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SHEET SEPARATING MECHANISM

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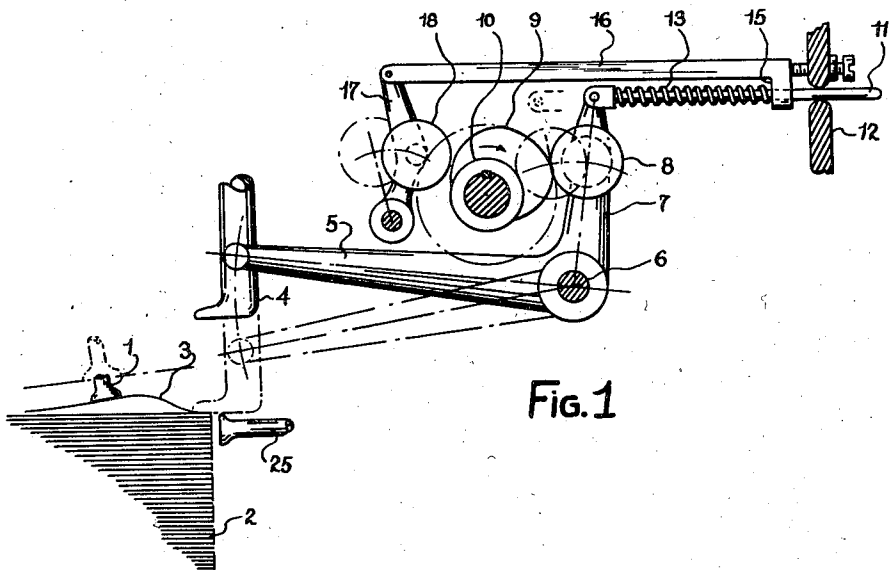


Fig. 1

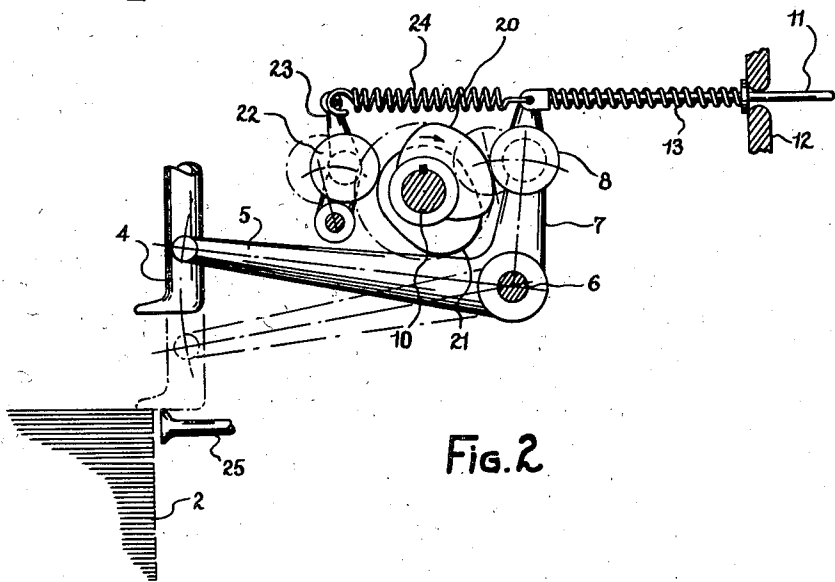


FIG. 2

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SHEET SEPARATING MECHANISM

Headley Townsend Backhouse, Wentworth,
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15 Claims. (Cl. 271-26)

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This invention relates to sheet separating mechanism for use in separating and feeding sheets of paper, card or the like, one at a time, from the top of a pile or stack for feeding to a printing or other machine and of the type comprising in combination a suction or mechanical gripper (usually a suction gripper) arranged to grip each uppermost sheet in the pile in turn at or near the rear edge of the sheet considered in relation to the direction of feed and to lift the edge, and a presser foot, or second sheet stop, which engages under pressure the remainder of the pile to prevent movement of a second sheet during the removal of the separated sheet.

Apparatus of the kind described is usually used in combination with sheet forwarding devices for feeding the separated sheets to a printing press or other machine operating on sheets, the sheets being fed singly or in a continuous stream of partly underlapped or overlapped sheets. The separating and lifting grippers aforesaid may be given a forwarding movement (i. e. in a direction substantially parallel to the plane of the top of the pile) to initiate the feeding of each sheet or the separating grippers may transfer the sheet to forwarding grippers (e. g. suckers) which are given a forwarding movement.

The present invention is concerned with improvements in the presser foot or second sheet stop employed in a sheet separator of the type described and with a method of separation in which such a presser foot is employed.

The invention provides a sheet separator of the type described, characterized by means for increasing, continuously or by one or more steps, the pressure applied by the presser foot to the upper surface of the pile during the separation of each sheet.

It is an advantage of sheet separators having the characteristic feature of the invention that the initial pressure applied by the presser foot may permit the sheet being separated to be withdrawn from underneath the presser foot and the increased pressure exerted by the presser foot may then be employed to clamp the remaining sheets and prevent movement thereof. The method of separating sheets which includes the step of withdrawing the sheets one at a time from beneath a retaining member at the rear of the pile accordingly constitutes an important feature of the invention.

It is customary to employ a spring for urging the presser foot into pressure engagement with the pile and according to the present invention in one of its forms, means are provided for increas-

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ing the force exerted by such a spring after the presser foot has engaged the pile. These means may, for example, include a reaction abutment for the spring which is movable to increase the loading of the spring after engagement of the presser foot with the pile.

A cam may be employed for controlling the action of the spring in lowering the presser foot into engagement with the pile, and the same cam may be arranged to move, through appropriate linkwork, the reaction abutment as aforesaid after the presser foot has been lowered.

In an alternative arrangement, one spring is employed for lowering, under cam control, the presser foot on to the pile and for applying the initial pressure to the pile and a second spring under variable loading is employed for increasing the pressure. A cam controlled movable anchor or abutment may be employed for increasing the loading of the second spring and the cam used for this purpose may be independent of that employed for lifting and lowering the presser foot.

The invention also provides the method of separating sheets one at a time from the top of a pile or stack for feeding to a printing or other machine which comprises the steps of applying limited downward pressure to the uppermost sheet of the pile at or near the rear edge thereof by presser means engaging the pile, engaging and gripping the sheet at or near the rear edge by gripper means, lifting the edge by the gripper means to withdraw the edge from under the presser means, applying increased downward pressure to the pile (e. g. by increasing the pressure exerted by the aforesaid presser means) and directing a blast of air between the uppermost sheet and the remainder of the pile.

In the preferred form of the method just described the air blast is directed through the presser means.

It is also preferred in carrying out the method to direct one or more blasts of air into the top portion of the pile at the back before engagement of the pile by the presser means in order to effect an initial, partial separation of the sheets.

Two specific forms of apparatus for carrying out the invention will now be described by way of example and with reference to the accompanying drawings, in which Figs. 1 and 2 are diagrammatic side views of said forms.

In each of these two examples, the apparatus operates at the rear of the pile and there are two or more suction grippers 1 operating above the

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pile 2 near to the rear edge. Each gripper, which is given rising and falling movements, is lowered on to the pile to engage each uppermost sheet 3 in turn and is then lifted while gripping the sheet. The lifted rear edge of the sheet is then transferred to forwarding suction grippers (not shown). In each example, there is associated with each separating gripper a presser foot 4 consisting of a foot carried on a bell crank lever 5 rotatably mounted on a shaft 6 extending parallel to the rear edge of the pile behind and slightly above the top of the pile. Both examples are arranged for feeding the separated sheets in a stream which may be arranged to be of partly underlapped or overlapped formation. In both examples also air blast means, comprising one or more blast nozzles 25, is so disposed as to fluff the sheets near the top of the pile, the blast being timed to occur while the presser foot is raised.

In the first example (illustrated in Figure 1) one arm of the bell crank lever 5 carries the foot and the other arm 7 which extends in the upward direction has a follower 8 cooperating with a cam 9 on a second shaft 10 parallel to the shaft 6 and positioned above and in front of that shaft within the angle of the bell crank. The arm 7 of the bell crank carrying the follower is also connected to a rod 11 slidable in a guide bearing 12 and surrounded by a compression spring 13, tending to maintain the follower in contact with the cam and to lower the foot on to the pile.

In the operation of the arrangement as so far described the cam 9 controls the lowering of the foot on to the top of the pile under the action of the spring in such timed relationship with the movement of the separating gripper that the foot lightly engages the uppermost sheet before and as it is lifted by the gripper 1. The engagement is such that the gripper may withdraw the sheet from under the foot. The pressure exerted by the foot on the pile is then increased by the means about to be described and, at the same time, the foot may direct an air blast underneath the partially lifted sheet to assist in the separation of the sheet from the pile.

Surrounding the aforesaid rod 11 there is a reaction abutment 15 for the spring 13 and this abutment is connected by a link 16 to a lever 17 which has a follower 18 cooperating with the aforesaid cam 9. The shape of the cam is such that after the foot has been lowered on to the pile there is a clearance between the cam and the follower on the bell crank lever. Further rotation of the cam brings it into engagement with the follower 18 on the lever 17 connected to the abutment 15 and rotates this lever in a direction to move the abutment along the rod to compress the spring thereby increasing the pressure exerted by the foot on the pile. Still further rotation of the cam releases the increased pressure and then brings the cam into re-engagement with the follower 8 on the bell crank lever to lift the foot off the pile and thereby to free the pile from the pressure of the foot and to allow sheets which may have been lifted or disturbed by the removal of the top sheet to fall back to their initial position.

In the second example (illustrated in Figure 2), there are two cams 20, 21, mounted on a shaft 10 positioned as described above and one of these cams—the cam 20—cooperates with a follower 8 on the bell crank to raise and lower the foot in the manner already described. The other cam, 21, cooperates with a follower 22 on a lever 23

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which is connected by a tension spring 24 to the bell crank lever 7 and the arrangement is such that after the foot has been lowered on to the pile by the compression spring 13 surrounding the guide rod 11, the cam 21 operates to increase the tension in the tension spring 24 and thereby to increase the pressure of the foot on the pile.

A more specific description of the complete method of separation according to the invention is as follows.

In this method nozzles 25 situated at the rear of the pile first direct blasts of air into the topmost portion of the pile, thus agitating the sheets and partially separating them. The sheets are prevented from moving in any direction other than a vertical one, by suitable guides placed around the four sides or corners of the pile. When sufficient air has entered between the sheets the hollow presser feet 4 descend and rest on the top of the pile with an initial limited pressure as described in the above example. This pressure is so limited that it is not so heavy as to press out all the air from between the sheets or to prevent the top sheet from being drawn or snatched out from under the presser feet.

After the presser feet have reached the top of the pile, the suction cups descend and grip the top sheet adjacent to the stops. The suckers are then caused to lift quickly, thus buckling and drawing out the top sheet from beneath the presser feet.

The presser feet are then given the secondary and heavier pressure so as to clamp down the remaining sheets in the pile. A blast of air is then directed through the presser feet between the partially lifted sheet and the pile, thus completely separating the sheet.

The lifting suckers, which now hold the sheet by its rear edge, may be given a forward motion so that the sheet moves under the action of the air blast substantially parallel to the top of the pile, so as to feed the sheet into nipping rollers, not shown, situated on the conveying portion of the feeder. Alternatively, the sheet may be transferred from the lifting suckers to a set of forwarding suckers, and thereafter pushed forward by air blast while controlled by these suckers into the nipping rollers aforesaid.

The air blast from the presser feet remains on during the time that the separated sheet is being forwarded by the forwarding or lifting suckers to the nipping rollers, after which both suction and air blast are cut off at approximately the same time.

When the sheet has been taken by the forwarding means and the suction and air blast cut off the presser feet are lifted approximately vertically from the pile, air is discharged through the fluffing nozzles 25 and the cycle of operation continued for the next uppermost sheet on the pile, the lifting and forwarding suckers being returned to their rearward position in time to perform their function of picking up and forwarding the sheets.

Having thus described my invention, I claim:
1. The method of separating and forwarding sheets one after another from the top of a supply thereof, which comprises applying light pressure on the top of the supply at a predetermined point along an edge thereof, gripping the uppermost sheet of the supply by suction adjacent said point and lifting the gripped sheet to separate it from the supply while said light pressure is applied, forwarding the lifted sheet from the supply, and increasing said pressure on the supply

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to clamp the next or underlying sheet to said supply during relative forward movement of said lifted sheet.

2. The method of feeding sheets from a supply thereof, which comprises applying light pressure on the top of the supply at spaced points along an edge thereof, gripping the uppermost sheet of the supply by suction adjacent said spaced points and lifting the gripped sheet to separate it from the supply while said light pressure is applied, advancing the lifted sheet relative to the supply, and increasing said pressure at said points on the supply to hold the next or underlying sheet against movement with the advancing lifted sheet.

3. The method of separating and forwarding sheets from a supply thereof, which includes the steps of gripping the uppermost sheet of the supply by suction at a predetermined point along and inwardly of an edge thereof and lifting the gripped sheet to separate the same from the supply, lightly pressing said uppermost sheet against the supply at said edge and adjacent said point to cause said sheet to buckle upon separation thereof from the supply and thereafter increasing the pressure on the supply below the separated uppermost sheet to hold the next or underlying sheet against movement relative to the supply.

4. The method of separating and forwarding sheets one at a time from the top of a pile, which comprises exerting light pressure on the top of the pile through a presser foot, causing a sucker to grip the top sheet of the pile in advance of said presser foot and pull the sheet out from under the presser foot, advancing the top sheet, increasing the pressure exerted by said presser foot to hold down the remaining sheets of the pile while said top sheet is advanced, lifting the presser foot and fluffing the sheets at the top of the pile preparatory to repeating the cycle.

5. In apparatus for feeding sheets one after another from a supply thereof, means yieldably holding an edge portion of the topmost sheet in engagement with the supply, suction means operable toward and away from the supply to grip the topmost sheet adjacent the holding means and draw said sheet from beneath said holding means to separate the same from said supply, and means operable after said topmost sheet is separated from said supply to apply increased pressure on said holding means to hold the remaining sheets of the supply against movement.

6. In apparatus of the class described, suction means operable to elevate a marginal portion of a sheet to separate the same from the top of a supply of sheets, spring actuated means engaged with the top of said supply for yieldingly resisting upward movement of the top sheet from said supply by said suction means and means for increasing the downward pressure exerted by said spring actuated means for firmly holding the remaining sheets of said supply against movement after said top sheet has been separated from the supply by said suction means.

7. In a sheet feeder, a presser foot movable into engagement with the top of a supply of sheets across a margin thereof, means for moving said presser foot into engagement with said supply and for applying light pressure thereon, and means for thereafter increasing the downward pressure exerted by said presser foot.

8. In a sheet feeder, a presser foot movable into engagement with the top of a supply of

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sheets across a margin thereof, means for moving said presser foot into engagement with said supply and for applying a light yieldable pressure thereon, and for thereafter applying increased yieldable pressure on said presser foot, and means for controlling the operations of said last named means.

9. In a sheet feeder, a device engaged with the top of a supply of sheets under limited downward pressure to enable separation of the top sheet from said supply, and operable to apply increased downward pressure on said supply for preventing forward movement of a succeeding sheet or sheets with a preceding sheet separated from said supply, means acting to apply said limited downward pressure upon said device, and means acting thereafter to apply said increased downward pressure upon said device.

10. In apparatus for feeding sheets from the top of a pile, a presser foot adapted to engage the uppermost sheet of the pile at the rear thereof, a spring means effective to exert light pressure upon said presser foot during part of the feeding cycle and means for modifying the action of said spring means for exerting increased pressure upon said presser foot during another part of the cycle, whereby a sheet may be pulled out from under the presser foot while the latter is under light pressure and the remaining sheets of the pile may be firmly held by the presser foot while under increased pressure.

11. Apparatus as defined in claim 10, comprising a spring for urging said presser foot into engagement with the pile and means for increasing the force exerted by said spring after the presser foot has engaged the pile.

12. Apparatus as defined in claim 11, wherein said means for increasing the force of the spring comprises a reaction abutment for the spring and means for moving said abutment to increase the loading of the spring after engagement of the presser foot with the pile.

13. Apparatus as defined in claim 12, comprising a rotating cam adapted to oppose the action of said spring and functioning to permit the spring to lower said presser foot into engagement with the pile, and comprising means responsive to the same cam for moving said reaction abutment as aforesaid after the presser foot has been lowered.

14. Apparatus as defined in claim 8, comprising a spring for lowering said presser foot onto the pile and applying initial pressure to the pile, a rotating cam for controlling the lowering action, a second spring adapted to exert downward pressure on said presser foot, and means functioning after said presser foot is in engagement with the pile for loading said second spring.

15. Apparatus as defined in claim 14, wherein the means for loading said second spring comprises a second cam rotating in synchronism with said first cam.

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