

## DESCRIPTION

### METHOD AND DEVICE FOR REGISTERING INSPECTION STANDARDS FOR A CHARACTER INSPECTING APPARATUS

## TECHNICAL FIELD

The present invention relates to a character inspecting apparatus for inspecting the quality of a character by image processing, and more particularly, to a method and a device for registering inspection standards for the character inspecting apparatus.

## BACKGROUND ART

With the increase in the production of electronic components, the quality inspection of appearances and characters thereof has been regarded as important. Particularly, high speed and high reliability are required for the quality inspection, and a reduction of changeover time when an object of inspection is changed is also required.

Apparatuses to which an image processing technique is applied are commonly used as the quality inspecting apparatuses for character strings stamped or printed on the electronic components, and the apparatuses are as follows. That is, a predetermined area of a component to be inspected is photographed by a camera as an inspection range, and the

image data thereof are stored in an image memory. Then, character models and character positions, which become inspection standards, are registered in advance, and the above image data and character models are sequentially compared by pattern matching at the respective registered character positions. As a result of the pattern matching, the presence or absence, and the good or bad quality of the characters are judged from similarities to the character models.

With respect to articles like electronic components in which objects of inspection are frequently replaced, it becomes important that the character models and the character positions which become inspection standards of the above character inspecting apparatus can be efficiently and correctly registered in a short time. A conventional device for registering in advance these inspection standard data will now be described with reference to Figs. 10 to 13.

A device for registering inspection standards for a character inspecting apparatus includes, as shown in Fig. 10, a camera 1 for inputting images of character strings stamped or printed on an electronic component to be inspected, and the image data are stored in an image memory 2. An electronic component 20, which is an object of inspection, has a determined area in which the character string is to be inspected (hereinafter, referred to as a

capture area) 21, and the registration device comprises a capture area storage section 4 for storing the capture area 21. A binarization execution section 3 performs binarization on the basis of the above image data and the capture area 21, and outputs the results to a character-capture execution section 5. The character-capture execution section 5 judges and captures (hereinafter, referred to as capturing) a character portion from the results of binarization, and outputs them to an inspection standard registration section 6. The inspection standard registration section 6 registers a character model and its character position corresponding to the captured character in an inspection standard storage section 8.

The binarization execution section 3 converts the image data in the image memory 2 into binary data in a region of the captured area stored in the capture area storage section 4. The image data are such that a gray scale for each pixel of the camera 1 is stored at a predetermined resolution. For example, at a resolution of 8 bits, gray scale data of 256 levels are obtained. When the gray scale data of 256 levels are arranged from the lowest (equivalent to black) to the highest (equivalent to white), and the number of pixels for each gray scale of the above image data is counted, a histogram shown in Fig. 12 is generated. Usually, since the characters stamped or printed on the electronic component

include many whitish characters, portions close to white represent character portions, and portions close to black represent bases in Fig. 12.

By converting the above histogram into binary data using a predetermined gray scale as a threshold value, the image data are separated into gray scale image data represented by black and white. Based on this result, the binarization execution section 3 outputs information about positions of the pixels separated into white portions to the character-capture execution section 5. Incidentally, fine adjustment of the number of pixels separated into the white portions can be effected by adjusting the positions of the predetermined gray scale which becomes the threshold value, so that the accuracy of capturing the characters can be improved.

The character-capture execution section 5 uses the information about positions of the pixels separated into white portions, and identifies a mass of pixels, which can be judged as one character, on the basis of a predetermined algorithm. Then, as shown in Fig. 13, for example, a predetermined area including the mass of the pixels identified as the character is judged as a character area 22 and captured. The image datum included in the captured character area 22 is taken as a character model to be inspected, and a predetermined position such as the central

position of the character area 22 is taken as a character position 23 of the character model. The character model and the character position 23 are output to the inspection standard registration section 6. The inspection standard registration section 6 registers the input character model and the character position 23 in the inspection standard storage section 8, respectively.

When registering an inspection standard of the next object of inspection during the actual changeover, the initial work which registers the inspection standard of the next lot is used. That is, as described above, the image data of the initial work are incorporated in the image memory 2 and converted into binary data within a region of the capture area to capture each of the character areas 22, whereby the character models and the character positions of the character string of the work to be inspected are obtained and stored. They are used as the character models and the character positions to be newly inspected, and the character quality can be inspected by pattern matching on the basis of the inspection standard during the same lot of electronic components.

However, in the above conventional device for registering inspection standards for the character inspecting apparatus, in the case of a poor quality character such that printing of the character to be

inspected of the initial work which registers the inspection standard is unclear, or the character includes scratches, etc., a faulty character model is registered as a reference model with an attendant registration of a wrong character position. In addition, with respect to a character string of high density having small character pitches, the character model cannot be captured normally, and a character model is generated in which a part or all of the adjacent characters are close to each other, so that a character model different from the actual one is usually registered. As a result, the inspection is conducted in accordance with such a faulty inspection standard, so that the character quality inspection may not be conducted normally, thereby causing reduction in the inspection accuracy.

In addition, since the character models are captured and registered each time the lot is newly changed, the character models and the character positions delicately change for each registration even if the initial work is not a defective product. In conducting the character quality inspection, a stable and reliable inspection can be often conducted if the reference character models and character positions are fixed. Therefore, there has been an increase in demand for stabilizing the character models and the character positions to be registered.

Further, depending on the character string to be

inspected, there may be a case where only a part of the character models in the character string may be preferably changed without changing the character positions in the inspection standards of the former work registered in the inspection standard storage section. In this case, according to the conventional device, it is necessary to register character models and character positions of a new character string. For this reason, workability of registration of the inspection standard is not so good, and control of the inspection standard becomes complicated.

#### DISCLOSURE OF THE INVENTION

The present invention has been made to solve the problems of the prior art, and its object is to provide a method and device for registering inspection standards for a character inspecting apparatus which can register inspection standards by a simple operation without depending on the character quality of a work registering the inspection standards, whereby a character quality inspection can be stably and accurately conducted.

According to the present invention, there is provided a method of registering inspection standards for a character inspecting apparatus incorporating image data of a character string of a work for registering a character string inspection standard by a camera, obtaining character areas

and positions of the character areas on the basis of the incorporated image data, and registering image data of the obtained character areas and the character area positions as character models and character model positions which become inspection standards, respectively, the method comprising:

storing in advance standard image data of all the characters to be inspected as standard character models of the characters;

executing pattern matching between character string image data of the work and the standard character models when obtaining the character areas and the character area positions; allocating standard character models of high similarity in the pattern matching to the character string image data as character models; calculating character positions of the allocated character models; and

registering the allocated character models and the calculated positions of the character models as the inspection standards.

According to the present invention, there is provided a device for registering inspection standards for a character inspecting apparatus including a camera for incorporating image data of a character string of a work to be inspected, an image memory for storing the incorporated image data and image data of a character string of a work for registering a character string inspection standard, and an inspection

standard storage section for storing image data of the character areas obtained on the basis of the character string image data of the work for registering a character string inspection standard and the positions of the character area as character models and character model positions which become inspection standards, respectively, the device comprising:

- a character model storage section for storing in advance standard image data of all the characters to be inspected as standard character models of the characters;

- a search area storage section for storing search area data which become execution range of pattern matching with respect to the image data of the work for registering a character string inspection standard;

- a pattern matching execution section for sequentially executing pattern matching between the incorporated image data and all the characters of the standard character models within the execution range of the pattern matching, allocating standard character models of high similarity in the pattern matching to the character string image data as character models, obtaining character areas of the allocated character models, and outputting the allocated character models and the obtained character areas;

- a character position calculating section for calculating coordinates of the obtained character areas as

character positions;

an allocation judging section for judging whether or not allocation is correct on the basis of the allocated character models and the calculated character positions, and outputting the allocated character models and the calculated character positions when the allocation is correct; and

an inspection standard registration section for registering the input allocated character models and the calculated character positions in the inspection standard storage section.

In addition, the device may attach thereto an allocated character designation section for designating the character string of the work to be inspected, and the pattern matching execution section, when executing the pattern matching, may sequentially execute pattern matching between the incorporated image data and the standard character models corresponding to the designated character string. Further, the device may comprise an inspected character changing section to which a character change command for changing only a part of characters in the character string of the former lot without changing character positions of the work of the former lot registered in the inspection standard storage section is input, and the inspected character changing section may input the character change command and a new character string, and replace only character models to

be changed in the inspection standard storage section to register new inspection standards while referring to the character models in the character model storage section corresponding to the new character string.

According to the above construction of the present invention, standard image data of all the characters to be inspected are stored in advance as standard character models of the characters. When the work is changed to a new one to be inspected, the image data of the character string of the work which registers their inspection standards are incorporated in the image memory, and pattern matching between the image data and the character models of all the characters stored in the character model storage section is sequentially executed within the range of the search area of the image data. On the basis of similarities of the pattern matching, the character models are allocated to the above image data, and the character positions of the allocated character string are calculated by the character areas of the character models. Here, "allocation" means that the above character models stored in advance are made to correspond to the inspection standard positions as standard models, and the same shall apply hereinafter. When the allocation is executed correctly, the allocated character models and the character positions of the character models are registered in the inspection standard storage section as

inspection standards.

When the thickness of the line of the character to be inspected tends to vary, several character models having different line thicknesses in response to the characters are stored in the character model storage section. When the inspection standards are registered in accordance with the above description, the inspection standards flexibly corresponding to the above variation can be obtained. As a result, the accuracy of the character inspection can be improved. In addition, there may be a case where one character in a character string may be any one of a plurality of character models such that the final numeral in a numeral string may be any one of "0 to 9". In this case, a plurality of character models are made possible to be allocated to one character position, which becomes the inspection standard, whereby even if the character string to be inspected changes within the range of the above character models capable of being allocated, character models which flexibly become inspection standards in response thereto can be registered.

When the character string to be inspected is already known, the thicknesses of the characters of the character string are fixed, and there is only one character model corresponding to the characters, the character string to be inspected is designated by the allocated character string

designation section. A pattern matching between the character models stored in the character model storage section corresponding to the characters of the designated character string and the image data within the range of the search area is executed. On the basis of similarities thereof, the character models and the character areas are allocated similarly to the above description, and the allocated character models and the character positions thereof are registered in the inspection standard storage section as the inspection standards. At this time, the processing time of the pattern matching is shortened.

Depending on the object of inspection, there may be a case where only a part of the character models in the character string may be preferably changed without changing the character positions in the inspection standards of the former lot registered in the inspection standard storage section. At this time, the inspected character changing section inputs a character change command and a new character string, and replaces only character models to be changed in the inspection standard storage section while referring to the character models in the character model storage section on the basis of the new character string. The new inspection standard can be easily registered in this way without changing the character positions, so that efficiency of registration work can be improved.

Accordingly, when a work registering the inspection standards is a defective product, the allocation is judged to be abnormal after executing the allocation, so that the work can be detected as a defective product. Thus, the character models and the character positions can be correctly registered without depending on the character quality of the defective product. In addition, with respect to the inspection of a character string of high density having small character pitches, correct inspection standards can be registered. As a result, the inspection accuracy during the actual character inspection can be improved, and working efficiency of the inspection becomes high.

#### BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a functional block diagram of a first embodiment of the present invention;

Fig. 2 is a circuit block diagram of the first embodiment;

Fig. 3 is a flowchart of an inspection standard registration according to the first embodiment;

Fig. 4 is an another circuit block diagram of the first embodiment;

Fig. 5 is a functional block diagram of a second embodiment of the present invention;

Fig. 6 is a flowchart of an inspection standard

registration according to the second embodiment;

Fig. 7 is a functional block diagram of a third embodiment;

Fig. 8 is a flowchart of an inspection standard registration according to a third embodiment;

Fig. 9 is an illustration of a processing flowchart according to the third embodiment;

Fig. 10 is a functional block diagram according to a prior art;

Fig. 11 is an illustration of an electronic component and a capture area according to the prior art;

Fig. 12 is an illustration of binarization of a device for registering inspection standards according to the prior art; and

Fig. 13 is an illustration of an example of character position calculation of the device for registering inspection standards according to the prior art.

#### BEST MODE FOR CARRYING OUT THE INVENTION

The preferred embodiments according to the present invention will now be described in detail with reference to the attached drawings.

Figs. 1 to 4 show a first embodiment. Referring to Fig. 1, a camera 1 incorporates image data of a character part, which is the object to be inspected, and a CCD camera

may be adopted, for example. The image data are input as gray scale data for each pixel of the camera 1, and the gray scale data are stored in an image memory 2 as digital values at a predetermined resolution. Similarly to the above description of the prior art, at a resolution of 8 bits, for example, gray scale data of 256 levels are obtained.

An area in which characters to be inspected are written is called a search area, and a search area storage section 13 for storing a range of the areas is provided. A character model storage section 7 stores in advance standard image patterns of all the characters used in characters or character strings to be inspected as character models (standard character models), and stores, for example, image patterns of alphanumeric characters and so forth. In the following description, the case of one character is also called a character string unless otherwise specified. In addition, an allocated character string designation section 14 designates the character string to be inspected to a pattern matching execution section 11 and an allocation judging section 15, and the character string can be designated as, for example, an ASCII code, or a JIS code. Image data in an image memory 2, search area data in the search area storage section 13, character models in the character model storage section 7, and character string data to be inspected from the allocated character string

designation section 14 are then referred to by a pattern matching execution section 11.

The pattern matching execution section 11 inputs the character codes of the designated character string from the allocated character string designation section 14 and the character models in the character model storage section 7 corresponding thereto, and executes pattern matching between these character models and the image data stored in the image memory 2 in the range based on the search area data from the search area storage section 13. As a result of the pattern matching, an image pattern portion having high similarity to a certain character model is regarded as a corresponding character area, and the above character model having high similarity is allocated to the character area. Then, the character area corresponding to the allocated character model is output to a character position calculating section 12.

The character position calculating section 12 calculates the character positions of the input character area, and outputs the above allocated character model and the calculated character positions to the allocation judging section 15. The allocation judging section 15 compares the above input character model and the character positions with the sequence of the designated characters input from the allocated character string designation section 14, and

judges whether or not the allocated characters are in line as designated, and whether or not the character pitches are normal, and so forth. When judged normal, the above character model and the character positions are output to an inspection standard registration section 6. The inspection standard registration section 6 registers the character model and the character positions in the inspection standard storage section 8.

The pattern matching execution section 11 uses the character patterns corresponding to the character codes of the designated character string as the character models to execute pattern matching between the image data and the character models. In the generally performed pattern matching, similarities between the character models and the image data are obtained, and the image data area of the portion where there is the highest degree of similarity to a certain character model is regarded as the character area on which the characters thereof are printed. In the following description, the processing for defining the characters and the character area by the pattern matching is referred to as search.

Referring to Fig. 2, a device for registering inspection standards can be composed of, for example, a CPU system to which a microcomputer (hereinafter, referred to as a CPU) is adopted. A CPU 30 is a common CPU which includes

therein a common storage section, a processing section, an execution control section, an interrupt service section, and so forth. A ROM 31 is a memory for storing a system program determining a system execution procedure, and RAM is a memory for temporarily storing data and so forth during calculation and execution.

In addition, the device for registering inspection standards has an external storage device 34, and the CPU 30 reads and writes the data of the external storage device 34 through an interface circuit (hereinafter, referred to as an I/F circuit) 33. The external storage device 34 may be composed of, for example, a hard disk device, a floppy disk device, or an IC memory card. The external storage device 34 is used as the search area storage section 12, the character model storage section 7 and the inspection standard storage section 8. Incidentally, when the amount of data of each of the above storage sections is small, the RAM 32 may be used as the storage section.

The image data from the camera 1 is stored in a video memory (hereinafter, referred to as a VRAM) 2a through an analog/digital conversion circuit (hereinafter, referred to as an A/D). The VRAM 2a is composed of a high-speed memory capable of reading and writing, such as a normal DRAM. The CPU 30 inputs image data from the VRAM 2a.

In addition, as means for designating the allocated

character string, an example of input by a communication from an external control device 40 is presented in this embodiment. Thus, a communication I/F circuit 14a is included as the allocated character string designation section 14, and the CPU 30 transmits and receives data such as the designated character string to and from the external control device 40 through the communication I/F circuit 14a. The external control device 40 may be, for example, a CPU system similarly composed of a CPU, and so forth.

A display 35 displays errors of the above allocation when they occur, and may be a lamp display, such as a danger reporting light and so forth. In addition, an error message may be displayed by a character display such as a CRT display and so forth. A reincorporation switch 36 is a switch for designating whether or not the image data is to be reincorporated when allocation errors occur. The display 35 and the reincorporation switch 36 input and output data to and from the CPU 30 through the I/F circuit 33.

A processing flow of the inspection standard registration of the CPU 30 in the above construction will now be described in detail with reference to Fig. 3. Here, it is assumed that a total of 36 character models of A to Z, and 0 to 9 are stored in the character model storage section 7. Incidentally, in the description of the flowchart, the step number is represented by S.

(S1) The number of error counts *n* is initialized, and the procedure advances to S2.

(S2) Image data to be inspected are incorporated from the camera 1, and the procedure advances to S3.

(S3) The incorporated image data are stored in the VRAM 2a, and the procedure advances to S4.

(S4) The allocated character string to be inspected is designated. In this embodiment, the character string is input through the communication I/F circuit 14a. Then, the procedure advances to S5.

(S5) The characters used in the input allocated character string, and the number thereof are analyzed. For example, when the character string of an electronic component as shown in Fig. 11 is analyzed, the result is such that there is one "J", two "A"'s, one "P", one "N", one "1", two "9"'s, and one "5".

(S6) On the basis of the analysis result, the allocated characters are compared with the corresponding character models in the character model storage section 7, and a search area in the VRAM 2a is searched. The search area data are stored in the search area storage section 13. The area of the highest similarity in this result is taken as the area of the corresponding allocated characters. The search is performed for the number of allocated characters, and is repeated until the search for all of the allocated

characters is finished. In the above example, each of "J", "P", "N", "1", and "5" is searched one time, and each of "A" and "9" is searched two times. Then, the procedure advances to S7.

(S7) On the basis of the area of the allocated characters obtained by the search, the character position of each of the allocated characters is calculated by a predetermined algorithm. As regards the character position, for example, the center of the character area may be taken as a character position 23, as shown in Fig. 13, or the upper left corner of the character area may be taken as the character position. Then, the procedure advances to S8.

(S8) The allocated characters are rearranged in accordance with the character positions of the allocated characters obtained by the search, and a judgement is made as to whether or not the sequence of the rearranged characters is in agreement with that of the designated character string. In addition, the character pitch is obtained from the character positions, and a judgement is made as to whether or not the pitch is in a predetermined range. When the sequences are in agreement with each other, and the pitch is in the predetermined range, the allocation is judged to be OK, and the procedure advances to S9. If not, the procedure advances to S10.

(S9) The character models of the allocated characters

obtained by the search, and the character positions corresponding to the character models are registered in the inspection standard storage section 8. Then, the procedure advances to the end to complete the processing of the character position registration.

(S10) A judgement is made as to whether or not the number of error counts  $n$  increases to a predetermined allowable number  $N$  or more. When  $N$  or more, the procedure advances to S11. If not, the procedure advances to S12.

(S11) An error display command is output to the display 35 to urge an operator, etc. to attend to the error. Then, the procedure advances to the end to complete the processing of the character position registration.

(S12) The number of error counts  $n$  is incremented by one, and the procedure advances to S13.

(S13) An error display command is output to the display 35 to urge the operator to judge whether or not the image data should be reincorporated. In the case where an allocation error occurs due to a designation mistake of the allocated character string from the external control device 40 made by a lot control mistake, it is not necessary to retake the image data. However, in other cases, it is considered possible that the cause is an indistinct image. Therefore, the operator instructs the retaking by the reincorporation switch 36. Then, the procedure advances to

S14.

(S14) The reincorporation switch 36 is input to judge whether or not the image data should be reincorporated. When reincorporated, the procedure returns to S2. If not, the procedure returns to S4.

As described above, the character models corresponding to the allocated character string and character positions of the character models are defined by the pattern matching (search) between the image data and the prestored character models, and the character models and the character positions of the character models are registered as inspection standards. Thus, when the first work is a defective product, the defectiveness can be inspected, and the character models and the character positions can be correctly registered without depending on the character quality. The actual character inspection is effected on the basis of the above registered character models and the character positions, so that the accuracy of the character inspection can be improved and working efficiency of the inspection becomes high.

Incidentally, the above-described allocated character string designation section 14 may be composed of a switch, etc. such that it is operated by the operator so as to directly designate the allocated character string. Fig. 4 shows an example in which a keyboard 14b is used as the

allocated character string designation section 14. This eliminates the necessity of the external control device 40, and can constitute a compact character inspecting apparatus. In addition, the keyboard 14b may be used as a substitute for the reincorporation switch 36 at this time. The processing flowchart of the inspection standard registration of the CPU 30 when the keyboard 14b is used may be the same as that shown in Fig. 3, and the same action and effect can be obtained.

Next, a second embodiment will be described. This embodiment does not require the allocated character string designation section 14 in the first embodiment, and its functional block diagram is shown in Fig. 5. As will be understood from Fig. 5, the construction is the same as that of the former embodiment except that the allocated character string designation section 14 is omitted. Since the functions of other components are the same as those of the above description except the pattern matching execution section 11, a description thereof will be omitted. In addition, a circuit block diagram showing this embodiment is omitted because it can be represented by the circuit block diagram in which the communication I/F circuit 14a and the external control device 40 shown in Fig. 2 of the former embodiment are omitted.

In this embodiment, the pattern matching execution

section 11 performs the search not on the basis of a designated allocated character string but on the basis of all the character models stored in the character model storage section 7. That is, the search on certain image data within the search area is executed for each character model. When similarity of a certain character model increases to a predetermined amount or higher in a certain image data area and the similarity increases to the highest, the character model is taken as the character model corresponding to the above area. This search is executed for all the character models.

The processing flow due to the described construction will be described with reference to Fig. 6. Similarly to the former embodiment, it is assumed that a total of 36 character models of A to Z, and 0 to 9 are stored in the character model storage section 7.

(S21) The number of error counts n is initialized, and the procedure advances to S22.

(S22) Image data to be inspected are incorporated from the camera 1, and the procedure advances to S23.

(S23) The incorporated image data are stored in the VRAM 2a, and the procedure advances to S24.

(S24) Each character model in the character model storage section 7 is searched with respect to the search area of the VRAM 2a. As a result, the area where the

similarity is higher than the predetermined amount, and the similarity is the highest at a certain character model is taken as the character area of the character corresponding to the character model. The search is repeated until it is executed to all the character models. In the example of the character string shown in Fig. 11, "J", "P", "N", "1", and "5" are searched one at a time, and "A" and "9" are searched two at a time, and their character areas are defined. Then, the procedure advances to S25.

(S25) On the basis of the character area of the character models obtained by the search, each of the respective character positions is calculated by a predetermined algorithm. The character position may be, for example, the center of the character area, or the upper left corner of the character area, similarly to the above description. Then, the procedure advances to S26.

(S26) The allocated characters are rearranged in accordance with the character positions obtained by calculation, and a judgement is made as to whether or not the pitch between the characters is in a predetermined range. If the pitch is in the predetermined range, the allocation is judged to be OK, and the procedure advances to S27. If not, the procedure advances to S28.

(S27) The positions of the allocated characters obtained by calculation are taken as the character

positions, and registered in the inspection standard registration section 8 together with the character models of the corresponding allocated characters. Then, the procedure advances to the end to complete the processing of the character position registration.

(S28) A judgement is made as to whether or not the number of error counts  $n$  increases to a predetermined allowable number  $N$  or more. When  $N$  or more, the procedure advances to S29. If not, the procedure advances to S30.

(S29) An error display command is output to the display 35 to urge an operator, etc. to attend to the error. Then, the procedure advances to the end to complete the processing of the character position registration.

(S30) The number of error counts  $n$  is incremented by one, and the procedure advances to S22.

As described above, the search area of the image data is searched on the basis of the prestored character models, the character models of the character string to be inspected are allocated, and the character positions thereof are determined. In addition, the allocated character models, and the character positions of the character models are registered as inspection standards. This will be effective when the external control device 40 or the operator does not control the character string, which becomes the object of inspection, or when the character to be inspected shows a

side range in variation of the quality. For example, in the case of ink sealing, since the thickness of the line of the character varies, a variation in the inspection results is exhibited when only one character model is registered with respect to a certain character, so that deficiencies in quality may be frequently judged. At this time, several character models having different line thicknesses, e.g., a thick line, an ordinary line, a thin line, and so forth are registered as character models with respect to a character that may exhibit a variation in line thickness, for example, "A". Then, a search is executed on the character "A" according to the several character models having different thicknesses of the line, and the character model having the highest similarity is adopted as the inspection standard. This allows an optimum character model to be allocated even to a character of which the thickness of the line varies for each lot, so that the character quality can be inspected accurately.

In addition, there may be a case where one character in a character string may be any one of a plurality of character models such that the final numeral in a numeral string, such as a year number, may be any one of "0 to 9". In this case, a plurality of character models are made possible to be allocated to the character positions, which become the corresponding inspection standards, and the

search is executed on the basis of the above plurality of character models capable of being allocated to the character positions. Accordingly, even if the character string to be inspected changes within the range of the above character models capable of being allocated, character models which flexibly become inspection standards in response thereto can be registered. Therefore, the control of the inspection standards is very simplified.

Further, similarly in this embodiment, when the first work is a defective product, the character models and the character positions can be correctly registered without depending on the character quality. The actual character inspection is effected on the basis of the registered character models and the character positions, so that the accuracy of the character inspection can be improved and working efficiency of the inspection becomes high.

In addition, when there is less possibility of failure of allocation such that similar models (for example, "0" and "Q", and "6" and "8", etc.) do not exist in character models, the judgement of the allocation result in S26 of the above processing flow does not have to be performed. In this case, the steps S21, S26, S28, S29, and S30 can be omitted, so that the processing flow becomes simple, and the processing time is shortened.

Next, a third embodiment will be described with

reference to Figs. 7 to 9. This embodiment enables a response to a case where the character positions to be inspected are the same as those of a former lot, but only the change of a part of the character string is desired.

A functional block diagram of this embodiment is shown in Fig. 7. Here, an inspected character changing section 17, which is newly provided with respect to the foregoing construction, will be described. The inspected character changing section 17 designates whether or not only a part of the inspected character string is changed without changing the character positions of the former lot when a lot to be inspected is newly changed. In addition, at the time of the change, a new allocated character string is input, and the corresponding character model in the inspection standard storage section 8 is changed while referring to the character model in the character model storage section 7 on the basis of the data.

In addition, a circuit block diagram may be the same as that of Fig. 2 or Fig. 4, and the inspected character changing section 17 may also be used as the allocated character string designation section 14. Here, in the construction as shown in Fig. 2, a change command of only the inspected characters and its new allocated character string may be input from the external control device 40 through the above-described communication I/F circuit 14a.

In addition, in the construction as shown in Fig. 4, the operator may input the change command, etc. by using the keyboard 14b also as the inspected character changing section 17.

Fig. 8 shows a processing flowchart of the CPU 30 of this embodiment in the described construction, and a detailed description will now be given with reference to Fig. 8. Here, it is similarly assumed that a total of 36 character models of A to Z, and 0 to 9 are stored in the character model storage section 7.

(S41) A command from the inspected character changing section 17 is input to judge whether or not only the characters are changed. When changed, the procedure advances to S42. If not changed, the procedure advances to S1 of Fig. 3, or to S21 of Fig. 6, and the above processing flows are performed.

(S42) A new allocated character string is input from the inspected character changing section 17, and the character models of the preceding allocated character string registered in the inspection standard storage section 8 are replaced with the character models corresponding to the new allocated character string. This allows the new character models and the character positions of the character models to be easily registered without executing the search of the new allocated character string.

As described above, when the character positions to be inspected are the same as those of a former lot, but only the change of a part of the character string is desired, the inspection standard can easily be changed. When an inspection date is printed as shown in Fig. 9, for example, only the numerals of the date are usually changed but the print positions are not changed, and this embodiment is effective when the inspection standard is registered in case of the character inspection of the inspection date. In this case, the inspection standard can be registered only by changing the character models of the date portions, so that workability of setup is improved.

Next, another embodiment will be described. Software containing the above-described inspection method is distributed such that a floppy disk is used as an electronic data recording medium which stores the software. The electronic medium is not limited to a floppy disk, and a hard disk, an IC card, and a CDROM, etc., may be employed. In addition, as regards to the form of the distribution, not only the distribution by the electronic medium but also the distribution by connecting hardware utilizing the above software and a development device accommodating the above software, such as a personal computer for development, through a public line or a network may be employed.

At the time of the above distribution, an installer for

installation may be attached to the hardware utilizing the above software, such as a specialized inspecting apparatus, or an apparatus to which a personal computer and an electronic camera are connected. Further, the software containing the above inspection method may be compacted, and the volume-compacted data may be distributed.

#### INDUSTRIAL APPLICABILITY

The present invention is useful as a method and a device for registering inspection standards for a character inspecting apparatus which can correctly register a work for registering the inspection standards even if it is a defective product, improve the accuracy of the character inspection, exhibit high working efficiency of the registration and the inspection, and flexibly respond to a change of a character string to be inspected, thereby simplifying the control of the inspection standards.

CLAIMS

1. A method of registering inspection standards for a character inspecting apparatus incorporating image data of a character string of a work for registering a character string inspection standard by a camera, obtaining character areas and positions of said character areas on the basis of said incorporated image data, and registering image data of said obtained character areas and said character area positions as character models and character model positions which become inspection standards, respectively, said method comprising:

storing in advance standard image data of all the characters to be inspected as standard character models of the characters;

executing pattern matching between character string image data of said work and said standard character models when obtaining said character areas and said character area positions; allocating standard character models of high similarity in said pattern matching to said character string image data as character models; calculating character positions of said allocated character models; and

registering said allocated character models and said calculated positions of the character models as said inspection standards.



2. A device for registering inspection standards for a character inspecting apparatus including a camera (1) for incorporating image data of a character string of a work to be inspected, an image memory (2) for storing said incorporated image data and image data of a character string of a work for registering a character string inspection standard, and an inspection standard storage section (8) for storing image data of the character areas obtained on the basis of the character string image data of said work for registering a character string inspection standard and the positions of said character area as character models and character model positions which become inspection standards, respectively, said device comprising:

a character model storage section (7) for storing in advance standard image data of all the characters to be inspected as standard character models of the characters;

a search area storage section (13) for storing search area data which become execution range of pattern matching with respect to the image data of said work for registering a character string inspection standard;

a pattern matching execution section (11) for sequentially executing pattern matching between said incorporated image data and all the characters of said standard character models within the execution range of said pattern matching, allocating standard character models of



high similarity in said pattern matching to said character string image data as character models, obtaining character areas of said allocated character models, and outputting said allocated character models and said obtained character areas;

a character position calculating section (12) for calculating coordinates of said obtained character areas as character positions;

an allocation judging section (15) for judging whether or not allocation is correct on the basis of said allocated character models and said calculated character positions, and outputting said allocated character models and said calculated character positions when the allocation is correct; and

an inspection standard registration section (6) for registering said input allocated character models and said calculated character positions in said inspection standard storage section (8).

3. A device for registering inspection standards for a character inspecting apparatus according to claim 2 attaching thereto an allocated character designation section (14) for designating the character string of said work to be inspected,

wherein said pattern matching execution section (11),



when executing said pattern matching, sequentially executes pattern matching between said incorporated image data and said standard character models corresponding to said designated character string.

4. A device for registering inspection standards for a character inspecting apparatus according to any one of claims 2 or 3 further comprising an inspected character changing section (17) to which a character change command for changing only a part of characters in the character string of the former lot without changing character positions of the work of the former lot registered in said inspection standard storage section (8) is input,

wherein said inspected character changing section (17) inputs said character change command and a new character string, and replaces only character models to be changed in said inspection standard storage section (8) to register new inspection standards while referring to the character models in said character model storage section (7) corresponding to said new character string.

