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(54) KNIFE FOLDING DEVICE

(57) In the knife folding machine of the present invention it is possible to easily adjust the stroke of the reciprocal movement of the knife blade 5. The rod 10 is reciprocated by the feed screw 12. The feed screw 12 is rotated by the servomotor 14. Thus when the knife blade 5 reciprocates between the first and second positions, the first and second positions thereof are separately adjusted by controlling the amount of the rotation of the servomotor 14.

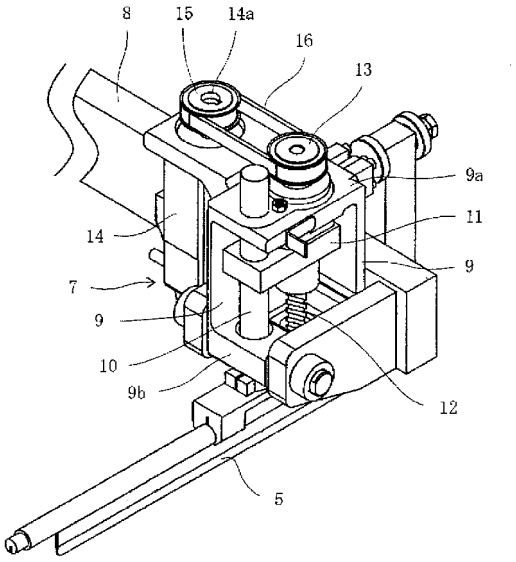

Fig. 3

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to a knife folding machine for folding a sheet, a sheet bundle and the like with a knife blade.

BACKGROUND OF THE INVENTION

[0002] A conventional knife folding machine generally comprises a table on which a sheet bundle is placed; a positioning means for positioning the sheet bundle at a predetermined folding position on the table; a knife blade; a pair of folding rollers opposed to the knife blade with the table therebetween at the folding position; and a slider crank mechanism. The slide crank mechanism reciprocates the knife blade between a first position and a second position through an opening for passing the knife blade. The opening is formed on the table. The first position is opposed to the rollers with the table therebetween and spaced from the table. The second position is disposed adjacent a gap between the rollers (also see, for example, Patent Documents 1 and 2).

[0003] The knife blade has one end fixed to a rod which is connected with a crank of the slider crank mechanism. During one revolution of the crank, the knife blade reciprocates between the first position (upper dead point) and the second position (lower dead point) so as to cause a folding operation. While the knife blade moves from the first position to the second position, the sheet bundle on the table is folded in two by the knife blade, then an edge of the folded portion thereof is pushed out of the opening and inserted into the gap between the folding rollers so that the sheet bundle can be folded by the folding rollers.

[0004] By the way, the sheet bundle consists of several sheets, and the thickness of each sheet and the number of sheets respectively varies depending on the kind of the sheet bundle so that the thickness of the sheet bundle varies. The second position of the knife blade should be adjusted in such a way that a distance between the second position and the gap is optimized. Because when the second position is too far away from the gap, the sheet bundle cannot be inserted into the gap. When the second position is too close to the gap, the knife blade enters the gap and stops the knife folding machine.

[0005] In the case of the conventional knife blade machine, the second position of the knife blade is adjusted by changing the position of the upper dead point of the slider crank mechanism. In this case, the change of the second position of the knife blade automatically effects the change of the first position since the stroke of the slider crank mechanism between the upper and lower dead points is constant.

[0006] In order to achieve a high-speed folding operation, it is preferable that the stroke of the reciprocal movement of the knife blade is changeable depending on the kind of the sheet bundle, that is, the first and second positions of the knife blade are separately changeable. However, in the conventional knife blade, the first and second positions of the knife blade cannot separately be changeable.

[0007] In addition, a rod is constantly subjected to an offset load in a direction away from the axis thereof during the folding operation since the slider crank mechanism transforms a rotary movement of a crank into a reciprocal linear movement of a rod, which leads to the deterioration of the durability of the knife folding machine.
In the conventional knife folding machine, when each sheet bundle is sequentially fed to the fold position every time each of the folding operations is completed, an overload of the knife blade cannot be detected during the folding operation even if a plurality of sheet bundles are accidentally fed at a time. As a result, the movement of the knife blade cannot be stopped but continued to cause a paper jam between the folding rollers, and the folding operation is interrupted for a long time.

[0008]

Patent Document 1: US4,568,319
Patent Document 2: JP 2007-91473

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0009] It is an object of the present invention to provide a knife folding machine which can separately change the positions of the opposite ends of the reciprocal movement of the knife blade, and achieve a high-speed folding operation and an excellent durability.
It is another object of the present invention to provide a knife folding machine having the function of detecting the overload of the knife blade during the folding operation.

SOLUTION TO THE PROBLEMS

[0010] In order to achieve the objects, the present invention provides a knife folding machine, comprising:

a frame having a support surface to support a lower surface of a sheet or a sheet bundle;
a positioning means attached to the frame to position the sheet or the sheet bundle at a fold position on the support surface;
a knife blade;
a pair of folding rollers opposed to the knife blade with the support surface therebetween at the fold position, the folding rollers being attached to the frame, the knife blade and the folding rollers being disposed in parallel to each other, an edge of the knife blade being opposed to a gap between the folding rollers, the support surface having a opening through which the knife blade passes;
a knife drive unit for reciprocating the knife blade in a direction perpendicular to the support surface

through the opening between a first position and a second position, the first position being opposed to the folding rollers with the support surface therebetween and spaced from the support surface, the second position being disposed adjacent the gap between the folding rollers;
a support arm attached to the frame to support the knife drive unit; and
a control unit for controlling the knife drive unit; wherein
the reciprocal movement of the knife blade between the first and second positions effects a folding operation, wherein
while the knife blade moves from the first position to the second position, the sheet or the sheet bundle on the support surface being folded in two by the knife blade, an edge of the folded portion thereof being pushed out of the opening and inserted to the gap between the folding rollers so that the sheet or the sheet bundle can be folded by the folding rollers; and wherein
the knife drive unit comprises:

a holder attached to the support arm;
a rod extending in a direction perpendicular to the support surface and attached to the holder to reciprocate in an axial direction thereof, the rod having one end attached to the knife blade;
a block attached to a center portion of the rod;
a feed screw extending in parallel to the rod and attached to the holder to rotate around an axis thereof, the block having a thorough hole which has thread grooves corresponding to the feed screw, the feed screw engaging with the through hole, the rod being reciprocated by the rotation of the feed screw;
a first pulley attached to an upper or lower end of the feed screw;
a servomotor attached to the holder and having a drive shaft, the drive shaft extending in parallel to the feed screw;
a second pulley attached to the drive shaft of the servomotor; and
a timing belt extended between the first and second pulleys, the servomotor being controlled by the control unit.

[0011] According to a preferred embodiment of the present invention, the control unit comprises:

a first input portion for receiving input of both a data of a distance (d1) from the support surface to the first position and a data of a distance (d2) from the support surface to the second position; and
a first memory for storing the datum of the distances (d1, d2) inputted through the first input portion; and wherein
the control unit controls the servomotor based on the datum of the distances (d1, d2) stored in the first memory.

[0012] According to further preferred embodiment of the present invention, the knife folding machine further comprising:

a feed means attached to the frame to sequentially feed the sheet or the sheet bundle to the fold position in a direction parallel or perpendicular to the knife blade on the support surface; wherein
the positioning means comprises a stopper disposed on a downstream side of the knife blade and extending in a direction perpendicular to a feed path of the sheet or the sheet bundle on the support surface, the stopper positioning the sheet or the sheet bundle at the fold position by the abutment of the front end of the sheet or the sheet bundle against the stopper.

[0013] According to further preferred embodiment of the present invention, the knife folding machine further comprising:

a sensor disposed in the middle way of the feed path of the sheet or the sheet bundle to detect a passage of a tail end of the sheet or the sheet bundle; wherein the stopper is movable along the feed path in a direction of toward and away from the sensor and disposed away from the sensor a distance (r) summed up in both of a distance (p) along the feed path of the sheet or the sheet bundle and a predetermined distance (q); wherein
the control unit comprises:

a second input portion for receiving input of a data of a delay time from when the tail end of the sheet or the sheet bundle (S) passes through the sensor till when the folding operation of the knife blade (5) starts; and
a second memory for storing the data of the delay time (t) inputted through the second input portion; and wherein

the control unit controls the servomotor of the knife drive unit based on a detecting data from the sensor and the data of the delay time (t) stored in the second memory.

[0014] According to further preferred embodiment of the present invention, the feed means comprises:

a drive roller and an idle roller attached to the frame and spaced from and in parallel to each other;
at least one conveyer belt extending between the drive roller and idle roller; and
a second servomotor attached to the frame to rotate the drive roller; wherein
a part of the support surface is formed by a feed

surface of the conveyer belt, each of rotation shafts of the drive roller and idle roller being disposed in parallel or vertical to the knife blade.

EFFECT OF THE INVENTION

[0015] The knife folding machine of the present invention comprises the rod supported to reciprocate in a direction perpendicular to the support surface for supporting the lower surface of the sheet or the sheet bundle, and the feed screw disposed in parallel to the rod and supported to rotate around an axis thereof. The rod and the feed screw are operatively connected with each other by the block. The rod is fixed to the knife blade at its one end and reciprocated by the feed screw. The feed screw is rotated by the servomotor. Thus the knife blade reciprocates between the first and second positions. As a result, it is possible to easily adjust the stroke of the reciprocal movement of the knife blade, and separately adjust the first and second positions thereof by controlling the amount of the rotation of the servomotor.

[0016] Further in the present invention, the rod is not be subjected to the offset load in a direction away from the axis thereof during the folding operation because the rod and the feed screw are disposed in parallel to each other, so that the durability of the knife folding machine improves. Since the rod, or the knife blade is reciprocated by the feed screw which is rotated by the servomotor, the overload subjected to the knife blade can be detected by the servomotor. As a result, when each sheet bundle is sequentially fed to the fold position every time each of the folding operations is finished, the paper jam is avoided by stopping the knife blade in the course of its folding operation even if a plurality of sheet bundles are accidentally fed at a time.

BRIEF DESCRIPTION OF THE DRAWING

[0017]

Fig. 1 is a perspective view showing a knife folding machine according to the first embodiment of the present invention, in which no sheet is set at a fold position of the knife folding machine.

Fig. 2 is a perspective view showing the knife folding machine according to the first embodiment of the present invention, in which a sheet is set at the fold position of the knife folding machine.

Fig. 3 is a perspective view showing a knife drive unit of the knife folding machine of Fig. 1.

Fig. 4A is a front view showing the knife drive unit of the knife folding machine of Fig. 1 when a knife blade is disposed at a first position.

Fig. 4B is a front view showing the knife drive unit of the knife folding machine of Fig. 1 when the knife blade is disposed at a second position.

Fig. 5 is a plan view showing a touch screen as a first and second input portions of the knife folding machine of Fig. 1.

DETAILED EXPLANATION OF THE PREFERRED EMBODIMENTS

[0018] A preferred embodiment of the present invention will be explained below with reference to the accompanying drawings. Fig. 1 is a perspective view showing a knife folding machine according to the first embodiment of the present invention, in which no sheet is not set at a fold position of the knife folding machine. Fig. 2 is a perspective view showing the knife folding machine according to the first embodiment of the present invention, in which a sheet is set at the fold position of the knife folding machine. As shown in Figs. 1 and 2, the knife folding machine of the present invention comprises a frame 1. A plurality of elongated plates 2, 2a are attached to the upper surface of the frame 1 and spaced from each other widthwise. The upper surfaces of these plates 2, 2a construct a part of a support surface 4 for supporting a lower surface of a sheet or a sheet bundle (hereinafter generically referred to as "a sheet S").

[0019] A pair of folding rollers 6a, 6b are opposed to a knife blade 5 with the support surface 4 therebetween at the fold position on the support surface 4. In this embodiment, the knife blade 5 is disposed above the center plate 2a (the support surface 4) and the folding rollers 6a, 6b are disposed below the center plate 2a. In another embodiment, the knife blade 5 may be disposed below the center plate 2a and the folding rollers 6a, 6b may be disposed above the center plate 2a.

[0020] The folding rollers 6a, 6b are attached to the frame 1. The knife blade 5 and the folding rollers 6a, 6b are disposed in parallel to each other and the center plate 2a. A opening 3 is formed on the center plate 2a and extends longitudinally thereof. The knife blade 5 passes through the opening 3 and one end of the knife blade 5 is opposed to a gap between the folding rollers 6a, 6b.

[0021] The knife folding machine comprises a knife drive unit 7. The knife drive unit 7 reciprocates the knife blade 5 between first and second positions through the opening 3 in a direction perpendicular to the support surface 4. The first position is spaced from and above the support surface 4. The second position is disposed adjacent the gap between the folding rollers 6a, 6b. The knife drive unit 7 is supported on a support arm 8 attached to the frame 1.

[0022] Fig. 3 is a perspective view showing a knife drive unit of the knife folding machine of Fig. 1. Fig. 4A is a front view showing the knife drive unit of the knife folding machine of Fig. 1 when a knife blade is disposed at the first position. Fig. 4B is a front view showing the knife drive unit of the knife folding machine of Fig. 1 when the knife blade is disposed at the second position.

As shown in Figs. 3 and 4, the knife drive unit 7 comprises a holder 9 attached to the support arm 8. The holder 9 has horizontal upper and lower support walls 9a, 9b which are vertically spaced from each other. A rod 10 extends

through the upper and lower support walls 9a, 9b in a direction vertical or perpendicular to the support surface 4. The rod 10 is attached to the holder 9 via bearings (not shown) disposed in the upper and lower support walls 9a, 9b so as to be reciprocated in an axial direction thereof. The knife blade 5 is fixed on the lower end of the rod 10. A block 11 is fixed on a center portion of the rod 10 (the portion extends between the upper and lower support walls 9a, 9b).

[0023] A feed screw 12 is attached to rotate around an axis thereof and extends in parallel to the rod 10 between the upper and lower support walls 9a, 9b of the holder 9. The block 11 has a through hole which provided with thread grooves corresponding to the feed screw 12. The feed screw 12 is engaged with the through hole. While the feed screw 12 rotates, the rod 10 reciprocates in a direction perpendicular to the support surface 4 through the block 11.

[0024] The knife drive unit 7 further comprises a first pulley 13 attached to an upper end of the feed screw 12, a servomotor 14 attached to holder 9 and having a drive shaft 14a in parallel to the feed screw 12, a second pulley 15 attached to the drive shaft 14a of the servomotor 14, and a timing belt 16 extended between the first and second pulleys 13,15.

[0025] In this embodiment, the first pulley 13 is attached to the upper end of the feed screw 12 and driven by the servomotor 14, but the first pulley 13 may be attached to the lower end of the feed screw 12 and driven by the servomotor 14.

[0026] The servomotor 14 is controlled by a control unit 22.

The control unit 22 comprises a first input portion 23 for receiving input of both a data of a distance d1 (see Fig. 4A) from the support surface 4 to the first position and a data of a distance d2 (see Fig. 4B) from the support surface 4 to the second position. The control unit 22 comprises a first memory 24 for storing the datum of the distances d1, d2 through the first input portion 23.

[0027] In this embodiment, as shown in Fig. 5, the first input portion 23 is formed by a lower input area 29a of a touch screen 29. In this embodiment, the lower input area 29a receives input of values corrected for default values respectively corresponding to distances from the support surface 4 to the first and second positions. Thus the distance d1 from the support surface 4 to the first position and the distance d2 from the support surface 4 to the second position are inputted. In the lower input area 29a there are upper and lower numerical value columns 30a, 30b. The upper numerical value column 30a indicates the corrected value of the distance from the first position to the support surface 4 by 0.1 mm. The lower numerical value column 30b indicates the corrected value of the distance from the second position to the support surface 4 by 0.1mm.

At the right side of the numerical value columns 30a, 30b, there are a "+" button for increasing the corrected value, a "-" button for decreasing the corrected value, and a "D" button for changing the corrected value to zero. Each of the corrected values can easily be inputted by depressing these buttons.

[0028] The control unit 22 calculates an amount of the rotation of the servomotor 14 corresponding to the distance from the first position to the second position based on the datum of the distances d1, d2 stored in the first memory 24 and controls the servomotor 14.

The servomotor 14 rotates the feed screw 12 to reciprocate the rod 10 or the knife blade 5 between the first position (see Fig. 4A) and the second position (see Fig. 4B) via the block 11.

[0029] The reciprocal movement of the knife blade 5 between the first and second positions effects a folding operation. While the knife blade 5 moves from the first position to the second position, the sheet S on the support surface 4 is folded in two by the knife blade 5, and an edge of the folded portion thereof is pushed out of the opening 3 and inserted to the gap between the folding rollers 6a, 6b so that the sheet S can be folded by the folding rollers 6a, 6b.

[0030] According to the present invention, the servomotor 14 rotates the feed screw 12 to reciprocate the rod 10 or the knife blade 5 between the first and second positions. As a result, the stroke of reciprocal movement of the knife blade 5 can easily be adjusted, and the first and second positions of the knife blade 5 can separately be adjusted by controlling the amount of the rotation of the servomotor 14.

[0031] Further in the present invention, the rod 10 is not subjected to the offset load in a direction away from the axis thereof during the folding operation because the rod 10 and the feed screw 12 are disposed in parallel to each other, so that the durability of the knife folding machine can be improved. Since the rod 10 or the knife blade 5 is reciprocated by the feed screw 12 which is rotated by the servomotor 14, the overload subjected to the knife blade 5 is detected by the servomotor 14. As a result, when each sheet S is sequentially fed to the fold position every time each of the folding operations is finished, the paper jam between the folding rollers 6a, 6b can be avoided by stopping the knife blade 5 in the course of its folding operation even if a plurality of sheets S are accidentally fed at one time.

[0032] The knife folding machine further comprises a feed means attached to the frame 1 to sequentially feed the sheet S to the fold position in a direction parallel to the knife blade 5 on the support surface 4.

In this embodiment, the feed means comprises a drive roller 17 and an idle roller 18 which are attached to the frame 1 and respectively disposed on one and the other end sides of the frame 1 below the support surface 4 (plates 2, 2a). Each of rotation shafts of the drive roller 17 and the idle roller 18 is disposed in parallel to each other and extends in a direction perpendicular to the knife blade 5. The drive roller 17 is driven by a second servomotor 19 fixed to the frame 1. The second servomotor 19 is controlled by the control unit 22.

[0033] A plurality of conveyer belts 20 extend between the drive roller 17 and the idle roller 18. Two conveyer belts 20 are arranged for each of the plates 2, 2a and spaced from each other. Each of upper side portions of the conveyer belts 20 is disposed above the plates 2, 2a. As a result, a part of the support surface 4 is formed by a feed surface of the conveyer belt 20.

[0034] The knife folding machine further comprises a positioning means attached to the frame 1 to position the sheet S at the fold position on the support surface 4. In this embodiment, the positioning means comprises a stopper 21 disposed at a downstream side of the knife blade 5 and extending in a direction perpendicular to a feed path of the sheet S on the support surface 4. The stopper 21 positions the sheet S at the fold position by the abutment of the front end of the sheet S against the stopper 21.

A horizontal support bar 27 is attached to the frame 1 at its opposed ends and extends in a direction perpendicular to the feed path of the sheet S at an upstream side of the opening 3 of the plate 2a. A sensor 28 is attached to the center of the support bar 27 to detect a passage of a tail end of the sheet S.

The stopper 21 is movable along the feed path of the sheet S in a direction of toward and away from the sensor 28. The stopper 21 is disposed away from the sensor 28 by a distance (r) summed up in both of a distance (p) along the feed path of the sheet S and a predetermined distance (q).

[0035] After the passage of the tail end of the sheet S, the control unit 22 controls the second servomotor 19 by lowering the rotary speed of the second servomotor 19 in such a way that the feed speed of the sheet S gradually lowers so as to become the slowest speed just before the abutment of the sheet S against the stopper 21.

[0036] The control unit 22 comprises a second input portion 25 for receiving input of a data of a delay time (t) from when the tail end of the sheet S passes through the sensor 28 till when the folding operation of the knife blade 5 starts, and a second memory 26 for storing the data of the delay time (t) inputted through the second input portion 25.

In this embodiment, as shown in Fig. 5, the second input portion 25 is formed by an upper input area 29b of a touch screen 29. In the upper input area 29b there is a display portion for indicating a set value of the delay time (t) in a step-by-step manner. At the right side of the display portion there is a "+" button for increasing the set value, meanwhile, at the left side thereof there is a "-" button for decreasing the set value. The set values can easily be inputted by depressing these buttons on the micro-second time scale.

[0037] The delay time (t) is a time from when the tail end of the sheet S passes through the sensor 28 till when the sheet S rebounds from the stopper 21 and stops. By use of the delay time (t) the knife blade 5 can work the sheet S only when the sheet S completely stops after its abutment against the stopper 21 and rebound, so that the sheet S can be correctly folded.

[0038] Thus before the folding operation of the knife blade machine starts, the stopper 21 is disposed away from the sensor 28 by a distance (r) summed up in both of a distance (p) along the feed path of the sheet S and a predetermined distance (q). The set value of the distance (d1) from the support surface 4 to the first position, the set value of the distance (d2) from the support surface 4 to the second position and the set value of the delay time (t) are inputted through the touch screen 29, respectively. The knife blade 5 moves to the first position based on the set value of the distance (d1) so as to be kept in a standby condition.

[0039] Then the folding operation of the knife folding machine starts. The first sheet S is conveyed to the fold position by the conveyer belts 20. When the sensor 28 detects the passage of the tail end of the sheet S, the control unit 22 starts the time measurement after the passage of the sheet S through the sensor 28, and at the same time gradually slows the feed speed of the sheet S. The sheet S abuts against and rebounds from the stopper 21, and then stops at the fold position (see Fig. 2). Soon after that, the control unit 22 detects the delay time (t) after the passage of the sheet S through the sensor 28 and the folding operation starts, so that the knife blade 5 is moved from the first position to the second position.

[0040] During the movement, the sheet S on the support surface 4 is folded in two by the knife blade 5, and the edge of the folded portion of the sheet S is pushed out of the opening 3 and inserted to the gap between the folding rollers 6a, 6b so that the sheet S can be folded by the folding rollers 6a, 6b. Then the knife blade 5 returns from the second position to the first position. During the reciprocal movement of the knife blade 5 between the first and second positions, the folding operation is caused. The next sheet S is conveyed by the conveyer belts 20 to be fed to the fold position every time each of the folding operations is completed.

DESCRIPTION OF THE REFERENCE CHARACTERS

[0041]

1 frame
2 plate
2a center plate
3 opening
4 support surface
5 knife blade
6a, 6b folding rollers
7 knife drive unit
8 support arm
9 holder
9a upper support wall
9b lower support wall
10 rod
11 block
12 feed screw

13 first pulley
14 servomotor
14a drive shaft
15 second pulley
16 timing belt
17 drive roller
18 idle roller
19 servomotor
20 conveyer belt
21 stopper
22 control unit
23 first input portion
24 first memory
25 second input portion
26 second memory
27 support bar
28 sensor
29 touch screen
29a lower input area
29b upper input area
30a, 30b numerical value column
S sheet

Claims

1. A knife folding machine, comprising:

a frame (1) having a support surface (4) to support a lower surface of a sheet or a sheet bundle (S);
a positioning means attached to the frame (1) to position the sheet or the sheet bundle (S) at a fold position on the support surface (4);
a knife blade (5);
a pair of folding rollers (6a, 6b) opposed to the knife blade (5) with the support surface (4) therebetween at the fold position, the folding rollers (6a, 6b) being attached to the frame (1), the knife blade (5) and the folding rollers (6a, 6b) being disposed in parallel to each other, an edge of the knife blade (5) being opposed to a gap between the folding rollers (6a, 6b), the support surface (4) having a opening (3) through which the knife blade (5) passes;
a knife drive unit (7) for reciprocating the knife blade (5) in a direction perpendicular to the support surface (4) through the opening (3) between a first position and a second position, the first position being opposed to the folding rollers (6a, 6b) with the support surface (4) therebetween and spaced from the support surface (4), the second position being disposed adjacent the gap between the folding rollers (6a, 6b);
a support arm (8) attached to the frame (1) to support the knife drive unit (7); and
a control unit (22) for controlling the knife drive unit (7); wherein
the reciprocal movement of the knife blade (5) between the first and second positions effects a folding operation, wherein
while the knife blade (5) moves from the first position to the second position, the sheet or the sheet bundle (S) on the support surface (4) being folded in two by the knife blade (5), an edge of the folded portion thereof being pushed out of the opening (3) and inserted to the gap between the folding rollers (6a, 6b) so that the sheet or the sheet bundle (S) can be folded by the folding rollers (6a, 6b); and wherein
the knife drive unit (7) comprises:

a holder (9) attached to the support arm (8);
a rod (10) extending in a direction perpendicular to the support surface (4) and attached to the holder (9) to reciprocate in an axial direction thereof, the rod (10) having one end attached to the knife blade (5);
a block (11) attached to a center portion of the rod (10);
a feed screw (12) extending in parallel to the rod (10) and attached to the holder (9) to rotate around an axis thereof, the block (11) having a thorough hole which has thread grooves corresponding to the feed screw (12), the feed screw (12) engaging with the through hole, the rod (10) being reciprocated by the rotation of the feed screw (12);
a first pulley (13) attached to an upper or lower end of the feed screw (12);
a servomotor (14) attached to the holder (9) and having a drive shaft (14a), the drive shaft (14a) extending in parallel to the feed screw (12);
a second pulley (15) attached to the drive shaft (14a) of the servomotor (14); and
a timing belt (16) extended between the first and second pulleys (13, 15), the servomotor (14) being controlled by the control unit (22).

2. The knife folding machine according to claim 1, wherein
the control unit (22) comprises:

a first input portion (23) for receiving input of both a data of a distance (d1) from the support surface (4) to the first position and a data of a distance (d2) from the support surface (4) to the second position; and
a first memory (24) for storing the datum of the distances (d1, d2) inputted through the first input portion (23); and wherein
the control unit (22) controls the servomotor (14) based on the datum of the distances (d1, d2) stored in the first memory (24).

3. The knife folding machine according to claim 2, further comprising:

a feed means attached to the frame (1) to sequentially feed the sheet or the sheet bundle (S) to the fold position in a direction parallel or perpendicular to the knife blade (5) on the support surface (4); wherein
the positioning means comprises a stopper (21) disposed on a downstream side of the knife blade (5) and extending in a direction perpendicular to a feed path of the sheet or the sheet bundle (S) on the support surface (4), the stopper (21) positioning the sheet or the sheet bundle (S) at the fold position by an abutment of a front end of the sheet or the sheet bundle against the stopper (21).

4. The knife folding machine according to claim 3, further comprising:

a sensor (28) disposed in the middle way of the feed path of the sheet or the sheet bundle (S) to detect a passage of a tail end of the sheet or the sheet bundle (S); wherein
the stopper (21) is movable along the feed path in a direction of toward and away from the sensor (28) and disposed away from the sensor (28) by a distance (r) summed up in both of a distance (p) along the feed path of the sheet or the sheet bundle (S) and a predetermined distance (q); wherein
the control unit (22) comprises:

a second input portion (25) for receiving input of a data of a delay time (t) from when the tail end of the sheet or the sheet bundle (S) passes through the sensor (28) till when the folding operation of the knife blade (5) starts; and
a second memory (26) for storing the data of the delay time (t) inputted through the second input portion (25); and wherein

the control unit (22) controls the servomotor (14) of the knife drive unit (7) based on a detecting data from the sensor (28) and the data of the delay time (t) stored in the second memory (26).

5. The knife folding machine according to claim 4, wherein
the feed means comprises:

a drive roller (17) and an idle roller (18) attached to the frame (1) and spaced from and in parallel to each other;
at least one conveyer belt (20) extending between the drive roller (17) and idle roller (18); and
a second servomotor (19) attached to the frame (1) to rotate the drive roller (17); wherein

a part of the support surface (4) is formed by a feed surface of the conveyer belt (20), each of rotation shafts of the drive roller (17) and idle roller (18) being disposed in parallel or vertical to the knife blade (5).

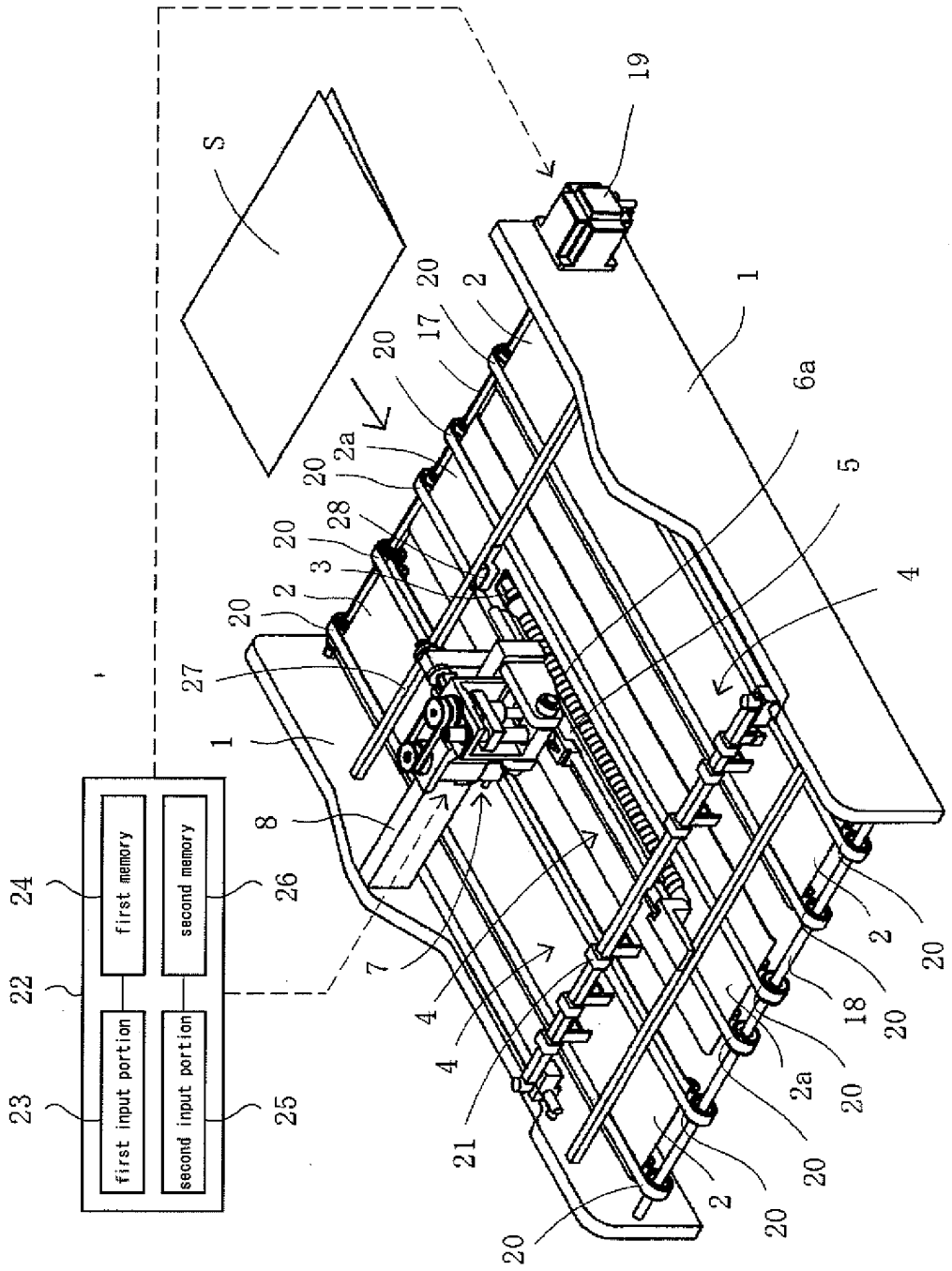
S
19
20
2
17
1
6a
2a
5
28
3
4
27
8
7
21
18
first memory
second memory
first input portion
second input portion
22
23
24
25
26

Fig. 1

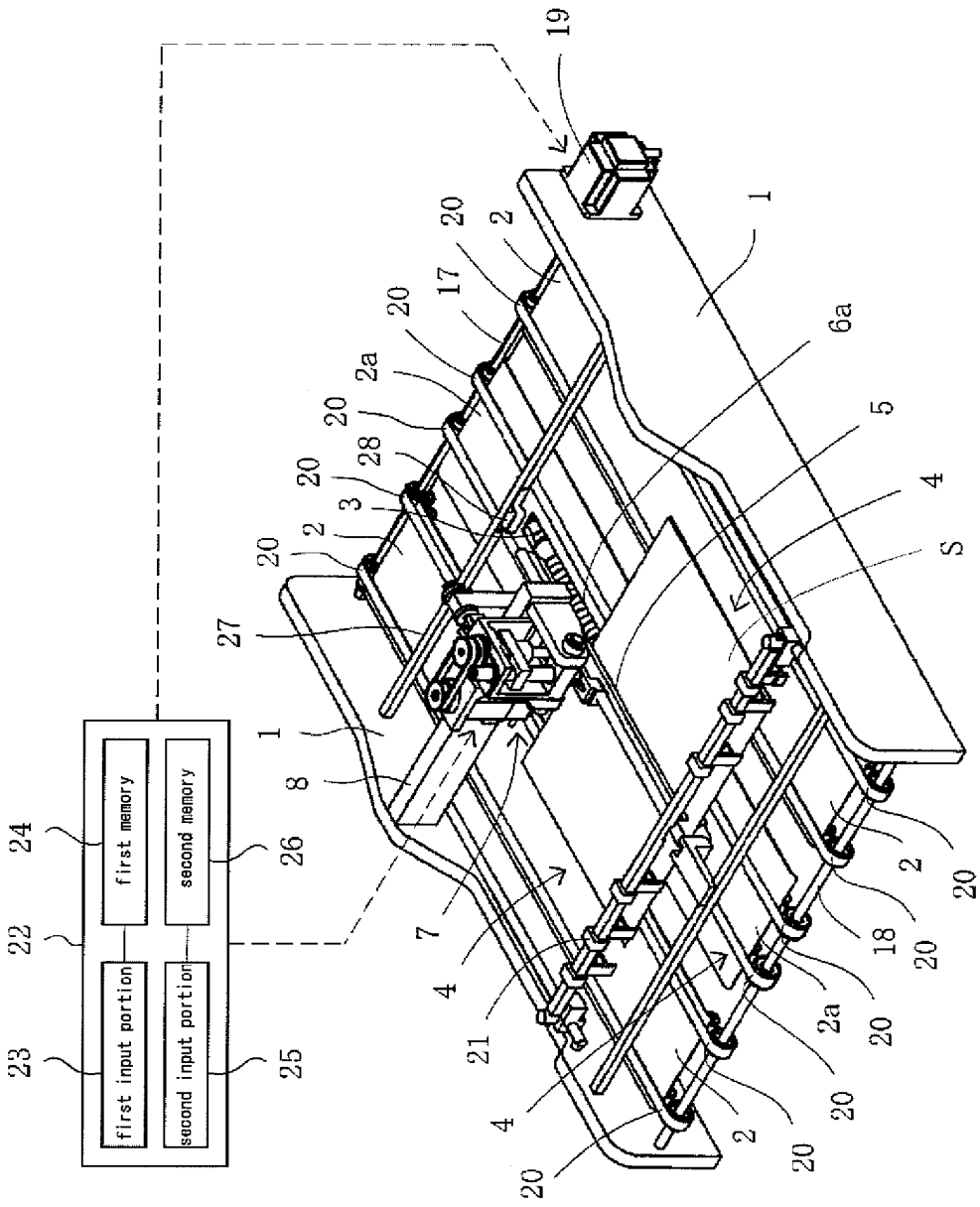
first memory
second memory
first input portion
second input portion
19
1
20
2
17
2a
6a
5
4
S
28
3
27
8
7
21
18
23
24
22
25
26

Fig. 2

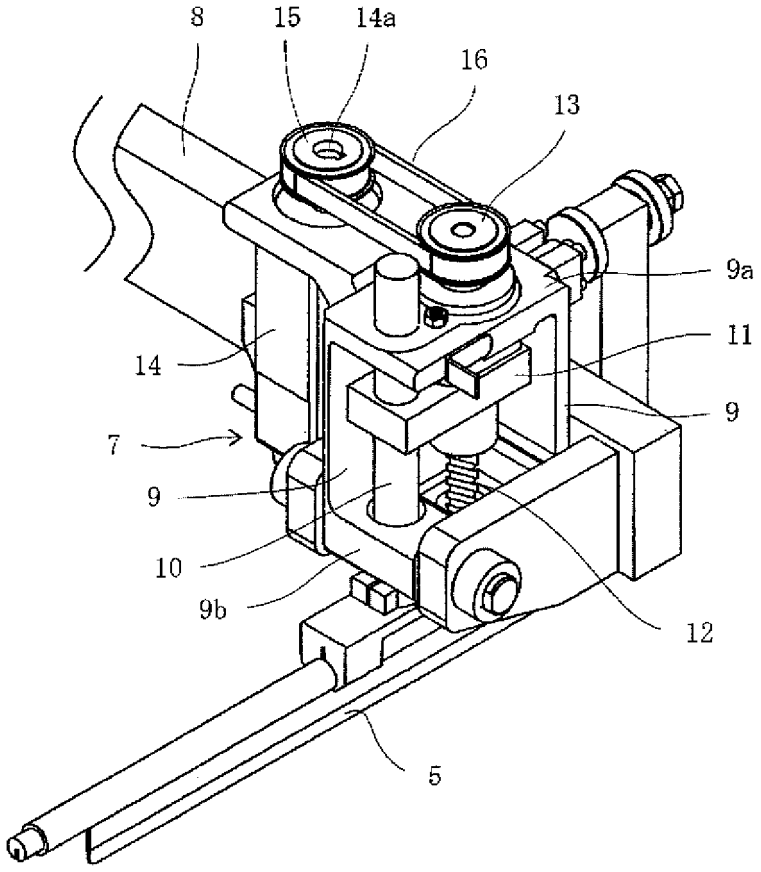

Fig. 3

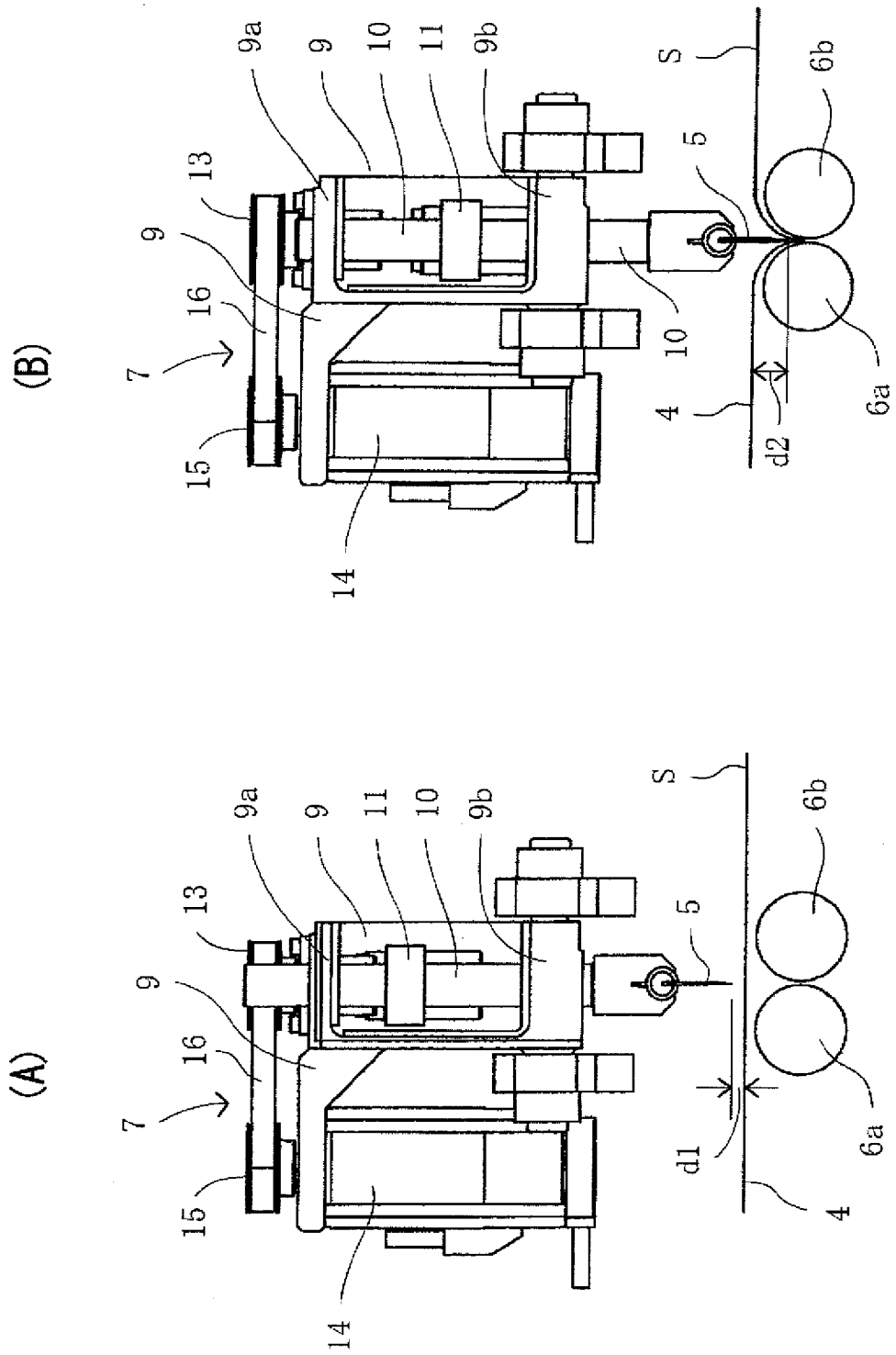

Fig. 4

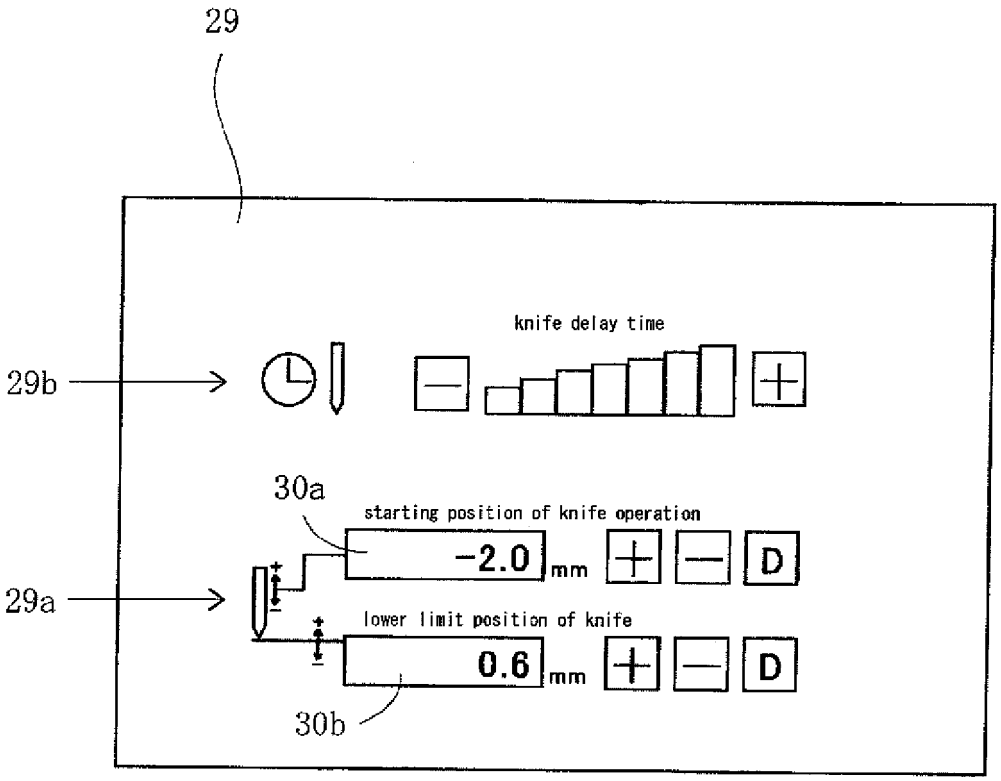
29
knife delay time
29b
30a
starting position of knife operation
-2.0
mm
D
29a
lower limit position of knife
0.6
mm
D
30b

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/070695

A. CLASSIFICATION OF SUBJECT MATTER
B65H45/18(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65H45/00-45/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2010
Kokai Jitsuyo Shinan Koho	1971-2010	Toroku Jitsuyo Shinan Koho	1994-2010

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 10-258966 A (Hitachi Seiko,Ltd.), 29 September 1998 (29.09.1998), paragraphs [0015] to [0023]; fig. 1 to 2 (Family: none)	1-3 4-5
A	JP 2003-238025 A (Mitsubishi Heavy Industries, Ltd.), 27 August 2003 (27.08.2003), entire text; all drawings (Family: none)	4-5
A	JP 10-265124 A (Hitachi Seiko, Ltd.), 06 October 1998 (06.10.1998), entire text; all drawings (Family: none)	1-5

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 February, 2010 (25.02.10)	09 March, 2010 (09.03.10)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/070695

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2008-143637 A (Komori Corp.), 26 June 2008 (26.06.2008), entire text; all drawings (Family: none)	1-5
A	JP 2006-69763 A (Fuji Xerox Co., Ltd.), 16 March 2006 (16.03.2006), entire text; all drawings & US 2006/49574 A1	1-5

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 4568319 A **[0008]**
- JP 2007091473 A **[0008]**