May 3, 1966 H. E. ZACHOW 3,249,242

TRANSFER APPARATUS FOR PAPER INSPECTION

Filed May 20, 1963 4 Sheets-Sheet 1

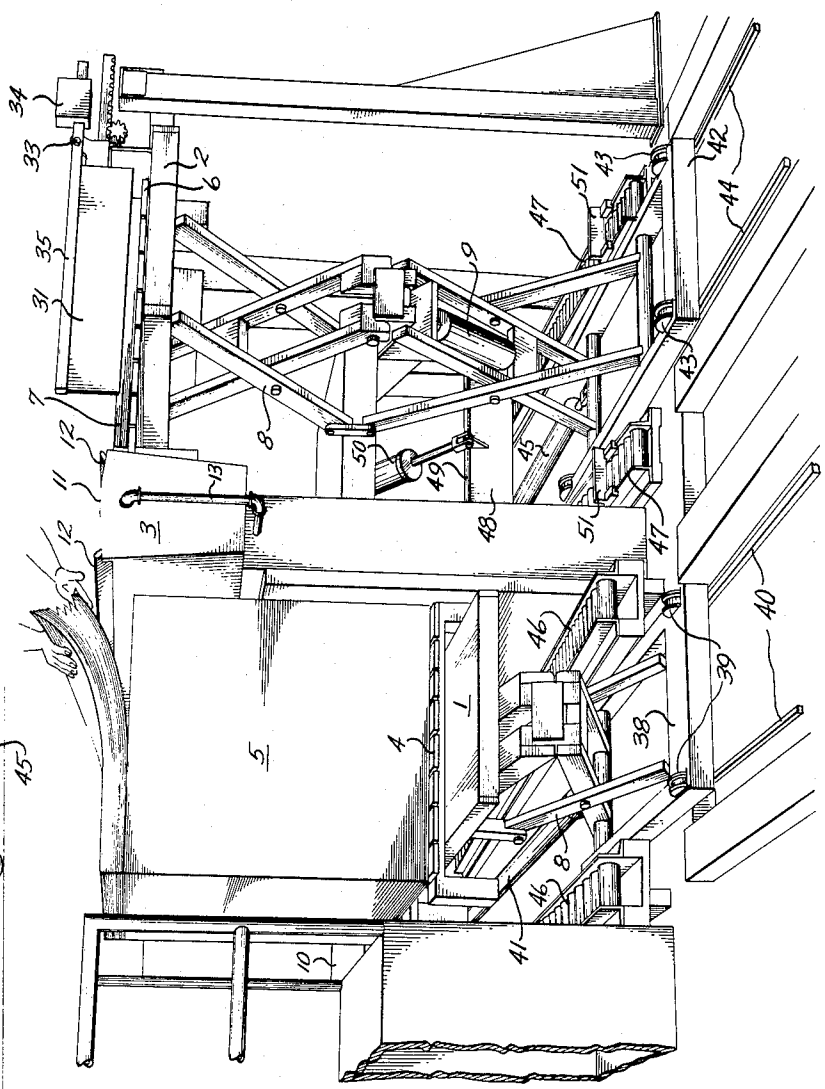


Fig. 1.

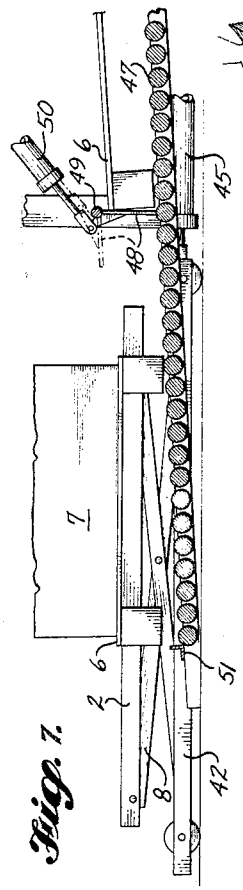


Fig. 2.

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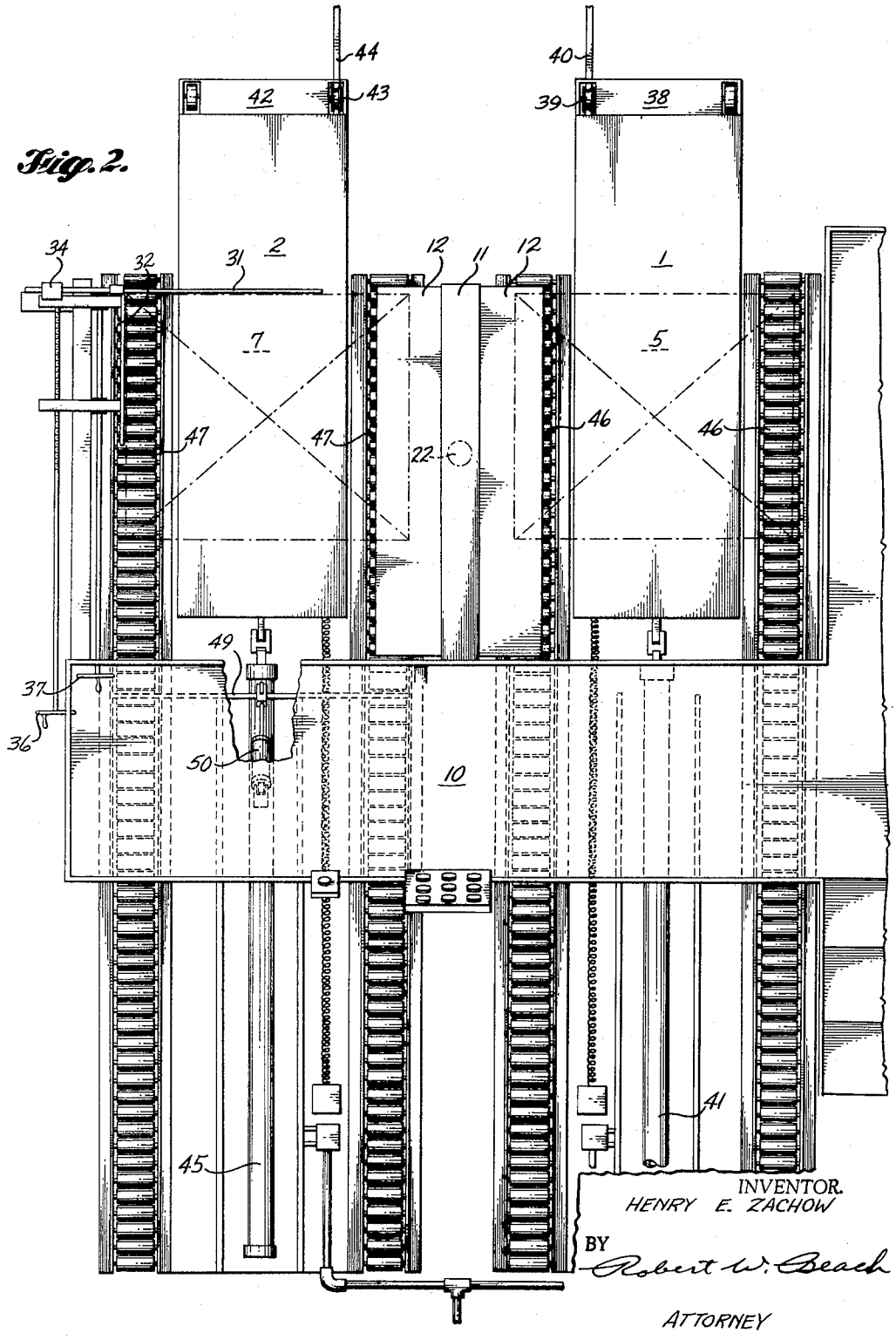
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TRANSFER APPARATUS FOR PAPER INSPECTION

Filed May 20, 1963 4 Sheets-Sheet 2

Fig. 2.



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Fig. 4.

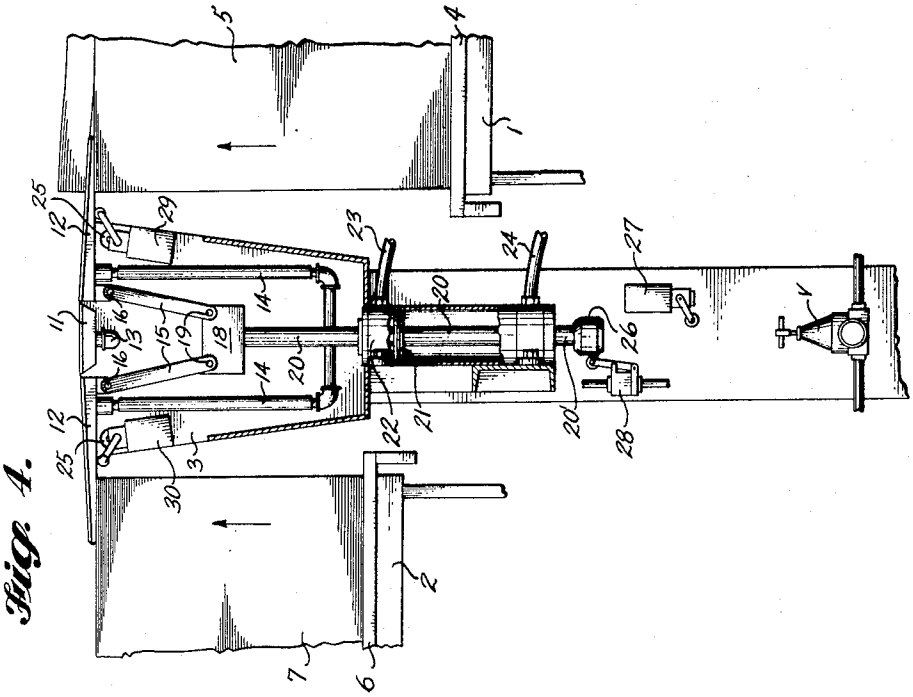
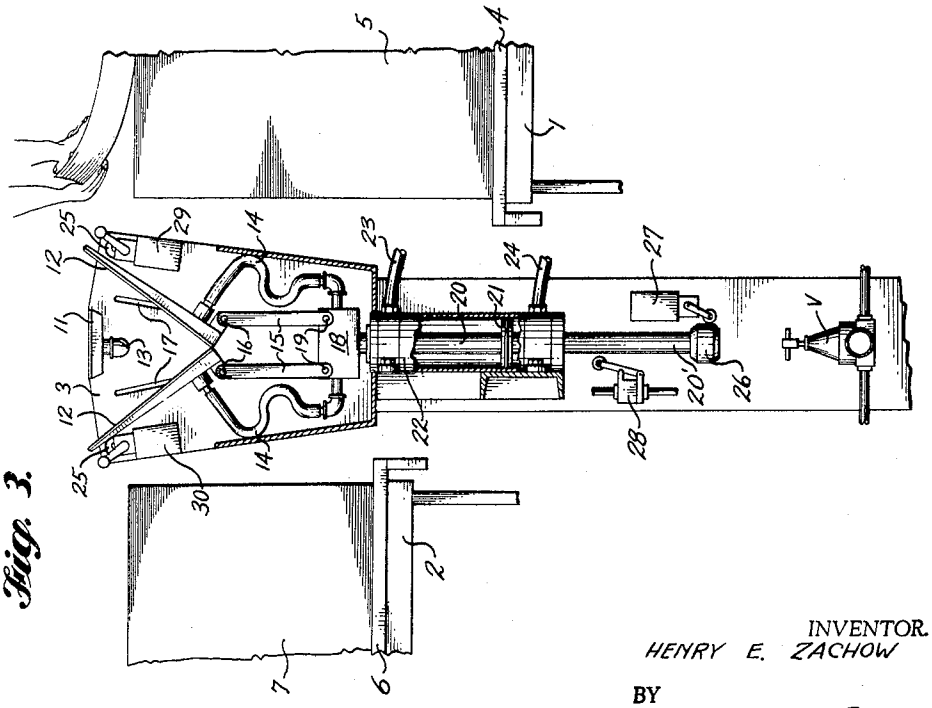


Fig. 3.



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Fig. 6.

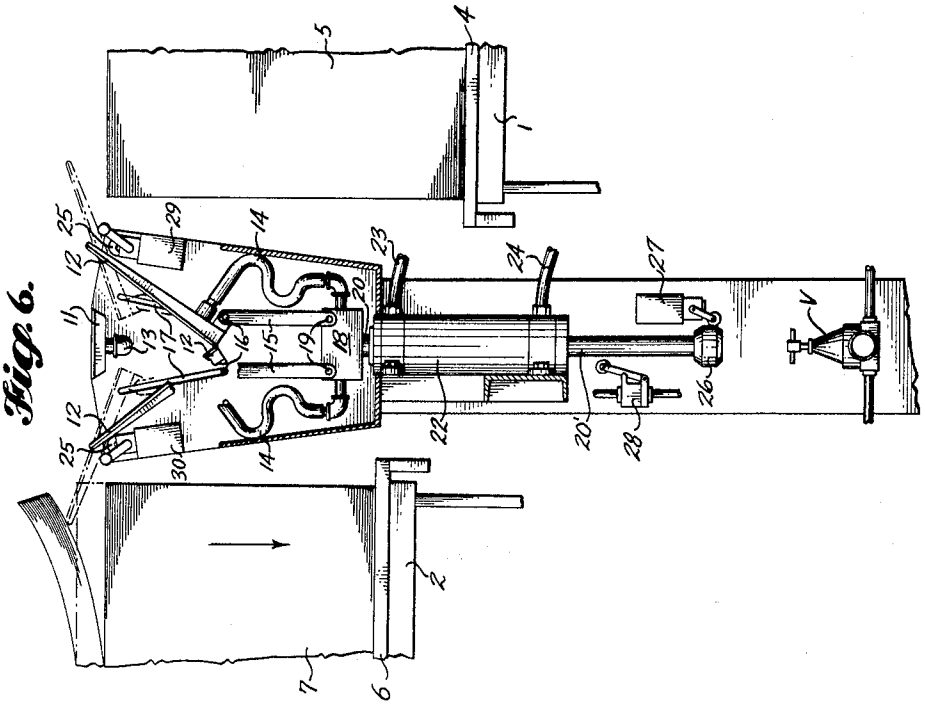
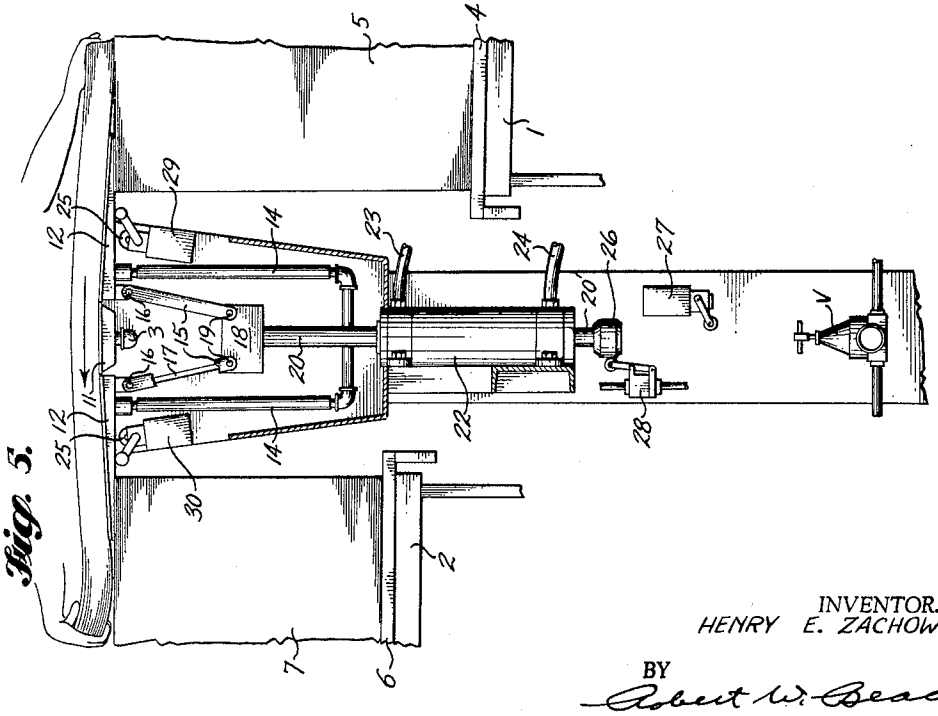


Fig. 5.



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United States Patent Office 3,249,242 Patented May 3, 1966

3,249,242

TRANSFER APPARATUS FOR PAPER INSPECTION

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Filed May 20, 1963, Ser. No. 281,625
9 Claims. (Cl. 214—6)

The present invention relates to apparatus facilitating transfer of sheets, particularly of paper, in incremental packs from one stack to another, particularly for inspection purposes.

Paper is manufactured in large sheets and, before it is trimmed to final size and packaged, it is necessary to inspect it and to remove defective sheets to avoid the inclusion of imperfect sheets in the final package. In order to insure thorough inspection of the sheets of paper in a large stack several feet high, it is customary to unpile the paper in such a stack and to repile it. Usually this operation is performed by removing incremental packs from a sheet stack after being inspected and repiling such sheet packs as they are removed from one stack so as to form a new stack.

It is a principal object of the present invention to provide apparatus which will enable sheets, such as paper, in one stack to be unpiled and repiled in a new stack expeditiously, whatever may be the height of the paper stack. During such operation, it is an object to enable a worker to handle the sheets always at the same level, at a convenient height for inspection, irrespective of the height of the stacks being unpiled and repiled.

A further object is to enable the worker to select incremental sheet packs of any thickness desired for inspection purposes and to manipulate such a sheet pack without being required to lift it from one stack and without dropping it on another stack while handling the sheet pack with minimum effort.

In thus handling sheets for inspection purposes, it is an object to provide apparatus by which sheet packs can be shifted from one stack to another quickly and easily while leaving the repiled sheet packs stacked evenly and squarely. Locating and guide mechanism is provided which is adjustable for locating sheets of various sizes.

Another object is to provide apparatus facilitating unpiling and repiling sheet material for inspection which can be operated principally by one worker from a single station while maintaining virtually complete control over the inspecting, unpiling and repiling operation.

As the repiling of a particular stack of sheets is completed, it is an object to remove such repiled stack quickly and to supply a new stack of sheets to be inspected and to provide a new receiver on which the sheets from such next stack can be repiled.

For accomplishing the foregoing objects, the apparatus of the present invention includes transfer mechanism in the form of an air suspension table located at the desired working height with a stack elevating support adjacent to one side of the table from which sheet packs can be unpiled and a stack depressing support at the opposite side of the table onto which sheet packs can be placed for accumulation into a repiled stack. Such table includes side leaves adjacent to the stack supports which are movable between positions projected into the respective stacks, for supporting edge portions of sheet packs above them, and positions retracted out of registry with the sheet stacks to enable the stack supporting means to be shifted in elevation without interference by the table. Automatic control mechanism is provided for coordinating the projection and retraction of such table leaves with elevational movement of the sheet stack supports. Empty sheet stack supporting skids can be supplied to and removed from the respective stack unpiling and repiling locations, and stack elevating mechanism of mobile type transports stacks to the unpiling location and removes stacks from the repiling location.

FIGURE 1 is a top perspective of the transfer apparatus and FIGURE 2 is a plan of such apparatus with parts broken away.

FIGURES 3, 4, 5 and 6 are end elevations of the apparatus with parts broken away, showing the apparatus in successive operational stages.

FIGURE 7 is a side elevation of the lower portion of the apparatus with parts broken away.

The transfer apparatus includes three principal components, namely, a sheet stack support **4** for a stack of paper to be unpiled, a sheet stack support **6** for a stack of paper being repiled and a transfer device **3** between the two sheet stack supports. The sheet stack support **4** conveniently in the form of a skid carrying a stack of sheets **5** to be inspected. Such sheet stack support can be elevated incrementally as successive packs of sheets are removed from the top of the stack **5**. The sheet stack support **6** is shown as a skid on which packs of sheets which have satisfactorily passed inspection can be piled. The sheet stack support **6** can be lowered incrementally as sheet packs are placed on the stack **7**. The transfer device **3** between the two stack supports preferably is of the dynamic air suspension type by which most of the weight of a sheet pack can be supported while such pack is being shifted edgewise from a location in registry with the sheet stack **5** into a location in registry with the sheet stack **7**.

The sheet stack supports **4** and **6** may be supported for such elevational movement by similar lift tables **1** and **2**, respectively, supported by linkage **8**, the specific character of which does not constitute part of the present invention. The tables can be raised or lowered and held in any desired elevational position by hydraulic jacks **9**. The supply of liquid under pressure to such jacks is controlled by a pump driven by an electric motor. Energization and deenergization of such motor can be controlled automatically in accordance with the operation of other components of the transfer apparatus.

The height at which the sheets will be inspected and transferred from one stack to the other is determined by the elevation of the transfer table **3** relative to the platform **10** on which the inspecting worker stands. This transfer table must be constructed in a manner to prevent interference with movement of sheet stacks carried by the respective stack supports **4** and **6**. It is desirable, however, for the transfer table to bridge between the stack supporting locations and even to extend partially over the sheet stack supports while a pack of sheets is being transferred from one stack to the other. Consequently, the transfer table is constructed to include portions which can be extended into partial overlying registry with the sheet stack supports **4** and **6**.

The transfer tabe **3** is of the dynamic air film suspension type shown best in FIGURES 3, 4, 5 and 6 as including a stationary central panel **11** and two extendible and retractable leaves **12** at opposite sides, respectively, of the central panel. Such central panel and the leaves are hollow and the interiors of these elements are supplied with air under pressure through the pipe **13** and the hoses **14**, respectively. The upper surfaces of the panel and leaves are perforated by holes through which air is breathed. Each hole is approximately one-sixteenth of an inch in diameter and such holes are spaced apart about three inches. A sheet overlying the dynamic air film suspension table will cause air discharged from such perforations to move parallel to the surface of the table to the edges of the sheet for discharge. The greater the downward load on such sheet, the closer it will be pressed toward the table, but the continued discharge of air from the perforations produces a dynamic air film between the

sheet and the table which acts to suspend the sheet with little or no actual contact with the table so that it can be slid edgewise easily relative to the table because its weight is suspended by the dynamic air film.

To the edges of the leaves **12** adjacent to the stationary panel **11**, links **15** are connected by pivot pins **16** having projecting ends which are slidably received in guide grooves **17**. These guide grooves diverge upwardly, as shown best in FIGURES 3, 5 and 6, so as to establish the path of movement of the edge of each leaf **12** adjacent to the panel **11** during movement of such leaf between a projected position and a retracted position. Such leaf movement is effected by a vertically reciprocable head **18** to which the lower ends of links **15** are connected by pivot pins **19**. Such reciprocable head is mounted on the upper end of the rod **20** of a fluid jack including a piston **21** reciprocable in a cylinder **22**. Such fluid jack is of the double-acting type having an upper connection **23** to the upper end of cylinder **22** and a lower pressure fluid connection **24** to the lower end of such cylinder.

Portions of the leaves **12** spaced from the pivots **16** bear on fulcrum rollers **25** mounted on the upper portion of the table frame. When the reciprocable head **18** is moved into its lowest position, shown in FIGURES 3 and 6, the leaves **12** are in their retracted positions with their edge portions remote from the links **15** bearing on the fulcrum rollers. As the reciprocable head **18** is driven upward, the ends of pivots **16** received respectively in the divergent guide grooves **17** will be moved away from each other and the leaves **12** bearing on the rollers **25** will be swung toward the substantially horizontal positions shown in FIGURES 4 and 5 as the leaves roll on the rollers **25** into their fully projected positions. When the leaves are in their retracted positions of FIGURES 3 and 6, such leaves are completely out of registry with the sheet stack supports **4** and **6**. When the leaves are projected edgewise from such retracted positions into the extended positions of FIGURES 4 and 5, however, a substantial portion of each leaf is located in overlying registry with one of the sheet stack supports.

It is preferred that the movement of the transfer table leaves **12** be coordinated automatically with elevational movement of the lift tables **1** and **2**. Such control mechanism may include a downward extension **20'** of the piston rod **20** carrying a knob **26** which is engageable with the arms of electric switches **27** and **28**. Additional electric switches **29** and **30** are arranged adjacent to the upper end of the transfer table frame in positions for engagement by the leaves **12** when they are in their projected positions resting on the fulcrum rollers **25**. Switch **27** is a limit switch which, when engaged by knob **26**, interrupts the supply of fluid to the pressure fluid connection **23** for terminating downward movement of the reciprocating head **18** and retraction of the leaves **12** and also initiates downward movement of lift table **2** carrying sheet stack support **6** on which the repiled stack of sheets is being accumulated. Such downward movement is interrupted by a timer. Limit switch **28** engageable by knob **26** at the upper end of the stroke of piston **21** interrupts the supply of pressure fluid to connection **24** so as to stop the leaves **12** in their fully projected positions.

Actuation of switch **28** by knob **26** has the further function of initiating supply of hydraulic liquid to the cylinders **9** for effecting upward movement of the sheet stack support lift tables **1** and **2**. When the arm of switch **29** is moved upward a predetermined amount permitted by raising from its projected position the leaf **12** in partial overlying registry with sheet stack support **4** by upward movement of the stack on such support, the pump supplying hydraulic liquid to the actuating cylinder **9** of the lift tabe **1** for such sheet stack support will be deenergized to stop the upward movement of the support. As the arm of switch **30** engaging the transfer table leaf **12** partially overlying the sheet stack support **6** in projected position rises as permitted by upward movement of the stack on such support, raising leaf **12** to clear the fulcrum rollers **25**, the pump supplying hydraulic liquid under pressure to the cylinder **9** of lift table **2** for sheet stack support **6** will be deenergized to terminate upward movement of this sheet stack support. Actuation of switch **28** by the knob **26** also initiates supply of air under pressure to the connections **13** and **14** for providing the air film on the transfer table. As the knob **26** leaves the switch arm **28** at the beginning of the retracting operation of the leaves, the supply of air to the connections **13** and **14** will be terminated.

In operation, the parts of the apparatus are in the positions shown in FIGURE 1 while the inspector riffles the edges of the sheets of paper in a pack for inspection purposes. The top of the stack of sheets on the sheet stack support **4** would then be approximately level with the top of the transfer table. The pack of sheets thus inspected by the inspector may be approximateley one ream and any defective sheets found can be plucked from the pack. When the inspection has been completed, the inspector will press a foot control to effect supply of fluid under pressure to connection **24** of the fluid jack for projecting the transfer table leaves. During this operation, the edge of the sheet pack inspected will be held in a raised position, as shown in FIGURE 3, so that the leaves **12** can be projected edgewise below such raised edge of the pack.

As the leaves **12** are projected into the positions shown in FIGURE 4, the sheet stack supports **4** and **6** for both sheet stacks will be lifted because of the actuation of switch **28**, as previously explained. Also at this time air will be supplied to the hollow interior of the central tranfer table panel **11** and the leaves **12** for discharge through the surface perforations in these parts. It is preferable also to provide air discharge perforations in the outer edges of the projected leaves **12**, or at least in the edge of that leaf disposed in partial overlying registry with the sheet stack support **4**, so that the air ejected from such edge apertures will tend to separate the inspected sheet pack from the remainder of the sheet stack on support **4**. The edge of the sheet pack shown as being held in raised position in FIGURE 3 may then be laid down on the leaf, as shown at the right of FIGURE 4.

With the sheet stacks **5** and **7** stationary in the upper positions shown in FIGURE 5 in which the sheet stacks have lifted the leaves **12** out of engagement with the fulcrum rollers **25** and the switches **29** and **30** have been actuated to interrupt upward movement of the sheet stacks, the weight of the leaves **12** will clamp the sheets in the stacks tightly together, particularly at the edges of such stacks adjacent to the transfer table. With the sheets beneath the leaves **12** thus held firmly and the pack of inspected sheets above the leaves being at least partially suspended by the film of air protected from the right leaf **12**, as seen in FIGURE 4, the inspector can grasp opposite edges of the sheet pack, as shown in FIGURE 5, and slide it across the transfer table onto the stack of sheets on sheet stack support **6**.

As the pack of sheets is moved from the stack on support **4** over the transfer table, the dynamic air film beneath the pack will support the greater portion of the weight of such pack directly; and as the pack is moved toward the position shown in FIGURE 6, the air discharged from the edge of the left leaf **12** shown in that figure will tend to maintain such sheet pack suspended until it has been moved fully into registry with the stack of paper on support **6**. The pack may be stopped in this position by engagement of the edges of the sheet pack with guides **31** and **32** located along adjacent edges of the sheet stack. As shown in FIGURE 1, guide **31** is supported by a pivot **33** and a counterweight **34** is mounted on the portion of the guide arm **35** projecting beyond the pivot **33** at the side opposite the paper-engaging portion of the guide. The position of guide

31 can be adjusted by manipulation of hand wheel 36 and the position of guide 32 can be adjusted by rotation of hand wheel 37 to locate the paper being repiled in the desired relationship to the sheet stack support 6.

When a pack of sheets has been slid in the manner described from the stack 5 being unpiled across the transfer table 3 to the stack of sheets being repiled, the inspector again may actuate a control, such as a foot control, to supply fluid under pressure to the upper connection 23 for the jack 21, 22 to move the reciprocable head 18 downward. Such retraction of the leaves 12 from the positions of FIGURE 5 to those of FIGURE 6 will withdraw a leaf from beneath the pack of sheets newly laid on the stack 7, as shown in FIGURE 6. The edge of such sheet pack which overlies the leaf 12 will then drop down onto the stack of sheets being repiled so that the new upper surface of such stack formed by the sheet pack will be a substantial distance above the transfer table 3.

As the knob 26 leaves the switch 28, the supply of air to the transfer table will be discontinued, as mentioned previously; and when the knob engages the switch 27, the sheet stack support lift table 2 will be energized to move downward, as indicated by the arrow in FIGURE 6. By virtue of the timing control mechanism discussed previously, such downward movement will be interrupted when the sheet stack support has reached a position such that the new upper surface of the stack is located a substantial distance below the upper surface of the transfer table, as shown in FIGURE 3. The inspector will then lift the edge portion of the next pack of sheets on stack 5 for inspection, as shown in FIGURE 1, after which this pack, in turn, will be transferred to the stack 7 following the procedure discussed above. This operation will be repeated until all of the sheet stack 5 has been unpiled from the sheet stack support skid 4 and repiled on the sheet stack support skid 6.

When the sheet stack 5 has thus been unpiled and repiled as the sheet stack 7, it is necessary to remove the empty skid 4 and replace it with a fresh sheet stack to be inspected and unpiled and to remove the repiled sheet stack 7 from its position adjacent to the transfer table and to replace it with another empty skid 6. Consequently, the lift 1 for sheet stack support skid 4 will be lowered until the legs of the skid support such skid on the roller conveyor 46. This roller conveyor is inclined downward away from the location alongside the transfer table 3 so that, when the lift table 1 has been lowered sufficiently to clear the skid, such skid will roll along the conveyor 46 toward the lower portion of the figure shown in FIGURE 2 until it is out of registry with the transfer table. The hoist for the lift table 1 is mounted on a carriage 38, shown best in FIGURE 1, supported by wheels 39, one of which engages track 40 to guide the carriage outward from a position alongside the transfer table 3 for movement under a new stack of sheets on a new skid 4. Such movement of the carriage is effected by the long fluid pressure jack 41, shown in FIGURES 1 and 2.

The completed stack 7 of repiled sheets is lowered sufficiently so that its upper side will clear the stacking guide plate 31 or such stacking guide plate may be swung into upright position clear of the stack. The stack will not be lowered sufficiently to remove the lift table 2 from the skid 6. The hoist for such lift table is mounted on carriage 42, which is supported by wheels 43, one of which engages track 44. A long fluid pressure jack 45, shown in FIGURES 1, 2 and 7, may be extended to move the lift table 2 out of position alongside the transfer table 3. The lift table may then be lowered further so that the sheet stack support skid 6 carried by it will rest on its legs in a position to be picked up by a lift truck for removal from the apparatus of the present invention. The mobile sheet stack support can then be retracted into a position alongside the sheet transfer table 3 again by retraction of jack 45.

A supply of empty skids 6 to receive repiled stacks of sheets can be stored on the roller conveyors 47, shown in FIGURES 1, 2 and 7, which slope from a location out of registry with the transfer table 3 to a location alongside such transfer table. If desired, such empty skids 6 can simply be shifted from the roller conveyors 46 over to the roller conveyors 47. Such empty skids are prevented from rolling into a position alongside the transfer table 3 until the inspector is ready for them by providing a control gate 48 mounted on pivot rod 49 extending across the inclined path defined by the tracks 47 in the position shown in FIGURES 1 and 7. When a new skid is needed for the next stack of repiled sheets, the gate 48 can be swung upward into skid-releasing position by a fluid pressure jack 50 connected to a crank arm on the gate 48. The skid will then roll down the conveyors 47 until it engages the stops 51, and the gate can be swung downward by the jack 50 to block succeeding empty skids 6 until they are needed. The stack support 2 can then be raised to lift the skid 6 generally into the position shown in FIGURE 1 for receiving the next stack of repiled sheets progressively, as described above.

While it is preferred that the various operations of the components of the apparatus be coordinated automatically as described above, the movement of each component can be initiated voluntarily by the inspector and terminated by the action of suitable limit switches, or the movement of the stacks can be terminated, as well as initiated, by voluntary control of the inspector, if desired. Also the various jacks and actuators have been designated as being fluid operated, but it is preferred that the stack support lifts be of the hydraulic actuated type and that the fluid pressure actuators for the leaves 12 and for translation of the lift-mounting carriages be of the pneumatic fluid actuated type.

I claim as my invention:

1. Sheet transfer apparatus comprising a first sheet stack support for supporting a stack of sheets to be unpiled by increments, a second sheet stack support for supporting a stack of sheets to be repiled by increments, said sheet stack supports being located in side-by-side relationship spaced apart a distance less than the width of sheets supported by said sheet stack supports, a transfer table located between said sheet stack supports and including three sections, namely, a stationary central panel and two movable side leaves on opposite sides of said stationary central panel, respectively, disposable in generally horizontal coplanar relationship, each of said side leaves being of a width greater than the distance between said stationary central panel and the sheet stack support at the corresponding side of said central panel for overlying a portion of such sheet stack support, and means connected to the edges of said side leaves adjacent to said central panel and operable to move such side leaf edges downward and toward each other beneath said stationary central panel and thereby move toward said stationary central panel the edges of said side leaves remote from said central panel.

2. Sheet transfer apparatus comprising a first sheet stack support for supporting a stack of sheets to be unpiled by increments, a second sheet stack support for supporting a stack of sheets to be repiled by increments, said sheet stack supports being located in side-by-side relationship, a transfer table between said sheet stack supports including two leaves the upper sides of which are perforated for discharge therefrom of air under pressure, means guiding said leaves for movement between projected generally horizontal coplanar relationship, in positions partially overlying said sheet stack supports, respectively, and retracted positions out of vertical registry with said sheet stack supports, a source of air under pressure, air supply means operatively connected to said leaves for supplying to them air under pressure from said source

when said leaves are in their projected positions, and control means operated automatically in response to movement of said leaves toward their retracted positions to control said air supply means to interrupt the supply of air to said leaves.

3. Sheet transfer apparatus comprising a first sheet stack support for supporting a stack of sheets to be unpiled by increments, a second sheet stack support for supporting a stack of sheets to be repiled by increments, means supporting said sheet stack supports and effecting elevational movement thereof, said sheet stack supports being located in side-by-side relationship, a transfer table including two leaves disposed in generally horizontal coplanar relationship in positions partially overlying said sheet stack supports, respectively, and control means actuated automatically in response to engagement of stacks of sheets on said sheet stack supports with said transfer table leaves to terminate upward movement of the respective sheet stack supports by the sheet stack support supporting and elevational moving means.

4. Sheet transfer apparatus comprising a transfer table including a stationary central panel and two leaves at opposite sides, respectively, of said central panel and adapted to be disposed in operative generally horizontal coplanar relationship with said central panel and having their adjacent edges spaced apart a substantial distance, means supporting and guiding said leaves for simultaneous movement of their adjacent edges downward and toward each other into closely adjacent relationship beneath said central panel with the leaves flaring upward from such adjacent edges to their opposite edges at substantially the same elevation as when said leaves were in such generally horizontal coplanar relationship, constituting retracted positions, and leaf-retracting means connected to said leaves and movable to shift said leaves from such operative relationship to such retracted positions.

5. Sheet transfer apparatus comprising a transfer table including a leaf having a perforated upper side, air supply means connected to said leaf, a fulcrum roller supportingly engaged with said leaf, leaf-retracting means connected to said leaf, movable to shift said leaf between an operable position supported in generally horizontal position in engagement with said fulcrum roller and retracted position shifted edgewise relative to said roller and including a reciprocable member and a link connecting said reciprocable member and said leaf for effecting movement of said leaf by reciprocation of said reciprocable member, and control means operated automatically in response to movement of said reciprocable member to control said air supply means for supplying air to said leaf when it is in its operative position and to interrupt supply of air to said leaf when it is in its retracted position.

6. Sheet transfer apparatus comprising a transfer table including a leaf having perforations therein, air supply means connected to said leaf, leaf-retracting means connected to said leaf and movable to shift said leaf between an operable position supported in generally horizontal position and a retracted tilted position, including a reciprocable member connected to said leaf for effecting movement of said leaf by reciprocation of said reciprocable member, and control means operable automatically

in response to movement of said reciprocable member to control said air supply means for supplying air to said leaf when it is in its operative position and to interrupt supply of air to said leaf when it is in its retracted position.

7. In the sheet transfer apparatus defined in claim 6, the reciprocable member including a cam reciprocable therewith, and a stationary switch connected to control the air supply means and engageable by said reciprocable cam to effect control of the air supply means in response to reciprocation of the reciprocable member.

8. Sheet transfer apparatus comprising a transfer table including a stationary central panel and two leaves at opposite sides, respectively, of said central panel, adapted to be disposed in operative generally horizontal coplanar relationship with said central panel and having their adjacent edges spaced apart a substantial distance, stationary fulcrum rollers supporting portions of said leaves remote from said central panel, a frame, means operatively connecting with said frame such adjacent edge portions of said leaves and guiding said leaves for simultaneous movement of their adjacent edges downward and toward each other into closely adjacent relationship beneath said central panel with the leaves flaring upward from such closely adjacent edges to their opposite edges, and leaf-retracting means including an upright reciprocable member beneath said stationary central panel and links connecting said reciprocable member and said leaves and movable to shift said leaves.

9. Sheet transfer apparatus comprising a transfer table including a stationary central panel and two leaves at opposite sides, respectively, of said central panel and adapted to be disposed in operative generally horizontal coplanar relationship with said central panel and having their adjacent edges spaced apart a substantial distance, a frame, guideways carried by said frame, means connected to said leaves movable in said guideways to control movement of the adjacent edges of said leaves in a predetermined path downward and toward each other into closely adjacent relationship beneath said central panel with the leaves flaring upward from such adjacent edges to their opposite edges at substantially the same elevation as when said leaves were in such generally horizontal coplanar relationship, constituting retracted positions, and leaf-retracting means connected to said leaves and movable to shift said leaves from such operative relationship to such retracted positions.

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