Nov. 10, 1959 H. R. FRANKLE ET AL 2,912,240

PAPER FEED

Filed March 31, 1955 4 Sheets-Sheet 1

Fig. 1.

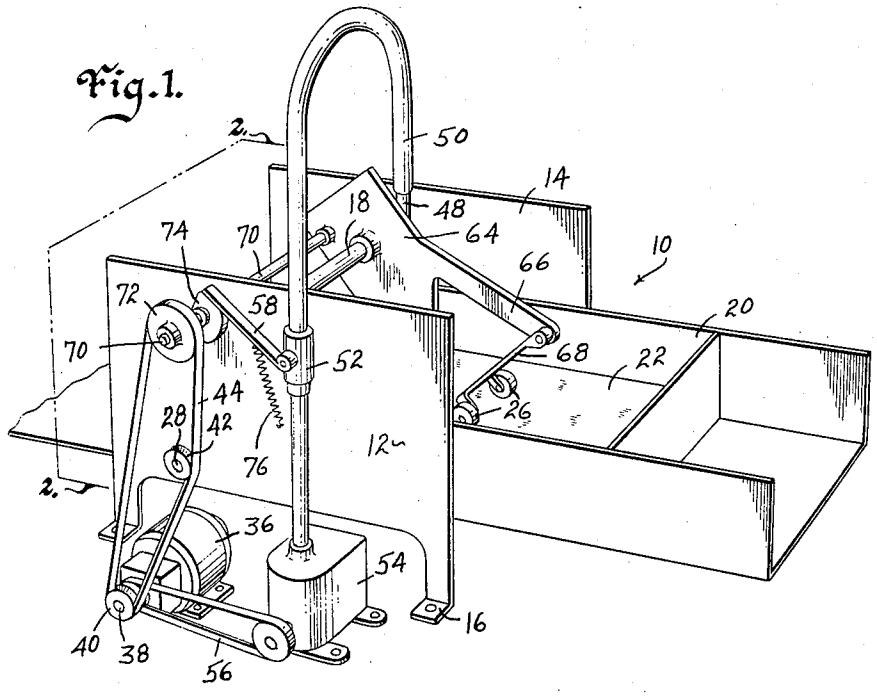
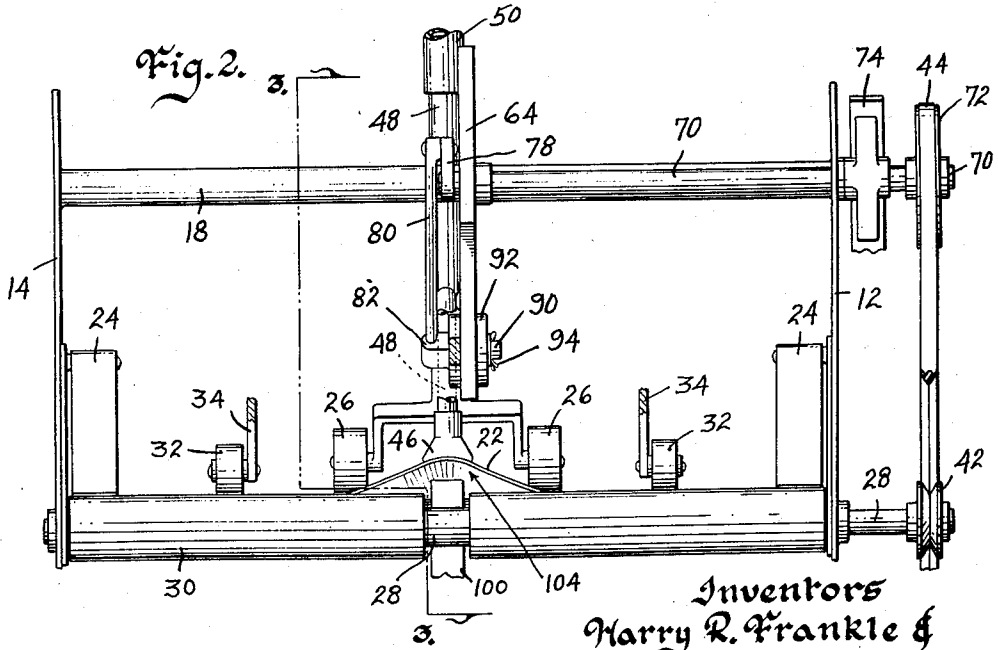


Fig. 2.



Witness
Edward P. Seeley

Inventors
Harry R. Frankle &
Perry T. Crane
by Talbert Dick & Adler
Attorneys

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Fig.3.

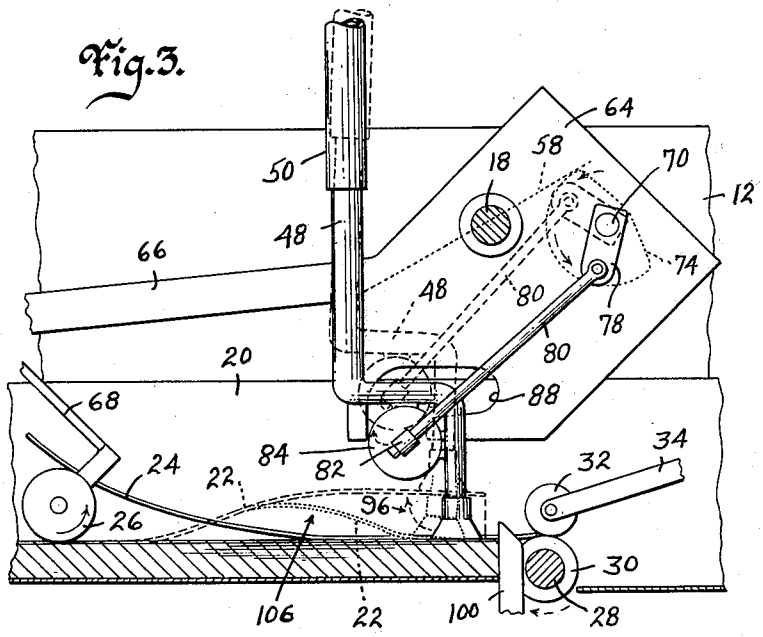


Fig.5.

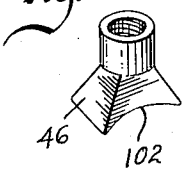


Fig.4.

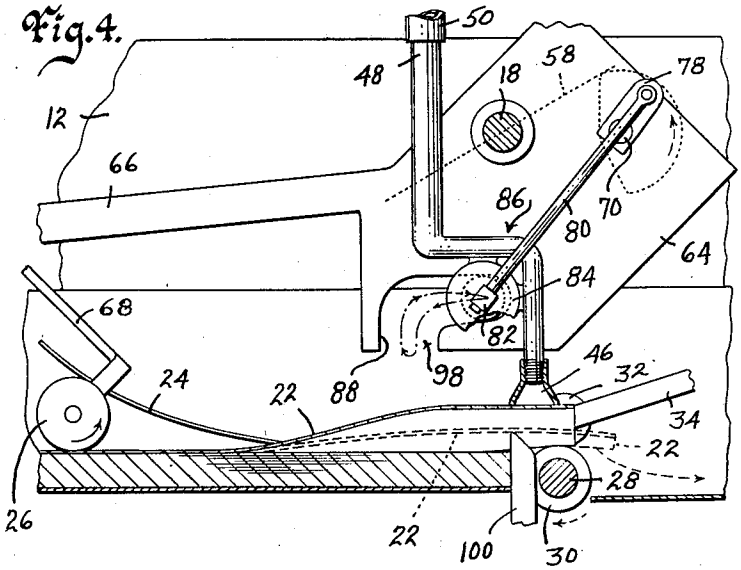
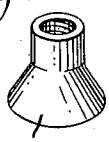


Fig.6.



Inventors
Harry R. Frankle &
Perry T. Crane
by Talbert Dick & Adler
Attorneys

Witness
Edward P. Seeley

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Fig.7.

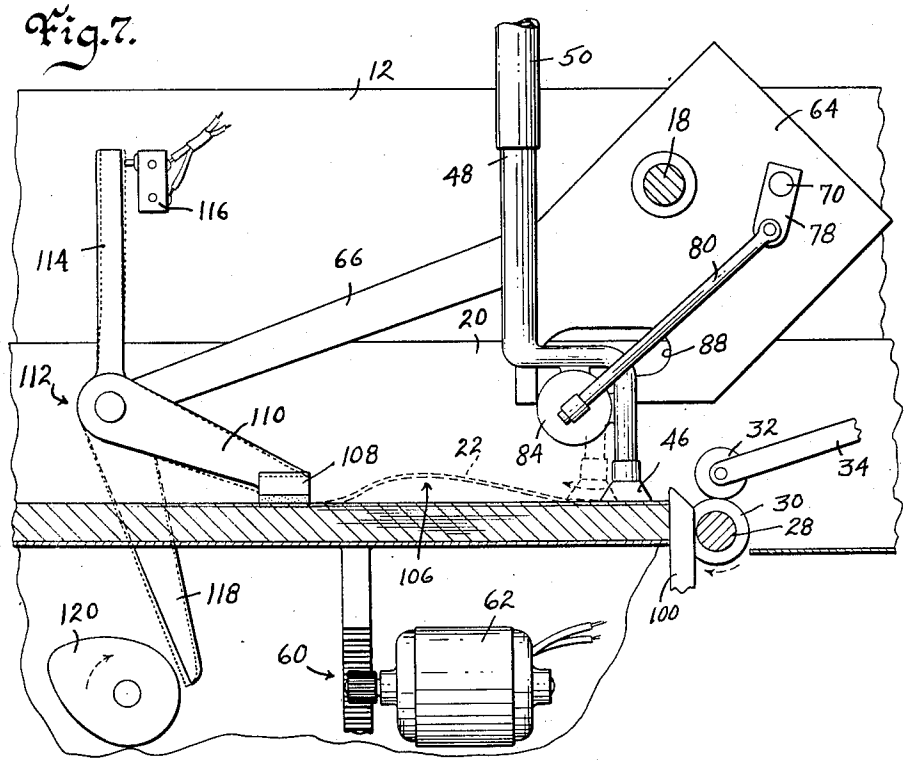
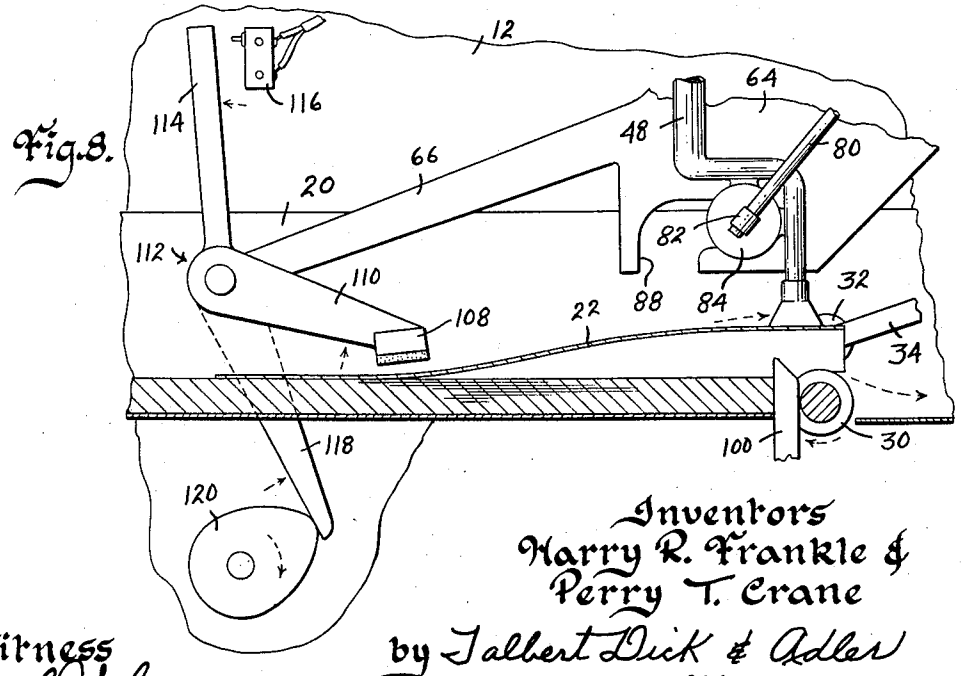


Fig.8.



Inventors
Harry R. Frankle &
Perry T. Crane
by Talbert Dick & Adler
Attorneys

Witness
Edward P. Luby

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Fig. 9.

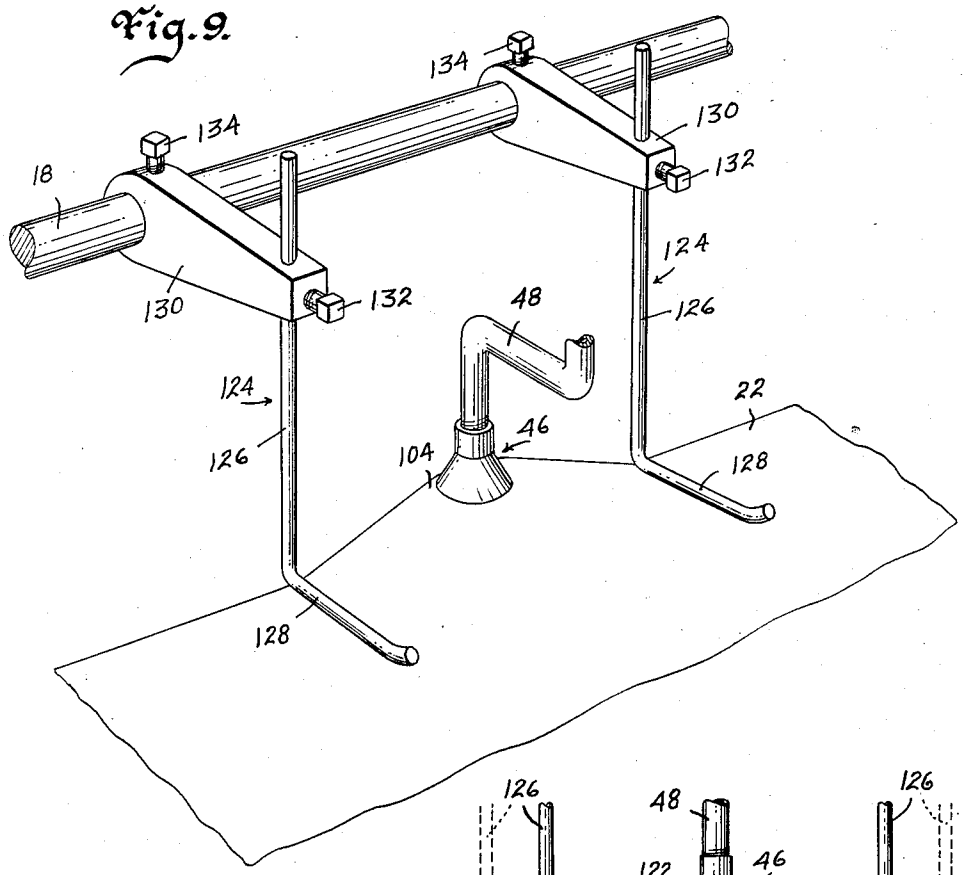


Fig. 10.

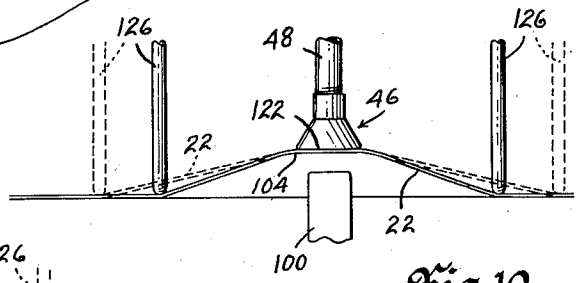
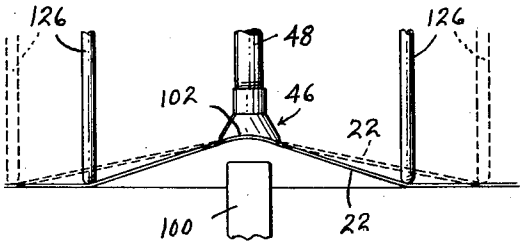


Fig. 11.



Witness
Edward P. Seeley

Inventors
Harry R. Frankle &
Perry T. Crane
by Talbert Dick & Adler
Attorneys

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PAPER FEED

Harry R. Frankle and Perry T. Crane, Des Moines, Iowa

Application March 31, 1955, Serial No. 498,128

11 Claims. (Cl. 271—20)

Our invention relates to improvements in automatic paper feeds for use with duplicating machines, printing presses and the like.

One of the major problems in high speed paper feeders is to maintain a consistent feeding of single sheets and to avoid the feeding of more than one sheet at a time. This problem varies inversely relative to the thickness of the paper used and consequently when thin paper such as that known as onion skin, for example, is used, it has been found that the feeding of more than one sheet at a time is not at all uncommon.

It is therefore one of the important objects of this invention to provide a noval paper feed mechanism that will consistently feed a single sheet of relatively thin paper at high rates of speed.

Another object of this invention is to provide a paper feed which embodies novel means for assuring the separation of stacked sheets in the feed operation. More particularly this is accomplished generally by a vertical stop at the front of the paper receiver or holder and a releasable paper hold down member engageable with the top of the stack at the rear portion thereof. A vacuum or suction foot is used to crimp or buckle the top sheet near the front, move it first rearwardly whereby it will buckle at the rear from contact with the hold down member, and then move it forwardly over the stop where ejection rollers or other means carry it to the proper destination. The buckling of the paper at both front and back each serve to separate the sheets and depending upon the thickness of paper, the means for causing the buckling at the two points indicated may be employed individually or together as will later appear.

These and other objects will be apparent to those skilled in the art.

Our invention consists in the construction, arrangements, and combination, of the various parts of the device, whereby the objects contemplated are attained as hereinafter more fully set forth, specifically pointed out in our claims, and illustrated in the accompanying drawings, in which:

Fig. 1 is a perspective view illustrating generally a paper feed apparatus to which our invention is applied,

Fig. 2 is an enlarged front elevational view of this paper feed taken from the line 2—2 of Fig. 1,

Fig. 3 is an enlarged side view partially in section of our new feed mechanism and is taken from the line 3—3 of Fig. 2 to show the sucker foot in initial stages of movement as indicated by the solid and broken lines respectively,

Fig. 4 is similar to Fig. 3 but shows the sucker foot about to release the paper, in solid lines, and the paper also shown in dotted lines after release as moving over the stop,

Figs. 5 and 6 are perspective views respectively of different shaped sucker feet,

Figs. 7 and 8 are enlarged side elevational views of this feed similar to Figs. 3 and 4 but showing a modified

arrangement for the rear paper hold down foot at the rearward portion of the sheet,

Fig. 9 is an enlarged fragmentary perspective view illustrating a novel paper hold or bumper means at each side of the suction foot, and

Figs. 10 and 11 are reduced front elevational views respectively of different types of sucker feet showing the use of the hold down members of Fig. 9.

Referring to the drawings the feed apparatus shown generally at 10 in Fig. 1 is merely illustrative of the cooperative relationship of several well known elements in devices of this class and consists of the following parts: A pair of upstanding spaced apart plates or support members 12 and 14 are provided with feet 16 for attachement to a table or the like (not shown) and may have the connecting cross member 18 to add rigidity. Disposed between plates 12 and 14 and on a horizontal plane is the open top box-like paper receiver or holder 20 in which is placed a supply of sheets of paper 22. As shown in Fig. 1 the paper 22 is fed from right to left which will be referred to herein as the rear and front respectively of this device to define the rear and forward edge of the paper to be fed. Resilient paper retainers or hold down members in the form of spring arms 24 may be secured to the respective inner sides of plates 12 and 14 to yieldingly engage the top of paper stack 22 if necessary. Likewise, one or more paper hold down rollers 26 (Figs. 1–4) which will later be described in detail may be suitably mounted to engage the rearward portion of sheets 22 and as indicated rotate only counterclockwise to allow for the forward movement of the respective sheets 22.

Between the lower forward portion of plates 12 and 14 and at the forward end of paper holder 20 there is rotatably disposed a shaft 28 which carries the lower ejection roller 30. A pair of upper ejection rollers 32 engage the lower roller 30 as shown in Fig. 2 and are suitably mounted by a bracket arm 34 to a supporting member (not shown) in a manner well known in the art. Shaft 28 is rotated clockwise (Figs. 3 and 4) by any suitable means here represented by the motor 36, motor shaft and pulley 38 and 40 respectively, pulley 42 on shaft 28 and belt 44 as shown in Fig. 1 and it will of course be understood that rotation of shaft 28 causes a counterclockwise rotation of rollers 32. These rollers 32 are illustrative of any one of several means which might be employed to carry the sheets 22 to a duplicating machine or the like and may take the form of fingers, grippers or other suitable means which are not material to this invention. A suction foot 46 is suspended over the paper 22 and centrally positioned relative to the sides thereof and near the forward edge. This foot is attached to the lower end of a rigid air tube 48 which at its other end is journalled in a flexible air tube or hose 50. Tube 50 connects to a valve means 52 which in turn is operatively connected to an air pump 54 operated by motor 36 by a belt connection 56 in an obvious manner. Means for opening and closing valve 52 is represented here by lever 58 and will later be described in detail as to its function. Means are also usually employed to raise the floor of paper holder 20 as needed and this is illustrated in Fig. 7 by the rack and pinion arrangement 60 connected to a motor 62. Thus far described we have merely indicated common elements in paper feeds of the type here involved and no invention is claimed in such parts per se. It will be appreciated that in feeds of this kind, a sheet of paper is picked up by the suction foot which carries it into contact with the ejector rollers or the like for movement into a duplicating machine, printing press or the like. Due to the problems encountered by the suction foot carrying more than one sheet at a time we

have made some novel improvements which we shall now describe.

A supporting plate 64 is vertically disposed between plates or sides 12 and 14 and is mounted to the cross member 18 so that air tube 48 is closely adjacent that side nearest side 14 as shown in Fig. 2. An integral arm 66 projects rearwardly from plate 64 and to the outer end is pivotally secured the support 68 which carries the hold down rollers 26 previously mentioned. Support 68 is so connected to arm 66 that it can be adjusted to increase or decrease the pressure against paper 22. A shaft 70 is rotatably arranged between the forward upper portions of plate 64 and side 12 in substantial vertical alignment with roller 30 and projects through side 12 to the outer side where a pulley 72 thereon is engaged by belt 44. On shaft 70 intermediate pulley 72 and the outer side of member 12 is placed the cam 74 which engages the outer end of lever 58 that operates valve 52. A spring 76 connects lever 58 to plate 12 to normally urge it downwardly and thus lever 58 is alternately raised and lowered to open and close valve 52 and is synchronized to open and provide suction to foot 46 when it picks up a sheet 22 and to close so as to release the suction when foot 46 reaches a position as will later appear when sheet 22 is to be released.

This relative operation between foot 46 and valve 52 is well known in the art but has been described to more clearly understand our invention.

On the same side of plate 64 as air tube 48 we have mounted a crank arm 78 connected at one end to shaft 70 for rotation therewith. To the opposite end of crank arm 78 one end of a connecting rod 80 is pivotally secured and extends therefrom downwardly and rearwardly for connection to a collar 82 which is secured to a disc like plate 84 that in turn is attached to the metal air tube 48. For this purpose tube 48 which is vertically disposed is bent first horizontally and then downwardly as indicated at 86 (Figs. 3, 4, 7 and 8) so that plate 84 can be rigidly secured to tube 48 at two points adjacent the inner side of the corner formed by the bend 86 and it will be understood of course that the particular shape of tube 48 is immaterial so long as it is inadequately supported. In this position plate 84 is adjacent the lower portion of plate 64 in which is formed a curved slot or notch 88 that opens at the bottom of plate 64 and extends upwardly and forwardly as shown. Slot 88 serves as a guide retainer for plate 84 which has the short shaft 90 that extends through this slot to the other side of plate 64 where the washer 92 and cotter pin 94 hold it in position. Thus arranged it is pointed out that when shaft 70 is rotating crank arm 78 moves as indicated by the arrows and rod 80 moves plate 84 first slightly rearwardly and thence upwardly and forwardly in a curved path and thence rearwardly and downwardly to its starting point. The starting point is designated by the arrow 96 in Fig. 3 and the entire path of movement is indicated by the arrows and broken line 98 in Fig. 4. In this operation, it will of course be understood that tube 48 being rigidly connected to plate 84 is moved correspondingly since it is connected to the flexible tube 50 and obviously the foot 46 follows a corresponding path.

In the longitudinal center of the lower ejection roller 30 a narrow section of the roller is removed to expose shaft 28, and a stop member 100 is positioned closely adjacent the rear side of such exposed shaft portion and perpendicular to the longitudinal axis thereof so that it projects upwardly to a point higher than the top of the paper supply 22. Stop 100 may be attached in any one of several ways to brackets or the like below the paper receiver 20 and the particular means employed is immaterial. Stop 100 may be rigid in the form of a metal, plastic or wood bar, but preferably we recommend the use of rubber as will later appear.

Thus constructed and arranged this device as shown in Figs. 1–4 will operate in the following manner. A supply of sheets 22 of paper are placed in paper receiver 20 where spring arms 24 if they are used and hold down rollers 26 bear against the top sheet. The forward end of the paper stack 22 will abut stop 100 which holds it against forward movement. Motor 36 is started and the suction foot 46 moves continually in the path as previously described and indicated at 98 in Fig. 4. In this movement, valve 52 opens to provide suction or a vacuum when foot 46 is at its lowermost position which is directly over and immediately adjacent the forward end of the top sheet 22. Foot 46 first grasps the forward center portion of the top sheet 22 causing the same to become crimped or buckled intermediate its sides at the forward edge to form the apex 104 (Fig. 2) which causes the top sheet to separate at such apex from the one below and then moves the top sheet 22 over the sheet below it slightly to the rear where hold down rollers 26 keep the paper from sliding. This causes the paper to buckle at the rear as shown at 106 in Fig. 3 which also causes a separation of the top sheet from the one below. Only a slight rearward movement of foot 46 is required to buckle the paper as described and foot 46 then carries the sheet upwardly and forwardly so that apex 104 in sheet 22 moves over stop 100. As this occurs, valve 52 will close to stop suction in foot 46 whereby the sheet 22 falls into contact with the ejection rollers 30 and 32 in a well known manner. Foot 46 of course returns to its starting position where valve 52 opens and the entire cycle described is repeated. In actual practice this feed has been extremely efficient in feeding but one sheet at a time and has operated successfully with onion skin paper at rates of 10,000 sheets per hour. It has been observed that by making stop 100 of rubber material similar to that in a pencil eraser, for example, the upper tip end provides a certain amount of friction sufficient to hold back a second sheet of paper in the event it may not have been completely separated from the top sheet by the buckling action previously described.

With reference now particularly to Figs. 7 and 8 we show a modified arrangement in place of the hold down rollers 26 in Figs. 3 and 4. Rollers 26 as indicated rotate only counterclockwise and therefore hold sheet 22 against the rearward push by the suction foot 46. Then as foot 46 pulls the paper in a forward direction, rollers 26 are rotated by friction of the paper so that the paper can be withdrawn. This requires a careful adjustment of rollers 26 so that only the proper pressure is exerted against the paper and we have found from experience that this type of hold down means requires a good deal of attention to keep it at the proper tension. We have therefore provided a friction hold down bar 108 as a modification of the rollers 26. Bar 108 is secured to the outer end of one arm 110 of a bellcrank 112 which is pivotally secured at its heel to the rear end of arm 66 in plate 64. Preferably bar 108 is elongated to bear against the top sheet 22 in a direction transversely of the direction of movement of the sheet as it is fed. The upper arm 114 of the bellcrank is positioned to actuate at times a switch 116 which connects with motor 62. A third arm or toe 118 on the bellcrank extends downwardly where it is engaged by a cam 120 that moves it forwardly (Fig. 8) at times. Thus arranged, cam 120 is initially out of contact with arm 118 so that foot 108 is in a down position by gravity and bears against the paper 22 as the suction foot 46 starts its rearward movement. This causes the paper to buckle as previously described. Then as foot 46 moves in a forwardly direction, cam 120 is set to move arm 118 so that arm 110 and bar 108 thereon are elevated whereby all pressure on paper 22 is released and foot 46 can freely pull the sheet forwardly over stop 100. As the supply of paper 22 diminishes, the plane of the top sheet is of course lowered so that bar 108 drops lower. This moves upper bellcrank arm 114 forwardly and where it will eventually actuate switch 116 so that

the floor of paper holder **20** is elevated by members **60** and **62**. The rise of paper **22** moves the bellcrank **112** accordingly until arm **114** disengages itself from switch **116**. This novel arrangement for the automatic operation of bar **108** and switch **116** adds materially to the efficiency in operation of this device. While we have illustrated the suction foot **46** and its related parts in Figs. 7 and 8, their operation here is the same as previously described. Foot **46** with the flat face **122** in Fig. 6 may be used in place of foot **46** with the concave face **102** in Fig. 5 although the concave surface aids in forming the apex **104**. However, we have provided certain other paper stop or hold down means (Figs. 9–11) which assure the formation of apex **104** and the separation of sheets **22** irrespective of whether the face of suction foot **46** is flat or curved. This takes the form of a pair of hold down or bumper members **124** disposed at opposite sides of foot **46** and may take any one of several forms of which one is here illustrated as L-shaped rod members having the respective upstanding arm **126** and horizontal leg **128**. Legs **128** are normally spaced above the top sheet of paper **22** so that as the paper is lifted by the suction foot **46** these legs will bear against the top sheet **22** or in other words the top sheet **22** is drawn upwardly into contact with the bumper legs **128** which then become hold down members at the points of contact so that further lifting action on paper **22** by foot **46** results in formation of the apex **104**. As shown, legs **128** extend parallel to the direction of movement of foot **46**. Arms **126** are each vertically adjustably disposed in one end of a respective bracket arm **130** by set screws **132** which at their other end are slidably arranged on cross member **18** by set screws **134**. Thus, each member **124** can be vertically moved toward or away from foot **46** as may be required by the thickness of paper used. It will thus be understood that by properly spacing members **124** the effect of the contact by these legs with the paper is to prevent sheets below the top sheet from being pulled up along with the top sheet. This results in the top sheet being pulled up from between members **124** and causing it to buckle to form apex **104** at such a height that it can be moved by foot **46** over the obstruction or stop **100**.

It will be appreciated that from the foregoing description that our means of separating the sheets **22** by the buckling at **104** and **106** is extremely efficient and novel in paper feeds of this type. Particularly we wish to point out that there are times where for better efficiency both points of buckling are preferable and at other times only one is required. For example, when thin paper is being fed, the hold down members **26** or **108** can be used satisfactorily either alone or with members **124**. Other well known means such as air pressure can be used to separate the sheets at the front which will be satisfactory since the primary means for separating the sheets is accomplished by the buckling at **106** which itself is a decided innovation in feeds of this class. Likewise, suction foot **46** has proved extremely efficient even when used without the buckling action at **106** and it is thus possible to use foot **46** without a rearward movement although the combination of the buckling at both **104** and **106** as described assures practically a foolproof operation. When foot **46** is used, however, without reference to buckling at **106** it is pointed out that there is usually a certain inherent resistance in the paper **22** to being buckled out of shape so that when suction through foot **46** is applied to the paper, the weight of the paper at the sides of the point of suction can be sufficient to resist elevation whereby apex **104** is formed. If the paper **22** on the other hand does not have sufficient weight for this, bumper members **124** are used as described with the result that no apex is formed below the top sheet where apex **104** appears. Thus, the top sheet because of apex **104** can clear the obstruction **100** and obviously the sheets below are held back by the obstruction.

On heavier paper, we wish to point out that rollers **26**, bar **108** or the like can be eliminated and means to effect the buckling at **104** as described to move the paper over an obstruction **100** will satisfactorily eliminate the problem of multiple feeding at one time.

We would also like to point out that while we illustrate our feed as taking paper off a horizontal plane, experience has established that in feeding cards, for example, they may be stacked vertically in a row and by tilting the suction foot **46** about 90 degrees, the same operation as described above is possible. Also in this respect it should be mentioned that some feeds are designed to feed paper from the bottom of the stack rather than from the top as illustrated here and in such case our feed mechanism can be inverted so that the bottom sheet is pulled down, below and past the obstruction **100** by the same operation described above including the buckling to assure separation of the sheets.

It is submitted that the invention shown and described is aptly suited to achieve the purposes intended and is characterized by a combination of highly useful and mutually cooperating elements that combine their respective and proportionate functions in accomplishing the objects sought to be obtained.

Some changes may be made in the construction and arrangement of our paper feed without departing from the real spirit and purpose of our invention, and it is our intention to cover by our claims, any modified forms of structure or use of mechanical equivalents which may be reasonably included within their scope.

We claim:

1. A paper feed apparatus, comprising, a support member, a holder secured thereto for retaining a supply of sheets of paper, a vacuum or suction producing mechanism mounted to said support member, a suction foot movably connected to said suction mechanism and disposed over the paper in said holder, said suction foot provided with a concave pick up surface for forming an apex in the sheet of paper when picked up, a hold down member, means attached to said support member for yieldingly holding it against the paper and spaced rearwardly from said suction foot, means on said support member operatively connected to said suction foot for moving it closely adjacent the top sheet of the paper so as to grasp the same up by suction, then moving said top sheet over the sheet below toward the hold down member which causes said top sheet to buckle and separate from the sheet below and then moving it away from said hold down member, valve means associated with said last mentioned means and said suction producing mechanism to open when said suction foot is in position to pick up the paper and to close when the suction foot moves away from the hold down member so the paper is released, and means to carry the released sheet into whatever device this paper feed is used with.

2. A paper feed apparatus, comprising, a support member, a holder secured thereto for retaining a supply of sheets of paper, a vertically disposed stop member at one end of said holder, a vacuum or suction producing mechanism mounted to said support member, a suction foot movably connected to said suction mechanism and disposed over the paper in said holder, said suction foot provided with a concave pick up surface for forming an apex in the sheet of paper when picked up, a hold down member, means attached to said support member for yieldingly holding it against the paper and spaced rearwardly from said suction foot, means on said support member operatively connected to said suction foot for moving it closely adjacent the top sheet of the paper so as to grasp the same up by suction, then moving said top sheet over the sheet below toward the hold down member which causes said top sheet to buckle and separate from the sheet below and then moving it away from said hold down member so that the apex formed in said paper moves over said stop member, valve means associated

with said last mentioned means and said suction producing mechanism to open when said suction foot is in position to pick up the paper and to close when the suction foot moves over said stop member so the paper is released, and means to carry the released sheet into whatever device this paper feed is used with.

3. In combination with a paper feed apparatus of the type having a suction foot for picking up a sheet of paper and moving it to a designated position, an improved means to assure separation of the sheets as they are picked up, comprising, a pair of bumper members oppositely disposed relative to said suction foot, means on said paper feed apparatus to normally hold said bumper members in spaced relationship with the top sheet of paper whereby when said paper is picked up by the suction foot it will bear against the bumper members and an apex in the paper will develop at the point of suction due to the resistance by the bumper members against the paper at the sides thereof and thereby effectively separate the top sheet from the one below.

4. In combination with a paper feed apparatus of the type having a suction foot for picking up a sheet of paper and moving it to a designated position, an improved means to assure separation of the sheets as they are picked up, comprising, an obstruction on said paper feed apparatus in the path of movement of the paper to be fed, a pair of bumper members oppositely disposed relative to said suction foot, means on said paper feed apparatus to normally hold said bumper members in spaced relationship with the top sheet of paper whereby when said paper is picked up by the suction foot it will bear against the bumper members and an apex in the paper in alignment with said obstruction will develop at the point of suction due to the resistance by the bumper members against the paper at the sides thereof and thereby effectively separate the top sheet from the one below, and means for moving said suction foot for carrying said apex over said obstruction.

5. In combination with a paper feed apparatus of the type having a suction foot for picking up a sheet of paper and moving it to a designated position, an improved means to assure separation of the sheets as they are picked up, comprising, a pair of paper bumper members, means on said paper feed apparatus supporting said paper bumper member at opposite sides respectively of the suction foot, means for selectively moving each paper bumper member toward and away from said suction foot, means on said paper feed apparatus to normally hold said bumper members in spaced relationship with the top sheet of paper whereby when said paper is picked up by the suction foot it will bear against the bumper members and an apex in the paper will develop at the point of suction due to the resistance by the bumper members against the paper at the sides thereof and thereby effectively separate the top sheet from the one below.

6. In combination with a paper feed apparatus of the type having a suction foot for picking up a sheet of paper and moving it to a designated position, an improved means to assure separation of the sheets as they are picked up, comprising, a pair of paper bumper members, means on said paper feed apparatus supporting said paper bumper member at opposite sides respectively of the suction foot, means for selectively moving each paper bumper member toward and away from said suction foot, means on said paper feed apparatus to normally hold said bumper members in spaced relationship with the top sheet of paper whereby when said paper is picked up by the suction foot it will bear against the bumper members and an apex in the paper will develop at the point of suction due to the resistance by the bumper members against the paper at the sides thereof and thereby effectively separate the top sheet from the one below, a paper hold down member, means on said apparatus to hold said paper hold down member in spaced relation to said suction foot and to the rear thereof relative to the direction of movement of the sheet of paper, and means for moving said suction foot after it has picked up a sheet of paper between said pair of bumper members toward said hold down member to cause said sheet to buckle and separate from the one below.

7. In combination with a paper feed apparatus of the type having a paper pickup member for taking paper from a stack and moving it to a designated position, an improved means to assure separation of the sheets of paper as they are picked up, comprising, a pair of bumper members oppositely disposed relative to said pickup member and normally spaced above the top sheet of paper in said stack, means imparting motion to said pickup member whereby the sheet picked up strikes said bumper members to form a buckle in said sheet, vertical adjustment means for selectively varying the spaced relationship between said bumper members and said stack, and lateral adjustment means to selectively vary the distance between said bumper members and said pickup member.

8. In combination with a paper feed apparatus of the type having a paper pickup member for taking paper from a stack and moving it to a designated position, an improved means to assure separation of the sheets of paper as they are picked up, comprising, a pair of bumper members oppositely disposed relative to said pickup member and normally spaced above the top sheet of paper in said stack, means imparting motion to said pickup member whereby the sheet picked up strikes said bumper members to form a buckle in said sheet, vertical adjustment means for selectively varying the spaced relationship between said bumper members and said stack, and lateral adjustment means to selectively and individually vary the distance between said bumper members and said pickup member.

9. In combination with a paper feed apparatus of the type having a suction foot for picking up a sheet of paper and moving it to a designated position, an improved means to assure separation of the sheets as they are picked up, comprising, a pair of side hold down members oppositely disposed relative to said suction foot, means on said paper feed apparatus to normally hold said hold down members in spaced relationship with the top sheet of paper, a third paper hold down member intermediate the first two and spaced rearwardly from said suction foot relative to the direction of movement of the paper, means imparting motion to said suction foot whereby it carries a sheet of paper into contact with said side hold down members to form a buckle in said paper, then rearwardly toward said third hold down member which causes said sheet to form a second buckle so that the effect of all hold down members is to effectively separate the top sheet from those below, said buckles having a respective axis transversely of the other, and said suction foot then carrying said paper to whatever device is to receive it.

10. A device as defined in claim 9 characterized by vertical adjustment means for varying the spaced relationship between said side hold down members and the paper, and lateral adjustment means to selectively vary the spacing between said side hold down members and said suction foot.

11. In combination with a paper feed apparatus of the type having a suction foot for picking up a top sheet from a stack of paper and moving it to a designated position, an improved means to assure separation of the sheets as they are picked up, comprising, a paper hold down member spaced rearwardly from said suction foot relative to the direction of movement of the paper, means imparting motion to said suction foot whereby it carries the top sheet from said stack of paper first rearwardly over the sheet below toward said hold down member which causes said top sheet to form a buckle to effectively separate the

same from the one below and then forwardly to whatever device is to receive it.

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