United States Patent

[11] 3,578,312

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[21] Appl. No. **811,741**
[22] Filed **Apr. 1, 1969**
[45] Patented **May 11, 1971**

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[32] Priority **Apr. 4, 1968**
[33] **Germany**
[31] **P 17 72 141.4**

[54] **SHEET FEEDING APPARATUS**
7 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **271/20,** 271/24
[51] **Int. Cl.** **B65h 3/08**
[50] **Field of Search** ..... 271/19, 20, 24—25, 21

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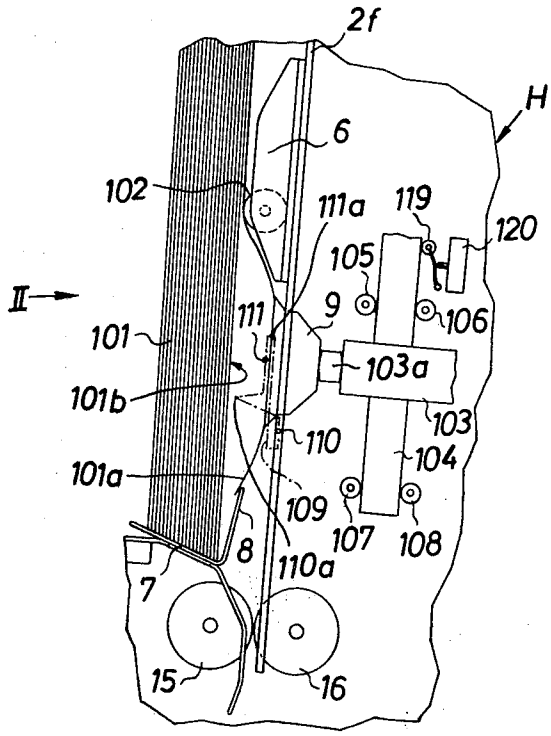
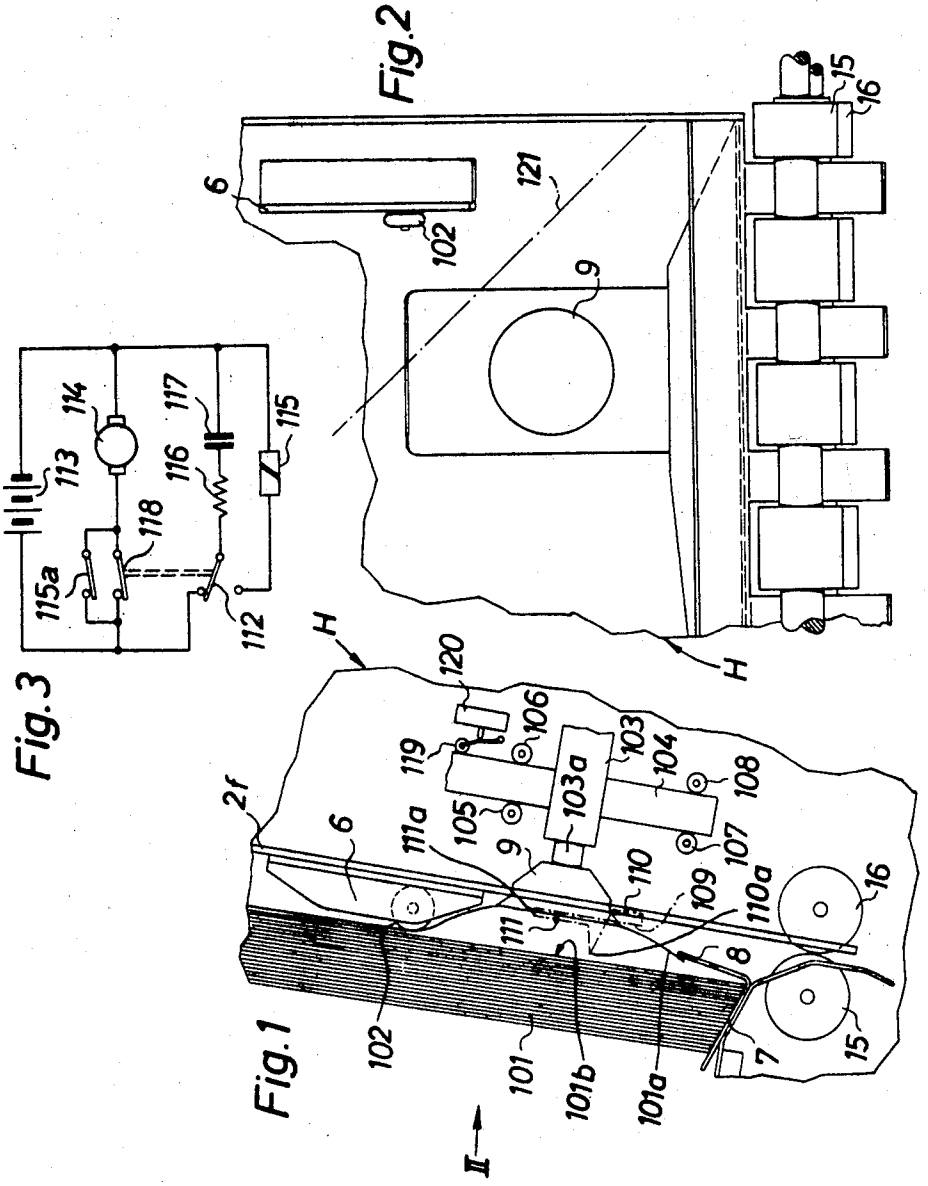
ABSTRACT: The foremost sheet of a pile of smooth-surfaced sheets abuts against a roller with its upper portion, and is located behind an upwardly extending stop with its lower edge prior to separation from the next following sheet. Such separation is brought about by a suction head which moves a portion of the foremost sheet away from the next-following sheet so that the foremost sheet is flexed between the roller and the stop and permits air to penetrate between its rear surface and the front surface of tee next-following sheet. After a predetermined period of dwell in a position corresponding to maximum flexing of tee foremost sheet, the suction head causes the lower edge of the foremost sheet to clear the stop and to move downwardly into the range of driven advancing rolls.





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SHEET FEEDING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to sheet feeding apparatus in general, and more particularly to improvements in sheet feeding apparatus of the type disclosed in Pat. No. 3,396,964 to Fengler et al. which is assigned to the same assignee. Still more particularly, the invention relates to improvements in the manner of separating the foremost sheet of a pile of stacked sheets from the next-following sheet.

The patent to Fengler et al. discloses an apparatus wherein a pile of sheets rests on a support in such a way that the upper part of the foremost sheet leans forwardly against an abutment and that the lower edge of the foremost sheet is located behind a stop. A suction head is employed to move the foremost sheet first upwardly so that the lower edge clears the stop, thereupon forwardly and away from the next-following sheet, and finally downwardly into the range of constantly driven advancing rolls which transport the thus-manipulated foremost sheet to a processing station, for example, into a film developing unit.

It was found that the sheets of a pile of photographic films in the apparatus of Fengler et al. tend to adhere to each other under certain circumstances, especially if the abutting surfaces of adjoining sheets are very smooth. Such adherence of adjoining sheets against each other is due mainly to the pressure of surrounding air because no air or little air is entrapped between the surfaces. It is therefore difficult to separate the sheets by moving the foremost sheet at right angles to and away from the next-following sheet because the force which is to effect such movement must overcome the entire pressure of surrounding air. Fengler et al. propose to move the foremost sheet first upwardly and thereupon away from the next-following sheet. The foremost sheet is then moved with a force which must suffice to overcome friction between its rear surface and the front surface of the next-following sheet. Such friction is also caused by the pressure of surrounding air.

SUMMARY OF THE INVENTION

An object of my invention is to provide a sheet feeding apparatus, particularly for feeding of smooth-surfaced photographic films or like sheets which tend to adhere to each other when assembled into a pile or stack, and to construct and assemble the apparatus in such a way that the foremost sheet can be separated from and moved with reference to the next-following sheet or sheets by exertion of lesser forces than in heretofore known sheet feeding apparatus.

Another object of the invention is to provide a sheet feeding apparatus which can be utilized with particular advantage as a means for delivering sheets of exposed film to a developing unit.

A further object of the invention is to provide a sheet feeding apparatus which can manipulate large and/or small sheets and which does not occupy more room than presently known sheet feeding apparatus.

The improved apparatus comprises a support for the lower edges of a pile of stacked sheets, abutment means provided for the foremost sheet of the pile and preferably located in such a way that the upper part of the foremost sheet leans forwardly (i.e., that the sheets of the pile are inclined with reference to a vertical plane), stop means extending upwardly from the support adjacent to the foremost sheet in the region of the lower edge of such foremost sheet, suction operated transfer means disposed in front of the foremost sheet of the pile on the support, and operating means for moving the transfer means away from the pile on the support to thereby move only a portion of the foremost sheet away from the next-following sheet while the foremost sheet abuts against the stop means and against the abutment means so that the thus moved portion of the foremost sheet is flexed, and for thereupon moving the flexed foremost sheet over the stop means, preferably with a predetermined delay which suffices to permit penetration of air between the rear surface of the flexed foremost sheet and the front surface of the next-following sheet so that subsequent manipulation of the foremost sheet necessitates the exertion of a relatively small force because the pressure at both sides of the foremost sheet is the same. During the initial stage of manipulation of the foremost sheet, the transfer means preferably moves at right angles to and away from the front surface of the next-following sheet.

It was found that innate elasticity of sheets of photographic film contributes to more rapid and more predictable separation of foremost sheets from the next-following sheets. Thus, when a portion of the foremost sheet is flexed by the transfer means and air is allowed to penetrate into the space between the foremost sheet and the next-following sheet, the foremost sheet tends to return into a single plane and is thereby separated from the next-following sheet. Thus, the separation of each foremost sheet from the next-following sheet normally progresses automatically at the rate at which air penetrates between the rear surface of the foremost sheet and the front surface of the next following sheet.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved sheet feeding apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a fragmentary schematic vertical sectional view of a sheet feeding apparatus which embodies one form of the invention;

FIG. **2** is a front elevational view as seen in the direction of arrow II in FIG. **1**, with the pile of sheets removed; and

FIG. **3** illustrates a portion of the electric circuit in the sheet feeding apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The apparatus which is shown in FIGS. **1** and **2** comprises a housing H having an internal wall **2***f* which supports a bracket **6** for an abutment here shown as a roller **102** which is rotatable about a horizontal axis. The housing H further accommodates a forwardly and downwardly inclined support **7** for the lower edges of a pile **101** of stacked smooth-surfaced sheets which tend to adhere to each other. The foremost sheet **101***a* of the pile **101** abuts with its upper portion against the roller **102**, and the position of the support **7** with reference to the roller **102** is such that the entire pile **101** leans forwardly at its upper end. The front edge of the support **1** is rigid or integral with an upwardly extending obstruction or stop **8** which is located at a level above two sets of constantly driven advancing rolls **15,16**.

The transfer means for delivering successive sheets of the pile **101** into the nip between the advancing rolls **15,16** comprises a suction head **9** which is located at a level between the abutment roller **102** and stop **8** and is movable by an operating device along a predetermined path **109** which is indicated in FIG. **1** by phantom lines. FIG. **2** shows that the roller **102** is laterally offset with reference to the suction head **9**.

The operating means for moving the suction head **9** along the path **109** comprises a prime mover, preferably an electric motor **114** which is shown in FIG. **3**, and a motion transmitting assembly including a first carriage **103***a* which is movable with the suction head **9** toward and away from the foremost sheet **101***a* on the support **7**, and a second carriage **104** which supports ways **103** for the carriage **103***a* and is movable up and down in substantial parallelism with the foremost sheet **101***a*. The housing H is provided with guide rolls **105,106,107,108** for the second carriage **104**. The output shaft of the motor **114** drives an eccentric (not shown) which effects reciprocatory movements of the second carriage **104**. The first carriage **103***a* is reciprocated by a suitable cam (not shown) which also

derives motion from the output shaft of the motor 114. The eccentric and the cam can be mounted directly on the output shaft of the motor 114. The numeral 110 denotes in FIG. 1 the initial position of the center of the suction head 9, and the numeral 111 denotes the position of such center when the suction head 9 dwells in an intermediate position during separation of the foremost sheet 101*a* from the next-following sheet 101*b* of the pile 101. During a complete cycle, the suction head 9 first moves upwardly in parallelism with the plane of the foremost sheet 101*a* (i.e., the carriage 104 moves upwardly while the position of the carriage 103*a* with reference to the carriage 104 remains unchanged); the suction head 9 thereupon moves substantially at right angles to and toward the foremost sheet 101*a* and begins to communicate with the suction generating means (not shown) when its center reaches the rearmost position 110*a* (such movement is effected by the carriage 103*a* which then moves with reference to the carriage 104); the suction head then moves the engaged portion of the foremost sheet 101*a* forwardly, i.e., away from the pile 101 because the carriage 103*a* moves with reference to the carriage 104; and the head 9 then moves upwardly with the carriage 104 so that its center reaches the position 111. A portion of the foremost sheet 101*a* is then flexed because the lower edge of the foremost sheet still abuts against the stop 8 and an upper portion of the sheet 101*a* still abuts against the roller 102 while the suction head attracts the sheet 101*a* in a region between the roller 102 and stop 8. Thus, the sheet 101*a* develops a bulge and permits air to penetrate between its rear surface and the front surface of the next-following sheet 101*b*. The position of the suction head 9 in FIG. 1 corresponds to that position which the suction head assumes when its center is held in the position 111. After a predetermined delay which suffices to permit penetration of air between the sheets 101*a*, 101*b*, the carriage 104 moves the suction head 9 and the sheet 101*a* upwardly so that the lower edge of the sheet 101*a* clears the stop 8; the carriage 104 then moves the suction head 9 downwardly so that the lower edge of the sheet 101*a* enters the nip between the two sets of advancing rolls 15, 16 and the sheet is entrained into the developing unit. The carriage 104 then moves the suction head 9 back to starting position in which its center assumes the position 110. The next cycle can begin, and such next cycle results in transfer of the foremost sheet 101*b* into the range of the rolls 15,16. It will be noted that, in its position of dwell, the rear face of the suction head 9 is located well in front of the stop 8 and roll 102. This is desirable because the lower edge of the foremost sheet then automatically moves over and in front of the upper edge of the stop 8 when the suction head 9 reaches its uppermost position (see the position 111*a* of the center in FIG. 1). If desired, the carriage 103*a* can move the suction head 9 slightly forwardly when the suction head reaches its upper and lower end positions; this is indicated by the short horizontal stretches of the phantom line representing the path 109. The suction head 9 is disconnected from the suction generating means when it reaches the lower end position, i.e., when the lower edge of the foremost sheet is engaged by the advancing rolls 15,16. The suction head is reconnected with the suction generating means when its center reaches the rearmost position 110*a*.

The delay means for holding the suction head 9 in the position corresponding to the position 111 of its center is shown in FIGS. 1 and 3. Such delay means comprises a detector 120 which is actuated by a trip 119 extending into the path of movement of the carriage 104 (which is the same as if the trip 119 were actuated by the suction head 9). The trip 119 actuates the detector 120 when the suction head 9 reaches the position shown in FIG. 1. The detector 120 comprises a housing for two electric switches 112,118 which are coupled to each other in such a way that the switch 118 closes when the switch 112 assumes the solid-line position and that the switch 118 opens when the switch 112 assumes the position indicated by broken lines. The switch 118 is in series with the motor 114 and is in parallel with a normally closed contact 115*a* of a relay 115. The latter is connected in series with a resistor 116 and a capacitor 117 when the switch 112 assumes the broken-line position. The contact 115*a* is in parallel with the switch 118 and can connect the motor 114 in circuit with an energy source 113 when the relay 115 is deenergized. Thus, when the relay 115 is energized and the switch 118 is open, the motor 114 is disconnected from the energy source 113.

The operation:

When the suction head 9 moves its center to the rearmost position 110*a* and is connected with the suction generating device, it engages the foremost sheet 101*a* and thereupon causes such sheet to move its adjoining portion away from the next-following sheet 101*b* so that the foremost sheet is flexed between the roller 102 and stop 8. Such flexed position of the sheet 101*a* is shown in FIG. 1. The line 121 of maximum flexing of the sheet 101*a* is shown in FIG. 2; this line extends at an angle of about 45° to a horizontal plane between the suction head 9 and roller 102. The latter insures that the sheet 101*a* is flexed gently and that such sheet is not scratched during flexing. The light-sensitive surface of the sheet 101*a* normally faces the suction head 9 and roller 102. The position of the sheet 101*a* in a condition of maximum flexing is shown in FIG. 1; the rear surface of the suction head 9 is then located well in front of the next-following sheet 101*b* to insure that the lower edge of the foremost sheet 101*a* automatically clears the top edge of the stop 8 when the center of the suction head 9 reaches the position 111*a*.

The carriage 104 actuates the trip 119 when the suction head 9 reaches the position shown in FIG. 1 (maximum flexing of the sheet 101*a*). The trip 119 then causes the switch 118 to open and the switch 112 to assume the broken-line position of FIG. 3 so that the relay 115 is energized in response to discharge of the capacitor 117. Thus, the relay 115 opens its contact 115*a* and the latter disconnects the motor 114 from the energy source 113; the motor 114 comes to a standstill and holds the carriages 103*a*, 104 against movement so that the suction head 9 dwells in the position shown in FIG. 1 and maintains the foremost sheet 101*a* in deformed condition. The length of the interval during which the suction head 9 dwells in the position shown in FIG. 1 depends on the length of time during which the relay 115 is being energized by capacitor 117. When the latter discharges across the resistor 116, the relay 115 is deenergized and the contact 115*a* is free to complete the circuit of the motor 114 so that the latter begins to move the aforementioned eccentric and cam in order to move the suction head 9 along the path 109. The switch 118 closes while the suction head 9 moves downwardly from its upper end position because the carriage 104 then moves beyond the trip 119. The switch 118 completes the motor circuit (which is already completed by the contact 115*a*) and the switch 112 then assumes the solid-line position of FIG. 3 to permit charging of the capacitor 117. The motor 114 continues to move the suction head 9 until the latter again assumes the position shown in FIG. 1. The capacitor 117 and its resistor 116 can be readily designed in such a way that the suction head 9 can dwell in the position shown in FIG. 1 for an interval of time which is long enough to insure that air can penetrate between the sheets 101*a*, 101*b* before the former is caused to clear the stop 8. However, it is equally within the purview of my invention to utilize other delay means for the suction head 9. For example, the aforementioned eccentric and cam on the output shaft of the motor 114 can be designed in such a way that the carriages 103*a*, 104 remain at a standstill for a desired interval of time when the suction head 9 reaches the position shown in FIG. 1. The utilization of specially designed cam and eccentric means simplifies the apparatus but contributes to its bulk.

Furthermore, the electrical delay means shown in FIG. 3 can be integrated into that part of the existing electrical circuit of the sheet feeding apparatus which times the connection and disconnection of the suction head 9 from the suction generating means and, if necessary, the dwell of suction head in its starting position. Also, the circuit of FIG. 3 can be provided with amplifier means (such as suitable transistors), especially

if the suction head **9** is to dwell in its intermediate position for relatively long intervals of time, for example, in excess of 2 seconds. The length of such intervals will depend on the length of time which is required to permit air to penetrate between the foremost sheet and the next-following sheet in order to insure convenient and predictable transfer of the foremost sheet into the range of advancing rolls **15,16**.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended.

I claim:

1. Apparatus for feeding sheets, comprising a support for the lower edges of a pile of stacked sheets; abutment means for the foremost sheet of the pile; stop means extending upwardly from said support adjacent to the foremost sheet of the pile in the region of the lower edge of the foremost sheet; suction-actuated transfer means disposed in front of the foremost sheet; operating means including motor means for moving said transfer means away from the pile on said support to thereby move a portion of the foremost sheet away from the next-following sheet while the foremost sheet abuts against said stop means and said abutment means so that the foremost sheet is flexed, and for thereupon moving the thus flexed foremost sheet over said stop means; and delay means arranged to hold said transfer means at a standstill for a predetermined interval of time while the foremost sheet undergoes maximum flexing, said delay means including detector means actuated by said transfer means to effect stoppage of said motor means for said interval of time in that position of said transfer means which corresponds to maximum flexing of the foremost sheet.

2. Apparatus as defined in claim **1**, wherein said operating means is arranged to effect movement of the foremost sheet downwardly in front of said stop means, and further comprising advancing means operative to engage the thus moved foremost sheet and to move it downwardly away from said transfer means.

3. Apparatus as defined in claim **1**, wherein said abutment means comprises roller means rotatable about a substantially horizontal axis.

4. Apparatus as defined in claim **3**, wherein said abutment means is located at a level above said transfer means.

5. Apparatus as defined in claim **4**, wherein said transfer means is located forwardly of said abutment means and said stop means while it moves the foremost sheet over said stop means.

6. Apparatus as defined in claim **1**, wherein said motor means includes an electric motor and said delay means further comprises normally deenergized relay means having contact means completing the circuit of said electric motor in deenergized condition of said relay means, said detector means including means for effecting energization of said relay means in that position of said transfer means which corresponds to maximum flexing of the foremost sheet.

7. Apparatus as defined in claim **7**, further comprising capacitor means for energizing said relay means, said delay means having switch means arranged to effect charging of said capacitor means in deenergized condition of said relay means.