

DESCRIPTION

TITLE OF INVENTION: IDENTIFICATION DEVICE,
IDENTIFICATION METHOD, AND PROGRAM

TECHNICAL FIELD

[0001] The present invention relates to an identification device, an identification method, and a program, and in particular, is ones to be suitable when used for identifying an article. This application is based upon and claims the benefit of priority of the prior Japanese Patent Application No. 2020-181789, filed on October 29, 2020, the entire contents of which are incorporated herein by reference.

BACKGROUND ART

[0002] On the surface of a steel product, for example, a plate, various types of information are displayed by using stencils, labels, and the like, for the purpose of actual article management, and the like. As a technique to identify such information displayed on a manufactured product, there has been a technique described in Patent Literature 1.

[0003] Patent Literature 1 has disclosed that after masking part or all of a product number regarding a product displayed on a screen on a crane machine, a crane operator visually confirms the product number of the product and inputs the confirmed product number through a voice or character input.

However, the technique described in Patent Literature 1 is based on the premise that the crane

operator can visually recognize the product number of the product. Therefore, if part of the information displayed on the product is indistinguishable or difficult to identify due to rubbing, dirt, or the like, there is a risk that the crane operator will fail to recognize the product number of the product. Further, if the crane operator is not near the product, he/she cannot identify the information displayed on the product.

[0004] Therefore, it is desirable to capture the information displayed on the manufactured product and improve the identification accuracy of the information in a captured image. As the technique of this type, there have been techniques described in Patent Literatures 2 to 6.

In the technique described in Patent Literature 2, a character string of a collation destination is stored, a character string of a collation source is recognized from a collation source image, and the character string of the collation source is collated with the character string of the collation destination. Further, in the technique described in Patent Literature 2, the processing of the aforementioned recognition and the processing of the aforementioned collation are executed a plurality of times using a plurality of collation source images that are temporally contiguous.

[0005] In the technique described in Patent Literature 3, for a plurality of different types of

articles, article information previously associated with overall image information expressing an overall external appearance of each article is stored for each of the articles. Then, collation of an image obtained by capturing a plurality of articles to be collated with the article information is performed. As a result of the collation, in the case where an article candidate group composed of a plurality of article candidates extracted with respect to the article to be collated is extracted with respect to a plurality of the articles to be collated, a plurality of the article candidates included in the article candidate group are collated by a group unit. The collation condition for this collation is that the number of articles to be collated from which the article candidate group is extracted and the number of respective article candidates included in a plurality of the article candidate groups match with each other. Further, in the technique described in Patent Literature 3, attribute information representing a predetermined type of numerical value associated with an article is associated with the article information for each of the articles, and the attribute information is extracted for each article candidate to perform collation.

[0006] In the technique described in Patent Literature 4, for a plurality of articles, overall image information expressing an overall external appearance of each article and partial feature

information including position information of a part of the external appearance of each article and attribute information of each article included in this part are stored in association with each other. Then, an image obtained by capturing an article to be collated is collated with the overall image information of each article. When a plurality of article candidates are extracted in this collation, the attribute information included in the partial feature information of a plurality of the article candidates is compared with a part of the image of the article to be collated corresponding to the position information included in the partial feature information.

[0007] In the technique described in Patent Literature 5, for a plurality of articles, overall image information expressing an overall external appearance of each article and partial feature information including position information of a part of the external appearance of each article and attribute information of each article included in this part are stored in association with each other. Then, as a target article candidate, articles are extracted in which character information in an image obtained by capturing an article to be collated matches with character information indicating the content of the attribute information included in the partial feature information and position information in an image of the character information in the image

obtained by capturing the article to be collated matches with the position information included in the partial feature information. Then, from the extracted target article candidates, an attribute limited target article candidate including the type of attribute information preset in the partial feature information is extracted. Then, overall collation is performed based on overall image information of the extracted attribute limited target article candidate and the captured image.

[0008] In the technique described in Patent Literature 6, for each of articles, overall image information expressing an overall external appearance of each particle is collated with an image obtained by capturing a plurality of articles to be collated. As a result of this collation, when a plurality of article candidates are extracted, position information and attribute information included in partial feature information of a plurality of the article candidates are collated with information in the articles to be collated included in the captured image.

CITATION LIST

PATENT LITERATURE

[0009] Patent Literature 1: Japanese Patent No. 6003918

Patent Literature 2: Japanese Patent No. 6505937

Patent Literature 3: Japanese Patent No. 5869987

Patent Literature 4: Japanese Patent No. 5869988

Patent Literature 5: Japanese Patent No. 5869989

Patent Literature 6: Japanese Patent No. 5891143

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0010] However, in the technique described in Patent Literature 2, if the character string of the collation source and the character string of the collation destination do not completely match, they are not collated correctly. Accordingly, in the technique described in Patent Literature 2, when the captured image of the information displayed on the article is set as the collation source image and (a part or all of) the information displayed on the article is not in a desired state due to peeling, tearing, rubbing, and/or soiling, similarly to the technique described in Patent Literature 1, the collation result of this information is N.G.

[0011] Further, the techniques described in Patent Literatures 3 to 6 are based on the premise that the information displayed on the article is correctly extracted from the captured image. Accordingly, when identifying an article using the techniques described in Patent Literatures 3 to 6, it is not easy to identify the article when (a part or all of) the information displayed on the article is not in a desired state due to peeling, tearing, rubbing, and/or soiling.

As above, with the techniques described in Patent Literatures 2 to 6, there is a risk that the article

cannot be identified when the information displayed on the article is not in a desired state.

Accordingly, in the techniques described in Patent Literatures 1 to 6, when identifying the article based on the captured image obtained by capturing the information displayed on the article, if the information displayed on the article cannot be extracted correctly, there is a risk that the article cannot be identified.

[0012] The present invention has been made based on the above problems, and an object thereof is to enable identification of an article when the article is identified based on a captured image obtained by capturing information displayed on the article, even if the information displayed on the article cannot be extracted correctly.

SOLUTION TO PROBLEM

[0013] The identification device of the present invention is an identification device that identifies an article, the device including: an image acquisition unit that acquires one or two or more captured images of a region including first information that is information displayed on the article; a recognition unit that recognizes at least one piece of the first information based on a captured image acquired by the image acquisition unit; a collation unit that collates at least partial information of first recognition information being the first information recognized by the recognition

unit with first storage information being first information stored beforehand in a storage medium as one piece of storage information; and a specification unit that specifies at least one candidate for the article based on a result of collation by the collation unit, in which the collation unit is able to collate recognition information, which is partly different from the first recognition information, with storage information stored beforehand in a storage medium as information corresponding to the recognition information.

[0014] The identification method of the present invention is an identification method that identifies an article, the method including: an image acquisition step that acquires one or two or more captured images of a region including first information that is information displayed on the article; a recognition step that recognizes at least one piece of the first information based on a captured image acquired by the image acquisition step; a collation step that collates at least partial information of first recognition information being the first information recognized by the recognition step with first storage information being the first information stored beforehand in a storage medium as one piece of storage information; and a specification step that specifies at least one candidate for the article based on a result of collation by the collation step, in which the collation step is able

to collate recognition information, which is partly different from the first recognition information, with storage information stored beforehand in a storage medium as information corresponding to the recognition information.

[0015] The program of the present invention is a program causing a computer to execute pieces of processing intended for identifying an article, the program including: an image acquisition step that acquires one or two or more captured images of a region including first information that is information displayed on the article; a recognition step that recognizes at least one piece of the first information based on a captured image acquired by the image acquisition step; a collation step that collates at least partial information of first recognition information being the first information recognized by the recognition step with first storage information being the first information stored beforehand in a storage medium as one piece of storage information; and a specification step that specifies at least one candidate for the article based on a result of collation by the collation step, in which the collation step is able to collate recognition information, which is partly different from the first recognition information, with storage information stored beforehand in a storage medium as information corresponding to the recognition information.

BRIEF DESCRIPTION OF DRAWINGS

[0016] [Fig. 1A] Fig. 1A is a view illustrating a first example of a display region and a display form on a plate.

[Fig. 1B] Fig. 1B is a view illustrating a second example of a display region and a display form on a plate.

[Fig. 1C] Fig. 1C is a view illustrating one example of a state where a plurality of plates are stacked.

[Fig. 2A] Fig. 2A is a view illustrating a first example of contents of displays by a stencil and a die stamp.

[Fig. 2B] Fig. 2B is a view illustrating a second example of contents of displays by a stencil and a die stamp.

[Fig. 3] Fig. 3 is a view illustrating one example of a content of a display by a label.

[Fig. 4] Fig. 4 is a diagram illustrating one example of a functional configuration of an identification device.

[Fig. 5] Fig. 5 is a view illustrating one example of a management table.

[Fig. 6] Fig. 6 is a view illustrating one example of an original plate and plates after cutting.

[Fig. 7] Fig. 7 is a view illustrating one example of positions of a stencil and a die stamp in an article and positions of components of respective display items in displays by the stencil and the die stamp.

[Fig. 8] Fig. 8 is a view illustrating one example of a position of a label in an article and positions of components of respective display items in a display by the label.

[Fig. 9A] Fig. 9A is a view illustrating a first example of information stored in the management table.

[Fig. 9B] Fig. 9B is a view illustrating a second example of information stored in the management table.

[Fig. 10] Fig. 10 is a flowchart explaining one example of processing of the identification device when creating and updating the management table.

[Fig. 11] Fig. 11 is a flowchart illustrating one example of processing of the identification device when identifying a plate.

[Fig. 12] Fig. 12 is a diagram illustrating one example of a configuration of hardware of the identification device.

DESCRIPTION OF EMBODIMENTS

[0017] Hereinafter, there will be explained one embodiment of the present invention with reference to the drawings.

Incidentally, the fact that objects to be compared, for example, lengths, positions, sizes, and intervals, are the same includes the case where they are strictly the same, as well as the case where they are different within a range that does not depart from the gist of the invention (for example, the case where they are different within a tolerance range defined at the time of design).

In this embodiment, there is explained, as an example, the case where in a factory that performs various types of processes, for example, a heat treatment and cutting on various plates (for example, thick steel plates) manufactured in a plurality of steel plants, the plates are identified before the plates are shipped to a customer of the plates. For example, the plates manufactured in the steel plant are loaded onto a transport ship. The transport ship then arrives at a wharf near the factory. The plates are unloaded from the transport ship and loaded onto a transport vehicle (for example, a truck). The plates transported by the transport vehicle are placed in a storage space in the factory when they arrive at the factory. The plates placed in the storage space are placed in a warehouse after being subjected to processes, for example a heat treatment and cutting (gas cutting). Thereafter, the plates are shipped from the factory to the customer. In such a case, the plates can be identified at any timing during the period after the plates are manufactured in the steel plant and before the plates are shipped from the factory to the customer.

[0018] Fig. 1A and Fig. 1B each are a view illustrating one example of a display region and a display form on a plate. Incidentally, the x-axis, the y-axis, and the z-axis illustrated in Fig. 1A to Fig. 1C indicate the orientation relationship between Fig. 1A to Fig. 1C and Fig. 7 and Fig. 8 to be

described later.

Fig. 1A is a view illustrating a first example of a display region and a display form on a plate. In Fig. 1A, a display region 101 is a display region by a stencil. A display region 102 is a display region by a die stamp. The display regions 101, 102 are present on the plate surface of the plate.

Incidentally, dashed lines illustrated in Fig. 1A to Fig. 1C are virtual lines and are not actually displayed. A label (side label) 103 is attached to a side surface (plate thickness portion) of the plate.

[0019] Fig. 1B is a view illustrating a second example of a display region and a display form on a plate. In Fig. 1B, a display region 111 is a display region by a stencil. A display region 112 is a display region by the die stamp. The display regions 111, 112 are present on the plate surface of the plate. A label 113 is attached to a side surface (plate thickness portion) of the plate.

[0020] As illustrated in Fig. 1A and Fig. 1B, the arrangement of the display regions 101, 111 by the stencil, the display regions 102, 112 by the die stamp, and the display regions by the labels 103, 113 differs depending on the steel plant or the like that manufactures the plate.

In the examples illustrated in Fig. 1A and Fig. 1B, based on at least one of the display by the stencil, the display by the die stamp, and the display by the labels 103, 113, actual article

management (management of the position of each plate) is performed.

Incidentally, the display region and the display form on the plate are not limited to those illustrated in Fig. 1A and Fig. 1B. For example, the display region by a stencil and the display region by a die stamp may be separated, or there may be no display by a die stamp.

[0021] Fig. 1C is a view illustrating one example of a state where a plurality of plates are stacked. As illustrated in Fig. 1C, it is sometimes impossible to visually recognize the display by the stencil and the display by the die stamp on the plate located at a lower portion of a plurality of the stacked plates. In this case, the actual article management can be performed based on displays by labels 123, 133.

Incidentally, Fig. 1C illustrates, as an example, the case where a plurality of plates are placed on top of each other so that the plate surfaces of the plates are parallel to the surface on which the plates are placed. However, the method in which the plates are placed on top of each other is not limited to such a method. For example, a plurality of plates may be placed on top of each other so that the plate surfaces of the plates are at a vertical or near-vertical angle to the surface on which the plates are placed.

[0022] Fig. 2A is a view illustrating a first example of contents of displays by a stencil and a

die stamp. Fig. 2B is a view illustrating a second example of contents of displays by a stencil and a die stamp.

In the examples illustrated in Fig. 2A and Fig. 2B, the display by the stencil include marks 201, 211, customer names 202, 212, standards 203, 213, sizes 204, 214, IDs 205, 215, customer codes 206, 216, order numbers 207, 217, and identification information 208, 218. The display by the die stamp includes IDs 209, 219.

[0023] The marks 201, 211 are marks that represent a manufacturer of the plate. The customer names 202, 212 are information indicating a customer (purchaser) of the plate. The standards 203, 213 are information indicating a standard of the plate. The sizes 204, 214 are information indicating a size (thickness × width × length) of the plate. The IDs 205, 215, 209, and 219 are information for uniquely identifying the plate, and are plate numbers (plate identification numbers) in the examples illustrated in Fig. 2A and Fig. 2B. Therefore, the same ID is never given to different plates. The customer codes 206, 216 are information that the manufacturer of the plate is designated by the customer to give to the plate. The order numbers 207, 217 are part of numbers for identifying an order for the plate from the customer.

[0024] The marks 201, 211, the customer names 202, 212, the standards 203, 213, the sizes 204, 214, the IDs 205, 215, 209, and 219, the customer codes 206,

216, and the order numbers 207, 217 are information that can be displayed on the plate generally. Incidentally, pieces of the information other than the IDs 205, 215, 209, and 219 may not be included in the display by the stencil or the display by the die stamp. Further, information other than the information described above may be included in the display by the stencil and the display by the die stamp. For example, as the display by the die stamp, display items equivalent to the display items by the stencil (for example, at least one of the mark, the customer name, the standard, the size, the customer code, the order information, and the identification information) are sometimes displayed.

[0025] In this embodiment, there is explained, as an example, the case where the identification information 208, 218 are included in the display by the stencil, in addition to the marks 201, 211, the customer names 202, 212, the standards 203, 213, the sizes 204, 214, the IDs 205, 215, the customer codes 206, 216, and the order numbers 207, 217. The identification information 208, 218 are dedicated information for identifying the plate (an ID of the plate) by an identification device 400, which will be described later. In this embodiment, there is explained, as an example, the case of using information with a high identification rate by character recognition processing as the identification information 208, 218. Examples of the

information with a high identification rate by the character recognition processing include A, B, D, E, F, G, H, K, M, N, S, W, X, Y, Z, 2, 3, 4, 5, 6, and 8. However, as will be described below, the identification information does not need to consist only of the information with a high identification rate by the character recognition processing. This will be explained later (see <<Second modified example>>). Further, the contents of the identification information 208, 218 are preferably different for each plate.

[0026] Fig. 2A and Fig. 2B illustrate, as an example, the case where the marks 201, 211 are different in position and the customer names 202, 212 are different in size. Further, for example, the number of digits in the customer codes 206, 216 may differ depending on the customer, or the notation method of the standards 203, 213 may differ depending on the steel plant that manufactures the plates. Further, for example, the order numbers 207, 217 may or may not be given depending on the customer. Thus, the content, the position, and the size of the displays by the stencil and the die stamp differ depending on the steel plant that manufactures the plates, the customer, or the like. However, the meaning of the same display item on the same plate should be the same for the display by the stencil and the display by the die stamp. Therefore, the IDs 205, 215 displayed by the stencil and the IDs 209, 219

displayed by the die stamp have the same meaning.

[0027] The marks 201, 211, the customer names 202, 212, the standards 203, 213, the sizes 204, 214, the IDs 205, 215, 209, and 219, the customer codes 206, 216, the order numbers 207, 217, and the identification information 208, 218 are information to be managed by the manufacturer of the plate. Further, the marks 201, 211, the customer names 202, 212, the standards 203, 213, the sizes 204, 214, the IDs 205, 215, 209, and 219, the customer codes 206, 216, the order numbers 207, 217, and the identification information 208, 218 are human identifiable information. The human identifiable information means that a person can understand the meaning of the information when he/she sees the information. Information that requires machine encoding and decoding to create and read, for example, bar codes and two-dimensional codes, is not the human identifiable information. Specifically, the marks 201, 211, the customer names 202, 212, the standards 203, 213, the sizes 204, 214, the IDs 205, 215, 209, and 219, the customer codes 206, 216, the order numbers 207, 217, and the identification information 208, 218 include at least one of characters, numeric characters, and symbols as information that does not require machine decoding for reading, and do not include information that requires machine decoding for reading.

[0028] Fig. 3 is a view illustrating one example of

a content of a display by a label.

In the example illustrated in Fig. 3, the display by the label includes a standard 301, an ID 302, a size 303, a delivery date 304, a customer code 305, and identification information 306. The delivery date 304 is information indicating the delivery date of the plate. The standard 301, the ID 302, the size 303, the customer code 305, and the identification information 306 are the same as the standards 203, 213, the sizes 204, 214, the IDs 205, 215, 209, and 219, the customer codes 206, 216, and the identification information 208, 218 respectively. Incidentally, pieces of the information other than the ID 302 do not need to be included in the display by the label. Further, information other than the information described above may also be included in the display by the label. The content, the position, and the size of the display by the label, as well as the displays by the stencil and the die stamp, also differ depending on the steel plant that manufactures the plates, the customer, or the like.

[0029] However, the meaning of the same display item on the same plate should be the same for the display by the stencil, the display by the die stamp, and the display by the label. Thus, when the displays by the stencil and the die stamp illustrated in Fig. 2A and Fig. 2B and the display by the label illustrated in Fig. 3 are made on the same plate, the IDs 205, 215 displayed by the stencil, the IDs 209, 219 displayed

by the die stamp, and the ID 302 displayed by the label mean the same content. Further, the standards 203, 213 displayed by the stencil and the standard 301 displayed by the label mean the same content. The size 303 and the customer code 305 mean the same contents as the sizes 204, 214 and the customer codes 206, 216, respectively. As described previously, the standards 203, 213, the IDs 205, 215, 209, and 219, the sizes 204, 214, the customer codes 206, 216, and the identification information 208, 218 are information to be managed by the manufacturer of the plate. Therefore, the standard 301, the ID 302, the size 303, the customer code 305, and the identification information 306 are also information to be managed by the manufacturer of the plate. Further, the delivery date 304 of the plate is also information to be managed by the manufacturer of the plate. Further, the standard 301, the ID 302, the size 303, the delivery date 304, the customer code 305, and the identification information 306 are human identifiable information.

[0030] After the marks 201, 211, the customer names 202, 212, the standards 203, 213, the sizes 204, 214, the IDs 205, 215, the customer codes 206, 216, and the order numbers 207, 217 are given to the plates, the identification information 208, 218 are sometimes given to the plates separately. In this case, the identification information 208, 218 may be given to the plates by a stencil or may also be given to the

plates by methods other than the stencil (for example, handwriting).

[0031] In this embodiment, the identification device 400 is used to automatically recognize the plate (plate ID) with such displays as above. Fig. 4 is a diagram illustrating one example of the functional configuration of the identification device 400. The hardware of the identification device 400 is fabricated by using, for example, an information processing device including a CPU, a ROM, a RAM, a HDD, and various interfaces, or dedicated hardware. Fig. 5 is a view illustrating one example of a management table 500 to be managed by the identification device 400. The management table 500 is explained first before explaining one example of the function of the identification device 400.

[0032] Pieces of information to be used by the identification device 400 to identify the plate (plate ID) are stored in the management table 500 as storage information. The storage information to be stored in the management table 500 includes information to be managed by the manufacturer of the plate. However, some of the storage information to be stored in the management table 500 may be information that can be used also in distribution or the like. Here, the information to be managed by the manufacturer of the plate is information set or acquired by the manufacturer of the plate. The information to be managed by the manufacturer of the

plate includes information that allows an operator who is an employee of the manufacturer of the plate to understand the meaning of the information. More specifically, the information to be managed by the manufacturer of the plate is, for example, information created by the manufacturer of the plate and stored in the management table 500 by the manufacturer of the plate.

In Fig. 5, pieces of information in the same column are the information for the same plate (sections under the same No. are the sections where pieces of the information for the same plate are stored).

In Fig. 5, pieces of information relating to the respective display items of the display by the stencil, the display by the die stamp, and the display by the label are stored in the sections of actual article display. Pieces of information other than the information relating to the respective display items of the display by the stencil, the display by the die stamp, and the display by the label are stored in the sections of non-actual article display.

[0033] There is explained one example of the information to be stored in the section of actual article display of the management table 500.

In the section of actual article display, pieces of storage information relating to a stencil are stored in the section of stencil.

In the section of ID of the section of stencil, the storage information indicating the contents and the positions of the components of the IDs 205, 215 included in the display by the stencil, and the storage information indicating other attributes of the components are stored. Incidentally, the components of the IDs 205, 215 included in the display by the stencil indicate pieces of individual information that constitute the display item, for example, characters, numeric character, symbols, and marks. Further, storage information indicating the other attributes of the components may be stored in the identification device 400 (a storage unit 403) or in an external device capable of communicating with the identification device 400 in association with the contents and the positions of the components.

In the section of customer name of the section of stencil, the storage information indicating the contents and the positions of the components of the customer names 202, 212 included in the display by the stencil is stored.

[0034] In the section of size of the section of stencil, the storage information indicating the contents and the positions of the components of the sizes 204, 214 included in the display by the stencil is stored.

In the section of standard of the section of stencil, the storage information indicating the contents and the positions of the components of the

standards 203, 213 included in the display by the stencil is stored.

In the section of customer code of the section of stencil, the storage information indicating the contents and the positions of the components of the customer codes 206, 216 included in the display by the stencil is stored.

[0035] In the section of order number of the section of stencil, the storage information indicating the contents and the positions of the components of the order numbers 207, 217 included in the display by the stencil is stored.

In the section of identification information of the section of stencil, the storage information indicating the contents and the positions of the components of the identification information 208, 218 included in the display by the stencil is stored.

In addition to the display items in the display by the stencil described above, the contents of display items that may be displayed as the display item in the display by the stencil are also stored in the management table 500. "..." present under the section of identification information of the section of stencil in Fig. 5 indicates the above. Further, the display items themselves may be added and/or deleted.

[0036] In the section of actual article display, pieces of storage information relating to a die stamp are stored in the section of a die stamp.

In the section of ID of the section of a die stamp, the storage information indicating the contents and the positions of the components of the IDs 209, 219 included in the display by the die stamp and storage information indicating other attributes of the components are stored. Incidentally, storage information indicating the other attributes of the components may be stored in the identification device 400 (storage unit 403) or in an external device capable of communicating with the identification device 400 in association with the contents and the positions of the components.

In addition to the display item in the display by the die stamp described above, the contents of display items that may be displayed as the display item in the display by the die stamp are also stored in the management table 500. "... " present under the section of ID of the section of a die stamp in Fig. 5 indicates the above. Further, the display items themselves may be added and/or deleted.

[0037] In the section of actual article display, pieces of storage information relating to a label are stored in the sections of label.

In the section of ID of the section of label, the storage information indicating the content and the position of the components of the ID 302 included in the display by the label and storage information indicating other attributes of the components are stored. Incidentally, storage information indicating

the other attributes of the components may be stored in the identification device 400 (storage unit 403) or in an external device capable of communicating with the identification device 400 in association with the contents and the positions of the components.

In the section of size of the section of label, the storage information indicating the content and the position of the components of the size 303 included in the display by the label is stored.

[0038] In the section of standard of the section of label, the storage information indicating the content and the position of the components of the standard 301 included in the display by the label is stored.

In the section of delivery date of the section of label, the storage information indicating the content and the position of the components of the delivery date 304 included in the display by the label is stored.

In the section of customer code of the section of label, the storage information indicating the content and the position of the components of the customer code 305 included in the display by the label is stored.

In the section of identification information of the section of label, the storage information indicating the content and the position of the components of the identification information 306 included in the display by the label is stored.

[0039] In addition to the display items in the

display by the label described above, the contents of display items that may be displayed as the display item in the display by the label are also stored in the management table 500 as the storage information. "•••" present under the section of customer code in the section of label in Fig. 5 indicates the above. Further, the display items themselves may be added and/or deleted.

[0040] Next, there is explained one example of storage information to be stored in the section of non-actual article display in the management table 500.

In the section of position in article, the storage information indicating the position of the display region when a predetermined position in the plate is set as the origin (reference) is stored.

In the section of stencil of the section of position in article, the storage information indicating the position of the display region by the stencil when a predetermined position in the plate is set as the origin (reference) is stored.

In the section of a die stamp of the section of position in article, the storage information indicating the position of the display region by the die stamp when a predetermined position in the plate is set as the origin (reference) is stored.

In the section of label of the section of position in article, the storage information indicating the position of the display region by the

label when a predetermined position in the plate is set as the origin (reference) is stored.

[0041] In the section of weight, the storage information indicating the weight of the plate is stored.

In the section of size, the storage information indicating the size (for example, thickness $\times$ width $\times$ length) of the plate is stored. The sizes stored in the sections of size in the section of actual article display are used for collation with the sizes 204, 214, and 303 to be recognized by the character recognition processing as will be described later. In contrast to this, the sizes stored in the sections of size of the section of non-actual article display are used for collation with measured values, for example, the weight of the plate. Specifically, a comparison may be made between the size stored in the section of size of the section of non-actual article display and the actual size.

[0042] In the section of storage space position, the storage information indicating the position of the plate is stored. For example, there is stored, in the section of storage space position, the storage information indicating the position of the plate grasped by the operator performing actual article management or the position of the plate grasped by using various sensors, for example, stock sensors.

In the section of registration time, the storage information indicating the date and time (timing

determined from the date and time) when the plate was placed at the current storage space position is stored.

[0043] In the section of parent ID, the storage information indicating an ID of an original plate is stored. Plates are sometimes cut in a factory. The original plate means the plate before cutting. Therefore, when the storage information indicating the ID of the original plate is stored in the section of parent ID, pieces of the storage information stored in the sections of the same column including the section of parent ID described above where the storage information indicating the ID of the original plate is stored become the storage information for the plate after cutting.

[0044] Fig. 6 is a view illustrating one example of the original plate and the plates after cutting. Fig. 6 illustrates, as an example, the case where a plate 600 is cut and plates 610, 620, 630, and 640 are manufactured. Displays are made on the respective plates 610, 620, 630, and 640 before or after cutting of the plates 610, 620, 630, and 640. Fig. 6 illustrates display regions 611, 621, 631, and 641 on the plates 610, 620, 630, and 640. In the display regions 611, 621, 631, and 641, pieces of information including IDs of the plates 610, 620, 630, and 640 are displayed. In the display regions 611, 621, 631, and 641, for example, the display by a stencil is made. In addition to the display by a stencil, at

least one of the display by a die stamp and the display by a label may be made. Further, the displays in the display regions 611, 621, 631, and 641 may be handwritten displays. When the plates 610, 620, 630, and 640 are manufactured as above, in the management table 500, in the sections of actual article display for the plates 610, 620, 630, and 640, pieces of storage information indicating the contents and the positions of components of display items to be displayed in the display regions 611, 621, 631, and 641 are stored. Further, in the sections of parent ID for the plates 610, 620, 630, and 640, storage information indicating the ID of the plate 600 is stored. As above, in this embodiment, there is explained, as an example, the case where pieces of the information on the plate after cutting are managed as a new column (No.) in the management table 500 illustrated in Fig. 5. In the management table 500, pieces of the information on the plate after cutting are stored in the section of actual article display and the section of non-actual article display. The information on the plate after cutting is acquired, for example, by a later-described image acquisition unit 411 acquiring a captured image of the display made before or after cutting and a later-described recognition unit 412 recognizing the captured image. The information on the plate after cutting does not necessarily need to be acquired in this manner. For example, the operator may specify

the information on the plate after cutting from the manufacturing conditions, operate a user interface of the identification device 400, and input the specified information to the identification device 400. Further, by combining the two, the information on the plate after cutting may be acquired.

[0045] Here, for example, there is a case where the plate 610 is cut and then yet another plurality of plates are manufactured. In this case, the information indicating the ID of the plate 610 is stored in the sections of parent ID for another plurality of the plates. The storage information indicating the ID of the plate 600 is stored in the section of parent ID for the plate 610. As above, by tracking pieces of the information stored in the sections of parent ID, it is possible to specify the transition of each plate. A sequence of the plates obtained by tracking pieces of the information stored in the sections of parent ID for a certain plate is referred to as a cut plate series of the plate. For example, the cut plate series of the plate 610 is the plates 600, 610. Further, in the section of parent ID of each plate, for example, not only the information indicating the ID of the nearest plate but also the storage information indicating the IDs of all the plates belonging to the cut plate series may be stored to recognize the cut plate series. In this case, any IDs defined by the manufacturer are used.

[0046] As above, pieces of the information of the IDs of the plates 610, 620, 630, and 640 to be additionally displayed in the display regions 611, 621, 631, and 641 of the plates 610, 620, 630, and 640 and pieces of the information of the parent IDs of these IDs are stored in the management table 500, and thereby pieces of the information of the plates 610, 620, 630, and 640 and the information of the original plate 600 can be linked. The information to be added to the plates 610, 620, 630, and 640 is used not only to identify the plates, but also to make transition of each plate (ID).

[0047] Incidentally, regarding the items in the sections of non-actual article display, only when the information of the item is acquired, the information is stored in the section of the item as the storage information, and when the information of the item is not acquired, the information is not stored in the section of the item. Further, the plate with an earlier registration time never moves earlier than the plate with a later registration time at the same position (namely, if there is a stack of plates, the underlying plate never disappears suddenly). When the plate is moved to a new storage space, the storage information indicating the new storage space position is stored in the section of storage space position, and the storage information indicating the date and time when the plate was placed at the new storage space position is stored in the section of

registration time.

[0048] In the section of image ID, storage information indicating an ID of a captured image including the display regions 101, 111 by the stencil and the display regions 102, 112 by the die stamp, and an ID of a captured image including the display regions by the labels 103, 113 is stored. In the identification device 400 (storage unit 403) or an external device capable of communicating with the identification device 400, the captured images specified by these IDs and pieces of the storage information indicating the components of the respective display items recognized by the character recognition processing or the like from these captured images are stored beforehand in association with these IDs. The captured images stored in this manner are to be collated with the captured image acquired by the later-described image acquisition unit 411, and thus, the captured images are preferably captured under the best possible image capturing conditions. Specifically, it is preferable that images are captured in a state where the display contents of the display regions 101, 111 by the stencil, the display regions 102, 112 by the die stamp, and the display regions by the labels 103, 113 can be visually recognized as clearly as possible, the dirt on the surface of the plate is as little as possible, and the lighting conditions at the time of image-capturing are as suitable as possible for

image-capturing.

[0049] Next, there is more specifically explained one example of the contents to be stored in the section of actual article display in the management table 500 and the contents to be stored in the section of position in article in the section of non-actual article display.

Fig. 7 is a view illustrating one example of the positions of a stencil and a die stamp in the article and the positions of the components of the respective display items in the displays by the stencil and the die stamp. Fig. 7 illustrates, as an example, the case where the displays by the stencil and the die stamp are made at the display positions illustrated in Fig. 1A and with the contents illustrated in Fig. 2A.

Fig. 7 illustrates the positions of the stencil and the die stamp in the article and the positions of the components of the respective display items by the stencil and the die stamp in x-y coordinates where, of the eight vertices of the rectangular parallelepiped plate, a vertex 104 illustrated in Fig. 1A is set as the origin, and from the vertex 104, the direction along the width direction of the plate is set to a positive direction of the x-axis and the direction along the length direction of the plate is set to a positive direction of the y-axis.

[0050] In this embodiment, among the positions of the components of the respective display items in the

display by the stencil, the x-y coordinates of the two vertices on a diagonal line out of the four vertices of a circumscribed rectangle 701 determined by the positions of the maximum value of the x-axis, the minimum value of the x-axis, the maximum value of the y-axis, and the minimum value of the y-axis are set to the position of the stencil in the article.

Fig. 7 illustrates that the x-y coordinates (Ws10, Ls10), (Ws11, Ls11) of two vertices 701a, 701b of the circumscribed rectangle 701 are the positions of the stencil in the article. Incidentally, to simplify the explanation, the circumscribed rectangle is assumed to be a rectangle parallel to coordinate axes (the x-axis and the y-axis in the example illustrated in Fig. 7) representing the position in article.

[0051] Further, the x-y coordinates of the position of the barycenter (or centroid) of the components (characters, numeric characters, symbols, marks) of each display item in the display by the stencil are set to the position of these components. Fig. 7 illustrates that the x-axis coordinates of 5, 6, 3, 4, 9, 7, -, 0, 1, which are the components of the ID 205 included in the display by the stencil, are Ws1, Ws2, Ws3, Ws4, Ws5, Ws6, Ws7, Ws8, and Ws9 respectively, and the y-axis coordinates of these components are all Ls1.

As described above, the position of each component of each display item in the display by the stencil is represented in x-y coordinates.

[0052] Similarly to the display by the stencil, regarding the display by the die stamp as well, among the positions of the components of the respective display items in the display by the die stamp, the x-y coordinates of two vertices 711a, 711b on a diagonal line out of the four vertices of a circumscribed rectangle 711 determined by the positions of the maximum value of the x-axis, the minimum value of the x-axis, the maximum value of the y-axis, and the minimum value of the y-axis are set to the position of the stencil in the article. Further, the x-y coordinates of the position of the barycenter (or centroid) of the components of each display item in the display by the die stamp are set to the position of these components.

[0053] Fig. 8 is a view illustrating one example of the position of the label in the article and the positions of the components of the respective display items in the display by the label. Fig. 8 illustrates, as an example, the case where the display by the label is made at the display position illustrated in Fig. 1A and with the display content illustrated in Fig. 3.

Fig. 8 illustrates the position of the label in the article and the positions of the components of the respective display items by the label in x-y coordinates where, of the eight vertices of the rectangular parallelepiped plate, a vertex 105 illustrated in Fig. 1A is set as the origin, and from

the vertex 105, the direction along the width direction of the plate is set to a positive direction of the x-axis and the direction along the plate thickness direction of the plate is set to a positive direction of the z-axis.

[0054] In this embodiment, the label is assumed to have a rectangular shape. The x-y coordinates of the two vertices on a diagonal line out of the four vertices of the label are set to the position of the label in the article. Further, the x-y coordinates of the position of the barycenter (or centroid) of the components of each display item in the display by the label are set to the position of these components. Fig. 8 illustrates that the x-y coordinates of two vertices 801a, 801b of the label are the position of the label in the article.

[0055] As described previously, in the management table 500 illustrated in Fig. 5, in the section of ID of the section of stencil in the section of actual article display, the information indicating the contents and the positions of the components of the IDs 205, 215 and other attributes that are included in the display by the stencil is stored. Thus, as illustrated in Fig. 9A, in the example illustrated in Fig. 7, in the sections of ID of the section of stencil in the section of actual article display, "5," "6," "3," "4," "9," "7," "-", "0," and "1" are stored as the content of the components of the ID 205 included in the display by the stencil. Further, in

the sections of ID of the section of stencil in the section of actual article display, (Ws1, Ls1), (Ws2, Ls1), (Ws3, Ls1), (Ws4, Ls1), (Ws5, Ls1), (Ws6, Ls1), (Ws7, Ls1), (Ws8, Ls1), and (Ws9, Ls1) are stored as the position of these components.

[0056] Fig. 9A illustrates, as an example, the case where an identification target exclusion category, a size, the number of dots, and an identification limit pixel number are included as the other attributes of the components of the IDs 205, 215 included in the display by the stencil. The identification target exclusion category is information for specifying some components that are excluded from the targets to be identified, where Y indicates that they are not excluded from the targets to be identified and N indicates that they are excluded from the targets to be identified. The components to be excluded from the targets to be identified are, for example, components to be excluded from the targets to be collated in a later-described collation unit 413. In this case, the components recognized in the recognition unit 412 are excluded from the targets to be collated in the collation unit 413. However, the components, which are excluded from the targets to be identified, are not limited to such components. The components to be excluded from the targets to be identified may be the components to be excluded from the targets to be recognized in the recognition unit 412, for example.

[0057] The size is information indicating the size of the component, where L indicates that the size of the component is relatively large, M indicates that the size of the component is medium, and S indicates that the size of the component is relatively small. The number of dots is information indicating the number of dots forming the component. For example, the number of dots being D5 indicates the number of dots that forms the content "5" of the component. The identification limit pixel number is information indicating the range of the number of pixels that can be identified for the captured image. For example, the identification limit pixel number being N5 indicates the range of the number of pixels that allows identification of the content "5" of the component. When the number of pixels forming the component in the captured image is outside the identification limit pixel number, it indicates that this component is excluded from the targets to be collated in the later-described collation unit 413. These pieces of information, for example, the identification target exclusion category, are information of the attributes of the components, and are information that it is impossible for those who are not involved in the display by the stencil to get. These pieces of information, for example, the identification target exclusion category, are stored in the management table 500 as the storage information to be used for identification of the

plate. These pieces of information, for example, the identification target exclusion category, which are used for identification of the plate, can be added • corrected in a later-described flowchart in Fig. 10, for example. In this embodiment, for example, the fact that the identification target exclusion category is Y and the fact that the number of pixels is equal to or more than the identification limit pixel number are one example of the conditions for recognition accuracy. Further, the component whose identification target exclusion category is Y and the component whose number of pixels in the captured image is within the range of the identification limit pixel number are one example of the information that satisfies the condition for recognition accuracy. In the example illustrated in Fig. 9A, among the components (5, 6, 3, 4, -) with the identification target exclusion category being Y, the components whose number of pixels in the captured image is within the range of the values (N5, N6, N3, N4, N-) in the sections of identification limit pixel number are the information that satisfies the condition for recognition accuracy.

[0058] Also in the sections of other display items in the section of actual article display, pieces of information indicating the contents and the positions of components of these display items and other attributes of the components are stored, as in the section of ID of the section of stencil.

Incidentally, as described previously, the information indicating the position of the component of each display item in the section of a die stamp is the x-y coordinates, as is the information indicating the position of the component of each display item in the section of stencil. In contrast to this, the information indicating the position of the component of each display item in the section of label is not the x-y coordinates but the x-z coordinates.

[0059] Further, as illustrated in Fig. 9B, in the example illustrated in Fig. 7, in the section of stencil of the section of position in article of the section of non-actual article display, (Ws10, Ls10) and (Ws11, Ls11) are stored as the information indicating the position of the stencil in the article.

Also in the section of a die stamp and the section of label of the section of position in article, the information indicating the position of the die stamp in the article and the information indicating the position of the label in the article are stored respectively, as in the section of stencil of the section of position in article. Therefore, even if the component, for example, a character is missing in one or two of the display by the stencil, the display by the die stamp, and the display by the label, the remaining display/displays allows/allow identification of the plate.

Incidentally, as described previously, the information indicating the position of the die stamp

in the article is the x-y coordinates as is the information indicating the position of the stencil in the article. In contrast to this, the information indicating the position of the label in the article is not the x-y coordinates but the x-z coordinates.

[0060] When newly creating or updating the management table 500, for example, the operator may operate the user interface of the identification device 400 and input the information that should be stored in each section of the management table 500 to the identification device 400. Further, the identification device 400 may receive the information that should be stored in each section of the management table 500 from an external device, for example, a computer that manages the operations of the factory.

[0061] Pieces of the information to be stored in the section of actual article display in the management table 500 and pieces of the information to be stored in the sections of position in article, weight, size, and parent ID in the section of non-actual article display are sometimes determined after the display on the plate is made, or sometimes determined before the display on the plate is made. Thus, when pieces of the information that should be stored in these sections have been already determined before the display on the plate is made, the identification device 400 acquires the information that should be stored in each of these sections as described

previously, for example, and stores it in each of these sections of the management table 500.

[0062] On the other hand, pieces of the information to be stored in the sections of storage space position, registration time, and image ID in the section of non-actual article display sometimes fail to be determined before the display on the plate is made. Thus, the identification device 400 acquires the information that should be stored in these sections, for example, at a timing when the information that should be stored in each of these sections is obtained, and stores it in each of these sections of the management table 500.

[0063] Next, there is explained one example of the functions of the identification device 400. Fig. 10 is a flowchart illustrating one example of processing of the identification device 400 when creating and updating the management table 500. Fig. 11 is a flowchart that explains one example of processing of the identification device 400 when identifying the plate. There is explained one example of the functions of the identification device 400 with reference to Fig. 10 and Fig. 11.

[0064] At Step S1001 in Fig. 10, an information acquisition unit 401 determines whether or not information that should be stored in the management table 500 has been input to the identification device 400. The information to be input to the identification device 400 at Step S1001 in Fig. 10

includes all pieces of the information that should be stored in the management table 500 in order to identify the plate, and includes all pieces of information acquired before the flowchart in Fig. 11 is executed, information acquired during the execution of the flowchart in Fig. 11, and information acquired after the flowchart in Fig. 11 is executed.

[0065] For example, the information to be stored in the section of actual article display and pieces of the information in the sections of position in article•weight•size in the section of non-actual article display are sometimes input to the identification device 400 before the flowchart in Fig. 11 is executed. However, these information may be input to the identification device 400 after the execution of the flowchart in Fig. 11 is started. For example, the identification information 208, 218, and 306 may be input to the identification device 400 at any timing after the identification information 208, 218, and 306 are acquired.

[0066] Further, pieces of the information in the sections of storage space position, registration time, image ID, and parent ID in the section of non-actual article display are input to the identification device 400 after these information are obtained. Further, when information is stored in the section of parent ID, this information becomes the information of the plate after cutting, and thus a new column

(No.) is added to the management table 500 in Fig. 5, and this information is stored in the corresponding column.

As above, the processing according to the flowchart in Fig. 10 is executed even while the flowchart in Fig. 11 is being executed.

[0067] As a result of the determination at Step S1001, when the information that should be stored in the management table 500 has not been input to the identification device 400, the processing according to the flowchart in Fig. 10 is finished. On the other hand, when the information that should be stored in the management table 500 has been input to the identification device 400, the processing at Step S1002 is executed. At Step S1002, an update unit 402 stores the information determined to have been input to the identification device 400 at Step S1001 in the corresponding section of the management table 500 stored in the storage unit 403 as storage information. When the information has not been stored in the corresponding section, the information determined to have been input to the identification device 400 at Step S1001 is newly registered in the management table 500. On the other hand, when the information has been stored in the corresponding section, the information determined to have been input to the identification device 400 at Step S1001 is updated in the corresponding section. At this time, the update unit 402 may leave or delete the information already

stored in the corresponding section. Then, the processing according to the flowchart in Fig. 10 is finished. Further, updating of the storage information in the management table 500 is executed not only in the flowchart in Fig. 10 but also in the processing according to the flowchart in Fig. 11 (see Step S1110 in Fig. 11).

[0068] At Step S1101 in Fig. 11, the image acquisition unit 411 acquires a captured image. In this embodiment, at Step S1101, a first captured image and a second captured image are acquired. The first captured image is a captured image including the display regions 101, 111 by the stencil and the display regions 102, 112 by the die stamp. The second captured image is a captured image including the display regions by the labels 103, 113.

[0069] The captured image acquired at Step S1101 is captured using, for example, an image capturing device installed in the factory, an image capturing device held by the operator (worker), or an image capturing device provided in an unmanned aircraft (drone). Incidentally, the image capturing device held by the operator (worker) may be, for example, an information terminal device (tablet terminal, smartphone, or the like) including an image capturing device. Further, when the image capturing device installed in the factory is unable to capture a desired region, prior to the processing at Step S1101, the operator (worker) adjusts the position and the

image capturing condition (for example, an angle of view) of the image capturing device.

[0070] Then, at Step S1102, the recognition unit 412 recognizes display information displayed on the plate from the captured image acquired at Step S1101. In this embodiment, the display information includes the components of the display items in the display by the stencil, the components of the display items in the display by the die stamp, and the components of the display items in the display by the label. In this embodiment, the display information is one example of first information. Incidentally, the first information is information displayed on an article (the plate in the example of this embodiment).

[0071] Accordingly, the recognition unit 412 recognizes the components of the display items in the display by the stencil and the display by the die stamp or the components of the display items in the display by the label as the display information included in the captured image (first captured image or second captured image) acquired at Step S1101.

The processing to recognize the content of the component of the display item can be implemented, for example, by a technique using well-known OCR (Optical Character Recognition), and thus detailed explanation thereof is omitted here. Incidentally, the processing at Step S1102 may be implemented using a technique using AI (Artificial Intelligence) , for example, NN (Neural Network) or a technique combining

AI and OCR (so-called AI OCR). The NN is configured so that, for example, when a captured image is input to an input layer of the NN, information indicating a component is output from an output layer of the NN. Incidentally, in this embodiment, when the recognition unit 412 is unable to recognize the content of the component of the display item (when the component is recognized as not being any of the characters, numeric characters, symbols, and marks, which are determined beforehand), the recognition result is that this component cannot be recognized. Further, the recognition unit 412 may calculate the reliability of the recognition result.

[0072] The recognition unit 412 specifies the format of the display based on the content of the recognized components. For example, in Fig. 2A, the mark 201 is present at the upper left, and the character size of the customer name 202, which is the following string of characters, is the same size as the other characters. On the other hand, in Fig. 2B, the mark 211 is present at the upper right, and the character size of the customer name 212, which is a string of characters on the first line, is about half the size of the other characters. Using such characteristics, the recognition unit 412 can specify the format of the display from among possible formats, and can specify the display item.

[0073] Incidentally, when the captured image is not acquired by the image acquisition unit 411 even after

a predetermined time has passed since the start of the processing at Step S1101, the processing at Step S1103 is executed without pieces of the processing at Steps S1101, S1102 being executed. In the following explanation, the display information recognized at Step S1102 is also referred to as recognition information. In this embodiment, the display information recognized at Step S1102 is one example of first recognition information.

[0074] Then, at Step S1103, the information acquisition unit 401 acquires non-display information that is not displayed on the plate to recognize it. The non-display information is information to be collated with the information stored in each section of non-actual article display and in the section of image ID in the management table 500 illustrated in Fig. 5. A specific example of the non-display information will be explained below. Incidentally, in the following explanation, the non-display information recognized at Step S1103 is also referred to as recognition information. In this embodiment, the non-display information is one example of second information. Incidentally, the second information is information that is not displayed on an article (the plate in this embodiment). Further, the non-display information recognized at Step S1103 is one example of second recognition information.

[0075] <<Recognition information of position in article>>

First, the information acquisition unit 401 derives the position of the display item. There is explained one example of the method of deriving the position of the display item by the information acquisition unit 401.

First, the information acquisition unit 401 performs edge detection processing based on the captured image acquired at Step S1101, detects edges of the plate, and specifies the region of the plate based on the detection result. Then, the information acquisition unit 401 determines whether the specified region is either the plate surface portion of the plate or the side surface (plate thickness) portion of the plate. This determination is implemented based on the aspect ratio of the specified region, for example. As a result of this determination, when the specified region is the plate surface portion of the plate, the information acquisition unit 401 determines that the captured image acquired at Step S1101 is the first captured image. On the other hand, when the specified region is the side surface (plate thickness) portion of the plate, the information acquisition unit 401 determines that the captured image acquired at Step S1101 is the second captured image.

[0076] Then, when the captured image acquired at Step S1101 is the first captured image, the information acquisition unit 401 detects the origin of the position in article (predetermined position on

the plate) in the first captured image.

The information acquisition unit 401 derives the origin of the position in article (predetermined position on the plate) in the first captured image based on a positional relationship preset as the positional relationship between the display region by the stencil and the origin of the position in article among the eight vertices of the rectangular plate, for example. For example, the following information may be preset in the identification device 400 as the positional relationship between the display region by the stencil and the origin of the position in article. That is, when the component of the display item in the display by the stencil is viewed so that the top of this component is positioned on the upper side, there may be preset, in the identification device 400, information indicating that the vertex on the lower left side of the display by the stencil is the origin of the position in article on the same plane as the display by the stencil. The information acquisition unit 401 derives the position based on the origin of the position in article in the first captured image as the position of the component of the display item in the display by the stencil and the position of the component of the display item in the display by the die stamp.

[0077] Further, the identification device 400 determines whether the component of the display item is either the component of the display item in the

display by the stencil or the component of the display item in the display by the die stamp based on information including, for example, at least one of the luminance value of the component of the display item and the distance between the components adjacent to each other.

[0078] Further, the identification device 400 may determine whether, for example, the component of the display item is either the component of the display item in the display by the stencil or the component of the display item in the display by the die stamp in the following manner. That is, the identification device 400 specifies, for each plate (for each column of the management table 500), which of the following rectangular regions the position of the component recognized as above is closer to: the rectangular region specified by the information stored in the section of stencil of the section of position in article of the section of non-actual article display in the management table 500, or the rectangular region specified by the information stored in the section of a die stamp of the section of position in article of the section of non-actual article display in the management table 500. In this case, the identification device 400 determines that the component of the display item is the component of the display item in the display by the stencil when the position of the component recognized as described above is close to the rectangular region specified by

the information stored in the section of stencil of the section of position in article of the section of non-actual article display in the management table 500. On the other hand, the identification device 400 determines that the component of the display item is the component of the display item in the display by the die stamp when the position of the component recognized as described above is close to the rectangular region specified by the information stored in the section of a die stamp of the section of position in article of the section of non-actual article display in the management table 500.

[0079] Incidentally, when the capturing of the region including the display regions 101, 111 by the stencil and the capturing of the region including the display regions 102, 112 by the die stamp are performed separately, it is not necessary to determine whether the component of the display item is either the component of the display item in the display by the stencil or the component of the display item in the display by the die stamp.

[0080] When the captured image acquired at Step S1101 is the second captured image, the information acquisition unit 401 detects the origin of the position in article (predetermined position on the plate) in the second captured image. Then, the information acquisition unit 401 derives the position based on the origin of the position in article in the second captured image as the position of the

component in the display by the label. The position of the component of the display item in the display by the label is derived in the same manner as the position of the component of the display item in the display by the stencil.

[0081] Then, the information acquisition unit 401 derives the positions of a circumscribed rectangle determined by the positions of the maximum value of the x-axis, the minimum value of the x-axis, the maximum value of the y-axis, and the minimum value of the y-axis from the positions of the components of the display items in the display by the stencil. The information acquisition unit 401 sets the x-y coordinates of the two vertices on a diagonal line out of the four vertices of the derived circumscribed rectangle as recognition information of the position of the stencil in the article.

[0082] Further, the information acquisition unit 401 derives the positions of a circumscribed rectangle determined by the positions of the maximum value of the x-axis, the minimum value of the x-axis, the maximum value of the y-axis, and the minimum value of the y-axis from the positions of the components of the display items in the display by the die stamp. The information acquisition unit 401 sets the x-y coordinates of the two vertices on a diagonal line out of the four vertices of the derived circumscribed rectangle as recognition information of the position of the die stamp in the article. Further, the

information acquisition unit 401 derives the positions of a circumscribed rectangle determined by the positions of the maximum value of the x-axis, the minimum value of the x-axis, the maximum value of the z-axis, and the minimum value of the z-axis from the positions of the components of the display items in the display by the label. The information acquisition unit 401 sets the x-y coordinates of the two vertices on a diagonal line out of the four vertices of the derived circumscribed rectangle as recognition information of the position of the label in the article.

[0083] <<Recognition information of weight>>

The information acquisition unit 401 acquires the ID of the plate and an actual measured value of the weight of the plate corresponding to this ID as recognition information of the weight of the plate.

[0084] <<Recognition information of size>>

The information acquisition unit 401 acquires the ID of the plate and an actual measured value of the size of the plate corresponding to this ID as recognition information of the size of the plate.

[0085] <Recognition information of storage space position>>

The information acquisition unit 401 acquires information indicating the position of the image capturing device that captured the captured image (first captured image or second captured image) acquired at Step S1101 as recognition information of

the storage space position.

[0086] <<Recognition information of parent ID>>

As illustrated in Fig. 6, when the original plate 600 is cut to manufacture the plates 610 to 640, the parent ID of the plates 610 to 640 after cutting is automatically specified from the process condition, which is the ID of the original plate 600. Displays including the IDs of the plates 610 to 640 after cutting are made in the display regions 611 to 641 by inkjet, laser marking, or the like. The displays including the IDs may be handwritten displays. Further, the information acquisition unit 401 may acquire the IDs, or the like of the plates 610 to 640 by the image acquisition unit 411 acquiring captured images of the display regions 611 to 641 and the recognition unit 412 recognizing the captured images in the same manner as the original plate 600. The association between the IDs or the like of the plates 610 to 640 and the parent ID, which is the ID of the original plate 600, may be performed automatically or manually. Additionally, the display on the original plate 600 may remain on the plates 610, 620 after cutting. The information acquisition unit 401 can also acquire such an ID included in the display on the original plate 600 as recognition information of the parent ID. Incidentally, such an ID is specified based on, among the components recognized at Step S1102, for example, the component that is not included in any of the rectangular regions specified

by pieces of the information stored in the sections of position in article (the section of stencil and the section of a die stamp) of the section of non-actual article display of the management table 500.

[0087] <<Recognition information of image ID>>

The information acquisition unit 401 acquires an ID of the captured image (first captured image or second captured image) acquired at Step S1101 as recognition information of the image ID. The information acquisition unit 401 acquires, for example, the ID added to the captured image acquired by the image acquisition unit 411 as the recognition information of the image ID of this captured image.

[0088] The non-display information (recognition information) recognized at Step S1103 is collated with the storage information stored in each section of non-actual article display in the management table 500 illustrated in Fig. 5 at Step S1106 to be described later. Further, the captured image (first captured image and second captured image) acquired at Step S1101 is collated with the captured image stored in association with the same ID as the ID to be acquired with this captured image among the IDs stored in the section of image ID in the management table 500 illustrated in Fig. 5 at Step S1106 to be described later.

When the processing at Step S1103 is finished, the processing at Step S1104 is executed. Incidentally, when the non-display information is not

acquired by the information acquisition unit 401 even after a predetermined time has passed since the start of the processing at Step S1103, the processing at Step S1104 is executed without the processing at Step S1103 being executed.

[0089] At Step S1104, the collation unit 413 selects one unselected collation target from collation targets. The collation target to be selected at Step S1104 is the information in each section (each item) of the management table 500 illustrated in Fig. 5. The collation target to be selected first is set to the information in the section of actual article display. Further, the collation target to be selected first is preferably the information determined for each plate (information unique to each plate). This is because if the recognition information of such a collation target matches the storage information stored in the management table 500, the recognition information of this collation target is specified to be the information of the plate in the column (No.) where this storage information is stored, without using any other recognition information. Therefore, in this embodiment, there is explained, as an example, the case where the ID in the section of stencil (the ID included in the display by the stencil) is the collation target to be selected first. However, it is not always necessary to employ the case. For example, the ID in the section of a die stamp or the

ID in the section of label may be the collation target to be selected first. Further, the order of selection of collation targets is not particularly limited. In this embodiment, there is explained, as an example, the case where collation targets are selected one by one in order from the top section of the management table 500.

[0090] <<The case where the collation target is the display information>>

Then, at Step S1105, the collation unit 413 acquires information whose accuracy is guaranteed among pieces of the recognition information of the collation target selected at Step S1104. The information whose accuracy is guaranteed is information of the component or the like, which is not excluded from the targets to be collated by the identification target exclusion category and the identification limit pixel number illustrated in Fig. 9A.

[0091] Incidentally, the information whose accuracy is guaranteed, which is one example of the information satisfying the conditions for recognition accuracy, is not limited to the information of the component that is not excluded from the targets to be collated by the identification target exclusion category and the identification limit pixel number illustrated in Fig. 9A. For example, separately from the identification target exclusion category and the identification limit pixel number, the components,

for example, 1, 7, 9, 0, C, I, L, O, P, Q, R, T, U, and V, which are considered to have a low identification rate by the character recognition processing, are determined beforehand in some cases. In this case, the components other than the components that are considered to have a low identification rate by the character recognition processing become the information whose accuracy is guaranteed. Both the components that are not excluded from the targets to be collated by the identification target exclusion category and the identification limit pixel number and the components other than the components that are considered to have a low identification rate by the character recognition processing may be the information whose accuracy is guaranteed. Further, the collation unit 413 may also handle the components that were not able to be recognized in the processing at Step S1102 as not being the information whose accuracy is guaranteed.

[0092] Then, at Step S1106, the collation unit 413 collates the recognition information of the collation target selected at Step S1104 with the storage information of the collation target. The storage information of the collation target is selected one by one from each column (No. 1, 2, 3, ...) of the management table 500. That is, the storage information to be collated with the recognition information of the collation target selected at Step

S1104 is each of pieces of the storage information stored in the respective columns of the management table 500. Thus, the recognition information of the collation target is the recognition information for the same article (plate in this embodiment) even at any Step S1106. In contrast to this, the storage information of the collation target is the storage information for a plurality of articles (plates in this embodiment) stored in the management table 500.

[0093] Further, when the information whose accuracy is guaranteed is acquired at Step S1105, the collation unit 413 collates only the information whose accuracy is guaranteed among pieces of the recognition information of the selected collation target with the storage information of the collation target.

[0094] The collation unit 413 extracts, from the columns (No.) of the management table 500, the column where the storage information that matches the recognition information of the collation target selected at Step S1104 is stored, and outputs information indicating the extracted column to a specification unit 414.

[0095] As above, the collation unit 413 determines whether or not the recognition information of the collation target and the storage information of the collation target match. The recognition information of the collation target is the information recognized at Step S1102 or Step S1103. The storage information

of the collation target is the information stored in the management table 500.

When the collation target is an ID, matching means that there is a complete match in content and order between the components of the recognition information of the collation target and the components of the storage information of the collation target. However, when the collation target is a part of an ID, if there is a complete match in content and order between the components of the recognition information of the collation target and the components of the storage information of the collation target, the information are considered to match.

[0096] In the example illustrated in Fig. 2A, the content of the components of the ID in the display by the stencil is 5, 6, 3, 4, 9, 7, -, 0, 1, and the alignment order is 5, 6, 3, 4, 9, 7, -, 0, 1 from the left. It is assumed that such information is stored in the section of ID of the section of stencil in the management table 500. Further, it is assumed that the information whose accuracy is not guaranteed is 0, 1, 7, and 9. Using such a case as an example, there are explained specific examples of the case where the collation target is the entire ID (where the accuracy of the entire ID is guaranteed) and the case where the collation target is a part of the ID (where the accuracy of only a part of the ID is guaranteed).

[0097] In the case of the collation target being the

entire ID, when the information in which 5, 6, 3, 4, 9, 7, -, 0, 1 are aligned in this order from the left is the recognition information of the ID in the display by the stencil, the recognition information of the ID in the display by the stencil and the storage information match. It is assumed that not only when a part of these components is missing, but also when components other than these components are aligned, the recognition information of the ID in the display by the stencil and the storage information do not match in content and order. For the other display information and non-display information as well, the match or not-match between the recognition information and the storage information is determined in the same manner.

[0098] When the collation target is a part of the ID, the content of the components whose accuracy is guaranteed among the components stored in the section of ID of the section of stencil in the section of actual article display is 5, 6, 3, 4, -, and the alignment order is 5, 6, 3, 4, - from the left. Thus, in the recognition information of the ID in the display by the stencil, when 5, 6, 3, 4, - are aligned in this order from the left, two components are present between 4 and -, and two components are present to the right of -, the recognition information of a part of the ID in the display by the stencil and the storage information match.

[0099] Further, the recognition unit 412 may regard

the components that cannot be recognized in the processing at Step S1102 and the components with the reliability of the recognition result being equal to or less than a threshold value (for example, "0," "1," "7," and "9") as a blank, and form information indicating the result recognized at Step S1102. In this case, the information becomes information indicating that the blanks are not subject to collation. In this way, the collation unit 413 can execute collation for each component in the order in which the components are aligned. An output unit 415 outputs a result of the collation for each component, thereby allowing the operator to easily confirm that the collation is performed correctly. In the example here, the ID, which is 9 digits, is stored in the management table 500. Therefore, the output unit 415 outputs the result of the collation for each component, allowing the operator to grasp which components match and which components do not match. Incidentally, the size of the region in which the component whose accuracy is not guaranteed should be present or the number of components whose accuracy is not guaranteed is specified based on the information stored in the section of size of the section of stencil in the management table 500 and the information stored in the section of size of the section of label in the management table 500, for example.

The content explained in the paragraph <<The case

where the collation target is the display information>> is also applicable to the cases where the collation target is the display information other than the ID.

[0100] In this embodiment, the storage information in each section (each item) of actual article display of the management table 500 is one example of the first storage information. Further, the storage information in each section (each item) of non-actual article display of the management table 500 is one example of the second storage information.

[0101] When the collation target selected at Step S1104 is the information in each section (each item) of non-actual article display in the management table 500 and the information in the section of image ID in the management table 500, the acquisition of the information whose accuracy is guaranteed is not executed (the processing at Step S1105 is omitted). In this case, at Step S1106, the collation unit 413 collates all pieces of the recognition information of the collation target selected at Step S1104 with all pieces of the storage information of the collation target. However, regarding the collation target selected at Step S1104, the information whose accuracy is guaranteed may be set for the information in each section of non-actual article display in the management table 500 and the information in the section of image ID of the management table 500. In this case, for example, the information whose

accuracy is guaranteed is a value within the range expected as the value for the information in each section. In this case, the acquisition of the information whose accuracy is guaranteed is executed even when the collation target selected at Step S1104 is the information in each section of non-actual article display in the management table 500 and the information in the section of image ID in the management table 500.

[0102] <<The case where the collation target is the storage space position>>

The recognition information of the storage space position is information indicating the position of the image capturing device that captured the captured image (first captured image or second captured image) acquired at Step S1101. The storage information of the storage space position is information indicating the position of the plate. Thus, the collation unit 413 determines whether or not the distance between the position of the plate specified from the information indicating the position of the plate stored in the section of storage space position of the section of non-actual article display and the position of the image capturing device that captured the captured image acquired at Step S1101 is equal to or less than a threshold value. When this distance is equal to or less than the threshold value, the collation unit 413 determines that the recognition information of the storage space position and the

storage information match, and when it is not equal to or less than the threshold value, the collation unit 413 determines that the recognition information of the storage space position and the storage information do not match.

[0103] The identification device 400 stores, for example, the information indicating the position of the image capturing device beforehand. When the position of the image capturing device can change, the identification device 400 may acquire and update the position information detected using a Global Positioning System (GPS) provided with the image capturing device or an information processing terminal hand-held by the operator (worker) as the position of the image capturing device. Further, when an image capturing device provided on an unmanned aircraft (drone) is used, the identification device 400 may acquire the position information detected using a GPS provided on the unmanned aircraft, for example, as the position of the image capturing device.

[0104] <<The case where the collation target is the registration time>>

As described previously, when the collation target is the registration time, there is no recognition information of the registration time. In this embodiment, collation of the registration time is executed as follows.

As illustrated in Fig. 1C, when a plurality of

plates are stacked, the plate with the shortest elapsed time among the plates with the same position of the x-y coordinates is stacked on top, and thus, it is considered that capturing of the display regions 101, 111 by the stencil is enabled. Thus, the collation unit 413 executes the following collation when the captured image acquired at Step S1101 is the first captured image (namely, when the captured image includes the display regions 101, 111 by the stencil). That is, the collation unit 413 collates, among candidates for the plate specified at the time when Step S1106 starts, the registration times stored in the sections of registration time of the section of non-actual article display of candidates for a plurality of the plates having the same information (x-y coordinates) indicating the position of the plate stored in the sections of storage space position of the section of non-actual article display. In this case, the plate with the latest registration time is specified as the plate captured in the first captured image acquired at Step S1101. In this case, among the candidates for a plurality of the plates having the same information (x-y coordinates) indicating the position of the plate stored in the sections of storage space position of the section of non-actual article display, all but the candidate for the plate having the latest registration time are excluded from the candidates for the plate. Incidentally, there is explained a

specific example of the method of specifying the candidate for the plate in the explanation of processing at Step S1107.

[0105] <<The case where the collation target is the captured image>>

The collation unit 413 extracts the same ID as the ID specified by the recognition information of the image ID acquired at Step S1103 from the section of image ID in the management table 500, and acquires the captured image stored in association with the extracted ID. The collation unit 413 collates the captured image acquired as above with the captured image acquired at Step S1101. For example, the collation unit 413 extracts one or two or more feature points from each of these captured images, and distinguishes whether these captured images match or do not match based on whether or not there is a common feature point among the extracted feature points, to what extent the feature points are common (approximate), or other factors. Such distinction can be performed by a well-known image identification processing technique, for example, face authentication or fingerprint authentication.

[0106] When the collation target is the information in the section of non-actual article display, matching means that the meaning indicated by the recognition information of the collation target and the meaning indicated by the storage information of the collation target are the same. For example, when

the recognition information of the weight is 10000 g and the storage information of the weight is 10 kg, the meaning indicated by the recognition information of the weight and the meaning indicated by the storage information of the weight are the same, and the recognition information of the weight and the storage information of the weight match. The collation unit 413 determines whether or not the recognition information of the weight and the storage information of the weight match, for example, by using a conversion formula that converts the unit indicated by the recognition information of the weight into the unit indicated by the storage information of the weight.

[0107] At Step S1106 executed as described above, the collation unit 413 outputs information indicating, among the columns (No.) of the management table 500, the column where the storage information matching the recognition information of the collation target selected at Step S1104 is stored to the specification unit 414.

[0108] Then, at Step S1107, the specification unit 414 determines whether or not only one plate has been specified from the plates managed in the management table 500 based on the information output from the collation unit 413 at Step S1106. As a result of the determination at Step S1107, when only one plate is not specified from the plates managed in the management table 500, the processing at Step S1108 is

executed. At Step S1108, the collation unit 413 determines whether or not all collation targets have been selected. As a result of the determination at Step S1108, when it is determined that all collation targets have not been selected, the processing at Step S1101 is executed again. Then, pieces of the processing at Steps S1101 to S1107 are executed again. As above, pieces of the processing at Steps S1101 to S1108 are repeatedly executed. There will be explained pieces of the processing at and after Step S1107 in detail below.

[0109] As a result of the determination at Step S1107, when only one plate is not specified from the plates managed in the management table 500, the specification unit 414 specifies the column (No.) specified by the information output from the collation unit 413 at Step S1106 as the candidate for the plate that should be identified and stores it. Then, the processing at Step S1108 is executed.

[0110] Whether or not only one plate has been specified from the plates managed in the management table 500 is determined as follows, for example.

When the number of columns specified by the information output at step S1106 immediately before this step is one, the specification unit 414 may determine that only one plate has been specified from the plates managed in the management table 500. The plate specified in this case is the plate corresponding to the specified column.

[0111] Further, the specification unit 414 may determine that only one plate has been specified from the plates managed in the management table 500 when information specifying the same column was output a predetermined number of times, which is two or more times, at Step S1106 that was executed a plurality of times in the past. In this case, the number of columns specified by the information output at Step S1106 that is executed one time may be 1 or 2 or more. Further, the plate specified in this case is the plate corresponding to the specified column.

[0112] Further, when only one plate is not specified from the plates managed in the management table 500, the specification unit 414 may specify, among the columns (No.) of the management table 500, the column where the storage information that only partly matches the recognition information of the collation target selected at Step S1104 is stored as the candidate for the plate that should be identified and store it. In this case, at Step S1106, the collation unit 413 outputs the information indicating, among the columns (No.) of the management table 500, the column where the storage information that only partly matches the recognition information of the collation target selected at Step S1104 is stored to the specification unit 414.

[0113] Further, the specification unit 414 may narrow down the candidates for the plate that should be identified. For example, the specification unit

414 may specify, among the columns (No.) stored as the candidate for the plate that should be identified, only the column whose ratio to the total number of columns stored as the candidate for the plate that should be identified is equal to or more than a threshold value as the candidate for the plate that should be identified. Incidentally, in counting the total number of columns, when there are a plurality of columns with the same No., the number of these columns is set to one. Further, the specification unit 414 may exclude, among the columns (No.) already stored as the candidate for the plate that should be identified when this step starts, the columns other than the same column as that specified by the information output at Step S1106 (the latest Step S1106) immediately before this step from the candidate for the plate that should be identified.

Two or more of the above methods that specify the candidate for the plate that should be identified may be combined.

[0114] As a result of the determination at Step S1107, when only one plate is not specified from the plates managed in the management table 500, the processing at Step S1108 is executed as described previously. At Step S1108, the collation unit 413 determines whether or not all collation targets have been selected. For example, when all sections (items) in the management table 500 have been selected, the collation unit 413 may determine that

all collation targets have been selected. Further, the collation unit 413 may determine that all collation targets have been selected when one or two or more sections preset as the collation target are selected among all sections (items) in the management table 500.

[0115] Further, the collation unit 413 may limit the collation target according to the storage space position of the plate. For example, actual collation is performed at the storage space position of each step. For this reason, when at least one of the IDs displayed by the stencil, the die stamp, and the label is set as the collation target and one plate is not specified (NO at Step S1107), the collation unit 413 may set only the storage space position of the management table 500 as the collation target.

Further, when specifying the plate after shipment from the factory, the collation unit 413 may select the non-display information, for example, the storage space position of the management table 500 as the collation target before the display information.

[0116] As described previously, as a result of the determination at Step S1108, when it is determined that all collation targets have not been selected, the processing at Step S1101 is executed again. Then, pieces of the processing at Steps S1101 to S1107 are executed again. Incidentally, as a result of the determination at step S1108, the processing to be executed first when it is determined that all

collation targets have not been selected is not limited to the processing at Step S1101. For example, when pieces of the information (captured image and non-display information) that need to be acquired at Steps S1001, S1003 in order to acquire the recognition information of all selection targets are acquired at a time at Steps S1001, S1003, as a result of the determination at Step S1108, the processing to be executed first when it is determined that all collation targets have not been selected may be Step S1104. As described previously, at Step S1104, one collation target is selected. Accordingly, when the recognition information of one collation target and the storage information of this single collation target match, at least one candidate for the plate that should be identified is specified.

[0117] As a result of the determination at Step S1107, when only one plate is specified from the plates managed in the management table 500, the processing at Step S1109 is executed. At Step S1109, the output unit 415 outputs article specification information. The article specification information includes the information (for example, the ID) of the plate that is determined to be specified at Step S1107, for example. The form of output is, for example, at least one of display on a computer display, storage in an internal or external storage medium of the identification device 400, and transmission to an external device of the

identification device 400.

[0118] This embodiment may also be designed so that the operator (worker) can confirm the information (for example, the ID) of the plate output by the output unit 415. The operator determines whether or not the information of the plate output by the output unit 415 is information different from the information of the actual article based on the captured image or the like. As a result of this determination, when the information of the plate output by the output unit 415 is information different from the information of the actual article, the operator operates the user interface of the identification device 400 to input the display information of the actual plate into the identification device 400. When the character recognition processing is executed using AI in the recognition unit 412, the identification device 400 uses the input display information of the plate as correct data to execute AI learning. This makes it possible to improve the recognition accuracy in the recognition unit 412. Incidentally, the processing at Step S1109 is finished, for example, when the operator has performed an operation corresponding to the confirmation of the information (for example, the ID) of the plate output in this step on the user interface of the identification device 400, or when a certain period of time has passed since the start of the processing at step S1109.

[0119] Then, at Step S1110, the update unit 402 updates the management table 500. For example, the update unit 402 updates the section of image ID in the management table 500 when the collation target when it is determined that only one plate has been specified at Step S1107 is the information in the section of actual article display.

[0120] Specifically, it is assumed that the collation target when it is determined that only one plate has been specified at Step S1107 is the information in the section of stencil or a die stamp in the section of actual article display. In this case, the update unit 402 updates the storage information of the image ID in the column corresponding to the plate specified at Step S1107 among the columns (No.) in the management table 500 to the ID of the first captured image acquired at Step S1101. Further, the update unit 402 updates the captured image stored in association with this image ID to the first captured image. Further, the update unit 402 updates the components of each display item stored in association with this image ID to the components of each display item of the first captured image. The components of each display item of the first captured image are specified from the result of the processing at Step S1102, for example.

[0121] Further, it is assumed that the collation target when it is determined that only one plate has been specified at Step S1107 is the information in

the section of label in the section of actual article display. In this case, the update unit 402 updates the storage information of the image ID in the column corresponding to the plate specified at Step S1107 among the columns (No.) in the management table 500 to the ID of the second captured image acquired at Step S1101. Further, the update unit 402 updates the captured image stored in association with this image ID to the second captured image. Further, the update unit 402 updates the components of each display item stored in association with this image ID to the components of each display item of the second captured image. The components of each display item of the second captured image are specified from the result of the processing at Step S1102, for example. [0122] As long as the operation is performed as above, the captured image to be collated with the captured image acquired at Step S1101 thereafter can be a captured image that is close to the actual display.

Incidentally, the section in the management table 500 to be updated is not limited to the section of image ID. For example, it is assumed that the collation target when it is determined that only one plate has been specified at Step S1107 is the weight. In this case, the update unit 402 may update the storage information of the weight in the column corresponding to the plate specified at Step S1107 among the columns (No.) of the management table 500

to the measured value of the weight acquired at Step S1103.

When the processing at Step S1110 is finished, the processing according to the flowchart in Fig. 11 is finished. Incidentally, when there is no information that should be updated in the processing at Step S1110, the processing at Step S1110 is omitted.

[0123] As a result of the determination at Step S1108, when it is determined that all collation targets have been selected, the processing at Step S1111 is executed. This case means that even when all collation targets are selected, only one plate is not specified at Step S1107. Thus, at Step S1111, the output unit 415 outputs article candidate information. The article candidate information includes the information (for example, the ID) of the candidate for the plate specified by the specification unit 414 at the time when Step S1111 starts, for example. The form of output is, for example, at least one of display on a computer display, storage in an internal or external storage medium of the identification device 400, and transmission to an external device of the identification device 400. The operator (worker) confirms the information (for example, the ID) of the candidate for the plate output by the output unit 415 and specifies the plate. By presenting information of a plurality of candidates for the plate to the

operator, it is possible to reduce the burden on the operator when specifying the plate. When the processing at Step S1111 is finished, the processing according to the flowchart in Fig. 11 is finished.

[0124] <Summary>

In this embodiment as above, the identification device 400 acquires a captured image of a region including pieces of display information displayed on the plate, and recognizes at least one piece of the display information based on the acquired captured image. The identification device 400 collates at least a part of recognition information, which is this recognized information, with storage information stored in the management table 500 corresponding to this recognition information. The identification device 400 specifies at least one candidate for the plate based on the result of this collation. At this time, the identification device 400 collates recognition information that is partly different from the recognition information with storage information stored in the management table 500 as the information corresponding to this recognition information. Therefore, when identifying the plate based on the captured image obtained by capturing the information displayed on the plate, it becomes possible to identify the plate even if all pieces of the information displayed on the plate cannot be correctly extracted.

[0125] Here, this recognition information

(recognition information that does not match the storage information) and the recognition information that is partly different from this recognition information are information for the same article (same plate in the example of this embodiment). Therefore, at Steps S1102, S1103, and S1106 that are executed in repeating processing in Fig. 11, the display information displayed on the same article (same plate in the example of this embodiment) is recognized. Further, each piece of the recognition information that is partly different from this recognition information (recognition information that does not match the storage information) does not completely match one piece of this recognition information (recognition information that does not match the storage information). The recognition information that is partly different from this recognition information is information that includes some of the components of this recognition information but does not include all of the components of this recognition information.

[0126] Further, the conventional techniques are based on the premise that even when display information (component) is already known on the manufacturer's side, recognition of the display information is performed correctly. That is, the conventional techniques are based on the premise that the display is clear and is free from scratches or stains. Therefore, even when the display is

scratched or stained, the display information becomes information including the error that the display information has been correctly recognized. Therefore, when the displayed display information is not in a desired state, the display information cannot be correctly recognized. That is, in the conventional techniques, the display information is assumed to be correctly displayed on the article, and thus it is not possible to execute the processing for erroneous recognition. Further, in the conventional techniques, it is determined that the collation has failed unless all pieces of the display information forming the collation target are correctly collated.

[0127] In contrast to this, in this embodiment, the information stored in the management table 500 is the information managed by the manufacturer of the plate. Accordingly, even when the recognition information and the storage information do not completely match, the candidates for the plate can be narrowed down by collating the recognition information that is partly different from the above recognition information with the storage information stored in the management table 500 as the information corresponding to the above recognition information. Therefore, even when the display information displayed on the plate is not in a desired state during the manufacturing process, the collation failure can be inhibited and the identification accuracy of the plate can be improved.

[0128] Further, in this embodiment, the

identification device 400 collates the information that satisfies the condition for accuracy among the recognition information with the information corresponding to the information that satisfies the condition for accuracy among the storage information. Accordingly, even when collations of all pieces of the recognition information fail, the identification of the plate can be performed as accurately as possible.

[0129] Further, in this embodiment, the identification device 400 collates the non-display information that is not displayed on the plate with the storage information stored in the management table 500 as the information corresponding to the non-display information. Thus, when the information displayed on the plate cannot be extracted correctly, the information that is not displayed on the plate can be utilized to identify the plate. As a preferred example of the non-display information that is not displayed on the plate, there is cited at least one of the position in article, the weight of the plate, the size of the plate, the storage space position, and the registration time.

[0130] Further, in this embodiment, the identification device 400 synthesizes the acquired captured image and the captured image that is stored in association with the same ID as the ID of the acquired captured image among the IDs stored in the sections of image ID of the management table 500.

Accordingly, the plate can be identified by utilizing the captured image of the plate when the information displayed on the plate cannot be extracted correctly.

[0131] Further, in this embodiment, the identification device 400 collates the recognition information of the display information different from the display information that has failed in collation with the storage information stored in the management table 500 as the information corresponding to the above recognition information. Accordingly, the plate can be identified by utilizing another information displayed on the plate when the information displayed on the plate cannot be extracted correctly.

[0132] <Modified examples>

<<First modified example>>

As in this embodiment, when the customer names 202, 212, the standards 203, 213, the sizes 204, 214, the IDs 205, 215, 209, and 219, the customer codes 206, 216, the order numbers 207, 217, the identification information 208, 218, the standard 301, the ID 302, the size 303, the delivery date 304, and the customer code 305 are set to the human identifiable information, not only the actual article management by the identification device 400, but also the actual article management by the operator (worker) is facilitated, which is preferable. However, at least one of the following information: the customer names 202, 212, the standards 203, 213,

the sizes 204, 214, the IDs 205, 215, 209, and 219, the customer codes 206, 216, the order numbers 207, 217, the identification information 208, 218, the standard 301, the ID 302, the size 303, the delivery date 304, and the customer code 305 may be converted (encoded) to non-human identifiable information, for example, bar codes or two-dimensional codes.

[0133] <<Second modified example>>

In this embodiment, there has been explained, as an example, the case where the information with a high identification rate by the character recognition processing is used to constitute the identification information 208, 218. However, the identification information is not limited to the case of using the information with a high identification rate by the character recognition processing.

[0134] For example, the components of the identification information may be determined according to predetermined rules, for example, four arithmetic operations and functions, so as to allow a person to understand the meaning of the identification information.

For example, when the components of the ID of the plate include numeric characters, the numeric characters constituting the identification information may be determined so that the value obtained by adding a numeric character of one digit forming the ID of the plate and a numeric character of the same digit as that of this numeric character

together becomes the smallest value among multiples of a predetermined value. For example, the IDs 205, 215 displayed by the stencil are "563497-01." When the predetermined value is 5, the identification information is "042113-54" ($5 + 0 = 5$, $6 + 4 = 10$, $3 + 2 = 5$, $4 + 1 = 5$, $9 + 1 = 10$, $7 + 3 = 10$, $0 + 5 = 5$, $1 + 4 = 5$).

[0135] Further, when the component of the last digit of the ID of the plate is a numeric character, information including a complement of this numeric character (complement of a radix in decimal system) as the component may be used as the identification information. For example, the IDs 205, 215 displayed by the stencil are "563497-01." Therefore, information including 9 ($1 + 9 = 10$) is set as the identification information. For example, information obtained by adding such a complement to the next digit after the last digit of the ID of the plate may be set as the identification information. In addition, information including the remainder value obtained by dividing the numeric character of the last digit of the ID of the plate by a predetermined value as the component may be set as the identification information. For example, the IDs 205, 215 displayed by the stencil are "563497-01." Therefore, when the predetermined value is 5, information including 1 (the remainder of $1 \div 5$ is 1) is set as the identification information. For example, information obtained by adding such a

remainder value to the next digit after the last digit of the ID of the plate may be set as the identification information.

[0136] Further, even when using the information with a high identification rate by the character recognition processing, the components of the identification information may be determined according to a predetermined rule. For example, among the components of the ID of the plate, the components with a low identification rate by the character recognition processing may be changed to components with a high identification rate, and the components with a high identification rate may be set as the identification information. For example, 1, 7, 9, 0, C, I, L, O, P, Q, R, T, U, and V may be replaced with characters, numeric characters, or symbols with a high identification rate by the character recognition processing.

In addition, the identification information may be displayed in a form different from other information. For example, at least one of the color, the type of character, the size of character, and the number of dots of character in the identification information may be different from other information. Further, instead of or in addition to the above, the number of pixels of the captured image of the identification information may be different from the number of pixels of a captured image of other information by capturing the identification

information in close proximity. For example, information that is different in color from the ID of the plate may be set as the identification information. Further, one made by changing the type of character of the ID of the plate may be set as the identification information. When the ID of the plate is numeric characters, for example, one made by changing these numeric characters to alphabets may be set as the identification information.

[0137] <<Third modified example>>

In this embodiment, there has been explained, as an example, the case where the ID 205 displayed by the stencil, the ID 209 displayed by the die stamp, and the ID 302 displayed by the label are the same as illustrated in Fig. 2A, Fig. 2B, and Fig. 3. However, the expressions and described contents of these IDs may differ. For example, the form of the ID not including a "hyphen" is also present. In such a case, information indicating that these IDs (the ID displayed by the stencil, the ID displayed by the die stamp, and the ID displayed by the label) are for the same plate is stored in the management table 500. As for the display items other than the ID, the expressions and described contents of the same display item may differ between the display by the stencil, the display by the die stamp, and the display by the label. For example, when the standard is displayed on both the stencil and the label, for example, the abbreviation of the standard may be

displayed on the label. Further, the number of digits of the customer code may differ between the display by the stencil and the display by the label, but the customer code is managed by the manufacturer. Further, as for the size, not all digits of the size may be displayed. In such a case as well, information indicating that those different expressions and described contents have the same meaning is stored in the management table 500.

[0138] <<Fourth modified example>>

As in this embodiment, using the non-display information makes it possible to more reliably identify the plate, which is preferable. However, it is not necessary to use the non-display information when identifying the plate. In this case, each of the sections of non-actual article display of the management table 500 illustrated in Fig. 5 is no longer necessary, and the processing at Step S1103 in Fig. 11 is no longer required.

[0139] <<Fifth modified example>>

In this embodiment, there has been explained, as an example, the case where the plate is identified at any timing during the period until the plate is shipped to the customer at the factory. However, the identification of the plate may be executed after the plate is shipped. Further, the information to be displayed on the plate to identify the plate may be given after the plate is shipped to the customer.

[0140] <<Sixth modified example>>

In this embodiment, there has been explained, as an example, the case where when the collation target selected at Step S1104 is the information in each section (each item) of actual article display in the management table 500, at Step S1106, collation is executed using only the information whose accuracy is guaranteed among pieces of the recognition information of the collation target selected at Step S1104. However, it is not always necessary to employ the case.

[0141] For example, the following may be employed.

When the number of pieces of information whose accuracy is guaranteed among the recognition information of the collation target is less than a predetermined number, at Step S1104, the collation unit 413 extracts the information whose accuracy is not guaranteed from the recognition information of the collation target so that the sum of the number of pieces of information whose accuracy is guaranteed and the number of pieces of information whose accuracy is not guaranteed becomes the aforementioned predetermined number. The collation unit 413 executes the collation using the information whose accuracy is guaranteed and the extracted information whose accuracy is not guaranteed. For example, it is assumed that 10 is set as the aforementioned predetermined number. Further, it is assumed that the number of pieces of information whose accuracy is guaranteed among the recognition information of the

collation target is six. In this case, four pieces of information whose accuracy is not guaranteed are extracted from the recognition information of the collation target so that the sum of the number of pieces of information whose accuracy is guaranteed and the number of pieces of information whose accuracy is not guaranteed is 10. Incidentally, when the number of pieces of information whose accuracy is guaranteed among the recognition information of the collation target is 10 or more, the collation is performed using all pieces of the information whose accuracy is guaranteed (namely, 10 or more pieces of information).

[0142] Further, the following may be employed.

As for the information in each section (each item) of actual article display in the management table 500, the information (collation target) of the same item may be selected twice consecutively. In this case, the collation unit 413 selects one unselected collation target among the collation targets. Then, at Step S1106, the collation unit 413 executes collation using all pieces of the recognition information of this collation target. Then, when it is determined to be NO at Step S1107 and Step S1108, at Step S1104, the collation unit 413 selects the same collation target as the collation target that was selected at the previous Step S1104. Then, at Step S1106, the collation unit 413 executes collation using only the information whose accuracy

is guaranteed among the recognition information of this collation target.

[0143] As above, this embodiment is not limited to the case where the collation unit 413 executes the collation using only the information whose accuracy is guaranteed among the recognition information of the collation target. That is, it is only necessary to design that the collation unit 413 can execute collation using, among the recognition information of the collation target, only partial information of the recognition information (information whose accuracy is guaranteed in the example of this embodiment).

[0144] <<Seventh modified example>>

In this embodiment, there has been explained, as an example, the case where the management table 500 is stored in the identification device 400. However, the management table 500 may be provided outside the identification device 400.

[0145] <<Eight modified example>>

In this embodiment, there has been explained, as an example, the case where the article is the plate. However, the article is not limited to the plate. For example, the article may be a manufactured product other than the plate. The article may be a manufactured product on which information managed by a manager, for example, a manufacturer is displayed. The manufactured product may be, for example, a slab, a billet, a sheet coil, or a steel pipe. Further, the article may be an article other than the

manufactured product. The article may be a container, for example.

[0146] <<Other modified examples>>

Incidentally, the embodiment of the present invention explained above can be fabricated by causing a computer to execute a program. Further, a computer-readable recording medium in which the aforementioned program is recorded and a computer program product, for example, the aforementioned program can also be applied as the embodiment of the present invention. As the recording medium, it is possible to use a flexible disk, a hard disk, an optical disk, a magneto-optic disk, a CD-ROM, a magnetic tape, a nonvolatile memory card, a ROM, or the like, for example. Further, the embodiment of the present invention may be implemented by a PLC (Programmable Logic Controller) or may be implemented by dedicated hardware, for example, an ASIC (Application Specific Integrated Circuit).

Further, the embodiment of the present invention explained above merely illustrates concrete examples of implementing the present invention, and the technical scope of the present invention is not to be construed in a restrictive manner by the embodiment. That is, the present invention may be implemented in various forms without departing from the technical spirit or main features thereof.

[0147] <Hardware>

There is explained one example of the hardware of

the identification device 400. In Fig. 12, the identification device 400 includes a CPU 1201, a main memory 1202, an auxiliary memory 1203, a communication circuit 1204, a signal processing circuit 1205, an image processing circuit 1206, an I/F circuit 1207, a user interface 1208, a display 1209, and a bus 1210.

[0148] The CPU 1201 overall controls the entire identification device 400. The CPU 1201 uses the main memory 1202 as a work area to execute a program stored in the auxiliary memory 1203. The main memory 1202 stores data temporarily. The auxiliary memory 1203 stores various data, in addition to programs to be executed by the CPU 1201.

[0149] The communication circuit 1204 is a circuit intended for performing communication with the outside of the identification device 400. The communication circuit 1204 may perform wireless communication or wire communication with the outside of the identification device 400.

[0150] The signal processing circuit 1205 performs various pieces of signal processing on signals received in the communication circuit 1204 and signals input according to the control by the CPU 1201.

The image processing circuit 1206 performs various pieces of image processing on signals input according to the control by the CPU 1201. The signal that has been subjected to the image processing is

output on the display 1209, for example.

The user interface 1208 is a part in which the operator gives an instruction to the identification device 400. The user interface 1208 includes buttons, switches, dials, and so on, for example. Further, the user interface 1208 may include a graphical user interface using the display 1209.

[0151] The display 1209 displays an image based on a signal output from the image processing circuit 1206. The I/F circuit 1207 exchanges data with a device connected to the I/F circuit 1207. In Fig. 12, as the device to be connected to the I/F circuit 1207, the user interface 1208 and the display 1209 are illustrated. However, the device to be connected to the I/F circuit 1207 is not limited to these. For example, a portable storage medium may be connected to the I/F circuit 1207. Further, at least a part of the user interface 1208 and the display 1209 may be provided outside the identification device 400.

The output unit 415 is fabricated by using the communication circuit 1204, the signal processing circuit 1205, and at least any one of the image processing circuit 1206, the I/F circuit 1207, and the display 1209, for example.

[0152] Incidentally, the CPU 1201, the main memory 1202, the auxiliary memory 1203, the signal processing circuit 1205, the image processing circuit 1206, and the I/F circuit 1207 are connected to the bus 1210. Communication among these components is

performed via the bus 1210. Further, the hardware of the identification device 400 is not limited to the one illustrated in Fig. 12 as long as it can perform the previously-described functions of the identification device 400.

INDUSTRIAL APPLICABILITY

[0153] The present invention can be utilized for identifying an article, for example.

CLAIMS

[Claim 1] An identification device that identifies an article, the device comprising:

an image acquisition unit that acquires one or two or more captured images of a region including first information that is information displayed on the article;

a recognition unit that recognizes at least one piece of the first information based on a captured image acquired by the image acquisition unit;

a collation unit that collates at least partial information of first recognition information being the first information recognized by the recognition unit with first storage information being first information stored beforehand in a storage medium as one piece of storage information; and

a specification unit that specifies at least one candidate for the article based on a result of collation by the collation unit, wherein

the collation unit is able to collate recognition information, which is partly different from the first recognition information, with storage information stored beforehand in a storage medium as information corresponding to the recognition information.

[Claim 2] The identification device according to claim 1, wherein

the collation unit collates information that satisfies a condition for recognition accuracy among the first recognition information with information

corresponding to the information that satisfies the condition for recognition accuracy among the first storage information.

[Claim 3] The identification device according to claim 1 or 2, further comprising:

an information acquisition unit that acquires second information, which is information not displayed on the article, as second recognition information, wherein

second storage information, which is the second information, is stored beforehand in a storage medium in association with the first storage information as storage information, and

the collation unit collates second recognition information acquired by the information acquisition unit with the second storage information.

[Claim 4] The identification device according to claim 3, wherein

the second information includes at least one of a position in article, which is the position of information displayed on the article based on a predetermined position of the article; a weight of the article; a size of the article; a storage space position, which is the position where the article is placed; and a registration time, which is the time when the article was placed at a current position.

[Claim 5] The identification device according to any one of claims 1 to 4, wherein

a captured image of a region including the first

information is stored beforehand in a storage medium in association with the first storage information as storage information, and

the collation unit collates at least a partial region of the captured image acquired by the image acquisition unit with at least a partial region of a captured image stored as the storage information.

[Claim 6] The identification device according to any one of claims 1 to 5, wherein

there are a plurality of pieces of the first information, and

the collation unit collates at least partial information of first recognition information being the first information that is not collated among the first information recognized by the recognition unit with first storage information being the not-collated first information that is stored beforehand in a storage medium as one piece of storage information.

[Claim 7] An identification method that identifies an article, the method comprising:

an image acquisition step that acquires one or two or more captured images of a region including first information that is information displayed on the article;

a recognition step that recognizes at least one piece of the first information based on a captured image acquired by the image acquisition step;

a collation step that collates at least partial information of first recognition information being

the first information recognized by the recognition step with first storage information being the first information stored beforehand in a storage medium as one piece of storage information; and

a specification step that specifies at least one candidate for the article based on a result of collation by the collation step, wherein

the collation step is able to collate recognition information, which is partly different from the first recognition information, with storage information stored beforehand in a storage medium as information corresponding to the recognition information.

[Claim 8] A program causing a computer to execute pieces of processing intended for identifying an article, the program comprising:

an image acquisition step that acquires one or two or more captured images of a region including first information that is information displayed on the article;

a recognition step that recognizes at least one piece of the first information based on a captured image acquired by the image acquisition step;

a collation step that collates at least partial information of first recognition information being the first information recognized by the recognition step with first storage information being the first information stored beforehand in a storage medium as one piece of storage information; and

a specification step that specifies at least one

candidate for the article based on a result of collation by the collation step, wherein

the collation step is able to collate recognition information, which is partly different from the first recognition information, with storage information stored beforehand in a storage medium as information corresponding to the recognition information.