United States Patent [19]

Lutts et al.

[11] **3,856,294**

[45] **Dec. 24, 1974**

[54] **MECHANISM FOR SEPARATING FLEXIBLE PLIES FROM A STACK**

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[73] Assignee: **USM Corporation,** Flemington, N.J.

[22] Filed: **June 6, 1972**

[21] Appl. No.: **260,306**

[52] **U.S. Cl.** **271/10,** 271/19

[51] **Int. Cl.** **B65h 3/00**

[58] **Field of Search** ..... 271/18 R, 19, 20, 21, 26, 271/27, 11, 10, 103, 91–93, 113; 294/64 R, 65

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Attorney, Agent, or Firm—Carl E. Johnson; Vincent A. White; Richard B. Megley

[57] **ABSTRACT**

A machine for picking up plies of flexible sheet material to be successively transferred from a stack includes an improved ply separating mechanism enabling an underply to remain undisturbed. The separating mechanism carries and actuates a pick-up device when it has seized an exposed, for instance the top ply, yieldably to rotate the device about an axis substantially normal to the stack while effecting lift-off. The separator and pick-up unit may cooperate with adjacent similar units, counter-rotatable or not, to impart stress in the intervening work piece portions for "peeling" apart and holding them during transfer. The ply separating mechanism is preferably automatically operable at the delivery position to cause work piece release by reason of inertia.

4 Claims, 9 Drawing Figures

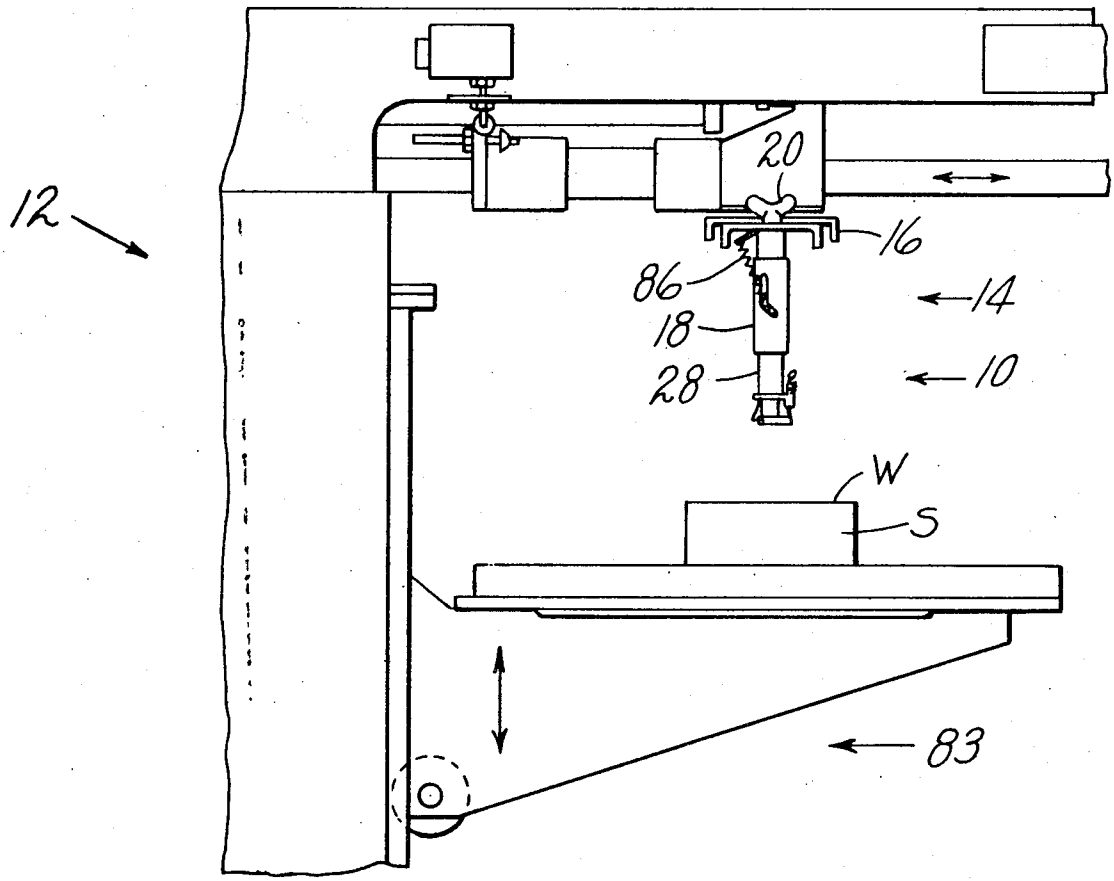


Fig. 1

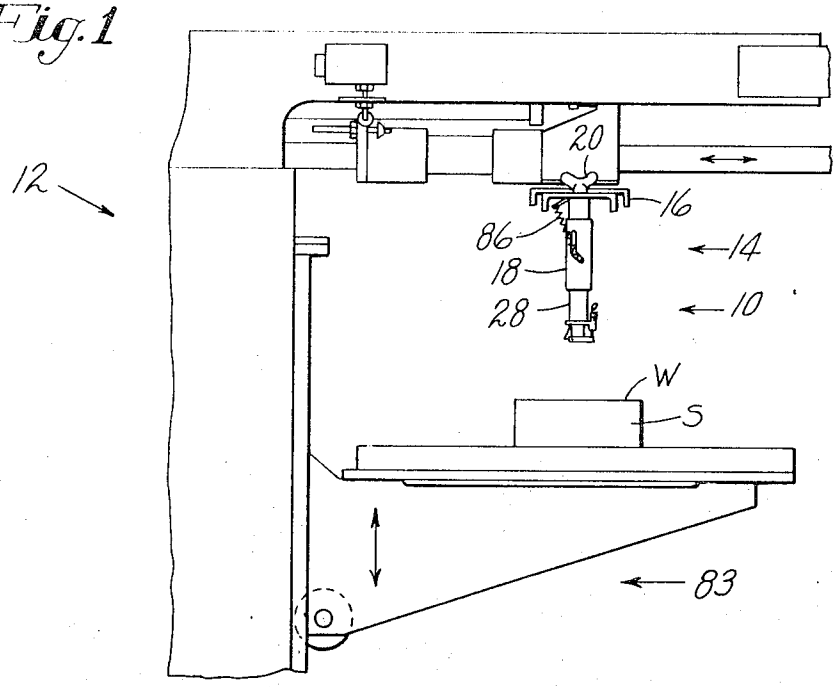


Fig. 2

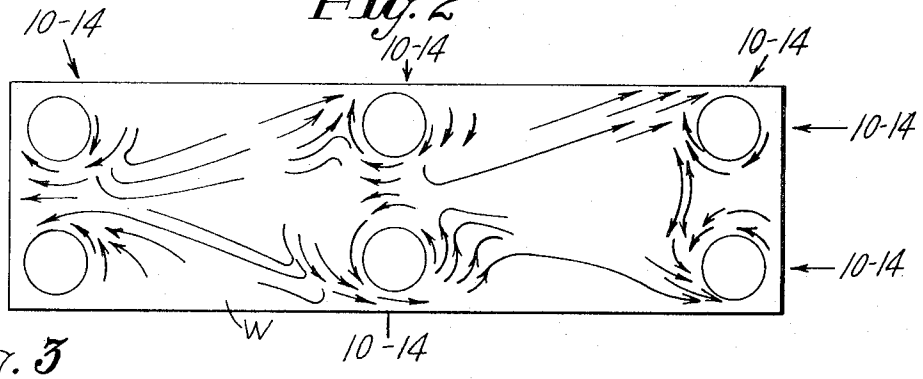


Fig. 3

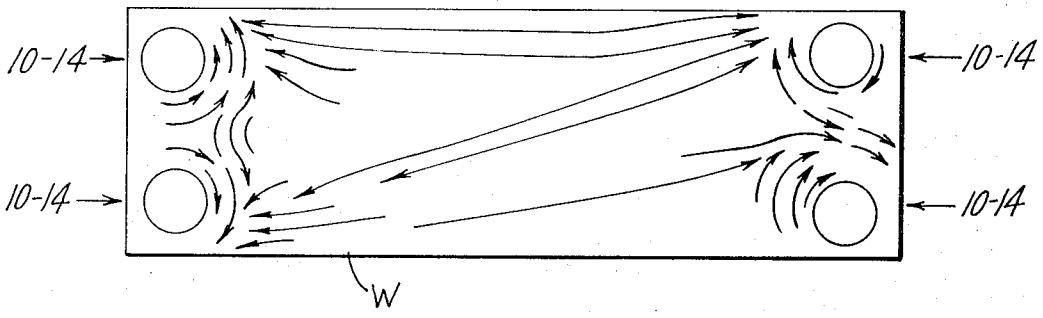


Fig. 4

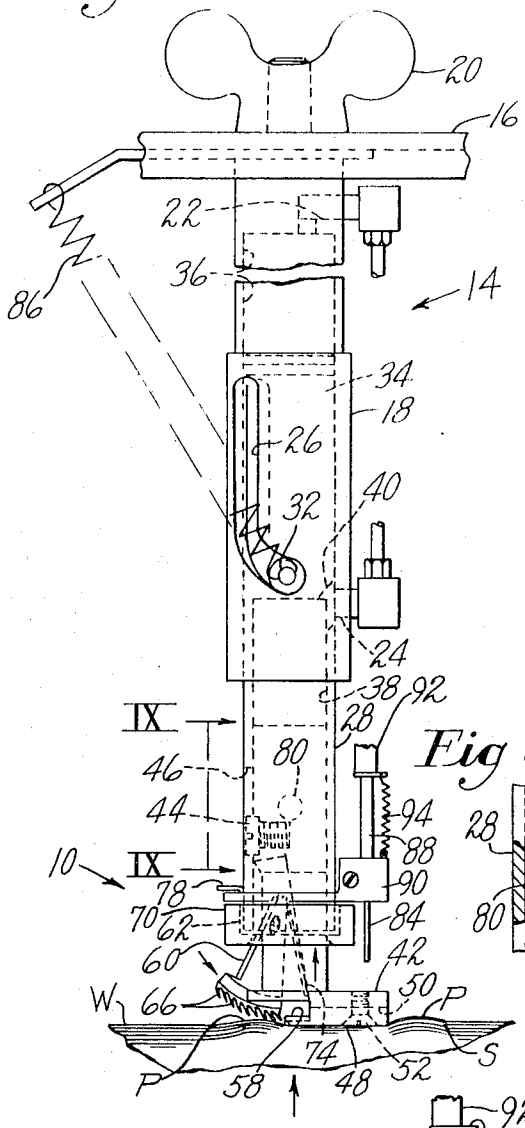


Fig. 7

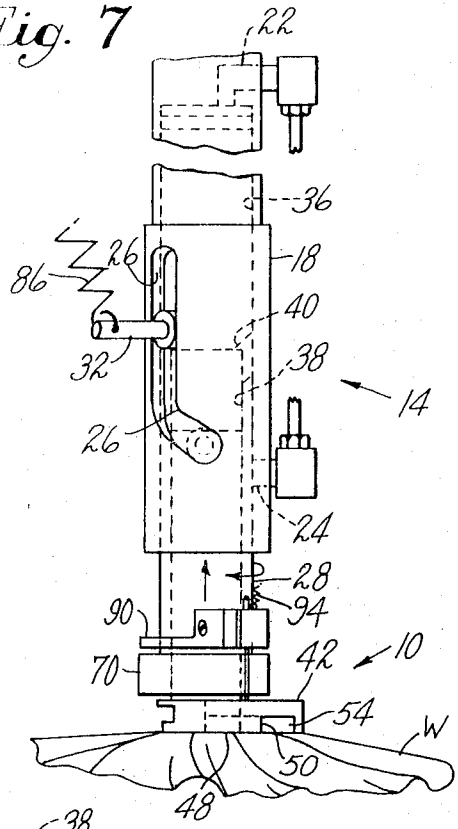


Fig 9

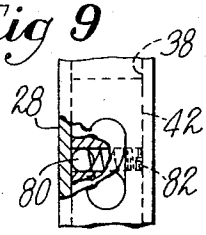


Fig. 8

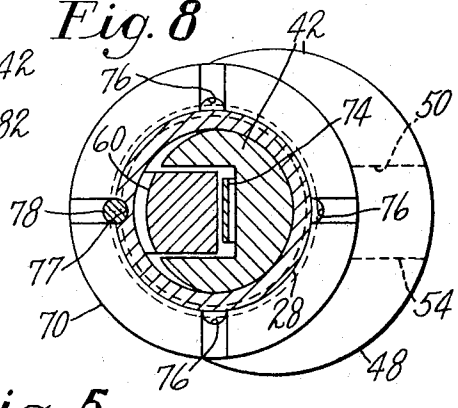


Fig. 6

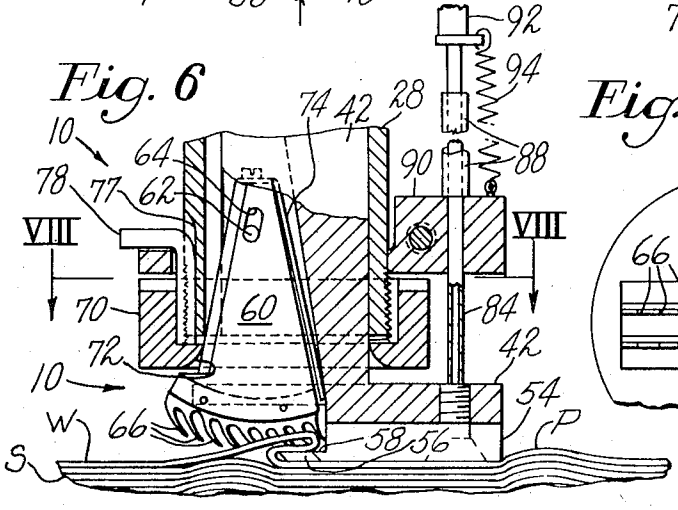
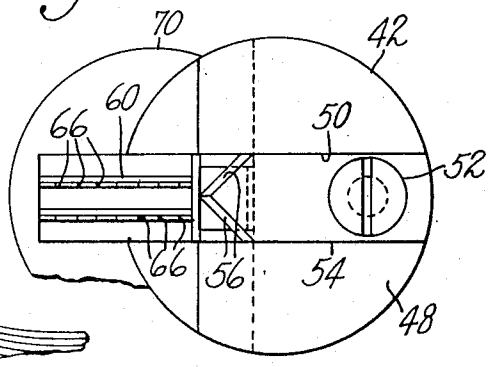


Fig. 5



MECHANISM FOR SEPARATING FLEXIBLE PLIES FROM A STACK

CROSS REFERENCE TO RELATED APPLICATION

Concurrently herewith an Application Ser. No. 260,305 is being filed in the name of Richard R. Walton et al pertaining to the pick-up means illustrated in the present application, and an application Ser. No. 260,304 is being filed in the name of James Stewart et al. pertaining to a nip adjusting mechanism shown herein.

BACKGROUND OF THE INVENTION

Successful removal and transfer of a flexible top sheet from a stack to a desired delivery position entails that there be no disturbance of an underply. Frequently, whether due to cleavage of interfacial fibers or otherwise, there is a strong tendency for the underply to be drawn and/or raised in whole or in part along with the adjacent or top ply. Different sheet materials, woven, non-woven, knit, etc., exhibit markedly different characteristics as regards the adherence of one ply to another of like or different material. Prior art sheet transferring devices operable upon fabric, for example, have utilized pointed work engaging elements, air flow or suction directed against the work, or buckling rolls, for example, in various arrangements in dealing with the two closely related problems of firstly seizing only the exposed or top ply, and secondly, separating the exposed or top ply, when seized, from the underply without disturbing the latter.

SUMMARY OF THE INVENTION

In view of the foregoing it is a primary object of this invention to provide, in combination with a ply pick-up device, an improved method and mechanism for separating the seized ply from an underply without disturbing the latter.

A further object of the invention is to provide a top ply separating mechanism whereby a pick-up device is caused to give at least one locality of the top ply a yieldable twist about an axis substantially normal thereto as the ply is lifted from an underply, and then untwisted at a delivery position whereupon the separating means effects work release.

To these ends, and as herein shown, a ply separating mechanism in one arrangement comprises a vertically reciprocable piston for carrying a pick-up device toward and from a stack of flexible sheet material, a tubular body slidably mounting the piston and providing a chamber therebetween, the piston and the body having a pin ahd helical slot connection, the slot extending heightwise of the stack, and control means for changing fluid pressure in the chamber to shift the heightwise and rotational position of the pick-up device with respect to the stack after its ply has been seized by the device.

A further feature of the invention resides in the provision in a sheet transferring machine having a ply separating means of the type indicated, of a first fluid pressure chamber above the piston in said body and a second chamber between the piston and the pick-up device, and control mechanism responsive to pressure in the first chamber for determining angular and heightwise relation to the body of the piston and a pick-up device carried thereby, the control mechanism being adapted for automatically changing fluid pressure in the second chamber to effect work release by the pick-up device at a work delivery position.

In its method aspect the invention features separating an exposed flexible sheet of material from a stack by seizing at least two spaced localities of the sheet, yieldingly rotating said localities about axes respectively substantially normal to the plane of the sheet to distort and tension it between said localities, and during the rotation removing the seized sheet from the stack.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other features of the invention will now be more particularly described in connection with an illustrative ply separating mechanism and with reference to the accompanying drawings thereof, in which:

FIG. **1** is a view in side elevation of a portion of an automatic fabric transfer machine employing at least one combination ply separating means and pick-up device such as the one shown above a stack of work pieces;

FIG. **2** is a schematic plan view of one possible arrangement of a plurality of pick-up and ply separating devices mounted for instance in the machine of FIG. **1**, adjacent pairs of devices being counter rotated for ply separation.

FIG. **3** is similar to FIG. **2**, but illustrates an arrangement of two pairs of pick-up and ply separating devices as employed for effecting a different stress pattern aiding in ply separation of a different type of work piece.

FIG. **4** is an enlarged view of a pick-up and ply separating assembly, of the type shown in FIGS. **1–3** in initial work engaging condition;

FIG. **5** is a bottom plan view of the pick-up portion;

FIG. **6** is an axial section showing a pincer of the pick-up device in work seizing position over a stack;

FIG. **7** is a view similar to FIG. **4** but showing the pick-up rotated and raised by its ply separating mechanism;

FIG. **8** is a transverse section taken on the line VIII-VIII of FIG. **6** indicating means for limiting the stroke of the pincer, and

FIG. **9** is a detail view of an adjustable detent for controlling friction.

DESCRIPTION OF PREFERRED EMBODIMENT

A machine of the general type for automatically feeding fabric sheets W or the like from the top of a stack S is illustrated and described in U.S. Pat. No. 3,531,103 issued Sept. 29, 1970, in the name of R. R. Walton. The particular pick-off devices therein rely on suction as does the adjustable pick-off means disclosed, for instance, in U.S. Pat. No. 3,550,932 issued Dec. 29, 1970, in the name of R. C. Mason. The present invention provides novel ply-separating means for controlling a mechanical pick-up device generally designated **10** (FIGS. **1, 4, 6,** and **7**) which is herein illustrated as employed in a fabric transfer machine **12** (FIG. **1**). The fluid pressure operated ply separating mechanism is generally designated **14,** the assemblage **10,14** (FIG. **4**) being shown by way of example only as adjustably mounted on a movable carrier **16** (FIGS. **1** and **4**) as, for instance, in the manner disclosed in the cited

Mason Patent. It will be understood that, according to the size, shape, and weight of the work pieces W to be transferred, one or a plurality of the assemblages **10,14** may be mounted in any selected pattern on the carrier **16** as suggested in FIGS. **2** and **3** or otherwise as needed.

The ply separating mechanism **14** herein claimed may be operated in combination with other pick-up means and the pick-up means **10** claimed in the cited concurrently filed Walton application may be operated in combination with other ply separating mechanism. The plies W to be successively transferred may initially be top, bottom, or otherwise externally exposed.

For detachably and slidably supporting the assemblage **10,14** a tubular body **18** (FIGS. **4, 7**) has a threaded stem at its upper end extending through a slot in the carrier **16** for receiving a thumb nut **20.** The body **18** is formed with ports **22,24** (FIGS. **4** and **7**) and a partly helical slot **26** for purposes later explained. Slidable axially in the body **18** is a piston **28** having a radial hole the wall of which is threaded for receiving a cam pin **32** slidably extending through the slot **26.** As shown in FIG. **4,** the upper portion of the slot **26** is longitudinal and the lower portion extends helically at about 45°, relative heightwise and turning movement of the piston **28** being thus limited. A head **34** of the piston is disposed at the lower end of an upper chamber **36** in the body **18** having communication with the port **22,** and a lower chamber **38** in the piston communicates with the port **24** via a hole **40** in the wall of the piston **28** when the latter is in its relatively lower position, the hole **40** being effectively closed by the wall of the body **18** when the piston **28** is relatively raised as shown in FIG. **7.**

Within the lower end of the piston **28,** a cylindrical stem of a presser foot **42** is axially slidable within limits, being secured by a set screw **44** (FIG. **4**) extending through a longitudinal slot **46** in the piston and threaded into the stem. As shown in FIGS. **4–6,** a work engageable peripheral portion **48** of the presser foot is eccentrically enlarged and circular, and centralized with respect to a diametric slot **50.** Secured in this slot by a set screw **52** is a V-shaped tooth **54** having its bevelled faces **56,56** receding in the slot and extending upwardly to define a shelf portion **58** having an apex slightly above the work engaging surface **48.** For cooperating with the presser foot **42** the pick-up device **10** includes a pinch pawl **60.** The pawl **60** has pin **62** and slot **64** connection in a heightwise kerf in the presser foot **42,** the arrangement being such that a pair of parallel rows of pointed and biased teeth **66** arcuately disposed on the underside of the pawl **60** are respectively movable in their planes to engage the top sheet W in the locality P (FIGS. **4, 6**) where it may have been bulged or puckered by the compressive action of the presser foot portion **48** and, by means next explained, gather the localized portion in pinching relation onto the shelf portion **58,** as shown in FIG. **6.**

Adjustably threaded onto the lower end of the piston **28** is a pinch adjusting ring nut **70** (FIGS. **4–8**) having a circular camming lip **72** (FIG. **6**). A leaf spring **74** is secured at one end to the pawl **60** and has a free downwardly extending portion engageable with an innerface **76** of the presser foot **42** to urge the pawl toward its open or inoperative position. The spring **74** accordingly yieldingly resists movement of the teeth **66** toward pinching relation with the presser foot **42,** and more positive pinching is effected as the lip **72** is relatively lowerd to cam the pawl **66** toward the shelf portion **58** by mechanism later explained. The ring nut **70** at 90° spacings is semi-bored as at **76** both radially and longitudinal to provide four alternative positions for mating with a cut-away portion **77** in the piston **28** and thus accommodating a pinch control lock pin **78.** It will be understood that the pin **78** is detachable and insertable to lock the ring nut in the particular 90° rotational setting affording best results for the heightwise position of the lip **72,** a relatively higher lip generally permitting a wider initial nipping position for pinching thicker or more substantial work pieces.

Preferably, the degree of friction between the presser foot stem and the piston **28** is adjustably controlled better to accommodate different types of work pieces W and insure that the top piece will be suitably puckered about the shelf portion **58,** for instance as illustrated at P (FIGS. **4** and **6**). To this end, and as herein shown in FIG. **9,** for instance, a spring pressed ball detent **80** engaging the interior wall of the piston **28** is nested in the presser foot stem and backed by an adjustable set screw **82.** It will be understood that threading the screw **82** inwardly to increase friction will cause the presser foot **42** to react harder on the stack S before relatively yielding upwardly.

In operation of the fabric transferring machine **12** relative movement of approach of the stack S and the pick-up device **10** is in this case effected by raising the stack by a cyclical elevator mechanism **83** (FIG. **1**) until a pneumatic sensor in the form of a tube **84** (FIGS. **4** and **6**) signals for stack lowering (following a time delay) after the top ply has been initially engaged as shown in FIG. **4.** The chamber **38** is then open to exhaust, and a low pressure (roughly on the average of about 20 pounds per square inch) provided in the chamber **36** is then only adequate to nearly counterbalance a tension spring **86** interconnecting the carrier **16** and the pin **32.** As shown in FIG. **4** the sensor tube **84** is slidably mounted in a vertical guide sleeve **88** fixed in a collar **90** secured on the piston **28.** The tube **84** is disposed to be blocked at its lower end by the presser foot **42** approaching an upper limit as shown in FIG. **6.** Air flow downwardly in a flexible supply line **92** connected to the tube **84** is thus stopped and the resultant signal, in addition to stopping elevation of the stack S, also signals for operation of the ply separating mechanism **14** by dumping pressure from the chamber **36** whereupon the spring **86** at once causes lifting and rotation of the piston **28** and likewise of the presser foot **42** for effecting separation of the picked-up top ply. The upward displacement of the sensor tube **84** is against resistance of a return spring **94.**

Reverting to a more detailed consideration of operation of the pick-up device **10,** which functions prior to rotation about a vertical axis, as the stack S is elevated the presser foot **42** yields upwardly with resistance as suitably selected and puckers a locality of the top ply W as at P eccentrically of the piston **28** thus causing an irregular and somewhat annular wave in the top sheet immediately beneath the open pincer teeth **66** to come into engagement therewith at each side of the apex of the shelf **58.** The pawl **60,** as the presser foot is relatively raised in the piston **28,** is cammed by the lip **72** to pinch the puckered portion upon the shelf **58.** In this action the rows of teeth **66** first urge the work against the V-tooth point and then rise further as allowed by

the slot **64** to move past that point on its opposite sides to hold a small work portion folded and clamped upon itself. Only the single top ply is thus pinched.

Upon actuation by the spring **86** as aforesaid, the piston **28** is raised following pick-up and, by means of the cam pin **32** of the ply separating mechanism **14,** rotated clockwise as viewed from above and shown in FIG. **7.** Thus at one or more selected localities the seized work is subjected to localized twisting to disrupt cleavage of interfacial fibers. It will be understood that, as typically shown in FIGS. **2** and **3,** certain pairs of the assemblies **10–14** may provide twisting in opposite direction, their slots **26** in such cases being oppositely inclined helically in order to provide desired stress patterns such as suggested in FIGS. **2** and **3** considered most effective for insuring that an underply is not disturbed as the top ply alone is separated and relatively raised.

The assemblies **10–14** are now jointly moved by the carrier **16** to laterally position the work over a selected delivery position. At the end of this lateral feeding stroke a switch (not shown) is actuated to pressurize the upper chamber **36** to a degree considerably higher than previously. This forces the piston **28** downward against influence of the spring **86** to return the cam pin **32** to the bottom of its slot **26.** The downward movement of the piston and its resultant rotation to unstress the ply then being carried open the port **40** to let air under pressure through the port **24** and into the chamber **38.** As a consequence the presser foot **42** is abruptly forced downwardly to enable the pawl **60** to be freed by inertia and thus causes the supported top ply to be released for delivery.

In the course of the return trip of the carrier **16** from the work delivery position to the pick-up position above the stack for repeating the cycle, the chamber **38** is exhausted and the chamber **36** is again provided with its lower pressure.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. In a machine for transferring single plies of flexible sheet material from the exterior of a stack and having at least one pick-up device, a ply separating mechanism comprising a reciprocable piston for carrying the pick-up device toward and from the stack, a tubular body slidably mounting the piston and providing a first chamber therebetween the piston and the body having a pin and helical slot connection, the slot extending heightwise of the stack with inclination to cause the device to impart torsion to a locality of a top ply for facilitating its initial separation from the stack, a second chamber disposed between the piston and the pick-up device, and control means for changing fluid pressure in the first chamber to effect cooperation between said pin and slot and thereby shift the pick-up rotatively and away from the stack when the top ply has been seized, said control means being adapted to change fluid pressure in the second chamber on arrival of the pick-up device with the top ply at a delivery position to effect work release by the device.

2. In a work transfer machine having a laterally movable carrier and a pick-up device, a ply separating means mounted on the carrier for moving the device between a pick-up position over a stack of flexible work pieces and a delivery position, the ply separating means comprising a tubular main body suspended at its upper portion from the carrier, a piston-like member telescopingly related to the body for movement heightwise of the stack and yieldably connected at a lower end to the pick-up device, a first fluid pressure chamber disposed between the body and the member and a second fluid pressure chamber between the member and said device, means providing limited relative rotation between the body and the member during telescoping movement of the latter, a spring connecting the carrier and the member for urging the latter heightwise of the stack, fluid pressure means coupled to the first chamber for overcoming the spring when a top ply has been seized by the device, and fluid pressure means operatively connected to the second chamber for thereafter causing the device to be moved abruptly at the delivery position for effecting work release.

3. A machine as in claim **2** wherein the means providing limited rotation between the main body and the member includes a pin and helical slot connection, the pin also being connected to one end of said spring.

4. In combination with a pick-up device, a ply separating mechanism comprising a pair of axially telescoping tubular members one of which carries said device for movement above a stack of plies to be singly transferred, said one of the members being responsive to telescoping movement with respect to the other upon engagement of the device with a top ply of the stack for effecting simultaneous rotation of the device about an axis substantially normal to said ply and relative elevation of the device with respect to the stack when its top ply has been seized, said device including a presser foot mounted thereon for limited heightwise sliding movement, spring means for urging said one member heightwise and away from the stack, fluid pressure means for urging the one member heightwise and toward the stack in opposition to the influence of said spring means, and control means actuatable, following operation of the pick-up device, first to cause said device to be raised from the stack and then, upon lateral shifting of the device with its picked-up ply to a delivery position, to cause said fluid pressure means abruptly to overcome the spring means and relatively move said presser foot with said one member to effect release of the ply.

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