Nov. 19, 1968 C. B. ALBRIGHT 3,411,770

SHEET SEPARATOR

Filed Aug. 4, 1966

FIG. 1

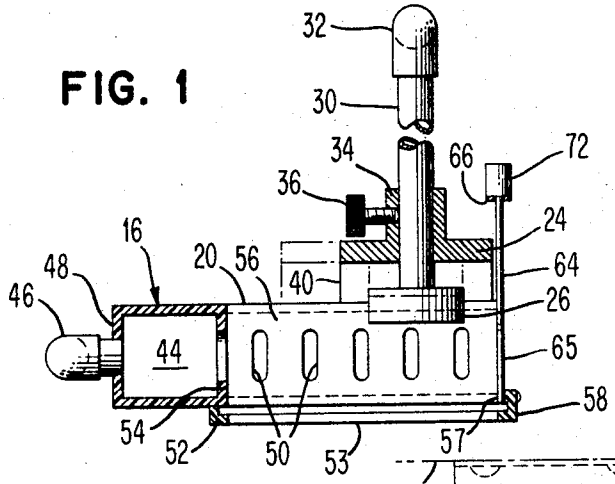


FIG. 2

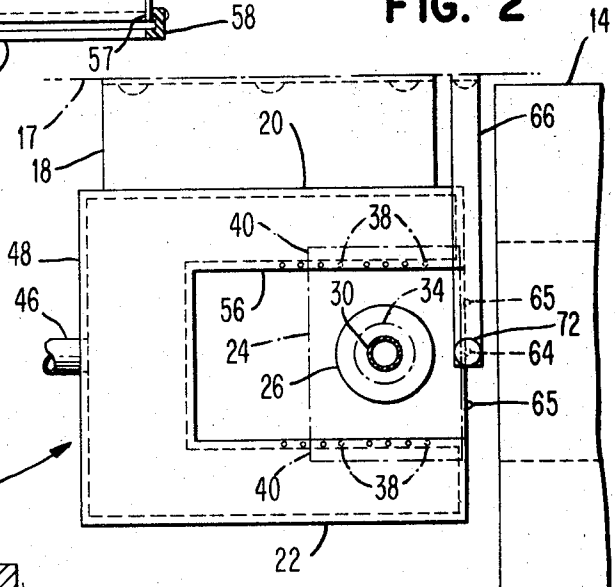
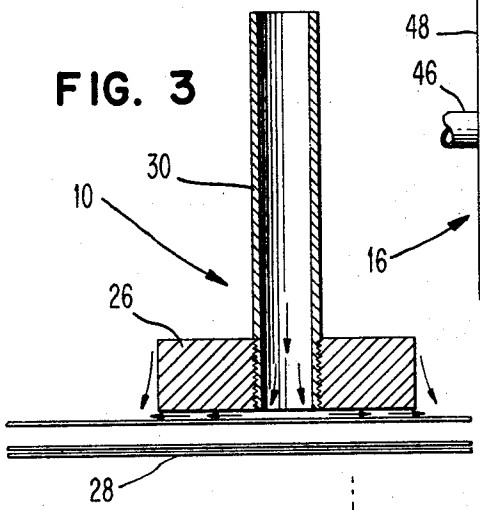


FIG. 3



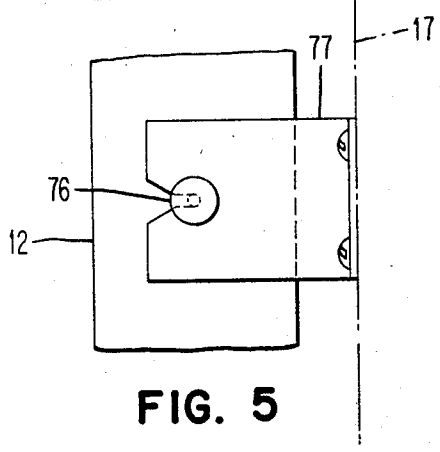


FIG. 5

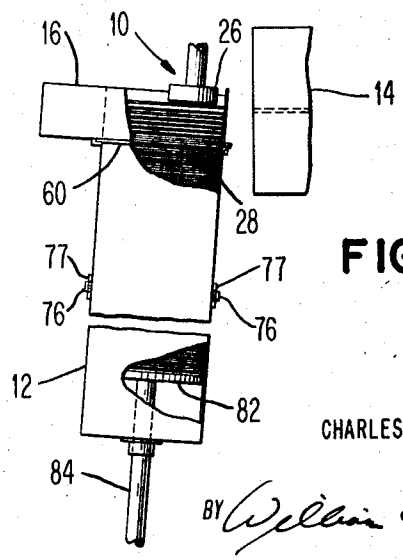


FIG. 4

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United States Patent Office 3,411,770 Patented Nov. 19, 1968

3,411,770

SHEET SEPARATOR

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Filed Aug. 4, 1966, Ser. No. 570,299
5 Claims. (Cl. 271—26)

ABSTRACT OF THE DISCLOSURE

The present device provides a jet of air which is directed vertically downward against a stack of unit records or sheets. The unit records are moved upwardly through a magazine at a controlled rate of speed toward the vertical jet of air. The magazine includes a preseparator device which emits jets of air transversely through the upper layers of the unit records as the unit records approach the vertical jet. The transverse jets serve to separate the upper layers thereby making them ready to be separated by the vertical jet. When the top unit record reaches a predetermined position, the velocity of the vertical stream in its radial excursion creates a differential of pressure and the top unit record is snapped upward from the stack. The magazine has an open end through which the separated top unit record is moved.

The invention relates to apparatus to effect a separation of sheets, or web means, and the feeding of said sheets into a sheet transport means employing an all fluid technique.

In accordance with the prior art, sheet means, such as documents, or unit records, have been separated with apparatus employing vacuum techniques wherein the vacuum outlet member comes in contact with the sheet, or document, in order to lift the document from a stack of such documents, in a manner similar to the ordinary household vacuum cleaner. Thereafter, the document, or sheet, has been pulled away from the vacuum outlet member by various means including belts, rollers, etc.

The present invention provides an apparatus whereby the sheets, or documents, are separated from their magazine stack by an all-fluid technique, that is, not in contact with any parts of the apparatus that would normally be identified as "hardware." The present invention further provides a means for delivering the separated documents into an all-fluid transport means, again without employing any contact with hardware. Although the present invention will be described in connection with a unit record system, it is to be understood that it can be used with other forms of sheet transport apparatus.

Briefly described, this invention provides a separator which directs a primary stream of air vertically downward through a round aperture and a round flat head against a stack of unit records or sheets. The unit records are moved upwardly trhough a magazine at a controlled rate of speed toward the separator head. Simultaneously, a second member identified as a pre-separator directs air transversely through the upper layers of the stack which urges the separation of these upper layers and simultaneously one component of this transverse air flow is directed towards a unit record all fluid transport means.

The primary air stream from the separator acts in a twofold manner. First of all, it keeps the unit records depressed in the preseparator until the top unit record reaches a physical position wherein the velocity of the stream in its radial excursion creates a sufficient differential of pressure (i.e., the Bernoulli effect) to cause the top unit record to snap upward in close proximity (in the present embodiment the selected unit record is within a few thousandths of an inch) to the bottom surface of the

separator head. It is at this time that the top document will be literally suspended in air. The apparatus further provides a means for gravitationally directing the last described suspended document toward the entrance of the document transport apparatus.

Accordingly it is an object of the present invention to provide an improved document feeding means which is characterized by an all fluid mode of operation.

In the drawings:

FIGURE 1 is a sectional view taken along the lines 1—1 of FIGURE 2;

FIGURE 2 is a top plan view of apparatus embodying the preferred form of the invention;

FIGURE 3 is an enlarged sectional view of the unit record separator head of the invention;

FIGURE 4 is an elevation view with parts broken away to show the interior of the apparatus; and

FIGURE 5 is a fragmentary view showing a magazine supporting element.

While the invention is useful in connection with a wide variety of unit record handling apparatus, it has been especially designed for use with the unit record handling system employing an all fluid technique wherein individual unit records are successively separated from a stack of unit records and then moved through an accelerator means and an alignment means, as well as through a reading station. The unit records are forwarded from the reading station to restacking stations in serial order as more fully described in applicant's co-pending application, Ser. No. 570,304, filed Aug. 4, 1966, entitled "Sheet Handling System Employing an All Fluid Transport Technique."

With reference to FIGURE 4 it is seen that the invention comprises broadly the unit record separator head **10**, a preseparator **16**, and a cartridge or magazine **12** for holding a supply of unit records to be fed into an accelerator **14** such as described in Applicant's co-pending application, Ser. No. 570,312, filed Aug. 4, 1966, and entitled "All Fluid Unit Record Accelerator."

As seen in FIGURE 2, the hollow U-shaped collar member **16** (preseparator), which is depicted as being attached to the fixed structure **17** by means of brackets **18**, is disposed to have its inner loop section, or bay area, located under the separator head **10**. Spanning the arms **20** and **22** of the collar is an inverted U-shaped bracket member **24** which is provided to enable an adjustable mounting of the separator head **26** over the unit records **28** (FIGURE 4) as they are moved upwardly through the magazine **12**.

The separator head **26** (FIGURE 1) is mounted on the lower end of a conduit, or tube **30**, the other end **32** of which is connected to a suitable pressurized source of air (not shown). In the preferred embodiment the tube **30** is at least six inches long in order to establish a laminar air flow. The tube **30** extends through a boss **34** on the top plate of the inverted U-shaped member **24**. The tube **30** is adjustably secured within the boss by the thumbscrew **36**. Accordingly, the upper section of tube **30** is flexible to accommodate any adjustments in the pressure head. Transverse adjustability of the separator head **26** is by means of a pair of pins **38** extending downwardly from the bottom edge of each of the bracket legs **40** into small apertures **42** in the top of the collar **16**.

The chamber **44** (FIGURE 1) in the collar **16** is connected into a suitable source of air pressure (not shown) by means of the tube **46** extending from its back wall **48**.

The inner walls of the U-shaped collar are provided with a plurality of vertically elongated apertures **50** (FIGURE 1) used for the purpose to be described hereinafter. Secured to the back wall **17** and further secured to the lower portion of the collar **16** are three channel

forming members **52**, **53** and **58**. The channel forming member **52** is disposed such that its most forward edge is aligned with the inward edge of the back wall **54**, while the channel forming member **53** is aligned with the side wall **56** and the channel forming member **58** is aligned with the front wall **57**. These last mentioned channel forming members provide a channel into which a flange **60** of the magazine **12** can be inserted in order that the magazine **12** can be releasably secured to the preseparating station with its upper end aligned such that the unit records will be fed into the space between the arms **20** and **22**. The channel forming member further plays the role of providing a means to mount a pair of spaced pins **62** each of whose upward extremity terminates just below the entrance to chute **63** of the accelerator **14**. Accordingly, a positive stop is provided to insure that individual documents will be fed into the chute as described more fully below.

In addition, a stop feed pin **64** is retractably supported above the collar **16** by the arm **66** which arm is secured to the fixed means **17**. The pin **64** can be moved by any demand feed or stop feed actuator, such as a solenoid or fluid operated device. For purposes of discussion, there is shown secured to the arm **66** a solenoid **72**. The control of the actuator or solenoid **72** is by a clock mechanism, or by a computer control, depending upon the utility to which the all fluid transport is applied.

The separator and feeding apparatus are mounted at a slight angle to the path of the chute **63**, as seen in FIGURE 4, of the accelerator **14** in order to take advantage of gravity, as will be more fully explained hereinbelow. The gravity component of force aids in feeding the unit records into the chute **63**.

The magazine **12** is stabilized in its operative position by mating the head pins **76** into the bracket **77**. Brackets **77** are secured to the securing wall **17** as depicted in FIGURE 5.

As seen in FIGURE 4, the unit records **28** are fed upwardly through the magazine **12** by a pressure plate **82** fixed to the upper end of a shaft means **84**. Shaft means **84** may be actuated by any suitable means such as a cam driven mechanism or in an alternative by a wormscrew wherein the shaft **84** is actually a screw device. For the purposes of this discussion it need only be understood that the shaft **84** is positively driven in an upward direction at a constant rate.

In one embodiment, the pressure plate **82** raises the unit record stack at approximately 10 inches per minute under a continuous feed mode of operation. However, the rate of rise of the pressure plate will be variable to accommodate various operating conditions of the handling apparatus mentioned above. As the records are arranged into the bay of the collar **16**, high pressure air being fed through tube **30** is directed against the top unit record. When the top unit record is a reasonably long distance from the opening of tube **30**, the static pressure exerted by the column of air coming from tube **30** will be exerted over a reasonably wide spread area of the record. This is true because a freely expanding jet assumes a conelike shape since it exerts force in all directions. However, because the top unit record is continually moved closer to the under surface of the separator head the coneline shape of the air jet issuing from tube **30** is gradually forced to change to a more flattened radial excursion and the effective radial flow area in the immediate region around the tube **30** is increased. As this action proceeds, the velocity pressure increases in the immediate flow area just mentioned, while the static pressure becomes lower in conformity with Bernoulli's principle. As the unit record continues to move towards the separator undersurface a critical point is reached where the net static pressure force acting on the upper surface of the unit record is less than the net static pressure force, (atmospheric or otherwise), acting on the lower surface and the unit record is then forced up toward the separator.

Once this critical action has begun, the effect is self-accelerating because the effective immediate radial flow area diminishes at an increasing rate and, thus, the static pressure force differential across the unit record becomes increasingly greater. However, an equilibrium point is reached by the unit record wherein its upward motion stops short of contact with the under surface of the separator head. Air flow is still emanating from tube **30** and a low static pressure region still surrounds the immediate region of tube **30**. However, as the air continues to flow radially further from tube **30** it is obvious that the flow area increases in proportion to its radius to tube **30**. Because of this fact, the velocity pressure decreases in proportion to the above-mentioned radius, while the static pressure, in conformity with Bernoulli's principle, rises. At some radius from the tube **30** the static pressure recovery is such that it rises above the next static pressure force acting on the lower surface of the unit record. Neglecting the force of gravity, and using the next static pressure force acting on the lower surface of the unit record as a reference line, a static pressure curve depicting the pressure profile from the tube **30** to the outer circumference of the separator head under surface would show that the area bounded by the curve below the reference line is equal to the area bounded by the curve above the line. Thus, the unit record is held in a state of equilibrium and held away from the under surface of the separator head by a thin layer of moving air. In actual practice the area below the reference line would be slightly larger than that above the line in order to maintain the unit record in suspension against the force of gravity.

As mentioned earlier, since the feeding cartridge and the separator head **26** are tipped forward toward the accelerator station of the transport, the unit record hanging in air is caused by the force of gravity to move toward the transport. This motion is aided further by two other forces. One such force is a stream of air from the far end of the preseparator **16** which is directed toward the transport. In other words, the air which is emanating from the elongated apertures in the back wall **54**. The second force is the strong stream of induced air leading directly into the entrance of the transport. This latter force is more fully described in my above-mentioned co-pending application entitled "All Fluid Unit Record Accelerator" wherein it is explained that the air jets within the accelerator create a pressure differential between the entrance of the chute and the ambiant surroundings and hence cause an airflow into the entrance of the chute.

The metal thickness of the separator head **26** has particular significance. If the separator head **26** were a thin plate, the high velocity air leaving the small gap between the head and the top unit record would set up an induced secondary air movement above and below the top unit record and this secondary air movement below the top unit record would tend to raise the second unit record following the one on top which is about to be fed. The vertical wall created by the metal thickness of the separator head **26** effectively reduces the secondary air flow to a point where the second unit record is unaffected.

As each unit record is fed from under the separator head the next one is snapped up into position as just described for feeding into the chute of the accelerator. The rate of feed, of course, depends upon the rate at which the pressure plate **82** moves the stack upwardly.

A feature of the invention is the fact that the feeding action of the unit record is accomplished by the pressures of the fluid (air) as well as gravity and hence no hardware actually comes in contact with the feeding action of the unit records.

The air pressure through the elongated apertures **50** on the inner walls of the collar **16** riffle and separate the records in the top layers of the stack which aids in the feeding process.

Feeding may be instantly halted or stopped by actuation of the solenoid **72** which can project pin **64** downwardly between the pin **62** and/or at the same time shutting off the driving means which drives the shaft **84** upward.

The present invention provides a device to separate sheet items to be processed. The present device employs a fluid technique to lift one item at a time from a pack of such items and to move that item forward by a fluid technique into a sheet item transport means.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A sheet item separator device employing a fluid technique to effect the separation of sheet items comprising:

(a) a magazine means to hold sheet items which are to be separated, said magazine having an open end;

(b) pusher means disposed for movement within said magazine means to push sheet items toward said open end;

(c) air jet means disposed in proximity to said open end of said magazine means to direct a single vertical jet of air onto the sheet item which is pushed closest to said open end in order to create a differential of pressure thereon to effect the lifting of said last mentioned sheet item from other sheet items held by said magazine means; and

(d) preseparator means having a U-shaped configuration and formed to fit along the sides of said magazine means and having apertures disposed along the surfaces including the closed end surface of said U-shaped configuration which face the inner portion of said magazine means, said apertures acting to provide jets of air which operate to riffle a group of sheet items which are approaching said open end.

2. A sheet item separator device according to claim **1** wherein said magazine means is tilted from a vertical position in order to enable any sheet item which has been lifted from said magazine means to move transversely to the movement of said pusher means in response to the force of gravity.

3. A sheet item separator device according to claim **1** wherein there is further provided a gate means disposed on one side of said magazine means at said open end thereof, said gate means being selectively operative to permit and alternatively to stop sheet items from traveling in a transverse direction with respect to said pusher means movement.

4. A sheet item separator device according to claim **1** wherein said pre-separator means has means to permit said magazine means to be operably engaged therewith and alternatively removed therefrom.

5. A sheet item separator device according to claim **1** wherein said air jet means includes a pressure plate means which has a predetermined thickness which is designed to eliminate the inducement of secondary air movement.

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