United States Patent

Ruck

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[54] VACUUM GATE

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[52] **U.S. Cl.**.....**271/64,** 271/74

[51] **Int. Cl.**.....**B65h 29/60**

[58] **Field of Search**.....271/64, 74, 76, 26, 45, 75, 271/47, 9, 26 ES, 63

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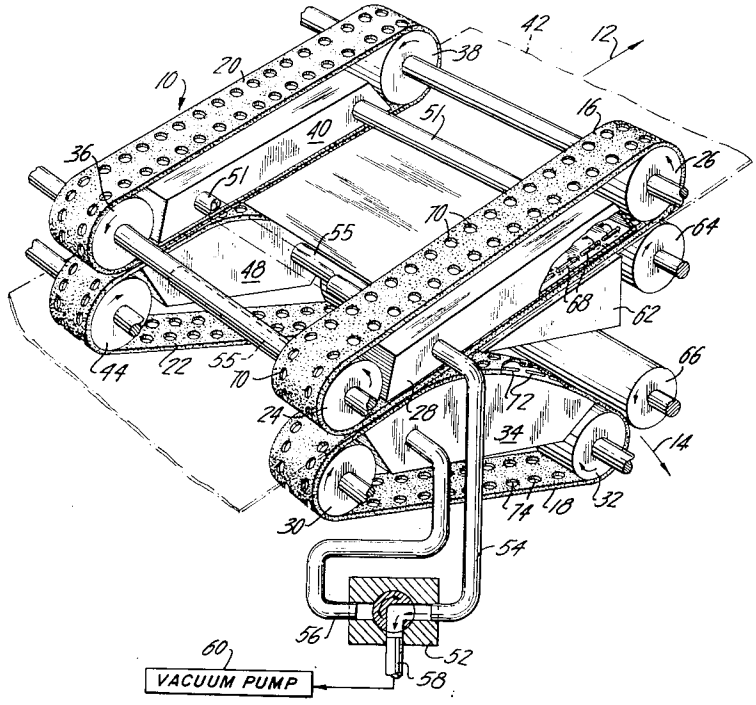
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[57] **ABSTRACT**

Sheets of material can be selectively transported along either of two alternative flow-paths each of which is followed by a continuous perforated belt constrained by guides. A vacuum chamber is disposed along each flow-path adjacent to the belt. The vacuum chambers are connected to a valve which is responsive to a control signal to selectively actuate either or both of the chambers. Sheets of material which enter the apparatus follow the flow-path adjacent to the vacuum chamber which has been actuated. The apparatus can be constructed using four perforated belts, two of which run parallel to each other along each of the flow-paths.

7 Claims, 2 Drawing Figures



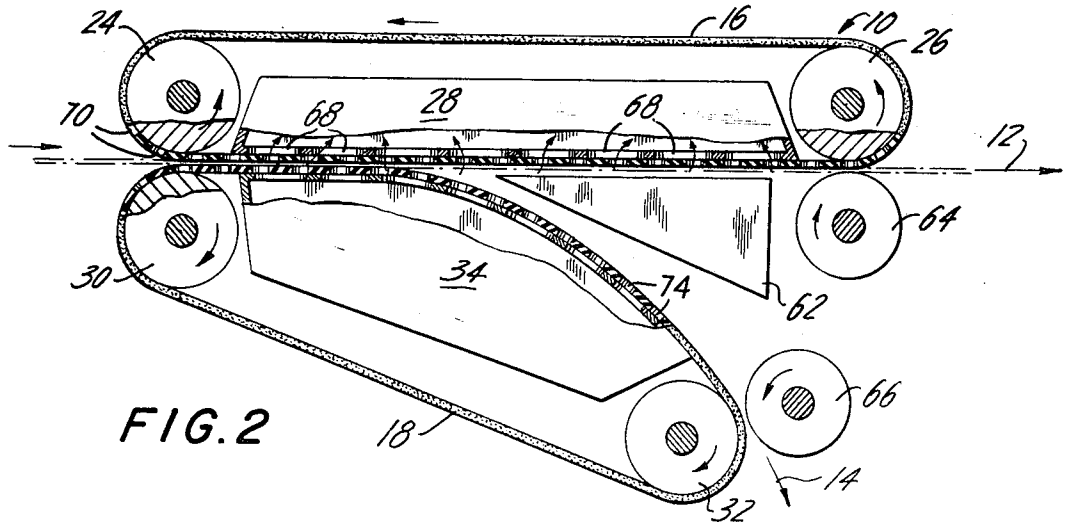


FIG. 2

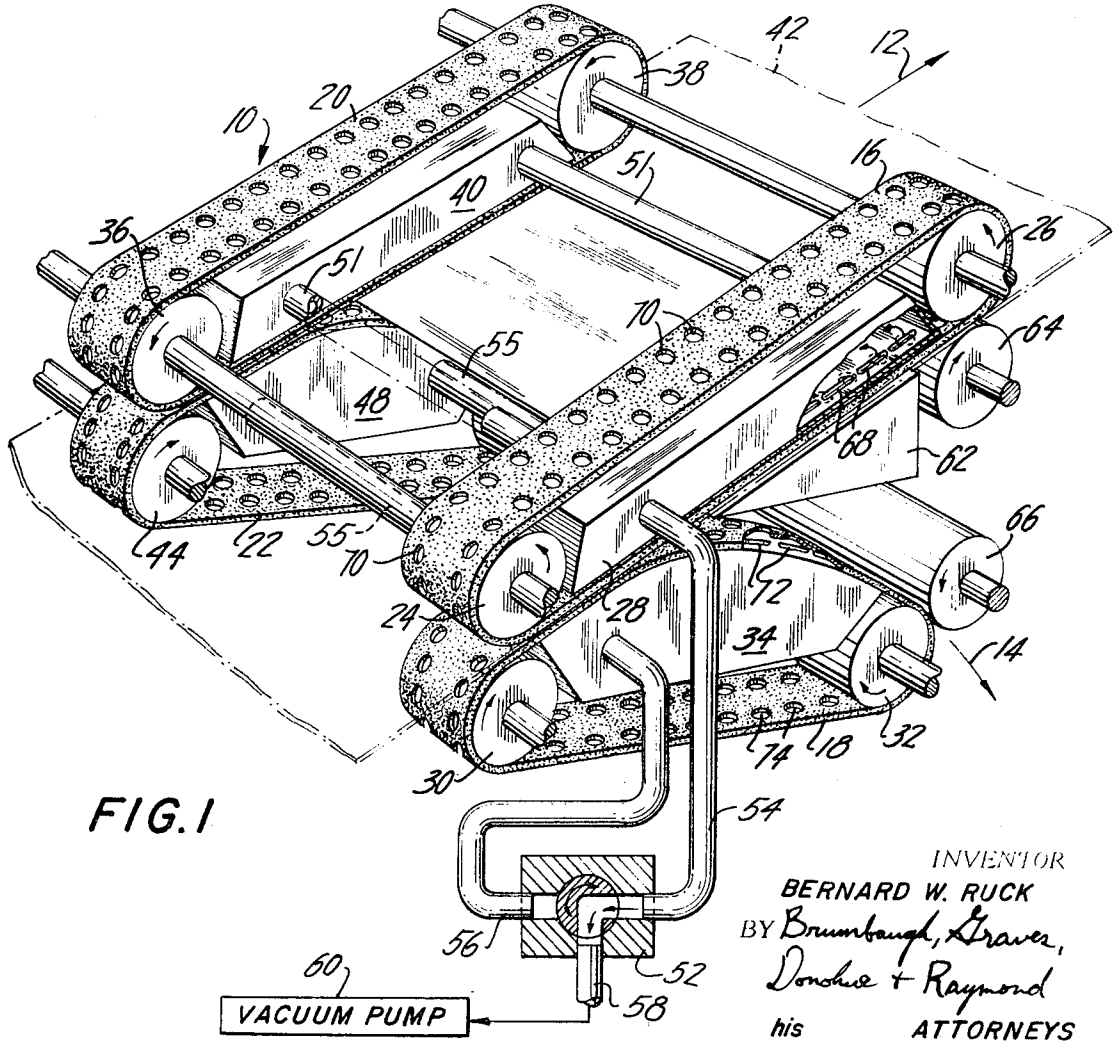


FIG. 1

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VACUUM GATE

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus for handling sheets of material, and more particularly, an apparatus in which sheets of material can be selectively caused to follow either of two flow-paths defined by perforated belts to which a vacuum is applied.

Electronic document reading and sorting devices of various types are currently being utilized to an increasingly great extent. This is true, for example, in the instance of both optical readers and devices which read magnetic or electrically conductive indicia printed on the documents. The efficient utilization of these devices requires that they be combined with mechanical apparatus that can accurately and reliably handle large numbers of documents within short periods of time.

Conventionally, documents are transported over rollers or conveyor belts which are combined with movable elements that form gates to divert the documents into appropriate flow-paths. Apparatus of this type sometimes employ vacuum operated components to hold and move the documents.

The speed of conventional document transport apparatus is generally limited by the operation of the gates at which documents are separated for movement along alternative flow-paths. These gates are often characterized by undesirable complexity and include moving parts which cross into the flow-paths. This tends to significantly reduce their reliability. There is, therefore, a recognized need for a simpler and more reliable type of gate which can direct the flow of documents into a selected flow-path without retarding the document flow. A gate of this type in which documents could be moved continuously along conveyor belts would be especially advantageous.

The need for such a device is not, of course, confined to the field of automated document readers and their associated apparatus. There are many instances in which sheets of material must be selectively directed into one of a plurality of flow-paths, thus presenting essentially the same problem as described above.

A related problem to which an effective solution is presently desired is that of efficiently separating double layers of sheet material, which may be stuck together by electrostatic or other forces, into two divergent flow-paths.

SUMMARY OF THE INVENTION

The present invention consists of an apparatus for selectively transporting sheets of material along either of two alternative flow-paths. It comprises a first continuous perforated belt which is constrained for movement along a first flow-path by a first guide means. A first vacuum means for attracting sheets of material to the first belt is disposed adjacent to the belt along the first flow-path.

A second continuous perforated belt is constrained by a second guide means for movement along a second flow-path. Sheets of material are attracted to the second belt by a second vacuum means disposed along the second flow-path. The first and second flow-paths have contiguous portions at the end of the apparatus at which sheets of material are received. The flow-paths are separated at the end at which the sheets are discharged.

The first and second vacuum means are each connected to a valve means for selectively actuating either of the vacuum means in response to a control signal. The valve means thus determines which of the two vacuum means is, at any given time, connected to a continuously operating vacuum pump. Both vacuum means can be connected to the vacuum pump simultaneously whereby the apparatus can be used to separate double layers of sheet material.

In one embodiment of the invention the first flow-path is substantially horizontal and substantially straight. The second flow-path is located below the first flow-path and is curved whereby the ends of the flow-paths at which the sheets of material are discharged are separated and divergent. The

flow-paths can, of course, be arranged in many other ways which may be equally advantageous or, perhaps, more advantageous in a particular environment.

The apparatus can be constructed using a third belt similar to the first and disposed parallel thereto, and a fourth belt similar to the second and disposed parallel thereto. In this way, the sheets of material which follow the first flow-path are engaged along one edge by the first belt and along an opposite edge by the third belt. Sheets of material which follow the second flow-path are engaged along one edge by the second belt and along an opposite edge by the fourth belt. This arrangement provides added stability for the sheets and decreases the necessary width of the belts and vacuum chambers.

The simplicity of the invention is of great importance with respect to its speed and its reliability. It should be noted that no moving parts which cross either of the two flow-paths are required.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the invention, reference may be had to the following detailed description taken in conjunction with the accompanying figures of the drawing in which:

FIG. 1 is a three-dimensional pictorial representation of an exemplary embodiment of a vacuum gate constructed in accordance with the invention; and

FIG. 2 is a side elevation of the vacuum gate shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A vacuum gate **10** for selectively transporting sheets of material along either a first flow-path **12** or a second flow-path **14** is shown in FIG. 1. Both flow-paths **12** and **14** are represented on the drawing by arrows.

The gate **10** includes four perforated continuous belts **16**, **18**, **20** and **22**. The first belt **16** is constrained for movement along the first flow-path **12** by a first guide means comprising a plurality of rollers **24** and **26** and the lower surface of a vacuum chamber **28**. The second belt **18** is constrained for movement along the second flow-path **14** by a second guide means comprising a plurality of rollers **30** and **32** and the upper surface of a vacuum chamber **34**. The third belt **20** is disposed parallel to the belt **16** and constrained for movement along the first flow-path **12** by a third guide means comprising a plurality of rollers **36** and **38** and the lower surface of a vacuum chamber **40**. The fourth belt **22** is arranged parallel to the belt **18** and is constrained for movement along the second flow-path **14** by a fourth guide means comprising a plurality of rollers **44** and **46** and the upper surface of a vacuum chamber **48**. (The roller **46** is not visible in the drawing because it is obscured by the vacuum chamber **28**.)

As a sheet of material **42** (shown in phantom lines) follows the first flow-path **12** it is engaged along one edge by the belt **16** and along the opposite edge by the belt **20**. If the sheet **42** were to follow the second flow-path **14** it would be engaged along one edge by the belt **18** and along the opposite edge by the belt **22**.

The vacuum chambers **28** and **40**, which are connected to each other by a plurality of conduits **51**, are connected to a control valve **52** by a conduit **54**. The vacuum chambers **34** and **48**, which are connected to each other by a plurality of conduits **55**, are connected to the control valve **52** by a conduit **56**. The control valve **52** is connected to a continuously operable vacuum pump **60** by a conduit **58**.

A wedge-shaped guide member **62** is disposed between separated portions of the first and second flow-paths **12** and **14** to guide the movement of sheets of material. Sheets are further guided as they are discharged from the gate **10** by either of two guide rollers **64** and **66**.

The vacuum gate **10** which is explained above and illustrated in FIG. 1 employs four perforated belts **16**, **18**, **20** and

22 which cooperate with each other to form the two flow-paths 12 and 14. In a simpler embodiment of the invention, only two belts are used. One belt follows each flow-path. Although this embodiment may require that the belts be wider and have more perforations, it simplifies the apparatus by reducing the number of separate elements needed. Whether the use of two, four or more belts is preferable is, of course, determined in part by the dimensions and other characteristics of the sheets of material to be handled.

The operation of the vacuum gate 10 will now be explained with reference to only the first belt 16 and the second belt 18 along with their associated vacuum chambers and guides. This is the portion of the gate 10 visible in FIG. 2. It will be understood, however, that the other belts, when employed, operate in an analogous manner.

A representative sheet of material 42 is caused to enter the vacuum gate 10 from the left as seen in FIG. 2 and is inserted between the two continuously circulating belts 16 and 18. The sheet then moves along between the belts 16 and 18 as it passes along the portions of the flow-paths 12 and 14 which are contiguous. The valve 52 activates either a first vacuum means comprising the vacuum chamber 28 or a second vacuum means comprising the vacuum chamber 34 in response to a control signal. If the control signal indicates that the first flow-path 12 is to be followed, the vacuum is applied to the chamber 28 and is communicated through a plurality of elongated orifices 68 in its lower surface and through the perforations 70 in the first belt 16 to the sheet 42. Thus, when the sheet 42 reaches the point at which the two flow-paths are separated, it will be attracted to the belt 16. Any portion of the sheet which tends to separate from the belt 16 despite the force of the vacuum will be deflected upwardly by the wedge-shaped guide 62. The sheet 42 then passes over the roller guide 64 and is discharged from the vacuum gate 10. It may thus continue along the first flow-path 12 carried by another sheet transporting apparatus.

If the control signal supplied to the control valve 52 were to indicate that the representative sheet 42 was to follow the second flow-path 14, the vacuum from the pump 60 would be applied to the vacuum chamber 34. The sheet 42 would then be attracted to the belt 18 as the vacuum was communicated to it through elongated orifices 72 provided in the upper surface of the vacuum chamber 34 and the perforations 74 in the belt 18. Thus, upon reaching the point at which the flow-paths 12 and 14 separate, the sheet 42 would pass under the guide member 62 and then under the guide roller 66 to another sheet transporting apparatus.

As can be understood from the foregoing explanation, the control valve 52 functions as a valve means for selectively actuating either the vacuum chamber 28 or the vacuum chamber 34. The control valve 52 is responsive to control signals which may be generated from indicia carried on the sheets of material which enter the vacuum gate 10.

The control valve 52 can also be caused to apply the vacuum to both of the chambers 28 and 34 simultaneously. When operated in this manner the gate 10 can be used to separate double layers of sheet material. The upper sheet is attracted to the belt 16 and follows the first flow-path 12. The lower sheet is attracted to the belt 18 and follows the second flow-path 14.

It is preferable to provide a substantially greater force of attraction along one flow-path than along the other flow-path so that all single sheets which enter the gate when both vacuum chambers 28 and 34 are actuated will follow a single predetermined flow-path. This can be accomplished, for example, by making the perforations 70 along the belt 16 larger or closer together than the perforations 74 along the belt 18. In this instance single sheets would follow the flow-path 12. It is noted that the force of gravity acting on such materials as sheets of paper is not sufficiently strong to reliably direct all single sheets into one flow-path.

When the gate 10 is used to separate double layers of material, it can be readily combined with an apparatus which delays the sheets that follow one of the two flow-paths. The flow-paths can then be rejoined at a downstream location and the delayed sheets inserted behind the sheets that they were previously associated with.

When it is desired to direct the movement of material into more than two flow-paths, a plurality of vacuum gates may be arranged in a series. Thus, any number of flow-paths can be connected using this invention.

It will be understood by those skilled in the art that the above-described embodiment is meant to be merely exemplary and that it is susceptible of variation and modification without departing from the spirit and scope of the invention. Therefore, the invention is not deemed to be limited except as defined in the appended claims.

I claim

1. An apparatus for selectively transporting sheets of material along either of two alternative flow-paths comprising a first continuous perforated belt, a first guide means for constraining said first belt for movement along a first flow-path, a first vacuum means for attracting sheets of material to said first belt, a second continuous perforated belt adjacent the first belt over a part of its length, a second guide means for constraining said second belt for movement along a second flow-path which extends in part in the same direction as the first flow-path to define a common flow-path wherein sheets of material are pressed between the first and second belts and which diverges in another part in a direction away from the first flow-path, a second vacuum means for attracting sheets of material to said second belt, and a valve means connected to said first and second vacuum means for selectively actuating either of said vacuum means in response to a control signal.

2. The apparatus of claim 1 wherein said first vacuum means comprises a first vacuum chamber disposed along said first belt adjacent to the first flow-path, and said second vacuum means comprises a second vacuum chamber disposed along said second belt adjacent to the second flow-path.

3. The apparatus set forth in claim 1 further comprising a vacuum pump connected to said valve means.

4. The apparatus set forth in claim 1 wherein said valve means is arranged for selectively actuating both of said vacuum means simultaneously whereby double layers of sheet material can be separated.

5. The apparatus set forth in claim 4 wherein the force of attraction along one flow-path is substantially greater than the force of attraction along the other flow-path whereby single sheets of material that enter the apparatus while both vacuum means are actuated are caused to follow a single predetermined flow-path.

6. The apparatus set forth in claim 1 further comprising a wedge-shaped guide member disposed between portions of the first and second flow-paths.

7. The apparatus set forth in claim 1 further comprising a third continuous belt similar to said first belt and disposed parallel thereto, and a fourth continuous belt similar to said second belt and disposed parallel thereto, whereby sheets of material which follow the first flow-path are engaged along one edge by said first belt and along an opposite edge by said third belt, and sheets of material which follow the second flow-path are engaged along one edge by said second belt and along an opposite edge by said fourth belt.

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