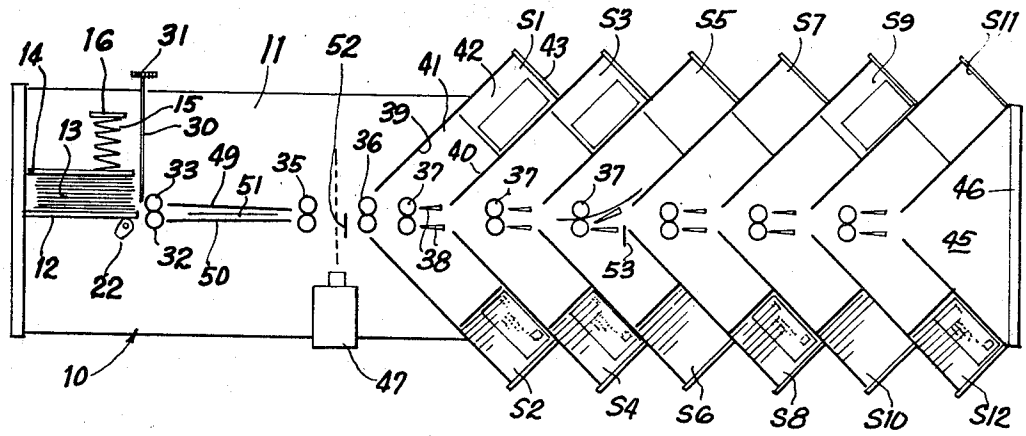
Jan. 7, 1969 H. J. ROSENBERG ET AL 3,420,368

MAIL SORTING MACHINE

Filed Sept. 14, 1966 Sheet 1 of 4

FIG. 1



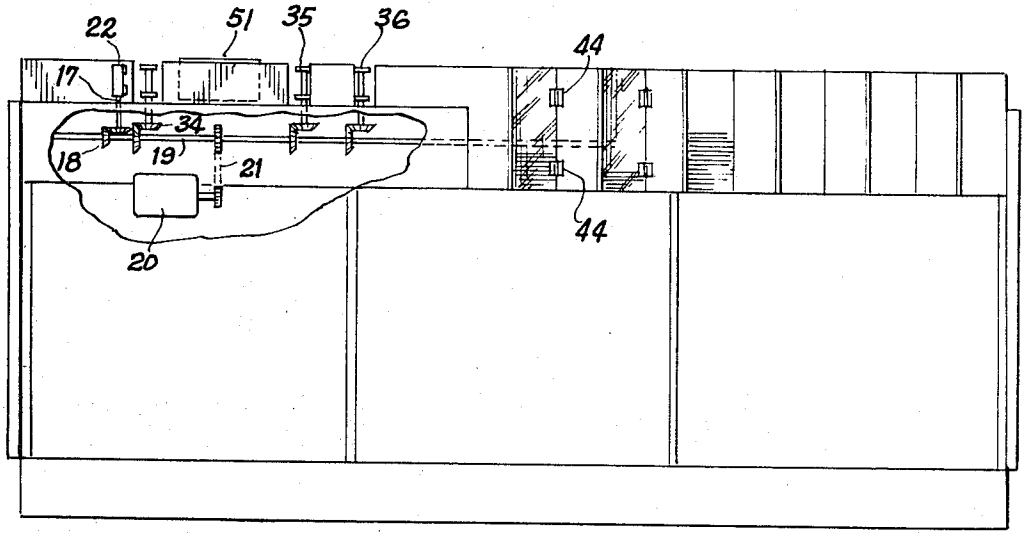


FIG. 2

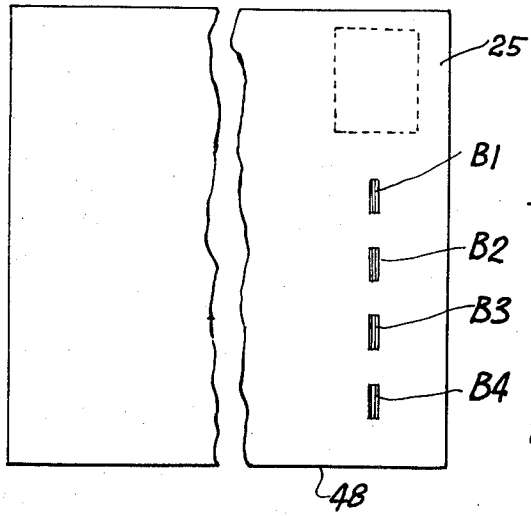


FIG. 3

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MAIL SORTING MACHINE

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FIG. 4

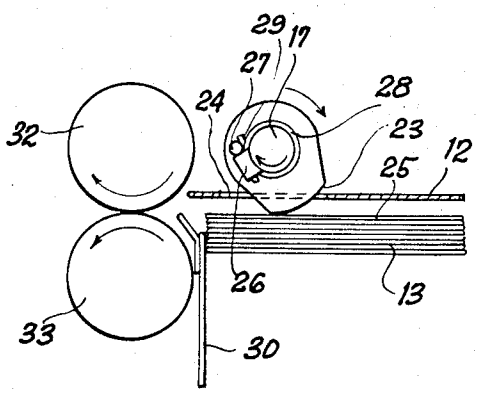


FIG. 5

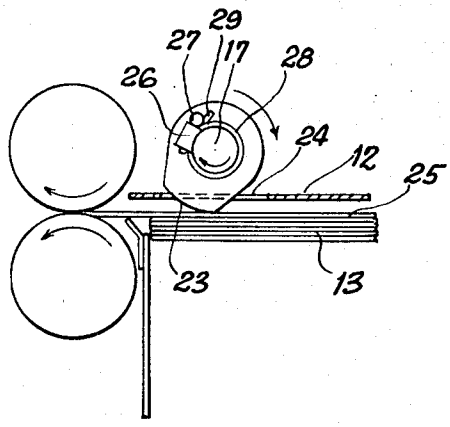


FIG. 6

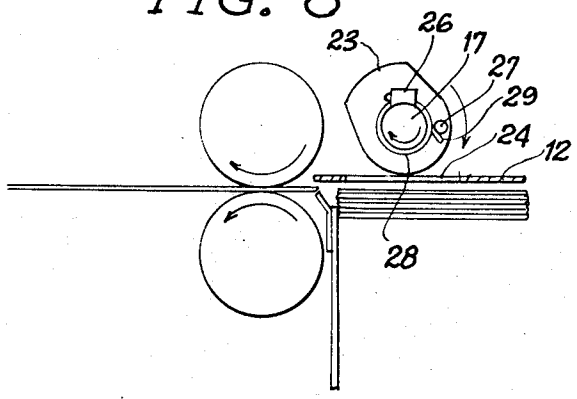
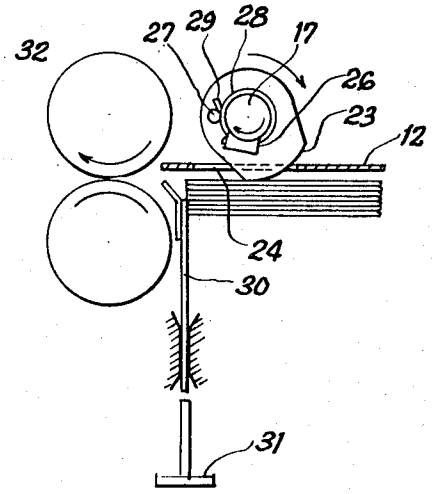


FIG. 7



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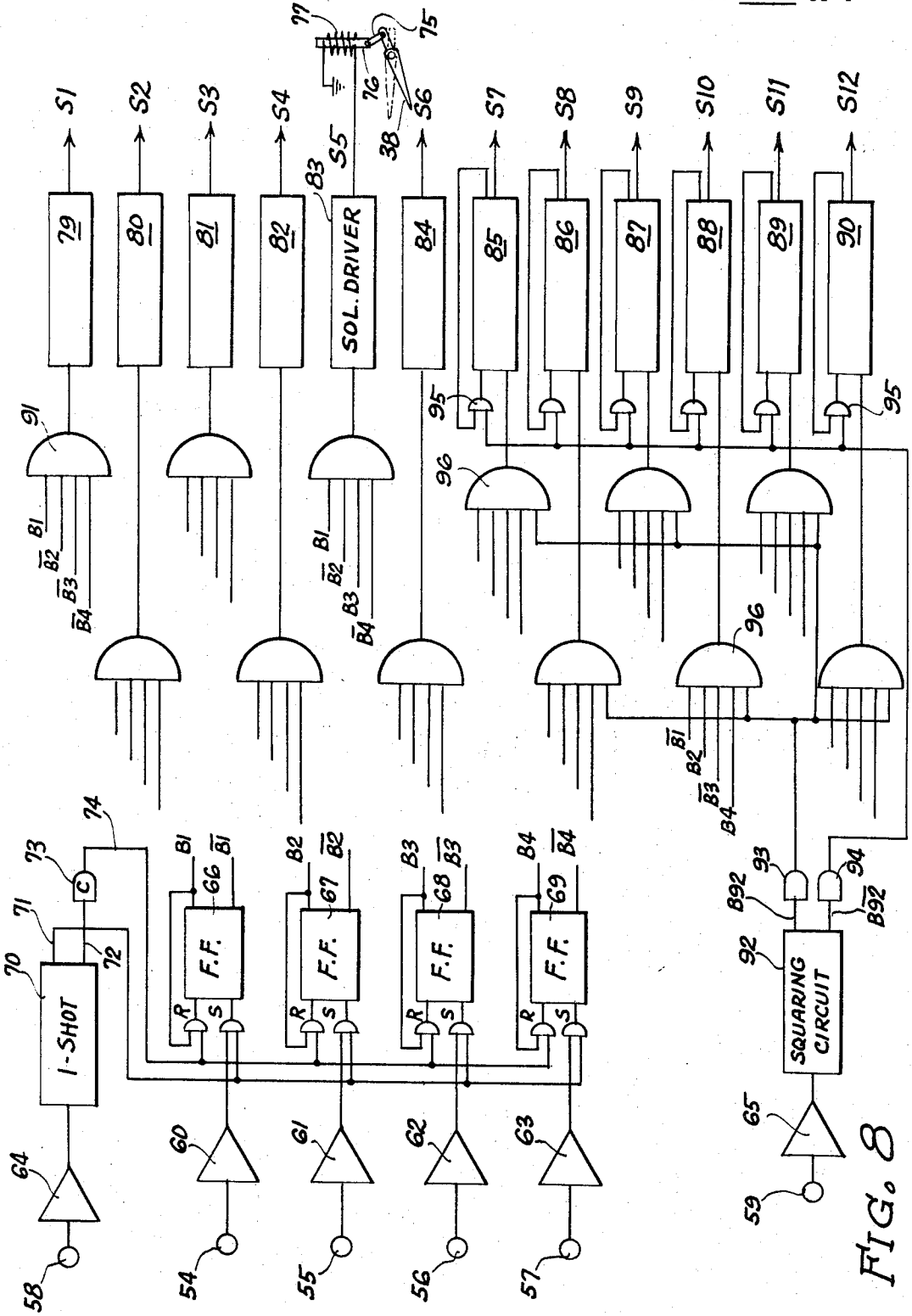

FIG. 8

MAIL SORTING MACHINE

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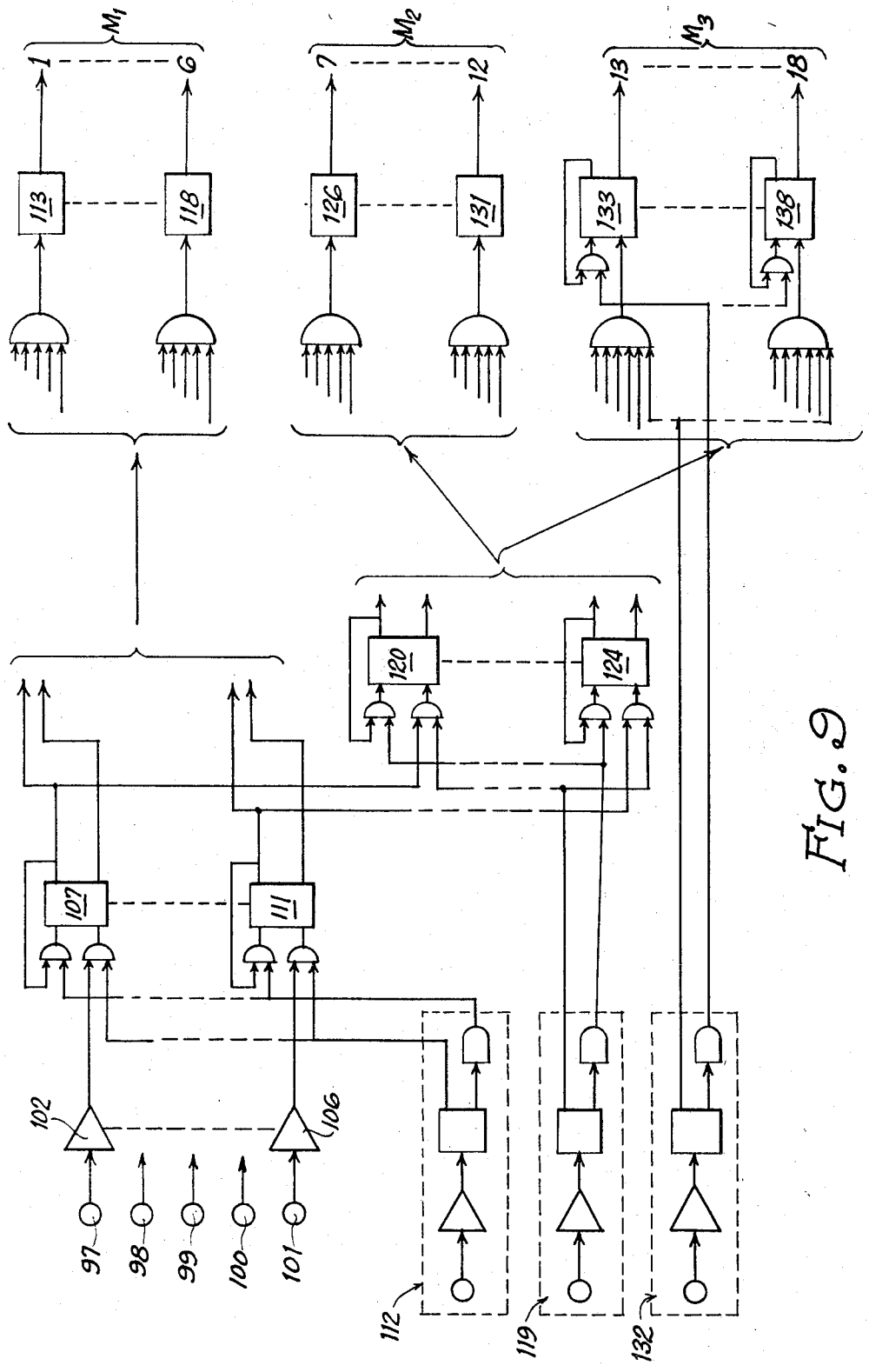

FIG. 9

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3,420,368

MAIL SORTING MACHINE

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Filed Sept. 14, 1966, Ser. No. 579,238
U.S. Cl. 209—73 9 Claims
Int. Cl. B07c 3/10

ABSTRACT OF THE DISCLOSURE

A coded envelope sorting device which comprises a reading head having a reference surface on which the envelopes are supported while they are being read, and a pick-off station ahead of the reading head, wherein means are provided for picking off an envelope from a stack, and imparting free flight to the envelope so that it lands on its edge on the reference surface and is thereby correctly presented to the reading head.

This invention relates to apparatus for automatically sorting mail, data cards, and the like, in accordance with variously coded information imprinted, punched, or otherwise associated with the material to be sorted.

It is very common for certain businesses, such as insurance companies, banks, magazine publishers, etc., to solicit business, conduct surveys, or the like, by mail and, for the convenience of the addressee, to enclose a reply envelope in the material sent to the addressee. The replies so received usually must be segregated as to the mailing to which they relate, or as to the geographical area from which the replies emanate, as well as other differentiating criteria. Where the mailing is extensive, the sorting of the reply mail is not only time-consuming, but requires services of large numbers of clerks who may have to be of a temporary character and hence difficult to obtain. In some of the mailings, the reply envelopes are imprinted with a visual code in the form of dots, dashes, or bars, arranged in a predetermined pattern by which the sorter can differentiate one envelope from another.

Efforts have been made in the past in related arts to sort mail according to address by electronically reading the printed or type address on envelopes. Other efforts have been made to sort checks in accordance with a magnetically imprinted numerical code. Such efforts have resulted in complex, expensive equipment which only the larger institutions can afford to purchase or lease.

The principal object of this invention is the provision of a relatively inexpensive and simple apparatus for sorting stacked envelopes in accordance with coded information imprinted or otherwise formed on the envelopes.

As a more specific object, this invention has within its purview the provision of a sorting machine which automatically removes envelopes from a stack, one at a time, transports the envelopes past a reading head, and deposits the envelopes into a selected one of a group of pockets or bins according to instructions from the reading head.

Envelopes which are to be sorted one at a time must move in a stream past a series of gates, one of which will be opened in accordance with the code imprinted on that envelope. Those gates which are farthest removed from the origin of the stream of envelopes require a length of time to reach such removed gate which may be greater than the time interval between envelopes passing the reading head. This then requires a memory device in the sorter which stores information received from the reading head after said reading head was cleared to read the coded information on a succeeding envelope. Such memory devices, or information storage devices, as heretofore proposed, have been complex and expensive, and it is accordingly a further object of this invention to provide a means

in a mail sorter for simply and economically storing information from a reading head and subsequently releasing the stored information by the movement of the envelope from which information was originally obtained by the reading head.

A further object of this invention is the provision of a mail sorting device wherein the mail sorts are divided into groups or modules according to the distance of the groups from a reading head, the distant groups being provided with power flip-flops which are triggered by means controlled by the position of the envelope being sorted.

These and other objects of this invention will become apparent from the following detailed description when taken together with the accompanying drawings in which

FIG. 1 is a schematic plan view of the mail sorter of this invention;

FIG. 2 is a side elevation, partly in section, of the mail sorter of FIG. 1;

FIG. 3 is a greatly enlarged view of the face of an envelope with a portion broken away, showing the preferred code bit format used in the sorting machine of FIG. 1;

FIGS. 4 to 7 are greatly enlarged fragmentary plan views of the means on the mail sorter for automatically removing one envelope at a time from a stack of envelopes and feeding the removed envelope into the first feed rollers of the sorter;

FIG. 8 is a schematic wiring diagram of the means for controlling and operating the sort gates for the sorter; and

FIG. 9 is a schematic wiring diagram of a modification of means of FIG. 8.

Considering first the mechanical aspects of the sorter, there is provided in the embodiment chosen to illustrate this invention an appropriate table-like frame **10** on which is an upper surface **11** disposed at a sufficient elevation from the floor to make all parts thereof conveniently accessible to an operator without requiring him to stoop. At the left hand end, as viewed in FIGS. 1 and 2, of the upper surface **11**, and disposed substantially centrally thereon, is a vertical plate **12** which preferably has a rectangular configuration of a size greater than the largest envelope to be sorted by the machine. Said plate acts as an abutment for a stock of envelopes **13**, which all have been faced the same way and which rest upon one longitudinal edge thereof. Said stack **13** is compressed against vertical plate **12** by a pressure plate **14** held against the stack by a spring **15** reacting against an abutment **16** on surface **11**. If desirable, spring **15** and abutment **16** may be located below surface **11** and made to contact plate **13** by a suitable extension on said plate (not shown).

On the opposite side of vertical plate **12** from stack **13** is disposed a pick-off mechanism which is shown more clearly in FIGS. 4 to 7, inclusive. Said figures are views of the device as seen by an operator standing at the loading side (upper) of the sorter and show the vertical plate **12** and the stack of envelopes **13**. The pressure of spring **15** is relatively light, so that a minimal friction force is developed between adjacent envelopes to interpose a minimum resistance to the sliding of one envelope upon another.

The pick-off mechanism is comprised of a shaft **17** extending vertically through the upper surface **11** of the frame **10** and continuously driven through appropriate gearing **18** (FIG. 2) from a shaft **19** disposed horizontally in frame **10** and providing the drive for all of the drive rollers in the sorter. A motor **20** and chain **21** also disposed within frame **10**, serve as a source of power for shaft **19**. On shaft **17** is loosely mounted a roller **22** which is provided with a protrusion **23** extending radially therefrom around approximately 20% or 72° of the circumference of the roller. Said protrusion **23** is preferably cylindrical in contour and forms the letter-contacting sur-

face of the roller. The material of which the protrusion **23** is made is preferably of a friction character such as rubber, cork, or the like.

Protrusion **23** is adapted to extend through a window **24** in plate **12** where it can contact and frictionally engage the face of an envelope **25** adjacent to plate **12**. A suitable drive for roller **22** is provided by a radial abutment **26** on shaft **17** which is adapted to contact a pin **27** extending axially of roller **22** into the path of movement of abutment **26**. A torsion spring **28** having one end (not shown) secured to shaft **17** and the other end **29** continuously bearing against pin **27**, normally urges pin **27** against the abutment **26**. Thus abutment **26** and pin **27** provide a lost motion connection between drive shaft **17** and the roller **22**.

An adjustable friction finger **30** is provided to hold back the envelope adjacent to envelope **25**, should said adjacent envelope exhibit a tendency to move with envelope **25**. Friction finger **30** may be manipulated by a knob **31** (FIGS. 7 and 1) within easy reach of the operator.

Adjacent pick-off rollers **22** is the first pair of feed rollers **32** and **33**. These feed rollers, as shown in FIGS. 5 and 6, are disposed in line with envelope **25** as it leaves the protrusion **23**, and are also located close enough to pick-off roller **22** so that both the feed rollers and the pick-off roller engage envelope **25** at the same time. The diameter and speed of the feed rollers **32, 33** are such as to move envelope **25** with a linear velocity of **120** inches per second. This velocity is higher than the peripheral velocity of protrusion **23**, for the reason that it is desirable to accelerate envelope **25** in two stages rather than at once. This means, therefore, that once the envelope is gripped between rollers **32** and **33** it moves faster than the peripheral velocity of protrusion **23** as the latter is driven by shaft **17**. Because of the lost motion connection provided by protuberance **26** and pin **27**, the protrusion **23** may be momentarily driven at some higher speed dictated by the movement of envelope **25** until said envelope is clear of the protuberance **23**.

Rollers **32** and **33** are driven from shaft **19** through suitable gearing **34**. Substantially identical gearing is used to drive a series of feed or transport rollers shown at **35, 36** and **37**, the last mentioned being repeated at the entrance to each pair of sorts.

For a better understanding of the remainder of the apparatus, a description of the envelope and the code format used thereon will now be given. Referring to FIG. **3** it may be noted that the envelope may have imprinted on the face thereof a series of vertically disposed and aligned dashes which have been designated **B1, B2, B3** and **B4**. These dashes individually are code bits, and for purposes of illustration are shown as black rectangles which may be printed on the envelope approximately one-half inch from the right hand edge thereof, as viewed in FIG. 3. Other code formats may be used with this invention, such as dots or discrete magnetic substances, or in the case of post cards, perforations of various configurations. Greater or lesser numbers of code bits may also be employed, depending upon the number of sorts to be made. In the illustrative example given in FIG. 3, four code bits are used which theoretically provides 16 unique combinations and therefore 16 different sorts. In the apparatus chosen to illustrate this invention, however, only 12 sorts are shown, it being understood that four sorts can be added to the 12 to take full advantage of the possibilities presented by the four bits.

Thus, in FIG. 1 the 12 sorts **S1** to **S12** are shown as being symmetrically arranged around a central straight line which is representative of the path followed by a letter through the sorting section of the apparatus. Each sort, such as **S1**, is provided with a pair of transport rollers **37** to propel a letter thereinto or past the sort, as the case may be, the path taken by the letter being determined by a mechanical pivoted gate **38**.

Each sort, such as **S1**, is comprised of a chute defined

by substantially vertical walls **39, 40** and a horizontal floor **41** which terminates in a pocket or bin **42** into which the envelopes fall and in which they are stacked flat. Said pockets **42** have transparent doors **43** which may be hinged as shown at **44** in FIG. 2. The transparent door permits the operator to observe the fullness of a pocket and alerts him to the necessity of removing the envelopes already in that pocket.

If, perchance, an envelope which is not coded should be included in the stack, or if there should be an error in the coding so that the apparatus does not direct the envelope into any of the sorts **S1–S12**, said envelope may then be deposited at the end of the apparatus in the area **45** which may comprise a slightly downwardly inclined surface having a wall **46** across the end thereof to prevent complete ejection of the envelope out of the apparatus.

Between feed rollers **32** and **36** is disposed a reading head **47** adapted to direct a beam of light upon each of the code bits **B1** to **B4** and, by reflected light from the code bit area, influence individual photo cells disposed in the head, there being one photo cell for each code bit area beam.

It is essential, inasmuch as the code bits are differentiated in a vertical direction, that the envelope be presented to the reading head with its lower edge **48** resting squarely on surface **11** as a reference plane. For various reasons, however, the envelopes may not leave the rollers **32, 33** in this position and, accordingly, means are provided intermediate rollers **32, 33** and the reading head for settling each envelope upon surface **11**. This means is comprised of relatively closely spaced vertical walls **49, 50** between which an envelope, such as **51**, is loosely confined. Said walls **49, 50** converge slightly toward rollers **35** so that envelope **51** is directed into the area from which rollers **35** may readily and unfailingly seize the envelope.

Rollers **32, 33** on the one hand and **35** on the other are spaced apart a distance considerably greater than the length of an envelope **51**. Furthermore, rollers **32, 33** are so inclined as to cause the envelope **51** to be ejected therefrom in free flight so that when the envelope falls upon surface **11**, it is automatically properly oriented with respect to surface **11** and therefore with respect to the reading head **47**. The free flight of the envelope **51** is illustrated in FIG. 2. From the time envelope **51** enters rollers **35** until it is directed to its ultimate destination, it is always in contact with a set of feed or transport rollers such as **36** or **37**. Its speed is thus precisely determined as well as its location relative to a succeeding envelope.

Reading head **47** which is also sometimes referred to herein as a scanning head, has not only the four photoelectric cells influenced by the reflected light from the four code bits areas, but has a fifth photo cell which is used to detect the leading edge of an envelope as it passes by, and upon detecting such leading edge, actuate the circuitry for the sorter in a manner to be hereinafter described. Depending upon the combination of code bits on any given envelope, one (and only one) of the sorting gates **38** will be actuated by a solenoid controlled by the circuitry.

Referring now to FIG. 8, there is shown in this figure a block diagram of the electronics or circuitry for the sorting device of FIGS. 1 and 2. As stated previously, the configuration shown in the diagram is based on the use of a four bit code and the illustrated 12 output sorts. The edge detector photo cell in the reading head **47** is sensitive to a beam of light disposed in the path of movement of the envelope at the reading head **47** and is shown schematically as a line **52** in FIG. 1. Another photo cell is associated with a second edge detector shown as a line **53** in FIG. 1, located at the end of the third set of rollers **37** and before the fourth set, so that as the envelope passes the second edge detector **53** it can actuate other

circuitry which controls the operation of the sort gates 38 associated with the sorts S7 to S12.

Thus in FIG. 8 the code bit photo cells are designated by the reference characters 54, 55, 56 and 57, and are shown schematically as circles. The photo cell for the first edge detector is shown at 58 and the photo cell for the second edge detector is shown at 59. The output signal from each photo cell is fed to individual amplifiers 60–64, which amplify these signals to a level suitable for logic operations. From the amplifiers 60–63 the code bit signal is sent to the set gate of individual bit flp-flops, said flip-flops being designated by the reference characters 66, 67, 68 and 69.

The signal from the amplifier 64 for the edge detector cell is sent to a one-shot multivibrator 70, the assertion output of which is connected through a lead 71 to the set gates of each of the flip-flops 66 to 69 and the negation output of which is coupled through a capacitance 73 and a lead 74 to the reset gates of the flip-flops 66 to 69.

The one-shot multivibrator 70, when tirggered by a signal from the edge detector cell 58 as amplified by amplifier 64 switches to the "on" state and stays on for a fixed time of approximately five milli-seconds. The assertion output in the lead 71 is negative during the "off" state and goes positive during the "on" state. The negation output in lead 74 is positive during the "off" state and goes negative during the "on" state. The assertion signal, being fed to the reset gate of all four flip-flops, serves to clear or reset the flip-flops before the code on the envelope enters the scan area of the reading head 47.

The lead 71 is connected directly to the set gate of all four flip-flops and serves as a sampling pulse for the four code cell amplifiers. The code amplifiers are sampled for the full one-shot duration of five milli-seconds. During this time, the letter moves approximately one-half inch and the code passes through the view of the code photo cells 54 to 57, inclusive. Any code cell which sees a bit B1 to B4, generates an output signal which is amplified and fed to the "set" gate of its respective flip-flop 66 to 69, and causes such flip-flop to be set. If a cell does not see a code bit, its flip-flop is left in the cleared state. At the end of the five milli-second sampling period, the "set" gates of the flip-flops are inhibited, and any further signals from the code cells due to other printing on the envelope is ignored.

The ultimate objective of the sorter is to cause the sort gate 38 for the particular sort S1 to S12 to be actuated to direct letters having the same code to the same pocket 42. As shown in FIG. 8, in one typical example, the gate 38 is shown as pivoted about a vertical axis and actuated through a link 75 by the armature 76 of a solenoid 77.

Each solenoid 77 is operated by a solenoid driver shown schematically as a rectangle in FIG. 8, and the several solenoids are numbered 79 to 90 for solenoids S1 to S12, respectively. Each solenoid driver is connected to the output of an "and" gate 91 which serves as a code detector and responds to only one of the sixteen possible code patterns. Said "and" gates 91 are thus connected to the outputs of the bit flip-flops 66 to 69 in unique ways so that, for example, the "and" gate 91 for driver 79 is connected to the assertion output B1 of flip-flop 66 and the negation outputs of the bit flip-flops 67, 68 and 69. The solenoids driver 83 may have its "and" gate connected to the assertion output B1 of flip-flop 66, the negation output B2 of flip-flop 67, the assertion output B3 of flip-flop 68, and the negation output B4 of flip-flop 69. Thus solenoid driver 79 will be turned on only when the letter code contains bit B1 and not bits B2, B3 and B4. Solenoid driver 80 may be energized only when the letter code contains B2 and not bits B1, B3 and B4, etc.

For an illustrative example of the operation of the sorter of this invention, let it be assumed that a letter which contained bits B1 and B3 in its code has passed reading head 47. This letter then causes flip-flops 66 and 68 to be set and flip-flops 67 and 69 to be left in the cleared condition. This is a code combination for driver 83, and accordingly it will be energized to actuate solenoid 77 and turn sorter gate 38 to deflect a letter into the sort S5. This gate remains actuated until the leading edge of the next letter is detected by edge detector cell 58, at which time the reset gate of each of the flip-flops 66 to 69 receives a signal which clears all of the flip-flops for the next code, that is, for the code of the oncoming letter. Any letter which is sorted into one of the first six pockets S1 to S6 is processed in a similar manner, the only variance being the code configuration and resultant gate actuation.

The division of the sorts into two or more groups or modules is dictated by the fact that the feed roller 22 and reading head 47 can process a letter in less time than it takes the letter to travel from the reading head to the last pair of sorts S11, S12. Therefore, to take maximum advantage of the more rapid operation of the feed roller and reading head, it is necessary to split the gates into groups requiring a travel time for the envelope which is just a little less than the time for an envelope to be picked up by the feed roller 22 and read by the reading head 47. The second or third groups, as the case may be, require logic operation which involves the retention of the signals from the reading head 47 after the reading head has been cleared by the edge detector of the next envelope to appear before the head.

To illustrate the need for a division of the sorts into groups, let it be assumed that a second letter is fed from the input stack 13 which contains bits B2 and B4 as its code. The letter is detected, as before, by edge detector cell 58 and this code is sensed and stored in the bit flip-flops 66 to 69, inclusive. In the example assumed, flip-flops 66 and 69 would be on and flip-flops 66 and 68 would be off. As shown in FIG. 8, this is the code for sort gate S10 and it therefore does not energize any of the first six gates S1 to S6. This lettter then travels along a straight path until it reaches the second edge detector 53, or as shown in FIG. 8, edge detector cell 59. Said cell 59 is mounted in the example given approximately 28 inches downstream from edge detector cell 58 and senses the leading edge of the letter immediately after it passes the sixth sort gate. The signal from the second edge detector photocell 59 is amplified by amplifier 65 and fed into a squaring circuit 92 which provides two complementary output signals B92 and $\overline{B92}$. These two signals are used to control solenoid drivers 85 through 90, which are different from solenoid drivers 79 to 84. The latter are essentially power amplifiers which are gated on and off, whereas drivers 85 to 90 are wired as power flip-flops which can be set and reset in the usual manner. When output signals are present at B92 and $\overline{B92}$, these indicate that a letter has passed the first six gates and is approaching the second set of six gates. The output leads B92 and $\overline{B92}$ are connected through capacitors 93 and 94 to the reset and "and" gates 95 and 96, respectively, of the solenoid drivers 85 to 90, respectively. At this time $\overline{B92}$ clears the drivers 85 to 90 inclusive of any previous setting, and a pulse from B92 is fed to the "set" gate 96 of each of the drivers. If the letter code stored in the bit flip-flops 66 to 69 satisfies the "set" gate of one of the solenoid drivers 85 to 90, then that driver is turned on and remains on until another letter is detected by edge detector 59. In the example chosen to illustrate the operation of the device, driver 88 would be "set" and the letter would be sorted into pocket S10.

The fact that solenoid drivers 85 to 90 inclusive function as flip-flops, is very important in determining the letter thru-put rate of the sorter. If drivers 85 to 90 did not have storage capabilities, the maximum thru-put rate would be determined by the physical distance from the scanning head 47 to the last sort gate 53 for sort S12, and by the linear velocity of the letter. In the machine chosen to illustrate this invention, the distance from the scanning head 47 to the last gate 53 is 50 inches and

the letter velocity is 120 inches per second. At this velocity, approximately 415 milli-seconds elapse between the time that a letter code is read and the time that the leading edge of the letter reaches the last sort gate. If storage were not provided at the second six drivers 85 to 90, the minimum interval between letters would be 415 milliseconds, and if letters were presented to the scanning head at less than this minimum interval, missorts would result.

By providing storage capability in the second six drivers **85** to **90** and triggering said second six drivers with the second edge detector **59**, the effective thru-put rate of the sorter is doubled. The minimum letter interval is now determined by the letter velocity and the distance from the scanning head **47** to the second edge detector photo cell **53**. In the illustrative embodiment this distance is 28 inches, and at a letter velocity of 120 inches per second, is equivalent to a time interval of 232 milliseconds. This means that letters can be presented to the scanning head **47** at intervals which are slightly greater than 232 milliseconds without chance of missorts. The intervals must be slightly greater, since the second edge detector **53** must be given an opportunity to function before the reset gates of the bit flip-flops **66** to **69** are triggered by the next envelope. In other words, within 232 milliseconds from the time its code is read, any given letter has either been sorted into one of the first six pockets, or its letter code has been transferred from the bit flip-flops **66** to **69** to the solenoid driver flip-flops **85** to **90** which operate the second six sort gates S7 to S12. In either case, the bit flip-flops can be cleared and a new code entered without affecting the previous letter.

The principle of dividing a plurality of sorts into modules made up of groups of sorts in order to increase, or at least to maintain, a predetermined thru-put rate can be extended almost indefinitely. An arrangement involving three modules, as an example, is shown in FIG. 9. In that figure, a code format using five code bits is used, which theoretically will yield thirty-two unique combinations and therefore thirty-two possible sorts. For simplicity only eighteen sorts are shown in FIG. 9, said eighteen sorts being divided into three modules (M1, M2, and M3) of six sorts each. Module M1 has sorts 1 to 6, M2 has sorts 7 to 12, and M3 has sorts 13 to 18.

At the reading head, which may be located at the same position in the sorter as head **47**, five photocells **97–101** are used to pick up the five code bits which may be identical in form to those shown in FIG. 8. The pulses from photocells **97–101** are fed to individual amplifiers **102–106** and the amplified pulses are then connected to the set gates of a first bank of flip-flops **107–111**, said flip-flops having been first reset and then sampled by the one-shot pulse of a first edge detector designated generally by reference character **112**. If the letter code read is for one of the six sorts in the first module M1, then the appropriate solenoid driver **113–118** and the sort gate operated thereby will be actuated to deflect the letter into the proper bin before it reaches the second edge detector.

If the letter code is for a sort in the second module M2, no sort gate is actuated until the letter reaches a second edge detector designated generally by reference character **119**. This second edge detector may be identical to the first edge detector and is located physically between the sixth and seventh sort gates. The function of the second edge detector **119** is to transfer the bit code from the first bank of flip-flops **107–111** to a second bank of flip-flops **120–124**. This is accomplished, as before, by the pulse from a one-shot multivibrator included in the edge-detector circuit, which first resets flip-flop **120–124** and then sets the bit code into said flip-flops. As soon as the code appears in the second bank of flip-flops **120–124**, the appropriate driver **126–131** and the sort gate operated thereby will be actuated to deflect the letter into its bin before the letter reaches the third edge detector photocell.

If the letter code is for a sort in the third module M3, no gate is actuated until the letter reaches a third edge detector designated generally by the reference character **132**. The third edge detector is similar in all respects to the first two edge detectors and is located physically between the twelfth and thirteenth sort gates. At this time, the pulse from the said third detector one-shot multivibrator transfers the bit code from the second bank of flip-flops **120–124** to appropriate driver flip-flops **133–138** in the third module M3 which actuate the proper sort gate and deflects the letter into its intended bin.

It may be apparent that additional modules of sorts may be used, with the bit code transferred from one module to the next by edge detectors working in conjunction with banks of bit flip-flops, without in any way decreasing the thru-put rate of the letters. As in the two-module system of FIG. 8, the rate at which letters are sorted, i.e., fed to the first edge detector, is determined by a combniation of the letter linear velocity and the length of *one* module, not by the overall distance between the first edge detector and the last sort gate in the machine.

It may be appreciated that the division of the sort gates into modules is dictated by the travel time of a letter from the pick-off station to the reading head, and by the desire to avoid the use of a plurality of individual reading heads stationed along the path of the letter, or alternatively to avoid the use of complex and expensive memory devices in which to store the code bit information after the reading head has been reset by the next letter. The use of banks of flip-flops intermediate the first and last module, and the use of driver flip-flops in the last module, provides a means for storing code bit information in, and cascading it from, module to module without requiring a duplication of reading heads and without resorting to expensive memory devices.

It is understood that the photoelectric bit scanning devices and edge detectors, the amplifiers, flip-flops, "and" gates and power flip-flops referred to hereinabove, are selected from readily available devices and hence are not described in detail.

We claim:

1. The combination in a device for sorting coded articles in accordance with a bit code associated with each said article of an article pick-off station, a plurality of sort gates, each sort gate being adapted to pass articles having a unique bit code, means for moving an article from the pick-off station to the sort gates, means intermediate the pick-off station and sort gates for reading the bit code on each article, a reference supporting surface at the reading means, and means for operating the sort gates in accordance with the bit code read by said reading means, characterized in that the means for moving an article from the pick-off station comprises means for imparting free flight to said article prior to its reaching the reading means, said free flight terminating on said reference supporting surface, whereby to assure correct referencing of the bit code relative to said reading head.

2. The combination according to claim **1**, further characterized in that said articles are rectangular and relatively flat, said pick-off station comprises a vertical abutment, resilient means for holding said articles with the flat side thereof against said abutment, a window in said abutment, rotatable means adapted to project through said window to contact and propel the article adjacent thereto horizontally, said means for imparting free flight to said article comprising a pair of rollers inclined to the verical to direct the article upward and horizontally, and spaced vertical walls between which the article is guided in its free flight.

3. The combination according to claim **1**, characterized further by bins associated with each sort gate, and transport rollers adjacent the upstream side of each sort gate and adapted to propel an article along sort gate and into the bin associated therewith.

4. The combination according to claim **1**, characterized further in that said sort gates are arranged in pairs dis-

posed one on each side of the path of said article, and said pairs are arranged substantially equi-distantly along said path of said article.

5. The combination according to claim 4, characterized further in that said pairs are divided into modules, said means for moving an article from the pick-off station comprising transport rollers in each module adapted to move an article therethrough, and means for synchronizing the operation of the pick-off station with said rollers whereby to cause the maximum time of an article to move through a module to be less than the time interval between successive articles moving through the pick-off station.

6. The combination according to claim 4, characterized further in that said sort gates are divided into adjacent modules along the path of said articles, means at the entrance to each module for detecting the presence of an article threat, means associated with each module for storing code bit information obtained by the reading head, and means controlled by said article detecting means for transferring the information from one storing means to the adjacent downstream storing means.

7. The combination according to claim 6, characterized further in that said storing means comprises flip-flops adapted to be set in accordance wtih said code bit information.

8. The combination in accordance with claim 6, characterized further by solenoids for operating said sort gates, solenoid drivers for said solenoids, and means controlled by said flip-flops for controlling operation of said solenoid drivers, the drivers for the solenoids in the last module in the path of the articles comprising power flip-flops.

9. The combination in accordance with claim 1, characterized in that said articles are rectangular letter envelopes, and the bit code format comprises a series of vertically spaced bars disposed a predetermined distance from the leading vertical edge of said envelope.

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