United States Patent

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[72] Inventor **Jaroslav Jiruse**
Blansko, Czechoslovakia

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[73] Assignee **Adamovske strojirny, narodni podnik**
Adamov, Czechoslovakia
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[54] **DRIVING MEANS FOR THE CONTROL OF FEEDING DEVICES OF SHEET MATERIAL**
7 Claims, 3 Drawing Figs.

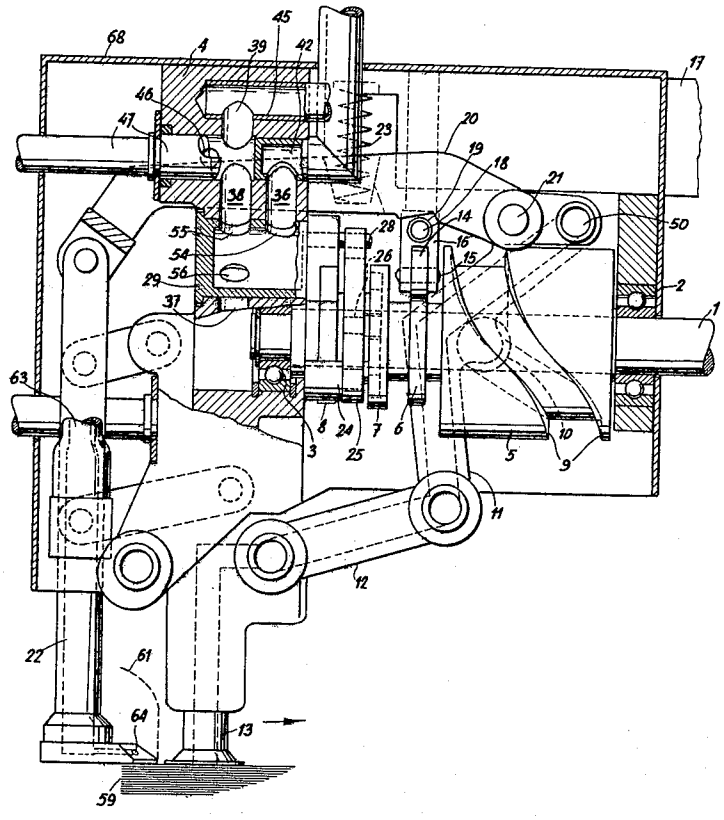
[52] **U.S. Cl.** **271/26**
[51] **Int. Cl.** **B65h 3/08**
[50] **Field of Search** 271/26, 5, 11

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Primary Examiner—Richard E. Aegerter
Attorney—Richard Low

ABSTRACT: Apparatus for the pneumatic feeding of individual sheets from a sheet stack to printing machines, in which the drive is derived from a driving shaft, the axis of which is parallel to the sheet stack and in direction of supply of the sheets. The driving shaft supports a number of cams transmitting motion to individual mechanisms of the feeding device and controlling vacuum and pressurized air supply for different functional purposes which are all located in a common housing.

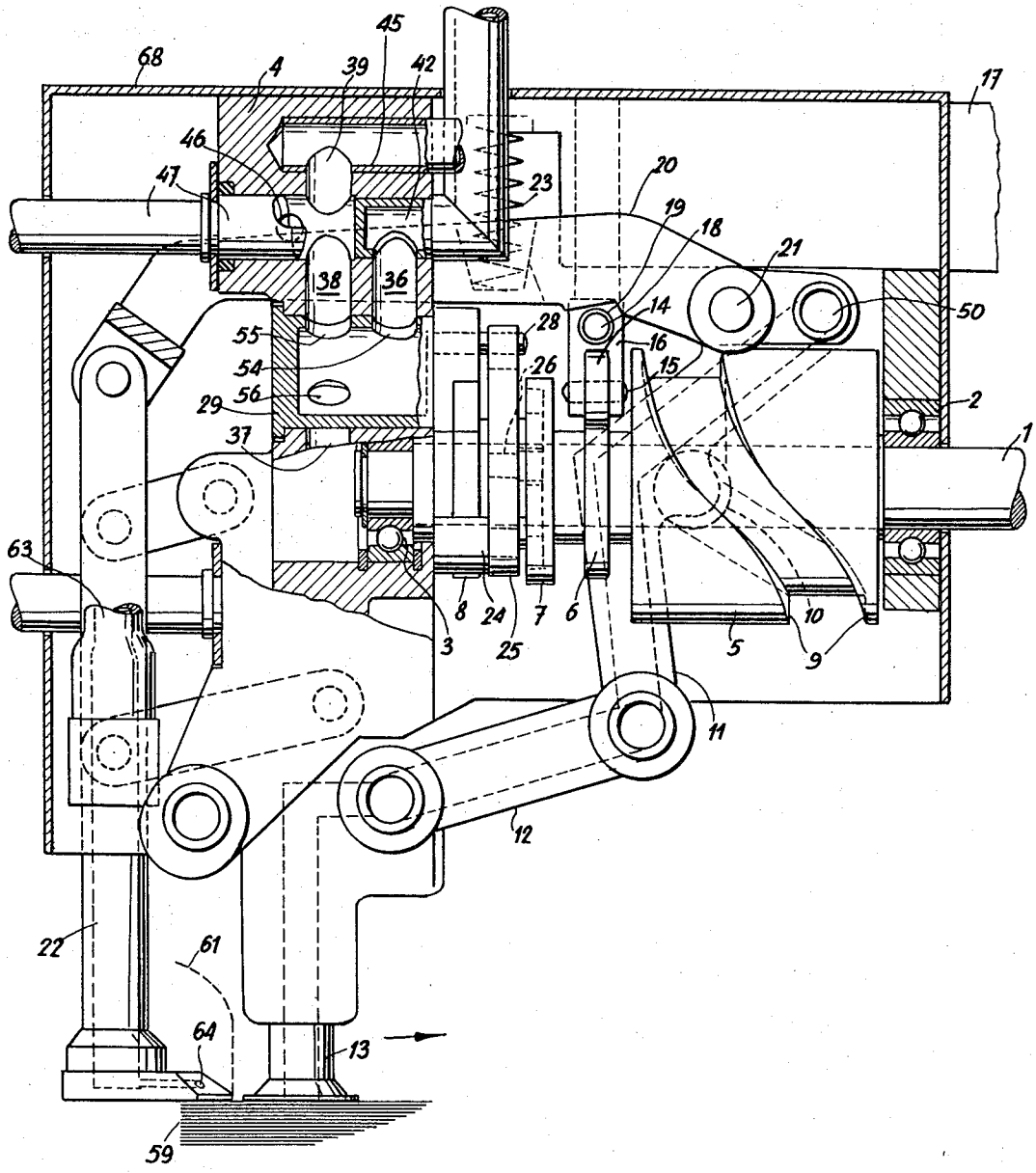


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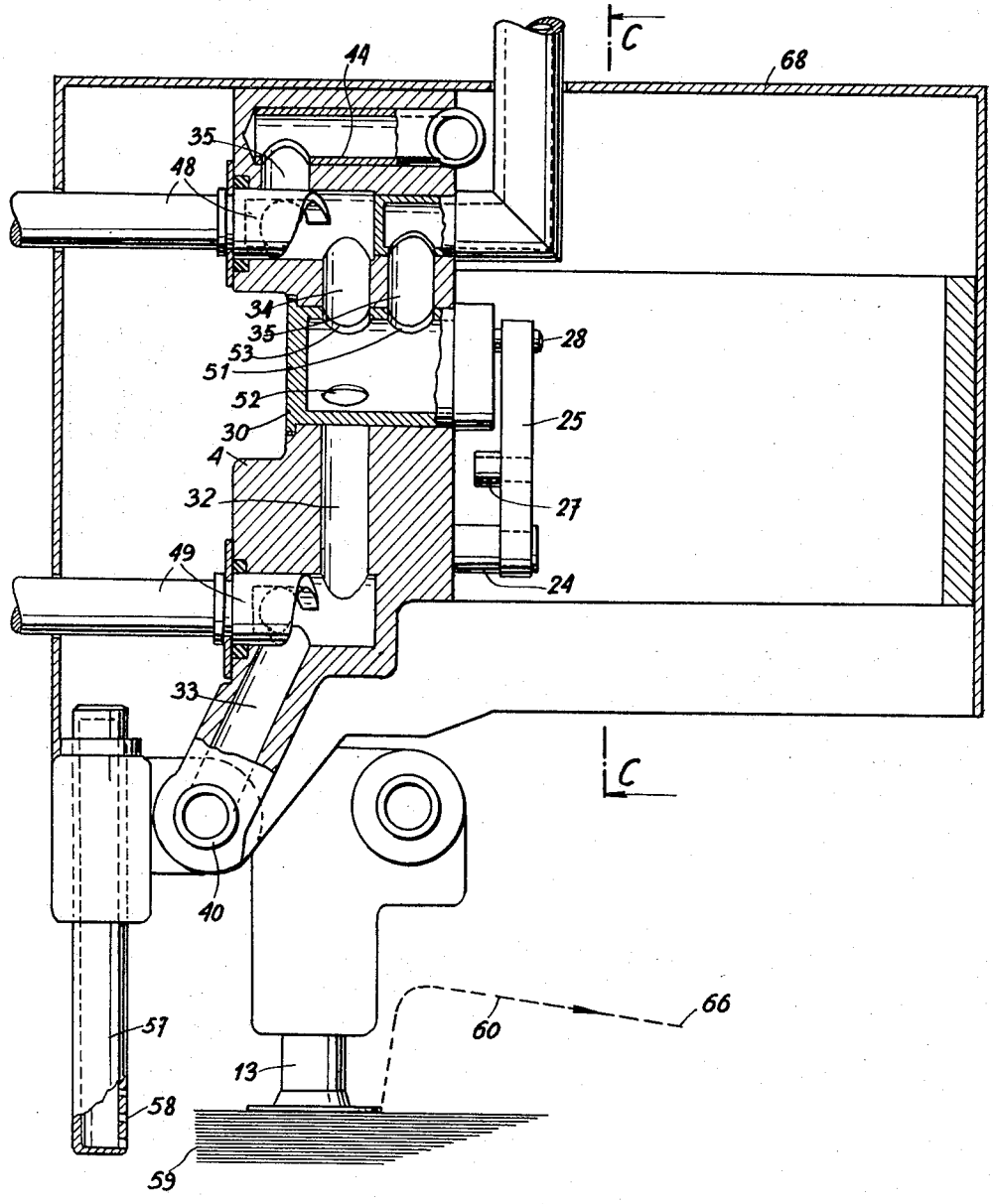
SHEET 1 OF 3

Fig. 1



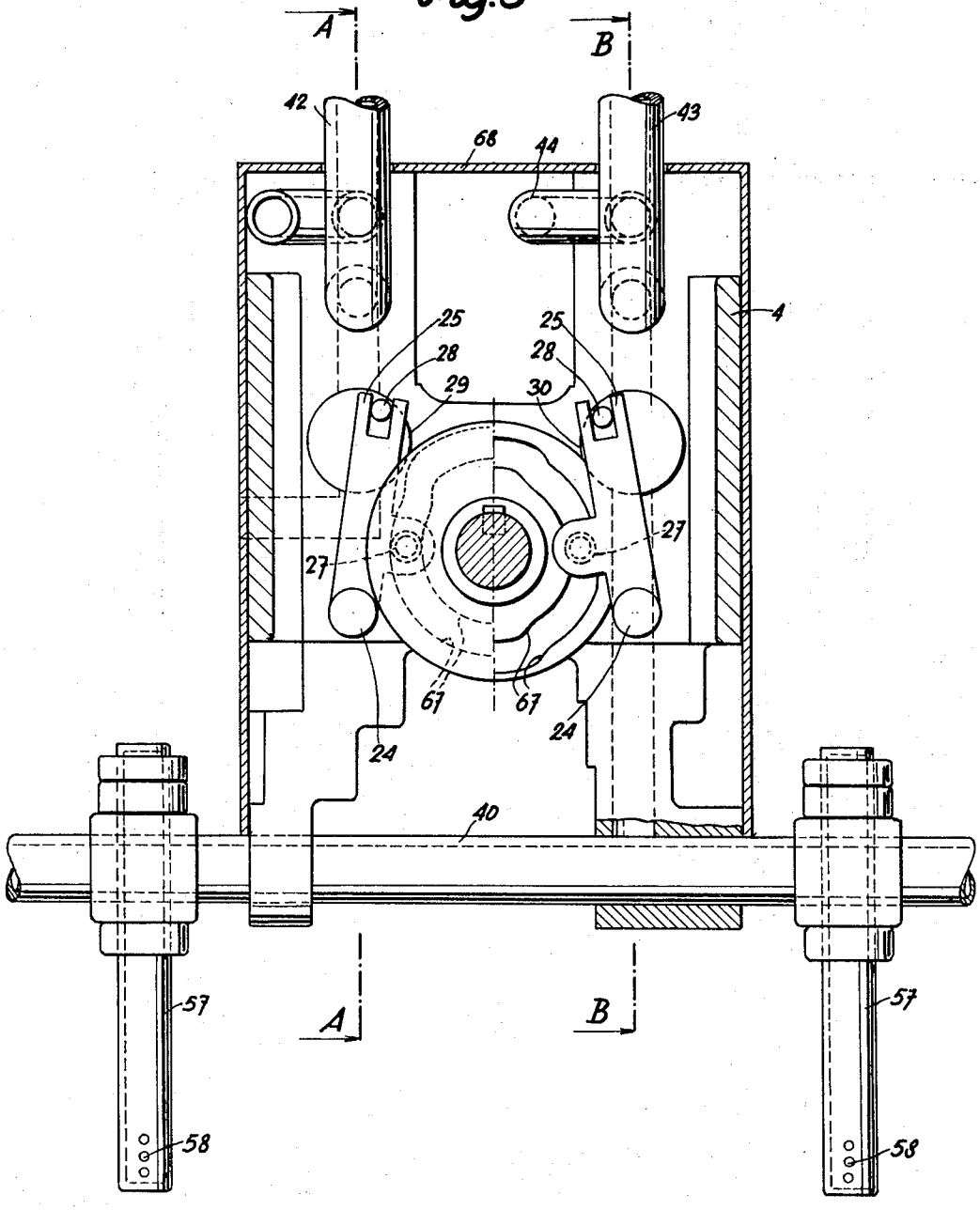
INVENTOR
Jaroslav Jiruše
BY
Richard Erdman

Fig. 2



INVENTOR
Jaroslav Jiruše
BY
Richard Urban

Fig. 3



INVENTOR
Jaroslav Jiruše
BY
Richard Uhl Atty

DRIVING MEANS FOR THE CONTROL OF FEEDING DEVICES OF SHEET MATERIAL

The present invention relates to a drive mechanism for pneumatic feeding devices particularly for printing machines which feed sheets from a stack to a conveyor, and which supplies overlapping sheets to the printing machine.

There are known pneumatic feeding devices arranged as independent units, where the operating movements of the individual mechanisms are controlled by means of cams fixed on a cam shaft, the longitudinal axis of which is perpendicular to the feeding direction of the supplied sheets. The cam shaft receives its drive from the printing machine by way of a retractable joint shaft, which enables changes of the position of the feeding device according to the size of the supplied sheets. Pneumatic valves and regulators of suction and compressurized air are arranged as special units, with vacuum and compressed air conduits leading to the proper feeding devices.

These feeding devices have the drawback, that the movement of the cam shaft is not quite uniform due to the retractable joint shaft, which itself is difficult to manufacture and expensive. Other drawbacks are the rather long air supply conduits required and the many remote control and regulating units situated at different places.

Other pneumatic devices are generally arranged similarly. The cam shaft is supported by a frame, the longitudinal axis of which is perpendicular to the supply direction of the supplied sheets and the drive is accomplished by a bevel gear and by a driving shaft, the longitudinal axis of which is parallel with the supply direction of the sheets. The pneumatic valves and regulation of vacuum and pressurized air are arranged within or externally of the frame of the feeding device in special units. The feeding device is controlled by cams, from which the movement for the supply of the sheets is derived by spring loaded rollers. These latter feeding devices have contrary to the previously mentioned devices, uniform drive and shorter air distribution conduits.

Their drawback is, however, that the proper mechanisms are rather complicated and expensive. As the bevel gear is situated within the machine frame, the whole arrangement is rather large and cumbersome. Furthermore at high speeds the rollers cannot follow the shape of the cams and produce the required changes of functional movements.

It is an object of this invention to provide a feeding device, which would operate at uniform speed, which would have short air supply conduits, which would allow operation at elevated speeds and be simple in design and of small size.

The arrangement according to this invention has a driving shaft rotatably supported by the frame of the device, the axis of said driving shaft being parallel with the sheet stack and in direction of the supplied sheets. A drum cam, a disc cam and vacuum and pressurized valve cams are fixed on said shaft. The drum cam is provided with a circumferential groove, in which is engaged a roller supported by an oscillating fork. The oscillating fork is linked with the suction mechanism, provided with suction cups, for picking up the sheets. The disc cam engages a spring loaded supporting lever linked with a sensing device. The vacuum and compressed air cams control by suitable valves respectively the air supply to the different accessories of the whole device.

A practical embodiment of the object of this invention is shown by way of example in the accompanying drawings whereby FIG. 1 is an elevation of the drive in partly sectional view along the line A–A in FIG. 3, FIG. 2 a similar partly sectional view along the line B–B in FIG. 3 and FIG. 3 is a side view in section along the line C–C in FIG. 2.

The drive of the feeding device according to this invention comprises a driving shaft 1 supported by bearings 2 and 3 located in the frame 4 of the whole device. A number of cams are fixed on the driving shaft 1, namely a drum cam 5, a disc cam 6, a vacuum valve cam 7 and a pressurized air valve cam 8. The drum cam 5 has a circumferential groove 9, in which a roller 10 of an oscillating fork 11 engages. The oscillating fork 11 is linked with the paper feeding mechanism 12 provided with suction cups 13. A roller 14 is rolled along the circumference of the disc cam 16, and is supported by a cylindrical bolt 15 fixed on a lifter 16 guided slidingly in a support 17. A bolt 18 is fixed on said lifter 16 and supports rollers 19 engaging the bottom of a supporting lever 20 which is pivotally supported by a shaft 21 fixed within the frame 4 of the whole device. The other extremity of said supporting lever 20 is linked by way of a bolt with a sensing element 22, which is spring loaded by the spring 23 generating a pressure force between the support 17 and the supporting lever 20. Two bolts 24 are furthermore fixed on the frame 4 of the device and support pivotally fork levers 25 provided with bolts 26 and with rollers 27, which engage into a profiled lateral groove 67 of the vacuum valve cam 7 and of the pressure valve cam 8 respectively. The forks of the fork levers 25 engage with cylindrical bolts 28 which are fixed on the bodies of a vacuum valve 29 and of a pressure valve 30 respectively. The valves 29 and 30 which are rotatably arranged in the frame 4 of the whole device. A number of conduit channels 31 to 39 are arranged in the frame 4 distributing a vacuum and compressed air and forming cylindrical spaces for a vacuum regulator 47, for a pressurized air regulator 48 and for a blower regulator 49. The vacuum valve 29 is a hollow body with an inlet port 54, a suction port 55 and an air supply port 56 (FIG. 1). The compressed air valve 30 is similarly a hollow body with a communication port 51, an inlet port 53 and a distribution port 52 (FIG. 2). The vacuum valve 29 cooperates with air channels 36, 37 and 38 provided in the body of the frame 4, while the pressurized air valve 30 cooperates similarly with air channels 31,32,34.

Pressurized air is supplied via the conduit 43 to the conduit 44 leading to the sensing device 22. The pressure regulator 48 which is adapted to throttle the passage of air to the pressure conduit 49 is inserted in a cavity of the frame 4. The pressure regulator 49 is located in a cavity of the frame 4 between the air channels 32 and 33 and throttles air passage to the blower tube 57. Both pressure regulators 48 and 49 are cylindrical bodies, which may by rotation obstruct the respective channels.

A suction pump is connected to the suction conduit 42 and creates underpressure in the suction conduit 45 within time intervals controlled by the vacuum valve 29, said underpressure being adjusted by the vacuum regulator 47 between the air channels 38 and 39 in a way similar to the regulations of the supply of compressed air by regulators 48 and 49.

An air distributing tube 40 is fixed on extensions of the frame 4 with holders supporting blowing tubes 57 provided with a number of openings 58. The distributing tube 40 receives pressure air via air channels 32 and 33. The whole arrangement is covered by a cover 68.

The arrangement operates as follows:

The driving shaft 1 is driven by an (not shown) adjustable coupling and motor at uniform speed, with the cams 5,6,7,8 fixed on said shaft 1 transmitting the operating motions to the individual mechanisms. The roller 10 engaging into the groove 9 of the drum cam 5 generates an oscillating movement of the fork 11 which in connection with a not shown mechanism transmits to the feeding mechanism 12 a motion, such that sheets supported by suction cups 13 are supplied to a conveying device in direction of the arrow in FIG. 1.

The rotation of the disc cam 6 causes lifting of the lifter 16 raising by way of the rollers 19 the supporting lever 20, which transmits the operating motion to the sensing element 22, the front edge of which moves along the track 61 (FIG. 1).

The rotation of the vacuum valve cam 7 and of the compressed air valve cam 8 changes the position of the vacuum valve 29 and of the overpressure valve 30 respectively. The following operating cycle is accomplished: The compressed air valve 30 is adjusted so that the communication port 51 of said valve 30 is opposite to the air channel 31 and its distribution port 52 opposite to the air channel 32 whereby the air channel 34 remains closed. Pressurized air supplied by way of the overpressure conduit 43 passes through channels 31,32,33 to the distributing tube 40 and furthermore to the blower tube

57 where it is directed by the blower openings 58 towards the sheet stack 59, raising the upper sheets thereof. In the following moment the vacuum valve 29 is adjusted so that its inlet port 54 is opposite to the air channel 36, its suction channel 55 is opposite to the air channel 38 with closed air channel 37. Thus the air passage is opened from the suction conduit 42 to the suction conduit 45 by way of hollow spaces 50 in the oscillating fork 11 and in the feeding mechanism 12 to the suction cups 13, which suck on the upper sheet from the sheet stack 59. The suction cups 13 start thereafter to move along the track 60 upwards and the sensing element 22 moves along the track 61 downwards until it comes in contact with the sheet stack 59. The pressure valve 30 is thereafter adjusted so, that its communication port 51 is opposite to the air channel 31 and its communication port 51 is opposite to the air channel 31 and its inlet port 53 opposite to the air channel 34 and the air channel 32 is closed. Thus a passage for pressurized air is established from the conduit 43 by way of the air channels 31,34,35 to the conduit 44 and through the supply conduit 63 to the sensing element 22, wherefrom pressure air is directed through outlet ports 64 below the paper sheet, supported by the suction cups 13, so that an air cushion is provided conveying the paper sheet in direction of the arrow in FIG. 2 towards a conveying device. Before the suction cups 13 reach their extreme position 66, the suction valve 29 is adjusted so that the inlet port 54 is opposite to the air channel 36 and the air supply port 56 is opposite to the air channel 37 whereby the air channel 38 is connected by way of a (not shown) channel on the external part of the suction valve 29 with the surrounding air, so that the suction cups 13 loose their suction and release the supported paper sheet.

The suction pump connected to the suction conduit 42 continues to suck air in the course of the rearward movement of the suction cups 13 by way of the air channels 36 and 37 open to ambient space.

The adjustment of the vacuum is accomplished by turning the regulator 47, opening and closing the channel 46 connecting the suction conduit 45 with the ambient space. The adjustment of pressure is accomplished by turning the regulator 48 and the blower regulator 49, limiting the passage of air to the air channels 33 or 35 respectively.

The adjustment of the feeding device in accordance with the size of paper sheets is accomplished by a not shown adjustable coupling of the driving shaft 1 transmitting the rotating motion to said shaft. This coupling can be a commonly used coupling allowing the adjustment of its position with respect to the driving shaft 1.

Advantages of the arrangement according to this invention are, that the drive safeguards the proper operation of the feeding mechanism and of the underpressure and overpressure valves without using any resilient pressure elements, so that no changes of functional movements result even at elevated speeds. The rotational motion of the driving shaft supporting the control cams is uniform and the air supply conduits are very short, what is a marked advantage for the operation of the feeding mechanism. A suitable arrangement of pneumatic valves and regulators permits the concentration of all the controls of the feeding device on the front wall of the machine to great operational advantage. The whole drive is simple and requires only a limited space.

I claim:

1. Apparatus for pneumatically feeding sheets from a stack to a receiving means comprising a supporting frame, a suction mechanism movable with respect to said frame, said suction mechanism having suction cups for holding said sheets during transfer, a sensing mechanism movable with respect to said frame for intermittently compressing the sheet stack and for directing an air stream to support a transferred sheet, flowing means for loosening the upper sheets of said stack, rotary suction and pressure valves mounted within said frame for controlling the supply of air to said suction mechanism, sensing device, and flowing means, a driving shaft rotatably supported within said frame, the axis of said driving shaft being arranged parallel with said sheet stack and the direction of transfer of said sheets, a plurality of cams fixed to said drive shaft and rotatable therewith, said cams being respectively associated with each of said suction, and sensing mechanisms and said rotary valves and connecting means between said cams and their associated mechanisms, whereby said associated mechanisms are simultaneously and synchronously operated.

2. The apparatus according to claim 1, wherein the cam associated with said suction means comprises a drum having a circumferential groove and its associated connecting mechanism comprises an oscillating lever having one end provided with a pair of forked arms straddling said drum, each arm having a roller engaged within said groove, the other end of said oscillating lever being connected to said suction mechanism.

3. The apparatus according to claim 1, wherein each of the cams associated with said rotary suction and pressure valves comprises a disc having a laterally extending groove formed in the face thereof and the associated connecting means comprises a forked lever movably supported by said frame and engaging said valve, said forked lever having roller means engaging into the groove of said cam.

4. The apparatus according to claim 3, wherein said rotary valves comprise a housing having a radial hole communicating with a source of air, and a cooperating rotating member axially aligned therein and having an aperture communicating with said aperture in said housing, said rotary member being connected to said forked lever, said rotary valve being aligned along an axis parallel to said drive shaft.

5. The apparatus according to claim 4, including means for regulating the relative rotation between said rotary member and said valve housing.

6. The apparatus as claimed in claim 1, wherein the cam associated with the sensing mechanism comprises a disc cam having a peripheral cam face and said connecting means associated therewith comprises a pivotal lifter member having a roller engaging said cam surface and being connected to said sensing mechanism.

7. The apparatus according to claim 6, including spring means for normally biasing said lifter member in a predetermined direction.