

Jan. 31, 1961

K. A. KLINGLER  
VACUUM DELIVERY BELT

2,969,869

Filed Sept. 12, 1957

2 Sheets-Sheet 1

*Fig. 1*

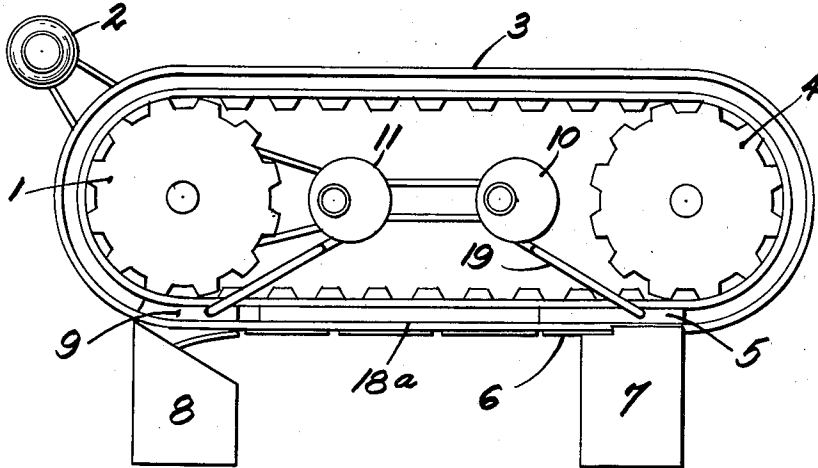


*Fig. 2*

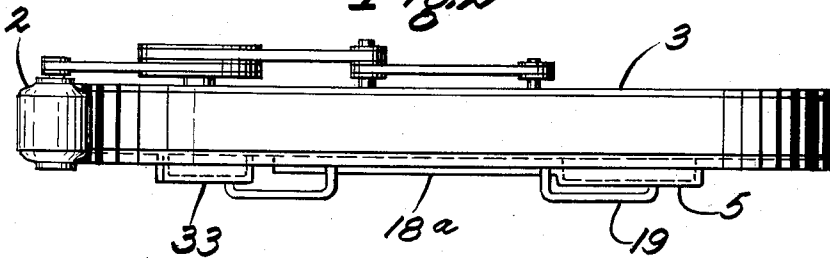


*Fig. 3*

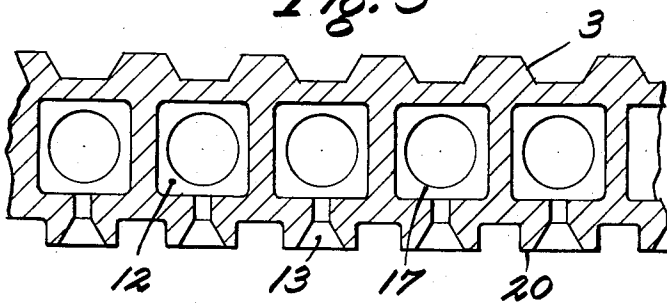
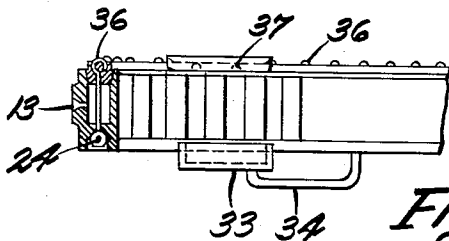


*Fig. 10*

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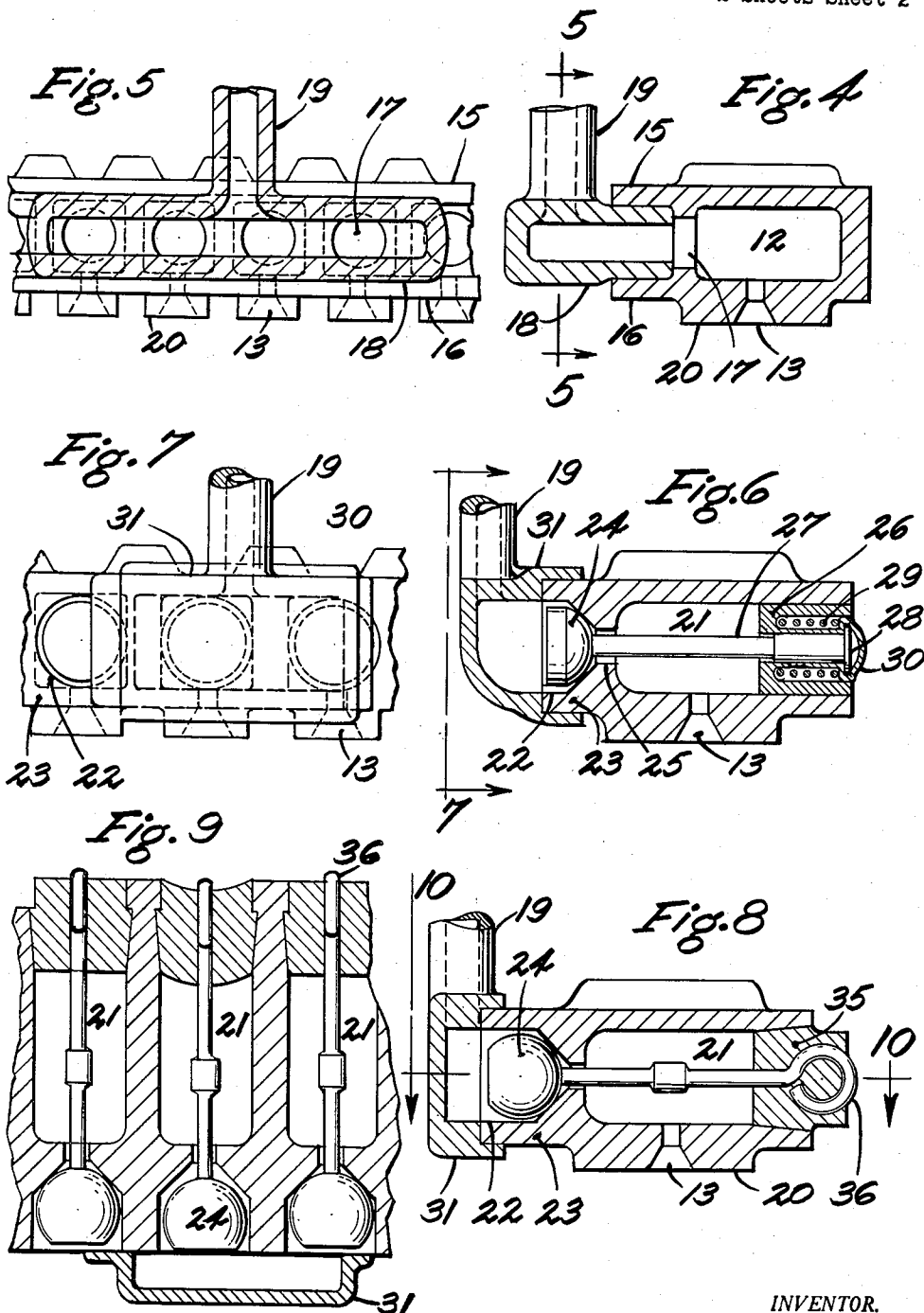
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2 Sheets-Sheet 2



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## VACUUM DELIVERY BELT

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Filed Sept. 12, 1957, Ser. No. 683,657

4 Claims. (Cl. 198—180)

My invention relates to improvements in sheet delivery mechanism and has for one object to provide a vacuum pick up and delivery belt which is especially applicable to pick up and release thin flexible sheets of paper, metal, plastic or the like or perhaps even newspapers and pamphlets.

Another object of my invention is to provide a suction belt which will pick up individual sheets or perhaps multiple layer products exposed to it, convey each sheet to a desired location and then release the sheet.

Another object is to provide a vacuum belt, containing a plurality of separate, successively arranged chambers within which a vacuum may be drawn and then later as the belt travels be released.

Another object is to provide in a vacuum belt, a plurality of separate, successively arranged chambers which after a vacuum has been drawn will maintain the vacuum until the vacuum is released at a predetermined delivery point in the belt travel.

Other objects will appear from time to time throughout the specification and claims.

My invention is illustrated more or less diagrammatically in the accompanying drawings, wherein—

Figure 1 is a side elevation of a sheet delivery apparatus;

Figure 2 is a plan view of sheet delivery apparatus;

Figure 3 is a longitudinal vertical section on an enlarged scale through the vacuum belt;

Figure 4 is a transverse section on an enlarged scale through the belt and suction nozzle;

Figure 5 is a section along the line 5—5 of Figure 4;

Figure 6 is a transverse section similar to Figure 4 of a modified form of belt and nozzle;

Figure 7 is a section along the line 7—7 of Figure 6;

Figure 8 is a transverse section similar to Figure 4 of a further modified form of belt;

Figure 9 is a plan view in part section of Figure 8;

Figure 10 is a detail plan view in part section of the form of belt shown in Figures 8 and 9.

Like parts are indicated by like characters throughout the specification and drawings.

Figures 1 and 2 show in general the delivery mechanism. The remaining figures illustrate details of the vacuum belt itself which is an essential part of the mechanism.

The drive pulley or sprocket 1 is driven by a motor 2. A flexible elastomeric belt 3 travels over the pulley 1 and over the idler pulley 4. The pulleys 1 and 4 may be toothed as indicated to interlock with teeth on the pulley side of the belt or the teeth may be omitted and the belt driven by friction alone. A suction or loading station 5 is associated with the belt 3 at the feed end and sheets 6 are presented to the belt by any suitable means 7 at the suction station, the details of which are not illustrated as they are conventional and form no part of the present invention. A sheet receiving receptacle 8 is associated with a sheet delivery station 9 where the individual sheets are released from the belt.

A suction pump 10 draws air from the vacuum cham-

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bers in the belt and sets up a vacuum therein as will hereafter appear. At the sheet delivery station 9, the vacuum is broken and each sheet is successively deposited into the sheet receiving receptacle and under some circumstances there will be associated with the delivery station means for not only breaking the vacuum but actually increasing pressure in the vacuum chamber above atmospheric for the purpose of insuring a positive separation of each sheet from the belt and its discharge into the receiving receptacle. This may take the form of a compressor 11.

Referring particularly to Figures 3, 4 and 5, the belt 3 is endless. Contained within the belt are a series of successively arranged separate vacuum chambers 12. Each chamber has one or more vacuum or suction mouths or ports 13 on the outer face of the belt in opposition to the pulley contacting face. Along one side of the belt is a continuous channel defined by opposed flanges 15, 16. Associated with each chamber 12 and in communication with the channel is a vacuum passage 17. A suction nozzle 18 is joined by a duct 19 to the suction pump 10. The suction nozzle 18 is located at the suction station 5 and extends in the general direction of the travel of the belt from the sheet receiving toward the delivery station. As the belt travels along this fixed suction nozzle which is in close contact with the belt, air is drawn through the duct 19 from the nozzle 18 out of the chamber 12 to define a vacuum. The vacuum slot 14 in the nozzle may extend from feed to unload station or the vacuum slot may extend only part way, the vacuum being maintained in each successive chamber 12 by the extent of the nozzle beyond the end of the groove or channel 14.

Once a sheet is presented to the flat underface 20 of the elastomeric belt surrounding the suction port 13 and at the time air is drawn from the chamber 12 setting up a vacuum, the sheet will seal the port 13 and the sheet will thereby be held against the underside of the belt as it travels along until the belt reaches the point where it has passed away from the suction slot 14 or from the continuation of the nozzle 18 beyond the slot 14. At that time air will enter the chamber 12, break the vacuum and the sheet will be deposited and the length of travel of the sheet depends upon the length of contact between the suction nozzle and the belt.

Referring to Figures 6 and 7, the elastomeric belt contains a plurality of vacuum chambers 21 associated with the suction ports 13 as before. In register with each vacuum chamber 21 in the side of the belt is a valve pocket 22, the valve pocket being disposed in a wide continuous belt extension strip 23 broken only by the valve pockets. The valve 24 seats in the valve pocket 22 and can open or close the duct 25 joining the vacuum chamber 21 and the valve pocket 22. Bounding the opposite end of each vacuum chamber 21 is an elastomeric plug 26 through which the valve stem 27 projects. The stem terminates at the end furthest removed from the valve 24 in a stem head 28. The plug 26 is apertured to contain a valve spring 29 which seats on the plug 26 and abuts the head 28 enclosed in the flexible pocket 30 integral with the plug 26 which encircles the stem and stem head so that the vacuum pocket 21 under the strength of the spring 29 which holds the valve 24 seated can maintain a vacuum when suction port 13 is closed by a sheet being carried by the belt.

The suction nozzle 31 fixed in position is in contact with the belt extension strip 23 and as the belt travels along bringing successive valve pockets 22 into register with the nozzle 31, the suction pump 10, through duct 19 and suction nozzle 31 can create a vacuum to overcome the spring 29 and unseat the valve 24. As soon as the pocket 22 passes out of register with the nozzle

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31, the valve seats and a vacuum is maintained in the vacuum chamber 21 by the presence of the sheet on the belt face 20. When each pocket reaches the delivery station 9, the vacuum will be broken by any suitable means engaging the head 28 to move it to the left and open the valve 24 as will hereafter appear.

A pressure nozzle 33 in contact with the belt extension strip 23 may, if desired, as it comes in register with valve pocket 22, discharge a blast of air received through the duct 34 from the blower 11 to force the sheet away from the belt.

In the modified form shown in Figures 8 and 9, the valve 24 is seated in the valve pocket just as in Figure 6 but the opposite end of the vacuum chamber 21 is closed by an elastomeric plug 35 in which is embedded the end of the valve stem 36 projecting beyond the elastomeric plug. In this case, the valve may be unseated at the pick up and when in register with the vacuum nozzle 31 or at the delivery end as the case may be to break the vacuum by contact with a cam 37 which will be positioned along the path of the belt so as to engage the head 36 or the head 28 or any other suitable projection so that the valve is unseated when desired to permit the vacuum to be drawn at the pick up end and to be broken at the discharge end.

The use and operation of my invention are as follows:

With the suction pump at work and if desired, the compressor operating, the belt will be driven by the motor and as each successive vacuum chamber comes in register with the suction means and also has presented to its suction port a sheet, a vacuum will be drawn, the sheet will be picked up and carried to the delivery point and released when the vacuum is broken.

In the form shown in Figures 4 and 5, the distance through which the sheet is carried depends upon the length of the vacuum nozzle which extends from the feed to the delivery end. In the modifications of Figures 6 to 10, an important difference is that once the vacuum has been drawn in the vacuum chamber and once the sheet is adhered by the suction to the belt, the belt travels on independent of the suction means. Thus the point at which delivery occurs is independent of the suction means and is controlled only by the adjustable means which may be moved along the belt to cause release at any desired point.

I have shown the vacuum chambers closely succeeding one another. Their spacing depends upon the type of sheets to be handled and the spacing of the sheets. The essential thing is however that the vacuum which does the work and holds the sheet to the belt is a vacuum generated in a chamber in every instance contained within the belt. The only vacuum seal, the only area which must be sealed against air leakage then is the area wherein the vacuum is being drawn. In the modified form where valves control and release the vacuum in individual chambers, the area of friction or sealing between the belt and the suction pump is reduced to a minimum, thereby strikingly reducing friction and leakage.

In the case of the elongated suction nozzle, the air pressure tends to squeeze the walls of the groove against the nozzle and this makes an adequate seal. Even after the vacuum chamber has passed beyond register with that part of the suction nozzle in which vacuum is present, the vacuum will still be maintained in each successive vacuum chamber until the vacuum chamber has passed beyond and is out of contact with the filler plate extensions 37, which projects beyond the suction portion of the vacuum nozzle. This extension may be of substantial length or may be just long enough to close the end of the nozzle as the case may be.

The same effect may be obtained if instead of a continuous elastomeric belt, I provide a chain belt with a plurality of elastomeric sections. In that case, each

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section containing one or more vacuum chambers will act just as if it were a part of a continuous belt because it is only when the downstream side of the vacuum chamber is exposed to the suction that a tight seal between the chamber and the suction is necessary. At other times, so long as the check valve is seated, the vacuum is maintained in each vacuum chamber and can only be broken by unseating the valve.

When the suction nozzle 18 of Figure 4 has an extension extending between the lips 15, 16 for a substantial distance beyond the point at which the vacuum is drawn, this extension operates in the same manner as do the valves 24 to maintain the vacuum in the individual vacuum chamber for a distance equal to the distance to which it is desired that the individual sheet be carried.

If the paper or other material being held to the belt by vacuum is porous, there is a possibility of a gradual loss of vacuum that will not occur when the vacuum nozzle is in contact with the belt from the loading to the discharge point but in those cases where the vacuum nozzle is only in contact at the loading point, it will sometimes be necessary to have additional vacuum nozzles presented to the belt as it travels along between the initial loading point and the discharge in order to replenish the vacuum effect to compensate for such leakage.

While my invention is primarily directed to the handling of paper, it is, of course, well adapted to the handling of other material, metal foil, thin sheets of other material or even blocks or objects made of sufficiently light material and of such lightness that they can be handled by a vacuum. For convenience, I have used in the claims the word "paper" as meaning any sheet or object no matter of what it is made which can be adhered to and handled by a vacuum belt.

I claim:

1. A flexible, elastomeric, conveyor belt, containing a plurality of vacuum pockets enclosed therein and extending across the body thereof, the belt having a generally smooth surface adapted to contact a sheet to be transported, a plurality of suction ports open through such smooth surface, each communicating with a vacuum pocket, valve pockets in the edge of the belt, each communicating with a vacuum pocket through a valve seat therein, a valve associated with each seat, means for biasing the valve into engagement with the seat, a valve stem extending from the valve through the vacuum pocket and projecting beyond the opposite edge of the belt.

2. A flexible, elastomeric, conveyor belt, containing a plurality of vacuum pockets enclosed therein and extending across the body thereof, the belt having a generally smooth surface adapted to contact a sheet to be transported, a plurality of suction ports open through such smooth surface, each communicating with a vacuum pocket, valve pockets in the edge of the belt, each communicating with a vacuum pocket through a valve seat therein, a valve associated with each seat, means for biasing the valve into engagement with the seat, a valve stem extending from the valve through the vacuum pocket and projecting beyond the opposite edge of the belt, valve unseating means located adjacent one edge of the belt at spaced points therealong positioned to contact each valve stem to unseat a valve as the belt travels past the unseating means.

3. A flexible, elastomeric, conveyor belt, containing a plurality of vacuum pockets enclosed therein and extending across the body thereof, the belt having a generally smooth surface adapted to contact a sheet to be transported, a plurality of suction ports open through such smooth surface, each communicating with a vacuum pocket, valve pockets in the edge of the belt, each communicating with a vacuum pocket through a valve seat therein, a valve associated with each seat, means for

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biasing the valve into engagement with the seat, a valve stem extending from the valve through the vacuum pocket and projecting beyond the opposite edge of the belt, a vacuum chamber, in gas tight, sliding relation with the edge of the belt adapted to register with successive valve pockets, and means for maintaining a vacuum in such chamber.

4. A flexible, elastomeric, conveyor belt, containing a plurality of vacuum pockets enclosed therein and extending across the body thereof, the belt having a generally smooth surface adapted to contact a sheet to be transported, a plurality of suction ports open through such smooth surface, each communicating with a vacuum pocket, valve pockets in the edge of the belt, each communicating with a vacuum pocket through a valve seat therein, a valve associated with each seat, means for biasing the valve into engagement with the seat, a valve stem extending from the valve through the vacuum

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pocket and projecting beyond the opposite edge of the belt, a vacuum chamber, in gas tight, sliding relation with the edge of the belt adapted to register with successive valve pockets, and means for maintaining a vacuum in such chamber, valve unseating means located adjacent one edge of the belt positioned to contact each valve stem to unseat a valve when the valve pocket containing the valve is in register with the vacuum chamber.

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