May 21, 1963 F. B. CURTENIUS 3,090,503

PAPER SHEET STACKER

Filed Nov. 10, 1960 2 Sheets-Sheet 1

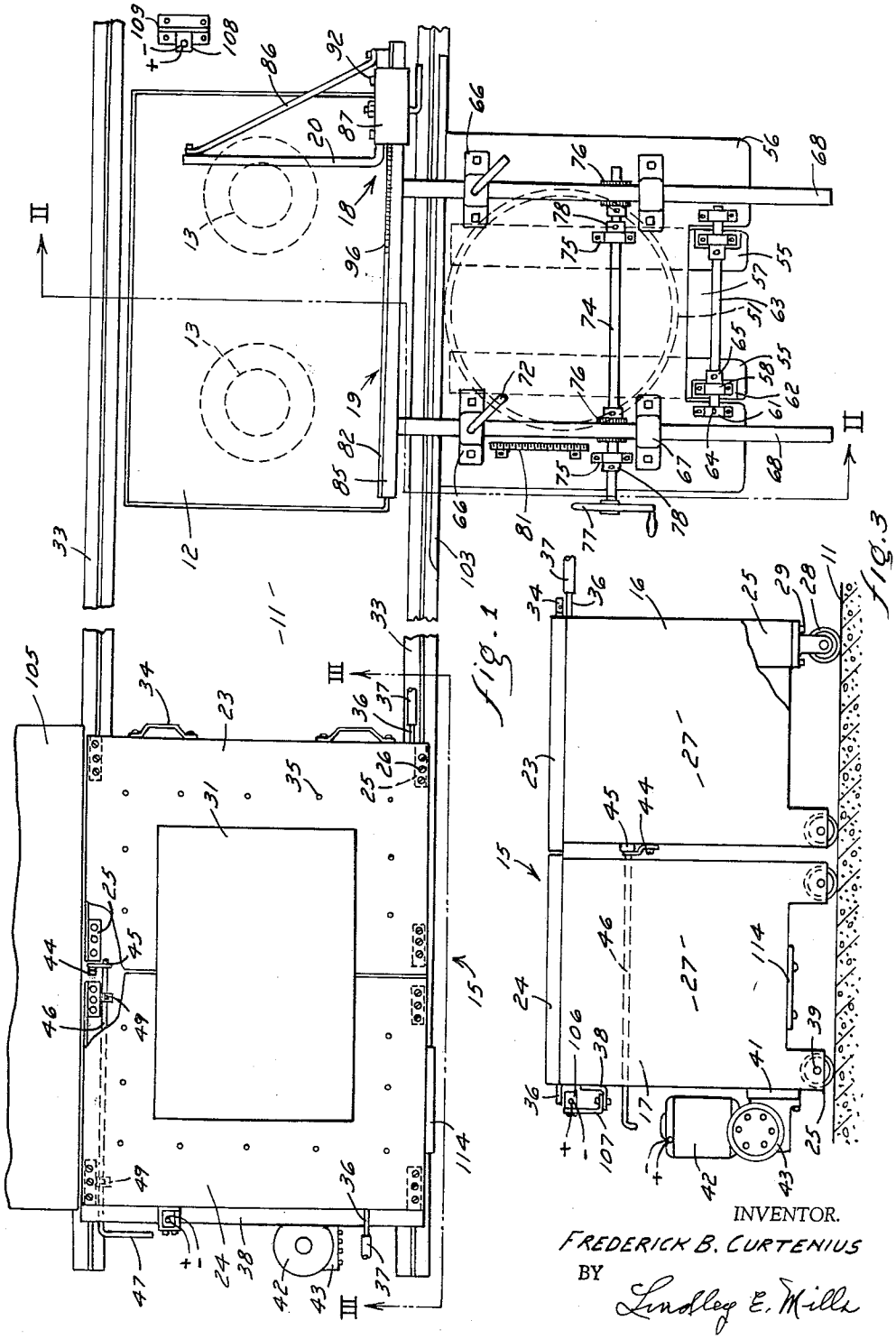

FIG. 1

FIG. 3

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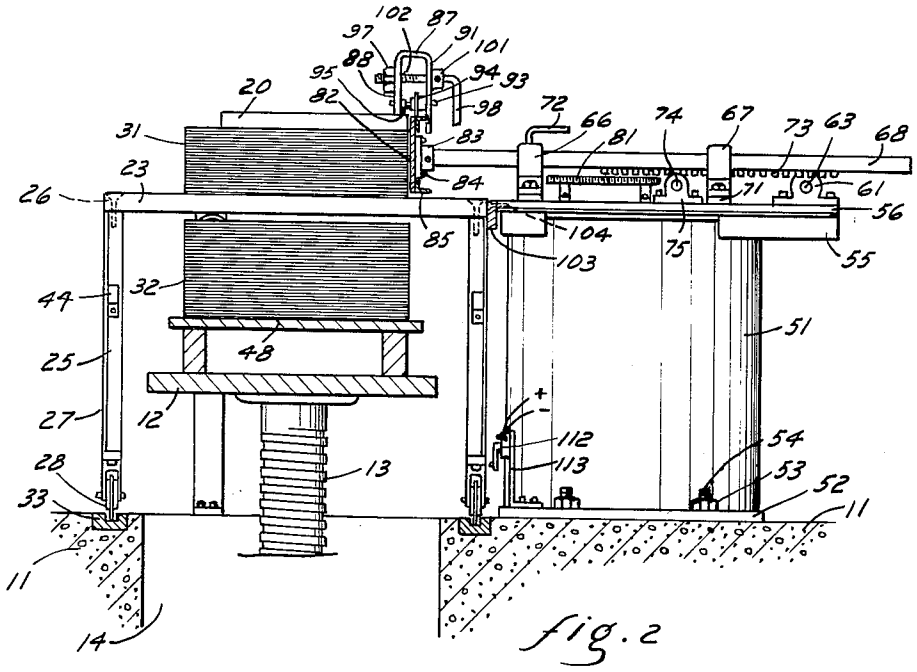

fig. 2

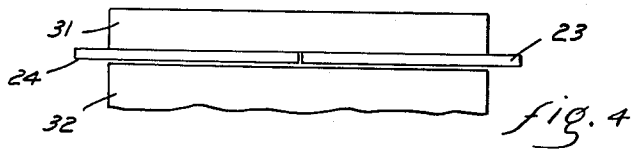

fig. 4

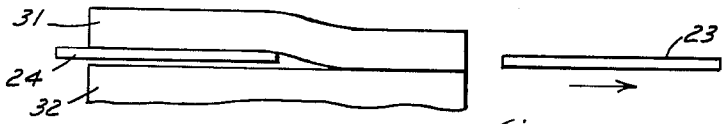

fig. 5

fig. 6

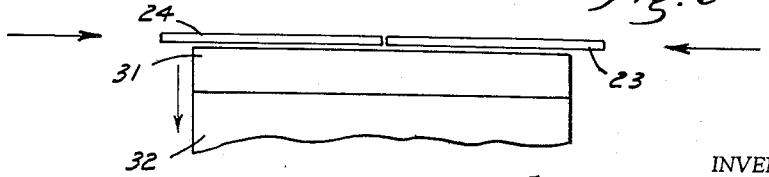

fig. 7

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3,090,503
PAPER SHEET STACKER

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This invention relates to apparatus and a method for stacking sheets of paper, particularly to apparatus and a method for stacking trimmed paper sheets in a manner to insure the sides of the stack being smooth, even and perpendicular to the surfaces of the sheets.

In the paper industry it is customary to handle paper intended for certain purposes in the form of stacks of flat sheets. Generally, these stacks are formed by first trimming roughly dimensioned sheets to exact dimensions and then stacking the exactly trimmed sheets on top of one another. The stack thus formed may be transferred to another part of the mill for use or it may be crated and shipped to paper converters or other users of such sheets. The usual trimming and stacking operation involves first assembling a number of roughly dimensioned sheets in piles several inches thick and then trimming all the sheets in the pile at one time on a trimming table with a large trimming knife or guillotine cutter. The piles of trimmed sheets are then stacked on top of one another until a stack of desired thickness, often several feet, is produced. Such stacks may weigh from a few to several hundred pounds, or more.

One serious problem encountered in the stacking of piles of trimmed paper sheets on one another as often carried out is the difficulty of placing one pile accurately on top of another pile to build up a stack the sides of which are smooth, even and perpendicular to the surfaces of the sheets. If the stack is formed with uneven sides, or if it "leans," considerable difficulty may be experienced in handling the stack without injuring the edges of the sheets which protrude from the stack. Since, in many instances, the sheets are trimmed before stacking to the precise dimensions required for subsequent use, it is imperative that any damage to the edges of any of the sheets be avoided. Any such damaged sheets, even though the damage to the edges may be very small, must often be discarded or retrimmed to smaller dimensions for some other use with the consequent waste and interference with production.

One method of stacking piles of trimmed paper sheets which has been employed with considerable success involves the use of a specially designed table, often referred to as a "piler table," which is formed with its top in two sections abutting one another and arranged so that the sections can either be set firmly together in abutting relationship or released and each section drawn away from its set position. The top sections are each provided with a number of small holes extending through the sections through which compressed air can be forced from suitable conduits to provide an air cushion between the surface of the section and a pile of paper sheets thereon to facilitate sliding of the pile on the table surface, this being conventional practice in the handling of piles or stacks of paper sheets on tables.

The piler table is also equipped with a suitable pile guide means having members located closely adjacent to the top surface of the table which have guide surfaces extending perpendicularly upward with respect to the table surface. The guide members are secured to the supporting framework of the table rather than to the movable table top sections themselves. A pile of trimmed paper sheets supported on the piler table can be slid into contact with the guide members and thus be positioned accurately on the table with respect to the guides. In the

case of piles of rectangular sheets, for example, suitable guides comprise a pair of members extending at right angles with respect to one another, thus forming a square corner between them into which a square corner of a pile of paper sheets can be slid to position it.

In stacking piles of paper sheets using a piler table, the table is first moved to a position adjacent to the trimming table. With the sections of the piler table set in abutting relationship, a pile of trimmed sheets is slid onto it and positioned accurately by means of the guides, the abutting table sections being shifted, if necessary, so that approximately equal parts of the pile lie on each of the sections of the table. The piler table, including its supporting framework and attached guide members and carrying the accurately positioned pile of sheets, is then moved to an accurately defined position with the table itself directly above a suitable skid located at a predetermined position, e.g. on the floor. The piler table, along with the pile-guiding members and associated supporting framework, with the accurately positioned pile of paper sheets supported on the table, is then lowered as a unit, being careful to maintain the horizontal character of the top table surface, until the under side of the table top is closely adjacent to, e.g. within approximately one-half inch, of the skid on the floor, or of the top-most sheet of a partially formed stack of sheets on the skid.

Compressed air is then forced through the holes in one section of the table top and this section is released from the other section and moved laterally away from it on suitably provided slideways to allow the part of the pile of sheets supported on it to drop onto the surface of the skid, or onto the surface of the topmost sheet of a partially formed stack on the skid, as the case may be. Compressed air is then forced through the holes in the other section of the piler table and this section is then drawn from beneath the stack of sheets supported on it. The piler table unit is then raised to its original position above the newly deposited pile of sheets, the top sections are moved and set into abutting relationship again and the table with its supporting framework and positioned guides is moved back to the trimming table to receive another pile of trimmed sheets. In this way essentially any number of piles of sheets trimmed to the same size may be stacked on the skid to form a stack with smooth, even sides which are perpendicular to the surfaces of the sheets. In the case of high stacks it is often necessary to elevate the table, and associated elements, with a pile of paper sheets on it, before it is moved to a position over the partially formed stack.

Although the foregoing method leads to the formation of stacks of paper sheets the sides of which formed by the edges of the individual sheets are smooth and even and extend perpendicularly with respect to the surfaces of the sheets, the apparatus heretofore employed is large, cumbersome and costly. This arises principally from the fact that the entire apparatus which supports the piler table and the pile-guiding members must travel as a unit from its position adjacent to a trimming table where it receives a pile of trimmed paper sheets to another position where the entire apparatus is positioned accurately with respect to the stacking skid. Since the accuracy with which one pile of sheets is deposited on top of the preceding pile is critical, it is essential that the positioning of the entire unit consisting of the piler table, the pile guide members and the entire framework supporting them be highly accurate and with no more variance from one time to the next than is permissible in the variation of the edges of the separate sheets from the vertical plane of the side of the stack. Furthermore, this accuracy of positioning of the unit must be maintained during lowering or raising of the unit. Not only does this require accurate construction and control of the entire unit but the members of the unit themselves

must be sufficiently heavy and rigid to insure a minimum of straining of the supporting and positioning elements even when supporting and transporting a heavy pile of sheets which may weigh up to several hundred pounds. The practical necessity of controlling the several steps of the stacking process automatically with apparatus heretofore available further complicates the matter since the controls must be capable of controlling such heavy apparatus rapidly and with a high degree of precision. The cost of the control mechanism alone for such heavy apparatus is not inconsiderable. It is apparent that any simplification of the foregoing process or of the apparatus heretofore used in carrying it out which could be devised which would permit the employment of less cumbersome and less costly apparatus, without at the same time sacrificing the accuracy with which the stack is built up, would be of great value.

According to the present invention, the foregoing and other difficulties involved in the stacking of piles of paper sheets on one another according to the general procedure described in the foregoing paragraphs are largely overcome without sacrifice of the accuracy of the stacking operation by employing the simplified apparatus which will be described herein. The apparatus with which this invention is concerned differs in several major and significant respects from the apparatus heretofore employed. One significant difference is in the employment of a pile guide which, although adjustable in suitable manner, is mounted on a fixed support and does not travel during normal operation of the apparatus either laterally, except for adjustment, or upwardly or downwardly, regardless of the travel of the piler table.

A further major difference involves the use of a piler table of unique design which will be described hereinafter, but one particular feature of which resides in its top surface being at all times at the same level. This level is related to the level of the trimming table in such a way, usually slightly lower than the level of the trimming table, that a pile of paper sheets can be slid easily from the trimming table onto the piler table. The fixed height of the pile guide members is such that the top surface of the piler table can pass beneath, but closely adjacent to, their lower edges.

A further significant difference in the apparatus with which this apparatus is concerned is the provision of a precision hoist located immediately below the pile guide members so that it can be raised or lowered with essentially no possibility of its twisting, moving laterally or tilting during the stacking of successive piles of paper sheets thereon, or on a suitable skid located on the stacking table. Generally the support for the pile guide is mounted on a rigid floor and the precision hoist is located in a well extending below the surface of the floor so that when not in use the surface of the hoist can be kept level with the floor and so that it can be raised or lowered from this position to a desired degree during the stacking operation.

The piler table itself, because of the foregoing relationships, need travel only between the position where it receives a pile of paper sheets herein for convenience referred to as a "first" position, to a position, herein for convenience referred to as a "second" position, where a pile of paper sheets supported on its upper surface is in the immediate vicinity of the adjusted pile guide members, there being no necessity to position the table with any great degree of accuracy in either position. Since the travel of the piler table is merely a linear travel back and forth between its first and second positions and no raising or lowering of the piler table is involved, it is sufficient to merely equip the table with wheels adapted to engage a track in the floor without further provision for controlling the accuracy of its travel.

The piler table is formed with a flat, plate-like top which is usually one-half inch or less in thickness but which is sufficiently rigid to support a pile of trimmed paper sheets on it without appreciable deflection of its top planar surface. The piler table is also formed so that it will straddle a partially formed stack of piles of paper sheets on the precision hoist when the top of the stack is located immediately below the lower surface of the table top. The two top sections of the piler table may be either locked together or unlocked and separated from one another to allow first one part of a pile of sheets on the table to be deposited on a partially formed stack of sheets located immediately below the table top and to then allow the rest of the pile to be deposited on the stack. In a preferred embodiment, the entire piler table is formed as two separate tables or sections which may be locked together with their tops in abutting relationship or unlocked and each section rolled on the track to relocate their respective tops.

Certain advantages of the apparatus of the invention, as well as of the method carried out using the apparatus will be apparent from the accompanying drawing and following description thereof illustrating one modification of the apparatus wherein, in the interest of clarity, certain features are shown on a somewhat exaggerated scale and wherein:

FIGURE 1 is a plan view, with certain of the parts partially cut away, of apparatus embodying certain features of the invention and showing a pile of trimmed paper sheets supported on a piler table;

FIGURE 2 is a vertical elevation taken along the line II—II of FIGURE 1, with certain of the parts of FIGURE 1 rearranged;

FIGURE 3 is a vertical elevation taken along the line III—III of FIGURE 1, but with the pile of trimmed paper sheets of FIGURE 1 omitted; and

FIGURES 4, 5, 6 and 7 are schematic views illustrating the principle involved in certain steps in the operation of the apparatus of FIGURE 1.

Before describing the apparatus in detail, reference will be made to schematic FIGURES 4, 5, 6 and 7 to give a general idea of the method as carried out by the apparatus. In FIGURE 4 two abutting top sections of a piler table are represented at **23** and **24**. A pile of trimmed paper sheets **31** is represented as being supported partially on the section **23** and partially on the section **24**. A partially formed stack of paper sheets, represented at **32**, is located below the sections **23** and **24** with the top sheet closely adjacent to the lower surfaces of the sections, it being understood that the pile of sheets **31** has previously been positioned accurately on the table top sections in the same location as the pile last deposited on the stack being built up.

Following the positioning of the foregoing elements and parts in the way described, the top section **23** of the piler table is drawn horizontally away from the other section **24** and from below the corresponding part of the pile of sheets **31**. This part of the operation is facilitated, and lateral movement of the pile **31** is prevented, by creating an air cushion between the pile **31** and the section **23** in the way indicated previously to be conventional in facilitating sliding of piles of paper sheets on tables. Because no air cushion is formed between the table top section **24** and the part of the pile of sheets **31** supported on it during the withdrawal of the section **23**, the friction between them enables the section **23** of the table top to be withdrawn free of the pile of sheets without causing any horizontal movement of the part of the pile supported on the table top section **24**. As a result of withdrawing the section **23** from beneath the pile of sheets **31**, the part of the pile originally supported on it is deposited smoothly on, and in accurate edge alignment with, the partially formed stack of sheets **32** below it. The relationships of the pile of sheets, the partially formed stack of sheets and the two sections of the table top upon completion of this part of the operation are clear from FIGURE 5.

The other section **24** of the table top is then withdrawn in similar manner from beneath the part of the

pile of sheets 31 supported on it, the air cushion decreasing the friction between the section 24 and the pile to a value less than the friction between the stack and the part of the pile already deposited thereon, thus avoiding any horizontal movement of the pile of sheets during this part of the operation and insuring completion of the deposition of the pile accurately on the partial stack. The relationships of the parts and elements at this stage are illustrated in FIGURE 6.

The partially formed stack of sheets is then lowered, as illustrated in FIGURE 7, sufficiently to allow the table top sections 23 and 24 to be reassembled in their abutting relationship, after which the cycle is completed by placing another pile of trimmed sheets on the table top and positioning it accurately as in FIGURE 4, all as will be described.

Referring now to FIGURES 1, 2 and 3 of the drawing, there is represented, generally, at 11 a floor or other solid structure upon which the apparatus of the invention is mounted in the way which will be described. The apparatus, generally, comprises a stacking table 12 which, as shown more clearly in FIGURE 2, is the platform of a precision hoist, a piler table shown, generally, at 15 of FIGURES 2 and 3, comprising two sections 16 and 17, and a pile-guiding means, shown, generally, at 18 of FIGURES 1 and 2, comprising guide members 19 and 20, together with associated operating, controlling and adjusting mechanisms.

The stacking table 12 is adapted to be raised for a suitable distance above the floor level and, if desired, to be lowered for a suitable distance below the floor level and to be stopped at any predetermined or desired level between the extremes of its vertical travel. In one preferred modification the stacking table 12 is mounted on a pair of interlocked screw jacks 13 operated by a single motor drive. The stacking table 12 can thus be moved upwardly or downwardly at will with its upper surface remaining horizontal and essentially free of any twisting, tilting or other motion having a lateral or horizontal component. Any other suitable means for raising and lowering the stacking table can be employed, if desired, provided the surface of the table is maintained essentially horizontal and essentially free of any lateral movement. A suitable skid 48 is usually placed on the stacking table 12 and a stack of paper sheets built up on the skid rather than directly on the table itself to facilitate subsequent handling of the stack, e.g. with a fork truck.

Referring more specifically to the piler table 15, it will be noted from FIGURES 1 and 3 that, in the preferred modification described, the table comprises the two sections 16 and 17, each fitted with a flat, heavy metal top 23 and 24, respectively, the upper surfaces of the tops being coplanar and adapted to abut one another, as shown clearly in FIGURE 3, thus together forming sections of the top of the piler table 15. For purposes of convenience, the top section 23 is sometimes herein referred to as the "forward" section of the top of the piler table 15 and the section 24 is sometimes referred to as the "rearward" section of the top of the piler table 15. In similar manner, the table sections 16 and 17 are sometimes referred to as the "forward" and "rearward" sections, respectively, of the table 15.

The table section 16 is constructed with the flat top section 23 and with vertical side members so as to be as rigid as possible without the use of cross-bracing which would interfere with the table straddling a partially formed stack of paper sheets on the stacking table 12, as shown more particularly in FIGURE 2. One suitable way of constructing the forward section 16 of the piler table is to provide a heavy, wide, but suitably thin, vertical leg 25 at each corner of the table, to the top ends of which the flat top table section 23 is secured, as by flush screws or bolts 26. A rigid side panel 27 is secured in suitable fashion to the outer surfaces

of the pair of legs 25 on each side of the table section 16. In this way an adequately rigid forward table section 16 is obtained.

To facilitate movement of the forward section 16 of the piler table 15 between its first and second positions in the manner which will be apparent as the description proceeds, a suitable wheel 28 is mounted in conventional fashion, as by bolts 29, on the bottom end of each of the table legs 25. The wheels 28 are adapted to roll on tracks 33 laid in the floor 11, as illustrated especially in FIGURE 1. To provide for more accurate control of the travel of the table section 16, it is sometimes advisable to provide a grooved track 33 and centrally flanged wheels 28 which fit the track groove closely to avoid as much as possible any sidewise movement of the wheels as they travel on the track.

The forward edge of the table top 23 is conveniently provided with a pair of conventional draw pulls 34, the purpose for which will be apparent later on. The table top 23 is also provided with a suitable number of small holes 35 extending vertically through it through which compressed air from a suitable conduit system, not shown, secured to the under side of the top can be blown in conventional fashion to create an air cushion between the table top and a pile of paper sheets, illustrated at 31 of FIGURE 1, supported thereon. Compressed air can be admitted to the conduit supplying air to the holes 35 by way of an extension 36 of the conduit projecting forwardly of the table section and located immediately adjacent to one of the legs 25. A reeled rubber hose 37 can be connected to the extension 36 in an entirely conventional manner to allow the table section 16 to travel on the track 33 without interference from the air hose. In a preferred modification the rubber air hose is tensioned by a conventional reel, so that it extends forwardly of the table section immediately above the track 33 to clear the rest of the apparatus, the reel being located forwardly of the extreme forward end of the forward table section 16 at the limit of its forward travel.

The rearward section 17 of the piler table 15 is constructed in a manner entirely analogous with the forward section 16. In this instance it is possible, since the rearward end of the section 17 is at no time required to straddle the stacking table 12, to provide cross-bracing members, such as a cross-bracing angle 38 and a cross-bracing plate 41 which can be secured, e.g. by welding or by bolting, to the rearward edges of the rearward pair of legs of the table section 17.

It is entirely satisfactory to cause the piler table 15 to travel along the rails 33 manually, if desired, but it is also convenient to provide motor driven means for the rearward table section 17. As shown somewhat schematically in FIGURES 1 and 3, electric drive of the piler table can be provided for by mounting a suitable motor 42 and gear reduction means 43 on the rearward surface of the bracing plate 41. The two rearward wheels 25 of the rearward table section 17 are secured on a common axle 39 extending the width of the table section so as to turn with the axle and a suitable driving means, e.g. a roller chain or other suitable means, not shown, is provided to transmit power from the output of the reducing gear 43 to the axle. The motor 42 is preferably reversible so that it can propel the piler table 15 in either direction along the track 33. In the case of the rearward table section 17, the reel, not shown, for the air hose 37 can be situated in a suitable overhead location, since there is no likelihood of its becoming fouled with other parts of the apparatus during normal operation of the apparatus.

Provision is made for locking the sections 16 and 17 of the piler table together with the respective table top sections 23 and 24 in closely abutting relationship. It is also essential to provide for unlocking the table sections 16 and 17 from one another and for the travel of each along the track 33 independently of one another. According to one modification, this is effected easily and satisfac-

torily by a modified shutterbar and swinging pawl arrangement, as illustrated in FIGURES 1 and 3. In this arrangement the shutterbar 44 is secured to the rearward edge of a rearward leg of the forward table section 16 so that it is spaced therefrom at the top and the pawl 45 is mounted on, and to swing with the rotation of, a pawl rod 46 mounted rotatably, as by bearings 49, on the inner sides of the legs of the rearward section 17 of the table, the pawl rod 46 thus extending longitudinally of the rearward section 17 and the pawl 45 being located so that, with the table top sections 23 and 24 in abutting relationship, rotation of the pawl rod 46 in the proper direction causes the pawl to engage the shutterbar and lock the table sections firmly together. Rotation of the pawl rod in the opposite direction causes the pawl 45 to disengage the shutterbar 44 and unlock the sections from one another. Rotation of the pawl rod 46 is provided for conveniently by prolonging it rearwardly past the rearward edge of the table top 24 and the cross-bracing member 38 and providing a bent transversely extending handle section 47 of its rearward end which can be operated manually to rotate the rod 46. A suitable ratchet arrangement, not shown, can be provided if desirable or necessary to prevent inadvertent rotation of the pawl rod 46.

In the event it is desired to lock the table sections 16 and 17 together at both sides, an identical shutterbar and pawl arrangement can be installed on the opposite side of the table and operated in the same manner. If desired, the two pawl rods can be operated from the one handle 47, e.g. by means of a suitable chain connecting them near their rearward ends, the chain being crossed to provide for the rotation of the two pawl rods in opposite directions upon operation of the handle 47.

The arrangement of, and adjusting mechanism for, the pile guide is illustrated in FIGURES 1 and 2, the pile guide being shown, generally, at 18 of FIGURE 1 and the forward section 16 of the piler table 15 being shown located in its second position in FIGURE 2. According to the modification shown, a solid support or base 51 is provided, upon which the pile guide and adjusting apparatus is mounted. The pile guide support can be formed in any suitable way although a convenient form, as shown especially in FIGURE 2, comprises a section of circular metal pipe of suitable wall thickness, length and diameter to provide a rigid support. The section of pipe 51 is cut at one end accurately in a plane transverse to the longitudinal diameter of the pipe and this end is then welded to a flat base plate 52 of suitable dimensions, the base plate being secured rigidly to the floor 11 closely adjacent to the track 33 by nuts 53 engaging heavy base bolts 54 anchored in the floor. The upper end of the pile guide support 51 is slotted transversely in a direction perpendicular to the direction of the track 33 to accommodate a pair of plate support bars 55 which are conveniently positioned in the slots and welded to the support 51 with their upper surfaces level and coplanar.

A pile guide support plate 56 of suitable dimensions, and having its edge facing the track 33, herein referred to as its "front" edge, parallel with the track, is positioned to lie flat on the supporting bars 55. The plate 56 has a central section along its rear edge cut away to expose the rear ends of the plate support bars 55. A swivel shaft bearing 58 is mounted on the rearward end of each of the plate support bars 55 and aligned with a shaft locking support 61 located on the support plate 56 adjacent to the end of the cut-away section 57. A spacer block 62 of suitable thickness is conveniently located beneath each of the swivel shaft bearings 58 to align it properly with the adjacent shaft locking support 61. A swivel shaft 63 is inserted through the two shaft bearings 58 and the two shaft locking supports 61 and locked against rotation or longitudinal movement in the latter, as by set screws 64. Longitudinal movement of the swivel shaft 63 in the shaft bearings 58 is prevented by a pair of collars 65 secured on the shaft closely adjacent to the respective bearings 58. The support plate 56 is thus adapted to swivel around the horizontal longitudinal axis of the swivel shaft 63 with its front edge rising approximately vertically from the plate supporting bars 55 when occasion demands, the advantage of which will be explained later.

A pair of solid bearings comprising a front bearing 66 and a rear bearing 67 is positioned adjacent to each side of the support plate 56, each pair being aligned and adapted to support slidably therein, for longitudinal movement through the pair, a pile guide adjusting rod 68 of suitable length and diameter. The bearings 66 and 67 are conveniently mounted on spacer blocks 71 located between the bearings and the plate 56 to insure the rods 68 being at the proper height. The front solid bearings 66 are each equipped with means, such as a threaded set screw attached to a handle 72 running in a threaded hole in the top of the bearing, to lock the corresponding adjusting shaft 68 against longitudinal movement following its accurate adjustment longitudinally in the bearings.

The adjusting rods 68 are each provided with a suitable rack 73 secured to its underside, the bearing 67 and, if desired, the bearing 66, being grooved correspondingly to accommodate the rack during longitudinal sliding movement of the rod through the bearings. A pinion shaft 74 is mounted rotatably in pinion shaft bearings 75 which are in turn mounted on the support plate 56, the shaft 74 extending below and transversely of the longitudinal axis of, the adjusting rods 68. Pinion gears 76 locked to the pinion shaft 74 engage the racks 73 on the adjusting rods 68. Suitable collars 78 locked on the shaft 74 adjacent to the bearings 75 prevent longitudinal movement of the pinion shaft in the bearings. Rotation of the pinion shaft 74, e.g. by means of a hand wheel 77 secured to an end of the shaft, causes the adjusting rods 68 to move in the same direction and for the same distances. A scale 81 of any suitable sort is mounted on the support plate 56 closely adjacent to one of the adjusting rods 68 by means of which adjustment of the rods lengthwise to any predetermined position can be effected accurately. It is convenient to judge the longitudinal position of the adjusting rod nearest the scale 81 by the position of a particular tooth of the rack 73 with respect to the scale 81. Alternatively, the shaft 68 adjacent to the scale 81 can be equipped with a pointer, not shown, clamped to it and adapted to travel along the scale. Adjustment of the adjusting rods to a predetermined position is effected by first turning the handles 72 to loosen the rods in the front bearings 66 and then rotating the hand wheel 77 in the desired direction until the shafts 68 have slid longitudinally to their desired positions. Rotation of the handles 72 in the opposite direction locks the rods 68 firmly in their adjusted positions.

The pile guide means 18 referred to previously is secured to the forward ends of the adjusting rods 68 in a manner such that, as the rods are caused to slide in their bearings in the way which has just been described, the pile guide means is caused to move horizontally in a direction perpendicular with respect to the direction of the track 33. In the modification shown the pile guide means comprises a pair of guide members, one member, herein sometimes referred to as the "first" guide member, being shown, generally, at 19 and the other guide member, herein sometimes referred to as the "second" guide member, being shown at 20. The guide members extend perpendicularly with respect to one another, thus furnishing a square corner between them into which a square corner of a pile of paper sheets supported on a piler table immediately beneath the guide members can be slid to position the pile accurately on the table with respect to the stacking table located below the piler table.

The guide member 19 comprises in this instance a flat guide plate 82 secured, as by a flanged collar 83 and suit-

able stud bolts 84, as shown particularly in FIGURE 2, to the forward ends of the adjusting rods 68 with its surface opposite the flanged collars being planar and extending in a precisely vertical plane parallel with the direction of the track 33. Stiffening angles 85 are secured along the upper and lower edges of the guide plate 82 to maintain its front surface accurately in a single vertical plane. Alternatively, a heavier guide plate 82 or a precisely formed channel member can be employed with equal facility and the stiffening angles 85 omitted.

The other guide member 20 is, in the present instance, formed from a suitable plate which is bent at right angles to provide one leg which bears slidably on the vertical surface of the guide plate 82, and another leg which extends at an angle of precisely 90° away from the surface of the guide plate 82 and with its face lying in a precisely vertical plane. A suitable brace 86 is preferably employed which extends from the end of one of the legs of the member 20 to the end of the other leg and is secured thereto with suitable stud bolts whereby stiffening of the angularly contoured member 20 is effected. Adjustment of the guide member 20 is effected by sliding it along the face of the guide plate 82 and locking it in desired position, as will be described.

To provide for adjustment and locking of the guide member 20 in a predetermined position with respect to the guide plate 82, a U-shaped yoke 87 is provided which may be formed by bending a plate of suitable width and thicknesses to bring the arms of the yoke 88 and 91 into parallel relationship with one another. The arms of the yoke are spaced from one another for a distance essentially the same as the combined thickness of the sliding leg of the guide member 20 and the total thickness of the guide member 19. The yoke is formed with one leg 88 long enough to extend from approximately the lower edge of the sliding leg of the member 20, to which it is secured by suitable screws or stud bolts 92, to a location sufficiently far above the upper edges of the guide members 19 and 20. The other arm 91 of the yoke is sufficiently long to extend below the upper edge of the guide member 20, but insufficiently long to extend downward to strike the adjusting rods 68 when the yoke and supported guide member 20 are slid along the guide member 19. In the present instance the arm 91 of the yoke projects below the protruding edge of the upper reinforcing angle member 85 and is grooved to receive the edge of the angle slidably as the yoke is slid along the member 20.

A yoke-supporting shaft 93 extends transversely of the yoke arms 88 and 91 and is mounted rotatably in registering holes in the two arms. A suitable roller 94 is locked to the shaft 93 and adapted to roll along the upper surface of the guide member 19, thus supporting the yoke and the attached guide member 20 during their travel along the guide member 19. Undue endwise movement of the shaft 93 in one direction is prevented by the roller 94 which bears on the arm 91 of the yoke and by a collar 95 which is also locked to the shaft 93 so as to bear against the opposite arm of the yoke.

A scale 96 is provided on the top of the guide member 19 by means of which the position of the guide member 20 can be adjusted accurately as desired. Following adjustment of the guide member 20, it is locked in position by compressing the arms of the yoke together far enough to cause them to grip the slidable leg of the member 20 and the member 19 between them sufficiently to prevent sliding movement of the member 20 with respect to the member 19. Although this can be accomplished in any convenient way, one way illustrated in FIGURE 2 includes the provision of a locking shaft 102 mounted for rotation in registering holes in the yoke arms 88 and 91. One end of the shaft 102 is threaded and engages a nut 97 secured permanently, as by welding, on the outer face of one arm of the yoke. A suitable collar 101 is locked to the shaft 102 so as to bear against the outer surface of the other arm of the yoke opposite the nut 97. The end of the shaft 102 projecting beyond the collar 101 is bent at approximately right angles to form a handle 98. Rotation of the shaft 102 by means of the handle 98 in one direction causes the arms 88 and 91 of the yoke to grip the members 19 and 20 tightly enough between them to lock the members in place with respect to one another and rotation of the shaft 102 in the opposite direction unlocks the members 19 and 20 with respect to one another to provide for sliding adjustment of the member 20 along the member 19.

It will thus be observed that, with the guide members 19 and 20 adjusted in the ways described, a pile of trimmed paper sheets located on the piler table in its second position immediately below the guide members can be slid along the surface of the table and guided by the two guide members into a predetermined precise location without the necessity of positioning the piler table accurately, either with respect to the guide members themselves or with respect to a stacking table located beneath the piler table.

Because the piler table is constructed as previously described and because it travels on a track, it is not convenient to provide for its being absolutely rigid at any point in its travel or at either location at the ends of its travel. In particular, the sliding of a pile of paper sheets along its surface in a direction transverse to the direction of travel of the table may cause the table to lean or move slightly in that direction due to the lack of transverse bracing of the table and due also to the looseness of fit of the flanged wheels 28 in the track 33. Should this condition occur when a trimmed pile of paper sheets is slid into contact with the vertical surface of the guide member 19 and should the force exerted on the opposite side of the pile then be relieved, a certain amount of "springing back" of the table may occur, thus separating the side of the pile of sheets slightly from the vertical surface of the guide member 19. To overcome this possibility, it is is convenient and preferable to provide an elongated wedge plate 103 which is secured, as by countersunk screws 104, to the front edge of the support plate 56, as illustrated particularly in FIGURES 1 and 2. The end of the wedge plate 103 facing the piler table in its first position adjacent to the trimming table 105 is beveled and the plate is positioned so that, as the piler table is moved along the track 33 into its second position beneath the guide members 19 and 20, its leading corner engages the beveled end of the wedge plate 103 and the edges of the sections of the table top then slide along the front side of the wedge plate, with the result that the entire piler table is wedged into a position such that any tendency for it to "spring back" will cause the side of a guided pile of trimmed paper sheets on the table to press more firmly against the vertical surface of the guide member 19 rather than to cause it to separate from the guide member surface. This wedging action of the plate 103 need be only very slight since it is only necessary that in its normal second position the edge of the table top sections engage the wedge plate firmly but without more than a minimum of pressure.

It will thus be apparent from the foregoing description that, in the operation of the apparatus, a pile of rimmed paper sheets 31 is first slid from a trimming table 105 onto the piler table 15 with the sections of the table locked together and with the table in its first position adjacent to the trimming table and the table and supported pile of sheets is then moved into its second position beneath the guide members 19 and 20, after which the pile of sheets is positioned accurately on the table by sliding it into firm contact with the guide members. The stacking table 12 is then elevated beneath the piler table 15 until the top sheet of a partially formed stack of paper sheets thereon is closely adjacent to the under surface of the sections 23 and 24 of the table top. The sections of the table 16 and 17 are then unlocked from

one another and the forward section 16 is pulled manually, by means of draw pulls 34, away from the rearward section 17 until the portion of the pile of sheets supported on the forward section has been deposited on the partially formed stack of sheets below it after the manner illustrated in FIGURE 5. The rearward section 17 of the piler table is then moved in the opposite direction, i.e. toward its first position, either manually or by means of the motor drive, thus depositing the rest of the pile of sheets on the partially formed stack after the manner of FIGURE 6. Following these steps, the stacking table 12 is lowered so that the sections of the table top 23 and 24 will clear it and the table sections 16 and 17 are then locked together again after the manner of FIGURE 7 and the table then moved back to its first position adjacent to the trimming table 105 to receive the next stack of trimmed sheets.

It will be observed that certain precautions should be taken in operating the apparatus of the invention to insure as accurate positioning as possible of the successive piles of paper sheets deposited on the stack of sheets being built up. For this reason it is essential that the pile guide 18 be retained at the same adjusted position during the formation of an entire stack of sheets. Furthermore, it will be noted that the upper sheet of a partially formed stack 32, in addition to being closely adjacent to the under surface of the piler table top sections 23 and 24, should be separated therefrom by as nearly the same distance as possible for deposition of the successive piles of sheets. Since, as illustrated in FIGURE 5, the pile being deposited on the stack flexes to some degree during its deposition, it is essential that the degree of flexing be maintained as nearly constant as possible from pile to pile or the side surface of the stack facing the withdrawn table top section 23 will not be as smooth as might otherwise be desired.

Although it is convenient to judge the distance of the uppermost sheet of the partially formed stack from the lower surface of the table top visually with considerable accuracy, it is sometimes preferable to provide means for controlling automatically the position occupied by the uppermost sheet. One such means illustrated in the drawing comprises a lamp and photocell arrangement. In this arrangement a lamp 106 is located, e.g. on a bracket 107 secured to the reinforcing angle member 38 adjacent to the rearward end of the rearward section 17 of the piler table, or on a rigid support, not shown, mounted on the floor 11 rearwardly of the limit of travel rearwardly of the rearward end of the rearward table section 17, and positioned to project a narrow beam of light horizontally forward under the two sections of the piler table top at the same distance below the table top sections 23 and 24 which it is desired that the top sheet of a partially formed stack occupy for receiving an additional pile of sheets. A photocell 108 is mounted, e.g. on a rigid stand 109 secured to the floor 11, forwardly of the forwardmost position occupied by the forward section 16 of the piler table during the stacking operation, it being understood that the relative positions of the photocell stand 109 and the stacking table 12 shown in FIGURE 1 have been distorted for the sake of convenience. The photocell 108 is located at the same level as the lamp 106 so that the beam of light from the lamp which normally enters the photocell is interrupted when the topmost sheet of the partially formed stack of sheets 32 has been elevated to the desired distance below the piler table top.

A suitable conventional electrical circuit, not shown, is provided including the photocell 108 and electric means for elevating the stacking table 12 such that, when, in one alternative arrangement of the circuit, the beam of light is interrupted by the uppermost sheet of the partially formed stack due to the elevation of the stack, the elevating means is inactivated immediately in response to the action of the photocell 108. Alternatively, when it is desired to lower the stacking table and partially formed stack of sheets after the deposition of one pile of sheets thereon to a position ready to receive a succeeding pile of sheets without overtravel downward, then it is convenient to arrange the photocell circuit to provide for arresting the downward travel of the table and partially formed stack as soon as the light beam is no longer interrupted by the topmost sheet of the partially formed stack. In this way extremely accurate positioning in a vertical direction of the uppermost sheet of the partially formed stack of sheets beneath the piler table is effected automatically.

It should also be pointed out that, regardless of the manner in which the stacking table 12 is elevated, there exists the possibility that it will at some time be elevated inadvertently too far and that a partially formed stack of sheets on it may actually engage and press upwardly against the table top sections 23 and 24 with considerable force. Since these sections are located beneath and very closely adjacent to the lower edges of the guide members 19 and 20, it is clear that if suitable means are not provided to prevent it there is a possibility that the piler table or the guide means, or both, could be damaged through such inadvertence. With the construction described previously, any such damage is avoided, even though the piler table itself be lifted completely from its track by excessive upward movement of the stacking table 12. Should such excessive upward movement occur, the support plate 56 carrying the guide members 19 and 20, and the adjusting mechanism located on the plate, merely swivels on the swivel rod 63 allowing the guide members 19 and 20 to be pushed upward without damage. Upon lowering the stacking table 12 again the several parts of the apparatus resume their normal positions and relationships and the stacking operation can be carried forward in the normal manner.

Although, as indicated previously, the precise positioning of the piler table in its second position beneath the guide means 18 is not critical, it is convenient, when the travel of the piler table is in response to a motor driving means, to provide controlling means to eliminate the possibility of inadvertent travel of the piler table in the forward direction for an undue distance past its second position. This possibility can be avoided in numerous ways, one such way comprising mounting a conventional limit switch 112, e.g. on a bracket 113 secured to the base plate 52 as shown in FIGURE 2, closely adjacent to the line of travel of the side members of the table sections 16 and 17. A suitable switch actuator, such as a short plate 114 shown in FIGURES 1 and 3, is secured to project from the side of the rearward table section 17 at a level such that as the table travels forward the switch actuator actuates the limit switch 112. A suitable conventional electrical circuit, not shown, is provided, which includes the limit switch 112 and the motor 42 which propels the piler table forwardly, by means of which actuation of the limit switch 112 causes the forward travel of the piler table to cease immediately. In this way the positioning of the piler table in its second position is effected with adequate accuracy and its undue travel forwardly is prevented positively. It is, of course, clear that further automation, and, if desired, complete automation, of the stacking operation described herein can be provided for in any suitable way.

It will be noted that in the foregoing drawing and description the movements and locations of certain of the parts have been indicated as being parallel with or perpendicular to the direction of the track 33. It will also be noted that in the preferred embodiment here described the line of abutment of the top sections 23 and 24 of the piler table 15 extends perpendicularly to the direction of the track 33. It will thus be clear that the description of the movement or location of a part as being parallel with or perpendicular to the direction of the track 33 can alter-

natively be described as being perpendicular to or parallel with, respectively, the line of abutment of the table top sections **23** and **24**.

I claim:

1. In apparatus for stacking a plurality of multi-sheet piles of paper sheets successively on one another to form a stack of sheets in which the edges of the separate piles form a smooth, even side of the stack extending perpendicularly with respect to the surfaces of the separate sheets, the combination including: horizontally adjustable pile-guiding means located on a fixed support adapted, upon sliding a pile of trimmed paper sheets along a table top located immediately below the pile-guiding means into contact with the means, to guide the pile accurately into a predetermined location; a stacking table located beneath the pile-guiding means movable upwardly and downwardly in a vertical direction, but essentially immovable in a lateral direction, the stacking table being adapted to support a skid upon which a plurality of piles of trimmed paper sheets can be stacked; a piler table comprising a pair of table undercarriage sections separably securable to one another and including separably abutting co-planar table top sections secured on the undercarriages, the undercarriages with the respective top sections being adapted to travel independently of one another when unsecured to one another and the table being adapted to travel in a direction essentially perpendicular to the line of abutment of the top sections between a first position wherein it is adapted to receive a trimmed pile of paper sheets slid from a trimming table onto its abutting top sections with a part of the pile supported on each section and a second position wherein, with the pile-guiding means adjusted to a predetermined position, an edge of a pile of paper sheets supported on the piler table is in the immediate vicinity of the pile-guiding means and the top surface of the piler table top is immediately below the pile-guiding means and above the stacking table, the piler table being free of members supporting its top which interfere with the elevation of the stacking table and a partially formed stack of sheets thereon to an extent sufficient to position the topmost sheet of the partially formed stack immediately below the separable sections of the piler table top; and means to raise and lower the stacking table.

2. Apparatus as claimed in claim 1 wherein the abutting top sections of the piler table are each flat, plate-like members having coplanar top surfaces and are sufficiently rigid to support a trimmed pile of paper sheets thereon with essentially no distortion of the planar top surface of either section.

3. Apparatus as claimed in claim 1 wherein the separably abutting top sections of the piler table are adapted to be locked securely in their abutting relationship and wherein, when the abutting sections are unlocked, the sections can be moved away from, and independently of, one another in opposite directions perpendicular to the line of abutment while maintaining the coplanar relationship of the top surfaces of the sections, the sections being adapted to be separated from one another for a distance at least as great as the greatest dimension perpendicular to the line of abutment of a pile of trimmed paper sheets supported on the piler table.

4. Apparatus as claimed in claim 1 wherein the pile-guiding means is swiveled on its fixed support to permit it to rise upwardly to avoid damage should the stacking table inadvertently be raised too high.

5. Apparatus as claimed in claim 1 wherein the fixed support for the pile-guiding means comprises supporting means mounted rigidly independently of the piler table and the stacking table and elements associated therewith.

6. Apparatus as claimed in claim 1 wherein the pile-guiding means comprises a first pile-guiding member adapted to be moved for adjustment horizontally in one direction and a second pile-guiding member adapted to be moved for adjustment horizontally in another direction, the first and second members each having vertical flat surfaces extending angularly with respect to one another, adapted to engage different side surfaces of a pile of paper sheets slid laterally along a table top into contact with them.

7. Apparatus as claimed in claim 6 wherein the second pile-guiding member is secured slidably to, and can be locked to, the first pile-guiding member and can be adjusted by sliding it therealong.

8. Apparatus as claimed in claim 1 including means adjacent to the second position of the piler table to secure its top section rigidly against lateral movement in a direction parallel to the line of abutment of the top sections when a pile of paper sheets is slid along its surface into contact with the pile-guiding means.

9. Apparatus as claimed in claim 1 including stacking table elevation-limiting means to limit automatically the movement of the stacking table upward to insure the topmost sheet of a partially formed stack of paper sheets on the table being elevated to the same predetermined position following the deposition of each pile of sheets on the stack when the table and partially formed stack are elevated to receive the next pile of sheets thereon.

10. Apparatus as claimed in claim 9 wherein the stacking table elevation-limiting means includes: means to project a beam of light horizontally above a partially formed stack of paper sheets on the stacking table in a location to be intercepted upon elevation of the stacking table and a partially formed stack of paper sheets to a predetermined height; a photoelectric cell positioned to receive the unintercepted light beam; and means responsive to the action of the photoelectric cell to arrest the elevation of the stacking table immediately upon interception of the light beam.

11. Apparatus as claimed in claim 1 wherein the means to raise and lower the stacking table vertically comprises twin precision screws adapted to rotate in the same direction at the same rates and over the same periods of time whereby tilting, twisting and other movements of the table having a horizontal component are prevented during raising and lowering of the table.

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