Oct. 12, 1965 E. J. WELHOUSE 3,211,449

PAPERMAKING MACHINE

Original Filed Dec. 30, 1957 5 Sheets-Sheet 1

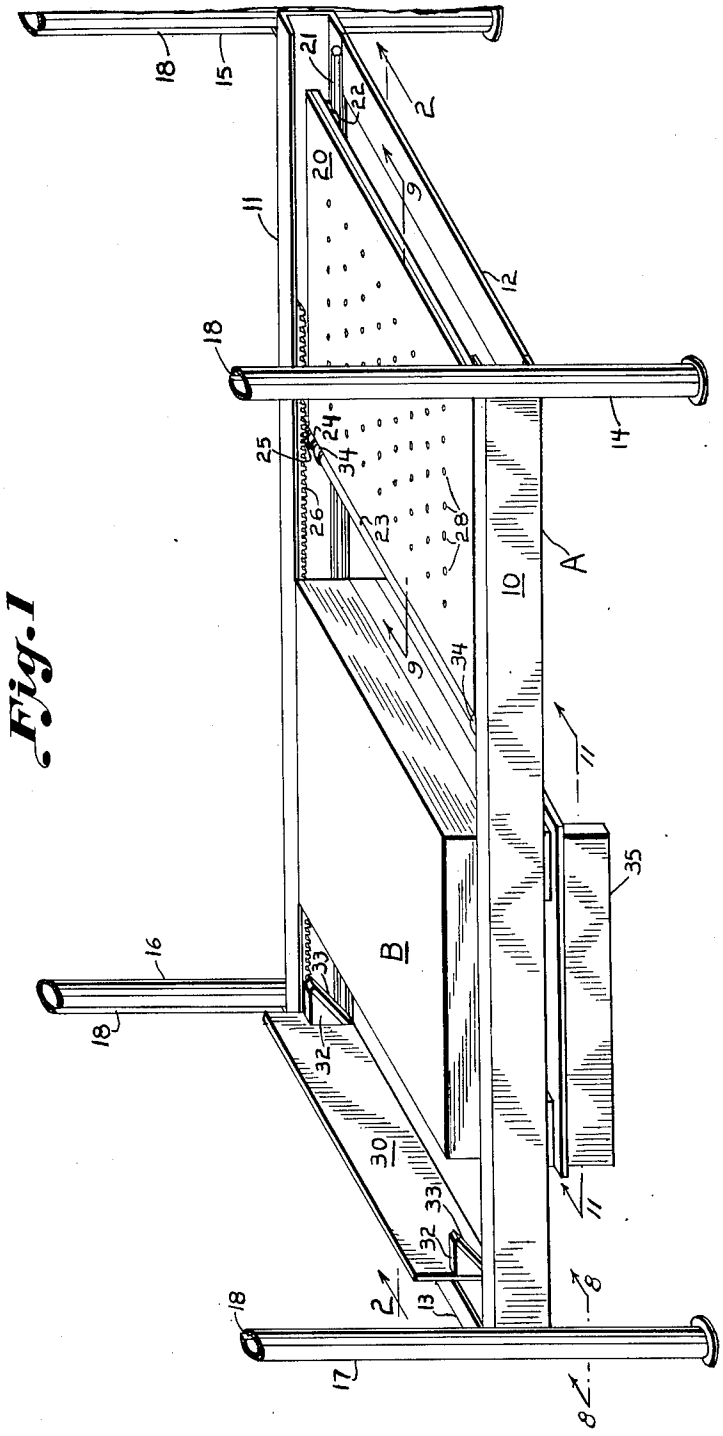


Fig. 1

PAPERMAKING MACHINE

Original Filed Dec. 30, 1957 5 Sheets-Sheet 2

Fig. 2

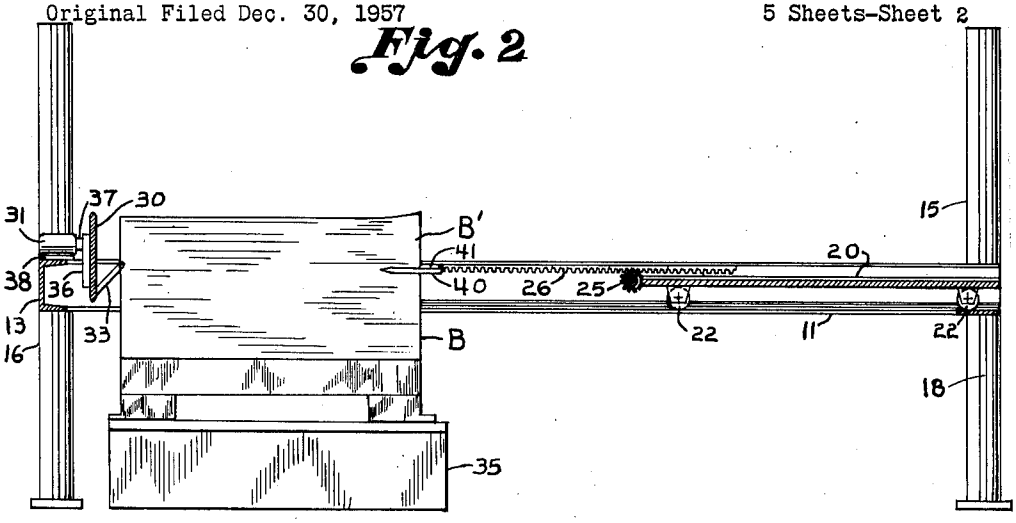


Fig. 3

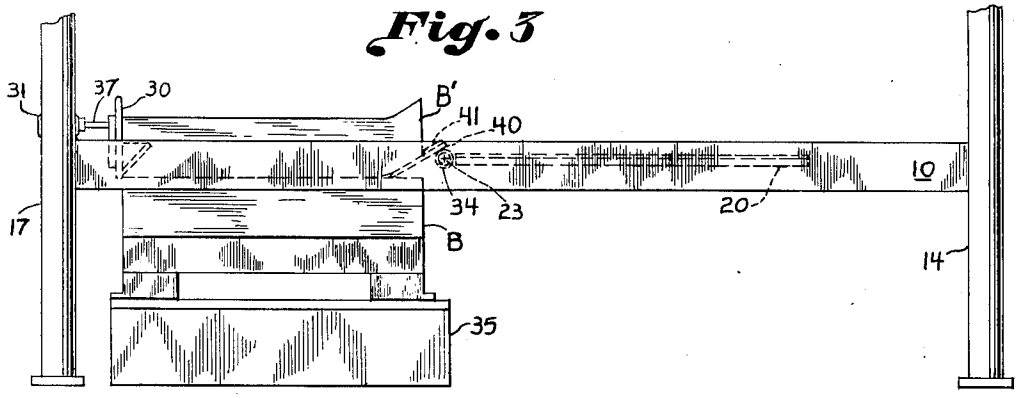
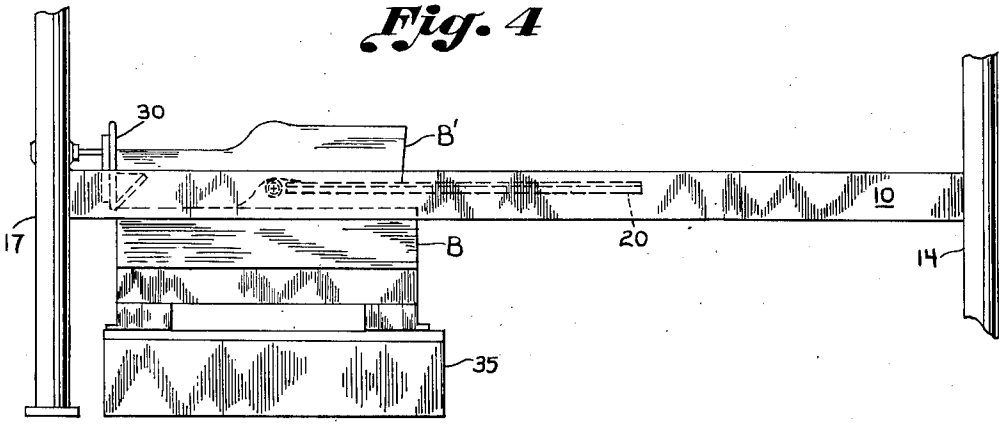


Fig. 4



PAPERMAKING MACHINE

Original Filed Dec. 30, 1957 5 Sheets-Sheet 3

Fig. 5

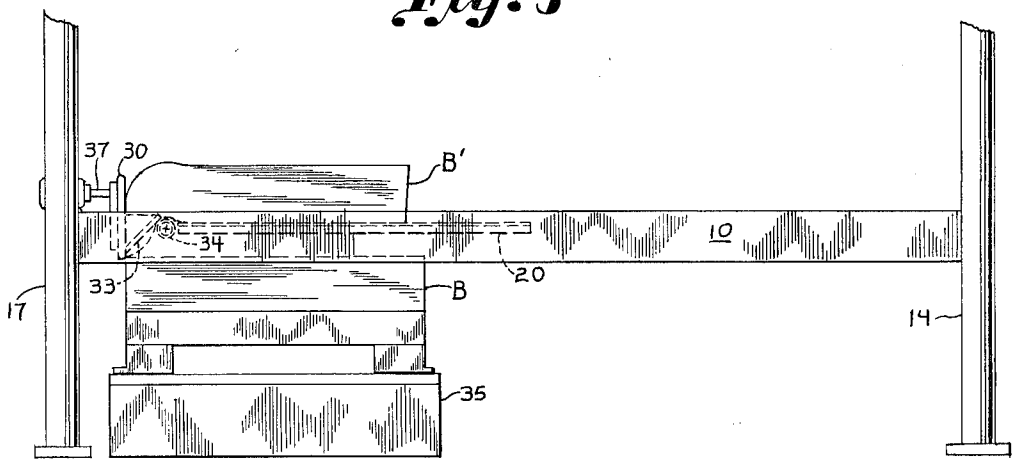


Fig. 6

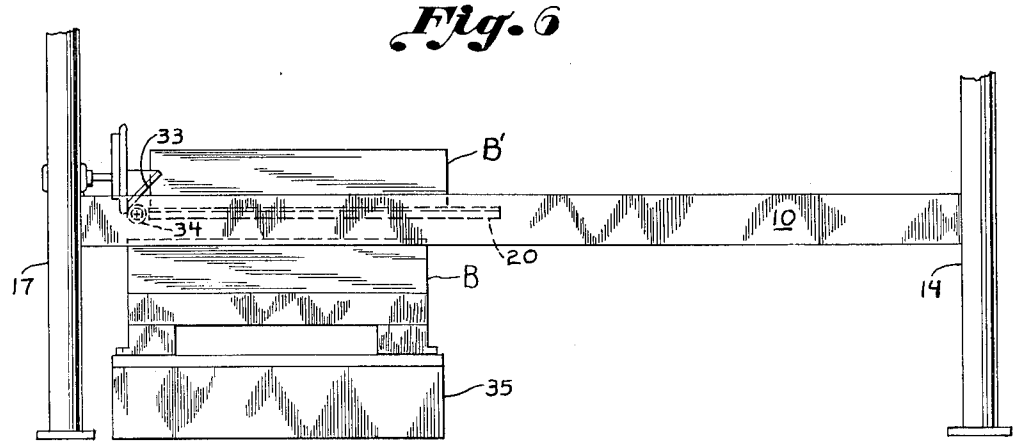
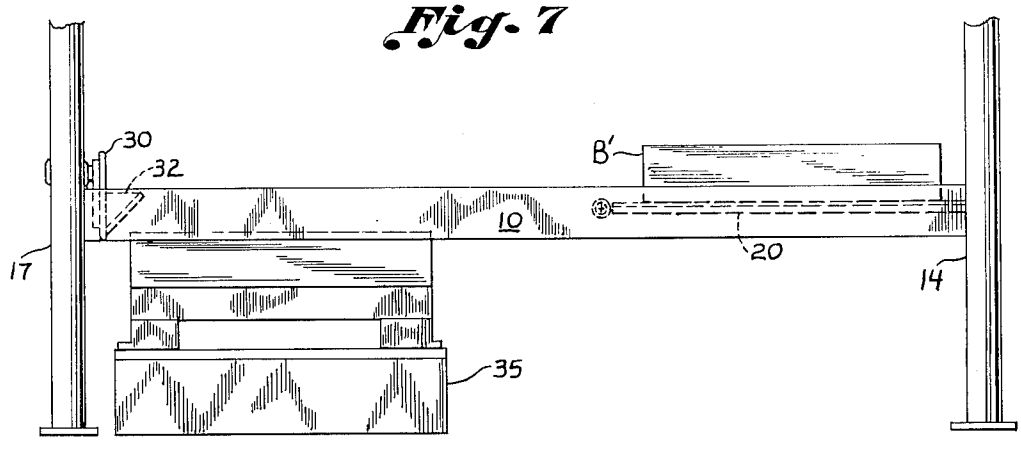


Fig. 7



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PAPERMAKING MACHINE

Original Filed Dec. 30, 1957 5 Sheets-Sheet 4

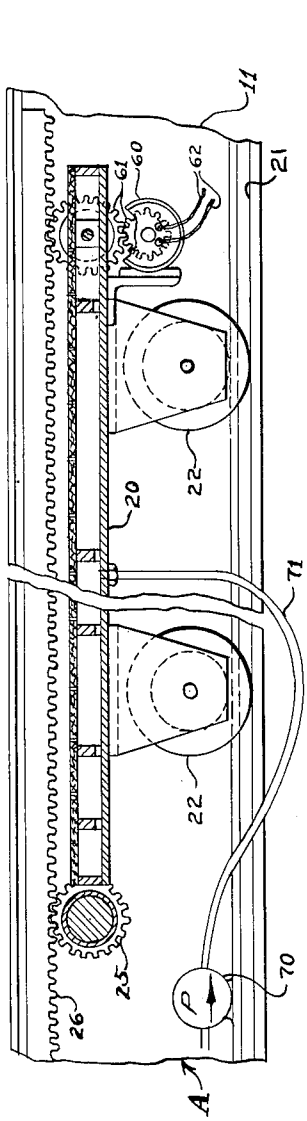

Fig. 9

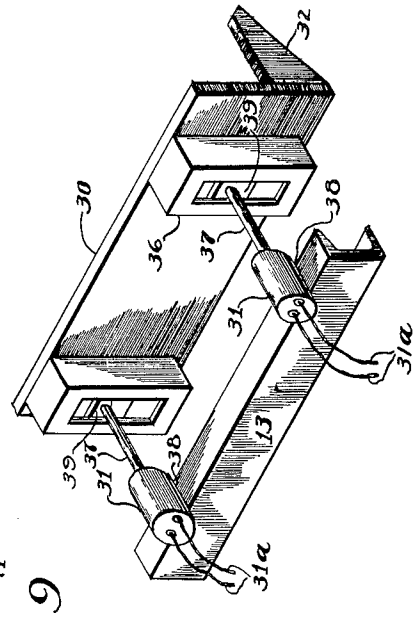

Fig. 10

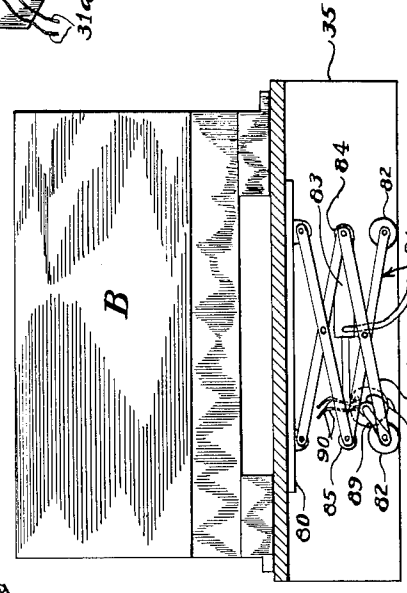

Fig. 11

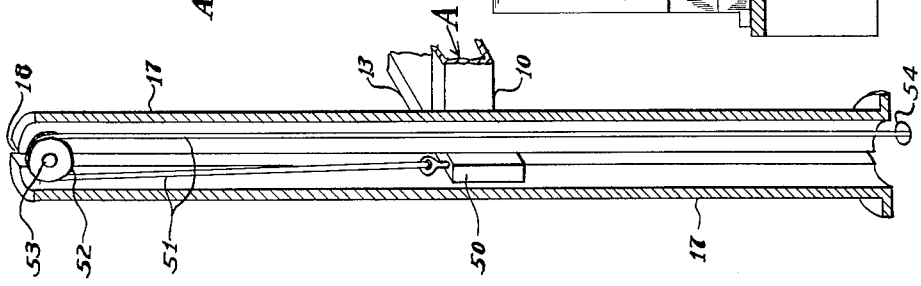

Fig. 8

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Fig. 12.

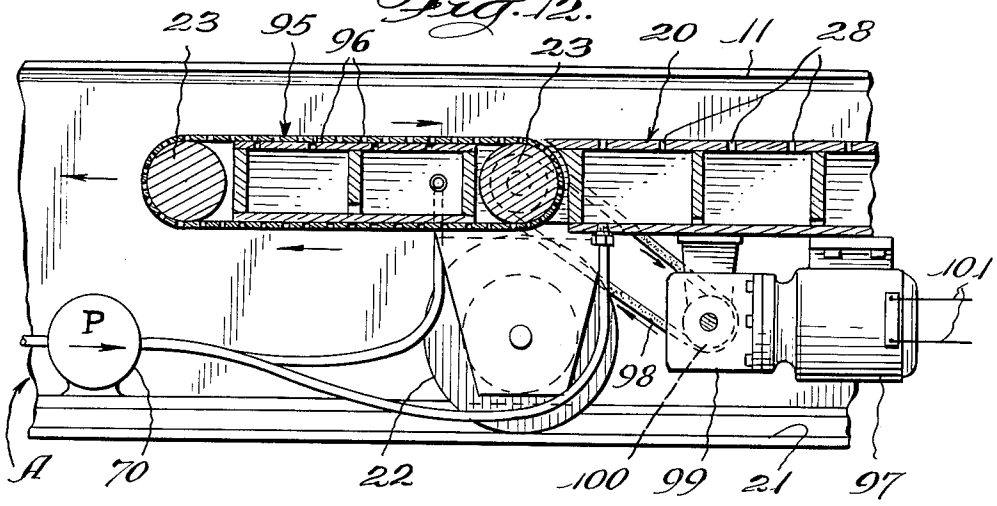
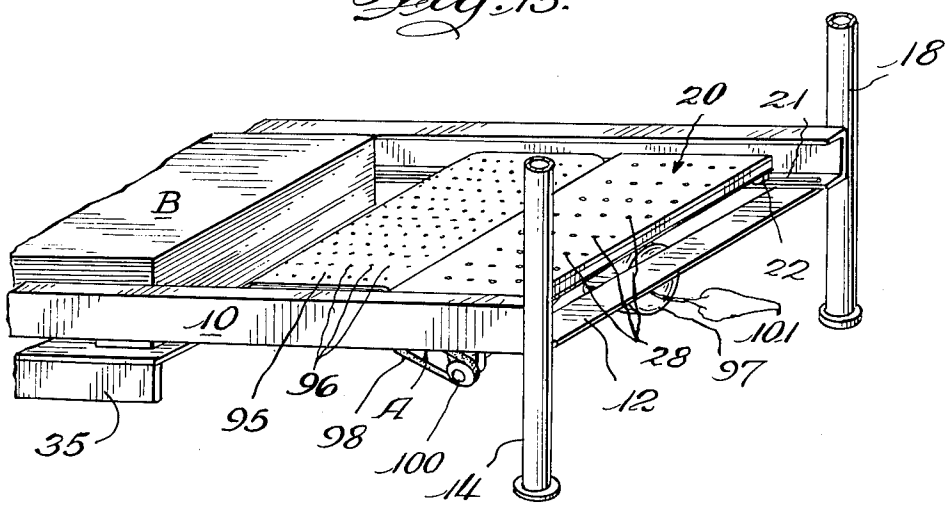


Fig. 13.



United States Patent Office 3,211,449 Patented Oct. 12, 1965

3,211,449

PAPERMAKING MACHINE

Ervin J. Welhouse, Kimberly, Wis., assignor to Kimberly-Clark Corporation, Neenah, Wis., a corporation of Delaware

Original application Dec. 30, 1957, Ser. No. 706,102. Divided and this application Nov. 14, 1963, Ser. No. 323,831

9 Claims. (Cl. 271—11)

This application constitutes a division of my co-pending application Serial No. 706,102, filed December 30, 1957, for Papermaking Machine.

This invention relates to apparatus for the transferring of stacks of relatively flexible sheet materials, such as paper, from one location to another. Such a transfer is commonly involved in the unpiling of a larger stack or pile of sheets into a series of smaller stacks, or conversely the assembling of a larger stack from a series of smaller ones.

In the stacking and unstacking of piles of paper sheets, current practice involves considerable manual handling, which is laborious, time consuming and expensive, and has proved far from satisfactory in quality of result obtained. These difficulties are particularly evident and troublesome in the handling of highly finished and light basis weight sheets, which are unusually susceptible to damage and are particularly difficult to handle.

The means of this invention substantially eliminates manual handling of the stacks of sheets, and provides a faster, easier, less wasteful and generally more satisfactory operation. The apparatus involves two stations or supports, with provision of means where relative motion between the supports in both vertical and longitudinal directions may be induced. A transversely extending edge of one of the supports is provided with a movable element to propel a stack of sheets which is to be transferred from one station to the other.

The specific objects and advantages of this invention will readily be perceived from the following description and the accompanying drawings, in which:

FIGURE 1 is a perspective view of a preferred form of the invention;

FIGURE 2 is a cross-sectional view taken along the line 2—2 of FIGURE 1;

FIGURES 3 to 7 are side elevation views, partially cut away, showing the apparatus of FIGURE 1 in successive stages of an unpiling operation;

FIGURE 8 is a cross-sectional view taken along the line 8—8 of FIGURE 1;

FIGURE 9 is a cross-sectional view taken along the line 9—9 of FIGURE 1, showing certain details of the invention;

FIGURE 10 is a perspective view of a part of the apparatus of FIGURE 1, taken from the left end of the apparatus as seen in FIGURE 1;

FIGURE 11 is a cross-sectional view taken along line 11—11 of FIGURE 1, showing details of a particular embodiment of the invention;

FIGURE 12 is a view similar to FIGURE 9 of a modified form of the invention; and

FIGURE 13 is a fragmentary perspective view of the modified form of the invention shown in FIGURE 12.

Referring to the figures, it is seen that the preferred form of the invention includes a table or support frame A made up of rigidly interconnected beams **10**, **11**, **12**, and **13**. Frame A is mounted on posts **14**, **15**, **16**, and **17** for controlled vertical sliding movement, which may be provided by conventional cables, rack and pinion combinations, cylinder-piston assemblies or the like, located within the posts and connected to portions of frame A extending within slots **18** in the posts. For example, referring also to FIGURE 8, frame A may at each of its corners be provided with an extending arm **50** extending into the adjacent one of posts **14** to **17** through slots **18**. A cable **51** is fastened to arm **50** and thence passed around a pulley **52** pivotally mounted as at **53** on the upper end of the post. The cable then passes downwardly through the post and through the floor or other support, as at **54**. The cables from the various post locations, supporting the four corners of frame A, are conventionally connected together and to a power source to provide equal lifting forces to the four corners of the frame.

Frame A slidably carries a thin air table or support **20**, which travels on track portions **21** of beams **10** and **11** for longitudinal movement parallel to those beams. For ease of movement, table **20** may be provided with a series of wheels **22** which ride on tracks **21**. Controlled movement of table **20** may be achieved by any conventional means, connected between the table and frame A whereby an operator may at will control the motion of table **20** longitudinally in relation to frame A. For example, referring also to FIGURE 9, table **20** may have an electric motor **60** mounted thereon and operatively connected to frame A by pinions **61** meshing with rack **26**. Motor **60** is selectively controlled through electrical wires **62** and thus the longitudinal position of table **20** relative to frame A may be controlled at will.

Table **20** preferably comprises a hollow member which is airtight except for a plurality of holes **28** in its top. Air is forced into the table under light pressure and as it escapes through holes **28** it substantially supports a stack of sheets which may be placed thereon. Referring again to FIGURE 9, pressure air may be supplied to the interior of table **20** from a pump **70** mounted on frame A and connected to the table as by a hose **71** of sufficient length to permit the described relative movement between the frame and table. An air table in the simple form as thus far described, without the mounting, is quite conventional, and so is not further detailed here.

Rotatably mounted along the forward longitudinal edge of table **20** is a movable surface, which in the preferred embodiment takes the form of a roller **23** of relatively small diameter, preferably of diameter approximating the small vertical dimension of the table. The mounting of roller **23** may be by such as journals **24** fixed to table **20**.

One end of roller **23** carries a pinion **25** which meshes with a rack **26** formed in an overhanging portion of beam **11**. As viewed in FIGURE 1, it will be clear that as table **20** moves from right to left, roller **23** will rotate in a clockwise direction, and vice versa. The pitch diameter of pinion **25** is selected so that the circumferential speed of roller **23** relative to table **20** will be substantially equal to the longitudinal speed of motion of the table. Preferably, this circumferential speed slightly exceeds the longitudinal speed, by an increment of about three percent, for reasons noted later herein.

An aligning stop **30** is mounted on beam **13**, against which a smaller pile portion of sheets, being piled or unpiled, can impinge to insure continued vertical alignment regardless of the transfer operation. As will be clear from FIGURES 2 to 7 and 10, stop **30** has a pair of vertically channeled members **36** fixed to its back side, within which lugs **39** on the piston ends **37** of solenoid **31**, cylinder piston assemblies, or the like are engaged in limited vertically-slidable relationship. The solenoids are fixed to beam **13** as at **38**, the solenoids being actuated through electrical wires **31***a* and thus permitting selective movement of stop **30** from right to left and vice versa as viewed in FIGURES 1 through 7. Thus stop **30** is movable both vertically and longitudinally of frame A.

Along each side of stop **30** there is mounted a side piece **32** having an edge **33** leveled at 45° to the vertical. These edges are positioned to contact enlarged bearing portions **34** formed near the ends of roller **23**, as table **20** reaches the end of its leftward travel as viewed in FIGURE 1. Since stop **30** is mounted for vertical travel, it is clear that further leftward movement by the table will force stop **30** upward, as will be further described later herein.

As seen in FIGURE 1, a stack of flexible sheets B, such as paper, is supported on a pallet or skid **35** immediately below the left end portion of frame A. This skid of sheets may be so positioned by any suitable means, such as a fork truck or conveyor. It is in the separation or unpiling of such a stack B into smaller piles that this invention finds one of its primary uses. This unstacking or unpiling operation may now be described.

Referring also to FIGURES 2 and 3, a portion B′ of stack B of sheets is lifted along an edge adjacent roller **23**, so that table **20** may be forced into the transverse separation thus formed. To accomplish this result, as shown in FIGURE 2, initially there may be inserted into the separation a divider **40**, which may have a piece **41** affixed thereto as a reinforcing member and to prevent entry of the divider into the separation further than desired.

Table **20** may then be adjusted to the proper height and horizontal positions so that roller **23** assumes a position immediately under the edge portion of divider **40** protruding from stack B. The table is then raised by the operator to lift the portruding edge of divider **40** as shown in FIGURE 3, to the point where the lowermost portion of table **20** is slightly higher than the plane of the uppermost sheet in the remainder of the stack below divider **40**. Table **20** is then forced inwardly a short distance, divider **40** may then be removed by the operator, and the table is then forced further to the left with roller **23** rotating opposite to the direction of movement of table **20**, carrying substack B′ up onto the table, as seen in FIGURE 4.

As the table reaches the position shown in FIGURE 5, enlarged portions **34** of roller **23** contact the beveled edges **33** of side pieces **32**, whereupon continued travel of the table **20** forces stop **30** upwardly to the position shown in FIGURE 6, with the effect of squaring up the side of the stack B′ which has been in contact with stop **30**, as that side is brought upwardly for support on the plane of table **20**. This action occurs simultaneously with the final leftward movement of table **20**, so that it is a squared substack B′ of sheets which is brought up on the table.

The pressure-air presented through holes **28** in the table **20** provides a cushion upon which the substack B′ is supported with but slight friction between the substack and the upper surface of the table. Consequently, the rotation of roller **23** during the final increment of leftward travel of the table ordinarily propels the pile B′ to the position shown in FIGURE 7.

The table may then be retracted to, for example, the most rightward position on frame A, and the substack B′ easily pushed off the table to an immediately adjacent operating station, or otherwise moved, for any further handling, such as trimming.

The movable surface along the leading transverse edge of table **20**, for example as presented by roller **23** in the preferred embodiment above described, provides an unusually important advantage when the material being transferred is of a delicate nature such as very light basis weight and/or highly finished paper sheet material. Without such a movable surface acting to lift and propel the substack onto the table, there is a tendency for the lowermost sheets in the substack to bunch in front of the leading edge of the table even though this edge may be highly polished and with a low coefficient of friction. Further, the necessary riding action of the sheets over a stationary leading edge is likely to result in irremediable damage to the lowermost sheets in the substack, which problem is compounded if the sheets tend to bunch in front of the leading edge. The lighter the sheet material being transferred, the greater the tendency of the sheets to bunch in front of the table; the more highly finished the sheets, the more likely and extensive the resulting damage.

When initially lifting the engaged edge of the substack B′ as shown in FIGURE 3, the lowermost edge of the substack should be raised so that the lowermost part of table **20**, including roller **23**, will only slightly but definitely clear the uppermost sheet immediately therebelow. In this connection, it might be noted that there are sometimes quantities of air entrapped between layers of the sheet material, with resulting raised areas in the stack, and care should be exercised to insure that the substack is sufficiently raised so that the lower part of the table and roller will clear any such raised areas as the table is inserted into the stack.

Roller **23** is preferably of the smallest feasible diameter, consistent with necessary strength, but ordinarily this diameter need be no smaller than the thickness of table **20**. Preferably the roller is mounted so that its uppermost portion is slightly above the plane of the upper surface of table **20**, as may particularly be seen in FIGURES 2 through 7. With this positioning, there is substantially eliminated any possibility that the leading edge of the lowest sheets in the substack will be engaged in the inherent small gap between the roller and the adjacent edge of the table as the substack is being propelled onto the table.

Roller **23** preferably is mounted to rotate with a circumferential speed relative to table **20** slightly in excess of the speed of longitudinal travel of the table, as previously indicated. This slight overspeeding of roller **23** insures that there is a positive horizontal propelling force applied to the substack, as well as a vertical propelling force, and that there will be no slight dragging force which would tend to cause bunching and marring of the lowermost sheets of the substack. However, depending upon the resultant coefficient of friction between the roller surface and the sheets, it is possible to operate the apparatus satisfactorily within a range of relative speeds, although in every instance the circumferential speed of the roller should be substantially equal to the longitudinal speed of the table.

Stop **30** preferably is mounted and automatically actuated so that with each initiation of leftward motion of the table **20**, stop **30** is firmly but resistably pushed to the right as viewed in FIGURE 1, and with initiation of rightward motion of the table stop **30** automatically retracts leftwardly. This may be achieved by any suitable conventional interconnection of the power source for solenoid **31** and electric motor **60**. Then, with location of the adjacent edge of stack B within the area in which stop **30** is longitudinally movable, upon initiation of leftward motion of table **20**, stop **30** will firmly come into contact with stack B to support the stack (particularly portion B′) against longitudinal force applied by insertion of the table. This insures maintenance of the squared edges of the substack B′. As previously noted, as raised portions **34** of roller **23** come into contact with edges **33**, stop **30** is raised, this applying a lifting force to the edges of sheets in substack B to assist them in assuming the final squared position on the table. Continued movement of the table sufficiently to raise stop **30** to permit roller **23** to pass therebeneath will insure positioning of substack B′ on the table beyond the roller.

It will be obvious that the apparatus as described will also work well in performing an operation just the reverse as that described, that is in the formation of a large stack of sheets from a series of smaller stacks or piles. In

such situations the operation of the machine is the reverse of that described and consequently is not further detailed, although in such operation the divider **40** is of less utility.

It will be obvious to those skilled in the art that various modifications of the apparatus which has been described will be possible without departing from the spirit of the present invention. It might particularly be noted, for example, that the movable surface provided by roller **23** need not be presented in the form of a geometric cylinder, but might equally well be in the form of a belt carried and propelled by two or more rollers, wheels or sets of pulleys. The surface of such a belt might be provided with a series of perforations through which pressure-air might be forced in substantially the manner and for the purposes as described in connection with table **20**. This might be particularly helpful should the longitudinal dimension of the upper surface presented by such a belt be increased to present a substantial portion of the total length of the movable table or platform. Such a belt might be especially useful for operation of the apparatus as a stacker, and in such operation the belt or roller could advantageously be selectively driven either as previously described or by an independent power source. For example, referring to FIGURES 12 and 13, such a belt **95** having perforations **96** therethrough may be supported by the two rollers **23**. The belt extends over the rollers and over the top of the table **20**. The independent power source may be an electric motor **97** driving a roller **23** by means of belts **98** and a motor output gear unit **99** having power output pulleys **100** for the belts **98**. The motor **11** may be energized through electrical wires **101** and may be selectively connected to the same power source as that for the motor **60** so that, when the table **20** is moved between parts of a pile of sheet material, the belt **96** on its upper pass moves substantially at the same speed as the table **20** but in the opposite direction.

Further, stack B could be positioned upon a vertically and/or longitudinally movable support, thus eliminating the need to provide the corresponding movements of table **20**—of course, eliminating longitudinal movement of the table limits the range within which the substack may be moved. For example, referring to FIGURE 11, pallet **35** may be supported on a platform **80** carried by a lazy tong mechanism **81** mounted on wheels **82**. Mechanism **81** may be controllably extended, thus raising platform **80** and pallet **35**, by a cylinder-piston assembly **83** connected between opposed pivot points **84** and **85** on the mechanism **81**, and supplied with actuating fluid through a conduit **86**. For longitudinal travel (from right to left as seen in FIGURES 1 to 7 and 11), this supporting mechanism may be powered by an electric motor **87** mounted on one of the arms **88** of mechanism **81** and controllably connected to one of the wheels **82** through a belt or chain **89**. Motor **87** is selectively actuated through electrical wires **90**. Roller **23** must in any event rotate proportionately to the relative horizontal movement between the table and stack B.

In view of the various obvious modifications which might be made, it is to be understood that no limits upon the invention are intended except as specifically set forth in the appended claims.

What is claimed is:

1. A device of the character described comprising a portable member adapted to be inserted between or withdrawn from a stack of sheets and a supporting medium for said sheets, a load supporting surface provided by said member, and means carried by said member for longitudinal movement relative to said surface, said means having operation to prevent contact between said surface and the bottom sheet of said stack during insertion or withdrawal of said member.

2. A device of the character described comprising an elongated, rigid member adapted to be inserted between or withdrawn from a stack of sheets and a supporting medium for said sheets, a load supporting surface provided by said member, and flexible means carried by said member for longitudinal movement relative to said surface, said flexible means being of a width substantially equal to the width of said surface and having operation to prevent contact between said surface and the bottom sheet of said stack during insertion or withdrawal of said member.

3. A device of the character described comprising an elongated relatively thin, rigid member adapted to be inserted between or withdrawn from a stack of sheets and a supporting medium for said sheets, a top surface on said member, a bottom surface on said member, and flexible tape means carried by said member for longitudinal movement relative to said top and bottom surfaces, respectively, said flexible tape means having operation to prevent contact between said top surface and the bottom sheet of said stack and between the said bottom surface and said supporting medium, respectively, during insertion or withdrawal of said member.

4. A device as set forth in claim **3** wherein the width of the flexible tape means is substantially equal to the width of said top and bottom surfaces.

5. A device of the character described comprising a relatively thin, hollow member adapted to be inserted between or withdrawn from a stack of sheets and a supporting medium therefor, a load supporting surface on said member, flexible tape means carried by said member for longitudinal movement relative to said surface, a portion of said tape means being located within said member and another portion of said tape means being exposed for engagement with the bottom sheet of said stacks, and means for moving said member relative to said tape means between said stack and said supporting medium.

6. Apparatus for handling a pile of light flexible sheet material comprising a table, means for movably mounting said table so that it may be moved between parts of the pile of sheet material with a forward edge proceeding from one side toward the other side of the pile, a roller on said forward edge and a second roller spaced from said first named roller both rotatably mounted on the table, a belt extending around said rollers approximately coextensive with a sheet material carrying surface of said table and means for moving said rollers and thereby said belt with a peripheral speed approximateley the same as the speed of travel of said table and opposite in direction with respect to said table at its said surface for facilitating movement of the table in the pile.

7. Apparatus for handling a pile of light flexible sheet material comprising a table, means for movably mounting said table so that it may be moved between parts of the pile of sheet material with a forward edge proceeding from one side toward the other side of the pile, a roller on said forward edge and a second roller spaced from said first named roller both rotatably mounted on the table, a belt extending around said rollers, means for supplying air under pressure into said table between said rollers, said belt being perforated and the upper surface of said table underlying said belt also being perforated so as to allow pressure air from within the table to support the sheet material on the table, and said belt and said rollers being movable to facilitate movement of the table in the pile.

8. Apparatus for handling a pile of light flexible sheet material comprising a table, means for movably mounting said table so that it may be moved between parts of the pile of sheet material with a forward edge proceeding from one side toward the other side of the pile, a roller on said forward edge and a second roller spaced from said first named roller both rotatably mounted on the table, a belt extending around said rollers approximately coextensive with a sheet material carrying surface of said table, means for supplying air under pressure into said table, said belt and said sheet material carrying surface

being perforated so as to allow pressure air from within the table to support the sheet material on the table, and means for moving said rollers and said belt with a peripheral speed approximately the same as the speed of travel of said table and opposite in direction with respect to said table at its said surface for facilitating movement of the table in the pile.

9. Apparatus for handling a pile of light flexible sheet material comprising a table, means for movably mounting said table so that it may be moved between parts of the pile of sheet material with a forward edge proceeding from one side toward the other side of the pile, a roller on said forward edge and a second roller spaced from said first named roller both rotatably mounted on the table, means for supplying air under pressure into said table between said rollers, flexible tape means extending around said rollers and arranged to allow pressure air from within the table to support the sheet material on the table and on the tape means, and means for moving said rollers and said tape means with a peripheral speed approximately the same as the speed for travel of said table and opposite in direction with respect to the direction of movement of the table for facilitating movement of the table in the pile.

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