July 4, 1961 F. SALTZ ET AL 2,991,074

CARD FEEDING MACHINE

Filed June 18, 1959 2 Sheets-Sheet 1

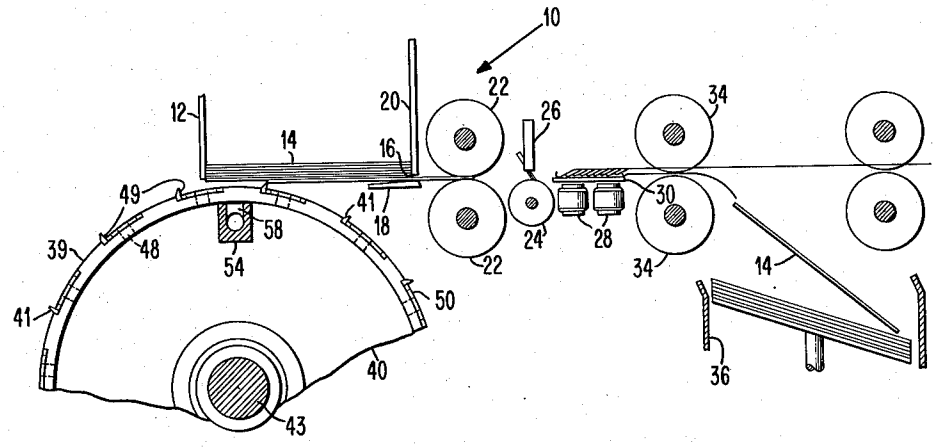


FIG. 1

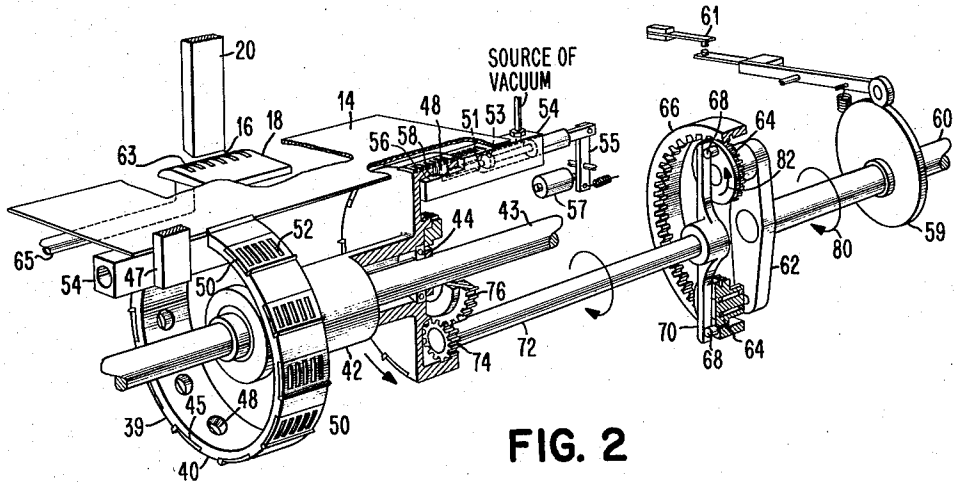


FIG. 2

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CARD FEEDING MACHINE

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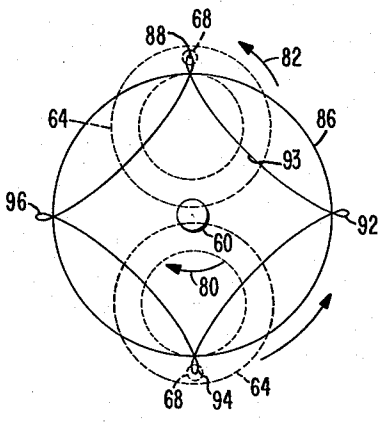


FIG. 3

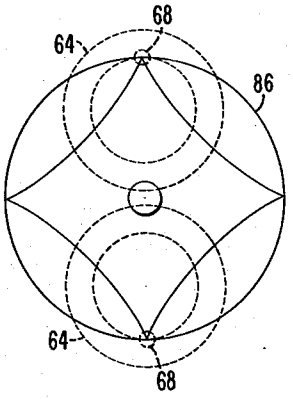


FIG. 4

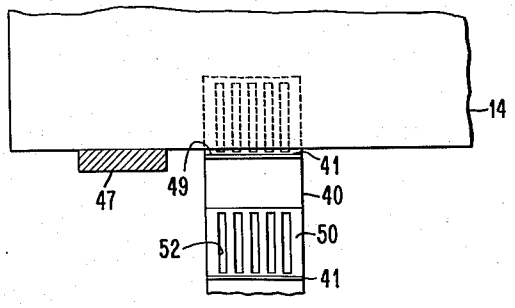


FIG. 5

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CARD FEEDING MACHINE

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This invention relates to high speed card feeding systems for business machines, and in particular, to a variable speed, unidirectional drum type picker knife feed mechanism for feeding cards at high or low speeds in sorting, collating, punching or other like business machines.

In prior card feed systems for business machines, for example, a sorter, cards are stacked in a container known as a hopper and singly removed by a reciprocating picker arm. The cards then singly pass through a throating device into a set of feed rolls in a card transport section. Additional feed rolls then transport the cards throughout the machine for sorting purposes where the cards may then be deposited in selected pockets.

For purposes of this invention, reference to picker knife or picker knives is intended to cover either a single picker knife or a mechanism having spaced picker knives capable of engaging the card at substantially the same time.

This invention has particular application to the mechanism for feeding cards. Now, there are various types of card feeding devices for feeding cards from a hopper into a card transport section. For example, there is the straight line oscillating picker knife which moves to and fro in a straight line as it picks cards from a hopper to deliver them through the throat into the first feed rolls. Then there is the oscillating arc type picker which is an oscillating pivotable picker arm which picks the card from the hopper and moves its trailing edge in the path of an arc which most closely follows the warp of the card. Another type picking arrangement is a drum with picker knives on its periphery which rotates at continuous velocity and relies on the picker knives to pick the cards. Another type drum is the vacuum drum which rotates at a continuous velocity and relies on the suction generated by the vacuum on the card to pick it and pass it into the feed rolls for delivery to the transport section.

Now, in the straight line oscillatable type picker knife and the arc picker type, the picker knife starts at zero velocity and accelerates to maximum velocity to accelerate the card to a speed which is substantially equal to the speed of the first feed rolls. After the card is passed into the first feed rolls, the picker knife, which is generally actuated by a cam, decelerates to zero velocity and then completely retracts to its original position to pick the next card. The time that the picker knife reciprocates back to pick the next card is actually lost time to the machine. In addition, this creates additional acceleration forces which the machine must be built to withstand.

The drum type picker is provided with picker knives and rotates at a continuous velocity. This type of picker knife arrangement is very limited in that it must operate at relatively low speeds, say 100 cards per minute. However, when operating at high speeds, the acceleration or impulse forces on the card are of such a magnitude as to cause card damage to the marginal edges which is unacceptable in high speed card feeding systems.

The drum type feed, where vacuum is applied as the means for pulling the card down to the drum periphery and for driving it through the throat into the first feed rolls, has certain shortcomings. For example, in such vacuum systems, the card cannot be aligned properly so as to be used in such machines as a sorter, collator or punch. These machines require accurate positioning and

alignment of the card at all times. An alignment means would be required in addition to location means to locate the card at various points in the system. Furthermore, these vacuum drums do not have a picker knife in addition to the vacuum for feeding the cards, relying solely on the vacuum for picking and feeding. Although this arrangement is of the unidirectional type in that there is no reversal of direction of rotation of the drum, it is rotated at a constant velocity and is limited to those types of arrangements where speed, accuracy and positioning are not a requirement of the device.

Now, it is known to use vacuum in arc pickers as well as applying vacuum at the throat. Also, it is known to apply vacuum at the base of the picking surface so as to pass over the picker knives. This helps to insure positive alignment since the vacuum pulls the card down to the base of the picker knife. The vacuum at the throat also serves to retard the movement of the card forward so that it is accurately positioned on the picker knives. It has been found that very accurate alignment of the trailing edge of the card with respect to the picker knives is necessary in order to feed at high speeds. This alignment minimizes card damage due to the picker knives striking uniformly along the marginal edges of the card as opposed to point contact. However, in the oscillating arc picker knife type of system, where the vacuum is used, a certain amount of lost time is inherent in the device on the return stroke.

It is therefore a general object of this invention to provide a picker knife mechanism which has substantial unidirectional motion but with a speed change from zero velocity to card transport velocity and return to zero velocity.

It is another object of this invention to provide a picker knife mechanism capable of operating at high speeds in a substantially unidirectional motion, yet providing a low level of velocity for engaging the card, and increasing the velocity to substantially match the card transport velocity, and thereafter reduce the picking mechanism to zero velocity, and giving the drum a slight reverse movement in the opposite direction to align the next card just prior to card engagement by the picker knives.

Briefly stated and in accordance with one aspect of this invention, a unidirectional moving drum is provided containing picker knives about its periphery, and incorporating a vacuum for pulling the card down to the base of the picker knife so that the picker knife can control card movement, and a drive system which introduces intermittent variable speed rotational motion to the drum which may include a slight reversal of direction of the drum just prior to engaging the next card.

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

In the drawings:

FIG. 1 is a schematic view showing the vacuum drum in combination with a business machine.

FIG. 2 is a view partially in broken section to show the intermittent motion drive for the drum and the manner in which the vacuum is applied to the card.

FIG. 3 shows a hypercycloid curve of the path of a pin for giving slight reverse movement of the drum.

FIG. 4 shows another hypercycloid curve of the path of a pin without providing for a slight reversal in movement of the drum.

FIG. 5 is a plan view showing the card being aligned to the hopper posts prior to engagement by the picker knives.

Referring to FIG. 1, a sorter, collator or punch is generally designated by the numeral **10**. Although the invention is shown in combination with a sorter, it is recog-

nized that the feed mechanism can also be used in connection with a collator or a punch. The general construction of the sorter is a common one in which a hopper **12** is provided which contains cards **14** to be sorted. Cards are generally fed through a throating device **16** defined by a throat block **18** (FIG. 2) and throat knife **20**. The cards then pass through first feed rolls **22** and then onto contact roll **24** where sensing brushes **26** are provided which sense openings in the card by making contact with the contact roll **24** to provide an impulse. When this happens the magnets **28** are impulsed which actuate an armature **30** for actuating the appropriate chute blade that corresponds to the opening in the card that was sensed by the brushes. The operation of the chute blade by the magnet is such as to pull it down into the path of the card that was sensed so as to pass through feed rolls **34** and thence into a selected pocket **36**. For purposes of describing this invention, only one pocket is shown. However, it is known that in sorters as many pockets as are necessary to sort the cards are generally provided. In order to pick the cards from the hopper and feed them into the first feed rolls, a pair of drums **40** are provided with each having a plurality of picker knives **41** equally spaced about their periphery, the distance between the picker knives being sufficient to accommodate a business record card. The drums each have a rim **39**, which carries the picker knives, and are interconnected by integral shafting **42**. The drums are rotatably mounted on a shaft **43** which is journaled in bearings **44**. To form a seat for each picker knife, the rim or periphery of the drum is hollowed out so as to provide a recess **45** extending substantially across the outer periphery of the rim. Connected with each recess is a vacuum port or opening **48** positioned under the rim. The trailing edge of the port **48** is in line with the face **49** of picker knife **41**. Supported on the drum and covering each of these recesses is a plate **50** containing slots **52** and the picker knives **41**.

In order to provide vacuum to the slots **52**, a manifold **54** is provided which is connected to a source of vacuum not shown. There is a manifold **54** for each drum, each connected to a source of vacuum. Each manifold is provided with a recess **56** which contains an opening **58** connected to the vacuum in the manifold **54**.

Therefore, it is readily apparent that as the drum passes the openings **58**, vacuum will be supplied to the opening **48** and into the recess **45** so as to provide a source of vacuum to the slots **52**. A valving arrangement is provided to supply vacuum substantially instantaneously to the ports **58**, **48** and slots **52**. The valving arrangement includes a valve seat **51** and valve **53** pivotally connected to an armature **55**. A magnet **57** is provided to actuate the armature **55** and valve **53** when it receives a pulse. The pulse is timed to open the valve at the appropriate time. There are various ways in which this timing can be provided. It is preferred to use a cam **59** mounted on continuously rotating input shaft **60**. The cam **59** actuates a circuit breaker **61** to close and open the circuit for impulsing the magnet **57** at the appropriate time.

Vacuum ports **63** connected to a conduit **65** are provided in the throat block **18** to pull the card down at the throat. This vacuum can be on at all times since the card being delivered will mask off the second card to the vacuum at the throat. It is preferred in this embodiment of the invention to provide hopper posts **47** (FIG. 5), one adjacent each drum, to provide an abutment means which is in accurate alignment with the picker knives. Therefore, when a card is first deposited against the hopper posts prior to picking by the picker knives it will be in accurate alignment with the picker knives. This alignment is important in high speed card feeds.

In order to accelerate the drums so as to accelerate the cards to the speed of the first feed rolls and then to decelerate the drums so that the next picker knives can pick the card after the drum has returned to zero velocity, a preferred intermittent or index motion drive system is provided in the form of a planetary gear system. A main drive shaft is shown at **60**. The shaft **60** is continuously rotating and carries with it an arm **62**. The arm **62** rotatably supports a pair of continuously driven planet gears **64**. The continuously driven planet gears operate in a fixed annular gear **66**. Located at about the gear pitch line of the planet gears is a driving pin **68**. Each continuously driven planet gear **64** contains such a pin. The pins **68** alternately drive the follower arms **70** which are supported on the output shaft **72**. The output shaft **72** is provided with a gear **74** which is in meshed engagement with a gear **76** directly connected to the drum carrying the picker knives.

For purposes of this invention, nonuniform motion is intended to cover motion having a changing speed, and uniform motion is intended to cover motion having a constant speed.

When the input drive shaft **60** is turning continuously its motion is transmitted to the driven planet gears **64** so as to drive them continuously, which in turn carry the pins **68**. The pins **68** have a compound motion in that they rotate about the center of the planet gear itself and also about the annular gear center. Therefore, the motion is such that they follow a hypercycloid motion. As the shaft **60** rotates in the direction indicated at **80**, the planet gears rotate in the direction indicated at **82**. Pins **68** will alternately drive the follower arms **70**. The pins drive the follower arms when the pins, rotating about the planet center lines, move toward the follower arms. One of the pins is always driving the follower arms while the other pin is moving away from the follower arms. The motion that the pins have are, therefore, imparted to the follower arms. The hypercycloid motion of these pins, as they proceed around the shaft **60**, results in nonuniform motion; and in addition, they act at varying radial distances from the center of the follower arms. As a consequence, the motion of the output follower arms **70** is an intermittent angular rotational motion.

Movement of the drum is a function of the movement of the pin. By determining the desired motion of the drum, the pin location and gear proportions can be selected to give this predetermined motion. Therefore, the drum will impart this motion to the card.

Reference is made to FIG. 3 which shows the hypercloid motion of each pin **68**. The pitch line of the fixed annular gear **66** and the planet **64** is represented by the common pitch line **86**. In order to slightly reverse the direction of motion of the drum so that the vacuum can pull the card backward against the hopper posts to accurately align the card prior to engagement by the picker knives, the pin **68** is positioned slightly outside the pitch line **86**. This is accomplished by making the disc for the planet **64** larger than the pitch line of the gear teeth. Therefore, the hypercycloid motion of the pin will take the path starting at position **88**. The loops will enable slight reversal of motion of the pins **68**, and therefore, the follower arms **70** and drums **40** will be slightly reversed.

Reference is made to FIG. 4 which shows another hypercycloid motion of the pins **68**. In this embodiment, the pins **68** are on the common pitch line **86**. The path taken by the pin will not provide for rearward movement of the drum **40**. There will be complete unidirectional motion of the drum as compared with the substantial unidirectional motion where the drum makes a slight reversal of direction for card alignment purposes.

Referring again to FIG. 3, the pin **68** and follower arms **70** (the motion of which represents the motion of the drum and card) first reach zero velocity shortly after the pin has crossed the common pitch line **86**. At position **88** the pin is motionless even though the planet gears **64** are rotating at continuous velocity, but the velocity transmitted by the pins **68** to the follower arms is zero.

At this point the port **48** is aligned with port **58**. The cam **59** is designed to close contacts **61** to pulse the magnet **57** to open the valve to permit vacuum to be applied to the slots **52** through the ports **48, 58**.

Now, since the pins **68** are outside the pitch line **86**, the path of the pins will reverse direction. Therefore, the drum will slightly reverse its direction of motion. The vacuum acting on the card will tend to pull it backward against the hopper posts **47** (FIG. 5) to align it with the picker knives **41**. At this point the picker knives are slightly behind the hopper posts. When the upper pin leaves the position **88**, the pin reverses its direction again relative to the follower arms (not relative to the pinion center line) to provided substantial unidirectional motion. As the upper pin **68** moves toward the position at **92**, the follower arms will be driven by the lower pin **68** to accelerate the drum. When the upper pin reaches point **93** (change in direction of acceleration), the drum will be at its maximum velocity since the pin **68** and follower arms **70** are at their maximum velocity. At this point the speed of the card matches the speed of the first feed rolls, and the card can be transferred to the feed rolls. Also, the cam **59** is designed to open the contacts at **61** to de-energize the magnet to close the valve **53** and shut off the vacuum.

Now, as the upper pin moves from point **93** to point **92**, the follower arms **70** have a braking motion so as to decelerate, as well as drum **40**, to zero velocity. During this time the lower pin **68** is approaching point **96**. During the reversal in direction of motion of the follower arms **70** and drum **40**, the accelerations are transferred from one pin to the other. In other words, when a pin moves toward the follower arms it drives the follower arms, and when a pin moves away from the follower arms it is not driving the follower arms.

It is preferred that the pins **68** be mounted to be in engagement with the follower arms **70** at all times. This can be done by slightly pretensioning or preloading the pins against the follower arms.

The preferred planetary gear system described has an advantage over a cam type drive system for use in this invention since a cam and follower system, without additional clutching means, is not a unidirectional driving device.

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

What is claimed is:

1. A card feed for use in business machines comprising at least one drum having a rim, a hopper containing cards to be fed, a plurality of picker knives equally spaced on the periphery of the rim, vacuum slots positioned adjacent each picker knife, vacuum ports positioned underneath the rim each connected to the vacuum slots and in line with each picker knife, a manifold provided with an opening to provide vacuum to the ports when they are in alignment, means for driving the drum unidirectionally from zero velocity to a maximum velocity, the means comprising a continuously rotating input shaft, gear means for changing this input from the input shaft to an output having an intermittent rotational motion for driving the drum, the output motion of the gear means being at zero velocity just prior to the port aligning with the manifold port so that the picker knife will strike each card at the minimum velocity.

2. A card feed for use in business machines comprising, a hopper containing cards to be fed, a drum, a rim on the drum, a plurality of picker knives on the rim for picking the cards, vacuum slots adjacent each picker knife to pull the card down on the rim and to the picker knives, a vacuum port under the rim in alignment with each picker knife, a manifold provided with an opening to provide vacuum to the port when the opening and port are in alignment, drive means for driving the drum nonuniformly and unidirectionally, the drive means including a constantly rotating input means and nonuniform output means, the nonuniform output means being connected to the drum so that the motion of the drum is a function of the output means whereby a card will be picked from the hopper while suction is applied at each port and when the drum is at substantially zero velocity.

3. A card feed for use in business machines comprising a hopper containing cards, a drum, picker knives mounted about the periphery of the drum for singly picking the cards, a source of vacuum, vacuum slots exposed to the source of vacuum and positioned adjacent each picker knife, a hopper post, the drum being substantially unidirectional in motion, nonuniform motion drive means for driving the drum from zero velocity to a maximum velocity, the drive means containing a reversing means for slightly reversing the motion of the drum before each picker knife engages a card, the hopper post being slightly ahead of the picker knife when the drum is completely reversed by the reversing means so that the vacuum applied to the card will pull the card against the hopper posts to align it to each picker knife just prior to the card being delivered from the hopper.

4. A card feed for use in feeding record keeping business cards comprising a hopper containing cards, a drum, a rim on the drum, picker knives mounted about the outer periphery of the rim, vacuum slots positioned in the outer periphery of the rim adjacent each picker knife, the drum being substantially unidirectional with a slight reversal in direction as each following picker knife approaches to pick the next card, nonuniform motion output drive means for driving the drum from zero velocity to maximum velocity and return to zero velocity with a slight reversal in direction of motion, constant rotation input drive means for driving the output drive means, vacuum source means, valve means connected to the input drive means to open and cut off the vacuum source means to the vacuum slots, the valve means and nonuniform drive means being responsive to the input drive means to expose the cards to the vacuum during the acceleration and reversal portion of the cycle.

5. A card feed for use in feeding cards in business machines, a hopper containing the cards, a drum, picker knives positioned about the periphery of the drum, vacuum slots positioned adjacent each picker knife, vacuum source means, valve means for controlling the supply of vacuum to the slots, aligning hopper posts, nonuniform drive means for driving the drum to enable each picker knife to successively pick a card, the valve means being connected to the drive means to selectively operate the valve means, the valve means being operative to permit vacuum to be applied to the card to deposit the card against the aligning hopper posts to align the card to the picker knives just prior to when the nonuniform drive means operates the drum to pick the next card.

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