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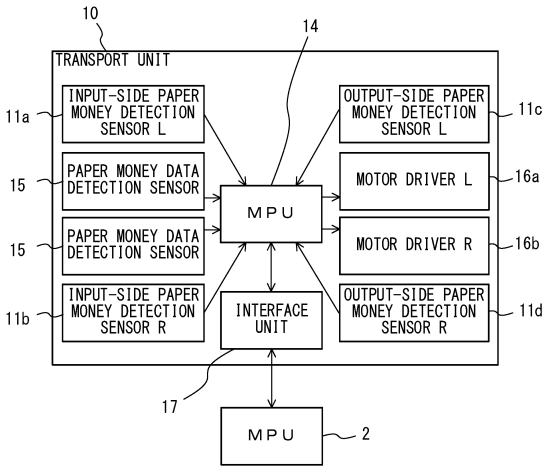
(54) **PAPER SHEET PROCESSING APPARATUS**

(57) Provided is paper sheet processing apparatus that includes plural transport units connected in the transport direction of paper sheets, each of the plural transport units including paper sheets detection sensors (input-side paper money detection sensors L11a, input-side paper money detection sensors R11b, output-side paper money detection sensors L11c, output-side paper money detection sensors R11d) for detecting presence/absence of the paper sheets, a transport mechanism for conveying the paper sheets, a driving means for driving the transport mechanism, and a controller unit (MPU 14) for controlling the driving means. The controller unit (MPU 14) controls the driving means to transport the paper sheets by means of the transport mechanism based on a detection result from the paper sheet detection sensors (input-side paper money detection sensors L11a, input-side paper money detection sensors R11b, output-side paper money detection sensors L11c, output-side paper money detection sensors R11d).



F I G. 2

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Description

FIELD

[0001] The present invention relates to a paper sheet processing apparatus that is provided with plural transport units, each having a controller unit.

BACKGROUND

[0002] In conventional paper sheet processing apparatuses such as ATM (Automated Teller Machine), paper sheets such as paper money are transported by belts or rollers and various types of processing such as discrimination are carried out.

[0003] A conveyer for paper sheets and the like that conveys paper sheets and the like has been proposed in which the conveyer includes plural conveyer units, plural conveyer motors that drive each of the conveyer units, and paper sheet sensors that detect the passage of the paper sheets at a fixed position in each of the conveyer units, and when the conveyance is not carried out due to abnormal occurrence, normally-conveyed paper money is stopped at a certain position so that presence/absence of the paper money can be readily checked (for example, see Patent document 1).

[0004] A voting paper classification device in which extension units can be connected to a base unit has been proposed in which the first controller unit of the base unit receives information of a connection order from the second controller units of the extension units in order to make the setting of the total number and the connection order of the extension units unnecessary (for example, see Patent document 2).

PRIOR ART DOCUMENT

Patent Document

[0005]

Patent document 1: Japanese Laid-open Patent Publication No. H08-259042
Patent document 2: Japanese Laid-open Patent Publication No. 2013-186870

SUMMARY

Problem to be solved by the invention

[0006] Paper sheet processing apparatuses may have divergent apparatus structures depending on their destinations, and although common designs are employed as much as possible for the forms of the paper sheet processing apparatuses, many destination-dependent designs remain. In addition, apparatus redesigning may be needed due to a change in the shape of the apparatus or the change in the number of mounted components (safe etc.).

[0007] Moreover, when the paper sheet processing apparatus has a design that depends on an individually tailored design, the transport path needs to have a unique transport path. In such a case, the transport path is constructed by connecting the entirety of the unique transport path by means of a belt etc., and the small number of large-output motors are used. Consequently, even in a portion at which no paper sheets are located, the belt is still operating, and this results in an increase in mechanical loss.

[0008] Note that in the above-described conveyer for paper sheets and voting paper classification device, individual transport units do not control transporting operations after detecting an input of paper sheets, and therefore a transport path cannot be flexibly constructed.

[0009] It is an object of the present invention to provide a paper sheet processing apparatus that enables flexible construction of a transport path by using transport units, each being independently controlled.

Means to solve the problem

[0010] In one aspect, the paper sheet processing apparatus is a paper sheet processing apparatus including plural transport units connected in the transport direction of paper sheets, each of the plural transport units including paper sheets detection sensors for detecting presence/absence of the paper sheets, a transport mechanism for conveying the paper sheets, a driving means for driving the transport mechanism, and a controller unit for controlling the driving means, and the controller unit controls the driving means to transport the paper sheets by means of the transport mechanism based on a detection result from the paper sheet detection sensors.

Advantageous effect of the invention

[0011] According to the above aspect, it is possible to flexibly construct a transport path by using transport units, each being independently controlled.

BRIEF DESCRIPTION OF DRAWINGS

[0012]

FIG. 1 is a right-side view illustrating an internal structure of an automated transaction apparatus;
FIG. 2 is a block diagram illustrating a control configuration of a transport unit;
FIG. 3A is a front view of an internal structure of a transport unit;
FIG. 3B is a top view of an internal structure of a transport unit;
FIG. 4 is a front view illustrating an internal structure of two transport units that are connected with each other;
FIG. 5 is a flowchart for explaining a control of a transport unit;
FIG. 6A is a front view illustrating an internal structure of a transport unit according to the first modification example;
FIG.6B is a top view illustrating an internal structure of a transport unit according to the first modification example;
FIG. 7 is a front view illustrating an internal structure of two obliquely-connected transport units according to the first modification example;
FIG. 8 is a front view illustrating an internal structure of two obliquely-connected transport units according to the second modification example;
FIG. 9 is a front view illustrating internal structures of plural transport units including a transport unit that has a transport direction switching guide according to the third modification example;
FIG. 10 is a front view illustrating internal structures of two transport units that have a transport direction switching guide according to the fourth modification example;
FIG. 11 is a flowchart for explaining a control of transport units that have the transport direction switching guides according to the third and fourth modification examples;
FIG. 12 is a front view illustrating internal structures of two connected transport units according to the fifth modification example;
FIG. 13 is an enlarged view of a portion A in FIG. 12;
FIG. 14 is a bottom view of the first reflection member and the second reflection member in FIG. 13 viewed from the direction C;
FIG. 15A is a front view illustrating an internal structure of a transport unit according to the sixth modification example;
FIG. 15B is a top view illustrating an internal structure of a transport unit according to the sixth modification example;
FIG. 16A is a front view to explain a positional relationship between belts of two adjacent transport units according to the seventh modification example; and
FIG. 16B is a top view to explain a positional relationship between belts of two adjacent transport units according to the seventh modification example.

DESCRIPTION OF EMBODIMENTS

[0013] In the following description, an automated transaction apparatus that is an example of a paper sheet processing apparatus according to the embodiments of the present invention is explained with reference to the drawings.

[0014] FIG. 1 is a right-side view illustrating an internal structure of an automated transaction apparatus 1.

[0015] The automated transaction apparatus 1 in FIG. 1 is an ATM as an example. The automated transaction apparatus 1 carries out processing such as depositing/dispensing, discriminating, and storing paper money B that is an example of paper sheets. Note that a paper sheet processing apparatus having the automated transaction apparatus 1 as an example may be any apparatus that carries out any processing of paper sheets.

[0016] As illustrated in FIG. 1, the automated transaction apparatus 1 includes a MPU (Micro Processing Unit) 2, a deposit/dispense unit 3, a discrimination unit 4, a temporary holding unit 5, a reject unit 6, storages 7 and 8, and a communication power cable 9. The automated transaction apparatus 1 also includes plural transport units 10 that are connected with each other in the transport direction of paper money B so as to go through the deposit/dispense unit 3, the discrimination unit 4, the temporary holding unit 5, the reject unit 6, and the storages 7 and 8.

[0017] MPU 2 is a processor storing firmware that controls operations of paper money processing units (the deposit/dispense unit 3, the discrimination unit 4, the temporary holding unit 5, the reject unit 6, the storages 7 and 8, transport units 10, and others) illustrated in FIG. 1. MPU 2 operates under control of a controller unit etc. (upper application) that controls the entirety of the automated transaction apparatus 1. For example, in deposit processing, firmware executes processing such as transporting, discriminating, and storing of paper money B inserted into the deposit/dispense unit 3

via middleware under control of an upper application.

[0018] MPU 2 carries out processing via the communication power cable 9, and such processing includes notifying initialization timing (wakeup), updating programs that MPU 14 described later in the transport units 10 reads out, and self-diagnosing the transport units 10 (e.g., test operations of medium detection sensors 11a to 11d, a motor R13a, and a motor L13b, which are described later).

[0019] In to the deposit/dispense unit 3, paper money B is inserted by a customer, and the deposit/dispense unit 3 dispenses paper money B from within the automated transaction apparatus 1.

[0020] The discrimination unit 4 carries out discrimination such as authentication and denomination determination of the paper money B inserted into the deposit/dispense unit 3.

[0021] The temporary holding unit 5 temporarily holds the paper money B on which discrimination was performed by the discrimination unit 4.

[0022] The reject unit 6 stores damaged paper money B that cannot be used for dispensing processing and paper money B of denominations that are not allowed to be stored in the storages 7 and 8. For example, when the storages 7 and 8 are storages for paper money in 10000 yen denomination and paper money in 1000 yen denomination, respectively, deposited paper money in 5000 yen denomination are stored in the reject unit 6.

[0023] The storages 7 and 8 store paper money B in different denominations.

[0024] The communication power cable 9 is connected to MPU 2 and each of the transport units 10 for communication connection between MPU 2 and each of the transport units 10 and for power supply to the transport units 10. Note that the topology of communication channels of the communication power cable 9 may be properly configured in consideration of the reliability. As long as the communication power cable 9 carries out power line communications, separate signal lines for communication are not needed.

[0025] Between plural transport units 10, a guide member 41 that guides paper money B and a transport direction switching guide 42 that divides a transport path of the paper money B are arranged. However, as described later in detail, because two transport units 10 may be connected with each other as illustrated in FIG. 4, the guide member 41 can be omitted. In addition, because the transport direction of paper money B can be switched by transport direction switching guides 23 and 24 in the transport units 10 (10B and 10C) as illustrated in FIG. 9 and FIG. 10, the transport direction switching guide 42 may also be omitted.

[0026] FIG. 2 is a block diagram illustrating a control configuration of a transport unit 10.

[0027] FIG. 3A is a front view of an internal structure of a transport unit 10.

[0028] FIG. 3B is a top view of an internal structure of a transport unit 10.

[0029] As illustrated in FIG. 2, a transport unit 10 has a paper money detection sensor 11 (in this specification, an input-side paper money detection sensor L11a, an input-side paper money detection sensor R11b, an output-side paper money detection sensor L11c, and an output-side paper money detection sensor R11d are collectively referred to as a paper money detection sensor 11.), MPU 14, a paper money data detection sensor 15, a motor driver K16a, a motor driver R16b, and an interface unit 17. As illustrated in FIG. 3B, the transport unit 10 has a transport mechanism 12, a motor L13a, a motor R13b, a power transmission belt L18a, a power transmission gear L18b, a power transmission belt R18c, a power transmission gear R18d, a frame 19, a base plate 20, and an attachment member 21.

[0030] The paper money detection sensor 11 is an example of a paper sheet detection sensor that detects presence/absence of paper money B (paper sheets). This paper money detection sensor 11 may be a single sensor, but may be preferably arranged on an input side that is an upstream side of a transport direction T of the paper money B (the input-side paper money detection sensor L11a and the input-side paper money detection sensor R11b) and an output side that is a downstream side of the transport direction T of the paper money B (the output-side paper money detection sensor L11c and the output-side paper money detection sensor R11d), as illustrate in FIG. 3A and FIG. 3B. In addition, the paper money detection sensor 11 may be preferably arranged at different positions with respect to a width direction W in such a manner that the input-side paper money detection sensor L11a and the output-side paper money detection sensor L11c are arranged at the left side toward the transport direction T and the input-side paper money detection sensor R11b and the output-side paper money detection sensor R11d are arranged at the right side toward the transport direction T.

[0031] Note that when the paper money B is transported in both ways (the forward direction and the backward direction) of the transport direction T in the transport units 10, the input-side paper money detection sensor L11a and the input-side paper money detection sensor R11b may become the output side in the transport direction and the output-side paper money detection sensor L11c and the output-side paper money detection sensor R11d may become the input side in the transport direction. Similarly, when the paper money B is transported in both ways of the transport direction T in the transport units 10, the input-side paper money detection sensor L11a and the output-side paper money detection sensor L11c that are arranged at the left side toward the transport direction T may be at the right side toward the transport direction, and the input-side paper money detection sensor R11b and the output-side paper money detection sensor R11d that are arranged at the right side toward the transport direction T may be at the left side toward the transport direction.

[0032] FIG. 3A and FIG. 3B illustrate an example in which each of the paper money detection sensors 11 (the input-side paper money detection sensor L11a, the input-side paper money detection sensor R11b, the output-side paper money detection sensor L11c, and the output-side paper money detection sensor R11d) includes two pairs (four sensors in total). The two pairs of (four) paper money detection sensors 11 are arranged at different positions with respect to the width direction W, and each pair includes top and bottom sensors facing each other (in a thickness direction orthogonal to both the transport direction T and the width direction W), one sensor being an emission unit that emits detection light to a transport path of the paper money B, the other being a reception unit that receives the detection light. Instead of the above two top-and-bottom pairs of the paper money detection sensors 11, each of the paper money detection sensors 11 may include four different sensors including an emission unit that emits detection light either from the top or bottom (here, the bottom as an example) to the other (here, the top as an example), a reflection unit that reflects the detection light to the width direction W, a reflection unit that reflects the light reflected by the reflection unit either to the top and bottom (here, to the bottom as an example), and a reception unit that receives the reflected light.

[0033] As illustrated in FIG. 3A and FIG. 3B, the transport mechanism 12 includes an input-side roller L12a, an input-side roller C12b, an input-side roller R12c, an input-side roller C12d, an output-side roller L12e, an output-side roller R12f, an input-side shaft L12g, an input-side shaft R12h, an output-side shaft L12i, an output-side shaft R12j, each being arranged in top-and-bottom pairs, and transports paper money B.

[0034] The input-side roller L12a and the input-side roller C12b are provided on the input-side shaft L12g. The input-side roller R12c and the input-side roller C12d are provided on the input-side shaft R12h. The output-side roller L12e is provided on the output-side shaft L12i. The output-side roller R12f is provided on the output-side shaft R12j.

[0035] The input-side shaft L12g and the input-side shaft R12h are coaxially arranged, but are separated from each other since these shafts are driven by different motors, i.e., the motor L13a and the motor R13b. For the same reason, the output-side shaft L12i and the output-side shaft R12j are coaxially arranged but are separated from each other.

[0036] Note that when only one motor is arranged in the transport unit 10, the transport unit 10 needs only two shafts, a shaft in which the input-side shaft L12g and the input-side shaft R12h are combined as one shaft and a shaft in which the output-side shaft L12i and the output-side shaft R12j are combined as one shaft. Moreover, in the present embodiment, the four input-side rollers, the input-side roller L12a, the input-side roller C12b, the input-side roller R12c, and the input-side roller C12d, and the two output-side rollers, the output-side roller L12e and the output-side roller R12f, are arranged at different positions with respect to the transport direction T. However, when the rollers are arranged at one position with respect to the transport direction T, only one shaft is needed. In addition, three or more shafts that are arranged at different positions in the transport direction T may be arranged.

[0037] The motor L13a that is an example of driving means for driving the transport mechanism 12 is, for example, arranged only on the top side of the transport unit 10, rotates the output-side shaft L12i through the power transmission belt L18a, and rotates the input-side shaft L12g through a gear provided on the output-side shaft L12i, the power transmission gear L18b, and a gear provided on the input-side shaft L12g.

[0038] The motor R13b that is an example of driving means for driving the transport mechanism 12 is, for example, arranged only on the top side of the transport unit 10, rotates the output-side shaft R12j through the power transmission belt L18c, and rotates the input-side shaft R12h through a gear provided on the output-side shaft R12j, the power transmission gear R18d, and a gear provided on the input-side shaft L12g.

[0039] Note that instead of arranging the power transmission gear L18b, the power transmission belt L18a may be put around the input-side shaft L12g in addition to the output-side shaft L12i, or a belt different from the power transmission belt L18a may be used for the output-side shaft L12i and the input-side shaft L12g so that the output-side shaft L12i and the input-side shaft L12g rotates together. Similarly, instead of arranging the power transmission gear R18d, the power transmission belt R18c may be put around the input-side shaft R12h in addition to the output-side shaft R12j, or a belt different from the power transmission belt R18c may be used for the output-side shaft R12j and the input-side shaft R12h so that the output-side shaft R12j and the input-side shaft R12h rotates together. Alternatively, the output shafts of the motor L13a and the motor R13b can be the output-side shaft L12i and the output-side shaft R12j, respectively.

[0040] When the motor L13a and the motor R13b are provided only on the top side of the transport unit 10, the input-side roller L12a, the input-side roller C12b, the input-side roller R12c, the input-side roller C12d, the output-side roller L12e, and the output-side roller R12f, which are arranged on the top side of the transport unit 10, function as driving rollers. On the other hand, the power transmission belt L18a, the power transmission gear L18b, the power transmission belt R18c, and the power transmission gear R18d are not arranged on the bottom side of the transport unit 10, and the input-side roller L12a, the input-side roller C12b, the input-side roller R12c, the input-side roller C12d, the output-side roller L12e, and the output-side roller R12f, which are on the bottom side, function as driven rollers. When the rollers on the bottom side (the driven rollers) directly contact with the rollers on the top side (the driving rollers) or are arranged to make a space to hold paper money B with the rollers on the top side, the rollers on the bottom side rotate with the rollers on the top side.

[0041] Note that when the motor L13a and the motor R13b are stepping motors etc. that can rotate in both forward and backward directions, the paper money B can be transported in two ways of the transport direction T as described

above.

[0042] The transporting rate of paper money B that is a rotation speed of the rollers may be preset in MPU 14 or may be calculated in accordance with differences in time at which paper money B is detected by the paper money detection sensors 11 of plural transport units 10 on the upstream side of the transport direction T.

[0043] MPU 14 illustrated in FIG. 2 is an example of a processor (controller unit) that controls the transport unit 10. For example, MPU 14 reads out and executes a specific control program from ROM (Read only memory) that is not illustrated but is arranged in the transport unit 10, and uses RAM (Random Access Memory) that is not illustrated but is arranged in the transport unit 10 as a storage area at the time of executing the control program.

[0044] MPU 14 controls the motor L13a through the motor driver L16a and also controls the motor R13b through the motor driver R16b. For example, MPU 14 controls the motor L13a based on a detection result of the input-side paper money detection sensors L11a and the output-side paper money detection sensors L11c and also controls the motor R13b based on a detection result of the input-side paper money detection sensors R11b and the output-side paper money detection sensors R11d.

[0045] Note that in order to simplify the control, MPU 14 individually controls the motor L13a and the motor R13b only in the transport unit 10 arranged at a position at which skewed paper money B cannot be accepted such as the transport unit 10 immediately before the discrimination unit 4, and in the transport unit 10 arranged at a position at which skewed paper money B can be accepted, when at least one of the input-side paper money detection sensor L11a and the input-side paper money detection sensor R11b detects paper money B without distinction between the two sensors, MPU 14 collectively controls the motor L13a and the motor R13b.

[0046] Alternatively, motors (the motor L13a and the motor R13b) and the paper money detection sensors 11 may be arranged on each of the right and left sides of the width direction W, as illustrated in FIG. 3B only in the transport unit 10 arranged at a position at which skewed paper money B cannot be accepted, and in the transport unit 10 arranged at a position at which skewed paper money B can be accepted, one motor may be provided, and a sensor may be arranged in the center etc. of the width direction W.

[0047] Note that MPU 14 may control the motor L13a and the motor R13b not only by obtaining a detection result of the paper money detection sensors 11 of the transport unit 10 to which such MPU 14 belongs, but also by obtaining a detection result of the paper money detection sensors 11 of another transport unit 10.

[0048] The paper money data detection sensors 15 are an example of paper sheet information detection sensors and are used for authentication etc. by detecting information that is different from presence/absence of paper money B (e.g. the thickness of paper money B) rather than for detection of presence/absence of the paper money B as in the paper money detection sensors 11. The paper money data detection sensors 15 may be optical sensors like the paper money detection sensors 11 or may be magnetic sensors or infrared sensors. Note that although FIG. 3B illustrates two paper money data detection sensors 15, two paper money data detection sensors 15 may detect information of paper money B as a pair, or one paper money data detection sensor 15 or three or more paper money data detection sensors 15 may be arranged. Alternatively, since the automated transaction apparatus 1 has a discrimination unit 4 as descried above, the paper money data detection sensors 15 may be omitted.

[0049] As illustrated in FIG. 2, the interface unit 17 communicates with MPU 2. The interface unit 17 may be used for obtaining detection results of presence/absence of paper money B from the other transport units 10 such as upstream side transport units 10 of the transport direction T.

[0050] The frame 19 illustrated in FIG. 3A and FIG. 3B includes flat guide plates 19a and 19a that are provided as a top-and-bottom pair to guide paper money B and flat side plates 19b and 19b that are provided at both ends of the width direction W.

[0051] As described above, the paper money detection sensors 11 emit detection light to a transport path of paper money B. The input-side roller L12a, the input-side roller C12b, the input-side roller R12c, the input-side roller C12d, the output-side roller L12e, and the output-side roller R12f transport paper money B while contacting with the paper money B. For that reason, the guide plates 19a and 19a have cutouts and holes that are not illustrated in the drawings for avoiding interference with the detection light and the rollers.

[0052] As illustrated in FIG. 3B, a stepped portion 19b-1 is provided at a one end side of the transport direction T of the side plate 19b in order to avoid interference with the side plate 19b of the adjacent transport unit 10. This stepped portion 19b-1 is parallel to and has the same thickness as the other portion of the side plate 19b, but is provided at a position away from paper money B in the width direction W than the other portion.

[0053] The base plate 20 has, for example, the paper money detection sensors 11 etc. mounted and two base plates 20 are provided as a top-and-bottom pair.

[0054] The attachment member 21 is a member such as a screw used for connecting a transport unit 10 with an adjacent transport unit 10 or for fixing a transport unit 10 within the automated transaction apparatus 1.

[0055] FIG. 4 is a front view illustrating an internal structure of two transport units 10 and 10 that are connected with each other.

[0056] As illustrated in FIG. 4, the two adjacent transport units 10 and 10 are fixed by the attachment member 21 at

one point in each of the top-and-bottom side plates 19b and 19b located at both ends of the frame 10 in the width direction W, as illustrated in FIG. 3B.

[0057] Note that when the two transport units 10 are the same (have the same structure), the structure of the automated transaction apparatus 1 can be made simple. However, the transport units 10 may have different structures as long as each transport unit 10 has the paper money detection sensors 11, the transport mechanism 12, at least one driving means (the motor L13a or the motor R13b), MPU 14 and others.

[0058] As illustrated in FIG. 4, a space P1 between two rollers (shafts) in the front and the rear in the transport unit 10 with respect to the transport direction T is desirably shorter than the length BL in the transport direction T of paper money B. A space P2 between rollers (shafts) in two adjacent transport units 10 and 10 with respect to the transport direction T is also desirably shorter than the length BL in the transport direction T of the paper money B. Although it is not illustrated, the length in the transport direction T of the transport unit 10 itself is preferably shorter than the length BL in the transport direction T of the paper money B.

[0059] Note that in order to avoid interference between the guide plates 19a and 19a of two adjacent transport units 10 and 10, the guide plate 19a at both ends in the transport direction T may have a projected portion that projects in the transport direction T and a recessed portion (a portion other than the projected portion) provided alternately over the width direction W like an inclined portion 19a-1 as illustrated in FIG. 6 described later so that projected portions of one transport unit 10 is inserted into recessed portions of the adjacent transport unit 10.

[0060] Here, a control of MPU 14 in the above-describe transport unit 10 is explained.

[0061] FIG. 5 is a flowchart for explaining the control of the transport unit 10.

[0062] Note that each processing in FIG. 5 is processing carried out by MPU 14 executing a program stored in a storage unit such as ROM.

[0063] MPU 14, first, repeats a determination of whether the input-side paper money detection sensors L11a and the input-side paper money detection sensors R11b detect input of paper money B or not, or, for more specific example, whether detection light of the input-side paper money detection sensors L11a and the input-side paper money detection sensors R11b is blocked or not until the paper money B is detected (step S11).

[0064] When the input of paper money B is detected (step S11: YES), MPU 14 determines whether there is a time lag (or the time lag is a specific period of time or longer) between the detection in the input-side paper money detection sensors L11a and the detection in the input-side paper money detection sensors R11b or not (step S12). This determination processing is determination processing of whether the paper money B is input in a skewed state or not.

[0065] When a result of the determination is no time lag (step S12: NO), MPU 14 controls the motor L13a and the motor R13b concurrently through the motor driver L16a and the motor driver R16b so that the paper money B is transported by the transport mechanism 12 (step S13).

[0066] On the other hand, when it is determined that there is a time lag (step S12: YES), MPU 14 controls the motor L13a and the motor R13b so as to correct the skewness of the paper money B (step S14). For example, when the input-side paper money detection sensors L11a detected the paper money B before the input-side paper money detection sensors R11b detected the paper money B, MPU 14 reduces the rotation speed of the motor L13a so as to be slower than the rotation speed of the motor R13b. When the input-side paper money detection sensors R11b detected the paper money B before the input-side paper money detection sensors L11a detected the paper money B, MPU 14 reduces the rotation speed of the motor R13b so as to be slower than the rotation speed of the motor L13a.

[0067] Next, MPU 14 repeats a determination of whether the output-side paper money detection sensors L11cand the output-side paper money detection sensors R11d detect output of paper money B or not, or, for more specific example, whether detection light of the output-side paper money detection sensors L11a and the output-side paper money detection sensors R11b is no longer blocked or not until output of the paper money B is detected (step S15). Note that when the output-side paper money detection sensors L11c and the output-side paper money detection sensors R11d are not arranged in the transport unit 10, instead of the determination processing as to whether the output is detected or not, determination processing as to whether a specific driving time has been elapsed or not may be carried out.

[0068] When output of the paper money B is detected (step S15: YES), MPU 14 controls the motor L13a and the motor R13b so as to stop transporting the paper money B by the transport mechanism 12 (step S16).

[0069] By means of MPU 14 of each of the transport units 10 carrying out the above-described processing, paper money B can be transported within the automated transaction apparatus 1.

[0070] FIG. 6A is a front view illustrating an internal structure of a transport unit 10A according to the first modification example.

[0071] FIG.6B is a top view illustrating the internal structure of the transport unit 10A according to the first modification example.

[0072] The first modification example is different from the transport unit 10 illustrated in FIG. 3A and FIG. 3B in such a point that inclined portions 19a-1 are provided at both ends of a top-and-bottom pair of guide plates 19a and 19a with respect to the transport direction T so as to increase the space between the top-and-bottom pair of guide plates 19a to facilitate the input of paper money B.

[0073] The inclined portions 19a-1 are portions at both ends of the guide plates 19a with respect to the transport direction T and in each of the portions, a projected portion that is discontinuously provided in the width direction W and projects in the transport direction T is inclined away from the facing guide plate 19a. The inclined portions (projected portions) 19a-1 may be projected portions provided for avoiding interference between the guide plates 19a of two adjacent transport units 10 as described above.

[0074] As described above, by providing the inclined portions 19a-1 to the guide plates 19a, when two transport units 10A are connected obliquely so that there is an inclination (an inclination from the width direction W) between the two transport units 10A as illustrated in FIG. 7, paper money B slipping out of a space between the transport units 10A and 10A can be prevented.

[0075] FIG. 8 is a front view illustrating an internal structure of two transport units 10A and 10A that are obliquely connected to each other by using the guide members 31 and 32 according to the second modification example.

[0076] As illustrated in FIG. 8, when an angle between the two adjacent transport units 10A and 10A (an angle from the width direction W) is greater that the angle illustrated in FIG. 7 and paper money B can possibly slip out of the space between the transport units 10A and 10A, the guide members 31 and 32 that are arranged independently from the transport units 10A may be used to fill the space.

[0077] The guide member 31 on the top side in FIG. 8 has a U-shape as an example when the guide member 31 is viewed from the transport direction T and guides paper money B with its bottom surface. The guide member 31 may be fixed by the attachment member 21 in a manner that the guide member 31 is put around the two adjacent transport units 10A and 10A. The guide member on the bottom side has an inverted U-shape as an example when viewed from the transport direction T and guides the paper money B with its top surface.

[0078] FIG. 9 is a front view illustrating internal structures of plural transport units 10, 10, 10B and 10 including a transport unit 10B that has a transport direction switching guide 23 according to the third modification example.

[0079] The transport unit 10B in FIG. 9 has a transport direction switching guide 23 that switches the transport direction T of paper money B to a different angle (an angle from the width direction W). This transport direction switching guide 23 is preferably movable between a switching position as illustrated in FIG. 9 for switching the transport direction T of paper money B and a retracted position that is a position at which the transport direction switching guide 23 is retracted from the switching position so as not to switch the transport direction T. However, when the transport direction T is switched by a certain switching angle, or in other word when the paper money B is not divided, the transport direction switching guide 23 may be immobile. Note that the transport direction switching guide 23 is arranged as a portion of a transport unit 10 but may be arranged between two adjacent transport units 10 and 10 independently from either of the transport units 10 as in the transport direction switching guide 42 illustrated in FIG. 1.

[0080] In the transport unit 10B in FIG. 9, an input-side paper money detection sensor L11a and an input-side paper money detection sensor R11b are not arranged as a top-and-bottom pair, which is illustrated in FIG. 3A, but these sensors are emission units that are arranged only on the top side of the transport unit 10B and emit detection light L1 downward. The detection light L1 is reflected by a prism unit 22 arranged so as to face the input-side paper money detection sensor L11a and the input-side paper money detection sensor R11b, is transmitted in the prism unit 22 in the transport direction T (transmitted light L2), and is again reflected upward in the prism unit 22. An output-side paper money detection sensor L11c and the output-side paper money detection sensor R11d arranged only on the top side of the transport unit 10B receive this reflected light L3a. Note that the prism units 22h are arranged separately across the transport path so as not to block the transport path of paper money B. When the detection light L1 emitted by the input-side paper money detection sensor L11a and the input-side paper money detection sensor R11b is not received by the output-side paper money detection sensor L11c and the output-side paper money detection sensor R11d, the paper money B is determined to be located within the transport unit 10B.

[0081] Note that in the transport unit 10B, when paper money B is transported in the transport direction T, the rollers on the top side rotate anticlockwise in FIG. 9 and the rollers on the bottom side rotate clockwise in FIG. 9. However, in a case of the transport direction T of paper money B being switched to the downward direction by the transport direction switching guide 23, the bottom right roller in the transport unit 10B needs to rotate anticlockwise when the roller is in contact with the bottom left roller in FIG. 9. In order to prevent the bottom right roller from contacting with the bottom left roller, the transport direction switching guide 23 is formed so that paper money B does not directly contact with the bottom right roller.

[0082] The position of the transport direction switching guide 23 is controlled by MPU 14 through a motor and a motor driver that are not illustrated. MPU 14, for example, causes the transport direction switching guide 23 to move in accordance with a moving instruction of the transport direction switching guide 23 from the above-described MPU 2 in FIG. 1.

[0083] Note that, as illustrated in FIG. 9, an external paper money detection sensor 33 (an example of external paper sheet detection sensors) that detects presence/absence of paper money B independently from the transport units 10 and 10B may be arranged between the two adjacent transport units 10 and 10B. Alternatively, the external paper money detection sensor 33 may be used for authentication etc. by detecting information that is different from presence/absence of paper money B (e.g. the thickness of paper money B) similarly to the above-described paper money data detection

sensor 15 illustrated in FIG. 2 and FIG. 3B.

[0084] The external paper money detection sensor 33 is a line sensor extending in the width direction W, although it is merely an example. MPU 2 may issue a moving instruction of the transport direction switching guide 23 based on a destination of the paper money B determined in accordance with the detection result of the external paper money detection sensor 33.

[0085] On the opposite side (the bottom side) across the transport path of paper money B from the external paper money detection sensor 33, a guide member 34 that guides paper money B may be arranged. Note that when a top-and-bottom pair of guide members 34 located across paper money B is arranged between the two adjacent transport units 10 and 10, a space between the two adjacent transport units 10 and 10, or in other words a length of the transport path configured by plural transport units 10, can be adjusted.

[0086] FIG. 10 is a front view illustrating internal structures of two transport units 10C and 10C that have a transport direction switching guide 24 according to the fourth modification example.

[0087] The transport direction switching guide 24 according to the fourth modification example is the same as the above-described transport direction switching guide 23 according to the third modification example except that the transport direction T of paper money B is switched to the vertical direction. For that reason, detailed descriptions are omitted.

[0088] The transport direction switching guide 24 of the transport unit 10C switches the transport direction T of paper money B to the vertical direction. In order to do so, the transport direction switching guide 24 of the first transport unit 10C switches the transport direction T from the rightward direction to the downward direction in FIG. 10. Next, the transport direction switching guide 24 of the second transport unit 10C switches the transport direction of paper money B from the downward direction to the leftward direction in FIG. 10. In this manner, the transport direction T of paper money B can be switched to an opposite direction. Note that the above-described second transport unit 10C is arranged in such an orientation that the first transport unit 10C is rotated clockwise by 90 degrees in FIG. 10.

[0089] Similarly to the above-described transport direction switching guide 23 in the transport unit 10B in FIG. 9, the transport direction switching guide 24 is preferably movable between a switching position as illustrated in FIG. 10 for switching the transport direction T of paper money B and a retracted position that is a position at which the transport direction switching guide 24 is retracted from the switching position so as not to switch the transport direction T. When the transport direction T is switched by a certain switching angle, or in other word when the paper money B is not divided, the transport direction switching guide 24 may be immobile.

[0090] FIG. 11 is a flowchart for explaining a control of the transport units 10B and 10C that have the transport direction switching guides 23 and 24, respectively, according to the third and fourth modification examples. Explanations of the items that are the same as the flowchart in FIG. 5 and the explanations of the above-described transport units 10B in FIG. 9 and 10C in FIG. 10 are omitted as appropriate.

[0091] Note that each processing in FIG. 11 is processing carried out by MPU 14 executing a program stored in a storage unit such as ROM.

[0092] MPU 14, first, determines whether a division instruction, or in other word the above-described moving instruction regarding the transport direction switching guide 23 or 24, has been received from MPU 2 or not (step S21). This moving instruction is preferably issued, for example, in accordance with a discrimination result of the discrimination unit 4 or a detection result of a sensor outside of the transport units 10B and 10C such as the above-described external paper money detection sensor 33 in FIG. 9.

[0093] When the moving direction regarding the transport direction switching guide 23 or 24 is received, MPU 14 causes the transport direction switching guide 23 or 24 to move to the above-described switching position (step S22).

[0094] Afterwards, MPU 14 determines whether the input-side paper money detection sensors L11a and the input-side paper money detection sensors R11b detect input of paper money B or not (step S23).

[0095] When the input of paper money B is not detected (step S23: NO), MPU 14, again, carries out the determination processing (step S21) of a moving instruction regarding the transport direction switching guide 23 or the transport direction switching guide 24.

[0096] When the input of paper money B is detected (step S23: YES), MPU 14 determines whether there is a time lag (or the time lag is a specific period of time or longer) between the detection in the input-side paper money detection sensors L11a and the detection in the input-side paper money detection sensors R11b or not (step S24).

[0097] When a result of the determination is no time lag (step S24: NO), MPU 14 controls the motor L13a and the motor R13b concurrently through the motor driver L16a and the motor driver R16b so that the paper money B is transported by the transport mechanism 12 (step S25).

[0098] On the other hand, when a time lag is determined (step S24: YES), MPU 14 controls the motor L13a and the motor R13b so as to correct the skewness of the paper money B (step S26) .

[0099] Next, MPU 14 repeats a determination of whether the output-side paper money detection sensors L11c and the output-side paper money detection sensors R11d detect output of paper money B or not until output of the paper money B is detected (step S27).

[0100] When output of the paper money B is detected (step S27: YES), MPU 14 controls the motor driver L16a and the motor driver R16b so as to stop transporting the paper money B by the transport mechanism 12 (step S28).

[0101] By means of MPU 14 of each of the transport units 10B and 10C carrying out the above-described processing, paper money B can be transported within the automated transaction apparatus 1 while the transport direction T is properly switched.

[0102] FIG. 12 is a front view illustrating internal structures of two connected transport units 10D and 10E according to the fifth modification example.

[0103] Compared with the transport unit 10 illustrated in FIG. 2, FIG. 3A and FIG. 3B, the transport unit 10D and the transport unit 10E illustrated in FIG. 12, which are an example of the first transport unit and the second transport unit arranged adjacent to each other, are different only in such points that paper money detection sensors 25 (in this description, input-side paper money detection sensors L25a, input-side paper money detection sensors R25b, output-side paper money detection sensor L25c, and output-side paper money detection sensors R25d are collectively referred to as paper money detection sensors 25) are arranged instead of the paper money detection sensors 11 and that the first reflection member 26 and the second reflection member 27 are arranged. For that reason, detailed explanations are omitted.

[0104] The paper money detection sensors 25 are arranged in top-and-bottom pairs, and the sensors in the bottom side are an example of emission units that emit detection light upward to the transport path of paper money B and the sensors in the top side are an example of reception units that receive the detection light.

[0105] The first reflection member 26 is arranged around the top-side sensors of the output-side paper money detection sensors L25c and the output-side paper money detection sensors R25d. The second reflection member 27 is arranged around the top-side sensors of the input-side paper money detection sensors L25a and the input-side paper money detection sensors R25b.

[0106] Note that FIG. 12 illustrates an example in which only the first reflection member 26 is arranged in the transport unit 10D and only the second reflection member 27 is arranged in the transport unit 10E. However, the second reflection member 27 may be further arranged around the input-side paper money detection sensors L25a and the input-side paper money detection sensors R25b of the transport unit 10D and the first reflection member 26 may be further arranged around the output-side paper money detection sensors L25c and the output-side paper money detection sensors R25d of the transport unit 10E.

[0107] Although the first reflection member 26 is arranged around each of the output-side paper money detection sensors L25c and R25d, when a single output-side paper money detection sensor is arranged in the transport unit 10D or 10E, the first reflection member 26 may be arranged around the single output-side paper money detection sensor. Similarly, although the second reflection member 27 is arranged around each of the input-side paper money detection sensors L25a and R25b, when a single output-side paper money detection sensor is arranged in the transport unit 10D or 10E, the second reflection member 27 may be arranged around the single output-side paper money detection sensor.

[0108] As illustrated in FIG. 13 (an enlarged view of a portion A in FIG. 12), the top-side sensors of the output-side paper money detection sensors L25c and the output-side paper money detection sensors R25d of the transport unit 10D receive a portion of detection light L11 and the detection light L21 emitted by the bottom-side sensors.

[0109] As illustrated in FIG. 14 (a bottom view of the first reflection member 26 and the second reflection member 27 in FIG. 13 viewed from the direction C), the first reflection member 26 of the transport unit 10D is a prism that has a rectangular plane inclined face 26a provided to surround an optical path 26b of the detection line L21 toward the top-side sensor of the output-side paper money detection sensors L25c or the output-side paper money detection sensors R25d and that reflects, with the inclined face 26a, the detection light L11 and the detection light L21 deviated from the output-side paper money detection sensor L25c or the output-side paper money detection sensor R25d to the transport unit 10E(reflected light L21 and reflected light L22). Note that instead of the plane inclined face 26a in the first reflection member 26, a reflection face with other shapes such as a curved face or a concave face may be used. In addition, the first reflection member 26 is not limited to a prism, but may be other members such as a half mirror arranged at a position of the inclined face 26a. The half mirror can be provided on the optical path of the detection light L21.

[0110] The top-side sensors of the output-side paper money detection sensors L25c and the output-side paper money detection sensors R25d of the transport unit 10E receive detection light L30 emitted by the bottom-side sensors.

[0111] As illustrated in FIG. 14, the second reflection member 27 of the transport unit 10E is a prism that has a rectangular plane inclined face 27a provided to surround an optical path 27b of the detection line L30 toward the top-side sensor of the output-side paper money detection sensors L25a or the output-side paper money detection sensors R25b and that reflects, with the inclined face 27a, the above-described detection light L21 and the above-described detection light L22 to the input-side paper money detection sensor L25a or the input-side paper money detection sensor R25b. Note that when the reception unit of the transport unit 10E receives the reflected light of the detection light L21 emitted by the emission unit of the transport unit 10D, MPU 14 may stop the emission unit of the transport unit 10E emitting the detection light.

[0112] Note that regarding the plane inclined face 27a in the second reflection member 27, a reflection face with other

shapes such as a curved face or a concave face may also be used instead of the plane inclined face 27a. In addition, the second reflection member 27 is not limited to a prism, but may be other members such as a half mirror arranged at a position of the inclined face 27a.

[0113] By means of the above-described first and second reflection members 26 and 27, the reception units (the top-side sensors) of the input-side paper money detection sensor L25a and the input-side paper money detection sensor R25b of the transport unit 10E can receive the detection light (a portion of the detection light L11 and the detection light L21) emitted by the emission units (the bottom-side sensors) of the output-side paper money detection sensor L25c and the output-side paper money detection sensor R25d of the transport unit 10D that is an upstream side transport unit adjacent to the transport unit 10E in the transport direction T.

[0114] FIG. 15A is a front view illustrating an internal structure of the transport unit 10F according to the sixth modification example.

[0115] FIG. 15B is a top view illustrating an internal structure of the transport unit 10F according to the sixth modification example.

[0116] In the sixth modification example, transport mechanism 28 is mainly different from the above-described transport mechanism 12 in a point that the transport mechanism 28 uses belts 28a to 28c as a transporting member to transport paper money B while contacting with the paper money B, instead of the rollers such as the input-side roller L12a of the above-described transport mechanism 12. For that reason, detailed explanations are omitted.

[0117] As illustrated in FIG. 15A and FIG. 15B, the transport mechanism 28 includes belts 28a to 28c, input-side belt rollers 28d to 28f, output-side belt rollers 28d to 28i, an input-side shaft 28j and an output-side shaft 28k, each of which being arranged in top-and-bottom pairs, to transport paper money B.

[0118] The belts 28a to 28c are put around the input-side belt rollers 28d to 28f and the output-side belt rollers 28g to 28i.

[0119] The input-side belt rollers 28d to 28g are provided on the input-side shaft 28j. The output-side belt rollers 28g to 28i are provided on the output-side shaft 28k.

[0120] In the sixth modification example, the output-side belt rollers 28g to 28i are rotated by rotating the output-side shaft 28k by a single motor L13a arranged on the top side of the transport unit 10 through the power transmission belt L18a. As a result, the belts 28a to 28c that are put around the output-side belt rollers 28g to 28i are rotated.

[0121] However, when a motor R13b is further arranged as illustrated in FIG. 3B, the input-side shaft 28j may be separated into coaxial two shafts like the input-side shaft L12g and the input-side shaft R12h and the output-side shaft 28k may be separated into coaxial two shafts like the output-side shaft K12i and the output-side shaft R12j, and a single belt, for example, may be put around the separated shafts to enable correction of skewness as described above.

[0122] FIG. 16A is a front view to explain a positional relationship between the belts 28a to 28c, 29a, and 29b of two adjacent transport units 10F and 10G according to the seventh modification example.

[0123] FIG. 16B is a top view to explain a positional relationship between the belts 28a to 28c, 29a and 29b of two adjacent transport units 10F and 10G according to the seventh modification example.

[0124] The belts 28a to 28c of the transport unit 10F, which is an example of the third transport unit, have been described in the sixth modification example. On the other hand, the belts 29a and 29b of the transport unit 10G, which is an example of the fourth transport unit arranged adjacent to the third transport unit (transport unit 10F), are put around the input-side shafts 28j and 28k illustrated in FIG. 15A and FIG. 15B at positions shifted from the belts 28a to 28c toward the width direction W, for example. When a number of transport units 10 are connected with one another, the transport units are preferably connected in a manner that the transport unit 10F and the transport unit 10G are arranged alternately. Note that the number of belts is different between the transport unit 10F and the transport unit 10E, but the number may be the same when the belts are arranged at different positions with respect to the width direction W.

[0125] Rear ends 28a-1, 28b-1, and 28c-1, which are end portions of the belts 28a to 28c of the transport unit 10F on the side of the transport unit 10G (the downstream side of the transport direction T), are, in terms of the positions with respect to the transport direction T, aligned with front ends 29a-1 and 29b-1, which are end portions of the belts 29a and 29b of the transport unit 10G on the side of the transport unit 10F (the upstream side of the transport direction T). In other words, the rear ends 28a-1, 28b-1, and 28c-1 of the belts 28a to 28c and the front ends 29a-1 and 29b-1 of the belts 29a and 29b are located on the same face S.

[0126] Note that the positions of the rear ends 28a-1, 28b-1, and 28c-1 of the belts 28a to 28c in the transport direction T may be located so as to overlap with the front ends 29a-1 and 29b-1 of the belts 29a and 29b at the downstream side of the transport direction T (i.e., there may be portions at which the belts 28a to 28c overlap with the belts 29a and 29b in the transport direction T).

[0127] As a transporting member, rollers are arranged instead of the belts 28a to 28c, 29a and 29b, and the positions of ends of the rollers with respect to the transport direction T are aligned with or overlap with each other on the same face S between adjacent transport units 10 and 10 as described above.

[0128] According to the above-described embodiments, the automated transaction apparatus 1, which is an example of a paper sheet processing apparatus, includes plural transport units 10 connected one another in a transport direction T of paper money B, which is an example of paper sheets. Each of the plural transport units 10 includes paper money

detection sensors 11(input-side paper money detection sensors L11a, input-side paper money detection sensors R11b, output-side paper money detection sensors L11c, output-side paper money detection sensors R11d), which are an example of paper sheet detection sensors that detect presence/absence of paper money B, a transport mechanism 12 that transports paper money B, a motor L13a and a motor R13b, which are an example of driving means to drive the transport mechanism 12, and MPU 14, which is an example of a control unit that controls the motor L13a and the motor R13b. MPU 14 controls the motor L13a and the motor R13b so as to transport paper money B by means of the transport mechanism 12 based on a detection result of the paper money detection sensors 11.

[0129] Each of the plural transport units 10 detects paper money B with the paper money detection sensors 11, transports paper money B by means of MPU 14 controlling the motor L13a and the motor R13b based on the detection result as described above. In this manner, each transport unit 10 can autonomously carry out the transporting operation as long as paper money B exists. In addition, a large-sized transport path can be constructed by properly connecting transport units 10. Furthermore, separate designing can be extremely easily considered at the time of configuring a large-sized automated transaction apparatus 1.

[0130] According to the present embodiments, it is possible to flexibly construct a transport path by using transport units 10, each being independently controlled.

[0131] Moreover, in each of the transport units 10, because paper money B is transported depending on the determination of MPU 14 and by using the power of the motor L13a and the motor R13b, driving belts that connect all transport paths in the automated transaction apparatus 1 do not need to be driven all the time. Consequently, since the power is used only in a portion in which paper money B is present, mechanical inertia force can be kept small, and mechanical loss can be reduced. Since a large-capacity motor driving circuit, which is used when a driving belt for connecting all transport paths in the automated transaction apparatus 1 is used, is not needed, the need of components that can tolerate the large capacity power can be eliminated.

[0132] Furthermore, performance can be ensured for each transport unit 10, designing can be carried out without giving strong consideration to EOL for each component.

[0133] In addition, because ATM that is produced in small quantities can be produced by manufacturing the transport units 10 in large quantities and combining those transport units 10, the volume efficiency is very high. Additionally, as the number of the transport units 10 becomes larger, the production is in larger quantities and even when a custom-made component is used, an impact to the cost can be reduced.

[0134] Moreover, various forms of transport path can be constructed by combining the transport units 10, which allows flexible response to requests from the destination about the specification in a short period of time. The attachment members 21 can be combined with the transport units 10 at the time at which large-volume production is determined, and the transport units 10 can be recycled.

[0135] The fifth modification example of the embodiments, as illustrated in FIG. 12 and FIG. 13, plural transport units 10 include the transport units 10D and 10E, which are examples of the first transport unit and the second transport unit arranged adjacent to each other. Paper money detection sensors 25 of the transport units 10D and 10E (input-side paper money detection sensors L25a, input-side paper money detection sensors R25b, output-side paper money detection sensors L25c, output-side paper money detection sensors R25d) includes emission units (the paper money detection sensors 25 on the bottom side) that emit detection light L11, detection light L21, and detection light L30 to the transport path of paper money B and reception units (the paper money detection sensors 25 on the top side) that receive the detection light. The reception units of the transport unit 10E (the paper money detection sensors 25 on the top side) receive detection light that is emitted by emission units of the transport unit 10D (the paper money detection sensors 25 on the bottom side).

[0136] Accordingly to this structure, the paper money detection sensors 25 of the transport unit 10E can optically detect presence/absence of paper money B in the transport unit 10D, which is on the upstream side of the transport direction T. MPU 14 can ensure the control (activation) of the motor L13a and the motor R13b at the time of input of paper money B, or in particular paper money B transported at high speed, without obtaining a detection result via a signal line from the transport unit 10D.

[0137] According to the present embodiments, the transport unit 10D has the first reflection member 26 that reflects a portion of detection light L11 and detection light L21, which is emitted by the emission units of the transport unit 10D (the paper money detection sensors 25 on the bottom side), toward the transport unit 10E. The transport unit 10E has the second reflection member 27 that reflects reflected light L12 and reflected light L22, which was reflected by the first reflection member 26, toward the reception units of the transport unit 10E (the paper money detection sensors 25 on the top side). As a result of this simple structure using the first reflection member 26 and the second reflection member 27, the paper money detection sensors 25 of the transport unit 10E can detect presence/absence of paper money B in the transport unit 10D.

[0138] According to the present embodiments, the transport mechanism 12 has plural transporting members (an input-side roller L12a, an input-side roller C12b, an input-side roller R12c, an input-side roller C12d, an output-side roller L12e, an output-side roller R12f), which are rollers or belts that transport paper money B while contacting with paper money

B at different positions in the width direction W orthogonal to the transport direction T. The transport unit 10 has plural paper money detection sensors 11 (input-side paper money detection sensors L11a, input-side paper money detection sensors R11b, output-side paper money detection sensors L11c, output-side paper money detection sensors R11d) that detect presence/absence of paper money B at different positions in the width direction W and a motor L13a and a motor R13b, which are examples of plural driving means that drive the plural transporting members. MPU 14 controls the motor L13a and the motor R13b to correct skewness of paper money B based on a detection result of the plural paper sheet detection sensors 11. The skewness of paper money B can be thereby corrected in each transport unit 10.

[0139] According to the seventh modification example of the present embodiments, as illustrated in FIG. 16A and FIG. 16B, plural transport units include the transport units 10F and 10G, which are examples of the third transport unit and the fourth transport unit arranged adjacent to each other, the transport units 10F and 10G have transporting members (belts 28a to 28c, 29a, 29b) that are rollers or belts to transport paper money B while contacting with paper money B. Rear ends 28a-1 to 28c-1, which are end portions of the belts 28a to 28c of the transport unit 10F on the side of the transport unit 10G (the downstream side of the transport direction T), are, in terms of the positions with respect to the transport direction T, aligned with front ends 29a-1 and 29b-1, which are end portions of the belts 29a and 29b of the transport unit 10G on the side of the transport unit 10F (the upstream side of the transport direction T) or are located closer to the side of the transport unit 10G than the front ends 29a-1 and 29b-1. Consequently, since a space between the transporting members in the transport direction T is not created between the plural transport units 10F and 10G, it is possible to prevent paper money B from jamming and to prevent paper money B from falling off the transport units 10.

[0140] Note that the present invention is not limited to the embodiments described above, but components can be modified and embodied without departing from the scope of the invention at the implementation. In addition, various inventions may be formed by appropriate combination of multiple components disclosed in the embodiments. For example, all components provided in the embodiments may be combined as appropriate. In this manner, the present invention can take various modifications or applications without departing from the scope of the invention.

Description of reference numerals

[0141]

1	automated transaction apparatus
2	MPU
3	deposit/dispense unit
4	discrimination unit
5	temporary holding unit
6	reject unit
7, 8	storage
9	communication power cable
10 (10A-10G)	transport unit
11	paper money detection sensor
11a	input-side paper money detection sensor L
11b	input-side paper money detection sensor R
11c	output-side paper money detection sensor L
11d	output-side paper money detection sensor R
12	transport mechanism
12a	input-side roller L
12b	input-side roller C
12c	input-side roller R
12d	input-side roller C
12e	output-side roller L
12f	output-side roller R
12g	input-side shaft L
12h	input-side shaft R
12i	output-side shaft L
12j	output-side shaft R
13a	motor R
13b	motor L
14	MPU
15	paper money data detection sensor
16a	motor driver L

16b	motor driver R
17	interface unit
18a	power transmission belt L
18b	power transmission gear L
18c	power transmission belt R
18d	power transmission gear R
19	frame
19a	guide plate
19a-1	inclined portion
19b	side plate
19b-1	stepped portion
20	base plate
21	attachment member
22	prism unit
23	transport direction switching guide
24	transport direction switching guide
25	paper money detection sensor
25a	input-side paper money detection sensor L
25b	input-side paper money detection sensor R
25c	output-side paper money detection sensor L
25d	output-side paper money detection sensor R
26	first reflection member
26a	reflection face
26b	optical path
27	second reflection member
27a	reflection face
27b	optical path
28	transport mechanism
28a-1, 28b-1, 28c-1	rear end
28d-28f	input-side belt roller
28g-28i	output-side belt roller
28j	input-side shaft
28k	output-side shaft
29a, 29b	belt
29a-1, 29b-1	front end
31	guide member
32	guide member
33	external paper money detection sensor
34	guide member
41	guide member
42	transport direction switching guide
B	paper money
T	transport direction
W	width direction

Claims

1. A paper sheet processing apparatus including a plurality of transport units connected in a transport direction to which a paper sheet is transported, each of the plurality of transport units comprising:

a paper sheet detection sensor configured to detect presence/absence of the paper sheet;
a transport mechanism configured to transport the paper sheet;
driving means configured to drive the transport mechanism; and
a controller unit configured to control the driving means,
wherein the controller unit controls the driving means so that the paper sheet is transported by the transport mechanism based on a detection result of the paper sheet detection sensor.

2. The paper sheet processing apparatus according to claim 1, wherein
the plurality of transport units includes a first transport unit and a second transport unit that are arranged adjacent to each other,
the paper sheet detection sensor of the first transport unit and the paper sheet detection sensor of the second transport unit include an emission unit configured to emit detection light toward a transport path of the paper sheet and a reception unit configured to receive the detection light, and
the reception unit of the second transport unit receives the detection light emitted by the emission unit of the first transport unit.

3. The paper sheet processing apparatus according to claim 2, wherein
the first transport unit has a first reflection member configured to reflect a portion of the detection light emitted by the emission unit of the first transport unit toward the second transport unit, and
the second transport unit has a second reflection member configured to reflect reflected light reflected by the first reflection member toward the reception unit of the second transport unit.

4. The paper sheet processing apparatus according to any one of claims 1 to 3, wherein
the transport mechanism has a plurality of transporting members that are rollers or belts to transport the paper sheet while contacting with the paper sheet at different positions in a width direction orthogonal to the transport direction,
the transport unit includes a plurality of paper sheet detecting sensors for detecting the presence or absence of the paper sheet at the different positions in the width direction, and a plurality of driving means for driving the plurality of transport members, and
the controller unit controls the plurality of driving means to correct skewness of the paper sheet based on a detection result of the plurality of paper sheet detection sensors.

5. The paper sheet processing apparatus according to any one of claims 1 to 4, wherein
the plurality of transport units includes a third transport unit and a fourth transport unit that are arranged adjacent to each other,
the transport mechanism of the third transport unit and the fourth transport unit has a transporting member that is a roller or a belt to transport the paper sheet while contacting with the paper sheet, and
a position with respect to the transport direction of a fourth-transport-unit-side end of the transporting member of the third transport unit is aligned with a third-transport-unit-side end of the transporting member of the fourth transport unit or is closer to the fourth transport unit side than the end.

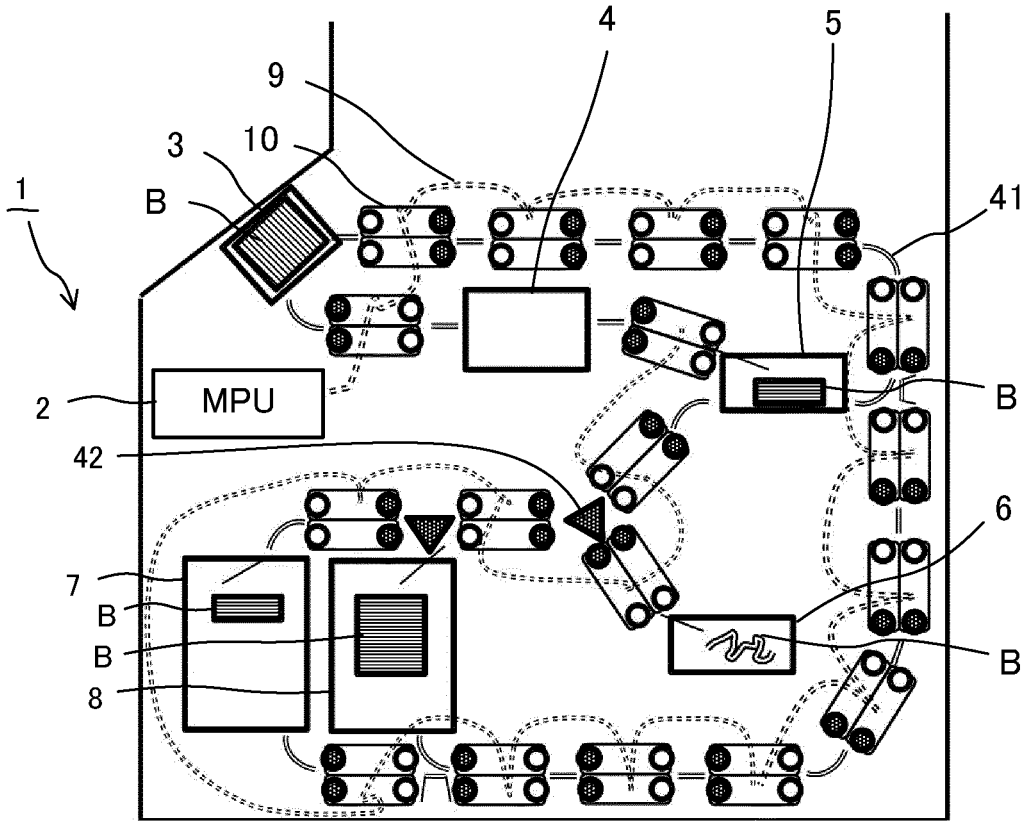

FIG. 1

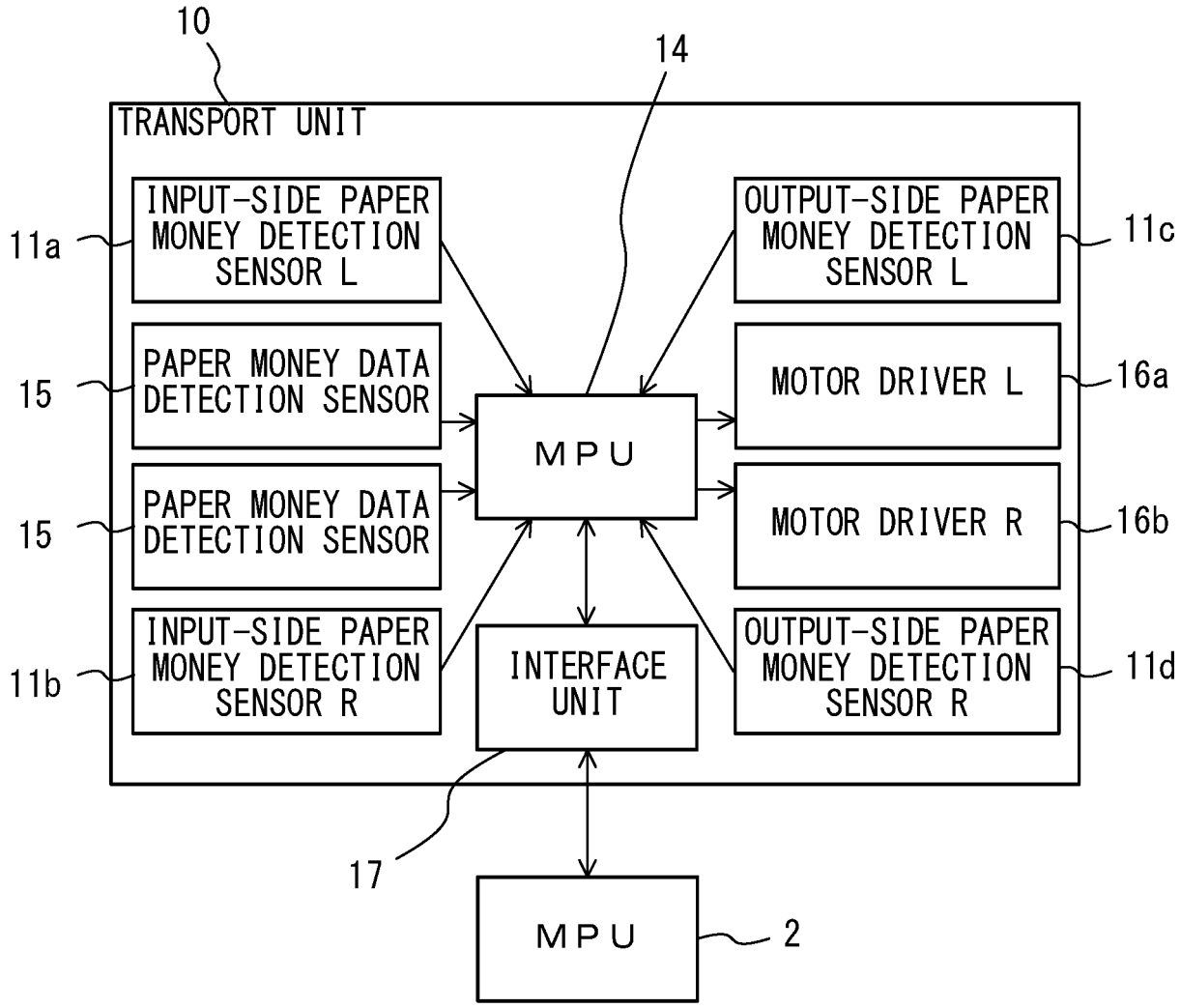
10
14
TRANSPORT UNIT
INPUT-SIDE PAPER MONEY DETECTION SENSOR L
11a
OUTPUT-SIDE PAPER MONEY DETECTION SENSOR L
11c
PAPER MONEY DATA DETECTION SENSOR
15
MPU
MOTOR DRIVER L
16a
PAPER MONEY DATA DETECTION SENSOR
15
MOTOR DRIVER R
16b
INPUT-SIDE PAPER MONEY DETECTION SENSOR R
11b
INTERFACE UNIT
OUTPUT-SIDE PAPER MONEY DETECTION SENSOR R
11d
17
MPU
2

FIG. 2

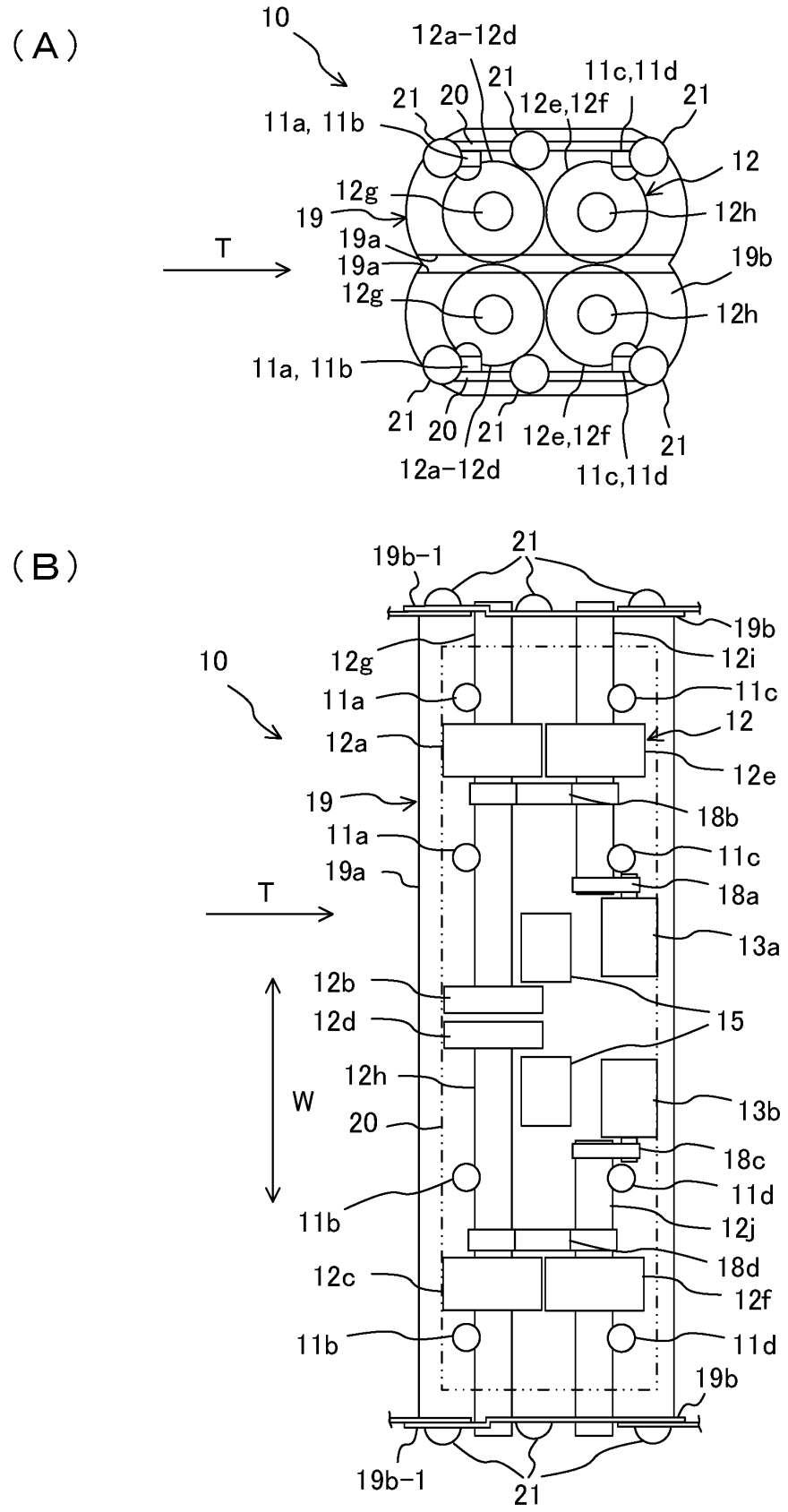
（A）
10
12a-12d
21
11c,11d
21
20
12e,12f
21
11a, 11b
12
12g
19
12h
T
19a
19a
19b
12g
12h
11a, 11b
21
20
21
12e,12f
21
12a-12d
11c,11d
（B）
19b-1
21
19b
10
12g
12i
11a
11c
12a
12
12e
19
18b
11a
11c
19a
18a
T
13a
12b
15
12d
12h
W
13b
20
18c
11d
11b
12j
18d
12c
12f
11b
11d
19b
19b-1
21

FIG. 3

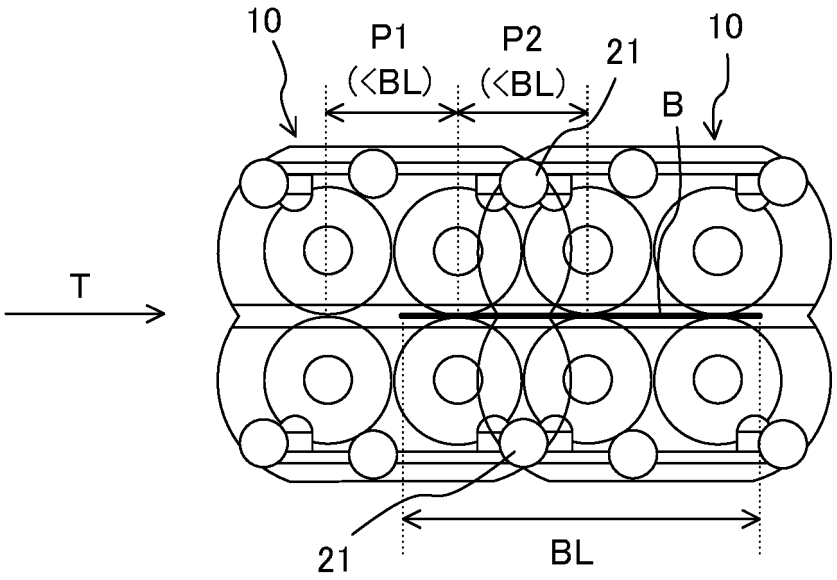

FIG. 4

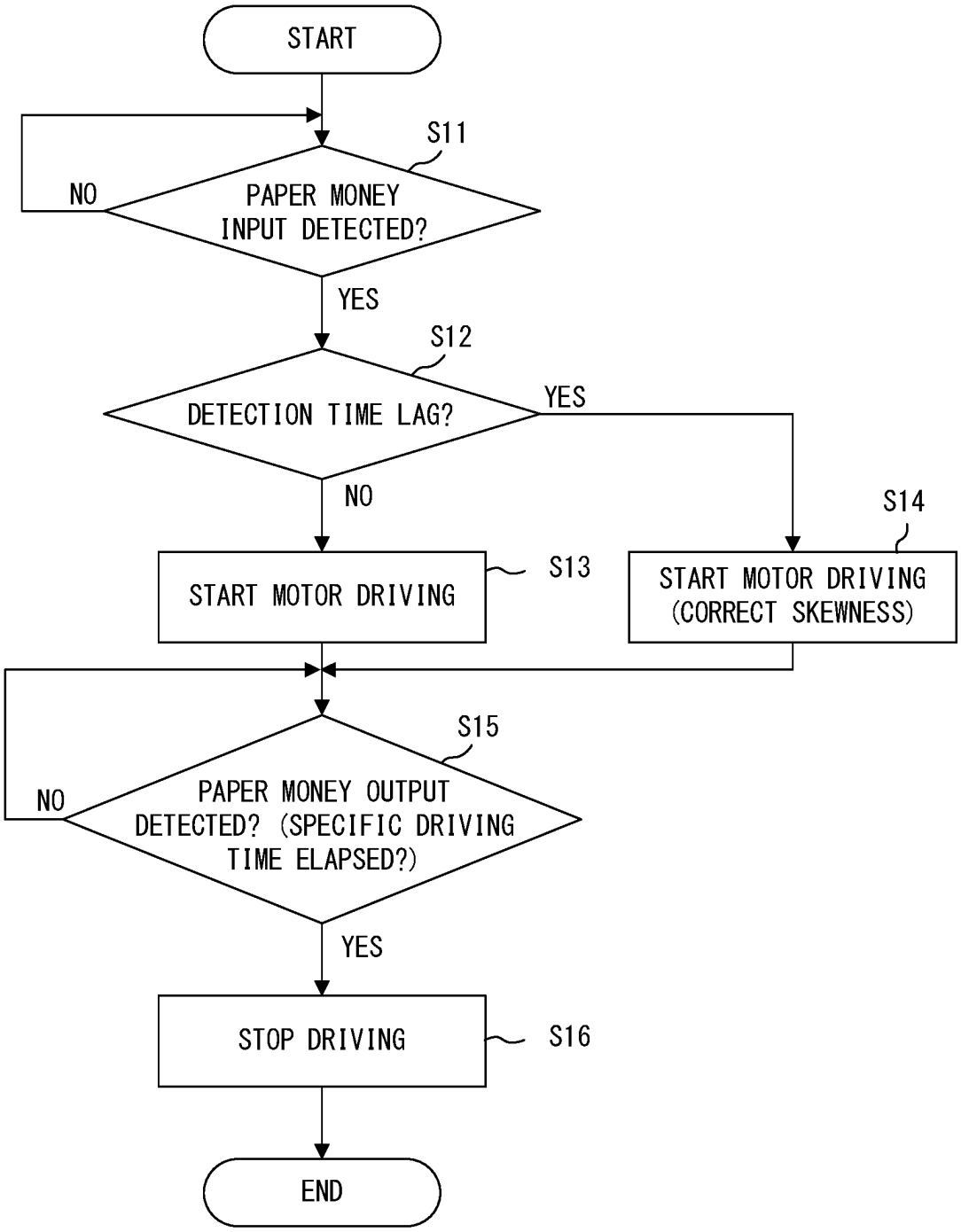
START
S11
NO
PAPER MONEY INPUT DETECTED?
YES
S12
DETECTION TIME LAG?
YES
NO
S14
S13
START MOTOR DRIVING
START MOTOR DRIVING (CORRECT SKEWNESS)
S15
NO
PAPER MONEY OUTPUT DETECTED? (SPECIFIC DRIVING TIME ELAPSED?)
YES
STOP DRIVING
S16
END

FIG. 5

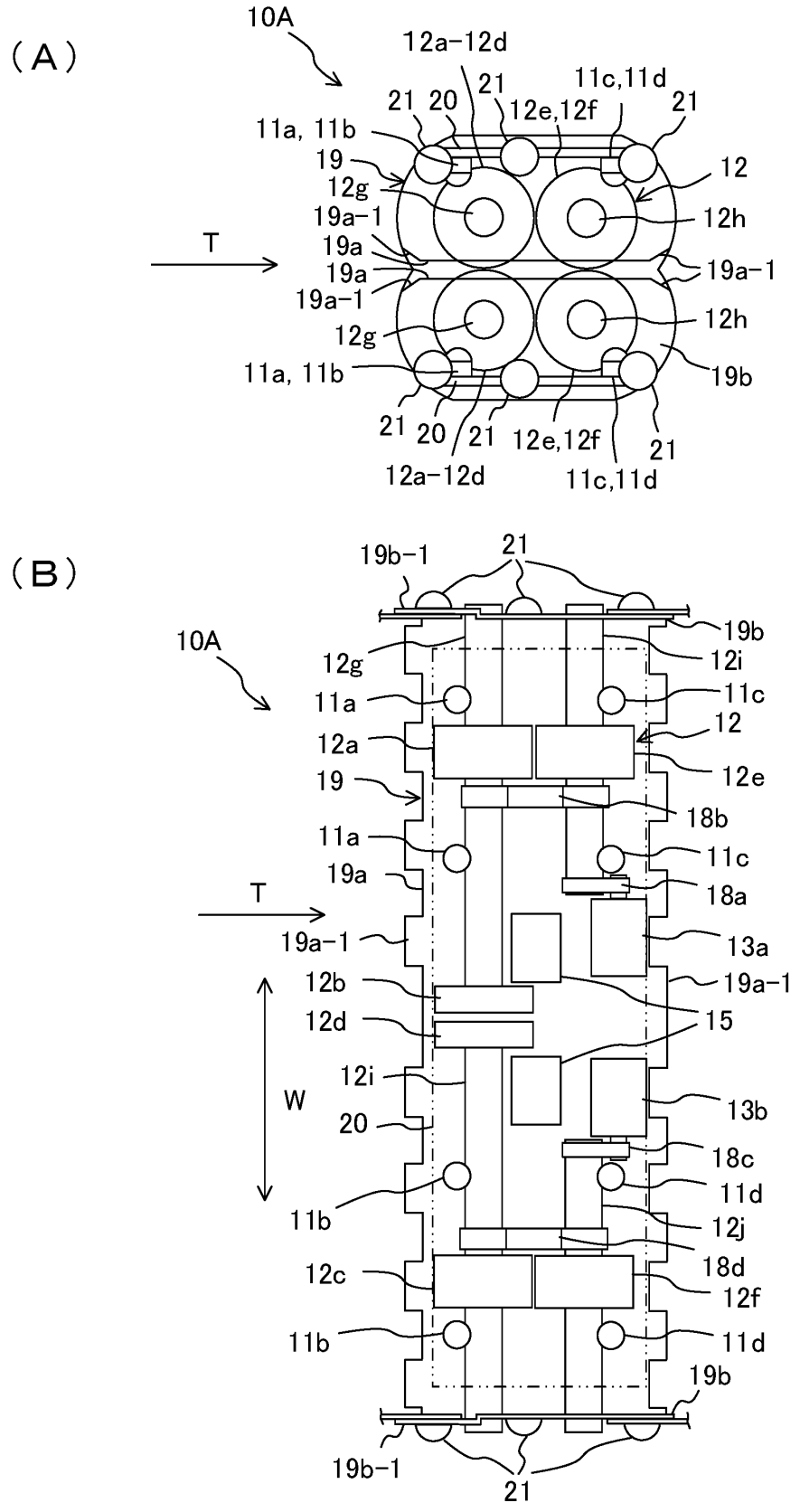
(A)
10A
12a-12d
21
11c,11d
21 20
12e,12f
21
11a, 11b
19
12g
19a-1
19a
19a
19a-1
12g
11a, 11b
T
12
12h
19a-1
12h
19b
21 20 21 12e,12f 21
12a-12d
11c,11d
(B)
19b-1
21
19b
10A
12g
12i
11a
11c
12a
12
12e
19
18b
11a
11c
19a
18a
T
19a-1
13a
19a-1
12b
15
12d
12i
W
13b
20
18c
11d
11b
12j
12c
18d
12f
11b
11d
19b
19b-1
21

FIG. 6

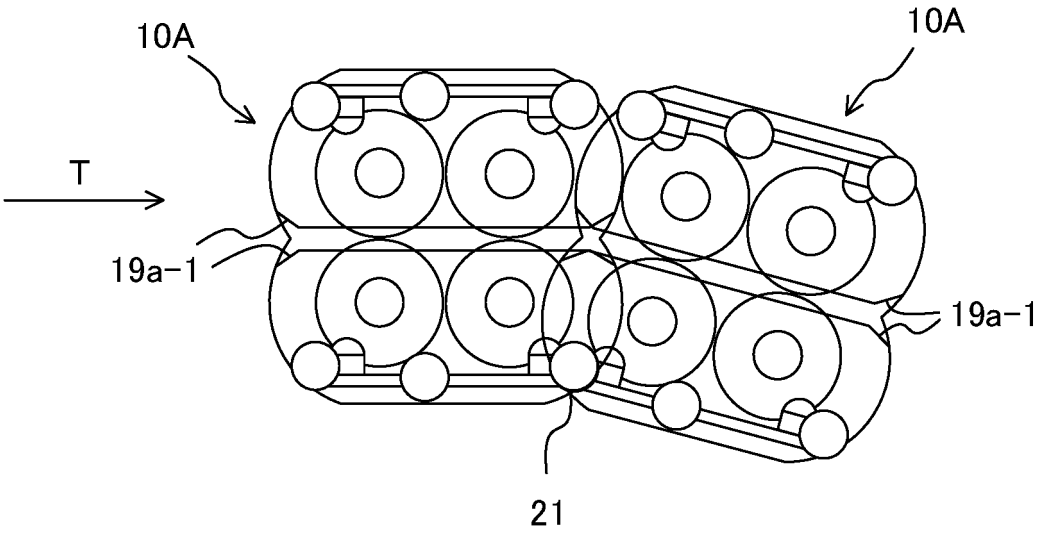

FIG. 7

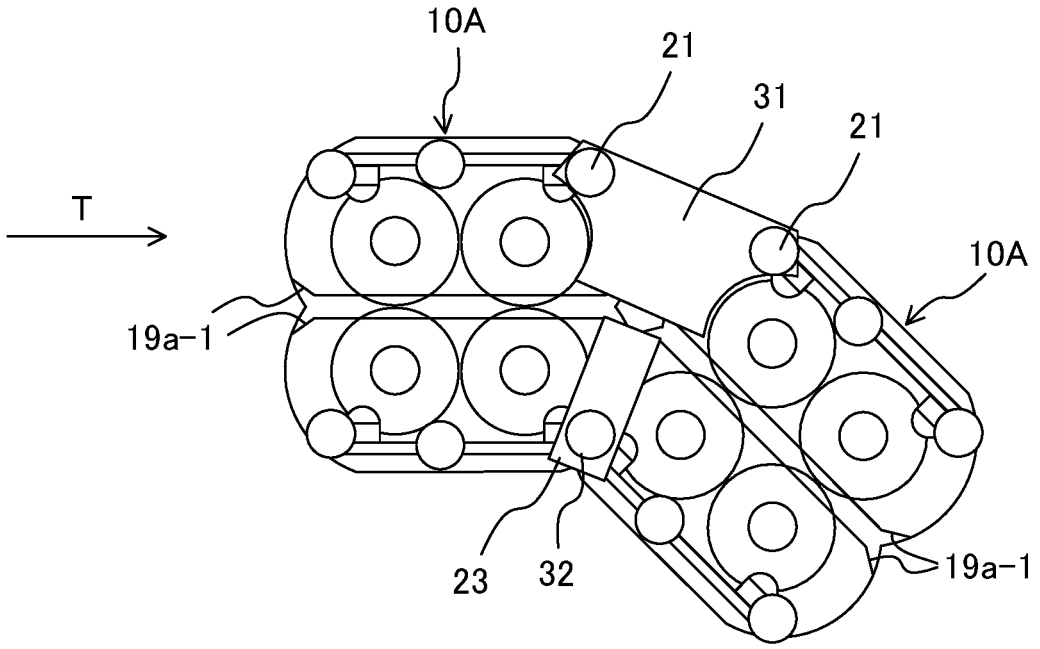

FIG. 8

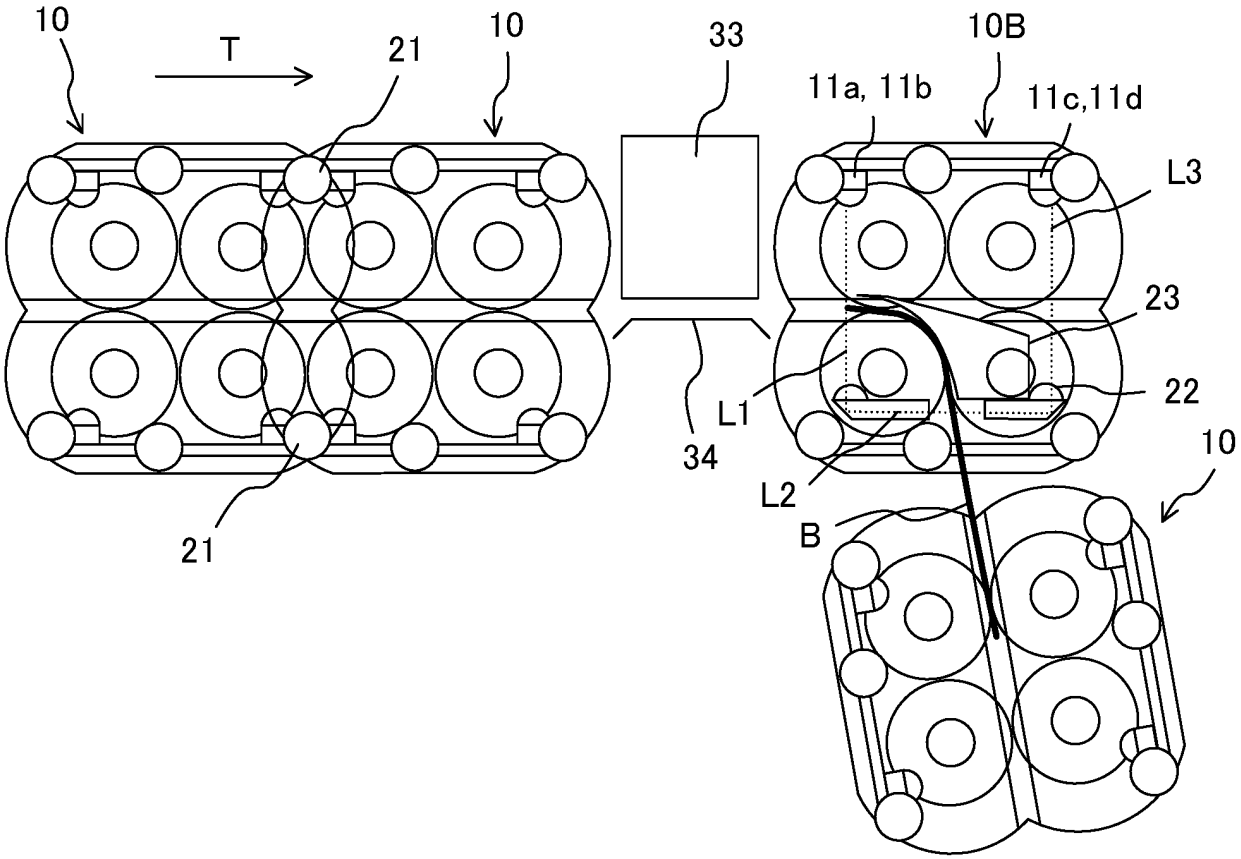

FIG. 9

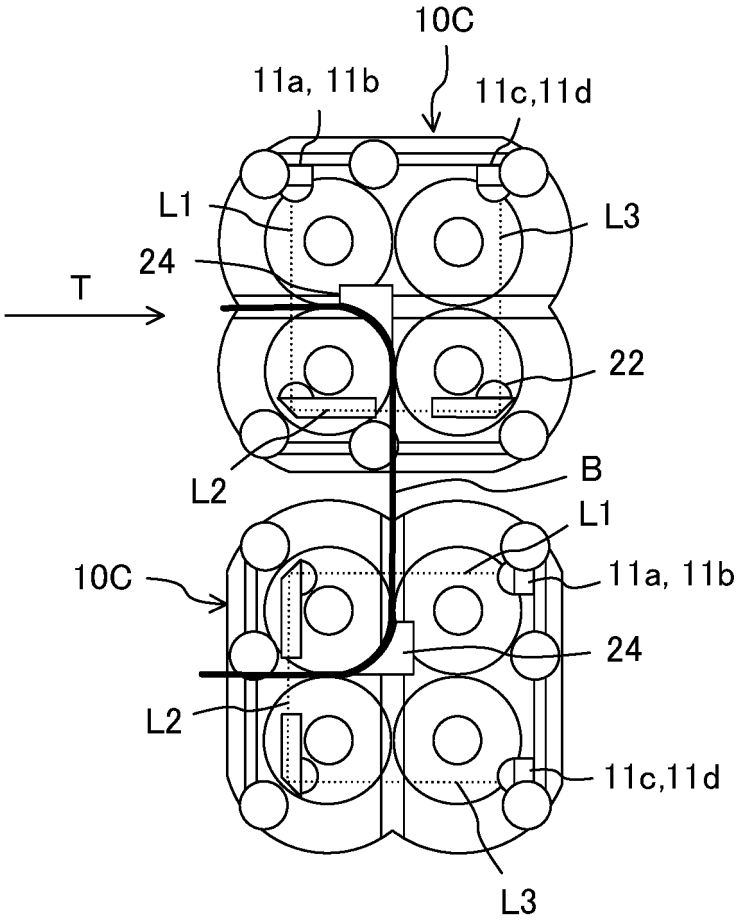
10C
11a, 11b
11c,11d
L1
L3
24
T
22
L2
B
L1
10C
11a, 11b
24
L2
11c,11d
L3

FIG. 10

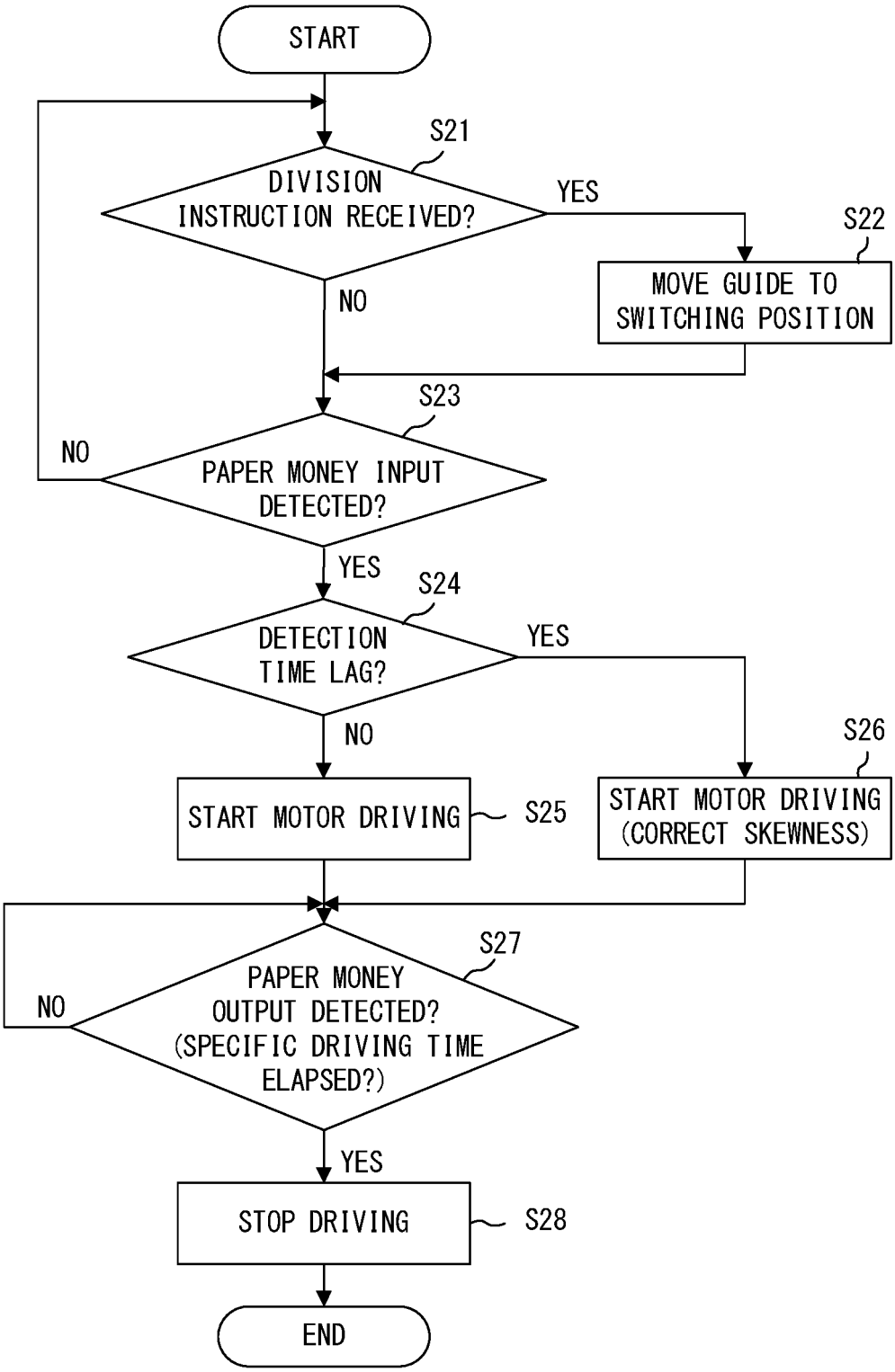
START
S21
DIVISION INSTRUCTION RECEIVED?
YES
S22
MOVE GUIDE TO SWITCHING POSITION
NO
S23
NO
PAPER MONEY INPUT DETECTED?
YES
S24
DETECTION TIME LAG?
YES
S26
NO
START MOTOR DRIVING
S25
START MOTOR DRIVING (CORRECT SKEWNESS)
S27
NO
PAPER MONEY OUTPUT DETECTED? (SPECIFIC DRIVING TIME ELAPSED?)
YES
STOP DRIVING
S28
END

FIG. 11

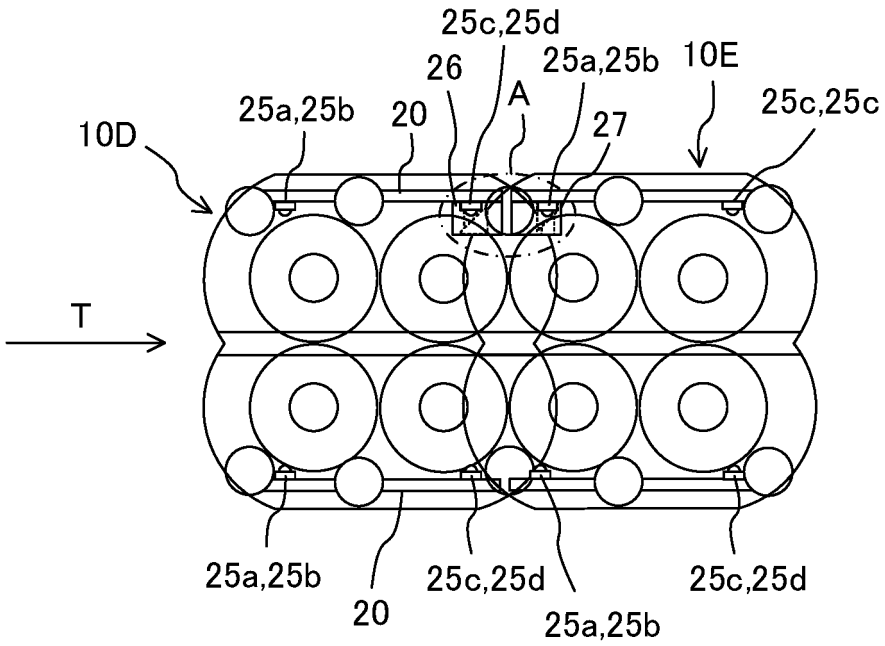
25c,25d
26
25a,25b
10E
A
25a,25b
20
27
25c,25c
10D
T
25a,25b
20
25c,25d
25a,25b
25c,25d

FIG. 12

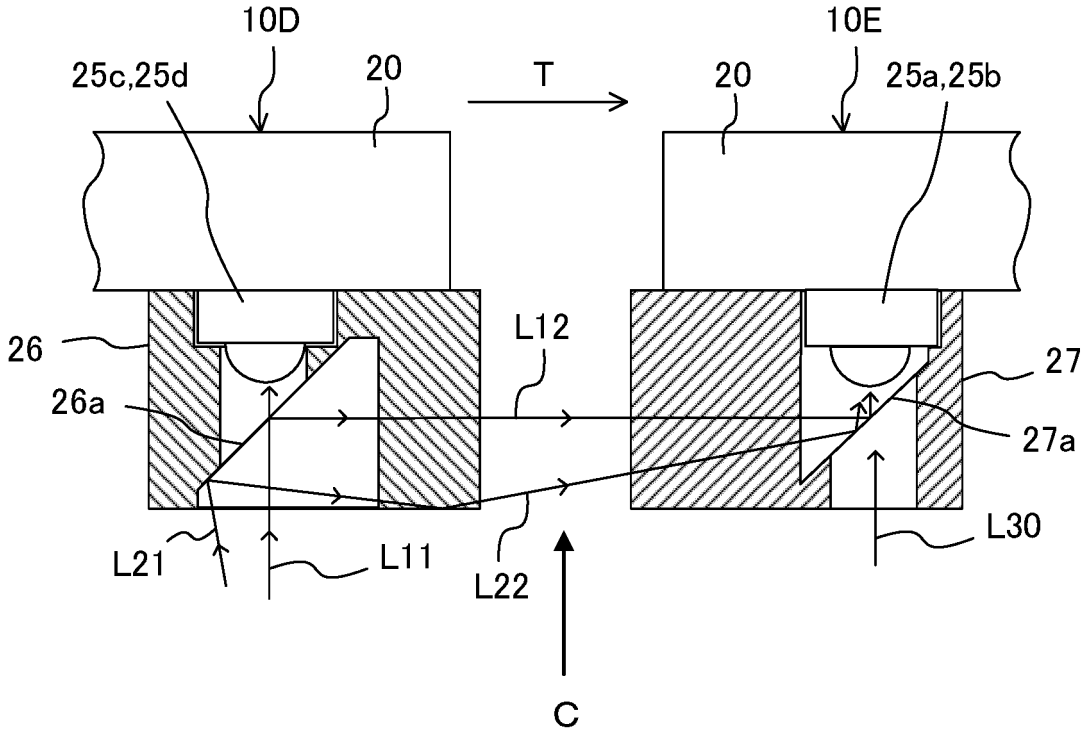

FIG. 13

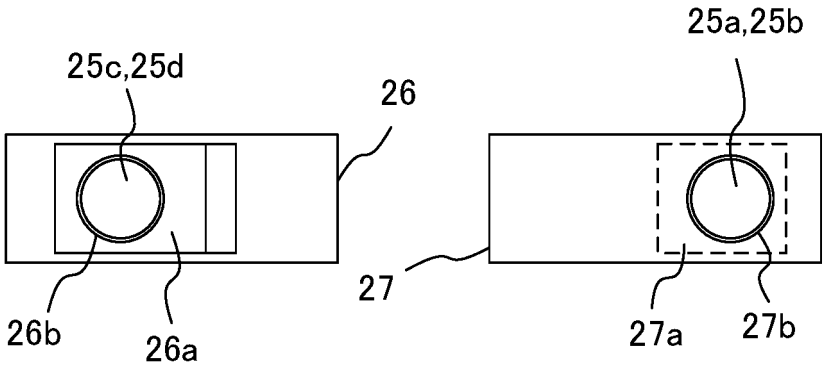

FIG. 14

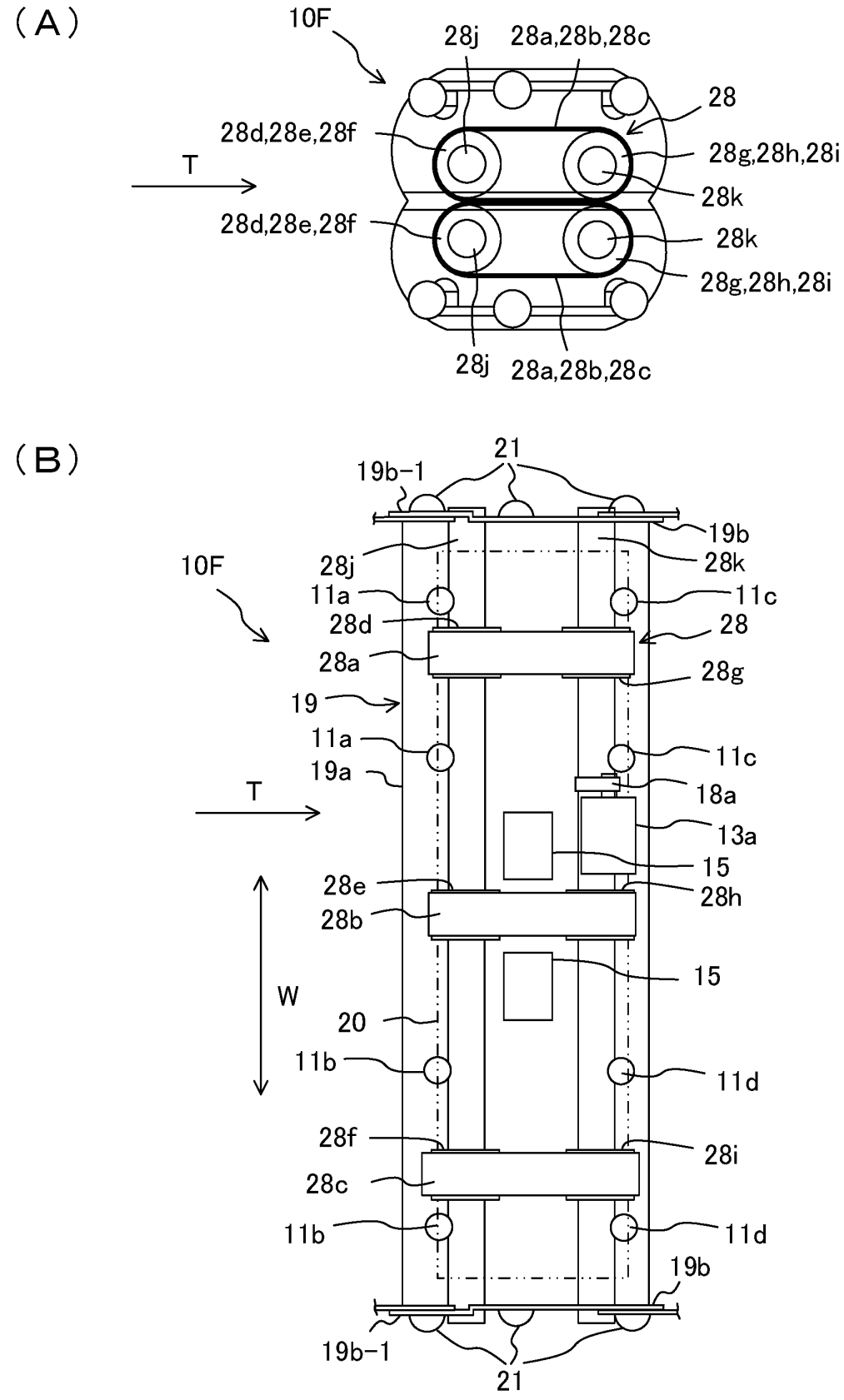
(A)
10F
28j
28a,28b,28c
28
28d,28e,28f
T
28g,28h,28i
28k
28d,28e,28f
28k
28g,28h,28i
28j
28a,28b,28c
(B)
21
19b-1
19b
10F
28j
28k
11a
11c
28d
28
28a
28g
19
11a
11c
19a
T
18a
13a
15
28e
28h
28b
15
W
20
11b
11d
28f
28i
28c
11b
11d
19b
19b-1
21

FIG. 15

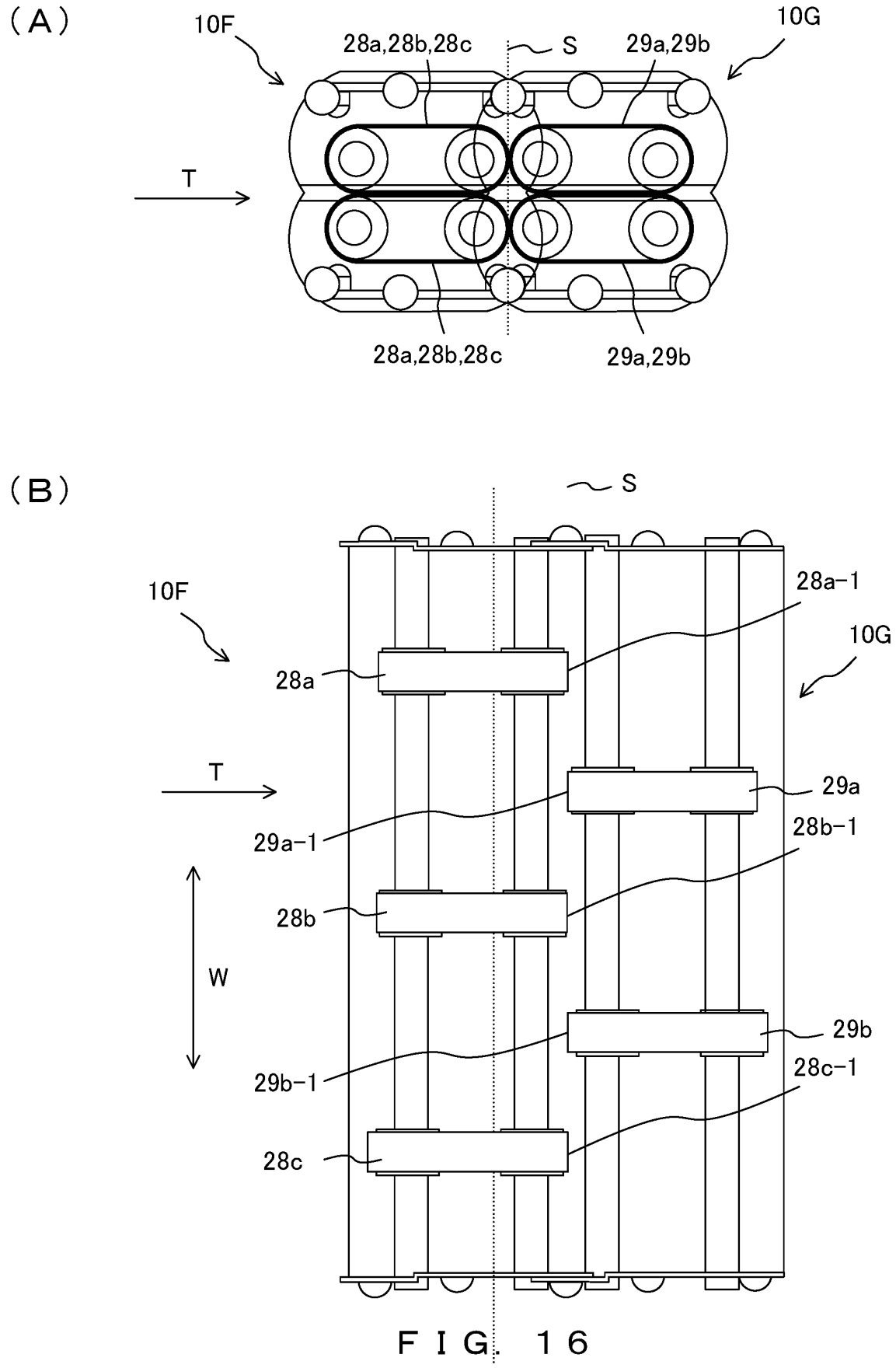
(A)
10F
28a,28b,28c
S
29a,29b
10G
T
28a,28b,28c
29a,29b
(B)
S
10F
28a-1
10G
28a
T
29a
29a-1
28b-1
28b
W
29b
29b-1
28c-1
28c

FIG. 16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/043206

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. B65H7/14(2006.01)i, A63F7/02(2006.01)i, B65H5/02(2006.01)i, B65H5/06(2006.01)i, B65H9/00(2006.01)i, G07D9/00(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl. B65H7/14, A63F7/02, B65H5/02, B65H5/06, B65H9/00, G07D9/00, G07D11/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2018
Registered utility model specifications of Japan 1996-2018
Published registered utility model applications of Japan 1994-2018

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 8-40593 A (YUA KAIHATSU KK) 13 February 1996, paragraphs [0033], [0034], [0042], fig. 3-5, 9-11 (Family: none)	1 2-5
X	JP 8-259042 A (SANYO ELECTRIC CO., LTD.) 08 October 1996, paragraphs [0019]-[0022], fig. 1-3 (Family: none)	1
A	JP 2014-222541 A (UNIVERSAL ENTERTAINMENT CORP.) 27 November 2014 (Family: none)	1, 4
A	JP 8-231074 A (HITACHI, LTD.) 10 September 1996 (Family: none)	1

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

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"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08.02.2018	20.02.2018
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

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Patent documents cited in the description

- JP H08259042 B **[0005]**
- JP 2013186870 A **[0005]**