device. In a particularly preferred embodiment, each said storage device is a card carrying an integrated circuit comprising both memory and a processing circuit.

In a preferred embodiment, each said reading device comprises a plurality of slots for receiving storage devices. This enables more than on storage device to be input and read by the reading device at the same time. The reading device may also be provided with a display.

Preferably, each said reading device includes timing means, such as a clock circuit.

The present invention also extends to a stand alone reading device for collecting information, said reading device comprising a processing circuit, a memory, a timing circuit, and more than one access slot, said processing circuit being arranged to read and store in said memory information carried on storage devices inserted in the said access slots.

The present invention also extends to a storage device for use with the process or system defined above.

According to a further aspect of the present invention there is provided a storage device for carrying information identifying an individual, a process step, or a product, said storage device comprising a card carrying an integrated circuit having both memory means and a processing circuit.

Embodiments of the present invention will hereinafter be described, by way of example, with reference to the

accompanying drawings in which:

Figure 1 shows a perspective view of a stand alone reading device for use in a system for controlling a production process,

Figure 2 shows a block diagram of the reading device of Figure 1,

Figure 3 shows schematically an industrial plant using a process of the invention for manufacturing products,

Figure 4A shows a plan view of an individual worker ID card, and Figure 4B shows a plan view of a job record card,

Figure 5 shows a schematic flow chart for one operation performed by a worker on a product with instructions from a stand alone reading device, and

Figure 6 shows an example of an employer production report which can be produced from information recorded by a stand alone reading device.

The invention will be particularly described below with reference to a process for manufacturing products. However, the invention is equally applicable to the control of any production process, for example, for testing or otherwise treating products. Furthermore, in the particular embodiment described, information about individual products is collected and utilised. Additionally information about specific process steps may be stored and collected.

The system for controlling the manufacturing process comprises a plurality of reading devices 2 as shown in the drawing. Each reading device 2 is located at a specific work station of the manufacturing process as described further below with reference to Figure 3.

All workers involved in the manufacturing process are provided with an individual worker ID card which is a

storage device programmed with information identifying the worker. Preferably the storage device also carries information as to the grade or skill level of the worker. The ID card may comprise, for example, a bar code card or a magnetic card. However, it is preferred that the ID card is an integrated circuit (IC) card having both memory and a processing circuit so that it can store information about the workers in a number of categories. The card can be made to be re-programmable if required. Such a card is described further below with reference to Figure 4A.

The reading device 2 is comprised of a main control or microprocessor 12, associated external memory 14, and a timing circuit 16. It is provided with a number of access slots 4. On arriving at a work station, therefore, the worker places his ID card in one of the slots 4 and the reading device is able to read the identification information on the card and to store the worker's identity and skill level together with the time at which the card was inserted into the reading device 2. Preferably, the card is retained within the reading device 2.

The reading device 2 is provided with a display 6 and with a key pad 8. Preferably, the microprocessor of the reading device 2 causes an audio warning to be sounded on a speaker 18 periodically. This is switched off by the worker pressing a particular button or combination of buttons of the key pad 8. This enables information as to the attendance of the worker to be stored in the memory 14 of the reading device 2.

As can be seen in Figure 2, the reading device 2 may be provided with a number of different input and output devices arranged to communicate with the processor 12. By way of appropriate input/output interfaces 18. The access slots 4 are provided with contacts, indicated at 20, for

the ID cards. In addition, one or more of a barcode reader 22, sensors 24, LED's 26 may be provided as required. The reading device 2 may also be provided with a socket 28 for a conventional parallel or serial interface connector, together with an appropriate interface 30 therefor. The reading device 2 may be connected to a mains supply and/or may have its own power supply 32.

Thus, it will be appreciated that the reading device is able to record and accumulate information as to the attendance time and machine usage by the worker.

In a similar manner, each product being manufactured is provided with an individual product ID card. When a product arrives at a work station, for example, the worker can insert the accompanying product ID card into one of the slots 4 of the reading device 2 where it is retained until the product is to leave the work station, at which time the product's ID card is removed from the reading device 2. Thus, the reading device is able to collect information as to the products which have arrived at a particular work station, and the time that they remain. The reading device is also able to record data identifying when no product is at the work station.

The information about a product carried by its associated ID card may, of course, be chosen as is required. Pre-programmed information may include identification data, such as one or more of a product identification code, a product serial number, and a work order number. In addition, information as to the original supplier, prospective customer, and other data may be stored. At each work station, the ID card of the product may be provided by the reading device with information as to the steps undertaken at that work station, and the time involved, and quality information. For example, each

worker at a work station may be required to perform a quality check on each product arriving and to record the results on the associated ID card by way of the reading device.

Each reading device 2 is a stand alone device. It has the capability not only to read from cards in the access slots 4 but also to write to those cards as appropriate. Thus, to collect data stored in each reading device 2 it is necessary only to write data from the memory thereof onto a card. This may be done in a number of ways.

In a first procedure, each worker ID card or product ID card inserted into an access slot 4 has written thereon the information collected by the reading device together with identification as to the particular reading device 2. Thereafter, the individual worker ID and product ID cards are inserted into a card reader in or associated with a control computer so that the data can be read and analysed by the computer. This card reader for the control computer may be any suitable device. Additionally and/or alternatively, an output card may be provided and it may be arranged that all of the information collected by a particular reading device 2 is written to this output card at periodic intervals, for example at the end of each shift. Again, the output card can be read by the computer or by a hand carried card reader.

Transfer of information between various cards and the memory of the reading device 2 can be arranged as is required so that the particular information that is wanted can be collected and subsequently analysed.

Each card can be provided with password protection.

It will be appreciated that without requiring a

sophisticated computer network, information as to the manufacturing process and as to workers' attendance and the like can be collected and input to a computer for analysis. The data collected may be used by different software systems to provide the management with any information required. As the system enables the path of each product through the process to be traced, it can be used, for example, for quality assurance procedures.

Generally, and as indicated above, it is intended that during the period of a working shift, or working day, each reading device 2 will continuously record data about the worker and about each production item. The production item data may include date, time, and the processing and quality status of each product. The data would then be collected at the end of the period as described. Of course, because the reading device 2 is a multi-slot device, data can additionally and/or alternatively be collected and checked, for example as a quality control procedure, during the actual production process.

The data collected, and the analyses performed thereon can, of course, be tailored to particular circumstances. For example, not only can attendance data for individual workers be collected, but the time individual workers take to perform particular tasks can be monitored. Similarly, the number of reject products emanating from a particular work station or worker can be monitored. The system can also be used to provide some control of a worker's activities. For example, a reading device may be arranged to sound an alarm if a worker of an inappropriate skill level attends at a particular work station.

For products, information as to their quality status, and the times of particular operations performed thereon can be collected. In addition, the control computer can

collect from the product ID cards information as to the numbers of units produced, and the quantities rejected. Information can thus be determined as to the total accumulated production time, the production yield percentage, and numbers of scrap or reject products.

A major advantage of the system described is its flexibility for work station processing. As it is "networkless" its installation is simple, yet the manual or semi-automatic processing saves time in recording individual and product information. In addition, the provision of a centralised computer reading data directly from cards rather than receiving data input manually, reduces error.

Figure 3 is a schematic plan view of an industrial plant indicating one implementation of a system and manufacturing process of the invention. The plant illustrated in Figure 3 has an office area 100 and an adjacent factory area 102. In the office area 100 there is provided a stand alone central computer 104 for collecting and analysing data from ID cards and for recording information onto job cards and individual ID cards.

In the factory area 102, a manufacturing operation is to be undertaken. Thus, raw material enters the factory area 102 as indicated by the arrows A and is fed to appropriate component making areas 106 and 116. There is preferably a storage area as indicated at 110 associated with each area 106 and 116 for storing the raw material as it arrives. In the area 106 there are a number of individual work stations 108, each provided with a respective stand alone reading device 2. At each work station 108, which is individually manned, there may be, for example, an injection moulding machine.

Similarly, in the area 116 raw material from the storage area 110 is moved as necessary to each of a number of individual work stations 112 each operated by an individual and each provided with an appropriate stand alone reading device 2. In this work area 116, for example, each of the work stations 112 may be comprised of a press.

As described above, each individual worker, indicated at 114 on Figure 3, has an individual ID card which is inserted in the reading device 2 at the associated work station whilst the worker performs tasks on the raw material to create component parts. If required, as the worker operates the machine at the work station 108, 112 to produce each component part, a component part IC card can be created by the reading device 2 at that work station to uniquely identify each component part produced.

The component parts produced in the work areas 106 and 116 are provided as required to an assembly area 120. If individual part ID cards are provided they accompany the component parts. In the assembly area 120 there are a number of individual work stations 122 at each of which an individual worker 114 performs predetermined operations on one or more component parts. At each work station 122 an associated reading device 2 is provided. It may be that at each work station 122 substantially identical tasks are performed. Generally, however, one or more component parts will be directed to a number of different work stations 122 whereby the various production steps on the resultant product are undertaken. Where each product goes through a number of processing steps it is useful to move the products sequentially through the work stations 122 as indicated by the arrow B.

At the first work station 122 in the assembly area 120

where production of a product commences, a product ID card is associated with that product and is arranged to uniquely identify that product. Thus, the reading device 2 at the first work station 122 may be arranged to provide an identification for the product and information as to its first processing steps. Alternatively, and particularly where the final product is based on a single main component part, the product ID card may be provided by the ID card of that main component part.

A further option is to provide to the assembly area 120 a series of uniquely identified product ID cards, the identification having been provided by the central computer 104. Such a pre-programmed ID card is then associated with each product at its first work station 122. Thereafter, and as described above, the individual product ID card would travel with the product during its production and further processing. The part ID cards, where they are provided, may be created similarly, and may also, if required, travel with the product so that its provenance is clear. Alternatively, at the first work station 122 at which a product is processed, information may be written to the product ID card from the ID cards of components parts utilised in the production of the product. This can be undertaken by the associated reading device 2. At this point, therefore, the parts ID cards can be collected and returned to the office area 100, for example, for data analysis and stock control functions performed by the computer 104.

The products produced in the area 120 are assembled in an assembly area 130 where they are packed for subsequent dispatch as indicated by the arrow C.

The reading devices 2 at the individual work stations as 108, 112 and 122 are used, as described above, to enable

the collection of information. However, the reading devices 2 may also be used to inform or instruct workers as to the tasks to be performed, and to provide control of those tasks.

Figure 4A shows a plan view of one example of an individual worker ID card 40. This card is an integrated circuit card carrying an integrated circuit 42 with associated memory. In the embodiment illustrated, the individual worker ID card 40 is also printed with the name and an identification number of the employee and, as indicated at 44, a photograph of the worker can also be incorporated in the card 40 so that it can serve as a normal identity card as workers walk around the industrial plant.

Figure 4B shows a job record card 46 which is also an IC card having an integrated circuit 42 with memory. A product ID card and a part card, for example, would appear identical to the job record card 46 except for any identifying legends printed thereon.

A job record card, as 46, can be used to control an individual reading device 2 to identify and control the tasks performed by an individual worker at an individual work station. One way in which this might be done is indicated in Figure 5 which is a schematic flow chart of steps at an individual work station which might be performed by an individual worker.

Each job record card 46 is appropriately programmed, for example, by the central computer 104 and is arranged to control the performance, at a particular work station, of one or more process steps of a part or product to be manufactured or otherwise processed. As indicated at Figure 5, after an appropriate initialisation process, the

job record card 46 is to be input to the stand alone reading device 2 at the appropriate work station. Preferably, the need to input the job record card 46 is prompted by the reading device 2. At function 50 of the flow chart of Figure 5, the insertion by the worker of the job record card 46 at the prompt of the reading device 2 is noted. The job record card then causes the reading device 2 to record the time in its own memory and to the job record card. At function 52, the job record card has caused the reading device 2 to require the individual worker to insert his ID card. The details are read, including the workers identification, from the workers ID card at function step 54. As described earlier, the reading device may check the skill level or the authorisation of the worker before proceeding further. If these checks show everything is in order, the production process, indicated as "C", can be commenced.

Before any further processing of the component part or the product is undertaken, it may be required to check the quality of the parts provided. The worker can be prompted to do this, as indicated by function 56. Thus, the worker may be prompted to undertake a simple visual inspection or to go through a more rigorous quality control process as indicated at "B". If no such check is required, or after it has been completed, the worker is prompted at step 58 to insert the product ID card accompanying the product being processed. If this is the first processing step in the production of the product, the worker may have to obtain and insert a new product ID card. The reading device 2 is then controlled to read the product information, for example, to ensure that there is an individual product number on the ID card. The reading device then displays, at function 60, the individual process steps to be undertaken by the worker. These displayed process steps may be a simple command to commence the processing, or may

be broken down into a series of discrete tasks to be undertaken. Where a series of discrete tasks are to be displayed the worker may be required to signify the end of one task before the next task is displayed.

Where the reading device has prompted the performance of several tasks in succession it may, at function 62, check that all of those tasks have been performed, and in appropriate time scales. If the worker has not responded to the prompts in appropriate time or order, the reading device may indicate that the product is to be rejected, as indicated at function 64. Assuming that all of the tasks have been satisfactorily completed, at function 66 the reading device prompts the worker to signal the completion of the task, for example by pressing a button. The reading device 2 will then write to the product ID card the time and other details of the process tasks and will similarly write time information to the individual ID card of the worker. The product might then be moved, accompanied by its product ID card, to a further work station whilst the job card 46 can take the worker through the same process tasks, for example, for a subsequent product.

As indicated above, at the end of a shift, or when leaving a particular work station, the worker will remove his individual ID card from the reading device associated therewith. The identification of the worker and the tasks performed by him at the work station are preferably recorded on the job record card. At the end of a shift, for example, the job record card can then be removed from the reading device 2 for analysis by the central computer 104. Figure 6 shows the sort of report which can be produced, for example from one job record card maintained within a specific reading device 2 for a specified shift. Obviously, further information or alternative information may be stored, and subsequently analysed, as is required.

It will be appreciated that variations and modifications to the invention as described above may be made within the scope of this application.

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CLAIMS

1. A method of controlling a production process comprising the steps of providing a respective first programmed storage device for each individual involved, each said first storage device carrying information identifying the corresponding individual, and providing a respective second programmed storage device for products treated by the process, each said second storage device carrying information identifying the product, wherein at least one stand alone reading device capable of reading the information on the first and second storage devices is provided, and wherein the method further comprises the step of causing the reading device to read first and second storage devices of individuals, and products associated with the process at a selected location and/or time, whereby said reading device collects information identifying the individuals, and products associated with the process at said location and/or time.

2. A method of controlling a production process as claimed in Claim 1, further comprising the step of providing said reading device with information identifying the step(s) of the process.

3. A method as claimed in Claim 1 or Claim 2, further comprising the step of enabling the output of information collected by said reading device.

4. A method as claimed in any preceding claim, wherein at least one reading device is associated with a respective work station.

5. A method as claimed in any preceding claim, further comprising the step of causing the or each reading device

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to request the input of information.

6. A method as claimed in Claim 5, wherein the or each said reading device is arranged periodically to output an audio or visual warning that information is required.

7. A method as claimed in any preceding claim, further comprising the step of enabling each reading device to additionally receive information by way of input means.

8. A method as claimed in any preceding claim, where when an individual worker is stationed at a particular work station provided with the respective reading device, a first programmed storage device associated with that individual is inserted into, and retained within, the reading device whilst the individual is at the work station, wherein the reading device is arranged to read the storage device to collect information identifying the individual, and wherein the reading device periodically outputs a warning signal requesting the individual to signify his continued attendance at the work station.

9. A method as claimed in any preceding claim, further comprising the step of providing each said reading device with information identifying process steps or actions.

10. A method as claimed in any preceding claim, further comprising the step of providing information identifying quality control procedures.

11. A method as claimed in any preceding claim, further comprising the step of providing information identifying the work order of the process.

12. A method as claimed in any preceding claim, further comprising the step of providing information identifying

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materials and/or parts to be utilised.

13. A method as claimed in any of Claims 9 to 12, wherein additional programmed storage devices are provided for carrying information identifying process steps or actions, and/or quality control procedures, and/or the work order of the process, and/or the materials and/or parts to be utilised.

14. A method as claimed in any preceding claim, wherein each said reading device is enabled to record real time.

15. A system for controlling a production process comprising a number of first storage devices, each said first storage device carrying information identifying a respective individual involved in the production process, a number of second storage devices, each said second storage device carrying information identifying products subject to the production process, at least one stand alone reading device capable of reading and storing information on said first and second storage devices, and output means enabling access to the stored information stored by said reading device.

16. A system as claimed in Claim 15, wherein said reading device is arranged to collect information identifying the individuals, and products associated with the process at a selected location and/or time.

17. A system as claimed in Claim 15 or Claim 16, wherein said output means is arranged to write to first and second storage devices and/or to further storage devices.

18. A system as claimed in any of Claims 15 to 17, wherein at least one reading device is associated with a respective work station.

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19. A system as claimed in any of Claims 15 to 18, further comprising a computer enabled to read information from said storage devices.

20. A system as claimed in any of Claims 15 to 19, wherein the or each said reading device is provided with warning means arranged periodically to output an audio or visual warning that information is required.

21. A system as claimed in any of Claims 15 to 20, wherein each reading device has input means whereby information may be input thereto.

22. A system as claimed in any of Claims 15 to 21, wherein each said reading device is enabled to record real time.

23. A system as claimed in any of Claims 15 to 22, wherein each of the first, second and any further storage devices readable by each said reading device comprises a card or a disc enabled to carry data.

24. A system as claimed in Claim 23, wherein each said storage device is programmable and can be read by the reading device.

25. A system as claimed in Claim 24, wherein each said storage device is a card carrying an integrated circuit comprising both memory and a processing circuit.

26. A system as claimed in any of Claims 15 to 25, wherein each said reading device comprises a plurality of slots for receiving storage devices.

27. A system as claimed in any of Claims 15 to 26, wherein each said reading device includes timing means.

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28. A stand alone reading device for collecting information, said reading device comprising a processing circuit, a memory, a timing circuit, and more than one access slot, said processing circuit being arranged to read and store in said memory information carried on storage devices inserted in the said access slots.

29. A method of controlling a production process substantially as hereinbefore described with reference to the accompanying drawings.

30. A system for controlling a production process substantially as hereinbefore described with reference to the accompanying drawings.

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