July 4, 1939. H. T. BACKHOUSE 2,165,172

SHEET-FEEDING MACHINE

Filed Nov. 30, 1936 4 Sheets-Sheet 1

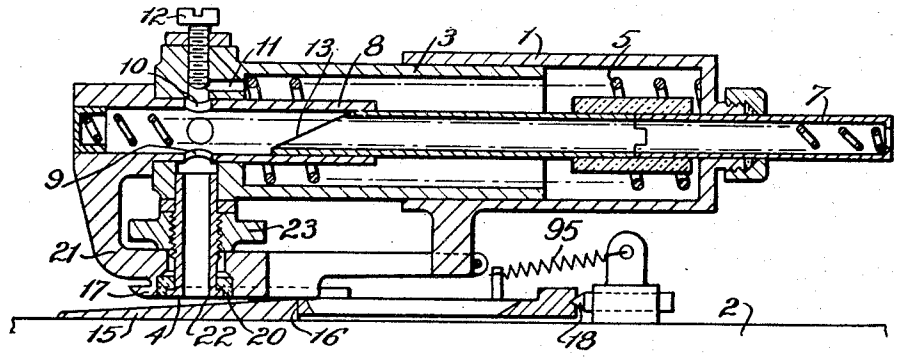

FIG. 1

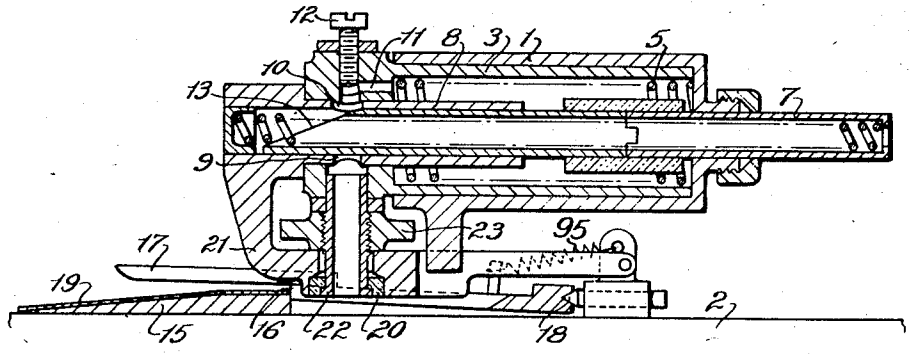

FIG. 2

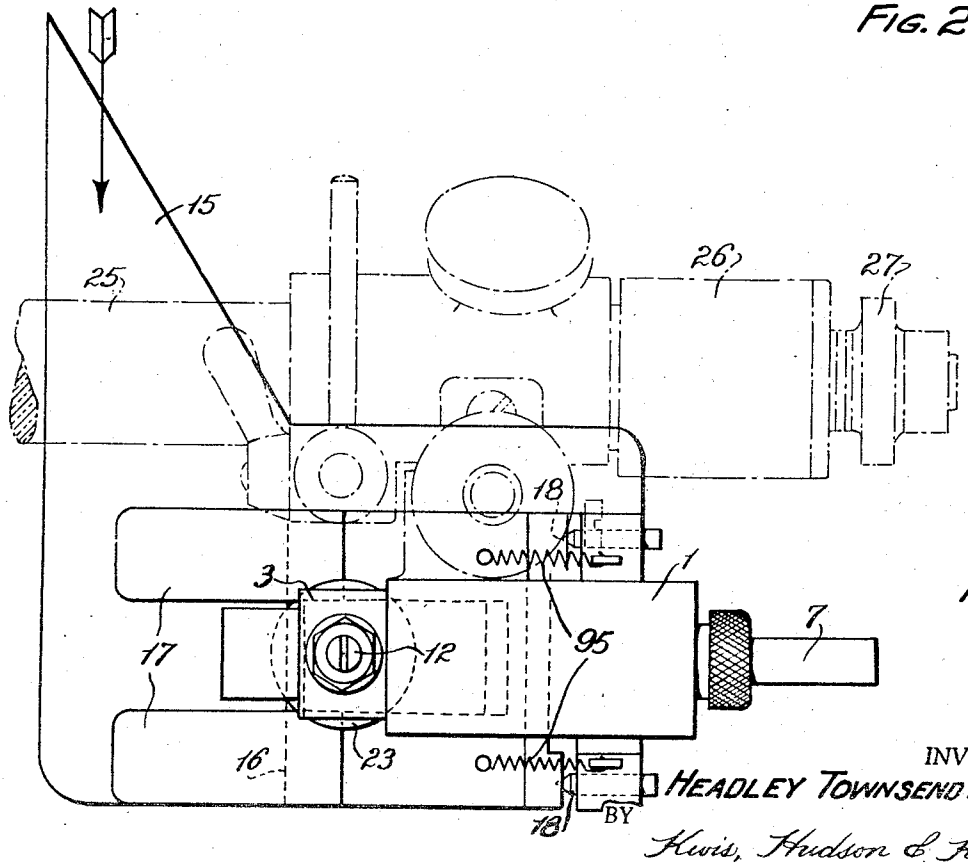

FIG. 3

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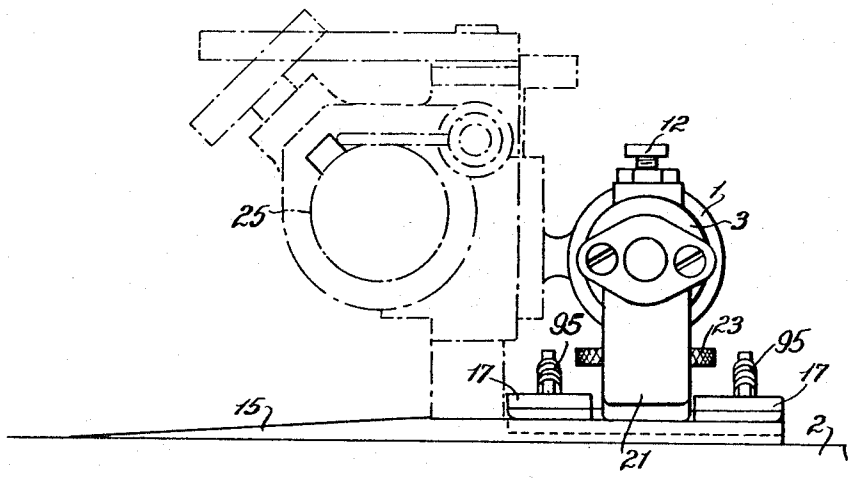

FIG. 4

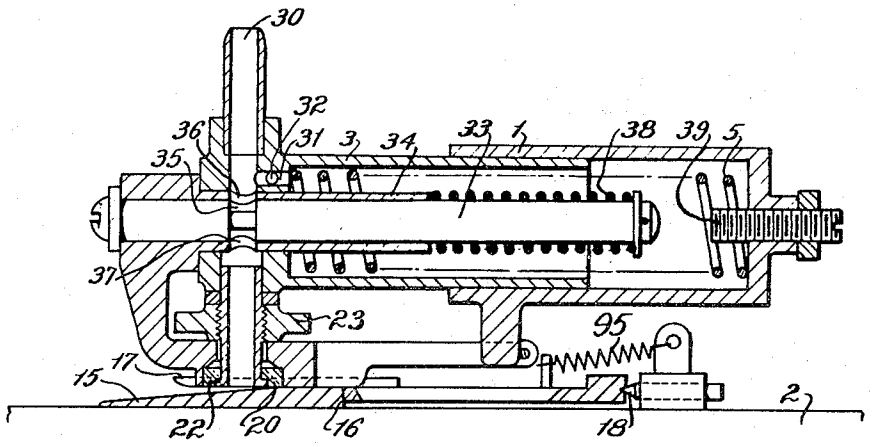

FIG. 5

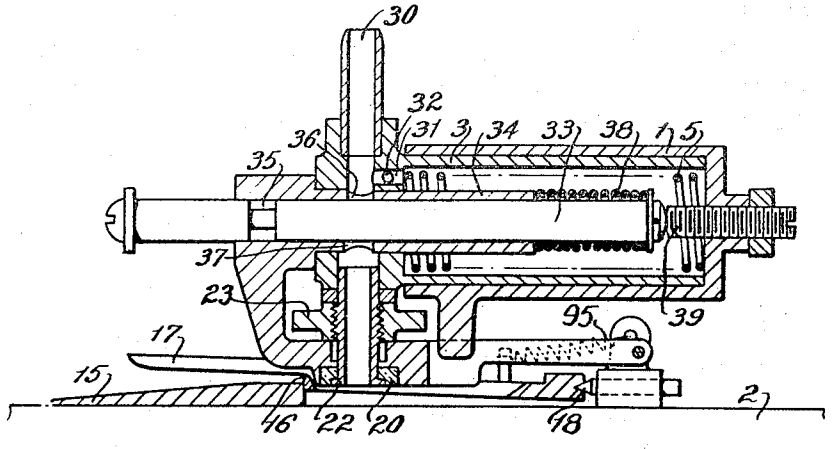

FIG. 6

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SHEET-FEEDING MACHINE

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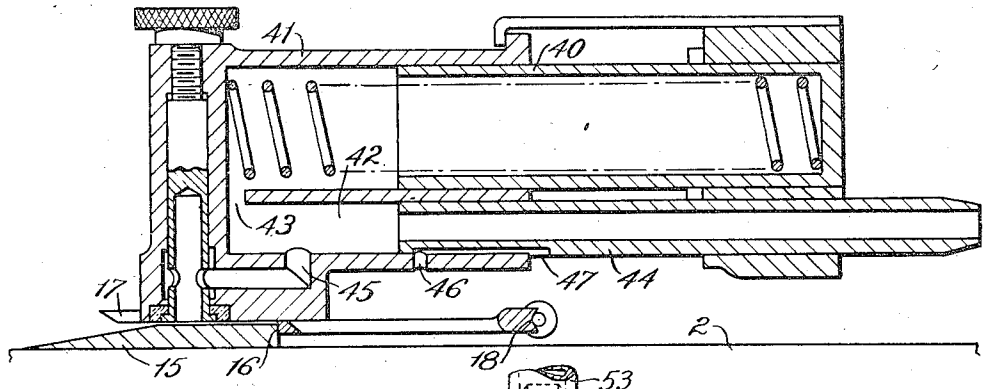

FIG. 7

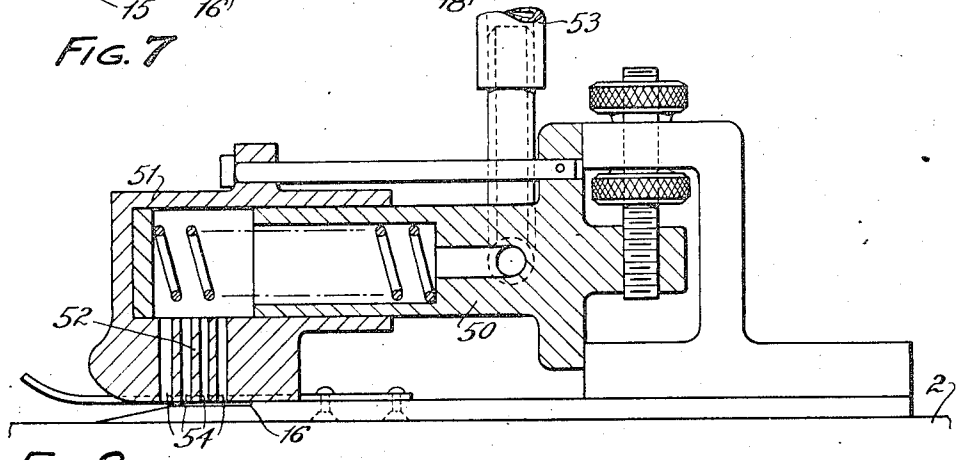

FIG. 8

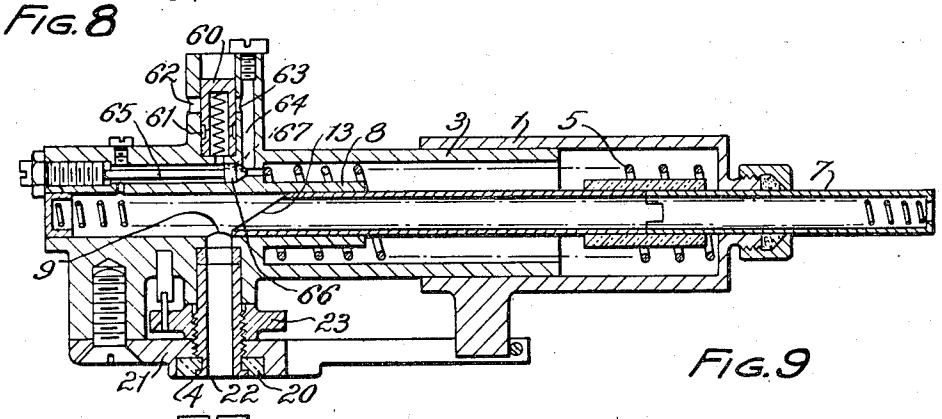

FIG. 9

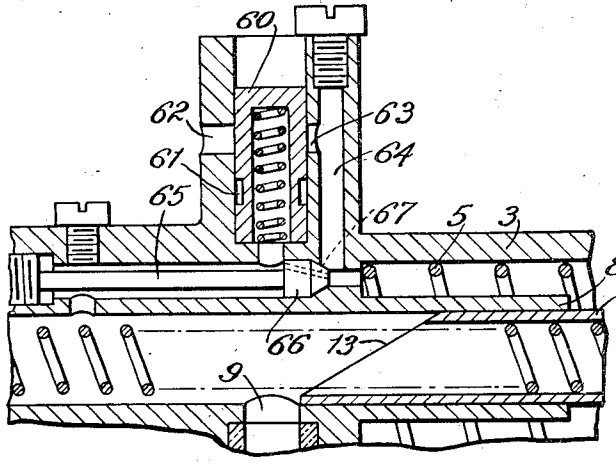

FIG. 10

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Fig. 11.

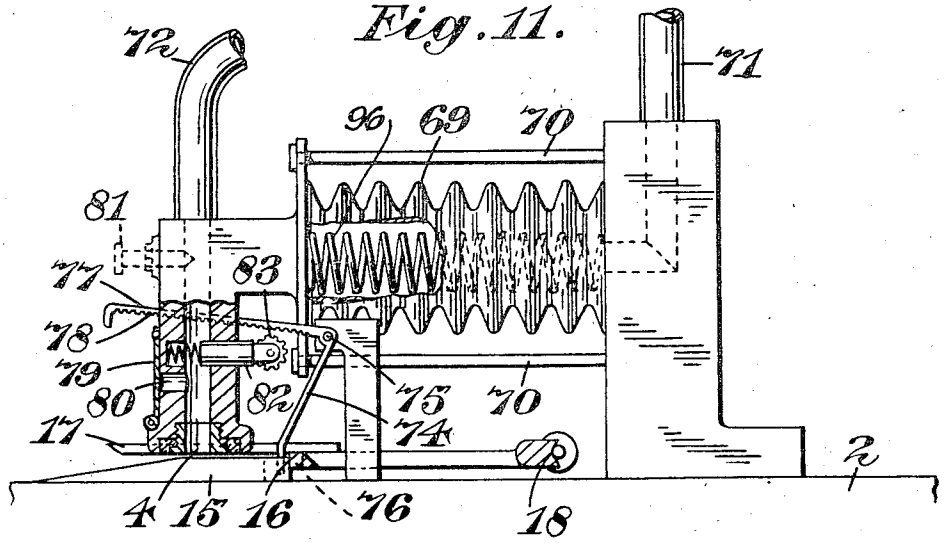
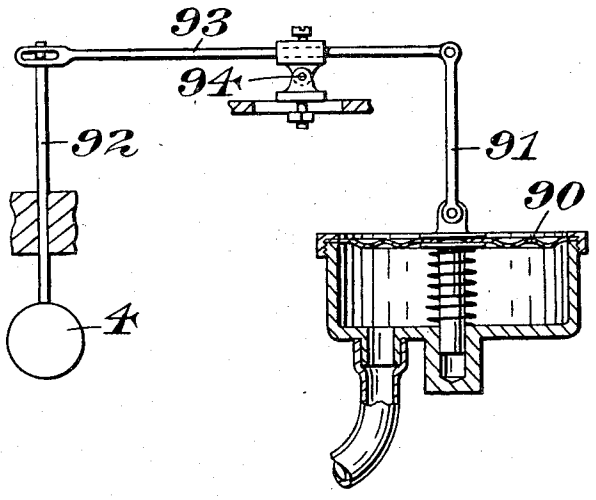


Fig. 12.



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Patented July 4, 1939 2,165,172

UNITED STATES PATENT OFFICE

2,165,172

SHEET-FEEDING MACHINE

Headley Townsend Backhouse, London, England

Application November 30, 1936, Serial No. 113,425
In Great Britain December 6, 1935

18 Claims. (Cl. 271—59)

This invention consists in improvements in or relating to sheet-feeding machines and has reference to machines of the type comprising a feed-board over which the sheets are fed (frequently in partly overlapped formation) and, associated with the feed-board, side-lay mechanism arranged to engage the sheets when they are on the board and to draw them sideways up to a gauge (which is usually adjustable in position) for the purpose of effecting lateral registration of the sheets. Feeding machines of this type are commonly employed in connection with printing presses.

The invention provides a sheet-feeding machine of the above type which is characterised by the use of pneumatic means for operating the side-lay mechanism to cause it to engage the sheets and to draw the sheets sideways.

Preferably the sheets are engaged and gripped by a sucker which is moved sideways by pneumatic means. In the preferred form of this arrangement means are provided for controlling the rate of application of suction to the means for moving the sucker sideways independently of the rate of application of the suction to sucker.

Alternatively, the sheets are gripped by a mechanical gripper pneumatically operated and the gripper is moved sideways by pneumatic means. The sucker or gripper may be moved sideways while engaging the sheets by pneumatic means and after releasing the sheets it may be returned to its original position by spring means suitably controlled by pneumatic valves. Alternatively, the sucker or gripper may be moved sideways while engaging the sheets by spring means and after releasing the sheets returned to its original position and released to effect the next registering movement by pneumatic means.

Some specific examples of the invention will now be described with reference to the accompanying drawings, in which—

Figure 1 is a cross-section of one form of side-lay mechanism, the mechanism being in the position for engagement with the sheet,

Figure 2 is a view corresponding to Figure 1 but with the mechanism in the position corresponding to the completion of the sideways movement,

Figure 3 is a plan view of the mechanism as shown in Figure 2,

Figure 4 is an end view of the mechanism shown in Figure 3,

Figure 5 is a section of an alternative form of the mechanism, the mechanism being in the position ready to engage the sheet,

Figure 6, is a view corresponding to Figure 5 but with the mechanism in the position at the end of its sideways movement,

Figure 7 is a section of a further alternative arrangement in the position ready to engage the sheet,

Figure 8 is a section of a still further alternative arrangement also with the mechanism in the position ready to engage the sheet,

Figure 9 is a view of a modified form of the arrangement shown in Figure 1, the device being in the position immediately after suction has been applied,

Figure 10 is a detailed view of part of the arrangement shown in Figure 9.

Figure 11 is a diagrammatic view of a further modified form of the device, and

Figure 12 is a diagram illustrating yet another modification.

Like reference numerals indicate like parts in the several figures of the drawings.

In the embodiment shown in Figures 1 to 4 the operating means comprise a fixed cylinder 1 open at one end located horizontally over the feed board 2 with its axis at right angles to the direction of travel of the sheets, and a trunk piston within the cylinder, carrying at its outer and closed end a dependent sucker 4 the mouth of which is closely adjacent to the feed board. A helical spring 5 within the piston and cylinder tends to maintain the piston normally at the outer extremity of a travel limited by a suitable stop at which position the sucker overhangs the margin of the sheet to be registered. The suction conduit passes through the closed end of the cylinder in the form of a tube 7 which extends into a longitudinal sleeve 8 formed inside the piston. This sleeve is provided with a port 9 at a position intermediate of its ends leading to the sucker mouth and a second port 10 opposite to the first port leading through a passageway 11 into the interior of the piston and cylinder, a needle valve 12 being provided in this passageway for varying the rate of application of the suction to the cylinder. The sleeve makes a substantially airtight joint with the end of the suction conduit and is free to slide longitudinally thereon. The end of the suction conduit is formed (as shown at 13) by cutting in a plane lying at about 30° to the axis of the conduit and is so arranged that as the sleeve moves over the conduit the tip of the conduit, after a predetermined movement, closes the port 9 leading to the sucker cutting off the suction to the sucker while maintaining open the port 10 and the passageway to the cylinder.

A rubber buffer for the piston may be provided within the cylinder at its closed end to prevent undue shock when the piston reaches the end of its sideways travel.

Supported from the cylinder in a position to lie on the feed table is a guide plate 15 and side-lay gauge or stop 16 and above the plate a pair of smoothers 17 rigid with the gauge 16 one to each side of the sucker considered in the direction of its movement, the edge of the sheet 19 being fed between the guide plate and the smoothers. The smoothers which may be of celluloid or other transparent material are in the form of plates hinged to turn upon the points 18 about an axis parallel with the direction of feeding of the sheets (as shown by the arrow in Figure 3) and are so arranged that they are pressed downwardly into close proximity with the sheet during the sidewise movement of the sucker thereby preventing buckling of the sheet when it comes into contact with the side-lay gauge. This depression of the smoothers results from the engagement of a depending part of the piston 21 with the inclined rear surface of gauge 16, whereby the travel of the piston to the left in Figure 2 under the influence of the spring 5 cams down the gauge 16 to the position of Figure 1, the smoothers moving down also because of their rigid connection with the gauge. When the piston moves toward the right over the gauge 16 the latter snaps upward to the position of Figure 2, and the smoothers rise away from contact with the sheet, so that its travel toward the press is not hindered.

The operation of the mechanism is that when a sheet being fed has reached the front lays suction is applied to the side-lay mechanism causing the sucker to lift and grip the sheet with the full force of the suction and closing the sucker mouth. The suction then builds up inside the cylinder at a rate predetermined by the setting of the needle valve and causes the piston to be drawn into the cylinder against the action of the spring, the piston carrying the sucker sideways and with it the sheet. After a predetermined movement the end of the suction conduit closes the port leading to the sucker mouth thereby preventing application of further suction to the sheet. The position at which this occurs is chosen as far as possible to correspond with the abutment of the sheet against the side-lay gauge. Movement of the piston continues under the action of the suction until the sucker is drawn sideways off the sheet leaving the sheet in its registered position, and allowing the smoothers to be lifted off the sheet by means of suitable springs 95. The sheet is then removed in the usual manner and the suction released allowing the piston and sucker to be returned to the initial position under the action of the spring.

In order to facilitate the return of the piston by the spring, means may be provided for the rapid admission of air to the interior of the piston and cylinder to restore atmospheric pressure therein immediately after the suction has been cut off from the suction conduit. For this purpose the needle valve may be suitably modified or an additional suction relief valve may be provided. For example a valve leading to the atmosphere arranged for automatic closing on the application of suction in the suction conduit may be employed as shown in Figure 9, or the needle valve may be arranged to close to its predetermined setting on application of suction.

Figure 9 shows the addition of a suction relief valve to the arrangement shown in Figure 1. The relief valve consists of a spring loaded plunger 60 provided with a circumferential groove 61 adapted, when the valve is in its upper position corresponding to the condition of "no suction" in the suction conduit, to put into communication two ports 62, 63. The port 62 is open to the atmosphere and the port 63 leads through the passage 64 to the cylinder. In the operation of the device as soon as suction is applied to the suction conduit the plunger 60 is drawn downwardly against the action of its spring into the position shown in the drawing and the admission of air to the cylinder through the port 62 prevented. After the piston has been drawn into the cylinder and the suction is released from the suction conduit (by the master control valve, not shown) the plunger returns to the upper position under the action of its spring thereby putting the cylinder into communication with the atmosphere and effecting rapid release of the suction in the cylinder.

A further modification shown in Figure 9 is the provision of the fixed choke 65 having a conical head 66 and a passageway 67 through the head, the passageway being of suitable predetermined size to provide the desired rate of application of suction to the cylinder. In use the choke is screwed in with its coned head 66 hard on its seating and the object of the arrangement is to provide means for readily cleaning the choke without disturbing any adjustment. If desired the fixed choke may be omitted and the suction relief valve employed with an adjustable needle valve control as shown for example in Figure 1.

The sucker mouth is adjustable in shape and effective size and is formed by an annular rubber ring 20 seated in a recess in the bottom face of a bracket 21 depending from the piston, the bottom of the recess being counter-sunk and the face of the ring being normally flush with the face of the recess. A flanged tube 22, through which the suction is applied, passes through the aperture in the ring and is arranged for axial adjustment by means of a nut 23 from a position (shown in the drawings) in which the outer face of the flange is in the plane of the bracket face and ring face (giving minimum effective size) to a position in which the flange is within the face of the bracket thereby forming the ring into cup shape (giving a larger effective size).

The side-lay mechanism is mounted on a bar 25 extending across the feed-board and is adjustable in position on this bar for the purpose of adjusting the position of the mechanism on the board. Fine adjustment of this position may also be obtained by longitudinal movement of the bar in its supporting brackets 26 by means of a nut 27.

In the modified form of the above embodiment shown in Figures 5 and 6, the suction conduit 30 is formed on the piston—the attachment to it being made by a flexible rubber connection—and leads through valve mechanism to the sucker, a second passage 31 leading from the conduit to the interior of the piston by way of a needle valve 32, for controlling the rate of air flow through the passage. The valve mechanism consists of a rod 33 arranged axially within the piston and longitudinally slidable in a sleeve 34 formed on the closed end of the piston. This rod has a circumferential groove 35 arranged to cooperate in the extended position of the piston

with ports 36, 37 formed in the sleeve, to complete the suction conduit to the sucker mouth. On application of the suction, after the piston has moved a short predetermined distance into the cylinder, the end of the rod 33 contacts with an adjustable stop 39 formed in the cylinder head and further movement of the rod is then prevented so that continuation of the movement of the piston causes the ports 36, 37 in the sleeve to be moved out of register with the groove 35 in the rod thereby cutting off the suction from the sucker mouth but not from the cylinder. A spring 38 surrounding the rod is provided for returning it to its initial position on release of the piston.

In a further embodiment shown in Figure 7 the arrangement is that the piston 40 remains stationary and the cylinder 41 which carries the sucker moves in relation to the piston. The cylinder in this example is formed with a second bore 42 parallel to the main bore 41 and communicating therewith through an aperture 43 of predetermined small dimensions formed in the wall between the two bores near the closed end thereof, the size of the aperture being controlled if desired by a needle valve (not shown). This second bore 42 slides over a second piston 44 which forms the suction conduit and the bore has in its walls a port 45 leading to the sucker mouth. This port is so positioned that it is closed by the suction conduit 44 before the cylinder reaches the end of its stroke thereby cutting off the suction to the sucker while at the same time leaving the passage 43 open to the operating cylinder. If desired, in this, and in the previous embodiments, means may be provided for releasing the residual suction at the sucker mouth after it has been cut off from the suction conduits. This release may, for example, be effected in the last embodiment by providing a port 46 in the wall of the second cylinder open to the atmosphere and providing a longitudinal passageway 47 on the surface of the suction conduit arranged to connect the port 46 with the passage 45 to the sucker near the end of the movement of the cylinder.

In the still further embodiment shown in Figure 8 the piston 50 remains stationary as in the last example and the cylinder 51 which carries the sucker moves in relation to the piston. In this embodiment, however, the suction is communicated to the sucker 52 from the conduit 53 by way of the piston and cylinder. The sucker mouth consists of four apertures 54 arranged in line in the direction of movement of the sucker so that as the cylinder moves over the piston the suction is cut off gradually from the sheet (i. e., from one aperture at a time) and as the sucker moves off the edge of the sheet the suction is released from the sucker mouths gradually. This arrangement of sucker mouths may if desired be employed in any of the examples previously described.

In place of the piston and cylinder devices described in the above examples the sucker may, if desired, be carried for sideways movement by a collapsible suction-operated bellows as shown diagrammatically in Figure 11 in which the bellows are represented by 69 and are slidable on guides 70, a spring 96 being provided to expand the bellows when the suction is broken. The suction in this example is taken through separate conduits 71 and 72 to the bellows and sucker 4 respectively. A further modification illustrated in Figure 11 is the means for cutting off the suction at the sucker mouth. These means are, in this case, arranged to be put in operation by the sheet itself as it reaches the side-lay stop instead of, as in some of the previous examples, by the piston or cylinder when it reaches a predetermined position. The means consist of a light trigger 74 arranged with its extremity in the path of the lateral movement of the sheet towards the gauge. This trigger is made in the form of a bell-crank pivoted above the sidelay gauge-plate on an axis 75 parallel to the line of travel of the sheets towards the press. One arm of the bell-crank hangs downwards, its free end forming the trigger against which the edge of the sheet will abut immediately before reaching the gauge-plate. The gauge-plate is suitably recessed or slotted as shown in dotted lines at 76 so that when the sheet moves the trigger the latter will enter the recess. Alternatively, the trigger may be mounted beyond one end of the gauge-plate, so that the latter will not obstruct its movement.

The second arm 77 of the bell-crank is approximately horizontal, and points in a direction away from the gauge plate and across the feedboard. The bell-crank is normally held in this position by light spring-pressure and a stop (not shown). The underside of this arm is provided with ratchet teeth 78. The moving suction-head is provided with a flap valve 79 which in its open position admits air through a passage 80 to the suction-conduit leading to the sucker mouth. This valve is normally closed by spring-pressure.

In operation, the suction head moves the sheet in the manner described until the edge of the sheet reaches the trigger mentioned above and moves it, causing the horizontal arm of the bell-crank to descend. The teeth of the ratchet are thus brought into the path of a stud carried by the valve so that further movement of the suction head opens the valve and releases the suction in the sucker-mouth.

In order that the admission of air through the passage 80 should not unduly reduce the suction in the bellows or cylinder the conduit leading to the sucker may have a constriction above the passage 80 such for example as a needle valve as shown in dotted lines at 81. Alternatively the suction may be cut off from the sucker entirely when the trigger has been operated. This may be effected by means of a plunger 82 normally spring-pressed into the outer or open position. This plunger carries on its outer end a toothed or knurled wheel 83 arranged for engagement with the ratchet teeth 78 when the trigger has been operated. The wheel 83 is rotatable on the plunger against the action of a friction device and the arrangement is that when the wheel has been engaged by the teeth 78 further movement of the suction head causes the plunger to be pushed across the suction conduit until it has cut off the suction. Thereafter continued movement of the suction head merely causes the wheel 83 to rotate while maintaining the suction cut off. Alternatively in place of the toothed wheel device the plunger 82 and the recess into which the end of it moves when cutting off the suction may be made so long that any desired movement of the suction head may be accommodated without the plunger coming into contact with the bottom of the recess.

A still further modification of the device is illustrated diagrammatically in Figure 12 (which is a plan view of the device) in which the means for effecting sideways movement of the suction head

4 comprise a suction operated flexible diaphragm 90. This diaphragm transfers its movement under suction to the suction head through links 91 and 92 and a lever 93, the fulcrum 94 of which is made adjustable in position for effecting an adjustment of the degree of movement of the suction head or of the force tendng to effect movement of the head.

The height of the sucker in relation to the sheet in any of the above examples may, if desired, be made adjustable (e. g., in the manner illustrated in Figure 8). Further the pressure exerted by the spring on the piston or cylinder for restoring them to the extended position after the suction has been released may be made adjustable by providing an adjusting screw passing in an axial direction through the end of the piston or the cylinder into contact with the end of the spring.

It is sometimes desired, in order that the device may occupy the minimum space, that the operating piston and cylinder described in the above examples be made as short as possible with the result that in the extended position the moving member (e. g., the cylinder) engages with the stationary supporting member (e. g., the piston) over only a short length causing the two members to wear and to tend to jam. This difficulty is increased by the fact that the moving member has its heaviest part (i. e., the sucker mouth and associated parts) at its unsupported end. The difficulty may however be overcome by providing an additional guide for the moving member. This guide may take the form of a cross-head formed on the unsupported end of the member sliding on guide rails on each side of the member and parallel thereto.

An alternative method of overcoming the difficulty is to arrange the operating piston and cylinder with their axis vertical and to transmit the movement thereof to the sheet gripping device by mechanical means for example a bell-crank and link. When the sheet gripping device in this arrangement is a sucker the suction may be applied to it through a separate flexible tube or the bell-crank and link or other mechanical connection may be made hollow and employed as the suction conduit.

It will be appreciated that an important advantage of the pneumatically operated sidelay mechanism described is that it can be placed as close to the front lays as may be desired so that when the machine is arranged to feed the sheet in partly overlapped formation a particularly small gap between the front edges of the overlapping sheets may be employed with the result that the speed of travel of the sheets from the sheet-separating device may be less than that normally necessary.

It will also be appreciated that by the use of pneumatic means according to the invention the whole of the power required for operating the side-lay mechanism and for controlling this operation may be conveyed to the side-lay by one air pipe, which may be a flexible rubber tube enabling the side-lay to be located in any desired position upon the feed-board while the valves which control the operation of the side-lay may be in any suitable position. Thus, there is no mechanical drive to the side-lay mechanism and adjustment of the position of that mechanism may readily be effected.

I claim:

1. A sheet feeding machine of the type comprising a feed board over which sheets are to be fed, a side gauge, a sucker for gripping the sheet, and pneumatic means for exhausting the air from said sucker and moving the sucker transversely to draw the sheet sidewise up to said gauge for the purpose of effecting lateral registration of the sheet.

2. In a sheet feeding machine as claimed in claim 1, means for controlling the rate of application of suction to the means for moving the sucker sidewise, said means being arranged to control said rate independently of the rate of application of suction to the sucker.

3. A sheet feeding machine of the type comprising a feed board over which the sheets are to be fed, a side gauge, side-lay mechanism arranged to grip the sheets on the board one by one and to draw them sidewise up to said gauge for the purpose of effecting lateral registration of the sheets, pneumatic means for operating said sheet moving mechanism, smoothers for the sheets arranged adjacent to the side-lay mechanism and means on the side-lay mechanism for holding said smoothers depressed as the sheet approaches the gauge to prevent buckling of the sheet.

4. In a sheet feeding machine as claimed in claim 1, means for varying the effective area of the sucker mouth.

5. A sheet feeding machine of the type comprising a feed board over which the sheets are to be fed, a side gauge, side-lay mechanism arranged to grip the sheets on the board one by one and to draw them sidewise up to said gauge for the purpose of effecting lateral registration of the sheets, suction means for operating said sheet gripping and moving means, and an automatic suction relief valve arranged to open after suction to the sheet moving means has been cut off.

6. In a sheet feeding machine of the type comprising a feed board over which sheets are to be fed, a side gauge, a sucker for gripping a sheet, and means for moving the sucker transversely of the line of sheet travel to draw the sheet sidewise up to said side gauge for the purpose of effecting lateral registration of the sheet, said sucker being provided with a plurality of separate mouths spaced apart transversely of the said line of travel.

7. Side-lay mechanism for a sheet feeding machine, comprising a sucker adapted to grip each sheet in turn, means for effecting movement of the sucker laterally of the feeding direction of the sheets, and means for reducing the suction at the sucker mouth operable by the sheet when it reaches a predetermined position in its sidewise movement.

8. Side-lay mechanism for a sheet feeding machine of the type described comprising a side gauge, suction means for gripping each sheet in turn, pneumatic means for moving the sheet gripping means laterally of the feeding direction to draw the edge of the sheet up to the side gauge, means for causing the gripping means to release the sheet when it has reached the gauge, and means for returning the sheet gripping means to its initial position ready to grip the next succeeding sheet.

9. A sheet feeding machine of the type comprising a feed board over which the sheets are to be fed, a side gauge, side-lay mechanism arranged to grip the sheets on the board one by one and to draw them sidewise up to said gauge for the purpose of effecting lateral registration of the sheets, pneumatic means for operating said sheet moving mechanism, smoothers for the sheets arranged adjacent to the side-lay mecha-

nism, and means on the side-lay mechanism for raising said smoothers after the sheet reaches the gauge.

10. A sheet feeding machine of the type comprising a feed board over which the sheets are to be fed, a side gauge, a suction gripper arranged to grip the sheets on the board one by one, means for moving said gripper sidewise for the purpose of effecting lateral registration of the sheets, and a pneumatic connection to said gripper and said gripper moving means for energizing the gripper and thereafter moving the gripper moving means.

11. A sheet feeding machine of the type comprising a feed board over which the sheets are to be fed, a side gauge, a suction gripper arranged so as to grip the sheets on the board one by one, means for moving said gripper sidewise for the purpose of effecting lateral registration of the sheets, and pneumatic means for operating said gripper and said gripper moving means, the action of said gripper moving means following and being dependent upon the sheet gripping action of said gripper.

12. In mechanism for side registering sheets, a side gauge, a gripper, and means for producing vacuum in the gripper and for moving it laterally by vacuum to grip a sheet and move said sheet laterally into engagement with said side gauge.

13. In mechanism for side registering sheets, a side gauge, and movable suction means spring operated in one direction and vacuum operated in the other direction for gripping successive sheets and moving them laterally one after another into engagement with said side gauge.

14. Side-lay mechanism for a sheet feeding machine of the type described comprising a side gauge, suction means for gripping each sheet in turn, suction means for moving the sheet gripping means laterally of the feeding direction to draw the edge of the sheet up to the side gauge, means for breaking the suction in the sheet gripping means when the sheet has reached the gauge, and spring means for returning the sheet gripping means to its initial position ready to grip the next succeeding sheet.

15. In a sheet feeding machine as claimed in claim 1, a removable choke element having a passage of predetermined size for controlling the rate of application of suction to the means for moving the sucker transversely said choke element and passage being arranged to control said rate independently of the rate of application of suction to the sucker.

16. A sheet feeding machine as claimed in claim 11 in which the pneumatic means for operating the gripper and gripper moving means comprises relatively movable elements arranged to cut off suction to the gripper at a predetermined point in its sidewise travel while permitting the continued application of suction to the gripper moving means.

17. A sheet feeding machine as claimed in claim 11 in which the pneumatic means for operating the gripper and gripper moving means comprises relatively slidable elements arranged to move in unison with said gripper to a predetermined point in its sidewise travel and thereafter to have sliding movement relative to each other for cutting off suction to the gripper while permitting the continued application of suction to the gripper moving means.

18. Sidelay mechanism as claimed in claim 6 in which the means for moving the sucker transversely comprises relatively movable piston and cylinder elements arranged to cut off suction to the sucker mouths successively as said mouths reach a position in their transverse travel corresponding to the position of the side gauge.

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