Sept. 2, 1958 S. T. STOOTHOFF ET AL 2,850,279

SHEET SEPARATOR

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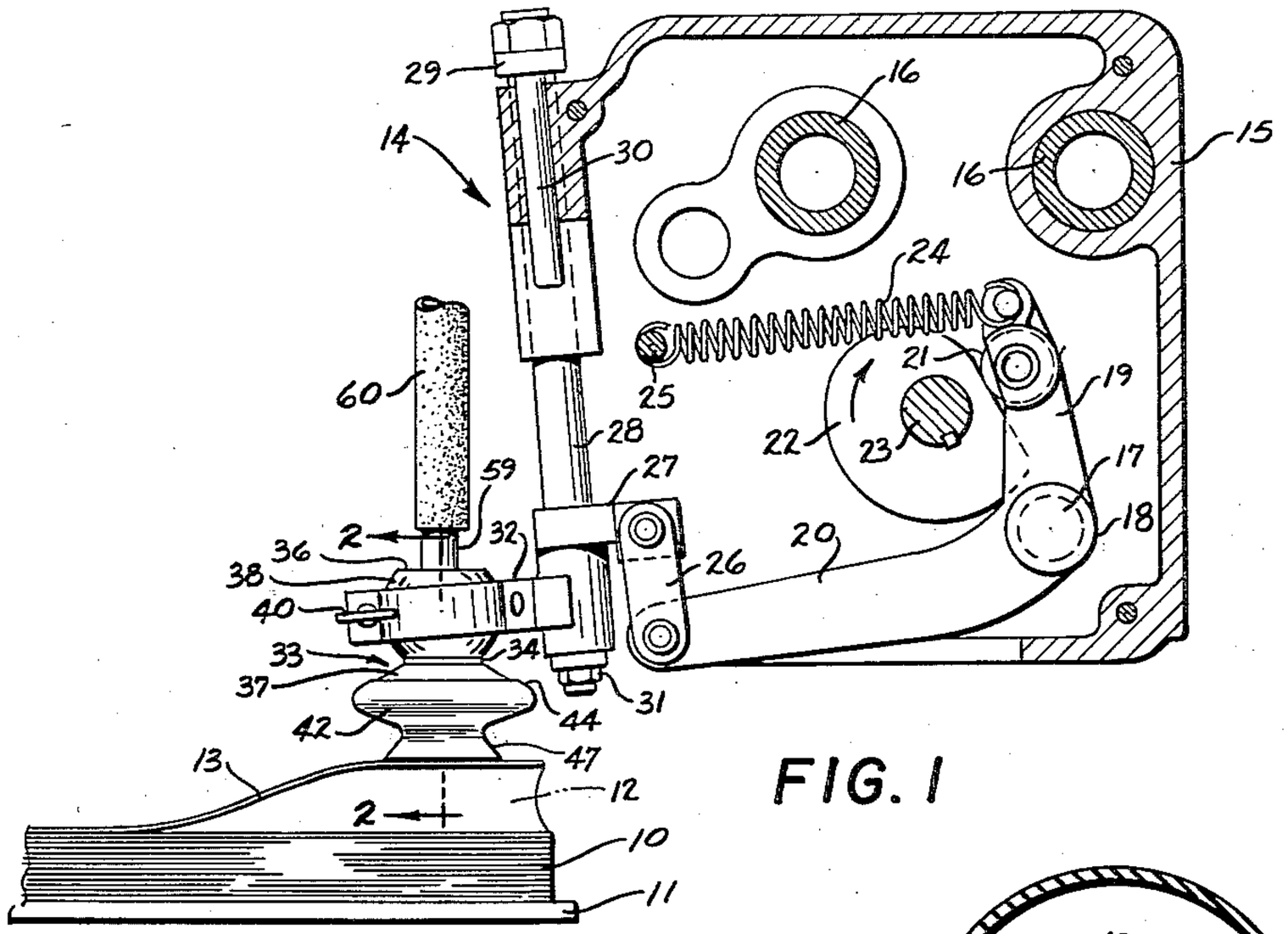

FIG. 1

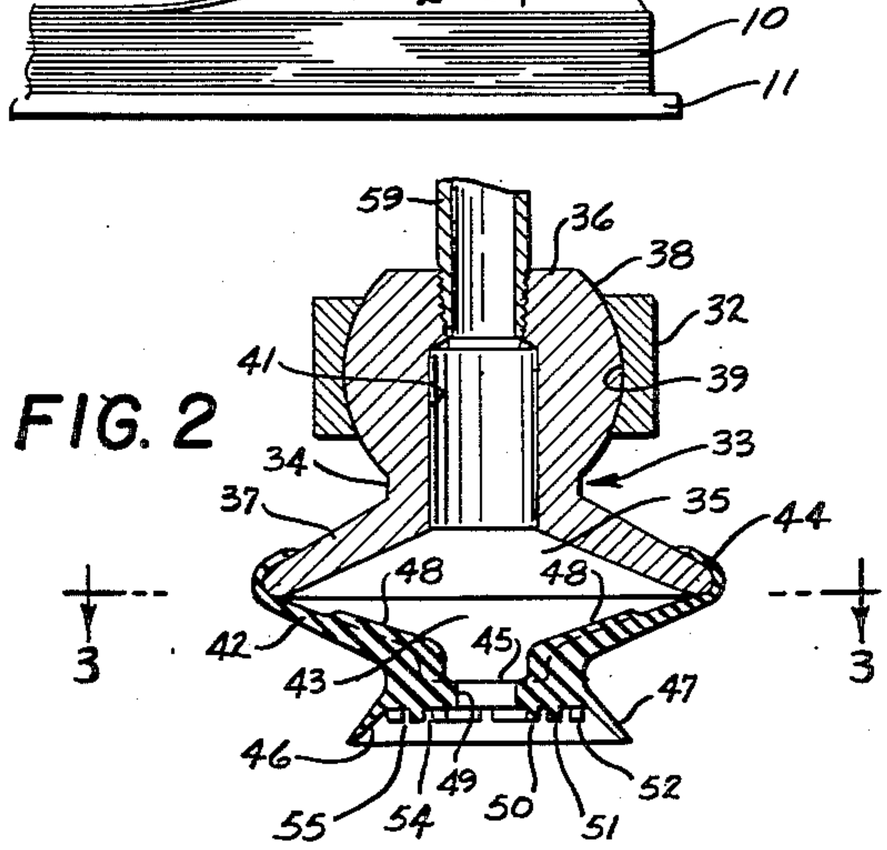

FIG. 2

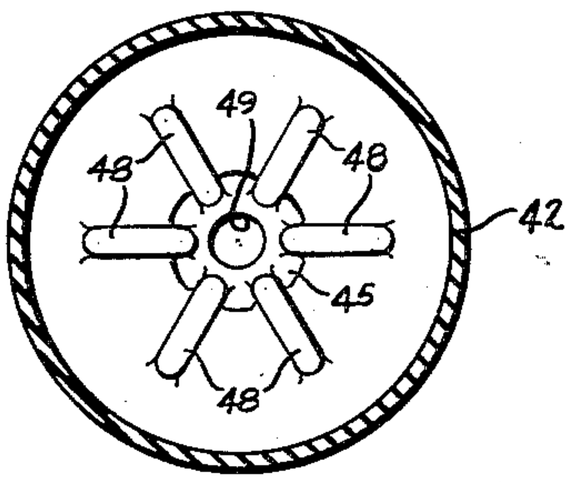

FIG. 3

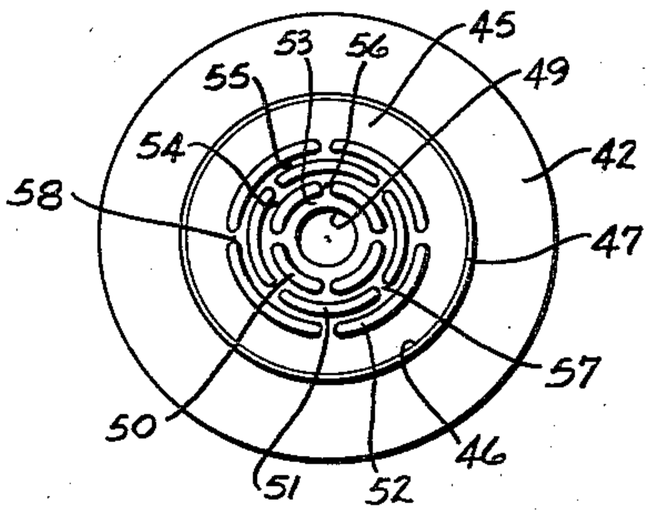

FIG. 4

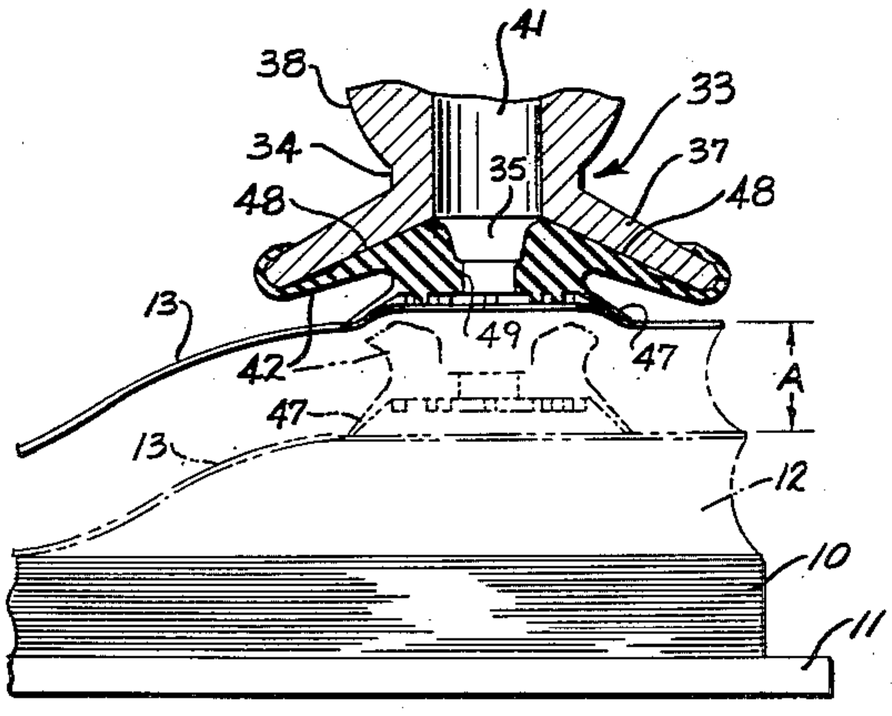

FIG. 5

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25 Claims. (Cl. 271—26)

This invention relates generally to sheet handling machines, such as sheet feeders, and more particularly to suction type sheet engaging devices thereof.

In the feeding of sheets from a supply to a printing press or other machine, the outermost sheet of said supply is, prior to feeding thereof to said press or machine, separated from the supply by a sucker or set of suckers acting on and adjacent to a transverse edge of said sheet. In existing types of sheet feeders, this sheet separating sucker or set of suckers is given two movements in a direction away from the supply after the outermost sheet is gripped thereby, i. e., a relatively short movement tc insure separation of said sheet from the next sheet, and then a relatively longer movement to lift the separated sheet to a predetermined position for feeding thereof from the supply by said sucker or set of suckers or by an auxiliary sucker or set of suckers or by other sheet forwarding or extracting devices, as well understood in the sheet feeding art. In order to obtain the described sheet separating and lifting movements, each sheet separating sucker is carried by an arm operable toward and away from the sheet supply, and is constructed to include a pneumatic cylinder on said arm and a piston in said cylinder which is spring operated toward the sheet supply and vacuum operated away from said supply and has fixed thereon a rubber sheet engaging suction cup.

While these sheet separation suckers of the cylinder and piston type have heretofore been very satisfactory in actual practice and for many years have been standard parts in a widely used sheet feeder, they are expensive to manufacture, they complicate the feeder structure, they add to the number of parts in the feeder, and they increase the manufacturing and maintenance cost of the feeder.

It is accordingly the primary object of the present invention to provide a novel and more simplified sheet separating sucker which will function in the manner above described without utilizing a cylinder and piston for this purpose.

Another object of the invention is to provide a suction type rubber sheet separating device of novel construction, which will function in the same manner and accomplish the same result as a cylinder and piston type of suction sheet separating device.

Another object is to provide a novel flexible rubber sheet engaging and vacuum applying cup which will automatically contract toward its carrying arm a desired distance when suction is created therein and it is sealed by a sheet, and will automatically expand away from said arm when suction is broken therein and the sheet is released thereby.

Still another object is to provide a suction type sheet engaging device particularly adapted for separating sheets from a supply and which is simple in design, is effective and reliable in operation, will not get out of order or require repairs, is composed of only two parts, and is relatively inexpensive to manufacture.

The above and further objects and novel features of the

present invention will more fully appear from the following detail description when the same is read in connection with the accompanying drawing. It is to be expressly understood, however, that the drawing is for the purpose of illustration only, and is not intended as a definition of the limits of the invention.

In the drawing, wherein like reference characters refer to like parts throughout the several views,

Fig. 1 is a vertical longitudinal sectional view of a sheet separating mechanism embodying the present invention, showing the parts thereof in the positions they occupy when a sheet is about to be gripped, separated and lifted from a supply thereof;

Fig. 2 is an enlarged vertical transverse sectional view on the line **2—2** of Fig. 1;

Fig. 3 is a horizontal sectional view on the line **3—3** of Fig. 2.

Fig. 4 is a bottom plan view of the sheet separating sucker shown in Figs. 1 and 2; and

Fig. 5 is a fragmentary view, similar to Fig. 2, but showing the sucker in the position it occupies when a sheet is gripped and separated thereby from the supply.

For purposes of description, and for no other reason, the novel sheet separating sucker is herein illustrated in a form particularly adapted for use in known sheet separating mechanisms which are incorporated in existing types of sheet feeding machines. It is accordingly to be understood, even though the following specification refers to a specific type of sheet separating mechanism, that this is done merely to simplify the description and without any intent to thereby limit the use of the novel sucker to such sheet separating mechanism or to indicate the range of usefulness of said novel sucker.

In the particular embodiment of the invention illustrated in the drawing, **10** indicates a supply pile or stack of sheets which is loaded on a board or platform **11**, said board and pile thereon being automatically raised to maintain the top of the pile at the proper feeding level as the sheets are fed in succession therefrom, as well understood in the art. The uppermost sheet or sheets are generally preliminarily separated from the pile and from each other in a known manner and by known means for this purpose, such as comber wheels or air blast devices (not shown), and said separation is effected either on the front corner portions of said sheets or on the rear corner portions thereof as indicated at **12** with respect to one rear corner portion of the topmost sheet **13** of the pipe **10.**

After preliminary separation of the top sheet **13** has been effected at its opposite corner portions, the sheet is further separated and lifted at said corner portions from the pile **10** by sheet separating mechanisms which may be of any well-known or desired construction and as herein shown, for purpose of illustration only, are essentially the same as those fully illustrated and described in the Leonard Baker United States Patent No. 2,389,480, granted November 20, 1945. These sheet separating mechanisms are incorporated in an existing type of sheet feeder and are arranged at opposite sides of said feeder and at the top and rear of the pile of sheets thereon. One only of the sheet separating mechanisms is herein illustrated and only that portion thereof with which the present invention is actually concerned. For a full disclosure of the construction, mounting, and operation of the sheet separating mechanisms reference may be had to the aforementioned patent.

As herein shown, the sheet separating mechanism, indicated generally at **14**, includes a housing **15** slidably mounted on a pair of transverse hollow cross shafts **16** to enable sidewise adjustment of said mechanism to accommodate sheets of different widths. The cross shafts **16** are suitably carried by the feeder frame to enable longitudinal adjustment of said shafts and therewith the

sheet separating mechanism **14** to accommodate sheets of different lengths. Pivotally mounted as at **17** within and on the housing **15** is a bell-crank lever **18** having an upwardly projecting arm **19** and a forwardly projecting arm **20**. Journalled on the bell-crank arm **19** is a roller **21** which engages a cam **22** fixed on a transverse cam shaft **23** journalled in a suitable bearing in the housing **15**. The shaft **23** is driven in a suitable manner to make one complete revolution for each cycle of operation of the sheet feeder with which the sheet separating mechanism **14** is associated. The roller **21** is biased toward cam **22** by a coil extension spring **24** having one end thereof connected to the bell-crank arm **19** and the opposite end connected at **25** to the housing **15**. The cam **22** being fixed to the shaft **23** rotates continuously and thus periodically raises the bell-crank lever **18** through engagement of the high part of said cam with the roller **21**, and enables lowering of said lever by the spring **24** through engagement of said roller with the low part of said cam.

Pivotally connected to the forward end of the bell-crank arm **20** are the lower ends of vertical links **26** the upper ends of which are pivotally connected to a block **27** suitably secured to the lower end of a rod **28** which is inclined upwardly and forwardly at a slight angle and is guided for vertical sliding movement in and relative to the housing **15**. The upper end of the rod **28** has fixed thereon a stop-plate **29** which is adapted to engage an adjustable stop-pin **30** carried by the housing **15**, whereby the extent of downward movement of said rod and the bell-crank lever **18** by the spring **24** may be varied for a purpose to be hereinafter explained. Mounted on the rod **28** between the block **27** and a nut **31** threaded on said rod is a split-bracket **32**. This bracket **32** is adapted to carry for lowering and raising movements thereby a novel sucker indicated generally at **33** which, in accordance with the present invention, includes a sheet engaging suction cup so constructed that upon sealing thereof by the separated corner portion of the topmost sheet **13** on the pile **10**, said cup itself will be flexed a desired distance away from the pile **10** toward the bracket **32** through the vacuum effect in said sucker and the resulting external atmospheric pressure on said cup.

The novel sheet separating and lifting sucker **33** in the form herein shown comprises an annular holder or suction head **34** (Fig. 2) preferably formed of aluminum or other light weight metallic or other rigid material. The holder **34** is provided in the lower surface thereof facing the pile of sheets **10** with an interior annular space or vacuum chamber **35** which increases in depth from the outer edge to the center thereof and is preferably, but not necessarily, frusto-conical in shape for this purpose. For the sake of lightness and simplicity in manufacture, the holder **34** preferably comprises a relatively small diameter hub **36** and a relatively thin downwardly and outwardly flaring annular flange **37** which is formed integrally with said hub at the lower end thereof and which defines the aforesaid frusto-conical space **35**. In the illustrated embodiment, the hub **36** is ball-shaped as indicated at **38** so that said hub may be received in a correspondingly shaped socket **39** formed in the bracket **32**, whereby the holder **34** may be adjusted to various angular positions on said bracket with respect to the upper surface of the pile of sheets **10**. The holder **34** is firmly held in various positions of angular adjustment thereof on the bracket **32** by a clamp screw **40** threaded into said bracket. The holder **34** is provided, preferably in the hub **36** thereof, with an axially extending vacuum duct or passage **41** which opens outwardly through opposite ends of said hub and communicates with the space **35** in said holder.

The downwardly facing open mouth of the interior space or chamber **35** in the holder **34** is completely closed by a preformed annular cap or cover **42** (Fig. 2) which extends completely across said space and is formed of a suitable flexible resilient material impermeable to air,

preferably molded rubber. The cap **42** is so molded that in its normal condition, shown in Fig. 2, it symmetrically tapers downwardly and inwardly away from the rim or edge of the flange **37** on the holder **34** toward the central axis thereof, or in other words, it flares upwardly and outwardly towards said flange-rim, whereby an interior annular space **43** increasing in depth from the outer edge to the center thereof is provided in and at the top of said cap augmenting the space **35** in the holder **34**, and the upper surface of said cap is spaced from the opposed lower surface of said holder a desired distance. The cap **42** is formed at the upper peripheral edge thereof with an inwardly turned upwardly extending annular lip **44** which is stretched over the flange **37** on the holder **34** to snugly engage said flange and thereby immovably, but removably, hold said cap on said holder in air-tight relation. The annular wall of the cap **42** is of increasing tapering thickness from the lip **44** and terminates in a central planar wall **45** from which projects a relatively thin-walled downwardly and outwardly flaring shallow skirt **46** forming a sheet engaging suction cup **47**. The cap **42** is provided on the inner surface thereof with a plurality of radially extending ribs **48** (Figs. 2 and 3) which begin substantially at the wall **45** and terminate a short distance inwardly from the peripheral edge of the flange **37** on the holder **34**. The ribs **48** and the increasing thickness of the body wall of the cap **42** imparts to the suction cup **47** a desirable rigidity, but provides for a desirable flexibility of said cap and said cup as a whole. Additionally, by virtue of the described construction of the cap **42**, the latter will have sufficient resistance to sustain the normal weight of itself and the suction cup **47**, as well as sufficient inherent resiliency so as to yield in one direction under atmospheric pressure, and to itself yield in the opposite direction when not subjected to a pressure less than atmospheric pressure.

The cap **42** is provided in the wall **45** thereof with a centrally disposed vacuum duct or passage **49** which communicates with the interior of the suction cup **47** and with the space between said cap and the holder **34**. The wall **45** of the cap **42** is further formed on the lower surface thereof within the suction cup **47** with a series of spaced arcuately shaped concentric ribs **50**, **51** and **52** which progressively increase in size from the duct **49** outwardly toward the rim or edge of said suction cup. The ribs **50**, **51** and **52** of each series are staggered with respect to each other and form therebetween a series of concentric channels **53**, **54** and **55** which are interconnected and connected with the duct **49** by spaces **56**, **57** and **58** formed between each of said ribs. The holder **34** has threaded therein coaxially with the duct **41** a rigid tubular fitting **59** which is connected by a flexible conduit **60** with a suitable source of vacuum through a suitable valve mechanism (not shown) whereby vacuum is created and broken at proper predetermined intervals in the suction cup **47** and in the space between the cap **42** and said holder through the ducts **49** and **41**.

In operation, assuming that a corner portion of the topmost sheet **13** on the pile **10** is being preliminarily separated to the position thereof shown in Fig. 1 from said pile as hereinbefore described, and that the sucker **33** is in its raised position effected through engagement of the roller **21** with the high part of the cam **22**. At this time the sucker **33** is open to atmosphere and the cap **42** thereof is in its normal condition as shown in Figs. 1 and 2. The sucker **33** is then connected to a source of vacuum through the valve mechanism, the conduit **60** and fitting **59**, and the bell-crank lever **18** is then lowered by the spring **24** through continued rotation of the cam **22** until the suction cup **47** slightly depresses the separated corner portion of the top sheet **13**, whereupon the sucker **33** is stopped against further downward movement through engagement of the stop-plate **29** with the stop-pin **30**, as shown in Fig. 1, and the separated corner portion of the sheet is drawn by

vacuum to the suction cup **47** and firmly gripped by said cup against slippage thereon due to the ribs **50**, **51** and **52**. The ribs **50**, **51** and **52** increase the sheet gripping area of the suction cup **47**, thereby enabling increased application of vacuum on the sheet by said cup.

Immediately upon sealing of the suction cup **47** by the separated corner portion of the sheet, the entire effect of the vacuum in the sucker **33** is applied on the cap **42** and, consequently said cap during the slight downward overtravel of said sucker is flexed upwardly toward the holder **34** and into the space **35** by the atmospheric pressure against the same and the suction cup until said cap contacts said holder, as shown in Fig. 5, thus raising the suction cup **47** and the corner portion of the sheet gripped thereby a corresponding distance, as represented by the dimension A in said figure, from the broken line positions to the full line positions thereof. The corner portion of the top sheet **13** is thus furthur separated from the pile or the underlying sheet, whereby lifting of said top sheet only and only single sheets is assured. Thereupon, the sucker **33** with the top sheet **13** firmly gripped by the upwardly flexed suction cup **46** is bodily lifted to a predetermined position through continued rotation of the cam **22** and engagement of the high part thereof with the roller **21**.

After the top sheet **13** is separated and lifted by the sucker **33** as aforesaid, said sheet is fed from the pile **10** in a manner well understood in the art, at which time vacuum is broken in the sucker **33** to release the sheet. Upon the breaking of vacuum in the sucker **33**, the cap **42**, because of its inherent resiliency, immediately expands downwardly away from the holder **34** and returns to its normal condition and original position, shown in Fig. 2, in readiness to act on the next sheet when the above-described operations are repeated.

There is thus provided a single relatively inexpensive element comprising the suction cup **47** with the cap **42** as an integral part thereof, for effectively separating and lifting single sheets from a supply thereof, which functions in the exact same manner as the relatively expensive plural part cylinder and piston type of sucker heretofore employed for this purpose.

While the foregoing description and accompanying drawing set forth with more or less particularity one embodiment of the present invention, it is to be expressly understood that said invention is not limited to said embodiment or to the described use thereof, or to the use thereof with the specific type of sheet separating mechanism disclosed herein. Various changes may be made, particularly in the design of the parts illustrated, without departing from the spirit and scope of the invention, as will now be apparent to those skilled in the art. For example, for mountings other than the described ball and socket mounting, a straight annular hub may be employed in lieu of the ball type hub, and the sucker may be mounted in its carrying arm by said straight hub or by the rigid vacuum conduit connected with said hub. Additionally, the interior space or vacuum chamber in the suction head or holder may be eliminated with a resulting less movement of the cap and suction cup, or the design of the cap may be altered in this case to maintain the described movement or a still greater movement as desired. Also, the described cap may be secured to the suction head by an annular band or the like; the interior space or chamber may be formed directly in the lower surface of a flangeless suction head or of a planar flange on said suction head; the suction head and cap may be so formed that the respective surfaces defining the space between the same are of concave configuration; and a light coil compression spring may be interposed between the holder and cap if deemed necessary or desirable. For a definition of the limits of the invention, reference is had primarily to the appended claims.

What is claimed is:

1. A sheet handling device comprising a rigid holder having a downwardly and outwardly flaring annular flange at the lower end thereof and a vacuum duct therein adapted to be connected with a source of vacuum and having one end thereof opening outwardly through a surface of said holder, a preformed cap of flexible material impermeable to air carried by said holder in air-tight relation and extending across the larger diameter of said flange, and a sheet engaging suction cup carried by said cap and communicating with said duct, said cap being of a form such that in normal condition it tapers upwardly and outwardly from said cup to said holder so that an interior space exists therein between the same and said holder, whereby said cap in use will be flexed from said normal condition towards said holder by the atmospheric pressure against the same and said suction cup upon creation of vacuum in said space and in said cup and sealing of said cup by a sheet, thereby imparting a corresponding movement to the suction cup and the sheet adhering thereto.

2. A sheet handling device comprising a rigid holder having a downwardly and outwardly flaring annular flange at the lower end thereof and a vacuum duct therein adapted to be connected with a source of vacuum and having one end thereof opening outwardly through a surface of said holder, a preformed cap of flexible material impermeable to air carried by said holder in air-tight relation and extending across the larger diameter of said flange, and a sheet engaging suction cup carried by said cap and communicating with said duct, said cap being of a form such that in normal condition it tapers upwardly and outwardly from said cup to said holder so that an interior space increasing in depth inwardly towards the center thereof is provided therein between the same and said holder, whereby said cap in use will be flexed from said normal condition towards said holder by the atmospheric pressure against the same and said suction cup upon creation of vacuum in said space and in said cup and sealing of said cup by a sheet, thereby imparting a corresponding movement to the suction cup and the sheet adhering thereto.

3. A sheet handling device comprising a rigid suction head having an interior space in a surface thereof and a vacuum duct communicating with said space and adapted to be connected with a source of vacuum, said space increasing in depth inwardly toward the center of said head, a preformed cap of flexible material impermeable to air carried by said head in air-tight relation and extending across said space, and a sheet engaging suction cup carried by said cap and communicating with said duct, said cap being of a form such that in normal condition an interior space exists therein at the top thereof augmenting said first-named space, whereby said cap in use will be flexed from said normal condition towards said head a distance corresponding substantially to the sum of said spaces and into the space in said head by the atmospheric pressure against the same and said suction cup upon creation of vacuum in said spaces and in said cup and sealing of said cup by a sheet, thereby imparting a corresponding movement to the suction cup and the sheet adhering thereto.

4. A sheet handling device comprising a rigid holder having a downwardly and outwardly flaring annular flange at the lower end thereof and a vacuum duct therein adapted to be connected with a source of vacuum and having one end thereof opening outwardly through a surface of said holder, a preformed cap of flexible resilient material impermeable to air stretched over and snugly fitting said holder in air-tight relation and extending across the larger diameter of said flange, and a sheet engaging suction cup carried by said cap and communicating with said duct, said cap being of a form such that in normal condition it tapers upwardly and out-

wardly from said cup to said holder so that an interior space increasing in depth inwardly toward the center of said cap is provided therein between said cap and said holder, whereby said cap in use will be flexed from said normal condition toward said holder by the atmospheric pressure against the same and said suction cup upon creation of vacuum in said space and in said cup and sealing of said cup by a sheet, thereby imparting a corresponding movement to the suction cup and the sheet adhering thereto, said cap having sufficient resiliency to itself yield to its normal condition upon breaking of vacuum in said duct.

5. A sheet handling device comprising a rigid suction head having an interior space in a surface thereof and a vacuum duct communicating with said space and adapted to be connected with a source of vacuum, said space increasing in depth inwardly toward the center of said head, a preformed flexible rubber cap carried by said head in air-tight relation and extending across said space, and a sheet engaging suction cup formed integrally with said cap and communicating with said duct, said cap being of a form such that in normal condition an interior space increasing in depth inwardly toward the center of said cap exists therein at the top thereof augmenting said first-named space, whereby said cap in use will be flexed from said normal condition towards said head a distance corresponding substantially to the sum of said spaces and into the space in said head by the atmospheric pressure against the same and said suction cup upon creation of vacuum in said spaces and in said cup and sealing of said cup by a sheet, thereby imparting a corresponding movement to the suction cup and the sheet adhering thereto.

6. A device for handling sheets, comprising a rigid holder having an annular flange at the lower end thereof and a vacuum duct adapted to be connected with a source of vacuum and opening outwardly through said holder end, an annular flexible cap extending across the open end of said duct and engaged around the peripheral edge thereof with the peripheral edge of said flange in air-tight relation, said cap being shaped to taper symmetrically from said flange edge downwardly away from said flange, and a sheet engaging suction cup carried by said cap and communicating with said duct, said cap being sufficiently flexible so as to yield under atmospheric pressure when vacuum is created in said duct and said cup is sealed by a sheet.

7. A suction device for the purpose described, comprising a rigid holder having a hub portion and an annular flange portion at the lower end of said hub portion, one of said portions having a vacuum duct therein opening at one end thereof outwardly through the lower surface of the said one portion and adapted to be connected at the opposite end thereof with a source of vacuum, an annular flexible cap extending across the open end of said duct and engaged around the peripheral edge thereof with the peripheral edge of said flange in air-tight relation, said cap being shaped to taper symmetrically from said flange edge downwardly away from said flange, and a sheet engaging suction cup carried by said cap and communicating with said duct, said cap having sufficient resistance to sustain the normal weight of itself and the suction cup, as well as being sufficiently flexible so as to yield under atmospheric pressure when vacuum is created in said duct and said cup is sealed by a sheet.

8. A suction device for the purpose described, comprising a rigid holder having a downwardly and outwardly flaring annular flange at the lower end thereof and a vacuum duct adapted to be connected with a source of vacuum and opening outwardly through said holder end, an annular flexible cap extending across the open end of said duct and engaged around the peripheral edge thereof with the peripheral edge of said flange in air-tight relation, said cap being shaped to taper symmetrically from said flange edge downwardly away from said flange, and a sheet engaging suction cup carried by said cap and communicating with said duct, said cap having sufficient resistance to sustain the normal weight of itself and the suction cup, as well as being sufficiently flexible so as to yield under atmospheric pressure when vacuum is created in said duct and said cup is sealed by a sheet.

9. A suction sheet handling device comprising a rigid holder having a downwardly and outwardly flaring annular flange at the lower end thereof and a vacuum duct adapted to be connected with a source of vacuum and opening outwardly through said holder end, an annular flexible rubber cap extending across the open end of said duct and having an upwardly inturned peripheral lip stretched over and snugly fitting said flange in air-tight relation, said cap having a planar wall portion spaced below the plane of the peripheral edge of said flange and a wall portion tapering upwardly and outwardly from said planar wall portion and terminating in said lip, and a sheet engaging suction cup formed integrally with said cap on the planar wall portion thereof, said planar wall portion having a vacuum duct extending therethrough and communicating with said suction cup and with said first-named duct, said cap being sufficiently resilient so as to yield under atmospheric pressure when vacuum is created in said ducts and said suction cup is sealed by a sheet.

10. A suction sheet handling device as defined in claim 9 wherein the tapering wall portion of said cap is of increasing thickness from the peripheral edge of said flange to the planar wall portion of said cap.

11. A suction sheet handling device as defined in claim 9 wherein the tapering wall portion of said cap is provided on the inner surface thereof with a plurality of radial ribs which extend substantially from the planar wall portion of said cap and terminate a short distance inwardly from the peripheral edge of said flange.

12. A sheet separating device for separating at least a portion of a sheet from a supply thereof, comprising a rigid holder having a hub portion and a downwardly and outwardly flaring annular flange at the lower end of said hub portion, said hub portion having a vacuum duct extending axially therethrough and adapted to be connected at the upper end thereof with a source of vacuum, an annular flexible rubber cap extending across the lower open end of said duct and having an upwardly inturned peripheral lip stretched over and snugly fitting said flange in air-tight relation, said cap having a planar wall portion spaced below the plane of the peripheral edge of said flange and a wall portion tapering upwardly and outwardly from said planar wall portion and terminating in said lip, and a sheet engaging suction cup formed integrally with said cap on the planar wall portion thereof, said planar wall portion having a vacuum duct extending axially therethrough and communicating with said suction cup and with said first-named duct, said tapering wall portion being of increasing thickness from the peripheral edge of said flange to said planar wall portion and having on the inner surface thereof a plurality of radial ribs extending substantially from said planar wall portion and terminating a short distance inwardly from the peripheral edge of said flange, said cap having sufficient resistance to sustain the normal weight of itself and the suction cup, as well as being sufficiently resilient so as to yield under atmospheric pressure when vacuum is created in said ducts and said cup is sealed by a sheet and to itself yield to its normal condition when vacuum is broken in said ducts.

13. For use in sheet handling machines, a flexible rubber sheet engaging and vacuum applying suction cup having a central vacuum duct therein and a flexible annular wall flaring upwardly and outwardly therefrom and formed at the top thereof with a peripheral lip.

14. For use in sheet handling machines, a flexible rubber sheet engaging and vacuum applying suction cup molded to have a central vacuum duct therein and a flexible annular wall flaring upwardly and outwardly therefrom and formed at the top thereof with an upwardly and inwardly turned peripheral lip.

15. A sheet engaging and vacuum applying element for use in sheet handling machines, said element being formed of flexible rubber and consisting of a planar wall portion having a vacuum duct extending therethrough, a lower annular wall portion flaring downwardly and outwardly from said planar wall portion, and an upper annular wall portion flaring upwardly and outwardly from said planar wall portion and formed at the top thereof with a peripheral lip adapted for attachment to an annular supporting member, the diameter of said upper portion at the larger end thereof being greater than that of said lower portion at the larger end thereof, the upper annular wall portion adjacent said planar wall portion having appreciable rigidity and the upper annular wall portion adjacent said peripheral lip being relatively flexible whereby upon the creation of a vacuum in said duct and the sealing of said duct in the lower flaring portion, the upper annular wall portion adjacent said lip will flex to a greater degree than the wall portion adjacent said planar wall.

16. A sheet engaging and vacuum applying element as defined in claim 15 wherein said upper wall portion is of increasing thickness to said planar wall portion and is provided on the inner surface thereof with a plurality of radially extending ribs of a length less than the length of said upper wall portion and beginning substantially at said planar wall portion.

17. A sheet engaging and vacuum applying element as defined in claim 15 wherein the lower annular wall portion is provided on the inner surface thereof with a series of spaced arcuately shaped concentric ribs and having each series staggered with respect to each other to form therebetween a series of concentric channels which are interconnected.

18. A sucker for the purpose described, formed of flexible rubber and consisting of a hollow downwardly and outwardly flaring lower portion, and a hollow upwardly and outwardly flaring upper portion communicating with said lower portion, the diameter of said upper portion at the larger end thereof being greater than that of said lower portion at the larger end thereof.

19. In a sheet feeder having mechanism for separating sheets successively from a supply thereof, said mechanism including a cam and spring operated arm operable toward and away from said supply, the improvement comprising a sheet engaging and vacuum applying sucker carried by said arm and consisting of a rigid holder having a downwardly and outwardly flaring annular flange at the lower end thereof and a vacuum duct adapted to be connected with a source of vacuum and opening outwardly through said holder end, an upwardly and outwardly flaring annular flexible rubber cap extending across the open end of said duct and having at the upper end thereof an upwardly inturned peripheral lip stretched over and snugly fitting said flange in air-tight relation, and a sheet engaging suction cup carried by said cap and communicating with said duct, said cap being sufficiently resilient so as to yield toward said holder under atmospheric pressure when vacuum is created in said duct and said suction cup is sealed by a sheet.

20. In a sheet feeder, mechanism for separating sheets one after another from the top of a supply thereof and comprising, a rigid holder operable toward and away from the top of said supply, said holder having a vacuum duct therein adapted to be connected with a source of vacuum and opening outwardly through the surface of said holder facing the top of said supply, a preformed hollow upwardly and outwardly flaring cap of flexible rubber material attached around the upper peripheral edge thereof to said holder in air-tight relation and enclosing the open end of said duct, a sheet gripping suction cup on said cap at the bottom thereof and communicating with the interior of said cap, and means for lowering said holder and therewith said cap and said cup an extent to bring said cup beyond the level of the top sheet of said supply, said cap and said cup, upon engagement of the latter with and sealing thereof by the top sheet and creation thereby of vacuum in said cap and said cup through said duct, being caused by the atmospheric pressure against the same to immediately contract as a unit upwardly toward and relative to the downwardly moving holder an extent in excess of the downward overtravel of said holder, whereby said upward contraction of said cap and said cup compensates said downward overtravel of said holder and gripping and lifting of the top sheet by said cup ensues without said cup applying a downward pressure on said sheet.

21. A sheet separating mechanism for sheet feeders wherein the top sheet of a supply of sheets is preliminarily separated from the next or underlying sheet to enable lifting of said top sheet and single sheets only from said supply, said sheet separating mechanism comprising a rigid holder operable toward and away from the top of said supply, said holder having a vacuum duct extending vertically therethrough and adapted to be connected at the upper end thereof with a source of vacuum, a preformed hollow upwardly and outwardly flaring cap of flexible rubber material attached around the upper peripheral edge thereof to said holder in air-tight relation and enclosing the lower end of said duct, a sheet gripping suction cup on said cap at the bottom thereof and communicating with the interior of said cap, and means for lowering said holder and therewith said cap and said cup an extent to bring said cup beyond the separated level of the top sheet of said supply, said cap and said cup, upon engagement of the latter with and sealing thereof by the top sheet and creation thereby of vacuum in said cap and said cup through said duct, being caused by the atmospheric pressure against the same to immediately contract as a unit upwardly toward and relative to the downwardly moving holder an extent in excess of the downward overtravel of said holder, whereby said upward contraction of said cap and said cup compensates said downward overtravel of said holder and gripping of the top sheet at the separated level thereof and lifting of said sheet by said cup ensues without said cup applying a downward pressure on said sheet.

22. A suction device for the purpose described, comprising a rigid holder having a ball-shaped hub portion adapted to be received in a correspondingly shaped socket and a downwardly and outwardly flaring annular flange at the lower end of said hub portion, said hub portion having a vacuum duct extending axially therethrough and adapted to be connected at the upper end thereof with a source of vacuum, an annular flexible cap extending across the open larger diameter of said flange and having an upwardly inturned peripheral lip stretched over and snugly fitting the peripheral edge of said flange in air-tight relation, said cap having a planar wall portion spaced below the plane of the peripheral edge of said flange and a wall portion tapering upwardly and outwardly from said planar wall portion and terminating in said lip, and a sheet engaging suction cup formed integrally with said cap on the planar wall portion thereof, said planar wall portion having a vacuum duct extending axially therethrough and in communication with said suction cup and with said first-named duct, said planar wall portion having a thickness greater than the thickness of said peripheral lip, said cap having sufficient resistance to sustain the normal weight of itself and the suction cup, as well as being sufficiently resilient so as to yield under atmospheric pressure when vacuum is created in said ducts and said cup is sealed by a sheet and to itself yield to its normal condition when vacuum is broken in said ducts.

23. A suction device as defined in claim 22 wherein the upwardly and outwardly tapering wall portion of said cap is of increasing thickness from the peripheral edge of said flange to said planar wall portion.

24. A suction device as defined in claim 22 wherein the upwardly and outwardly tapering wall portion of said cap is provided on the inner surface thereof with a plurality of radial ribs which extend substantially from the planar wall portion of said cap and terminate a short distance inwardly from the peripheral edge of said flange.

25. A suction device as defined in claim 22 wherein the sheet engaging suction cup is provided on the inner surface thereof with a series of spaced arcuately shaped concentric ribs spaced outwardly toward the rim or edge

of said cup and having each series staggered with respect to each other to form therebetween a series of concentric channels which are interconnected.

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