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Jiruse

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[54] **AIR DISTRIBUTING DEVICE FOR A PNEUMATIC SHEET-FEEDING DEVICE**

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[52] **U.S. Cl.** **271/98;** 137/625.24; 271/31; 271/108

[51] **Int. Cl.** **B65h 3/08**

[58] **Field of Search** 271/98, 93, 108, 97, 30, 271/31; 137/625.24, 625.16; 251/137

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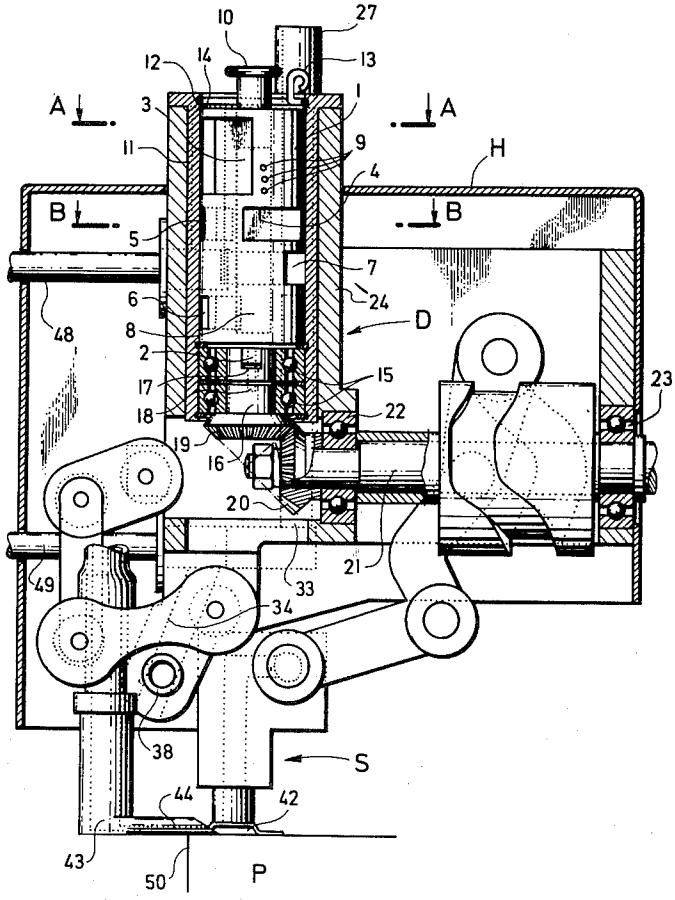
[57] **ABSTRACT**

Apparatus for the distribution of air in a pneumatic sheet feeding device for printing machines, wherein a plurality of sheets are located in a pile, comprising a body having a cylindrical bore and a spool member rotatably mounted in said body. The spool member has an axial bore defining a central chamber and a plurality of recesses formed on its circumference. The recesses define with the body a plurality of distributing channels intersecting the central chamber. The body has an inlet for pressurized air, an inlet for the exhaust of air under vacuum and a plurality of outlet openings leading to the sheet feeding devices. The spool member is connected to the drive shaft for conjoint rotation therewith, so as to be operable in sequence therewith.

7 Claims, 4 Drawing Figures



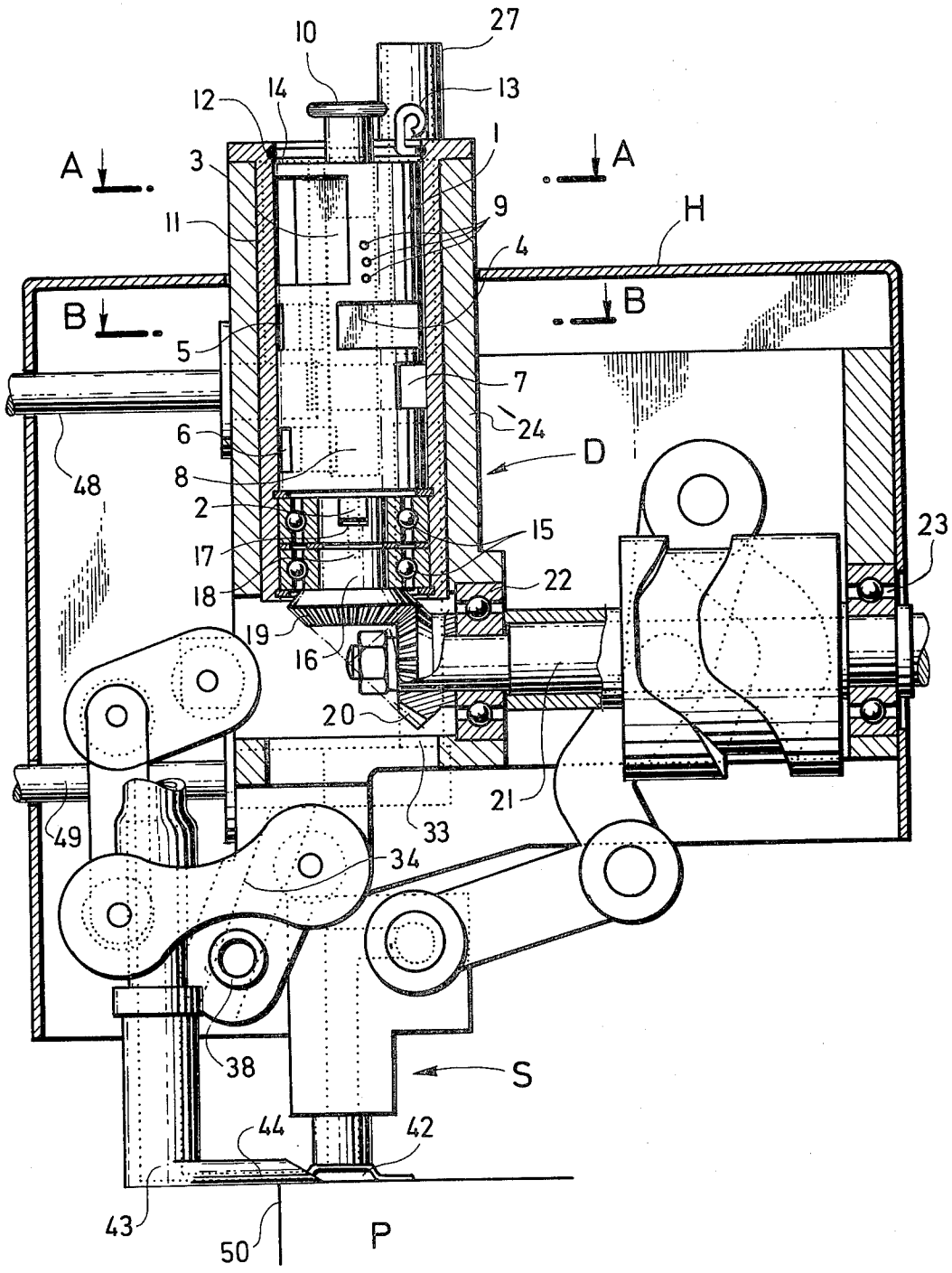

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FIG. 1

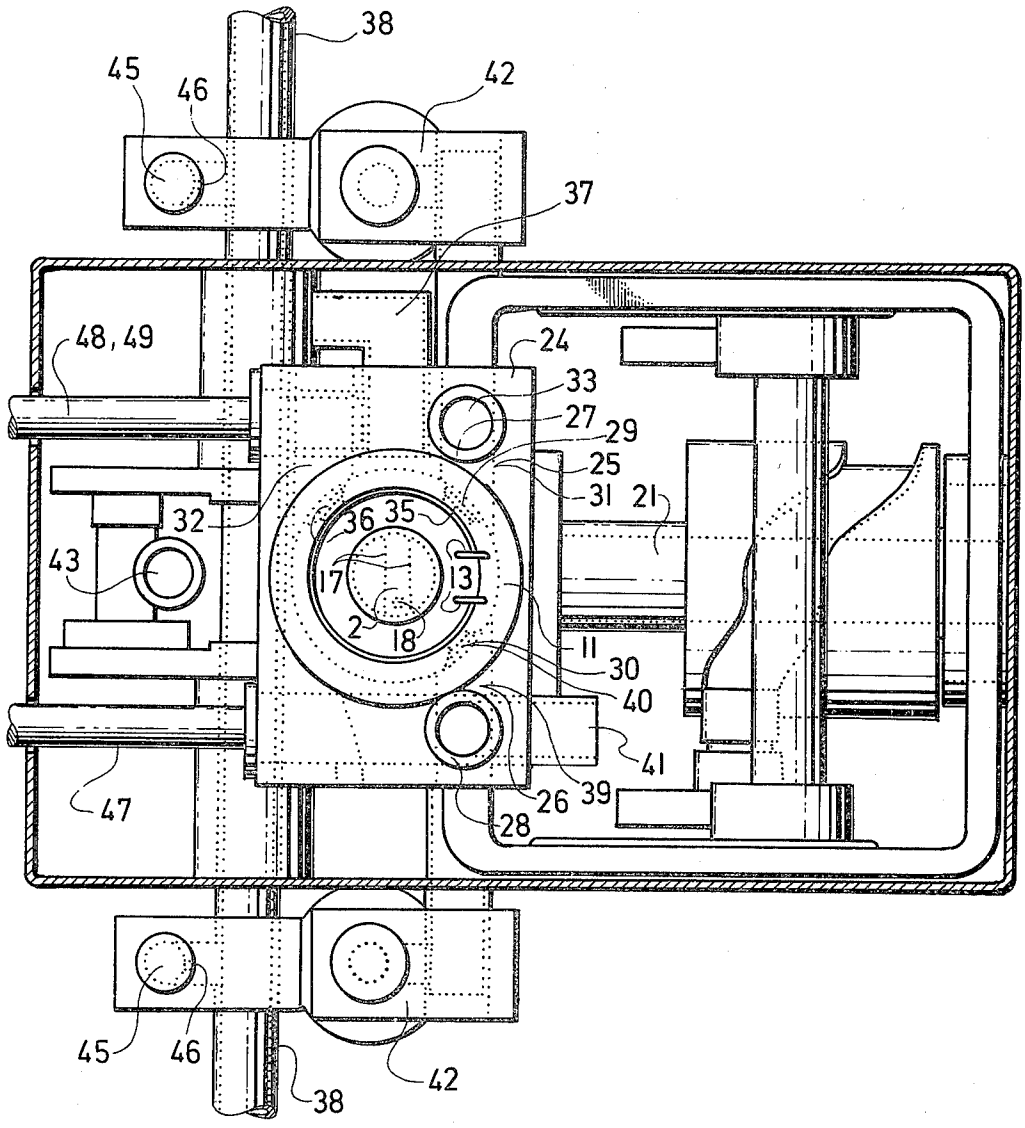
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FIG. 2

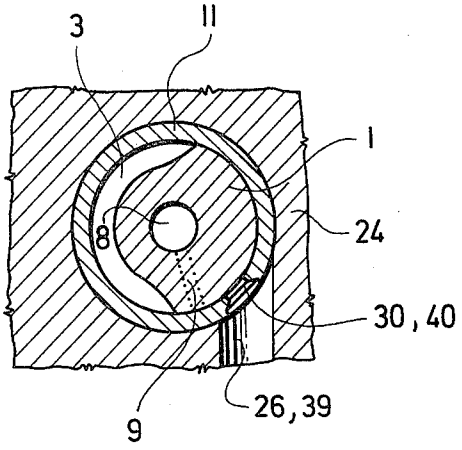

FIG. 3

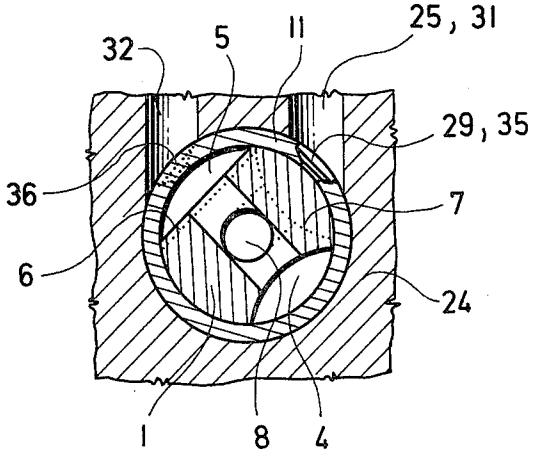

FIG. 4

AIR DISTRIBUTING DEVICE FOR A PNEUMATIC SHEET-FEEDING DEVICE

BACKGROUND OF INVENTION

The present invention relates to a pneumatic sheet feeding device for printing machines and in particular to an air distribution system and valve therefor.

As is well known, paper sheets are stacked in a large quantity in a pile for individual feeding to the printing press. The individual sheets of paper are removed from the pile one by one in general by a pneumatic sheet feeding device which works in such a manner that the uppermost paper sheets of the pile are first separated from each other by a blast of pressurized air streaming against the edges of the sheets in the pile from an air distributing device. Thereafter the uppermost paper sheet of the pile is seized by a suction cup to which a vacuum is applied. The uppermost sheet is then lifted by the suction cup while the pressurized air streaming against the edges of the paper forms an air cushion beneath the top sheet. The sheet is carried by the suction means to the feed or transfer cylinders of the printing press where it is released by the suction cups to be gripped by another set of feed means. This working cycle is repeated successively and regularly in timed rhythm with the printing operation of the printing press. It is therefore necessary for the accurate operation of this sheet feeding device that an air distribution system be provided which provides successive impulses of pressurized air and air under vacuum which impulses arises at the paper at a precise given time and in a precise repetitive cycle.

One of the known air distributing systems for pneumatic sheet feeding devices is arranged directly in the distribution housing of the pnuematic sheet feeding device itself, that is, in the housing in which the air supplying the distributing conduits are located. In the body of the distribution housing there is fixed a pair of sleeves in each of which is arranged a valve controlled by a cam or by a similar fork-shaped element by which it may be reciprocated. One valve serves for the control of the pressurized air while the second valve serves for the control of the air under vacuum. By reciprocally moving the valves the corresponding air channels to the suction cups and air blast nozzles, are opened or closed and in this way the pneumatic cycle of the sheet feeding device is controlled. Another known sheet feeding device is provided with a similar air distribution system with the difference that the valves are provided with gears which are in engagement with the drive shaft of the suction cups of the sheet feeding device. In this case, the pneumatic cycle is not controlled by a reciprocal movement of the valves but by a rotation of the valves themselves.

The above described air distributing systems are generally reliable. However, they have the disadvantage that two valves are always necessary, one each for the distribution of air under pressure and/or air under vacuum. A further disadvantage lies in the fact that a complex arrangement of drive elements is necessary for synchronizing the operation of the two valves. Since the elements are arranged on the inner part of the distribution housing they are somewhat difficult to install. Since also pneumatic systems tend to suck in and carry into the air stream small paper particles, dust and dirt it is necessary to periodically clean the valves and the air distributing system as a whole. The known devices

make this a very difficult task since it is necessary to dismantle two valves within the body of the distribution housing, all of which is very difficult and time consuming.

It is an object of the present invention to provide a pneumatic sheet feeding device having an air distributing system which overcomes the disadvantages of the prior art.

It is a further object of the present invention to provide a pneumatic sheet feeding device having an air distributing system in which only one member serves the dual function of controlling the feeding of air under pressure and the distribution of air under vacuum.

It is a further object of the present invention to provide a simple and inexpensive air distributing system and valve mechanism for a pneumatic sheet feeding device which may be easily installed and dismantled for cleaning.

It is a further object of the present invention to provide a pneumatic sheet feeding device having an air distributing system which is simple and takes up very small room and which is easily adjustable under operating conditions.

It is still another object of the present invention to provide an air distributing system for a pneumatic sheet feeding device which is accurate in operation and which permits a very accurate adjustment of the setting of the working timing of the valve with the sheet feeding suction cups themselves.

These objects, other objects, as well as numerous advantages will be seen from the following disclosure of the present invention.

SUMMARY OF INVENTION

According to the present invention a pneumatic sheet feeding device for supplying sheets from a pile is provided comprising a housing, a drive shaft mounted in the housing and at least one suction cup linked to the housing and connected to the drive shaft for reciprocating movement with respect to the top of the pile of sheets. At least one nozzle is provided adjacent the pile of sheets for the delivery of air under pressure to the edge of the sheets on the pile. An air distribution system is provided comprising a body mounted in the housing and having a cylindrical bore in which a spool valve member is rotatably mounted. The spool member has an axial bore defining a central chamber and a plurality of recesses formed on its circumference defining with the body a plurality of distributing channels. The central bore intersects each of the peripheral recesses so that the defined distributing channels can be interconnected with each other through the central chamber. The body is provided with openings for the inlet of air under pressure and for the inlet of air under vacuum as well as a plurality of outlet openings leading to the suction cups and the nozzles. The spool is connected to the drive shaft for conjoint rotation and the distributing channels, and the inlet and outlet openings are arranged axially and radially with respect to each other so that air is caused to flow between the edges of the sheets to separate the sheets, suction is caused to be applied to the suction cups to lift the sheets and thereafter air is caused to flow into the suction cups to release the sheets in a cyclical sequence whereby successive sheets may be removed from the pile. It will be seen briefly from the foregoing that only a single valve is provided which serves the dual function of controlling both the

air under pressure and the air under vacuum. And since the valve member is connected for operation to the drive shaft which also moves the suction cups a direct in time relationship can be made between the creation of the impulses of air and the movement of the suction cups.

Preferably a tubular sleeve is interposed between the body and the spool member. The sleeve has a plurality of openings corresponding to the openings in the body and is rotatable relative to the body to selectively align the openings and therefore adjust the passage therethrough so that a more accurate timing and flow of air can be obtained.

Furthermore, it is preferable that a plurality of radial channels be formed in the spool which aligns with the inlet for the pressurized air at the time when the suction cups have carried the topmost paper sheet furthermost away from the pile and into engagement with the feed transfer means of the printing press itself. This permits a blast of pressurized air through the suction cups which releases the paper immediately and also clears the suction cup of any contaminance.

The sleeve and/or body if a sleeve is not employed is provided at its upper part with an inwardly directed collar in which is removably located a spring like securing element. The spring element bears against a pressure plate located at the upper end of the valve spool. This arrangement maintains the valve spool securely in place within the body but permits the easy removal of the spool should it be necessary for replacement and/or cleaning. Preferably the drive shaft for the suction cups is arranged in a horizontal plane parallel with the top of the pile of paper and extending in a direction of the sheet feeding while the spool valve is arranged in a vertical plane and includes gear means for connecting the two which itself includes keying means which allows the removal of the valve spool from the drive shaft with ease.

Full details of the present invention are given in the following description of one of the preferred embodiments of the invention and are shown in the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

In the drawings:

FIG. 1 is a front elevation, partly in section, of the pneumatic feed device including the air distribution system of the present invention,

FIG. 2 is a plan view of the device of FIG. 1 in partial section,

FIG. 3 is a section taken along line A-A of FIG. 1 and

FIG. 4 is a section taken along line B-B of FIG. 1.

DESCRIPTION OF INVENTION

As seen generally in FIG. 1 the pneumatic sheet feeding device comprises a housing H adapted to be mounted on the side walls or other frame of the printing machine above the pile of paper sheets generally depicted by the reference letter P. Linked to the housing and depending therefrom are the suction cup means and the nozzle means of the pneumatic transfer system generally depicted with the letter S while extending vertically out through the top of the housing H is the air distribution system embodying the present invention, which is generally depicted by the letter D.

The air distribution device D comprises a spool valve member 1 rotatably mounted in a tubular sleeve 11 which is itself placed in sliding contact within the bore of a cylindrical body 24 suitably secured in a vertical direction within the housing H. The spool valve member 1 has its circumferencial surface cut out with several selectively positioned slots, depressions or the like which defined with the tubular surface of the sleeve 11 distributing channels 3, 4, 5, 6 and 7 respectively. A chamber 8 is formed along the central axis of the spool valve member 1 from its upper end terminating short of its lower end. Extending radially from the chamber 8 to the surface of the spool valve member 1 are a plurality of small radial bores 9 positioned adjacent the distributing channel 3. The upper end of the chamber 8 is closed by a plug 10 which may be threaded or otherwise suitably retained in the end of the spool 1. The sleeve 11 at its upper end is provided with an inwardly directed collar 12 forming an annular slot in which a spring element 13 and a bearing plate 14 can be disposed. The bearing plate 14 bears against the upper end of the valve member 1 to limit its axial movement while the spring member 13 is of the split ring type having upwardly extending finger grips so that it may be easily squeezed and removed from the groove 12. In this manner the spool element 1 is limited in its axial upward movement.

The lower end of the spool valve member 1 rests upon a pair of radial thrust bearings axially aligned and separated by annular washers or shims. Extending through the upper washer from the spool valve member 1 is a rectangular key element 2 extending diametrically across the face of the spool valve member 1. Held within the inner race of the radial bearings 15 is a shaft 16 which has a slot 17 conforming to the key 2 and into which the key 2 of the spool valve member 1 seats. A positioning pin 18 extends upwardly from the bottom of the slot 17 into a corresponding hole in the key 2. The pin 18 and its corresponding hole are offset from the center of the valve member 1 so that a unidirectional installation of the valve 16 there is integrally formed a bevel gear 19 which engages with a mating bevel gear 20 fixed at the end of a shaft 21 which is arranged perpendicular to the vertical axis of the spool valve member 1 and in a horizontal plane parallel with the top of the sheets on the pile P and extending in the direction of the feed of the sheets themselves. The drive shaft 21 is rotatably mounted at its front end in a bearing 22 secured in the body 24 of the air distributing system while at its back end it is secured in a radial bearing 23 secured in the housing H.

The body 24 is provided with a pair of laterally extending supply channels 25 and 26 which are directed in a tangential manner toward the spool valve member 1. The channels 25 and 26 terminate in vertically directed fittings 27 and 28 which are respectively connected to a source of air under pressure and to a source of air under vacuum. The supply channel 25 is located on an axial plane corresponding to the location of the distributing channels 4 and 5 relative to the axis of the spool valve member 1, as seen in FIG. 1. Interposed between the end of the supply channel 25 and the spool valve member 21 is an inlet opening 29 formed in the sleeve 11. On the other hand the supply channel 26 is located above the supply channel 25 in a plane corresponding to the plane in which the distributing channel 3 is located. Interposed between the end of the supply channel 26 and the face of the spool valve member 1 is an inlet port 30 which is formed in the sleeve 11.

Below the supply channel 25 there is provided an outlet channel 31 which leads to a vertical bore 33 formed in the body 24. The vertical bore 33 communicates with a channel 34 which extends downwardly into a horizontally disposed pipe 38 which extends transversely to the direction of movement of the paper sheet. The outlet channel 31 is on a plane with the distributing channel 6 and the sleeve 11 is provided with an inlet opening 35 which is interposed between the outlet channel 31 and the distributing chamber 6. Located diametrically opposite to the supply channel 26 and on a plane corresponding to that of the distributing channel 7. Interposed between the distributing channel 7 and the outlet channel 32 is an opening 36 formed in the sleeve 11. The outlet channel 32 communicates with a fitting 37. Located below the supply channel 26 and in line with the radial bores 9 is an outlet channel 39 which communicates with a fitting 41. The sleeve 11 is provided with an inlet port 40 interposed between the outlet channel 39 and the spool valve member 1.

The sheet feeding device, which is only partially illustrated is provided with a sensing element 43 extending vertically along the line with the shaft 21. The sensing element 43 has a horizontal extension having an outlet port 44 at its end which is adapted to rest on the pile of sheets. The sensing element 43 is connected to the fitting 37. The sheet feeding device further has several nozzles 45 which extend downwardly along the edge of the pile of sheets and are provided with openings 46. The nozzles 45 are connected to the distributing pipe 38. The sheet feeding device also has a pair of suction cups 42 which are pivotally mounted by suitable linkage on the housing H and which are driven via a rotating cam mounted on the shaft 21 and suitable cam followers and links all in conventional manner. The suction cups 42 are connected to the outlet fitting 41 and is providing with an air regulating valve 47 which controls and regulates the degree of suction fed to it. The suction cups are also connected via the fitting 37 to the source of air under pressure and air regulating valve 48 and 49 are provided to control the degree of pressure in this system.

The described device operates as follows:

The sheet feeding device comprising the suction cups 42 are operated in conventional manner by the rotation of the shaft 21 so that they move in a reciprocating path up and down from the top of the sheets 50 in the pile P and in a more or less elliptical path by which the sheet 50 is moved to a further transfer device. The sensing device 43 is furthermore linked to the rotating cam by suitable linkages not fully described and only partially shown in the drawings so that it too may reciprocate from a position engaging the topmost sheet 50 to a position allowing that sheet to be lifted and moved by the suction cups 42. The pneumatic functions of the sheet feeding device are controlled by the rotary movement of the valve 1 which is directly linked to the drive shaft 21. Pressurized air is supplied via the fitting 27 into the supply channel 25 of the body 24 and from there the air stream moves to the inlet opening 29 of the sleeve 11. Further turning of the spool valve 1 causes the pressurized air stream to flow via the distributing channel 5, which is arranged on the plane of that of the inlet opening 29 so that the pressurized air enters into the central chamber 8 from which it exits via the distributing channel 6 through the outlet opening 35 in the sleeve 11 and into the inlet channel 31. From the inlet channel 31 the pressurized air passes via the conduits 33 and 34 into the distributing pipe 38 from which it is caused to exit through the openings 46 of the nozzles 45. The exiting air from the nozzles 45 blow an air blast between the paper sheets 50 at the topmost portion of the pile P so that it causes the topmost sheets to lift and separate slightly from each other. Since the rotation of the drive shaft 21 is continuous the spool valve 1 continues to rotate and is brought to a position where the distributing channel 3 communicates with the inlet opening 30 in the sleeve 11 and with the outlet channel 40. In this manner a passage is formed for the flow of air under suction which enters via the fitting 28 the supply channel 26 into the distributing chamber 3 from which it exits via channel 39 and the fitting 41 to the suction cups 42. A non-illustrated conduit connects the fitting 41 and the suction cups 42.

The suction cups 42 thereupon seize by sucking up the topmost paper sheet 50 from the pile and by the movement caused by the rotating shaft 21 lifts the paper sheet simultaneously the sensing element 43 is elevated from the top of the pile P so that a gap is formed under the lifted sheet allowing the sheet to be transferred by the suction means 42. A further rotation of the spool valve 1 brings the distributing channel 4 into communicating position with the inlet opening 29 so that air under pressure enters in this manner into the air mixing chamber 8 and flows via the distributing channel 7 the port 36, the outlet channel 32, and the fitting 37 directly to the sensing element 43. Suitable conduit means may be employed to connect the fitting 37 and the sensing means 43. Thus an air stream under pressure begins to blow from the outlet port 44 of the sensing element 43 beneath the lifted paper sheet 50. This creates an air cushion between the sheet held by the suction cups 42 and the next succeeding sheet on the pile P. The mechanical movement of the suction cup 42 thereafter carried the lifted paper sheet to the printing cylinders where it is grasped by a further transfer mechanism. The spool valve member 1 is arranged so that as the time the suction cups 42 are to release the paper sheet to the transfer mechanism of the printing cylinders, the spool valve member 1 has rotated so that the inlet opening 30 is closed by the circumference of the spool valve member 1. At this time the radial bores 9 are brought into aligned position with the outlet opening 40 so that air under pressure which has flowed into the air mixing chamber 8 now flows out of the radial bores 9 into the outlet channel 39 from which it flows into the fitting 41 and directly into the suction cups 42. This provides a blast of air under pressure through the suction cups which immediately release the paper sheet 50 held by the suction cups. The continuing of the shaft 21 brings the suction cups back into position over the pile P and the cycle is thereafter repeated.

A significant advantage of the present invention lies in the fact that the spool valve member 1 may be easily removed so that the interior of the air distributing system may be easily cleaned. This is accomplished by pressing together the two eyes of the spring securing element 13 so that the split ring element becomes smaller and can be easily removed from the recess 12 in the sleeve 11. The bearing member 14 and the valve 1 may then be lifted from the sleeve 11 by simply pulling on the plug 10 which closes the chamber 8. The reassembly of the valve 1 into the sleeve 11 is facilitated

by the keying of the member **2** into the slot **17** and its proper positioning is insured by locating the pin **18** in its proper position.

A further advantage of the present invention lies in the fact that the sleeve **11** may be easily turned with respect to the body **24** so that the corresponding openings in the sleeve can be more easily aligned with the openings in the body **24** and the extent of these openings varied so that a more accurate setting of the timing relationship in the air distributing system may be obtained. Indexing means and means for adjustably positioning the sleeve in its selected position may also be provided if desired.

It will be seen from the foregoing that the pneumatic feed system is provided with an air distributing mechanism and system which is simple in construction and occupies only a small space. Furthermore, the air distributing system provides a very accurate, selective and sequential cyclical operation which may be accurately timed with the mechanical functions of the sheet feeding device.

Various changes, modifications and embodiments have been suggest in the foregoing description, others will be obvious to those skilled in the art. It is intended therefore that the present disclosure be taken as illustrative only and not as limiting of the present invention.

What is claimed is:

1. Apparatus for the distributing of air in a pneumatic sheet feeding device for printing machines, wherein a plurality of sheets are located in a pile, the sheet feeding device having a housing, a drive shaft mounted in said housing, at least one suction cup linked to said housing and connected to said drive shaft for reciprocating movement with respect to the top of the pile of sheets, and at least one nozzle for the delivery of air under pressure to the edge of the sheets of said pile, said air distribution apparatus comprising a body having a bore, a valve member rotatably mounted in said bore, said valve member having an axial bore defining a central chamber and a plurality of recesses formed on its circumference being intersected by said central chamber, said recesses defining with said body a plurality of distributing channels, said body having an opening for the inlet of pressurized air and an inlet for the exhaust of air under vacuum communicating with said distribution channels for providing air under pressure to or removing air under vacuum from said chamber, and a plurality of outlet openings communicating with said distribution channels and leading to said suction cups and said nozzles for delivery and withdrawal of air therefrom, a tubular sleeve interposed between said body and said valve, said sleeve having a plurality of openings corresponding to the openings in said body, said sleeve being rotatable relative to said body to selectively align said openings and adjust the passage therethrough, means connecting said valve member to said drive shaft for conjoint rotation therewith, said distributing channels, said inlet openings and said outlet openings being axially and radially arranged with respect to the axis of said chamber so that on rotation of said valve member air is caused to flow between the edges of said sheets to separate said sheets, suction is caused to be applied to said suction cups to lift said sheets and air is thereafter caused to flow into said suction cups to release said sheets in a cyclical sequence.

2. The apparatus according to claim **1** wherein the pressurized air flowing into said suction cups is obtained through a plurality of radial channels formed within said body, said channels being aligned with the inlet of said pressurized air at the time said distributing channels are blocked from the inlet of said suction.

3. The apparatus according to claim **1** including a radially inwardly directed collar formed on the upper end of said sleeve, a bearing plate located on the end of said valve member and a resilient securing element removably located in said collar and urging against the bearing plate.

4. The apparatus according to claim **1** wherein the means for connecting said valve member and said drive shaft comprises a second shaft and gear means connecting said shafts, said second shaft and said valve member having cooperating kay means for separably locating the same for conjoint rotation.

5. The apparatus according to claim **4** wherein said key means comprises a slot in said second shaft and an extending member formed on the end of said valve, and a positioning pin extending from said valve and a hole for receiving said pin in said shaft.

6. The apparatus according to claim **4** wherein said drive shaft is arranged in a horizontal plane parallel with the top of the said pile of sheets and extending in a direction of the sheet feeding, said second shaft being arranged in a vertical plane thereto.

7. The apparatus according to claim **1** including a sensing device adapted to sense the level of sheets in said pile, said sensing device having a nozzle connected to the air distributing system to provide a blast of air against the edge of said sheets and to continue said air as the suction means lifts the topmost sheet from said pile.

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