CLOTHING FOLDING MACHINE

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ABSTRACT
A garment folding apparatus according to the present invention includes a folding mechanism including a width direction folding section and a length direction folding section for folding a garment hung on a hanger in a horizontal direction and a vertical direction into a predetermined size. The width direction folding section includes a pair of clamps for picking two horizontal-direction ends of the garment hung on the hanger, and a pair of folding width determination sections. The clamps pivot while picking the garment so as to wrap the garment around the folding width determination sections and fold the garment along the folding width determination sections.
FIG. 1A
FIG. 1B
FIG. 8
FIG. 9
FIG. 17
FIG. 18
FIG. 21
FIG. 22
FIG. 30
FIG. 33
CLOTHING FOLDING MACHINE

TECHNICAL FIELD

[0001] The present invention relates to a garment folding apparatus capable of automatically folding garments.

BACKGROUND ART

[0002] Folding garments in households is listed as one of relatively stressful housekeeping works. Various electric and electronic housekeeping apparatuses have been developed and generally used, but no apparatus for automatically holding garments has been put to practical use. Therefore, people engaged in housekeeping strongly desire the development of an apparatus for alleviating the work of folding garments.

[0003] For industrial use, apparatuses for folding garments, especially shirts, for cleaning business are known. Patent Document No. 1 discloses an apparatus which works as follows. A garment is spread on a table with the front side up and with both side parts being hung down. Folding plates are slid to below the garment from both sides to fold the hung-down side parts of the garment. Patent Document No. 2 discloses an apparatus which works as follows. A garment is spread with the front side down on a table divided into three parts. Two side parts of the table are moved to above the garment to fold side parts of the garment. Such apparatuses are mainly used in the actual cleaning business practice.

[0004] However, an apparatus having such a structure needs to include a large working table on which the garment can be spread horizontally, which requires a large floor area. In addition, the work of spreading the garment on the table needs to be done manually and is inefficient.

[0005] By contrast, Patent Document No. 3 discloses an apparatus which works as follows in order to decrease the necessary floor area. A garment is hung on a sloped plate. Air is blown to both side parts of the garment to flap the side parts rearward. Then, folding plates are slid from both sides of the garment to the back thereof to fold the garment.

DISCLOSURE OF INVENTION

Problems to be Solved by the Invention

[0010] However, the garment folding apparatus disclosed in Patent Document No. 3 requires a device such as a compressor or the like for blowing air in order to flap the garment rearward.

[0011] For these reasons, the conventional garment folding apparatuses as disclosed in Patent Documents Nos. 1 through 3 require a wide installation area or a compressor which generates a large operation noise. Although being suitable for use in cleaning plants, such apparatuses are not suitable for use in households.

[0012] The present invention has an object of solving these problems of the conventional art and providing a garment folding apparatus suitable for use in households.

Means for Solving the Problems

[0013] A garment folding apparatus according to the present invention includes a folding mechanism for folding a garment hung on a hanger in a horizontal direction and a vertical direction into a predetermined size.

[0014] In one preferable embodiment, the garment folding apparatus moves a plurality of hangers each suspended from a hanging pole and having the garment hung thereon to a predetermined position sequentially, and folds the garment hung on each hanger by the folding mechanism.

[0015] In one preferable embodiment, the folding mechanism includes a width direction folding section and a length direction folding section.

[0016] In one preferable embodiment, the width direction folding section includes a pair of clamps for picking two horizontal-direction ends of the garment hung on the hanger, and a pair of folding width determination sections; and the clamps pivot while picking the garment so as to wrap the garment around the folding width determination sections and fold the garment along the folding width determination sections.

[0017] In one preferable embodiment, the pair of folding width determination sections each include an edge extending in the vertical direction for defining a position along which the garment is to be folded; and the pair of clamps each rotate around a vertical axis passing in the vicinity of the edge of the corresponding folding width determination section as the rotation center.

[0018] In one preferable embodiment, when the pair of clamps rotate while picking the two ends of the garment, the pair of clamps each move to a position which is above a pre-rotation position thereof by 1 cm or more.

[0019] In one preferable embodiment, the pair of clamps hold the garment hung on the hanger at positions at which the clamps do not interfere with the hanger.

[0020] In one preferable embodiment, the garment folding apparatus further includes a hanger folding section for instructing the hanger to be folded such that the garment can be pulled out from the hanger.

[0021] In one preferable embodiment, the width direction folding section further includes a hanger holder for holding the garment inside the pair of folding width determination sections.

[0022] In one preferable embodiment, the garment holder holds the garment so as not to interfere with the hanger when the hanger is folded.

[0023] In one preferable embodiment, the length direction folding section includes a folding length determination section having a horizontal rod connectable with the garment, and a folding-up section for folding a bottom part of the garment upward at a position of the folding length determination section.

[0024] In one preferable embodiment, the folding-up section approaches the garment from the opposite direction to the folding length determination section, passes below the folding length determination section, and then moves upward.

[0025] In one preferable embodiment, the folding-up section has a rotatable roller at a tip thereof, and an outer circumferential surface of the roller contacts the garment.
In one preferable embodiment, the width direction folding section includes a central holding section for holding a central part of the garment hung on the hanger, and a pair of outer holding sections for holding two horizontal-direction outer parts of the garment which are outer to the central part; and in the state where the central holding section and the outer holding sections hold the garment, the outer holding sections are bent toward the central holding section, and thus the garment is folded in the horizontal direction.

In one preferable embodiment, the central holding section includes a central supporting body having a recess and a projection on a surface facing the garment, and a central press for pressing the garment to a bottom of the recess; the outer holding sections each include an outer supporting body having a recess and a projection on a surface facing the garment, and an outer press for pressing the garment to a bottom of the recess; and in the state where the outer holding sections are bent toward the central holding section, the projection of each of the outer holding sections and the projection of the central holding section hold the garment therebetween.

In one preferable embodiment, the recess of the central holding section and the recess of each of the outer holding sections have a groove-like shape extending in the vertical direction, and the central press and the outer presses each have a comb teeth-like shape extending in the vertical direction.

In one preferable embodiment, the central holding section and the outer holding sections each have a plane contactable with the garment and a plurality of air suction holes provided in the plane.

In one preferable embodiment, the length direction folding section includes a folding length determination section including a bottom end of the central holding section or the outer holding sections, and a folding-up section for folding a bottom part of the garment upward at a position of the folding length determination section.

In one preferable embodiment, the garment folding apparatus further includes a stocker for storing the garment; and a transfer section for transferring the folded garment to the stocker.

In one preferable embodiment, the transfer section includes a supporting surface for keeping the folded garment in a generally vertical state, and inclines the supporting surface to and along the supporting surface and thus to drop the garment into the stocker.

In one preferable embodiment, the transfer section pulls out the supporting surface from below the garment in the state where a part of the inclined supporting surface in the vicinity of a tip thereof contacts a vertical wall of the stocker, and thus drops the garment into the stocker.

In one preferable embodiment, the transfer section moves to above the stocker in the state where the supporting surface is horizontal, takes away the supporting surface from below the garment, and thus drops the garment into the stocker while being kept horizontal.

In one preferable embodiment, the transfer section sequentially drops a plurality of garments vertically and stores the garments as standing vertically and being arranged in a line in the stocker.

In one preferable embodiment, the garment folding apparatus further includes a sensor for detecting a drying state of the garment hung on the hanger suspended from the hanging pole, wherein the folding mechanism operates based on a result of the detection of the sensor.

In one preferable embodiment, the garment folding apparatus further includes a first sensor for detecting a drying state of the garment hung on the hanger suspended from the hanging pole; and a communication section for transmitting a detection state of the sensor to an external communication device and receiving an instruction to fold the garment from the external communication device.

In one preferable embodiment, the garment folding apparatus includes a hanger moving section for moving the hanger along the hanging pole; a roof for covering the hanging pole; and a second sensor for detecting an amount of rainfall; wherein the hanger moving section moves the hanger to below the roof based on a result of the detection of the second sensor.

In one preferable embodiment, the folding mechanism further includes a vapor generation section for generating water vapor, wherein water vapor generated by the vapor generation section is sprayed toward the garment immediately before an operation of folding the garment.

A hanger according to the present invention includes a suspension section suspendable from a hanging pole; a pair of arms for supporting a garment; and a state switching section for transferring the arms from a horizontally opened state into a folded state; wherein at least a part of the state switching section is exposed outside in the state where the garment is hung on the hanger.

In one preferable embodiment, the pair of arms each include supporting sections for contacting and supporting the garment in the state where the arms are horizontally opened and a connecting section for connecting the supporting sections, the connecting section being located below the supporting sections; and the pair of arms are hung downward from the suspension section in the state of being folded.

In one preferable embodiment, the pair of arms each include a supporting section provided at a tip thereof and a connecting section adjacent to the tip.

In one preferable embodiment, the pair of arms each include a vertical section having an edge extending in a vertical direction; and a tip section rotatably supported by the vertical section so as to be in a horizontally extended state and a vertically hung state.

In one preferable embodiment, where the tip section is hung, the edge of the vertical section defines a folding position in a width direction of the garment hung on the hanger.

In one preferable embodiment, at least a part of the pair of arms has an extendable/contractable link structure, and the link structure is driven by moving the part of the arms and thus the arms are entirely contracted toward a center thereof.

EFFECTS OF THE INVENTION

A garment folding apparatus according to the present invention can fold a garment hung on a hanger. Therefore, the garment folding apparatus requires a smaller installation area than an apparatus for folding a garment spread horizontally. Since the garment folding apparatus can fold a garment hung on a hanger, a washed garment, when being dried, can be automatically transferred to the garment folding apparatus to be folded with no manual work.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1A is an isometric view generally showing a garment folding apparatus and a hanger in Embodiment 1 according to the present invention.
[0048] FIG. 1B is a side view schematically showing a structure of the garment folding apparatus in Embodiment 1.

[0049] FIG. 2 is an isometric view showing the hanger in Embodiment 1.

[0050] FIG. 3 is an isometric view showing a main part of the garment folding apparatus in Embodiment 1.

[0051] FIG. 4 is an isometric view showing a garment holder of the garment folding apparatus in Embodiment 1.

[0052] FIG. 5 is an isometric view showing a main part of the hanger in Embodiment 1.

[0053] FIG. 6 is an isometric view showing a main part of the hanger and the garment folding apparatus in Embodiment 1.

[0054] FIG. 7 is an isometric view showing an operation of the hanger and the garment folding apparatus in Embodiment 1.

[0055] FIG. 8 is an isometric view showing an operation of the hanger and the garment folding apparatus in Embodiment 1.

[0056] FIG. 9 is a front view showing a garment held by the hanger and the garment folding apparatus in Embodiment 1.

[0057] FIG. 10 is an isometric view showing an operation of the hanger and the garment folding apparatus in Embodiment 1.

[0058] FIG. 11 is an isometric view showing an operation of the hanger and the garment folding apparatus in Embodiment 1.

[0059] FIG. 12 is an isometric view showing an operation of the hanger and the garment folding apparatus in Embodiment 1.

[0060] FIG. 13 is an isometric view showing an operation of the hanger and the garment folding apparatus in Embodiment 1.

[0061] FIG. 14 is an isometric view showing an operation of the hanger and the garment folding apparatus in Embodiment 1.

[0062] FIG. 15 is an isometric view showing an operation of the hanger and the garment folding apparatus in Embodiment 1.

[0063] FIG. 16 is an isometric view showing an operation of the hanger and the garment folding apparatus in Embodiment 1.

[0064] FIG. 17 is an isometric view showing an operation of the hanger and the garment folding apparatus in Embodiment 1.

[0065] FIG. 18 is an isometric view showing an operation of the hanger and the garment folding apparatus in Embodiment 1.

[0066] FIG. 19 is a front view showing a characteristic structure of a garment folding apparatus and a hanger in Embodiment 2 according to the present invention.

[0067] FIG. 20 is a front view showing an operation of the hanger in Embodiment 2.

[0068] FIG. 21 is a front view showing a characteristic structure of a garment folding apparatus and a hanger in Embodiment 3 according to the present invention.

[0069] FIG. 22 is a front view showing an operation of the hanger and the garment folding apparatus in Embodiment 3.

[0070] FIG. 23 is a front view showing an operation of the hanger and the garment folding apparatus in Embodiment 3.

[0071] FIG. 24 is a front view showing an operation of the hanger in Embodiment 3.

[0072] FIG. 25 is an isometric view showing a characteristic structure of a garment folding apparatus and a hanger in Embodiment 4 according to the present invention.

[0073] FIG. 26 is an isometric view showing a structure of a width direction folding section of the garment folding apparatus in Embodiment 4.

[0074] FIG. 27 is an isometric view showing a structure of the hanger and the width direction folding section in Embodiment 4.

[0075] FIG. 28 is an isometric view showing an operation of the hanger and the garment folding apparatus in Embodiment 4.

[0076] FIG. 29A is a partial plan view showing an operation of the garment folding apparatus in Embodiment 4.

[0077] FIG. 29B is a partial plan view showing an operation of the garment folding apparatus in Embodiment 4.

[0078] FIG. 29C is a partial plan view showing an operation of the garment folding apparatus in Embodiment 4.

[0079] FIG. 30 is an isometric view showing an operation of the hanger and the garment folding apparatus in Embodiment 4.

[0080] FIG. 31A is a partial plan view showing an operation of the garment folding apparatus in Embodiment 4.

[0081] FIG. 31B is a partial plan view showing another structure of the garment folding apparatus in Embodiment 4.

[0082] FIG. 32A is a partial plan view showing still another structure of the garment folding apparatus in Embodiment 4.

[0083] FIG. 32B is a partial plan view showing the still another structure of the garment folding apparatus in Embodiment 4.

[0084] FIG. 33 is an isometric view generally showing another exemplary structure of the garment folding apparatus in Embodiment 4.

DESCRIPTION OF THE REFERENCE NUMERALS

[0085] 10 garment
[0086] 110 hanging pole
[0087] 121 hanger carrier
[0088] 200, 2200, 3200, 4200 hanger
[0089] 201h state switching section
[0090] 202, 203, 2202, 2203, 3202, 3203, 4202 arm
[0091] 202c, 202h, 203c, 203h connecting section
[0092] 400 folding section
[0093] 411, 412 clamp arm
[0094] 421, 422 folding width determination section
[0095] 430 base
[0096] 440 hanger folding section
[0097] 450 folding length determination section
[0098] 460 transfer section
[0099] 477, 478 sensor
[0100] 473 communication control section
[0101] 480 stocker
[0102] 490 case
[0103] 500 garment folding apparatus
[0104] 501 folding mechanism
[0105] 502 width direction folding section
[0106] 503 length direction folding section
[0107] 504 garment holder
[0108] 2203r state switching section
[0109] 3203r state switching section
[0110] 4430 garment supporting body
[0111] 4411, 4412 outer supporting body
[0112] 4400 central press
[0113] 4401, 4402 outer press
[0114] 4401r, 4402r comb teeth
[0115] 4430r, 4411r, 4412r plane
[0116] 4430h, 4411h, 4412h air suction hole
BEST MODE FOR CARRYING OUT THE INVENTION

Embodiment 1

[0117] Hereinafter, Embodiment 1 of a garment folding apparatus and a hanger used for the garment folding apparatus according to the present invention will be described. The garment folding apparatus according to the present invention is capable of folding a garment hung on a hanger. Therefore, the garment folding apparatus according to the present invention is capable of preferably folding a garment washed and then dried while being hung on a hanger and putting the garment into a stocker for storage. The present invention may be usable as a garment folding system including the garment folding apparatus and a hanger in combination.

[0118] FIG. 1A is an isometric view of a garment folding apparatus 500, and FIG. 1B is a schematic side view of the garment folding apparatus 500 showing elements of the garment folding apparatus 500.

[0119] As described below in detail, the garment folding apparatus 500 includes a folding mechanism 501 for folding a garment hung on a hanger into a predetermined size in a horizontal direction and a vertical direction. In this specification, the direction in which the garment is hung on a hanger due to the gravitational force is the vertical direction, and the direction perpendicular to the vertical direction is the horizontal direction. The vertical direction and the horizontal direction will also be respectively referred to as the “length direction” and the “width direction” of the garment hung on a hanger.

[0120] In this embodiment, the garment folding apparatus 500 includes a hanging pole 110 on which a washed garment is dried. The hanging pole 110 is kept at a predetermined height by a pole stand 101. A plurality of hanger carriers 121 are attached to the hanging pole 110, and a hanger 200 is suspended from each of the plurality of hanger carriers 121. As described below in detail, the hanger carriers 121 are movable in the directions of arrows 120A and 120B.

[0121] On the hanger 200 suspended from the hanging pole 110, a washed garment is hung to be dried. Therefore, the garment folding apparatus 500 is preferably installed outdoors. In the case where the garment folding apparatus 500 is installed outdoors, the folding mechanism 501 is preferably provided with a case 490 having a roof 490a in order to prevent the folded garment from being wetted by the rain or the like. The case 490 is located such that a part of the hanging pole 110 is covered by the roof 490a. The folding mechanism 501 is located inside the case 490.

[0122] The case 490 may accommodate a sensor 478 for detecting rainfall, a sensor for detecting a drying state of the garment, a driving section 472 for driving the folding mechanism 501, a control section 471 for controlling the folding mechanism 501, and a communication control section 473 for transmitting and receiving information with an external communication device. These elements will be described later in detail.

[0123] FIG. 2 is an isometric view showing the hanger carrier 121 attached to the hanging pole 110 and the hanger 200 suspended from hanger carrier 121.

[0124] The hanging pole 110 includes a rack 112 in an axial direction thereof. The hanger carrier 121 includes a bearing section 121m, a driving section 121d, a hole 121u, and a pinion gear (not shown). The bearing section 121m has a through-hole through which the hanging pole 110 may pass, and the hanging pole 110 is inserted through the through-hole so as to be movable in the directions of arrows 120A and 120B along the axial direction of the hanging pole 110. The pinion gear of the hanger carrier 121 is in engagement with the rack 112 of the hanging pole 110. Through the hole 121u, the hanger 200 may be suspended.

[0125] The driving section 121d drives and rotates the pinion gear in accordance with an instruction from the control section 471 of the garment folding apparatus 500. Therefore, the hanger carrier 121 is freely movable along the directions of arrows 120A and 120B (FIG. 1A) along the hanging pole 110. The rack 112 and the hanger carrier 121 form a hanger moving section.

[0126] The hanger 200 includes a main body 201, arms 202 and 203, a cover 204, and a hook 201/1. The arms 202 and 203 are rotatably supported by the main body 201. For hanging a garment 10, the arms are extended generally in the horizontal direction and fixed. Thus, the arms 202 and 203 support the garment 10 in the horizontal direction. The arm 202 includes supporting sections 202a, 202b, and 202c for supporting the garment 10 and connecting sections 202d and 202e for connecting the supporting sections. The connecting sections 202d and 202e are located below the supporting sections. Similarly, the arm 203 includes supporting sections 203a, 203b, and 203c for supporting the garment 10 and connecting sections 203d and 203e for connecting the supporting sections. The connecting sections 203d and 203e are located below the supporting sections.

[0127] The cover 204 protects the main body 201 from rain or the like. The hook 201/1 is attached to the main body. The hook 201/1 is hung in the hole 121u of the hanger carrier 121, so that the hanger 200 is suspended from the hanging pole 110 via the hanger carrier 121.

[0128] FIG. 3 is an isometric view showing the folding mechanism 501. The folding mechanism 501 includes a width direction folding section 502 and a length direction folding section 503.

[0129] The width direction folding section 502 includes clamps 411m and 412m, folding width determination section 421 and 422, and a garment holder 504.

[0130] The clamps 411m and 412m pinch both of two horizontal-direction ends of the garment 10 hung from the hanger 200. The folding width determination section 421 and 422 are located so as to be extendable in the vertical direction, and respectively include vertical edges 421e and 422e in outer parts thereof.

[0131] The clamp 411m is attached to a clamp arm 411 which is rotatable around an axis 411a vertically passing in the vicinity of the vertical edge 421e as the rotation center. The clamp 412n is attached to a clamp arm 412 which is rotatable around an axis 412a vertically passing in the vicinity of the vertical edge 422e as the rotation center.

[0132] The clamps 411m and 412m rotate around the axes 411a and 412a while picking the garment 10 such that the garment 10 is wrapped around the folding width determination sections 421 and 422, and thus fold the garment 10 along the vertical edges 421e and 422e of the folding width determination section 421 and 422.

[0133] The garment holder 504 holds the garment 10 in cooperation with the folding width determination section 421 and 422. FIG. 4 is an isometric view showing a structure of the garment holder 504. The garment holder 504 includes a base 430 and column-like projections 431, 432, 433, and 434 provided on the base 430. As shown in FIG. 3, the projections 431
and 433 hold the garment 10 in cooperation with the folding width determination section 421. The projections 432 and 434 hold the garment 10 in cooperation with the folding width determination section 422.

[0134] In order to prevent the hanger 200 from being caught or held together with the garment 10 when the clamps 411m and 412m pinch the garment 10 or when the garment holder 504 holds the garment 10, the connecting sections 202h, 203h, 202c and 203c are shaped to extend below the supporting sections 202a, 202b, 202e, 203a, 203b and 203e as shown in FIG. 2. In other words, the clamps 411m and 412m and the garment holder 504 hold the garment 10 without interfering with the hanger 200.

[0135] The base 430 includes cut-off parts 430w and 430b. When the hanger 200 or the holder 504 move in the state where the hanger 200 is folded, the hanger 200 passes through cut-off parts 430w and 430b without colliding against the holder 504. The length direction folding section 503 includes a folding length determination section 450 and a folding-up section 461. The folding length determination section 450 has a rod-like shape extended in the horizontal direction, and includes an edge 450e in a bottom part thereof. The folding-up section 461 has a plate-like shape, and includes an edge 461e in a top part thereof.

[0137] The folding-up section 461 is a part of a transfer section 460 for transferring the folded garment 10. Specifically, the folding-up section 461 has a bottom section 462 and sides 463 form the transfer section 460 having a rectangular space which is opened in a pair of sides facing each other and in the top. As described below in detail, the folding length determination section 450 and the folding-up section 461 cooperate with each other to fold the garment 10 in the vertical direction.

[0138] As described below in detail, these elements of the folding mechanism 501 can approach or retract from the garment 10 at an appropriate timing under the control of the control section 471. A driving mechanism for allowing the elements to approach, or retract from, the garment may be realized by a combination of known mechanical mechanisms or mechanical elements.

[0139] For example, a combination of clamp 411 and the folding width determination section 421, and a combination of the clamp 412m and the folding width determination section 422, may each be moved by a structure which rotates around a vertical axis (not shown) as the rotation center as if a leaf of a double door was closed, and approaches the garment hung on the hanger 200 and then is positioned.

[0140] The clamps 411m and 412m may be opened or closed by a component grasping mechanism of an industrial machine used for assembling components or an operation mechanism of a robot arm which has remarkably been advanced technologically in recent years.

[0141] The garment holder 504 may be moved along the hanging pole 110 by using an existing linear driving mechanism such as, for example, a rack pinion, a linear motor or a wire.

[0142] Now, a folding mechanism of the hanger 200 will be described. FIG. 5 and FIG. 6 are each an isometric view showing a structure of the main body 201 of the hanger 200 in detail. The arms 202 and 203 have the same shape, and respectively include a gear 202g and a projection 202i, and a gear 203g and a projection 203i, at an end thereof. The gears 202g and 203g each have a hole at the rotation center thereof and are respectively outserted on shafts 201a and 201c provided in the main body 201. By this structure, the arms 202 and 203 are rotatably supported by the main body 201.

[0143] The gears 202g and 203g are engaged with each other via the holes 201a of the main body 201, and thus the arms 202 and 203 rotate in association with each other. A rotation shaft 201c of the arm 203 is provided with a loading spring 205. One end of the loading spring 205 is hung on a spring hanger 211k and the other end thereof is hung on the arm 203. The arm 203 is loaded by the loading spring 205 in the direction of being folded from a horizontal state as represented with arrow 203f. Owing to the engagement of the gears 202g and 203g, the arm 202 is also loaded to rotate in the direction of arrow 202d.

[0144] When the arm 203 is raised to be close to a horizontal state, the projection 203f of the arm 203 is hung on a claw 211p provided to the main body 201, thus preventing the arm 203 from rotating the direction of arrow 203d. At this point, the arm 202 moving in association with the arm 203 owing to the gears 203g and 202g is also raised to be close to a horizontal state. Thus, the arms 202 and 203 are opened in almost the horizontal direction.

[0145] In this state, the garment 10 is hung on the hanger 200 and dried. The cover 204 represented with the dashed line protects the main body 201 and a connection section of the arms 202 and 203 from rain, and has a hole 204u.

[0146] A cam 440h at a tip of a hanger folding section 440 is inserted through the hole 204u into a space between the claw 211h and the main body 201. The cam 440h rotates to raise the claw 211h and thus to disengage the claw 211h from the projection 203f.

[0147] The arm 203 rotates in the direction of arrow 203d owing to the force of the loading spring 205, and the arm 202 moving in association with the arm 203 also rotates in the direction of arrow 203d. As a result, the arms 202 and 203 are both hung down to be in a folded state.

[0148] The claw 211h is a state switching member for transferring the hanger 200 to a transversely opened state to a folded state. The claw 211h is exposed outside even in the state where the garment 10 is hung on the hanger 200. This allows the hanger folding section 440 to enter the main body 201. In the case where the garment is a jacket, the claw 211h is preferably located so as to be seen from the nape thereof or the like.

[0149] Hereinafter, with reference to FIG. 1 and FIG. 7 through FIG. 18, an operation of the garment folding apparatus 500 will be described in detail.

[0150] First, the operator hangs each of washed garments 10 on a hanger 200 in the state where the arms 202 and 203 are opened as shown in FIG. 1A, and suspends each hanger 200 from a hanger carrier 121 provided on the hanging pole 110. Since the hanger carrier 121 is provided slidably on the hanging pole 110, the operator can set an interval between a plurality of garments 10 as desired.

[0151] After the operator finishes hanging an arbitrary number of garments 10 in this way, the garments 10 are dried by the heat of the sun as time passes like garments hung on a usual hanging pole. When the operator turns on the power (not shown) of the garment folding apparatus after finishing hanging the garments 10, the sensor 477 detects the drying state of the garment 10 closest to the folding mechanism 501 and keeps on transmitting the information on the drying state to the folding control section 471. As the sensor 477 for
detecting the drying state of the garment 10, a moisture meter using microwave or infrared ray is usable.

[0152] The sensor 477 outputs a signal corresponding to the drying state of the garment 10. When the garment 10 reaches a predetermined drying state and the sensor 477 outputs a signal of a value corresponding to the predetermined drying state, the control section 471 outputs an instruction to the driving section 472 to start a folding operation of the folding mechanism 501.

[0153] The hanger carrier 121 closest to the folding mechanism 501 moves in the direction of arrow 120A in a self-propelled manner into the case 490 and stops. In the case where the sensor 477 is located on the running path of the garment 10, the sensor 477 is rotated in the direction of arrow 477D as shown in FIG. 1A when the garment 10 approaches the sensor 477 such that the sensor 477 avoids colliding the garment 10. Then, the sensor 477 may be moved in the direction of arrow 477U to return to the original position thereof to detect the drying degree of the next garment 10.

[0154] Alternatively, the garment folding apparatus 500 may operate as follows assuming that all the garments 10 on the hanging pole 110 are in the same drying state. When the sensor 477 detects that the garment 10 closest to the folding mechanism 501 is dried, the garment folding apparatus 500 may start taking in all the garments 10. The sensor 477 may be located off the running path of the garments 10.

[0155] When the garment 10 of interest is moved to a predetermined position as shown in FIG. 7, the folding width determination sections 421 and 422 are moved downward from above in the direction of arrow 410D and stop at a predetermined position. Next, the hanger carrier 121 moves in the direction of arrow 120B in a self-propelled manner until the garment 10 is fit on the folding width determination sections 421 and 422. At the same time, the garment holder 504 moves in the direction of arrow 430B. The projections 431 and 433 pressure-contact the folding width determination section 421 via the garment 10, and the projections 432 and 433 pressure-contact the folding width determination section 422 via the garment 10. Thus, the garment 10 is held.

[0156] At this point, the hanger folding section 440 also moves in the direction of arrow 430B, and the cam 440B at the tip thereof goes into the main body 201 of the hanger 200. At this point, the hanger 200 may be fixed by being engaged with the cam 440B of the hanger folding section 440 which has moved together with the garment holder 504, in order to prevent the hanger 200 from moving unnecessarily.

[0157] Next, as shown in FIG. 8, the clamp arms 411 and 412 are moved downward in the direction of arrows 411D and 412D respectively along shafts 421d and 422d provided to the folding width determination sections 421 and 422. Then, the clamps 411m and 412m are closed to hold the left and right shoulders of the garment 10. As shown in FIG. 9, the garment 10 is held by the garment folding mechanism in this state at hatched areas 411J, 412J, 431J, 432J, 433J, and 434J.

[0158] Next, as shown in FIG. 10, the cam 440B at the tip of the hanger folding section 440 is rotated to cause the arms 202 and 203 to hang downward. Thus, the hanger 200 is put into a folded state.

[0159] Next, as shown in FIG. 11, the clamp arms 411 and 412 are respectively rotated at about 180 degrees around the vertical axes 411a and 412a as the rotation center in the directions of arrows 411L and 412L to rotate the left and right shoulders of the held garment 10 inwardly. By this operation, the garment 10 is bent so as to be wrapped around the folding width determination sections 412 and 422, and is folded inwardly along the vertical edges 412e and 422e of the folding width determination sections 412 and 422, which substantially match the vertical axes 411a and 412a. Thus, the folding operation of the garment 10 in the width direction is finished. Then, the folding length determination section 450 moves in the direction of arrow 450A and is set at a position in the vicinity of the garment 10 and below the folding width determination sections 421 and 422.

[0160] Next, as shown in FIG. 12, the transfer section 460 moves in the direction of arrow 460B toward the garment 10 i.e., from the opposite direction to the folding length determination section 450. The edge 461e of the folding-up section 461 passes below the edge 450e of the folding length determination section 450 while brushing the edge 450e. As shown in FIG. 13, the garment 10 is bent in an S shape between the folding length determination section 450 and the folding-up section 461.

[0161] Then, when the transfer section 460 moves upward in the direction of arrow 460U as shown in FIG. 12, a lower half of the garment 10 is folded upward along the edge 450e of the folding length determination section 450 while being rubbed by the edge 461e of the folding-up section 461. As shown in FIG. 14, when the bottom section 462 of the garment transfer section 460 reaches a level which is 1 to 2 cm below the edge 450e of the folding length determination section 450, the transfer section 460 stops. At this point, a portion 10w of the folded-up lower half of the garment 10 which exceeds the folding-up section 461 is folded along the edge 450e of the folding length determination section 450 and hung down. In this manner, the garment 10 is folded twice in the length direction by the movement of the garment transfer section 460 in only two directions. Thus, the folding operation of the garment 10 in the length direction is finished.

[0162] After the folding operation of the garment 10 is thus finished, the elements of the folding mechanism 501 are pulled out from the garment 10. This operation will be described with reference to FIG. 15.

[0163] First, the clamps 411m and 412m are opened to release the shoulders of the garment 10 from the held state. The clamp arms 411 and 412 are moved upward in the direction of arrows 411U and 412U, and then are rotated outwardly in the directions of arrows 411H and 412H. Thus, the clamps 411w and 412w and the clamp arms 411 and 412 return to the initial state thereof shown in FIG. 7.

[0164] The garment holder 504 and the hanger folding section 440 are also separated from the garment 10 to release the garment 10 from the held state. As a result, the garment 10 is supported only by the transfer section 460.

[0165] Next, the transfer section 460 and the folding length determination section 450 are moved downward in the direction of arrow 460D. By this operation, the folded garment 10 is moved downward, and the folding width determination sections 421 and 422 and the hanger 200 are pulled out from the garment 10. Even if there is a slight frictional resistance between the garment 10 and the folding width determination sections 421 and 422 or the hanger 200, the garment 10 is moved downward together with the transfer section 460 and the folding length determination section 450 against the frictional resistance because the garment 10 are kept folded by the folding length determination section 450.

[0166] Thus, the garment 10 is put into the transfer section 460. As shown in FIG. 16, the transfer section 460 is rotated in the direction of arrow 460R. By this operation, the folding-
up section 461, which is a supporting surface of the garment 10, is inclined to pull the garment 10 into the state movable to a stocker 480. The folding length determination section 450 moves away from the garment 10 in the direction of arrow 4501 to be pulled out from the garment 10. Thus, the garment 10 is dropped into the stocker 480 in the direction of arrow 10). [0167] Referring to FIG. 17, when one garment 10 is completely folded as described above, the hanger folding section 440 moves downward in the direction of arrow 4403 to fit into the cut-off part 430b formed in the base 430 of the garment holder 504 and thus provides a pass for the hanger 200. Then, the hanger 200 pulled out from the garment 10 moves deeper in the direction of arrow 120A by the hanger carrier 121 through the cut-off part 430b of the base 430 of the garment holder 504. Thus, the folding operation of one garment 10 is finished.

[0168] Next, when the sensor 477 detects that the garment 10 closest to the garment folding mechanism 501 has reached the predetermined drying state, the hanger carrier 121 having the garment 10 hung therefrom moves in the direction of arrow 120A in a self-propelled manner into the case 490 and stops. In this manner, the folding operation is repeated to sequentially drop the garments 10 into the stocker 480, where the garments 10 are stacked. When the folding operation of all the garments 10 on the hanger pole 110 is finished, the sensor 477 detects that there is no more garment 10. At the same time when the last garment 10 is put into the stocker 480, the operation of the garment folding apparatus 500 is terminated. Such a series of folding operations are always performed only in the case 490, and therefore are not influenced by wind or the like, which would sway the garments 10.

[0169] As described above, the garment folding apparatus in this embodiment can fold a garment which is hung on a hanger. Such a garment folding apparatus requires a smaller space than an apparatus for folding a garment spread horizontally. Since the garment folding apparatus in this embodiment can fold a garment hung on a hanger, washed garments can be sequentially transferred to the garment folding apparatus in this embodiment automatically to be folded with no manual work. This makes it possible to fold a plurality of garments continuously and automatically, which alleviates the load of housekeeping work.

[0170] The garment folding apparatus in this embodiment folds the garments 10 in the case 490. Therefore, the case 490 may also be used to store the garments 10 to protect the garments 10 from rainfall. Specifically, as shown in FIG. 1A, the sensor 478 for detecting rainfall is set at a position exposed to rain, and an output of the sensor 478 is input to the control section 471.

[0171] When the garment 10 is hung from the hanger pole 110 and the operator turns on the power of the garment folding apparatus, the sensor 478 starts detecting rainfall. When the sensor 477 for detecting the drying degree of the garment 10 detects the presence of the garment 10 and also the sensor 478 detects rainfall, the folding control section 471 transmits information on the amount of rainfall and also information that there is a garment on the hanger pole to a home gateway (not shown) via the communication cable 474. The home gateway (not shown) notifies such information to an external communication device such as, for example, a cellular phone or a personal computer of the operator via a general communication network such as the Internet or the like. Upon receipt of this information, the operator transmits information instructing to take in the garment. When this information is transmitted to the control section 471 via the home gateway and the communication cable 474, the control section 471 instructs the driving section 472 to take in the garment. Thus, all the hanger carrier 121 are put into the case 490.

[0172] In order to store all the garments 10 in the case 490, it is preferable that as shown in FIG. 1B, length L of the case 490 in the direction in which the hanger pole 110 is extended is larger than the product of length m of each hanger carrier 121 and the number of the hanger carriers 121. In this case, all the garments 10 are accommodated in the case 490 without being wetted by the rain. When being additionally provided with a sensor function or a communication function in this manner, the garment folding apparatus 500 can fold the garments while the operator is not home or can take in the garments to protect the garments against rainfall.

[0173] In FIG. 11, the clamp arms 411 and 412 are rotated by about 180 degrees to rotate the left and right shoulders of the held garment 10 inwardly. At this point, the clamp arms 411 and 412 are rotated at a constant height (at a constant position on the shafts 422 and 422A provided to the folding width determination sections 421 and 422). By contrast, when the positions of the clamp arms 411 and 412 in the height direction are raised after the 180-degree rotation by at least 1 cm from those before rotation, the garment 10 can be pulled in the vertical direction. Depending on the material of the garment 10, it is preferable that the clamp arms 411 and 412 are moved in the height direction by 1 cm or more and 5 cm or less. By this operation, even in the case where the garment 10 is a shirt and lower buttons thereof are off, the garment 10 can be prevented or alleviated from floating up above the folding width determination sections 421 and 422.

[0174] As shown in FIG. 4, the garment holder 504 includes four projections 431, 432, 433 and 434. Alternatively, in order to reduce the production cost of the garment folding apparatus, only the projections 431 and 432 may be provided. In this case, although the folded state of the garment 10 in the width direction may be slightly less neat, the basic folding operation can be performed and substantially the same effect can be provided as the case with four projections.

[0175] As shown in FIG. 1A, the communication control section 473 transmits and receives information via the communication cable 474. Alternatively, the communication control section 473 may transmit and receive information wirelessly.

[0176] In order to allow the garment folding apparatus to fold the garment 10 hung on the hanger 200 with high precision or in order to prevent the hanger 200 from moving in reaction to the rotation of the cam 440A provided at the tip of the hanger folding section 440, the position of the hanger 200 may be fixed with respect to the garment folding apparatus as follows. A positioning pin may be inserted into the main body 201 or the main body 201 may be adsorbed by a magnet to be fixed.

[0177] In this embodiment, the sensor 477 detects the amount of moisture in the garment 10 in order to detect the drying state of the garment 10. Alternatively, a weight detection section may be provided in the hanger carrier 121 to detect that the weight is decreased as the garment 10 is dried. The garment folding apparatus may allow the operator himself/herself to check the drying state of the garment 10 and start the folding operation by his/her decision.
The garment folding apparatus in this embodiment may further include a vapor generation section. In this case, immediately before the holding operation of the garment 10 shown in FIG. 8, vapor generated by the vapor generation section may be applied to the garment 10 to smooth the wrinkles out of the garment 10.

A rotatable roller may be provided to the edge 461e of the folding-up section 461 to avoid a frictional resistance, or to avoid the garment 10 from being caught by the edge 461e, when the hem of the garment 10 is rubbed by the edge 461e.

In this embodiment, the transfer section 460 is rotated to incline downward and then the folding length determination section 450 is pulled out. The folded garment 10 may be transferred to the stocker 480 by other means. For example, before the transfer section 460 is rotated, the folding length determination section 450 may be pulled out and the stocker 480 may be moved. Then, as shown in FIG. 18, the transfer section 460 is rotated and thus inclined, so that the edge 461e of the folding-up section 461 hits an inner surface of a vertical wall 481 of the stocker 480. The garment 10 slides down on the inclined folding-up section 461, and one end of the garment 10 hits the inner surface of the vertical wall 481 of the stocker 480.

Then, the stocker 480 is moved in parallel to the direction in which the folding-up section 461 of the transfer section 460 is inclined. By this, the garment 10 moves in the direction in which the stocker 480 advances while the one end of the garment 10 is in contact with the vertical wall 481 of the stocker 480. When the garment 10 loses the folding-up section 461 which has been supporting the bottom of the folded garment 10, the garment 10 is dropped into the stocker 480. In this way, the garment 10 can be put into the stocker 480.

Alternatively, after the folded garment 10 is inserted into the transfer section 460, the transfer section 460 may be rotated until the folding-up section 461 of the transfer section 460 becomes horizontal. In this case, after the transfer section 460 is moved right above the stocker 480, the folding-up section 461 may be opened to two sides to drop the garment 10 to the stocker 480.

In the stocker 480, the garments 10 may be sequentially stacked horizontally, or may be arranged in a line as standing vertically.

Embodiment 2

Embodiment 3

This embodiment, the garment holder includes projections 432i, 431j, 2433i and 2434j. Unlike the projections 433 and 434 in Embodiment 1, the projections 2433j and 2434j are extended in the vertical direction.

With reference to FIG. 19 and FIG. 20, an operation of the hanger 2200 in this embodiment and the garment folding apparatus in this embodiment will be described. As shown in FIG. 19, the state switching section 2203r is driven in the direction of arrow 2203L by a driving mechanism (not shown) provided in a folding section 400 in the state where the garment 10 is held by the garment holder as Embodiment 1. By this, as shown in FIG. 20, the arms 2202 and 2203 are contracted and folded into a size with which the arms 2202 and 2203 can be pulled out from the garment 10.

The hanger 2200 can be put into a folded state or an opened state by the arms 2202 and 2203 being contracted or extended in the horizontal direction. Therefore, the area in which the arms 2202 and 2203 are moved for folding the hanger 2200 can be small, which can enlarge the area in which the projections of the garment holder hold the garment 10.

This allows the provision of the projections 2433j and 2434j having a large area, which can hold the garment more firmly. As a result, the garment can be folded in a better finish.

Even if the area of the projections 2433j and 2434j is substantially the same as the area of the projections 433 and 434, in Embodiment 1, substantially the same effect as that of Embodiment 1 can be provided.

Embodiment 3

Embodiment 3 of a garment folding apparatus and a hanger used for the garment folding apparatus according to the present invention will be described.

FIG. 21 is a front view showing positions at which the garment 10 hung on a hanger 3200 is held by the garment folding apparatus in this embodiment. In FIG. 21, the elements other than the garment holder are the same as those in the garment folding apparatus in Embodiment 1 (FIG. 1 through FIG. 18), and so these identical elements bear the identical reference numerals thereto and descriptions thereof will be omitted.

As shown in FIG. 21, the garment folding apparatus in this embodiment includes none of the folding width determination sections 421 and 422 and the garment holder 504 unlike in Embodiment 1.

The hanger 3200 includes arms 3202 and 3203. The arm 3202 includes a tip section 3202p, a vertical section 3202v, and coupling sections 3202c. The arm 3203 includes a tip section 3203p, a vertical section 3203v, and coupling sections 3203c. The vertical section 3202v and the coupling sections 3202c form a link structure and are attached to a main body 3201b via two pivoting shafts. The vertical section 3203v and the coupling sections 3203c also form a link structure and are attached to the main body 3201b via two pivoting shafts. The tip sections 3202p and 3203p are pivotally supported by the vertical sections 3202v and 3203v, respectively. One of the coupling sections 3203c pivotally supported by the main body 3201b includes a state switching section 3203s. The coupling sections 3202c and 3203c pivotally supported by the main body 3201b respectively include gears 3202g and 3203g, which are engageable with each other.
Hereinafter, with reference to FIG. 21 et seq., an operation of the hanger 3200 in this embodiment and the garment folding apparatus in this embodiment will be described.

Like in Embodiment 1, as shown in FIG. 21, the clamp arms 411 and 412 hold both shoulders of the garment 10 in the state where the garment 10 is hung on the hanger 3200. In this embodiment, the garment 10 is held by the clamp arms 411 and 412 because the garment folding apparatus includes none of the folding width determination sections 421 and 422 and the garment holder 504.

As shown in FIG. 22, the tip sections 3202p and 3203p of the arms 3202 and 3203 are released from the state of being extended horizontally by a driving mechanism (not shown) to rotate inwardly in the directions of arrows 3202pD and 3203pD. By this operation, the tip sections 3202p and 3203p are hung down vertically and substantially overlap the vertical sections 3202v and 3203v. As a result, vertical edges 3202e and 3203e of the vertical sections 3202v and 3203v of the arms 3202 and 3203 appear at both ends of the hanger 3200. In this state, the garment 10 is supported at the areas 411a and 412a by the clamp arms 411 and 412 as well as by supporting sections 3202s and 3203s, which are top ends of the vertical sections 3202v and 3203v of the arms 3202 and 3203. Therefore, the garment 10 can be kept in a vertically suspended state even with none of the folding width determination sections 421 and 422 and the garment holder 504 required in Embodiment 1.

In FIG. 22, the vertical edges 3202e and 3203e of the vertical sections 3202v and 3203v are located to outer vertical edges 3202e' and 3203e' of the tip sections 3202p and 3203p. Alternatively, the vertical edges 3202e and 3203e may be located outer to the vertical edges 3202e and 3203e, or the vertical edges 3202e and 3203e may overlap the vertical edges 3202e and 3203e. In any case, the garment 10 is folded along the outer vertical edges.

Next, as shown in FIG. 23, the clamp arms 411 and 412 are rotated inwardly by about 180 degrees around the vertical axes 411a and 412a as the rotation center in the directions of arrows 411L and 412L to rotate the left and right shoulders of the held garment 10 inwardly. Since the vertical axes 411a and 412a substantially match the vertical edges 3202e and 3203e, the garment 10 is folded inwardly along the vertical edges 3202e and 3203e. Accordingly, in this embodiment, the vertical edges 3202e and 3203e of the vertical sections 3202v and 3203v of the arms 3202 and 3203 act as the folding width determination sections.

After the folding operation in the width direction is finished, the folding operation in the length direction is performed in substantially the same manner as in Embodiment 1 described with reference to FIG. 11 through FIG. 14. Thus, the folding operation is completed.

Then, as shown in FIG. 24, the state switching section 3203s located in the vicinity of a hanger hook 3201 is moved in the direction of arrow 3203S by a mechanism (not shown) provided in the folding section 400. As a result, the vertical section 3203v of the arm 3203 is rotated inwardly in the direction of arrow 3203vD by the link structure with the coupling section 3203s while being kept vertical. Thus, the vertical section 3203v is hung vertically. The coupling sections 3202s and 3203s of the arms 3202 and 3203 are rotated in association with each other by the engagement of the gears 3202g and 3203g. Therefore, the vertical section 3202v of the arm 3202 is also rotated in the direction of arrow 3202vD by the link structure with the coupling section 3202s while being kept vertical. Thus, the vertical section 3202v is hung vertically. In this manner, the hanger 3200 is folded. Then, the garment 10 is moved downward in the direction of arrow 4601 as described in Embodiment 1 with reference to FIG. 15 to easily pull the hanger 3200 from the garment 10.

In this embodiment, as shown in FIG. 22, the tip sections 3202p and 3203p of the hanger 3200 are hung to be inside the vertical sections 3202v and 3203v. Even if the vertical edges 3202e and 3203e of the hanger tip sections 3202p and 3203p are outer to the vertical edges 3202e and 3203e of the vertical sections 3202v and 3203v, the vertical edges 3202e and 3203e act as the folding width determination sections and provide the same effect.

In this embodiment, the hanger itself can be used as the folding width determination section with no need for a separate element such as a garment holder for supporting the garment. This simplifies the structure and elements of the garment folding apparatus and reduces the cost thereof.

Embodiment 4

Embodiment 4 of a garment folding apparatus and a hanger according to the present invention will be described.

FIG. 25 is an isometric view showing a main part of a hanger 4200 in this embodiment and a garment folding apparatus in this embodiment. The elements other than those shown in FIG. 25 are the same as those of the garment folding apparatus in Embodiment 1 (FIG. 1 through FIG. 18), and so these identical elements bear the identical reference numerals thereto and descriptions thereof will be omitted.

The hanger 4200 includes a hook 4201 and an arm 4202 which can be shaped like an arm for supporting the garment 10 when being filled with a fluid such as a gas or a liquid.

The garment folding apparatus in this embodiment includes a width direction folding section 502. FIG. 26 is an exploded isometric view of the width direction folding section 502, and FIG. 27 is an isometric view showing the width direction folding section 502 from a different angle from that in FIG. 25. With reference to FIG. 25 through FIG. 27, a structure of the width direction folding section 502 will be described.

The width direction folding section 502 includes a central holding section 510 and outer holding sections 511 and 512.

The central holding section 510 includes a central supporting body 4430 having a plurality of projections 4430p extending in the vertical direction and a plurality of grooves 4430g formed by the plurality of projections 4430p, and also includes a central press 4400 having a plurality of comb teeth 4400t extending in the vertical direction.

The outer holding section 511 includes an outer supporting body 4411 having a plurality of projections 4411p extending in the vertical direction and a plurality of grooves 4411g formed by the plurality of projections 4411p, and also includes an outer press 4401 having a plurality of comb teeth 4401t extending in the vertical direction. Similarly, the outer holding section 512 includes an outer supporting body 4412 having a plurality of projections 4412p extending in the vertical direction and a plurality of grooves 4412g formed by the plurality of projections 4412p, and also includes an outer press 4402 having a plurality of comb teeth 4402t extending in the vertical direction.
The outer supporting bodies 4411 and 4412 respectively have bosses 4411b and 4412b having holes through which shafts 4430a1 and 4430a2 provided at both of two ends of the central supporting body 4430 can be inserted. The outer presses 4401 and 4402 respectively have bosses 4401b and 4402b having holes through which shafts 4400b1 and 4400b2 provided at both of two ends of the central press 4400 can be inserted.

The central supporting body 4430 and the outer supporting bodies 4411 and 4412, and the central press 4440 and the outer presses 4401 and 4402, hold the garment 10 therebetween by putting the comb teeth and the grooves thereof into engagement with each other. At this point, the pivoting shafts 4430a1 and 4430a2 for pivoting the outer supporting bodies 4411 and 4412 are located coaxially with the pivoting shafts 4400b1 and 4400b2 for pivoting the outer presses 4401 and 4402.

As shown in FIG. 27, the projections 4430p of the central supporting body 4430, the projections 4411p and 4412p of the outer supporting bodies 4411 and 4412, the comb teeth 4400b of the central press 4400, and the comb teeth 4401p and 4402p of the outer presses 4401 and 4402 each have a top end which extends to slightly below the arm 4202 of the hanger 4200.

The central supporting body 4430, the outer supporting bodies 4411 and 4412, and the outer presses 4401 and 4402 are at substantially the same level at bottom ends thereof, and the length from the positions of the bottom ends thereof to the arm 4202 matches the size of the garment 10 in the length direction when being folded. A sloped surface 4400p sloping downward toward the garment 10 is provided at the bottom of the comb teeth 4400b of the central press 4400, and sloped surfaces 4401p and 4402p sloping downward toward the garment 10 are also provided at the bottom of the comb teeth 4401p and 4402p of the outer presses 4401 and 4402. By this arrangement, the garment 10 is mildly stepped between the upper half which is held and the lower half which is not held, so that the garment 10 is unlikely to be wrinkled.

Hereinafter, with reference to FIG. 25 and FIG. 28 through FIG. 30, an operation of the hanger 4200 in this embodiment and the garment folding apparatus in this embodiment will be described.

The operation until the hanger 4200 having the garment 10 hung thereon by the operator is moved into the case 490 by a self-propelled movement of the hanger carrier 121 is the same as that in Embodiment 1. As shown in FIG. 25, the central supporting body 4430 and the outer supporting bodies 4411 and 4412 move in the direction of arrow 4430c, and the central press 4400 and the outer presses 4401 and 4402 move in the direction of arrow 4400c, to hold the garment 10 therebetween as shown in FIG. 29A at a level below the hanger 4200.

Next, as shown in FIG. 28, the arm 4202 of the hanger 4200 is made flat by pulling out the fluid therefrom by a mechanism (not shown). Then, the central supporting body 4430, the outer supporting bodies 4411 and 4412, the central press 4400, and the outer presses 4401 and 4402 are entirely moved downward in the direction of arrow 4430d while holding the garment 10. The flat hanger 4200 is pulled out from the collar opening of the garment 10. In this state, the garment 10 is held by the central supporting body 4430, the outer supporting bodies 4411 and 4412, the central press 4400, and the outer presses 4401 and 4402, and therefore is not dropped.

Then, as shown in FIG. 29B, the outer supporting body 4411 is rotated in the direction of arrow 4411a around an axis 4411a as the rotation center, and the outer supporting body 4412 is rotated in the direction of arrow 4412a around an axis 4412a as the rotation center. Thus, the projections 4411p of the outer supporting body 4411 and the projections 4412p of the outer supporting body 4412 are put into pressure-contact with the projections 4430p of the central supporting body 4430. At this point, the outer press 4401 is rotated in the direction of arrow 4401a as the rotation center, and the outer press 4402 is rotated in the direction of arrow 4402a around an axis 4402a as the rotation center. The axis 4401a is coaxial with the axis 4411a and the axis 4402a is coaxial with the axis 4412a. Therefore, the comb teeth 4401p of the outer press 4401 rotate while holding the garment 10 together with the outer supporting body 4411, and the comb teeth 4402p of the outer press 4402 rotate while holding the garment 10 together with the outer supporting body 4412.

The axes 4401a (4411a) and 4402a (4412a) are set in the vicinity of two teeth at both of two ends of the comb teeth 4400b. Namely, these two teeth of the comb teeth 4400b each act as the folding width determination section for the garment.

After the garment 10 is folded in the width direction, as shown in FIG. 29C, the comb teeth 4400b, the comb teeth 4401a and the comb teeth 4402a are moved in the directions of arrows 4400r, 4401r and 4402r respectively, and thus are released from the state of holding the garment 10. As a result, the garment 10 is held only by the projections 4411p, 4412p and 4430p.

Then, as shown in FIG. 30, the central press 4400 and the outer presses 4401 and 4402 are moved in the direction of arrow 4400d to be pulled out from the garment 10, the central supporting body 4430 and the outer supporting bodies 4411 and 4412. Then, the garment 10 is folded in the length direction as in Embodiment 1. Therefore, bottom edges 4411e and 4412e of the outer supporting bodies 4411 and 4412 act as the folding length determination sections. Then, the garment 10 is released from the central supporting body 4430 and the outer supporting bodies 4411 and 4412, and is transferred to the stocker 480 in substantially the same manner as in Embodiment 1.

As described above, according to this embodiment, the garment is held two-dimensionally and then folded. Therefore, even when a plurality of garments are folded, the size of the folded garments is constant with little variance. In addition, the garments can be folded with high folding quality.

In this embodiment, the comb teeth 4400b, 4401a and 4402a are cylindrical and correspond to the grooves 4430g, 4431g and 4432g in a one-to-one manner. Alternatively, as shown in FIG. 31A, two comb teeth 4401a may be provided for one groove 4411g. The projections may have pointed tips as represented with 4411p. In these cases, the same effect as described above can be provided.

In this embodiment, the comb teeth 4400b, 4401a and 4402a are fixed with respect to the central press 4400 and the outer presses 4401 and 4402. Therefore, the central press 4400 and the outer presses 4401 and 4402 are moved to release the garment 10 from the pressure contact. Alternatively, as shown in FIGS. 31A and 31B, the cross-section of
The comb teeth 4401t and 4400t' perpendicular to the longitudinal direction thereof may have an anisotropic shape and the comb teeth 4401t and 4402t' may be rotated to release the garment 10 from the pressure contact. In this case also, the same effect as described above can be provided.

The comb teeth 4400t, 4401t and 4402t excluding comb teeth 4421t and 4422t may be moved downward from the state shown in FIG. 29C to realize the state in FIG. 32A. Then, the comb teeth 4421t is moved in the direction of arrow 4421T and the comb teeth 4422t is moved in the direction of arrow 4422T to stretch the garment 10 with a tensile force. Then, the central press 4400t and the outer presses 4401t and 4402t are pulled out from the garment 10 as shown in FIG. 32, and the garment 10 is folded in the length direction. This effectively allows the garment 10 to be folded with less wrinkles.

In this embodiment, the central supporting body 4430t and the outer supporting body 4411t and 4412t have projections and grooves on a surface thereof which contacts the garment 10. Alternatively, as shown in FIG. 33, the central supporting body 4430t and the outer supporting body 4411t and 4412t may have planes 4430t, 4411t and 4412t contacetable with the garment 10. Air may be absorbed through air suction holes 4430th, 4411h and 4412th formed in these planes by a suction device (not shown) such as a pump or the like to adsorb the garment 10 to the planes 4430t, 4411t and 4412t. In this case, the central press 4400t and the outer presses 4401t and 4402t are not necessary. Such a structure can provide an equivalent effect to that described above.

INDUSTRIAL APPLICABILITY

A garment folding apparatus according to the present invention is preferably usable for an apparatus for folding garments for various purposes. Specifically, a garment folding apparatus according to the present invention is preferably usable for a compact garment folding apparatus which does not require a large installation area and is suitable for a home-use garment folding apparatus.

1. A garment folding apparatus, comprising a folding mechanism for folding a garment hung on a hanger in a horizontal direction and a vertical direction into a predetermined size.

2. The garment folding apparatus of claim 1, which moves a plurality of hangers each suspended from a hanging pole and having the garment hung thereon to a predetermined position sequentially, and folds the garment hung on each hanger by the folding mechanism.

3. The garment folding apparatus of claim 2, wherein the folding mechanism includes a width direction folding section and a length direction folding section.

4. The garment folding apparatus of claim 3, wherein: the width direction folding section includes a pair of clamps for picking two horizontal-direction ends of the garment hung on the hanger, and a pair of folding width determination sections; and the clamps pivot while picking the garment so as to wrap the garment around the folding width determination sections and fold the garment along the folding width determination sections.

5. The garment folding apparatus of claim 4, wherein: the pair of folding width determination sections each include an edge extending in the vertical direction for defining a position along which the garment is to be folded; and the pair of clamps each rotate around a vertical axis passing in the vicinity of the edge of the corresponding folding width determination section as the rotation center.

6. The garment folding apparatus of claim 5, wherein when the pair of clamps rotate while picking the two ends of the garment, the pair of clamps each move to a position which is above a pre-rotation position thereof by 1 cm or more.

7. The garment folding apparatus of claim 6, wherein the pair of clamps hold the garment hung on the hanger at positions at which the clamps do not interfere with the hanger.

8. The garment folding apparatus of claim 7, further comprising a hanger folding section for instructing the hanger to be folded such that the garment can be pulled out from the hanger.

9. The garment folding apparatus of claim 8, wherein the width direction folding section further includes a garment holder for holding the garment inside the pair of folding width determination sections.

10. The garment folding apparatus of claim 9, wherein the garment holder holds the garment so as not to interfere with the hanger when the hanger is folded.

11. The garment folding apparatus of claim 10, wherein the length direction folding section includes a folding length determination section having a horizontal rod contactable with the garment, and a folding-up section for folding a bottom part of the garment upward at a position of the folding length determination section.

12. The garment folding apparatus of claim 11, wherein the folding-up section approaches the garment from the opposite direction to the folding length determination section, passes below the folding length determination section, and then moves upward.

13. The garment folding apparatus of claim 12, wherein the folding-up section has a rotatable roller at a tip thereof, and an outer circumferential surface of the roller contacts the garment.

14. The garment folding apparatus of claim 3, wherein: the width direction folding section includes a central holding section for holding a central part of the garment hung on the hanger, and a pair of outer holding sections for holding two horizontal-direction outer parts of the garment which are outer to the central part; and in the state where the central holding section and the outer holding sections hold the garment, the outer holding sections are bent toward the central holding section, and thus the garment is folded in the horizontal direction.

15. The garment folding apparatus of claim 14, wherein: the central holding section includes a central supporting body having a recess and a projection on a surface facing the garment, and a central press for pressing the garment to a bottom of the recess; the outer holding sections each include an outer supporting body having a recess and a projection on a surface facing the garment, and an outer press for pressing the garment to a bottom of the recess; and in the state where the outer holding sections are bent toward the central holding section, the projection of each of the outer holding sections and the projection of the central holding section hold the garment therebetween.
16. The garment folding apparatus of claim 15, wherein the recess of the central holding section and the recess of each of the outer holding sections have a groove-like shape extending in the vertical direction, and the central press and the outer presses each have a comb teeth-like shape extending in the vertical direction.

17. The garment folding apparatus of claim 14, wherein the central holding section and the outer holding sections each have a plane contactable with the garment and a plurality of air suction holes provided in the plane.

18. The garment folding apparatus of claim 14, wherein the length direction folding section includes a folding length determination section including a bottom end of the central holding section or the outer holding sections, and a folding-up section for folding a bottom part of the garment upward at a position of the folding length determination section.

19. The garment folding apparatus of claim 11, further comprising:
   a stocker for storing the garment; and
   a transfer section for transferring the folded garment to the stocker.

20. The garment folding apparatus of claim 19, wherein the transfer section includes a supporting surface for keeping the folded garment in a generally vertical state, and inclines the supporting surface to move the garment on and along the supporting surface and thus to drop the garment into the stocker.

21. The garment folding apparatus of claim 20, wherein the transfer section pulls out the supporting surface from below the garment in the state where a part of the inclined supporting surface in the vicinity of a tip thereof contacts a vertical wall of the stocker, and thus drops the garment into the stocker.

22. The garment folding apparatus of claim 20, wherein the transfer section moves to above the stocker in the state where the supporting surface is horizontal, takes away the supporting surface from below the garment, and thus drops the garment into the stocker while being kept horizontal.

23. The garment folding apparatus of claim 19, wherein the transfer section sequentially drops a plurality of garments vertically and stores the garments as standing vertically and being arranged in a line in the stocker.

24. The garment folding apparatus of claim 19, further comprising a sensor for detecting a drying state of the garment hung on the hanger suspended from the hanging pole, wherein the folding mechanism operates based on a result of the detection of the sensor.

25. The garment folding apparatus of claim 19, further comprising:
   a first sensor for detecting a drying state of the garment hung on the hanger suspended from the hanging pole; and
   a communication section for transmitting a detection state of the sensor to an external communication device and receiving an instruction to fold the garment from the external communication device.

26. The garment folding apparatus of claim 19, comprising:
   a hanger moving section for moving the hanger along the hanging pole;
   a roof for covering the hanging pole; and
   a second sensor for detecting an amount of rainfall; wherein the hanger moving section moves the hanger to below the roof based on a result of the detection of the second sensor.

27. The garment folding apparatus of claim 19, wherein the folding mechanism further includes a vapor generation section for generating water vapor, wherein water vapor generated by the vapor generation section is sprayed toward the garment immediately before an operation of folding the garment.

28. A hanger, comprising:
   a suspension section suspensible from a hanging pole;
   a pair of arms for supporting a garment; and
   a state switching section for transferring the arms from a horizontally opened state into a folded state; wherein at least a part of the state switching section is exposed outside in the state where the garment is hung on the hanger.

29. The hanger of claim 28, wherein:
   the pair of arms each include supporting sections for contacting and supporting the garment in the state where the arms are horizontally opened and a connecting section for connecting the supporting sections, the connecting section being located below the supporting sections; and
   the pair of arms are hung downward from the suspension section in the state of being folded.

30. The hanger of claim 29, wherein the pair of arms each include a supporting section provided at a tip thereof and a connecting section adjacent to the tip.

31. The hanger of claim 28, wherein the pair of arms each include:
   a vertical section having an edge extending in a vertical direction; and
   a tip section rotatably supported by the vertical section so as to be in a horizontally extended state and a vertically hung state.

32. The hanger of claim 31, wherein the tip section is hung, the edge of the vertical section defines a folding position in a width direction of the garment hung on the hanger.

33. The hanger of claim 28, wherein at least a part of the pair of arms has an extendable/contractable link structure, and the link structure is driven by moving the part of the arms and thus the arms are entirely contracted toward a center thereof.

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