

May 15, 1956

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2,745,665

SUCTION FEEDING MECHANISM

Filed Sept. 16, 1952

4 Sheets-Sheet 1

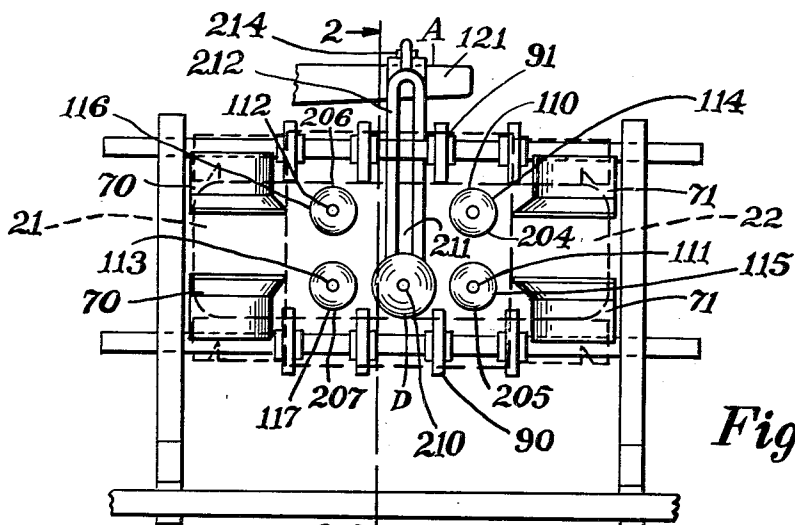


Fig. 1.

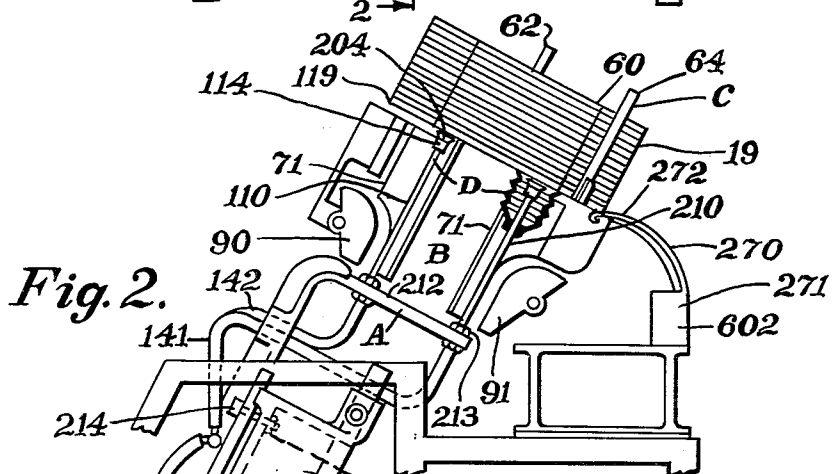


Fig. 2.

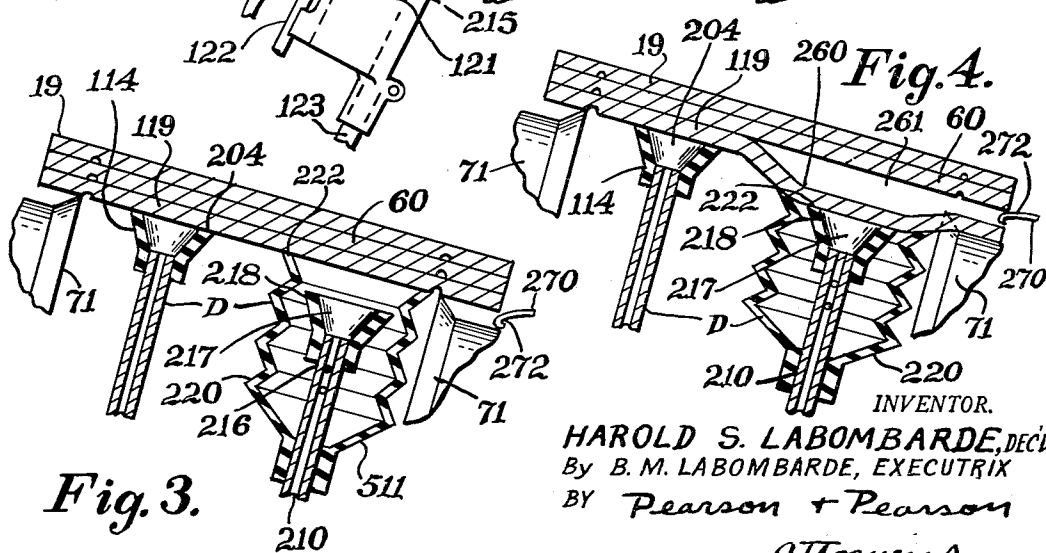
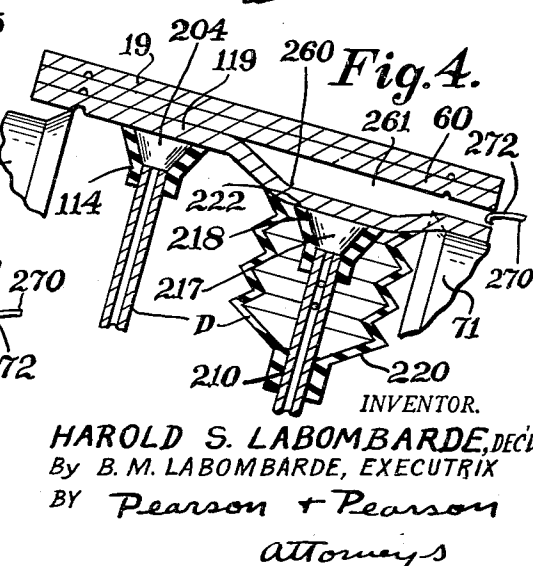


Fig. 3.



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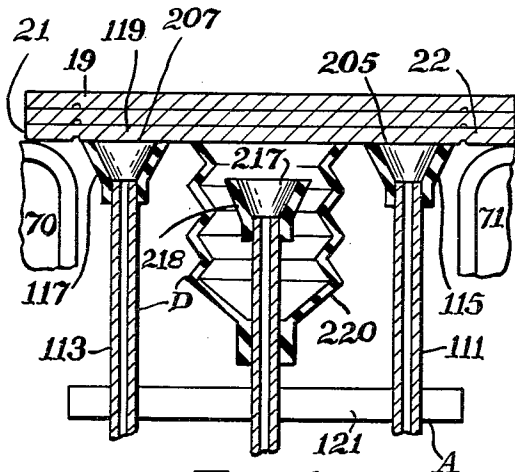


Fig. 5.

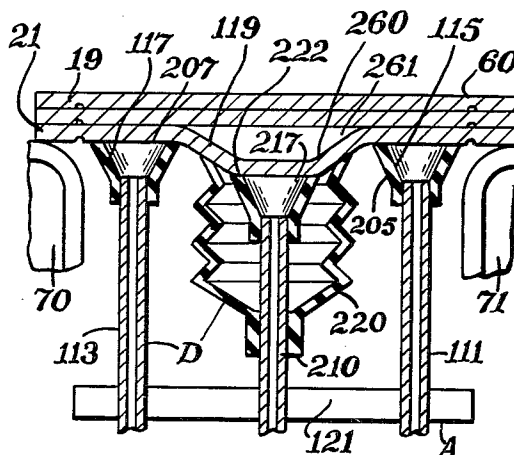


Fig. 6.

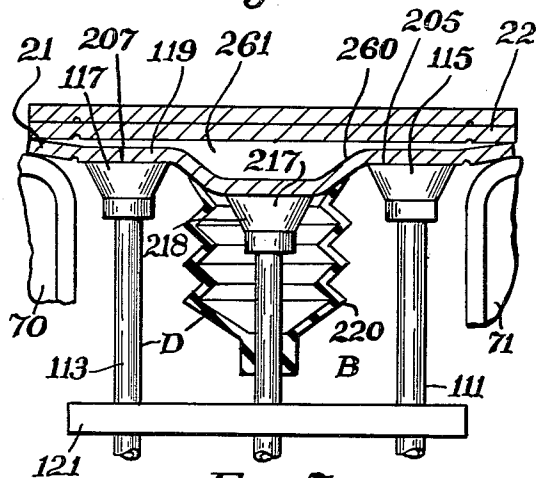


Fig. 7.

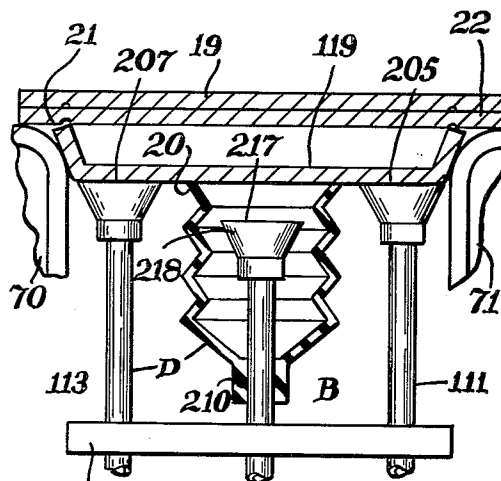


Fig. 8.

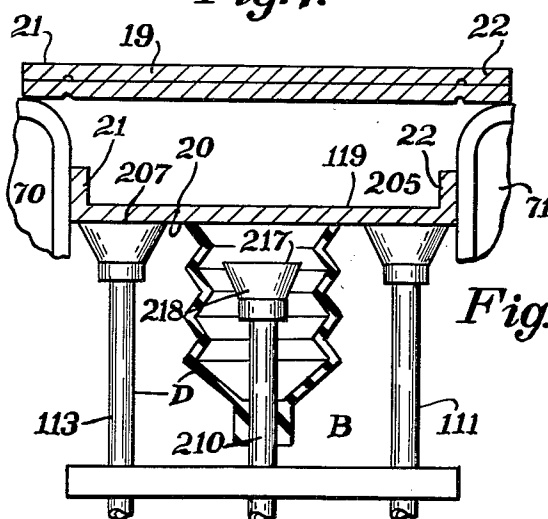


Fig. 9.

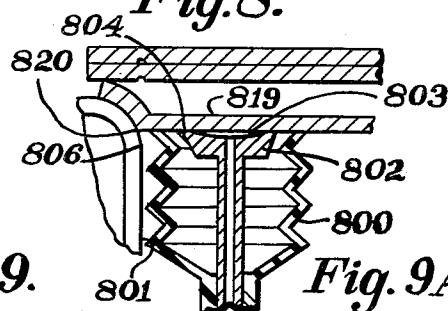


Fig. 9A

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## SUCTION FEEDING MECHANISM

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4 Sheets-Sheet 3

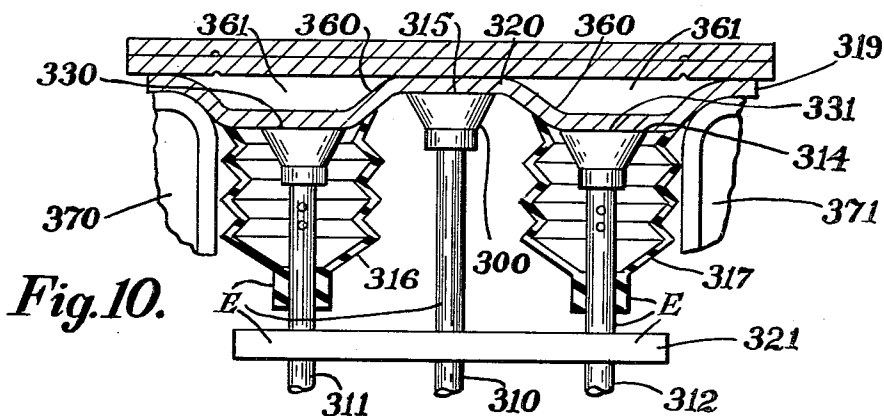


*Fig. 10.*

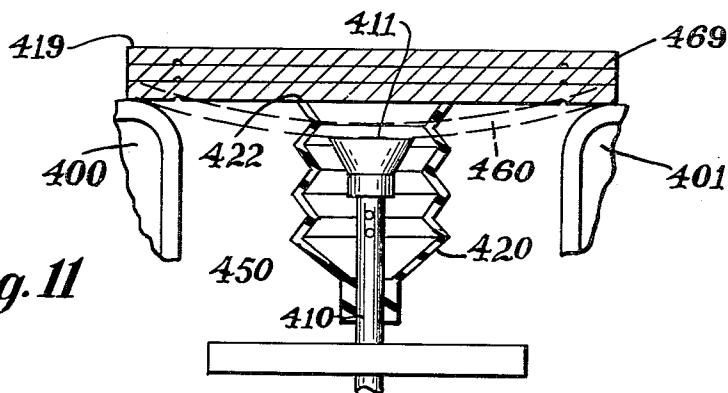


*Fig. 11*

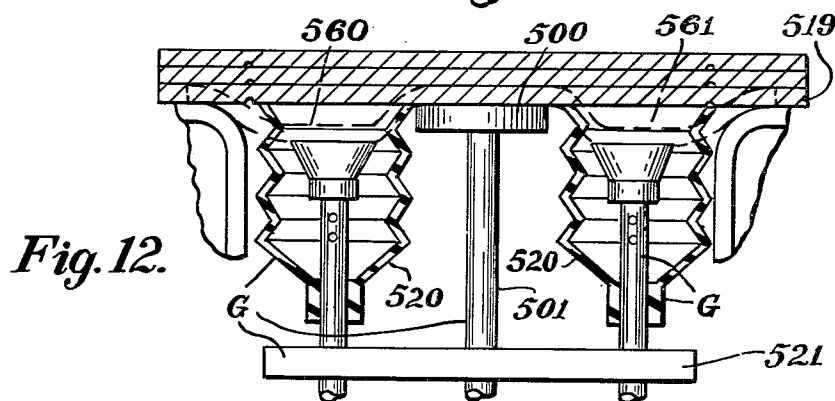


*Fig. 12.*

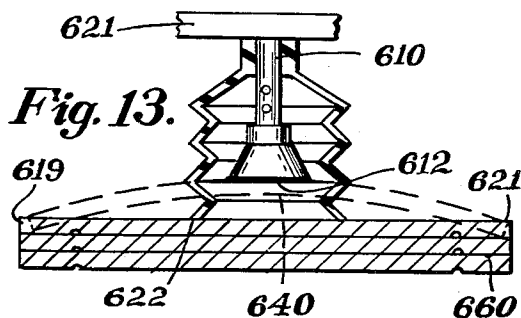


*Fig. 13.*

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SUCTION FEEDING MECHANISM

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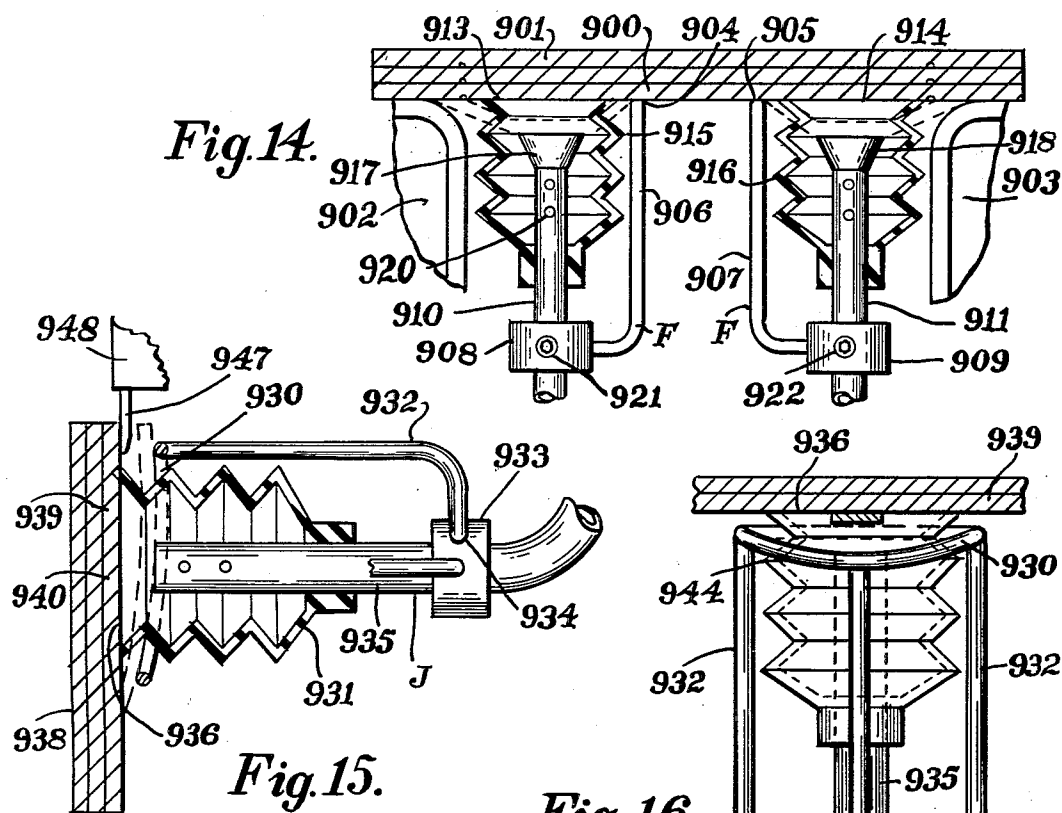


**Fig. 16.**

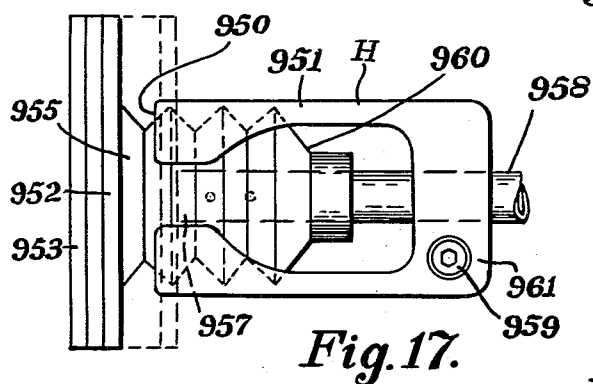
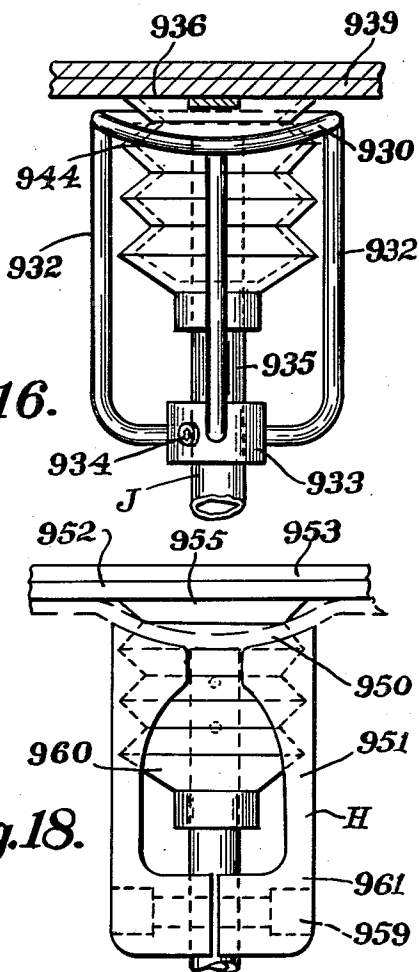
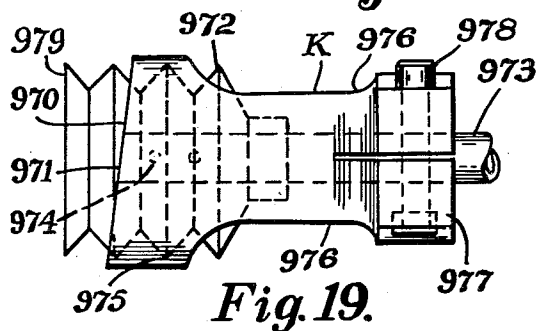


**Fig. 18.**



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## SUCTION FEEDING MECHANISM

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Application September 16, 1952, Serial No. 369,892

11 Claims. (Cl. 271-26)

This invention relates to a new suction device for use in separating an end sheet from a stack of bendable sheets. It is particularly useful in machines for making containers from flat blanks for example, folding apparatus for paper boxes, envelopes or the like.

In the paper box machine industry it is customary to first crease and slit a plurality of box blanks and then to place a stack of such blanks in magazines of various types in a folding machine. Mechanism has heretofore been provided on the folding machine for individually and successively removing the end blanks from an end of the stack and feeding the same to the holding apparatus. Such mechanism has been in the form of a reciprocating edge arranged to slide the end blank off the stack or has been in the form of a suction cupped, or vacuum cupped, arm arranged to grip the flat surface of an end blank and draw it away from the stack. At high speeds with such mechanism it has been found difficult to avoid the sliding or drawing off of several blanks at a time due to the adhesion of the blanks to each other.

The principal object of this invention is to provide an improved suction device which pneumatically adheres to an area of the flat surface of a bendable sheet, then pneumatically bends, bows or arches the adhered portion out of the plane of the sheet, while still adhered thereto, and then mechanically moves away with the bent, bowed or arched sheet still pneumatically adhered thereto.

Feeding devices of this type are called upon to feed many variations of thicknesses and sizes of boxboard or similar material and also different types of such material, some being porous enough to allow the suction applied to the first sheet to penetrate through to the second sheet. This causes the feeding of what are known as doubles and triples which produce an unusable product or may jam the folding or other mechanism. Another object of this invention is to prevent the feeding of doubles and triples, even on such porous material and yet be able to use a sufficient amount of suction to feed at high speeds and to avoid skipping.

On some types of blanks, particularly those not made of porous material, there is a tendency for one or more subsequent blanks to follow the first blank when operating at high speeds. This is usually caused by the creation of a vacuum when one of the blanks is drawn quickly away from the other. Another object of this invention is, therefore, to prevent the feeding of a double caused by such a vacuum as described above.

Another object of the invention is to provide an improved flexible suction device having a suction sleeve positioned around a suction tube, the sleeve having a flexible retractable mouth which adjusts itself to the curved configuration it creates in an end sheet of a stack.

Still another object of the invention is to provide a suction sleeve with a flexible, retractable mouth, the sleeve being of bellows shape and of resilient material thereby achieving an air tight seal during the retraction of the

sleeve mouth without the use of a slidable piston or cylinder.

An important object of the invention is the provision of a flexible suction bellows having a retractable flexible mouth surrounding a rigid suction tube and having a rigid surface positioned outside the mouth, the rigid surface being angularly and axially adjustable to various positions to limit and control the configuration of that portion of an end sheet bowed by the retractable mouth.

A further object of the invention is to provide a suction device usable on a number of types of sheet feeding machines by merely changing the position or style of the rigid surface associated therewith. For example the surface may include suction grips if it is desired to grip as well as guide, it may take the form of a portion of the inner wall of a cone or of a cylinder or of an inclined plane, if such a configuration of the end sheet is desired, or it may be entirely on the plane of the sleeve mouth if it is desired to restrain the end sheet from bending except opposite the sleeve mouth.

A still further object of the invention is to provide a new cooperation with a movable element such as a reciprocating knife, arranged to move into the space behind the portion of an end sheet bent by the retractable sleeve mouth of the suction device, achieved by the fact that the sleeve mouth is flexible.

Another object of the invention is to provide a suction device with a retractable flexible mouth and a rigid surface therearound in which the rigid surface is movable from a position parallel to the direction of the grain of the sheets in the stack to a position perpendicular thereto to take advantage of the maximum resistance to bending of such sheets.

For convenience, the invention herein is illustrated as applied to a paper box blank folding machine as shown in the co-pending application of Austin S. Chandler, filed March 23, 1951, Serial No. 217,121 entitled "Formless Paper Box Machine" said application being owned by the same assignee as this application. It is also illustrated as applied to a well known type of sheet feeder in which an arm is pivoted to draw the end sheet of a stack into the nip of a pair of feed rolls.

It should be understood, however, that the invention can be applied to many other machines wherein it is desired to separate an end sheet from a stack of bendable sheets by the application of suction on the surface of each successive end sheet of the stack.

In the drawings, Fig. 1 is a diagrammatic plan view showing the invention applied to a formless paper box machine and showing in dotted lines a typical box blank used therewith.

Fig. 2 is a diagrammatic side elevation on line 2-2 of Fig. 1 of the device shown in Fig. 1.

Fig. 3 is an enlarged fragmentary side elevation of one form of the new suction device in contact with an end sheet of a stack of blanks, the fixed rigid surface thereof including suction cups.

Fig. 4 is a view similar to Fig. 3 showing the device after air has been exhausted therefrom.

Fig. 5 is a side elevation showing the suction device in the position of Fig. 3.

Fig. 6 is a side elevation showing the suction device in the position of Fig. 4.

Figs. 7-9 are views similar to Figs. 5 and 6 showing the cycle of operations of the device as an end blank is withdrawn from a stack of blanks.

Fig. 9A is a view similar to Figs. 5-9 showing a suction tube mouth, including an enlarged flat portion nearly equal in area to the inside area of the suction sleeve.

Fig. 10 is a view similar to Fig. 6 of several of the new suction devices with a fixed suction member intermediate thereof.

Fig. 11 is a view similar to Fig. 5 showing my new suction device as it may be used without its fixed rigid surface member.

Fig. 12 is a view similar to Figs. 6 and 10 showing the form of the new suction device in which the fixed rigid surface is alongside the retractable sleeve mouth and does not include a suction cup therein.

Fig. 13 is a view similar to Fig. 5 of the new suction device as it may be used without its fixed rigid surface member in operating downwardly on a stack of blanks.

Fig. 14 is a view similar to Fig. 12 showing the preferred form of the invention with the fixed rigid surface attached in the preferred manner to the rigid suction tube so that it is angularly movable therearound.

Fig. 15 is a side sectional view of a substantially vertical stack of blanks showing the new suction device at the end of a pivoted arm and with the rigid surface defining a portion of the inside of a cone.

Fig. 16 is a plan view of the device shown in Fig. 15.

Fig. 17 is a view similar to Fig. 15 showing a rigid surface which defines a portion of the inside of a cylinder and made of sheet material rather than being skeletonized in wire.

Fig. 18 is a plan view of the device shown in Fig. 17.

Fig. 19 is a view similar to Fig. 17 showing a rigid surface defining an inclined plane surface and a suction tube mouth in the same plane as the surface.

As shown in Figs. 1 and 2, a type of machine on which this device is particularly useful is the above mentioned formless paper box machine which includes a magazine C for a stack of flat box blanks, a forming channel B for folding each blank into a box and a reciprocating carriage A with the improved suction device D for drawing each blank through the forming channel. For a more detailed description of such a machine, reference is made to said co-pending application. It should be understood, however, that my invention herein is not limited exclusively to formless paper box machines, but may be used to separate an end sheet from a stack of sheets regardless of whether the end sheet is thereafter slid edgewise off the stack or is surface drawn away from the stack.

A plurality of flat bendable sheets such as the paper box blanks 19 are shown forming a stack 60 in the upstanding guides 62, 64 of magazine C in Fig. 2. An end blank such as the lowermost blank 119 of stack 60 may be supported in any suitable manner, for example, on the upstanding curved portions of plates 70, 71 of forming channel B or on short lugs extending inwardly under the periphery of a blank 119. Such lugs are sometimes used in the magazines of other types of machines in which the magazine is spaced apart from the forming channel.

The forming channel B, as illustrated herein, is directly under the magazine and is rectangular in cross section with its four walls made up of a first pair of forming plates 70, 71 and a second pair of forming plates 90, 91 the second pair being transverse to the first pair of plates. The suction device D includes four or more suction tubes 110, 111, 112 and 113, each having suction cups 114, 115, 116 and 117 fixed at the free end thereof and each tube being fixed to a reciprocating carriage 121 slidable in tracks or guides 122, 123. The pneumatic operating means, or suction apparatus, includes a suitable suction pump and flexible tubes such as 141, 142 each connecting to a tube 110, 111, 112 and 113 and each controlled by a suitable valve all well known in the art and described in said co-pending application.

The effectiveness of feeding apparatus such as A, in separating the end sheet 119 from a stack of sheets such as 60, is greatly increased by the use therewith of the new suction device D shown in Figs. 1 to 9.

In this form of the invention, the rigid suction tube 210, and its fixed tube mouth 217, is positioned intermediate of a plurality of comparatively widely spaced fixed rigid surfaces 204, 205, 206 and 207 formed by the upper ends of tubes 110, 111, 112 and 113. Mouth 217

is on a lower plane than the ends of said tubes and preferably is located near an edge of a blank such as 119. In this form the rigid surfaces are provided with suction cups.

In the above mentioned application, the four suction cups 114, 115, 116 and 117 were shown as each located proximate a corner of the bottom panel of a creased blank because they function to draw the blank by its bottom panel through forming channel B. The suction device D with its suction tube 210 can however, not only be so associated with the bottom panel but can also be associated with one of the side or end panels of a flat blank since its grip is in this type machine is usually only temporary while it is bending or bowing the blank to separate it from its stack.

Suction tube 210 is adjustably fixed in a slot 211 of an arm 212 by nuts such as 213 and arm 212 is pivotally mounted on carriage 121 by screws such as 214 and nuts such as 215 in order that the tube may be fixed in any desired position and/or any desired height with relation to an end blank, or sheet, such as 119 of magazine C. At the upper, or free end 216 of suction tube 210 is the tube mouth 217, which is preferably in the form of a suction cup of rigid material such as 218. The fixed, rigid mouth 217 of fixed, rigid suction tube 210, at the top limit of the stroke of reciprocating carriage 121, is at all times spaced from the surface of the end blank or sheet, such as 119 of the stack 60.

The rigid surface formed by suction cups 114, 115, 116 or 117, fixed on moving carriage 121, periodically contacts the surface of an end blank 119, but while mouth 217 and tube 210 of suction device D accompany the rigid surface toward and away from the blank they do not contact the blank until it is pneumatically retracted in the direction of mouth 217.

A tubular imperforate suction sleeve 220 is mounted around the end 216 and mouth 217 of tube 210 having a base portion 211 air sealed around tube 210 and having a flexible sleeve mouth 222 in advance of tube mouth 217 of the suction tube. As shown, sleeve 220 is bellows shaped and of resilient material such as rubber, "neoprene" or the like so that sleeve mouth 222 springs back to its advanced position, after retraction to the plane of the mouth 217, by its inherent resiliency. As shown in Figs. 3 and 5, sleeve mouth 222 in its advanced position is on the same plane as the mouths of suction cups 114, 115, 116, 117 and contacts the undersurface of end blank 119 at the same time as the mouths of such cups and before air is exhausted from any of the suction pipes 110, 111, 112, 113 or 210.

As shown in Figs. 4 and 6 immediately after contact of the mouths of suction cups 114, 115, 116 and 117 and mouth 222 of sleeve 220 with said end blank, air is exhausted therefrom by means of flexible tubes such as 141, 142 and a suitable valve and air pump well known in the art and shown in the above mentioned co-pending application. While each suction cup 114, 115, 116 and 117 grips its portion of the area of the end blank 119, mouth 222 of sleeve 220 not only grips an area thereof but also retracts to the plane of mouth 217 of tube 210 thus creating a bend 260 in the blank 119. An air space 261 is thus created between blank 119 and the next succeeding blank 19, thereby destroying any vacuum therebetween and counteracting the usual adhesive force by which the flat surfaces of two overlying sheets are held together. Upon arriving in the plane of mouth 217 of tube 210, the bend 260 in blank 119 may also be gripped by the suction of mouth 217 as well as by the suction of mouth 222 of sleeve 220.

One or more leaf springs 270 may be provided, each having one end 271 mounted on a machine frame piece such as 602, and each having a downwardly curved free end 272 positioned under the edge of a blank 119 proximate the contact point of mouth 222 of sleeve 220 with the blank. As best shown in Figs. 3 and 4, each

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spring 270 is flexed downwardly by the convex side of bent portion 260 of blank 119 and then springs or reflexes upwardly over the edge into the concavity 261 of the bend, and into contact with the undersurface of the next lowermost blank of the stack 60. Spring 270 thus assists the sleeve 220 in creating and maintaining an air space 261 above the end blank 119 each time an end blank is bent out of its flat plane by the retractable mouth 222.

As shown in Fig. 7 fixed suction cups 114, 115, 116 and 117, as well as sleeve mouth 222 and tube mouth 217 maintain their grip on the undersurface of blank 119 as the moving carriage 121 commences its downward stroke through forming channel B, the bend 260 usually being retained until the air space 261 created therebehind has expanded over the entire surface of the blank. The folding guides 70 and 71 are thus caused to upfold the articulated panels of blank 119, such as 21 and 22, and the suction cups 114, 115, 116 and 117 by maintaining a constant suction grip on the bottom panel 20, assure that the upfold will take place at the line of articulation of panels 21 and 22.

In Figs. 8 and 9 are shown the fixed suction cups 114, 115, 116 and 117 continuing to maintain their suction grip on bottom panel 20 of blank 119 as it is drawn downwardly through the forming channel B by carriage 121, thereby setting up the blank into a box. However, the suction in pipe 210 has been released by suitable valves so that mouths 222 and 217 have released their grip. The resilient sleeve thus returns to its advanced position and the bend 260 is eliminated from the blank 119 as it continues through forming channel B.

By including suction cups in the rigid surface surrounding sleeve 220 it is possible to grip and hold a blank 119 in exact alignment with forming channel B and at the same time create a temporary bend in the blank intermediate of the two suction cups.

Instead of providing comparatively widely spaced rigid surfaces 204, 205, 206 and 207 around the retractable mouth 222, as shown in Fig. 10, I may use a suction device E similar to D, except that the suction sleeves such as 316, 317 are spaced around a fixed rigid surface 315. The rigid surface 315 may be the mouth of a suction cup 300 at the end of a rigid suction tube 310 and may be positioned opposite the central portion 320 of the surface of a blank 319. Before the exhaustion of air through tubes 310, 311 and 312, the mouths 313 and 314 of retractable suction sleeves 316 and 317 are on the same plane as the mouth 315 of fixed suction cup 300 and all contact the undersurface of blank 319 together at the top of the stroke of a reciprocating carriage 321. Upon exhaustion of air through tubes 310, 311 and 312, the mouths 313 and 314 retract to the plane of mouths 330, 331 of tubes 311 and 312, thus creating bends such as 360 around the periphery of blank 319 and creating an air space 361 therearound. Upon movement of carriage A downwardly through the forming guides 370, 371 the suction in tubes 311 and 312 may be released thus straightening bends 360, 361 and fixed suction cup 300 continues to draw blank 319 through the forming channel.

As shown in Fig. 9A, when a suction sleeve such as 800 is located near forming channel walls, such as 801, the fixed tube mouth 802 may include an enlarged flat portion 803. The outer edge 804 of the flat portion 803 is spaced from but proximate the inside wall 806 of the sleeve 800 near channel wall 801 and preferably throughout its perimeter. This construction assists in creating a fold at the line of articulation 820 of a blank such as 819. It is also obvious that the sleeve 800 and the flat portion 803 could be of polygonal rather than circular cross section thus permitting installation in the rectangular corners of a forming channel if desired.

As indicated in Fig. 11, a sleeve 420, without a rigid surface element, is useful between stationary supports

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400, 401 for the stack 469 of blanks such as 419. Upon exhaustion of air through tube 410, the sleeve mouth 422 retracts to the plane of tube mouth 411 to create a bend 460 in blank 419 which extends between stationary supports 400 and 401. Instead of thereafter releasing the suction in tube 410, it is retained while the suction sleeve 420 draws the blank 419 entirely through the forming channel such as 450.

In Fig. 12, at G is shown a preferred construction with a rigid surface 500 fixed on a rod 501 which in turn is fixed on a reciprocating carriage 521, there being no suction cups included in surface 500. A plurality of suction sleeves 520 are positioned around surface 500, near the periphery of the sheet, which upon exhaustion of air therefrom, create bends 560 in blank 519 and an air space 561 similar to those shown in Fig. 10. Instead of releasing the suction in the sleeves 520, after bending takes place, the suction is maintained while they draw the blank through the forming channel in its slightly bowed or bent condition.

In Fig. 13, is shown a sleeve 620 without a fixed rigid surface as it may be applied from above to a stack 660 of blanks, or sheets, such as 619. The weight of the peripheral surface 621 of each sheet 619 causes a bend or bow 640 to occur therein as the mouth 622 of suction sleeve 620 retracts to the plane of mouth 612 of suction tube 610. Thereafter the suction in device G can be retained while the moving member 621, on which it is mounted, is further withdrawn from the stack, or the suction can be released and the end blank 619 slid off the stack by mechanism well known in the trade and not shown herein. As in the other rigid suction tubes of the invention, perforations 660 may be provided to maintain suction in the bellows 620 after retraction.

The term "flexible" is used in describing the sleeve mouth of my device to mean a mouth of rubber, fabric or similar material which is conformable to the shape of surfaces it contacts and to distinguish it from the suction tube, suction tube mouth and rigid surface of the device which might be of slightly flexible material but which preferably are of metal or hard rubber called "rigid" herein. The term "fixed" is used herein to describe the parts of the new suction device which remain in the same relative position to each other while the flexible mouth of the suction sleeve is pneumatically retracted.

The suction sleeve of the device could theoretically be partly of rigid material and partly of flexible material and it is therefore described as imperforate with an air sealed base and a mouth of flexible imperforate material thereby intending to include any sleeve mainly of flexible, imperforate material expandable and contractable like a bellows and having a flexible mouth portion which can be pneumatically retracted.

The rigid surface outside the periphery of the suction sleeve may, as described above, be entirely in the plane of the unretracted sleeve mouth. It is never in advance of the sleeve mouth and some part thereof is always in advance of the tube mouth. In other words it may be shaped to hold the blank flat or shaped to limit the amount of bow in the blank.

In Fig. 14 another construction of the preferred form of my device is shown, the elements thereof being the same as in the device of Fig. 12 and mounted in an equivalent manner. An end blank 900, of a stack 901, is supported on members 902, 903 and the suction device F reciprocates toward and away from the stack. A fixed rigid surface 904, 905 is positioned in the same area as the surface 500 of Fig. 12 but, instead of a single supporting member 501, each surface is provided with a supporting member such as 906, 907 supported by a collar such as 908, 909 carried by a suction tube such as 910, 911. The fixed rigid surfaces 904 and 905 are on the same plane as the unretracted flexible sleeve mouths 913, 914 of the imperforate suction sleeves 915, 916 and are in advance of the fixed rigid tube mouths 917, 918. Per-

forations such as 920 are provided in each tube such as 910 to maintain suction in the sleeve after retraction. Set screws 921, 922 are provided in collars 908, 909 to permit each supporting member and its fixed rigid surface to be moved around the suction sleeve mouth, or back from the plane of the sleeve mouth, to permit various desired angular relationships therebetween. It will be apparent that a fixed rigid surface such as 500 in Fig. 12 or 204 in Fig 3, can be similarly positioned in various angular relationships to their suction sleeves by means of nuts such as 213 and slots such as 211 in the reciprocating carriage such as A.

In Fig. 15, a suction device G, is shown similar to the suction device F except that the rigid surface 930 extends entirely around the suction sleeve 931 and has been moved rearwardly on suction tube 935 by means of members 932, collar 933 and screw 934, whereby no part of the surface is in the plane of the unretracted suction sleeve mouth 936. The device G is shown as it may be applied to a type of sheet feeder in which the stack of blanks 938 is substantially vertical and only the upper portion 939 of the endmost blank 940 is moved away from the stack and into the nip of feed rolls, not shown, by the suction device. The lower portions of the blanks 943 in stack 938 are held back by well known mechanism and the suction tube 935 is curved and pivoted to follow a curved path also in a well known manner.

As best shown in Fig. 16, the fixed rigid surface 930 is in the plane of a segment of the inside of a hollow truncated cone thus forming a conoidal bowed surface in each endmost blank 939 when the sleeve mouth 936 adheres to a blank and retracts with it toward the fixed rigid suction tube mouth 944. In the position shown, the apex of the cone segment formed by rigid surface 930 is at the lower portion of the stack of blanks. However, blanks placed in the stack usually have a uniform direction of the fibres therein, called the grain and bow more easily parallel to the grain than transverse to the grain. Since the suction device such as G forces a bow in the endmost blank, it is advantageous to have the next endmost blank in the position offering the most resistance to bowing. Therefore, depending on the particular direction of the fibres of the blanks in the stack the rigid surface 930 of the suction device G may be moved through an angle of 90° to force a bow in the blank in a direction transverse to the direction of the fibres of the blanks. In so doing the apex of the cone segment formed may be toward a side edge rather than toward the top or bottom edge of the blanks.

As also shown in Figs. 15 and 16, instead of a leaf spring such as 270 to hold back the next endmost sheet, by reason of the flexible mouth of the suction sleeve of the device, a positively reciprocating element, such as a knife 947, may be used for this purpose. Knife 947 is mounted on the magazine 948, in any well known manner and its use with the new section device achieves the new result that, even if the magazine is empty, the reciprocation of the knife cannot damage the suction sleeve or suction sleeve mouth which simply flexes out of the way.

In Figs. 17 and 18, a suction device H is shown similar to suction device G except that the fixed rigid surface 950 of the fixed rigid member 951 is in the plane of a segment of the inside of a hollow cylinder and the member 951 is of sheet material rather than skeletonized in wire. The endmost blank 952 of a vertical stack 953 which the imperforate flexible suction sleeve mouth 955 of sleeve 960 has pneumatically adhered thereto and pneumatically retracted therewith is given a curved, bowed or arched configuration. As in all of the suction devices described herein, the fixed rigid surface 950 has no portion in advance of the sleeve mouth 955 and has at least some portion in advance of the fixed rigid tube mouth 957 of fixed rigid suction tube 958. A suitable collar 961 and set screw 959 is provided for moving member 951 longitudinally along tube 958 or angularly around tube 958 to

conform to the direction of the grain of the blanks as explained above.

In Fig. 19 is shown a suction device K, similar to suction devices G and H except that the fixed rigid surface 970 is in a common plane with the fixed rigid tube mouth 971, the plane being inclined rather than curved. The imperforate suction sleeve 972, fixed rigid tube 973 and perforations 974 in the tube 973 are the same as in the other views above. A portion of the fixed rigid member 975 is broken away at 976 to conserve material and a suitable collar 977 and set screw 978 are provided for the purposes described above.

The mouth 979 of sleeve 972 is not shown in contact with a blank in this view to illustrate the fact that the suction sleeve mouths of my invention may be well in advance of the rigid portions of the device. High speed feeding is thus achieved because the end blank is seized by the advanced suction sleeve mouth, at the instant of contact, and remains air sealed thereafter while the blank is retracted with a constant firm grip. No air leakage occurs regardless of the angle of approach or configuration of the blank and the blank is positively gripped at once and continues so gripped throughout the feeding operation.

I claim:

1. In a suction device, for use in sheet feeding, the combination of a rigid suction open tube; an open rigid tube mouth at the end of said tube; an imperforate flexible, resilient bellows shaped suction sleeve surrounding said tube mouth and having its base fixed to and air sealed around the tube in rear of the tube mouth; air passages through the tube wall between said tube mouth and said sleeve base, and an imperforate, integral, flexible, sleeve mouth on said sleeve in advance of said tube mouth; a rigid member fixed to said suction tube in rear of said sleeve base and movable with said tube, said member having a rigid surface adjacent but outside the perimeter of said sleeve mouth, at least some portion of which surface is in advance of the tube mouth but none of which surface is in advance of the sleeve mouth, said sleeve mouth being retractable in the direction of said tube mouth when a sheet seals said sleeve mouth and suction is applied through said suction tube.

2. A combination as specified in claim 1 wherein the rigid surface of said rigid member outlines a substantially closed figure around the sleeve mouth in the plane of a segment of the inside of a hollow cylinder, for forming a correspondingly shaped bow in a sheet when said suction mouth is retracted.

3. A combination as specified in claim 1 wherein the rigid surface of said rigid member outlines a substantially closed figure around the sleeve mouth in the plane of a segment of the inside of a hollow truncated cone, for forming a correspondingly shaped bow in a sheet when said suction mouth is retracted.

4. A combination as specified in claim 1 wherein the rigid surface of said rigid member outlines a substantially closed figure around the sleeve mouth and said rigid surface and the mouth of said suction tube are in a common curved plane, for cooperatively bowing an adhered portion of a sheet into said common curved plane when said suction mouth is retracted.

5. A combination as specified in claim 1 wherein the rigid surface of said rigid member includes a plurality of suction cups outlining a substantially closed figure around the sleeve mouth.

6. In a suction device, for use in sheet feeding, the combination of a rigid suction open tube; a rigid open tube mouth at the end of said tube; an imperforate flexible, resilient bellows shaped suction sleeve surrounding said tube mouth and having its base fixed to and air sealed around the tube in rear of the tube mouth; air passages through the tube wall between said tube mouth and said sleeve base; a flexible imperforate integral sleeve mouth on said sleeve in advance of said

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tube mouth, said sleeve mouth being retractable in the direction of said tube mouth when a sheet seals said sleeve mouth and suction is applied through said suction tube.

7. In a suction feeding device for individually and successively separating an end sheet from a stack of flat bendable sheets in a magazine the combination of a rigid suction tube; a rigid tube mouth at the end of said tube; an imperforate flexible, resilient, bellows shaped suction sleeve surrounding said tube mouth and having its base fixed to and air sealed around the tube in rear of the tube mouth; air passages through the tube wall between the tube mouth and the sleeve base; a flexible integral imperforate sleeve mouth on said sleeve in advance of said tube mouth; a rigid member fixed to said suction tube in rear of said sleeve base and movable with said tube, said member having a rigid surface beyond the perimeter of said sleeve mouth, at least some portion of which surface is in advance of the tube mouth but none of which surface is in advance of the sleeve mouth; suction means connected to said suction tube for causing said sleeve mouth to adhere to an individual end sheet of said stack and for causing said bellows shaped sleeve to retract said sleeve mouth in the direction of said tube mouth while so adhered and mechanical means for successively moving said tube rigid member and sleeve away from said stack with an end sheet adhered to said retracted sleeve mouth.

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8. A combination as specified in claim 7 wherein said rigid surface includes a suction cup operatively connected with said suction tube to adhere to each end sheet simultaneously with the mouth of said suction sleeve.

9. A combination as specified in claim 7 wherein said rigid surface outlines a substantially closed figure around the sleeve mouth, said figure being in at least two planes, each at a different distance in advance of said tube mouth and adapted to form a directional bow in an end sheet during retraction of the sleeve mouth.

10. A combination as specified in claim 9 plus a split collar on said member, encircling said tube for changing the angular relationship of said rigid surface with said rigid tube mouth in accordance with the direction of the grain of the sheets in said stack.

11. A combination as specified in claim 7 plus an element, associated with said magazine, mounted to move into and out of the space under that portion of an endmost sheet adhered to, and retracted by, the mouth of said sleeve in synchronization with said retraction.

#### References Cited in the file of this patent

##### UNITED STATES PATENTS

|           |        |               |
|-----------|--------|---------------|
| 1,585,368 | Blaine | May 18, 1926  |
| 2,163,274 | Dixon  | June 20, 1939 |