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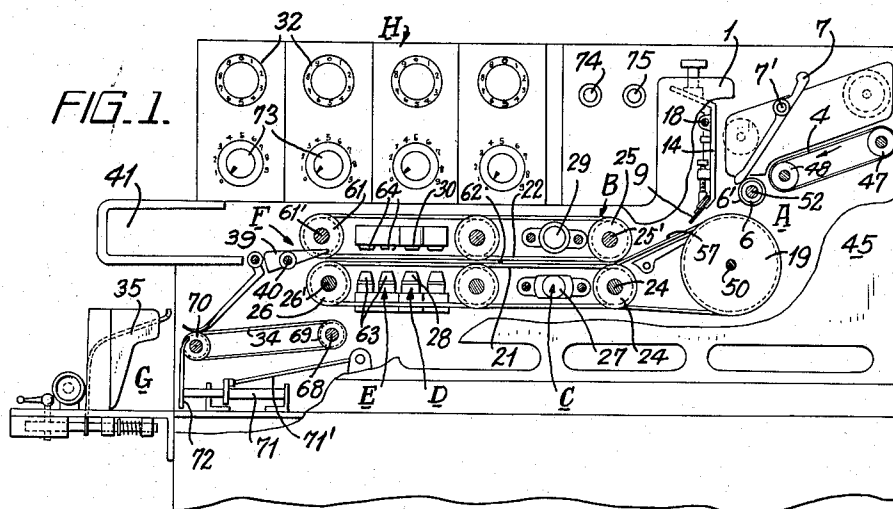
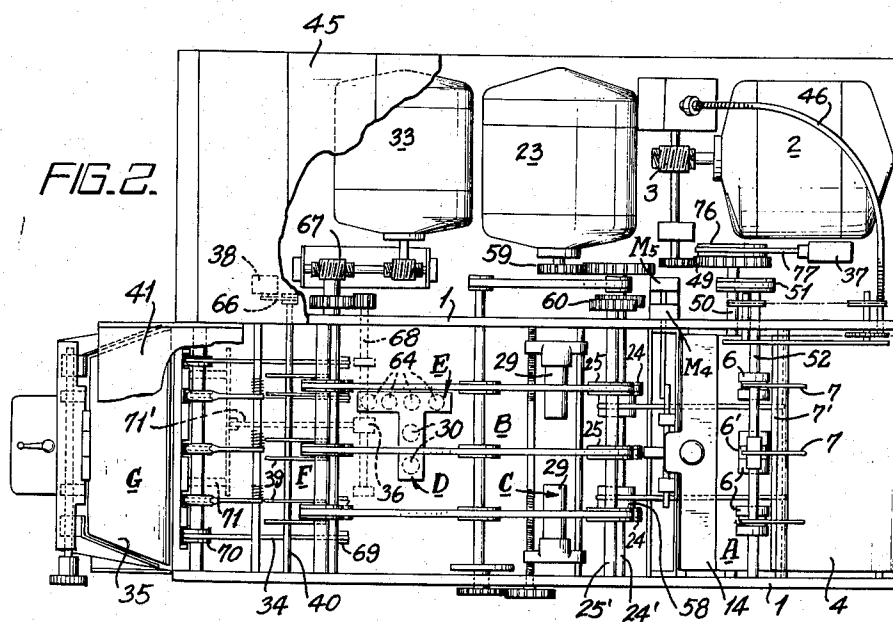
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APPARATUS FOR COUNTING BANK NOTES AND SIMILAR ARTICLES

Filed June 22, 1959

3 Sheets-Sheet 1



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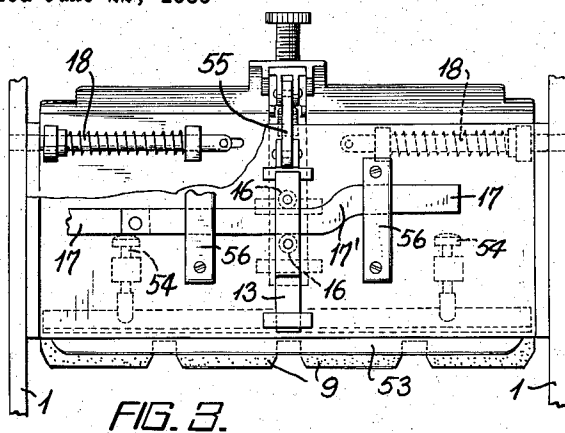
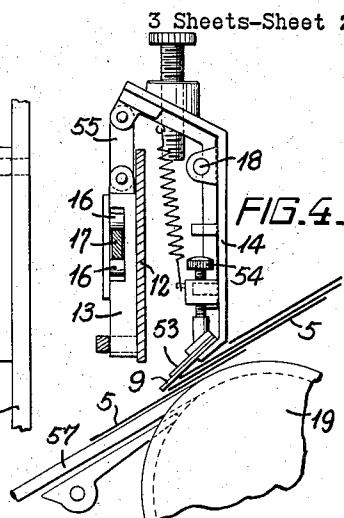
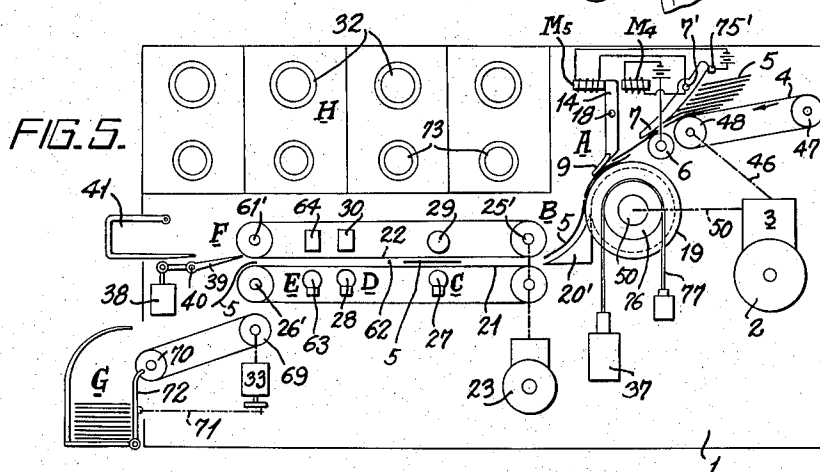
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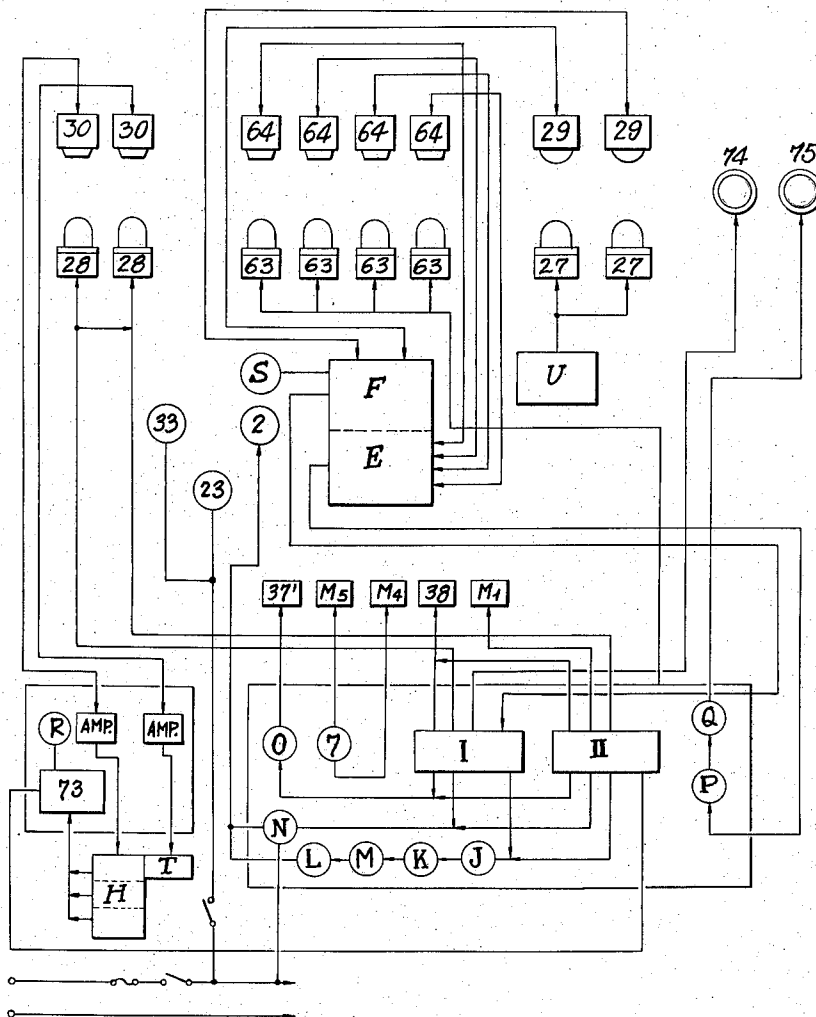
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FIG. 6.



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APPARATUS FOR COUNTING BANK NOTES AND SIMILAR ARTICLES

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2 Claims. (Cl. 93-93)

This invention relates to apparatus for counting bank notes and similar articles.

It is an object of the present invention to provide an apparatus which counts bank notes quickly and accurately. In the banking business, the counting of bank notes is of great importance and heretofore required much time. It is a further object of the invention to save much of the time formerly spent in manually counting bank notes. According to the invention when bank notes in a pile are fed to a delivery device comprising a rotary drum having a coefficient of friction much greater than that of bank notes to be counted and a pressing element having a coefficient of friction smaller than that of the said drum but greater than that of bank notes, the bank notes are caught by the drum one by one from the bottom of the pile and are advanced. The bank notes are then further advanced in a passage formed by confronting endless belts running at a speed much higher than the circumferential speed of the drum of the delivery device, whereby the bank notes are separated from one another by a substantial distance of space. The number of bank notes can then be conveniently counted by counting the number of spaces between bank notes by means of a phototransistor used as a signal generator and an electric counting device operated by the signal to count the number of spaces.

The present invention has various other features and advantages in addition to those as described above. All these features and advantages of the present invention will be made clear by reference to an embodiment of the present invention as shown in the accompanying drawings wherein:

FIG. 1 is a front view of the apparatus of the present invention, of which the front wall of the case is partially broken away in order to show the internal construction;

FIG. 2 is a plan view of the apparatus in FIG. 1 with some parts being removed for the sake of clarifying the drawing;

FIG. 3 is a front view showing on a larger scale a pressing element and means for bringing said element in contact with a rotary drum or departing it therefrom;

FIG. 4 is a side view of the apparatus of FIG. 3 together with a part of the rotary drum;

FIG. 5 is a diagrammatic view of the apparatus with portions removed for convenience of explanation; and

FIG. 6 is a diagram showing a coordination system for operation of the apparatus.

In FIGS. 1 and 2, are shown the various devices which make up the apparatus for counting bank notes. Specifically, there is shown a delivery device A, a high speed advancing device B, a device for detecting overlapping notes C, a signal device D, a device for detecting notes delivered with no spacing E, a device for rejecting overlapping notes F, a device for piling counted bank notes G, and an electric counting device H as, for example, a "Decatron counter."

Bank note are delivered one by one by the delivery device A to the counting signal device D through the high speed advancing device after passing the detector for overlapping notes C, and then to the device for piling counted bank notes G.

The signal device D transmits a signal to the electric

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counting device H every time when a bank note passes the counting signal device. When bank notes in overlapping condition pass by the detector C, they are detected and sent to a storage 41 which is different from the device for piling counted bank notes G. Furthermore, the overlapped bank notes are not counted. The above illustrates the general principle of the apparatus of the present invention.

The delivery device A comprises an endless belt 4 wound on rollers 47 and 48, rollers 6 associated with levers 7, and a drum 19 associated with a pressing element 9. A motor 2 (FIG. 2) supported in the casing 45 drives the roller 47 through a reduction gear 3 and a flexible shaft 46 to drive the endless belt 4 in the direction of the arrow in the drawing. This motor 2 also drives the drum 19 through the reduction gear 3, a gear 49 and a shaft 50. The rollers 6 are mounted on a shaft 52 which is driven by the shaft 50 through a V-belt 51 wound on rollers on shafts 50 and 52. Accordingly when the motor 2 is rotated, the belt 4, the rollers 6 and the drum 19 are driven.

One of the rollers 6 is provided with a slip ring 6' which is normally in contact with a lever 7 rotatable around a pivot 7', energize a magnet M₄ (FIG. 5). However, when a bank note is passed between the slip ring 6' and the lever 7, the magnet M₄ is deenergized and magnet M₅ is energized. With regard to the function of the magnets M₄ and M₅, explanation will be made hereinafter.

The drum 19 is associated with a pressing element 9. Element 9 is fixed as shown most clearly in FIG. 4 by a screw 54 on a plate 53 which forms the bottom of a support member 14 pivoted at 13 on a frame 1 of the casing 45. Element can be brought into contact with or spaced from the drum 19 by rotation around the pivot 13. The mechanism for this operation is as follows. A plate 12 is fixed on the frame 1 and a movable lever 13 is mounted on said plate. This lever 13 is connected to the support member 14 by a link 55. The lever 13 has a slot in which rollers 16 are provided. The rollers 16 are in engagement with a cam lever 17 which is slidably supported by guide supports 56 fixed on the plate 12. Cam lever 17 has a bent portion 17' therein. The cam lever controlled by the magnets M₅, above mentioned, and when the magnet M₅ is energized, namely when a bank note is passed between the lever 7 and the slip ring 6', the lever 17 is pulled to the right to turn the support member 14 counter-clockwise to cause the pressing element 9 to contact the drum. When the bank note is not passed between lever 7 and slip ring 6', the pressing element is raised from the drum by the action of the magnet M₄ which pulls the cam lever 17 to the left to turn the support member 14 clockwise. This movement of the support member 14 prolongs the life of the drum 19 and the pressing element 9 which would otherwise wear rapidly if always maintained in contact with each other.

According to the present invention, the coefficient of friction of the drum 19 is greater than that of the pressing element 9 which has in turn a coefficient of friction greater than that of the bank note to be counted. According to test and experience, it has been found that the ratio of 3:2:1 gives very satisfactory results although the particular ratio is not critical. When bank notes are supplied on the belt 4, they are forwarded by the roller 6 to the drum 19.

Since the drum 19 has a much greater coefficient of friction than that of the bank note, only the bottom bank note is caught and forwarded by the drum 19 to pass between the drum 19 and the pressing element 9, and thus the bank notes are forwarded one by one by the drum 19.

In order to obtain the desired coefficient of friction

as ascribed above to the drum 19 and the pressing element 9, it is preferable to coat the surface of the drum with rubber having a large coefficient of friction, for example, neoprene, and to manufacture the pressing element from a material of a lesser coefficient of friction, for example, a synthetic rubber.

Following the passage between the pressing element 9 and the drum 19, a guide 20' or a guide belt 57 is provided to guide the bank note to the high speed advancement device B. This advancement device comprises two sets of endless V-belts 21, 22 between which bank notes are passed. These belts 21, 22 are driven by a motor 23 through gears 59, 60 and shafts 24', 25'. The shafts have fixed pulleys 24, 25 thereon over which the belts are wound in cooperation with the pulleys 26, 61 rotatably mounted on shafts 26', 61'. The belts 21, 22 form a passage 62 for the bank notes. The speed of the belts 21, 22 is made much greater than the circumferential speed of the drum 19 and therefore the bank notes delivered between the belts 21, 22 one by one from the delivery device A will be spaced from one another. According to test and experience, it has been found that when the speed of belts 21, 22 are made about twice the speed of the drum 19, satisfactory operation is obtained although this ratio is not critical.

A signal device D comprises a lamp 28 and a photo-transistor 30 arranged on opposite sides of the passage 62 in confronting relation. When a bank note is passed between the lamp 28 and the photo-transistor 30, the light ray from the lamp 28 is interrupted by the bank note and the photo-transistor 30 is not actuated. The bank notes on the belt 21 are spaced as described above, and when a space reaches between the lamp 28 and the photo-transistor 30, the light ray falls on the photo-transistor 30 which generates a signal. It is apparent that the number of bank notes passed through the passage 62 can be determined by counting the number of spaces as long as the bank notes are passed through the passage 62 one by one and spaced from one another. However, it is possible that two bank notes in overlapping relation are discharged from the delivery device A in overlapping relation. This may happen when a torn bank note is repaired causing an abnormal increase in the coefficient of friction of the note. In order to avoid errors in counting resulting from overlapped bank notes the apparatus of this invention has a device C for detecting overlapping notes and a device F for rejecting overlapping notes as shown in FIG. 6.

The device C comprises a lamp 27 connected with an electric source U and a photoelectric cell 29. The lamp 27 and photoelectric cell 29 are placed on opposite sides of the passage 62 in confronting relation. The lamp 27 is designed to emit a comparatively strong light to pass through a single bank note and the light from the lamp 27 reaches the photoelectric cell and therefore this does ordinarily actuate the magnet 38, but in the case of overlapping bank notes the light from the lamp is prevented completely from reaching the photoelectric cell and consequently the magnet 38 is actuated. When magnet 38 is energized a fork 39 (FIG. 1) which is normally in an up position at the level of the passage 62 is pulled down to lead the overlapping bank notes to a storage 41 for overlapping bank notes. It is of course necessary not to include these rejected notes in the number of counted notes. For this purpose, when the photoelectric cell 29 detects overlapping notes, a warning lamp 74 is lighted and lamp 28 for counting notes is extinguished through a relay I (FIG. 6) controlling the device for rejecting overlapping notes.

Furthermore a magnet 37' (see FIG. 5 and FIG. 6) is operated through a relay O to pull a brake band 77 which is wound over a brake drum 76 fixed on the shaft 50 of the drum 19 of the delivery device A to stop the rotation of the drum 19. At the same time, relays L and M are operated by the signal to reverse the direction of

rotation of the motor 2 temporarily and then a relay J is operated to stop the motor 2. After the stopping of the motor, a relay is operated to reverse the rotation of the motor in a normal direction for restarting.

Thus all the mechanisms are stopped. After restoring the fork 39 in the original position, the operation may be restarted. The rejected overlapping bank notes in the store 41 may be discarded or returned to the delivery device A as desired.

As stated above, counting of the number of bank notes is carried out by counting the number of spaces in the series of bank notes passing through the passage 62. Accordingly if bank notes are passed with no spacing, the count will be erroneous. In order to avoid errors due to continuous passage of bank notes without spacing, a device E for detecting notes delivered without spacing is provided. This device is formed with a plurality of photo-transistors 64 each associated with a lamp 63 arranged on opposite sides of the passage 62 in confronting relation and at a spacing exceeding the length of a bank note being counted. When bank notes spaced one another are passed, at least one of the photo-transistors receives light from one of the lamps 63, but when two or more bank notes are passed in succession with no spacing between them, all the photo-transistors are intercepted simultaneously by the bank notes in continuous condition. A relay P is energized when all the transistors are intercepted and a lamp 75 is blinked on and off to give a warning by relay Q. If such a warning is given, all the motors of the apparatus may be stopped by operating controlling buttons by hand or by some automatic device and the bank notes in the piling device G may be recounted by returning them to the delivery device A. According to test and experience, it has been found that continuous delivery of bank notes occurs very rarely when the speed of the belts 21, 22 is about twice or more the circumferential speed of the drum 19 of the delivery device.

The bank notes passed through the signal device D are forwarded to the device G for piling counted bank notes. This device G has a motor 33 (FIG. 2) which drives a shaft 68 through a gear 67. V-belts 34 are wound around rollers 69 on the shaft 68 and rollers 70, and act to receive bank notes from the passage 62 and carry them forward. The shaft 68 rotated by the motor 33 through the gear 67 also rotates a shaft on which a cam 36 is mounted as shown by broken lines in FIG. 2. This cam is connected through a link 71' and a rod 71 to a transverse plate 72 (FIG. 5) to give it vibration. This vibration of the plate 72 assists the piling operation of bank notes forwarded by the belts 34 into a box 35.

The electric counting device H illustrated in FIG. 1 is a device adapted for indicating a number of four significant figures. In the drawing, counting discs 32 have pre-set dials 73, and the desired number of bank notes to be counted can be preset on dials 73. When the desired number of bank notes have been counted, that is, are piled in the box 35, a relay II is activated to energize a magnet M1 to give indication, and a buzzer is rung. At the same time, the lamp 28 is extinguished and the fork 39 is lowered by magnet 38 to stop the motor 2 through controlling relays J, K, M and L and to stop the rotation of the drum 19 of the delivery device A by the brake belt 77 operated by the magnet 37'. In this operation, the drum 19 is stopped instantaneously despite its inertia, since in addition to the braking action of the brake belt 77, the motor 2 is also stopped by reversed rotation caused by relays L and M as explained hereinbefore.

Consequently, supply of any excessive number of bank notes to the piling box 35 is effectively prevented.

In FIG. 6, N indicates a button for starting the motor 2, R a button for setting the counting dial 32 at zero graduation, S a button for returning the fork 39 of the device F for rejecting overlapping notes.

While the explanation is made as an apparatus for

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counting bank notes in the above, it is apparent that this apparatus can be used for counting not only bank notes but also similar articles.

It is also apparent that the invention can be modified or varied in many ways not departing from the spirit and the general principle of the invention.

It is therefore to be understood that this invention covers all such modifications and variations and is not limited to the embodiment as explained with reference to the drawings but only by the appended claims.

What I claim is:

1. Apparatus for counting bank notes comprising a delivery device including a rotary drum adapted for rotation and a pressing element associated with said rotary drum to selectively contact the same to advance a bank note therebetween, said drum having a coefficient of friction greater than that of the bank notes to be counted and said pressing element having a coefficient of friction less than that of the rotary drum but greater than that of the bank notes; advancement means including two sets of endless belts, each being adjacent said rotary drum for receiving bank notes advanced therefrom, said belts being in confronting position with respect to one another to define a passageway therebetween for said bank notes, said belts being provided with a higher speed than the circumferential speed of the rotary drum for maintaining said bank notes on said belts in spaced relation, signal means for generating a signal comprising a lamp and a photo-transistor in confronting relation on opposite sides of the passageway, said signal being interrupted by passage of said bank notes between said lamp and photo-transistor, an electric counting device connected to said signal means to receive signals therefrom and to indicate the number of bank notes passed through said signal means, a device operatively associated with the advancement means to stack the bank notes delivered therefrom, means for detecting in the advancement means bank notes in abutting relation, the last said means comprising two photo-transistors adjacent said passageway and spaced apart a distance greater than the length of a single bank note and a lamp in confronting relation to each of the latter said photo-transistors on the opposite side of the passageway to normally energize said latter photo-transistors; said latter photo-transistors being deenergized by the interposition of a bank note between the lamp and the latter photo-transistors, and detection means to give notice of abutting bank notes and actuated with both of said latter photo-transistors simultaneously deenergized.

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2. Apparatus for counting bank notes comprising a delivery device including a rotary drum adapted for rotation and a pressing element associated with said rotary drum to selectively contact the same to advance a bank note therebetween, said drum having a coefficient of friction greater than that of the bank notes to be counted and said pressing element having a coefficient of friction less than that of the rotary drum but greater than that of the bank notes; said delivery device further including means for displacing the pressing element to contact the rotary drum with bank notes between the pressing element and the rotary drum, the latter said means being constituted by a cam lever; a controlling device adjacent said rotary drum for supplying bank notes thereto, magnets to operate said cam lever, said magnets being energized by the presence of a bank note in the controlling device to displace the pressing element to contact the rotary drum; advancement means including two sets of endless belts, each being adjacent said rotary drum for receiving bank notes advanced therefrom, said belts being in confronting position with respect to one another to define a passageway therebetween for said bank notes, said belts being provided with a higher speed than the circumferential speed of the rotary drum for maintaining said bank notes on said belts in spaced relation, signal means for generating a signal comprising a lamp and a photo-transistor in confronting relation on opposite sides of the passageway, said signal being interrupted by passage of said bank notes between said lamp and photo-transistor, an electric counting device connected to said signal means to receive signals therefrom and to indicate the number of bank notes passed through said signal means, and a device operatively associated with the advancement means to stack the bank notes delivered therefrom.

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