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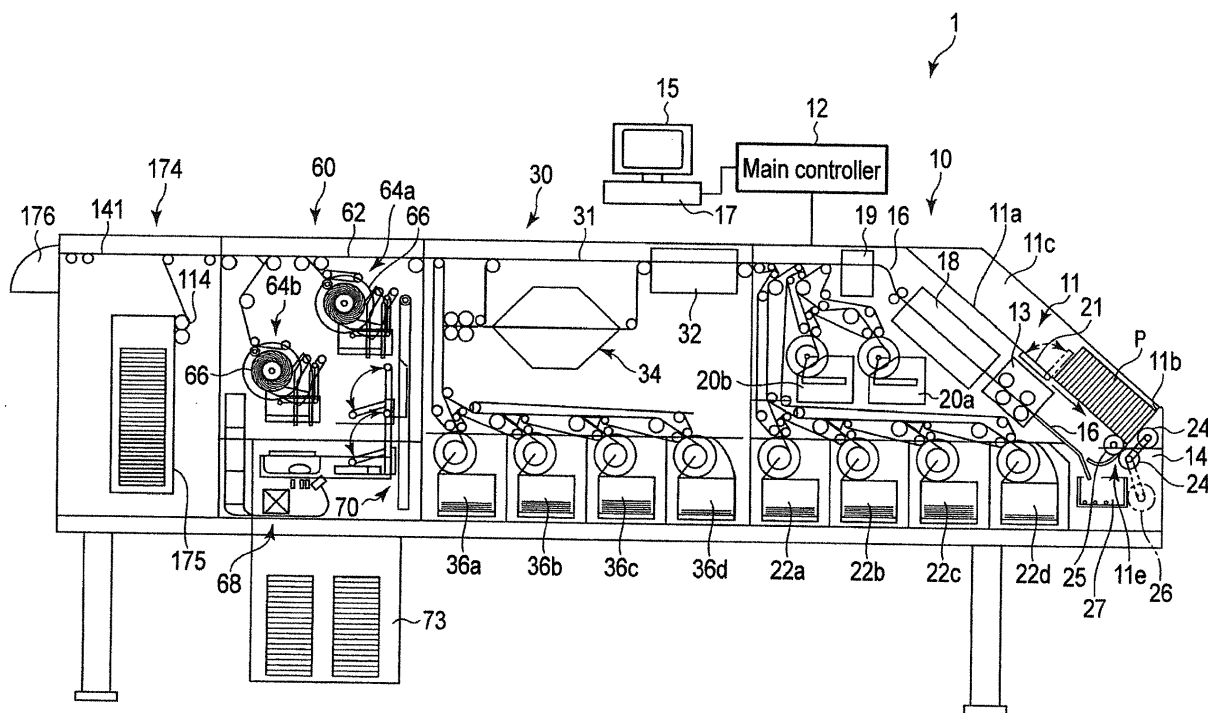
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(54) **Paper-sheet processing apparatus**

(57) According to one embodiment, a paper-sheet processing apparatus includes a feed unit (11), a pickup unit (14), an inspection unit (18), a stacking unit (66), a backup drive unit, a banding unit (68), at least one power supply, a mode setting unit, and a fixing unit. At least one power supply supplies electric power to electrically operational parts of the extraction unit, inspection unit,

stacking unit, backup drive unit, and a banding unit. The mode setting unit sets a standby mode in which electric power supply to at least one of the electrically operational parts is suspended temporarily. While the standby mode is set by the mode setting unit, the fixing unit fixes the backup to a position for setting of the standby mode.



**FIG. 1**

**Description**

## FIELD

**[0001]** Embodiments described herein relate generally to a paper-sheet processing apparatus.

## BACKGROUND

**[0002]** A paper-sheet processing apparatus comprises a pickup apparatus which picks up, one after another, a large number of paper sheets, an inspection unit which inspects the paper sheets picked up, and a stacking/banding apparatus which stacks and bands the inspected paper sheets in units of stacks each including a predetermined number of paper sheets. The stacking/banding apparatus comprises a backup where paper sheets are stacked. The backup is driven in accordance with a stacked quantity of paper sheets.

**[0003]** In recent years, there is a demand for reduction of electric power consumption by turning off surplus power supplies during operation or suspension of operation, in order to improve power saving of the apparatus.

**[0004]** However, if the power supply of a motor for driving the backup is turned off, the position of the backup shifts.

**[0005]** In this case, paper sheets stacked on the backup need to be once taken out and then stacked again after a restart, due to resumption of a normal mode from a standby mode.

(Object of the Invention)

**[0006]** An embodiment of the invention is directed to providing a paper-sheet processing apparatus which can achieve power saving without a complex recovery operation.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0007]**

FIG. 1 is a sectional view showing a paper-sheet processing apparatus according to the first embodiment;

FIG. 2 is a sectional view showing a banding module of the paper-sheet processing apparatus;

FIG. 3 is a front view showing a temporary stacking unit of the paper-sheet processing apparatus;

FIG. 4 is a block diagram schematically showing a system configuration of the paper-sheet processing apparatus;

FIG. 5 is a flowchart showing for explaining an operation example of the banding module;

FIG. 6 is a block diagram schematically showing a system configuration of a paper-sheet processing apparatus according to the second embodiment;

FIG. 7 is a front view showing a temporary stacking

unit of a paper-sheet processing apparatus according to the third embodiment; and

FIG. 8 is a block diagram schematically showing a system configuration of the paper-sheet processing apparatus.

## DETAILED DESCRIPTION

**[0008]** In general, according to one embodiment, a paper-sheet processing apparatus comprises a feed unit, a pickup unit, an inspection unit, a stacking unit, a backup drive unit, a banding unit, at least one power supply, a mode setting unit, and a fixing unit. A plurality of paper sheets are set on the feed unit. The pickup unit picks up paper sheets out of the feed unit. The inspection unit inspects the paper sheets picked up as described above. The stacking unit stacks each predetermined number of the inspected paper sheets onto the backup. The backup drive unit adjusts the position of the backup in accordance with the quantity of stacked paper sheets. The banding unit bands a bundle of the stacked paper sheets by winding a band around the bundle of the stacked paper sheets. At least one power supply supplies electric power to electrically operational parts of the pickup unit, inspection unit, stacking unit, backup drive unit, and banding unit. The mode setting unit sets a standby mode in which electric power supply to at least one of the electrically operational parts is suspended temporarily. The fixing unit fixes the backup to the position for setting of the standby mode when the standby mode is set by the mode setting unit.

## First Embodiment

**[0009]** Hereinafter, embodiments will be described in detail with reference to the drawings.

**[0010]** FIG. 1 is a sectional view schematically showing an entire configuration of the paper-sheet processing apparatus 1 according to the first embodiment;

**[0011]** As shown in FIG. 1, the paper-sheet processing apparatus 1 which processes bank notes as paper sheets comprises a main module 10, an alignment module 30, a banding module 60 as a stacking/banding apparatus, and an expansion module 174. These modules are arranged in line and are electrically and mechanically connected to each other.

**[0012]** A main controller 12 which controls operation of the main module 10 and the whole apparatus is provided in the main module 10. The main controller 12 is connected to an operation unit 17 to input various information to the present apparatus, and a monitor 15 as a display apparatus which displays operation states and processing states of the present apparatus.

**[0013]** The main controller 12 is connected to an unillustrated host computer and performs transmission/reception of information to/from the host computer and organizes information.

**[0014]** According to the operation of an operator by the

operation unit 17 connected to the main controller 12, various operation settings are carried out, including setting of a transaction method such as a money reception service or a money organization service, a loading processing of loading into a loading room, an inspection processing for bank notes in the loading room, setting of a stockroom to contain processed bank notes P, setting of a stacking/banding processing, and a qualified/damaged level setting for setting a determined quality level for each bank note.

**[0015]** In accordance with processing information from the inspection apparatus 18 described later, the main controller 12 calculates a processing efficiency per unit time, processing efficiency for each of a plurality of days, processing efficiency for each operator ID, a total number of sheets to process, and management information including total operating time. The main controller 12 then stores calculation results into a memory of the main controller 12, and displays them on the monitor 15.

**[0016]** As shown in FIG. 1, the main module 10 comprises a feed unit 11 where a large number of paper sheets are stacked, a pickup mechanism 14 which picks up, one after another, paper sheets P from the feed unit 11, and a conveyor path 16 through which bank notes P picked up by the pickup mechanism are conveyed. The conveyor path 16 is provided with a plurality of sets of endless conveyor belts, not shown, which are extended in a manner that each set of the conveying belts sandwich the conveyor path 16. The picked up bank notes P are conveyed sandwiched between the conveying belts.

**[0017]** The feed unit 11 comprises a support surface 11a which extends at an inclination of an arbitrary angle to a perpendicular direction, a mount surface 11b which extends in a direction substantially perpendicular to the support surface 11a, and a pair of guide walls 11c which are provided to stand along two side edges of the support surface 11a and the mount surface 11b. An extraction port 11e for taking in the bank notes P into inside of the present apparatus is formed at a boundary part between the support surface 11a and the mount surface 11b.

**[0018]** A plurality of bank notes P, e.g., 2,000 or more bank notes P can be stacked and set on the feed unit 11. The stacked bank notes P are set in the feed unit 11, stacked at an inclination along the support surface in a manner that the lowermost one of the bank notes is on the mount surface 11b and that, for example, a side edge of longer sides of the bank note is on the support surface 11a. The stacked bank notes P are sequentially taken into the present apparatus in an order from the lowermost bank note P through the extraction port 11e by the pickup mechanism 14.

**[0019]** The feed unit 11 comprises a temporary stacking plate 21 which moves each of the bank notes P toward the side of the extraction port or, namely, toward the mount surface 11b. The temporary stacking plate 21 is provided to be contained in the support surface 11a and to be movable along the support surface.

**[0020]** The pickup mechanism 14 which picks up one

after another of the bank notes P from the feed unit 11 comprises a plurality of pickup rollers (extraction rollers) 24 provided to be capable of making contact with a bank note P on the mount surface 11b, a separation roller 25 provided in rolling contact with a pickup roller 24 on the side of the extraction port 11e, and a drive motor 26 which rotates the pickup rollers 24 at a predetermined speed.

**[0021]** As the pickup roller 24 rotates, the lowermost bank note P is picked up (or extracted) by the pickup rollers 24 and fed through the extraction port 11e to the conveyor path 16 from the extraction port 11e. At this time, the second and successive bank notes P each are isolated from the extracted bank note. In this manner, the bank notes P are picked up from the feed unit 11 and fed to the conveyor path 16.

**[0022]** As shown in FIG. 1, a conveying-pitch correction unit 13 which corrects the pitch of conveying the bank notes P by the conveyor path 16, the inspection apparatus 18 which inspects one after another of the bank notes P the conveying pitch of which has been corrected, and a bar code reader 19 are arranged along the conveyor path 16. The inspection apparatus 18 is provided in the upper side of the extraction port 11e of the feed unit 11 along the perpendicular direction. The inspection apparatus 18 detects the denomination, shape, thickness, front/back, truth/false, qualified/damaged, and double pickup for each of the bank notes P conveyed. Here, qualified/damaged detection is intended to mean determination between a re-circulable fresh bank note and a fatigued bank note which is soiled and damaged and is therefore not re-circulable. For example, the bar code reader 19 reads batch cards which have passed the inspection apparatus 18 when using batch cards, or reads bar codes added to casino tickets. The bar code reader 19 sends read information to the main controller 12.

**[0023]** The conveyor path 16 once extends down from the pickup mechanism 14 and the extraction port. The conveyor path 16 is then obliquely inclined in relation to the perpendicular direction, and extends up from below. In addition, the conveyor path 16 communicates with the alignment module 30 described later. An ejection port is formed in the lowermost part of the conveyor path 16, and a collection box 27 is further provided below the ejection port. Extraneous materials which fall along the conveyor path 16 are ejected from the ejection port, and are collected into the collection box 27.

**[0024]** As shown in FIG. 1, in the main module 10, two rejection units 20a and 20b are provided along the conveyor path 16, and a plurality of stockrooms 22a, 22b, 22c, and 22d each of which stacks bank notes are located in line. The bank notes P which have passed through the inspection apparatus 18 are sorted into rejected notes and processed notes by gates not shown. The rejected notes are determined to be counterfeit notes by the inspection apparatus 18 or determined to be folded, torn, skewed, or beyond recognition because of double picking. The rejected tickets are collected and stacked, sorted into the rejection unit 20a or 20b. Except for counterfeit

notes, the rejected notes are set again on the feed unit 11 and are taken in again, or are incorporated into calculation data by manual input. Inspection results such as a sum amount and a total number of bank notes processed by the inspection apparatus 18 are fed to and stored into the main control part 12 and are displayed on the monitor 15.

**[0025]** The processed notes are bank notes P each determined by the inspection apparatus 18 to be a true and qualified note or a true and fatigue note. The processed notes are fed to and stacked in the stockroom 22a or 22d. For example, the processed notes are stacked and sorted into corresponding ones of the stockrooms 22a and 22d depending on bank note types. Fatigue notes are stacked together in a stockroom.

**[0026]** When batch cards are used, the batch cards pass through the inspection apparatus 18 and the bar code reader 19 and are thereafter fed to and stacked into the refectation unit 20a or 20b.

**[0027]** The main module 10 comprises, as electrically operational parts which are operated by electric power, the monitor 15, drive motor 26, inspection apparatus 18, rejection units 20a and 20b, and motors which activate gates of the individual units and the conveyor mechanism.

**[0028]** The main module 10 comprises a drive mechanism, a power supply, and various sensors, which are not shown but drive the pickup mechanism 14, inspection apparatus 18, and conveyor mechanism.

**[0029]** As shown in FIG. 1, the alignment module 30 comprises the conveyor path 31 which conveys the bank notes P fed from the main module 10, the alignment mechanism 32 provided in an upstream side along the conveyor path 31, a reverse apparatus 34 provided in a downstream side of the alignment mechanism 32 along the conveyor path 31, and a plurality of stockrooms 36a, 36b, 36c, and 36d arranged in line along the conveyor path 31.

**[0030]** The bank notes P fed from the alignment mechanism 32 or the reverse apparatus 34 are fed to the banding module 60 through the conveyor path 31 or are fed to and stacked onto any of stockrooms 36a, 36b, 36c, and 36d. The stockrooms 36a, 36b, 36c, and 36d of the alignment module 30 can be used also as stockrooms which collect and stack bank notes, sorted respectively depending on bank note types, or as rejected-note rooms or fatigue-note rooms which collect and stack rejected or fatigue notes extracted from the main module 10.

**[0031]** Otherwise, if a banding processing for banding bank notes is set, true or damaged notes extracted from the main module 10 or true or damaged notes extracted from the alignment module 30 are fed to the banding module 60 through the conveyor path 31 of the alignment module 30 and banded for each predetermined number of notes.

**[0032]** FIG. 2 is a front view of the banding module 60 as a stacking/banding apparatus. As shown in FIG. 1 and FIG. 2, the banding module 60 comprises a conveyor

path 62 which communicates with the conveyor path 31 of the alignment module 30, a first stacking apparatus 64a and a second stacking apparatus 64b each of which collects and stacks the bank notes fed through the conveyor path 62 for every predetermined number of bank notes, a banding apparatus 68 which bands each predetermined number of stacked bank notes, e.g., every hundred bank notes stacked by the stacking apparatuses into a bundle wrapped with a band, and a conveyor mechanism 70 which conveys bank notes P stacked by the first stacking apparatus 64a and bundles of bank notes banded by the second stacking apparatus 64b. Further, an ejection unit 73 which receives and stacks the bundles of bank notes banded by the banding apparatus is provided below the banding apparatus 68.

**[0033]** The first stacking apparatus 64a and the second stacking apparatus 64b are located, shifted from each other in up and down directions and left and right directions. The second stacking apparatus 64b is located, shifted obliquely down at an angle  $\theta$  of about 10 to 80 degrees to the first stacking apparatus 64a in a manner that a part of the apparatus 64b overlaps the first stacking apparatus 64a in a perpendicular direction. The banding apparatus 68 is located below the second stacking apparatus 64b.

**[0034]** Each of the first and second stacking apparatuses 64a and 64b comprises a temporary stacking unit 65 and an impeller stacking apparatus 66 as a stacking mechanism which stacks one after another of a predetermined number of fed bank notes P onto the temporary stacking unit 65. The impeller 66a of the impeller stacking apparatus 66 is configured by building a plurality of vanes on the periphery of a rotation shaft and is rotated in synchronization with conveyance of the bank notes P, so that each of the fed bank notes P is received between vanes. By using the impeller 66a, the bank notes P are stacked into the temporary stacking unit 65, absorbing the kinetic energy of the bank notes P conveyed at a high speed and while aligning the bank notes P.

**[0035]** The temporary stacking unit 65 of the first stacking apparatus 64a comprises a backup 75a, for example, which is movable in up and down directions and stacks the bank notes P onto the backup. The temporary stacking unit 65 of the second stacking apparatus 64a comprises a backup 75b, for example, which is movable in up and down directions and stacks the bank notes P onto the backup.

**[0036]** In addition, the first stacking apparatus 64a and the second stacking apparatus 64b each are provided with an indicator 71, such as an LED, which indicates a processing state of the apparatus, such as an error of a stacking apparatus or an availability state of resupply of bank notes. The indicators 71 are provided at positions where a visual check is easily available from outside by opening an outer cover of the banding module 60. The indicators 71 indicate various processing states of the stacking apparatuses by means of blinking, turning on, turning off, and lighting in different colors, to allow an

operator to determine, for example, whether bank notes need be supplied again or not, whether any error has occurred or not, and whether a calculation result of bank notes has been fixed or not.

**[0037]** FIG. 3 is a front view of the stacking unit 65 which the first stacking apparatus 64a and the second stacking apparatus 64b each comprise. The temporary stacking unit 65 of the first stacking apparatus 64a and the temporary stacking unit 65 of the second stacking apparatus 64b have the same configuration as each other. The first stacking apparatus 64a will now be described in detail as a typical example.

**[0038]** As shown in FIG. 3, the temporary stacking unit 65 comprises a substantially horizontal backup 75a where bundled bank notes are stacked, a connection shaft (support member) 76 connected to the backup 75a and extending in a perpendicular direction, a support frame 79 which supports and guides the connection shaft 76 to be capable of freely elevating up and down, and a backup drive unit 81 which moves the backup 75a up and down by the connection shaft 76.

**[0039]** The backup drive unit 81 comprises a rack 85 fixed to the connection shaft 76 and extending in a perpendicular direction, a backup motor (servo motor) 78, and a gear train 77 which transmits a drive force to the connection shaft 76 from a backup motor 78 provided between the rack 85 and a drive gear 78a attached to the drive shaft of the backup motor. The backup motor 78 and the gear train 77 are supported by the bracket 87.

**[0040]** The gear train 77 comprises a first gear 77a, a second gear 77b, and a third gear 77c. The first gear 77a and the second gear 77b each are configured in a structure in which a large diameter gear and a small diameter gear are combined so as to respectively have rotation axes corresponding to each other. The third gear 77c is configured by a gear having a diameter substantially equal to that of the large diameter gears of the gears of the first gear 77a and the second gear 77b.

**[0041]** The large diameter gear of the first gear 77a is meshed with the drive gear 78a attached to the drive shaft of the backup motor 78. The large diameter gear of the second gear 77b is meshed with the small diameter gear of the first gear 77a. The third gear 77c is meshed with the small diameter gear of the second gear 77b and with the rack 85. As the backup motor 78 drives, the drive gear 78a, first gear 77a, second gear 77b, and third gear 77c are rotated accordingly in order. As the third gear 77c rotates, the third gear 77c moves the rack 85, connection shaft 76, and backup 75a up or down in accordance with the rotation direction of the third gear 77c.

**[0042]** The temporary stacking unit 65 adjusts the height position of the backup 75a according to the quantity of stacked bank notes in order that the stacking apparatus 64 appropriately stacks the bank notes onto the backup 75a. That is, the temporary stacking unit 65 adjusts the height position of the backup 75a by moving up and down the backup 75a by the backup drive unit 81. For example, the stacking unit 65 adjusts the backup 75

to move up when zero or a small quantity of bank notes are stacked in a bundle. Otherwise, when a large quantity of bank notes are stacked in a bundle, the temporary stacking unit 65 adjusts the backup 75 to move down.

5 As a result, the temporary stacking unit 65 can maintain a constant distance from the upper surface of the bundle of bank notes stacked to the stacking apparatus 64.

**[0043]** The first stacking apparatus 64a and the second stacking apparatus 64b respectively comprise fixing mechanisms which fix the backup 75a and the backup 75b to positions for setting of a standby mode during the standby mode described later.

**[0044]** As shown in FIG. 2, the conveyor mechanism 70 which conveys bundles of stacked bank notes between the first stacking apparatus 64a and second stacking apparatus 64b and the banding apparatus 68 comprises a pair of guide rods 74 provided to stand along a perpendicular direction, a base carrier 80 capable of freely elevating up and down along the guide rods 74, and a sheet carrier (conveyor tray) 82 provided on the base carrier 80 to be reciprocally movable along horizontal directions. The base carrier 80 and the sheet carrier 82 configure the conveyor carrier.

**[0045]** The base carrier 80 is formed in a shape of a substantially rectangular dish and is supported, at an end part, by the pair of guide rods 74. The base carrier 80 is guided to be capable of freely elevating up and down along these guide rods. The base carrier 80 extends substantially horizontally. In addition, the base carrier 80 is connected to drive belts by a pair of brackets. By driving regularly or reversely a motor not shown, the drive belts travel in an up or down direction, and a space carrier 80 is elevated up or down by these drive belts. The base carrier 80 is elevated up and down among a first position where the base carrier 80 is adjacent and opposed to the backup 75a of the first stacking apparatus 64a below the backup 75a, a second position where the base carrier 80 is opposed to a side of the backup 75b of the second stacking apparatus 64b, and a third position where the base carrier 80 is opposed to a side of a discharge table 84 of the banding apparatus 68 described later. For example, a position sensor such as a photo interrupter is provided at each of the positions described above. By detecting the base carrier 80 by the position sensors, the base carrier 80 can be moved to and positioned at any of these positions.

**[0046]** On the other hand, the sheet carrier 82 is formed in a shape of a rectangular plate which is larger than the dimensions of the bank note P and is configured to allow stacked bank notes to be set on itself. The sheet carrier 82 is provided to be reciprocally movable along horizontal directions on the base carrier 80. That is, the base carrier 80 is provided on the sheet carrier 82 so as to be reciprocally movable along a direction intersecting the moving direction of the base carrier 80 between a standby position where the sheet carrier 82 is positioned overlapping the base carrier 80 and an advanced position where the sheet carrier 82 projects substantially horizontally from

the front end of the base carrier. On the base carrier 80, a drive source such as a motor or plunger which moves the sheet carrier 82 in the horizontal directions is provided.

**[0047]** The sheet carrier 82 is provided with a plurality of bank note clampers 88 which hold bundled bank notes on the sheet carrier 82. These bank note clampers 88 are attached to the rotation shaft 89 supported by the sheet carrier 82. As the drive motor provided on the sheet carrier 82 pivots the rotation shaft 89, the bank note clampers 88 are pivoted between an open position of being apart from a support surface of the sheet carrier 82 and a clamp position of pressing bundled bank notes from above to clamp and hold the bundled bank notes.

**[0048]** Stacking of bank notes by the first and the second stacking apparatuses 64a and 64b and conveyance of bundled bank notes by the conveyor mechanism 70 are performed as follows. For example, a predetermined number of, for example, one hundred bank notes of a unique type are stacked on the backup 75a by the first stacking apparatus 64a. At this time of stacking, the base carrier 80 is made to wait at the first position, and the sheet carrier 82 on the base carrier 80 is adjacent and opposed to the backup 75a below the backup 75a. During the stacking, the backup 75a is gradually moved down from a position near the impeller 66a to adjust the position of the backup in accordance with the quantity of stacked bank notes. When one hundred bank notes P are stacked on the backup 75a, the stacked bank notes P are then moved onto the sheet carrier 82 from the backup 75a. Subsequently, the stacked bank notes P are pressed by the bank note clampers 88 to hold the stacked bank notes P on the sheet carrier 82, and the base carrier 80 is thereafter dropped to the third position.

**[0049]** Next, the sheet carrier 82 moves forward from the standby position to the advanced position, and moves the stacked bank notes P onto the ejection table 84 of the banding apparatus. Subsequently, an end part of the stacked bank notes P in a longitudinal direction thereof is gripped with a hand of a grip/draw mechanism of the banding apparatus 68 which will be described later, and simultaneously the clampers 88 are made to release its hold. Thereafter, the sheet carrier 82 is moved to the standby position from the advanced position. The bundle of stacked bank notes P is thereby delivered to the banding apparatus 68.

**[0050]** On the other hand, after one hundred bank notes are stacked by the first stacking apparatus 64a, the 101-st and later bank notes are fed to the second stacking apparatus 64b. A predetermined number of the fed bank notes, for example, one hundred bank notes are stacked on the backup 75b by the second stacking apparatus 64b. During stacking, the base carrier 80 is made to wait at the second position and is opposed to a side of the backup 75b. Also during stacking, the backup 75a is gradually moved down from a position near the impeller 66a to adjust the position of the backup in accordance with the quantity of stacked bank notes. When

one hundred bank notes P are stacked on the backup 75b, the sheet carrier 82 moves forward from the standby position to the advanced position, enters and is nested into the backup 75b, and is positioned below the stacked bank notes P.

**[0051]** In this state, the stacked bank notes P are pressed by the bank note clampers 88 to hold the stacked bank notes P on the sheet carrier 82. Thereafter, the sheet carrier 82 is returned to the standby position, and the sheet carrier 82 and the stacked bank notes P are moved onto the base carrier 80. Next, the sheet carrier 82 and the base carrier 80 are moved down to the third position.

**[0052]** Subsequently, at the third position, the sheet carrier 82 moves forward from the standby position to the advanced position, and moves the stacked bank notes P onto the ejection table 84 of the banding apparatus. Next, an end part of the stacked bank notes P is gripped by the hand of the grip/draw mechanism of the banding apparatus 68 which will be described later, and simultaneously the clampers 88 are made to release its hold. Thereafter, the sheet carrier 82 is moved to the standby position from the advanced position. In this manner, the stacked bank notes P are transferred to the banding apparatus 68.

**[0053]** Next, the banding apparatus 68 will be described.

**[0054]** As shown in FIG. 2, the banding apparatus 68 comprises a substantially rectangular discharge table 84 which is set to be inclined obliquely downward in relation to a level surface, and a band feeder which feeds out wrapping bands. Stacked bank notes P are supplied to above the discharge table 84. The band feeder comprises a belt reel 83 around which a wrapping band for banding stacked bank notes P is wound, and a band feed mechanism which draws and feeds the wrapping band out into a looped shape from the band reel. In addition, the banding apparatus 68 comprises an unillustrated band winder which winds the wrapping band around bundled bank notes, a heater which heats and seals the wound wrapping band, and an unillustrated cutter which cuts the wrapping band.

**[0055]** The banding module 60 comprises, as electrically operational parts, the impeller stacking apparatuses 66, backup motor 78, heater 69, indicators 71, and a motor which drives individual parts of the banding module, such as gates.

**[0056]** As shown in FIG. 1, the expansion module 174 provided in the downstream side of the banding module 60 comprises a conveyor path 141 through which bank notes P fed from the banding module 60 are conveyed, and stockrooms 175 each of which has a large volume capable of stacking a particular quantity of bank notes fed through the conveyor path 141.

**[0057]** The expansion module 174 comprises, as an electrically operational part, a motor which drives a gate and the conveyor path 141 to operate.

**[0058]** A safety pocket 176 is provided in the most

downstream side of all the modules. When there is any bank note which could not be processed during conveyance, this bank note is discharged into the safety pocket 176 and is withdrawn from the apparatus.

**[0059]** Next, a system configuration of the paper-sheet processing apparatus 1 will be described.

**[0060]** FIG. 4 is a block diagram schematically showing a system configuration of the paper-sheet processing apparatus 1.

**[0061]** The main controller 12 is provided in a control board in the main module 10. The main controller 12 comprises a module CPU 13a which controls an operation of each component of the main module and calculates an efficiency of operation states, and a memory which stores various data, a control program, and management information. As the aforementioned various data, the memory stores operator IDs, date/time, serial numbers, assignment information, bank logos, administrator signature images, print information printable on bundling bands such as fonts of languages of respective countries, and processing speeds in a plurality of steps for paper sheets.

**[0062]** As shown in FIG. 4, the main controller 12 is connected to an operation unit 17 which inputs various information to the apparatus, and the monitor 15 as a display apparatus which displays operating states and processing states of the apparatus. The operation unit 17 is configured by a mouse and a keyboard. Alternatively, the monitor 15 and the operation unit 17 may be integrally configured as a touch panel.

**[0063]** The operation unit 17 comprises a switch for specifying an operating state of the paper-sheet processing apparatus 1. The operation unit 17 comprises an ON switch for switching the paper-sheet processing apparatus 1 into an ON state, a standby switch for switching the paper-sheet processing apparatus 1 into the standby mode, a cancel switch for releasing the paper-sheet processing apparatus 1 from the standby mode, and an OFF switch for switching the paper-sheet processing apparatus 1 into an OFF state. When any of the switches is pressed, the operation unit 17 then transmits a signal indicative of the corresponding pressed switch to the module CPU 13a.

**[0064]** The main controller 12 comprises a module CPU 13a, a timer 13b, a system controller, an APL PC board which controls the monitor 15 and operation unit 17, a RECO electrically connected to the system controller, a motor controller, a color sensor controller electrically connected to the motor controller, a PCB, and a gate controller. The timer 13b, motor controller, PCB, and gate controller are electrically connected to the module CPU 13a.

**[0065]** The module CPU 13a is installed on a control board. The module CPU 13a is supplied with electric power from the control board. Further, the module CPU 13a may control each unit via the control board. The module CPU 13a is also electrically connected to a module CPU 61a and a module CPU 177a. The module CPU 13a, module CPU 61a, and module CPU 177a can mutually

transmit and receive data.

**[0066]** The timer 13b measures the time elapsed since a bank note P is stacked for the last time. The timer 13b transmits information indicative of the measured elapsed time to the module CPU 13a. The timer 13b may transmit the information indicative of the elapsed time to the module CPU 13a at constant time intervals and may transmit the information indicative of the elapsed time to the module CPU 13a in response to a request from the module CPU 13a.

**[0067]** The system controller is also electrically connected to the module CPU 61a and module CPU 177a. The system controller transmits, to the module CPU 13a, module CPU 61a, and module CPU 177a, instructions input to the operation unit 17 or displays data on the monitor 15 in accordance with instructions from the CPUs.

**[0068]** The motor controller controls each of the motors in the main module 10. The gate controller controls each of gates in the main module 10.

**[0069]** The main-module power-supply box 12a supplies electric power to the control board of the module CPU 13a. The main-module power-supply box 12a also supplies electric power to component parts of the main module 10 under control of the module CPU 13a. The component parts of the main module 10 operate with the electric power supplied from the main-module power-supply box 12a.

**[0070]** An expansion module controller 170 is provided on a control board in the expansion module 174. The expansion module controller 170 controls an operation of each component part of the expansion module 174.

**[0071]** The expansion module controller 170 comprises the module CPU 177a, a centering unit, a PCB, a gate controller, and a motor controller. The centering unit, motor controller, PCB, and gate controller are electrically connected to the module CPU 177a.

**[0072]** The module CPU 177a is installed on the control board. The module CPU 177a is supplied with electric power from the control board. Further, the module CPU 177a may control component parts thereof through the control board.

**[0073]** The motor controller controls each of motors in the expansion module 174. The gate controller controls each of gates in the expansion module 174.

**[0074]** The expansion-module power-supply box 170a supplies electric power to the control board of the module CPU 177a. The expansion-module power-supply box 170a supplies respective units of the expansion module 174 under control of the module CPU 177a. The component parts of the main 174 operate with the electric power supplied from the expansion-module power-supply box 170a.

**[0075]** A banding module controller 59 is provided on the control board in the expansion module 60. The banding module controller 59 controls component parts of the expansion module 60. Further, the banding module controller 59 controls electric power supply to the first power supply system 63 and the second power supply system

67.

**[0076]** The banding module controller 59 comprises the module CPU 61a, a banding controller, a motor controller 61b, and a motor controller 61c. The banding controller, motor controller 61b, and motor controller 61c are electrically connected to the module CPU 61a.

**[0077]** The module CPU 61a is installed on the control board. The module CPU 61a is supplied with electric power from the control board. The module CPU 61a may control component parts through the control board.

**[0078]** The module CPU 61a controls power supply to the first power supply system 63 and the second power supply system 67. That is, the module CPU 61a controls the banding-module power-supply box 59a, and makes the banding-module power-supply box 59a supply electric power to the first power supply system 63 and the second power supply system 67. When the banding module 60 is in the standby mode described later, the module CPU 61a stops electric power supply to the first power supply system 63. The first power supply system 63 and the second power supply system 67 each may be a physically independent electric system or each may serve as an independent electric system as the module CPU 61a executes firmware.

**[0079]** The banding controller controls the motor controllers 61b and 61c, based on commands from the module CPU 61a.

**[0080]** The motor controller 61b controls the motor 63a. The backup motor controller 61c controls the backup motor 78.

**[0081]** The banding-module power-supply box 59a supplies electric power to the control board of the module CPU 61a. The banding-module power-supply box 59a supplies electric power to component parts of the banding module 60 under control of the module CPU 61a. The component parts of the banding module 60 operate with the electric power supplied from the banding-module power-supply box 59a.

**[0082]** The banding-module power-supply box 59a supplies electric power to the first power supply system 63 and second power supply system 67 under control of the module CPU 61a. If the first power supply system 63 and the second power supply system 67 are physically independent power supply systems, respectively, the banding-module power-supply box 59a comprises a first power module which supplies the first power module with electric power and a second power module which supplies the second power supply system 67 with electric power. The banding-module power-supply box 59a supplies electric power to the first power supply system 63 and second power supply system 67 by switching on or off the first and second power modules under control of the module CPU 61a. Otherwise, if the first power supply system 63 and the second power supply system 67 are made to serve as independent power supply systems by firmware, the banding-module power-supply box 59a supplies electric power to the first power supply system 63 and the second power supply system 67 under control

of the firmware.

**[0083]** The first power supply system 63 cannot be supplied with electric power when the banding module 60 is in the standby mode. That is, the module CPU 61a stops electric power supply to the first power supply system 63 when the banding module 60 is in the standby mode.

**[0084]** When the banding module 60 is in the standby mode, the first power supply system 63 supplies electric power to parts which cause no problem if electric power supply is stopped. The first power supply system 63 supplies electric power to, for example, the motor 63a, heater 69, and indicators 71.

**[0085]** The motor 63a drives parts of the banding module 60 to operate except for the backup 75. For example, the term "motor 63a" is a general term covering the motor which drives the impeller stacking apparatus 66, the motor which drives the bank note clamper 88, and the motor which drives the sheet carrier 82.

**[0086]** The second power supply system 67 is supplied with electric power even when the banding module 60 is in the standby mode. That is, the module CPU 61a stops electric power supply to the second power supply system 67 when the banding module 60 is in the standby mode.

**[0087]** When the banding module 60 is in the standby mode, the second power supply system 67 supplies electric power to parts which cause a problem if electric power supply is stopped. The second power supply system 67 supplies electric power to, for example, the backup motor 63a, sensors 67a, and an inter-board communication unit 67b.

**[0088]** The sensors 67a are provided in component parts of the banding module 60, and detect positions of bank notes P and the occurrence of jamming. The sensors 67a transmit detected information to the module CPU 61a.

**[0089]** The inter-board communication unit 67b is an interface to communicate with other module CPUs (e.g., the module CPU 13a and module CPU 177a). The module CPU 61a transmits/receives data to/from other CPU modules through the communication unit 67b. The inter-board communication unit 67b may be, for example, an interface for LAN communication.

**[0090]** Next, an operation example of the paper-sheet processing apparatus 1 will be described.

**[0091]** The paper-sheet processing apparatus 1 can be switched into an ON state, an OFF state, and a standby mode.

**[0092]** Descriptions below will be made of an operation example when the paper-sheet processing apparatus 1 transits to the ON state, OFF state, or standby mode.

**[0093]** In the ON state, the power supply of the paper-sheet processing apparatus 1 is on, and the paper-sheet processing apparatus 1 stacks and bands bank notes P. In the OFF state, the power supply of the paper-sheet processing apparatus 1 is off, and all operations of the paper-sheet processing apparatus 1 are stopped.

**[0094]** In the standby mode, the power supply of the paper-sheet processing apparatus 1 is on, and opera-

tions of component parts of the paper-sheet processing apparatus 1 are stopped. In the standby mode, a part of the paper-sheet processing apparatus 1 is supplied with electric power in order to allow immediate operation start while the other parts are not supplied with electric power.

**[0095]** When the operating state transits to the standby mode, the module CPU 13a then makes the main-module power-supply box 12a stop electric power supply to component parts of the main module 10. Accordingly, the motors, sensors, and indicators in the main module 10 stop. Further, the module CPU 13a makes the main-module power-supply box 12a supply electric power to the module CPU 13a and inter-board communication unit which is an interface for communication between boards. In this manner, the module CPU 13a can determine whether the cancel switch is pressed or not, and can make the paper-sheet processing apparatus 1 transit to the ON state from the standby mode. The module CPU 13a transmits, to the module CPU 177a and module CPU 61a, a signal indicating that the paper-sheet processing apparatus 1 has transited into the standby mode.

**[0096]** The module CPU 177a makes the expansion-module power-supply box 170a stop electric power supply to component parts of the expansion module 174. Accordingly, the motors, sensors, and indicators in the expansion module 174 stop. Further, the module CPU 177a makes the expansion-module power-supply box 170a supply electric power to the module CPU 177a and the inter-board communication unit as an interface for communication between boards. In this manner, the module CPU 177a can receive a signal indicative of transition to the ON state from the module CPU 13a, and can make the expansion-module power-supply box 170a supply electric power to component parts of the expansion module 174.

**[0097]** The module CPU 61a makes the banding-module power-supply box 59a stop electric power supply to the first power supply system 63. The motors 63a, heater 69, and indicators 71 which are thereby supplied with electric power from the first power supply system 63 stop.

**[0098]** The module CPU 61a maintains electric power supply to the module CPU 61a and the second power supply system 67. By maintaining the electric power supply to the backup motor 78 in the second power supply system 67, the backup motor 78 is driven and fixed even in the standby mode. As a result, the backup 75 which operates in interlock with operation of the backup motor 78 does not move down by gravity even in the standby mode and is maintained at a position immediately before the paper-sheets processing apparatus 1 transits to the standby mode. Therefore, after the standby mode is released, the banding module 60 can additionally stack bank notes onto the bank notes P already stacked on the backup 75.

**[0099]** Further, by supplying electric power to the module CPU 61a and inter-board communication unit 67d, the module CPU 61a can receive a signal indicative of

transition to the ON state from the module CPU 13a, and can make the banding-module power-supply box 59a supply electric power to component parts of the banding module 60.

**[0100]** When the standby switch to make the paper-sheet processing apparatus 1 transit to the standby mode is pressed in the ON state, the paper-sheet processing apparatus 1 transits to the standby mode. The paper-sheet processing apparatus 1 transits to the standby mode if no bank note P is stacked for a predetermined period.

**[0101]** When the cancel switch to release the standby mode is pressed in the standby mode, the paper-sheet processing apparatus 1 transits to the ON state, and stacks and bands bank notes P.

**[0102]** FIG. 5 is a flowchart for explaining an operation example of the paper-sheet processing apparatus 1.

**[0103]** In this example, the paper-sheet processing apparatus 1 is supposed to be in the OFF state.

**[0104]** Firstly, the module CPU 13a of the paper-sheet processing apparatus 1 determines whether the ON switch to make the paper-sheet processing apparatus 1 transit to the ON state has been pressed or not (Step S11). That is, the module CPU 13a determines whether a signal indicating a press made on the ON switch has been received from the operation unit 17 or not.

**[0105]** If the ON switch is determined to have not been pressed (Step S11, NO), the module CPU 13a returns to Step S11.

**[0106]** If the ON switch is determined to have been pressed (Step S11, YES), the module CPU 13a performs an initialization processing (Step S12). The initialization processing sets component parts of the paper-sheet processing apparatus 1 into a state capable of stacking and banding bank notes P. For example, in the initialization processing, the module CPU 13a transmits a command to execute the initialization processing to the module CPU 61a and module CPU 177a. The module CPU 13a, module CPU 61a, and module CPU 177a drive motors of the respective modules, and arrange movable parts at appropriate positions. For example, the module CPU 61a makes the motor 63a and the backup motor 78 drive, and arranges the impeller stacking apparatuses 66, bank note clampers 88, sheet carrier 82, and backup 75 at appropriate processing positions.

**[0107]** After performing the initialization processing, the module CPU 13a determines whether the standby switch has been pressed or not (Step S13). That is, the module CPU 13a determines whether a signal indicating a press made on the ON switch has been received from the operation unit 17 or not.

**[0108]** If the ON switch is determined to have not been pressed (Step S13, NO), the module CPU 13a determines whether the predetermined period has elapsed since any bank note P was stacked for the last time (Step S14). That is, the module CPU 13a determines whether an elapsed time has exceeded the predetermined period or not, based on information indicative of the elapsed

time which is transmitted from the timer 13b.

**[0109]** If the predetermined period is determined to have not elapsed (Step S14, NO), the module CPU 13a determines whether the OFF switch has been pressed or not (Step S15). That is, the module CPU 13a determines whether a signal indicating a press made on the OFF switch has been received from the operation unit 17 or not.

**[0110]** If the OFF switch is determined to have not been pressed (Step S15, NO), the module CPU 13a returns to Step S13.

**[0111]** If the standby switch is determined to have been pressed (Step S13, YES) or if the predetermined time has passed (Step S14, YES), the module CPU 13a performs processing (Step S16). The standby processing sets the paper-sheet processing apparatus 1 into a state capable of transiting to the standby mode. The standby processing continues the processing which cannot be suspended halfway. For example, when the impeller stacking apparatus 66 is conveying a bank note P, the standby processing functions to rotate the impeller stacking apparatus 66 to a conveyance end position for the bank note P and loads the bank note P onto the backup 75.

**[0112]** Otherwise, when a bank note P is on the conveyor path 16, 31, or 62, the standby processing conveys the bank note P to the banding module 60, rotates the impeller stacking apparatus 66, and loads the bank note P onto the backup 75.

**[0113]** After performing the standby processing, the module CPU 13a transits to the standby mode (Step S17). That is, the module CPU 13a stops electric power supply from the main-module power-supply box 12a. Further, the module CPU 13a transmits, to the module CPU 61a and module CPU 177a, a signal indicating that the paper-sheet processing apparatus 1 has transited to the standby mode.

**[0114]** Upon receipt of the signal, the module CPU 177a stops electric power supply from the expansion-module power-supply box 170a.

**[0115]** Upon receipt of the signal, the module CPU 61a stops electric power supply to the first power supply system 63. For example, when the first power supply system 63 and the second power supply system 67 are physically independent, the module CPU 61a transmits, to the banding-module power-supply box 59a, a command to stop electric power supply to the first power supply system 63. The banding-module power-supply box 61a receives the command and stops electric power supply to the first power supply system 63. Otherwise, if the first power supply system 63 and the second power supply system 67 are made independent by firmware, the module CPU 61a stops electric power supply to the first power supply system 63 by the firmware.

**[0116]** After transition to the standby mode, the module CPU 13a determines whether the OFF switch has been pressed or not (Step S18). If the OFF switch is determined to have not been pressed (Step S18, NO), the

module CPU 13a determines whether the cancel switch to release the standby mode of the paper-sheet processing apparatus 1 has been pressed or not (Step S19). That is, the module CPU 13a determines whether a signal indicating a press made on the cancel switch has been received from the operation unit 17 or not.

**[0117]** If the cancel switch is determined to have not been pressed (Step S19, NO), the module CPU 13a returns to Step S18.

**[0118]** Otherwise, if the cancel switch is determined to have been pressed (Step S19, YES), the module CPU 13a subjects components other than the backup 75 to the initialization processing (Step S20). That is, the module CPU 13a makes the main-module power-supply box 12a supply electric power to the respective components of the main module 10. After the respective components are supplied with electric power, the module CPU 13a arranges movable parts to appropriate initial positions. Further, the module CPU 13a transmits a signal indicating of transition to the ON state from the standby mode, to the module CPU 61a and module CPU 177a.

**[0119]** The module CPU 177a receives the signal and makes the expansion-module power-supply box 170a supply electric power to the component parts of the expansion module 174. After the component parts are supplied with electric power, the module CPU 13a arranges respective movable parts at appropriate initial positions.

**[0120]** The module CPU 61a receives the signal and makes the banding-module power-supply box 59a supply electric power to the first power supply system 63. When the first power supply system 63 is supplied with electric power, the module CPU 61a arranges movable parts (for example, the impeller stacking apparatus 66, bank note clasper 88, and sheet carrier 82) other than the backup 75 to appropriate initial positions.

**[0121]** When other component parts than the backup 75 are subjected to the initialization processing, the module CPU 13a returns to Step S13.

**[0122]** If the OFF-switch is determined to have been pressed (Step S15, YES) or if the OFF-switch is determined to have been pressed (Step S18, YES), the module CPU 13a performs a termination processing (Step S21). The termination processing sets the paper-sheet processing apparatus 1 into a state capable of transiting to the OFF state. For example, if bundled bank notes P are stacked on the backup 75 of the banding module 60, the termination processing makes the stacked bank notes P be discharged to outside of the backup 75. When the impeller stacking apparatus 66 is conveying a bank note P, the termination processing rotates the impeller stacking apparatus 66 to the conveyance end position for the bank note P, and stacks the bank note P onto the backup 75. In this case, the termination processing subsequently discharges stacked bank notes P to outside of the backup 75. After performing the termination processing, the module CPU 13a turns off the power supply of the paper-sheet processing apparatus 1 (Step S22). That is, the module CPU 13a transmits a command which

turns off the power supply, to the module CPU 61a and module CPU 177a. The module CPU 13a also turns off the power supply of the main-module power-supply box 12a.

**[0123]** Upon receipt of the signal, the module CPU 13a turns off the power supply of the expansion-module power-supply box 170a. Upon receipt of the signal, the module CPU 13a turns off the power supply of the banding-module power-supply box 59a.

**[0124]** At this time point, the module CPU 13a may control the banding-module power-supply box 59a so as to supply electric power only to the operation unit 17 which detects a press down on the ON switch. In this case, the module CPU 13a may make the main-module power-supply box 12a supply electric power to the module CPU 13a so as to be capable of receiving the signal which detects a press down on the ON switch.

**[0125]** When the power supply of the whole paper-sheet processing apparatus 1 is turned off, the module CPU 13a terminates operation.

**[0126]** The paper-sheet processing apparatus configured as described above can transit into the standby mode. During the standby mode, the backup of the banding module is fixed in the position at the time of setting the standby mode and does not move. Accordingly, the backup is maintained in a state that paper sheets remain stacked. As a result, when returning to the normal mode from the standby mode, there is no need of picking up or resupplying bank notes stacked on the backup. Further, there is no need of operation for initializing the backup. Accordingly, the paper-sheet processing apparatus 1 can continuously restart stacking of paper sheets. From the above, the standby mode can be set without causing any laborious recovery processing and a paper-sheet processing apparatus capable of reducing power consumption can be achieved.

## Second Embodiment

**[0127]** Next, the second embodiment will be described.

**[0128]** A paper-sheet processing apparatus according to the second embodiment has a configuration different from that of the first embodiment in that a backup motor 78 is supplied with electric power from a first power supply system 63, and in that a first gear 77a, a second gear 77b, and a third gear 77c can fix the backup 75 by use of gear ratios and weights of respective gears. In the second embodiment, the other features of the configuration of the paper-sheet processing apparatus than those described above are the same as those of the paper-sheet processing apparatus according to the first embodiment. Identical components will be respectively denoted by identical reference symbols, and detailed descriptions thereof will be omitted herefrom.

**[0129]** FIG. 6 is a block diagram schematically showing a system configuration of the paper-sheet processing apparatus 1.

**[0130]** As shown in FIG. 6, a backup motor 78 is com-

prised in a first power supply system 63. That is, when a banding module 60 enters into a standby mode, a banding module controller 59 stops electric power supply to a backup motor 78.

**[0131]** The first gear 77a, second gear 77b, and third gear 77c of a backup drive unit configure a fixing mechanism having a structure capable of supporting the weight of stacked bank notes P stacked on the backup 75 even if electric power supply to the backup motor 78 stops. That is, even when electric power supply to the backup motor 78 stops, the first gear 77a, second gear 77b, and third gear 77c can support the backup 75 so as not to move down, owing to the resistance generated from the gear ratios and weights of the respective gears. The backup 75 is fixed without moving down by the resistance generated from the respective gears.

**[0132]** For each of the first gear 77a, second gear 77b, and third gear 77c, the gear ratio and weight are determined depending on the weights of the backup 75 and bank notes P stacked. For example, the weight of the backup 75 is supposed to be 700 g, and the weight of one hundred bank notes P is supposed to be 100 g. The weight of a connection shaft 76 is supposed to be 300 g. In this case, the weight of the first gear 77a is 100g. A large diameter gear of the first gear 77a comprises forty gear teeth, and a small diameter gear thereof comprises sixteen gear teeth. Further, the weight of the second gear 77b is 100 g. A large diameter gear of the second gear 77b comprises forty gear teeth, and a small diameter gear thereof comprises sixteen gear teeth. The weight of the third gear 77c is 100g. The third gear 77c comprises forty gear teeth. A gear installed at a distal end of a rotation shaft of the backup motor 78 comprises nine gear teeth.

**[0133]** When the banding module 60 transits to the standby mode, the module CPU 61a then stops electric power supply to the first power supply system 63. Accordingly, the module CPU 61a stops electric power supply to the backup motor 78.

**[0134]** When electric power supply to the backup motor 78 is stopped, the backup 75 is then not supported by the drive force of the backup motor 78. However, since the first gear 77a, second gear 77b, and third gear 77c are configured to support the weight of the backup 75 and the weight of bank notes P stacked on the backup 75, the backup 75 can be maintained at the same position as the position immediately before transition of the paper-sheet processing apparatus to the standby mode. Accordingly, the banding module 60 can continuously stack bank notes P onto the backup 75 after releasing the standby mode, as in the first embodiment.

**[0135]** The paper-sheet processing apparatus configured as described above can stop electric power supply even to the backup motor in the standby mode. As a result, in the standby mode, the paper-sheet processing apparatus 1 can save more electric power than the paper-sheet processing apparatus 1 according to the first embodiment.

## Third Embodiment

**[0136]** Next, a paper-sheet processing apparatus according to the third embodiment will be described.

**[0137]** The third embodiment has a configuration different from that of the first embodiment in that the backup motor 78 is supplied with electric power from a first power supply system 63, in that a temporary stacking unit 65 comprises a solenoid, a plunger, and a fixing member, which function as a fixing mechanism, and in that a connection shaft 76 is provided with an engagement part. In the third embodiment, the other features of the configuration of the paper-sheet processing apparatus than those described above are the same as those of the paper-sheet processing apparatus according to the first embodiment. Identical components will be respectively denoted by identical reference symbols, and detailed descriptions thereof will be omitted herefrom.

**[0138]** FIG. 7 is a front view of the temporary stacking unit 65 which the paper-sheet processing apparatus 1 according to the third embodiment comprises.

**[0139]** As shown in FIG. 7, the fixing mechanism of the temporary stacking unit 65 comprises an engagement part, a solenoid, and a plunger provided on the connection shaft 76. That is, an engagement groove 93 which functions as an engagement part is provided in a lower end part of the connection shaft 76. The engagement groove 93 is formed in a shape of a gear in which convex and concave parts are alternately arranged in the perpendicular direction.

**[0140]** A solenoid 90 and a plunger 91 are provided substantially horizontally below a gear train 77. The plunger 91 is inserted in the solenoid 90 to be reciprocally movable along horizontal directions. In the solenoid 90, a compression spring 94 energizes the plunger 91 in a direction of protruding from the solenoid 90. Further, a fixing member 92 is attached to a distal end of the plunger 91. The fixing member 92 comprises an engagement end having a convex and concave shape or a shape of a gear which can engage in the engagement groove 93.

**[0141]** The solenoid 90 and plunger 91 are provided to be opposed to the connection shaft 76. The plunger 91 is supported to be movable between a fixing position where the fixing member 92 provided at the distal end engages in the engagement groove 93 of the connection shaft 76 and a release position where the fixing member is apart from the engagement groove 93. When the solenoid 90 is electrically conducted, the plunger 91 is drawn to the releasing position by a magnetic field generated from the solenoid. When the electric conduction to the solenoid 90 is stopped, the plunger 91 is energized by the compression spring 94 and moves to the fixing position. When the plunger 91 moves to the fixing position, the fixing member 92 engages in the engagement groove 93 of the connection shaft 76 and fixes the connection shaft 76. In this manner, the connection shaft 76 and the backup 75a are fixed to the stop position, to prevent further movement.

**[0142]** When the backup motor 78 moves the backup 75, the module CPU 61a of the banding module 60 performs control of making an electric current flow to a coil of the solenoid 90 and draws the plunger 91 into the solenoid 90. As a result, the fixing member 92 moves apart from the connection shaft 76, and the backup motor 78 can then move the backup 75.

**[0143]** FIG. 8 is a block diagram schematically showing a system configuration of the paper-sheet processing apparatus 1.

**[0144]** As shown in FIG. 8, the first power supply system 63 comprises the backup motor 78 and solenoid 90.

**[0145]** Therefore, when the paper-sheet processing apparatus 1 is set in the standby mode, electric power supply to the backup motor 78 and the solenoid 90 is stopped.

**[0146]** The module CPU 61a transits to the standby mode after forming a state in which the fixing member 92 is in contact with the connection shaft 76 through the standby processing.

**[0147]** When the paper-sheet processing apparatus 1 transits to the standby mode, the module CPU 61a then stops electric power supply to the first power supply system 63. Accordingly, the module CPU 61a stops electric power supply to the solenoid 90.

**[0148]** When electric power supply to the backup motor 78 is stopped, the backup 75 is then not supported by the drive force of the backup motor 78. However, the fixing member 92 provided at the distal end of the plunger 91 remains pressed to the connection shaft 76 by the stress of a spring. As a result, the backup 75 remains continuously fixed by the fixing member 92 provided at the distal end of the plunger 91, and can be maintained at the same position as the position immediately before transition of the paper-sheet processing apparatus to the standby mode. Accordingly, the banding module 60 can continuously stack bank notes P onto the backup 75 after releasing the standby mode, as in the first embodiment.

**[0149]** The paper-sheet processing apparatus configured as described above can stop electric power supply even to the backup motor in the standby mode, as in the second embodiment. As a result, in the standby mode, the paper-sheet processing apparatus 1 can save electric power from the paper-sheet processing apparatus 1 according to the first embodiment. In addition, the paper-sheet processing apparatus can fix the backup irrespective of gear ratios and weights.

**[0150]** While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

Claims

- 1. A paper-sheet processing apparatus, comprising:
  - a feed unit (11) in which a plurality of paper sheets are stacked; 5
  - a pickup unit (14) which extracts paper sheets from the feed unit;
  - an inspection unit (18) which inspects the paper sheets extracted; 10
  - a stacking unit (66) which stacks each predetermined number of the paper sheets inspected, onto a backup (75);
  - a backup drive unit (81) which adjusts the position of the backup, depending on a quantity of the stacked paper sheets; 15
  - a banding unit (68) which bands the stacked paper sheets by wrapping a band around the stacked paper sheets;
  - at least one power supply (12a, 59a, 170a) 20 which supplies electric power to electrically operational parts of the pickup unit, inspection unit, stacking unit, backup drive unit, and banding unit;
  - a mode setting unit (13a) which sets a standby mode of temporarily stopping electric power supply to at least one of the electrically operational parts; and 25
  - a fixing unit (77, 78, 90, 91, 92, 93) which fixes the backup to a position for the standby mode when the standby mode is set by the mode setting unit. 30
- 2. The paper-sheet processing apparatus of Claim 1, wherein 35
  - the backup drive unit comprises a motor (78) which drives the backup, and
  - the fixing unit comprises a power supply system (63) which supplies electric power to the motor, and during the standby mode set, the fixing unit supplies electric power to the motor of the backup drive unit and fixes the backup to a stop position by the motor. 40
- 3. The paper-sheet processing apparatus of Claim 1, wherein 45
  - the backup drive unit comprises a motor (78) and a gear train (77) which transmits a drive force of the motor to the backup, and
  - the fixing unit is configured by the gear train, and the gear train employ gear ratios and a weight at which the backup and the paper sheets stacked on the backup can be supported at a stop position. 50
- 4. The paper-sheet processing apparatus of Claim 1, wherein 55
  - the backup drive unit comprises a support member (76) connected to the backup and supported to be freely movable, and a motor which drives the support

member, and  
 the fixing unit comprises an engagement part (93) provided on the support member, a plunger provided to be movable between a fixing position where the plunger engages with the engagement part and a release position where the plunger is apart from the engagement part, a solenoid which energizes the plunger to a releasing position, and an energizing member (94) which energizes the plunger to the fixed position, and when the standby mode is set and electric power supply to the solenoid is stopped, the plunger is moved to the fixing position, and the support member is fixed by the plunger.

- 5. The paper-sheet processing apparatus of Claim 1-4, further comprising
  - a measurement unit (13b) which measures a time elapsed since a paper sheet is stacked for the last time, wherein
  - the mode setting unit sets the standby mode if the time measured by the measurement unit exceeds a predetermined time period.

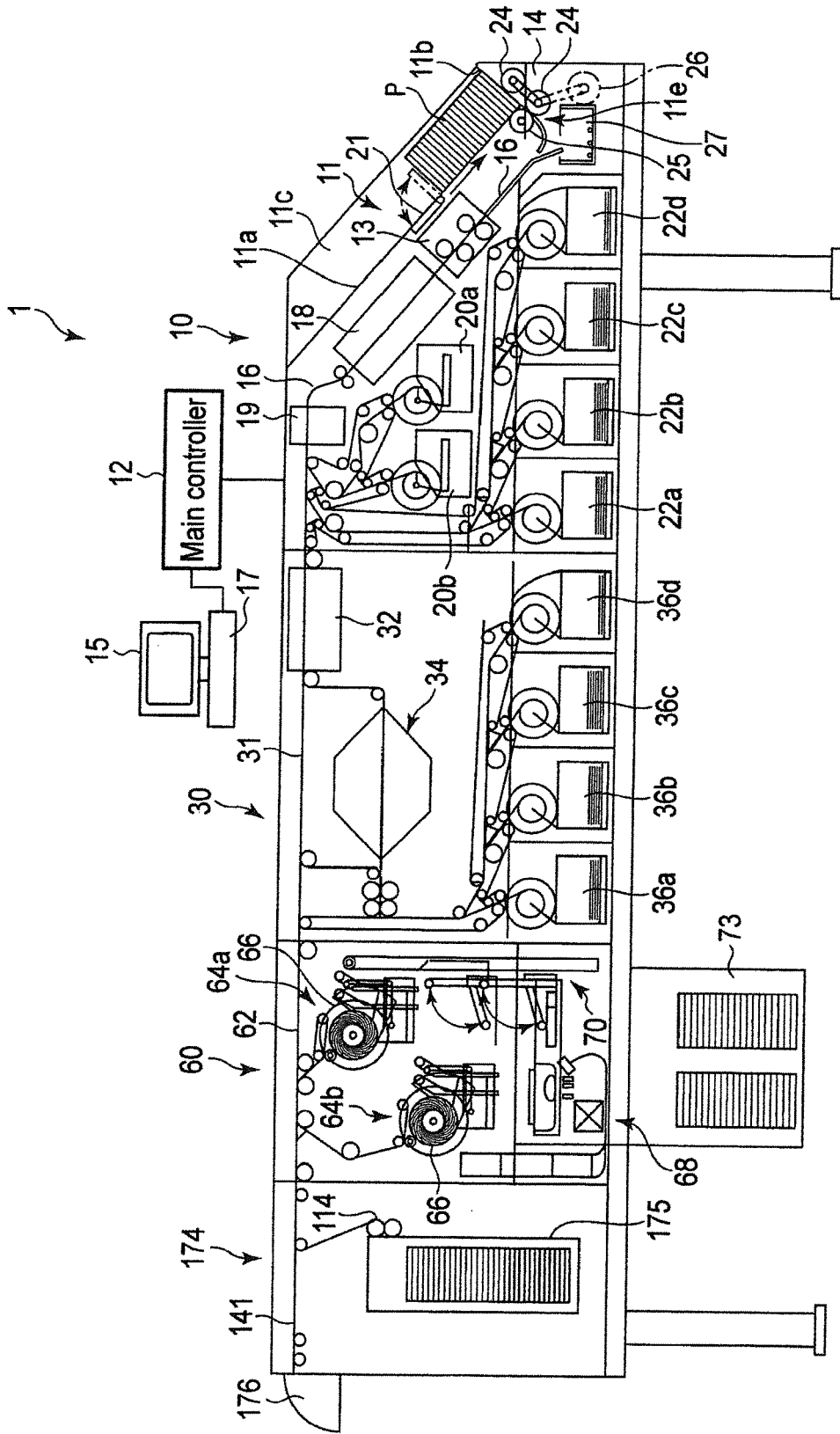


FIG. 1

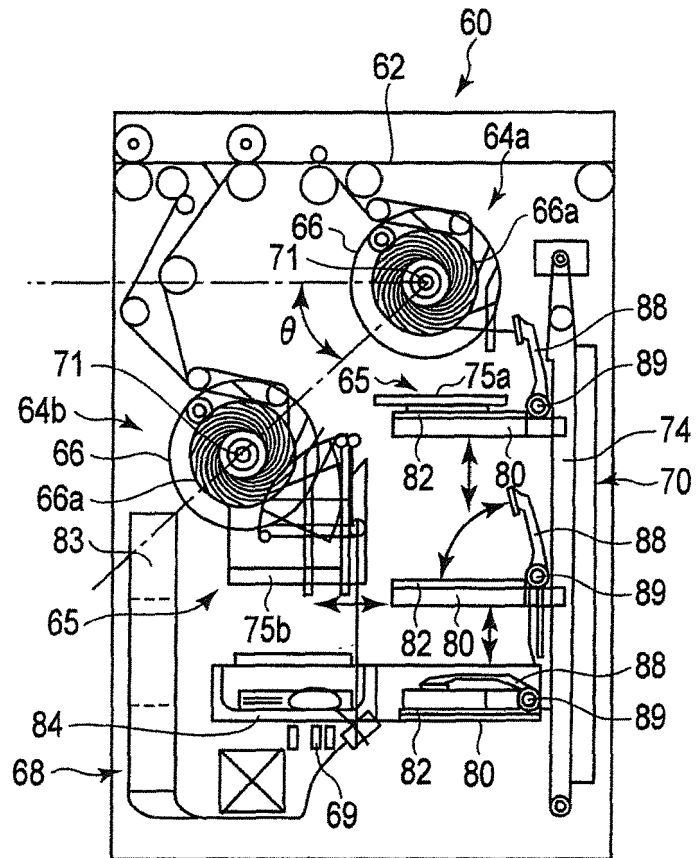


FIG. 2

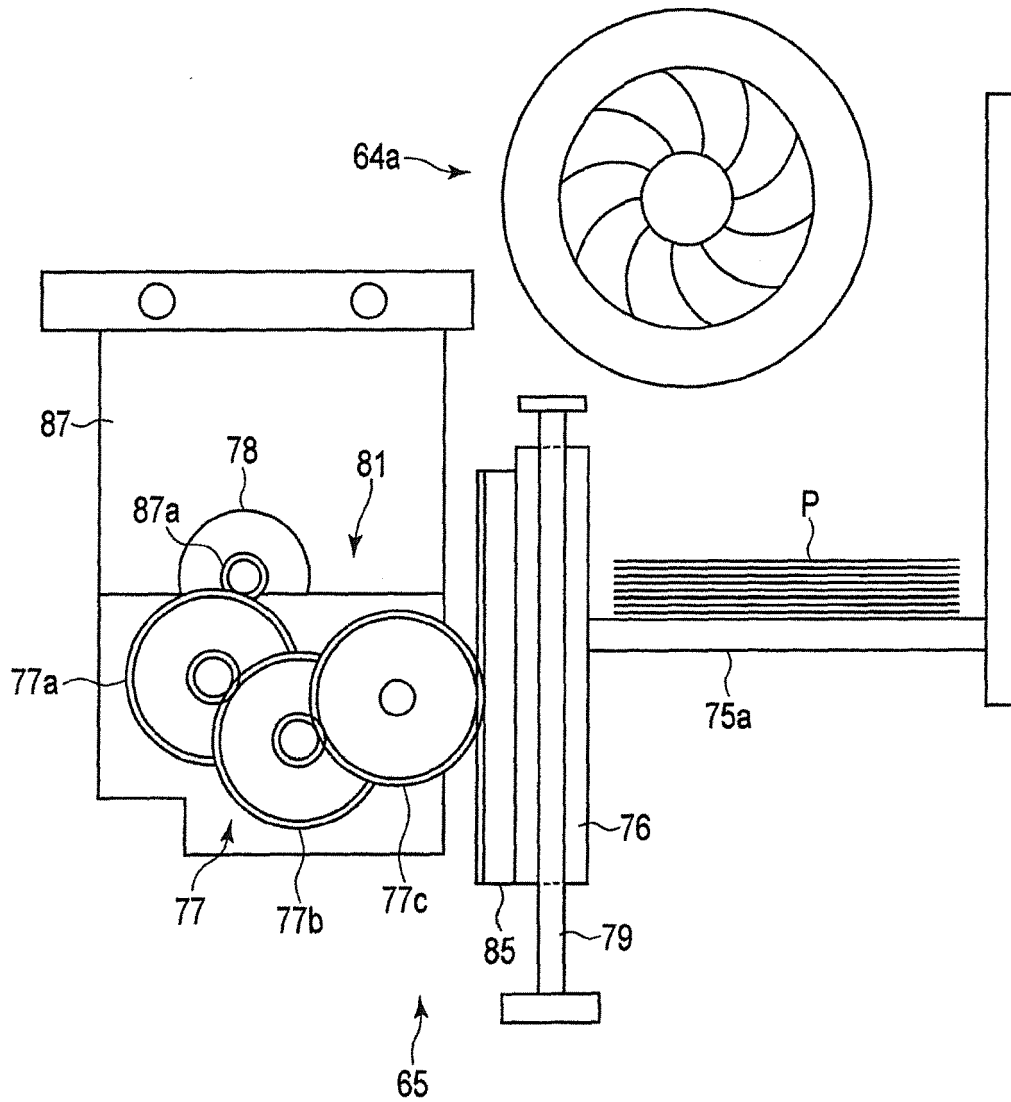


FIG. 3

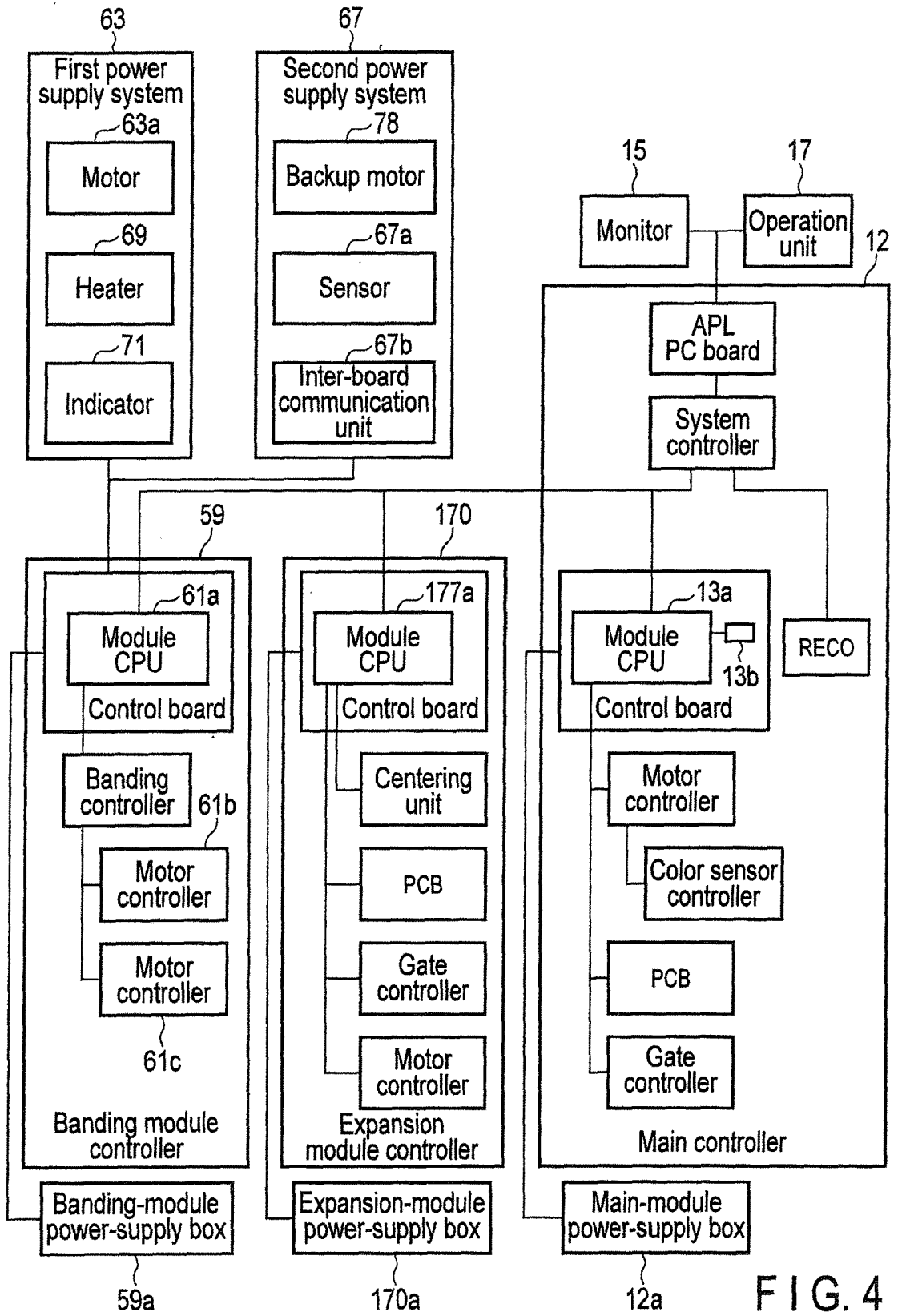


FIG. 4

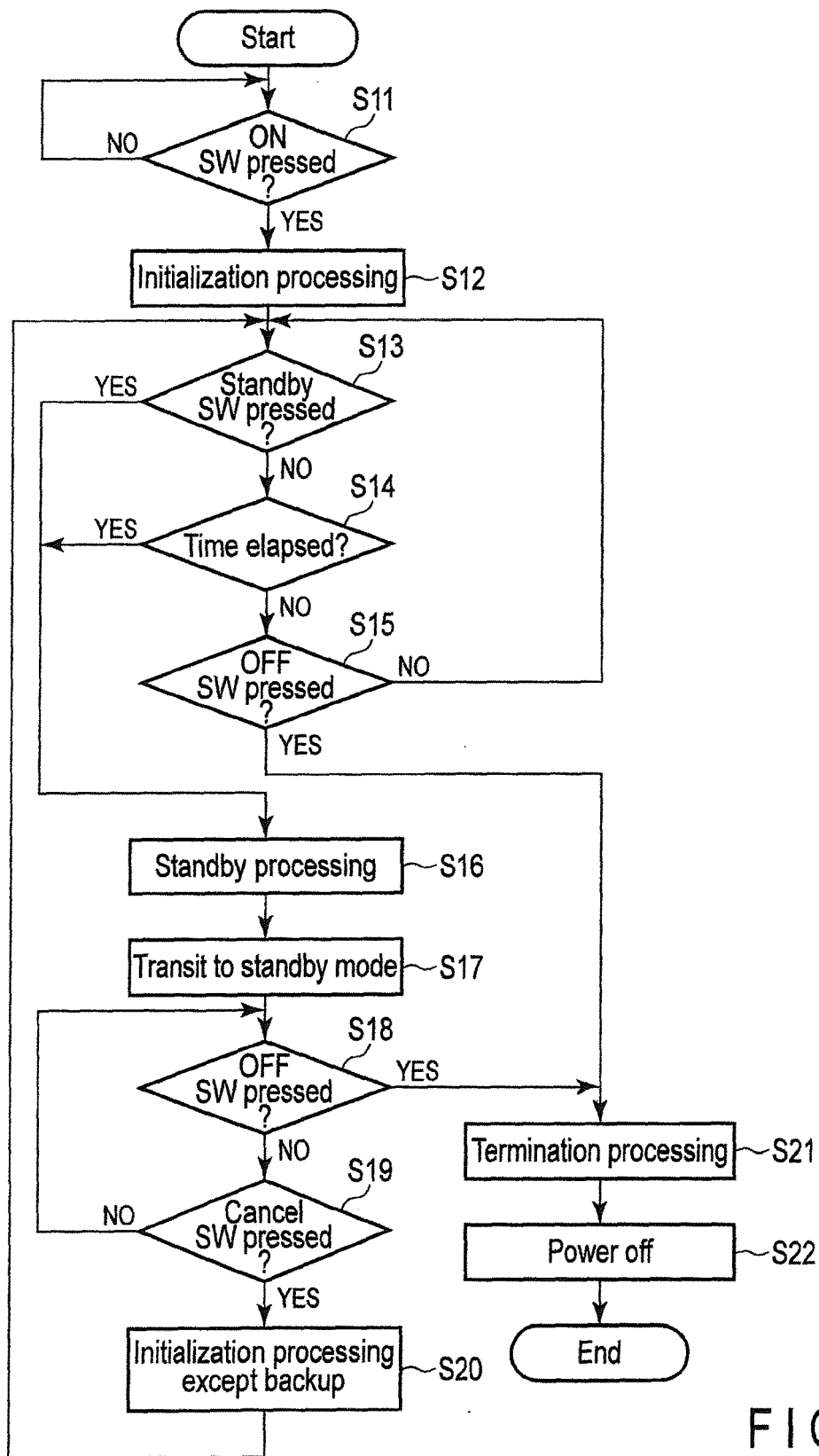


FIG. 5

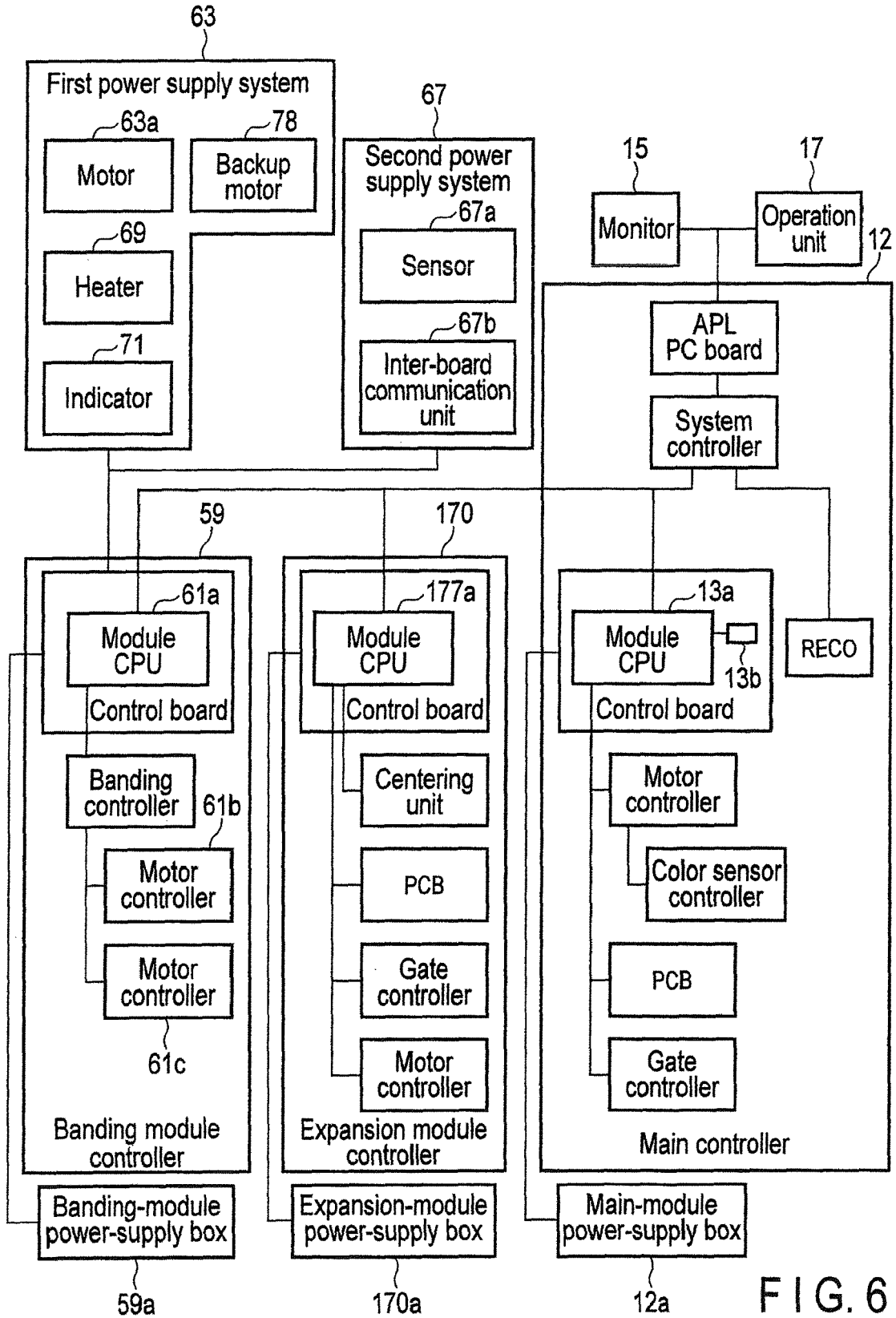


FIG. 6

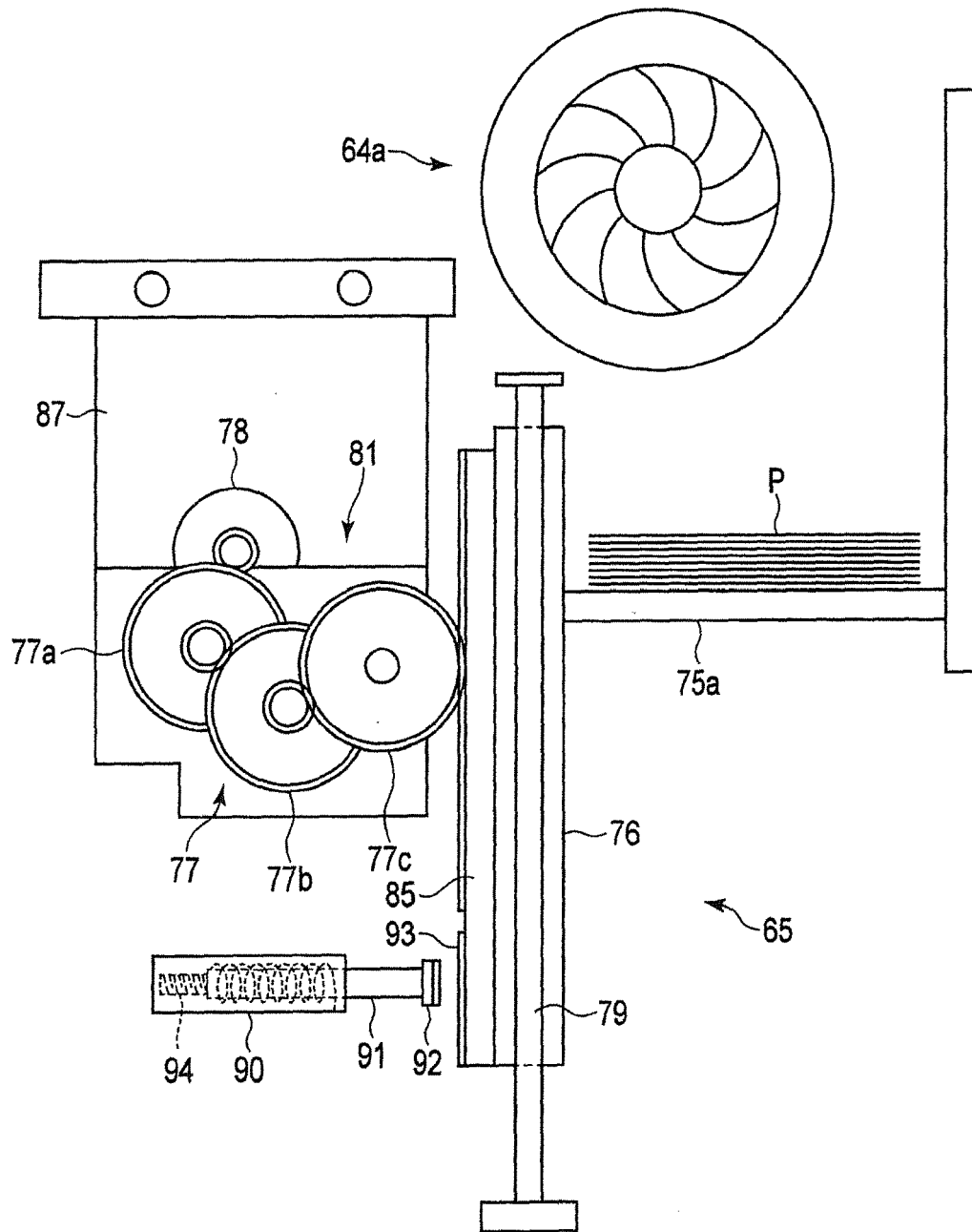


FIG. 7

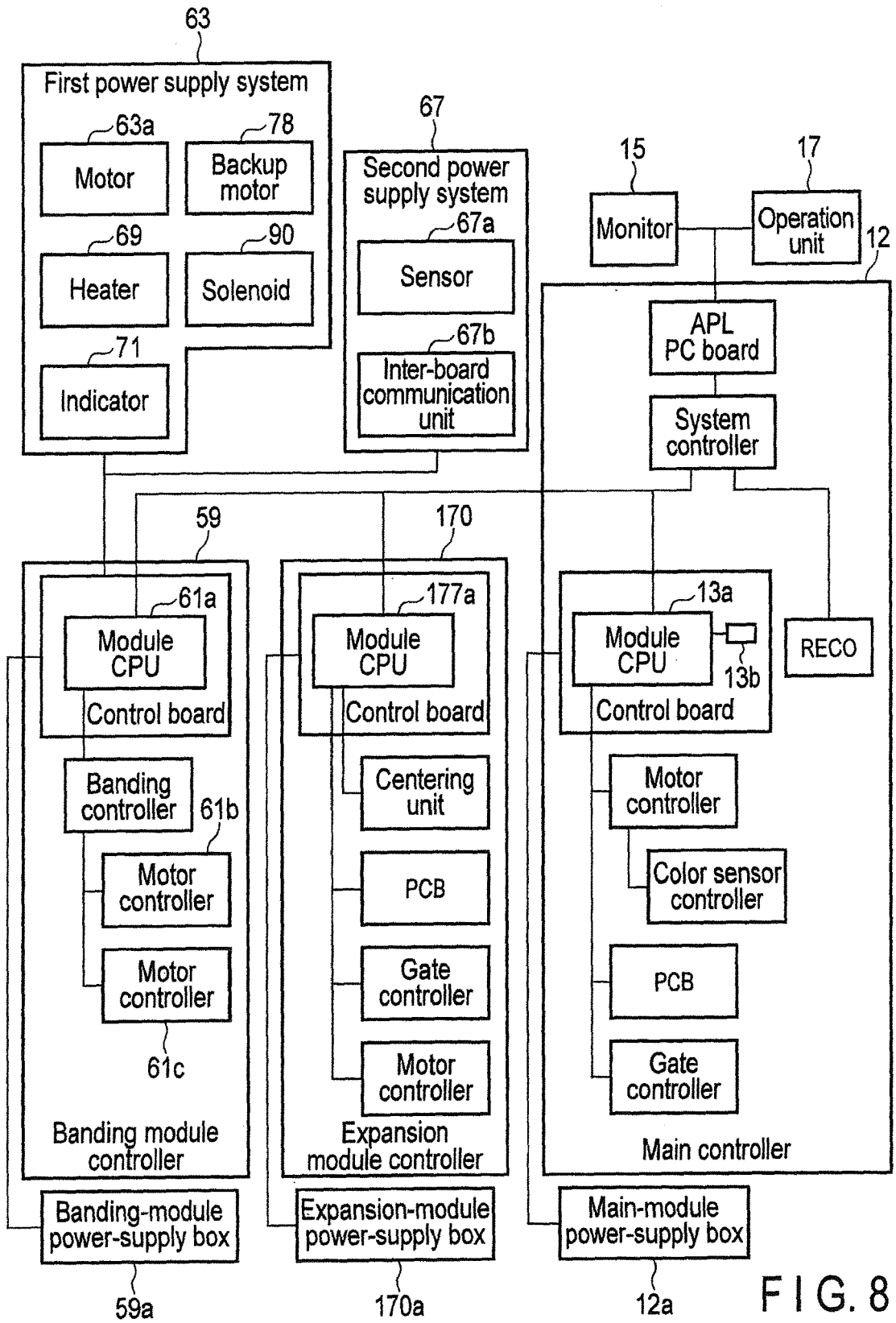


FIG. 8



EUROPEAN SEARCH REPORT

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