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3,123,355

SHEET FEEDING APPARATUS

Filed Jan. 30, 1961

3 Sheets-Sheet 1

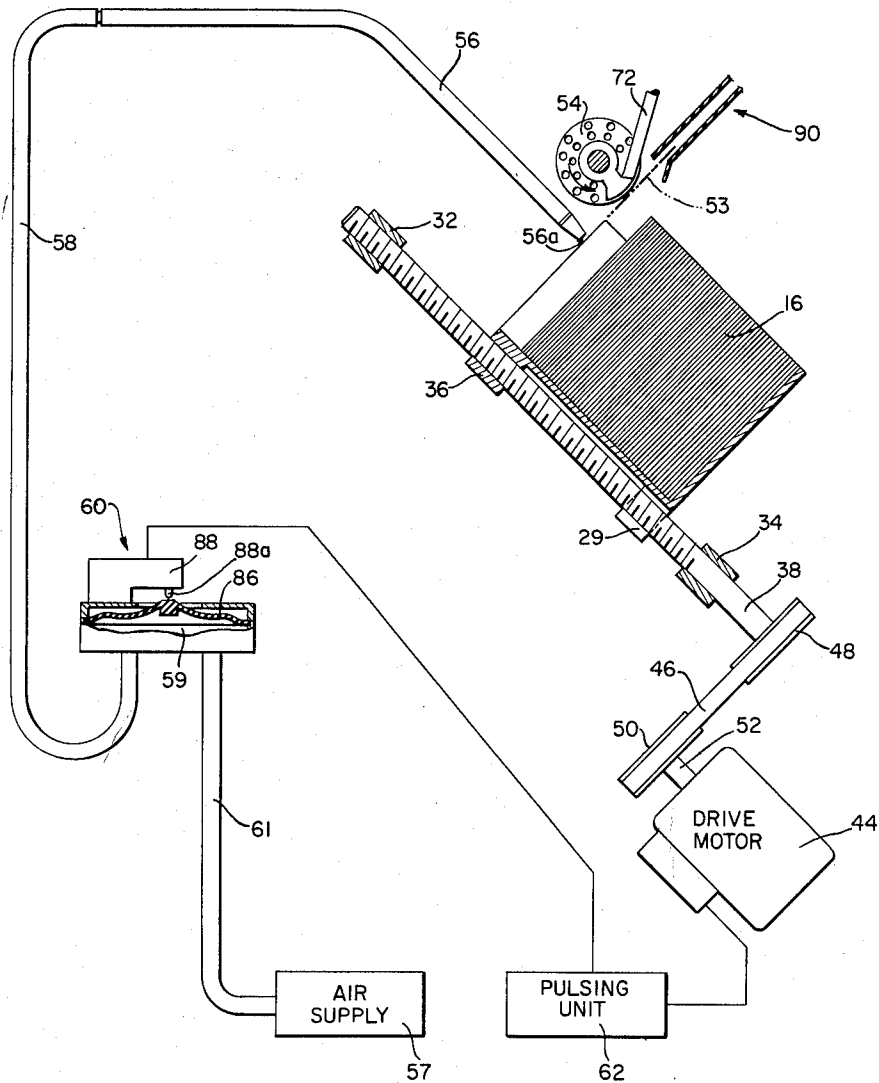


Fig. 1

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3 Sheets-Sheet 2

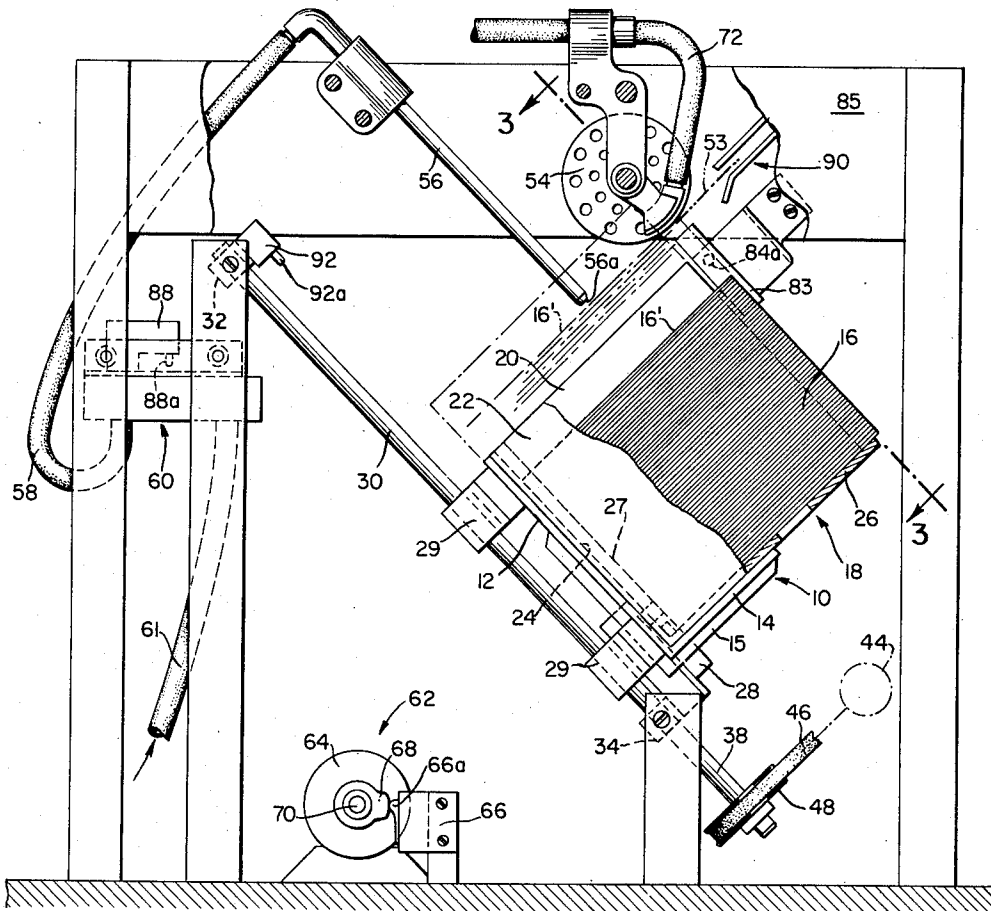


Fig. 2

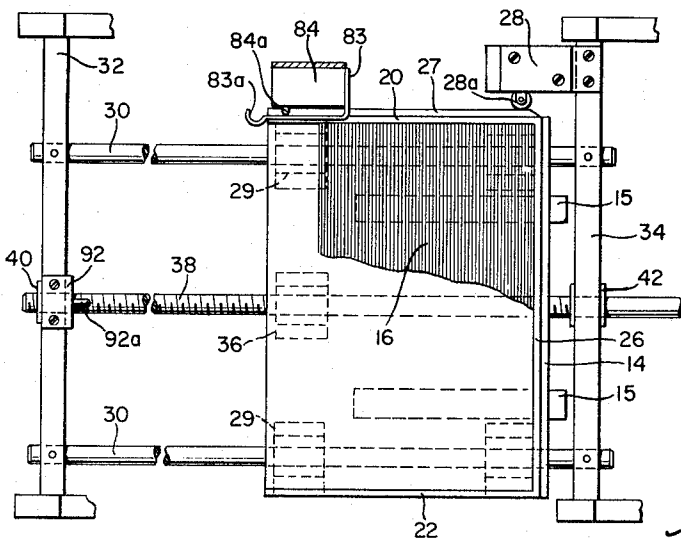


Fig. 3

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SHEET FEEDING APPARATUS

3 Sheets-Sheet 3

Fig. 4

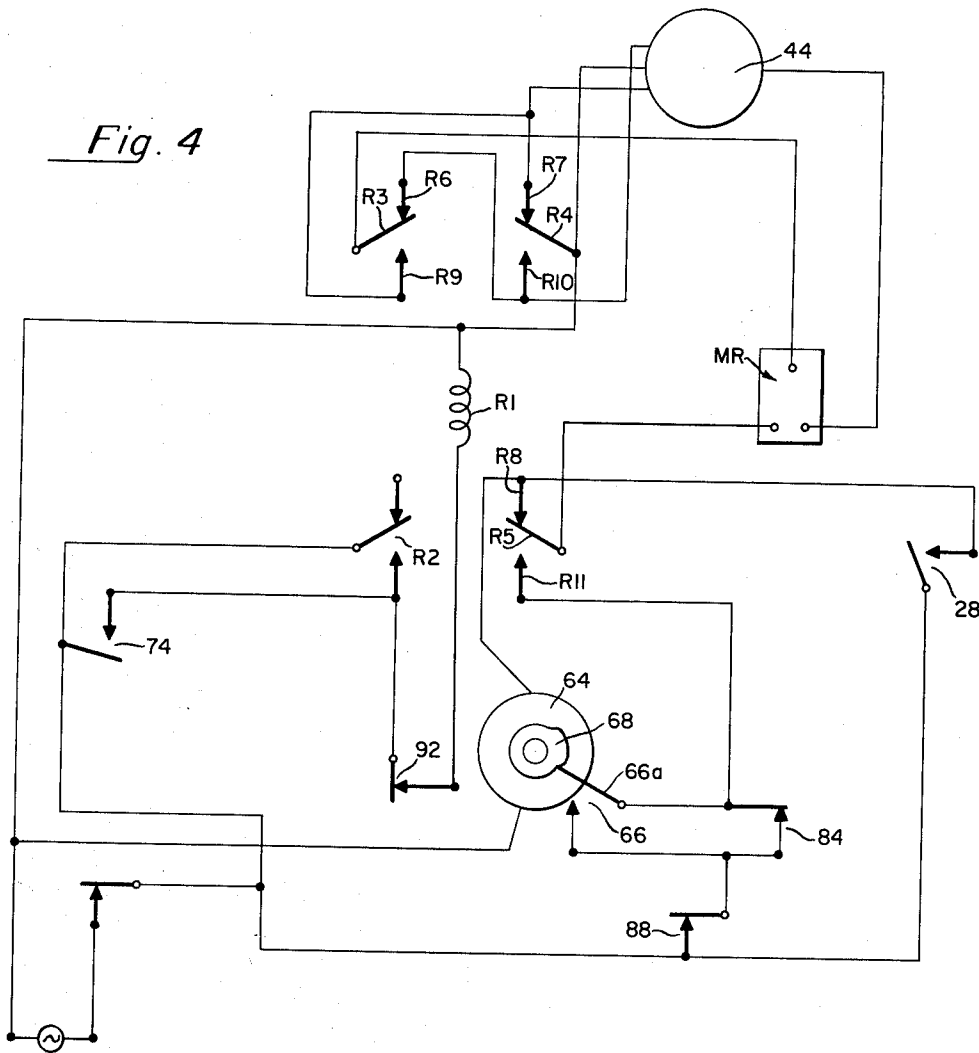
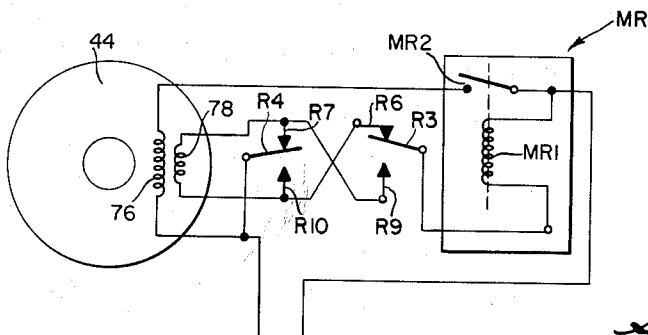


Fig. 5



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1

3,123,355

SHEET FEEDING APPARATUS

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6 Claims. (Cl. 271-62)

This invention relates generally to sheet feeding machines and more particularly to apparatus of the kind disclosed in U.S. Patent No. 2,902,278, assigned to Burroughs Corporation, the same assignee as that of the present invention, for automatically controlling the advancement of a stack of sheets to a sheet separation station for maintaining the sheet removal end of the stack at a substantially constant position as sheets are removed from the stack at the separation station.

In certain types of sheet feeding machines, mechanisms are utilized for advancing a stack of sheets to a feeding device and for maintaining the stack at a substantially constant feeding level as sheets are fed from the stack by the feeding device. Such mechanisms generally include a continuously operating drive motor and some type of coupling device, such as a ratchet mechanism, clutch, and the like, for coupling the stack support to the drive motor each time the stack must be advanced to the feeding level. While such prior art mechanisms have heretofore been satisfactory, it is, of course, highly desirable, as accomplished by the present invention, to eliminate the constant operating characteristic of the drive motor and to eliminate also the use of coupling devices such as the aforementioned ratchets, clutches, and the like.

An object of the invention is to provide an improved apparatus for advancing a stack of sheet-like articles to a sheet separation station or feeding level.

Another object of the invention is to provide an intermittently operable motor drive for advancing a stack of sheets to a feeding level, in which a characteristic of the motor drive is that it must overcome only a minimum of inertia each time it is operated.

Another object of the invention is to provide apparatus including a drive motor for advancing a sheet stack support toward and away from a sheet separation station, and including instrumentalities for conditioning the motor for high-speed approach of the stack support, low feed rate for presenting successive sheets from a stack on the support to a feeding device, and high speed for returning the empty stack support to its starting or loading position.

A further object of the invention is to provide a drive mechanism for advancing a sheet stack support, in which the drive mechanism may be directly coupled to the stack support at all times, thereby to provide a simplified construction and an instantly responsive mechanism for advancing and retracting the sheet stack support.

In accordance with the above objects, and first considered briefly in its broad aspects, the invention utilizes a sheet stack support and associated members for advancing a stack of sheets to a sheet separation station, or feeding level, at which place the sheets are separated individually and successively from the stack by a feeding device and forwarded to their destination. Means are provided for gauging or sensing the level of the sheet stack, as sheets are separated therefrom by the feeding device, for actuating a drive motor in a jogging motion for driving the stack advancing means to present successive end sheets of the stack substantially at the feeding level. The gauging or sensing means conditions electrical circuitry to provide discrete electrical current pulses to the drive motor of appropriate duration to effect the jogging action of the motor.

The invention will be more clearly understood when

2

the following detailed description of a specific embodiment thereof is read in conjunction with the accompanying drawings, in which:

FIG. 1 is a diagrammatic illustration of a sheet feeding apparatus embodying the principles of the present invention;

FIG. 2 is a front elevational view of an assembled sheet feeding apparatus corresponding to the apparatus shown in FIGURE 1;

FIG. 3 is a view taken in the direction of arrows 3-3 of FIG. 2, and with certain parts omitted;

FIG. 4 is a schematic diagram of the control circuitry; and

FIG. 5 is a schematic diagram of the drive motor circuit.

Turning now to the details of the drawings, and more particularly to FIGURE 2 thereof, the preferred embodiment of the invention comprises a V-shaped sheet stack support or cradle 10 having an upwardly extending side wall 12, an upwardly extending bottom wall 14, and V-shaped reinforcing members 15. A stack of sheets or cards 16 is deposited in a removable container 18 carried on the support 10, the container 18 having side walls 20, 22, and 24, and a bottom wall 26. A stop flange 27, extending upwardly from the side wall 12 of the support 10, positions the container 18 in the support, and holds open a return limit switch 28 (FIGS. 3 and 4) when the support is in its lowermost position, as shown.

Secured to the outer lower surface of the side wall 12 of the support 10 are guide bearings 29 slidably mounted on guide shafts or ways 30 secured at their end regions in fixed frame members 32 and 34 of the apparatus. An elevating nut 36 (FIG. 3), likewise secured to the outer lower surface of the side wall 12, has threaded engagement on an elevating screw 38 journaled in suitable bearings 40 and 42 secured respectively in the frame members 32 and 34. The elevating screw 38 is coupled, preferably directly as shown, to an electric drive motor 44 (FIG. 1) by means of an endless belt 46 engaged about pulleys 48 and 50 secured respectively on the elevating screw 38 and the shaft 52 of the drive motor.

Various types of drive motors may be utilized in the present invention, however, the particular drive motor 44 shown herein has been chosen for purposes of illustration since it operated quite satisfactorily when used in the illustrated apparatus.

The particular type of drive motor 44 used was an A.-C. single-phase induction motor (FIG. 5), 115 volts, 60 cycle, 1725 r.p.m., 1/2 H.P., manufactured by General Electric Company, Model No. 5KH29GG2, which uses the split phase method of starting. The motor utilizes two windings, a starting winding and an armature winding which are supplied with currents sufficiently displaced in phase from each other so that an approximation to a two-phase revolving field is obtained. The starting winding has the higher resistance of the two and is cut off when the motor reaches approximately 80% of synchronous speed. In this particular motor a relay MR (FIGS. 4 and 5) is used for opening the starting winding 76, however, different types of motors may use a centrifugal device, or the like, for the same purpose.

As will be described more fully hereinafter, the stack of sheets 16 is advanced or elevated to a feeding station or feeding level 53 (FIG. 2), indicated by a dot-dash line, adjacent to a sheet feeding device 54 at which place sheets 16 are separated individually and successively from the top or end of the stack by the feeding device 54. The sheet feeding device 54 may be of any well known construction, however, for purposes of illustration in the present embodiment, the vacuum wheel type of feeder of the class shown in U.S. Patent No. 939,260 is shown herein. Arranged adjacent to the feeding level 53, and prefer-

ably in the path of movement of the sheet stack 16, is an element of a sensing apparatus, in this case a tube or pipe 56, for detecting or gauging the position of successive top or end sheets 16. The sensing apparatus preferably takes the form of the pipe 56 and communicating members such as a source of positive pressure or air supply 57 (FIG. 1), hoses 58 and 61, and a diaphragm switch apparatus 60 having a chamber 59 in communication with the hoses 58 and 61.

A pulsing unit 62 (FIG. 2) comprises an electric motor 64, a pulsing switch 66 and a cam 68 secured on the shaft 70 of the motor 64 for actuating the arm 66a of the switch 66.

The operation proceeds as follows: The electrical control circuitry is initially in a normal or non-operating condition, as shown in FIGURE 4, and air under pressure is supplied to the sensing pipe 56 from the air supply 57 and discharged through the pipe orifice 56a toward the sheet stack 16. The vacuum wheel 54 is rotated continuously from a suitable source of power, not shown, and air under vacuum pressure applied to the periphery of the wheel, as is understood, from a suitable source of sub-atmospheric pressure, not shown, in communication with a hose 72. A push-button starting switch 74 (FIG. 4) is actuated by the operator to energize the coil R1 of a relay thereby to close a holding circuit R2 of the relay and move its transfer contacts R3, R4 and R5 from the normally closed contacts R6, R7, and R8, respectively, to the normally open contacts R9, R10, and R11, respectively.

A circuit is thus completed to energize the coil MR1 (FIG. 5) of the drive motor 44 relay MR, and close the drive motor relay contacts MR2 to energize the drive motor starting winding 76. When the drive motor 44 attains a speed of approximately 80% of synchronous speed, the counter E.M.F. of the main or armature winding 78 will reduce the flow of current through the relay coil MR1 thereby opening the drive motor relay contacts MR2 to open the starting winding circuit, as is understood.

The drive motor 44 attains full speed and rotates the elevating screw 38 to advance the support 10, container 18 and sheet stack 16 upwardly. As the support moves upwardly, the stop flange 27 by-passes the plunger 28a of the return limit switch 28 and allows this switch to close, thereby starting the pulsing unit motor 64 and establishing a circuit for the return movement of the support 10, as will appear more clearly hereinafter.

As the top or end 16' of the sheet stack approaches and is within a short distance of the feeding level 53, the side of the sheet stack 16 will actuate the free end 83a of a fixed spring arm 83 (FIGS. 2 and 3) to press against the plunger 84a of a rapid travel limit switch 84, carried by the support structure 35, thereby opening this switch and disconnecting the driving motor 44 from high speed operation. With the rapid travel limit switch 84 now open, a circuit to the driving motor 44 will be completed each time the pulsing switch 66 is closed by the cam 68. Thus the driving motor 44 is now actuated by a series of regulated pulses providing current to the starting coil 76 and providing a jogging action of the drive motor 44 in which its shaft 52 is rotated a part of a revolution for each current pulse.

The jogging action of the drive motor 44 thus effects advancement of the sheet stack 16 in short increments of movement until the top or end 16' of the sheet stack reaches the feeding level 53. At this position, the top of the sheet stack will be slightly spaced from the mouth or orifice 56a of the pipe 56 and will have restricted the flow of air discharging from the pipe to such an extent as to cause an increase in pressure in the chamber 59 of the diaphragm switch structure 60, thereby to force the diaphragm 86 outwardly to press against the plunger 83a of the diaphragm switch 88, opening this switch and

rendering the pulsing switch 66 ineffective and stopping the driving motor 44.

The sheets 16 are at this time being separated individually and successively from the top or end of the stack by the feeding device 54 and delivered thereby into a feeding path chute 90 toward their destination. As the top of the sheet stack 16 is lowered by the feeding of sheets therefrom, the flow of air through the pipe 56 will increase until the pressure lowers sufficiently in the chamber 59 to allow the diaphragm switch 88 to close. The pulsing switch 66 will now again be effective for jogging the driving motor 44 until the depleted sheet stack 16 is again advanced to the feeding level 53, at which time the diaphragm switch 88 will again open, as described above.

The operation will be repeated automatically until the last sheet 16 has been fed from the stack. At this time, or shortly thereafter, an upper limit switch 92 (FIGS. 2 and 3) will be opened by contact of its plunger 92a with the elevating nut 36 thereby to deenergize the relay coil R1, open the holding circuit R2, restore the transfer contacts R3, R4 and R5 to their original positions, and reverse the drive motor 44 for returning the stack support or cradle 10 and container 18 to the lowermost or loading position, at which place the return limit switch 28 will be opened by the stop flange 27 thereby stopping the drive motor 44 and pulsing unit motor 64.

From the foregoing description, it will now be apparent to those skilled in the art that the invention provides an improved sheet feeding apparatus which may be made quite sensitive for maintaining the sheet stack within narrow limits of the feeding level 53, by suitably forming the pipe orifice 56a and by properly adjusting the flow of air through the pipe 56.

While there has been disclosed a specific structure exemplary of the principles of the invention, it is to be understood that this is the preferred embodiment thereof and that the invention is capable of being constructed in a variety of shapes, sizes and modifications without departing from its true spirit and scope. Accordingly, it is to be understood that the invention is not to be limited by the specific structure disclosed but only by the subjoined claims.

What is claimed is:

1. A sheet feeding apparatus comprising, a support for a stack of sheets, an electric drive motor coupled to said support, electrical circuit means operable for rotating said motor at substantially full speed for advancing said support at high speed from a sheet stack loading station toward a sheet separation station, a pulsing unit for opening and closing said circuit at intervals to effect intermittent rotation of said motor in stepwise movements each a part of a revolution and normally ineffective when said support is at the loading station, switching means actuated by movement of said support for stopping full-speed rotation of said motor when the support is a short distance from the sheet separation station and for rendering effective said pulsing unit for continuing the advancement of the support in stepwise movements to the sheet separation station, a sensing tube having an orifice adjacent to said sheet separation station for discharging air toward the advancing sheet stack, the advancing sheet stack effecting a restriction of the flow of air from said orifice as the sheet stack arrives at said separation station, means for forcing air through said sensing tube and orifice, a switch in said circuit, and diaphragm means responsive to said restriction of air flow for actuating said switch to render said drive motor inoperative, said pulsing unit being responsive to the subsequent actuation of said switch effected by the separation of a predetermined number of sheets from the end of said stack for effecting rotation of said motor in stepwise movements each a part of a revolution to advance the depleted sheet stack to said separation station.

2. A sheet feeding apparatus according to claim 1

5

wherein said pulsing unit comprises, an electric motor which is actuated by said movement of said support, a switch member in said circuit, and a cam continuously rotatable by said last-mentioned motor for opening and closing said switch member.

3. A sheet feeding apparatus comprising, a support for a stack of sheets, an electric drive motor coupled to said support and provided with a low-speed starting winding and a high-speed main winding, electrical circuit means operable for energizing the main winding for rotating said motor at full speed for advancing said support from a sheet stack loading station toward a sheet separation station, a device for opening and closing said circuit at intervals to energize the starting winding intermittently thereby to effect intermittent rotation of said motor in stepwise movements each a part of a revolution and normally ineffective when said support is at the loading station, first switching means actuated by movement of said support for conditioning said electrical circuit means so that the main winding is ineffective thereby stopping full-speed rotation of said motor when the support is a short distance from the sheet separation station, second switching means actuated by movement of said support for rendering effective said device for continuing the advancement of the support in stepwise movements to the sheet separation station after full-speed rotation of the motor has been stopped, a sensing tube having an orifice adjacent to said sheet separation station for discharging air toward the advancing sheet stack, the end sheet of the advancing sheet stack effecting a restriction of the flow of air from said orifice as the sheet stack arrives at said separation station, means for forcing air through said sensing tube and orifice, a switch in said circuit, and diaphragm means responsive to said restriction of air flow for actuating said switch to render said device ineffective to cause rotation of said drive motor, said device being responsive to the subsequent actuation of said switch effected by the separation of a predetermined number of sheets from the end of said stack for again energizing the starting winding intermittently thereby effecting rotation of said motor in stepwise movements each a part of a revolution to advance the depleted sheet stack to said separation station.

4. A sheet feeding apparatus comprising, a support for a stack of sheets, an electric drive motor coupled to said support and provided with a low-speed starting winding and a high-speed main winding, electrical circuit means operable for energizing the main winding for rotating said motor at substantially full speed for lifting said support from a sheet stack loading station toward a sheet separation station, a switching device for opening and closing said circuit at intervals to energize the starting

6

winding intermittently thereby to effect intermittent rotation of said motor in stepwise movements each a part of a revolution, a cam for operating said switching device, a second electric motor for rotating said cam and normally inoperative when said support is at the loading station, first switching means actuated by upper movement of said support for conditioning said electrical circuit means so that the main winding is ineffective thereby stopping full-speed rotation of said drive motor when the support is a short distance from the sheet separation station, second switching means actuated by upper movement of said support for operating said second electric motor for continuing the advancement of the support in stepwise movements to the sheet separation station after full-speed rotation of the drive motor has been stopped, a sensing tube having an orifice adjacent to said sheet separation station for discharging air toward the advancing sheet stack, the advancing sheet stack effecting a restriction of the flow of air from said orifice as the sheet stack arrives at said separation station, means for forcing air through said sensing tube and orifice, a switch member in said circuit, and diaphragm means responsive to said restriction of air flow for actuating said switch member to render said switching device ineffective and said drive motor inoperative, said switching device being responsive to the subsequent actuation of said switch member effected by the separation of a predetermined number of sheets from the top of said stack for again energizing the starting winding intermittently thereby effecting rotation of said drive motor in stepwise movements each a part of a revolution to advance the depleted sheet stack to said separation station.

5. A sheet feeding apparatus according to claim 4 characterized further by the provision of an electrical device in said electrical circuit means operating automatically to open the circuit of the starting winding whereupon the main winding effects high speed rotation of said electric drive motor.

6. A sheet feeding apparatus according to claim 5 wherein said electrical device is a relay.

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