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(54) **Work piece processing system**

(57) The present invention provides a work piece processing system capable of classifying and accumulating machined products based on their objects, efficiently accumulating them in a limited area, and simply creating a relevant control programs. A work piece processing system comprises a work piece machining device 1, a transfer device 2, a control device 3, and an automatic programming device 4. The automatic programming device 4 generates a machining program 13 and a classification and accumulation program 15 based on product shape information 7a and classification information 9.

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Description

Field of the Invention

[0001] The present invention relates to a work piece machining and accumulation device for using a work piece machining device such as a punch press machine or a laser machining device to cut products out from a work piece such as sheet metal or the like and classifying and loading the cut products in an accumulation area.

Background of the Invention

[0002] As techniques for cutting products out from a work piece and machining and accumulating them, the following have been put to practical use:

(a) After machining has been finished, a picking device picks up a product and classifies and loads it in classification boxes.
(b) After machining has been finished, the position relationship in the arrangement of products existing during blanking is reproduced on an accumulation side before accumulation.

[0003] In the method of classifying and loading products in classification boxes in (a), a large number of classification boxes must be arranged if there are many types of products. Consequently, the occupied area of an accumulation area increases, so this method is actually infeasible. In addition, it cannot flexibly deal with a change in the classification method. In the method of reproducing the arrangement existing during blanking, on the accumulation side before accumulation in (b), classification must be carried out at the post-process according to their types or delivery dates.

[0004] In addition, creation of an automatic operation program involves the following problems. That is, when creating a machining program for controlling a work piece machining device or a classification and accumulation program for allowing a transfer device to classify and accumulate products, inconsistency, if any, between classification information and the specification of the transfer device or general production limitations or requirements such as high yields or low costs must be corrected to within a predetermined level. In this case, in classifying products into classification boxes (or pallets), the contents of processing such as the inconsistency correction must be manually determined before directly inputting to an automatic programing device, information required by the classification and accumulation program (for example, classification box numbers). As a result, the manual determination of the contents of the inconsistency correction and the information input operation require a large amount of time and labor.

[0005] An object of the present invention is to provide a work piece processing system capable of classifying and accumulating machined products based on their objects, efficiently accumulating them in a limited area, and simply creating a relevant control programs.

Summary of the Invention

[0006] A configuration of the present invention will be described with reference to Figure 1 corresponding to an embodiment. This work piece processing system comprises a work piece machining device (1) for cutting products (M) out from a material work piece (W), a transfer device (2) for transferring the products (M) from the work piece machining device (1) to arbitrary positions in an accumulation area (E), a control device (3) for program-controlling the work piece machining device (1) and the transfer device (2), and an automatic programming device (4).

[0007] The automatic programming device (4) generates as a program to be executed by the control device (3), a machining program (13) for allowing the work piece machining device (1) to cut a work piece (W), based on predetermined information including shape information (7a) for the products (M) and classification information (9) indicating a product arrangement form on the accumulation area (3), and a classification and accumulation program (15) for allowing the transfer device (2) to pick up the machined product (M) and to carry out classification corresponding to the classification information (9) in order to accumulate the product in the accumulation area (e).

[0008] According to this configuration, the automatic programing device (1) generates the machining program (13) and the classification and accumulation program (15) from the predetermined information including the shape information (7a) and classification information (9) for the set products (M). Based on the generated machining program (13), the work piece machining device (1) cuts the products (M) out from the material work piece (W) according to control provided by the control device (3). The transfer device (2) picks up the machined product (M) according to the classification and accumulation program (15), and carries out classification corresponding to the classification information (9) in order to accumulate the product at a predetermined position in the accumulation area (E). Thus, the products (M) can be classified and accumulated irrespective of the blanking of the products (M) of the material work piece (W). In addition, since the shape information (7a) and classification information (9) for the products (M) is used to generate the machining program (13) and the classification and accumulation program (14) beforehand, blanking and machining suitable for classification can be carried out to enable an efficient process from machining to classification and accumulation.

[0009] Furthermore, this work piece processing system can correct to within a predetermined level,

inconsistency, if any, between the classification information (9) and the specification of the transfer device (2) or general production limitations or requirements such as high yields or low costs. The system can then reflect the resulting machining sequence and classification destinations in the machining program (13) and the classification and accumulation program (14). It can also create these programs (13), (14) easily.

[0010] According to the present invention, the classification information (9) may include classification type information (9a) indicating one of a plurality of classification types including loading by delivery date, loading by process, loading as blanked, space-saving loading, loading by product, and arbitrary loading, and the automatic programming device (1) may have an accumulation area blanking means (42) for determining the location of each product (M) relative to a predetermined accumulation area (E) according to a predetermined blanking rule (45), based on the classification type information (9a) and the product shape information (7a).

[0011] In this manner, the accumulation area blanking device (42) is provided in the automatic programming device (1) to determine the accumulation position of each product (M) according to the predetermined blanking rule (45) based on the classification type information (9a) and the product shape information (7a). Consequently, the classification and accumulation program (15) is generated so as to efficiently carry out various loadings such as loading by delivery date, loading by process, loading as blanked, space-saving loading, loading by product, and arbitrary loading, thereby enabling more efficient accumulation.

[0012] According to the present invention, the transfer device (2) may comprise a running body (27) capable of running between the work piece machining device (1) and the accumulation area (E) for products (M) and having a plurality of suction pads (35) for sucking products (M) and a pad range varying means (37) for varying the arrangement range of the plurality of suction pads (35), and may include as the predetermined information for generating the machining program (13) and the classification and accumulation program (14), specification information (10) for the transfer device (2) including the pad range varying means (37).

[0013] In this manner, by varying the arrangement range of the suction pads (35) of the transfer device (2), the interference between the work piece machining device (1) and the transfer device (2) is avoided to enable products of various shapes and sizes to be sucked, thereby eliminating limitations on the shape and size of products (M) that can be handled by the transfer device (2). In addition, the specification information (10) for the transfer device (2) including the pad range varying means (37) is included as the predetermined information for generating the machining program (13) and the classification and accumulation program (14), enabling the arrangement range of the suction pads (35) to be appropriately changed for each product (M) while enabling the machining program (13) to be generated according to the limited range based on the specification of the transfer device (2).

Brief Description of the Drawing

[0014]

Figure 1 is a block diagram showing a conceptual configuration of one embodiment of the present invention.

Figure 2 is a top view showing a work piece machining device and a transfer device according to the embodiment of the present invention.

Figure 3 is a front view showing the work piece machining device and the transfer device.

Figure 4 is an explanatory drawing of automatic work piece blanking and automatic area blanking.

Figure 5 is a flowchart of a mechanical operation.

Figure 6 is a perspective view showing various classification methods.

Figure 7 is a block diagram showing part of a conceptual configuration of another embodiment according to the present invention.

Figure 8 is a block diagram showing part of a conceptual configuration of yet another embodiment according to the present invention.

Figure 9 is an explanatory drawing of a process for creating a unit-oriented program according to the present invention.

Detailed Description of the Preferred Embodiments

[0015] One embodiment of the present invention will be described with reference to Figures 1 through 6. First, this device is explained in brief. This work piece machining and accumulation device comprises a work piece machining device 1 such as a punch press machine or a laser machining device, a work piece storage device 5, a transfer device 2, a control device 3 for controlling the work piece machining device 1 and the transfer device 2, and an automatic programming device 4. In this configuration, the work piece machining device 1 cuts out products M, and the transfer device 2 then picks up the product and classifies and accumulates it at a predetermined position in an accumulation area E.

[0016] Figure 6 shows various examples of classification during accumulation. Figure 6A shows an example of loading as blanked in which the products are arranged as blanked relative to the work piece. Figure 6B shows an example of loading by product in which the products M are arranged by grouping them based on their types. Figure 6C shows an example of loading by subsequent step in which the products are arranged in groups corresponding to the respective subsequent steps. In the illustrated example, the subsequent steps are a bending step and a coating step, and the products

are placed in different classification boxes B for the corresponding steps. In addition, if only the bending step is subsequently carried out, smaller and larger products are placed in different classification boxes, or if only the coating step is subsequently carried out, the products M are placed in different classification boxes B for the respective coating colors. Figure 6D shows an example of loading by order in which the products are arranged in groups corresponding to the respective orders and in which different classification boxes B are used for the respective orders. Figure 6E shows an example of loading by delivery date in which the products are arranged in groups corresponding to the respective delivery dates and in which different classification boxes B are used for the respective delivery dates. If the plurality of classification boxes B are used as in Figures 6C to 6E, the accumulation area E (Figure 1) is divided into partitioned classification areas E1, E2 corresponding to the classification boxes B.

[0017] This work piece processing system can use the following techniques for these classification methods.

(a) Classification based on loading by product

[0018] The automatic programming device 1 sets automatic nesting for the accumulation area E so that the same machined products M are automatically accumulated in the limited accumulation area E irrespective of blanking for the material work W.

(b) Classification by other objects

[0019] Object-based classification codes attached to the corresponding products M are translated into accumulation position data (XY address) for each of the partitioned accumulation areas E1, E2 so that the products are accumulated in classification boxes B provided for the respective delivery dates.

[0020] The automatic programming device 1 acts as a program creation means for automatically generating a machining program 13 and a transfer program 14 based on product information 7, material information 13, classification information 9, and transfer device specification information 10 set in an information setting means 6. The automatic programming device 1 is composed of a computer device comprising a display means such as a CRT and an input means such as a keyboard or a pointing device. The information setting means 6 stores each information and may be provided as part of the automatic programming device 1 or separately from it. The transfer program 14 includes a load program (not shown in the drawings) for loading a work in the work piece machining device 1 and a classification and accumulation program 15 for transferring the products M. In this example, the automatic programing device 4 is composed of part of a CAD/CAM device. The automatic programming device 4 comprises a machining program generation section 18 and an accumulation program generation section 19.

[0021] The control device 3 is composed of a computer device separate from the automatic programming device 4, and comprises a work piece machining device control means 20 and a transfer device control means 21 for numerically controlling the work piece machining device 1 and the transfer device 2, respectively; and a synchronization control means 22 for allowing both control means 20, 21 to synchronize with each other for predetermined control. The control device 3 has annexed there to a manual instruction means 23 for instructing the transfer device 2 through annual operations.

[0022] The control device 4 uses the classification and accumulation program 15 in the transfer program 14 created by the automatic programing device 1 to pick up a product, and synchronously controls the work piece machining device 1 and the transfer device 2 to move the transfer device 2 to the home position 0 in the accumulation area E. Subsequently, the control device 4 references the corresponding product-based XY address relative to the accumulation area home position 0 to move the transfer device 2 at a low speed in order to accumulate the product M.

[0023] The details of each configuration and its processing and operations are described below.

[0024] As shown in Figures 2 and 3, the work piece machining device 1 cuts, on a table 1a, the products M out from the work piece W used as a material and in this example, comprises a turret-type punch press machine. P denotes a machining position (a punch position).

[0025] The work piece storage device 5 comprises the accumulation area E for the products M, a material accumulation area 24, and a residual material accumulation area 25 arranged in a line. The area E, 24, 25 are each composed of a top surface of a pallet capable of moving in the arrangement direction of these areas, wherein the pallet is stopped at a predetermined position. The arrangement direction (Y-axis direction) of the areas E, 24, 25 is orthogonal with the direction in which the work piece machining device 1 and the work piece storage device 5 are arranged (X-axis direction). An auxiliary table 33 is installed between the work piece machining device 1 and the work piece storage device 5.

[0026] The transfer device 2 is a means for picking the product M machined by the work piece machining device 1 and transferring it to the accumulation area E for classification, and is used as both a means for loading the material work piece W in the work piece machining device 1 from the material loading area 24 of the work piece storage device 5 and a means for unloading to the residual material accumulation area 25, a skeleton-like residual material resulting from cutting-out of the products M by the work piece machining device 1.

[0027] The transfer device 2 is composed of a rail-like movable table 26 provided like an erected rail

extending in the arrangement direction (X-axis direction) of the work piece machining device 1 and the work piece storage device 5 and that can be moved in a direction orthogonal with this arrangement direction; a running body 27 installed on the rail-like movable table 26 so as to run in the longitudinal direction of the table 26 (X-axis direction); and a work piece gripping means 28 installed on the running body so as to rise and fall. Thus, the work piece gripping means 28 can be moved in three axial directions that are orthogonal with one another. Movement of the rail-like movable table 26, running of the running body 27, and rising and falling of the work piece gripping means 28 are executed by driving provided by servo motors 29, 30, 31 (Figure 3) for the respective axes. The rail-like movable table 26 is installed on rails 32 along the respective sides of the work piece storage device 5 so as to move over the work piece storage device 5, and extends to above the work piece machining device 1 like a cantilever.

[0028] The work piece gripping means 28 comprises a plurality of suction pads 35 attached on a gripping mean frame 36, and has a gripper (not shown in the drawings) for gripping a residual material as required. The gripping means frame 26 has a main frame 36a located at the center and a pair of movable frames 36b provided on the respective sides of the main frame 36a so that the movable frames 36b leaves and approaches the main frame 36a to vary the arrangement range of the plurality of suction pads 30 in the running direction.

The movable frames 36b and a drive means (not shown in the drawings) such as a cylinder device for moving the movable frames 36b constitute a pad range varying means 37. The maximum extension of the work piece gripping means 28 is shown by the solid line in Figure 2, while its minimum extension is shown by the chain line in the same figure.

[0029] Each suction pad 35 sucks a work piece in vacuum, and is connected through a pipe to a negative pressure generation means (not shown in the drawings) such as a vacuum pump. One or more of the plurality of suction pads 35 are each composed of a group of pads comprising a large number of small suction pads 35a as shown in Figure 2 by enlarging part of this figure. Each small suction pad 35a is connected to the negative pressure generation means via a contraction means. Consequently, if the suction pad 35 consisting of the groups of pads is located in such a way that part of it is not in contact with the product M, it can suck the product M using only those small suction pads 35a that are opposed to the product M and without an suction error caused by the leakage of a negative pressure.

[0030] The machining program generation means 18 of the automatic programming device 4 has a material blanking means 38 and an NC data generation means 39, and a general blanking rule 40 and an accumulation-considered blanking rule 41 are provided for the material blanking means 39. The material blanking means 38 is a means for blanking each product M out from the material work piece W and carries out blanking according to the general blanking rule 40 or the accumulation-considered blanking rule 41. Based on the results of the blanking, the NC data generation means 39, for example, allots tools for punch pressing and sets relevant machining conditions according to a predetermined rule in order to finish the executable machining program 13.

[0031] The accumulation program generation means 19 has an accumulation area blanking means 42, a pad range determination means 43, and an NC data generation means 44, and a blanking rule 45 is provided for the accumulation area blanking means 42. The accumulation area blanking means 42 blanks each product M so as to correspond to the accumulation area E (or the partitioned accumulation areas E1, E2) according to the blanking rule 45. The pad range determination means 43 determines for each product M, the arrangement range of the suction pads 35 provided by the pad range varying means 37. The pad range determination means 43, for example, determines, for example, whether one or both of the movable frames 36b of the gripping means frame 36 are opened or both are closed. Based on the results of blanking executed so as to correspond to the accumulation area and the results of the determination made by the pad range determination section 43, the NC data generation means 44 finishes the transfer program 14 comprising executable NC data for moving the transfer device 2.

[0032] The product information 7 set by the information setting means 6 includes product shape information 7a and number of products per shape information 7b indicating the number of products M for each shape. The classification information 9 includes classification type information indicating the type of classification as shown in Figure 6; and information indicating how the accumulation area is set for each classification type, for example, whether the products are classified using the overall accumulation area as one accumulation area or the accumulation area E is divided into the plurality of partitioned accumulation areas E1, E2 for, for example, the respective classification boxes B so that the products can be classified into the partitioned accumulation areas E1, E2.

[0033] The product shape information 7a consists of, for example, developments obtained by subjecting to 3D expansion or surface synthesis, graphical data on work piece folded products designed by the CAD/CAM device constituting the automatic programming device 4, or consists of graphical data obtained by a CAD device separated from this CAD/CAM device. The product shape information 7a includes data on the external shapes of the products M and data on punched holes formed if the inside of the product is punched and on molded shapes.

[0034] The classification types included in the classification type information 9a include loading types such

as arbitrary loading, loading by delivery date, loading by process, loading as blanked, space-saving loading, loading by product, and loading by order. The space-saving loading is a method for loading the products in such a way as to minimize a space in the accumulation area E required by the products, without considering other purposes. The arbitrary loading is a method for loading the products in the accumulation area E without complying with a particular rule. The other loading types are as described above in Figure 6.

[0035] The product information 7 and the classification information 9 may be input to the automatic programming device 4 via a communication line such as a bus or a telephone line or via a storage medium.

[0036] Figure 4 shows two types of automatic blanking processing: blanking carried out by the material blanking means 38 in Figure 1 (automatic material blanking A) and blanking executed by the accumulation area blanking means 42 (automatic area blanking B).

[0037] The material blanking means 38 has the general blanking rule 40 and the accumulation-considered blanking rule 41 so that blanking can be carried out by considering classification during accumulation. The accumulation-considered blanking rule 41 includes rules set for the classification methods for the respective objects described above in Figure 6 (loading as blanked, loading by product, loading by subsequent process, loading by order, loading by delivery date) so that one of the classification method rules is adopted that corresponds to the classification type information 9a in the classification information 9. To the extent that the accumulation-considered blanking rule 41 is not violated, the plurality of products M are automatically blanked so as to maximize the yield relative to the material work piece W, according to the general blanking rule 38.

[0038] The accumulation area blanking means 42 automatically blanks each product M so as to correspond to the accumulation area E (E1, E2) according to the blanking rule 45 to generate the classification and accumulation program 15 corresponding to the results of the classification. The blanking rule 45 includes rules corresponding to the classification methods for the respective objects described above in Figure 6 (loading as blanked, loading by product, loading by subsequent process, loading by order, loading by delivery date) so that one of the rules is selected that corresponds to the classification type information 9a. In the selected classification method, the accumulation position of each product M is determined so as to minimize that area of the specified planar range constituting the accumulation area E in which no product M is placed. In the classification method for dividing the accumulation area E into the plurality of partitioned accumulation areas E1, E2, automatic blanking is carried out so as to minimize that area of each partitioned accumulation area E1, E2 in which no product M is placed.

[0039] In the classification and accumulation program 15 obtained as a result of automatic blanking, the accumulation position of each blanked product M is defined as an XY address relative to the accumulation area home position 0. If the accumulation area E is divided, the accumulation position of each product M is defined as an XY address relative to the accumulation area home position 01, 02 of the corresponding partitioned accumulation area E1, E2.

[0040] Figure 5 shows a mechanical operation controlled by the control device 3 in Figure 1. Based on the two types of NC data, that is, the machining program 13 obtained by the automatic programming device 1 and the transfer program 14 (including the classification and accumulation program 15), the control device 3 executes immediate processing to change NC data owned by itself in order to control the transfer device 2 and the work piece machining device 1.

[0041] A real time control item A indicates control based on the NC data (the machining program 13 in Figure 1) obtained through the automatic material blanking (A) described in Figure 4. The real time control item A allows the work piece machining device 1 to machine the product by externally shaping it and internally processing it by means of punching and then allows the transfer device 2 to pick up the product. If the picking fails, a reattempt is made by slightly shifting the picking position.

[0042] After the picking, the control device 3 controls the running body 27 of the transfer device 2 to move to the accumulation area home position 0 at a high speed. Once the transfer device has reached the accumulation area home position 0, control is provided based on a real time control item B. That is, the control device 3 moves the running body 27 at a low speed (for example, skip movement) to an accumulation position corresponding to the product M that is specified in the classification and accumulation program 15.

[0043] After this positioning, the work piece gripping means 28 of the running body 27 is lowered to accumulate the product M in the accumulation area E. At this point, an accumulation height control section (not shown in the drawings) provided in the control device 3 counts and updates an accumulation height each time one product is accumulated in each accumulation position, thereby controlling in real time, an accumulation height instruction for lowering the work piece gripping means 28 of the transfer device 2.

[0044] The accumulation operation performed if the accumulation area E is partitioned is principally the same as the accumulation operation performed if the accumulation area E is not partitioned except that the operation is performed for each of the partitioned accumulation areas E1, E2 as follows: After the product has been picked up, it is fed at a high speed to the home position 01, 02 of the corresponding accumulation area E1, E2, and is then moved at a low speed to the accumulation position specified by the classification and accumulation program 16. Partition specification data

described in the classification and accumulation program 15 is used to determine to which of the partitioned accumulation areas E1, E2 the product corresponds. The partition specification data is specified by the classification area information 9a in the classification information 9 input to the automatic programming device 1, or is generated according to the object classification code set for each product M, during blanking executed by the accumulation area blanking means 45. Accumulation position data for the inside of each partitioned accumulation area E1, E2 is processed using the same address data (XY address).

[0045] In the classification method for partitioning the accumulation area into the plurality of partitioned accumulation areas E1, E2, the accumulation area blanking means 19 may translate the object-based classification code provided for each product into specification data for the partitioned accumulation area E1, E2 and an XY address in this area E1, E2.

[0046] Although in this embodiment, the product information 7 and the classification information 9 are input to the automatic programming device 4, the material blanking information 45 and the product information 46 may be input to the automatic programming device 4A so that the automatic programming device 4A uses this input information to generate the machining program and the transfer program, as shown in Figure 7. In this case, the product information 46 includes delivery dates, subassembly unit names, product shapes, materials, and board thicknesses. The material blanking information 45 specifies blanking for each product M relative to the material work piece W. The material blanking information 45 and the product information 46 are set in the information setting means 6A. The information setting means 6A may constitute the automatic programming device 4A or may be provided separately from this device 4A. In this embodiment, those points that have not been particularly described are the same as in the embodiment explained in Figures 1 to 6.

[0047] In addition, in each of the above embodiments, the machining program 13 and the transfer program 14 are generated as independent programs. The automatic programming device, however, may generate as a unit-oriented program, a group of unit machining instructions 13a in the machining program 13 for machining a single product M and a group of unit transfer instructions 14a in the transfer program 14 for transferring a single product M in order to configure the machining program and the transfer program using sets of unit-oriented programs.

In this case, the machining program and the transfer program may constitute a single program.

[0048] Figure 8 shows an example of an automatic programming device that generates such a unit-oriented program, and Figure 9 shows a process for creating such a program. In this embodiment, those points that have not been particularly described are the same as in the embodiment explained in Figures 1 to 6.

[0049] In Figure 8, a unit-oriented program generation means 47 provided in the automatic programming device 3B automatically generates, based on the product shape information 7a (Figure 1), a unit-oriented program 48 that is an NC program for automatically blanking a single product M. The unit-oriented program 48 includes the work piece machining information and the pad range information from the pad range varying means 37. The work piece machining information and the pad range information are generated by a product-based machining program generation means 49 and a product-based pad range setting means 50 in the unit-oriented program generation means 47, respectively.

[0050] Figure 9 shows a process for creating the unit-oriented program 48. Based on the product shape information 7a, the product-based machining program generation means 49 (Figure 8) automatically arranges the tools as shown in step S1. The details of the processing in step S1 are omitted. The display means 16 (Figure 1) displays the results of this automatic tool arrangement so that an operator can check them (S2). After the check, the tool arrangement is manually modified if required. Subsequently, a pad range is specified. The pad range may be specified automatically by the unit-oriented program generation means 47 or manually. A product-based pad range setting means 50 in Figure 8 specifies the pad range in the unit-oriented program 48. In this manner, the unit-oriented program 48 for automatic blanking is completed. This unit-oriented program 48 is created for each product M and stored in a predetermined storage area.

[0051] The work piece processing system according to the present invention comprises the work piece machining device, the transfer device for transferring the products to the accumulation area, the control device for program-controlling the work piece machining device and the transfer device, and the automatic programming device, and the automatic programming device generates as a program to be executed by the control device, the machining program and the classification and accumulation program based on predetermined information including the shape information for the products and the classification information indicating the arrangement of the products on the accumulation area. Thus, this system can classify and accumulate the machined products based on their objects and efficiently accumulate them in the limited area, and can create the machining program and classification and accumulation program so as to operate efficiently. Besides, the machining program and the classification and accumulation program can be created easily.

[0052] If the classification information includes classification type information indicating one of a plurality of classification types including loading by delivery date, loading by process, loading as blanked, space-saving loading, loading by product, and arbitrary loading, and if the automatic programming device has an accumulation area blanking means for specifying the accumulation

position of each product relative to a predetermined accumulation area according to a predetermined blanking rule, based on the classification type information and the product shape information, then the classification and accumulation program can be generated so as to efficiently carry out loading depending on the various objects to achieve further efficient accumulation.

[0053] If the transfer device has a plurality of suction pads for sucking products and a pad range varying means for varying the arrangement range of the plurality of suction pads, and includes as the predetermined information for generating the machining program and the classification and accumulation program, transfer device specification information including the pad range varying means, then the arrangement range of the suction pads can be changed for each product and the machining program can be generated according to the limited range based on the transfer device specification.

Claims

1. A work piece processing system characterized in that the system comprises a work piece machining device for cutting products out from a material work piece, a transfer device for transferring the products from the work piece machining device to arbitrary positions in an accumulation area, a control device for program-controlling the work piece machining device and the transfer device, and an automatic programming device, said automatic programming device generating as a program to be executed by said control device, a machining program for allowing said work piece machining device to cut a work piece, based on predetermined information including shape information for the products and classification information indicating a product arrangement form on said accumulation area.

2. A work piece processing system as in Claim 1, characterized in that said automatic programing device generates a classification and accumulation program for allowing said transfer device to pick up a machined product and to carry out classification corresponding to said classification information in order to accumulate the product in said accumulation area.

3. A work piece processing system as in Claim 1 or Claim 2, characterized in that said classification information includes classification type information indicating one of a plurality of classification types including loading by delivery date, loading by process, loading as blanked, space-saving loading, loading by product, and arbitrary loading, and in that said automatic programming device has an accumulation area blanking means for specifying the location of each product relative to a predetermined accumulation area according to a predetermined blanking rule, based on the classification type information and the product shape information.

4. A work piece processing system as in anyone of Claims 1 to 3, characterized in that said transfer device comprises a running body capable of running between the work piece machining device and the product accumulation area and having a plurality of suction pads for sucking products and a pad range varying means for varying the arrangement range of the plurality of suction pads, and includes as said predetermined information for generating said machining program and said classification and accumulation program, transfer device specification information including the variable range provided by said pad range varying means.

FIG. 1

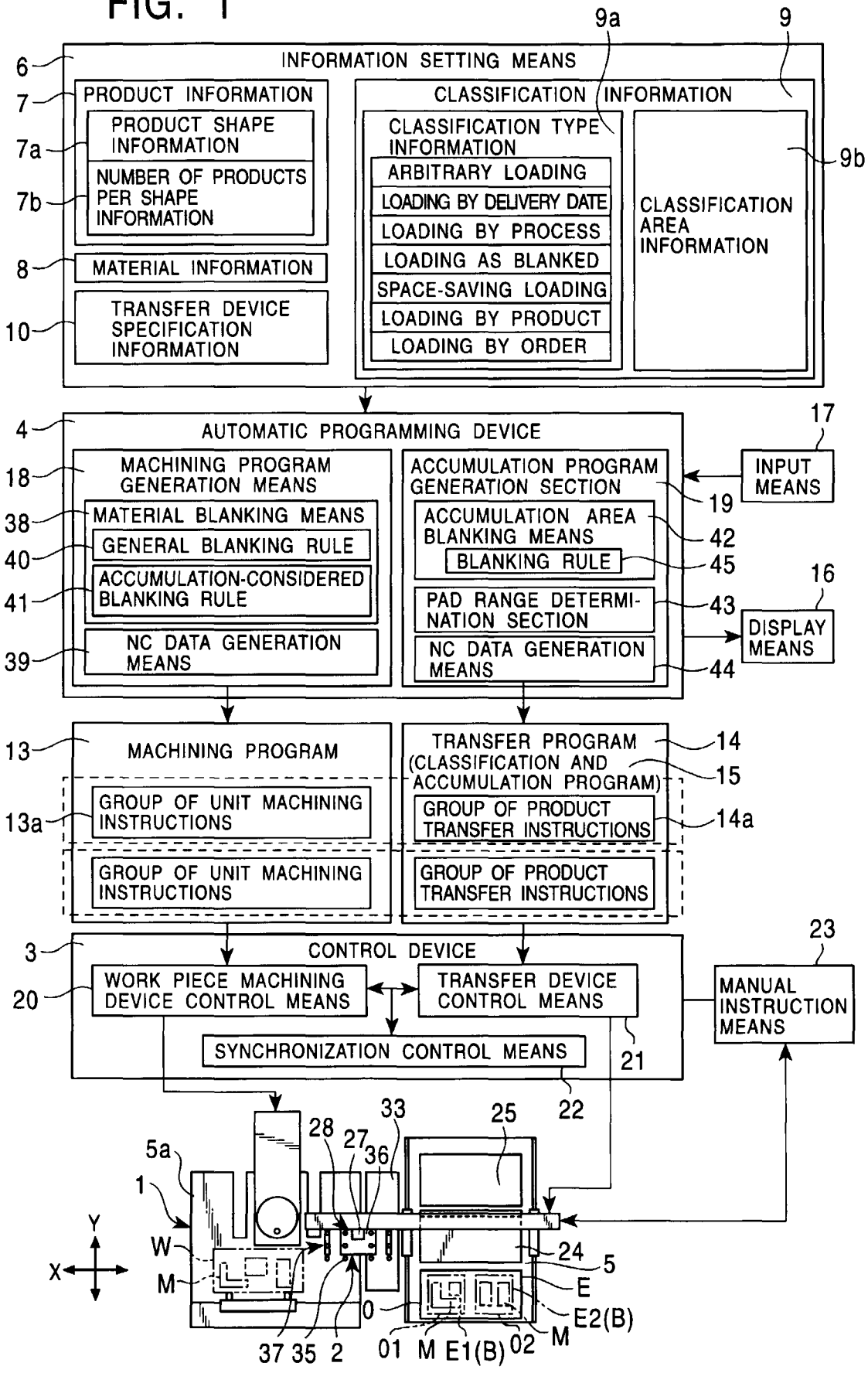

INFORMATION SETTING MEANS
PRODUCT INFORMATION
PRODUCT SHAPE INFORMATION
NUMBER OF PRODUCTS PER SHAPE INFORMATION
MATERIAL INFORMATION
TRANSFER DEVICE SPECIFICATION INFORMATION
CLASSIFICATION INFORMATION
CLASSIFICATION TYPE INFORMATION
ARBITRARY LOADING
LOADING BY DELIVERY DATE
LOADING BY PROCESS
LOADING AS BLANKED
SPACE-SAVING LOADING
LOADING BY PRODUCT
LOADING BY ORDER
CLASSIFICATION AREA INFORMATION
AUTOMATIC PROGRAMMING DEVICE
MACHINING PROGRAM GENERATION MEANS
MATERIAL BLANKING MEANS
GENERAL BLANKING RULE
ACCUMULATION-CONSIDERED BLANKING RULE
NC DATA GENERATION MEANS
ACCUMULATION PROGRAM GENERATION SECTION
ACCUMULATION AREA BLANKING MEANS
BLANKING RULE
PAD RANGE DETERMINATION SECTION
NC DATA GENERATION MEANS
INPUT MEANS
DISPLAY MEANS
MACHINING PROGRAM
GROUP OF UNIT MACHINING INSTRUCTIONS
GROUP OF UNIT MACHINING INSTRUCTIONS
TRANSFER PROGRAM (CLASSIFICATION AND ACCUMULATION PROGRAM)
GROUP OF PRODUCT TRANSFER INSTRUCTIONS
GROUP OF PRODUCT TRANSFER INSTRUCTIONS
CONTROL DEVICE
WORK PIECE MACHINING DEVICE CONTROL MEANS
TRANSFER DEVICE CONTROL MEANS
SYNCHRONIZATION CONTROL MEANS
MANUAL INSTRUCTION MEANS
Y
X
W
M
37 35 2
01 M E1(B) 02 M
E
E2(B)
24
5
0
6
7
7a
7b
8
10
9a
9
9b
4
18
38
40
41
39
17
19
42
45
43
44
16
13
13a
14
15
14a
3
20
21
22
23
5a
1
28
27
36
33
25

FIG. 2

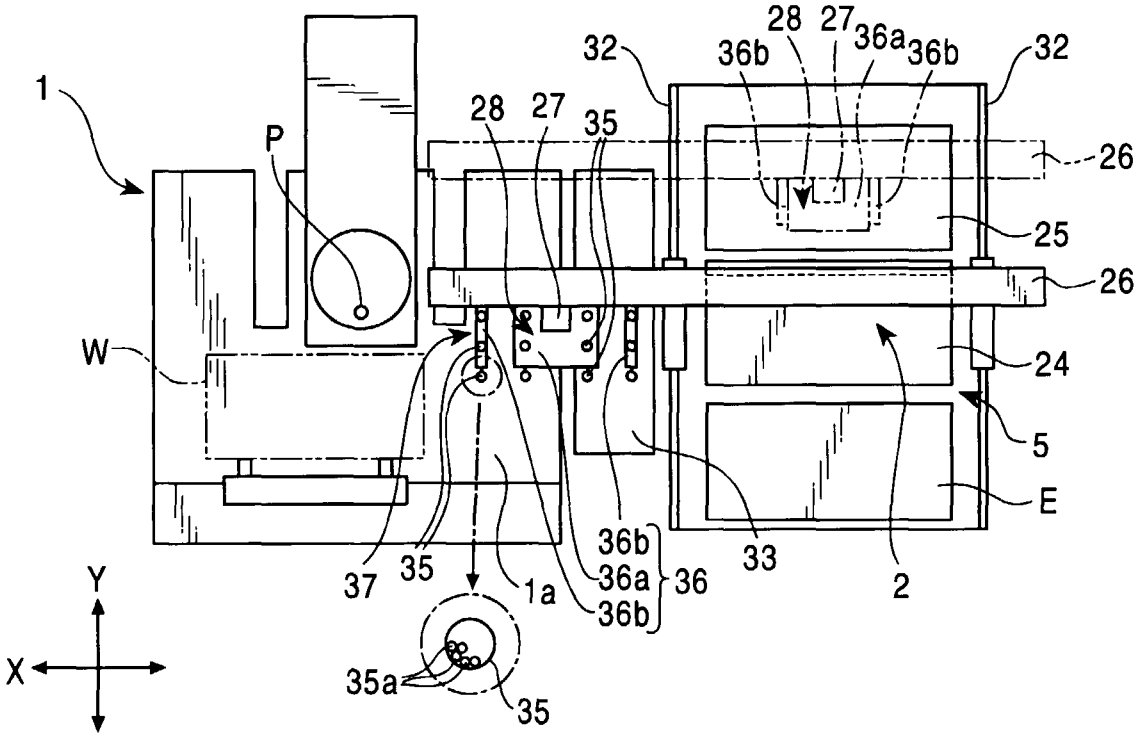

1
P
W
28
27
35
32
36b
28
27
36a
36b
32
26
25
26
24
5
E
33
2
36b
36a
36b
36
37
35
1a
35a
35
Y
X

FIG. 3

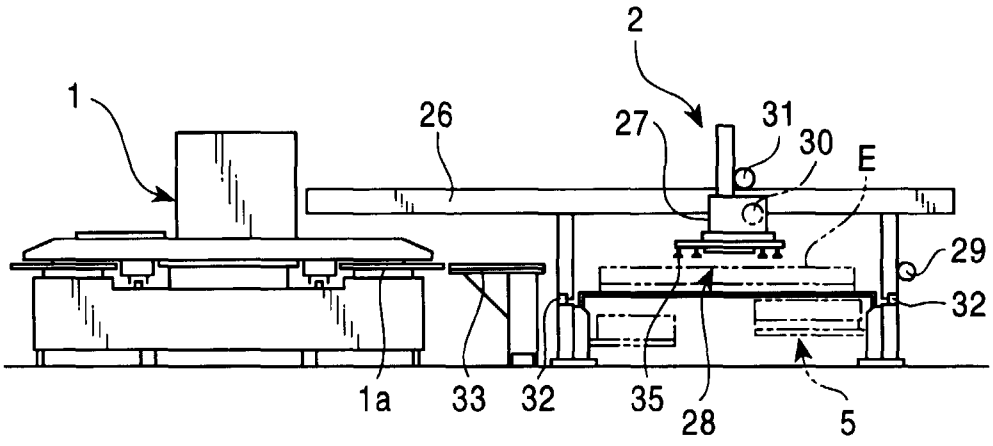

2
1
26
27
31
30
E
29
32
1a
33
32
35
28
5

FIG. 4

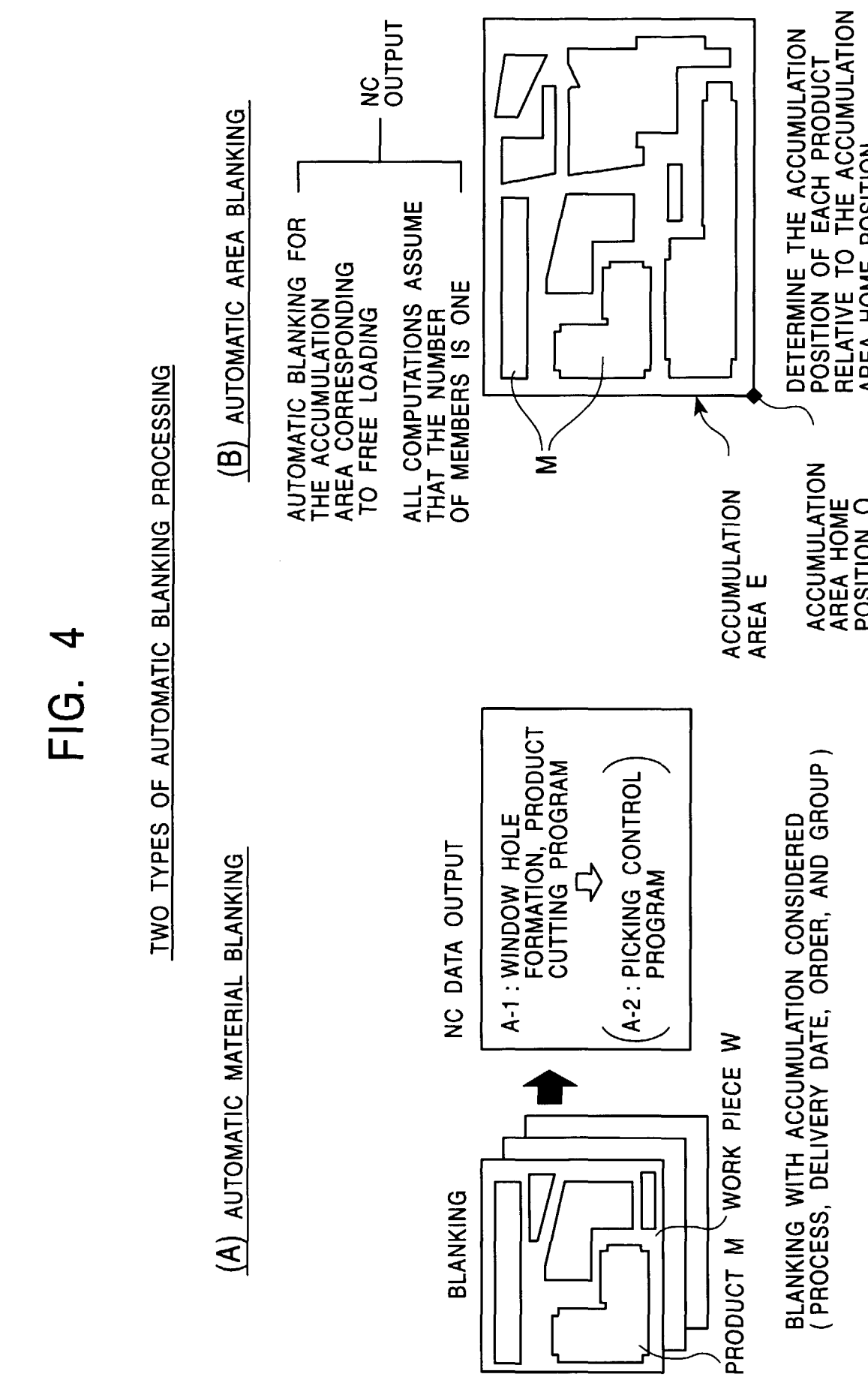

TWO TYPES OF AUTOMATIC BLANKING PROCESSING
(A) AUTOMATIC MATERIAL BLANKING
BLANKING
NC DATA OUTPUT
A-1 : WINDOW HOLE FORMATION, PRODUCT CUTTING PROGRAM
(A-2 : PICKING CONTROL PROGRAM)
PRODUCT M
WORK PIECE W
BLANKING WITH ACCUMULATION CONSIDERED
(PROCESS, DELIVERY DATE, ORDER, AND GROUP)
(B) AUTOMATIC AREA BLANKING
AUTOMATIC BLANKING FOR THE ACCUMULATION AREA CORRESPONDING TO FREE LOADING
NC OUTPUT
ALL COMPUTATIONS ASSUME THAT THE NUMBER OF MEMBERS IS ONE
M
ACCUMULATION AREA E
ACCUMULATION AREA HOME POSITION O
DETERMINE THE ACCUMULATION POSITION OF EACH PRODUCT RELATIVE TO THE ACCUMULATION AREA HOME POSITION

FIG. 5

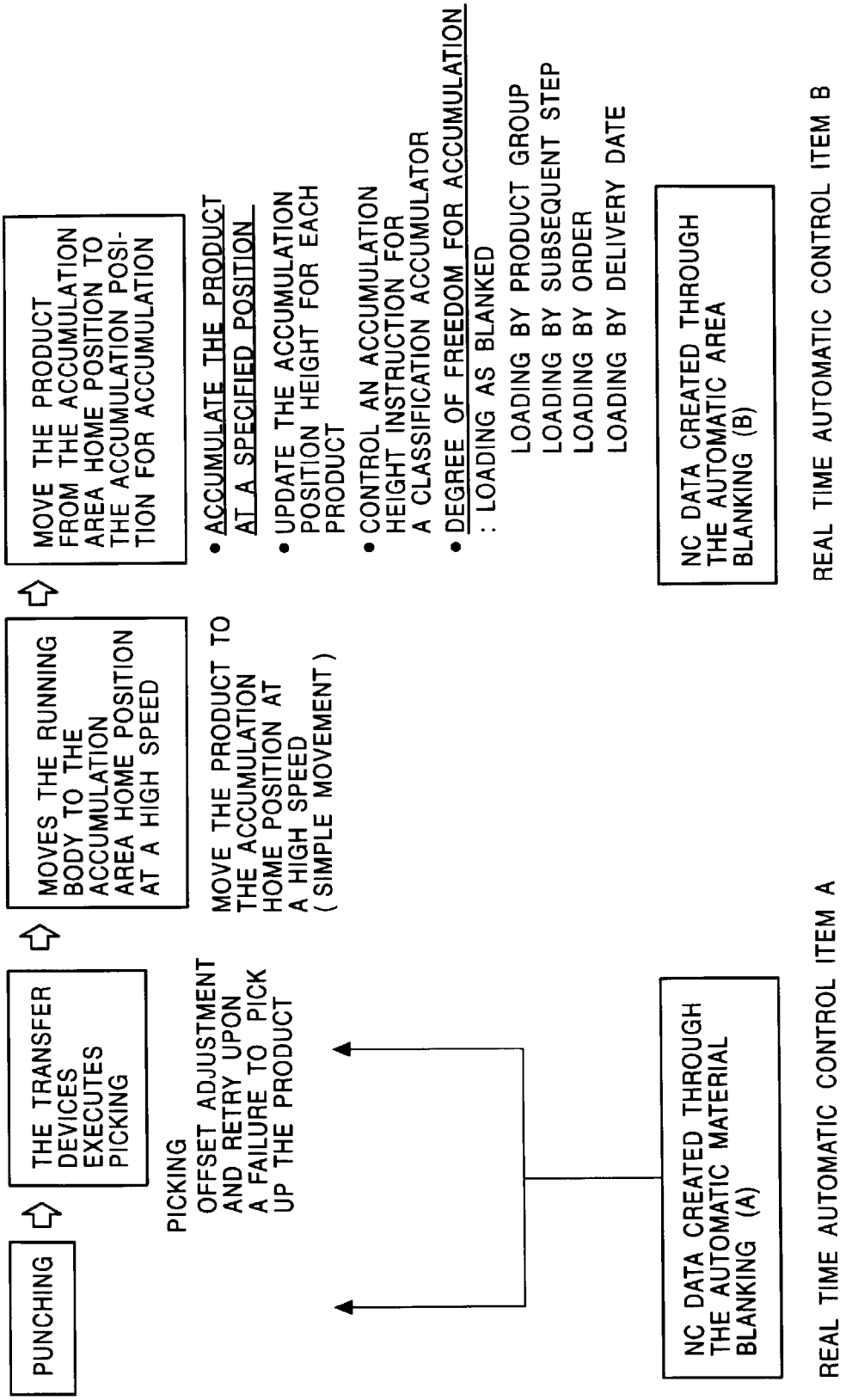
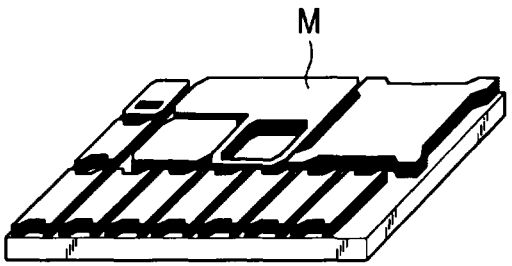

PUNCHING
THE TRANSFER DEVICES EXECUTES PICKING
PICKING
OFFSET ADJUSTMENT AND RETRY UPON A FAILURE TO PICK UP THE PRODUCT
MOVES THE RUNNING BODY TO THE ACCUMULATION AREA HOME POSITION AT A HIGH SPEED
MOVE THE PRODUCT TO THE ACCUMULATION HOME POSITION AT A HIGH SPEED (SIMPLE MOVEMENT)
MOVE THE PRODUCT FROM THE ACCUMULATION AREA HOME POSITION TO THE ACCUMULATION POSITION FOR ACCUMULATION
• ACCUMULATE THE PRODUCT AT A SPECIFIED POSITION
• UPDATE THE ACCUMULATION POSITION HEIGHT FOR EACH PRODUCT
• CONTROL AN ACCUMULATION HEIGHT INSTRUCTION FOR A CLASSIFICATION ACCUMULATOR
• DEGREE OF FREEDOM FOR ACCUMULATION
: LOADING AS BLANKED
LOADING BY PRODUCT GROUP
LOADING BY SUBSEQUENT STEP
LOADING BY ORDER
LOADING BY DELIVERY DATE
NC DATA CREATED THROUGH THE AUTOMATIC MATERIAL BLANKING (A)
NC DATA CREATED THROUGH THE AUTOMATIC AREA BLANKING (B)
REAL TIME AUTOMATIC CONTROL ITEM A
REAL TIME AUTOMATIC CONTROL ITEM B

FIG. 6A

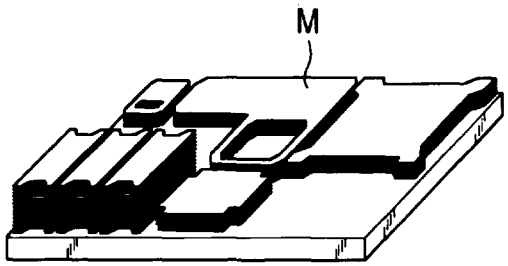
LOADING AS BLANKED



ARRANGED AS BLANKED AND NESTED

FIG. 6B

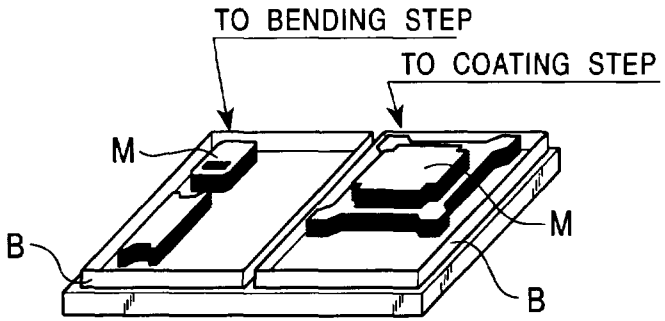
LOADING BY PRODUCT



ARRANGED IN GROUPS CORRESPONDING TO PRODUCT TYPES

FIG. 6C

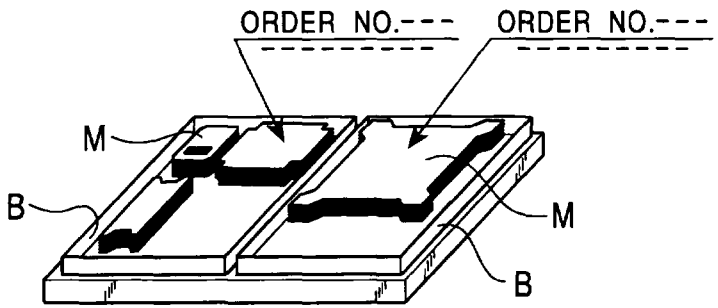
LOADING BY SUBSEQUENT STEP



ARRANGED IN GROUPS CORRESPONDING TO THE SUBSEQUENT STEPS SUCH AS BENDING AND COATING

FIG. 6D

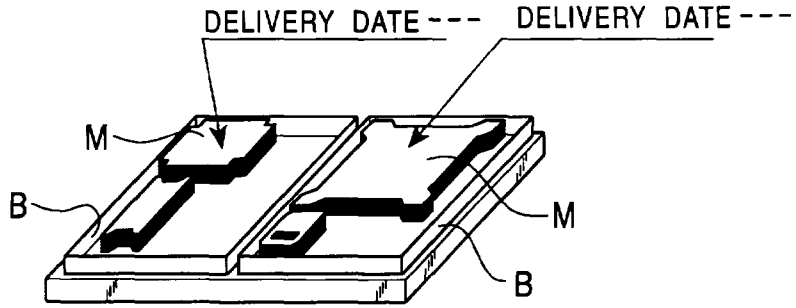
LOADING BY ORDER



ARRANGED IN GROUPS CORRESPONDING TO ORDERS

FIG. 6E

LOADING BY DELIVERY DATE



ARRANGED IN GROUPS CORRESPONDING TO DELIVERY DATES

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FIG. 7

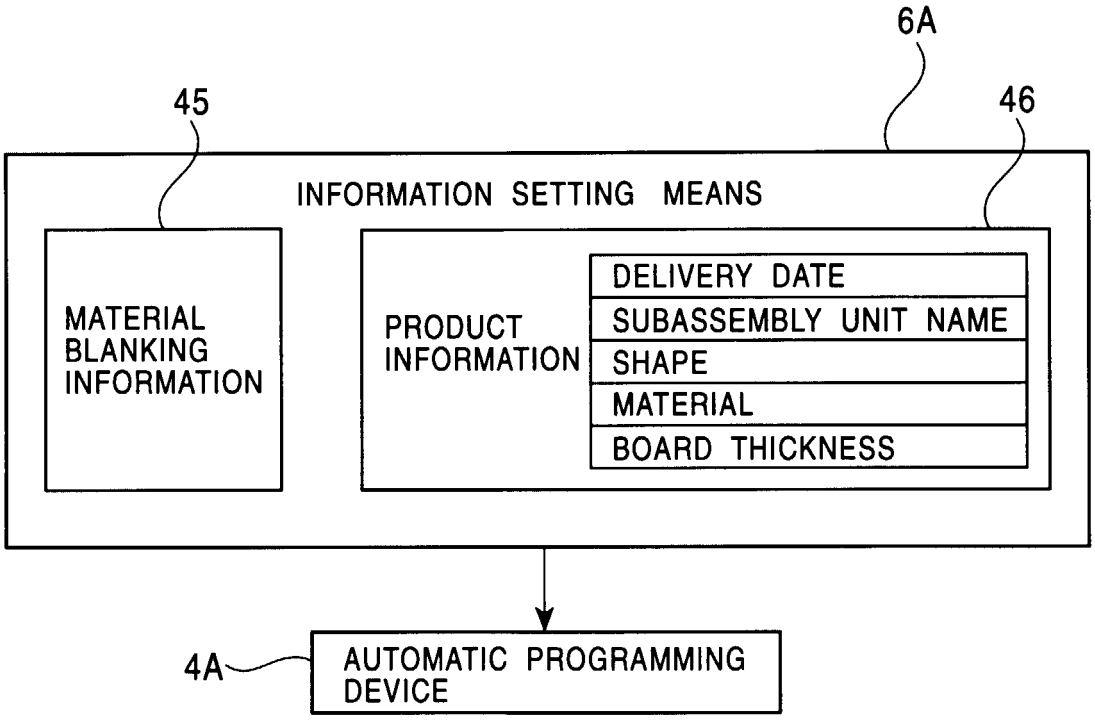

6A
45
46
INFORMATION SETTING MEANS
MATERIAL BLANKING INFORMATION
PRODUCT INFORMATION
DELIVERY DATE
SUBASSEMBLY UNIT NAME
SHAPE
MATERIAL
BOARD THICKNESS
4A
AUTOMATIC PROGRAMMING DEVICE

FIG. 8

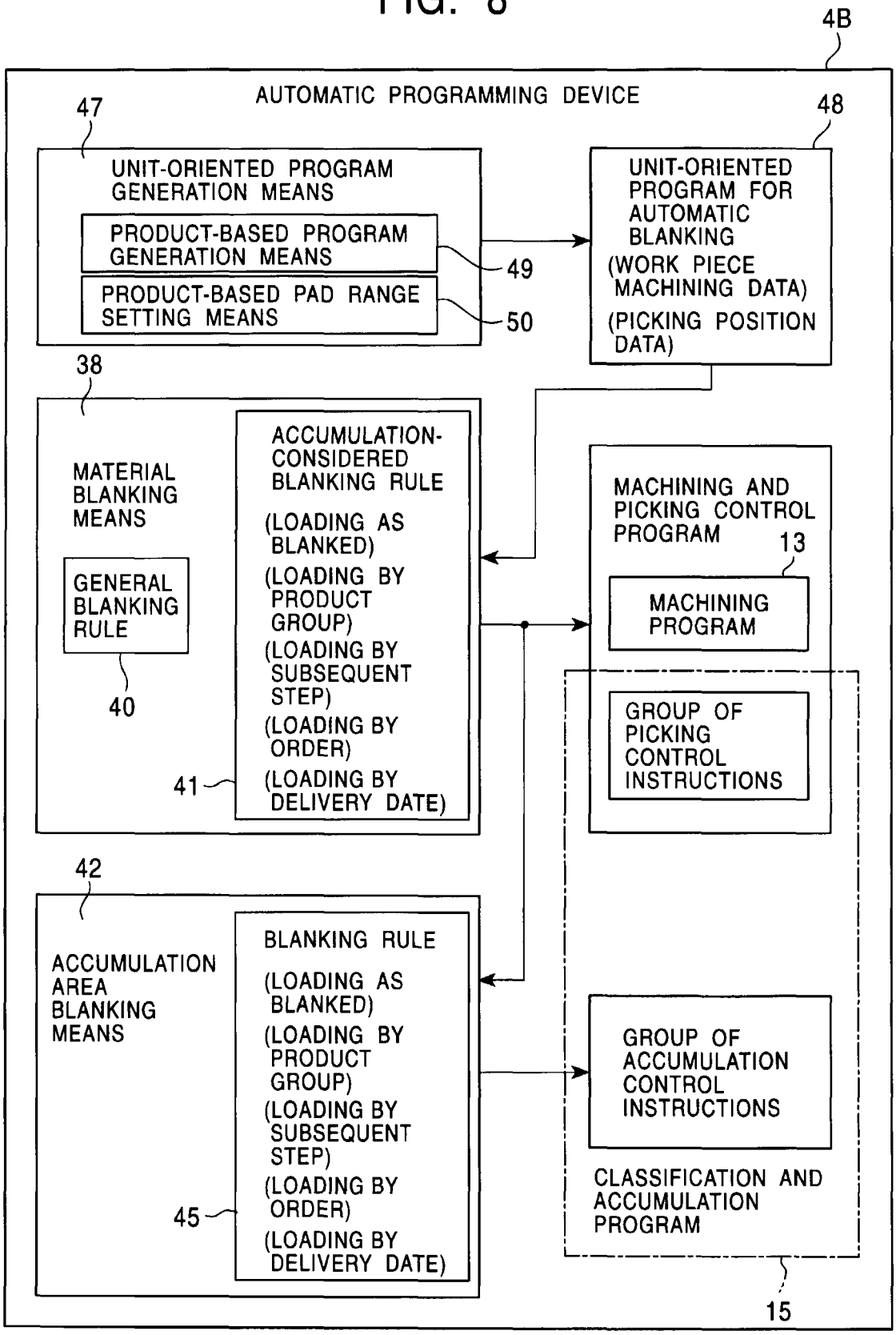
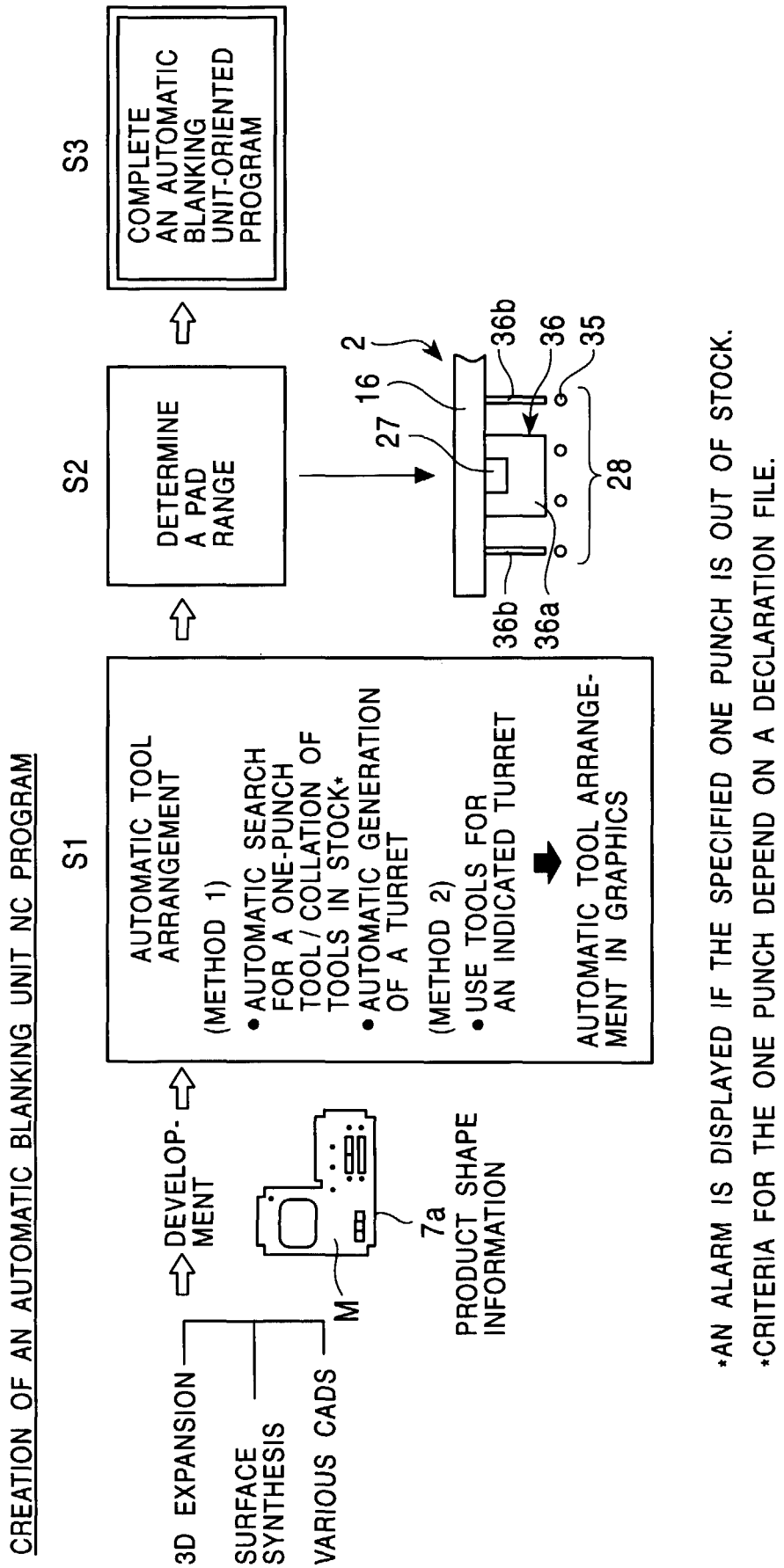

4B
AUTOMATIC PROGRAMMING DEVICE
47
UNIT-ORIENTED PROGRAM GENERATION MEANS
PRODUCT-BASED PROGRAM GENERATION MEANS
PRODUCT-BASED PAD RANGE SETTING MEANS
49
50
48
UNIT-ORIENTED PROGRAM FOR AUTOMATIC BLANKING
(WORK PIECE MACHINING DATA)
(PICKING POSITION DATA)
38
MATERIAL BLANKING MEANS
GENERAL BLANKING RULE
40
ACCUMULATION-CONSIDERED BLANKING RULE
(LOADING AS BLANKED)
(LOADING BY PRODUCT GROUP)
(LOADING BY SUBSEQUENT STEP)
(LOADING BY ORDER)
(LOADING BY DELIVERY DATE)
41
MACHINING AND PICKING CONTROL PROGRAM
13
MACHINING PROGRAM
GROUP OF PICKING CONTROL INSTRUCTIONS
42
ACCUMULATION AREA BLANKING MEANS
BLANKING RULE
(LOADING AS BLANKED)
(LOADING BY PRODUCT GROUP)
(LOADING BY SUBSEQUENT STEP)
(LOADING BY ORDER)
(LOADING BY DELIVERY DATE)
45
GROUP OF ACCUMULATION CONTROL INSTRUCTIONS
CLASSIFICATION AND ACCUMULATION PROGRAM
15

FIG. 9


CREATION OF AN AUTOMATIC BLANKING UNIT NC PROGRAM
S1
S2
S3
3D EXPANSION
SURFACE SYNTHESIS
VARIOUS CADS
DEVELOP-MENT
M
7a
PRODUCT SHAPE INFORMATION
AUTOMATIC TOOL ARRANGEMENT
(METHOD 1)
• AUTOMATIC SEARCH FOR A ONE-PUNCH TOOL / COLLATION OF TOOLS IN STOCK*
• AUTOMATIC GENERATION OF A TURRET
(METHOD 2)
• USE TOOLS FOR AN INDICATED TURRET
AUTOMATIC TOOL ARRANGE-MENT IN GRAPHICS
DETERMINE A PAD RANGE
COMPLETE AN AUTOMATIC BLANKING UNIT-ORIENTED PROGRAM
2
16
27
36b
36
35
28
36b
36a
*AN ALARM IS DISPLAYED IF THE SPECIFIED ONE PUNCH IS OUT OF STOCK.
*CRITERIA FOR THE ONE PUNCH DEPEND ON A DECLARATION FILE.