March 31, 1964 L. I. KRAMER 3,127,168

SHEET FEEDING APPARATUS

Filed Aug. 24, 1960 4 Sheets-Sheet 1

FIG-1

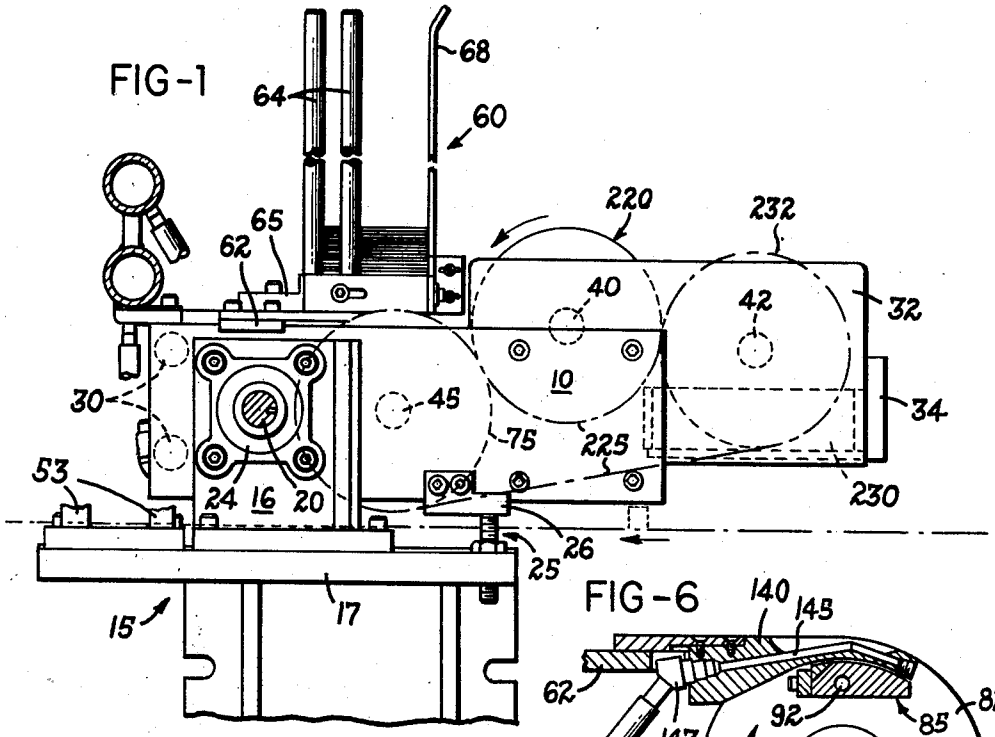


FIG-6

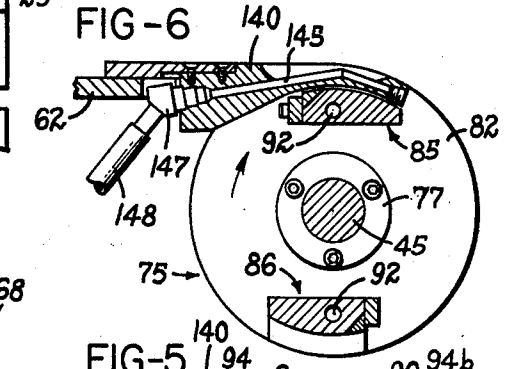


FIG-3

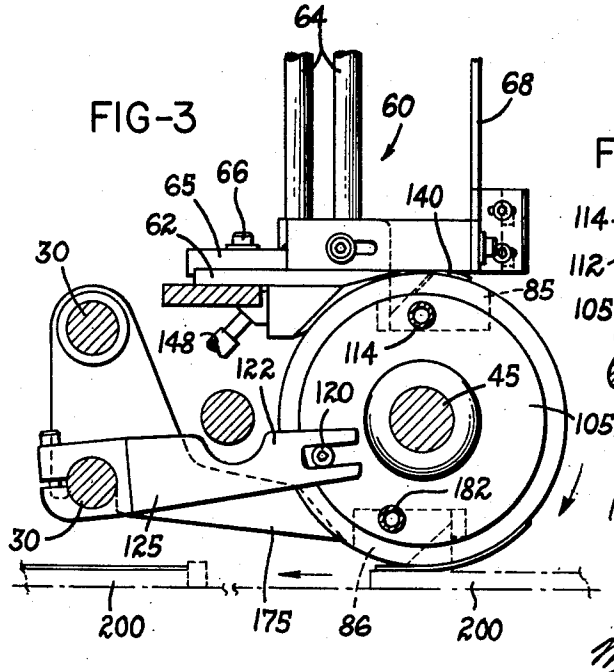
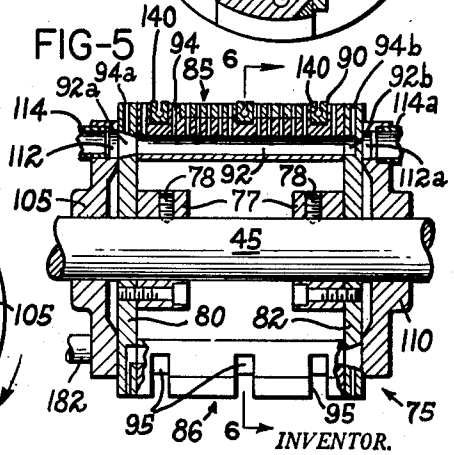


FIG-5



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SHEET FEEDING APPARATUS

Filed Aug. 24, 1960 4 Sheets-Sheet 2

FIG-2

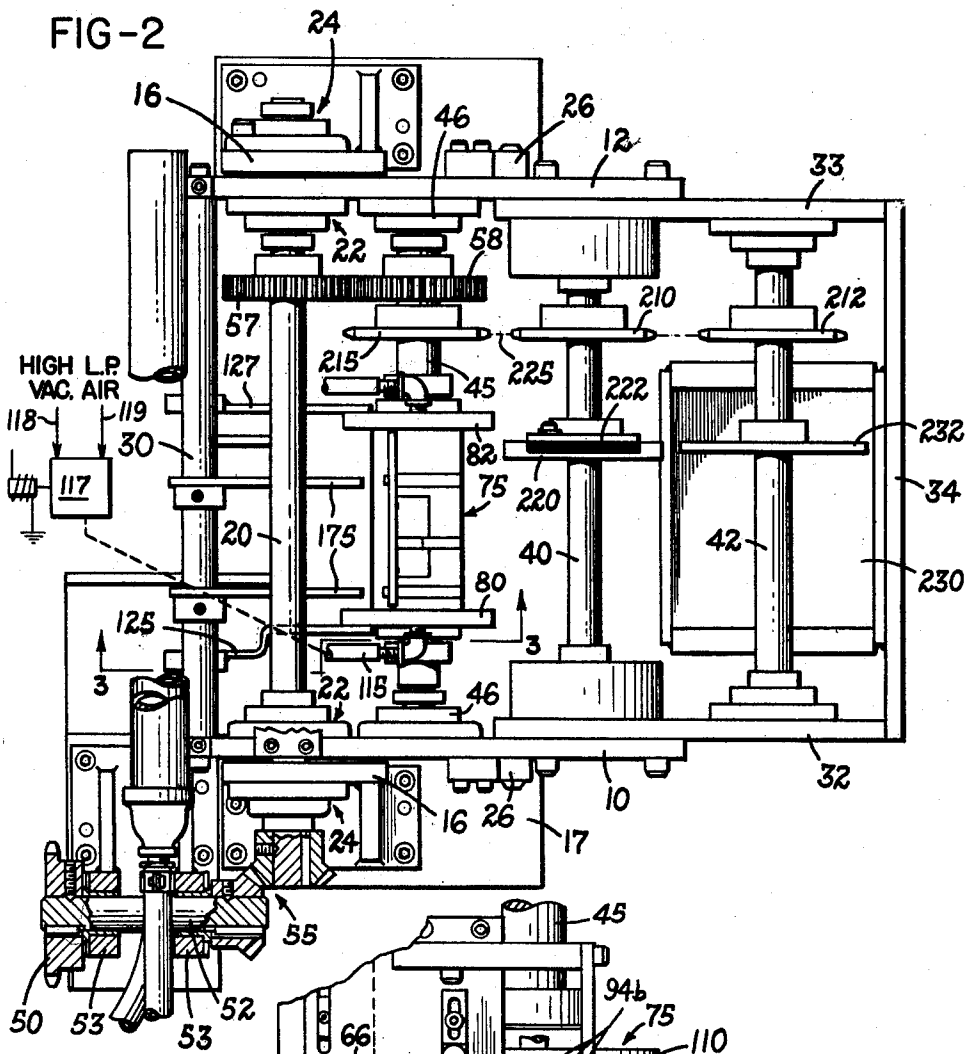


FIG-4

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SHEET FEEDING APPARATUS

Filed Aug. 24, 1960 4 Sheets-Sheet 3

FIG-9

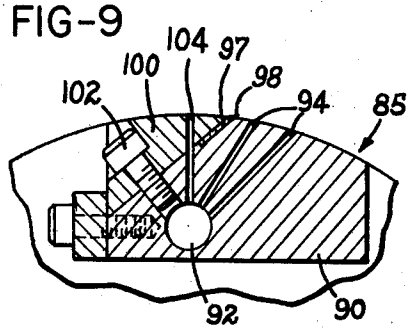


FIG-8

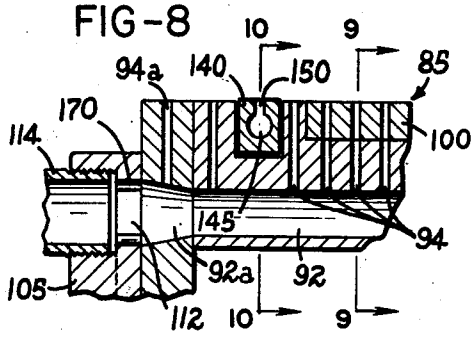


FIG-10

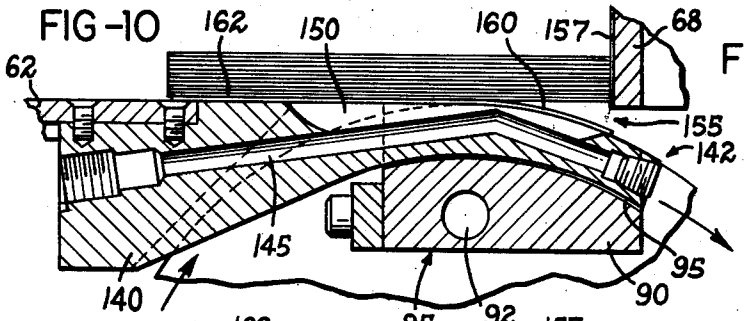


FIG-7

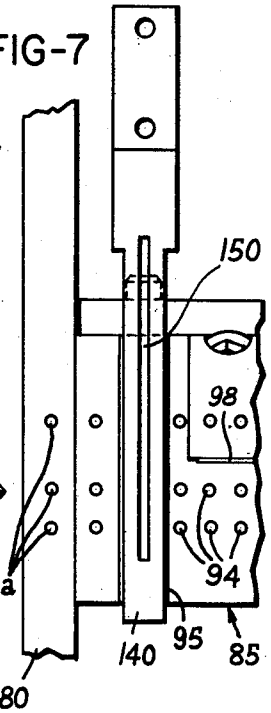


FIG-11

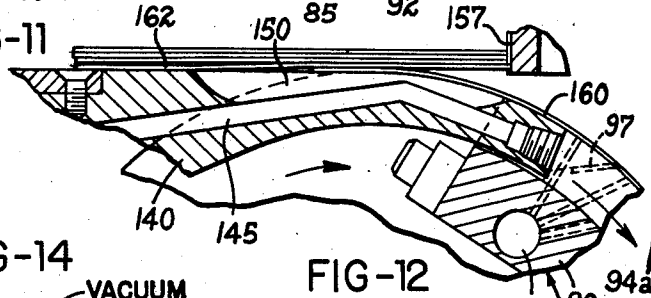


FIG-14

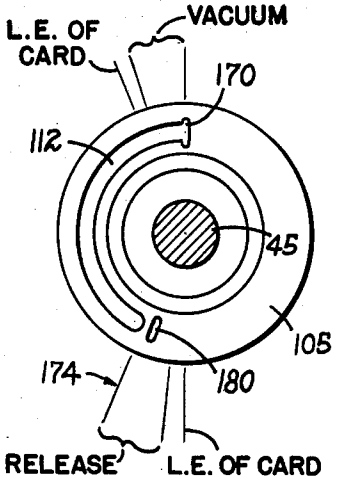


FIG-12

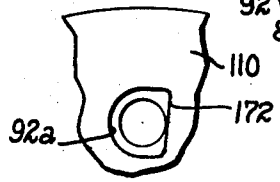
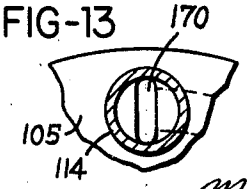


FIG-13



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SHEET FEEDING APPARATUS

Filed Aug. 24, 1960 4 Sheets-Sheet 4

FIG-15

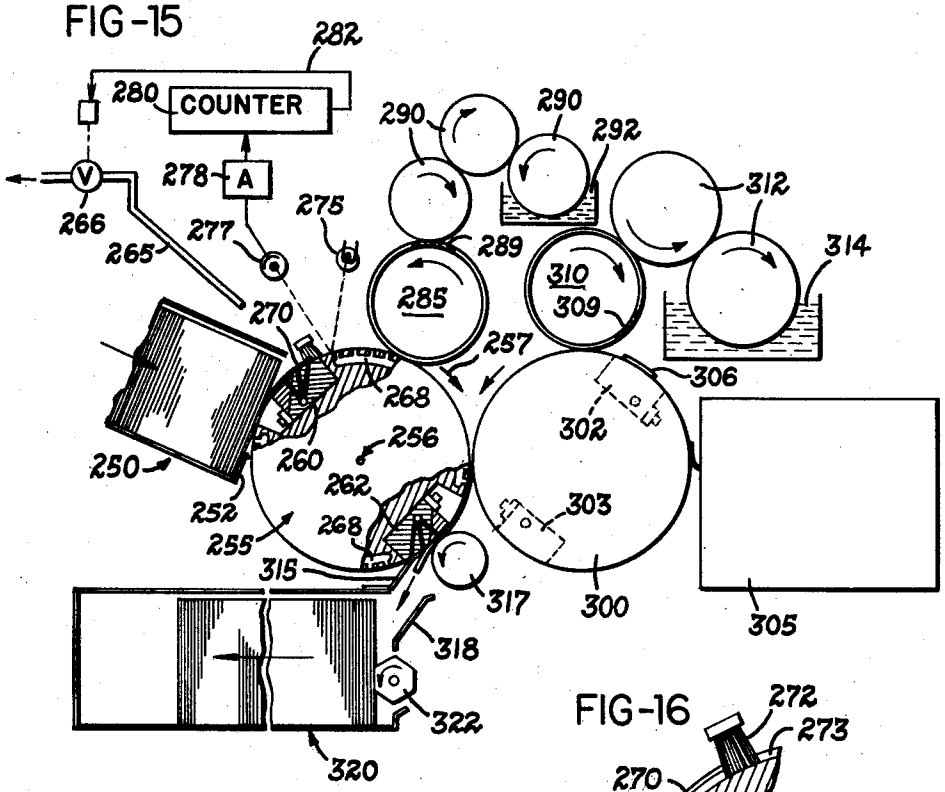
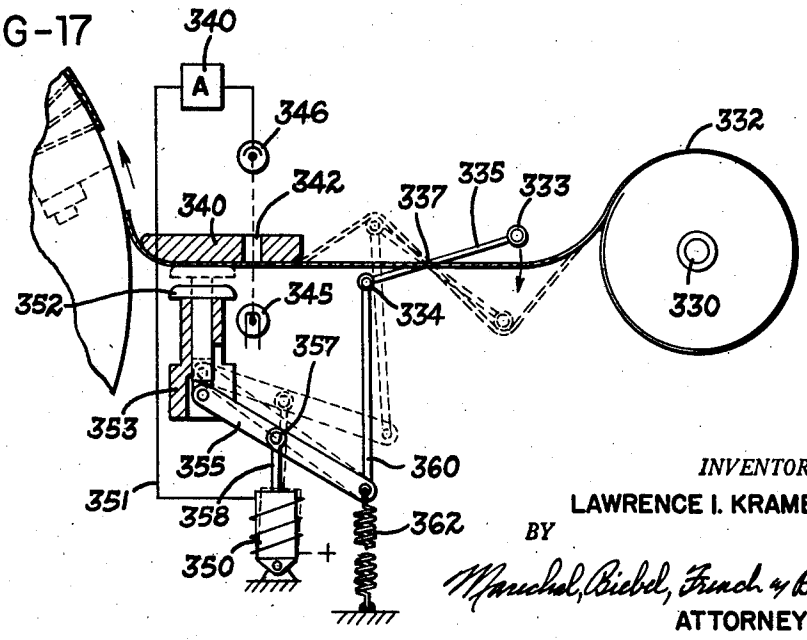


FIG-16

FIG-17



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United States Patent Office 3,127,168
Patented Mar. 31, 1964

3,127,168

SHEET FEEDING APPARATUS

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Filed Aug. 24, 1960, Ser. No. 51,726
11 Claims. (Cl. 271—29)

This invention relates to sheet feeding apparatus, particularly in connection with feeding cards, labels, and similar flexible sheet material.

The present invention is particularly useful in feeding cards and the like singly from a stack or pile thereof at substantially high rates, for example from 30,000 per hour to in excess of 100,000 per hour. When operating at such speeds the feeding apparatus must be capable of positive handling of each card, and also of separating a single card or sheet from a stack or pile of cards without upsetting the feeding function. Thus, in order to provide positive removal from the stack at high speeds it is desirable to move the leading edge of the card being removed from the stack into a deflected position where it can be readily engaged with a moving pickup head. Furthermore, to avoid disturbing the stack or pile as a single card is removed, it is desirable to control the tail or trailing edge of each card to prevent the tail from flicking other cards in the stack in such a way as might disturb the continuity of feeding.

Therefore, the primary object of this invention is to provide a novel high speed sheet feeding apparatus.

Another object of this invention is to provide novel apparatus for accurate high speed counting of cards, labels, small booklets and pamphlets, and like materials, preferably in combination with apparatus for segregating each counted batch from a stack of such material of undetermined quantity.

Another object of this invention is to provide a unique means for intermittent counting, program counting, predetermined counting, and differentially counted batches of card or sheet material to be separated at exceptionally high speeds, by providing for substantially instantaneous stopping of the feeding of such material without changing the speed of any moving part of the device.

Another object of this invention is to provide such a device in which the "on-feed" and "off-feed" can be entirely controlled by changing a source of pressure, negative or positive, to a rotating gripper head.

A further object of the invention is to provide novel apparatus for feeding sheets of material, small booklets and pamphlets, and the like, including a hopper or similar receiver for holding a stack of separate pieces of such material together with apparatus for deflecting one piece of the material at an open end of the hopper into position such that the leading edge of the segregated pieces before it is actually removed from the hopper is positioned away from the remainder of the stack and in readiness to be engaged by a gripping device moving at relatively high speed for carrying the deflected piece to a predetermined removed position.

Another object of the invention is to provide sheet feeding apparatus including a hopper or similar receiver for holding a stack of cards or sheets to be fed, together with stationary grippers or positioning fingers extending across an open end of the hopper in a position such that the leading edge of the card, before it is actually moved in translation from the hopper, is deflected away from the remainder of the cards in the hopper.

A further object of the invention is to provide in combination with the above mentioned stationary fingers or grippers a gripping head which is moved cyclically past the stationary grippers and operated in timed relation to engage a single deflected card and to move such card away from the hopper.

A further object of this invention is to provide such feeding apparatus wherein the stationary gripper and the gripping device on the pickup head operate by engaging with a surface of each single card being fed and applying a vacuum or negative pressure thereto to clamp the card to the gripping surface.

Another object of this invention is to provide a novel moving gripper device for engaging sheet material, including a vacuum gripper in combination with a knife edge, and so arranged that the vacuum gripping action engages a card or sheet with the knife edge and the two cooperate to retain the sheet positively and precisely to the moving gripper while the sheet is accelerated and moved at relatively high speeds.

Another object of this invention is to provide sheet feeding apparatus wherein the sheets are fed from a stack to a drum carrying a pickup head with grippers for retaining the leading edge of the sheet, in combination with a further gripping or positioning device which controls the tail of the moving sheet to avoid flicking the sheets in the stack as the tail of the single sheet being fed passes out from beneath the stack.

A further object of the invention is to provide apparatus for separating, delivering, and counting if necessary, units such as cards, labels, stamps, etc., formed initially as a continuous strip which may be divided into such individual units, wherein the apparatus segregates the individual units from the strip, delivers them to a predetermined position, and if required counts the units so delivered and may discontinue the segregation and delivery operation after a predetermined count if such function is required or desired.

Another object of the invention is to provide a novel hopper arrangement in connection with a sheet feeding apparatus as above mentioned, including a stationary knife edge which engages the leading edges of cards or sheets stacked in the hopper, and operates in conjunction with the stationary support or positioning arms and grippers to retain the leading edges raised within the hopper, with the exception of the card or sheet about to be engaged by the moving grippers.

An additional object of the invention is to provide for a positive or pressured release of the cards or sheets from the moving grippers, as by applying air under pressure to these grippers when they pass a predetermined discharge station.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings:

FIG. 1 is a side elevational view of the novel sheet or card feeding apparatus provided by the invention;

FIG. 2 is a top plan view of the apparatus;

FIG. 3 is an enlarged detail view showing the bottom of the feeding hopper and the rotary gripper drum positioned therebeneath;

FIG. 4 is a detail view looking down upon the drum through the hopper structure;

FIG. 5 is a vertical section taken axially through the rotary gripper drum;

FIG. 6 is a sectional view taken on line 6—6 of FIG. 5;

FIG. 7 is an enlarged plan view of a segment of the drum showing the cooperation between the drum and the supporting fingers at the bottom of the hopper;

FIG. 8 is a detail section taken along the same plane as FIG. 5, but on a larger scale;

FIG. 9 is a section taken on line 9—9 of FIG. 8;

FIG. 10 is a sectional view taken generally along line 10—10 of FIG. 8, and also including a portion of the hopper structure above the drum;

FIG. 11 is a view similar to FIG. 10 with the parts in an advanced or moved position to illustrate the valving

action of the successively fed sheets or cards over the stationary fingers;

FIGS. 12 and 13 are detail views of the rotary valving for controlling the vacuum connections to the gripper heads on the drum;

FIG. 14 is a diagram of the rotary valving action;

FIG. 15 is a somewhat schematic diagram of a modified type of feeding apparatus provided by the invention, including a counter for counting the units, such as cards, fed from a stack and capable of predetermining the number of labels or cards segregated if so desired; the modified apparatus also includes means for separating interconnected units such as stamps from a roll or strip thereof and feeding them separately, preferably in timed relation with the card or label feeder, for assembly thereof at a predetermined position;

FIG. 16 is a detail view of the indexing brush shown in FIG. 15; and

FIG. 17 is a somewhat diagrammatic view on a larger scale showing the apparatus for feeding out a continuous strip of separate labels or pieces, such as a roll of stamps, and providing for separation of the individual pieces and feeding thereof from the strip.

Referring to the drawings, and particularly to FIGS. 1 and 2, the apparatus is mounted upon a frame including main side members **10** and **12** which are supported upon mountings **15** through mounting brackets **16** which are in turn bolted to support plates **17**. A main supporting and drive shaft **20** extends transversely between the side plates **10** and **12**, through suitable bearings **22**, and beyond these bearings into suitable stationary mounted bearings **24** which are secured upon the brackets **16**. In this manner, the framework for the entire apparatus is pivotally mounted about the axis of the shaft **20**, and may be adjusted about this axis by the set screw and lock nut arrangement **25** which engages a lug **26** on each side of the frame, fixed to the plates **10** and **12**, respectively.

At one end, to the left in FIGS. 1 and 2, the side plates **10** and **12** are interconnected through cross rods **30**, and at the other end these plates are connected by means of a U-shaped member including side pieces **32** and **33** which are bolted respectively to the side plates **10** and **12**, and an end piece **34** which is suitably secured across the ends of the side pieces **32** and **33**. This U-shaped member, in conjunction with the shafts **40** and **42** rotatably supported therewithin, provides a mounting for a gluing attachment which may optionally be employed with the feeding apparatus, as will be described in detail further on.

Adjacent and parallel to the input drive shaft **20** is a drum mounting and drive shaft **45** which extends across the framework between the side plates, and is mounted at its opposite ends in bearings **46**. The rotary drive for the feeding mechanism is provided through a suitable input socket **50** or the like secured to a right angle jack shaft **52** which is rotatably mounted in bearings **53** to one side of the main framework, and which drives the main input shaft **20** through beveled gearing **55**. In turn, shaft **20** carries a drive pinion **57** meshing with a gear **58** secured on the drum shaft **45**, and in this manner the drum shaft may be rotated at relatively high speed from a power source outside the apparatus, and without interference to the adjustable rotatable mounting of the apparatus as previously described.

The card or sheet feeding apparatus provided by this invention is primarily designed to feed cards or sheets singly in succession, and at substantially high speeds, from a pile of such sheets or cards. In the embodiment illustrated, the cards or sheets are placed within a feed hopper **60** provided by a base plate **62** (FIG. 4) from which a plurality of guide rods **64** extend upwardly in spaced relation. Each guide rod is provided with an independent adjustable mounting in the form of a transverse strap **65** secured to the bottom thereof and slotted

to receive a fastening screw **65**, as shown particularly in FIG. 4. On the front of the bottom plate **62** there is a pair of vertically extending straps **68** which are fastened in fixed relation thereto, defining the index position for the forward or leading edge of the cards or sheets in the hopper. Thus, the rods **64** may be adjusted to accommodate cards or sheets of relatively different sizes, with the leading edge of each card in the stack always aligned in the proper index position, as indicated by the dot-dash lines **69** in FIG. 4.

It will be understood that the feed of cards or sheets from the above described hopper is under gravity, with the stack settling toward the bottom plate **62**. However, it is obvious that the hopper could be mounted in non-vertical, or even inverted position as opposed to that illustrated, and suitable biasing means may be used to feed the stack toward the bottom plate **62**.

Immediately beneath the feed hopper **60** the rotary feed drum **75** is mounted upon shaft **45**, secured thereto by the collars **77** from which set screws **78** extend (FIG. 5) to secure the drum **70** in fixed position thereon. The drum **75** includes a pair of side plates **80** and **82** which are connected by a plurality of pickup heads. In the illustrated embodiment there are two such pickup heads **85** and **86**, although it is understood that there may be more or less in number depending upon the dimensions of the drum and the cards or sheets to be fed, as well as other variable dimensions in construction of the apparatus.

Referring to FIGS. 4, 5, 7, 8 and 9, each of the pickup heads includes a main body **90** having a cross passage **92** and a plurality of outwardly extending holes or passages **94** which communicate with the larger cross passage **92** and extend to the surface of the head. The bore or passage **92** is extended by complementary bores **92***a* and **92***b* in the side plates **80** and **82**, respectively, and these also have small passages **94***a* and **94***b* which extend to the surface thereof, which is coextensive with the surface of body **90**. Each of the pickup head bodies **90** also is provided with a plurality of slots **95** extending in the direction of the periphery of the pickup drum and aligned about the periphery of the drum.

In each pickup head there is a knife blade **98** having an edge **98** (FIG. 9) which is slightly exposed, for example approximately 0.0001 inch. The blade is clamped in place by a removable block **100** retained by bolts **102** and having passages **104** appropriately arranged to align with underlying passages **94** in the body of the pickup head.

On opposite sides of the drum are stationary valve plates **105** and **110** (FIG. 5), and the plate **105** includes an elongated arcuate slot or passage **112** connected with a fitting **114** which may be connected through tube **115** (FIG. 2) to a four-way solenoid controlled valve **117** which will control the connection of this tube to a suitable source of vacuum or negative pressure **118** and alternately to a low positive pressure source **119**. The valve plate **105** is adapted to remain in stationary position on the rotating shaft **45**, and for this purpose a stud **120** extends from the side thereof engaged within the bifurcated end **122** of an adjusting arm **125** which is clamped to the lower cross rod **30**. Thus, adjustment of arm **125** will vary the fixed position of the valve plate **105** and therefore the relation of the opening **112** in the valve plate with respect to the fixed base plate of the hopper.

The lower pickup head **86**, as shown in FIG. 5 particularly, is constructed in the same fashion, and differs primarily in that the through passage **92***a* in the side plate **82** is located 180° around the drum from the passage **92***b* therein for the pickup head **85**. The valve plate **110** also includes an elongated arcuate slot **112***a* connected to a fitting **114***a*, and through these parts vacuum is supplied to the head **86** when it is in predetermined position beneath the hopper base plate. The valve plate **110** also has an independent adjustment arm **127** (FIG. 2) which

functions to control positioning of valve plate 110 in the same manner as the arm 125 positions the plate 105.

Referring particularly to FIGS. 4, 7, 8, 10 and 11, immediately beneath the base plate 62, and extending forwardly therefrom, are several stationary supporting arms or fingers 140, which are bolted at their rearward end to the forward end of base plate 62, projecting therefrom toward the lower edge of the hopper straps 68 and curve downwardly therebeneath at their free ends 142. These fingers are of generally rectangular cross-section, as shown particularly in FIG. 8, and include interior passages 145.

In each supporting finger the passage 145 terminates at its rearward end in a fitting 147 which connects to a tube 148 providing a source of vacuum to be applied through the passage 145. At the top of each finger 140, above the passage 145, there is an open slot 150 which extends beneath the center of the stack of cards or other sheet material in the hopper and forwardly and downwardly away from the front edge of the hopper, as shown particularly in FIGS. 10 and 11. The curved forward edge 142 of the supporting arms thus cooperates with the bottom of the hopper front straps 68 and their supporting structure to define a hopper outlet opening 155 through which the cards or sheets are discharged singly, in rapid succession. Preferably, on the side of the straps 68 facing into the hopper, there are a plurality of knife edges 157, one of which is shown in FIGS. 10 and 11, engaging the leading edge in raised position, and holding the cards essentially level in the hopper, from which position the lowest of the cards is deflected during the feeding action, as will presently be described.

The force applied by the stationary or positioning vacuum in the supporting fingers is substantially less than the force applied by the "rotating" vacuum which is applied through the moving pickup heads 85 and 86. For example, in a specific embodiment of the invention, the slots 150 (when there is no card placed upon them) will pass a relatively high volume at relatively low negative pressure, for example six inches H_2O. On the other hand, the vacuum applied through the rotary valving to the pickup heads is relatively much higher, for example in the range of 25 to 27 inches Hg, and the passages 94, 94*a* and 94*b* are of such small size that if uncovered at this relatively high vacuum there is still a rather low volume of flow therethrough, but a relatively high force is exerted by the vacuum pickup of the pickup heads.

Because of this relation of holding (or positioning) and pickup forces, the pickup heads are capable of readily removing a card or sheet from the deflected position to which it is drawn in covering relation with the positioning finger slots 150, as shown particularly by the lowermost card 160 in FIG. 10. This pickup ability is enhanced by the presence of the knife edge 98 in the pickup head, against which the card is drawn by the vacuum. It will be noted that the knife is slanted forwardly in the direction of movement of the pickup head, and this together with the applied vacuum provides a firm grasp of the card which causes it to follow with the pickup head and slide off of its position on the fingers 140.

At the same time, the trailing edge of the card 160 will pass over the rearward portion of the slot 150, and the next card 162 in the stack will be drawn onto the finger by the vacuum force exerted across the slot 150. Therefore, the surface of the next card 162 will follow the trailing edge of card 160 and the two cooperate in a sort of valving action to provide an essentially complete seal as the card 160 is discharged through opening 155. This will ultimately result in the leading edge of card 162 being drawn downwardly and inwardly, away from the knife edge 157 and over the forward edge of the slot 150 on the holding or positioning fingers to seal off these slots completely while the card 150 passes onward as the drum rotates.

This operation also provides an adequate control over the tail or trailing edge of the card being removed, and prevents the card from flicking, due to its natural resistance to bending (particularly in the case of paperboard or the like). Otherwise, the tail of the removed card may disturb the pile in the hopper and interfere with smooth operation of the feeding function, and when operating at high speeds this control of the tail or trailing edge of the card is conductive to smooth high speed operation, where cards are being removed from the hopper at extremely high rates, for example in the range from 30,000 per hour to 100,000 per hour or in excess thereof.

Referring particularly to FIGS. 12, 13 and 14, the rotary valving apparatus is shown in greater detail, and it will be noted that the forward or leading edge of the arcuate vacuum conducting slot 112 is enlarged in a radial direction, as shown at 170 to provide a passage of momentarily greater cross-section when the passage or bore 92*a* passes thereover. The bore 92*a* also has its forward or leading edge enlarged from circular configuration, as shown at 172 in FIG. 12. The enlarged passage thus provided at the beginning of overlapping between the passage 92*a* and the slot 112 causes an abrupt application of high vacuum or negative pressure to the pickup head which assures proper pickup of the card positioned on the stationary fingers 140. Obviously, referring to FIGS. 12, 13 and 14, as the drum rotates and the pickup head progresses, vacuum will be continuously supplied through the elongated arcuate slot 112 to the pickup head until the passage or bore 92*a* reaches the end of the desired carry length, for example to the release position indicated in FIG. 14 by the arcuately extending marker line 174. As the vacuum is shut off by passage of the bore 92*a* beyond the extent of slot 112, the force holding the card 160 upon the pickup head will be released and the card will be discharged from the pickup head. Under some conditions of operation, in the event that there is a slight residual negative pressure maintained within the pickup head, or the card remains grasped by the knife edge 98, the cards may not fall away, and stripper arms 175 (FIGS. 2 and 3) extend at their forward ends into the same slots 95 in the pickup heads which receive the supporting fingers 140. These strippers will engage the leading edge of the card and cause it to fall from the pickup head. The stripper arms are supported upon the cross rods 30, as shown particularly in FIG. 3.

Under some circumstances, in order to promote release of the cards or sheets from the pickup heads when operating at the high speeds mentioned above, it may be desirable to provide a momentary positive pressure condition within the pickup head to force the release of the card or sheet therefrom. If such an arrangement is needed, the positive pressure can readily be supplied through the slot 180 (FIG. 14) which is of approximately the same dimension as the enlarged slot 130 on the vacuum supply, and which is connected in any suitable fashion to a source of positive air pressure through a supply tube 182 (FIG. 5). This momentary application of positive pressure during travel of the pickup head through the release sector, indicated by legend on FIG. 14, will assure the proper release or discharge of the card or sheet from the pickup head as it passes over the desired release position.

In the illustrated embodiment the rotary valving is disclosed as arranged for carrying the cards or sheets through an angular distance of somewhat less than 180°, such that the cards are discharged in predetermined position upon parts moving beneath the pickup drum on a conveyor or the like. In FIG. 3, which illustrates a suitable assembly of an application of the feeding apparatus, the cards are deposited upon books or magazines 200 which are passing beneath the feeder drum at a rate coordinated with the rotation thereof. This proper correlation of conveyor movement with operation of the feeding apparatus disclosed herein can easily be obtained by connecting the power drive to sprocket 50 (FIG. 2) to a power take-off which rotates at a correct desired

speed from the conveyor drive. Suitable drive arrangements of this type are well known in the art.

If desired, it is possible to provide any suitable type of sensing device (i.e. a conventional photocell and light beam arrangement, or a switch operating finger) which will indicate the presence of the books or magazines 209 passing to the feeding apparatus. In the event that there are no books or other delivery source for the cards, the feed can automatically be disrupted, the particular arrangements of such control will be obvious to those skilled in the art.

The rotary valving arrangement for the pickup head 86 including the drum side plate 82 and the stationary valve plate 110, is of essentially the same construction, with that valve plate having an elongated arcuate slot 112*a*, as previously described, which also includes an enlarged leading edge portion identical to the slotted part 170, and extending in essentially the same angular path as the slot 112. Thus, the vacuum or negative pressure is applied to the pickup head 86 during its travel from beneath the positioning or holding fingers 140 to the release or discharge position. The valve plate 110 will also include a positive pressure port identical to the port 180, if such is provided in the plate 105, in order to provide the pressure release arrangement for the pickup head 86 if this feature is incorporated.

Referring to FIGS 1 and 2, a gluing attachment may be included in accordance with the invention for applying a spot or strip of glue or other suitable adhesive to the cards, labels, sheets, etc, as they are fed singly by the rotary drum Suitable structure for this purpose is shown as including the shafts 40 and 42 which are mounted transversely of the U-shaped frame extension including the parts 32, 33 and 34 These shafts are mounted in suitable bearings as shown in FIG. 2, and are driven in timed relation to the drum shaft 45 by means of sprockets 210 and 212 respectively, which are driven by a chain passing around a sprocket 215 on shaft 45. Shaft 40 carries a gluing wheel 220 on which a segmental gluing pad or the like 222 is supported for contact with a portion of each card or sheet as it is engaged with a pickup head and passes in contacting relation with the pad 222. In the case of the dual pickup head drum illustrated, there will be two such glue applying pads 222, and they will be located at a radius from shaft 40 essentially the same as the distance between the card or sheet carried on the pickup head and the axis of rotation of shaft 45. The sprocket chain 225 (FIG. 1) passes around the bottom of sprocket 210, as shown, so that shafts 45 and 42 rotate in the same direction and shaft 40 is counterrotated with respect thereto. Thus, the glue applying pads contact each card or sheet without any substantial relative movement therebetween along the line of contact.

The glue or adhesive reservoir is provided by a small tank 230 mounted within the frame, and a transfer wheel or disk 232 is mounted on shaft 42 above the tank, extending partially thereinto, This disc is of suitable diameter such that it runs in contact with the glue applying pads 222 when they pass the periphery thereof, and serves to transfer the correct amount of glue or other adhesive to the pads for application to the cards.

The present invention, therefore, provides novel feeding apparatus for separating sheets, cards, labels, etc., from a stack thereof and feeding them singly at high speed to a desired position. The apparatus is equally effective when operating upon thin sheets such as thin paper labels, or relatively thick sheets such as rather stiff semi-flexible cards of paperboard or the like. It should be noted that the gripper heads maintain a positive grip on each sheet or label or card during the feeding movement, without regard to thickness, since there are no fingers or the like engaging the thickness of material at the leading edge or at the sides. The hopper is adjustable in size to accommodate varying dimensions of sheets being fed, and the entire apparatus may be constructed to any suitable proportion, with due regard to the features of construction noted above.

The positioning or holding fingers cooperate, in combination with the novel coaction between adjacent cards or sheets being fed from the bottom of the pile, to maintain each sheet being fed partially separated, particularly at its leading edge, from the remainder of the stack in the hopper, and thus each leading edge of the sheet or card next to be fed in deflected in the direction along which it will be removed by the pickup head. Actual experience with apparatus constructed in accordance with the invention, feeding paperboard cards of 3½ x 5½ inches dimension with the greater length as the leading edge, has demonstrated that this apparatus can easily operate at rates in the order of 2000 cards or labels per minute, or approximately 120,000 per hour. With proper dimensioning of the apparatus it is also possible to feed booklets, assembled pluralities of signatures, or the like at speeds far in excess of any presently known feeding apparatus for handling this type of material.

The present invention also has particular utility with regard to the segregation of batches of a predetermined number of cards, labels, booklets, etc., from a stack thereof, and also for counting the number of units so segregated from a stack. For example, it may be desired merely to maintain a running count of the number of cards passed through the feeding apparatus. In such instances a conventional counter may be operated from a photocell triggering device which is activated in response to passage of a card along with the feeding drum through a position beyond the discharge end of the hopper which contains the stack of cards to be fed. Since the apparatus carries the cards singly in succession the resultant count will be a number of pulses from the photocell trigger system equal to the number of cards carried past the photocell, to vary the light received thereby, and these pulses may be received and accumulated in a conventional counter. The general arrangement of such a system is shown in connection with FIG. 15, which will be described below in greater detail in connection with further features of a modified form of the apparatus.

It should be understood, however, that this type of counting apparatus is equally adaptable to the above described said mechanism, and since it is possible to preset conventional counters to emit a shutoff signal or pulse after a predetermined count, it is thus possible to use such an output from the counter to control valve 117 in the high vacuum line, and thus to stop the feeding action after a predetermined count. This may be accomplished conveniently, and with extremely accurate and positive action, by causing valve 117 to switch from the high vacuum supply 118 to the low positive pressure source 119, thus supplying low pressure air through the gripper heads and in effect forming an air film or air bearing between the card and the pickup heads sufficient to avoid engagement of the deflected card with the knife edge (when such is used) but insufficient to lift the card from the stationary fingers 140. In this manner, the cards or labels fed through the apparatus may be fed out and/or assembled in batches of exact predetermined numbers, and the number of individual cards or units in each batch may be varied at will.

With the cards thus being separated singly at high speed, it is also possible to utilize non-electronic scanning devices to read intelligence printed on the cards as they are passed at high speeds past such scanning devices, and thus the present invention provides an apparatus which will feed intelligence bearing cards past such a scanner at a very high speed.

Referring to FIGS. 15–17, a modified type of apparatus is shown in somewhat diagrammatic form, with the particular embodiment shown as an example having utility in the imprinting and stamping of return postage cards. It will be appreciated, however, that many other uses will be suggested to those skilled in the art.

In this embodiment cards are fed individually at high speed from a counter, and a message, advertisement, etc., is printed on each card, after which a postage stamp is automatically placed in proper position on each card. The stamps are fed from a continuous strip or roll, in which the individual stamps or units may be delineated by transverse perforations which will separate under a predetermined force. The stamp, therefore, will be fed individually from the common strip, the adhesive thereon activated, and thence applied to the cards. Again, it will be obvious to those skilled in the art that there are many other uses for which the stamp feeding apparatus may be employed.

Referring specifically to FIG. 15, the cards, labels, booklets or the like are supplied to the apparatus in a stack supported in a hopper **250** having an open lower end with a stop plate **252** at the lowermost corner which may be employed to assist in positioning the lowest piece in the stack. A cyclic feeder for carrying individual units away from the stack is provided in the form of a rotary feed drum **255** which is driven about its axis **256** by any suitable rotary drive, rotating in the direction of arrow **257**. The feeder drum **255** includes a pair of oppositely disposed high vacuum gripper heads **260** and **262** which are of the same construction as the heads **85** and **86** previously described, preferably including a knife edge which projects a slight distance above the surface thereof. The relatively high vacuum connection to these heads may be controlled by the same type of rotary valve mechanism previously described and shown particularly in FIGS. 5 and 8–14. This rotary valve may in turn be connected to the high vacuum source V through a line **265** including a solenoid operated control valve **266**.

The positioning of the leading edge of the lowest card or unit in the stack in its deflected or "ready" condition, away from the remainder of the stack, may be accomplished in substantially the same manner by means of a relatively low vacuum device including the passages **268** in the drum which are connected continuously to a source of relatively low vacuum, of an order such as previously described, and having a plurality of outlets over a substantial portion of the surface of drum **255** as shown. This vacuum source will have a rather low retentive power, sufficient however to slide the lowermost card in the stack forward from its position into the "ready" position where its leading edge is deflected around a segment of the revolving feeder drum. A portion of the leading edge of such a card **270** is shown so positioned in FIGS. 15 and 16. This leading edge of the card engages with the stiff bristles **272** of a stop brush, which bristles extend into slight grooves **273** which may be formed in the surface of the feeder drum. Due to the low retentive force of the low vacuum apparatus, the bristles will have sufficient strength to retain the card **270** in this position and the drum will continue to rotate, now relative to the card **270**, until one of the high vacuum heads **260** or **262** passes beneath the card and, with the relatively high vacuum valved thereto, will grip the card and carry it past the bristles **272** which then bend out of the way under the force of the now tightly gripped card **270**. Obviously, releasable stop fingers or the like may be employed in place of the stop brush, although this mechanism may be somewhat preferred because of its relative simplicity.

It should be noted that when the leading edge of the card engages bristles **272**, and before one of the gripper heads reaches the feeding position where it engages the card, the low vacuum force will provide a type of "air bearing" since a slight film of air may pass beneath the card when the drum is moving relative thereto. Similarly, the low vacuum source provides a continuous valving or positioning device such as previously described in connection with the stationary fingers **140**, since as a card is fed forward under control of the high vacuum gripper the low vacuum source will tend to maintain contact between the trailing edge of the card and the next card in the stack, carrying the leading edge of the latter down into the "ready" position.

Immediately beyond the stop brush a light source **275** is directed against the surface of the feeder drum which may conveniently be coated, painted or otherwise treated to have an essentially dull or non-reflective surface. The light beam is so directed that when it is reflected from the point where it strikes the feeder drum surface it will be intercepted by a photocell **277**, the output of which is connected through a conventional photocell amplifier **278** to provide input pulses to a suitable conventional digital counter **280**. Any suitable type of counter capable of accumulating a count of individual inputs or "bits" of information may be utilized, and this information may merely be maintained as a running total of the number of cards passed through the feeder. The cards will have a more reflective surface than the surface of the feeder drum, and thus passage of each card across the path of the light beam will reflect light to the photocell and cause a single pulse to be emitted through amplifier **278** to the counter. Since there will be but one pulse for each single card or other unit carried through the light beam, the counter will maintain an accurate count of the actual number of cards fed, since there will be no false count if the feeder should accidentally skip a card or otherwise fail to pick up a card from the "ready" position.

Such counters may also be preset, as is well known in the art, to provide an output pulse or other output signal for control purposes after the counter has reached a predetermined sum. It is also well known that the counter may be preset to any desired value within the limits of its counting system. Therefore, an output line **282** may be connected to energize or otherwise actuate the solenoid controlling valve **266**, and if this valve is normally open to connect the high vacuum supply to the gripper heads, then when a predetermined count is reached the solenoid will close this valve and the feeding mechanism will cease to carry cards beyond the "ready" position. The accurately counted batch of cards previously passed over the feeder drum may then be assembled, as will be explained, for any desired purpose.

Beyond the photocell pickup, each card is carried past a printing roller or cylinder **285** carrying imprint plate **287**. This cylinder rotates at the same peripheral speed as the feed drum **255**, but is of half the diameter such that the plate **285** will contact each of the cards carried past the printing station by the heads **260** and **262** respectively. The imprint plate **287** may contain any information which it is desired to print on each card, and the plate is inked through a set of inking rollers **290** of conventional type, receiving ink from a conventional fountain **292**. The printed cards are then passed through a nip defined by the feed drum **255** and a further feed drum **300** which also carries a pair of pickup heads **302** and **303** which are of essentially the same construction as the heads **260** and **262**, and which are valved to a relatively high vacuum source through the same sort of rotary valving previously described.

The drum **300** preferably is driven in timed relation from the same source as the drive for drum **255**, and it is adapted to carry individual stamps, postage stamps for example, from a supplier mechanism indicated by the general reference numeral **305**, and to applying a stamp to each card. A single stamp **306** is shown being carried by the head **302** and about to be wetted by a pad **309** carried on a cylinder **310** which rotates in the opposite direction from drum **300**, at the same peripheral speed, and which is of one-half the diameter of drum **300** such that the pad **309** will moisten the adhesive on a stamp carried by each of the heads **302** and **303**. The pad **309** is wetted during each revolution thereof by water or other wetting agent received through the wetting rollers **312** from the fountain supply **314**.

The printed cards, with stamp applied, then pass over

the stripper fingers 315 which strip the leading edge of the card away from feeder drum 255, in conjunction with release of the vacuum from the heads 260 and 262 by their rotary valving mechanism (and possibly application of pressure as previously described, if so desired), and the cards as they are engaged by the stripper are also carried forward by contact with a driven impeller roller 317 which maintains a control of the card and moves it forwardly past a guide bar 318 into a receiver hopper 320. Preferably, the counted and prepared cards in the hopper 320 are jogged or vibrated by a rotating vibrator head 322 which acts to index each card against the bottom edge of hopper 320 as shown and also supply an intermittent impelling force which positions the batch forwardly into the hopper as well as setting each received card properly.

The stamp supply mechanism 305 shown in FIG. 15 is illustrated in greater detail in FIG. 17. This apparatus includes an axle or shaft 330 on which a roll of stamps, labels, or the like 332 is placed initially. The individual stamps may be separated by perforations or the like, as in a roll of postage stamps, although they are connected as an integral strip wound in a roll. The strip passes forwardly between rollers 333 and 334 carried on an oscillating feed arm 335 which is mounted to pivot on an axis 337. The stamps pass forwardly through these rollers beneath stationary clamp pad 340 having a through aperture 343 which is adapted for alignment with the perforations defining individual stamps in the strip, as shown in FIG. 17.

A slight source 345 is mounted to pass a beam of light through such perforations and the aperture 342 to be intercepted by a photocell 346, and the resultant impulses from such photocell, form intermittent interruption of the light beam by passage of the stamps, are transmitted through the amplifier 348 and directed to control a clamping solenoid 350, as indicated by the schematic output line 351. A lower movable clamping pad 352 is mounted for reciprocating movement within a suitable housing 353, and is controlled by a cross arm 355 having a pivotal connection at 357 with the rod 358 moved by the solenoid armature. The link or rod 355 also extends beyond the solenoid rod and is connected to a link 360 having a connection at its upper end with the oscillating feeder arm 335, and biased to its lower position by a spring 362 which is suitably anchored as shown.

The lines 365 indicate the separation or perforation strips which define the connection between stamps. It should be noted that when the pad 352 is in its clamping position (dotted lines) such a perforation line beneath or between the clamping parts, while the reading stamp of the strip is resting over the surface of the rotating drum 300. If desired, the clamping parts can be arranged to weaken each perforation section as it is clamped, and thus the weakened parts are advanced when the strip is pulled forward and the individual stamps will break away when the pickup heads 302 or 303 engage the stamp resting against the drum.

It is of course necessary to provide a release of the clamping parts to permit the next stamp to be drawn out before the break occurs, but this can be accomplished readily in any convenient fashion, for example, by a position signal read from a cam or spot on drum 300 at a point just after the pickup heads have engaged a stamp.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. Apparatus for feeding sheets of material such as cards and like flexible material, comprising a hopper for receiving and supporting a stack of separate sheets to be fed singly, means at one end of said hopper defining an outlet through which single sheets are discharged, a movable pickup head having a knife edge mounted in fixed position thereon and projecting therefrom for a slight distance substantially less than the thickness of a sheet for non-perforating contact with each sheet along a line generally transverse to the direction of movement of said head, vacuum conducting means in said head arranged to create a negative pressure at the surface of said head adjacent said knife edge to draw a single sheet into engaged relation with said knife edge, means mounting said head for driven movement in a circular path past said hopper outlet including a drum rotatable about an axis located beneath said hopper and extending generally parallel with respect to said outlet, means for rotating said drum at constant velocity to pass said head cyclically across said outlet, and rotary valve means adapted for connection to a source of vacuum and operative in timed relation to movement of said head past said outlet to connect said vacuum conducting means in said head to a source of vacuum when said head is adjacent said outlet and for a predetermined extent of travel of said head away from said outlet.

2. High speed card feeding apparatus of the character described comprising a supply hopper having an essentially open bottom and adapted to accommodate a stack of cards for gravity feed toward said bottom to be fed singly therefrom, a stationary support arm extending partially across said open bottom of said hopper and having a free end in spaced relation to said bottom of said hopper defining therewith an opening through which single cards are discharged, vacuum retainer means in said arm adapted to engage the leading edge of a single card from the bottom of a stack in said hopper and to retain the leading edge aligned with said opening, a pickup head including selectively operable gripper means capable of overcoming the retaining force of said retainer means, a rotatable drum mounting said pickup head, drive means connected to rotate said drum at constant velocity about an axis spaced below said support arm for moving said pickup head in a circular path past said support arm in close cooperating relation therewith, and control means connected to actuate said gripper means in said head selectively during movement thereof past said support arm for engaging a single card on said arm and removing the card therefrom to a delivery position spaced about the periphery of said drum from said support arm.

3. Card feeding apparatus comprising hopper means for supporting a stack of cards to be fed singly, a stationary support arm mounted to engage the lowest card in a stack carried in said hopper means and having a free edge extending away from said stack, vacuum retainer means on said support arm adapted to engage a portion of the lowermost card in a stack and to deflect that portion away from the stack, a pickup head including selectively operable vacuum gripper means for engaging the deflected portion of a card retained on said support arm, means adapted to move said pickup head past said free end of said support arm, a knife edge mounted stationary in said pickup head projecting slightly from the surface thereof for cooperation with said vacuum gripper means to engage the deflected end of a card with a force in excess of the retaining force exerted by said vacuum retainer on said arm, and control means connected to apply a negative pressure selectively to said vacuum gripper means in coordinated relation with movement of said pickup head past said support arm to provide a gripping force of a higher order than said retainer means to remove a card from said support arm and to release said gripping force after said head has traversed a predetermined path past said free end of said open arm to deliver cards singly in succession to a predetermined location.

4. Card feeding apparatus comprising hopper means for supporting a stack of cards to be fed singly, a sta-

tionary support arm mounted to engage the lowest card in a stack carried in said hopper means and having a free edge extending away from said stack, vacuum retainer means on said support arm adapted to engage a portion of the lowermost card in a stack and to deflect that portion away from the stack, a pickup head including selectively operable vacuum gripper means for engaging the deflected portion of a card retained on said support arm, a rotatable drum carrying said pickup head and mounted to rotate about an axis below and extending transversely with respect to said support arm, means for rotating said drum at constant velocity and in a direction to move said pickup head in a circular path past said free end of said support arm, a knife edge mounted in fixed position on said pickup head for cooperation with said vacuum gripper means to engage the deflected end of a card with a force in excess of the retaining force exerted by said vacuum retainer on said arm and without perforating the card, and control means connected to apply a negative pressure selectively to said vacuum gripper means in coordinated relation with movement of said pickup head past said support arm to provide a gripping force sufficient to remove a card from said support arm and to release said gripping force after said head has traversed a predetermined path past said free end of said open arm to deliver cards singly in succession to a predetermined location.

5. Apparatus for feeding sheet materials such as cards, labels, and the like, comprising a hopper adapted to hold a stack of separate sheets to be fed singly from one end thereof, a supporting finger extending across said one end of said hopper and having a free end terminating in spaced relation to said one end of said hopper defining therewith an outlet through which single sheets are removed, said finger having an elongated opening in the surface thereof facing the interior of said hopper and against which the endmost sheet in the stack is retained during feeding operations, means for connecting said opening continuously to a source of negative pressure for providing a retaining force operative to hold the sheet at the end of the stack in feeding position against said finger, a pickup head operable to engage a sheet retained on said finger with sufficient force to overcome said retaining force, and drive means supporting said pickup head for movement past said finger in the same plane as said finger surface against which the sheet is retained to engage with a single sheet and to carry the sheet through said outlet, the sheet engaged with said head cooperating with the next adjacent sheet in the stack to maintain said opening substantially covered to transfer said retaining force to said next sheet as said engaged sheet is discharged through said outlet while maintaining control of the trailing edge of the engaged sheet to prevent its disruption of the stack.

6. Apparatus for feeding sheet materials such as cards, labels, and the like, comprising a hopper adapted to hold a stack of separate sheets to be fed singly from one end thereof, a supporting finger extending across said one end of said hopper and having a free end directed away from said one end terminating in spaced relation to said one end of said hopper defining therewith an outlet through which single sheets are removed, said finger having an elongated opening in the surface thereof facing the interior of said hopper and against which the endmost sheet in the stack is retained during feeding operations, means for continuously connecting said opening to a source of negative pressure for providing a maintained retaining force operative to hold the endmost sheet in the stack in feeding position against said finger with a leading edge deflected from the next adjacent sheet, a pickup head operable to engage a sheet retained on said finger with sufficient force to overcome said retaining force, and drive means supporting said pickup head for movement past said finger and into contact with said deflected sheet to engage with such single sheet and to carry the sheet through said outlet, the sheet engaged with said head cooperating with the next adjacent sheet in the stack to maintain said opening substantially covered, transferring said retaining force to said next sheet as said engaged sheet is discharged through said outlet and moving the leading edge of said next sheet to the deflected position.

7. Apparatus for feeding sheet materials such as cards, labels, and the like, comprising a hopper adapted to hold a stack of separate sheets to be fed singly from one end thereof, an elongated supporting finger extending across said one end of said hopper and having a free end terminating in spaced relation to said one end of said hopper defining therewith an outlet through which single sheets are removed, said finger having an opening in the surface thereof facing the interior of said hopper and against which the endmost sheet in the stack rests during feeding operations, said opening being extended in the direction of elongation of said finger to engage with an extended portion of said endmost sheet in a direction transverse to the leading edge of the sheet which is adjacent said outlet, means for connecting said opening to a source of negative pressure for providing a retaining force operative to hold the endmost sheet in a feeding position against said finger, a pickup head having an opening in the surface thereof adapted to be selectively connected with a source of negative pressure for engaging the endmost sheet with said pickup head, the positioning and pickup forces exerted at said finger opening and at said pickup head respectively being coordinated to provide a pickup force in excess of the retaining force, drive means supporting said pickup head for movement past said finger in contact with the sheet held in feeding position, means for selectively connecting said pickup head to a source of negative pressure in coordinated relation with relative movement of said pickup head past said finger to engage the single sheet on said finger and carry the sheet through said outlet, and the trailing edge of each sheet engaged with said head cooperating with the following sheet in the stack to maintain said elongated opening substantially covered for transferring said retaining force to the following sheet as each sheet engaged with said pickup head is discharged through said outlet.

8. Apparatus for feeding sheet materials such as cards, labels, and the like, comprising a hopper adapted to hold a stack of separate sheets to be fed singly from one end thereof, an elongated supporting finger extending across said one end of said hopper and having a free end extending in an arc away from said one end and terminating in spaced relation to said one end of said hopper defining therewith an outlet through which single sheets are removed, said finger having an opening in the surface thereof facing the interior of said hopper and against which the endmost sheet in the stack rests during feeding operations, said opening being extended in the direction of elongation of said finger to engage with an extended portion of the sheet positioned thereon in a direction transverse to the leading edge of the sheet which is adjacent said outlet, means for connecting said opening to a source of negative pressure for providing a retaining force operative to hold the endmost sheet in a feeding position against said finger with the leading edge of the sheet in deflected position against said free end of said finger, a pickup head having an opening in the surface thereof adapted to be selectively connected with a source of negative pressure for engaging the endmost sheet with said pickup head, the positioning and pickup forces exerted at said finger opening end at said pickup head respectively being coordinated to provide a pickup force in excess of the retaining force, drive means supporting said pickup head for movement in a circular path past said finger with a portion of such path coinciding with the arcuate extent of said finger, means for selectively connecting said pickup head to a source of negative pressure in coordinated relation with relative movement of said pickup head past said finger to engage the single sheet on said finger and carry the

sheet through said outlet, and the trailing edge of each sheet engaged with said head cooperating with the following sheet in the stack to maintain said elongated opening substantially covered for transferring said retaining force to the following sheet as each sheet engaged with said pickup head is discharged through said outlet and for carrying the leading edge of the following sheet to said deflected position.

9. Apparatus for feeding cards and like sheets of material, comprising a supply hopper having an open bottom end and adapted to accommodate a stack of cards to be fed singly, a first rotatable drum mounted to rotate about an axis adjacent and extending transversely with respect to said open end of said hopper, means for withdrawing the leading edge of the endmost card in said hopper from said hopper, means cooperating with said drum to provide a withdrawable stop adapted to engage the leading edge of a card on said drum and retain said card in a partially withdrawn position against the force of said withdrawing means, a pickup head mounted in said drum and including selectively operable gripper means, controls connected to actuate said gripper means for engaging the deflected portion of the card retained by said stop and to carry said card past said stop for feeding to a position remote from said hopper, a second drum having a further pickup head and mounted next to said first drum, means supplying individual labels to said further pickup head from a continuous strip of such labels, and drive means rotating said drums in opposite direction at synchronous speed to carry said labels into contact with cards on said first drum for transfer of a label to a card.

10. Apparatus for feeding sheets of material singly in rapid succession, comprising a hopper for supporting a stack of separate sheets to be fed singly, means at one end of said hopper defining an outlet therefrom, means for deflecting and holding an edge of a single sheet in said hopper away from the remainder of the stack and toward said outlet, a movable pickup head including means for creating a negative pressure at the surface of said pickup head for retaining the deflected portion of the sheet to be fed against said head, means mounting said head for driven movement in a circular path past said hopper outlet and intersecting the deflected edge of a sheet for withdrawing sheets individually through said outlet, control means operative to connect said negative pressure means to a source of negative pressure only to said passage of said head past said hopper outlet and for a predetermined distance spaced from said outlet to carry each sheet through said outlet to a predetermined discharged position, and counter means operable to count each sheet actually carried from said hopper and also operable to disconnect said control means from said source of negative pressure upon feeding of a predetermined number of sheets by said apparatus.

11. Apparatus for feeding sheet materials such as cards, labels, and the like, comprising a hopper adapted to hold a stack of separate sheets to be fed singly from one end thereof, a supporting finger extending across said one end of said hopper and having a free end terminating in spaced relation to said one end of said hopper defining therewith an outlet through which single sheets are removed, said finger having an elongated opening in the surface thereof facing the interior of said hopper and against which the endmost sheet in the stack is retained during feeding operations, means for connecting said opening to a source of negative pressure for providing a retaining force operative to hold the sheet at the end of the stack in feeding position against said finger, a pickup means operable to engage a sheet retained on said finger, and drive means arranged to move said pickup means toward and away from said finger to engage with a single sheet thereon and to carry the sheet through said outlet, the one sheet carried by said pickup means cooperating with the next sheet in the stack to maintain said opening substantially covered to transfer said retaining force to said next sheet as said one sheet is discharged through said outlet.

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