May 7, 1957 A. W. NOON 2,791,424

AUTOMATIC SEPARATING SYSTEM

Filed Nov. 9, 1953

Fig. 1

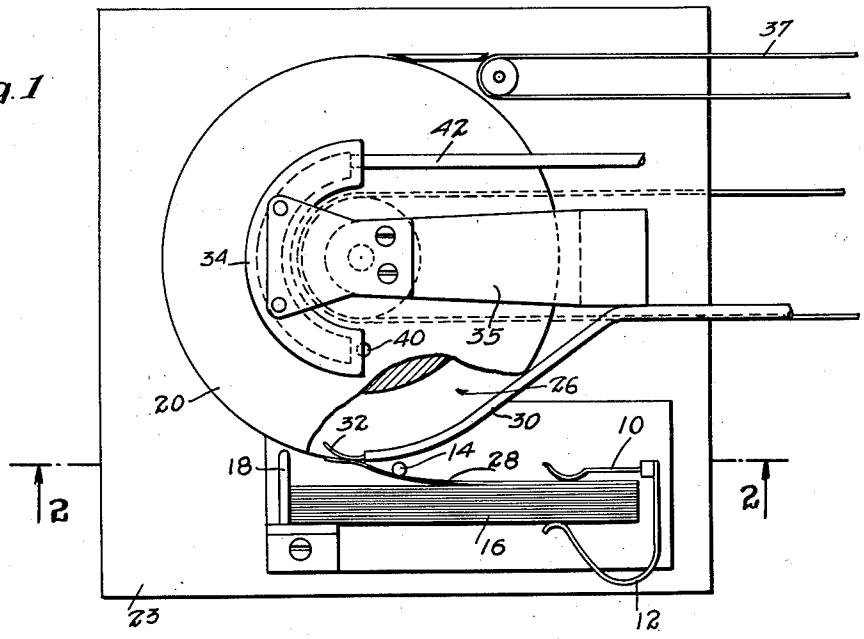


Fig. 2

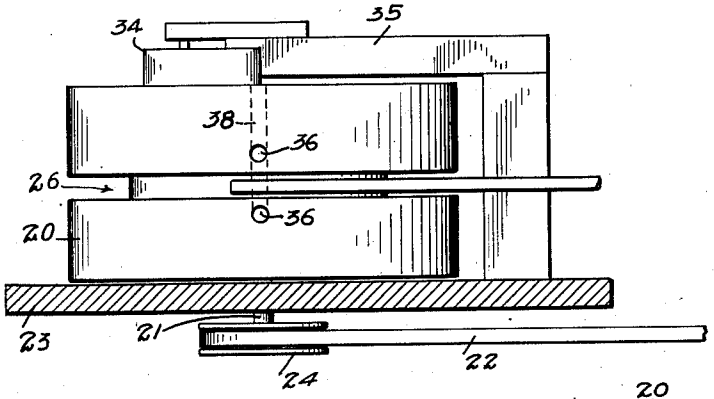


Fig. 3

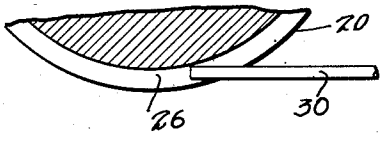
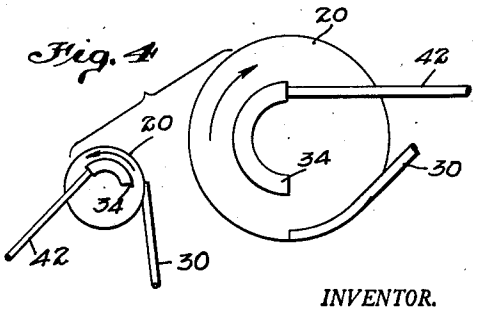


Fig. 4



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United States Patent Office

2,791,424

Patented May 7, 1957

2,791,424

AUTOMATIC SEPARATING SYSTEM

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Application November 9, 1953, Serial No. 390,897

8 Claims. (Cl. 271—28)

This invention relates to a system for automatically separating sheets of flexible material, such as paper, from a stack of said sheets. More particularly, this invention is an improvement in such apparatus.

A number of systems for automatically removing a top sheet from a stack of sheets are known. Usually, these involve some device for picking off the top sheet and moving it to a position where it can be operated upon or operated with. The present invention provides a mechanism for performing this operation at high speed. Furthermore, it operates without marring or marking the sheets being handled.

A feature of this invention is the simplicity of the apparatus used.

Another feature of the invention is that the apparatus permits rapid handling and separation of the sheets of material from a stack of said sheets without marring or marking them.

Another object of the present invention is to provide a new and useful system for automatically picking up a single sheet of flexible material from a stack of said sheets and conveying it to a desired operation zone.

The above features and objects of the present invention are accomplished by providing apparatus wherein there is created a first low air pressure area proximal to the uppermost sheet of the stack, which causes that sheet to be elevated toward the low air pressure area. A second low air pressure area or partial vacuum, which is movable over a desired path, is then brought into the area wherein the top sheet of the stack is elevated. This second partial vacuum is made sufficiently strong to be able to pick up the thus previously elevated sheet from off the stack. The sheet is then carried through the path of travel of the vacuum to the desired operating area.

For a further explanation of the invention and for a full and complete understanding thereof, reference is now made to the following explanation and drawings wherein:

Figure 1 is a plan view of an embodiment of the invention with certain parts shown broken away for clarification,

Figure 2 is a view along the line 2—2 of the embodiment of the invention,

Figure 3 shows a view in section of alternative apparatus for creating the first low air pressure area, and

Figure 4 is a schematic view of an arrangement whereby the removal of any more than a single sheet at a time can be corrected.

Reference is now made to Figure 1, which shows an embodiment of the invention. For the purposes of an explanation, assume that a stack of individual sheets of paper are sought to be automatically separated and fed, one at a time, to other handling apparatus. The stack is shown positioned in a holder. This holder may include a fixed retainer arm **10** and a spring clamping member **12**, as well as a stacking pin **14**. The spring clamping member positions the stack **16** and bears upwardly against the fixed retainer arm **10**. A stop pin **18** is also used at one end of the stack to assist in maintaining the sheets in alignment. The function of the stacking pin **14** will become apparent as the description of the operation of the apparatus progresses.

A cylindrical drum **20** is mounted for rotation on a shaft **21** which is supported from a base **23**. As seen in Figure 2, this shaft may be driven by a belt **22** and pulley drive **24**. This type of drive is merely exemplary and is not to be taken as a limitation on the invention. The cylindrical drum **20** has a slot **26** cut in the outer periphery thereof. The drum is mounted so that the slot is proximal to the top sheet **28** of the stack. A hose **30** is supported to have an end pointed into the slot **26** at a position near one end (the stop pin end) of the top sheet of the stack. As shown in the drawing, the end portion of the hose is curved substantially with the drum periphery and a deflector **32** is attached to the nozzle and bent inward toward the drum. An air supply (not shown) provides air which has a velocity sufficient so that it creates a low pressure area, in accordance with well known physical principles, at the outlet side of the deflector. As a result the end of the top sheet **28** of the stack is pushed upward until it is substantially in contact with the periphery of the drum **20**.

A valve in the form of an arcuate trough **34** is mounted on a support **35** so that the arc is concentric with the drum and covers the path along which it is desired to move each one of the sheets from the stack as they are separated therefrom. The open end of the trough faces the side of the drum and is slidably sealed against incoming air, using the drum side as one wall. This type of slidable seal is well known in the art and can be effectuated by using stiff felt material, for example. On either side of the slot, as may be seen in Figure 2, there are two openings **36** which communicate through a common passage **38**, as shown by the dotted lines in Figure 2, to an opening in the side of the drum **40**. This opening in the side is positioned to be included within the trough opening when the drum is rotated.

At one end of the arcuate trough **34** another nozzle **42** is inserted. At the other end of this nozzle, there is provided a mechanism (not shown) for creating a vacuum within the trough. Accordingly, as the drum is rotated, the opening **40** in the side thereof will pass on to the trough. Immediately the vacuum will be communicated to the two holes **36** on the periphery of the drum. When these holes **36** are brought near the elevated portion of the top sheet **28**, the elevated portion is drawn upward until it seals these holes. As the drum continues to rotate, the top sheet will be carried with the drum until it reaches the other side of the trough arc where the opening to the side of the drum passes out from under the trough. At this time the vacuum applied to the two holes **36** is broken and the sheet of material is then removed, as by a conveyor belt **37**, or other pickup mechanism to the next operation. The mechanism for the removal of the sheet is exemplary and not to be construed as a limitation upon the invention.

The purpose of the stacking pin **14** is to assist the spring clamping member in preventing the top sheet from being removed with the rotation of the drum by the pull of the low air pressure provided in the slot. As the top sheet of the stack is moved to its new location, the spring clamping member **12** forces the stack upward and the next sheet takes its place to be removed from the stack. The spring clamping member may be replaced by any device such as any elevating platform which continuously urges the stack upwards. If it is desired, the low pressure area in the slot can be obtained merely by directing the end of the hose from the air supply into the slot.

This may be seen in the section of the apparatus shown in Figure 3.

Referring now to Figure 4, there is shown in schematic form another embodiment of the invention which may be used in the event either electrostatic attraction or the tackiness of the sheets may cause some difficulty with respect to the separation of single sheets. This difficulty may be avoided by providing two of the above described apparatuses. These are represented by two circles 20 with nozzles directed at these circles to provide the proper orientation of the two apparatuses with respect to each other. The same reference numerals as are used in Figures 1 and 2 are applied to similar functioning apparatus. In this manner, the low pressure area of the second separate apparatus will serve to peel the excess sheet from the one being carried. The vacuum provided by the apparatus will then completely separate the two sheets so that the top one is individually conveyed to the next operating station. Conveyance can be provided from the second apparatus to the next operating station also.

Using the embodiment of the invention as shown in the drawings and described herein, it has been possible, with one revolution of a drum, to separate the top sheet of a stack of paper sheets. Satisfactory operation was achieved with drum speeds on the order of 1000 R. P. M. By adding a second set of holes in the periphery of the drum, the capacity of the device can be materially increased.

Accordingly, there has been shown and described above a novel and useful device for automatically separating sheets of flexible material rapidly and without marking or defacing them from a stack of sheets.

I claim:

1. Apparatus for separating a sheet of flexible material from a stack of said sheets comprising a movable surface having a slot therealong and an opening therethrough proximal to said slot, means to position said movable surface with the slotted portion proximal to the top sheet of said stack, means for moving air in said slotted portion proximal to said top sheet with a velocity sufficient to elevate a portion of said top sheet toward said surface, means to move said movable surface in the direction of said slot, and means for creating a vacuum through said opening sufficient to completely lift said top sheet thereby to carry said top sheet in the direction of the motion of said surface.

2. Apparatus as recited in claim 1 having in addition means to remove any adhering sheet to said top sheet said removing means being positioned proximal to said movable surface at a position subsequent to said stack of sheets.

3. Apparatus as recited in claim 1 wherein said movable surface comprises the surface of a rotatable cylinder.

4. Apparatus for separating sheets of flexible material from a stack of said sheets comprising a cylindrical surface having a peripheral slot and an opening through said surface near said slot, means for rotatably supporting said cylindrical surface proximal to the top sheet of said stack, means for directing an air stream through the portion of said slot near said top sheet with a velocity sufficient to produce elevation of a portion of said top sheet towards said cylindrical surface, means for rotating said cylindrical surface, means for restraining said top sheet against moving with said cylindrical surface, and means for establishing over a desired arcuate interval a vacuum through said surface opening sufficient to remove said top sheet from said restraining means thereby to carry said top sheet in the direction of motion of said surface through said desired arcuate interval.

5. Apparatus as recited in claim 4 wherein said means for establishing over a desired arcuate interval a vacuum through said surface opening includes a stationary arcuate trough coaxially positioned with respect to said cylindrical surface and extending over the same arc as said arcuate interval, means for applying a vacuum to one end of said trough means for providing a communicating passage between said opening in said cylindrical surface and said trough while said opening is moving through said desired arcuate interval, and means to close said trough except to said communicating passage.

6. Apparatus as recited in claim 4 wherein said means for directing an air stream through said slot includes a hose, and a flat deflector at one end of said hose positioned to deflect any air coming out of said hose into said slot.

7. Apparatus for separating sheets of flexible material from a stack of said sheets comprising a cylindrical drum having a slot on the periphery, an arcuate trough mounted to be stationary and concentric with said drum and to include a portion of the area of said stack of sheets, an air seal between a side of said drum and said trough opening, an opening in the periphery of the drum adjacent said trough, an opening in the area of the side of said drum which passes under said trough, a communicating passage between both said openings, means to rotatably mount said drum with its peripheral slot over said stack of sheets, means for directing an air stream into said slot at a position over said stack of sheets with a velocity sufficient to elevate a portion of the top sheet toward the drum, means to rotate said drum, means to restrain said top sheet against motion with said drum, and means to apply a vacuum to one end of said trough sufficient to lift and move said top sheet from said restraining means when said opening in said periphery passes through the arc of said trough.

8. Apparatus for separating sheets of flexible material from a stack of said sheets as recited in claim 7, having in addition means to remove any adhering sheet to said top sheet including another apparatus as recited in claim 7 positioned proximal to said cylindrical drum at a position past said stack of sheets.

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