A controlled motion is applied to drive a pawl and ratchet mechanism in incremental steps for indexing the platen of a business machine. A pneumatic dashpot is attached to the plunger of an axial-pull solenoid wherein the use of both an orifice and a flip-type seal within the dashpot balances the available actuating forces and results in a smoother indexing action under varying loads on the platen.

3 Claims, 8 Drawing Figures
PLATEN INDEXING ACTUATOR

BACKGROUND OF THE INVENTION

In the business machine field, it is well-known that different forms of paper or other media are used in certain business operations such as registering, recording, accounting and the like. For example, in an accounting machine operation, it is generally the case that the machine is built with a platen and its associated mechanism to accommodate at least two distinct media forms, say in the nature of a journal roll on one portion of the platen and a ledger card on the other portion, i.e., the right and left hand sides. The ability to independently feed two side-by-side forms is accomplished by means of a split platen wherein the different forms of various widths can be inserted into the machine. Additionally, the forms may be of different thicknesses and therefore require varying forces to feed and to properly index the forms around the platen. In view of the different forms being used in the machine, it is apparent that the force required to feed or to index one form is different from the force required to feed or index another so that means must be found to provide for an even and smooth operation. It has been found that with indexing means in the form of electromagnetic solenoids, such solenoids are subject to varying forces and loads in the operation thereof and some type of controlling means must be made available to accomplish smooth operation. The present invention relates to an indexing means in the form of a solenoid operator with a dashpot connected thereto.

In the matter of solenoid and dashpot mechanisms, the prior art shows and describes, in U.S. Pat. No. 793,063 to J. J. Ghegan, an electrical instrument having a movable armature and a dashpot with a piston and rod responsive to changes in current. The extent or amplitude of the armature motion is governed by the strength of the current and the dashpot cushions the longer or extreme motions of the armature.

U.S. Pat. No. 1,590,001 to H. C. Van Valkenburg covers the solenoid having a dashpot secured onto a fixed ring, a piston, and a rod connected to a movable core or plunger which travels in a central sleeve and rises or falls in accordance with current in the solenoid coil. A paper feeding device for printing machines is disclosed in U.S. Pat. No. 2,056,393 to F. Didzuns wherein the solenoid plunger has a rod connected to a link pivoted to a double arm mounted on a shaft to which is secured a ratchet wheel engageable by a pawl to rotate the platen.

Further prior art is shown and described in U.S. Pat. No. 2,308,660 to H. K. Kouyoumjan wherein a time-delay relay of the electromagnetic and dashpot type has a cylinder secured and sealed at one end thereof to a dashpot body with a central opening, and with a stem passing therethrough. The piston has a flat plate connected in an arrangement to be pivoted at one side and connected to a further cylinder which is normally perpendicular to the axis of the dashpot cylinder.

SUMMARY OF THE INVENTION

The present invention relates to indexing mechanism and more particularly to a platen indexing actuator in a business machine for providing a smooth motion of operation.

As is well-known in the art of business machines, the platen carries the paper or like record medium in a manner permitting advancement of such paper in incremental steps between the times of the printing operations. With the advent of higher speed machines, it is important and necessary that the advancement of the paper be controlled in a manner to insure smooth motion and proper registration of the paper forms for the printing operations.

The solenoid of the present invention has a plunger which is connected to a pawl and ratchet mechanism, in turn, driving the platen in incremental steps to advance and properly register the paper between such printing operations. A dashpot having a piston and rod is secured to one end of the solenoid, the motion of such piston and rod being in line with the motion of the solenoid to cushion and control the drive on the pawl and ratchet mechanism with a smooth motion regardless of the range of loads imposed on the platen by various thicknesses of paper and/or forms. Since the force generated by the solenoid is a function of its stroke position and the applied voltage, the driving force varies throughout the cycle, as well as from cycle to cycle. The dashpot balances the available actuating force with the applied load to provide an even indexing motion.

A sharp-edged orifice within the dashpot vents the air pressure at a predictable rate and makes the dashpot self-regulating. Increases in actuator velocity due to light loads or high forces produce a higher resultant back pressure in the dashpot whereas a reduction in velocity allows the back pressure to drop and thus permit the solenoid to operate at full capacity. The dashpot is arranged to have a maximum compression ratio when the solenoid has maximum force so their capabilities are matched throughout the cycle of operation. Guide bushings are built into the solenoid for low frictional forces and a flip-type seal is incorporated into the dashpot piston to insure positive sealing during the operation.

In view of the above discussion, the principal object of the present invention is to provide a mechanism for indexing a platen in even incremental steps. Another object of the present invention is to provide a solenoid drive actuator with a dashpot for smoothing the actuating motion.

A further object is to provide a self-regulating indexing mechanism that will balance the forces within an operation.

Additional advantages and features of the present invention will become apparent and fully understood from a reading of the following description taken together with the annexed drawing, in which:

FIG. 1 is a perspective view of a portion of a business machine incorporating the structure of the present invention;

FIG. 2 is a plan view of certain drive and control mechanism for said business machine;

FIG. 3 is a plan view of the platen indexing mechanism of the present invention;

FIG. 4 is a front elevational view showing additional control mechanism for the platen;

FIG. 5 is a side view, partly in section, of the platen indexing mechanism;

FIG. 6 is an enlarged view of a portion of the dashpot piston and the sealing means;

FIG. 7 is a view showing the platen sequence switches; and
FIG. 8 is a diagram showing typical force curves of the solenoid-dashpot actuator.

Referring now to FIG. 1 of the drawing, the basic forms handling apparatus 10 of a business machine contains the mechanisms, electrical power drivers, and compression roll assemblies necessary to hold, space, and feed the standard cut forms and the roll-type journal forms normally used in a business operation. The forms feeding or handling apparatus is modular in design to enable changeability and convenience in maintenance and provides the media paths or chutes and the means of moving the various forms and journals through the machine in response to programmed commands.

The forms feeding apparatus comprises a pair of spaced, upright side frames 12 and 14 connected by suitable structural members in the form of bars 16, shafts, angles or the like and includes a platen 18 of the split type, manually controllable by operator knobs 20 and 22. The split platen 18 enables the independent control of two forms positioned side-by-side in the unit either by operation of the knobs 20 or 22, or by operation of the solenoids, as will be hereinafter described. The platen 18 is suitably journaled in the side frames 12, 14 and includes shaft extensions 24 and 26 between the frames 12, 14 and the knobs 20, 22 for the control mechanism, there being auxiliary frames 28 and 30 to accommodate such control mechanism. The two parts of the platen 18 may also be operated together or coupled, in which case, they are simultaneously driven by both right and left knobs 20, 22 or by the solenoids. Forms may be inserted into or removed from either side of the machine without affecting registration of the form on the other side, and, further, each form will move with its journal form, whether the platen 18 is coupled or uncoupled.

The forms handler has two media paths, with one path arranged for rear insertion of forms, such as tally rolls, journals, and continuous forms, and the other path arranged for front insertion of ledger cards and cut forms. A plurality of spaced front compression rolls 40 are positioned along a path adjacent the platen 18 and hold all forms against the platen 18. When the machine is operated in the split-platen, i.e., the platen uncoupled, mode, dual compression roll drive lines provide separate control of the right and left forms. Each compression roll 40 may be operated by either drive line or by both drive lines through mechanical programming of actuator arms. In the unsplit platen, i.e., platen coupled, mode, any manual or programmed platen drive control will result in movement of the entire platen 18 as a unit. The right and left compression rolls 40 are operated by means of a cam line in response to solenoid signals received from a control module. A number of microswitches are used to indicate the status of the solenoid-activated elements of the forms handler, location of the platen 18, and status of the platen coupling, with certain of these microswitches being mounted on the cam line assembly. The microswitch which is used to indicate platen coupling or uncoupling is mounted on the left side frame 14 and is triggered by the actuating collar. Additional platen sequence switches are used to indicate change in position of the right platen when a ledger system is operated within the machine.

Summarizing the several operations, the outputs of the forms handler are microswitch type outputs which indicate the positions of the compression rolls 40, the line guide, and the platen 18, and whether the platen 18 is coupled or uncoupled. The right front compression roll switch is a cam-operated microswitch which opens after the right front compression rolls 40 have opened and closes after the right front compression rolls 40 have closed. Similarly, the left front compression roll switch changes state in response to the left front compression rolls 40 opening or closing. The line guide cam line switch performs the same function. The second line guide switch, a microswitch on the outside of the right main frame 12, indicates the position (up or down) of the line guide and is used to inhibit printing, in the event that the operator manually lowers the line guide or in the event of a command for the control system. The platen sequence switches operate in response to movement of the platen 18, and the switch outputs are used to indicate direction of platen movement, and are fed to the ledger system to be used to maintain correct line counts. The platen couple switch is a microswitch which is open when the platen 18 is uncoupled (split) and closed when the platen 18 is coupled. A more detailed description of the compression rolls 40 and their operation is contained in a co-pending application, Ser. No. 325,844, filed Jan. 22, 1973, entitled “Programmable Platen Compression Rolls,” inventors J. J. Terbay and R. P. Taylor, and assigned to the same assignee as the present application.

Referring now to FIG. 2, the drive control mechanism for forms feeding operation includes a drive motor 50 secured to the side frame 12 and suitably driving a magnetic clutch assembly through a gear 52 meshing with a gear 54 on the clutch drive shaft 60, the clutch assembly also including an armature 56 and a rotor 58. The clutch rotor 58 is coupled to the drive shaft 60 through a collar wherein the energization of the magnetic clutch bonds the armature 56 and rotor 58 to transmit power to the shaft 60. The drive shaft 60 is connected by a coupling 62 to a square drive shaft 64 for driving the tractor mechanisms (not shown) which feed the forms or other media through the machine. The timing disk 66 is carried on the shaft 60 and an escapement mechanism including a ratchet 68, a solenoid 70 and a stop pawl 72 are positioned to effect a braking device to stop the drive mechanism on a selected line. When the escapement solenoid 70 is energized, the stop pawl 72 engages with the ratchet 68 which is coupled to the clutch drive shaft 60. The ratchet 68 and the clutch drive shaft 60 are stopped and the magnetic clutch is then deenergized to allow the ratchet 68 to be positioned by a detent arm 71 and engageable therewith.

A select clutch 73 has a gear 74 engaging with an idler gear 76 meshing with a tape drive gear 78 for a tape drive sprocket 80 on a shaft 82. A fine-adjust knob 84 is on the shaft 60 adjacent the select clutch 73 and an advance knob 86 is secured to the end of shaft 60 for the manual operation thereof. In such manual operation, the fine-adjust knob 84 is axially moved against the tractor advance knob 86 whereby the select clutch 73 is disengaged thereby permitting rotation of the clutch drive shaft 60 without rotating the escapement ratchet 68, the timing disk 66, or the gear 74 for the tape drive sprocket 80. The rotation of these knobs 84, 86 together rotates only the clutch drive shaft 60 and the tractor drive shaft 64. The timing disk 66 pro-
vides indication by means of spaced teeth and optic means for identifying the position of the tractor shaft position.

In FIG. 3 is shown a plan view of the platen indexing actuating mechanism. Since an actuating mechanism is disposed on each side of the machine, only the structure of the left side is shown and described. The platen shaft 61 (see also FIGS. 4 and 5) carries a sleeve 63 running substantially to the left end thereof with the sleeve 63 supporting thereon the platen knob 85 and release knob 83 similar in construction to knobs 86 and 84, respectively. A select clutch 65 is positioned on the outside of the auxiliary frame member 30, with a flanged collar 67 on the inside of member 30, there being a side frame standoff 79 between member 30 and side frame 14. Adjacent the collar 67 is a dual purpose ratchet wheel 100 having teeth 102 and teeth 119 on the periphery thereof, the two sets of teeth 102, 119 being disposed in side-by-side relationship. Proceeding along the sleeve 63 are a shifter mechanism and housing 69, a detent spring 75, and a shifter collar 77, such collar 77 being useful in selecting the coupled or uncoupled arrangement of the platen 18.

Referring now to FIG. 4, certain parts such as the advance knob 85, the fine-adjust knob 83 and the coupling detent are duplicated along with the showing of the actuating member 69 and the collar 77 in a position to engage a roller 92 of a platen coupling switch 90 secured to the side frame 14 which action indicates the position as to whether the platen 18 is coupled or uncoupled.

In the FIG. 5 construction, the invention is more fully disclosed as a platen indexing actuator to insure smooth operation of the platen 18 to take care of all manner of forms passing through the machine. The ratchet wheel 100 in the form of a dual gear is secured to the platen shaft 61, the ratchet teeth 102 being of a certain shape and engageable by a pawl 104 pivotally connected to one end of an operating link 106, loaded by a spring 108, and connected to a solenoid plunger 110 actuated by a solenoid 112 which is secured to the frame member 30 of the machine. The teeth 102 of ratchet 100 are designed to be unidirectionally driven by the pawl 104 wherein when the solenoid 112 is momentarily energized, the rod 106 is drawn towards the solenoid 112, and the pawl 104 engages the teeth 102 to thereby index the driving shaft 61. The spring 108 returns the pawl 104 to the position shown. A stop element 105 is secured to frame member 30 for limiting the extent of movement of plunger 110. Cooperating with the just described pawl-ratchet mechanism is a detent device in the nature of an arm 114, held at one end by a spring 116 and pivotable on pin 118, the detent device arm having a roller 117 engageable with teeth 119 of ratchet wheel 100.

Attached to the solenoid 112 is a dashpot body 120 enclosing a piston 122 secured by means of a rod 124 to the plunger 110 of the solenoid 112. The dashpot housing includes a cap 126 containing a filter 128, and an umbrella type check valve 130. A flip-type seal 132 (FIG. 6) is provided in a groove 131 around the periphery of the dashpot piston 122 and in the chamber area of the dashpot cylinder. A sharp-edged orifice 133 within the pneumatic dashpot and cooperating with the valve 130 vents the air pressure at a predictable rate and makes the unit self-regulating. The flip seal 132 in the dashpot piston 122 provides for positive sealing with minimum friction. Additionally, the air in the dashpot is recirculated to minimize the possibility of contaminants decreasing the life of the seal 132.

In FIG. 7 is shown, in more detail, the platen sequence switches 135, 136, and 137 having respective arms 138, 139, 140 and rollers 141, 142, 143 engageable with cam surfaces of a cam wheel 144 carried on the drive shaft 61. These switches 135, 136, 137 operate in a sequential manner to indicate change in position of one portion or side of the platen 18 in coupling and uncoupling thereof and to provide a line count of the form under operator or program control. It will be noted that roller 141 is, in the position shown, riding on the cam surface 146 proximate the center thereof, whereas roller 142 is about to enter the groove 148, and roller 143 is in the groove 148.

The self-regulating capability of the actuator is depicted in FIG. 8. Typical force versus time curves at one voltage level for an actuation are plotted for both a light load and a heavy load condition. The load imposed by the platen 18 and paper forms under light load is curve 150 and under heavy load is curve 151. The force developed by the solenoid is curve 152 for a light load and 153 for a heavy load. The balancing back pressure generated within the dashpot is curve 154 for a light load operation and curve 155 for the heavy load operation.

It is thus seen that herein shown and described is a platen indexing actuator in the form of a solenoid-dashpot combination which has features and advantages that incorporate smoothness of operation with precise positioning of the platen 18. While only one embodiment has been disclosed herein, certain variations on the above may occur to those skilled in the art, so it is contemplated that all such variations having these features are within the scope of the invention.

What is claimed is:

1. Actuating mechanism for indexing a platen in a business machine, said mechanism comprising an electromagnetic solenoid secured to the machine, means including a pawl and a ratchet operably connected with said platen and with said solenoid for driving said platen in incremental manner, and means including an air pressure regulating device secured to said solenoid and having a rod and a piston axially aligned therewith, said device including an orifice and a check valve for regulation of air pressure therein, and a seal encircling said piston for maintaining such regulation of air pressure, whereby the actuating force of said solenoid is balanced with the actual load being applied on the platen.

2. Mechanism for indexing a platen in a business machine, the combination comprising an electromagnetic solenoid secured to the machine, said solenoid having an armature and a plunger extending in one direction, ratchet means on the platen, pawl means connected to said plunger and operably associated with said ratchet means for driving thereof in incremental manner in one direction of rotation, and means including an air pressure regulating device having a rod and a piston axially aligned with and secured to said plunger of said solenoid, said device including an orifice and a check valve for regulation of air pressure therein, and a flip seal posi-
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3. In a business machine having a platen, mechanism for incrementally rotating said platen in indexing manner, said mechanism comprising a solenoid secured to said machine and having an armature-actuated plunger extending in one direction therefrom, ratchet means secured to said platen at one end thereof, a pawl pivotally connected to said solenoid plunger and engageable with said ratchet means for driving thereof in one direction of rotation, and means including a dashpot secured to said solenoid for controlling the actuating force of said plunger in relation to the forces of rotation of said platen, said dashpot including a rod and a piston operably connected with said plunger, a sharp-edged orifice and a check valve in said dashpot for regulation of air pressure therein, and a flip-type seal encircling said piston and positioned for maintaining regulation of said air pressure, whereby the actuating force of said solenoid is balanced with the actual load being applied on said platen.

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