Jan. 5, 1932. A. E. LARD 1,839,973

MACHINE FOR SORTING AND COUNTING PAPER MONEY

Original Filed June 29, 1926 8 Sheets-Sheet 1

Fig. 13.

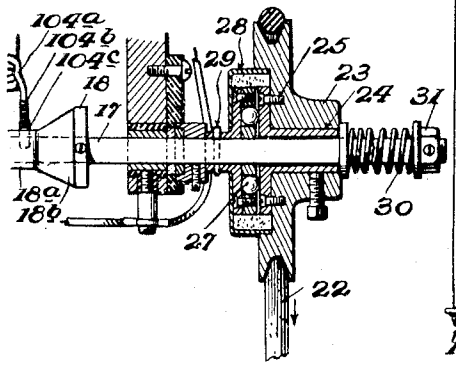


Fig. 1.

Inventor

Allan E. Lard,

By Mauro & Lewis,

Attorneys

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MACHINE FOR SORTING AND COUNTING PAPER MONEY

Original Filed June 29, 1926 8 Sheets-Sheet 2

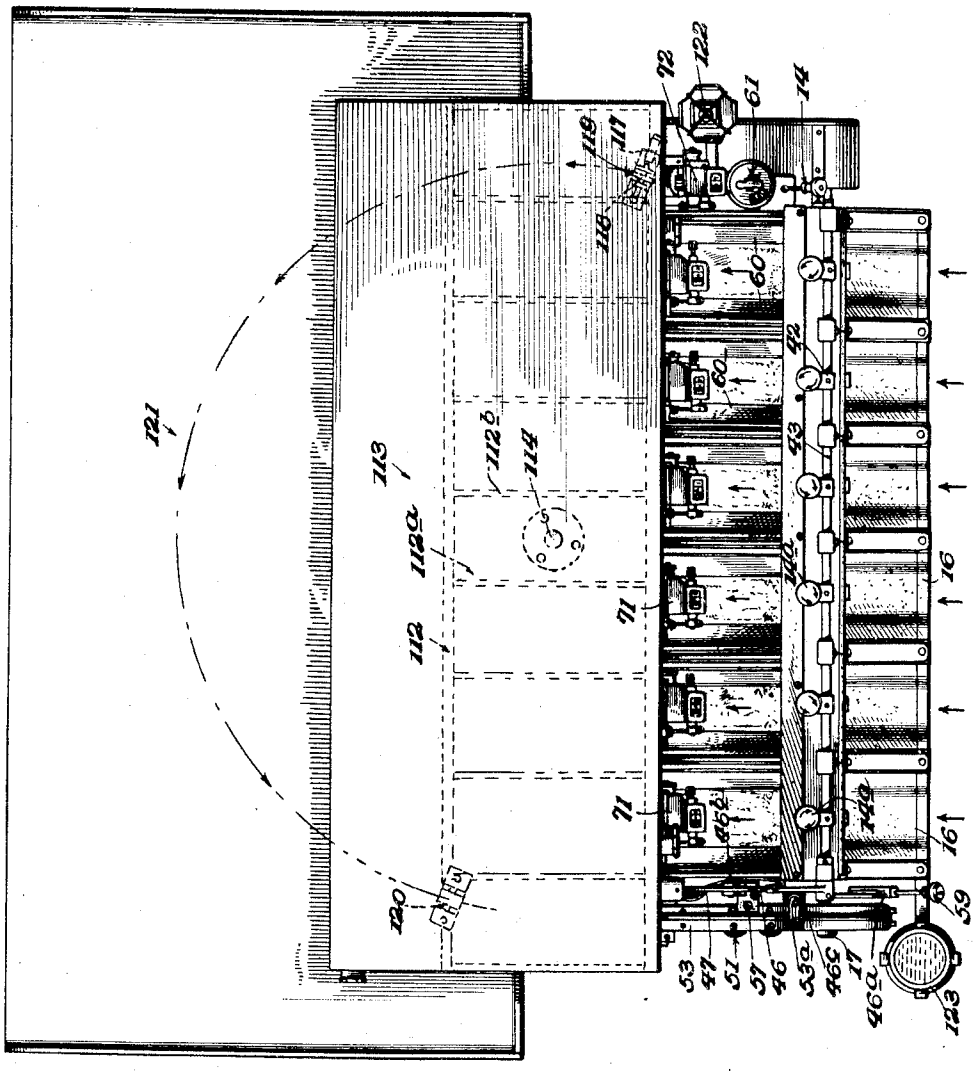


Fig. 2.

Inventor
Allan E. Lard.

By Mauro & Lewis,

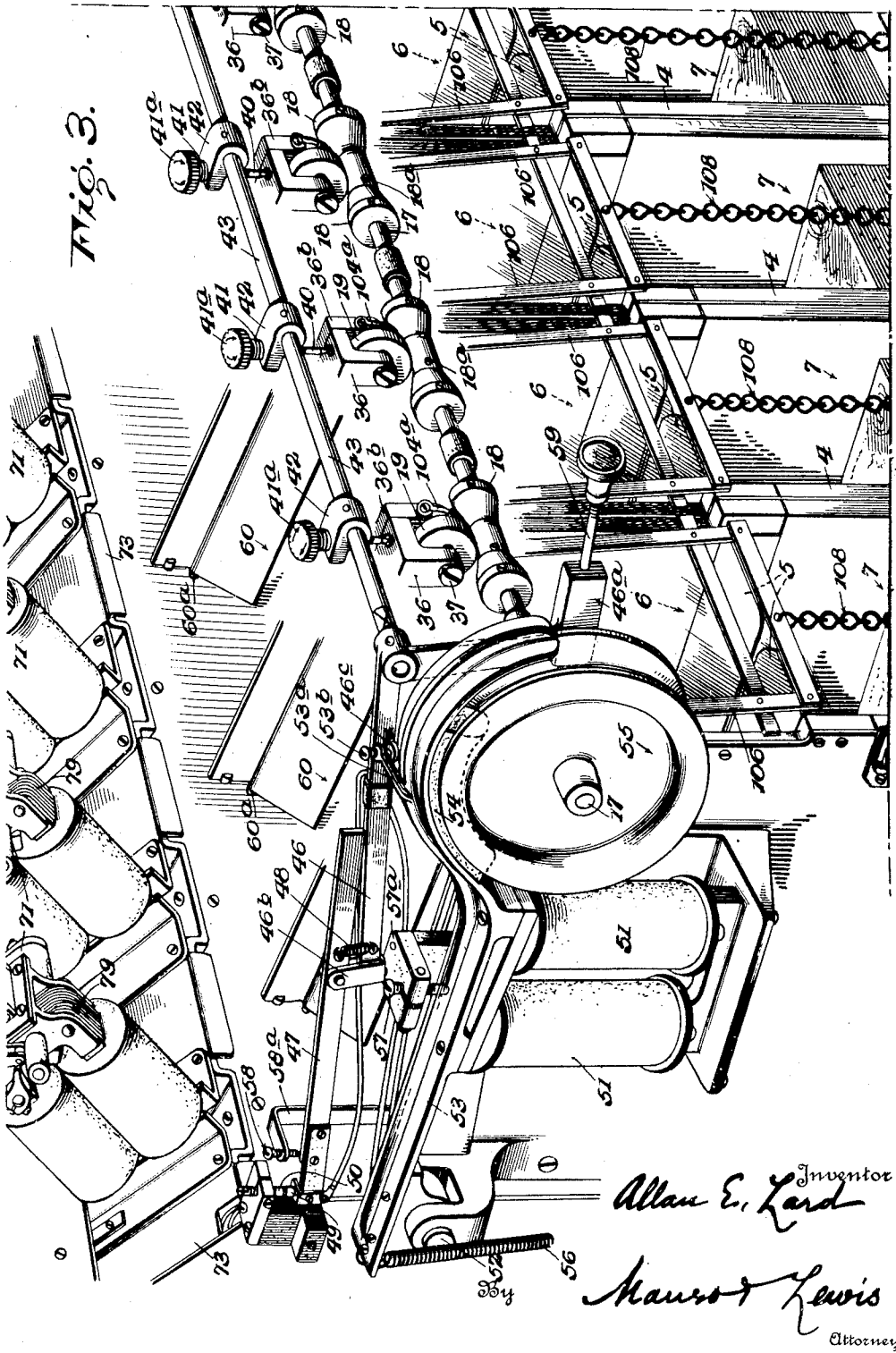
Attorneys

Jan. 5, 1932. A. E. LARD 1,839,973

MACHINE FOR SORTING AND COUNTING PAPER MONEY

Original Filed June 29, 1926 8 Sheets-Sheet 3

Fig. 3.



Inventor
Allan E. Lard

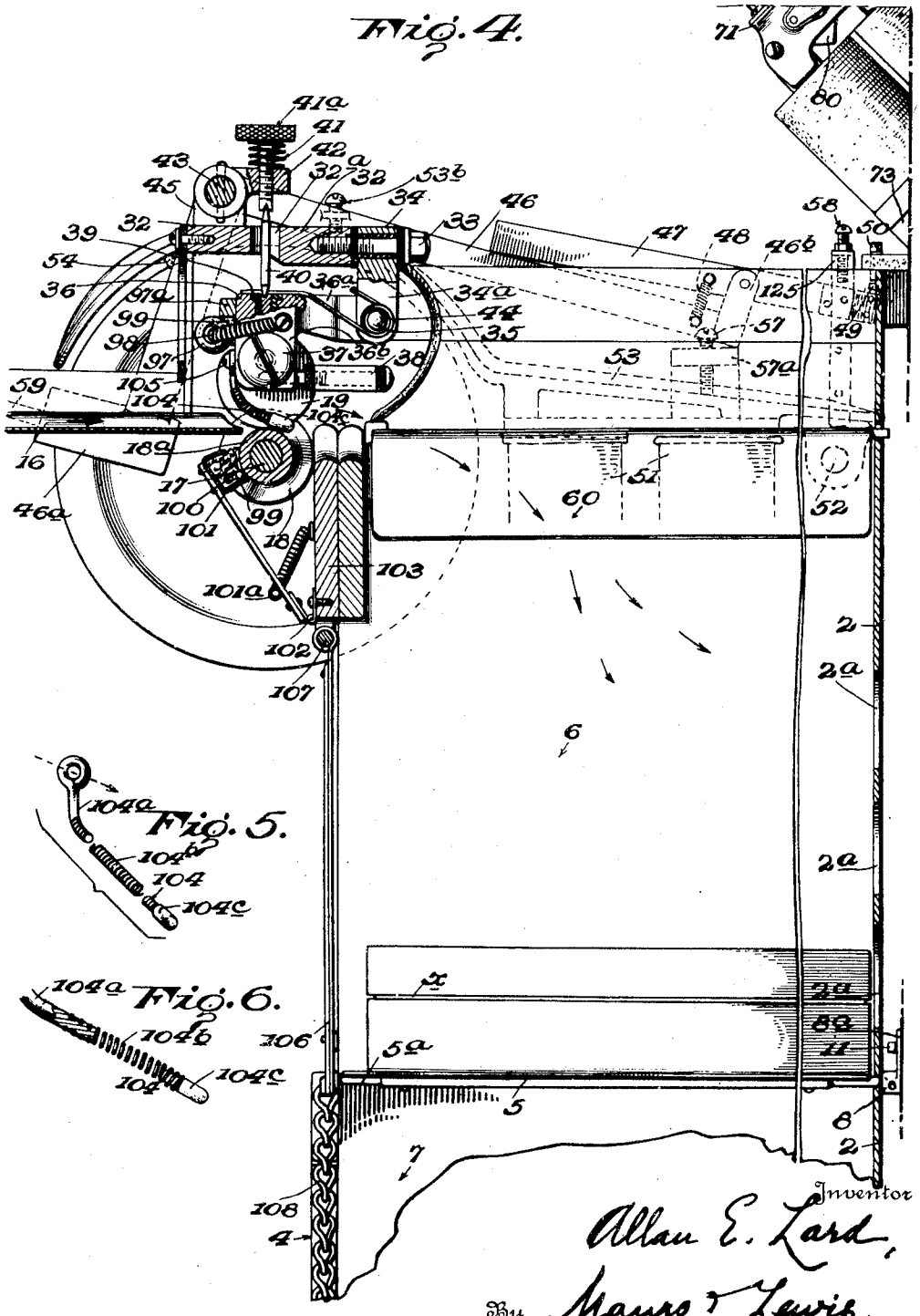
By Mauro & Lewis
Attorneys

Jan. 5, 1932. A. E. LARD 1,839,973

MACHINE FOR SORTING AND COUNTING PAPER MONEY

Original Filed June 29, 1926 8 Sheets-Sheet 4

Fig. 4.



Inventor

Allan E. Lard,

By Mauro & Lewis,

Attorneys

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MACHINE FOR SORTING AND COUNTING PAPER MONEY

Original Filed June 29, 1926 8 Sheets-Sheet 5

Fig. 8.

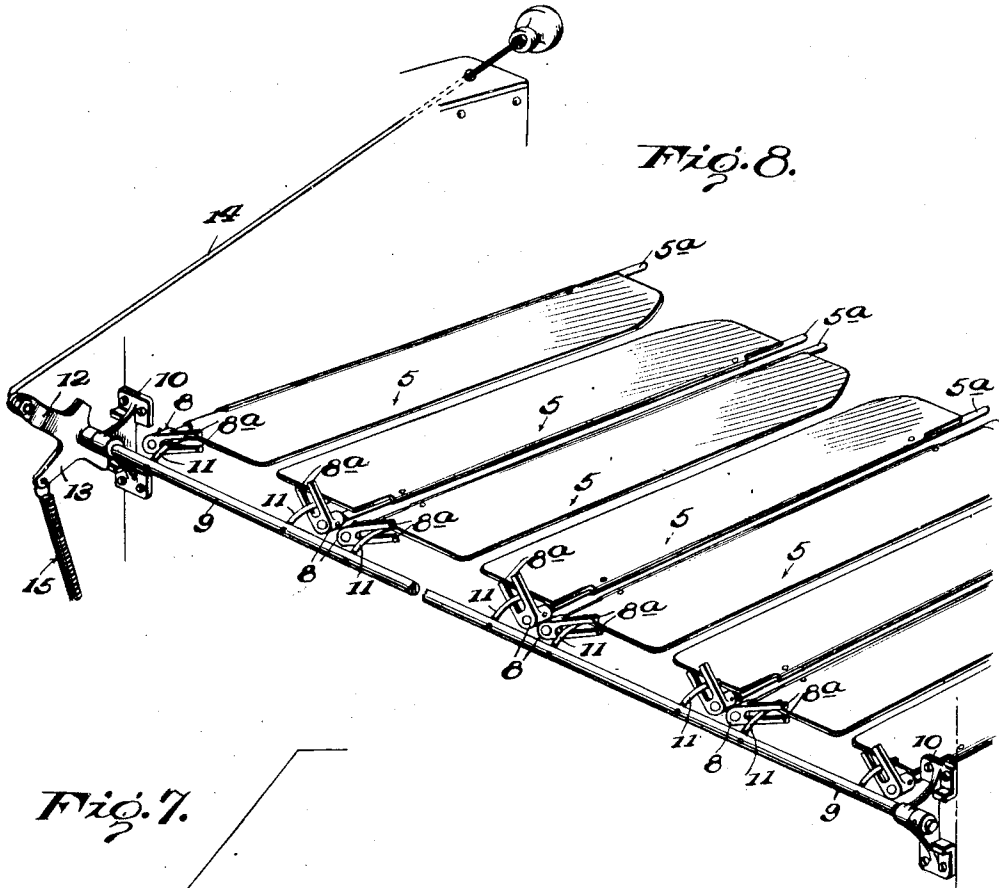
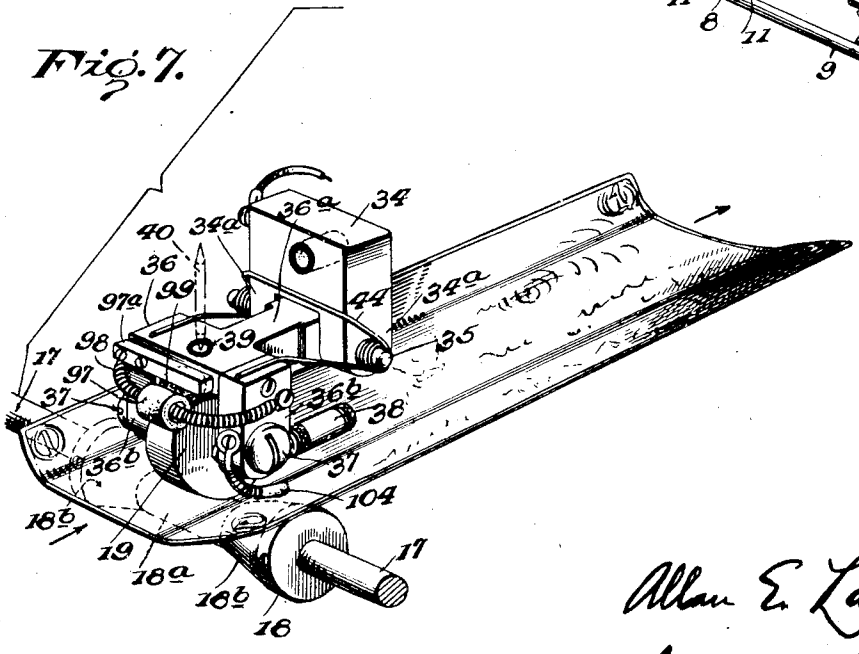


Fig. 7.



Inventor

Allan E. Lard,

By Mauro & Lewis

Attorneys

Jan. 5, 1932. A. E. LARD 1,839,973

MACHINE FOR SORTING AND COUNTING PAPER MONEY

Original Filed June 29, 1926 8 Sheets-Sheet 6

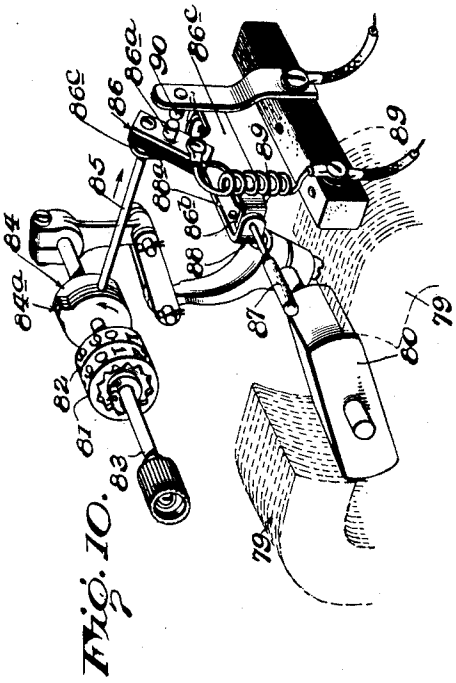


Fig. 10.

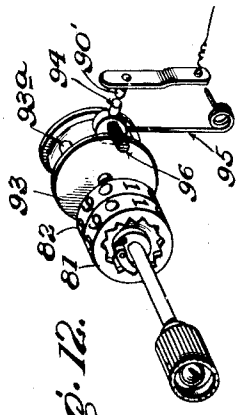


Fig. 12.

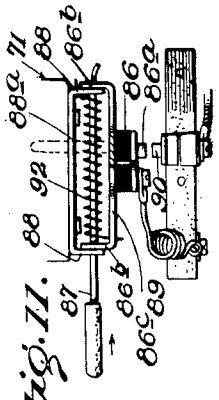


Fig. 11.

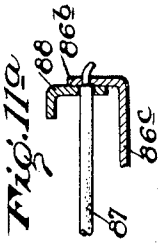


Fig. 11a.

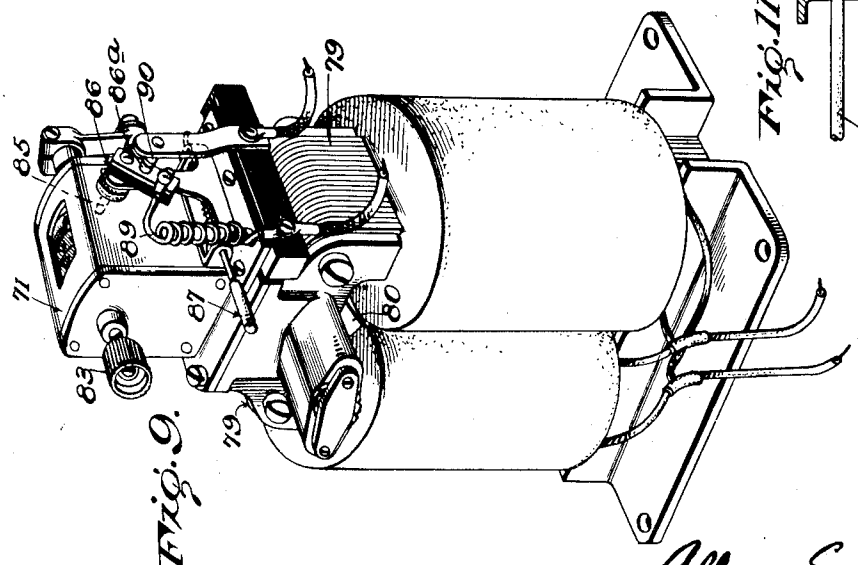


Fig. 9.

Inventor
Allan E. Lard,
By Mauro & Lewis,
Attorneys

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MACHINE FOR SORTING AND COUNTING PAPER MONEY

Original Filed June 29, 1926 8 Sheets-Sheet 7

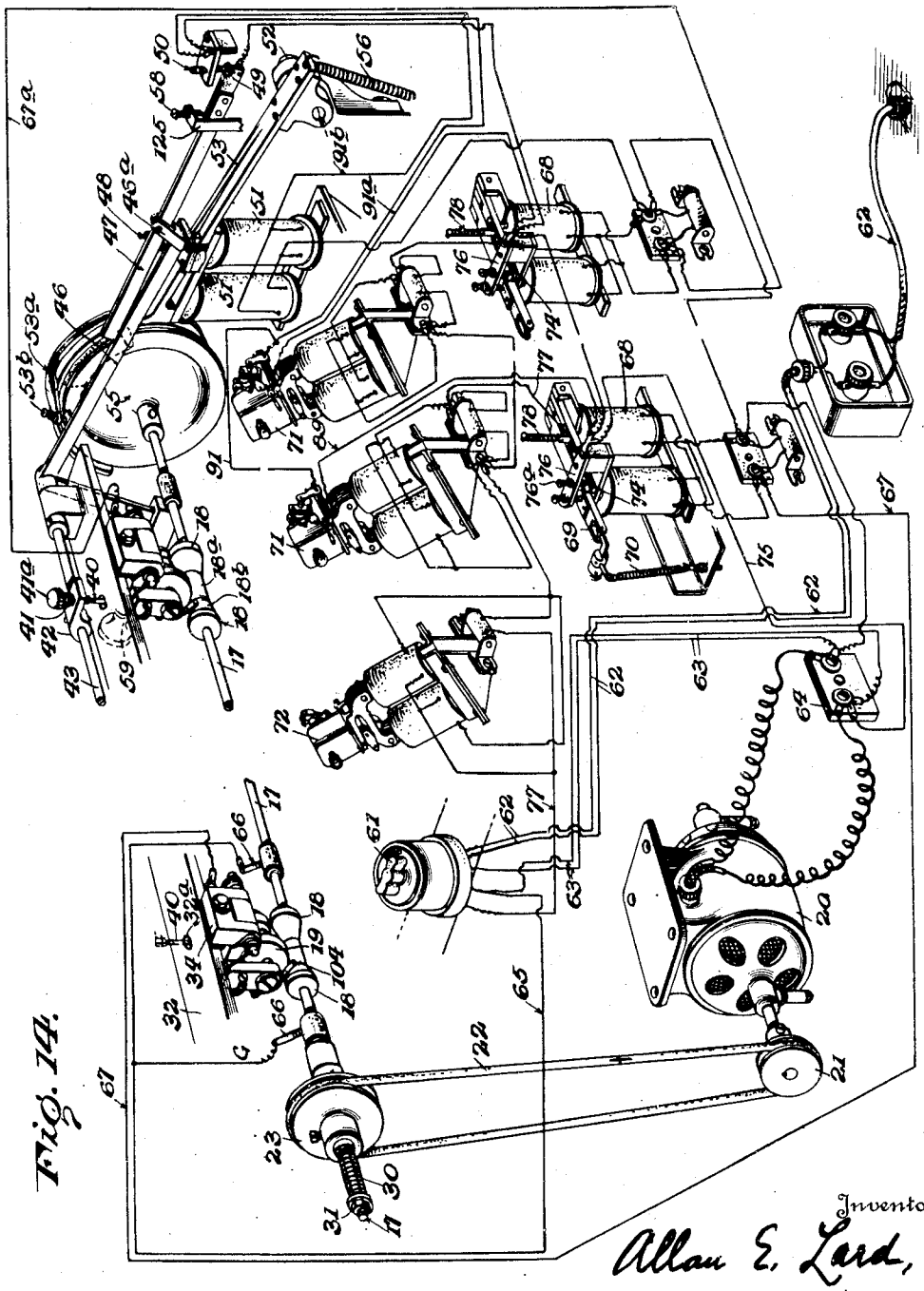


Fig. 14.

Inventor
Allan E. Lard,
By Marks & Lewis,
Attorneys

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MACHINE FOR SORTING AND COUNTING PAPER MONEY

Original Filed June 29, 1926 8 Sheets-Sheet 8

Fig. 15.

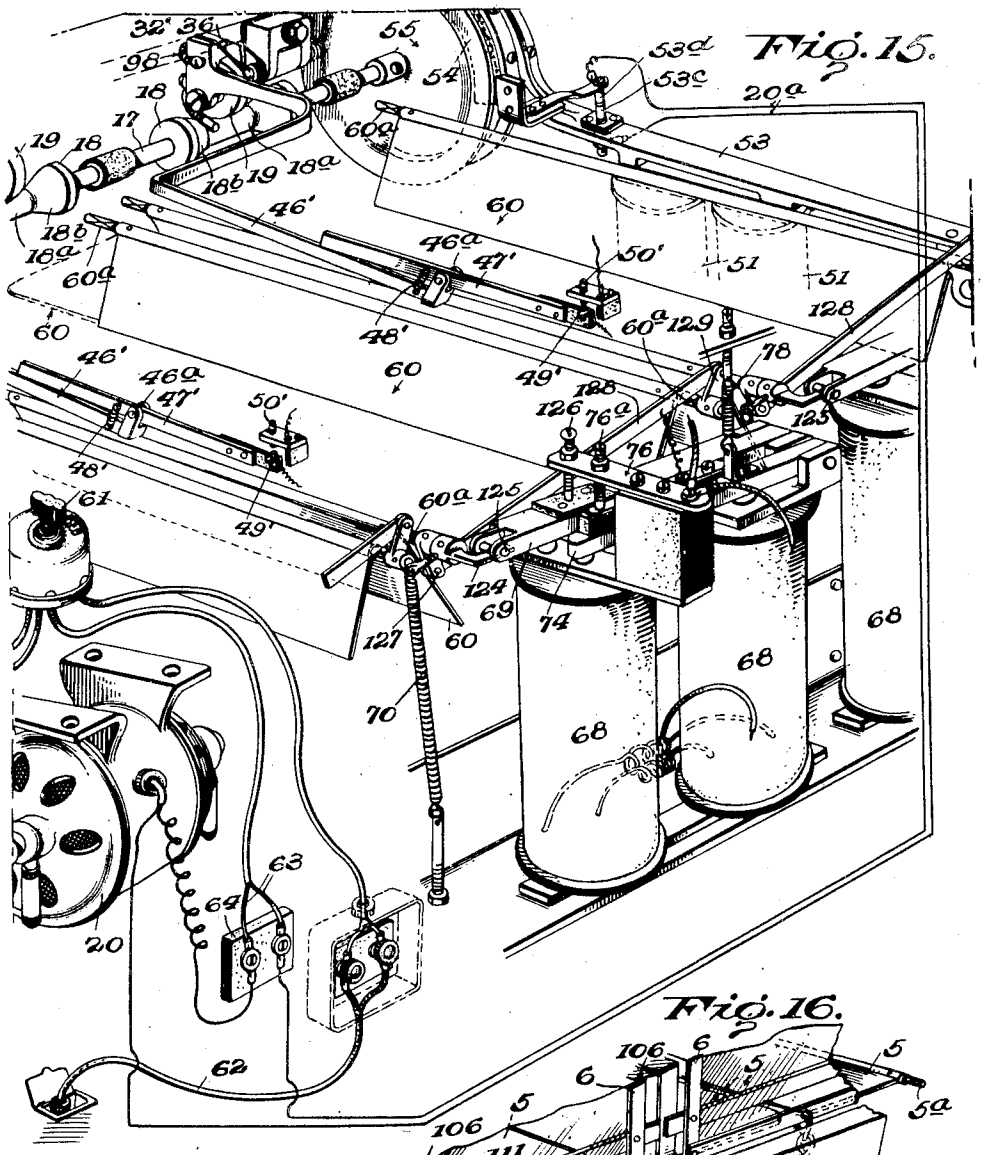
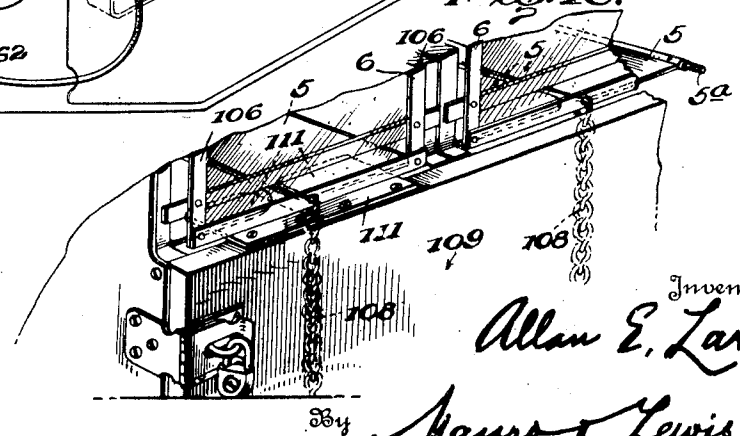


Fig. 16.



Inventor
Allan E. Lard,
By Mauro & Lewis,
Attorneys

Patented Jan. 5, 1932 1,839,973

UNITED STATES PATENT OFFICE

ALLAN E. LARD, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO THE FEDERAL BILL COUNTER COMPANY, OF WASHINGTON, DISTRICT OF COLUMBIA, A CORPORATION OF DELAWARE

MACHINE FOR SORTING AND COUNTING PAPER MONEY

Original application filed June 29, 1926, Serial No. 119,411. Divided and this application filed August 30, 1927. Serial No. 216,414 and in Great Britain June 29, 1927.

This invention relates to machines for sorting and counting paper money and particularly to such machines of the general type shown in U. S. Letters Patent No. 1,159,826 of Nov. 9, 1915, to J. P. Buckley, and No. 1,328,263 of Jan. 20, 1920, to J. P. Buckley and A. E. Lard.

In banking establishments it is desirable that the paper money handled be assorted and arranged in packages or bundles of a predetermined number of bills. Generally one hundred bills are stacked together and bound by a strap of paper, the strap carrying a notation of the sum of money in the stack and an identification of the person responsible for the assembling and counting of the stack. Such a stack is commonly designated a "strap". Paper money received by banks in packages or straps must be assorted and also accurately counted to check the correctness of the amount represented to be in each package by the notation on its strap; this is called "verifying the strap". Paper money received in loose or unstrapped condition must also be accurately assorted and counted into stacks and each stack strapped with a notation on the strap of the amount in the strap and of the person responsible for the counting. By such counting of either unstrapped bills or strapped bills, or both, the total amount or sum of paper money handled is ascertained and verified. The sorting of paper money into packages or "straps" usually puts in each strap only bills of the same denomination. Sometimes there is a further differentiation in the sorting between "fit" and "unfit" bills. Some banking institutions require still further sorting into classes such as "legal", "silver", "Federal Reserve Bank Notes", "fit" and "unfit", etc. The performance entirely by hand of such work of assorting and counting paper money requires assorting and counting as separate operations and involves much time and is correspondingly expensive. To reduce the expense and avoid the errors found to be inevitable in such hand-counting and assorting of paper money, it has heretofore been proposed to provide machines for doing that work.

A general object of the present invention is the provision of means by the use of which paper money may be assorted and counted with maximum accuracy, at maximum speed consistent with such accuracy, and with minimum expense of time and labor by a person entrusted with the work from the time the money is delivered to said person until it leaves his or her custody counted, assorted when that is desirable or necessary, and strapped in packages with each strap bearing a notation of the amount in its package and of the identity of the person responsible for the counting.

Further objects, more or less related to the aforesaid general object, are the provision, in conjunction or association with paper money assorting and counting mechanism, of means which will facilitate and expedite to the approximate maximum the handling and the convenient and readily accessible temporary storage or filing of the paper money, from the time it is received by the person entrusted with the counting thereof until it leaves the custody of said person duly counted and strapped in packages; and the combining of such associated means and assorting and counting mechanism in a single organization, or what may be termed an "installation unit", capable of being furnished, marketed and installed as such in any convenient space in a bank, mercantile establishment, or the like, said unit in and by itself including all necessary provision for the counting, assorting, and convenient handling and storage or filing of the money from the time said money is delivered to the operator or person in charge of the installation unit until the money leaves said unit.

A further object is the provision of means whereby, upon occasions of necessitated temporary absences from an installation unit, the operator thereof can readily close and lock such compartments of the unit as may contain paper money either awaiting assorting and counting, already assorted and counted, or both.

Another object of the present invention is the provision of an improved paper money assorting and counting machine capable of accurate and reliable operation at high speed.

The machines heretofore proposed for assorting and counting paper money include machines of the type disclosed in the hereinbefore enumerated patents wherein there are a plurality of compartments for the different assortments of bills respectively, and to each compartment a pair of feeding and counting rollers to which the bills are fed by hand one by one, each bill being automatically counted by its passage between the rollers.

Further objects of the present invention are the provision, in an assorting and counting machine and particularly in such a machine of the type above named, of new and improved means for automatically stopping the feed rollers, and particularly for so stopping said rollers after a predetermined number of bills have been fed into any one of the several compartments for receiving bills directly from the rollers; of manually operable means for releasing the aforesaid automatic roller stopping means; of means for assuring the flow of electric current between the upper and lower feed rollers when no bill is passing between the latter, and particularly the provision for that purpose of a yielding contact so constructed and mounted as not to impede or interfere with the passage of bills between the rollers and between said yielding contact and its cooperating contact; of manually operable means for insuring disengagement or release of the brake members after the same have been automatically engaged to arrest rotation of the feed rollers; of manually operable starting means (such as an electric switch having two "on" positions) adapted to put the machine in operation with the counters thereof inoperative, a condition desirable in testing and adjusting, or to put the machine in operation with the counters operative, that being the normal working condition; of new and improved means insuring the delivery of bills from the feed-rollers into the compartments in such condition that the bills will be smoothly stacked without bends or folds therein whether they be old and flimsy or new and relatively stiff, and particularly the provision of such means including lower feed rollers so formed as to impart a trough-shape to bills passing thereover; of new and improved means for controlling the flow of electric current which actuates the counters or registers and the upper money supporting shelves or flaps, whereby said parts will operate accurately and reliably at high speed; of new and improved means, closures, or guards, located at the exits from the several compartments of the counting and assorting machine for preventing bills introduced into said compartments from accidentally passing or falling out of the same, said means being so constructed as to be readily displaceable to positions leaving said exits unobstructed for the withdrawal of bills from the compartments, the guards or closures for the upper compartments being preferably so constructed as to provide air exit openings adapted to coact with other air exit openings in the walls of the compartments to equalize the air pressure under falling bills and thereby assure regular and even stacking, and the guards for the lower compartments being preferably flexible guards, such as chains, hanging from the guards or closures of the upper compartments and thus assisting in holding said last-named guards in and returning them to their normal positions.

This is a division of my application filed June 29th, 1926, Sr. No. 119,411, and particularly relates to the subject matter set forth in the appended claims.

The aforesaid and other objects and advantages are attained by the present invention as will be more fully understood by reference to the accompanying drawings illustrating what is at present regarded as the preferred mechanical embodiment of the invention. In said drawings—

Fig. 1 shows in side elevation a complete installation unit;

Fig. 2 is a top plan view of the complete installation unit shown in Fig. 1;

Fig. 3 is an enlarged detail perspective of a portion of the front of the counting mechanism;

Fig. 4 is a vertical section through a portion of the counting mechanism with some parts shown in elevation;

Figs. 5 and 6 are detail views of an electrical contact member adapted to complete an electrical circuit by its engagement with one of the money-feeding rollers;

Fig. 7 is a detail perspective view of a pair of the feed-rollers and associated parts and showing a piece of paper money being fed between and by said rollers;

Fig. 8 is a detail perspective view showing the lower hinged money-supporting shelves or flaps and the manually operable means for swinging said shelves downward to drop money from the shelves into spaces or compartments beneath the same;

Fig. 9 is a perspective view of a register or counter, there being one such counter to each pair of feeding and counting rollers.

Figs. 10, 11, and 11*a*, are detail views of the counter shown in Fig. 9;

Fig. 12 is a detail view showing a modified construction of parts of the counter of Figs. 9 and 10;

Fig. 13 (sheet one) is a detail sectional view of one type of clutch which may be employed in rotating the money-feeding rollers;

Fig. 14 is a diagrammatic view of the electrical circuits and various parts of the mechanism to which said circuits are connected. For simplification of illustration this view shows only two pairs of money-feeding rollers and their corresponding counters and

electrical apparatus, whereas the showing of Fig. 2 calls for six such pairs of rollers with corresponding counters and electrical apparatus;

Fig. 15 is a perspective view including a showing of a modified embodiment of the invention with respect to a portion of the mechanism; and

Fig. 16 is a detail perspective view of a portion of the front of the machine and showing means for locking the lower money-supporting shelves or flaps in their horizontal or elevated positions.

The unit installation provided by this invention includes paper money assorting and counting mechanism shown at the right in Figs. 1 and 2, a work-table shown at the left in said figures and arranged back to back with said mechanism, and a paper money storage or filing case positioned above and adapted to be moved, preferably rotated, to face its open side toward either said mechanism or said table.

The assorting and counting mechanism will first be described. It has supporting legs 1, two of which appear in Fig. 1, a cabinet above the legs, and bill-feeding and counting mechanism at the top portion of said cabinet. The cabinet is closed at its bottom, has a back-wall 2 and end-walls 3, 3 and is open at its top and also at its front except for closure means at the front presently described. Equally spaced vertical parallel partitions 4 divide the interior of the cabinet into spaces each of which is horizontally divided by a pair of hinged shelves, shutters, or flaps, 5, 5 into two compartments, the lower preferably deeper than the upper. In the particular embodiment shown in Fig. 1, there are six such upper compartments and immediately beneath them six lower compartments, with a pair of the flaps 5, 5 between each upper compartment and its corresponding lower compartment. Any other desired number of compartments may be employed. Means are provided for normally maintaining the flaps 5 in horizontal bill-supporting position and for swinging them downward on their horizontal pivot rods 5*a* (Fig. 8) to drop or discharge bills into the lower compartments 7. A sleeve 8, rigidly secured to the rear end of each pivot rod 5*a*, has a pair of arms 8*a* projecting therefrom at right angles to the axis of said pivot. A shaft 9, supported in brackets 10 mounted at convenient points on the frame, extends transversely of the machine and closely adjacent to the arms 8*a* substantially in the horizontal plane of the pivots 5*a*. A series of fingers 11 are carried by the rod 9 in positions to extend into the slots formed between the pairs of arms 8*a* respectively. A bell-crank lever secured to one end of the shaft 9 has an upper arm 12 and a lower arm 13. A pull-rod 14 is pivotally attached to the upper arm 12 and extends to a convenient point at the front of the frame by which it is slidably supported. A spring 15 is attached at one end to the lower arm 13 and at its opposite end anchored at a suitable point on the frame. Normally the spring 15 acts through the bell-crank lever, shaft 9, fingers 11, and arms 8*a*, to maintain the flaps 5 in a horizontal position. If it is desired to discharge bills from the upper compartments 6 into the lower compartments 7, the operator manually pulls rod 14 toward the right, as viewed in Fig. 8, whereupon all of the flaps 5 are swung downward in unison about their pivots 5*a* to a substantially vertical position, whereupon the bills may fall by gravity into the lower compartments 7. Spring 15 returns the flaps 5 to normal position when pull upon rod 14 is released.

The means for feeding bills into each of the upper compartments 6 include a pair of feed-rollers, one pair for each compartment, and means are provided for facilitating the feeding of the bills to the rollers. Extending transversely of the front of the machine at a suitable distance above the flaps 5, is a series of feed-trays 16 (Fig. 2) which are preferably concave in section, as most clearly shown in Fig. 4. Extending transversely of the machine frame immediately to the rear of trays 16 and slightly below the bottoms thereof, is a rotatably mounted shaft 17 which carries a plurality of lower feed-rollers 18 so spaced along shaft 17 as to position one roller directly in front of each compartment 6.

Difficulty has heretofore been encountered in feeding old or flimsy bills into counting machines because of a tendency of the forward ends of such bills to droop and fold or double up after passing the feed rollers, thereby preventing proper stacking of the bills. To overcome such difficulty, the lower feed rollers 18 are preferably formed in such a manner as to present a substantially concave surface to the bills, whereby their long sides are bent upwardly and a certain amount of longitudinal rigidity thus given each bill. Each of the lower feed-rollers is preferably formed in three sections all rigidly attached to shaft 17. As shown, the center section 18*a* is constituted by a cylindrical sleeve and the two end sections 18*b* are substantially frusto-conical in shape, the small end of each of the cone-shaped portions being in abutting engagement with the opposite ends of the sleeve 18*a*. Upper feed-rollers 19 are rotatably mounted above the lower feed-rollers 18 respectively, in a manner to be described more fully hereinafter. Each upper roller 19 normally has direct engagement with the central portion 18*a* of the corresponding lower feed-rollers and is preferably of less width than said sleeve portion 18*a*.

Suitable means are provided for driving the lower feed-rollers at a high rate of speed, the upper rollers 19 being preferably driven

by their peripheral engagement with the lower rollers. For this purpose there is employed an electric motor 20 which is preferably provided with a suitable speed regulator, and which is preferably mounted on and carried by the frame beneath the lower compartments 7. Any suitable drive may be interposed between the motor 20 and the shaft 17. In the form shown, the motor has a pulley 21 (Fig. 14) engaged by suitable belting 22 which also passes over a pulley 23 mounted on one end of shaft 17.

In certain instances, for example, to stop the passage of more than one bill at a time through the rollers, it is desirable to stop the rotation of the lower feed-rollers 18 without stopping the motor 20. For that purpose a clutch, preferably a friction-clutch (Fig. 13) is interposed between pulley 23 and shaft 17, said clutch being adapted to readily slip when overloaded as when there is an application of the brake hereinafter described. In the form shown, the friction-clutch includes a flanged sleeve 24 which is floated on shaft 17 and rigidly attached by screws 25 to the pulley 23. The flange of sleeve 24 is yieldingly maintained by a coil-spring 30 in driving engagement with a plurality of balls 27, which are carried in a housing 28 rigidly secured to shaft 17 by means of a pin 29. Spring 30 is retained on the end of shaft 17 in abutting engagement with the pulley and sleeve by means of nut 31. Any other suitable form of friction-clutch may be employed in place of the one illustrated and described.

Adjustable means are provided for mounting the upper feed-rollers 19 whereby a single bill may be readily fed between the rollers, but in the event the operator should inadvertently feed two or more superposed bills simultaneously between any pair of the rollers, all of the rollers will be automatically stopped. For this purpose the frame of the machine includes a bar 32 (Fig. 4) extending across the front of the machine and in the rear edge of which bar a yoke-shaped frame 34 is secured by a bolt 33, said frame including a pair of arms 34*a* (Fig. 7). Frame 34 is insulated from the machine frame as clearly shown in Fig. 4. Pivotally secured to frame member 34, by a pivot-member 35 extending through arms 34*a*, is a bearing block 36 provided with a rearwardly extending arm 36*a* which engages the pivot 35, and also provided with a pair of downwardly extending arms 36*b*. An axle 37 is rotatably mounted in the arms 36*b*, and has upper feed-roller 19 rigidly attached thereto intermediate said arms. An oil-cup 38 (Fig. 7) is secured to each of arms 36*a* for lubrication of the journal of axle 37 in said arm. A bearing-seat 39 in the upper surface of block 36 is preferably formed of suitable insulating material. The lower end of pin 40 rests in the cup 39 and the upper extremity of said pin engages a seat formed in the lower end of an adjusting screw 41 which is threaded into a rock-arm 42 rigidly secured to a transversely extending shaft 43. A suitable opening 32*a* is provided in the frame-bar 32 to permit free passage of pin 40. Preferably the adjusting screw 41 is provided with a knurled head 41*a* by which it may be adjusted to determine the thickness of paper money that may be passed between the roller 19 and its cooperating roller 18 without actuating the hereinafter described brake mechanism to stop rotation of all of the feed rollers. The desired adjustment leaves slight play or freedom of pin 40 between its top and bottom seats, just sufficient to permit roller 19 to be lifted the thickness of one bill without imparting upward movement to pin 40 sufficient to rotate shaft 43, but at the same time the adjustment is such that the introduction between the rollers of two superposed bills will impart upward movement to pin 40 sufficient to rotate shaft 43 in a manner to bring about actuation of the brake mechanism to stop rotation of all of the feed rollers. A suitable spring 44, mounted on the pivot 35 with its free ends bearing upon the upper surface of the block 36, serves to yieldingly maintain an upper roller in light engagement with lower roller 18 except when a bill is being fed between the rollers. The shaft 43 is rotatably mounted in brackets 45 (Fig. 4) which may be formed on or secured to the bar 32. In order that any excessive upward movement of roller 19 relative to roller 18, such for example as is imparted to the roller 19 when two superposed bills are simultaneously fed between the rollers, will result in the stoppage of the feed-rollers, the shaft 43 is provided with means for bringing about actuation of brake mechanism for stopping the rotation of shaft 17 carrying lower feed-rollers 18. Secured to one end of the shaft 43 is a two-part lever constituted by members 46 and 47 (Figs. 3 and 4). Member 46, which may be provided on its front or outer end with a depending counter-weight portion 46*a*, has at its inner end an upwardly-extending arm 46*b* to which the member 47 is pivoted. A suitable spring 48 yieldingly draws the forward end of member 47 downward into engagement with the upper edge of member 46. The rearward end of member 47 is provided with a contact 49 adapted to engage a contact 50 for closing an electric circuit through an electromagnet 51. Fulcrumed at a suitable point 52 on the frame of the machine is a brake-lever 53 provided on its outer arcuate end with a brake-shoe 54 adapted to engage the grooved periphery of a brake-drum 55. The brake-shoe is normally maintained out of engagement with the brake-drum 55 by a coil-spring 56 attached to the inner end of the lever 53 and at its other end anchored to a suitable part of the frame. The upward movement of the brake lever 53 is limited by a stop screw 57 adjustable in an

opening through a block of insulating material 57*a* (Figs. 3 and 4). In the normal position of the two-part lever 46—47 the inner end of the part 46 thereof rests by gravity against the upper surface of the block 57*a*, as best shown in Fig. 4, with the contact 49 on the rearward or inner end of part 47 out of engagement with its cooperating contact 50. The passage of a single bill between the rollers 18 and 19 results in upward movement of roller 19 a distance equal to the thickness of the bill; this, according to the adjustment before described, does not move the pin 40 upward sufficient to rotate shaft 43 and impart upward movement to the two-part lever 46—47. But should the operator accidentally or inadvertently feed two superposed bills between the feed-rollers, the pin 40 will be moved upward sufficient to rotate the shaft 43 enough to thereby lift the two-part lever and engage its contact 49 with contact 50, thus closing a circuit which will energize electromagnet 51, which in turn will draw down the lever 53, engage its brake-shoe 54 with the brake-drum 55, and thereby stop rotation of the shaft 17 and hence of all of the feed-rollers. It is not necessary under these conditions to stop the driving motor 20, because with the shaft 17 held against rotation by the brake the clutch (Fig. 13) between the pulley 23 and shaft 17 will slip while the pulley continues to be rotated from the motor by the belt 22. Should the thickness of the plurality of superposed bills (more than two for example) inadvertently fed between a pair of rollers be sufficient to elevate the two-part lever more than enough to engage the contact 49 with contact 50, no damage to the mechanism or wedging of the bills between the rollers will result, because in that event the spring 48 will permit the forward end of lever-part 47 to be lifted from its contact with the upper edge of part 46 and thereby accommodate the extra upward movement of the parts. Under such conditions the tension of spring 48 will be added to that of spring 44 in pressing the roller 19 against the superposed bills interposed between said roller and its cooperating roller 18.

For releasing the brake, after it has been applied by two or more superposed bills in the manner just described, and thus permitting the feed rollers to resume rotation, manually operable means are provided in conjunction with the two-part lever 46—47 for further actuating the same to disengage the contact 49 from contact 50 to thereby deenergize the brake magnet 51 and for thereafter also lifting the brake-shoe 54 out of engagement with the groove of brake-drum 55 to insure disengagement of these brake parts in case the tension of spring 56 should be insufficient for that purpose. While the tension of spring 56 should be sufficient to hold the lever 53 elevated against its stop screw 57, it is not desirable to use a more powerful spring because that would necessitate the use of a more powerful magnet to draw the lever down against the tension of the spring. Hence it may sometimes happen that upon deenergization of the brake magnet 51 the grip of the brake-shoe in the groove of the brake-drum will resist the lifting power of the spring 56 upon the lever 53. The aforesaid manual lifting of the brake-shoe out of engagement with its drum provides against such contingency and insures resumption of rotation of the feed-rollers when all is in readiness to continue counting and sorting of the paper money. As shown in the drawings the manually operable means consists of a push-member or key 59 secured to and projecting forward from the counter-weight portion 46*a* of the lever 46. Assuming that two or more superposed bills have passed part way between two feed rollers, thereby closing the contacts 49 and 50, energizing magnet 51, applying the brake and thus stopping rotation of all feed rollers—thus warned of an abnormal condition requiring correction, the operator will grip with her right hand the inner end of the superposed bills where they project beyond the rollers and then with her left hand press inward upon key or push-member 59 thereby rotating shaft 43 and imparting further upward movement to the two-part lever 46—47. Such rotation of shaft 43 lifts rock-arms 42 and the adjusting screws 41*a* in their engagement with the upper ends of pins 40 and thus relieves any pressure that spring 48 may have been exerting through one of said pins 40 and corresponding roller 19 upon the two superposed bills engaged by said roller. In other words, the added pressure of spring 48 is removed leaving only the normal pressure of spring 44 pressing roller 19 into contact with the two superposed bills and thereby avoiding excess pressure and wedging which might interfere with the further operation of the mechanism. The first part of the said further upward movement of the two-part lever 46—47 causes the inner end of lever-part 47 to engage and pivot against a stop-screw 58 carried by a bracket member 58*a*, thereby moving the inner end of lever-part 47 downward and disengaging contact 49 from its cooperating contact 50 and thus deenergizing the brake-magnet 51; the latter part of said movement of the two-part lever brings a lug 46*c* on lever part 46 into engagement with the end of a screw 53*b* adjustably carried by an arm 53*a* of brake-lever 53, and lifts said brake-lever and thereby disengages its shoe from the groove of the brake-drum 55, should it so happen that said lever has not been already lifted by its spring 56 immediately upon the deenergization of the brake-magnet 51. The brake having thus been released by the actuation of push mem-

ber 59, the feed rollers immediately resume rotation and complete the feeding of the superposed bills still gripped by the right hand of the operator. After noting how many superposed bills there are, say two, the operator drops the upper one into the compartment to correspond to the count of one that has been added on the register by the passage of the bills between the rollers, and then feeds the other bill between the rollers of the compartment to which it belongs by the sorting to register a count of it.

While, as above noted, the mechanism is susceptible of being adjusted to stop all of the feed rollers by the introduction of two superposed bills between any pair of the feed rollers, nevertheless under such conditions of adjustment a bill folded back upon itself at a corner or end will not actuate the brake and stop the feed-rollers because at the high speed at which the rollers rotate the two thickness portion of the bill will pass between the rollers before the brake can act to stop the rollers.

If desired, the apparatus may embody means for automatically stopping the driving motor at the same time the feed-rollers are stopped. For example, the brake-arm 53 may be provided with a contact 53*c* (Fig. 15) adapted to engage a contact 53*d* mounted at a suitable point on the frame of the machine. As pointed out above, the brake-arm 53 normally occupies a raised position with the brake-shoe 54 disengaged from the drum 55, and when said brake arm is in that position contact 53*c* has engagement with contact 53*d* to complete a circuit 20*a* through the motor 20. When solenoid 51 is energized and arm 53 is moved downwardly to engage the brake-shoe 54 with the brake-drum 55, contacts 53*c* and 53*d* are separated and the circuit 20*a* to the motor 20 is opened, thereby stopping said motor. Disengagement of the brake-shoe from the drum, in the manner hereinbefore pointed out, closes the contacts 53*c* and 53*d* and again starts the motor.

To insure proper stacking of the bills in the various compartments means are provided for cooperating with the concave lower rollers 18 to prevent folding or bending of the forward or advancing end of each bill as it is fed into a compartment. For this purpose each of the upper compartments is provided with a pair of swinging shutters or flaps 60, carried by pivots 60*a* rotatably supported on the frame of the machine in substantially the same horizontal plane as the bottom of the feed-plates 16. Associated with said flaps are means for swinging them downwardly about pivots 60*a* to a substantially vertical position to permit a bill supported by said flaps to fall by gravity into a compartment 6. Preferably electrically-actuated means are employed for controlling the movement of the flaps 60. Current for said electrically-actuated means may be controlled by a master-switch 61, which also controls current for motor 20, said switch being mounted at a convenient point on the front of the machine (Figs. 2 and 14). Current is led from the power-line (Fig. 14) through suitable leads 62 to the switch 61 adapted to be moved to two "on" positions. When the switch is moved to the first "on" position current flows through leads 63 past terminals mounted on block 64 to energize the motor 20. Simultaneously current flows through lead 65 and a suitable number of contact points 66 to shaft 17 and lower feed-rollers 18. From feed-rollers 18 the current flows upwardly through upper feed-rollers 19 normally in engagement therewith, and thence through lead 67, and corresponding leads, such as 67*a*, to the coils of a plurality of solenoids 68, respectively, one solenoid being provided for each of the upper compartments. Or preferably the current should flow in the reverse direction so as to pass from the upper feed-rollers 19 to the lower feed-rollers 18. Fig. 14 shows only the feed-rollers, electric apparatus, and electric circuit connections, for the first and last compartments, breaks in the circuit conductors indicating where omissions have been made of the electric apparatus for intermediate compartments. As soon as the coils 68 are energized the pivoted armatures 69 are drawn downwardly against the tension of springs 70 (see also Fig. 15). The rear ends of the pivots 60*a* of each pair of flaps 60 are operatively connected together and to the armatures 69 by means of suitable linkage. A right angle member 124 (Fig. 15) is rigidly mounted on the pivot member 60*a* of one of a pair of the flaps 60. The portion of the member 124 which extends to right angles to the longitudinal axis of pivot member 60*a* passes underneath a pin 125 carried on the end of the armature 69, engagement between these parts being maintained by the spring 70 which is suitably secured to the member 124 and acts through the latter to normally maintain the armature 69 in a raised position against a suitable stop 126. Rigidly attached in any desired manner to pivot 60*a*, adjacent the member 124, is a lever 127 which is pivotally connected to a link 128 that extends transversely of the upper compartment in the rear thereof, and has pivotal engagement at its opposite end with a lever 129 which is rigidly attached to the pivot 60*a* of the other flap 60 of the pair. When the solenoid 68 is energized armature 69 is drawn downwardly against the tension of spring 70 and the flaps are moved through levers 127, 129, and link 128 to a vertical position. When the circuit is broken through the coils of the solenoid 68 spring 70 acts through member 124 to return the armature 69 to normal raised position

and through the pair of levers and the link 128 returns the flaps 60 to their raised position which may be at an angle of approximately 45° or thereabouts to the horizontal.

When a bill is fed beween a pair of rollers 18, 19, the rollers are separated, breaking the electric circuit which includes the coils of the solenoids 68 associated with the particular rollers between which the bill is passing. The corresponding armature 69 is thereby released and spring 70 swings the flaps 60 upwardly through an angle of approximately 45° to 60° and the forward portion of the bill as it passes through the rollers is supported by said flaps. As the rear end of the bill leaves the rollers, the circuit to the solenoids 68 is again established, the armature 69 is drawn downwardly, the flaps 60 are returned to a vertical position, and the bills fall by gravity into the upper compartment 6, the bottom of which is constituted by a pair of flaps 5, 5, as before described.

It is desirable that each bill be counted as it passes into a compartment and that the total number of bills passed into the various compartments be counted. For this purpose each compartment is preferably provided with an electrically-actuated counter or register 71 (Figs. 9, 10 and 14), and associated therewith is a totalizer or a master-counter 72, common to all of the counters 71. Preferably, the compartment counters 71 are mounted on a portion 73 of the machine frame above and in the rear of the upper compartments 6 (Figs. 1, 2 and 3) and the totalizer 72 is preferably mounted on the upper right hand side of the machine (Figs. 1 and 2). Each of the solenoids 68 is provided with a small armature 74 (Figs. 14 and 15) which constitutes one of a pair of controls for the flow of current through the associated counter 71 and totalizer 72. When the switch 61 is turned to its first "on" position, the current flows through lead 63, lead 75, a bar 76, a contact 76*a*, armature 74, and a lead 77, to the windings of the counter 71 and totalizer 72. These windings are not energized, however, since the circuit to the same is open at switch 61, no contact being established at this time at said switch with the lead 77. Simultaneously with said flow of current through leads 63, 75, etc., the current flows through lead 65, rollers 18, 19, lead 67, to the windings of the solenoid 68 energizing the latter and drawing armatures 69 and 74 downwardly, breaking the circuit between armatures 74 and contacts 76*a*. The two controls for the counter 71 and totalizer 72 are constituted by switch 61 and armature 74 at each of which the return circuit 77 through said counters and totalizer is broken when said switch is in its first "on" position.

Before starting the machine upon regular work, and from time to time thereafter during the progress of regular work, it is desirable to make adjustments and also tests of the mechanism. Such tests involve the feeding of bills between the feed-rollers, as in the case, for example, of attaining the desired adjustment to exclude the passage of more than one bill at a time. With the counters in operation such feeding of bills between the rollers would actuate the counters, thus requiring that they be reset to where they were or allowance or correction otherwise made for the counting during testing. To eliminate the chance of errors by such resetting the counters, or errors from forgetting to reset the counters, or in otherwise allowing for such counting during testing, it is desirable to put the counters out of operation during such testing or adjusting. The aforesaid first "on" position of the switch 61 attains this and otherwise provides the desired conditions in that it sets the feed-rollers in operation and renders the mechanism operative with the exception of the counters, no current being made available for actuating thereof. Thus, bills may be fed between the pairs of feed-rollers and the mechanism otherwise tested and adjusted without disturbing the counters, whether they stand at zero or indicate the results of assorting and counting already in progress and unfinished.

After testing and adjusting with switch 61 in its first "on" position, the operator turns said switch to its second "on" position, thereby closing the return circuit 77 at said switch; but since armature 74 has been drawn downwardly by solenoid 68 the circuit through the counters and totalizer is still open at said armature. Such an arrangement is found desirable due to the fact that if the return circuit 77 is not broken at switch 61 at the time current is supplied to leads 65 and 62, said current may flow through the armature 74 and the coils of the counter and totalizer, thereby prematurely actuating said counter and totalizer prior to the passage of a bill between the feed rollers. If, when switch 61 is in its second "on" position and armature 74 is down, a bill is passed between any pair of rollers 18, 19, the solenoid 68 associated with said pair of rollers will be deenergized in a manner before described, whereupon a spring 78 moves armature 74 into engagement with contact 76*a*, closing the circuit through the counter 71 associated with the particular compartment into which the bill passes and also through the totalizer 72. The closing of the circuit through the counter and totalizer actuates these members and the bill is counted in a manner to be hereinafter described.

Various types of counters may be employed in the present machine, but preferably said counters are of the magnetic type and embody means for stopping the rotation of the feed-rollers after a predetermined number of bills have been fed into any one compartment. Preferably the predetermined number is one

hundred. In the form shown, the totalizer 72 is of substantially the same construction as the counters 71 but does not embody means for stopping the feed-rollers. Referring to Figs. 9, 10, 11 and 11*a*, each of the counters 71 comprises an actuating electromagnet including the usual windings energizing poles 79, 79 between which poles an oscillatory armature 80 is rotatably mounted and adapted to be oscillated in clockwise direction by energization of the poles and to be oscillated in reverse direction back to normal position by means of a spring (not shown), all as is well understood in the art. Actuation of armature 80 by passage of current through the electromagnet also results in rotation of the usual numeral-wheels 81 and 82. A manually-operable member 83 is provided for setting the numeral wheels to zero position. Associated with and fixedly connected to the "tens" wheel 82 to rotate therewith, is a disk 84 provided with a cam projection 84*a* which, upon a complete rotation of disk 84 (that is at the count of one hundred) engages one end of rod 85 and moves it endwise. At its other end rod 85 is rigidly secured to an upstanding arm of a plate 86*c* the latter having at its opposite ends two ears 86*b* by which said plate pivots on a manually operable rod 87 passing through said ears and secured in one ear whereby endwise movement of rod 87 will be communicated to plate 86*c* and through it to rod 85 moving the latter sidewise. As best shown in Fig. 11*a*, the end of rod 87 which passes through ear 86*b* is reduced, forming on the rod a shoulder bearing against the inner surface of said ear, the tip end of the rod beyond the ear being bent over to prevent its withdrawal from the opening through which it passes, and in this manner securing the rod to the ear. An electric contact point 86*a* is secured to plate 86*c* with interposed insulation 86. Rod 87 passes through and is pivotally rotatable in ears 88, 88 at opposite ends of a plate 88*a* secured at a suitable point on the side of the casing of the counter. A coil spring 92 about rod 87 bears at its left hand end (Figs. 10 and 11) against plate 86*c* and at its right hand against plate 88*a*, the spring thus tending to move the rod 85 in the direction opposite the arrow in Fig. 10, thereby normally holding it in engagement with the periphery of disk 84; and the spring also tends to hold ears 86*b*, 86*b* in engagement with ears 88, 88 respectively, thus opposing endwise movement of rod 87. An electric lead 89, which is in circuit with lead 75, lead 63, switch 61, and lead 62, conducts current to the contact point 86*a*; and when the cam projection 84*a*, rotating in the direction of the arrow, Fig. 10, engages and actuates rod 85 endwise, said rod and the plate 86*c* to which it is attached are rocked about rod 87 against the tension of spring 92 until the contact 86*a* is thereby moved into engagement with a cooperating contact point 90, whereby current is delivered through leads 91, 91*a*, 91*b* (Fig. 14), to energize the electromagnet 51, thereby actuating the brake-lever 53 and stopping rotation of all of the feed-rollers. The operator notes the particular counter 71 which has thus reached the count of one hundred and drops into the corresponding compartment on top of the bills therein a suitable separator, such as shown at *x*, Fig. 4, to thereby separate the bills already counted into that compartment from others which are to follow. The separators preferably approximate the length and width of the bills and may be made of any suitable material such as stiff cardboard. All is now in readiness to restart the rotation of the feed-rollers and to continue the sorting and counting, it being recalled that at the counter which has brought about the application of the brake the cam projection 84*a* stands against the rod 85 holding contact 86*a* in engagement with contact 90 and thereby closing the circuit which energizes the brake-magnet 51.

To restart the machine the operator first grips and moves the rod 87 toward the right, Figs. 10 and 11 (which would be toward the left in the position in which the counter is positioned in the machine before the operator), to deenergize the brake-magnet, and then actuates pusher 59 to insure moving the brake-shoe out of grip with the groove of the brake-drum in the manner before described. Said movement of rod 87 compresses coil-spring 92 which resists the movement. This movement of rod 87 also moves rod 85 sidewise until it is disengaged from cam projection 84*a*; and by the action of spring 92 rod 85 is then moved endwise (opposite the direction of the arrow Fig. 10) into contact with a concentric portion of the periphery of disk 84 and at the same time pressed against the side of said projection 84*a*, all with the result of separating contacts 86*a* and 90. When the counter is further actuated moving cam projection 84*a* away from rod 87, the spring 92 will move said rod sidewise (toward the left Fig. 10) back to its normal position with its end in the path of said cam projection, as shown in Fig. 10.

Another embodiment of the counter stop mechanism is illustrated in Fig. 12, wherein a disk 93, provided with a cam projection 93*a*, is rotated by the "tens" numeral-wheel 82. A complete rotation of disk 93 brings said cam projection 93*a* into action upon a contact 94 yieldingly supported by a resilient member 95, thereby moving contact 94 into engagement with cooperating contact 90′ and thus completing an electric circuit which energizes the brake solenoid, applies the brake, and stops the feed-rollers. To restart the feed-rollers the operator

grips the handle or pin 96, which is rigid on the contact member 94, and moves the latter toward the right (Fig. 12) off the cam projection 93*a*, thereby permitting resilient member 95 to move contact 94 away from contact 95, and thus deenergizing the brake solenoid.

Since the feed-rollers 18, 19 constitute contacts for completing an electric circuit, it is desirable that the peripheries of the same be maintained free of dirt and other impurities which adhere to the bank notes and which are likely to accumulate to such an extent, on those portions of the peripheries of the rollers as make contact with the paper money, as to insulate said peripheries. Accordingly, means are provided for maintaining clean those portions of the surfaces of the rollers which make contact with each other when no paper money is interposed. As shown, a sleeve 97 (Figs. 4 and 7) is slipped over a coil-spring 98 which is secured at its opposite ends to the bearing-block 36, whereby the sleeve 97 is yieldingly pressed against a small body of steel wool 99 and the latter thus crowded into engagement with the periphery of wheel 19 with the cooperation of a bar 97*a* mounted on block 36. The central portion 18*a* of the lower feed-roller is maintained clean by means of steel wool 99 carried in a cup 100 that is secured to an arm 101 which is pivotally connected as at 102 to a frame portion 103. The bight of a suitable spring 101*a* engages the arm 101 and yieldingly maintains the steel wool in engagement with the roller.

It may happen that the operator neglects to renew the steel wool after it has become inpregnated with foreign matter and thus incapable of further cleaning. In such event the machine may cease to function properly and the attention of the operator may not be immediately called to that fact. It is therefore extremely important that further means be provided for insuring the flow of current between the feed-rollers, when no bill is passing between the same, and that said means be so constituted as not to interfere with the proper feeding of bills into the machine and passage thereof through the rollers. Accordingly, a yielding contact 104 is secured to the block 36 and is adapted to engage the periphery of the lower feed-roller 18, one of said contacts being provided for each pair of rollers. As shown in Figs. 5 and 6, the contact 104 comprises a rigid member 104*a* having at its upper end an eye whereby it is secured by a screw 105 to the block 36. The lower end of member 104*a* is threaded to receive a coil-spring 104*b* which carries on its lower extremity a threaded steel stud or contact tip 104*c*. The contact, and particularly its tip, bears on the lower feed-roller 18 at a point which is not opposed by the upper roller 19 and hence is not likely to become caked with impurities. Due to the resiliency of spring 104*b* the contact does not interfere with and readily yields to and is displaceable by the passage of a bill between the pair of rollers.

If desired, the machine may be so constructed that it is unnecessary to include the feed-rollers 18, 19 in the electrical circuit employed for actuating or controlling the actuation of the counters. As illustrated in Fig. 15, each pair of rollers is provided with a two-part lever operatively connected to the upper roller of the pair, whereby the passage of a bill between the rollers will actuate said lever, due to the movement of said upper feed-roller, and close a circuit leading to the associated counter 71. The use of the armature 74 (Figs. 14 and 15) is then unnecessary since the closing of the circuit to the counter, by actuation of the two-part lever operates said counter. As shown, the two-part lever is constituted by members 46′ and 47′. Member 46′ has two substantially right angle bends therein, and at its outer or front end is secured to the block or support 36 of the upper feed-roller. The member or bar 47′ is pivotally secured to ears 46*a* on the inner end of member 46′. A spring 48′ normally maintains the forward end of member 47′ in engagement with the upper edge of member 46′ in a manner similar to that previously described in connection with the two-part lever 46—47. Suitably secured to the inner end of member 47′ is a contact 49′ which is normally out of engagement with a contact 50′ mounted at a convenient point on the frame of the machine. Contacts 49′ and 50′ are adapted to complete a circuit through the corresponding counter 71. When a bill is fed between the rollers 18, 19, the upward pivotal movement of roller 19 moves the two-part lever upward, thereby engaging contact 49′ with contact 50′ and closing the circuit to the counter 71, whereby the latter is actuated and the bill is counted. After the bill has passed completely through the rollers, the latter again move into engagement and the circuit to the counter is again broken at contacts 49′, 50′.

Means are provided for preventing bills discharged from flaps 60 into the upper compartments 6, or from flaps 5 into the lower compartments 7 from passing out of the compartment and said means are so constructed that the air pressure underneath a bill falling into a compartment 6 is equalized. As shown more clearly in Figs. 3 and 4, the open end of each of the upper compartments 6 is normally closed by a transparent door embodying a frame 106 pivoted at 107 to a suitable part of the frame. Preferably the width of the frame 106 is less than the width of the compartment 6, whereby air may escape past the closure and also

through suitable openings 2*a* formed in the rear wall of the compartment. As shown, a chain 108 is secured to the lower central portion of the frame 106, the lower end of the chain extending to the bottom of the lower compartment 7. The chain by its weight normally maintains the transparent door or closure for the upper compartment in closed position and also prevents a bill or bills from passing out of the lower compartment. Each of the compartments is readily accessible for the removal of bills therefrom.

Since it is desirable at times to temporarily leave the machine with money in the lower compartments, means are provided for preventing ready removal of the money from said compartments. For this purpose a sectional cover 109, 109*a* (Figs. 1 and 16) is pivoted at 110 to the front of the machine frame, the end of section 109 overlapping the adjacent end of section 109*a*. Section 109 is provided on its free end with a plate 111 (Fig. 16). When the cover 109 is swung upwardly to close the compartments, plate 111 passes below the lower edge of frame 106 and projects beneath a pair of the flaps 5. Since all of the flaps 5 are operatively connected for movement in unison, engagement of plate 111 under a single pair of the same prevents downward movement of all of the flaps 5.

As before stated, it is desirable and highly important to facilitate to the approximate maximum the handling and temporary storage of the paper money from the time it is received by an operator, or person entrusted with the assorting and counting thereof, until it leaves the custody of such person assorted and counted and strapped in packages. To that end there is provided what has been termed an "installation unit" with said mechanism as a part of such unit. As shown in Figs. 1 and 2, such unitary organization includes the assorting and counting mechanism supported at opposite ends on suitable legs with the electric motor mounted on the under side thereof clear of the floor. The operator may sit or stand in front of said mechanism while using the same to sort and count money. A work-table 121 is arranged back to back with said mechanism and supported by suitable legs so as to face in a direction opposite that in which the mechanism faces. Above the mechanism and work-table there is a money-receiving cabinet 112 suitably divided interiorly, as by horizontal partitions 112*a* and vertical partitions 112*b*, to receive money both before and after it is assorted and counted by said mechanism. Cabinet 112 is closed at its top, bottom, sides and back and has an open front which may be closed by a hinged cover 113 adapted to be locked upon such occasions as the operator may desire to leave her on his installation unit with bills temporarily stored in the cabinet. Cabinet 112 is rotatably mounted and supported on a standard 114 and thereby adapted to be faced with its open front either toward the assorting and counting mechanism, or toward the table 112. A pin 117 engaged through ears 118 on the cabinet and through cooperating bracket arm 119 will secure the cabinet in one position; and the same pin 117 engaged through ears 120 on the cabinet and through said bracket arm 119 will secure the cabinet in the other position. Money to be sorted is placed in the compartments of the cabinet, and with the open front of the latter faced toward the mechanism said money is assorted and counted by the use of the mechanism and into the compartments thereof. As the lower compartments of the mechanism become full the assorted and counted money is removed therefrom and placed back in the compartments of the cabinet awaiting application of straps. When it comes time to apply the straps, the cabinet will be rotated 180° to face its open side toward the table, and the operator now standing before the table will remove from the cabinet 112 onto the table 121 the packages of money separated by the cardboard separators such as before mentioned and will apply to the packages paper bands or straps bearing the desired notations or data. A file spindle 122 (Figs. 1 and 2) may be provided for receiving the paper bands taken from the "straps" of money just prior to passing the bills into the mechanism for sorting and counting, since these bands usually carry information which it is desirable to preserve, pending verification. Sponge-cup 123 may be provided at a convenient point on the front of the machine for moistening the fingers in handling the money.

Any danger of fire from electrical sparks or any likelihood of electrical shocks to the operator are avoided by proper insulation which need not be described in detail but which is illustrated in part in the drawings.

While there has thus been provided a machine which greatly facilitates and expedites the sorting and counting of paper money, it is to be understood that it is designed and adapted for a variety of uses, such for example as counting and sorting checks, bonds, stock, transfers, tickets, etc.

What is claimed is:

1. The combination with a counter including in its construction a rotatable numeral indicator wheel; of a disc rotatable with said numeral wheel and having on its periphery a cam projection; an electric switch including a movable contact adapted to be engaged with a cooperating contact by the action of said cam projection; a carrier on which said movable contact is mounted, said carrier being under yielding pressure tending to normally position it with a part thereof engaging the periphery of said disc in the path of said cam projection and with said movable

contact disengaged from its cooperating contact, whereby upon the count of a predetermined number said cam projection will actuate said carrier and bring said switch contacts into engagement; and a manually operable member associated with the carrier whereby the carrier may be moved out of engagement with said cam projection and to a position disengaging said contacts.

2. The combination with a counter constituting a distinct unit in itself, of an electric switch including a movable contact and a cooperating contact; a carrier for said movable contact; spring means normally yieldingly holding and moving said carrier to position to disengage said movable contact from its cooperating contact; a rotary actuator rotated by said counter mechanism and acting upon the count of a predetermined number to move said carrier, against the tension of said spring means, to position to engage said contacts; and a manually operable member associated with said carrier whereby it may be moved to position to disengage said contacts.

3. The combination with a counter constituting a distinct unit in itself, of an electric switch including a movable contact and a cooperating contact; a carrier for said movable contact; spring means normally yieldingly holding and moving said carrier to position to disengage said movable contact from its cooperating contact; means actuated by said counter mechanism upon the count of a predetermined number to move said carrier, against the tension of said spring means, to position to engage said contacts and a manually operable member associated with said carrier whereby it may be moved to position to disengage said contacts.

4. A machine of the class described wherein rollers are employed for feeding bills into a compartment, said rollers constituting contacts in an electrical circuit which is broken each time a bill passes between the rollers, and wherein braking means are employed for stopping the rollers, the combination with said rollers of an electrical counter adapted to be actuated thereby, said counter constituting a distinct unit in itself removable as such and including numeral wheels, a cam associated with one of said wheels, a contact actuated by said cam, and a second contact adapted to be engaged by the first-named contact to energize said brake after a predetermined number of bills have been passed through the rollers.

5. A machine of the class described wherein rollers are employed for feeding bills into a compartment, said rollers constituting contacts in an electrical circuit which is broken each time a bill passes between the rollers, and wherein brake means are employed for stopping the rollers, the combination with said rollers of an electrical counter adapted to be actuated thereby, said counter including numeral wheels, a cam associated with one of said wheels, a contact actuated by said cam, means normally maintaining said contact in the path of movement of said cam, means for moving said contact out of the path of said cam, and a second contact adapted to be engaged by the first-named contact when the latter is actuated by said cam and thereby to complete a circuit through said brake means.

6. A machine of the class described wherein rollers are employed for feeding bills into a compartment, said rollers constituting contacts in an electrical circuit which is broken each time a bill passes between the rollers, and wherein brake means are employed for stopping the rollers, the combination with said rollers of an electrical counter adapted to be actuated thereby, said counter including numeral wheels, a cam associated with one of said wheels, a contact actuated by said cam, resilient means normally maintaining said contact in the path of said cam, manually operable means for moving said contact out of the path of the cam, said contact being returned to its normal position by said resilient means, and a second contact adapted to be engaged by the first contact when the latter is actuated by said cam and thereby to close a circuit through said brake means to stop the rollers after a predetermined number of bills have been passed therethrough.

7. A machine of the class described wherein rollers are employed for feeding bills into a compartment, said rollers constituting contacts in an electrical circuit which is broken each time a bill passes between the rollers, and wherein brake means are employed for stopping the rollers, the combination with said rollers of an electrical counter adapted to be actuated thereby, said counter including numeral wheels, a cam associated with one of said wheels, a contact pivotally mounted adjacent said cam and adapted to be actuated thereby, a second contact adapted to be engaged by the first-named contact when the latter is actuated by said cam and thereby to close a circuit through the brake means and stop the rollers, means for moving the first contact out of engagement with the second contact, and means for returning the first-named contact to normal position.

8. In a machine for counting paper money and the like, the combination of a plurality of sets of bill-feeding rolls; a counter individual to and actuated under control of each set of rolls, said counter including an electro-magnet; a brake for simultaneously stopping all of the rolls; an electric switch associated with each counter and actuated thereby to effect the application of said brake to stop the rolls upon the count of a predetermined number; a circuit for each counter

magnet including contacts adapted to be opened and closed; and a circuit controlled by the passage of bills between the feeding rolls and including an electromagnet for opening and closing the contacts in said first-named circuit.

In testimony whereof I have signed this specification.

ALLAN E. LARD.