March 4, 1969 C. O. SIEBKE 3,430,946

SHEET TENSIONING AND TRANSFER MECHANISM FOR PRESSES

Filed Dec. 19, 1966 Sheet 1 of 3

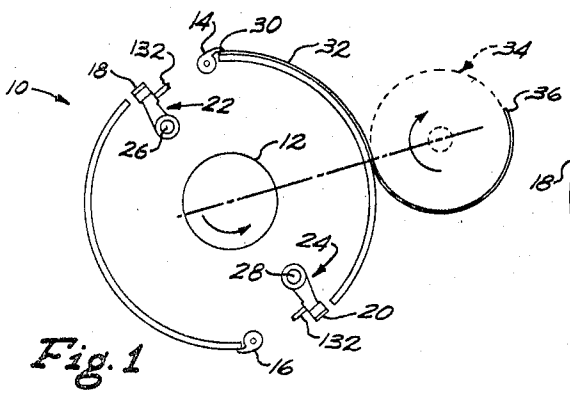

Fig. 1

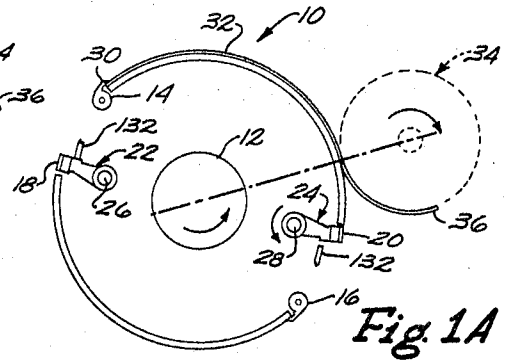

Fig. 1A

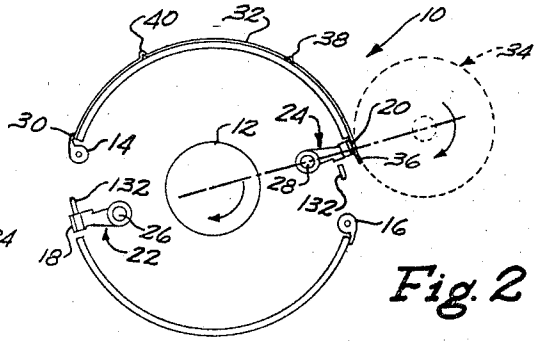

Fig. 2

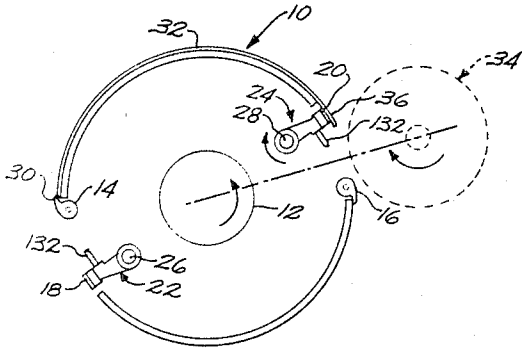

Fig. 3

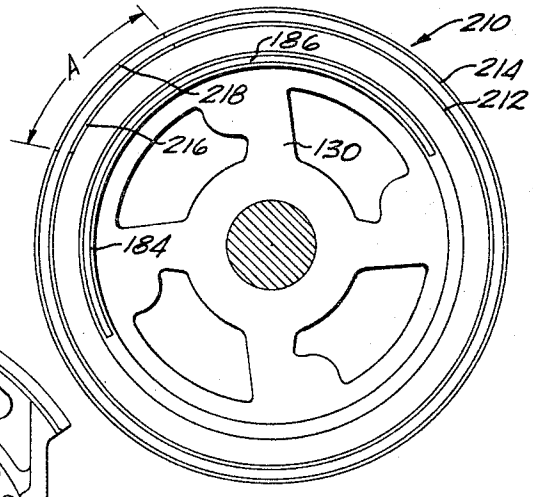

Fig. 13

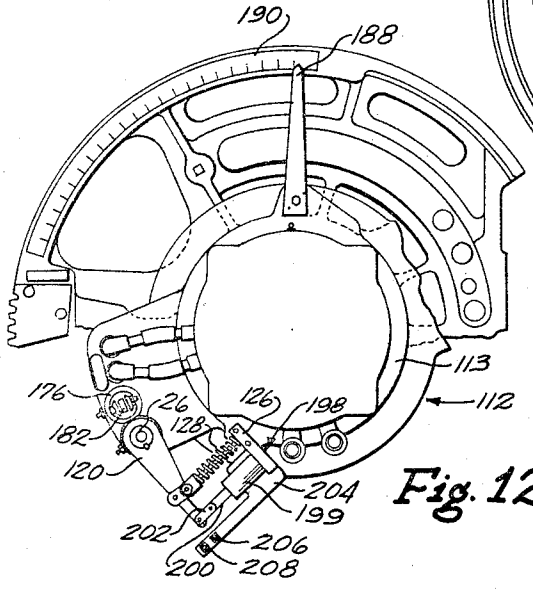

Fig. 12

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SHEET TENSIONING AND TRANSFER MECHANISM FOR PRESSES

Filed Dec. 19, 1966 Sheet 2 of 3

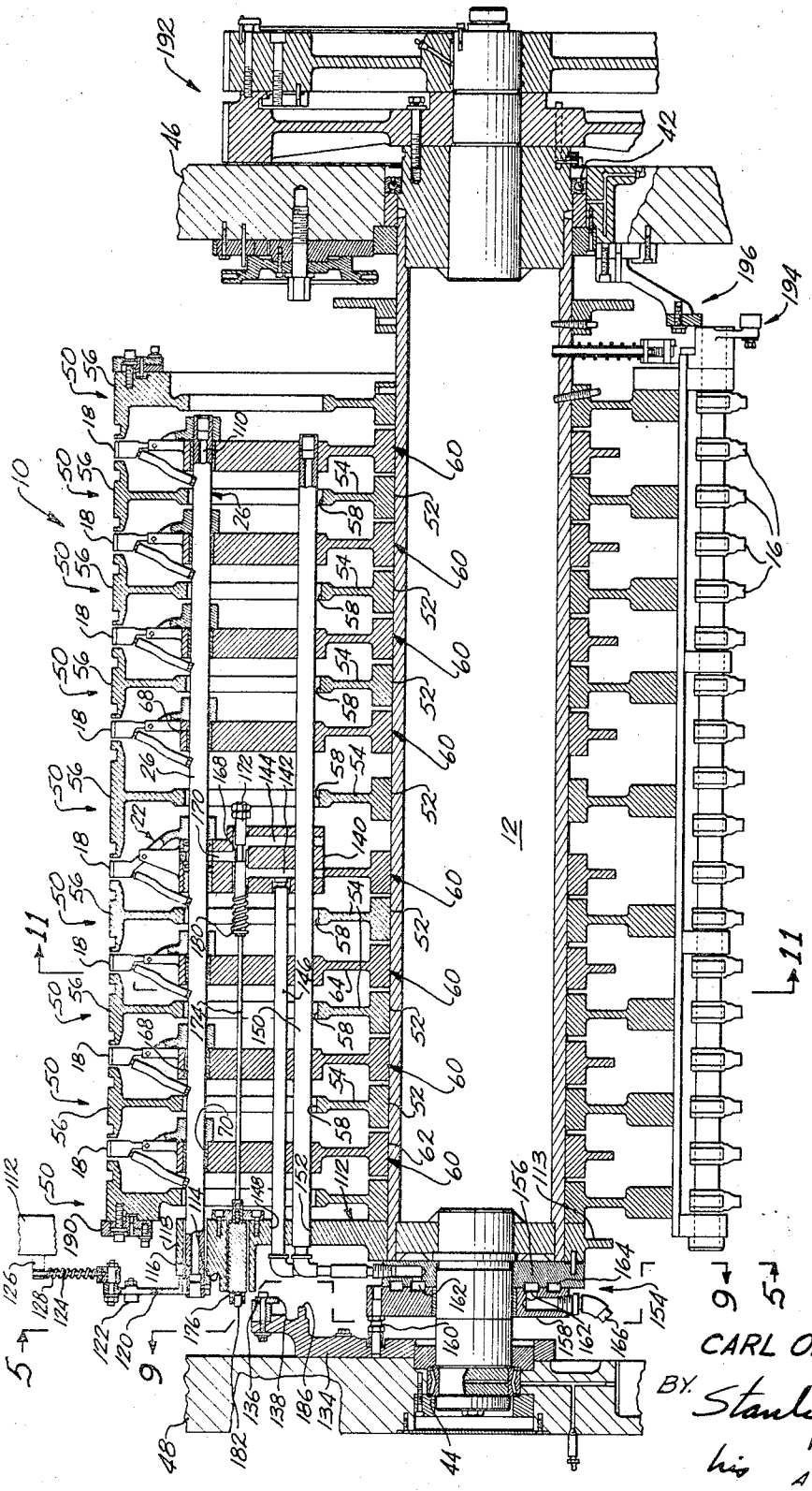

Fig. 4

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SHEET TENSIONING AND TRANSFER MECHANISM FOR PRESSES

Filed Dec. 19, 1966 Sheet 3 of 3

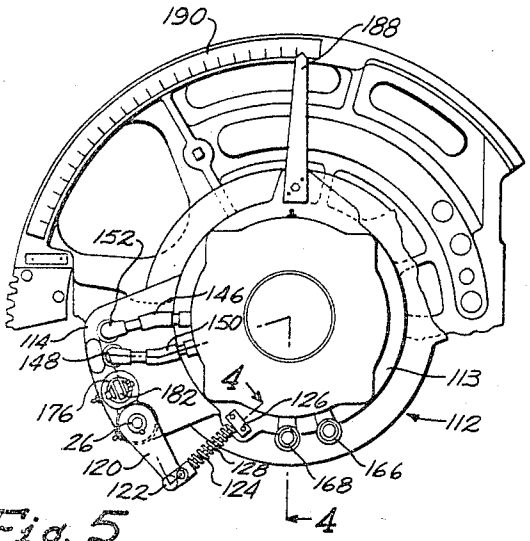

Fig. 5

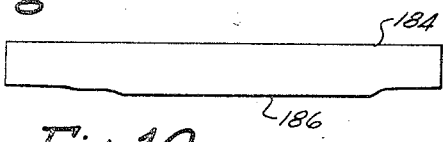

Fig. 10

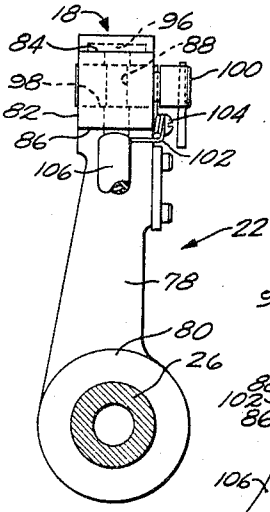

Fig. 6

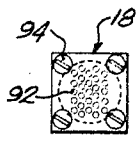

Fig. 7

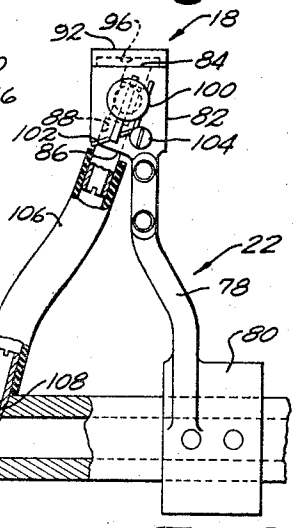

Fig. 8

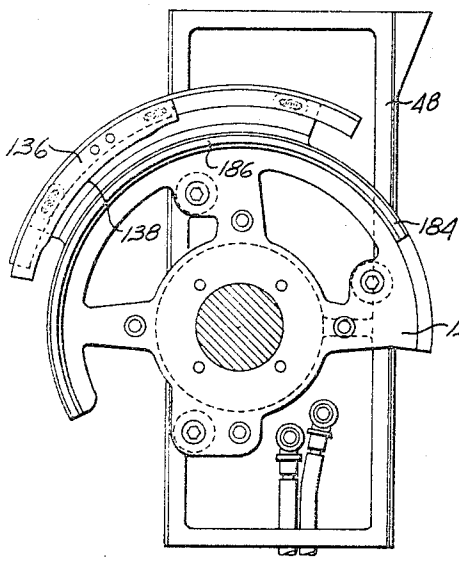

Fig. 9

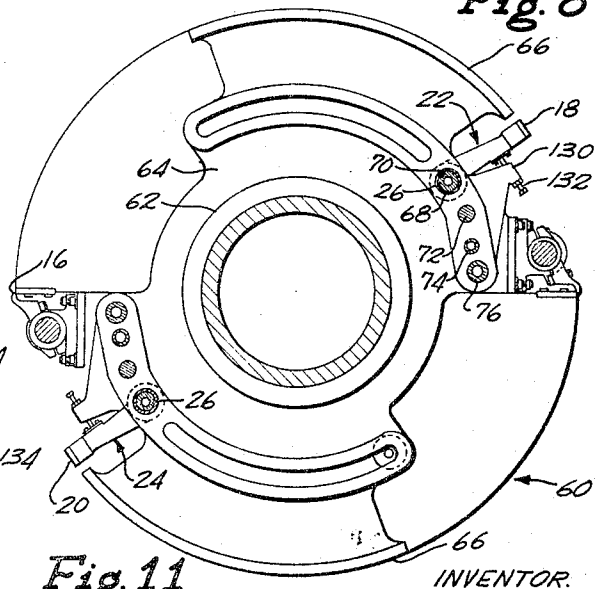

Fig. 11

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United States Patent Office

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SHEET TENSIONING AND TRANSFER MECHANISM FOR PRESSES

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Filed Dec. 19, 1966, Ser. No. 602,857
U.S. Cl. 271—51 20 Claims
Int. Cl. B65h 5/12, 5/14

ABSTRACT OF THE DISCLOSURE

Apparatus in a rotary press sheet transfer cylinder for pulling a sheet taut on the outer surface or periphery of the cylinder. Suction devices positioned on the periphery of the cylinder are secured to arm members that are in turn secured to an actuating shaft supported within the cylinder. The trailing edge of the sheet to be transferred is engaged by the suction devices and the shaft with the arms secured thereto is rotated to pull the sheet taut over the peripheral surface of the cylinder.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to a sheet handling device for holding and tensioning a sheet on a cylinder and more particularly to a sheet handling device for tensioning a paper sheet on the outer surface of a printing press transfer cylinder.

Description of the prior art

In the past, as described in Patent No. 2,757,610 to Gegenheimer et al. entitled "Sheet Handling Mechanism and Method for Multi-Color Perfector Press," granted Aug. 7, 1956, the transfer cylinder of a rotary press was provided with suction heads to hold the trailing edge of the paper sheet on the cylinder during rotation and transfer thereof. The suction heads were fixed relative to the cylinder and the paper sheet had to be delivered to the cylinder in a flat wrinkle free condition in order to transfer the sheet in a smooth and unwrinkled condition. There was no provision in Patent No. 2,757,610 for tensioning the sheet of paper after it was positioned on the cylinder.

Patent No. 3,096,088 to Young entitled, "Sheet Holding and Transfer Mechanism for Presses," granted on July 2, 1963, discloses apparatus for pulling and tensioning the sheet on the transfer cylinder by moving the suction heads along the periphery of the cylinder after the suction heads have engaged the trailing edge of the paper sheet. The suction heads are arranged to move on the cylinder peripheral surface in a direction away from the leading edge of the sheet and thus pull the sheet into a smooth and taut condition on the cylinder.

In the above discussed prior art patents to Young and Gegenheimer et al., the sheet transfer cylinder is provided with gripping means for receiving and gripping the leading edge of the sheet to be transferred. The suction heads on the peripheral or external surface of the cylinder are spaced from the gripping means a preselected distance so that the suction heads are beneath the trailing edge of

the sheet. By applying a suction the trailing edge of the sheet is engaged by the suction heads and held on the cylinder. The suction heads of Young are urged by springs toward the gripping means. After the trailing edge of the sheet is in overlying relation with and secured to the suction heads by suction, the suction heads are moved away from the gripping means against the opposing force of the internal springs by suction. It is this movement of the suction heads that tensions the sheet and draws it taut over the surface of the transfer cylinder.

It is essential in pulling and tensioning the sheet on the external surface of the cylinder that all of the suction heads move away from the gripping means simultaneously and traverse the same distance in order to evenly tension the entire sheet on the transfer cylinder. Small variations in the resiliency of the internal springs within the suction heads may cause one or more of the suction heads to move sooner than the other suction heads or may cause the suction heads to move different distances relative to the gripping means. This results in the sheet being pulled or tensioned unevenly over the periphery of the cylinder.

Further, in Young the suction for engaging the sheet to the suction head and compressing the internal springs to move the suction heads is obtained from the same source so that the suction must be sufficient to engage the sheets to the suction heads and also sufficient to compress the internal springs and move the suction heads away from the gripping means. Using the same suction for both operations may also cause uneven tensioning of the sheet on the transfer cylinder. In addition, for certain types of paper, such as tissue paper, the suction required to compress the internal springs within the suction heads may be excessive. A fixed minimum suction is required to compress the internal springs within the suction heads. This minimum suction may exceed the strength of the tissue paper to the extent that the tissue paper is damaged when subjected to this excessive suction through the suction heads. If the suction is reduced to prevent damage to the tissue paper, insufficient suction is present to compress the internal springs and properly tension the sheet of tissue paper on the transfer cylinder.

SUMMARY OF THE INVENTION

The present invention eliminates the above discussed problems by providing a mechanical means for moving the suction heads away from the gripping means for tensioning the sheet on the transfer cylinder. The suction applied to the suction heads is solely for engaging the sheet to the suction head. Where tissue or fragile paper is being processed the suction can be reduced to a minimum that does not damage the paper and the mechanical means, independent of the suction pressure, is operable to move the suction heads away from the gripping means. The suction heads are all interconnected to the mechanical means and move simultaneously the same distance along the cylinder periphery to thereby apply an even tension to the sheet.

Briefly, the present invention provides a sheet transfer cylinder having gripping means for receiving and gripping the leading edge of the sheet to be transferred. A sheet engaging device having suction heads on the periphery of the cylinder is operable to engage the trailing edge of the sheet by suction. The sheet engaging device is movably

mounted within the body of the cylinder so that the suction heads are movable along the periphery of the cylinder toward and away from the gripping means. A mechanical means including an actuator positioned externally of the cylinder is arranged to move the sheet engaging device so that the suction heads move toward the gripping means to engage the trailing edge of the sheet and thereafter move the sheet engaging device so that the suction heads move away from the gripping means to draw the sheet taut over the outer surface or periphery of the cylinder.

Accordingly, it is the principal object of the present invention to provide a mechanically actuated device for moving a sheet engaging member toward and away from the gripping means to thereby evenly tension the sheet on the periphery of the cylinder.

Another object of this invention is to connect a plurality of sheet engaging members to each other so that all of the sheet engaging members will simultaneously move away from the gripping means along the periphery of the cylinder.

Another object of this invention is to provide a suction type sheet engaging member in which the sole function of the suction is to engage the sheet to the sheet engaging member.

These and other objects and advantages of this invention will be more completely disclosed and described in the following specification, the accompanying drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIGURE 1 is a schematic end view of a second transfer cylinder illustrating a paper sheet on the second transfer cylinder after the second transfer cylinder has received the sheet from a first transfer cylinder. The suction heads are in a first position away from the grippers and abutting a stop member.

FIGURE 1A is a view similar to FIGURE 1 illustrating the second transfer cylinder rotated on its axis to a position where the suction heads have moved to a second position toward the grippers and spaced from the stop member.

FIGURE 2 is a view similar to FIGURE 1A illustrating the second transfer cylinder further rotated on its axis to a position where the suction heads engage the trailing edge of the sheet. The paper sheet is illustrated with several wrinkles therein.

FIGURE 3 is a view similar to FIGURE 2 illustrating the second transfer cylinder still further rotated on its axis with the suction heads engaging the trailing edge of the sheet with the suction heads moved back to the first position away from the grippers. The movement of the suction heads away from the grippers has removed the wrinkles illustrated in FIGURE 2.

FIGURE 4 is a developed view of the transfer cylinder taken along the line 4—4 in FIGURE 5 illustrating the sheet engaging device and the mechanical actuation therefor.

FIGURE 5 is a fragmentary end view in elevation of the transfer cylinder illustrating the mechanical actuating means for the sheet engaging device taken generally along the line 5—5 in FIGURE 4.

FIGURE 6 is a view in side elevation of one of the sheet engaging vacuum arms.

FIGURE 7 is a plan view of the suction head secured to the top portion of the vacuum arm.

FIGURE 8 is a view in front elevation of a sheet engaging vacuum arm mounted on a support shaft having a passageway therethrough.

FIGURE 9 is a side view in elevation taken along the line 9—9 in FIGURE 4 illustrating the cam disc for rotating the vacuum arms and actuating the suction valve. The cam disc is mounted on the frame of the rotary press.

FIGURE 10 is a developed view of the cam surface for actuating the suction valve illustrated in FIGURE 9.

FIGURE 11 is a side view in elevation illustrating one of the shaft supporting discs taken generally along the line 11—11 in FIGURE 4.

FIGURE 12 is a view similar to FIGURE 5 illustrating another embodiment of an actuating means for the sheet engaging vacuum arms.

FIGURE 13 is a side view in elevation of an actuating disc having contact surfaces for the actuating means illustrated in FIGURE 12.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings and particularly to FIGURES 1–3 there is shown schematically an end view of a second transfer cylinder generally described by the numeral **10**. The transfer cylinder **10** is supported and mounted for rotation in the frame of a rotary press on shaft **12**. Two sets of gripper fingers are shown generally at **14** and **16** mounted on the periphery of the cylinder **10** to grip the leading edge of a sheet to be transferred by the transfer cylinder **10**. Two sets of suction heads shown generally at **18** and **20** are movable along the periphery of the cylinder for engaging the trailing edge of the sheets to be transferred. Suction heads **18** and **20** are mounted on sheet engaging vacuum arms generally designated by the numerals **22** and **24** which are in turn nonrotatably secured to vacuum arm shaft generally designated **26** and **28** respectively. Vacuum arm shafts **26** and **28** are supported by the second transfer cylinder **10** and have an axis parallel to and spaced from the cylinder axis of rotation.

The general operation of the transfer cylinder in engaging and tensioning a sheet is as follows. As the transfer cylinder **10** rotates on its axis in the direction of the arrow in FIGURE 1, the leading edge **30** of a sheet **32** that is to be transferred by the cylinder **10** is taken from a first transfer cylinder **34** by the gripper fingers **14** in the manner described in Patent No. 2,757,610, included herein by reference, and transferred to the transfer cylinder **10**. In the position illustrated in FIGURE 1, the vacuum arms **24** abut stop members **132** and the suction heads **20** are in a first position away from the gripper fingers **14**.

In FIGURE 1A, the second transfer cylinder **10** has rotated about its axis to a position where the vacuum arms **24** have moved toward the grippers **14**. The trailing edge **36** of sheet **32** is not as yet in overlying relation with the suction heads **20**. The suction heads **20** have moved toward the grippers **14** by rotation of the shaft **28** in the direction of the arrow in FIGURE 1A.

In FIGURE 2, the second transfer cylinder **10** has further rotated about its axis from the position illustrated in FIGURE 1A and the trailing edge **36** of sheet **32** is in overlying relation with the suction heads **20**. Suction is applied to the suction heads at approximately the position illustrated in FIGURE 2 to engage the trailing edge **36** of the sheet **32** to the respective suction heads **20**. The sheet **32** may have a nonplanar configuration and contain wrinkles generally designated by the numerals **38** and **40**.

After the trailing edge of the sheet is engaged by the suction heads **20**, on further rotation of the second transfer cylinder **10**, as illustrated in FIGURE 3, the shaft **28** is rotated in the direction of the arrow in FIGURE 3 opposite to the direction illustrated in FIGURE 2. This rotation of shaft **28** moves the suction heads **20** along the periphery of cylinder **10** away from the grippers **14** to thereby pull the sheet **32** by the trailing edge **36** taut over the periphery of the cylinder **10** and removes the wrinkles **38** and **40** previously present in the sheet **32**. The rotation of shaft **28** first in one direction and then in the opposite direction occurs while the cylinder **10** is rotating in one direction about the axis of shaft **12**.

EMBODIMENT I—FIGURES 4–11

FIGURES 4–11 illustrate one embodiment of the mechanical actuating mechanism for moving suction heads **18** and **20**. FIGURE 4 is a developed section and illustrates one set of vacuum arms and one set of gripper fingers which for convenience will be generally referred to, respectively, by the numerals **16** and **18**. In the No. 2 transfer cylinder of a multi-color and perfector press, as described in Patent No. 2,757,610, there are two sets of gripper fingers and two sets of suction heads. It should be understood, however, the hereinafter described invention is applicable to sheet handling devices having one or more sets of gripper fingers and one or more sets of suction heads.

In FIGURE 4, the shaft **12** of transfer cylinder **10** is of tubular construction and is mounted for rotation in journals **42** and **44** in frame members **46** and **48** respectively. Secured to the tubular portion of main shaft **12** are a plurality of spaced sheet supporting discs generally designated by the numeral **50** that have a hub portion **52** and radially extending disc like spokes or web portions **54**. The web portions **54** have radial flanged sheet supporting end portions **56** that are arranged to support the paper sheet. The external surface of the cylinder sheet supporting portions **56** form the outer periphery of the transfer cylinder **10**.

The sheet supporting disc web portions have elongated semicircular openings **58** therein to permit adjustment of the vacuum arm shaft **26** toward and away from the gripper fingers **16** as will be later described.

Also supported on the tubular portion of main shaft **12** are a plurality of shaft supporting discs generally designated by the numeral **60** (FIGURES 4 and 11) and each has a hub portion **62** secured to the main shaft **12**. Disc like web portions **64** extend radially from the hub portion **62** and have flanged radial sheet supporting peripheral segments **66** that are also arranged to support the sheet on the transfer cylinder outer surface. The sheet supporting segments **66** are in the same cylindrical plane as the sheet supporting surfaces **56** of sheet supporting discs **50**.

The shaft supporting discs **60** have aligned passageways **68** therethrough in which bearings **70** are positioned. The vacuum arm shaft **26** extends through the axially aligned passageways **68** and is rotatably supported by the bearings **70**. The web portions **64** of certain of the shaft supporting discs **60** have aligned passageways **72** for a valve actuator shaft and passageways **74** and **76** for air and suction conduits later described. The shaft supporting discs **60** are adjustable on the shaft **12** to move the suction heads **18** and **20** toward or away from the grippers **14** and **16** so that the suction heads **18** and **20** may be positioned beneath the trailing edge of paper sheets having different lengths.

The vacuum arm shaft **26** has a plurality of vacuum arms generally designated by the numeral **22** secured thereto and rotatable therewith. One of the vacuum arms **22** is illustrated in detail in FIGURES 6, 7 and 8 and includes a body portion **78**, a hub portion **80** and a suction head receiving end portion **82**. The suction head receiving portion **82** has an upper suction head receiving surface **84** and a bottom surface **86**. A passageway **88** extends from the bottom surface **86** through the suction head receiving end portion **82** to the upper surface **84**. The suction head **18** has a perforated or foraminous top surface **92** and is secured to the suction head receiving portion top surface **84** by screws **94**. The suction head **18** has a chamber **96** connected to the passageway **88** in the vacuum arm end portion **82** so that the chamber **96** may be evacuated by applying a suction or vacuum to the passageway **88** or air under pressure may be supplied to chamber **96** through passageway **88** as will be later described. The suction heads **18**, for convenience of description, are called "suction heads" although it should be understood the heads **18** also serve as blower heads.

The suction head end portion **82** also has a bore **98** therethrough normal to and intersecting passageway **88**. A manually rotatable valve **100** is positioned in bore **98** and is operable to open and close passageway **88**. The valve **100** is locked in position by a spring **102** secured to the suction head receiving end portion **82** by a screw **104**. A flexible conduit **106** is connected at one end to the passageway **88** in the suction head receiving end portion **82** and at the other end to an opening **108** in the vacuum arm shaft **26**. The vacuum arm shaft **26** has an axial bore **110** that is connected to the conduits **106** at the openings **108**. Air or suction is provided for the suction heads **18** through the axial bore **110** in vacuum arm shaft **26** as later described.

As is apparent from FIGURES 4 and 11, the axis of the vacuum arm shaft **26** is spaced radially from the axis of the transfer cylinder main shaft **12** and is parallel thereto. The vacuum arm shaft **26** is also spaced inwardly from the periphery of the transfer cylinder **10** and the vacuum arms **22** extend radially toward the periphery of the cylinder **10** with the suction heads **18** positioned in the same plane as the sheet supporting surfaces of the discs **50** and **60**.

Secured to the end of cylinder main shaft **12** adjacent the frame **48** is a support member **112** that it rotatable with the cylinder **10**. The support member **112** has an annular body portion **113** with a radially extending support portion **114**. The vacuum arm shaft **26** has an end portion **116** extending through a passageway **118** (FIGURE 4) in the radially extending support portion **114** and is rotatably supported therein. An actuating lever **120** is nonrotatably secured to the vacuum arm shaft end portion **116** and is operable to rotate the vacuum arm shaft **26** in the support passageways **118** and **68**. A cam roller **122** is rotatably connected to the end of lever **120**. The lever **120** has a pin **124** connected thereto and loosely positioned in a bracket **126** secured to the annular member **112**. A spring **128** is positioned around pin **124** and urges the lever away from the annular member **112**. The spring **128** exerts a force on the end of lever **120** to rotate the vacuum arm shaft **26** in a clockwise direction as viewed in FIGURES 5 and 11. Each of the shaft supporting discs **60** has a radially extending stop portion **130** with an adjustable stop member **132** positioned therein. The spring **128** through lever **120** and vacuum arm shaft **26** urges the vacuum arms **22** against the end of stop member **132** to thereby maintain the suction heads **18** in a position away from the grippers **16**. By rotating the vacuum arm shaft **26** through lever **120** in a counterclockwise direction, as viewed in FIGURES 5 and 11 the suction heads **18** are moved in a direction toward the grippers **16**.

Referring to FIGURES 4 and 9, a cam disc **134** is secured to the inner surface of frame **48** and has a radially inwardly extending cam segment **136** with a cam surface **138**. The cam roller **122** (FIGURES 4 and 5) on the end of lever **120** is arranged to contact the cam surface **138** during rotation of the cylinder **10** to move lever **120** in a direction to compress spring **128**. The cam surface **138** thus through cam roller **122**, lever **120** and vacuum arm shaft **26** moves the suction heads **18** on vacuum arms **22** toward the grippers **16** a preselected distance. This distance is controlled by the shape and dimensions of the cam **136**.

The mechanism for applying suction to the suction heads **18** is illustrated in FIGURE 4. The intermediate shaft support disc **60** has a valve housing **140** with an air port **142** and a vacuum or suction port **144**. An air pressure conduit **146** is connected to the air port **142** and is supported in the shaft supporting discs **60** and extends through a passageway **148** in the radially extending portion **114** of support member **112**. A suction conduit **150** is connected to the suction port **144** and extends through a similar passageway **152** in the support member **112**. An annular rotary valve generally designated by the numeral **154** is mounted on the shaft **12** and has a rotatable por-

tion **156** secured to and rotatable with the cylinder **10** and a fixed portion **158** connected to the frame member **48** by a pin **160**. The conduits **146** and **150** have their end portions connected to the rotatable portion **156**. The rotatable portion **156** and fixed portion **158** have annular recessed portions **162** and **164** that communicate with the respective air and suction conduits **146** and **150** through suitable passageways in the valve rotatable portion **156**. A source of suction such as a conventional vacuum pump (not shown) is connected through conduit **166** to the valve fixed portion **158** and is arranged to provide a suction through annular passageway **162** to the suction conduit **150**. There is a similar source of air under pressure (not shown) connected to a conduit **168** (FIGURE 5) that supplies air under pressure through suitable passageways in the valve fixed portion **158** to annular passageway **164** and air conduit **146**. With this arrangement, air under pressure is provided in conduit **146** and a suction is provided in conduit **150**. Suitable annular seal means are positioned between the fixed and rotatable portions of valve **154** to seal the respective annular passageways **162** and **164**.

The valve **140** has a chamber **168** connected to air port **142** and suction port **144**. There is an outlet port **170** in valve housing **140** that communicates with the axial bore or passageway **110** in the vacuum arm shaft **26**. A rod-like valve member **172** is positioned in chamber **168** and is arranged to alternatively connect outlet port **170** with air port **142** or suction port **144**. The rod-like valve member **172** is connected to a rod **174** that is supported in the shaft supporting discs **60** and has an end portion connected to an actuator **176** supported in a passageway **178** in the radially extending portion **114** of support member **112**. The valve **172** has a spring member **180** that normally biases the valve member to a position where the air port **142** is connected to outlet port **170**. By moving the rod axially against the spring **180** (as is illustrated in FIGURE 4), the airport **142** is closed and the suction port **144** is connected to the outlet port **170**. The rod **174** is arranged to move axially to connect the respective air and vacuum ports **142** and **144** to the outlet port **170**. The actuator **176** supported in support member **112** has a cam roller **182** on its end portion.

The actuator for valve **140** is a semicircular cam segment **184** on cam disc **134** illustrated in FIGURES 9 and 10. The cam segment **184** has a cam surface **186** that extends inwardly toward the transfer cylinder **10**. FIGURE 10 is a developed view of the cam segment **184** and illustrates the inwardly extending raised cam surface **186**. Upon rotation of the cylinder **10**, the roller **182** rotatably secured to valve actuator **176** contacts the cam surface **186** and moves the valve rod **174** inwardly to the position illustrated in FIGURE 4 to connect the suction port **144** in valve housing **140** to the outlet port **170** and thus provide a suction for suction heads **18**. It should be noted that the cam surfaces **186** and **138** are arranged in the same quadrant so that the suction head is subjected to a suction pressure when the lever **120** moves the vacuum arms **22** and suction heads **18** away from the grippers **16**.

The vacuum arms **22** and their associated structure may be moved toward and away from the grippers to accommodate different sized sheets processed in the rotary press. A clamp screw (not shown) may be loosened to adjust the annular support member **112** (FIGURE 5) and the annular support member **112** with the associated structure positioned thereon may be rotated relative to the cylinder main shaft **12** with the vacuum arms **22** and their associated structure about the axis of main shaft **12** within the limits of the elongated semicircular openings **58** in the sheet supporting discs **50**. A pointer **188** extends radially from the annular support member body portion **113** and cooperates with an index plate **190** mounted on the sheet supporting disc **50** adjacent the end of cylinder **10** to indicate the arcuate distance between the grippers **16** and the suction heads **18** on the periphery of the cylinder **10**. This arcuate distance is equivalent to the length of the sheet that may be processed in the rotary press with the trailing edge of the sheet in overlying relation with the suction heads **18** when the front edge of the sheet is engaged by the grippers **16**.

The transfer cylinder **10** is driven by drive gears **192**, as illustrated in FIGURE 4 and the grippers **16** that are associated with the cylinder **10** are generally illustrated in FIGURE 4. There is also illustrated generally actuating mechanisms **194** for the grippers **16** and a cam **196** secured to the inner surface of frame **46** for opening and closing the grippers **16**. The mechanism for rotating the transfer cylinder **10**, the grippers and the arrangement for actuating the grippers is similar to that described in the Gegenheimer et al. Patent No. 2,757,610. The apparatus and method of operation illustrated and described in the Gegenheimer et al. Patent No. 2,757,610 is incorporated herein by reference.

EMBODIMENT II—FIGURES 12 AND 13

In FIGURES 12 and 13 there is illustrated an electromechanical device for moving the suction heads **18** toward and away from the grippers **16**. FIGURE 12 is similar to FIGURE 5 and similar numerals will designate similar parts. A solenoid generally designated by the numeral **198** is supported by an extension of bracket **126**. The solenoid **198** has a solenoid coil **199** and a cylindrical core or armature **200**. The armature **200** is connected to lever **120** by means of a pivot link **202**. The solenoid **198** has a flange member **204** extending therefrom that supports a pair of brushes **206** and **208**. The flange member **204** is preferably resilient to urge the brushes **206** and **208** against contact surfaces on a disc **210** generally illustrated in FIGURE 13. Suitable conductors (not shown) connect the brushes **206** and **208** with the solenoid coil **199** so that current from brushes **206** and **208** will energize coil **199** creating a magnetic flux and pulling armature **200** inwardly in coil **199**.

The disc **210** is similar to the cam disc **134** to the extent that cam member **184** is secured thereto and has a cam surface **186** similar to that illustrated in FIGURE 9 to actuate the valve member **172**, as previously discussed. The disc **210** has appropriate circular contact surfaces **212** and **214** on which the brushes **206** and **208** ride upon rotation of cylinder **10**. The contact surfaces **212** and **214** have appropriate electrically conductive portions **216** and **218** for the segment illustrated by the line A in FIGURE 13. The remainder of the contact surfaces are nonconductive surfaces.

As the cylinder **10** rotates, the brushes **206** and **208** remain in contact with the circular contact surfaces **212** and **214** and as the brushes traverse the electrically conductive portions **216** and **218**, the brushes **206** and **208** complete an electrical circuit through surfaces **216** and **218** to energize the solenoid coil **199**. When the coil **199** is energized, the core or armature **200** moves inwardly and rotates the lever **120** and vacuum arm shaft **26** in a counterclockwise direction, as viewed in FIGURE 12, to move the suction heads **18** toward the grippers **16** and further compresses spring **128** in a manner similar to that previously described. When the cylinder rotates to a position where the brushes **206** and **208** contact the nonconductive portions of contact surfaces **212** and **214**, the spring **128** expands and rotates the lever **120**, vacuum arm shaft **26** and vacuum arms **22** until the vacuum arms **22** abut the stop member **132** (FIGURE 11) and thus move the suction heads **18** away from the grippers **16**.

OPERATION

In operation, the transfer cylinder **10** is rotated at a preselected speed by the drive gears **192**. The leading edge of the sheet that is transferred from the #1 transfer cylinder **34** (FIGURE 1) is engaged by the grippers **16** in

the manner described in Patent No. 2,757,610. The grippers secure the leading edge of the sheet to the transfer cylinder **10** and the body of the sheet assumes the curvature of the transfer cylinder **10**. The vacuum arms **22** and associated apparatus is adjusted relative to the grippers **16** by adjusting annular support member **112** so that the trailing edge of the sheet will be in overlying relation with the suction heads **18**. Before the trailing edge of the sheet is in overlying relation with the suction heads **18**, the cam roller **122** associated with lever **120** contacts the cam surface **138** on cam member **136** and rotates the lever **120**, vacuum arm shaft **26** and vacuum arm **22** and moves the vacuum arms and suction heads toward the grippers **16** to a position similar to that illustrated in FIGURE 1A. The suction heads are moved toward the grippers **16** before the suction heads reach the common center line between the second and first transfer cylinders **10** and **34**. The cam roller **182** associated with the valve actuator **176** then contacts the raised cam surface **186** on the semicircular cam member **184** to move the valve actuator **176** and valve stem **172** to the position illustrated in FIGURE 4 to thus connect the outlet port **170** with suction port **144** to provide a suction in suction heads **18**. The suction heads are in approximately the position illustrated in FIGURE 2 when the suction is applied thereto. The trailing edge of the sheet is thus engaged by the suction heads **18** by suction.

While the sheet trailing edge remains engaged to the suction heads by the suction, the cam roller **122** moves off the cam surface **138** and spring **128** expands and rotates the lever **120** and vacuum arm shaft **22** in a clockwise direction to thereby rotate the vacuum arms **22** and move the suction heads **18** away from the grippers **16**. The cam surface **138** is so arranged that the vacuum arms **22** move away from the grippers **16** a short time after the suction heads **20** have passed the common center line between the second and first transfer cylinders **10** and **34** as is illustrated in FIGURE 3. This movement of the suction heads **18** away from the grippers **16** by the expansion spring **128** while the trailing edge of the sheet is engaged by the suction heads **18**, pulls the paper sheet engaged by grippers **16** taut on the surface of cylinder **10**. The suction heads **18** remains in this latter position away from the grippers **16** under the force of spring **128** until again urged toward the grippers **16** by the cam actuated lever. Further rotation of cylinder **10** moves cam roller **182** associated with valve actuator **176** off of the raised cam surface **186** to move the valve **172** to open the air port **140** to outlet port **170**. The positive air pressure exerted through the suction heads **18** disengages the trailing edge of the sheet from the suction heads. This latter operation is accomplished as the sheet is being transferred from the #2 transfer cylinder and is engaged by grippers on a subsequent transfer cylinder. As the transfer cylinder **10** picks up another sheet of paper, the above sequence is repeated thus tensioning each sheet as it is transferred by transfer cylinder **10**.

With this arrangement, the amount of suction in suction heads **18** is determined by the engaging force required between the trailing edge of the paper sheet and the suction head. The mechanical actuating means i.e. cam **136**, lever **120**, vacuum arm shaft **26**, vacuum arms **22** and spring **128**, move the suction heads toward and away from the grippers **16** and is independent of the suction pressure in the suction heads **18**. Because all of the vacuum arms **22** are fixedly secured to the vacuum arm shaft **26**, all of the suction heads move simultaneously toward and away from the grippers **16** and move the same incremental distance along the periphery of the transfer cylinder **10**. The sequence of subjecting the suction heads **18** to a suction and moving the suction heads toward and away from the grippers is controlled by the relative positions of the cam members **136** and **184**. It should be understood that the cam arrangement could be such that the suction heads **18** would be moved away from the grippers **16** upon actuation by a cam surface and moved toward the grippers by another mechanical device.

The electromechanical actuating mechanism in FIGURES 12 and 13 operates in a similar manner to the actuating mechanism illustrated in FIGURES 4–11. The lever arm **120** is moved in a counterclockwise direction by means of the solenoid **198**. The brushes **206** and **208** and the conductive contact surfaces **216** and **218** control the segment where the solenoid coil **199** is energized and the armature **200** is pulled into the coil **199** to move lever **120** and rotate the vacuum arm shaft **26**. In the embodiment illustrated in FIGURES 12 and 13, the air suction valve is actuated by a raised cam mechanism **186**. It should be understood, however, that the air-vacuum valve could also be actuated by a similar electrical device as that illustrated in FIGURE 12 for rotating lever **120**.

According to the provisions of the patent statues, I have explained the principle, preferred construction, and mode of operation of my invention and have illustrated and described what I now consider to represent its best embodiments. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A sheet handling device comprising:

a sheet transfer cylinder having gripper means for receiving and gripping the leading edge of a sheet to be transferred,

sheet engaging means extending toward the periphery of said cylinder adjacent the trailing edge of said sheet,

said sheet engaging means having a sheet engaging portion movable along the periphery of said cylinder operable to engage said trailing edge of said sheet,

first mechanical means operable to move said sheet engaging portion of said sheet engaging means away from said gripper means,

adjustable stop means on said cylinder to limit movement of said sheet engaging means in a direction away from said gripper means,

second mechanical means operable to move said sheet engaging portion toward said gripper means,

said first mechanical means and said second mechanical means being operable to move said sheet engaging portion toward said gripper means for engaging the trailing edge of said sheet and thereafter moving said sheet engaging portion away from said gripper means while said gripper means engages said leading edge of said sheet to thereby draw said sheet taut over the periphery of said cylinder.

2. A sheet handling device as set forth in claim **1** in which said sheet engaging portion includes:

a suction head for engaging the sheet to be transferred,

valve means within said transfer cylinder,

conduit means connecting said valve means to said suction head,

cam actuated means controlling said valve means.

3. A sheet handling device as set forth in claim **1** in which:

said second mechanical means includes a lever means operable to move said sheet engaging portion of said sheet engaging means toward said gripper means.

4. A sheet handling device as set forth in claim **3** in which:

said lever means includes roller means rotatably secured thereto,

a cam member positioned adjacent to said cylinder, said cam member having a cam surface fixed relative to said cylinder,

said roller means being operable to engage said cam surface and rotate said lever means to thereby move said sheet engaging portion toward said gripper means.

5. A sheet handling device as set forth in claim 3 in which:
said lever means includes electrically actuated means secured thereto,
said electrically actuated means being operable to rotate said lever means to thereby move said sheet engaging portion toward said gripper means.

6. A sheet handling device as set forth in claim 1 in which:
said sheet engaging means includes a vacuum arm extending to the periphery of said cylinder,
said vacuum arm having a sheet engaging end portion movable along the periphery of said cylinder, said sheet engaging end portion being operable to engage said trailing edge of said sheet,
said second mechanical means includes electrically actuated means to rotate said vacuum arm toward said gripper means.

7. A sheet handling device as set forth in claim 6 in which:
said electrically actuated means includes a solenoid coil secured to said cylinder with a movable core positioned therein, said core connected to said vacuum arm so that upon energization of said solenoid coil said core moves into said solenoid and rotates said vacuum arm to thereby move said vacuum arm sheet engaging end portion toward said gripper means.

8. A sheet handling device as set forth in claim 1 in which:
said first mechanical means includes resilient means urging said sheet engaging portion of said sheet engaging means away from said gripper means.

9. A sheet handling device as set forth in claim 8 in which:
said resilient means urges said sheet engaging portion of said sheet engaging means away from said gripper means,
said second mechanical means being operable to move said sheet engaging portion of said sheet engaging means against said resilient means toward said gripper means.

10. A sheet handling device as set forth in claim 8 in which:
said sheet engaging means includes support means within said cylinder, said support means being secured to said second mechanical means,
said second mechanical means being operable to rotate said support means to thereby move said sheet engaging portion of said sheet engaging means against said resilient means toward said gripper means.

11. A sheet handling device as set forth in claim 1 in which:
said sheet engaging means includes a vacuum arm extending to the periphery of said cylinder,
said vacuum arm having a sheet engaging end portion movable along the periphery of said cylinder, said sheet engaging end portion being operable to engage said trailing edge of said sheet,
said second mechanical means includes cam actuated means to rotate said vacuum arm toward said gripper means.

12. A sheet handling device as set forth in claim 11 in which:
said cylinder includes adjustable stop means for said vacuum arm, said adjustable stop means being operable to limit the movement of said vacuum arm in a direction away from said gripper means.

13. A sheet handling device as set forth in claim 11 in which:
said first mechanical means being operable to urge said vacuum arm end portion away from said gripper means,
said cam actuated means being operable to move said end portion toward said gripper means,
said first mechanical means and said cam actuated means being operable to move said vacuum arm end portion toward said gripper means to a sheet engaging position with said trailing edge of said sheet and thereafter move said vacuum arm end portion away from said gripper means after said trailing edge of said sheet has been engaged by said vacuum arm end portion to thereby draw said sheet taut over the periphery of said cylinder.

14. A sheet handling device as set forth in claim 11 in which:
said cam actuated means includes support means for said vacuum arm, said vacuum arm being nonrotatably secured to said support means,
said cam actuated means being operable to rotate said support means and said vacuum arm nonrotatably secured thereto to thereby move said vacuum arm sheet engaging end portion toward said gripper means.

15. A sheet handling device as set forth in claim 14 in which:
said first mechanical means includes resilient means connected to said cam actuated means, said resilient means being operable to rotate said support means and move said vacuum arm sheet engaging end portion away from said gripper means to thereby draw said sheet taut over the periphery of said cylinder.

16. A sheet handling device as set forth in claim 14 in which:
said support means includes a shaft rotatably supported within said transfer cylinder in parallel relation to the axis of rotation of said cylinder.

17. A sheet handling device as set forth in claim 11 in which:
said cam actuated means includes support means for said vacuum arm, said vacuum arm being nonrotatably secured to said support means,
said cam actuated means includes a lever nonrotatably secured to said support means, said lever being operable to rotate said support means to thereby move said vacuum arm sheet engaging end portion toward and away from said gripper means,
said first mechanical means includes a spring connected to said lever, said spring being operable to rotate said support means and move said vacuum arm sheet engaging end portion away from said gripper means,
said cam actuated means including a roller member rotatably secured to said lever and a cam member positioned adjacent to said cylinder, said cam member having a surface fixed relative to said cylinder,
said roller means being operable to engage said cam surface upon rotation of said cylinder and rotate said lever and said support means to thereby move said vacuum arm sheet engaging end portion toward said gripper means.

18. A sheet handling device comprising a sheet transfer cylinder having gripper means for receiving and gripping the leading edge of a sheet to be transferred and sheet suction engaging means movable along the periphery of said cylinder to engage the trailing edge of the sheet:
said sheet suction engaging means including a sheet engaging portion substantially tangent with said cylinder periphery and a supporting portion rotatably mounted within the body of said cylinder,
suction means being connected with said sheet engaging portion to provide a controlled vacuum for holding the trailing edge of said sheet,
means to rotate said supporting portion whereby said sheet engaging portion is moved along said cylinder periphery toward and away from said gripper means, and
adjustable stop means on said cylinder to limit movement of said sheet engaging portion away from said gripper means.

19. A sheet handling device as set forth in claim 18 wherein said sheet engaging portion is the head of an arm whose body comprises an integral portion of said supporting portion:

said arm being mounted on a shaft within the body of said cylinder,

said shaft being driven so as to make said head move along said cylinder periphery by moving said arm.

20. A sheet handling device as set forth in claim 18 in which said means provided to rotate said supporting portion includes mechanical actuators:

said mechanical actuators comprising a cam operated lever to move said sheet engaging portion along said cylinder periphery toward said gripper means and resilient means to move said sheet engaging portion away from said gripper means.

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