United States Patent

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[73] Assignee The United States of America as represented by the Secretary of the Army

[54] **FLUIDIC WEIGHING AND SORTING SYSTEM**
5 Claims, 3 Drawing Figs.

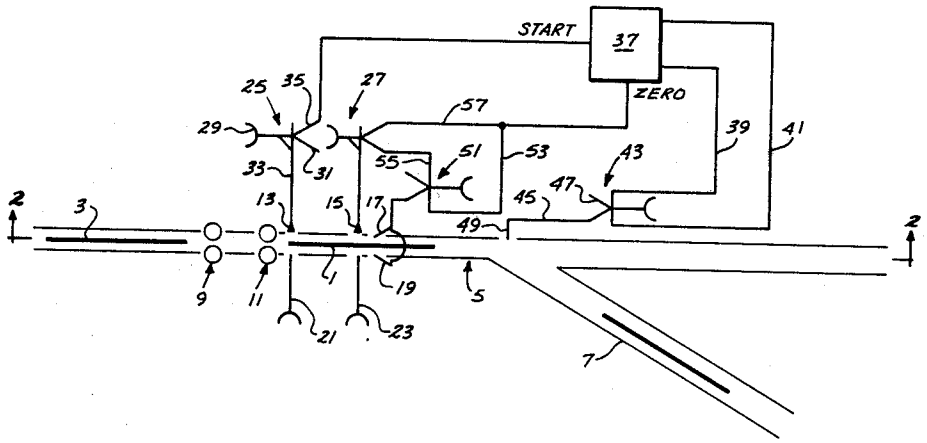
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[50] Field of Search ..... 209/74, 120, 121; 177/(Inquired)

[56] References Cited
UNITED STATES PATENTS

3,317,039	5/1967	Wadey	209/121X
3,369,661	2/1968	Bradshaw	209/121X

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ABSTRACT: A fluidic system for weighing and sorting items transported along a main guide path into a plurality of groups. A predetermined velocity is imparted to the item, which is then acted upon by a retarding means to slow down the item at a rate proportional to the weight of the item. The item actuates a delay means which in turn operates a switching means causing items of a first weight to be diverted into a branch guide while all other items continue down the main guide.



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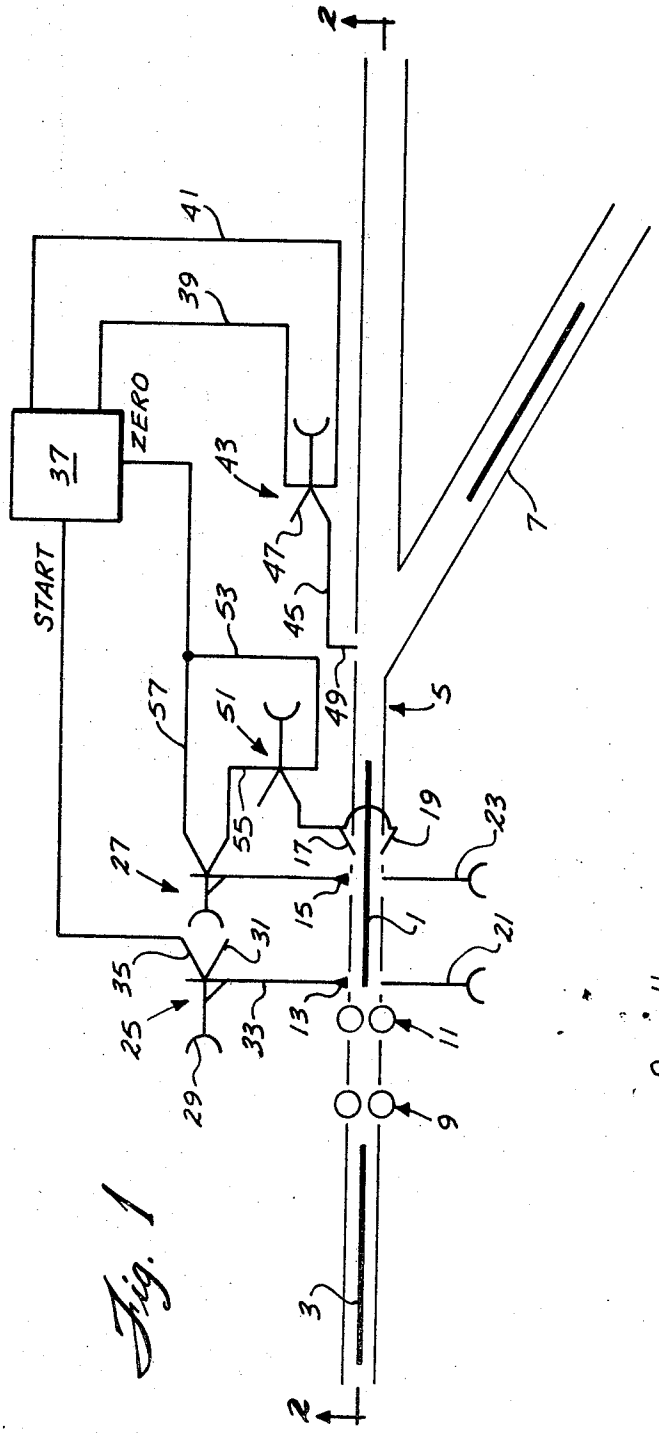


Fig. 1

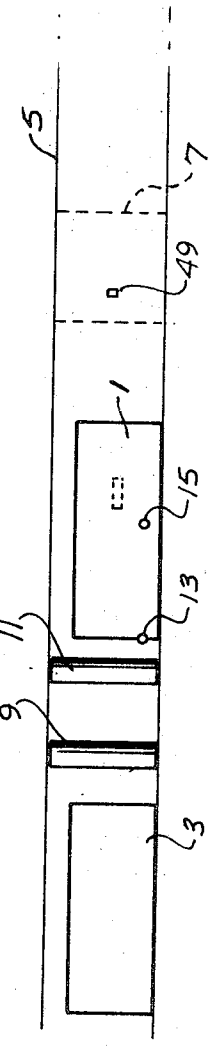


Fig. 2

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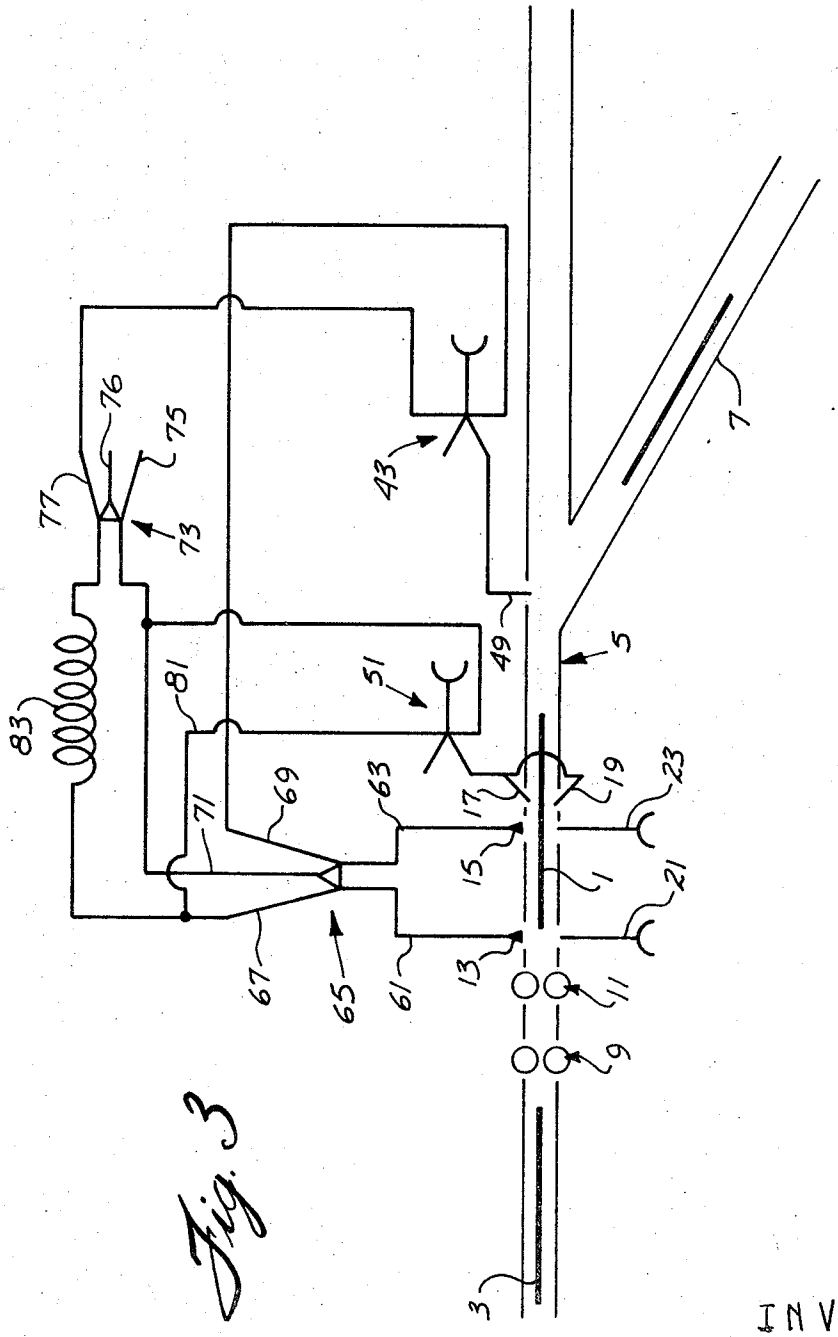


Fig. 3

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FLUIDIC WEIGHING AND SORTING SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to systems for sorting items such as cards, letters and other like items into a plurality of weight groups. Such systems typically employ mechanical parts moving at high speeds to handle and transport the items. Whenever high speed mechanical action is involved, there is always the problem of breakdown of the moving parts or damage to the items caused by jamming or mishandling.

SUMMARY OF THE INVENTION

The present invention avoids the problems of conventional systems by providing a flueric system which operates without moving mechanical parts in the sensing, logic and gating functions. The system comprises a main guide path along which items are carried by fluid flow. The items are launched in the path at a predetermined velocity by pinch rollers turning at a predetermined velocity. A branch guide path is located downstream of the pinch rollers a predetermined distance. As an item leaves the pinch rollers, slowdown jets are energized to exert a uniform fixed force over the same exposed length of each item, thereby retarding the item at a rate proportional to the weight of the item.

A switching fluid amplifier is located adjacent the branch guide path to switch items of a first weight into the branch guide path in accordance with signals received from a delay means and to allow all other items to pass along the main guide. The delay means in one embodiment of the invention includes a timer control and in a second embodiment includes a delay line. The delay means is energized by item sensing means located in the main guide path.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic view of one system embodiment of the invention;

FIG. 2 is a diagrammatic cross-sectional view taken along line 2–2 of FIG. 1; and

FIG. 3 is a diagrammatic view of a second system embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is a diagrammatic view of one system constructed in accordance with the present invention; and FIG. 2 is a diagrammatic cross-sectional view taken along line 2–2 of FIG. 1. A plurality of spaced items 1 and 3 are shown being transported down a main guide path 5 which has a branch guide path 7 joined thereto. Pairs of pinch rollers 9 and 11 are located in main guide 5 to engage the items being transported and impart a predetermined fixed velocity thereto. Spaced from pinch rollers 11 at a distance less than the length of any given item to be transported are sensing ports 13 and 15, and retarding jet nozzles 17 and 19. Sensing ports 13 and 15 receive their inputs from fluid flow through control lines 21 and 23, respectively.

Biased fluid amplifiers 25 and 27 are conventional devices in which a main input at 29 normally produces an output on line 31 in the absence of a bias input on line 33. When a bias input is present on line 33, main input 29 is diverted to output line 35 and remains there until bias input 33 is removed, whereupon the output will switch to line 31. Such elements are conventional in the art and their operation need not be discussed further.

Output line 35 of amplifier 25 is connected to the start input of delay control means 37. This delay control means 37 is a timer having output lines 39 and 41 which form the control inputs to the bistable memory amplifier 43. Amplifier 43 is located at the junction of main guide 5 and branch guide 7. When output line 45 of amplifier 43 is energized, diverting nozzle 49 will cause any item passing along main guide 5 to be diverted into branch guide 7. Diverting nozzle 49 is turned on by an input from line 39 and remains on until an input is obtained from line 41 to cause bistable amplifier 43 to switch to output 47 and be exhausted to the atmosphere or otherwise disposed of.

The retarding jet nozzles 17 and 19 are energized by bistable amplifier 51 which is switched by inputs on control lines 53 and 55. Retarding jets 17 and 19 are turned on by an output on line 55 from amplifier 27. This output occurs whenever sensing port 15 is blocked by an item proceeding down main guide 5. Retarding jets 17 and 19 are turned off by an input on line 53, which is energized by amplifier 27 through output 57 when there is a bias input from sensing port 15 caused by no item being present in that particular portion of main guide 5. Output 57 of amplifier 27 also sets to zero the delay control timer 37, thereby preventing any output on lines 39 or 41.

As the system begins operation, sensing ports 13 and 15 are unobstructed, thereby causing outputs on lines 35 and 57 of amplifiers 25 and 27, respectively. This means that the start input to delay control timer 37 is enabled, but since zero input line 57 is also enabled, there is no usable output from the timer. When item 1 moves to the right down guide 5 and blocks both sensing ports 13 and 15, amplifiers 25 and 27 are switched so that timer 37 has no input either to the start or zero input lines. When amplifier 27 is switched to output line 55, bistable amplifier 51 is switched to turn-on retarding jets 17 and 19 which act against the motion of card 1 being imparted by pinch rollers 11. As the trailing edge of card 1 uncovers sensing port 13, amplifier 25 will be switched back to an output on line 35, thereby starting timer 37. At this time zero input line 57 is not enabled so an output is obtained on line 39 of timer 37 to switch bistable amplifier 43 to output line 45 and energize diverting nozzle 49. There is a predetermined time interval in timer 37 between the occurrence of an output on line 39 before an output will appear on line 41. This time interval must be less than the time required for the trailing edge of any given item to travel from pinch rollers 11 to sensing port 15. Any items passing nozzle 49 during the interval after output line 39 is energized, but before line 41 is energized, will be diverted down branch guide 7. It is the action of retarding jets 17 and 19 that determines which items will be diverted and which will proceed down main guide 5.

The effect of the retarding jets is to decrease the velocity of the transported item, the rate of decrease being a function of the weight of the item. The flow rate and the velocity of the retarding jets are fixed, and all items travel at a constant velocity as they are released from the pinch rollers. Since the length of the item acted upon by the retarding jets is fixed at the distance between the pinch rollers 11 and the retarding jets 17 and 19, the rate of decrease of velocity of the items is primarily a function of the items' weights. By choosing the interval of time between outputs occurring on line 39 and 41 the cutoff weight can be determined for items that are to be allowed to proceed down main guide 5. Since items having greater weight will be less affected by the action of retarding jets 17 and 19 and therefore arrive at branch guide 7 in a shorter time than the lighter items, the continuation of main guide 5 will carry the lighter items, with the heavier items being diverted into branch guide 7.

When the first item 1 has cleared both of the sensing ports 13 and 15 there will again be inputs to the start and zero terminals of timer 37 resulting in no output from timer 37. Diverting nozzle 49 may be off or on depending upon whether or not item 1 was lighter than the required weight to be diverted into branch guide 7 or whether item 1 was diverted into branch guide 7. The condition of diverting nozzle is immaterial, since the next succeeding item will produce a start input to timer 37 when the trailing edge of the item clears sensing port 13, thereby energizing line 39 to divert the output of bistable amplifier 43 to diverting nozzle 49, if the output was not already present there. The sequence of logical operations on succeeding items proceeds in the same manner as that described in connection with item 1, until all of the items have been sorted.

A second embodiment of the invention is shown in FIG. 3 where like components have been shown with like numbers. The sensing and gating functions are the same as those described in connection with the system of FIG. 1 and will not be repeated here. The logic for controlling the operation is different, however, and the description will be devoted to the operation of the logic.

Prior to item 1 entering the main guide path 5, sensing ports 13 and 15 are unobstructed and there is flow in lines 61 and 63 to AND gate 65. AND gate 65 is constructed such that an input on line 61 alone will cause an output to appear on line 67 alone. Similarly, an input on line 63 alone will cause an output to appear on line 69 alone. When both inputs 61 and 63 are present, their combined output is present in line 71 with no outputs on either of lines 67 or 69.

The initial inputs on lines 61 and 63 cause an output on line 71 which is also an input line to AND gate 73. An input on line 71 to AND gate 73 causes an output on line 75 which is exhausted and not utilized. When item 1 interrupts the flow through sensing port 13, AND gate 65 switches to output line 69, thereby switching bistable memory amplifier 43 to its exhaust output if it were not already in such state. As item 1 blocks sensing port 15 both inputs to AND gate 65 are shut off, but this produces no change in the control logic.

When the trailing edge of item 1 clears sensing port 13, input line 61 is energized and produces an output on line 67 of AND gate 65. This action causes an input to bistable amplifier 51 on line 81 and turns on the retarding jets 17 and 19 which had previously been shut off when output line 71 of AND gate 65 was energized. The output on line 67 also passes through delay line 83 to AND gate 73 where it produces an output on line 77. Fluid flow in line 77 causes memory amplifier 43 to switch and energize diverting nozzle 49 if there is no input on line 71.

Let it be assumed that item 1 is light enough in weight so that retarding jets 17 and 19 slow down its forward progress and cause item 1 to exceed a predetermined interval between the trailing edge leaving pinch rollers 11 and clearing sensing port 15. In this case the input on line 63 caused by item 1 clearing sensing port 15 will cause AND gate 65 to switch to an output on line 71. AND gate 73 will therefore be switched away from output 77, but this action will have occurred too late to prevent output 77 from having switched memory amplifier 43 to energize diverting nozzle 49. Since diverting nozzle 49 has been energized, then the light item will be diverted into branch guide 7.

Next, let it be assumed that item 1 is sufficiently heavy so that retarding jets 17 and 19 do not slow the item down and cause the item to exceed the predetermined interval between trailing edge of item 1 leaving pinch rollers 11 and arriving at sensing port 15. The input to AND gate 65 on line 63 produced by the trailing edge of item 1 clearing sensing port 15 will energize AND gate 73 through output line 71. The predetermined interval referred to is controlled by the delay caused by delay line 83. If line 71 is energized prior to a pressure wave or fluid in line 67 passing through the required delay interval of delay line 83 and arriving at AND gate 73, then AND gate 73 will produce an output on line 75. Upon arrival of fluid through delay line 83, AND gate 73 will be switched to an output on line 76, but in no case will an output be produced on line 77 to switch memory amplifier 43 and energized diverting nozzle 49. This action allows item 1 to pass straight down guide path 5 and not be diverted into branch guide 7.

It will be appreciated that the amount of delay in delay line 83 will be the controlling factor as to the cutoff point in item weight between those items diverted into branch guide 7 and those allowed to pass along guide path means 5. By designing the delay line to have the desired delay, the weight factor in the sorting process may be determined.

The items may be sorted into more than two weight groups by additing identical circuits to control additional branch guides.

I claim:

1. A flueric weighing and sorting device for sorting items into a plurality of weight groups comprising:
   - a main guide path;
   - means for launching items in said main guide path with a predetermined velocity;
   - a branch guide path located downstream a predetermined distance from said launching means;
   - means for retarding the velocity of an item at a rate proportional to the weight of the item;
   - switching means for diverting items from said main guide path into said branch guide path;
   - delay means for actuating said switching means; and
   - sensing means in said main guide path adjacent said launching means for controlling said retarding means and said delay means;
   - whereby items of a first weight will be diverted into said branch guide while all other items will continue down said main guide path.

2. The combination according to claim 1 wherein said means for launching comprises a plurality of pinch rollers turning at a constant predetermined velocity.

3. The combination according to claim 1 wherein said means for retarding comprises fluid jet means directed against opposite sides of an item with a predetermined force and over a predetermined length of said item.

4. The combination according to claim 1 wherein said delay means comprises:
   - a timer energized by said sensing means to produce a delayed output which turns off said switching means;
   - whereby any item arriving at said branch guide path thereafter will continue along said main guide path and not be diverted.

5. The combination according to claim 1 wherein said delay means comprises:
   - a delay line energized by said sensing means to produce a delayed output which turns on said switching means,
   - whereby an item arriving at said branch guide path thereafter will be diverted into said branch guide path.