

[54] **METHOD AND APPARATUS FOR FORMING AN EVEN EDGED PILE OF FLEXIBLE SHEETS**

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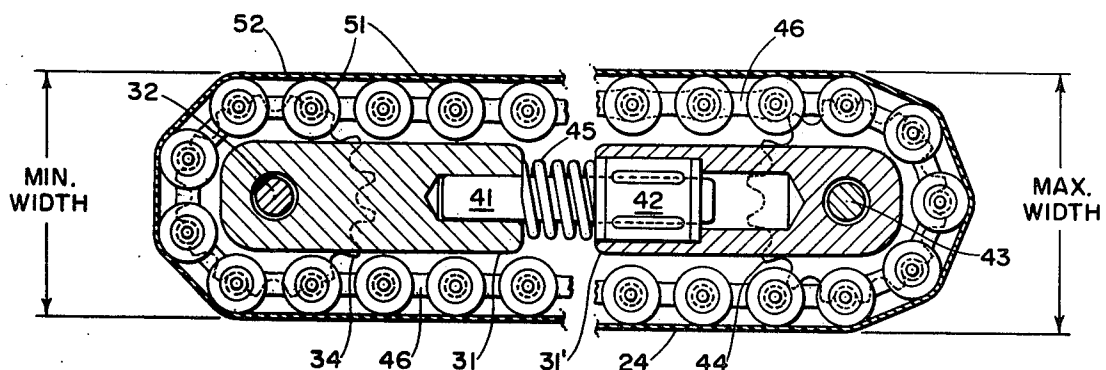
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[57] ABSTRACT

In a layboy for piling flexible sheets which are successively delivered in a generally horizontal direction of travel jogger mechanisms are provided in opposed positions to act on the lateral edges of the sheets as they are received in the layboy with the jogging surfaces which contact the sheets having a continuous motion in the direction of travel of the sheets and incremental oscillatory motion transverse to the direction of travel which jogs the sheets and forms an even edged pile. The jogging surface which provides these components of motion corresponds to the peripheral path of a chain drive on sprocket gears.

18 Claims, 4 Drawing Figures



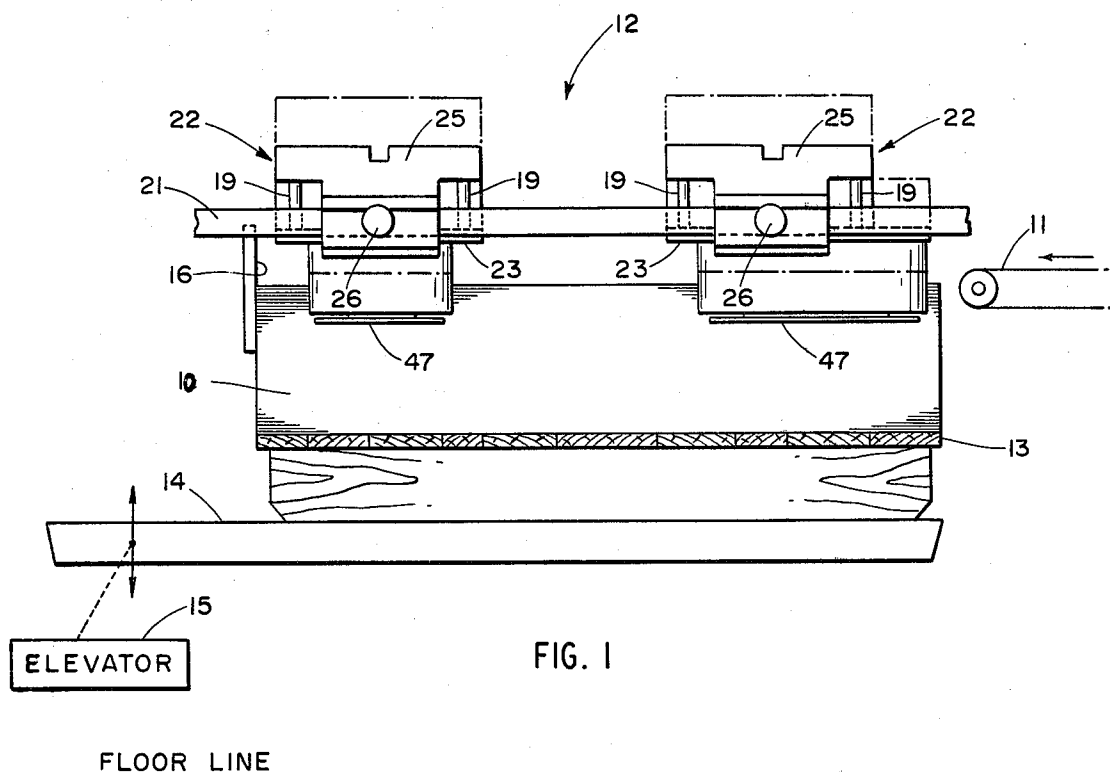
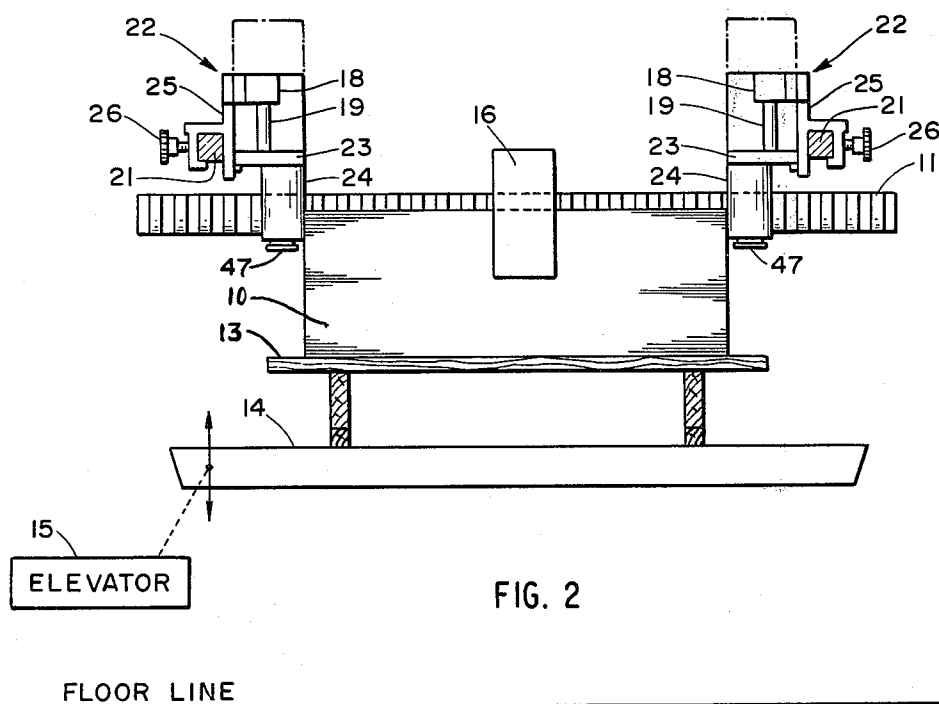


FIG. 3

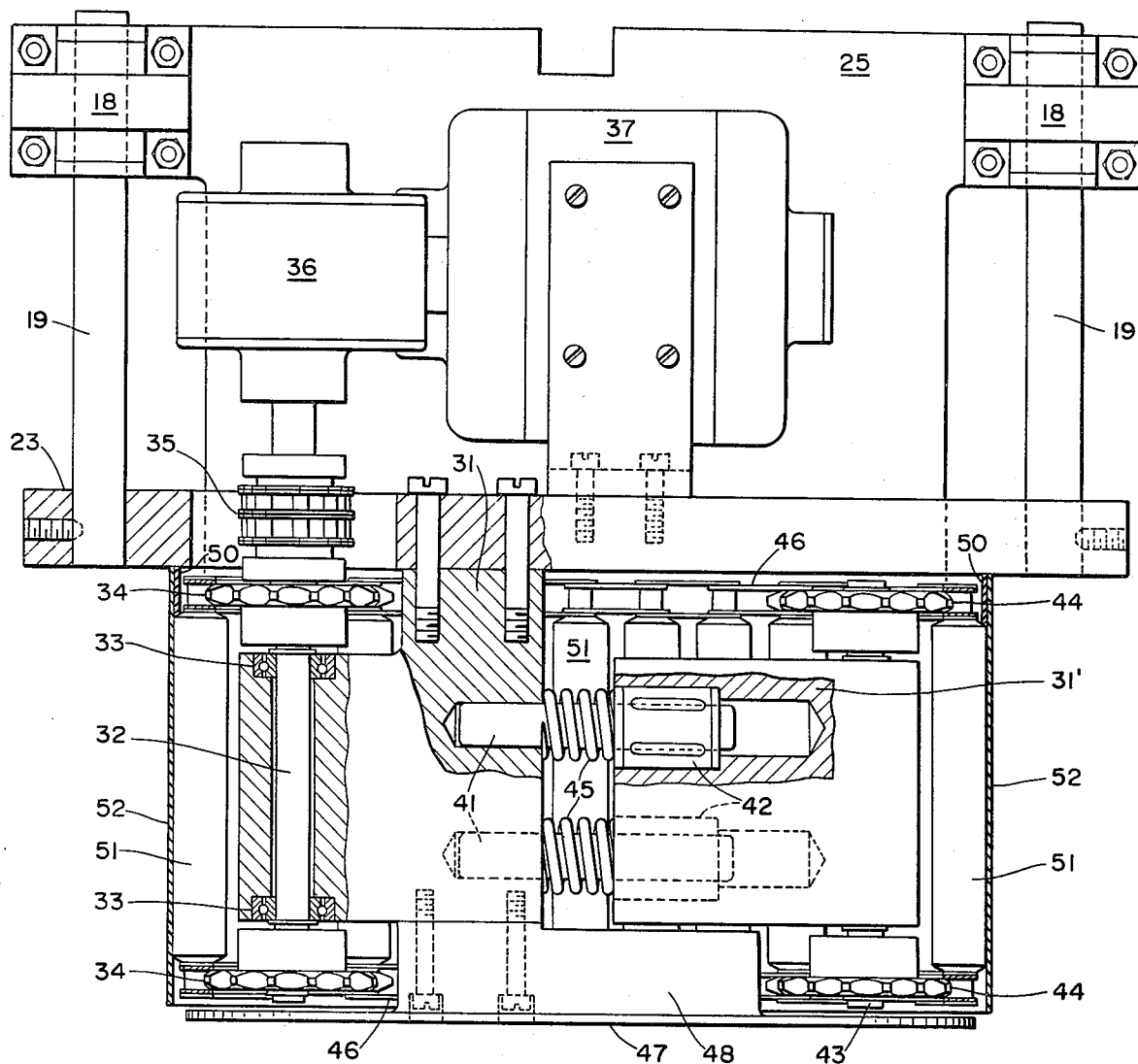
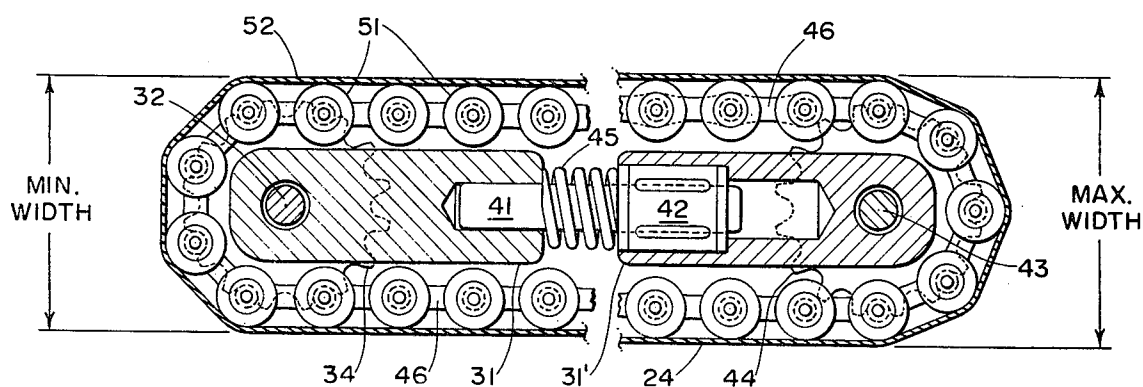


FIG. 4

METHOD AND APPARATUS FOR FORMING AN EVEN EDGED PILE OF FLEXIBLE SHEETS

BACKGROUND OF THE INVENTION

The continuous cutting of large rolls of paper to form sheets of predetermined size and the forming of a pile of such sheets is a well known operation in the paper industry. Generally, this operation is performed with high quality papers and the pile of sheets is sold for use in printing techniques where precise feeding for color registration is generally required. In converting the large paper rolls into a stack of individual cut sheets inspection and sorting operations are performed to assure high quality and the sheeting operation is performed with precision to insure accurate size. When these operations are completed and the acceptable cut sheets are delivered to a layboy for forming the pile there remains the problem of forming a stack in which the sheets are piled uniformly and for this purpose the layboy is generally equipped with jogger boards and various other devices which are intended to produce a uniform and even edged pile of sheets.

In spite of considerable effort to produce even edged piles in a layboy there is still a substantial amount of repiling that is required in order to supply the customer with a stack of sheets suitable for direct use in his printing operation. This repiling, of course, requires additional time and labor and thus adds to the expense of the delivered product. In addition the rehandling of the sheets exposes them to the possibility of damage and great care is required in order to produce a finished stack of sheets with the requisite quality as required for precision printing.

SUMMARY OF THE INVENTION

The present invention provides method and apparatus for producing an even edged stack of sheets with the requisite precision for sale directly to the printing trade without the necessity for repiling or otherwise improving the alignment of the sheets in the stack in the as-piled condition. For this purpose the sheets are delivered to a layboy and subject to transverse jogging forces which are repeated at a rapid rate while at the same time being subjected to contact with surfaces which are moving in the direction in which the sheets are moving when they are delivered to the layboy. With this arrangement the sheets are arrested against the end stop of the layboy and maintained in that position by virtue of the contact with the surface which is moving in the same direction while being subjected to a transverse jogging force which is rapidly repeated and maintains the top of the pile in a "live" condition so that the delivered sheets settle into and form the existing pile with a precision edge alignment not heretofore available. For this purpose a mechanism is provided in the form of a sprocket gear and chain drive assembly which has the characteristics of providing peripheral motion one component of which will be in the direction of travel of the sheets while the pitch of the sprocket gear causes the drive chain to oscillate transverse to its peripheral path to supply the transverse jogging component of force on a rapidly repeated basis. The transverse oscillatory motion is the result of the articulation of the chain links as they make chordal contact with the pitch circle of the sprocket gear.

This basic mechanism can be utilized in various forms to provide an area contact with the upper portion

of the pile of sheets by using two such chain drive assemblies in spaced condition with transverse elements extending between the chain drives and to provide a continuous surface contact member an endless belt can be fitted over the chain drive assembly.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation view of the delivery end of a conveyor system and the associated layboy for receiving sheets delivered thereby constructed in accordance with the present invention.

FIG. 2 is an end elevation of the apparatus shown in FIG. 1 looking in the direction of arrival of oncoming sheets.

FIG. 3 is a side elevation view of a jogger mechanism constructed in accordance with the invention shown partly in section and partly broken away to reveal details.

FIG. 4 is a somewhat schematic view showing further construction details and broken into two portions to show the maximum and minimum width configuration of the jogger mechanism.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a sheet delivery system in the form of an endless conveyor 11 projects sheets into a layboy generally designated 12 where they are stacked on a support platform 13 which may be a wooden skid adapted to be used with a forklift truck for transporting the stack of paper piled thereon. The skid 13 rests on a support surface 14 which is positioned in elevation by an elevator mechanism 15. The general arrangement is to operate the elevator 15 to maintain the position of the top of the pile at approximately the height of delivery of sheets from the conveyor 11. Sheets which are projected from the conveyor 11 travel due to their own momentum across the top surface of the pile of sheets 10 until they are arrested by hitting a backstop 16.

Referring now to both FIGS. 1 and 2, the position and mounting arrangements for jogger mechanisms will be described. The layboy 12 is positioned relative to the frame of the machine having support members 21 upon which are mounted opposed jogger mechanisms 22 with suitable arrangements made for selection of the spacing therebetween to correspond to the width of the sheets being stacked.

The jogger mechanisms 22 generally comprise a support plate 23 from which depends a mechanism having active jogger constraint surface 24. Motor drive means for activating the jogger mechanism are mounted above the plate 23. As indicated in FIGS. 1 and 2 the jogger mechanisms 22 are vertically movable to raise the active surface 24 when the skid 13 is raised to position corresponding to the level of the delivery conveyor 11 at the start of a pile of sheets. As shown in FIGS. 1 and 2 the active jogger surfaces 24 extend above and below the top surface of the pile of sheets 10 to operate on the arriving sheets as they fly across the top surface of the pile and also to operate on the top portion of the stack 10 to maintain that portion of the stack active until the sheets find an equilibrium position with their edges stacked uniformly with the edge of the stack 15.

The support plate 23 is slidably suspended from a mounting bracket 25 by means of guides 18 and guide rods 19. The bracket 25 is arranged to be suspended from the structural member 21 on the frame of the machine and may be secured thereto in a movable position

by means of a hand wheel set screw arrangement 26. With this arrangement the width adjustment can be made by adjusting the spacing between the members 21 by means, not shown, and the lateral position of the jogger mechanisms selected by sliding the assembly along support member 21. Other suitable arrangements for adjusting the effective position of the active surfaces 24 may of course be used.

Referring now to FIG. 3 the support plate 23 is shown connected to a support block 31 through which a first shaft 32 extends and is supported for rotation by bearings 33. The shaft 32 extends through the bearings 33 and beyond the block 31 to provide hubs for a pair of sprocket gears 34 which are fixed to the shaft 32. At the top of the shaft 32 one section of a releasable coupling 35 is attached, the other portion of the coupling 35 being connected to the output shaft of a gear reduction mechanism 36 driven by an electric motor 37. The motor 37 is mounted on the top surface of the support plate 23 and is connected to support the gear reduction mechanism 36 as shown.

The block 31 is bored to receive with press fit two rods 41 which project horizontally therefrom and pass through linear bearings 42 which are press fit into a second block base member 31' which supports a second shaft 43 rotatably mounted in bearings in the block 31'. The shaft 43 at each end has a pair of sprocket gears 44 which are aligned with corresponding sprocket gears 34 on the shaft 32. The spacing between the center lines of shafts 32 and 43 is an integral number of chain pitch units to maintain the jogger surface effective and parallel to the direction of paper flow. The sprocket gears 34 common to shaft 32 are radially aligned with their teeth precisely registered as to radial position such that when they rotate a transverse member supported therebetween is translated substantially without skew motion components. Gears 44 on common shaft 43 are also so aligned. A pair of compression springs 45 are placed on the rods 41 which when compressed urge the blocks 31 and 31' away from each other to tension the belt 52.

A pair of drive chains 46 are meshed with each set of aligned sprocket gears 34, 44, with the length of the chains 46 and the various dimensions of the parts described therein being such that when the chains are in place the compression springs 45 maintain force on the blocks 31, 31', urging them apart and maintaining tension on the drive chains 46. A guard plate 47 having semicircular end portions is attached to a mounting base 48 and secured by means of screws to the base 31. The outline of the guard plate 47 generally corresponds to the peripheral path of the drive chain 46. The plate 47 is sufficiently strong to support the assembly and serves to raise the assembly to the displaced position shown in FIGS. 1 and 2 when contacted by the skid 13 as the skid 13 is elevated to a position for starting a new pile.

Extending transversely between the pivots in corresponding links of the chains 46 is a set of support rollers 51 which are mounted on bearings to turn with respect to their end supports in the links of the chains 46. Each of the rollers 51 may be constructed of Teflon or other smooth surface rigid material to provide support for an endless flexible belt 52 which is dimensioned to be under tension when supported on the set of rollers 51. In this fashion the endless belt 52 will remain in contact with the surface of the rollers 51 and provide a continuous surface tangential to the rollers throughout their

movement as the chains 46 move around the peripheral path in engagement with the sprocket gears 34, 44. Sprockets with the number of teeth a multiple of four were chosen such that the active and passive sides of the belt move together and apart in unison thus reducing vibration. Sprockets with an odd number of teeth would cause the active and passive sides of the belt to move towards the center of the pile and away from the center of the pile at the same time.

Referring now to FIG. 4, the nature of the motion of the set of rollers 51 and the endless belt 52 tensioned thereon will be described. First it will be noted that the pitch of the teeth on the sprocket gears 34, 44, is approximately half the pitch or spacing of the links of the chains 46. While this is not a requirement to achieve a jogging motion from a mechanism of this type it does serve to amplify the transverse motion of the rollers 51 and belt 52. For example, double-pitch chain is essentially standard chain with its pitch extended to twice the standard pitch. Sprockets for double-pitch chain have different pitch diameters than sprockets of the corresponding standard chain. With standard sprockets of 24 or more teeth, this difference is so slight that the standard chain sprocket may be used with double-pitch chain. The tooth pitch of the sprockets in this case is only approximately half the chain link pitch. The same transverse amplitude could have been obtained using single-pitch but the weight of the chain would be much greater. With any given chain pitch, amplification of transverse oscillatory motion can be achieved by decreasing the number of teeth in the sprocket rather than with double-pitch chain as shown.

Each link in the chains 46 spans two teeth in the gear sprocket 34, 44, and as shown on the left hand side of FIG. 4 when the chain 46 is positioned such that the rollers 51 are symmetrically distributed on opposite sides of the horizontal center line through the shafts 32, 43 a minimum width condition exists. On the other hand, as shown in the right half of FIG. 4 when the chain 46 is positioned such that rollers at each end are on the horizontal center line through the shafts 32, 43, the maximum width condition for the rollers 51 and belt 52 exists. As the sprocket gears 34, 44 rotate and the two chains 46 travel around the peripheral paths defined thereby the rollers 51 oscillate between the maximum and minimum width conditions illustrated in FIG. 4 with a frequency determined by the pitch and speed of the drive chains 46. As indicated in FIG. 4, the variation between maximum and minimum occurs for each half link displacement of the drive chains and a full oscillation cycle thus occurs for rotation corresponding to one link displacement.

Analysis will show that the length of the peripheral path and hence the length of the belt 52 under tension remains constant throughout the cycle. Either the external surfaces of the rollers 51 themselves or the outer surface of the belt 52 tensioned thereon can be used to contact the edge of flexible sheets and apply the jogging forces in the direction of travel of such sheets and also transverse thereto due to the in and out motion between the maximum and minimum width positions as illustrated in FIG. 4.

When the belt 52 is used it may be convenient to bond a flexible retaining strip 50 (shown in FIG. 3) to the inside surface at the top edge. The strip 50 rides on the beveled end surface of the rollers 51 and is thus prevented from running off. The bottom edge of the belt 52 does not extend as far as the guide plate 47

which is thereby exposed and can be contacted by the skid to elevate the jogger mechanisms at the start of a new pile.

The belt 52 may be any suitable fabric or impregnated cloth such as Nylon which has limited stretch and good wear resistance. A belt made of Page-Tex No. 101B material manufactured by Page Belting Company of Concord, New Hampshire has proved satisfactory.

The jogger mechanisms are operated at the same speed by energizing all of the drive motors 37 to drive the sprockets 34 through gear reductions 36. The speed may be selected by a variable speed control (not shown) for the motor 37 preferably operated to make the linear speed of the belts 52 approximately equal to or greater than the linear speed of arriving sheets. A slightly higher speed for the belts 52 is preferable where light weight sheets are being processed. The motor control may be coordinated with machine operation, if desired, to start and stop with machine delivery of sheets and the speed may be varied as the delivery speed varies. Either manual or automatic speed control for the motors 37 may be used.

The invention may be practiced otherwise than by utilizing the specific mechanisms herein disclosed. It will be perceived that other surface contact members than the endless belt 52 may be used. Also belt 52 may be omitted altogether and the surfaces of rollers 51 used to contact the edges of the flexible sheets. Furthermore, the jogger mechanisms can be used advantageously with a layboy to receive sheets delivered by hand in a hand sorting or repiling operation. Accordingly, the invention is not limited to the details of the disclosure but such embodiments as are within the scope of the appended claims are to be considered as within the range of equivalents of the invention.

What is claimed is:

1. The method of forming an even edged pile of flexible sheets delivered in a generally horizontal direction to the top surface of said pile comprising the steps of: confining the opposite lateral edges of sheets delivered to said pile by contact with active surface area constraints spaced nominally the width of said sheets; and

moving said active surface area constraints continuously in the direction of travel of the delivered sheets while providing incremental oscillatory variation of the spacing between said surface area constraints on said opposite lateral edges by reciprocating said active surface areas substantially normal to said direction of travel to make said contact with said lateral edges along extended portions thereof during each reciprocation.

2. In a layboy for receiving and piling flexible sheets including a platform for supporting the pile of sheets, and jogger means positioned for aligning received sheets into an even edged pile, the improvement comprising:

a set of jogger mechanisms supported at the top of said pile on opposite sides of said layboy and spaced to contact the edges of sheets delivered to said layboy between opposed mechanisms, each of said mechanisms having

a pair of parallel substantially vertically disposed shafts spaced along the direction of travel of said sheets;

a pair of sprocket gears mounted in spaced relation on each of said shafts, each of said gears being

mounted for rotation in alignment with a corresponding gear on the other of said shafts; a pair of endless drive chains engaging the aligned gears on said shafts;

a set of members extending between said drive chains and movable therewith;

means for driving said sprockets to move said members along the peripheral path of said drive chains with a transverse oscillatory motion component produced by the pitch of said sprocket gears, the motion of said members in contact with the edges of said sheets being in the direction of travel of said sheets delivered to said layboy.

3. Apparatus according to claim 2 in which said members comprise rollers rotatable on support bearings between said drive chains.

4. Apparatus according to claim 3 and including an endless belt supported on and movable with said rollers.

5. Apparatus according to claim 2 in which said set of mechanisms comprises two pairs of mechanisms opposed on opposite edges of said pile, one pair of said mechanisms having said peripheral path extend to a position adjacent the point of delivery of said sheets to said layboy.

6. Apparatus according to claim 2 including means for supporting said jogger mechanisms for sliding vertical movement and means contacting said platform for elevating said mechanisms at the elevated position of said platform.

7. A jogger mechanism comprising: a base adapted to be supported horizontally;

a pair of spaced vertical shafts supported on said base;

a pair of spaced sprocket gears mounted on each of said shafts, each of said gears being mounted for rotation in alignment with a corresponding gear on the other of said shafts;

a pair of endless drive chains engaging the aligned gears on said shafts;

a set of members extending between said drive chains and movable therewith;

means for driving said sprockets to move said members along the peripheral path of said drive chains with a transverse oscillatory motion component produced by the pitch of said sprocket gears; and means for tensioning said drive chains between said gears to make the peripheral portion of said drive chains extending between said sprocket gears move as a unit with said oscillatory motion component.

8. Apparatus according to claim 7 in which said members comprise rollers rotatable on support bearings extending between said drive chains.

9. Apparatus according to claim 8 and including an endless tensioned belt supported on and movable with said rollers.

10. Apparatus according to claim 9 in which said belt has an internal flexible strip attached continuously along the top edge of said belt.

11. Apparatus according to claim 7 in which said means for tensioning comprises a base having separate bearing blocks rotatably supporting said shafts and means slidably connecting said blocks with spring loading to urge them apart for maintaining tension on said drive chains.

12. Apparatus according to claim 11 wherein said base comprises a substantially horizontal plate, means for securing one of said bearing blocks to depend from

said support plate, a pair of spaced parallel rods extending upwardly from said support plate; and a mounting bracket for said jogger mechanism, said bracket having guide members for slidably receiving said guide rods to permit relative vertical motion between said mechanism and said bracket. 5

13. Apparatus according to claim 12 and including mounted on said support plate a drive motor and a drive coupling between said motor and one of said shafts. 10

14. Apparatus according to claim 7 in which the pitch of said drive chains is a multiple greater than the tooth pitch of said sprocket gears to amplify said transverse oscillatory motion component. 15

15. A jogger mechanism according to claim 7 in which the spacing between said parallel shafts is equal to the length of an integral number of chain pitch units. 20

16. A jogger mechanism comprising:
a base adapted to be supported horizontally;
spaced vertical shaft means supported on said base;
sprocket gear means on said shaft means;
endless drive chain means engaged with said sprocket gear means; 25

jogger surface means supported on said drive means;
means for driving said sprocket gear means to move said jogger surface means along the peripheral path of said drive chain means with a transverse oscillatory motion component; and 30

means for tensioning said drive chain means between said sprocket gear means to make the peripheral portion of said drive chain means extending between said sprocket gear means move as a unit with said oscillatory motion component. 35

17. A flexible sheet piling system comprising:
a layboy having a horizontal support surface for said sheets and elevator means for vertically moving said support surface;
means for transporting and successively delivering said sheets in a generally horizontal direction into said layboy; 40

jogger means driven for applying aligning forces to opposite edges of said sheets transverse to the direction of travel as said sheets are delivered to said layboy, said jogger means comprising for each of said opposite edges a chain-sprocket mechanism, an endless belt supported on the periphery of said chain-sprocket mechanism, the outer surfaces of said belt providing active surfaces for contacting said sheets, said active surfaces extending above and below the top surface of a pile of sheets in said layboy, said mechanism continuously oscillating the position of said active surfaces of said belt transverse to said periphery and moving said belt continuously in the peripheral direction with one of said active surfaces of said belt moving in the direction of travel of said sheets; and 45

means for mounting said jogger means for sliding vertical movement and operative to raise said active surfaces to extend above said support surface when said elevator means is raised to start a new pile of said sheets on said support. 50

18. Apparatus according to claim 17 and including rollers supported on said chain-sprocket mechanism and a belt tensioned on said rollers to move with said chain-sprocket mechanism. 55

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