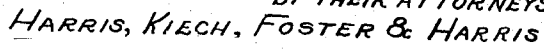


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APPARATUS FOR HANDLING SHEETS OF PAPER

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4 Claims. (Cl. 271-11)

This invention relates to the handling of sheet material and in particular to an apparatus for separating individual sheets of material such as paper or the like from a stack of sheets for feeding the individual sheets into associated apparatus.

Conventional vacuum feeds for feeding single sheets of paper and the like to a printing press do not operate satisfactorily when used with low grade paper such as newsprint. The low grade papers have numerous porous spots therein which cause the vacuum feed wheels and the like to often feed two and three sheets together into the press when only one sheet is intended. Therefore, it is desirable to supply only one sheet at a time to the feed mechanism which moves the sheet to the press or other apparatus.

It is an object of the invention to provide an apparatus which will handle sheet material, especially low quality sheet material which may be quite porous and irregular in form, such as used newsprint which is even more difficult to handle than fresh newsprint.

It is another object of the invention to provide an apparatus which will cyclically and automatically separate single sheets of material from a stack of sheets. A further object of the invention is to provide such an apparatus which is automatically operated without requiring the use of gears, cams or similar mechanisms.

It is a further object of the invention to provide an apparatus for handling sheets of material in which the lifting mechanism is forced against the top sheet of the stack by a spring or by gravity, thereby closing off a vacuum nozzle in the lifting mechanism so that the nozzle and the sheet which closes it are moved away from the stack of sheets against the action of the spring or gravity. Another object of the invention is to provide apparatus for moving the lifted sheet from the nozzle to permit the nozzle to again be forced toward the stack of sheets for continuous repetition of the lifting operation.

It is another object of the invention to provide an apparatus for lifting sheets of material from a stack of sheets having a needle positioned adjacent the vacuum nozzle with the point of the needle piercing the top sheets of the stack and thereby restraining motion of the sheets away from the stack, such restraining action resulting in separation of the top sheet which is moved up past the point onto the body of the needle.

It is a further object of the invention to provide an apparatus for handling sheets of material including means for directing a stream of air at the edge of the stack between the lifted top sheet and the remainder of the stack to separate all of the top sheets from the stack. Another object of the invention is to provide such an apparatus including a continuously rotating vacuum feed wheel which pulls the separated sheet from the nozzle and moves it away from the stack.

The invention also comprises novel details of construction and novel combinations and arrangements of parts, which will more fully appear in the course of the following description. The drawing merely shows and

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the description merely describes preferred embodiments of the present invention which are given by way of illustration or example.

In the drawing:

Fig. 1 is an end view of the preferred embodiment of the invention with portions of the main frame of the apparatus omitted;

Fig. 2 is a sectional view taken along the line 2-2 of Fig. 1 showing the embodiment of Fig. 1 with a stack of sheets of material positioned thereunder;

Fig. 3 is a partial sectional view showing an alternative form of the needles of the embodiment of Fig. 1; and

Fig. 4 is a partial sectional view showing an alternative form of the nozzle of Fig. 2.

The embodiment of the invention shown in the drawing includes a main frame 10, a nozzle mount 11, needle carriers 12 and 13, an air line 14, a feed wheel 15 and a table 16. A stack 17 of sheet material, such as used newsprint or the like, is supported on the table 16 with the nozzle mount 11 and needle carriers 12, 13 preferably positioned adjacent an edge of the stack.

The nozzle mount 11 may include a length of tubing 20 fixed in the frame 10 with a second length of tubing 21 telescopically mounted thereon so that the second length of tubing 21 may be retracted and extended relative to the length of tubing 20. Opposed, axially extending guide slots 22, 23 in the tubing 21 engage guide pins 24, 25 respectively, screwed into the tubing 20 to limit the relative movement of the tubings both axially and in rotation. An adjustable collar 26 is positioned on the tubing 20 by a set screw 27 to provide an adjustment for the upper limit of movement of the tubing 21 relative to the tubing 20.

The lower end 30, which is the nozzle or open end of the tubing 21, is preferably somewhat flattened to provide an opening of lesser cross-section area than the body of the tubing and to provide a longer line of contact between the open end and a sheet of material. A washer 31 is positioned around the outer tubing 21, movement of the washer downward along the tubing being blocked by the flaring of the tubing produced in the flattening operation. A spring 32 is positioned around the tubing 21 with the ends of the spring resting against the guide pins 24, 25 and the washer 31 respectively, the spring being compressed when installed so as to urge the open end 30 of the outer tubing 21 downward to the position shown in Fig. 1.

The needle carriers 12 and 13 are identical in construction and the carrier 12 will be described herein. A tube 35 has one end fixed in the main frame 10 and a collar 36 fixed to the other end. A plug 37 is slidably positioned within the collar 36 with a needle 38 being set in the plug 37 and held in place by a set screw 39. A spring 40 (Fig. 3) is positioned within the tube 35 with one end resting against the plug 37 and the other end against a pin 41 fixed in the tube 35. The two needle carriers 12, 13 are preferably positioned on each side of the nozzle 30 with the axes of the needles 38 parallel to the line of movement of the tubing 21 along the tubing 20.

An alternative form for the needles 38 of Fig. 1 is shown in Fig. 3, wherein a needle 45 has a pointed end section 46 with a narrow taper, a short intermediate section 47 with a wide taper, and a longer body section 48 with a narrow taper.

The air line 14 includes a tube 50 mounted in the main frame 10 with a collar 51 screwed onto the end of the tube and a nozzle 52 screwed onto the collar 51.

The feed wheel 15 may be conventional in design and is shown mounted on a hollow shaft 54 with means not shown for driving the wheel in counterclockwise rotation as viewed in Fig. 2. The wheel is basically cylindrical

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in shape with a plurality of radial passages 56 connecting with the hollow shaft 54 through a port 57.

In the operation of the apparatus of the invention for cyclic and automatic removal of the top sheet of material from the stack of sheets, a vacuum is applied to the tubing 20 at the upper end thereof to provide air flow in the direction of the arrow 60. The table bearing the stack of sheets is positioned under the nozzle mount so that the open end 30 of the tubing 21 rests on the top sheet of the stack, the nozzle being then in a position as shown in dashed line in Fig. 2. The open end of the nozzle is closed by contact with the stack of material and the vacuum produces a lifting force which counteracts the force of the spring and raises the tubing 21 to the position shown in solid lines in Fig. 2, the vacuum causing the top sheet of the material to be raised also, the top sheet being pulled up over the needles 38.

When the stack of material is placed under the nozzle mount, the points of the needles will penetrate several sheets of the material and when the nozzle moves upward carrying the top sheet over the bodies of the needles, the restraining force exerted by the points of the needles will prevent more than one sheet being raised. When two needles are positioned on opposing sides of the nozzle as shown in Fig. 1, a sheet of material will tend to bow upward at the center thereof and increase the friction drag exerted by the needles. In certain applications of the apparatus, the additional restraining force exerted by the second section of the three section needle of Fig. 3 may be utilized to improve the separating action.

Air under pressure is fed into the air line 14 in the direction of the arrow 61. The nozzle 52 connected to the air line is positioned at the edge of the stack adjacent the lifting nozzle 30 to direct an air stream along the top of the stack slightly above the top as shown by the arrows 62. After the vacuum mechanism has lifted the top sheet from the stack in the area of the contact of the sheet with the nozzle 30, the air blast from the nozzle 52 passes between the top sheet and the remainder of the stack and aid in separating the entire top sheet so that it floats above the stack with the downstream edge of the sheet fluttering.

The feed wheel 15 is rotated continuously in a counter-clockwise direction as viewed in Fig. 2 and a vacuum is applied to the hollow shaft 54 producing an air flow through the port 57 and the lower radial passages in the direction of the arrows 63. When the top sheet is raised from the stack, a portion of the floating sheet will contact the rim of the feed wheel 15 and be held in contact therewith by the vacuum. As the feed wheel rotates, the sheet will be transported to the right as seen in Fig. 2, the shutting off of the vacuum by the port causing the moving sheet to separate from the wheel when the end of the sheet passes the wheel. The force exerted by the wheel in moving the sheet to the right will tear the sheet from the needles and pull it from the open end of the vacuum nozzle. When the open end of the vacuum nozzle is again open, the lifting force due to the vacuum disappears and the nozzle is moved downward into engagement with the new top sheet of the stack by the action of the spring. Then the cycle of operation described above is repeated. Thus it is seen that an automatic cyclic operation is obtained without requiring mechanical reciprocation or indexing of elements or shutting off of pressures and vacuums.

It is not essential to the operation of the apparatus of the invention that the top sheet of the stack of sheets always be at the exact same level, since considerable movement is provided for the vacuum nozzle and the needles are lightly spring loaded to compensate for variations in position of the stack. However, when a large stack of sheets is being fed to the apparatus, it may be desirable to utilize a feed table such as that used in printing presses in which the feed table is moved upward as sheets of material are removed therefrom.

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The spring 32 may be omitted if desired and the force due to gravity relied upon to move the vacuum nozzle downward into engagement with the top sheet of the stack. However, it is preferable to utilize a spring having a light force since more rapid action may be obtained in most applications of the invention. Of course, if the stack of sheets and the apparatus are tilted at an angle to the horizontal, the use of a spring such as the spring 32 would be desirable because the force due to gravity would then be negligible. Such rapid action is desirable, both from an economic aspect and an operational point. If a new sheet is separated from the stack as soon as the previous sheet leaves the feed wheel, there will be no opportunity for the force due to the vacuum of the feed wheel to lift more than one sheet.

It is desirable that a minimum force be exerted on the top sheet by the vacuum at the nozzle so that the force required to pull the sheet from the nozzle and needle is not excessive. Furthermore, if the force at the nozzle is too large, part of the top sheet will be rushed into the nozzle, or more than one sheet will be lifted. However, at the same time, the force exerted at the nozzle must be sufficient to compress the spring and lift the top sheet and the nozzle. The size and shape of the nozzle and the spring and the magnitude of the applied vacuum in any particular embodiment are correlated to produce the desired operation.

An alternative form of construction for the retractable nozzle of the invention is shown in Fig. 4, wherein the nozzle 30 is coupled to the tubing 20 by a corrugated spring bellows 70, the operation of this embodiment being the same as that of the embodiment shown in Figs. 1 and 2.

Although exemplary embodiments of the invention have been disclosed and discussed, it will be understood that other applications of the invention are possible and that the embodiments disclosed may be subjected to various changes, modifications and substitutions without necessarily departing from the spirit of the invention.

We claim as our invention:

1. In an apparatus for removing single sheets of material from a stack of sheets, the combination of: a moving nozzle having an open end; a fixed nozzle mount, said nozzle being retractably carried on said mount for movement between a position adjacent the stack of sheets to engage and separate the top sheet from the stack, and a raised position in which said sheet is engaged by a feed means; spring means engaging said nozzle and said mount for urging said open end of said nozzle into contact with the top sheet of the stack; means for applying a vacuum to said nozzle to move said nozzle relative to said mount against the urging of said spring means when said open end is closed by engagement with a sheet of the material for separating the top sheet from the stack; feed means for removing said sheet from said raised nozzle, whereby said nozzle will automatically move toward and away from said stack of sheets to continuously separate and raise the top sheet to be engaged and removed by said feeding means; and needle means carried by said mount for engaging the top sheets of the stack adjacent said open end of said nozzle, the movement of said nozzle along said mount impaling the top sheet onto said needle means.

2. In an apparatus for removing single sheets of material from a stack of sheets, the combination of: a moving nozzle having an open end; a fixed nozzle mount, said nozzle being retractably carried on said mount for movement between a position adjacent the stack of sheets to engage and separate the top sheet from the stack, and a raised position in which said sheet is engaged by a feed means; spring means engaging said nozzle and said mount for urging said open end of said nozzle into contact with the top sheet of the stack; means for applying a vacuum to said nozzle to move said nozzle relative to said mount against the urging of said spring means when said open

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end is closed by engagement with a sheet of the material for separating the top sheet from the stack; feed means for removing said sheet from said raised nozzle, whereby said nozzle will automatically move toward and away from said stack of sheets to continuously separate and raise the top sheet to be engaged and removed by said feeding means; and needle means carried by said mount for engaging the top sheets of the stack adjacent said open end of said nozzle, the movement of said nozzle relative to said mount impaling the top sheet onto said needle means, said needle means including a needle member having three sections, the first section being pointed and having a narrow taper, the third section being of greater cross-section area than the first section and having a narrow taper, and the second section joining the first and the third sections and having a wide taper.

3. In an apparatus for removing single sheets of material from a stack of sheets, the combination of: a moving nozzle having an open end; a fixed nozzle mount, said nozzle being retractably carried on said mount for movement between a position on the stack of sheets adjacent an edge thereof to engage and separate the top sheet from the stack, and a raised position in which said sheet is engaged by a feed means; spring means engaging said nozzle and said mount for urging said open end of said nozzle into contact with the top sheet of the stack; means for applying a vacuum to said nozzle to move said nozzle relative to said mount against the urging of said spring means when said open end is closed by engagement with a sheet of the material for separating the top sheet from the stack; feed means for removing said sheet from said raised nozzle, whereby said nozzle will automatically move toward and away from said stack of sheets to continuously separate and raise the top sheet to be engaged and removed by said feeding means; needle means carried by said mount for engaging the top sheets of the stack adjacent said open end of said nozzle, the movement of said nozzle relative to said mount impaling the top sheet onto said needle means; and means for directing a stream of air toward the one edge of the stack and along the top sheets thereof.

4. In an apparatus for continuously removing single sheets of material from a stack of sheets, the combination of: a reciprocating nozzle having an open end; a fixed nozzle mount, said nozzle being retractably carried on said mount for movement between a position on the stack of sheets adjacent an edge thereof to engage and separate the top sheet from the stack, and a raised position in which said sheet is engaged by a feed means; spring means engaging said nozzle and said mount for urging said open end of said nozzle into contact with the top sheet of the stack; means for applying a vacuum to said nozzle to move said nozzle relative to said mount against the urging of said spring means when said open end is closed by engagement with a sheet of the material, said movement raising the top sheet from the stack; needle means carried by said mount for engaging the top sheets of the stack adjacent said open end of said nozzle, the movement of said nozzle relative to said mount impaling the top sheet onto said needle means; means for directing a stream of air toward the one edge of the stack between the raised top sheet and the remainder of the stack; and feed means for engaging the top sheet when raised and pulling the raised top sheet from said needle means and said open end of said nozzle; the removal of the raised sheet from said nozzle permitting reciprocation of said nozzle to engage and raise the newly exposed top sheet for removal.

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