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Aronson

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[54] **HIGH SPEED SHEET FEEDING APPARATUS**

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[52] **U.S. Cl.** **271/11,** 271/20, 271/95, 271/99

[51] **Int. Cl.** **B65h 3/10,** B65h 5/06

[58] **Field of Search** 271/20–23, 271/99–101, 107, 94, 95, 96, 115, 116, 11

[56] **References Cited**

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Assistant Examiner—James W. Miller

[57] **ABSTRACT**

A high speed sheet feeding apparatus in which the lowermost sheet of a stack is propelled from the stack by a rotating perforate cylindrical member connected to a source of vacuum. A pawl actuated by an adjustable cam governs the amount of rotation of the cylindrical member for each sheet in accordance with the length of the sheet. At the start of each feeding cycle a detent on the pawl urges the cylindrical member in the direction opposite its feeding rotation for a short distance. As a result, the lowermost sheet is initially slightly buckled, freeing it from the next adjacent sheet and insuring single sheet feed.

9 Claims, 4 Drawing Figures

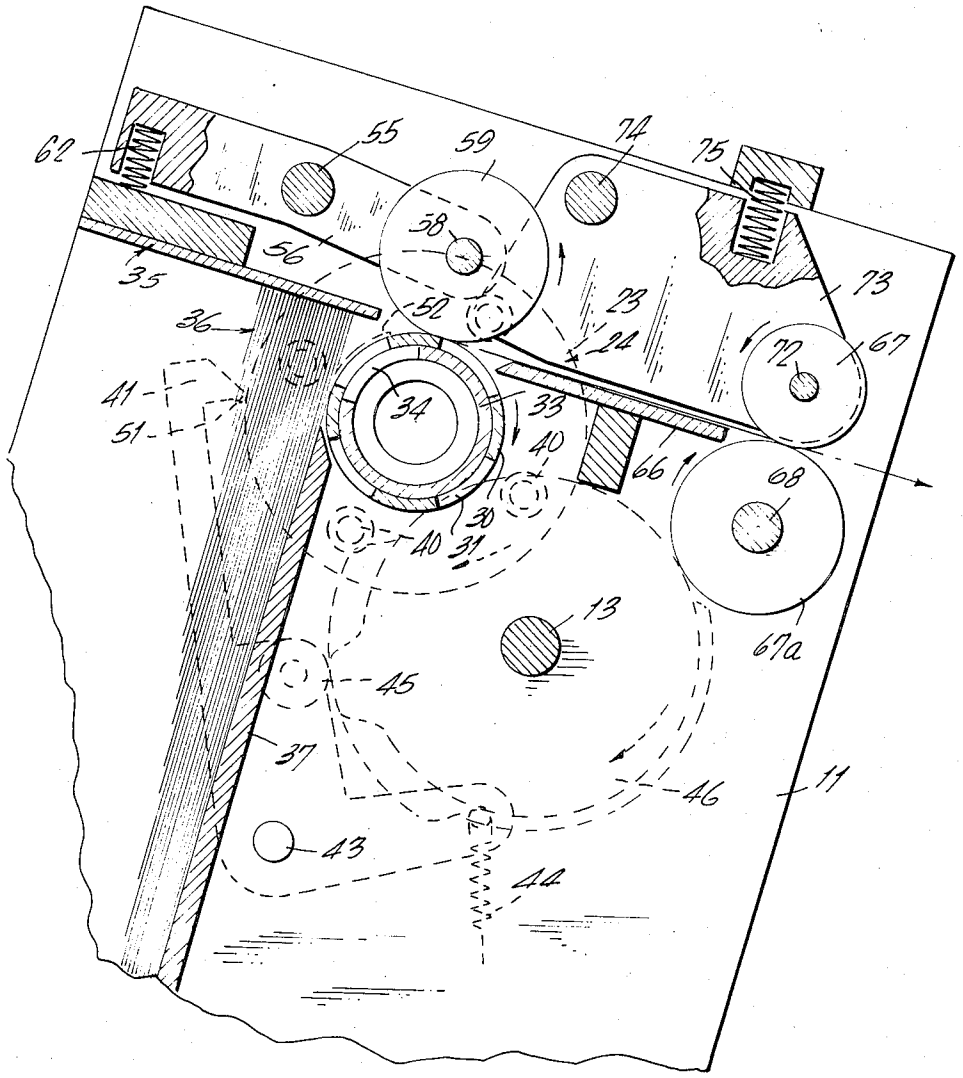


FIG. 1

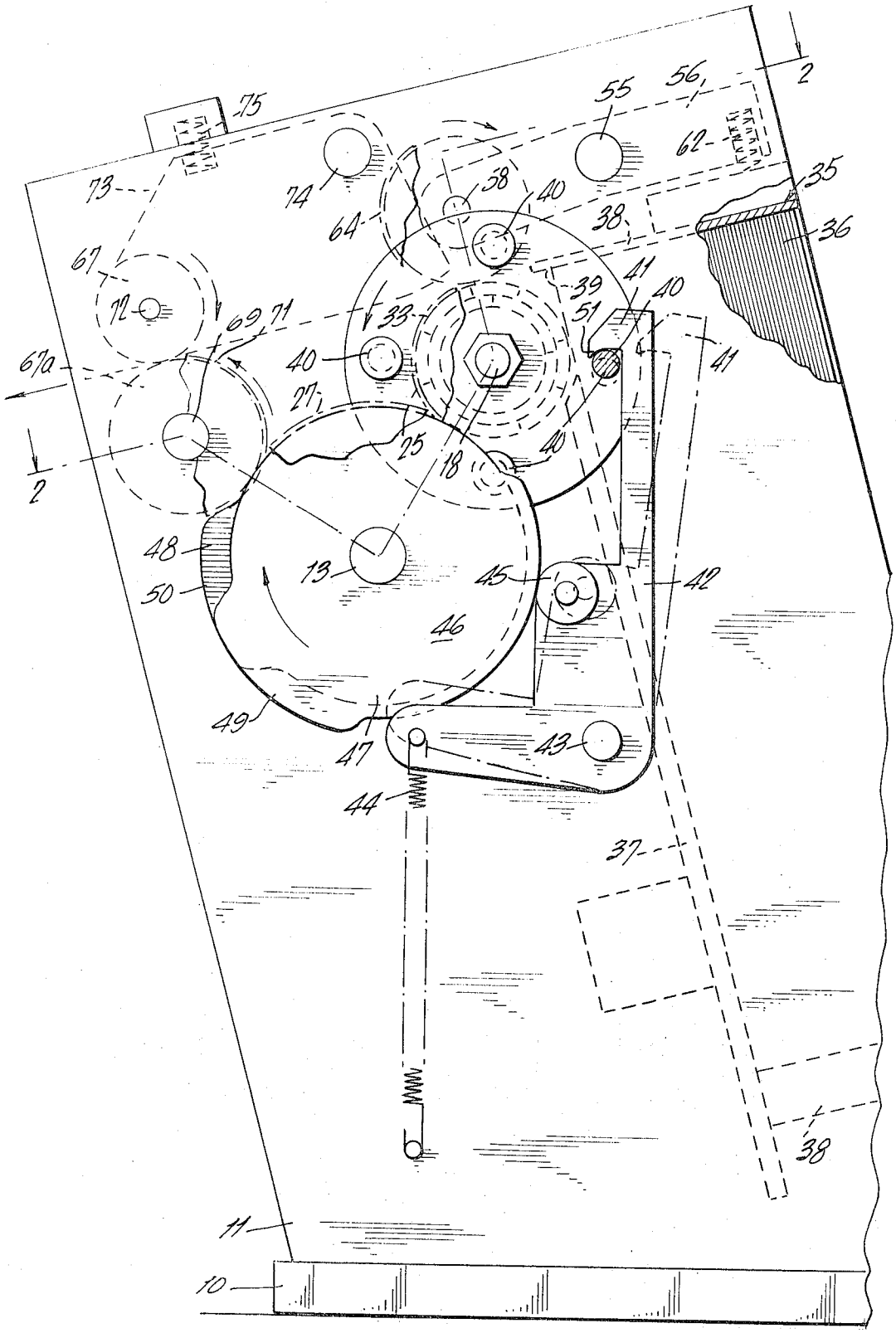
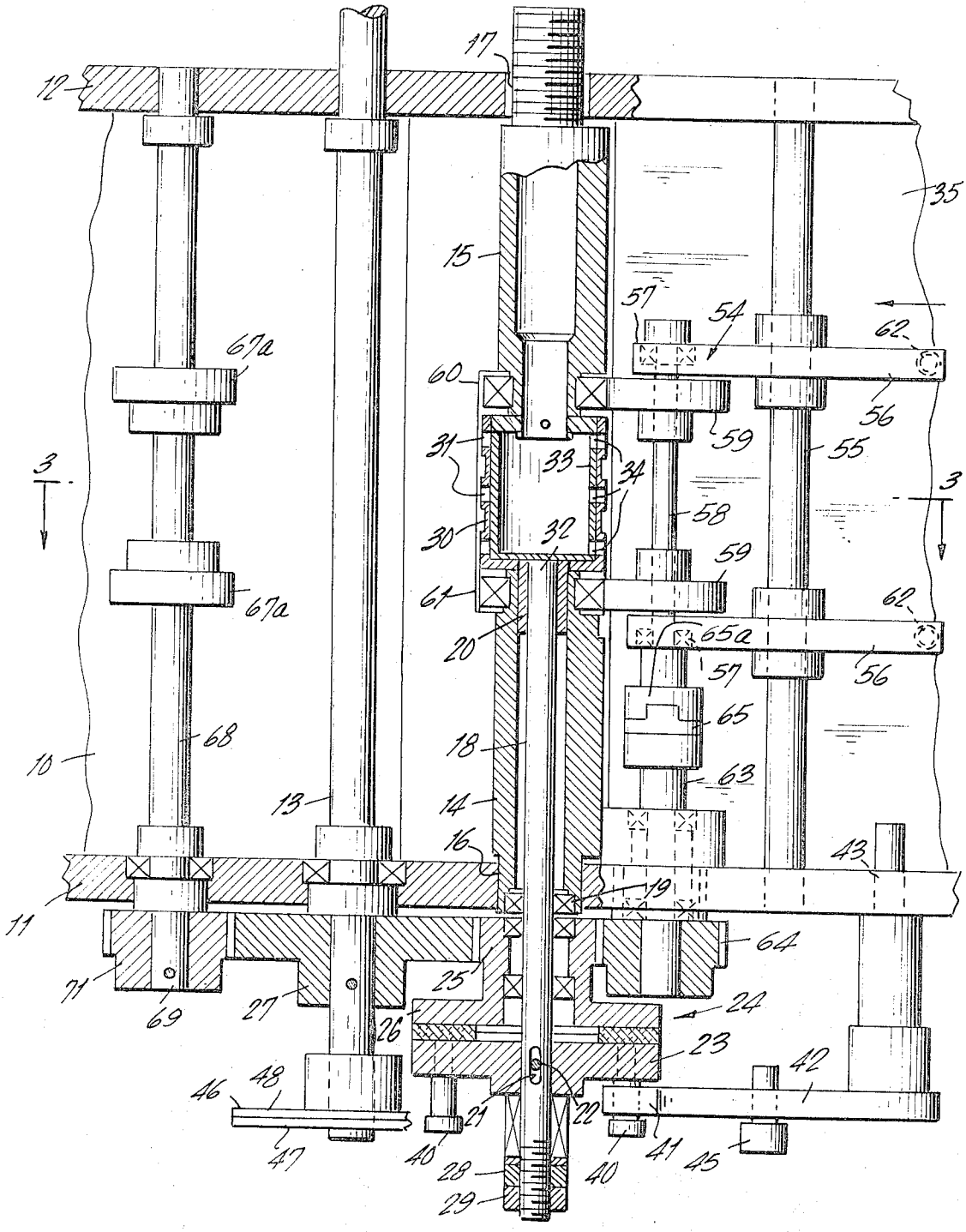

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FIG. 2


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65a
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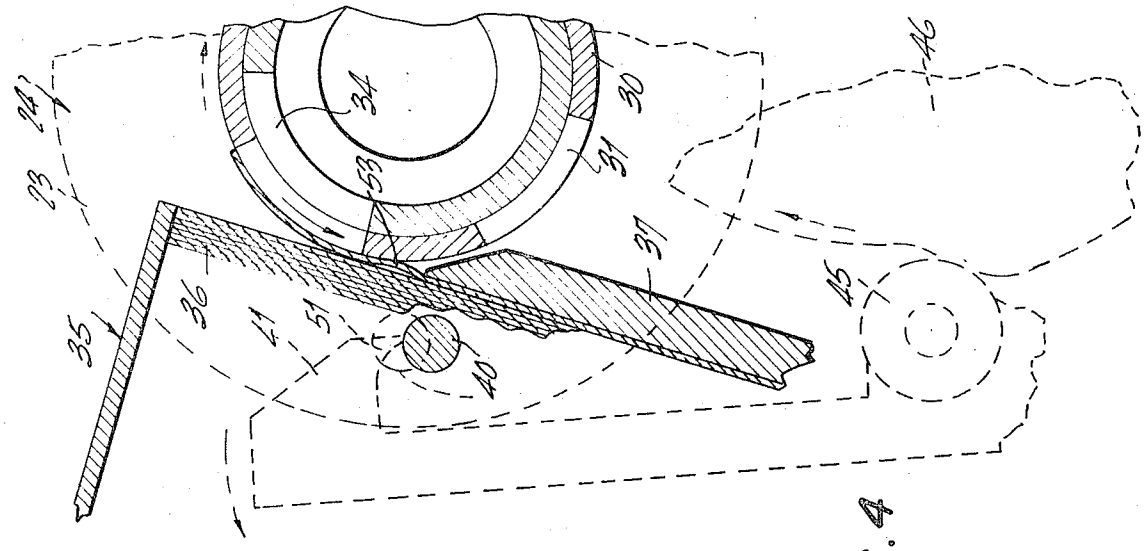


FIG. 4

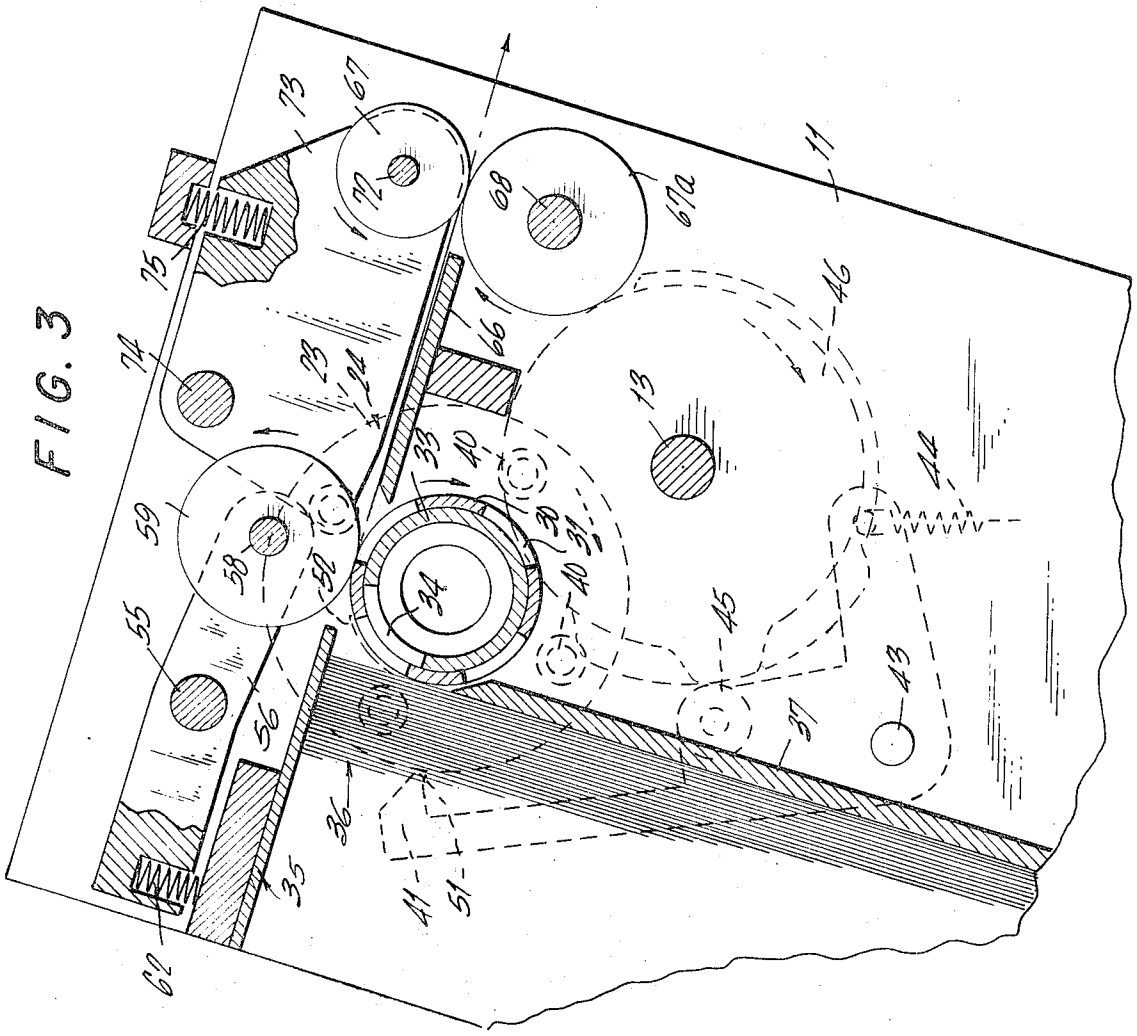


FIG. 3

HIGH SPEED SHEET FEEDING APPARATUS

BACKGROUND OF THE DISCLOSURE

It is well-known to feed sheets of material such as paper, cardboard and the like from the bottom of a stack by means of oscillating cylinders and suckers connected to a source of vacuum. Examples of such devices are to be found in U.S. Pat. Nos. 2,704,209 issued to J. Halahan et al Mar. 15, 1955; 2,770,458 issued to J. Halahan et al. Nov. 13, 1956; 2,859,964 issued to T. F. Aronson et al. Nov. 11, 1958 and others. Such prior art devices, however, were subject to certain limitations as to speed of operation, dependability of single sheet feed, the necessity for valving, thickness of material which could be fed etc.

Accordingly, it is an object of the present invention to provide a sheet feeding apparatus which can operate at high speed on a wide variety of sheet materials.

Another object is to provide a sheet feeding apparatus in which the sheet being fed is under positive control for the major portion of its length.

A further object is to provide a positive separation of the bottom sheet from the next adjacent sheet at the start of each feed cycle so that more than one sheet is not fed out at one time.

An object of the present invention is to prevent damage to the sheet being fed by reason of stresses set up in the sheet by the feed mechanism.

Still another object of the present invention is to provide a sheet feeding apparatus which lends itself to easy adjustment for different lengths of material.

SUMMARY

The sheet feeding apparatus of the present invention includes an inclined or horizontal sheet receiving hopper having an opening therein through which the lowermost sheets can be drawn and fed in a desired path. A hollow, cylindrical member connected to a constant source of vacuum and having a series of openings therein is disposed in contact with a portion of the lowermost sheet which overlies the hopper opening. A circular plate having a plurality of pins extending outwardly thereof is carried upon a shaft upon which the cylindrical member is mounted. The amount of rotation of the cylindrical member and therefore the amount of feed imparted to each sheet is controlled by a cam actuated pawl which is preset to permit one or more pins to be moved past the pawl by a suitable power source during each cycle.

At the start of each sheet feed cycle, a detent on the pawl tooth engages the pin upon which it has come to rest at the end of the last cycle. The shape of the detent is such that is imparts a small motion to the cylindrical member opposite the direction of feed. This small motion causes the lowermost sheet which is held to the cylindrical member by the vacuum to buckle slightly thereby releasing it from the next adjacent sheet so that only one sheet will be fed by the apparatus in each cycle.

DESCRIPTION OF THE DRAWINGS

In the accompanying drawings forming part hereof similar parts have been given the same reference numerals, in which drawings;

FIG. 1 is a view in side elevation of a complete embodiment of the present invention.

FIG. 2 is a view taken on line 2 — 2 in FIG. 1 looking in the direction of the arrows, with certain elements somewhat laterally displaced for the sake of clarity.

FIG. 3 is a fragmentary cross-sectional view taken on line 3—3 in FIG. 2 looking in the direction of the arrows with certain parts shown in dashed lines.

FIG. 4 is a fragmentary cross-sectional view on an enlarged scale similar to FIG. 3 showing the manner in which the lowermost sheet is slightly buckled to free it from the next adjacent sheet.

GENERAL DESCRIPTION

Referring to the drawings and particularly to FIGS. 1 and 2, there is shown a base 10 having spaced upstanding side plates 11, 12 secured thereto. A drive shaft 13 coupled to a source of rotary power such as an electric motor (not shown) extends across the sheet feeding apparatus and is journaled in each of the side plates 11, 12.

Spaced first and second hollow shafts 14, 15 (see FIG. 2) are secured at their outer ends 16, 17 to the side plates 11, 12 and extend coaxially toward each other along a path parallel to the drive shaft 13. The first hollow shaft 14 receives therein a driven shaft 18 which is freely journaled within bearings 19, 20.

The outer end of shaft 18 is provided with an elongated slot 21 to receive a pin 22 carried by the first plate 23 of a clutch 24. A small spur gear 25 is incorporated into the other plate 26 of the clutch 24. The spur gear is in mesh with a drive gear 27 pinned to the drive shaft 13. Adjustability is provided for the clutch 24 by means of the nuts 28, 29 threaded on to the end of shaft 18.

A hollow cylindrical sheet feed member 30, having a plurality of equally spaced slots 31 therein is secured to the inner end 32 of the driven shaft 18 and is rotated therewith. The sheet feed member 30 also rides upon a hollow cylindrical vacuum chamber 33 which is freely fitted within the sheet feed member 30. The vacuum chamber 33 is secured to the inner end of the hollow shaft 15 which is connected to a constant source of vacuum (not shown). A single row of spaced openings 34 is provided in the vacuum chamber 33 so that the slots 31 in the sheet feed member which are brought into register with the vacuum chamber slots 34 provide communication with the vacuum within the chamber 33.

As shown in FIG. 1, a sheet receiving rack or hopper 35 is provided in the sheet feeding apparatus and is adapted to hold a stack of individual sheets 36. The hopper consists of a bottom support member 37 and upstanding walls 38 adjustably secured to the bottom support 37 to accommodate sheets of different sizes. While the hopper 35 has been shown with the bottom support 37 on an incline, it will be understood that a horizontal disposition of the bottom support 37 is within the purview of the present invention.

The bottom support 37 for the stack of sheets 36 is provided with an opening or window 39 into which the sheet feed member 33 extends and through which the lowermost sheet can be pulled by the sheet feed member.

A plurality of spaced pins 40 are carried by the first plate of the clutch 23 and extend outwardly thereof as shown in FIG. 2. Each pin 40 is engagable by a pawl 41 disposed in the pin's path of travel. The pawl 41 is formed at one end of a bell crank lever 42 pivotally se-

cured at 43 to the side plate 11. The bell crank lever 42 is normally urged in the direction of the pins 40 by coil spring 44. A roller 45 is carried by the bell crank lever 42 and extends outwardly thereof in the path of an adjustable cam 46.

The cam 46, best shown in FIGS. 1, 3 and 4 consists of two cam discs 47, 48 each having a lobe 49, 50. By rotating the discs 47, 48 with respect to each other, the length of the cam lobe may be adjusted. The cam 46, is secured to the drive shaft 13 and rotates with it. As the cam lobe engages the roller 45, it rotates the bell crank lever 42 swinging the pawl 41 away from the pins 40. When the pin 40 engaged by the pawl 41 is released the first clutch plate 23 is free to rotate and turn the sheet feed member 30.

It will be seen from an examination of FIGS. 1, 3 and 4, that the end of the pawl 41 is provided with a depending detent 51 which partially encircles the pin 40 engaged by the pawl. This causes the initial movement of the clutch 23 and consequently the sheet feed member 30 to be in a direction counter to the sheet feed path.

From the foregoing description the operation of the sheet feed apparatus will be understood to be as follows:

With a stack of individual sheets 36 within the hopper 35, the source of vacuum activated, and the source of rotary power started; one of the slots 31 in the sheet feed member 30 which is in register with the openings 34 will cause the vacuum to pull the leading portion of the lowermost sheet in the stack through the window 39 in the bottom support 37 as shown in FIG. 3 at 52. The leading portion of the sheet will overlie the slots 31. As the cam 46 is rotated by the drive shaft 13, it will urge the pawl 41 away from the pin 40. As best shown in FIG. 4, the motion of the pawl 41 first causes the detent 51 to impart a reverse movement of the pin 40 resulting in a small counter rotation of the sheet feed member 30 and a small buckling of the sheet held thereby as shown at 53. This buckling frees the lowermost sheet from the next adjacent sheet and insures single sheet feeding even at high speeds.

The pawl 41 is held out of the path of the pins for an interval depending upon the adjustment of the cam lobes 49, 50 which adjustment is related to the length of the sheet being fed. At the end of each feed cycle the roller 45 rides off the cam lobes and the coil spring urges the pawl 41 into the path of the pins 40. The feed cycle is then completed.

It will be noted that as successive slots 31 reach the openings 34 in the vacuum chamber 33 the sheet being fed will receive additional propulsion thereby, aiding in pulling it from the stack, reducing stresses within the sheet and keeping the sheet under control as it is being fed.

To further control the sheet as it is being fed out of the stack, there is provided a spaced roller assembly 54 mounted upon a transverse shaft 55. The shaft 55 is carried at each end by the side plates 11, 12 and rockably supports two spaced arms 56. The arms 56 extend in a direction parallel to the line of travel of the sheets. The inner ends of the arms 56 extend over the sheet feed member 30 as shown in FIG. 3 and are transversely bored and provided with bearings 57 as shown in FIG. 2. A roller shaft 58 is freely received withing the bearings 57. Two spaced rollers 59 are carried by and secured to the roller shaft 58. The outer surfaces of the rollers 59 are urged against the races of two spaced bearings 60, 61 which are carried upon the inner ends of hollow shafts 14, 15 on each side of the sheet feed member 30. A coil spring 62, best shown is FIG. 3, on each of the outer ends of the arms 56 serves to urge the rollers 59 in the direction of the bearings 60, 61.

It will be seen that sheets being fed out of the stack will be led between the rollers 59 and the surfaces of bearings 61 and directed along the proper line of travel. Rotary motion is imparted to the rollers 59 by means of a stub shaft 63 having a spur gear 64 at its outer end in mesh with the spur gear 25 of the clutch 24 and a coupling 65 at its inner end engaging a complimentary coupling 5*a* on the roller shaft 58.

After the fed sheet leaves the sheet feed member 30 and rollers 59 it is further directed out of the sheet feeding apparatus by a guide plate 66 and one or more pairs of pinch rollers 67, 67*a*.

The pinch rollers 67, 67*a* are best shown in FIGS. 1, 2 and 3 and consist of a lower set of spaced rollers 67*a* secured to a transverse shaft 68 which is freely journaled at each end to the side plates 11, 12. One end of the shaft 68 extends beyond side plate 11 to provide a stub shaft 69 to which a driven gear 71 is secured. The spur gear 71 is in mesh with gear 27 on the drive shaft 13. The rollers 67*a* are thus driven by the rotary motion of the drive shaft 13.

The upper pinch rollers 67 as best shown in FIG. 3 are freely journaled upon shafts 72 extending outwardly of carriers 73. The carriers are swingably held by stub shafts 74 secured to the side plates 11, 12, and are urged in the direction of the bottom pinch rollers 67*a* by small coil springs 75. The upper pinch rollers 67 are thus in yielding contact with the lower pinch rollers 67*a* and the sheets are fed therebetween.

As a result of the gear train which is in mesh with the drive gear 27 no stresses are set up in the sheets being fed. In addition, the single direction of rotation of the feed member 30 (other than the initial short reverse motion to release the bottom-most sheet) and the continuing control of the sheet as it is being fed makes it possible to feed relatively thin sheets at high speeds. There is no stress set up within the sheet, as for example, by pinch rollers pulling the sheet in one direction while a vacuum feed member is pulling the sheet in opposite direction.

From the foregoing it will be seen that there has been provided a sheet feeding apparatus, capable of operating at high speeds and on a wide variety of sheet sizes and thicknesses.

I claim:

1. A high speed sheet feeding apparatus for leading individual sheets out of a stack of sheets along a desired path comprising a base plate, spaced upstanding side plates secured to the base plate, opposed first and second shafts carried by the side plates at their outer ends and extending inwardly of the side plates toward each other, a clutch member coupled to the first shaft, means including a drive shaft to impart rotary motion to the clutch member, a hollow perforate cylindrical sheet feed member coaxially carried between the first and second shafts, a hollow cylindrical vacuum chamber within the feed member, said vacuum chamber having at least one slot therein in communication with the interior thereof and a constant source of vacuum attached to said vacuum chamber, a rotatable plate operatively coupled to the sheet feed member, a plurality of

spaced pins carried by the plate and extending outwardly thereof, a pawl swingably disposed in the path of the pins to normally restrain the pins, a cam adjacent said pawl to swing the pawl into and out of engagement with the pins, a hopper to receive the stack of sheets having a bottom support and upstanding walls, said bottom support being provided with an opening therein through which the lowermost sheet can be extracted, said bottom support being non-vertically disposed and with the lowermost sheet in contact with the sheet feed member through the bottom member opening, rollers to guide the sheet as it is being fed by the sheet feed member, and a depending detent partially encircling the pin upon which it is brought to rest whereby when the pawl is initially released from the pin, the detent will impart a short counter revolution to the sheet feed member.

2. Apparatus according to claim **1** in which the first and second shafts are hollow, an elongated driven shaft is disposed within the first shaft secured at its outer portion to the clutch member and at its inner end to the sheet feed member and the vacuum source is connected to the second hollow shaft.

3. Apparatus according to claim **2** in which the clutch member includes the rotatable plate operatively coupled to the elongated driven shaft and an inner second plate for driving engagement with the first plate.

4. Apparatus according to claim **2** in which the feed member is freely carried upon the vacuum chamber and grasps the sheet along that portion of the feed member opening in register with the vacuum chamber slots.

5. Apparatus according to claim **2** in which the pawl is in the form of a bell crank lever having a roller thereon disposed in the path of the cam, and a spring is coupled to the pawl to yieldably urge it in the direction of the pins.

6. Apparatus according to claim **2** in which the rollers include spaced rollers on each side of the feed member, spaced yieldable rollers carried upon a transverse shaft, driven by the power source and riding upon the feed member rollers and at least one pair of pinch rollers transversely carried between the side plates to receive sheets coming from the feed member.

7. Apparatus according to claim **1** in which the cam comprises a first and a second disc carried upon the drive shaft, a cam lobe on each of the discs disposed in the path of the pawl bell crank lever and means to adjust the lobes with respect to each other to increase or decrease the dwell of the pawl bell crank lever.

8. A high speed sheet feeding apparatus comprising a frame, opposed first and second shafts carried by the frame at their outer ends and extending inwardly toward each other, clutch means coupled to the first shaft, means including a drive shaft to impart rotary motion to the clutch member, a hollow perforate cylindrical sheet feed member carried between the first and second shafts, a hollow cylindrical vacuum chamber within the feed member, said vacuum chamber having at least one slot therein, a source of vacuum in communication with the interior of said vacuum chamber, a rotatable plate operatively coupled to the sheet feed member, a plurality of spaced pins carried by the plate and extending outwardly thereof, a pawl swingably disposed in the path of the pins to normally restrain at least one of the pins, cam means to swing the pawl into and out of engagement with the pins, a non-vertically disposed hopper to receive the stack of sheets, a bottom support for said hopper, said bottom support being provided with an opening therein through which the lowermost sheet can be extracted, said lowermost sheet adapted to contact the sheet feed member through the bottom member opening, and a depending detent partially encircling the pin upon which it is brought to rest whereby when the pawl is initially released from the pin, the detent will impart a short counter revolution to the sheet feed member.

9. A high speed sheet feeding apparatus comprising a hollow cylindrical vacuum chamber having at least one slot in the wall thereof communicating between the exterior and interior thereof, a hollow perforate cylindrical sheet feed member rotatably carried upon the vacuum chamber, hopper means for supporting a stack of sheets adjacent the sheet feed member, drive means for rotating the sheet feed member so as to bring successive perforations in register with the vacuum chamber slots, clutch means interconnecting the drive means and the sheet feed member, a plate operatively coupled to the clutch means, a plurality of outwardly extending pins on said plate, a swingable pawl disposed in the path of the pins, a detent on said pawl adapted to overlie at least one of said pins when it is brought to rest and cam means to bring the pawl into and out of engagement with the pins to interrupt the sheet feeding apparatus.

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