June 21, 1960 A. C. REINCKE 2,941,799

SHEET MATERIAL SEPARATOR AND HANDLING DEVICE

Filed April 30, 1956 2 Sheets-Sheet 1

FIG. 1

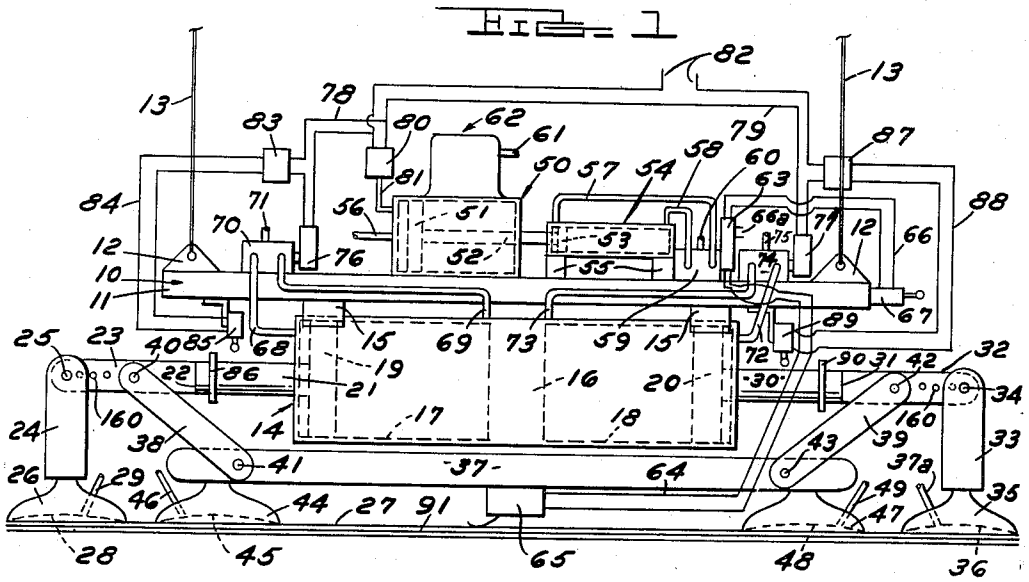


FIG. 2

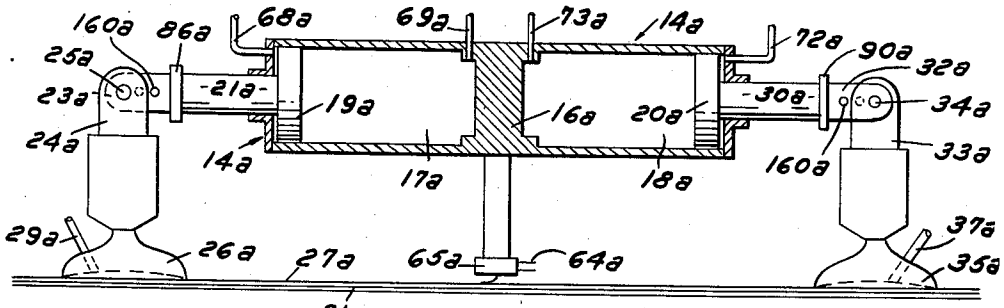
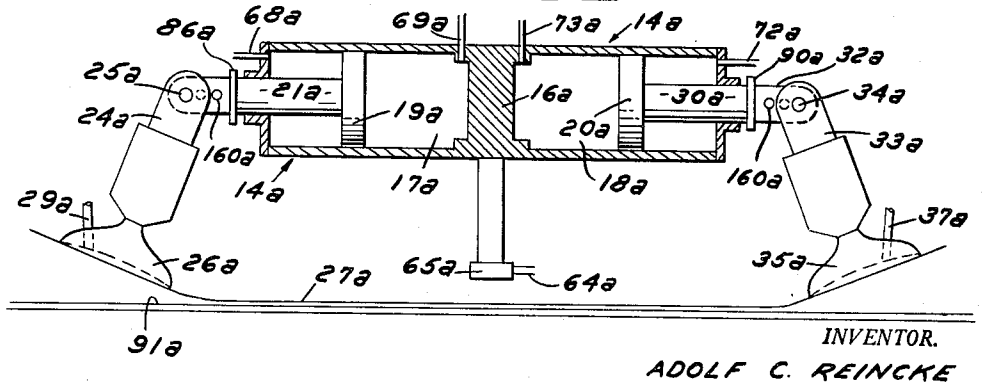


FIG. 3



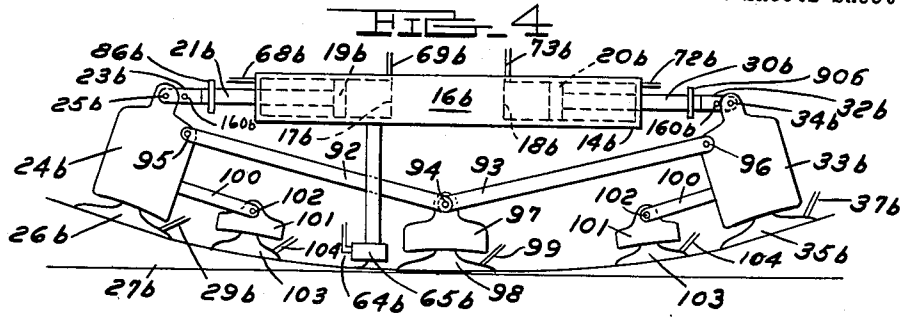
INVENTOR.
ADOLF C. REINCKE
BY Robert G. Ingentag
ATTORNEY

June 21, 1960 A. C. REINCKE 2,941,799

SHEET MATERIAL SEPARATOR AND HANDLING DEVICE

Filed April 30, 1956 2 Sheets-Sheet 2

FIG. 4



INVENTOR.
ADOLF C. REINCKE
BY Robert G. Mentag
ATTORNEY

United States Patent Office 2,941,799 Patented June 21, 1960

2,941,799

SHEET MATERIAL SEPARATOR AND HANDLING DEVICE

Adolf C. Reincke, 23335 Clairwood, St. Clair Shores, Mich.

Filed Apr. 30, 1956, Ser. No. 581,424

6 Claims. (Cl. 271—27)

This invention relates to flexible sheet material separating and handling apparatus, and, more particularly, to apparatus of this type which is capable of separating and lifting flexible sheets one by one from a stack of such sheets, which sheets normally tend to stick together due to suction therebetween or which tend to stick together due to oil, grease, and/or the like, which may be spread over the abutting surfaces of the sheets.

Heretofore, much difficulty has been experienced in flexible sheet feeding apparatus in preventing the picking up of more than one sheet at a time. The sheets in a stack of clean flexible sheet material have a tendency to stick together until the air has been admitted between them, whereby, when the top sheet is picked up, the second sheet tends to stick thereto and be picked up therewith. The same sticking tendency is aggravated when the surfaces of the flexible sheets are covered with oil, grease and/or other like substances which increase the tendency of one sheet to adhere to another. Accordingly, it is the primary object of this invention to provide a separating and handling apparatus which may be used with a crane or other elevating equipment, and which is adapted to grip and separate the top sheet from a stack of flexible sheet material by peeling or bending upwardly a pair of oppositely disposed edges or corners of the top sheet, whereby, the adhesion forces between the top sheet and the second sheet are broken and the top sheet may be lifted from the stack without moving the second sheet.

It is another object of this invention to provide a flexible sheet material separating and handling apparatus which is adapted to lift sheets one by one and overcome any tendency of the sheets to stick together by bending the sheets, and which is capable of straightening the sheets, if desired, for feeding the sheets into a work position in a straightened condition.

It is still another object of this invention to provide a flexible sheet material separating and handling apparatus which may be used singly or plurally, and which may be made in any desired size.

It is a further object of this invention to provide a flexible sheet material separating and handling apparatus which is simple and compact in construction, economical of manufacture, and efficient in operation.

Other objects, features and advantages of this invention will be apparent from the following detailed description and appended claims, reference being had to the accompanying drawings forming a part of the specification wherein like reference numerals designate corresponding parts of the several views.

In the drawings:

Fig. 1 is a side elevational view of an illustrative embodiment made in accordance with the principles of the invention;

Fig. 2 is a partial side elevational sectional view of another embodiment of the invention;

Fig. 3 is a view of the structure illustrated in Fig. 2, showing the apparatus of Fig. 2 in a sheet edge bending position; and,

Fig. 4 is a partial side elevational view of still another embodiment of the invention.

Referring now to the drawings, and in particular to Fig. 1, where is shown an illustrative embodiment of the invention, the reference numeral **10** designates a supporting apparatus which includes a longitudinally extending supporting frame **11**, on each end of which is fixedly mounted a lifting lug **12**. The lugs **12** are adapted to have affixed thereto chains, or cables as **13**, or other suitable means for attaching the lifting apparatus to a crane or other conventional elevating or work transfer equipment. The supporting frame **11** may comprise any suitable means, as a longitudinally extending bar, a plate, and the like. The lugs **12** and cables **13** may be broadly classified as an attaching means for securing the supporting frame **11** to the aforementioned lifting or elevating equipment.

A dual cylinder fluid power means **14** is horizontally disposed below the supporting means **11** and is fixedly attached thereto by any suitable means, as by the depending members **15**, which may be welded to the power means **14**. The power means **14** is provided with a central dividing wall **16**, whereby two power cylinders, as **17** and **18**, are formed in an end to end, coaxial disposition. Operatively mounted in the cylinders **17** and **18** are the pistons **19** and **20**, respectively, which are adapted to be actuated by any suitable fluid means, as by compressed air, in a manner more fully explained hereinafter. Integral with the piston **19** is a piston rod **21** which extends axially outwardly of the cylinder **17**, to the left as viewed in Fig. 1. Extending outwardly, coaxially, from the end **22** of the piston rod **21** is an integral arm **23**, from the end of which is pivotally mounted a normally depending arm **24**. The arm **24** is pivotally mounted on the arm **23** by any suitable means, as by the pin **25** which may have the ends thereof peened over. Fixedly mounted on the lower end of the arm **24** is a gripping means in the form of a suction cup **26** which is adapted to grip the surface of the work sheet **27**. The suction cup **26** is of the usual type and has a chamber **28** formed in the lower side thereof from which the air may be exhausted by means of the conduit **29**, in a manner as more fully explained hereinafter.

Integral with the piston **20** is a piston rod **30** which extends axially outwardly of the cylinder **18**, to the right as viewed in Fig. 1. Extending outwardly, coaxially, from the end **31** of the piston rod **30** is an integral arm **32**, from the end of which is pivotally mounted a normally depending arm **33**. The arm **33** is pivotally mounted on the arm **32** by any suitable means, as by the pin **34** which may have the ends thereof peened over. Fixedly mounted on the lower end of the arm **33** is a gripping means in the form of a suction cup **35** which is adapted to grip the surface of the work sheet **27** in a position spaced apart from the suction cup **26**. The suction cup **35** is of the usual type and has a chamber **36** formed in the lower side thereof from which the air may be exhausted by means of the conduit **37***a* in a manner as more fully explained hereinafter.

A longitudinal member, as the bar **37**, is disposed below said cylinders, and said longitudinal member is swingably suspended from the arms **23** and **32**, by means of the arms **38** and **39**, respectively. The upper end of the arm **38** is pivotally mounted on the arm **23**, by any suitable means, as by the pin **40**, and, the lower end of the arm **38** is pivotally mounted on the longitudinal member **37** by any suitable means, as by the pin **41**. The arm **39** is similarly mounted between the arm **32** and the longitudinal member **37**, as indicated by the numerals **42** and **43**. It will be seen, that the pivot points **40** and

42 are normally disposed laterally outwardly of the pivot points 41 and 43, when the separating apparatus is in the position shown in Fig. 1 for initially engaging a work sheet surface. Fixedly mounted on the lower side of the longitudinal member 37 are a pair of spaced apart gripping means, in the form of the suction cups 44 and 47, which are similar to the suction cups 26 and 35. The suction cups 44 and 47 have formed therein the chambers 45 and 48 from which the air may be exhausted through the conduits 46 and 49, respectively, for gripping a work sheet surface. The arms 23 and 32 may be provided with additional holes as indicated by the numerals 160, whereby, the arms 24 and 33 may be moved to different positions on arms 23 and 32 to accommodate work sheets of different sizes.

Fixedly mounted on the supporting means 11 is a vacuum pump 50, of any suitable type, which is provided with a piston 51 to which is fixed a paston rod 52. The piston rod 52 extends outwardly of the vacuum pump and is fixed to a piston 53 in a fluid cylinder 54, which is fixedly mounted on the supporting means 11 by any suitable means, as by the legs 55. The left end of the vacuum pump, as viewd in Fig. 1, is connected by the conduit 56 to the conduits in the various suction cups, as 29, 46, 49 and 37*a*. The actual connections between conduit 56 and the conduits in the suction cups are broken away and are not shown for the sake of clearness in the drawing, but such connections will be obvious. The fluid cylinder 54 is provided with fluid inlet lines 57 and 58 at the opposite ends thereof, which lines are connected to the four-way, solenoid operated air valve 59, which valve may be of any conventional design. Air is admitted to the valve 59 through the conduit 60 which is connected by suitable conduit means (not shown) to the outlet 61 on the air pump 62. The air pump 62 may be any suitable air pump and is adapted to be mounted on the supporting means, as on the top of the vacuum pump 50. If desired, the aforementioned vacuum pump, the air pump, the solenoid, and the fluid cylinder may be mounted on the lifting device which carries the separating apparatus, or they may be disposed on a separate mounting means in a suitable position adjacent to the working area of the separating apparatus, and be connected to the separating apparatus by means of suitable connecting conduits and control wires.

A valve actuating solenoid 63 is connected to the air valve 59 in the usual manner and is electrically connected through the conductors 64 to a micro-switch 65 which is fixedly mounted on the lower side of the longitudinal member 37. The micro-switch is adapted to contact the surface of the work sheet 27. The solenoid 63 is also connected by means of the electrical conductors 66 to a second micro-switch 67, the function of which will be explained later. The solenoid 63 would be connected in any suitable manner to a source of electrical power, as indicated at 66*a*, for energizing the aforementioned control circuits.

Each end of the fluid cylinder 17 is connected by fluid inlet conduits, as 68 and 69, to a four-way solenoid operated air valve 70 which is connected through the conduit 71 to the air pump outlet 61. The ends of the fluid cylinder 18 are connected by the fluid inlet conduits 72 and 73 to a four-way solenoid operated air valve 74, which is connected through the conduit 75 to the air pump outlet 61. It will be understood, that the conduits between the air pump outlet 61 and the valve inlets 71 and 75 are not shown for the sake of clarity in the drawing.

The air valves 70 and 74 are connected to the solenoids 76 and 77 in the usual manner, and said solenoids are interconnected by the electrical conductors 78 and 79. A combined vacuum control switch and regulator valve 80 is electrically connected in the circuit between said solenoids by means of the conduit 81 which is connected to the vacuum pump 50. The circuit between the solenoids 76 and 77 may be connected to a suitable power source, as at 82. The solenoid 76 is connected by means of a suitable relay, as 83, and the conductors 84 to the micro-switch 85 which is mounted on the underside of the supporting means 11. The micro-switch 85 is adapted to be actuated by the ring 86 which is fixed on the piston rod 21 in a predetermined position. The solenoid 77 is connected by means of a suitable relay, as 87, and the conductors 88 to the micro-switch 89 which is mounted on the underside of the supporting means 11. The micro-swich 89 is adapted to be actuated by the ring 90 which is fixed on the piston rod 30 in a predetermined position.

In the use of a separating and handling apparatus as shown in Fig. 1, the crane, or other lifting or work transfer means, carrying the apparatus would lower it down onto the surface of the top work sheet 27, with the various suction cups disposed as shown in Fig. 1. The pistons 19 and 20 in the power cylinder 14 would be disposed as illustrated in Fig. 1, and the piston 51 in the vacuum pump would also be disposed as shown in Fig. 1. When the micro-switch 65 operatively engages the surface of the top sheet 27, solenoid 63 will be energized to operate the air valve 59 for operating the cylinder 54. The piston 51 in the vacuum cylinder or pump 50 will be moved to the right, as viewed in Fig. 1, thereby creating a vacuum in the conduits leading to the various suction cups. When sufficient vacuum has been created to firmly attach the suction cups to the sheet 27, the combined vacuum control switch and regulator valve 80 will close the circuits to the solenoids 76 and 77 which in turn operate the air valves 70 and 74 to permit air to flow into the conduits 68 and 72 to force the pistons 19 and 20, respectively inwardly. At the same time, it may be interconnected with the lifting device to start its operation. It is assumed, of course, that the air pump 62 has been started by the usual manual start switch. The switch 80 also functions as a safety device for the suction cups, for example, if a suction cup is damaged, or foreign matter is under it, enough vacuum will not be created under the cup to close the switch 80, thereby rendering the lifting device, as well as the separating device, inactive and thereby avoiding mishaps.

As the pistons 19 and 20 move inwardly, the arms 38 and 39 will pivot around the points 41 and 43, respectively, in a clockwise and counter-clockwise direction, respectively. This action will cause the arms 24 and 33 carrying the suction cups 26 and 35, to pivot at the upper ends thereof, inwardly toward the power cylinder 14, and to peel or bend the edges of the sheet 27 upwardly. The power cylinder 14, of course, during this action rises relative to the longitudinal member 37. The aforegoing action breaks the adhesion effect between the top sheet 27 and the second sheet 91, which adhesion effect is usually caused either by air being trapped between the sheets or by oil and grease on the abutting surfaces of the sheets. When the pistons 19 and 20 have moved inwardly a predetermined distance, the rings 86 and 90 will engage the micro-switches 85 and 89, respectively, and the relays 83 and 87 will be actuated, to in turn actuate the solenoids 76 and 77 to reverse the flow of air to the cylinders 17 and 18. The pistons 19 and 20 will then be moved outwardly again to the position shown in Fig. 1, and the sheet 27 will again be disposed straight. The lifting means carrying the separating apparatus will have moved the entire apparatus upwardly from the stack of other sheets immediately after the adhesion effect is broken, and the sheet edges have been peeled back or bent back. The lifting means will then convey the separating apparatus and the attached sheet 27 to the desired work position. An abutment or stop may be suitably arranged on the work position to engage the micro-switch 67 when the sheet 27 has been lowered into the work position to energize the solenoid 63 to operate the air valve 59 and reverse the flow of air to the fluid cylinder 54, whereby the vacuum pump piston 51 will be moved to the left, as

viewed in Fig. 1, and the suction cups will release the work sheet **27**. The separating apparatus may then be moved back to the stack of sheets to pick up another sheet, and to start the cycle over again.

If it is desired to feed the sheet **27** into a work position in a bent shape, then the rings **86** and/or **90** could be deleted and a second stop could be disposed on the work position to actuate the micro-switches **85** and/or **89** to return the pistons **19** and/or **20** to the initial position. A separating and handling apparatus as shown in Fig. 1, is adapted to separate and handle sheets of material made from metal, either ferrous or non-ferrous, plastic, and various other materials. The apparatus of Fig. 1, would be made in a size suitable for extending from one edge or corner of a sheet to an opposite edge or corner, and such apparatus may be used singly or in batteries. It will be understood, that one or more of the power pistons, such as **19** or **20** may be held in the inward position by disabling the control circuit therefor, if it is desired to load a work sheet into a work position with one or both sides thereof bent or twisted upwardly. It will also be understood, that, although air is described as being the fluid used in the fluid system, that any other desirable fluid may be used, as a suitable hydraulic oil, and the like.

Figs. 2 and 3 illustrate another embodiment of the invention, which is adapted for separating and handling lightweight sheets of any material. The structure is substantially the same as the embodiment of Fig. 1, with the exception that the longitudinal member **37**, and the arms **38** and **39**, of the apparatus of Fig. 1 are deleted. The micro-switch **65***a* would be mounted on the lower side of the cylinder **14***a* and would depend therefrom so as to contact the sheet **27***a* to perform the same function as the micro-switch **65** of Fig. 1. The various parts of this embodiment are marked with the same numerals as are the corresponding parts of the embodiment of Fig. 1, but in addition, the numerals are also marked with the small letter "*a*." The embodiment of Figs. 2 and 3 would be provided with the same fluid operating and control means as that employed in the embodiment of Fig. 1, and the operation of the apparatus would be the same as for that of Fig. 1. Fig. 2 shows the apparatus engaging the work sheet **27***a* and Fig. 3 shows the edges of the sheet being peeled back prior to the lifting of the sheet. The cylinder **14***a* would, of course, be carried on a suitable supporting means simlar to the supporting means **11** of Fig. 1, and in the same manner as the embodiment of Fig. 1.

Fig. 4 discloses still another embodiment of the invention in which the similar parts of the embodiment of Fig. 1 are marked with similar numerals followed by the letter "*b*." The embodiment of Fig. 4 is adapted for use on sheets of heavyweight material wherein a larger gripping force is needed. The power cylinder **14***b* would be carried on a supporting means as that shown for the embodiment of Fig. 1, and the fluid operating and electrical control means would be the same as shown in Fig. 1. This embodiment eliminates the longitudinal member **37** of the embodiment of Fig. 1 and substitutes the following described structure therefor. A pair of arms **92** and **93** are provided for swingably mounting between the gripping means **24***b* and **33***b* a third gripping means **97**. The arms **92** and **93** are pivotally connected at their inner ends as at **94**, and the outer ends thereof are pivotally mounted on the gripping means **24***b* and **33***b*, as indicated by the numerals **95** and **96**, respectively. The third gripping means **97**, having the suction cup **98** mounted thereon, is pivotally connected to the arms **92** and **93** at the point marked **94**, and is provided with a conduit **99** for the exhaustion of air from its usual chamber. Each of the gripping means **24***b* and **33***b* is provided with an inwardly, laterally extending fixed arm **100**, from the end of which is pivotally mounted a gripping means **101**. The pivotal point of the mounting of the gripping means **101** is indicated by the numeral **102**, and said gripping means carries a suction cup **103** which is provided with a conduit **104** for the exhaustion of air therefrom, in the same manner as the gripping means of the embodiment of Fig. 1.

The embodiment of Fig. 4 operates in the same manner as the embodiment of Fig. 1. The pistons **19***b* and **20***b* would be in their outermost position when the work sheet engaging position is assumed, and the edges of a work sheet would be peeled or bent as shown in Fig. 4, in a manner providing a uniform curvature from the edges thereof, inwardly.

While it will be apparent that the preferred embodiments of the invention herein disclosed are well adapted and calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What I claim is:

1. A flexible sheet material separating and handling apparatus of the class described, comprising: a supporting means; attaching means for lifting said supporting means; a pair of cylinders fixedly mounted on said supporting means in an end to end relationship; a piston slidably mounted in each of said cylinders; a piston rod fixed on each of said pistons and extending through the outer ends of the cylinders; a source of fluid under pressure operatively connected to said cylinders; an arm mounted on each of said piston rods; a suction cup swingably mounted on each of said arms for releasably gripping an edge of the top surface of a flexible sheet of material on a stack of sheet material; means for exhausting the air from the suction cups after said cups have engaged a sheet; and, control means for selectively actuating said air exhausting means and for admitting fluid under pressure to said cylinders from said source of fluid at predetermined times.

2. The structure as set forth in claim 1, including a plurality of suction cups swingably carried on said apparatus between said first named suction cups and adapted to be connected to said air exhausting means and to coact with said first named suction cups.

3. A flexible sheet material separating and handling apparatus of the class described, comprising: a supporting means; attaching means for lifting said supporting means; a pair of laterally spaced apart arms carried by said supporting means and adapted for movement relative to said supporting means; a gripping means freely pivotally mounted on each of said arms for releasably gripping an opposite pair of edges on the top surface of a flexible sheet of material on a stack of sheet material, whereby, when the attaching means lifts said supporting means, said gripping means will pivot relatively to said supporting means and said opposite pair of edges will be peeled upwardly to break the adhesion effect between said sheet and the next adjacent sheet; said pair of arms being coaxially disposed and carried by said supporting means in a slidable end to end relationship; and, actuating means provided on said supporting means for selectively moving said arms toward and away from each other, whereby, when said arms are moved away from each other said gripping means will be in a position to grip said opposite pair of edges on the top surface of a flexible sheet of material, and, when said arms are moved toward each other said gripping means will be moved upwardly and inwardly, and said edges of the gripped sheet will be further peeled upwardly to insure removal of but one sheet from said stack.

4. A flexible sheet material separating and handling apparatus of the class described, comprising: a supporting means; attaching means for lifting said supporting means; a pair of laterally spaced apart arms carried by said supporting means and adapted for movement relative to said supporting means; a gripping means freely pivotally mounted on each of said arms for releasably gripping an opposite pair of edges on the top surface of a flexible sheet of material on a stack of sheet material, whereby, when the attaching means lifts said supporting

means, said gripping means will pivot relative to said supporting means and said opposite pair of edges will be peeled upwardly to break the adhesion effect between said sheet and the next adjacent sheet; a pair of cylinders fixedly mounted on said supporting means in an end to end relationship; a piston slidably mounted in each of said cylinders; a piston rod fixed on each of said pistons and extending through the outer ends of the cylinders; means for moving said pistons in said cylinders; said pair of arms being connected to the outer ends of said piston rods; a longitudinally extending member disposed below said cylinders; an arm at each end of said longitudinally extending member having one end thereof pivotally connected to said longitudinally extending member and the other end thereof pivotally connected to one of said first named pair of arms; gripping means fixedly mounted on said longitudinally extending member; and, control means for controlling said means for moving said pistons in said cylinders.

5. A flexible sheet material separating and handling apparatus of the class described, comprising: a supporting means; attaching means for lifting said supporting means; a pair of laterally spaced apart arms carried by said supporting means and adapted for movement relative to said supporting means; a gripping means freely pivotally mounted on each of said arms for releasably gripping an opposite pair of edges on the top surface of a flexible sheet of material on a stack of sheet material, whereby, when the attaching means lifts said supporting means, said gripping means will pivot relative to said supporting means and said opposite pair of edges will be peeled upwardly to break the adhesion effect between said sheet and the next adjacent sheet; a pair of cylinders fixedly mounted on said supporting means in an end to end relationship; a piston slidably mounted in each of said cylinders; a piston rod fixed on each of said pistons and extending through the outer ends of the cylinders; means for moving said pistons in said cylinders; said

pair of arms being connected to the outer ends of said piston rods; and, control means for controlling said means for moving said pistons in said cylinders.

6. A flexible sheet material separating and handling apparatus of the class described, comprising: a supporting means; attaching means for lifting said supporting means; a pair of laterally spaced apart arms carried by said supporting means and adapted for movement relative to said supporting means; a gripping means freely pivotally mounted on each of said arms for releasably gripping an opposite pair of edges on the top surface of a flexible sheet of material on a stack of sheet material, whereby, when the attaching means lifts said supporting means, said gripping means will pivot relative to said supporting means and said opposite pair of edges will be peeled upwardly to break the adhesion effect between said sheet and the next adjacent sheet; a pair of cylinders fixedly mounted on said supporting means in an end to end relationship; a piston slidably mounted in each of said cylinders; a piston rod fixed on each of said pistons and extending through the outer ends of the cylinders; means for moving said pistons in said cylinders; said pair of arms being connected to the outer ends of said piston rods; control means for controlling said means for moving said pistons in said cylinders; a laterally extending arm fixedly mounted on each of said first named gripping means; a gripping means pivotally mounted on each of said laterally extending arms; a gripping means centrally disposed below said supporting means; and, means swingably mounting said last named gripping means between said first named gripping means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,225,006	Gudger et al.	Dec. 17, 1940
2,743,923	Watter	May 1, 1956