United States Patent

[11] 3,620,526

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[54] **CONSTANT-SPACE ARTICLE SINGULATOR**
1 Claim, 12 Drawing Figs.

[52] **U.S. Cl.** ..... **271/26 E,** 137/81.5, 271/56
[51] **Int. Cl.** **B65h 3/12**
[50] **Field of Search** ..... 271/26 E, 12, 56, 30 A, 43 A, 62 B; 137/81.5; 73/37.7, 159

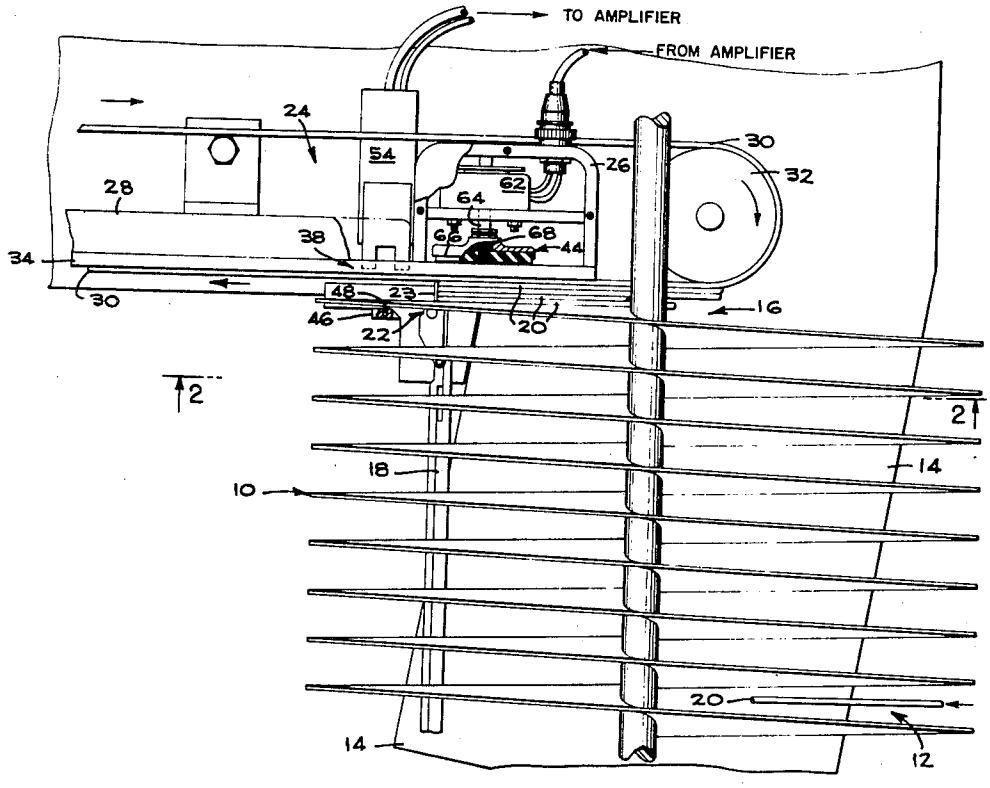
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ABSTRACT: A letter-handling apparatus wherein letters are singulated from a stack of letters and transferred with a uniform spacing along an endless belt utilizes a fluidic edge-sensing device to electrically activate and deactivate a solenoid-operable vacuum pickup box for drawing letters one at a time at equally spaced intervals from the stack of letters. The fluidic edge-sensing device is disposed slightly downstream of the vacuum pickup box so as to sense the leading edge of the first letter withdrawn and simultaneously activate the solenoid to prevent the withdrawal of a subsequent letter until the trailing edge of the first letter passes the sensing device. When the trailing edge passes the sensing device, the sensing device deactivates the solenoid and renders the vacuum pickup box operable to withdraw a second letter.



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SHEET 1 OF 4

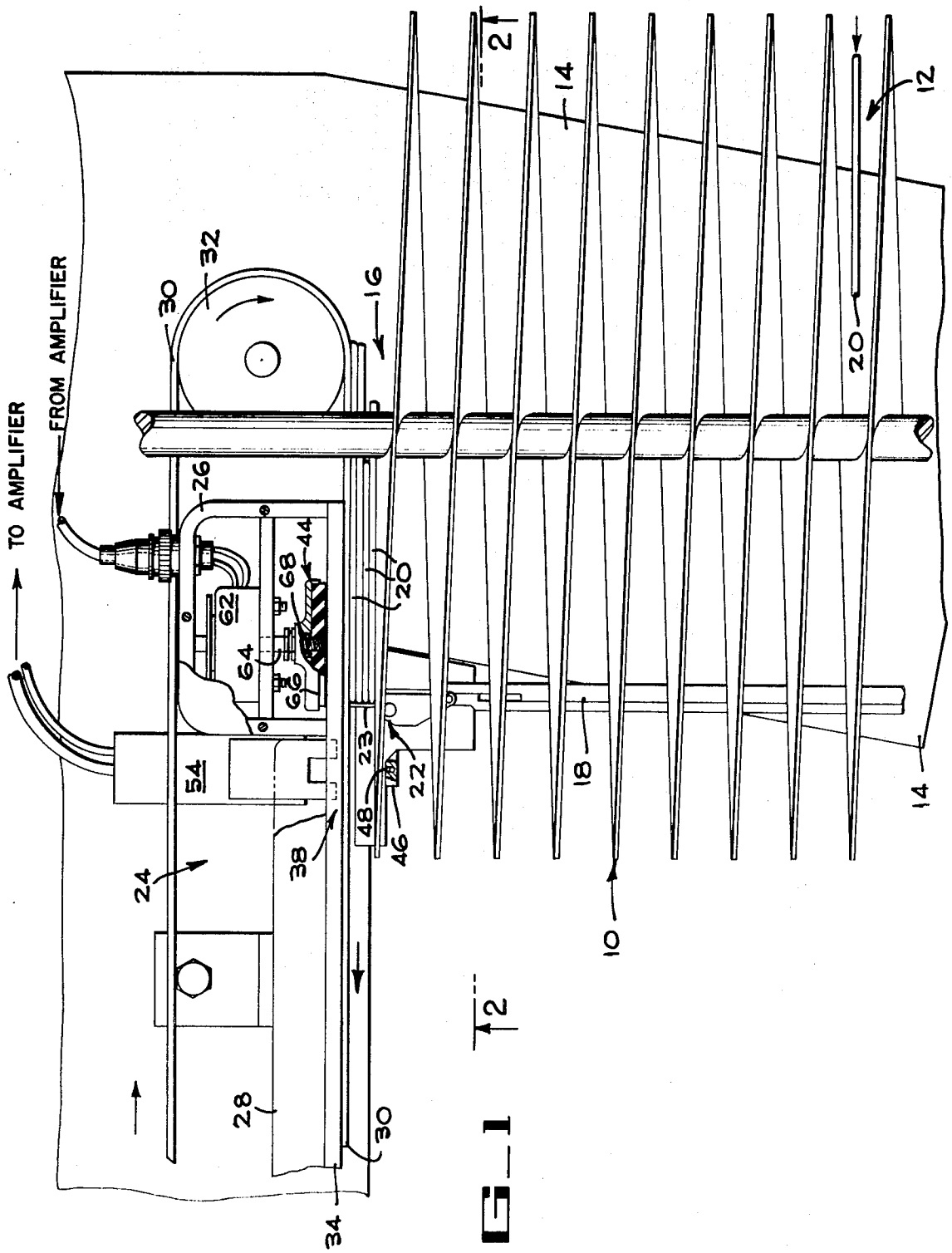


FIG. 1

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C. E. Tripp
ATTORNEYS

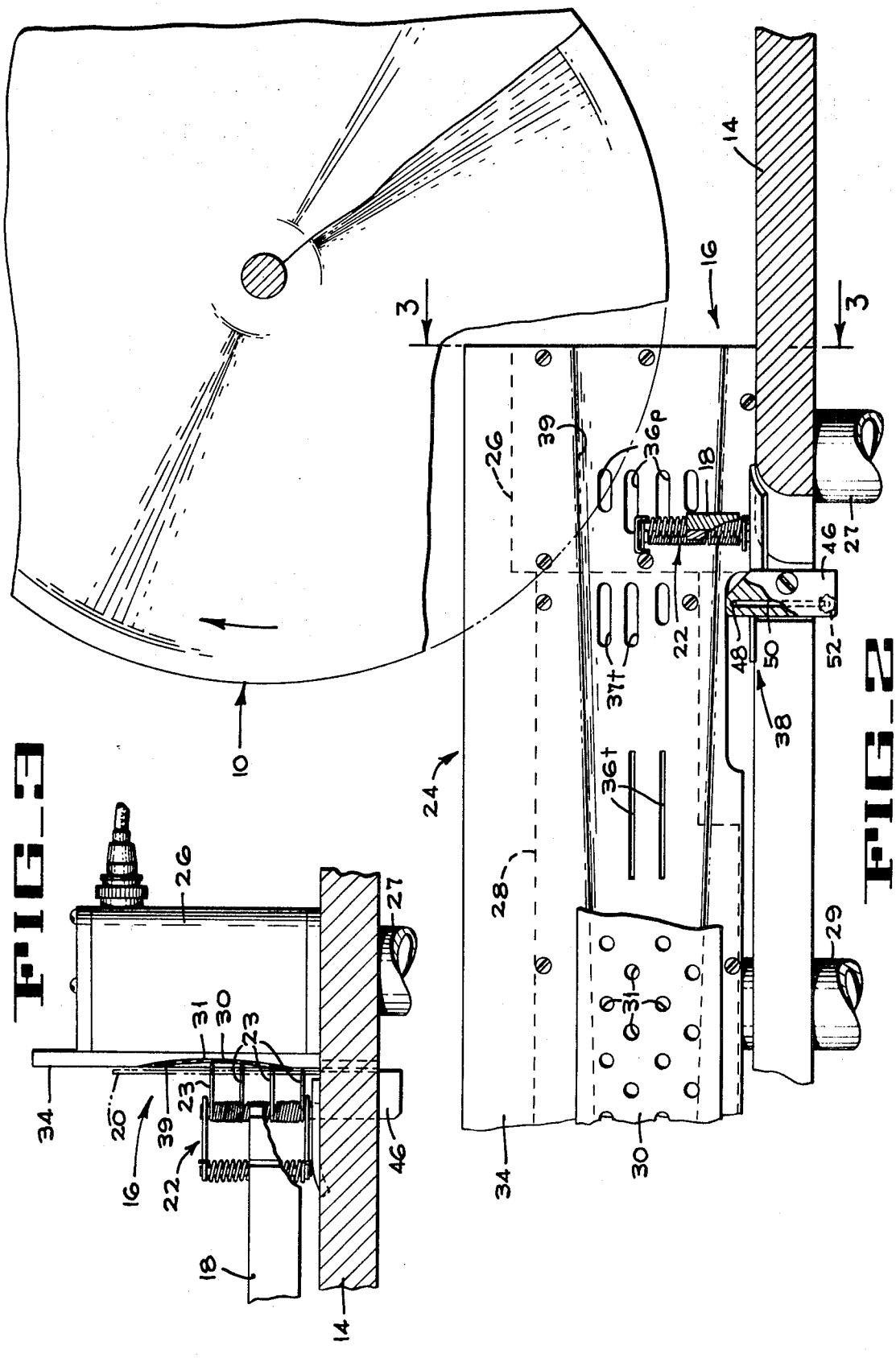

10
14
16
3
3
26
39
36p
18
22
37t
36t
24
28
34
30
31
29
27
46
48
50
52
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FIG_2
FIG_3
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14

FIG_4

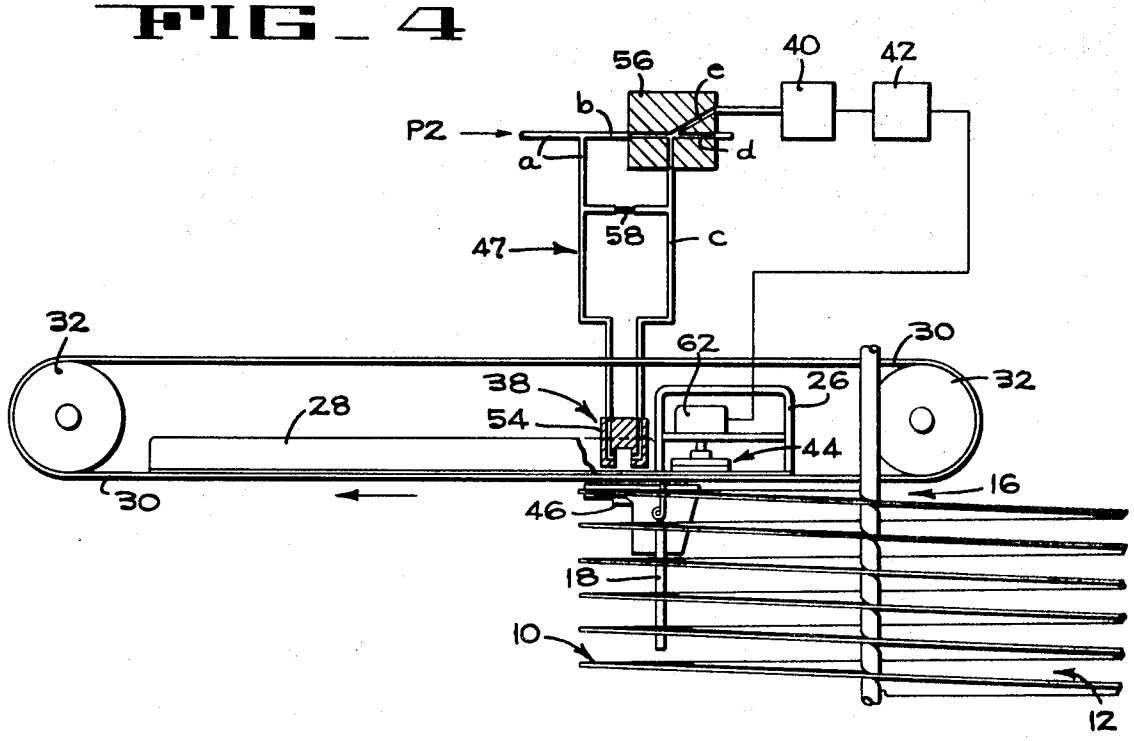


FIG_5

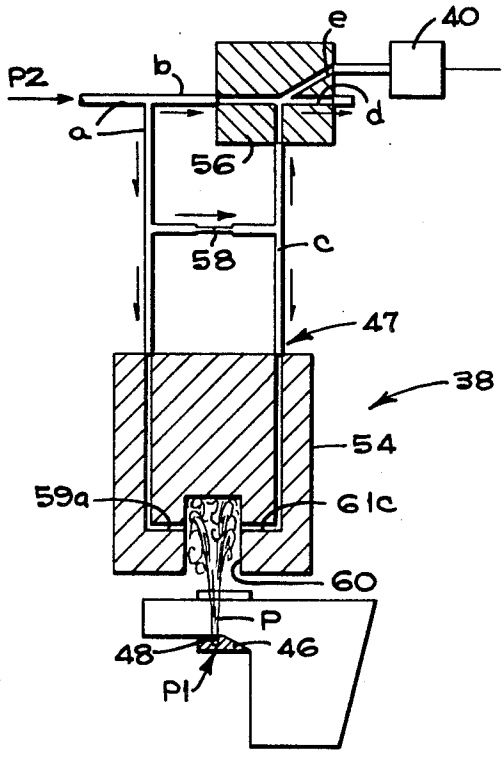
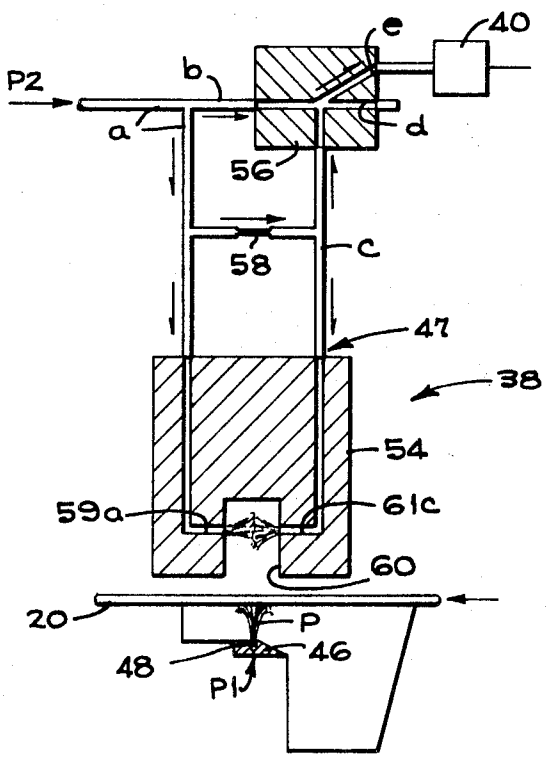


FIG_6



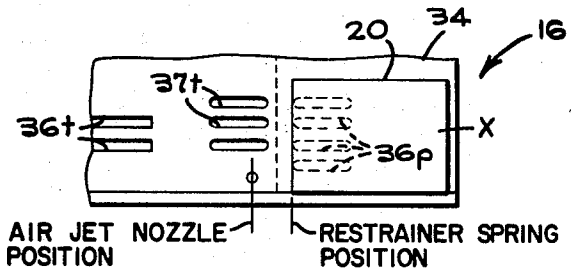


FIG_7A

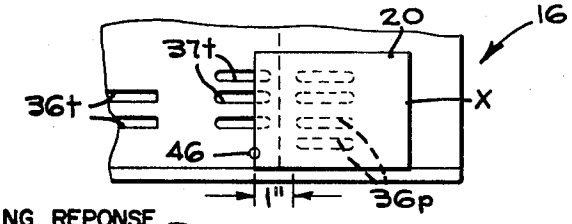


FIG_7B

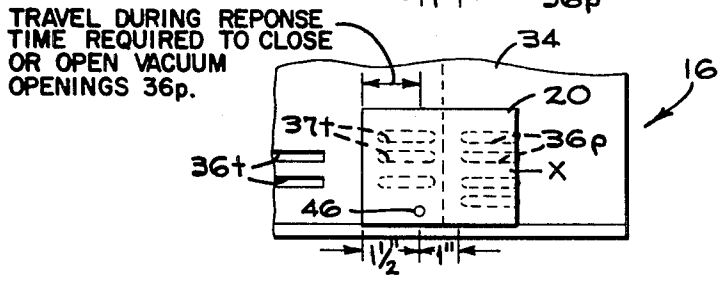


FIG_7C

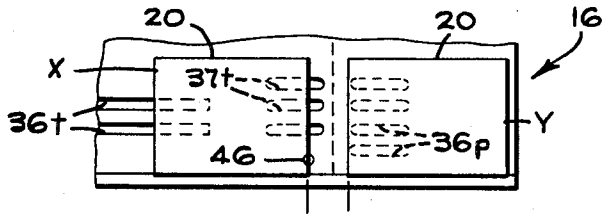


FIG_7D

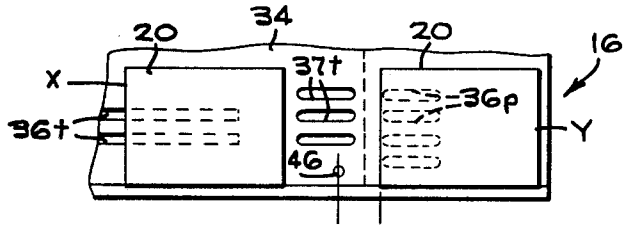


FIG_7E

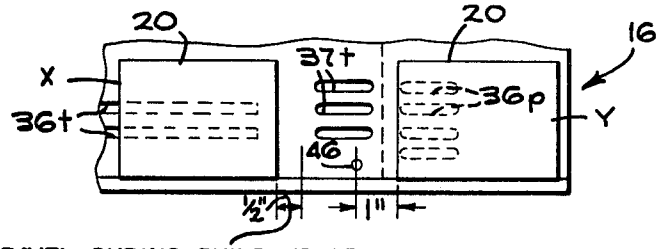


FIG_7F

TRAVEL DURING BUILD-UP OF VACUUM AND INITIAL SLIPPAGE OF LETTER ON BELT.

CONSTANT-SPACE ARTICLE SINGULATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to the handling of planar sheets, paper packets, relatively flat articles, thin packages, and the like, but more particularly to the handling of letter mail.

High-speed automatic mail-handling systems usually employ some form of physical gating to direct the flow of mail of a line of individual pieces into separate channels for subsequent processing. The gating often imposes limits on the speed of mail travel and thus on the total system output. This is due to mass inertia of the gate itself and its associated mechanism. However, an even greater contributory factor to output reduction is the necessity of a definite gap between individual pieces of mail in order that the gate may operate selectively on consecutive mail.

As the physical dimension of machinable mail is variable, within limits, one method of providing such a gap is to ensure that the spacing always is equivalent to the maximum length of mail plus a further increase to allow gating time space on consecutive maximum length mail. This method is obviously inefficient when mail of shorter than maximum length is processed, due to the tremendous waste of otherwise utilizable belt space between the pieces of mail.

The traditional approach to the problem is to employ a fully holed vacuum belt which allows letters to be singulated continuously end to end, with no spaces between, and then to incorporate an acceleration roller or belt in the path of the mail. The leading edge of the mail is accelerated, pulling the letter away from the following piece, thus making a gap between the pieces of mail. While this method is preferable to the first approach, it still leaves much to be desired, since long pieces of mail are subjected to a longer period of acceleration than short pieces, therefore, the gaps generated vary considerably, the large gaps behind the long mail still wasting utilizable space.

Satisfactory results have also been achieved by the use of a plain belt with small groups of vacuum holes spaced approximately average mail length apart. If, for example, the group spacing is 8¾ inches, mail between 4 inches and 9 inches in length will be picked up on each group of holes; but, any mail 9 inches to 12 inches in length will occupy two groups of holes, thus reducing throughput by 50 percent. Furthermore, the shorter pieces on the belt, already with a considerable gap between them, are subjected to an even greater gap by the subsequent acceleration roller which is necessary with this method because mail of average length occupies an end-to-end position on the belt with no gaps between.

As may be deduced, the ideal approach is to generate a constant space between each piece of mail, as short as possible to gain maximum throughput, but long enough to allow satisfactory operation of gating mechanisms, regardless of the length of individual pieces of mail.

To accomplish this, some form of sensing both the leading and trailing edge of varying length mail must be provided, with extremely rapid system response times. Provisional consideration might include photoelectric detection, but experience with this method on mail-handling equipment has proven not entirely satisfactory due to inadequate response time, usually through associated relays, light source failures, high maintenance cost and the ever-present problem of paper dust that tends to obscure the optical components. Consideration might also be given to mechanical detection, however, the cumbersome nature of the equipment and the necessarily slow responses due to mass inertia limit the adequacy of mechanical sensors.

2. Description of the Prior Art

The most pertinent prior art references known to applicant are U.S. Pat. No. 2,856,187 issued to A. Burckhardt et al. on Oct. 14, 1958 and U.S. Pat. No. 2,970,834 issued to S. W. Martin et al. on Feb. 7, 1961.

Both patents disclose letter feeding apparatuses wherein letters are taken from a stack and transferred one at a time by a transfer belt so that they are spaced equidistances from each other. Both apparatuses utilize devices for sensing the leading and trailing edge of a letter being transferred to activate a vacuum pickup port. The Burckhardt et al. apparatus utilizes a photoelectric sensing device whereas the Martin et al. apparatus utilizes a mechanical sensing finger.

SUMMARY OF THE INVENTION

The singulating apparatus of the present invention is adapted for receiving a stream of letter mail, planar sheets, paper packets, relatively flat articles, thin packages, or the like, stacking the articles so that they stand on edge in abutting face-to-face relationship, then singulating the articles one at a time so that they may be transferred in single file with a constant gap between each succeeding article.

Separation of the articles one by one from the stack to uniformly space them on a transfer belt is accomplished with an article-separating device which includes a solenoid operable vacuum pickup box, a continuously operable vacuum transfer box, an endless moving perforated belt cooperating with both of the vacuum boxes, and a fluidic sensing device operable to activate or deactivate the solenoid of the vacuum pickup box upon sensing of the leading or trailing edge respectively of an article passing thereby.

The vacuum pickup box faces the foremost article in a stack of articles with the perforated belt between it and the foremost article. The vacuum pickup box is normally open with the solenoid in a deactivated state so as to draw the foremost article against the perforated belt. The vacuum in the pickup box is sufficient to cause the foremost article to adhere to the belt so that it may be transferred in a direction parallel to the face of the article. Once the article is moved a small distance from its initial position, the transfer vacuum box becomes effective to maintain the adherence of the article to the belt while it passes through the fluidic sensing device. The fluidic sensing device is actuated when the leading edge of the article passes therethrough and deactuated when the trailing edge of the article passes therethrough.

The fluidic sensing device is connected to a transducer to convert the fluidic response into a small electric signal. The electric signal is amplified in an amplifier and used to activate the solenoid in the pickup box.

In practice, most of the fluidic sensing device and the transducer are incorporated into a single compact unit which is simple in design and therefore has good life expectancy and low maintenance cost.

Accordingly, it is an object of the present invention to provide an article-singulating apparatus for quickly and efficiently removing articles from a stack and transferring them single file at a predetermined spacing.

Another object is to provide an article-singulating apparatus that utilizes a fluidic sensing means for detection of the leading and trailing edge of an article that has been removed from a stack of articles.

Another object is to provide an article-singulating apparatus that utilizes a solenoid-operable vacuum box to alternately pick up articles from a stack of articles while getting its energy from a transducer operably connected to the fluidic sensing means.

Still another object is to provide an article-singulating apparatus that has good life expectancy and low maintenance cost.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of the letter-singulating apparatus with a stack of letters thereon and with parts of the apparatus broken away for clarity.

FIG. 2 is a vertical section taken along line 2—2 of FIG. 1 with the stack of letters and parts of the apparatus removed for clarity.

FIG. 3 is a vertical section taken along line 3—3 of FIG. 2 showing the restrainer spring and the concave front of the vacuum plate.

FIG. 4 is a schematic view of the letter singulating apparatus illustrating the cooperation of the fluidic sensing device and the solenoid in the vacuum pickup box.

FIGS. 5 and 6 are enlarged schematic views of the fluidic sensing device to illustrate the operation thereof.

FIGS. 7A to 7F are operational views to illustrate how the predetermined constant spacing of the letters is achieved.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The article-singulating apparatus of the present invention described in connection with the handling of letter mail and best seen in FIG. 1 includes a rotating helix feeder 10 into which incoming mail is fed on edge at feeding station 12. The helix moves the incoming mail on edge along a feeding platform 14 and stacks it on edge in a stack at a singulating station 16. An edging bar 18, disposed parallel to the rotational axis of the helix 10, guides the forward edge of each letter 20 as the helix moves the letter across feeding platform 14 so that the forward edges of all letters in the stack at station 16 are in alignment. The forward edges of the letters 20 at singulating station 16 are held against forward movement by fingers 23 of a pivoting restrainer spring 22 (FIG. 3) so that only the foremost letter in the stack can get past the fingers and then only when it has been separated from the remainder of the stack by the separating device 24 in a manner to be described below.

The separating device 24 includes a vacuum pickup box 26, a continuous vacuum transport box 28, and an endless belt 30 surrounding the vacuum boxes 26 and 28 and having uniformly distributed perforations 31 therein. The perforated belt 30 which is flexible but nonextensible is trained over rollers 32, which drive the belt in the direction indicated by the arrows in FIG. 1. One of the rollers 32 is driven by motor means that is not shown.

The vacuum boxes 26 and 28 face in the general direction of the helix feeder and are connected to vacuum pumps through hoses 27 and 29 (FIG. 2) respectively. Vacuum pickup box 26 is aligned directly with the stack of letters 20 at singulating station 16, being separated therefrom only by the perforated belt 30. A vacuum box faceplate 34, best seen in FIG. 2, is secured to the open front faces of the vacuum boxes, as a part thereof, and contains a plurality of elongated horizontal openings 36*t*, 36*p* and 37*t* aligned with perforations in the belt 30 through which air can pass. The openings 36*t* in front of the vacuum transport box 28 are arranged in two horizontal rows and are small enough so that even continuous exposure to the atmosphere will not destroy the vacuum pressure in the transport box 28. The openings 36*t* are large enough, however, so that the suction exerted therethrough will hold a letter 20 against the belt 30. Three openings 37*t* in the front of the vacuum transport box are larger than openings 36*t* and are located at the end of the vacuum transport box contiguous with the vacuum pickup box. These enlarged openings 37*t* provide a good suction grip on a letter being transferred away from the vacuum pickup box 26 after the vacuum pickup box has been rendered inactive in a manner to be described later.

Elongated openings 36*p* in front of the vacuum pickup box 26 are substantially the same size as openings 37*t* so as to create a strong suction effect on letters disposed in alignment therewith. They are disposed in vertical alignment for good exposure to a letter situated in face-to-face alignment with the pickup box 26. The strong suction is necessary to draw the foremost letter 20 from the stack of letters at station 16 so that the letter will cling tightly to belt 30 and move past restrainer spring 22 which will hold back letters that are not drawn tightly against the belt. The large size of openings 36*p* does not cause a collapse of the pressure in vacuum pickup box 26 because the holes are alternately sealed and unsealed in a manner to be described below, thus avoiding long exposure of the box 26 to the atmosphere. It is understood that other variations in the size, shape, and orientation of the openings 36*t*, 36*p* and 37*t* are possible without hampering or otherwise adversely affecting the operation of the apparatus. It is only important that the overall effect be consonant with the effect set forth above in regard to the preferred embodiment.

Reference to FIGS. 2 and 3 will reveal that the vacuum plate 34 has a tapered concave groove 39 in its face. The groove 39 is provided so that a central portion of the foremost letter in the stack of letters at station 16 will be drawn into the groove leaving the following letter in an erect position thus breaking any vacuum seal that may exist between the two letters. As best seen in FIG. 3, the fingers 23 of the restrainer spring 22 extend into the groove 30 so that they get a better grip on the following letter and are thus more effective in preventing the following letter from being removed with the foremost letter. It should be pointed out that the flexibility of the belt 30 enables it to conform to the curvature of groove 39 so that it will not prevent a letter 20 from being drawn into the groove.

The vacuum transport box 28 is continuously operable to create a continuous suction effect through the belt 30 to hold any letter that passes in front of the box against the belt. The vacuum pickup box 26 is not continuously operable, however, as it is desirous, for reasons to be explained more clearly below, to withdraw letters from the stack at station 16 at spaced intervals so that the letters will be transferred by belt 30 with a predetermined gap therebetween.

The alternating operability of the vacuum pickup box 26 is effected by a fluidic edge-sensing device 38 that is operably connected through a control circuit, including a transducer 40 and amplifier 42 (FIG. 4), to a solenoid operable vacuum control valve 44 disposed within box 26 to seal or unseal the openings 36*p* of the pickup box depending on the signal sent thereto by the fluidic sensing device.

The fluidic sensing device 38 comprises an air jet nozzle 46 and a fluidic sensor 47. The air jet nozzle 46 has an outlet orifice 48 (FIG. 2) connected via passage 50 to an air hose connection 52 for fluid communication with an air supply (not shown). The orifice 48 of air jet nozzle 46 faces the belt 30 and is disposed on the same side of the belt 30 as the letters 20, but it is lower in elevation than the lower edge of belt 30 so that the airstream discharged therethrough will pass beneath the belt. The airstream will not pass beneath letters retained on the belt, however, because discharge orifice 48 is disposed above the level of feeding platform 14 which determines the elevation of the lower edge of the letters. Therefore, letters retained by belt 30 and moving from right to left as viewed in the drawings, will intercept the airstream leaving outlet orifice 48.

The fluidic sensor 47 of the fluidic sensing device 38 is part of a substantially U-shaped element 54 which includes a monostable NOT-module 56 (part of the control circuit) and the transducer 40. The fluidic sensor portion of the U-shaped element 54 contains a system of fluid channels which cooperate with the monostable NOT-module 56 to give small air pressure signals to the transducer 40 in accordance with the presence or absence of a letter 20 in front of the air nozzle 46.

An understanding of the operation of the fluidic sensing device 38 and its cooperation with the transducer 40, amplifier 42, and solenoid operable vacuum control valve 44 is facilitated by reference to FIGS. 4, 5, and 6. Referring first to FIGS. 5 and 6, it can be seen that two air pressure sources are utilized one, P1, to supply air at a constant pressure to the air jet nozzle 46 and the other, P2, to supply air at a constant pressure to the fluidic sensor 47. The air from P2 is fed into a pressure line *a* which is always at the same pressure as an inlet passage *b* to the NOT-module 56. The air in pressure line *a*, however, in split so that part flows through a fixed restrictor 58 and subsequently into an operational line *c*. The terminal ports of the pressure line *a* and the operational line *c* face each

other across a gap 60 at one end of the U-shaped element 54 so that the flow of air out of the respective terminal ports is opposing unless disturbed by some external element, such as the stream of air coming from the air jet nozzle 46. It is of importance to note at this point that at all times there is a positive air pressure at both of the terminal ports to prevent the ingress of dust or dirt into the internal channels. There is a flow differential between the lines *a* and *c* caused by the fixed restrictor 58 so that the planar flow of air from the unrestricted pressure line port 59*a* reduces the outflow of air from the restricted operational line port 61*c* causing an increase in pressure in the operational line *c* over that which would exist if there were no opposition to the outflow from the operational line port 61*c*. This increase in pressure provides the means by which an air signal is sent to the transducer 40 to initiate activation of the solenoid operable vacuum control valve 44.

As mentioned above, air passes into the monostable NOT-module 56 through inlet passage *b*. This air leaves the module through either one of two outlets, but only one outlet, vent passage *d*, is a stable outlet; the other outlet, signal passage *e*, is unstable. Operational line *c* communicates with inlet passage *b* of the NOT-module precisely at the juncture of the outlets *d* and *e* so that a change in pressure in operational line *c* results in a change of the flow of air from one outlet of the NOT-module to the other. In other words, under normal conditions when the airstream from source P1 (the air jet nozzle 46) is passing into the gap between opposing ports 59*a* and 61*c* causing an air turbulence in the gap so that the pressure in operational line *c* is low, the air flowing into the NOT-module 56 will pass out vent passage *d*. However, when the airstream from source P1 does not pass into the gap between ports 59*a* and 61*c*, as when a letter 20 is blocking the airstream, the planar flow of air from port 59*a* across the gap reduces the flow of air from port 61*c* causing an increase in pressure in the operational line *c* which functions to deflect the passage of air out of the NOT-module from the vent passage *d* to the signal passage *e*.

With particular reference to FIG. 4, the signal passage *e* is connected to an air sensitive diaphragm (not shown) of the solid state transducer 40 so that when the flow of air out of the NOT-module is through signal passage outlet *e*, the transducer is actuated and responds by emitting an electrical signal. The electrical signal from the transducer is faint, so it is passed through an amplifier 42 that raises the electrical signal to a level sufficient to operate a solenoid 62 (FIG. 1) in vacuum pickup box 26. An armature 64 of the solenoid 62, which constitutes the plunger of the vacuum control valve 44, supports a sealing cup 66 for movement toward and away from the vacuum plate 34 in direct alignment with openings 36*p* so that when the sealing cup 66 is held against the vacuum plate and covers the openings 36*p*, the vacuum within box 26 is ineffective to withdraw a letter 20 from the stack at station 16. A coil spring 68 within cup 66 biases the vacuum control valve 44 away from the plate 34 so that, upon deactivation of the solenoid, the armature 64 of the valve 44 is quickly forced back, rendering the vacuum pickup box 26 effective to withdraw a letter 20 from the stack of letters. Of course, deactivation of the solenoid is effected when the air outlet from the NOT-module is changed from the unstable signal passage *e* to the stable vent passage *d*.

In accordance with the above, it can be seen (FIG. 5) that normally the air stream from the air jet nozzle passes into the gap between ports 59*a* and 61*c* causing a turbulence of the air in the gap and leaving the air pressure in operational line *c* at its low level; but every time a letter 20 passes between the air jet nozzle 46 and the fluidic sensor 47 (FIG. 6), the turbulence in the gap ceases and the pressure in line *c* increases to effect a fluidic signal to the transducer 40 and thus an electrical signal to operate control valve 44 closing the vacuum pickup box 26 so that no letter will be withdrawn from the stack of letters.

The letter-singulating apparatus described in connection with the present invention can be employed in a mail-handling system where it would precede in sequence a cancelling machine that utilizes a physical gating system to divert letters into different channels according to the orientation of the letter in regard to the position of the stamp thereon. The gating system has a maximum operating speed, so in order to maximize output of the canceler it is important that letters are fed uniformly and at a speed to conform with the operating speed of the gating system. The speed of the input belt of a typical canceler is 550 ft./min., so it is desirable to feed letters to the canceler input belt also at a speed of 550 ft./min. Therefore, to maximize output of the canceler, it remains only to assure that the letters fed to the canceler are constantly spaced a distance sufficient to allow time for the gating system to physically position itself to receive the letters one at a time and yet not make the spacing so great that the gate need wait in one position for a relatively long period of time to receive a letter. If the spacing is too close, there will be a malfunction of the apparatus in that more than one letter will be fed into a gate before the gate has time to physically move to the correct position to receive the second letter. On the other hand, if the spacing between the letters is too great, there will be a waste of time in that the gate will be in position to receive a letter far before the letter arrives. For these reasons it is important that the spacing be accurate and reliable.

It has been found that a spacing of 3 inches between letters travelling at a belt speed of 550 ft./min. permits a maximum output from the canceler used in practice in cooperation with the present singulating apparatus. Reference to FIGS. 7A to 7F will facilitate an explanation of the manner in which the present invention accurately spaces letters at a predetermined gap, in this instance 3 inches, to conform with a belt speed of 550 ft./min. and thus maximum output from the canceler.

FIG. 7A shows a letter 20, designated X for convenience of explanation, positioned as the foremost letter in a stack at singulating station 16 with its leading edge against the restrainer spring 22. Inasmuch as openings 36*p* in vacuum pickup box 26 are normally open, letter X is drawn against belt 30 by the vacuum in box 26 to frictionally engage the belt and thus overcome the resistance of the restrainer spring. The letter travels 1 inch before its leading edge interrupts the stream of air emanating from the air jet nozzle 46 (FIG. 7B). The vacuum control valve 44 is then activated as discussed above to close openings 36*p* and render ineffective pickup box 26. During the response time required to activate control valve 44 (about 13.6 milliseconds) the letter X travels 1½ inches to a position shown in FIG. 7C. Until the trailing edge of letter X passes the air jet nozzle position (FIG. 7D), the vacuum pickup box 26 is ineffective to withdraw the next letter Y at the singulating station. However, as soon as the trailing edge of letter X passes the air jet nozzle 46 (FIG. 7D) air from the nozzle passes into gap 60 of the fluidic sensor to deactivate the vacuum control valve 44 and render effective the vacuum pickup box 26. Again, during the response time required to deactivate the control valve (about 13.6 milliseconds), the letter X will travel 1½ inches to the position shown in FIG. 7E. At this point the trailing edge of letter X is spaced 2½ inches from the leading edge of letter Y but due to initial slippage of letter Y on belt 30 and the time required for the vacuum to build up sufficiently to draw the letter Y against the belt 30, letter X has travelled another half inch to the position shown in FIG. 7F and is thus spaced 3 inches (the desired spacing) from letter Y. The above sequence is, of course, repeated as long as there are letters at station 16 to be singulated from the stack.

It is to be understood that the apparatus is not limited to spacing letters 3 inches apart as the belt speed could be altered to achieve a different spacing or the air jet nozzle moved nearer or further away from the restrainer spring to achieve the same result. A 3-inch spacing is illustrated only as an example to facilitate an understanding of the invention.

In operation, letters 20 are fed on edge by any suitable means into the rotating helix feeder 10 at feeding station 12 whereupon the letters are transferred along feeding platform 14 with their leading edge against the edging bar 18 until they

reach singulating station **16** where they are stacked on edge in abutting facelto-face relationship. At the singulating station **16**, the restrainer spring **22** prevents letters from being frictionally moved away from the station by the moving perforated belt **30** unless the foremost letter in the stack is drawn tightly against the belt by the vacuum in pickup box **26**. In this instance, and only in this instance, can the foremost letter get past the restrainer spring because of the magnitude of the biasing force of the spring requiring a letter to be tightly gripped by the belt to overcome the biasing force. The vacuum pickup box **26**, which faces the foremost letter in the stack at station **16**, is normally open and operable to withdraw a letter **20** from the stack of letters causing tight frictional engagement of the letter against the moving belt **30**. Once the letter is so engaged it overcomes the resistance of restrainer spring **22** and begins to travel on the face of belt **30** toward the vacuum transport box **28**. A small movement of the letter places the forward portion of the letter in a position to overlie openings **37***t* communicating with the continuously operable vacuum transport box. Immediately after the letter comes under the influence of the vacuum transport box the leading edge of the letter intercepts the flow of air emanating from orifice **48** of the air jet nozzle **46**. The letter prevents the nozzle air from flowing into gap **60** of the fluidic sensor thus causing an increase in pressure in operational line *c* of the sensor so that air entering the NOT-module through inlet passage *b* is deflected from its normal travel out vent passage *d*, and passes through signal passage *e*. The air passing through signal passage *e* is received by transducer **40** which converts the fluidic signal into an electric response. The response is amplified in amplifier **42** and utilized to operate the solenoid **62** of vacuum control valve **44** to render the pickup temporarily ineffective to withdraw another letter from the stack. As pointed out above, the response time, from the moment a letter **20** passes air jet nozzle **46** until the moment the vacuum control valve **44** has opened or closed, is extremely rapid, about 13.6 milliseconds. Once the trailing edge of the letter passes the air jet nozzle **46**, the flow of air emanating from the nozzle again passes into gap **60** of the fluidic sensor and accordingly, lowers the pressure in operational line *c* so that the air leaving NOT-module **56** is diverted back to its stable vent passage outlet *d*. This cuts off the electric signal to the vacuum control valve **44** so that bias spring **68** can return valve **44** to its normally retracted position. The vacuum pickup box **26** is then open and operable to withdraw the new foremost letter **20** in the stack at station **16** to begin an identical cycle. Continuous operation of the apparatus uniformly spaces the singulated letters on belt **30** so that they can be fed into a canceler at the desired speed and predetermined spacing for maximum output of the canceler.

It has been found that the article-singulating apparatus of the present invention is not limited in use to the singulation of letter mail but is equally useful in other environments. In particular it has been proven very useful in the singulation of seed packets that resemble letter mail in physical attributes. Other similar uses of the apparatus will become apparent to those skilled in the art and applicant does not wish to be limited in use to the singulation of letters as herein specifically described.

Although the best mode contemplated for carrying out the present invention has been herein shown and described, it will be apparent that modification and variation may be made without departing from what is regarded to be the subject matter of the invention.

What we claim is:

1. A device for separating relatively thin articles and transferring them single file along a transfer path with a substantially constant space between each successive article comprising in combination means for storing a stack of relatively thin articles, an endless belt having perforations throughout its length and being disposed so that one side engages the foremost article in the stack of articles, means for moving said belt, a first vacuum box disposed on the opposite side of said belt from said stack of articles to create a suction through the perforations in said belt to cause said foremost article to adhere to and be transported by the belt, said first vacuum box having a concave face plate over which the belt passes and into which the foremost article of the stack of articles can be drawn with the belt by the vacuum in said first vacuum box, solenoid operable valve means cooperative with the said first vacuum box to alternately allow and prevent the suction of said box to cause the said foremost article to adhere to the belt, and control means including a fluidic sensing device cooperative with the said valve means and responsive to the position of an article being transferred along said path for controlling the operation of said valve means, said fluidic sensing device including an air nozzle disposed on one side of said belt and a fluidic sensor disposed on the opposite side of said belt to receive the stream of air emanating from the nozzle when an article traveling along said path does not interrupt said stream of air, said control means including in addition to said fluidic sensing device, a transducer operatively connected intermediate said fluidic sensor and said solenoid to convert a fluidic signal from the fluidic sensor to an electrical signal to activate the solenoid of the valve means.

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