March 13, 1962 J. GUTTELING 3,025,052

SHEET FEEDING DEVICE

Filed Sept. 23, 1958 2 Sheets-Sheet 1

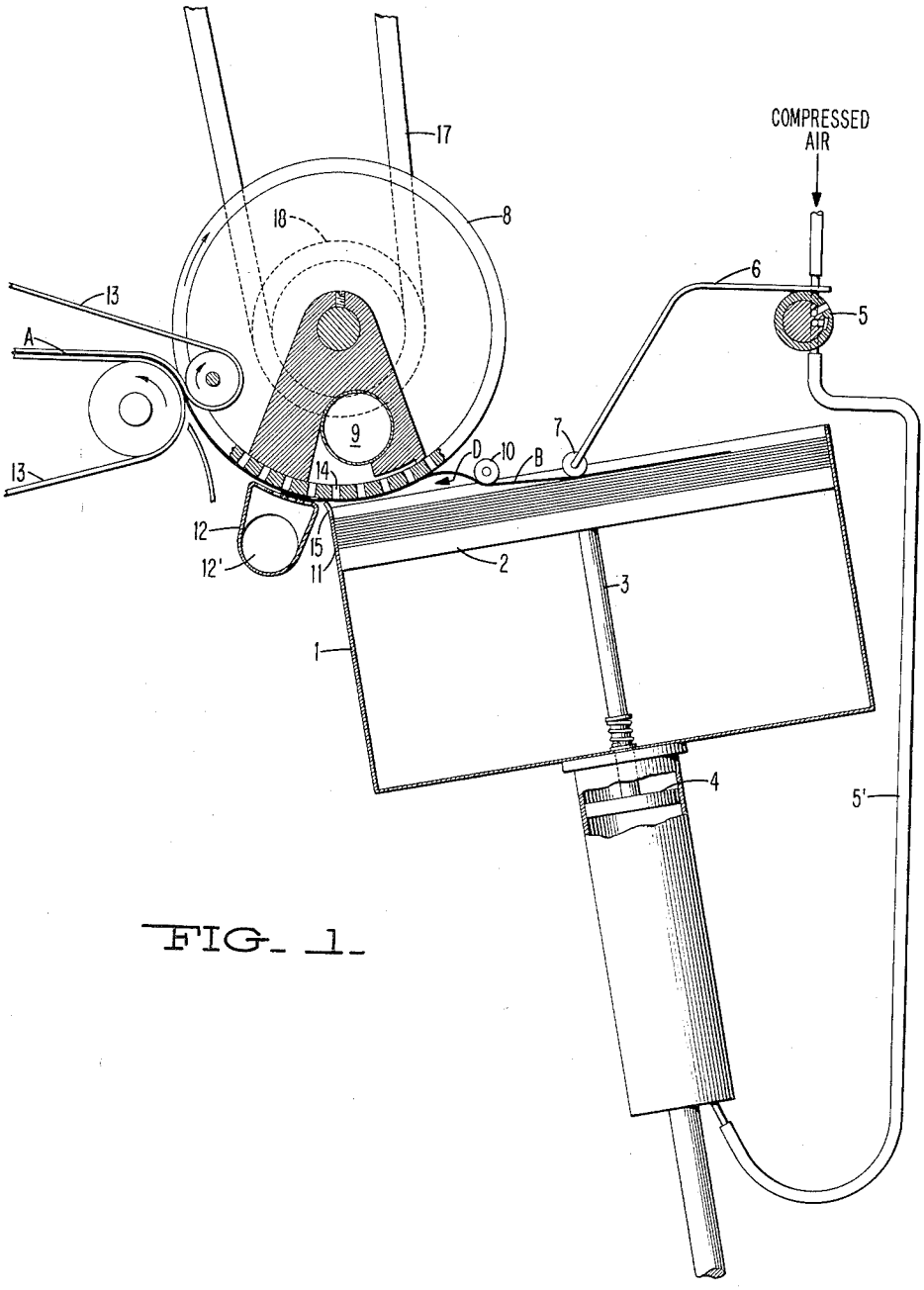

FIG. 1.

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March 13, 1962 J. GUTTELING 3,025,052

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Filed Sept. 23, 1958 2 Sheets-Sheet 2

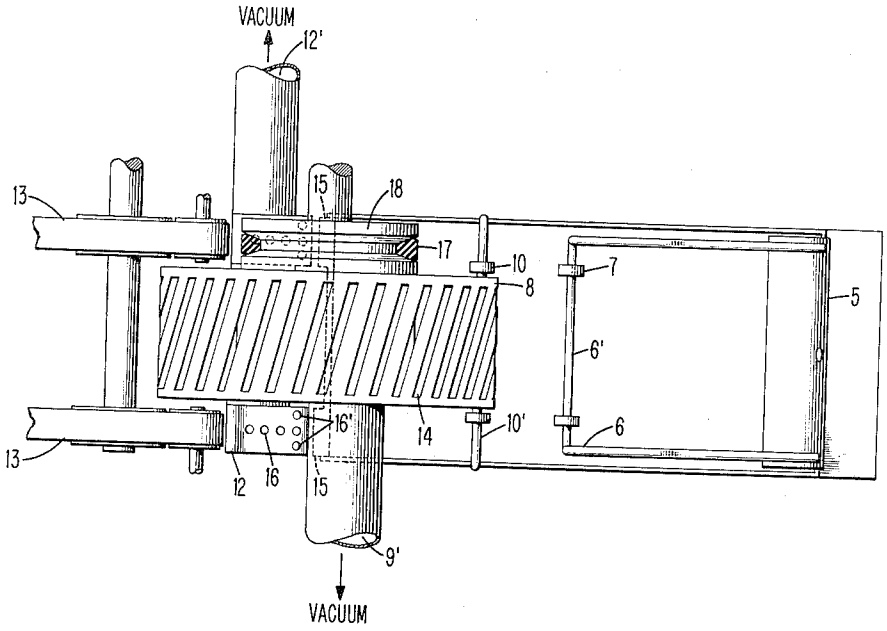

FIG. 2.

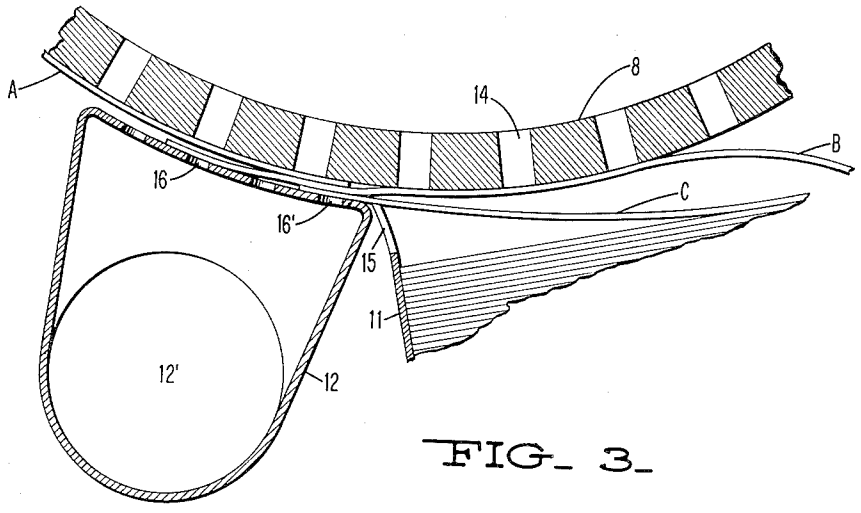

FIG. 3.

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3,025,052

SHEET FEEDING DEVICE

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5 Claims. (Cl. 271—28)

This invention relates to a sheet feeding device, and, in particular, to a vacuum assisted high speed feeding device for removing sheets from a stack or hopper one sheet at a time.

When sheets consist of thin paper, such as checks or the like, and have poor rigidity, removing them one at a time by means of a reciprocating picker knife is unreliable. It has been found that, in view of perforations, static electricity, and numerous other reasons, thin paper documents have a tendency to stick together. Quite frequently more than one sheet at a time will be picked up and taken along. Also, it is difficult to apply picker knife type reciprocating feeding devices when the thicknesses of the sheets vary and the sheets have unequal dimensions.

Although there have been previous attempts to provide machines which are capable of separating two sheets, they are not capable of separating more than two sheets, which is the general case. For example, one such known device provides a rotating drum with a vacuum nozzle for picking sheets from a feeder bin or hopper. Positioned adjacent the leading edge of the sheet is another vacuum nozzle to act on the leading edge of the sheets. In this arrangement, if more than two sheets are picked by the rotating drum, the vacuum nozzle at the leading edges will only be able to withhold one of the sheets from passing and the other sheets will jam the feed. This would be due to the bottommost sheet covering the ports on the vacuum nozzle at the leading edge of the sheets and leaving no other means to withhold the inbetween sheets.

In another known arrangement, a rotating vacuum drum is used to pick sheets. The arrangement is used with photographic equipment to separate a sensitized sheet from an original sheet. The two sheets are passed along on a feeder belt and passed between a rotating vacuum drum and a stationary vacuum chamber. Since the sheets stick together, the drum pulls the sensitized sheet away from the original sheet and passes it into a container, with the original sheet passing over the vacuum chamber by the feeding belt into another separate chamber. In this arrangement, the feeder drum does not deliver all of the sheets to a single container, but rather, the sheets are separated to pass into separate containers. In addition, the machine is not capable of withholding more than two sheets from passing over the stationary or rotating drum so that the drum can thereafter pick the topmost sheet of the remaining sheets.

In still another known arrangement, a vacuum drum is provided to pick sheets from a hopper, which sheets are separated by a blast of air from an adjacent chamber. In this arrangement, the sheets are separated prior to being picked and no separation means is provided after they are picked. Further, separating sheets by merely a blast of air without entrapping the air between the sheets is unreliable.

These and other prior methods of feeding sheets are not capable of feeding sheets one at a time if more than two sheets are picked by the rotating drum.

It is therefore an object of the invention to provide a device capable of feeding sheets of relatively arbitrary thicknesses, rigidity and dimensions, one at a time, at high speed, even though the feeding device picks two or more sheets from a stack of sheets.

It is another object of this invention to provide a sheet feeding arrangement which has a means for removing the sheets and another means for withholding any extra sheets that might be picked up and spreading them out so that the extra sheets can be removed singly.

Briefly stated, and, according to one aspect of this invention, I provide a rotating vacuum drum moving in the direction of transport of the sheets, which drum is positioned opposite the leading edge of the first sheet in the stack that is to be carried off, and stationary vacuum chambers positioned to either side of the rotating vacuum drum. Although it is preferable that the vacuum drum contain slots moving over a vacuum chamber which is positioned at the inside or near the leading edge of the stack, other means, such as an endless belt with apertures for moving over a vacuum chamber could also be used. When two or more sheets are picked by the rotating drum, vacuum ports on the stationary vacuum chamber are arranged in such a manner as to provide a graduated attraction to the sheets and tend to fan out the extra sheets so that they can thereafter be picked up one at a time by the vacuum drum.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which discloses, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

FIG. 1 is a sectional view of the rotating drum and vacuum chambers arranged to deliver single sheets.

FIG. 2 is a top view of the vacuum drum and vacuum chamber showing the relative position of the slots on the drum and the apertures in the stationary vacuum chamber.

FIG. 3 is an enlarged view of FIG. 1 showing the position of the sheets when more than two sheets are picked up by the vacuum drum.

Referring to FIG. 1, sheets are shown stacked in a hopper 1, provided with a movable pressure plate 2 for continually urging the sheets upwardly. The movable plate 2 is attached to a piston 4 by means of a connecting rod 3 so as to generally urge the movable plate upwardly. A control valve 5 is provided so that air can be admitted through the conduit 5' to provide compressed air which can act on piston 4 to tend to maintain it in its upward position. The control valve 5 is operated by levers 6 which are connected by a cross bar 6' (FIG. 2) which carries freely rotatable rollers 7.

In order to control the pressure exerted on the piston 4 by the compressed air and in turn exerted by the movable plate 2 on the stack of sheets, the levers 6 are fixed to the outer part of the valve by welding or the like so that the lever 6 can rotate the outer part of the valve around the inner part. The inner part is provided with ports for the inlet and outlet lines for compressed air. The outer part contains ports which are so positioned that when the rollers 7 are in a low position the appropriate ports are so aligned that compressed air is admitted under the piston 4; and, with the rollers 7 in a high position, the appropriate ports are so aligned that the space under the piston is connected with the atmosphere. In the former case, the paper stack rises, whereas in the latter case it descends. In the normal operating position, which is best suited for the feeding of sheets from the hopper, the control valve 5 is closed so that no compressed air is feeding into or out of the chamber below the piston 4.

In order to feed sheets from the hopper, an annular drum 8 of tubular cross section is positioned above the paper stack at a sufficient distance to most efficiently pick the sheets. The drum rotates clockwise and is driven by means of a belt 17, running over pulley 18, which is secured to the drum. The drum 8 is provided with through slots 14 (FIG. 2), which are inclined at an angle

of approximately 15° to the axis of the shaft so as to just extend beyond each other. Inside the drum and wiped by the inner annular surface thereof there is a stationary sector with a chamber 9, connected with the vacuum source 9'. As the slots register with the vacuum in chamber 9, sufficient suction is created to pull a sheet from the stack against the drum and slightly into the slots. The sheet is then carried away from the drum.

In order to guide the sheets which are picked off by the drum, rollers 10 and rollers 7, rotatable on fixed shafts 10' and 6' are provided. In order to further guide the sheets, the front wall 11 of hopper 1 extends to a point at a small distance from the drum and together with the drum constitute a throat for the sheets. Also, the front wall is slightly bent to assist in guiding the sheets.

Since the sheets have a tendency to stick together, the front wall 11 of the hopper 1 is provided with a recess 15 which is substantially the width of the drum. Through this recess air can flow into the tapered space between an attracted sheet B and the sheets left behind. This facilitates separation of the attracted sheet from the other sheets. Separating can be improved further by blowing air into the space D by a blower (not shown).

In the event that the drum 8 picks up one or more extra sheets, I provide two vacuum chambers 12 positioned on either side of the drum 8 so as to retain these extra sheets to be later picked up by the drum 8 one at a time. The chambers 12 are connected to a source of vacuum 12'. Although positioned to the side of the vacuum drum 8, the vacuum chambers 12 are also spacedly positioned from the periphery of the drum a sufficient distance to form a guide path for the sheets that are attracted by the drum. The periphery of the chambers 12 is curved to follow the periphery of the drum 8. Furthermore, the chambers 12 are positioned immediately following the recess 15 to pick up any extra sheets as they pass over the front wall of the hopper. The curved surfaces of the chambers 12 which are adjacent the periphery of the drum are provided with apertures 16, some of the apertures 16' being arranged to form a T-shaped pattern with the apertures 16. The vacuum chambers 12 are partially coextensive with the chamber 9 in the drum 8 so that suction through the apertures 16' opposes the suction through the slots 14 in the drum 8.

The position of the chambers 12 and their apertures 16 together with the width of the slots 14 are so selected that when the drum 8 attracts and conveys a single sheet from the stack, the suction exercised by the apertures 16 in the stationary chambers 12 is insufficient to draw it from the drum or to delay a sheet taken along by the drum. To prevent damage to the leading edge of a sheet, the apertures 16 are small and round. The sheet taken along by the drum is guided between two pairs of conveyor belts 13 mounted on either side of the drum (FIGS. 1 and 2), which are designed to have a higher velocity than the circumferential velocity of the drum. Once the sheets are positioned between the conveyor feed belts 13, they draw the sheet from the drum and convey it further

When one or more sheets stick to the sheet that is being picked, and are fed into the card feed path defined by the periphery of the vacuum chambers 12, the vacuum inside the drum can only act on the top-most sheet and cannot influence the bottom-most sheet. Therefore, the vacuum in the chambers 12 fully acts on the bottom-most sheet and holds it stationary while the top-most sheet passes over it and is carried away by the drum.

Referring now to FIG. 3, a common situation is shown in which more than one sheet attaches to the sheet A being picked. When this happens, sheet A is carried off by the conveyor belt 13 and the drum 8, while sheet C is arrested by the first apertures 16' of the chambers 12. Sheet B is then carried over sheet C by some of the slots 14 and moved sufficiently along to cover more of the apertures in chambers 12 where it is then arrested. As pointed out previously, sheet B may be attracted to the drum 8 before sheet A has passed entirely on its way. However, due to the fact that the timing belts 13 move at a greater speed than the speed of the periphery of the drum 8, sheet A will be pulled away from the leading edge of sheet B. Therefore, when more than two sheets are picked simultaneously, the apertures 16' in chambers 12 exert sufficient suction so as to hold the bottommost sheet C, and the remaining attracted sheets fan out over the bottommost sheet and are held by the remaining apertures 16 so that even though the first sheet C is first in being held by the apertures 16' in chambers 9, it is the last to be picked by the drum 8 for feeding to the feed belts 13.

In the embodiment described above, either thin sheets or cards can be carried off and fed one at a time at a speed of at least 1000 cards per minute. Furthermore, the sheets can be of different thicknesses and stacked promiscuously and still be carried off.

It is also understood that it is possible to carry off the sheets one by one, by a conveyor belt instead of the vacuum drum 8 in FIG. 1. Furthermore, it is intended that this invention also cover an arrangement in which the sheets are carried off from a hopper that feeds the sheets from below instead of above as shown in FIG. 1. This can be accomplished by rotating FIG. 1 180° clockwise, and omitting the servo mechanism and providing in lieu of the rollers 6 and 7 a stationary bottom, extending partially across the hopper 1 from the back wall to the vicinity of the drum. This will still enable the vacuum to draw the sheets onto the drum.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intent, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In a device for feeding sheets successively from a stack in a hopper, the combination of a rotary drum adjacent the hopper and having concentric inner and outer surfaces, a stationary member within said drum having an arcuate surface concentric with and wiped by said inner surface as the drum rotates, said member having a vacuum chamber opening through the arcuate surface intermediate its ends said drum having a plurality of through openings, different ones of which successively register according to a constant time sequence with said chamber as the drum rotates, for picking a sheet off the stack and attracting it directly to said outer surface and advancing such sheet along a predetermined feed path; and stationary means providing suction ports spaced at different distances downpath of the pick-up point of the drum openings and exerting a suction force opposing and of lesser magnitude than the suction force exerted by vacuum in the vacuum chamber acting through the then registered openings, said drum normally picking successive single sheets off the stack and advancing them serially past the suction ports, those suction ports nearest the hopper being of greater effective area than those remote from the hopper so that if three sheets stick and are picked off by the drum the suction ports will hold the second and third sheets back while permitting the first sheet to be advanced by the drum and will hold the third sheet more firmly than the second sheet to facilitate shingle-like separation of the second and third sheets and assure that the second sheet will be advanced ahead of the third sheet.

2. In a device for feeding sheets successively from a stack in a hopper, the combination of a rotary annular drum adjacent the hopper and of substantially narrower width than and longitudinally aligned with the sheets; a stationary sector member within said drum having an

arcuate surface concentric with and wiped by the inner surface of said drum as the drum rotates, said member having a vacuum chamber opening through its arcuate surface intermediate the ends thereof; said drum having a plurality of through openings which successively register with said chamber as the drum rotates for picking a sheet off the stack and attracting it directly to said outer surface and advancing such sheet along a predetermined feed path; and stationary means spaced at each axial side of the drum and providing suction ports spaced at different distances downpath of the pick-up point of the drum openings, said ports exerting a suction force acting near the side edges of the sheet and in opposition to and of lesser magnitude than the suction force exerted by vacuum in the vacuum chamber acting through the then registered openings, said drum normally picking successive single sheets off the stack and advancing them serially past the suction ports, said suction ports being effective in event a plurality of sheets stick and are picked off by the drum to retard all but the leading sheet in physical contact with the drum while said leading sheet is advanced past said ports, whereupon the next of said sticking sheets will then automatically be fully attracted to said drum and advanced thereby.

3. The combination according to claim 2, wherein said openings through the drum are in the form of equally spaced slots each extending at a uniform predetermined angle to the axis of the drum, said angle being of such magnitude that any plane passing through the drum axis will pass through the leading and trailing end portions of adjacent slots.

4. In a device for feeding sheets successively from a stack in a hopper, the combination of a rotary drum adjacent the hopper and having concentric inner and outer surfaces; a stationary member within said drum having an arcuate surface concentric with and wiped by said inner surface as the drum rotates and having a vacuum chamber opening through said arcuate surface; said drum having a plurality of through openings successively exposed to the vacuum chamber as they rotate therepast for picking a sheet off the stack and attracting it directly to said outer surface and advancing such sheet along a path, stationary means providing suction ports spaced progressively at different distances downpath from the pick-up point of said drum and exerting a suction force on the sheets opposing and of lesser magnitude than that exerted by vacuum in the vacuum chamber acting through such exposed openings, and take-away means disposed downpath of the ports and less than one sheet length from the pick-up point of the drum for accelerating a sheet advanced thereto by the drum to strip it from the drum,

said suction ports being effective in event a plurality of sheet stick and are moved toward said ports by said drum to retard advance of all sheets except that leading one in physical contact with the drum so that said one sheet will be slid relative to the remaining sticking sheets and advanced to the take-away means, whereupon said drum will fully attract the sheet adjacent said one sheet and advance same as soon as said one sheet is taken away from the drum by said take-away means.

5. In a device for feeding sheets successively from a stack in a hopper, the combination of a rotating annular drum having a plurality of openings extending generally radially therethrough, a stationary member within the drum having an arcuate surface wiped by the inner surface of the drum as the latter rotates, said member having a cavity intermediate the ends of the arcuate surface and forming part of a vacuum chamber with which different ones of said openings successively register periodically as the drum rotates thereby to cause successive sheets to be picked from the stack by attraction directly to the then registered openings for advancement by the drum through a throat, and stationary means spaced slightly from the drum and cooperating therewith to define the throat, said stationary means providing suction ports opening through its throat-defining surface and spaced progressively at different distances downpath from the pickup point of the drum and exerting a suction force opposing, and of lesser magnitude than, the suction force exerted by the vacuum in the vacuum chamber acting through the then registered openings, such that if a plurality of sheets stick and are concurrently picked by the drum, the sticking sheet farthest from the drum will be held back by the suction port nearest the hopper, and the next sheet closer to the drum will be advanced into contact with a suction port somewhat farther from the hopper, etc., thus shingling all sheets between said farthest sheet and nearest sheet as the latter is advanced by the drum through the throat so that as the trailing edge of the nearest sheet moves downpath of said cavity the next sheet will be attracted to the drum for advancement thereby.

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