Jan. 2, 1962 M. M. LEVY 3,015,389

FEEDING MECHANISM AND METHOD FOR FLAT ARTICLES

Filed Dec. 18, 1959 3 Sheets-Sheet 1

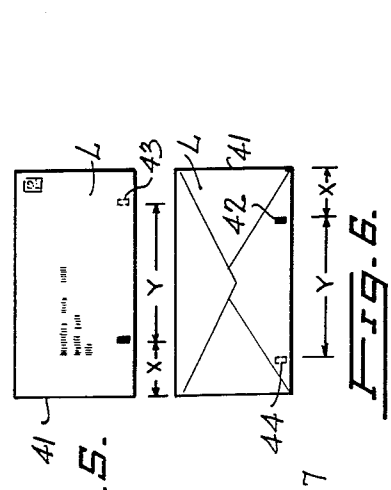


FIG. 5.

FIG. 6.

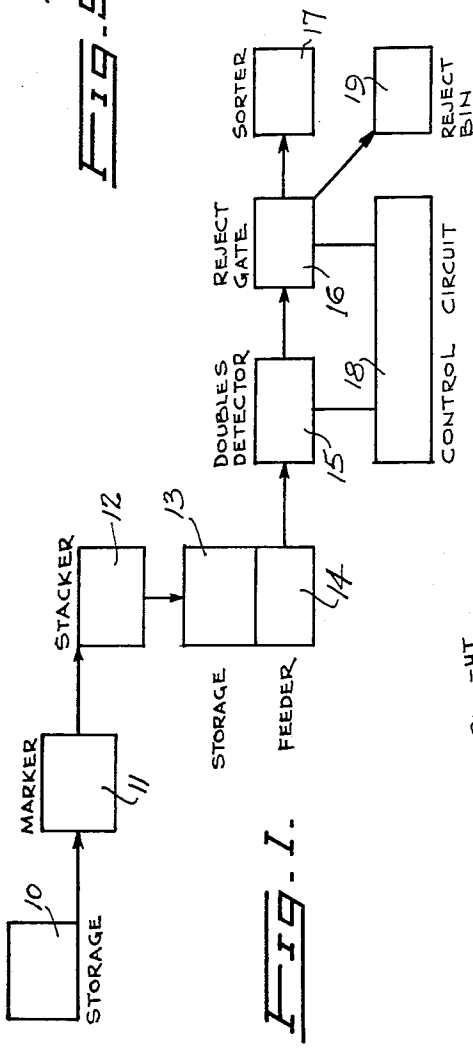


FIG. 1.

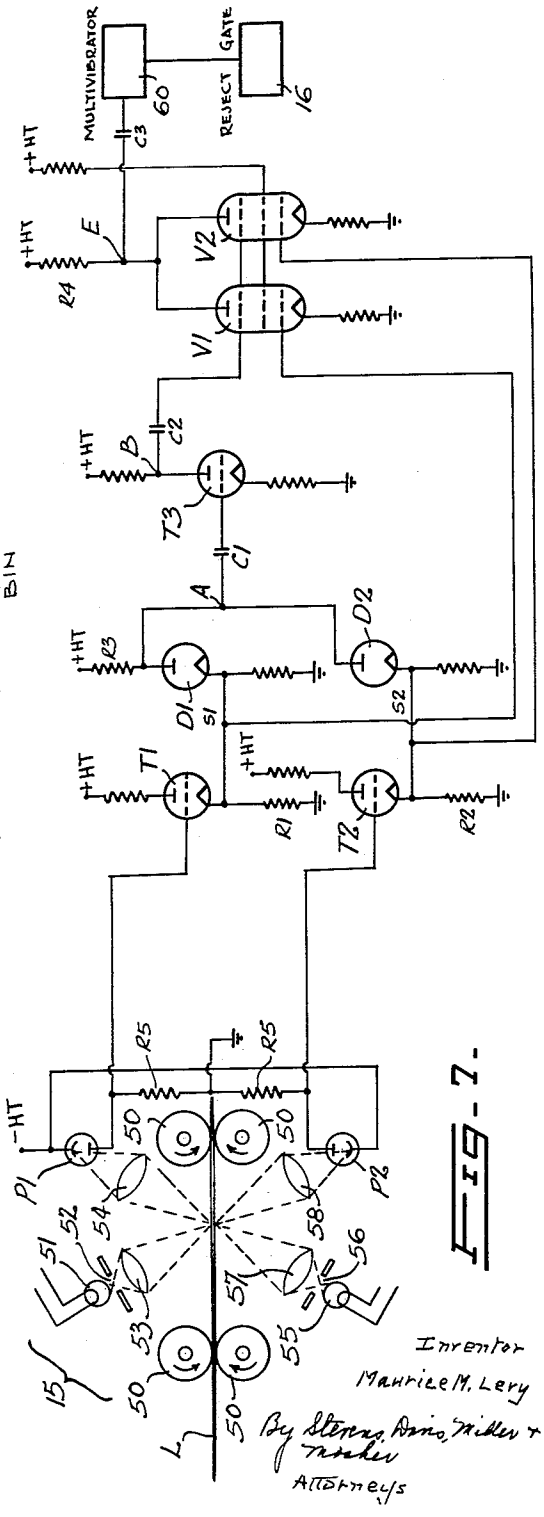


FIG. 7.

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FEEDING MECHANISM AND METHOD FOR FLAT ARTICLES

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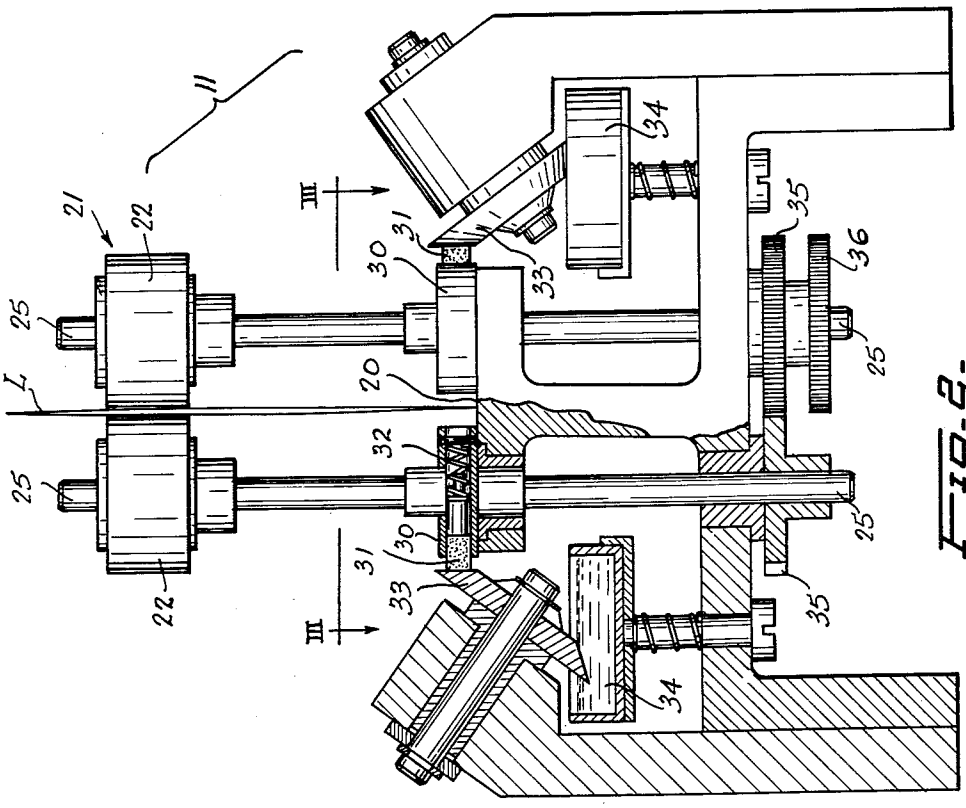


Fig. 2.

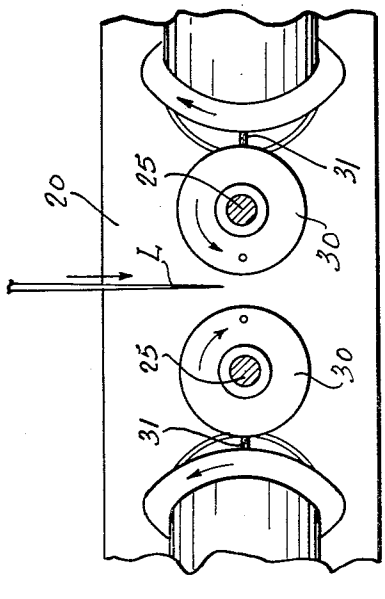


Fig. 3.

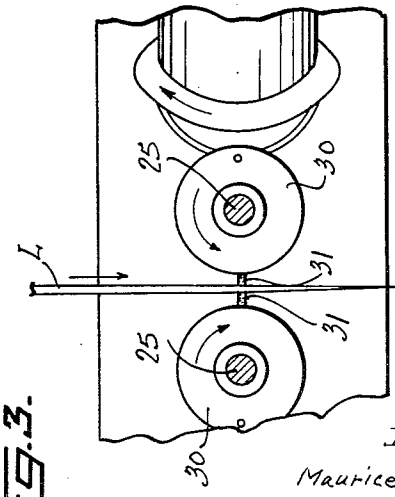


Fig. 4.

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FEEDING MECHANISM AND METHOD FOR FLAT ARTICLES

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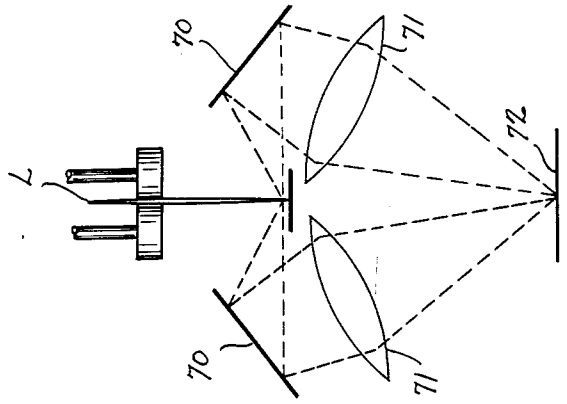


Fig. 11.

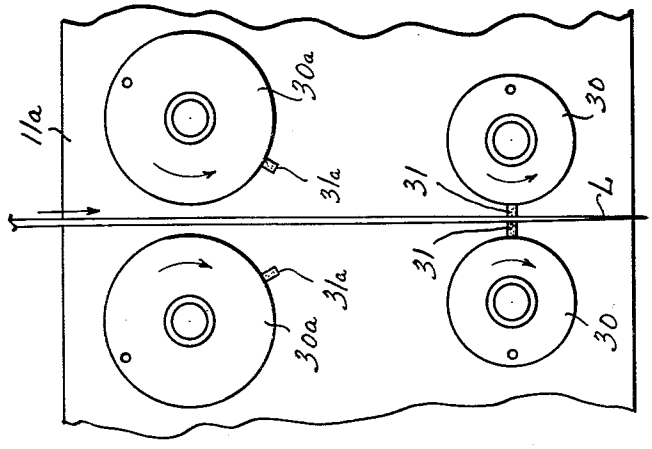


Fig. 8.

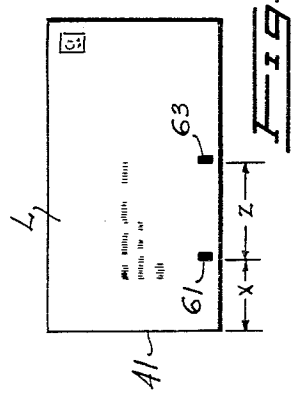


Fig. 9.

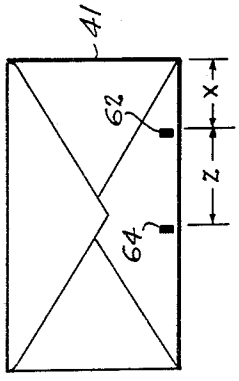


Fig. 10.

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3,015,389

FEEDING MECHANISM AND METHOD FOR FLAT ARTICLES

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Filed Dec. 18, 1959, Ser. No. 860,594
11 Claims. (Cl. 209—111.5)

This invention relates to a feeding mechanism and method for flat articles such as letter mail. The invention is primarily directed towards the handling of letter mail (including postcards but excluding parcels) because it is in this field that the disadvantage which the invention sets out to minimise is principally experienced. The invention is, however, applicable to the handling of other flat articles such as punched cards and bank notes that are stored in large numbers and at various times sorted, stacked or otherwise individually manipulated. The invention will be exemplified with reference to its use with letter mail, but this is for simplicity of illustration and is not intended to exclude its use for the handling of other articles to which it is obviously applicable.

The modern mechanisation of postal operations requires the handling of letters accurately, reliably, and at high speeds. Machines are now in existence for automatically franking and cancelling the stamps on letters, and machines have also been developed for applying coded addresses to letters and for automatically reading such codes and sorting the letters accordingly. One difficulty which arises in the high speed handling of letter mail is the tendency of two or more letters to become interlocked with each other. Envelopes often have partially or wholly unsealed flaps and other ungummed edges which can readily become interlocked with those of another letter when the letters are lying face to face in a stacker. As a result, when the letters are withdrawn from the stack to be fed individually into some instrumentality, such as a sorter, every once in a while the mechanism will feed a "double" which is the term applied to a plurality of letters or other items of letter mail that have become interlocked with one another sufficiently to withstand the tendency of the feeding mechanisms to separate them.

The present invention is concerned with a system for detecting such doubles, so that they can be deflected from the main stream of mail handling, either for mechanical or manual separation, as necessary.

Apparatus illustrating a manner of carrying the invention into practice is shown by way of example in the accompanying drawings.

FIGURE 1 is a schematic layout showing the whole system;

FIGURE 2 is a vertical cross-sectional view of the marker used in this system;

FIGURE 3 is a fragmentary view taken on the line III—III in FIGURE 2;

FIGURE 4 is a view similar to FIGURE 3 showing the parts in another position;

FIGURE 5 is a view of the front face of an envelope illustrating markings thereon;

FIGURE 6 is a rear view of the envelope of FIGURE 5;

FIGURE 7 is a diagrammatic view of the doubles detector and details of the control circuit seen in FIGURE 1;

FIGURE 8 is a plan view illustrating a modified construction of marker;

FIGURE 9 is a view of the front of an envelope marked in accordance with the modification of FIGURE 8;

FIGURE 10 is a rear view of the envelope seen in FIGURE 9; and

FIGURE 11 is a diagram illustrating a manner of comparing the envelope markings manually.

FIGURE 1 shows the over-all system. Letter mail is assumed to be initially in storage **10**, from whence it is fed by conventional feeding means to a marker **11**, from which it passes by a suitab'e conveyor to a stacker **12**. Although the mail so stacked may immediately be forwarded to the sorter, it is common for there to be an intermediate period of storage, for which reason the mail is shown as passing to storage **13**. When the time comes to sort this marked mail, it will be fed by feeder **14** through a doubles detector **15** from whence it passes through a reject gate **16** to the sorter **17**. The doubles detector **15** feeds a control circuit **18** which operates the reject gate **16**. In the event that a letter is rejected by gate **16**, it passes to a reject bin **19**. The storage devices, stackers, feeder, reject gate and sorter are all elements previously known and no attempt will be made herein to describe their specific structures. The present invention is concerned with the use in a system of this type of the marker **11** and the doubles detector **15** with its associated control circuit **18**.

One form of marker **11** is shown in FIGURES 2, 3 and 4. FIGURE 2 shows a letter L resting on a plate **20** and being fed forwardly in a vertical position by means of a pair of feed rollers **21**. Each such roll **21** includes a rubber letter-contacting member **22** and is secured to a shaft **25**. As best seen in FIGURE 3, the shafts **25** rotate in opposite directions so as both to feed the letter forwardly. Mounter on the shafts **25** below the rollers **21** are a pair of oppositely disposed marking rollers **30**. Each marking roller **30**, which is close to the supporting plate **20** so as to be in register with the lower edge of the letter L, carries a marking pad **31** which projects from its periphery at a selected point thereon, such pad **31** being resiliently mounted by means of spring **32**. FIGURES 2 and 3 show the marking rollers **30** arranged with their pads **31** in position diametrically opposite the letter L and in contact with inking rollers **33** each of which is advanced progressively by the pad every time a pad **31** comes into contact with it. Rollers **33** acquire ink from a bath **34**. In this way, the pads are kept adequately inked, although, if preferred, one of the newly developed permanently inked marking materials may be used in the manufacture of the pads. No applied inking procedure would then be required. At their lower ends shafts **25** are coupled together by gearing **35**, and a further spur gear **36** is provided for connection to a source of motive power (not shown).

FIGURE 4 shows the circumstances a short time later, after each shaft **25** has rotated through 180° bringing the marking pads **31** into contact with the letter L. The result is the simultaneous imposing of a pair of marks on the lower edge of the letter, one such mark being on each face of the letter. The two marks are necessarily in register with one another, since the shafts **25** are geared together by gearing having a one to one ratio and the pads **31** are originally arranged in alignment with each other. The diameter of the marking rollers **30** will be so arranged in relation to the shortest letter to be handled that the marking pads **31** must contact every letter at least once somewhere along its length. On the longer letters two marks may appear on each side depending on the position of the pads when the letter is fed in. The position along the letter where the marks appear is deliberately made random. The linear speed of pads **31** is made equal to the speed of travel of the letter so as to avoid smudging.

Attention is directed to FIGURES 5 and 6 which show a typically marked letter. FIGURE 5 shows the front face of the letter with a mark **40** applied thereto, the

leading edge of which mark is at a distance X from the leading edge 41 of the letter L. The value of X will vary in a random fashion from letter to letter. FIGURE 6 shows the rear face of the same letter and it will be seen that the companion mark 42 on the rear face of the letter is similarly disposed with its leading edge the same distance X from the letter edge 41. If the letter is long enough to receive a second impression from each of the pads 31, such impressions will appear as a pair of marks 43 and 44, each a further distance Y from the first mark. The value of Y will be constant for any given marker construction.

In the preceding description it has been assumed that the letters are fed correctly from storage 10, that is that each letter is fed individually. This will not always be true; an occasional double will be fed from storage 10. When this happens, the marks 40 and 42 (and possibly 43 and 44) will be placed on the front and back respectively of the two letters, so that the unexposed faces of the letters that lie against one another will be unmarked. Each letter will then have only one marked face, and this fact will be detected subsequently in the doubles detector 15, so that such incorrectly marked letter can be deflected by the gate 16 to the reject bin 19. As well as detecting any such incorrectly marked letters, the doubles detector 15 detects any letters that have been properly individually marked by marker 11 but are fed as doubles by feeder 14.

The letters, when marked, will be passed, as previously explained to a stacker 12 and hence through storage 13 to a feeder 14 which serves to pass the letters individually and with a closely controlled periodicity to the starter 17, doubles detector 15 and reject gate 16 being interposed. Such a feeder 14 may, for example, be of the type described in my Patent No. 2,995,362.

The mechanical structure of the doubles detector 15 is illustrated diagrammatically in the left hand part of FIGURE 7. In this view the letter L is shown being fed forward by two pairs of conventional feeding rollers 50 and being passed with its lower edge on which the marks appear within the optical field of a pair of lamp and photo-cell combinations. A first lamp 51 shines through a slit 52 and lens 53 which focuses the beam onto the lower edge of one face of the letter, from whence any reflected light is collected in lens 54 and concentrated on photo cell P1. On the other side of the letter, and in exact register with the first optical assembly, there is a second similar optical assembly consisting of a lamp 55, slit 56, lenses 57 and 58 and photo cell P2. In this way both faces of each letter are scrutinized simultaneously.

The anodes of the two photo cells P1 and P2 are connected to ground through resistors R5 and each to a respective one of the control grids of a pair of cathode follower triodes T1 and T2, and the cathodes of cells P1 and P2 are each connected to negative H.T. While the cell P1 is receiving light, its cathode is negatively charged so that tube T1 is cut off. Similarly cell P2 manually cuts off tube T2. When either of cells P1 or P2 fails to receive a signal due to the passage of a black mark past the optical field of view of such cell, one or both of the tubes T1 and T2 will be permitted to conduct. When the tube T1 conducts, its cathode potential rises in relation to ground by reason of resistor R1, so that it passes a positive mark-sensing signal S1 to the cathode of diode D1. Similarly, conduction of tube T2 will pass a positive mark-sensing signal S2 to the cathode of diode D2, since tube T2 has a similar cathode resistor R2. The anodes of diodes D1 and D2 are connected together at point A and hence to the positive high tension source through a resistor R3. Point A is also connected to the grid of triode T3 through a capacitor C1. The application of a positive signal to the cathode of one only of either of the diodes D1 and D2 will tend to cause such diode to stop conducting. In other words, the application of such a positive signal will change the normally comparatively low impedance path of the one diode under consideration into a comparatively high impedance path, because the potential of the anodes is common and is determined by the other diode which receives no signal and remains a low impedance path. The two diodes are in parallel so that if only one of them receives a sensing signal, the other will continue to constitute a comparatively low impedance path and effectively short circuit the cut off diode. The main potential drop will thus remain in resistor R3 and the potential of the point A will remain low. On the other hand, should both diodes receive a sensing signal simultaneously, the potential of the point A will rise following the rise of the potential of the cathodes.

This positive signal is applied to the grid of triode T3 which accordingly conducts. Triode T3 works as an amplifier and inverter, converting the positive pulse applied to its grid into a negative pulse at point B. This negative amplified pulse is then passed through capacitor C2 to both the suppressor grids of a pair of pentodes V1 and V2. The control grids of pentodes V1 and V2 also receive the positive signals S1 and S2 from triodes T1 and T2.

Now, if the two signals S1 and S2 appear simultaneously, the control grids of both pentodes V1 and V2 will assume a positive potential, so that these pentodes will tend to conduct. However, if signals S1 and S2 have been received simultaneously, a negative pulse will have been transmitted from triode T3 to the suppressor grids of pentodes V1 and V2 in the manner already described. These latter grids will thus prevent conduction in both pentodes. There will accordingly be no current in the anode resistance R4 of pentodes V1 and V2.

On the other hand, if only one of the signals S1 and S2 is received from triode T1 or T2, one or other of the pentodes V1 and V2 will have its control grid made positive, while no signal will be received from triode T3 on the suppressor grid of either of the pentodes. Thus the pentode receiving the positive signal on its control grid will conduct, and there will be a current in anode resistance R4. This will cause the potential of point E to fall, the resultant negative pulse being transmitted through capacitor C3 to a multi-vibrator 60 which energizes the reject gate 16. The multi-vibrator 60 will be conventional in design and may be replaced by any device that will serve to translate the electrical pulse that it receives from the electronic circuit into the mechanical operation of the reject gate 16. This latter will be a simple mechanical gate which when operated diverts the letter next received into the reject bin 19. The pulse received by the multi-vibrator 60 will be short (as long as it takes a mark to cross the optical field of one of the cells P1 and P2) and the multi-vibrator will serve the purpose of holding the gate 16 open for the necessary length of time to enable the letter to be diverted, and then automatically reclosing the gate so that the next letter will not be diverted unless it too gives rise to a signal at point E. Any relay device which holds in the operated condition for a predetermined time after being actuated could be substituted for the multi-vibrator 60.

The part of the circuit shown in FIGURE 7 containing triodes T1, T2 and T3, diodes D1 and D2 and the suppressor grids of pentodes V1 and V2 operate as a normally open AND gate, since a negative signal to close the gate appears on the suppressor grids of pentodes V1 and V2 whenever a signal is received from both cell P1 and cell P2. No operating signal appears if only one or the other of cells P1 and P2 operates. The two control grids of the pentodes represent a normally closed OR gate (that is they are effective when either cell P1 or cell P2 emits a signal). The effect is thus that of an OR gate feeding through an AND to provide the final required signal at point E. The signal will appear at E only when both the OR gate has been opened by the appearance of

at least one of the signals S1 and S2, and the AND gate has not been closed by simultaneous reception of signals S1 and S2. Thus point E receives a reject signal any time when either cell P1 or cell P2 alone emits the sensing signal which is generated by passage of a mark past the optical field of such cell, but does not emit a reject signal when both cells P1 and P2 emit such a sensing signal simultaneously.

It follows that, when a normally marked letter on which the two marks **40** and **42** are in proper register with each other is fed through the doubles detector **15**, the reject gate **16** will not be operated and the letter will pass properly to the sorter **17**. If an incorrectly marked letter, that is to say a letter that has been marked only on one side as a result of passage of a double through the marker **11**, is passed individually through the doubles detector **15**, a reject signal will result and the letter will never reach the sorter **17**. Similarly, in the event that a pair of letters, each of which has been properly individually fed through the marker **11** and hence properly marked, is fed as a double by the feeder **14** through the doubles detector **15**, it is extremely unlikely that the marks on the two sides of the letter will coincide. This is unlikely, not only because the letters will probably not lie with their leading edges coincident, but also by virtue of the random placing of the marks on the letters. Thus again, the reject gate **16** will be operated.

There is, of course, a chance that the marks on two letters will coincide, although the probability of this happening is very small. It can be calculated having regard to the dimensions involved, in which connection it is especially desirable to keep the width of the marks (that is the dimension in the direction of travel) small. If it is desired to reduce this probability even further, the modification shown in FIGURE 8 can be adopted. In this case, a modified marker **11*a*** has two pairs of marking rollers **30** and **30*a*** bearing marking pads **31** and **31*a***. Rollers **30*a*** are of different diameter from rollers **30**. This arrangement will ensure the presence of two marks on the letter L in the manner shown in FIGURES 9 and 10 where the first marks **61** and **62** formed by marking pads **31** are a distance X from leading edge **41** and marks **63** and **64** formed by marking pads **31*a*** are a distance Z from marks **61** and **62**. This use of two pairs of marking rollers positively ensures two marks on each face of the letter, both such marks being random in position, and thus reduces the probability of a double accidentally having registering marks. Unlike the distance Y which is determined by the dimensions of the apparatus, the distance Z is made random by rotating rollers **30*a*** at a different rotational speed from rollers **30**. Care should be taken to ensure that the linear speed of pads **31*a*** should agree with the linear speed of pads **31** and with the speed of travel of the letter. Otherwise there is danger of smudging. With the roller diameters different, the same linear speed necessarily involves a different rotational speed and hence a different periodicity between rollers **30** and **30*a***. Hence distance Z is random.

In the foregoing description, it has been assumed that normal inking marks are applied to the letters. If preferred, one of the other known methods of marking, such as the use of fluorescent or phosphorescent paint or magnetic powder may be adopted with corresponding modification to the scrutinizing system to make such marks capable of being sensed and identified. It will be appreciated that the marks must be readily distinguishable from other markings that the articles may bear, such as ink writing, typewritten addresses, code marks indicating addresses, or printing.

In addition, the sensing system may be modified by the substitution of other known AND and OR gate circuits connected to obtain the same sensitivity to a single mark on one face of a letter in the absence of a companion mark on the opposite face.

Throughout the foregoing description it has been assumed that the marks on the two sides of the letters are in register with each other. This is the most convenient way to apply the marks, but nevertheless it will be apparent that it is within the broad scope of the invention to space the marks apart a predetermined distance from each other. Thus, while the mark **40** is retained at distance X from edge **41**, mark **42** could be moved to a distance $X+Q$ from edge **41**, Q being a known constant value. The two optical or other detecting systems would then be required to be spaced apart by a distance Q so as to receive the two marks simultaneously, or an electrical delay for the first signal received could be provided equal to the time taken for the letter to travel the distance Q. Such modifications would seem normally only to represent needless complications, and they are mentioned merely to provide a basis for the statement that the invention contemplates the imposition of a pair of marks on the opposite major faces of the letter or other article in any predetermined spatial relationship to each other. This predetermined relationship will normally be registration, but, whatever relationship is chosen, the doubles detector will be set to be sensitive to the presence of any mark which does not bear such chosen relationship to a second mark on the other exposed article face being simultaneously scrutinized. Any mark so detected without a properly placed companion mark will generate the necessary indicating signal.

Although less preferred, the step of detecting and comparing the marks can be carried out manually by means of a pair of optical systems shown diagrammatically in FIGURE 11 and comprising mirrors **70** that reflect the images of the marks on both faces of the letter L, through lens **71** onto a common screen **72**. Visual scrutinizing of the screen can then be employed to detect lack of registration between marks.

I claim:

1. A method of detecting non-individual handling of a plurality of flat articles each bearing a pair of identifiable marks, individual marks of said pair being disposed on respective opposite major faces of each said article in a predetermined spatial relationship to each other, said relationship being the same for all said articles, said method comprising passing such marked articles seriatim and substantially individually along a path of travel while scrutinizing both exposed major faces of each article and detecting any said mark appearing on an article face other than in said predetermined relationship to a said mark appearing on the other article face being simultaneously scrutinized.

2. A method according to claim 1, including the step of diverting from said path of travel the arctile under scrutiny whenever any said mark is detected on an article face other than in said predetermined relationship to a said mark on the other article face under simultaneous scrutiny.

3. A method comprising imposing a pair of identifiable marks on each of a plurality of flat articles, the individual marks of each said pair being imposed on respective opposite major faces of each said article in a predetermined spatial relationship to each other, said relationship being the same for all said articles, passing such marked articles seriatim and substantially individually along a path of travel while scrutinizing both exposed major faces of each article and detecting any said mark appearing on an article face other than in said predetermined relationship to a said mark appearing on the other article face being simultaneously scrutinized.

4. A method according to claim 3, including the step of diverting from said path of travel the article under scrutiny whenever any said mark is detected on an article face other than in said predetermined relationship to a said mark on the other article face under simultaneous scrutiny.

5. A method comprising passing a plurality of flat ar-

ticles substantially individually along a first path of travel and during such passage imposing at least one identifiable mark on each major exposed article face, each mark so imposed on one exposed face bearing a predetermined spatial relationship to a companion mark imposed on the corresponding, oppositely directed, simultaneously exposed article face, said predetermined relationship being the same for all articles while the relationship between the position of each mark and the structural limits of each article in the direction of travel is random, collecting said marked articles and subsequently passing them seriatim and substantially individually along a second path of travel while scrutinizing simultaneously both exposed major faces of each article, detecting any said mark appearing on an article face other than in said predetermined relationship to a said companion mark appearing on the other article face being simultaneously scrutinized, and deflecting from said second path of travel the article bearing any such detected mark unrelated to a companion mark in said predetermined relationship.

6. A method according to claim 5, wherein two identifiable marks are imposed on each major exposed article face, the mutual spatial relationship between said marks being random.

7. Apparatus comprising means for scrutinizing both exposed major faces of each of a series of flat articles having pairs of identifiable marks thereon, the marks of each pair being disposed on respective opposite major faces of each said article in a predetermined spatial relationship to each other, said relationship being the same for all said articles, means for exposing the major faces of said articles seriatim and substantially individually to said scrutinizing means, said scrutinizing means including means for determining the spatial relationship of the marks on the exposed faces of each said article and for detecting the occurrence of any spatial relationship other than said predetermined relationship.

8. Apparatus comprising means for scrutinizing simultaneously both exposed major faces of each of a series of flat articles having pairs of identifiable marks thereon, the marks of each pair being disposed on respective opposite major faces of each said article in a predetermined spatial relationship to each other, said relationship being the same for all said articles, means for exposing the major faces of said articles seriatim and substantially individually to said scrutinizing means, said scrutinizing means including means for detecting each mark of each said pair of marks and generating a corresponding signal, signal comparison means, means for feeding the signals generated in said detecting means to said signal comparison means, said signal comparison means including means for determining the temporal relationship of said signals corresponding to the spatial relationship of said marks and means sensitive to the existence of a mark-indicating signal unrelated to a companion mark-indicating signal in the temporal relationship corresponding to said predetermined spatial mark relationship.

9. Apparatus comprising means for imposing a pair of identifiable marks on each of a plurality of flat articles, the individual marks of each said pair being imposed on respective opposite major faces of each said article in a predetermined spatial relationship to each other, said relationship being the same for all said articles, scrutinizing means, means defining a path of travel, and means for passing such marked articles seriatim and substantially individually along said path of travel past said scrutinizing means to expose both major faces of each said article to said scrutinizing means, said scrutinizing means including means for detecting each mark of each said pair of marks and thereby determining the spatial relationship of said pair of marks to each other, and means operated by said detecting and determining means for deflecting from said path of travel any article on which a said mark is detected other than in said predetermined spatial relationship to another said mark.

10. Apparatus comprising means defining a first path of travel, means for conveying flat articles seriatim and substantially individually along said path of travel, means associated with said path of travel for imposing at a random position in relation to the direction of travel on each of the exposed major faces of each said article a respective one of a pair of identifiable marks disposed in register with each other, means for collecting said marked articles, means defining a second path of travel, means for conveying said marked articles seriatim and substantially individually along said second path of travel, scrutinizing means associated with said second path of travel for scrutinizing simultaneously both exposed major faces of each said marked article, for detecting each said mark thereon and for sensing the presence of a single said mark without an associated registering mark on the opposite exposed article face.

11. Apparatus according to claim 10 including means for diverting an article from said second path of travel and means connecting said scrutinizing means to said diverting means for operating the latter to divert the article under scrutiny whenever said scrutinizing means senses the presence of a single said mark without an associated registering mark on the opposite exposed article face.

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