

DESCRIPTION

TITLE

COLLATOR AND CONTROL PROGRAM THEREFOR

FIELD

5 Embodiments of the present invention relate to a
collator and a control program for the collator.

BACKGROUND

10 A collator that forms a paper bundle having a
plurality of types of paper sheets piled, from a plurality
of paper bundles having paper sheets piled by type, is used
to create bundles of newspaper inserts, for example.

15 The collator includes a plurality of paper feed racks
for allowing paper sheets to be stacked thereon by type in
a state in which the paper feed racks are arranged in the
vertical direction. The collator feeds out paper sheets
stacked on the paper feed racks to a common conveyance path
at appropriate timings, so that a paper bundle having a
plurality of types of paper sheets piled is formed on this
common conveyance path.

20 For this type of collator, a collator provided with a
function called a continuous feed function has been known
(for example, Jpn. Pat. Appln. KOKAI Publication No. 2007-
39216). Specifically, as long as a paper feed rack in which
a continuous feed function is set to "valid" has any
25 stacked paper sheets remaining thereon, no paper sheet is
fed out from another paper feed rack adjacent to this
particular paper feed rack. When paper sheets stacked on a

paper feed rack in which a continuous feed function is set to "valid" are all fed out therefrom, this particular paper feed rack is brought into a state in which paper sheets are not fed out, while another paper feed rack adjacent to this particular paper feed rack starts feeding out paper sheets.
5 This enables paper sheets of one type to be continuously fed out from a plurality of paper feed racks.

SUMMARY

According to the previously technique described above,
10 as a paper feed rack that feeds out paper sheets, shifting is only allowed from a paper feed rack that performs a prior feed-out of paper sheets to its adjacent paper feed rack. Thus, there is no degree of freedom.

For example, one collator has detachable paper feed
15 racks so that by removing one paper feed rack, the number of paper sheets stacked on a paper feed rack located one stage lower can be increased. The paper feed rack which increased the number of stackable paper sheets as described above has no upwardly-adjacent paper feed rack, so that a
20 continuous feed function is not available in some cases.

Under these circumstances, there is a demand for the improvement in convenience by increasing the degree of freedom in the shifting of a paper feed rack with a continuous feed function.

25 According to an aspect of the invention, a collator includes three or more paper feed racks arranged in a vertical direction, each of which allows a large number of

paper sheets to be stacked; feed-out mechanisms that are correlated with the paper feed racks, respectively, and feed out one by one the paper sheets stacked on the correlated paper feed racks; a common conveyance path that conveys the paper sheets fed out by the plurality of feed-out mechanisms, respectively; detectors that are provided in a manner to be correlated with the paper feed racks respectively, and which detect a state in which the paper sheets stacked on the correlated paper feed racks have run out; feed-out control means that operates a feed-out mechanism correlated with a paper feed rack having a valid setting, out of the plurality of paper feed racks, at a timing predetermined in a manner such that the paper sheets fed out by the feed-out mechanism overlap with the paper sheets fed out by another feed-out mechanism on the common conveyance path; and setting change means that, if one detector of the detectors detects a state in which the paper sheets have run out, cancels the valid setting of the paper feed rack correlated with the one detector, and that if the correlated paper feed rack has the setting of continuous feed, changes from an invalid setting to a valid setting for a predetermined paper feed rack out of a paper feed rack that is adjacent to the correlated paper feed rack and a paper feed rack that is not adjacent.

According to the above aspect of the present invention, it is possible to provide a collator and a control program for the collator, with improved convenience, by increasing

the degree of freedom in the shifting of a paper feed rack with a continuous feed function.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective diagram showing an outer appearance of a collator according to an embodiment.

FIG. 2 is a diagram showing a structure of a mechanism provided inside the collator shown in FIG. 1, for conveying paper sheets.

FIG. 3 is a view showing a part-broken concrete structure of a feed-out mechanism in FIG. 2.

FIG. 4 is a block diagram showing a structure of a control system of the collator shown in FIG. 1.

FIG. 5 is a diagram schematically showing contents of a setting table.

FIG. 6 is a flowchart of control processing executed by a processor shown in FIG. 4.

FIG. 7 is a timing chart showing the timings of executing the primary paper feed and the secondary paper feed for two adjacent paper feed racks.

FIG. 8 is a timing chart showing the timings of executing the primary paper feed and the secondary paper feed for two paper feed racks that form a set for continuous feed.

FIG. 9 is a timing chart showing the timings of executing the primary paper feed and the secondary paper feed for three paper feed racks that make a set for continuous feed.

DETAILED DESCRIPTION

Hereinafter, embodiments of the present invention will be described with reference to the drawings.

FIG. 1 is a perspective view showing an outer appearance of a collator 100 according to an embodiment.

In FIG. 1, the left-front side is defined as "the front side" of the collator 100, the right-rear side is defined as "the rear side" of the collator 100, the left-rear side is defined as "the left side," and the right-front side is defined as "the right side."

The collator 100 includes a support member 1, a support member 2, a top plate 3, a bottom plate 4, a plurality of paper feed racks 5, a plurality of paper feed racks 6, a paper feed rack 7, a hopper 8, an upper panel 9, a lower panel 10, a plurality of main panels 11, and a touch panel 12.

The support member 1 and the support member 2 each have a rectangular plate-like appearance, and while their longitudinal directions are oriented in the vertical direction, they face each other so as to be positioned on the left side and the right side, respectively.

The top plate 3 connects the support member 1 and the support member 2 in the vicinity of each of their upper ends. The bottom plate 4 connects the support member 1 and the support member 2 in the vicinity of each of their lower ends.

In the present embodiment, the collator 100 includes

eleven paper feed racks 5. The paper feed racks 5 are supported by the support members 1, 2 in a state in which the paper feed racks 5 are arranged in a line in the vertical direction between the support members 1, 2. The paper feed racks 5 allow paper sheets to be stacked on their upper surfaces. The paper feed racks 5 receive input of paper sheets from the front side.

FIG. 1 shows only one paper feed rack 6; however, the number of paper feed racks 6 is equal to the number of the paper feed racks 5. That is, in the present embodiment, there are eleven paper feed racks 6. The paper feed racks 6 are supported by the support members 1, 2 in a state in which the paper feed racks 6 are arranged in a line in the vertical direction between the support members 1, 2. The paper feed racks 6 allow paper sheets to be stacked on their upper surfaces. The paper feed racks 6 receive insert of paper sheets from the rear side. Each of the paper feed racks 6 is arranged laterally in line with each of the paper feed racks 5.

However, the number of the paper feed racks 5 and the number of the paper feed racks 6 may be any number greater than 3. At least part of the paper feed racks 5, 6 may be detachable with respect to the support members 1, 2. In addition, the number of paper feed racks 5 may be different from the number of paper feed racks 6.

The paper feed rack 7 is arranged to be adjacent to the lower side of the lowermost paper feed rack 5 between

the support members 1, 2, and is supported by the support members 1, 2. The paper feed rack 7 allows paper sheets used as folded sheets to be stacked on the upper surface thereof. The paper feed rack 7 receives insert of paper sheets from the front side. Herein, a folded sheet indicates a paper sheet that sandwiches a paper bundle in a state in which this paper sheet is folded in two.

The hopper 8 is arranged to be adjacent to the lower side of the paper feed rack 7 between the support members 1, 2, and is supported by the bottom plate 4. The hopper 8 allows a formed paper bundle to be stacked on its upper surface.

The upper panel 9 is attached to the front face of the support member 1 and includes an operation switch 9a, a discharge switch 9b, and a test switch 9c. The operation switch 9a inputs instructions to start and stop a collating operation. The discharge switch 9b inputs instructions to start an operation for discharging any paper sheet staying inside the collator 100. The test switch 9c inputs instructions to start a trial collating operation. Although not shown in FIG. 1, an upper panel 9 is attached to the rear face of the support member 1.

The lower panel 10 is attached to the front face of the support member 1 and includes a lock switch 10a, a forward/reverse switch 10b, and a speed adjustment dial 10c. The lock switch 10a inputs instructions for emergency stop of a collation operation. The forward/reverse switch 10b

inputs instructions as to a paper feed direction after an emergency stop. The speed adjustment dial 10c inputs designation of a folding speed. Although not shown in FIG. 1, a lower panel 10 is attached to the rear face of the support member 1. However, the lower panel 10 attached to the rear face of the support member 1 includes a power switch instead of the speed adjustment dial 10c. The power switch turns on/off power intake from an external commercial power supply.

10 The front face of the support member 1 is provided with a discharge adjustment dial and a folding adjustment dial, which are not shown in FIG. 1 because they are placed in the shade of the paper feed rack 7. The discharge adjustment dial inputs designation of a speed at which a formed paper bundle is discharged. The folding adjustment dial inputs designation of a folding position at the time when a folded sheet is formed by folding a paper sheet stacked on the paper feed rack 7.

20 The collator 100 includes the main panel 11, the number of which is one more than the number of the paper feed racks 5. That is, in the present embodiment, there are twelve main panels 11. These twelve main panels 11 are attached to the front face of the support member 2 in a state in which they are aligned next to the paper feed racks 5 and the paper feed rack 7, respectively. Each of these main panels 11 includes a paper feed switch 11a, an error switch 11b, a continuous feed switch 11c, and a

separation adjustment dial 11d. However, the continuous feed switch 11c is not provided to the main panels 11 aligned next to the uppermost paper feed rack 5 and the paper feed rack 7, respectively. The main panels 11 are correlated with the paper feed racks 5, 7 aligned next to the main panels 11, respectively. The paper feed switch 11a and the error switch 11b input the designation as to whether the setting of the correlated paper feed rack is made valid or not. The continuous feed switch 11c inputs the designation as to whether the continuous feed function is applied or not. The separation adjustment dial 11d inputs designation of the magnitude of a force to be applied to paper sheets so a feed-out mechanism to be describe later as to feed out one paper sheet from the paper sheets stacked on the correlated paper feed rack. Although not shown in FIG. 1, main panels 11 are attached to the rear face of the support member 2, in a manner such that they are correlated with the paper feed racks 6, respectively. That is, the collator 100 includes the twenty-three main panels 11 in total.

The touch panel 12 is attached to the side face of the support member 2. The touch panel 12 displays various types of information related to operations of the collator 100. The touch panel 12 inputs designations of various settings related to operations of the collator 100.

FIG. 2 is a diagram schematically showing a structure of a mechanism provided inside the collator 100 for

conveying paper sheets S. In FIG. 2, the same elements as those in FIG. 1 are denoted by the same reference numerals, and a detailed description of such elements will be omitted.

5 The collator 100 includes a plurality of feed-out mechanisms 21, a plurality of feed-out mechanisms 22, a feed-out mechanism 23, a plurality of guides 24, a plurality of vertical conveyance rollers 25, a plurality of vertical conveyance rollers 26, a sheet folding unit 27, and a conveyance belt 28, as elements of mechanisms related
10 to conveyance of the paper sheets S.

The feed-out mechanisms 21 are provided in a manner such that they are correlated with the paper feed racks 5, respectively. That is, in the present embodiment, there are eleven feed-out mechanisms 21. The feed-out mechanism 21
15 feeds out one by one the paper sheets S stacked on the correlated paper feed rack 5.

FIG. 3 is a view showing a concrete structure of each feed-out mechanism 21 with part broken.

20 The feed-out mechanism 21 includes a driving paper feed roller 21a, a driven paper feed roller 21b, a timing belt 21c, a separation plate 21d, conveyance rollers 21e, 21f, a paper feed sensor 21g, a continuous feed sensor 21h, and a jamming sensor 21i.

25 The driving paper feed roller 21a and the driven paper feed roller 21b can be swung vertically by a bracket (not shown). The driving paper feed roller 21a and the driven paper feed roller 21b are rotated with a driving force that

is generated by a motor (not shown in FIG. 3) and is transmitted through a first electromagnetic clutch (not shown in FIG. 3). The driven paper feed roller 21b is connected to the driving paper feed roller 21a by the timing belt 21c, and rotates along with the rotation of the driving paper feed roller 21a. An electromagnetic brake (not shown in FIG. 3) is attached to the driving paper feed roller 21a.

The separation plate 21d is arranged below the driving paper feed roller 21a and is pressed against the circumferential surface of the driving paper feed roller 21a. The separation plate 21d is formed of, for example, a rubber material, and gives a large frictional force to the paper sheets S. This allows the separation plate 21d to stop the lower paper sheets S inserted between the separation plate 21d and the driving paper feed roller 21a, and allows the driving paper feed roller 21a to feed out only one of these paper sheets S, which is located at the top.

The conveyance rollers 21e, 21f are arranged so as to face each other with their circumferential surfaces in contact with each other. Furthermore, the conveyance rollers 21e, 21f are arranged next to the driving paper feed roller 21a in a manner such that the paper sheet S fed out from the paper feed rack 5 by the driving paper feed roller 21a enters the interval between the conveyance roller 21e and the conveyance roller 21f. The conveyance

rollers 21e, 21f feed out the paper sheet S fed therein by the driving paper feed roller 21a toward the guide 24.

5 The conveyance rollers 21e, 21f are rotated with a driving force that is generated by the aforementioned motor and is transmitted through a second electromagnetic clutch (not shown in FIG. 3). The driving paper feed roller 21a is rotated with a driving force that is generated by the above-described motor and is transmitted through a first electromagnetic clutch (not shown). An electromagnetic
10 brake (not shown) is attached to the driving paper feed roller 21a.

The paper feed sensor 21g includes an actuator 21g-1 and a micro switch 21g-2. The actuator 21g-1 is pressed down by the paper sheet S that has entered the interval
15 between the conveyance roller 21e and the conveyance roller 21f. The micro switch 21g-2 is turned on by the actuator 21g-1 pressed down as described above. In this manner, the paper feed sensor 21g detects that the paper sheet S is present between the conveyance roller 21e and the
20 conveyance roller 21f.

The continuous feed sensor 21h detects the paper sheet S stacked on the paper feed rack 5. As the continuous feed sensor 21h, for example, an optical sensor of a reflective type is used. This makes it possible to determine, when the
25 continuous feed sensor 21h detects no paper sheet S, that the paper sheet S is not properly stacked on the paper feed rack 5. The continuous feed sensor 21h is an example of a

detector that detects the state in which the paper sheet S stacked on the paper feed rack 5 has run out.

5 The jamming sensor 21i detects the paper sheet S fed by the conveyance rollers 21e, 21f. This makes it possible to determine that jamming is happening if the jamming sensor 21i keeps detecting the paper sheet S even after a certain period of time has elapsed from the starting of the feed-out of the paper sheet S by the conveyance rollers 21e, 21f.

10 As shown in FIG. 2, the feed-out mechanisms 22 are provided in a manner such that they are correlated with the paper feed racks 6, respectively. That is, in the present embodiment, there are eleven feed-out mechanisms 22. The feed-out mechanism 22 feeds out one by one the paper sheets S stacked on the correlated paper feed rack 6. Since the structure of the feed-out mechanism 22 is similar to that of the feed-out mechanism 21, its illustration and description are omitted.

20 The feed-out mechanism 23 is provided in a manner to be correlated with the paper feed rack 7. The feed-out mechanism 23 feeds out one by one the paper sheets S stacked on the paper feed rack 7. Since the structure of the feed-out mechanism 23 is similar to that of the feed-out mechanism 21, its illustration and description are omitted.

25 The guides 24 are provided in a manner such that each of them is correlated with a pair of the feed-out

mechanisms 21, 22. That is, in the present embodiment, there are eleven guides 24. The guides 24 are aligned in the vertical direction. The guide 24 feeds out the paper sheets S fed from the feed-out mechanisms 21, 22, respectively, which form a pair correlated with this particular guide 24, into the interval between the vertical conveyance roller 25 and the vertical conveyance roller 26. Furthermore, each of the guides 24 other than the one located at the top feeds the paper sheet S, which is fed out from the upwardly-adjacent vertical conveyance rollers 25, 26, into the interval between the downwardly-adjacent vertical conveyance rollers 25, 26.

The vertical conveyance rollers 25, 26 are provided in a manner to be correlated with the guides 24, respectively. That is, in the present embodiment, there are eleven vertical conveyance rollers 25 and eleven vertical conveyance rollers 26. The vertical conveyance rollers 25, 26 are arranged so as to face each other with their circumferential surfaces in contact with each other. Furthermore, the vertical conveyance rollers 25, 26 are arranged to be downwardly adjacent to the correlated guide 24 in a manner such that the paper sheet S fed in by the guide 24 enters the interval between the vertical conveyance rollers 25, 26. The vertical conveyance rollers 25, 26 feed out the paper sheet S fed therein by the guide 24, to a lower side.

In this manner, the guides 24 and the vertical

conveyance rollers 25, 26 form a common conveyance path for conveying the paper sheet S fed out from the plurality of paper feed racks 5, 6.

5 The sheet folding unit 27 includes a conveyance belt 27a, a folding box 27b, a folding box sensor 27c, a folding knife 27d, and folding rollers 27e, 27f.

10 The conveyance belt 27a conveys the paper sheet S fed out by the feed-out mechanism 23 from the paper feed rack 7 until the leading end of this paper sheet S passes through the upper side of the folding rollers 27e, 27f and reaches the inside of the folding box 27b.

15 The folding box 27b holds the end portion of the paper sheet S. While the folding box 27b holds the end portion of the paper sheet S, the central portion of this particular paper sheet S is positioned above the folding rollers 27e, 27f. The folding box 27b is moved in the lateral direction by a moving mechanism (not shown in FIG. 2) in accordance with the rotation of the folding adjustment dial.

20 The folding box sensor 27c detects the state in which the paper sheet S is held by the folding box 27b.

25 The folding knife 27d is vertically moved by a reciprocating mechanism (not shown) in synchronization with a timing at which the paper sheet S is conveyed on the common conveyance path. When the leading end of the paper sheet S is fed into the folding box 27b by the conveyance belt 27a as described above, the folding knife 27d is located upward and does not interfere with this paper sheet

S. The folding knife 27d is moved downward by a folding knife driver (not shown) so that the central portion of the paper sheet S positioned above the folding rollers 27e, 27f is bent toward the interval between the folding roller 27e and the folding roller 27f.

The folding rollers 27e, 27f are positioned below the vertical conveyance rollers 25, 26. The folding rollers 27e, 27f feed out to a lower side, the paper sheet S that is positioned in a bent state above the folding rollers 27e, 27 as described above, together with a bundle of paper sheets S fed from the lowermost vertical conveyance rollers 25, 26. Accordingly, the paper sheet S that is positioned in a bent state above the folding rollers 27e, 27f as described above is folded in two as a folded sheet in a state in which the bundle of paper sheets S fed in from the lowermost conveyance rollers 25, 26 is sandwiched by this folded sheet.

The conveyance belt 28 conveys a bundle (paper bundle) B of the paper sheets S which have been fed out from the folding rollers 27e, 27f and have the folded sheet attached thereto, toward the front side of the collator 100 and discharges this paper bundle B toward the hopper 8.

FIG. 4 is a block diagram showing a structure of a control system of the collator 100. In FIG. 4, the same elements as those in FIG. 1 to FIG. 3 are denoted by the same reference numerals.

The collator 100 has rack-correlated units 31 in a

manner to be correlated with the paper feed racks 5 and the paper feed rack 7, respectively. Each of the rack-correlated units 31 is formed by connecting to an input/output circuit 31a, each of the paper feed switch 11a, the error switch 11b, and the continuous feed switch 11c of the main panel 11 provided to the correlated paper feed rack 5, and each of the paper feed sensor 21g, the continuous feed sensor 21h, the jamming sensor 21i, the first electromagnetic clutch 21j, the second electromagnetic clutch 21k, and the electromagnetic brake 21m, which are included in the feed-out mechanism 21 provided to the correlated paper feed rack 5. However, the continuous feed switch 11c is not included in the rack-correlated units 31 that are correlated with the uppermost paper feed rack 5 and the paper feed rack 7. The input/output circuit 31a generates and sends detection information to a data transmission path 43, in which the detection information indicates a state of each of the connected switches and sensors of various types and makes it possible to identify which switch or sensor the state corresponds to. When receiving transmission of control information for each of the first electromagnetic clutch 21j, the second electromagnetic clutch 21k, and the electromagnetic brake 21m through the data transmission path 43, the input/output circuit 31a changes an excitation state of the first electromagnetic clutch 21j, the second electromagnetic clutch 21k, or the electromagnetic brake

21m, in accordance with this control information.

Instead of having the continuous feed switch 11c, each of the rack-correlated units 31 correlated with the paper feed racks has the folding box sensor 27c connected to the input/output circuit 31a.

The collator 100 has rack-correlated units 32 in a manner of being correlated with the paper feed racks 6, respectively. The rack-correlated units 32 are formed in the same manner as the rack-correlated units 31. However, the paper feed sensor, the continuous feed sensor, the jamming sensor, the first electromagnetic clutch, the second electromagnetic clutch, and the electromagnetic brake with which each rack-correlated unit 32 is provided are included in the feed-out mechanism 22 provided with respect to each correlated paper feed rack 6.

The operation switch 9a, the discharge switch 9b, the test switch 9c, the lock switch 10a, the speed adjustment dial 10c, an inverter 34, a motor 35, the discharge adjustment dial 37, a discharge motor 38, and a rear display 39 are connected to the input/output circuit 33. The input/output circuit 33 generates and sends detection information to the data transmission path 43, in which the detection information indicates states of the connected switches of various types and a folding encoder 36 and make it possible to identify which device the state corresponds to. When receiving transmission of control information for each of the motor 35, the discharge motor 38, and the rear

display 39 through the data transmission path 43, the input/output circuit 33 changes an operation state of the motor 35, the discharge motor 38, and the rear display 39.

5 The inverter 34 obtains an AC driving signal for driving the motor 35 from a DC driving signal that the input/output circuit 33 outputs for controlling an operation of the motor 35, and the inverter 34 supplies this AC driving signal to the motor 35.

10 The motor 35 generates a driving force for driving the aforementioned rollers and belts of various types for conveying the paper sheets S. In the explanation of FIG. 3, this motor 35 is described as generating a driving force for rotating the driving paper feed roller 21a, the driven paper feed roller 21b, and the conveyance rollers 21e, 21f.

15 The encoder 36 generates a timing signal in accordance with a timing of conveying the paper sheet S on the common conveyance path.

20 Although not shown in FIG. 1, the discharge adjustment dial 37 has been described as being provided on the front face of the support member 1.

 The discharge motor 38 generates a driving force for discharging a sheet paper staying inside the collator 100.

25 The rear display 39 is provided on the rear face of the support member 1. The rear display 39 displays various abnormalities and usage states by an illumination lamp at the time of collation work.

 A processor 41 constitutes, along with the storage 42,

a computer that controls the collator 100.

The processor 41 is correlated with the central part of the computer. The processor 41 controls respective portions to realize various functions as the collator 100 according to an operating system and an application program.

The storage 42 corresponds to a main storage portion and an auxiliary storage portion of the computer. The storage 42 includes a nonvolatile memory area and a volatile memory area. The storage 42 stores an operating system and an application program in a nonvolatile memory area. In some cases, the storage 42 causes the volatile memory area to store a part of the application program. In some cases, the storage 42 causes a nonvolatile or volatile memory area to store data necessary for the processor 41 to execute processing for controlling respective portions. The storage 42 uses the volatile memory area as a work area in which data is appropriately rewritten by the processor 41.

The data transmission path 43 transmits various types of data exchanged between respective portions and the processor 41. The touch panel 12 is connected to the data transmission path 43.

Next, operations of the collator 100 configured as described above will be described. Since many operations of the collator 100 are similar to those of existing collators of the same type, their detailed description will be omitted. Here, an operation related to the continuous feed function will be described in detail.

For each of the paper feed racks 5, 6, and 7, the collator 100 is enabled to set the validity/invalid of paper feed from the paper feed rack, the execution/non-execution of error detection related to paper feed from the paper feed rack, and the application/non-application of continuous feed to a paper feed rack and the one-stage upper paper feed rack. For this, the storage 42 stores a setting table.

FIG. 5 is a diagram schematically showing contents of the setting table. However, the setting table may include information outside that which is shown in FIG. 5.

The setting table describes the validity/invalid of paper feed, the execution/non-execution of error detection, and the application/non-application of continuous feed, in association with each rack number for identifying the paper feed racks 5, 6, 7. In the present embodiment, the paper feed rack 7 is assigned with the rack number of "0", the paper feed racks 5 are assigned with the rack numbers of "1" to "11" in order from the bottom, and the paper feed racks 6 are assigned with the rack numbers of "12" to "22" in order from the top. The paper feed rack 7 and the paper feed racks 5, 6 as the uppermost stage have no pair for continuous feed. Thus, for the paper feed rack 7 and the paper feed racks 5, 6 as the uppermost stage, the application/non-application of continuous feed is fixed to a Null value. However, instead of a Null value, "non-applied" may be fixedly described to denote such

information.

FIG. 5 shows a setting example in the case where the paper bundle B is created by bundling the paper sheets S stacked on the paper feed racks 5, using the paper sheet S stacked on the paper feed rack 7 as a folded sheet. The paper sheets S of the same type are stacked on the lowermost paper feed rack 5 assigned with the rack number of "1" and the one-stage upper paper feed rack 5 assigned with the rack number of "2". Since the continuous feed is set to "applied" with respect to the rack number of "1", the paper feed racks assigned with the rack numbers of "1" and "2" respectively are handled as a set for continuous feed. With the paper feed rack 5 assigned with the rack number of "6" being removed, the paper sheets S of the same type are stacked on the paper feed rack 5 assigned with the rack number of "5," and the two-stage upper paper feed rack 5 assigned with the rack number of "7". Since the continuous feed are set to "applied" with respect to each of the rank numbers of "5" and "6", the paper feed racks assigned with the rack numbers of "5" to "7" respectively are handled as a set for continuous feed. For one set of paper feed racks handled as continuous feed, paper feed for one of these racks is set to "valid", and the other to "invalid".

When an operation is performed by an operator using any of the main panels 11, the processor 41 updates the description of the setting table in accordance with the

operation. That is, every time the paper feed switch 11a or the error switch 11b is operated using the main panel 11 correlated with the paper feed rack assigned with the rack number of "n", the processor 41 reverses the validity/invalidity of paper feed associated with the rack number "n" in the setting table. If the paper feed is changed to "valid" in response to the operation of the paper feed switch 11a, the processor 41 sets "non-execution" to the error detection associated with the rack number "n" in the setting table. If the paper feed is changed to "valid" in response to the operation of the error switch 11b, the processor 41 sets "execution" to the error detection associated with the rack number "n" in the setting table. Every time the continuous feed switch 11c is operated using the main panel 11 correlated with the paper feed rack assigned with the rack number of "n", the processor 41 reverses the application/non-application of continuous feed associated with the rack number "n" in the setting table.

FIG. 6 is a flowchart of control processing executed by the processor 41, based on a control program which is one of the application programs stored in the storage 42. This procedure of processing is merely an example. As long as similar results can be obtained, the processing order of each step may be altered appropriately, or other processing may be added.

Typically, the control program in which the control

processing shown in FIG. 6 is described is stored in the storage 42 at the time when the collator 100 is assigned to a user. However, the collator 100 may be assigned to a user in a state in which the above control program is not stored in the storage 42. In this case, the control program is recorded in a removable recording medium such as a magnetic disk, a magneto-optical disk, an optical disk, a semiconductor memory, etc., and is assigned to a user. Alternatively, the control program is assigned to a user through a network. Under the instructions by a user or a maintenance worker, this control program may be written in the storage 42 of the collator 100 assigned separately as described above.

The processor 41 starts the control processing shown in FIG. 6 in response to the operation switch 9a being operated in a state in which the collation operation is not executed. The processor 41 executes the control processing shown in FIG. 6 in parallel for the respective paper feed racks 5, 6. In the following explanation, out of the paper feed racks 5, 6, a paper feed rack targeted to this control processing is referred to as a target rack.

In step S_{a1}, the processor 41 refers to the setting table and checks whether or not the paper feed of a target rack is set to "valid". In the case of making a determination of "No" because the paper feed of the target rack is set to "invalid", the processor 41 keeps waiting by repeating step S_{a1} until the paper feed of the target rack

is validated. In other words, if the paper feed of the target rack is set to "invalid", the processor 41 stands by without execution of processing described below. The processor 41 makes a determination of "Yes" and proceeds to step Sa2 if the paper feed of the target rack is set to "valid".

In step Sa2, the processor 41 checks whether or not the continuous feed sensor 21h correlated with the target rack is on. If the paper sheet S is properly stacked on the target rack, the continuous feed sensor 21h is on. If the continuous feed sensor 21h is on, the processor 41 makes a determination of "Yes", and the processing proceeds to step Sa3.

In step Sa3, the processor 41 starts the primary paper feed regarding the target rack. The primary paper feed is an operation of feeding out the paper sheet S in order to move the leading end of only one of the paper sheets S stacked on the target rack to the interval between the conveyance rollers 21e, 21f. Specifically, the processor 41 brings the first electromagnetic clutch 21j into the excitation state and the electromagnetic brake 21m into the non-excitation state in the one of the feed-out mechanisms 21, 22 correlated with the target rack. This causes the driving paper feed roller 21a and the driven paper feed roller 21b to rotate, respectively. Accordingly, one of the paper sheets S stacked on the target rack is fed into the interval between the conveyance roller 21e and the

conveyance roller 21f by the driving paper feed roller 21a and the driven paper feed roller 21b. When the leading end of the paper sheet S reaches the interval between the conveyance roller 21e and the conveyance roller 21f, the
5 paper feed sensor 21g is turned on.

In step Sa4, the processor 41 waits for the paper feed sensor 21g correlated with the target rack to be turned on. If the paper feed sensor 21g is turned on as described above, the processor 41 makes a determination of "Yes", and
10 proceeds to step Sa5.

In step Sa5, the processor 41 stops the primary paper feed. Specifically, the processor 41 brings the first electromagnetic clutch 21j into the non-excitation state and the electromagnetic brake 21m into the excitation state,
15 as a result stops the rotation of the driving paper feed roller 21a, the driven paper feed roller 21b, and the conveyance rollers 21e, 21f. In this manner, in a state in which the leading end of the paper sheet S is positioned between the conveyance roller 21e and the conveyance roller
20 21f, the primary paper feed is stopped.

In step Sa6, the processor 41 waits for a feed-out timing set for the target rack to come. This feed-out timing is set in advance by a designer or a maintenance worker of the collator 100, for example, in a manner such
25 that the paper sheets S fed out from the paper feed racks 5, 6 respectively overlap each other on the common conveyance path composed of the guides 24 and the vertical conveyance

rollers 25, 26. In the case of making a determination of "Yes" because a feed-out timing has come, the processor 41 proceeds to step Sa7.

5 In step Sa7, the processor 41 starts the secondary paper feed. The secondary paper feed is an operation of feeding out the paper sheet S to the common conveyance path. Specifically, the processor 41 brings both of the first electromagnetic clutch 21j and the second electromagnetic clutch 21k into the excitation state in the one of the
10 feed-out mechanisms 21, 22 correlated with the target rack. This causes the driving paper feed roller 21a, the driven paper feed roller 21b, and the conveyance rollers 21e, 21f to rotate, respectively. Accordingly, the paper sheet S having its leading end positioned between the conveyance
15 roller 21e and the conveyance roller 21f is guided by the guide 24, while being fed into the interval between the vertical conveyance roller 25 and the vertical conveyance roller 26. While the collating operation is being carried out, the vertical conveyance rollers 25, 26 are constantly
20 rotating, and the paper sheet S fed as described above is conveyed downward through the common conveyance path by the vertical conveyance rollers 25, 26. At this time, if there is an additional paper sheet S fed into the common conveyance path from the upstream side of the common
25 conveyance path, the aforementioned paper sheet S overlaps this additional paper sheet S on the common transport path.

In step Sa8, the processor 41 checks whether or not

the continuous feed sensor 21h correlated with the target rack is turned off. If the continuous feed sensor 21h is still on, the processor 41 makes a determination of "No" and proceeds to step Sa9.

5 In step Sa9, the processor 41 checks whether or not the paper feed sensor 21g correlated with the target rack is turned off. If the paper feed sensor 21g remains to be on, the processor 41 makes a determination of "No" and returns to step Sa8.

10 In this manner, in steps Sa8 and Sa9, the processor 41 waits for the continuous feed sensor 21h or the paper feed sensor 21g to be turned off.

 When the paper sheet S almost completely disengages from the interval between the conveyance roller 21e and the conveyance roller 21f, the paper feed sensor 21g is turned
15 off. If the paper feed sensor 21g is turned off in this way, the processor 41 makes a determination of "Yes" in Step Sa9, and proceeds to step Sa10.

 In step Sa10, the processor 41 stops the secondary
20 paper feed. Specifically, the processor 41 brings the second electromagnetic clutch 21k into the non-excitation state as a result stops the rotation of the conveyance rollers 21e, 21f. Even before the paper feed sensor 21g is turned off, if a predetermined period of time has elapsed
25 from the starting of the secondary paper feed, the processor 41 brings the first electromagnetic clutch 21j into the non-excitation state as a result stops the

rotation of the driving paper feed roller 21a In step Sa12,
and the driven paper feed roller 21b. Even when the driving
paper feed roller 21a and the driven paper feed roller 21b
stop rotating, as long as the conveyance rollers 21e, 21f
5 rotate, the paper sheet S sandwiched between the conveyance
rollers 21e, 21f is made to pass through the interval
between the driving paper feed roller 21a and the
separation plate 21d and then drawn out.

Thereafter, the processor 41 returns to step Sa1 and
10 repeats the processing from step Sa1 onward in the same
manner as described above. That is, when the continuous
feed sensor 21h remains on, the processor 41 starts the
primary paper feed immediately after the completion of the
secondary paper feed.

15 In this manner, by the processor 41 executing the
processing from step Sa3 to step Sa10 in the control
processing based on the control program, the computer
having the processor 41 as the central part functions as
feed-out control means.

20 FIG. 7 is a timing chart showing timings of executing
the primary paper feed and the secondary paper feed for two
adjacent paper feed racks 5.

These two paper feed racks 5 are assigned with the
rack numbers of "3" and "4", respectively, and as shown in
25 FIG. 5, paper feed for both the racks is set to "valid".

As shown in FIG. 7, with respect to the paper feed
rack for which paper feed is set to "valid", if the

continuous feed sensor 21h remains on for the reason that the paper sheet S stacked on the paper feed rack is still present, the secondary paper feed is started at each paper feed timing for each paper feed rack. Every time the
5 secondary paper feed started in this way is completed, the primary paper feed is started.

When the secondary paper feed is executed with respect to the last paper sheet S stacked on the target rack, the continuous feed sensor 21h is turned off before the paper
10 feed sensor 21g is turned off. In this case, the processor 41 makes a determination of "Yes" in step Sa8, and proceeds to step Sa11. If no paper sheet S is stacked on the target rack when the control processing shown in FIG. 6 is started, and the continuous feed sensor correlated with the target
15 rack is off, the processor 41 makes a determination of "No" in step Sa2, and proceeds to step Sa11.

In step Sa11, the processor 41 refers to the setting table and checks whether or not the continuous feed of the target rack is set to "applied". If the continuous feed is
20 set to "applied", the processor 41 makes a determination of "Yes" and proceeds to step Sa12.

In step Sa12, the processor 41 checks whether or not the continuous feed sensor 21h correlated with the paper feed rack located one stage upper than the target rack is
25 on. If the correlated continuous feed sensor 21h is on, the processor 41 makes a determination of "Yes" and proceeds to step Sa13.

In step Sa13, the processor 41 checks whether or not the a present time falls within the first permissible starting period for the paper feed rack located one stage upper than the target stage.

5 FIG. 8 is a timing chart showing timings of executing the primary paper feed and the secondary paper feed for two paper feed racks 5 that form a set for continuous feed.

 These two paper feed racks 5 are assigned with the rack numbers of "1" and "2" respectively and form a set for
10 continuous feed because, as shown in FIG. 5, the continuous feed of the lower paper feed rack 5 assigned with the rack number of "1" is set to "applied".

 As shown in FIG. 8, the first permissible starting period starts from the paper feed timing. The length of the
15 first permissible starting period is predetermined as a time obtained by subtracting both a time required to perform the primary paper feed once and a first portion of extra time of sufficient length from a single cycle of a paper feed timing. Even if the primary paper feed is
20 started at any timing within the first permissible starting period, as long as the primary paper feed can be completed before the next paper feed timing comes, the first extra time may be set at will. The first portion of extra time is determined by, e.g., a designer or a maintenance worker of
25 the collator 100.

 If the present time falls within the first permissible starting period, the processor 41 makes a determination of

"Yes" in step Sa13, and proceeds to step Sa14.

5 In step Sa14, the processor 41 changes the setting of the paper feed of the target rack to "invalid", and changes the setting of paper feed of the paper feed rack located one stage upper than the target rack to "valid". In this manner, by the processor 41 executing the control processing based on the control program, the computer having the processor 41 as the central part functions as setting change means.

10 In step Sa15, the processor 41 waits for the paper feed sensor 21g correlated with the target rack to be turned off. If the paper feed sensor 21g is turned off, the processor 41 makes a determination of "Yes", and executes the processing from step Sa10 onward in the same manner as
15 described above. At this time, since the paper feed of the target rack is set to "invalid", the processor 41 makes a determination of "No" in step Sa1, so that paper feed from the target rack is stopped.

20 In the control processing separately performed by the processor 41 with respect to the paper feed rack located one stage upper than the target rack described above, the processor 41 makes a determination of "Yes" in step Sa1 because the setting is changed in step Sa14 as described above. Therefore, the primary paper feed by the control
25 processing is started, and thereafter the same processing is performed as described.

Thus, when the following conditions (1) to (3) are

satisfied, as shown in FIG. 8, the paper feed from the lower paper feed rack forming a set for continuous feed is stopped, and the paper feed from the upper paper feed rack is started.

5 (1) The continuous feed sensor 21h of the lower paper feed rack forming a set for continuous feed is turned off.

 (2) The continuous feed sensor 21h of the upper paper feed rack forming a set for continuous feed is on.

 (3) The timing at which the continuous feed sensor 21h
10 of the lower paper feed rack forming a set for continuous feed is turned off falls within the first permissible starting period for the upper paper feed rack.

 On the other hand, when the continuous feed sensor 21h correlated with the paper feed rack located one stage upper
15 than the target rack is off, the processor 41 makes a determination of "No" in Step Sa12 and proceeds to step Sa16.

 In step Sa16, the processor 41 refers to the setting table and checks whether or not the continuous feed of the
20 paper feed rack located one stage higher than the target rack is set to "applied". If the continuous feed is set to "applied", the processor 41 makes a determination of "Yes" and proceeds to step Sa17.

 In step Sa17, the processor 41 confirms whether or not
25 the continuous feed sensor 21h correlated with the paper feed rack two stages upper than the target rack is on. If the correlated continuous feed sensor 21h is on, the

processor 41 makes a determination of "Yes" and proceeds to step Sa18.

5 In step Sa18, the processor 41 checks whether or not the present time falls within the second permissible starting period for the paper feed rack located two stages upper than the target stage.

10 FIG. 9 is a timing chart showing timings of executing the primary paper feed and the secondary paper feed for three paper feed racks 5 that form a set for continuous feed.

15 These three paper feed racks 5 are assigned with the rack numbers of "5" to "7", respectively, and form a set for continuous feed because, as shown in FIG. 5, the continuous feed of the paper feed racks 5 assigned with the rack numbers of "5" and "6" is set to "applied".

20 As shown in FIG. 9, the second permissible starting period starts from the paper feed timing. The length of the second permissible starting period is predetermined as a time obtained by subtracting both a time required to perform the primary paper feed once and a second portion of extra time from a single cycle of a paper feed timing. Even if the primary paper feed is started at any timing within the second permissible starting period, as long as the primary paper feed can be completed before the next paper feed timing comes, the second portion of extra time may be set at will. The second permissible starting period is determined by, e.g., a designer or a maintenance worker of

25

the collator 100. The second portion of extra time may be the same as the first portion of extra time; however, herein, the second portion of extra time is assumed to be shorter than the first portion of extra time. Accordingly, the second permissible starting period is longer than the first permissible starting period.

If the present time falls within the second permissible starting period, the processor 41 makes a determination of "Yes" in step Sa18, and proceeds to step Sa19.

In step Sa19, the processor 41 changes the setting of the paper feed of the target rack to "invalid", and changes the setting of paper feed of the paper feed rack located one stage upper In the control processing separately performed by the processor 41 with respect to the paper feed rack located than the target rack to "valid". In this manner, by the processor 41 executing the control processing based on the control program, the computer having the processor 41 as the central part functions as setting change means. Thereafter, the processor 41 executes the processing from step Sa15 onward as described above.

In the control processing separately performed by the processor 41 with respect to the paper feed rack located two stages upper than the target rack described above, the processor 41 makes a determination of "Yes" in step Sa1 because the setting is changed in step Sa19 as described above. Therefore, the primary paper feed by the control

processing is started, and thereafter the same processing is performed as described.

Thus, when the following conditions (1) to (4) are satisfied, as shown in FIG. 9, among the three paper feed racks forming a set for continuous feed, the paper feed from the lowermost paper feed rack is stopped, and the paper feed from the uppermost paper feed rack is started while the middle paper feed rack is skipped.

(1) The continuous feed sensor 21h of the lowermost paper feed rack forming a set for continuous feed is turned off.

(2) The continuous feed sensor 21h of the middle paper feed rack forming a set for continuous feed is off.

(3) The continuous feed sensor 21h of the uppermost paper feed rack forming a set for continuous feed is on.

(4) The timing at which the continuous feed sensor 21h of the lowermost paper feed rack forming a set for consecutive stages is turned off falls within the second permissible starting period for the uppermost paper feed rack.

In the case of any one of the following (1) to (5), the processor 41 proceeds to step Sa20.

(1) The processor 41 makes a determination of "No" in step Sa11 because the continuous feed of the target rack is set to "non-applied".

(2) The processor 41 makes a determination of "No" in step Sa13 because the present time falls out of the first

permissible starting period.

(3) The processor 41 makes a determination of "No" in step Sa16 because the continuous feed of the paper feed rack located one stage upper than the target rack is set to "non-applied".

(4) The processor 41 makes a determination of "No" in step Sa17 because the continuous feed sensor 21h correlated with the paper feed rack located two stages upper than the target rack is off.

(5) The processor 41 makes a determination of "No" in step Sa18 because the present time falls outside the second permissible starting period.

In step Sa20, the processor 41 sets an error flag related to the target rack. By this, the processor 41 terminates the control processing shown in FIG. 6.

The control processing based on a state of the error flag is executed as another processing operation of the processor 41. The processor 41 stops all of the collation operations by the collators 100, for example, in response to the fact that the error flag related to the paper feed rack set to make error detection regarding paper feed is set.

As described above, when the paper sheets S stacked on one paper feed rack are all fed out, the collator 100 can continuously feed the paper sheets S from an upwardly-adjacent paper feed rack or from a two-stage upper paper feed rack. In other words, it is possible to carry out the

continuous feed function using not only a set of the paper feed racks that are adjacent to each other but also a set of the paper feed racks that are not adjacent to each other. As a result, according to the collator 100, the degree of freedom in the shifting of a paper feed rack with a continuous feed function is increased, and the convenience is improved as compared to before. In other words, for example, as described above, the continuous feed function can be implemented in a form which was implementable before, for example, a form in which the paper feed rack 5 assigned with the rack number of "6" is removed, and the paper sheets S of the same type are sequentially fed from the paper feed racks 5 assigned with the rack numbers "5" and "7" respectively.

A paper feed timing of the paper feed rack located one stage upper than a particular paper feed rack comes earlier than the paper feed rack located two stages upper than the paper feed rack in question. That is, a time from a timing when the continuous feed sensor on a particular paper feed rack is turned off to a paper feed timing is shorter in the two-stage upper paper feed rack as compared to the one-stage upper paper feed rack. For this reason, in the case where the first permissible starting period determined by adding a sufficient portion of extra time in consideration of a paper feed timing in the one-stage upper paper feed rack is applied to a determination in step Sa18, a determination of "No" is made in step Sa18 even if a timing

allows the primary paper feed to be completed before the next paper feed timing comes. This may cause a situation in which the primary feed cannot be started. However, according to the collator 100, because the second
5 permissible starting period set as longer than the first permissible starting period is applied to the case where, subsequent to the paper feed from one paper feed rack, the paper feed from the two-stage upper paper feed rack continues, the possibility that the primary paper feed is
10 started appropriately can be increased.

Without distinction, the second permissible starting period can be applied to the determination in step Sa13 in the case where subsequent to the paper feed from one paper feed rack, the paper feed from the one-stage upper paper
15 feed rack continues. However, as in the embodiment described above, it is preferable to apply an individual permissible starting period for each paper feed rack.

The above embodiment can be modified in various ways as described below.

20 In the above embodiment, the paper feed rack having the setting that the continuous feed is "applied" and the paper feed rack located adjacent to and above this particular paper feed rack are defined as "a set for continuous feed". Alternatively, in the above embodiment,
25 in the case where all of adjacent paper feed racks have the setting where the continuous feed is "applied", these adjacent paper feed racks and the paper feed rack located

one stage upper than the uppermost paper feed racks in these adjacent paper feed racks are defined as "a set for continuous feed". However, a set for continuous feed may be managed using management data whereby, for example, a set number for identifying a set for continuous feed is associated with rack numbers of paper feed racks included in this particular set. Specifically, for example, the setting shown in FIG. 5 uses management data whereby the set number of "1" is associated with the rack numbers "1" and "2", and the set number of "2" is associated with the rack numbers "5" to "7". However, in this case, the paper feed racks included in a set for continuous feed are not necessarily adjacent to each other in the vertical direction. For example, management data whereby the set number of "2" is associated with the rack numbers of "5" and "7" may be used.

In the embodiment described above, the order for selecting a paper feed target for continuous feed is set in a manner such that a paper feed rack located in a lower position is selected first. However, this order for selection can be set at will. For example, the selection order can be set in a manner such that a paper feed rack located in an upper position is selected first. Alternatively, the selection order can be designated by an operator. In the latter case, for example, a set for continuous feed may be managed using management data whereby rack numbers listed in the selection order are

associated with a set number. That is, for example, management data whereby the set number of "3" is associated with the rack numbers of "9", "10", "13", and "14" is used. In this case, the processor 41 shifts a paper feed target in the order of the paper feed rack 5 assigned with the rack number of "9", the paper feed rack 5 assigned with the rack number of "10", the paper feed rack 6 assigned with the rack number of "13", and the paper feed rack 6 assigned with the rack number of "14". That is, the paper feed rack as a paper feed target is subsequently shifted from the upper paper feed rack, the rear side paper feed rack, and the lower paper feed rack.

However, in the case where the order for selecting the paper feed rack as a paper feed target for continuous feed can be set at will, continuous paper feed cannot be performed when shifting the paper feed rack as a paper feed target, which may cause a risk of paper feed omission. If such paper feed omission is accepted, any selection order may be able to be set without any restrictions. However, if such paper feed omission needs to be prevented, restrictions as in the embodiment described above are added to the setting of the selection order.

Other than the above, various modifications may be carried out without departing from the spirit of the invention.

CLAIMS

1. A collator comprising:

three or more paper feed racks arranged in a vertical
5 direction, each of which allows a large number of paper
sheets to be stacked;

feed-out mechanisms that are correlated with the paper
feed racks, respectively, each of the feed-out mechanisms
performs a primary paper feed by which a leading end of one
10 paper sheet of the paper sheets stacked on a correlated
paper feed rack of the paper feed racks is protruded from
leading ends of the other paper sheets, and a secondary
paper feed by which one paper sheet having a leading end
protruded by the primary paper feed is fed out from the
15 correlated paper feed rack;

a common conveyance path that conveys the paper sheets
fed out by the plurality of feed-out mechanisms,
respectively;

detectors that are provided in a manner to be
20 correlated with the paper feed racks respectively, and
which detect a state in which the paper sheets stacked on
the correlated paper feed racks have run out;

feed-out control means that operates a feed-out
mechanism correlated with a paper feed rack having a valid
25 setting, out of the plurality of paper feed racks, at a
timing predetermined in a manner such that the paper sheets
fed out by the feed-out mechanism overlap with the paper

sheets fed out by another feed-out mechanism on the common conveyance path; and

setting change means that, if one detector of the detectors detects a state in which the paper sheets have
5 run out and if a timing of the detecting is within a permissible starting period that is predetermined as a time obtained by subtracting both a time required to perform the primary paper feed once and an extra time from a single cycle of a paper feed timing, cancels the valid setting of
10 the paper feed rack correlated with the one detector, and that if the correlated paper feed rack and a paper feed rack one stage upper than the correlated paper feed rack toward an upstream side of the common transport path have the setting of continuous feed and if the paper feed rack
15 one stage upper toward the upstream side is removed, changes from an invalid setting to a valid setting for a paper feed rack one more stage upper than the paper feed rack one stage upper toward the upstream side of the common transport path.

20

2. A control program for a computer that controls the collator comprising:

three or more paper feed racks aligned in a vertical direction, each of which allows a large number of paper
25 sheets to be stacked;

feed-out mechanisms that are correlated with the paper feed racks, respectively, each of the feed-out mechanisms

performs a primary paper feed by which a leading end of one paper sheet of the paper sheets stacked on a correlated paper feed rack of the paper feed racks is protruded from leading ends of the other paper sheets, and a secondary
5 paper feed by which one paper sheet having a leading end protruded by the primary paper feed is fed out from the correlated paper feed rack;

a common conveyance path that conveys the paper sheets fed out by the feed-out mechanisms, respectively;

10 detectors that are provided in a manner to be correlated with the paper feed racks respectively, and which detect a state in which the paper sheets stacked on the correlated paper feed racks have run out;

the control program for causing the computer to
15 function as:

feed-out control means that operates a feed-out mechanism correlated with a paper feed rack having a valid setting, out of the plurality of paper feed racks, at a timing predetermined in a manner such that the paper sheets
20 fed out by the feed-out mechanism overlap with the paper sheets fed out by another feed-out mechanism on the common conveyance path; and

setting change means that, if one detector of the detectors detects a state in which the paper sheets have
25 run out and if a timing of the detecting is within a permissible starting period that is predetermined as a time obtained by subtracting a time required to perform the

primary paper feed once and an extra time from a cycle of a paper feed timing, cancels the valid setting of the paper feed rack correlated with the one detector, and that if the correlated paper feed rack and a paper feed rack one stage
5 upper than the correlated paper feed rack toward an upstream side of the common transport path have the setting of continuous feed and if the paper feed rack one stage upper toward the upstream side is removed, changes from an invalid setting to a valid setting for a paper feed rack
10 one more stage upper than the paper feed rack one stage upper toward the upstream side of the common transport path.