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(56) Documents Cited
None

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UK CL (Edition O) **B8R RTC RT7 RT8**
INT CL^6 **B65H 29/40**

(54) Sheet transfer system

(57) A sheet transfer system for transferring sheets, such as banknotes, to and from a sheet stack. The system comprises a rotatably mounted sheet transfer member having a body with at least one outwardly opening slot into which a sheet can be received. On rotation of the member a sheet in the slot is transferred to stack 26. The body has at least one reduced diameter section 22. A sheet withdrawal device 6 is provided for withdrawing sheets from the stack, whereby, during a withdrawal operation, Figure 4, the transfer member is rotated to bring the or one reduced diameter portion 22 to face the stack.

Fig.2.

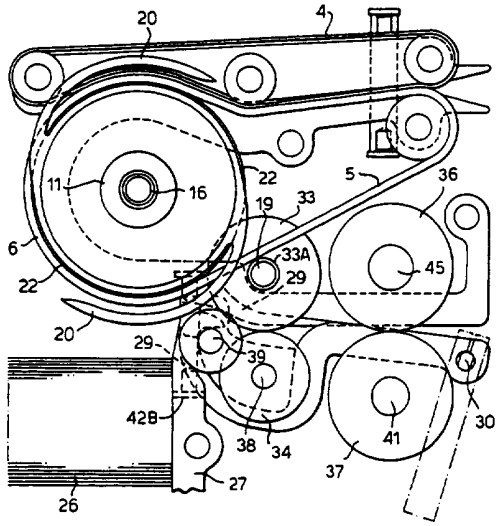
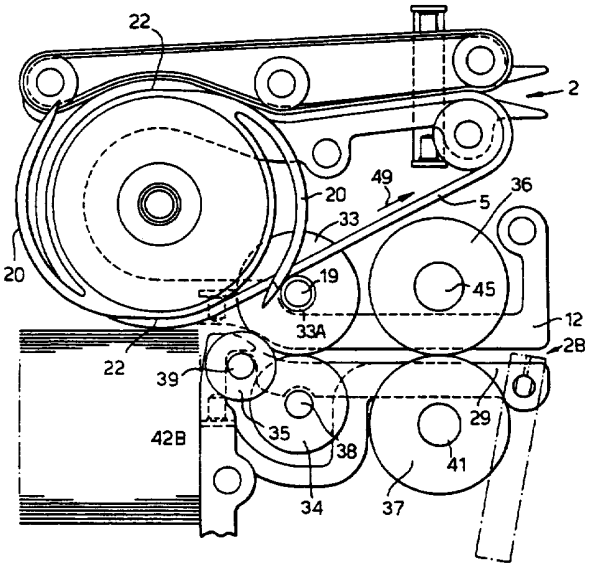


Fig.4.



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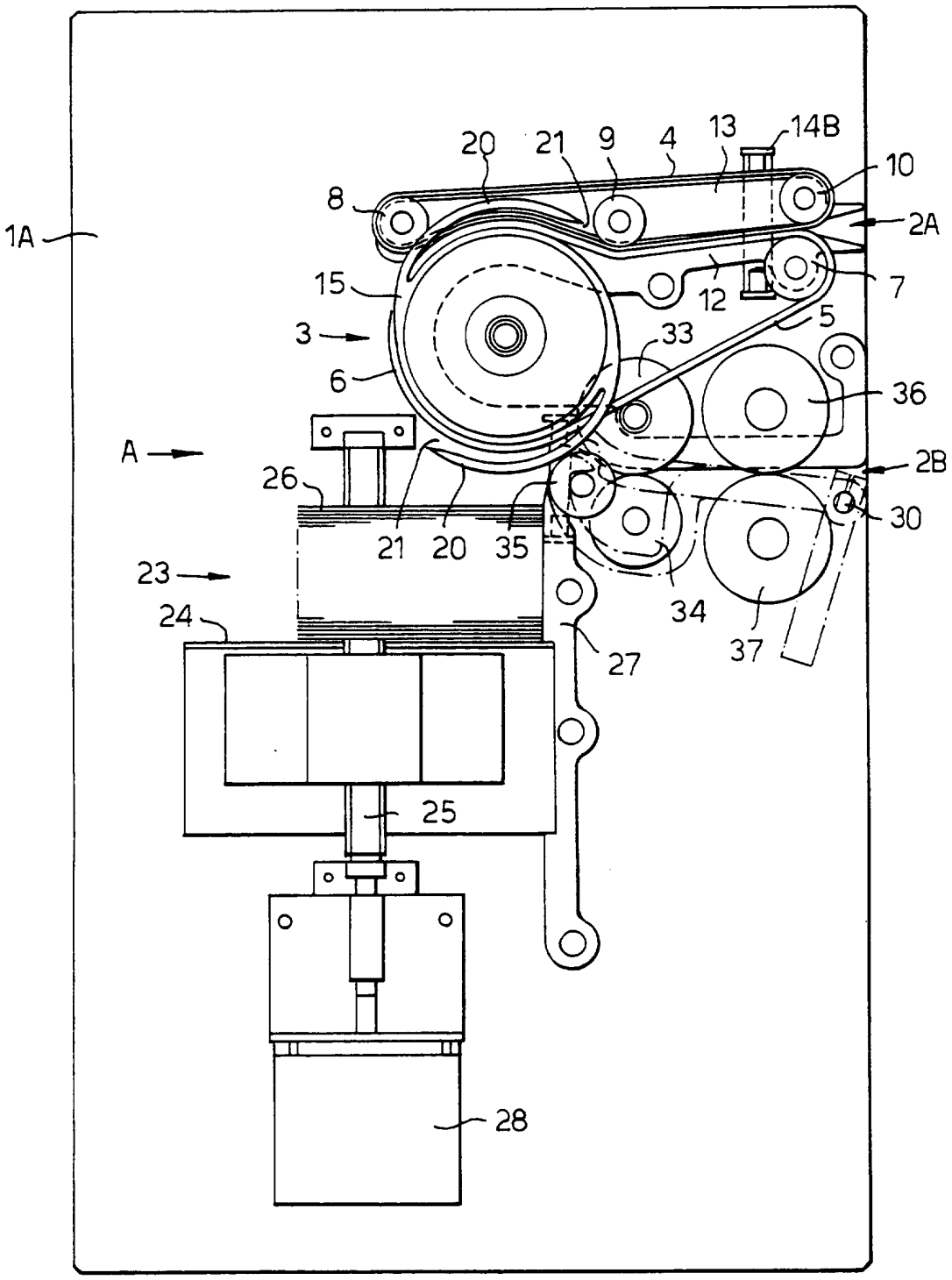
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

Fig.1.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4
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14B
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2A
15
12
7
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Fig.2.

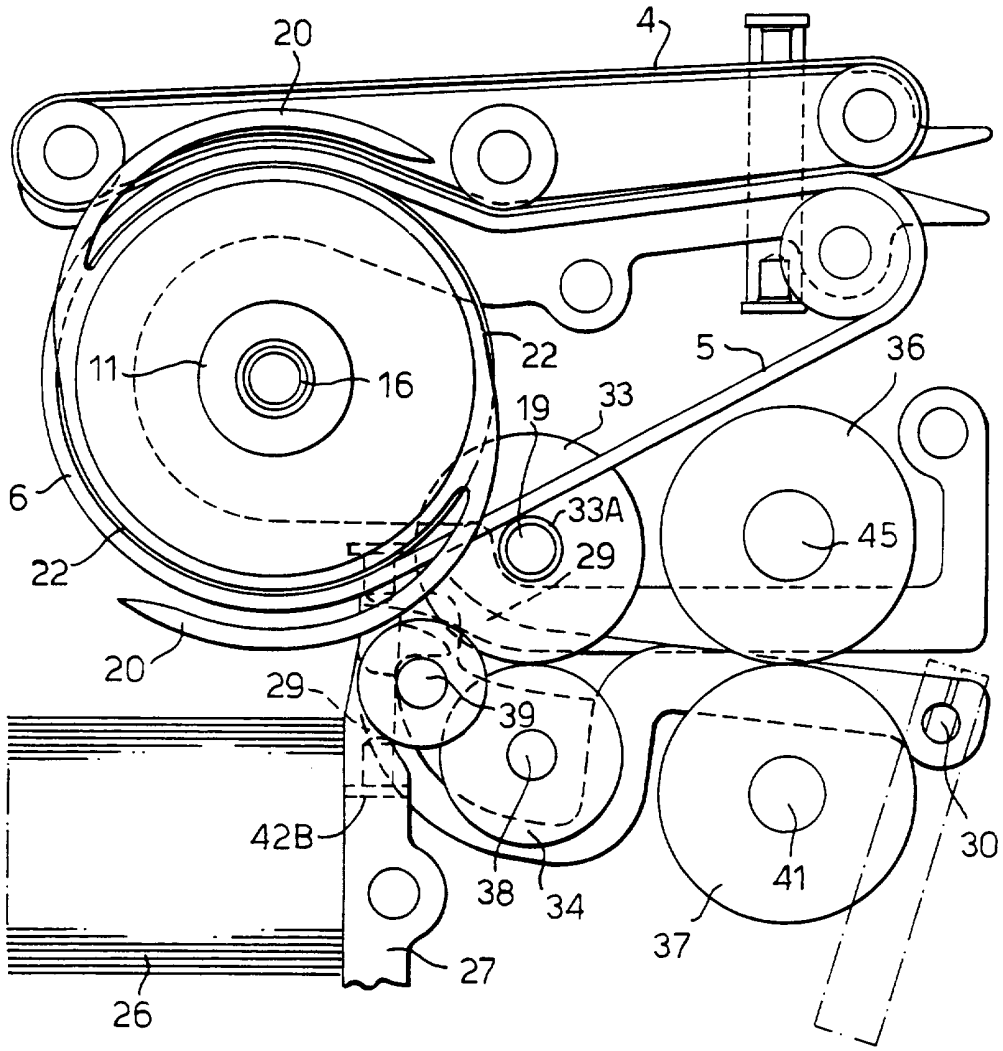


Fig.3.

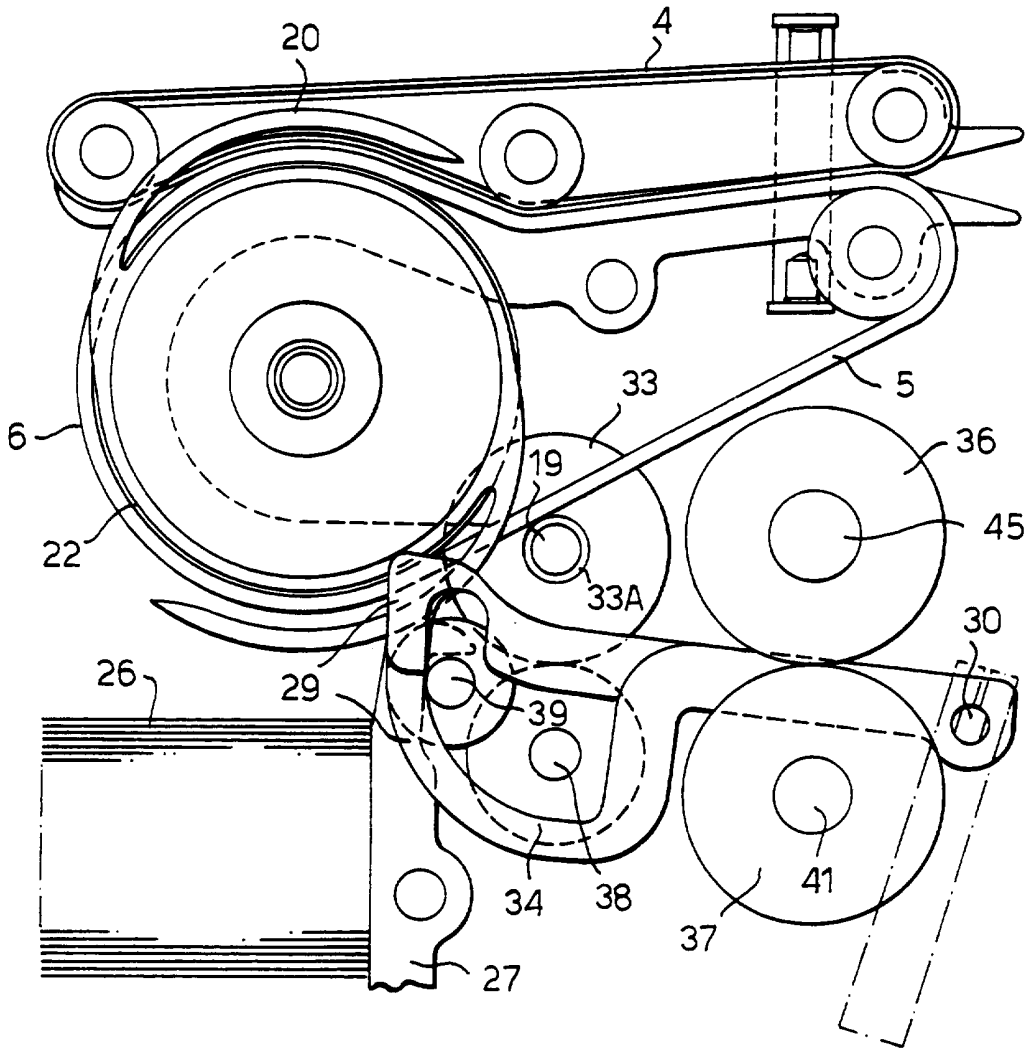


Fig.4.

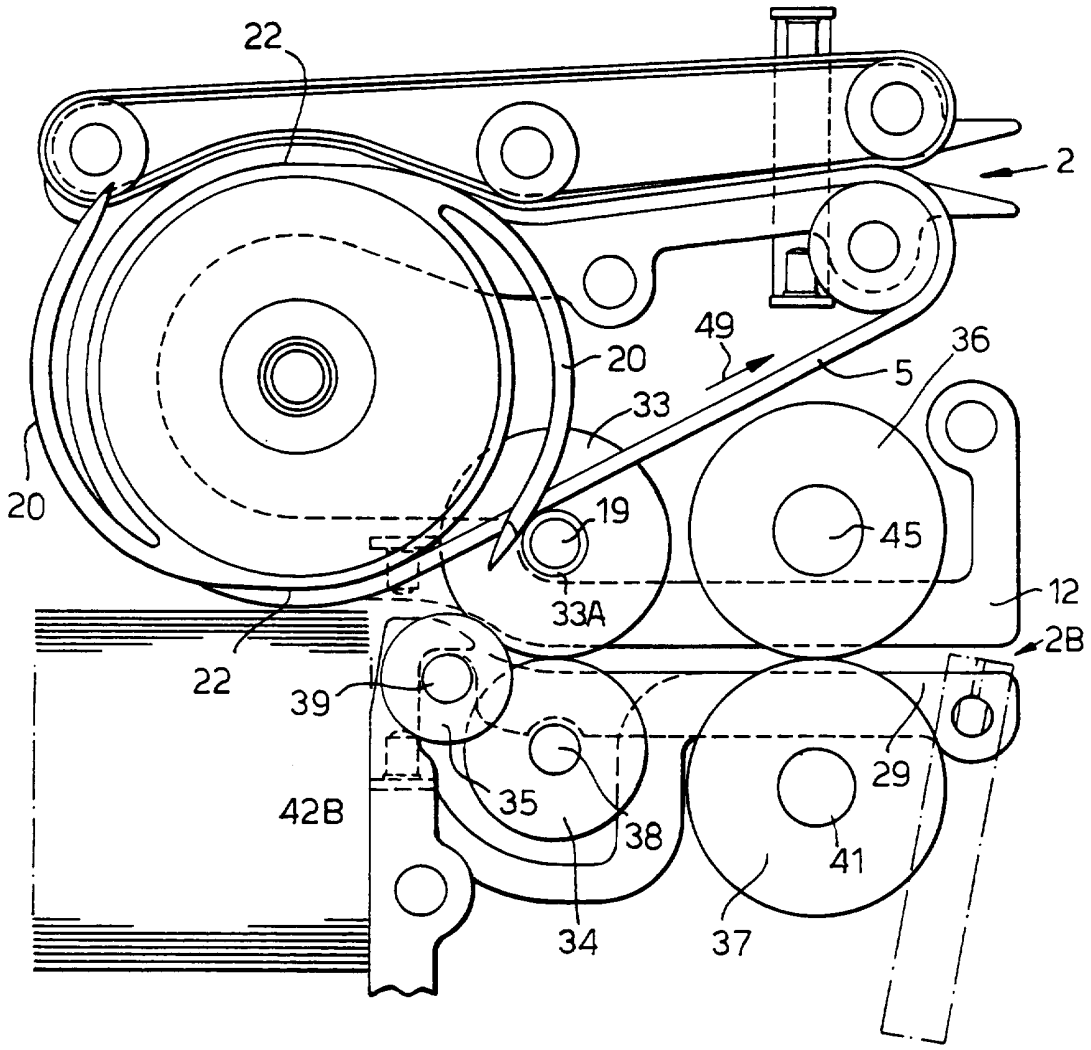
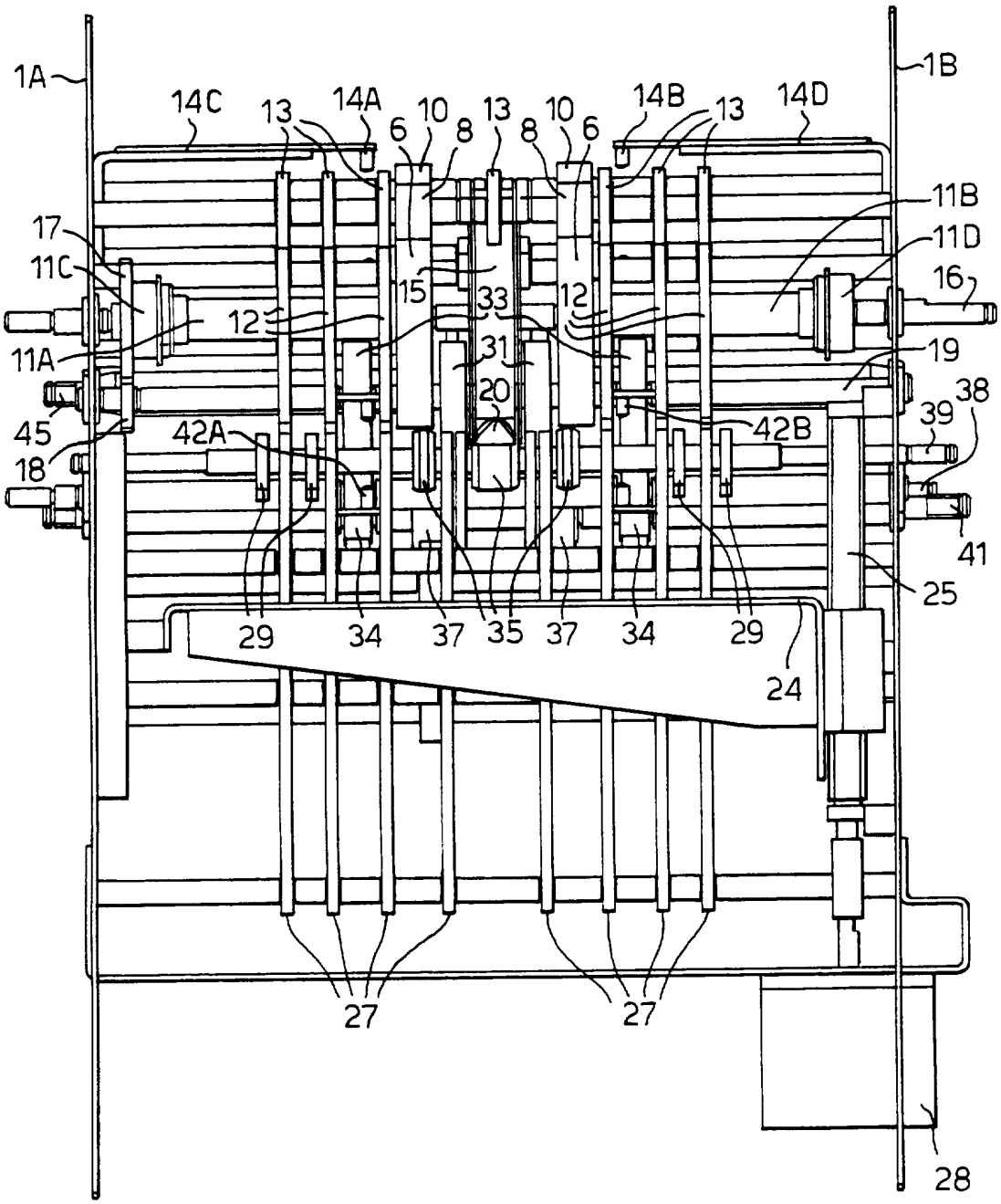


Fig.5.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11C
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11A
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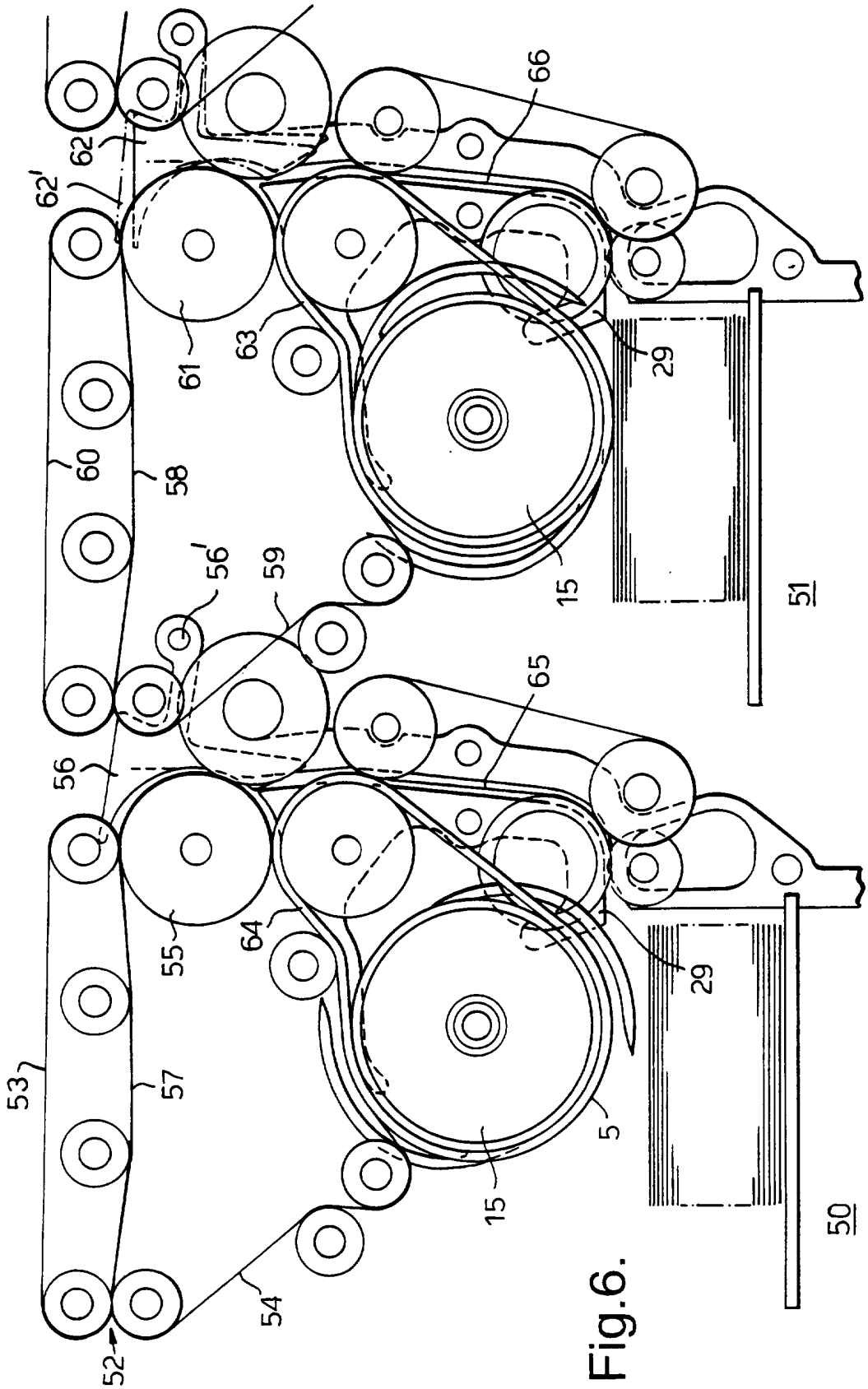

Fig.6.

The invention relates to a sheet transfer system and sheet dispensing and accepting apparatus, for example for use in dispensing and accepting sheets such as banknotes, cheques and other security documents.

Cash dispensing and accepting apparatus are well known as individual items either for dispensing cash to a customer or accepting cash from a customer. An example is disclosed in EP-A-0606721. Combined dispensing and accepting apparatus is also known and examples are described in GB-A-2122008 and GB-A-2104877. These combined apparatus are relatively complex in construction and there is a need to reduce the complexity of such apparatus in order to reduce down time and reduce cost.

In accordance with the present invention, a sheet transfer system for transferring sheets to and from a sheet stacking position comprises a rotatably mounted sheet transfer member having a body with at least one outwardly opening slot into which a sheet can be received, whereby on rotation of the member a sheet in the slot is transferred to a sheet stacking position, and wherein the body has at least one reduced diameter section; and a sheet withdrawal device for withdrawing sheets from the stacking position, whereby, during a withdrawal operation, the transfer member is rotated to bring the or one reduced diameter section to face the stacking position.

We have devised a new form of sheet transfer system in which the sheet transfer member can be used in the normal way for transferring sheets to a stacking position but which can be removed from influencing a stack during a withdrawal operation simply by rotating it to bring the reduced diameter section to face the stacking position. It is not necessary to pivot or otherwise remove the member away from the sheet stacking position when it is desired to withdraw sheets from the stack. This leads to a much simpler construction than has been possible in the past.

The member may have any number of slots depending upon its size but in the preferred example, the member has a

pair of sheet receiving slots and a pair of reduced diameter sections alternately positioned with the slots.

Typically, the transfer member will be in the form of a disc and will be made of one piece. However, the member could have a cylindrical or other form.

Typically, if more than one such transfer member is provided, the members are mounted coaxially with their slots aligned.

In some cases, sheets will be fed to the transfer member and withdrawn from the transfer member by separate means. Conveniently, however, the withdrawal device is positioned also to feed sheets to the transfer member during a sheet receiving operation. This leads to a much simpler arrangement which can be made in a very compact manner.

For example, the withdrawal device may comprise at least one friction pulley coaxially mounted with the transfer member, the pulley having a diameter which overlaps the or each reduced diameter section of the sheet transfer member when the said section faces the stacking position.

In addition, or alternatively, the withdrawal device may comprise at least one friction belt which is positioned beyond the perimeter of the sheet transfer member in the vicinity of the reduced diameter section when the said reduced diameter section faces the stacking position.

Some examples of cash dispensing and accepting apparatus in accordance with the present invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 is a side elevation of one example of the apparatus;

Figure 2 is an enlarged view of part of the apparatus shown in Figure 1;

Figure 3 is a view similar to Figure 2 but with some parts omitted for clarity;

Figure 4 is a view similar to Figure 2 but showing the apparatus during a sheet withdrawal operation;

Figure 5 is a view taken in the direction A in Figure 1 with no sheets stacked; and,

Figure 6 is a side elevation of a second example of apparatus having multiple stores.

The sheet transporting part of the apparatus shown in Figures 1 to 5 is mounted between a pair of side plates 1A,1B. Most of the drive elements (only some shown) are mounted outside the side plates. A transport system (only part of which is shown) transports sheets from an inlet opening 2A to a sheet store transfer position 3, the transport system being defined by two laterally spaced, cooperating pairs 4,5 of feed belts (not shown in Figure 5) entrained about rollers. Belts 5 are driven via the drive rollers 6. The drive rollers 6 are non-rotatably mounted to respective shafts 11A,11B rotatably carried on a shaft 16 journalled between the side plates 1A,1B. The shaft 11A carries a gear 17 which meshes via an idler gear (not shown) with a gear 18 fitted with an integral one way clutch arrangement (not shown) fitted on a shaft 19 journalled between the side plates 1A,1B. Each shaft 11A,11B is independently driven by respective motors (not shown) coupled via timing belts (not shown) to respective toothed pulleys 11C,11D. Each belt 5 drives the cooperating belt 4 by virtue of their frictional engagement. Guides 12,13 are also provided to assist in the feeding of sheets. Two sensor systems 14A,14B are associated with respective pairs of belts 4,5 to deal with skew fed sheets as will be described in more detail below. The sensor systems 14A,14B are mounted on respective brackets 14C,14D attached to the side walls 1A,1B respectively.

Sheets are fed by the belts 4,5 to a stacking wheel 15 (defining a transfer member) non-rotatably mounted to the shaft 16 which is driven by a DC (or alternatively a stepper) motor (not shown). The shaft 16 is coaxial with

and extends through the shafts 11A,11B on which the pulleys 6 are mounted, the shafts 11A,11B being rotatable about the shaft 16. The stacking wheel 15 is a one-piece moulding having a pair of tines 20 defining respective sheet receiving slots 21 with the body of the wheel. The stacking wheel 15 can be seen in more detail in Figure 2.

The outer surface of the stacking wheel 15 has a pair of flats 22, each flat being positioned between the pair of tines 20 but being diametrally opposed. It will be noted in Figure 2 that the outer diameter of the stacking wheel 15 in the region of the tines 20 is greater than that of the pulleys 6 while in the region of the flats 22, the diameter of the stacking wheel 15 is less than the pulleys 6 so that the pulleys 6 (or at least the belts 5) protrude or extend beyond the perimeter of the stacking wheel 15 in these regions.

In operation, the stacking wheel 15 rotates in an anti-clockwise direction as seen in Figure 1 while sheets arriving at the inlet 2A are carried by the belts 4,5 to the stacking wheel 15 where they are individually received in slots 21. The timing of movement of the stacking wheel 15 is controlled by a controller (not shown) in accordance with the detection of sheets by the sensor systems 14A,14B so that an arriving sheet is fed correctly into a slot 21. Rotation of the stacking wheel 15 then carries sheets in the slots 21 towards a sheet store 23. The store 23 is defined by a sheet stack support plate 24 which is mounted to a lead screw 25. Sheets are stacked 26 on the support plate 24 with their leading edges adjacent vertical guides 27. Vertical travel of the plate 24 is caused by rotating the lead screw 25 (or other linear positioning mechanism) by a motor 28. The vertical position of the plate 24 is determined in accordance with the mode of operation of the apparatus (dispensing or accepting) in conjunction with sensors (not shown). Thus, when the apparatus is to accept sheets or when there are no sheets on the plate 24 or no sheets have been transported to the store, the plate is

positioned so that there is a clearance between the plate 24 or the uppermost note of a stack of sheets on the plate and the stacking wheel 15. When sheets are to be fed from the store 23, the plate 24 is moved so that the uppermost sheet on the stack sufficiently contacts the belts 5 so that it can be withdrawn (as will be explained below).

As the stacking wheel 15 rotates, any sheets contained within the slots 21 are stripped out by one or more stripper plates 29 (Figures 2 and 3) pivoted to the apparatus at 30 and drop onto the support plate 24 or a stack 26 already supported on the plate 24. The support plate 24 is gradually lowered by the motor 28 as more sheets are stacked on to it.

Sheets are withdrawn from the stack 26 by virtue of frictional engagement between the friction belts 5 and the uppermost sheet on the stack while the stack is urged against the belts 5 by the motor 28. These sheets are fed to a pair of coaxially mounted separation rollers 31 non-rotatably mounted on the shaft 19 which are normally driven anti-clockwise through a one-way clutch from the drive arrangement used to rotate one of the drive rollers 6 (although they will also be rotated in the same direction by virtue of a sheet being pulled by the downstream rollers 33,34 and transport rollers 36,37), and a pinch which exists between rollers 33 rotatably mounted to the shaft 19 by a bearing 33A and being rotated anti-clockwise by corresponding contacting rollers 34 (rotating clockwise) non-rotatably mounted on a shaft 41. The rollers 31 and 33 have substantially the same diameters. Counter-feed rollers 35 (rotatably driven anti-clockwise) fixed on a shaft 39 prevent the withdrawal of multiple sheets simultaneously. The sheets are guided between part of the guide members 12 and part of the plates 29 and through the nips defined between rollers 36 fixed on a shaft 45 and corresponding rollers 37 on a shaft 47. Shafts 41,38 and 45 are driven at constant speed by the main transport drive system (not shown). Laterally spaced sensors 42A,42B are

provided, supported by respective brackets, to detect and count the leading edge of each sheet as it is picked up by the transport system and, if sheet skew is detected, to adjust the rate of rotation of at least one of the rollers 6 by suitably controlling the appropriate drive motor to substantially straighten the sheet in the transport.

The sheets are then fed further through the transport system to a sheet outlet 2B.

The operation of the apparatus shown in Figures 1 to 4 will now be described in more detail.

In a sheet accept operation, sheets are fed to the inlet 2A at the entrance to the belts 4,5. The belts 5 and hence the belts 4 are driven at a uniform speed that matches the upstream transport speed before the point 2A. At this stage, the stacking wheel 15 is stationary and is located as shown in Figure 2 with a slot 21 aligned to receive incoming sheets. The support plate 24 is also positioned so that a clearance exists between the plate or the uppermost sheet of a stack on the plate and the stacking wheel 15. The control system (not shown) indicates that a sheet stacking sequence is to commence. The first sheet to be stacked is fed by the belts 4,5 into the slot 21. If the sensor system 14A,14B indicates that the leading edge of the sheet is skewed, the control system adjusts the drive of one or both of the pulleys 6 and hence the belts 5 to ensure that the sheet is fully fed into the slot 21 of the stacking wheel with the leading edge of the sheet substantially parallel to the axis of the shaft 16. Once a sheet has fully entered the slot 21, the motor connected to the shaft 16 is actuated (or a clutch is actuated) and the stacking wheel 15 rotates in an anti-clockwise direction until the next slot 21 is aligned with the output side of the belts 4,5 so as to receive the next sheet. This process continues until the control system recognises that the final sheet of the batch to be stacked has entered the stacking wheel 15.

As the stacking wheel 15 rotates, each sheet is brought into alignment with the store 23 and its leading edge will engage the stripper plate 29 so that on further rotation of the stacking wheel 15 the sheet is stripped from the stacking wheel and drops onto the stack 26. When the system notes that a final sheet has arrived, it causes the stacking wheel to continue to rotate until that final sheet has been stripped. During this process, the plate 24 is lowered to maintain a clearance between the top of the stack 26 and the stacking wheel 15.

In a dispense operation, the stacking wheel 15 is rotated to bring one of the flats 22 around to face the stack as shown in Figure 4. In this position, the belts 5 protrude beyond the diameter of the stacking wheel 15 adjacent the stack 26. In addition, the plate 29 is pivoted downwardly and away from the stacking wheel 15 to the position shown in Figure 4. The plate 24 is raised until the uppermost sheet of the stack 26 engages the belts 5 with sufficient force. The motors connected to the pulleys 6 are then actuated to cause the belts 5 to move in the direction of arrow 49 and the uppermost sheet of the stack 26 will be urged under friction towards the feed rollers 33,34 while the stacking wheel 15 remains stationary. Movement of the belts 5 continues until completion of the dispense cycle. Counter-feed rollers 35 resist the feeding of more than one sheet from the stack. The sensors 42A,42B register each sheet as it is fed and if the sensors 42A,42B detect a leading edge of a sheet at different times this indicates the sheet is being skew fed and the rate of rotation of at least one of the rollers 6 can then be adjusted to straighten the sheet. As more sheets are fed from the store 23, the plate 24 is raised to maintain contact between the uppermost sheet and the belts 5. The transport system then transports the withdrawn sheets to a sheet outlet.

Various modifications of the system described are possible. For example, the rollers 33,34 or 36,37 could define a sheet thickness detector.

The transport systems could be formed by pairs of belts, pairs of rollers or vacuum feed devices in a conventional manner.

The separation rollers 31 could be driven independently rather than through a one-way clutch device from the drive to the pulleys 6.

Finally, separate transport systems could be provided for conveying sheets to and from that part of the apparatus shown in Figures 1 to 5. However, it is particularly convenient if a common transport system is utilized and such a system is partially shown in Figure 6. In this example, two sheet stores 50,51 are shown, each having a construction similar to the sheet store 23. Sheets are fed to the sheet store using a stacking wheel 15 similar to that described above. These aspects of the apparatus shown in Figure 6 will not therefore be described in detail. Sheets being fed into the apparatus during an accept operation are fed to a position 52 defining the entrance to a feed path defined by laterally spaced pairs of belts 53,54. The belt 54 is driven by a drive roller 55 from a motor (not shown), the belt 54 frictionally driving the belt 53. A diverter 56 is positioned at the other end of the path 57 defined by the belts 53,54 and is pivotable about a point 56' between a divert position shown and a position which allows sheets to pass on to a second feed path 58 defined between laterally spaced pairs of belts 59,60 (only one pair shown in Figure 6). The belts 59 are driven by a roller 61 connected to a drive motor (not shown) and the belts 59 frictionally drive the belts 60.

In an accept operation, the control system first decides into which store 50,51 an incoming sheet is to be stored. In the situation shown in Figure 6, an incoming sheet is to be stored in the store 50 so that the diverter 56 is activated by the control system to divert sheets away

from the path 58 while a diverter 62 is deactivated. Sheets diverted by the diverter 56 pass into an input path 64 from where they enter slots in the stacking wheel 15, as before. After a sheet or batch of sheets has been supplied, the diverters 56,62 are deactivated. If the incoming sheet is to be fed to the store 51, then the diverter 56 remains deactivated and the diverter 62 is moved to its activated position 62′ (shown in phantom) and the sheet is fed via the diverter 62 into a path 63 and from there into a slot in the stacking wheel 15.

In a dispense operation, both diverters 56,62 are deactivated. The appropriate stacking wheel 15 is rotated to bring its flat to face the store, the stripper plate 29 is moved away, and the respective one of the support plates in the stores 50,51 is activated to cause the corresponding stack to engage the belts 5. The uppermost sheet is then withdrawn and fed along a path 65 or 66 where it will engage the respective diverter 56,62. In the deactivated state, the diverters are free to pivot under the influence of the sheet so that the diverter is progressively rotated by the sheet to assume the position (shown for example at 62′ in Figure 6) at which the sheet is guided into the respective path 57 or 58. In addition, during a dispense operation, the belts 53,54,59,60 are moved in the opposite or reverse direction so that dispensed sheets are fed back to the position 52 and from there on through the transport system to the outlet.

CLAIMS

1. A sheet transfer system for transferring sheets to and from a sheet stacking position, the system comprising a rotatably mounted sheet transfer member having a body with at least one outwardly opening slot into which a sheet can be received, whereby on rotation of the member a sheet in the slot is transferred to a sheet stacking position, and wherein the body has at least one reduced diameter section; and a sheet withdrawal device for withdrawing sheets from the stacking position, whereby, during a withdrawal operation, the transfer member is rotated to bring the or one reduced diameter section to face the stacking position.

2. A system according to claim 1, the member having a pair of sheet receiving slots and a pair of reduced diameter sections alternately positioned with the slots.

3. A system according to claim 1 or claim 2, wherein the transfer member is a disc.

4. A system according to any of the preceding claims, wherein the withdrawal device is positioned also to feed sheets to the transfer member during a sheet receiving operation.

5. A system according to any of the preceding claims, wherein the withdrawal device comprises at least one friction pulley coaxially mounted with the transfer member, the pulley having a diameter which overlaps the or each reduced diameter section of the sheet transfer member when the said section faces the stacking position.

6. A system according to any of claims 1 to 4, wherein the withdrawal device comprises at least one friction belt which is positioned beyond the perimeter of the sheet transfer member in the vicinity of the reduced diameter section when the said reduced diameter section faces the stacking position.

7. A system according to claim 6, wherein the or each friction belt also defines part of a sheet transport system for transporting sheets to the sheet transfer member.

8. A system according to claim 7, wherein a plurality of said friction belts is provided, laterally spaced apart, the belts being independently driven, the system further comprising sensing means positioned to sense whether or not a sheet is being fed to the transfer device in a skewed condition, and means for controlling the manner in which the belts are driven so as to align any sheets which are sensed as being fed in a skewed condition.

9. A sheet transfer system substantially as hereinbefore described with reference to any of the examples shown in the accompanying drawings.

10. Sheet accepting and dispensing apparatus comprising one or more sheet stores; a corresponding number of sheet transfer systems according to any of the preceding claims, the or each system being associated with a respective store; and a transport system for transporting sheets to the sheet transfer system(s) and away from the sheet transfer system(s).

The Patent Office

Application No: GB 9609964.3
Claims searched: 1-10

Examiner: E. W. Bannister
Date of search: 6 August 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B8R (RT7, RT8, RTC)

Int Cl (Ed.6): B65H 29/40

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
	None	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.