This invention relates to a sheet feeding device and, more particularly, to a device for feeding record cards at high speed.

Previous attempts to increase the rate of feeding record cards have resulted in various vacuum-assisted feeding means. Feeding speeds have been further increased by applying a progressively greater vacuum force for a progressively smaller period of time. However, this technique for increasing the feeding rate is limited due to the record cards being held together by the vacuum force acting through the data holes. It has also been found that even in the case of record cards with no data holes, due to the porous nature of the cards, high vacuum forces act through the cards to pull several cards together. This action makes the card feeding unreliable since the cards may jam and fail to feed, or the cards may be fed at an irregular rate. An attempt has been made to solve this problem by using a nonporous card material, such as Mylar film for example, but this card does not possess all the advantages of the standard record card. It is therefore an object of this invention to provide a record card feeding means for selectively feeding record cards from a hopper at a high feeding rate.

It is another object of this invention to provide a high speed card feed wherein the feeding is controlled by selectively forming an air bearing between a feeding means and the record card.

It is a further object of this invention to provide a feeding means for selectively feeding a single card at high speed on signal from an associated data processing system.

It is a still further object of this invention to provide a high speed card feed for continuously feeding cards with constant spacing.

According to the invention, a record card feeding means is provided for selectively feeding record cards at high speed from a hopper by means of a vacuum force acting to pull the record cards toward contact with a frictional feeding means. A high velocity stream of fluid is directed to overcome the vacuum force so that a fluid bearing is provided between the feeding means and the record card. Selective control is provided by interrupting the fluid stream so that the vacuum force pulls the record card into contact with the frictional feeding means, and a card is fed thereby.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawings.

FIG. 1 is a diagrammatic, schematic view of a record card feeding means embodying the invention.

FIG. 2 is a perspective view, partly in broken section, of the record feeding means of FIG. 3.

FIG. 3 is a top view, partially in section, of a specific embodiment of the record card feeding means of FIG. 1.

FIG. 4 is a schematic block diagram of the control circuitry for the record card feeding means of FIG. 1.

FIG. 5 is a sectional view of the feeding control means taken along lines 5—5 of FIG. 7.

FIG. 6 is a top view, partially in section, of the feeding control means of FIG. 7.
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which is selectively actuable by an electromagnetic device 36. The nozzle assembly 32 comprises an airtight enclosure having six output ports 38 through which air is ejected at high velocity when the slider valve member 34 is open. Air is transmitted to the enclosure from a suitable pump (not shown) by means of a pipe 40. The fluid for the nozzle assembly is maintained at a pressure in the range of 5 to 10 p.s.i. For the embodiment shown, air at 8 p.s.i. and approximately 1½ c.f.m. has been found adequate. If desired, the vacuum force (approximately 40 inches of water) for the card feeding means and the fluid for the slider valve control means and the separating means may be generated from a fan within an enclosure along with suitable regulating means for the vacuum and fluid pressure levels. The inlet for pipe 40 is located adjacent the operating coil 42 of electromagnet 36 so that the air will provide a cooling source for the coil to prevent overheating within the enclosed chamber.

The slider valve member 34 is actuated by an extension 44 of the armature 46 of the electromagnet 36. Armature 46 is pivoted mounted at point 48, and when the electromagnet is de-energized the armature is biased by spring 50 to a position whereby arm extension 44 is to the right (FIG. 7) and the slider valve 34 is open. To close slider valve 34 so that no air is forced out of ports 38, electromagnet 36 is energized by a suitable electric signal from the control circuit 52 over lines 54. Line 56 may be coupled to a reference potential, such as ground, to complete the circuit. This action pulls the armature down into contact with the pole pieces 58 and extension arm 44 moves to the left (FIG. 7) against the bias of spring 50, thereby closing shutter valve 34 so that no air moves through ports 38. Slider valve 34 comprises an elongated flat member mounted for transverse sliding movement within a recess 60 of the nozzle assembly housing. The member 34 has six openings 61 which match with ports 38 and an additional hole 63 into which extension arm 44 is mounted. The slider valve is made of any suitable material which is light in weight so that the interia is minimized, and also a material that can be accurately machined to the desired tolerance. One suitable material is a nylon which is suitable for bearing applications and is impregnated with graphite, such as that sold under the trade name of Nylatron for example.

The drive roll 30 functions to frictionally engage the record carrier and move the card along the card path. A roll 31, which is turned by the card in the opposite direction from drive roll 30, is provided to prevent feeding of more than one card at a time. The distance between roll 31 and roll 30 is set greater than the thickness of one record card but less than the thickness of two cards. A separating means may be used as a further aid to separating the cards near the feeding end of the hopper. The separating means comprises a series of small nozzles 33 which are mounted to direct a continuous stream of air toward the edges of the cards in the hopper so that separation of the cards is facilitated. The frictional surface is provided by the outer driving portions 62 of the roll. Driving portions 62 may be made of any suitable frictional material, and a polyurethane material having a 60-65 durometer surface hardness has been found suitable for this purpose. A polyurethane material having a 90 durometer surface hardness has been found suitable for reverse roll 31.

In the embodiment shown, drive roll 30 comprises six driving portions 62, each of which spans the area covered by two rows of data hole positions. This spacing insures sufficient contact surface between the card and the roll so that the cards will not be damaged by the sudden contact of the drive roll. The stream of air from ports 38 is directed to the midpoint of driving surfaces 62, and this point is aligned with the area between two rows of data hole positions. Thus, the maximum effect of the air is realized since the air is directed to that area of the card in which no data holes are punched. Five vacuum producing areas are provided in the drive roll, and these areas are between the six driving portions 62 of the roll. The vacuum force on the roll is produced by the partial vacuum inside enclosure 14 working through the driving portions of the wheel. The vacuum areas are aligned with the portion of the record card between two lines of data hole positions. Thus, the result is that by proper choice of the vacuum level and the air pressure level in the control means, a control can be obtained whereby the feeding of the cards results from application of an electrical control pulse to electromagnet 36 which controls the slider valve.

The electrical control circuit 52 comprises means for controlling the feeding of cards in three different modes. The first mode of operation is the feeding of cards at a time in response to an external signal, such as a signal from an associated data processing system for example. A second mode of operation comprises feeding the cards continuously at a selected rate. The third mode of operation comprises feeding the cards continuously with a predetermined spacing between cards.

To feed cards selectively on a single cycle basis, there is provided an external signal, such as the signal FEED A CARD from an electronic data processing system for example. The signal is coupled through OR circuit 96 as one input of AND circuit 74. The other input from AND circuit 74 is provided by the output signal from detection circuit 78 from a single shot multivibrator 76, and this inverted output is normally up so that AND circuit 74 is conditioned. The output of AND circuit 74 is coupled to energize a single shot multivibrator 68, and the output of the single shot multivibrator 68 is coupled to a suitable driver circuit 70 to produce an electronic control pulse on line 54. The output on line 54 is coupled to energize the magnet 36 to thereby cause a card to be fed from the hopper along the card path to the utilization device. The period of single shot multivibrator 68 is chosen to set the card feeding rate since this circuit determines the time that feed magnet 36 is energized. For example, for a 4,000 cards-per-minute feeding rate, a time of 15 milliseconds is provided for each card feed cycle. This is typically utilized by choosing a period of 7 milliseconds for the period for feeding air from ports 38. The feed magnet 36 pick time is 1.5 milliseconds, and the period of single shot multivibrator 68 is chosen as 6.5 milliseconds so that air from ports 38 is cut off for this period, and a card is fed. The signal FEED A CARD is then down so that AND circuit 74 will then be deconditioned, and no further cards are fed until another signal is received. However, to prevent a second FEED A CARD signal from being acted upon before the first card has been fed, single shot multivibrator 76 is actuated through switch 86 to generate an output through inverter 78 on line 88. This output deconditions AND circuit 74 for the duration of the output of single shot multivibrator 76. It can thus be seen that the minimum time between card feed cycles is set by the period of the output of single shot multivibrator 76.

To feed cards continuously, a START line 90 is brought up on the machine by any suitable means, such as a pushbutton switch 92 for example. This output provides one input to AND circuit 80. The output of AND circuit 82 is coupled through inverter 84 to the other input of AND circuit 80. Thus, when the START signal is present and OR circuit 94 is not conditioned, AND circuit 80 is conditioned so that an output is coupled through OR circuit 86 to condition AND circuit 74. The operation is then similar to that described above for single cycle operation with the exception that the card feeding operation will be continuous. This occurs because AND circuit 80 remains continuously conditioned as soon as the output from single shot multivibrator 76 goes down after feeding the previous card so long as AND circuit 80 remains conditioned. An output from a STOP control 98, such as a pushbutton switch or an output from jam detection device 100, energizes OR circuit 94 and thereby deconditions AND circuits 74, 80, 82.
In some instances it may be desirable to feed cards with constant spacing between the cards. The first card is fed as stated above; however, switch 86 which connects the output of single shot multivibrator 68 to the input of single shot multivibrator 76 is moved to the dotted position (FIG. 2). Switch 86 is a double pole switch which in the embodiment shown comprises a control panel switch controlled by the machine operator. A sensing means 102, such as a solar cell and light, is provided to sense the trailing edge of the first card, and this output is amplified in amplifier 104 and coupled by line 87 to the input of single shot multivibrator 76. The output duration of single shot multivibrator 76 is set so that the desired spacing between cards is achieved, and this output is coupled to condition AND circuit 74 so that another feed cycle is initiated. Thus, it can be seen that the cards are fed continuously with the intercard spacing determined by the period of single shot multivibrator 76. To stop the feeding of the cards, a STOP signal generates a signal through OR circuit 94 as before to decondition AND circuits 74, 80, 82 and prevents the feeding of additional cards.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that the foregoing and other changes in the form and details of the invention may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A record card feeding means for feeding record cards from a hopper, comprising:
a feeding means disposed adjacent a record card in said hopper;
means for producing a vacuum force on the periphery of said feeding means adjacent said record card;
means for directing a high velocity stream of fluid to create a fluid bearing adjacent to said feeding means for overcoming said vacuum force; and
means for producing a vacuum force on the periphery of said feeding means adjacent said record card;
means for directing a high velocity stream of fluid to create a fluid bearing adjacent to said feeding means for overcoming said vacuum force; and

2. A record card feeding means for feeding record cards from a hopper, comprising:
a feeding means disposed adjacent a record card in said hopper;
means for producing a vacuum force on the periphery of said feeding means adjacent a first predetermined portion of said record card;
means for directing a high velocity stream of fluid to a second predetermined portion of said record card to create a fluid bearing adjacent to said feeding means for overcoming said vacuum force; and
means for selectively interrupting said high velocity fluid stream so that said vacuum means pulls said record card to said feeding means to feed said record card.

3. A record card feeding means for feeding record cards from a hopper, comprising:
a rotatable feeding means having a frictional surface disposed adjacent a record card in said hopper;
means for producing a vacuum force on the periphery of said feeding means adjacent said record card;
means for directing a high velocity stream of fluid to a predetermined portion of said record card to create a fluid bearing adjacent to said feeding means for overcoming said vacuum force;
means for selectively interrupting said high velocity fluid stream so that said vacuum means pulls said record card to said frictional surface of said feeding means to feed said record card.

4. A record card feeding means for feeding record cards from a hopper, comprising:
a rotatable feeding means having a frictional surface disposed adjacent a record card in said hopper;
means for producing a vacuum force on the periphery of said feeding means adjacent said record card;
means for directing a high velocity stream of fluid to create a fluid bearing adjacent to said feeding means for overcoming said vacuum force; and
means for selectively interrupting said high velocity fluid stream so that said vacuum means pulls said record card to said feeding means to feed said record card.
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Card exit portion of said hopper means tends to be moved into contact with said feeding means responsive to said vacuum force; means for directing a high velocity stream of fluid between said record card and said feeding means in said card exit portion of said hopper means to create a fluid bearing adjacent to said feeding means for overcoming said vacuum force; and means for selectively interrupting said high velocity fluid stream so that said vacuum means pulls said record card to said feeding means to feed said record card.

A record card feeding means for feeding record cards from a hopper, comprising:
- Hopper means having a record card exit portion;
- A rotatable feeding means disposed adjacent a record card exit portion of said hopper;
- Means for producing a substantially airtight enclosure about said feeding means;
- Means for producing a vacuum in said enclosure, said vacuum force operable through said card exit portion of said hopper means to pull said record card toward said feeding means;
- Means for directing a high velocity stream of fluid between said record card and said feeding means to create a fluid bearing adjacent to said feeding means for overcoming said vacuum force; and
- Means for selectively interrupting said high velocity fluid stream so that said vacuum means pulls said record card to said feeding means to feed said record card.

A record card guiding means positioned to keep said record card in contact with said frictional surface of said feeding means whereby the record card is fed along a predetermined card path.

11. A record card feeding means for feeding record cards from a hopper, comprising:
- Hopper means comprising a record card exit portion;
- A rotatable feeding means having a frictional surface disposed adjacent a record card in said hopper;
- A substantially airtight enclosure about said feeding means;
- Means for producing a vacuum force within said enclosure, said vacuum force operable through predetermined portions of said feeding means adjacent said record card exit portion of said hopper means to pull said record cards toward said feeding means;
- Means for directing a plurality of high velocity streams of fluid between said record card and said feeding means in said record card exit portion of said hopper means to pull said record card into close proximity to said feeding means and to create a fluid bearing adjacent to said feeding means for overcoming said vacuum force;
- Electically operated valve means for selectively interrupting said plurality of high velocity fluid streams so that said vacuum means pulls said record card to said frictional surface of said feeding means to feed said record card from said hopper means; and
- Card guiding means positioned to keep said record card in contact with said frictional surface of said feeding means whereby the record card is fed along a predetermined card path.

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