

April 21, 1964

L. C. PEARCE

3,129,622

BLANK FORMING MACHINE AND METHOD OF DIE CUTTING BLANKS

Filed April 24, 1961

5 Sheets-Sheet 1

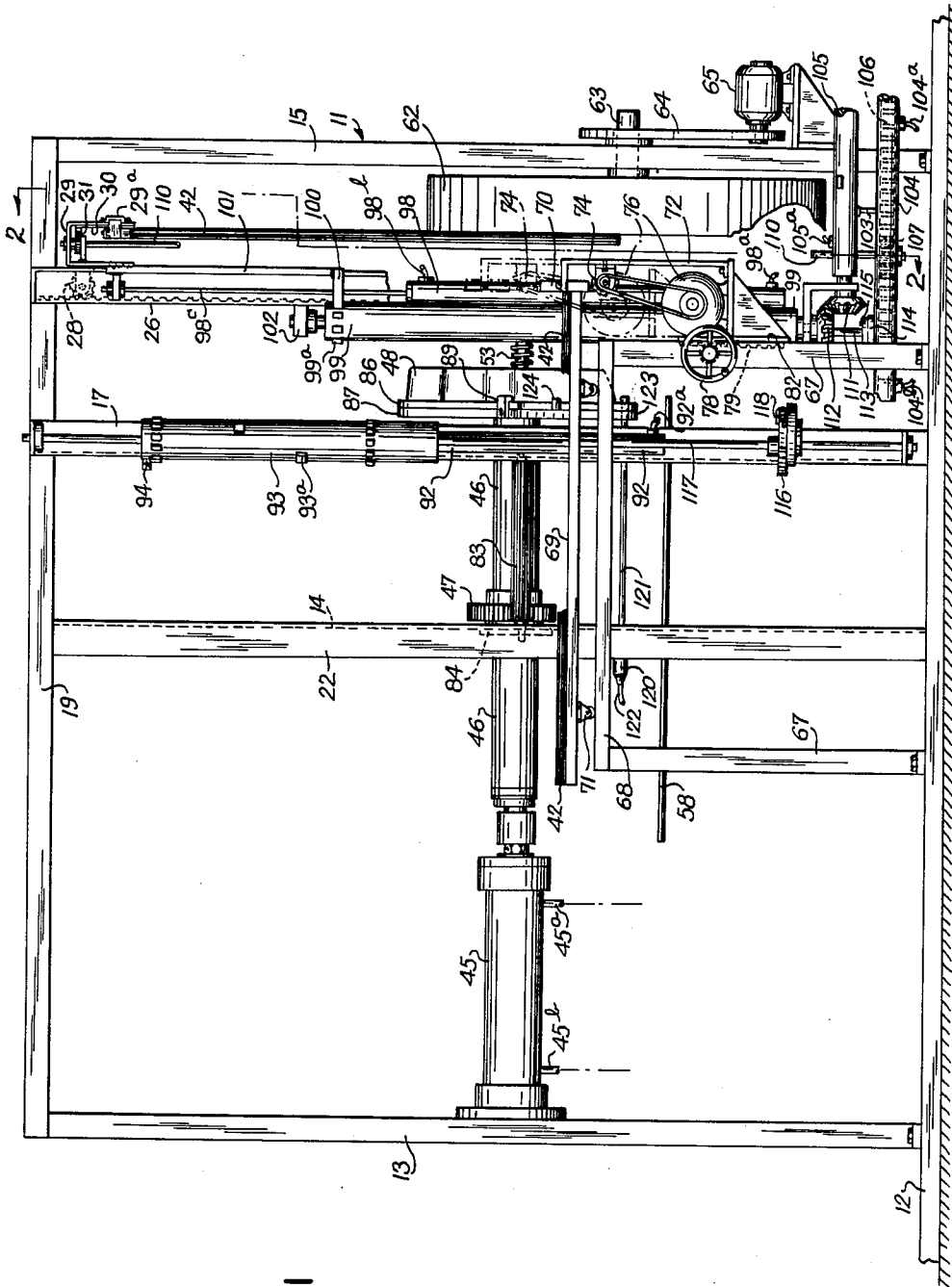


FIG. 1

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April 21, 1964

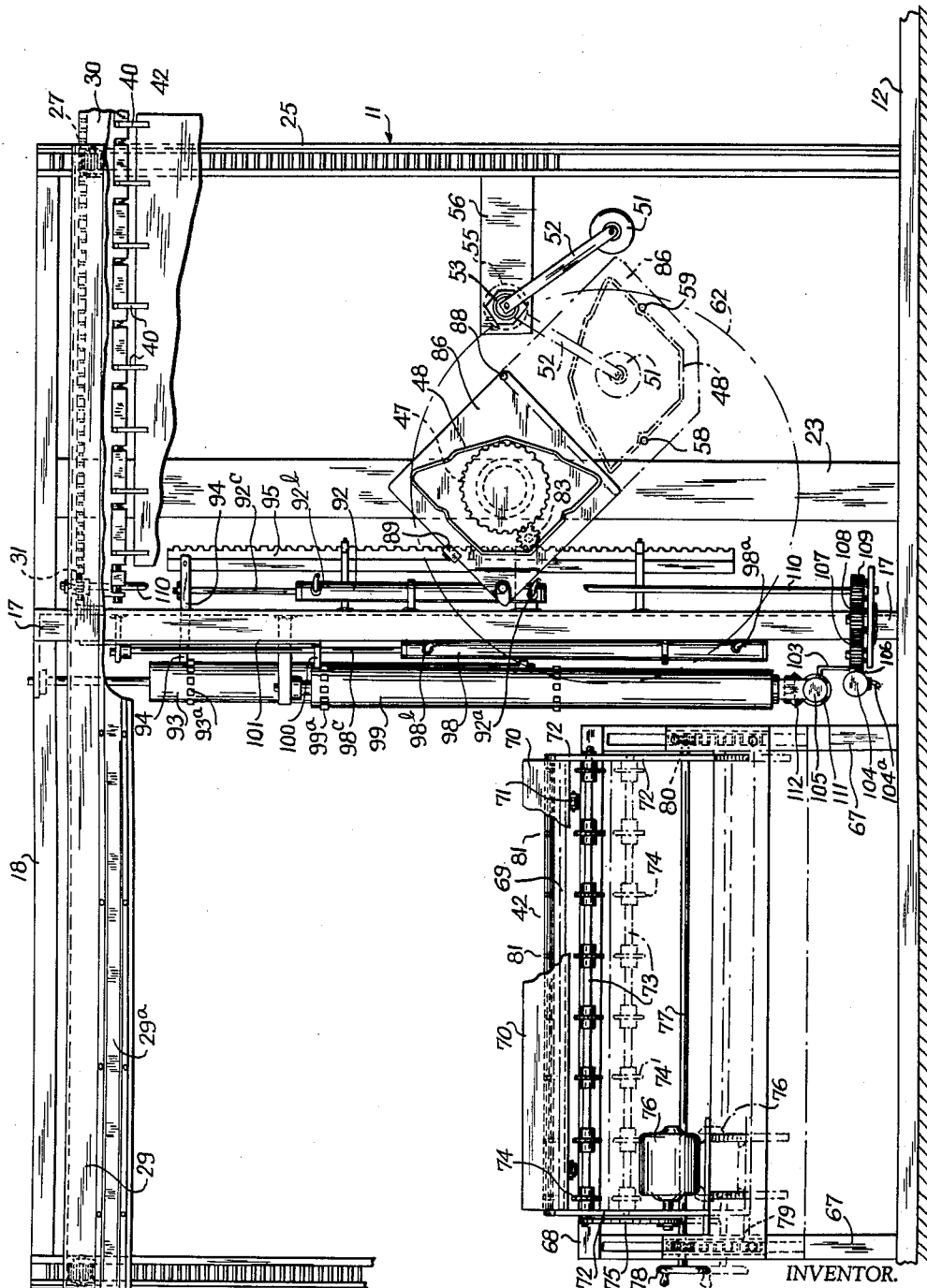
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5 Sheets-Sheet 3

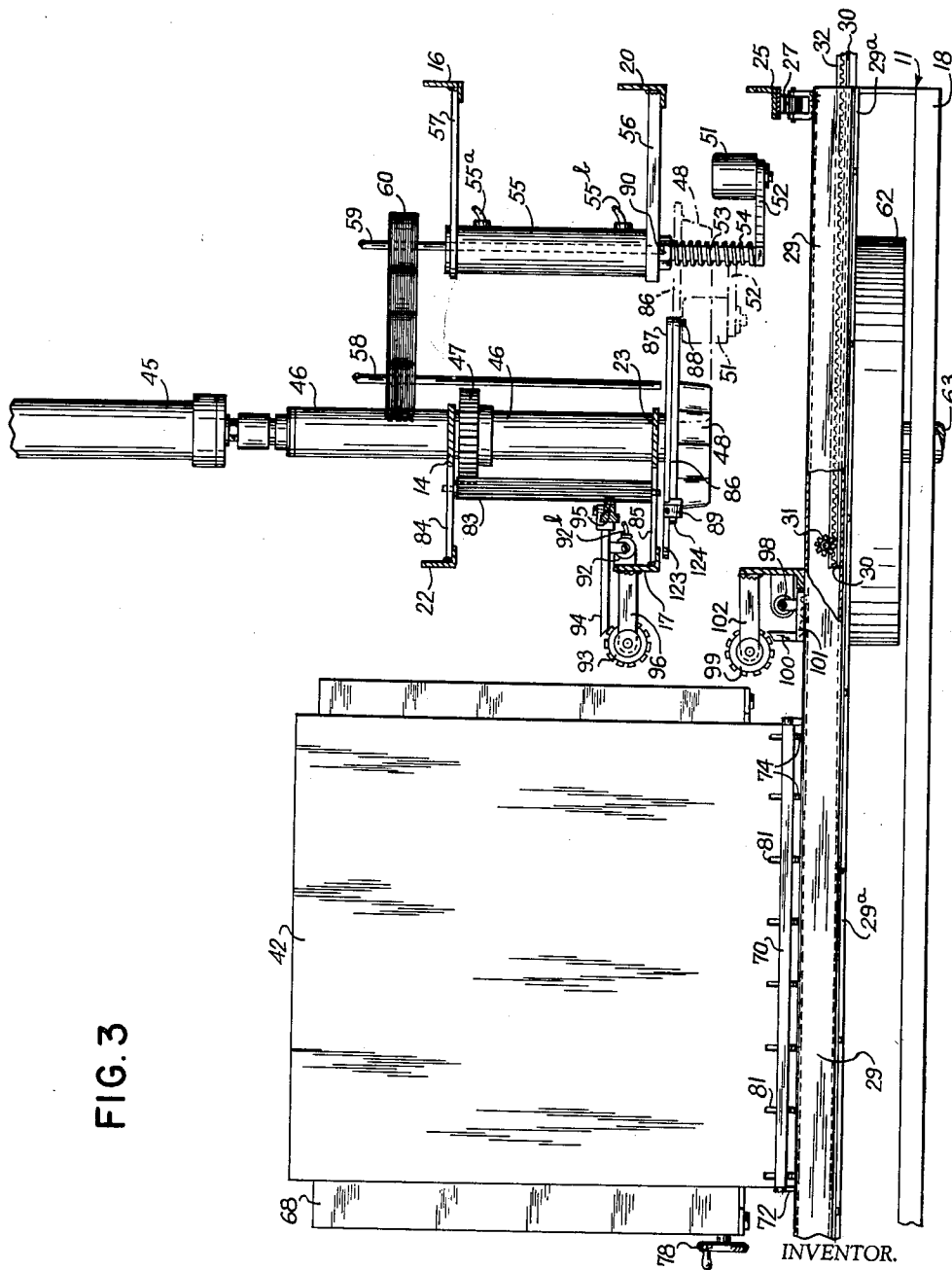


FIG. 3

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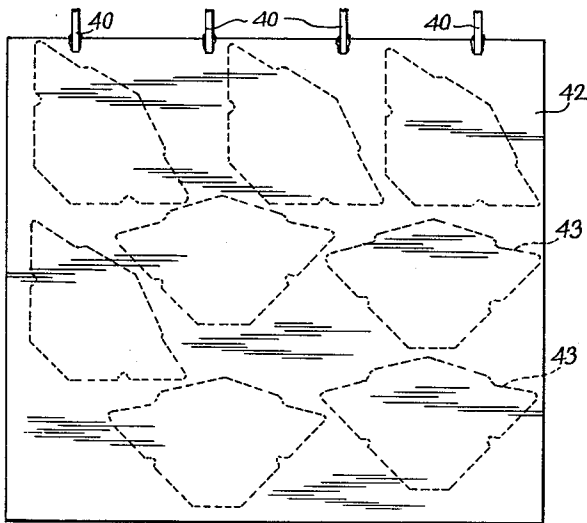


FIG. 4

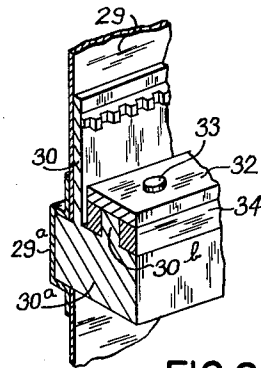


FIG. 8

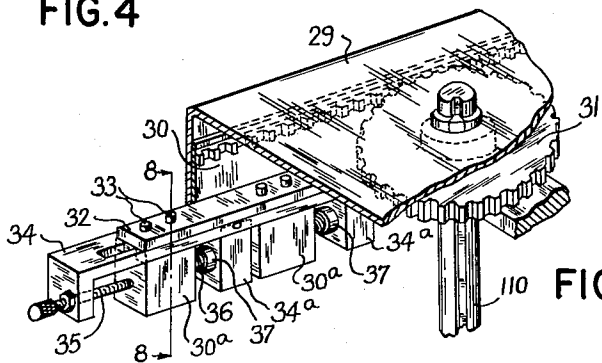


FIG. 5

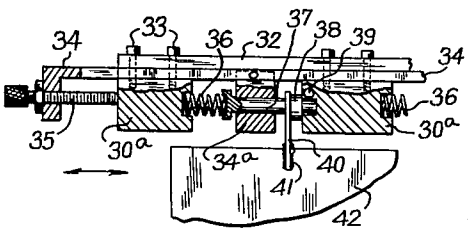


FIG. 6

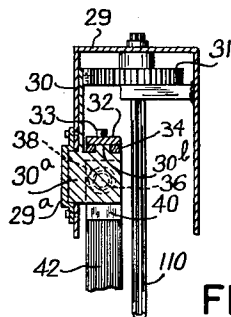


FIG. 7

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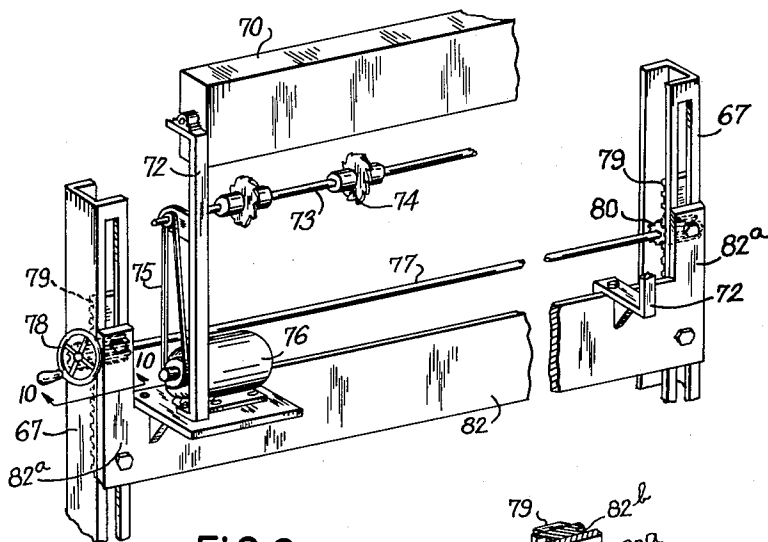


FIG. 9

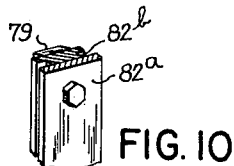


FIG. 10

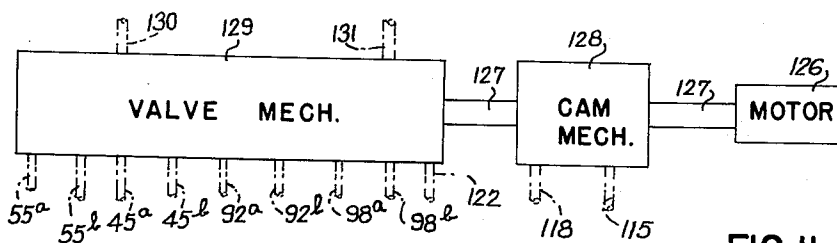


FIG. 11

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BLANK FORMING MACHINE AND METHOD OF DIE CUTTING BLANKS

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Filed Apr. 24, 1961, Ser. No. 105,078

16 Claims. (Cl. 83—36)

My invention relates to machines for forming of blanks for envelopes, for example, from piles or stacks of sheet material such as paper.

An object of my invention is to provide an improved means for die cutting of blanks from a pile or stack of sheet material in a manner to provide improved results.

Another object is the provision for rapid and efficient die cutting of blanks of desired shape from a pile or stack of sheet material such as paper.

Another object is the provision for so handling a pile of sheet material such as paper from which a plurality of blanks are die cut by a series of cutting operations as to assure the accommodation of the pile to the repeated penetrating actions of the cutting die.

Another object is the provision of improved mechanism for handling the pile of sheet material such as paper during successive die-cutting movements of a cutting die against the pile.

Another object is the provision of a unique accommodation of mechanisms cooperating to give superior results in the forming of blanks, such as envelope blanks, from a pile or stack of sheet material, such as paper.

Another object is the provision of an improved method for handling a pile of sheet material such as paper during repeated penetrations of the pile by a blank forming cutting die.

Another object is the provision of a unique superior method for suspending a pile of sheet material such as paper or the like in a vertical plane during the die-cutting operation.

Another object is the provision of a unique and important method utilizable in a blank cutting operation.

Another object is the provision of an improved method for die cutting blanks from a pile of sheet material.

Other objects and a fuller understanding of my invention may be had by referring to the following description and claims taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a side view of a blank forming machine embodying my invention;

FIGURE 2 is a cross-sectional view of my machine taken through the line 2—2 of FIGURE 1;

FIGURE 3 is a plan view of my machine as looking down on the machine in FIGURE 2 and with some portions of the machine not shown for purposes of clarity;

FIGURE 4 is a plan view of a pile of paper from which a plurality of blanks are cut and showing in outline form the shape of the blanks to be cut therefrom;

FIGURE 5 is a detailed enlarged sectional view showing the structure of a carrier utilized in my machine for suspending a pile of paper in a vertical plane;

FIGURE 6 is a longitudinal sectional view through the movable part of the carrier shown in FIGURE 5 to show the internal parts utilized for suspending a pile of paper therefrom;

FIGURE 7 is a cross-sectional view of the carrier mechanism utilized in my machine for suspending a pile of paper;

FIGURE 8 is a cross-sectional view taken through the line 8—8 of FIGURE 5;

FIGURE 9 is an enlarged detailed view showing portions of the mechanism for cutting slots in the pile of paper to be suspended in the machine;

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FIGURE 10 is an enlarged sectional view showing a detail of the parts shown in FIGURE 9; and

FIGURE 11 is a diagrammatical view of the valve mechanism and cam mechanism driven by an electric motor and which are utilized in controlling the operation of parts in my machine.

With reference to the several views of the drawings of my machine, the machine is carried by a supporting frame indicated generally by the reference character 11. This frame 11 embodies a base 12. Extending upwardly from base 12 at locations therearound and secured thereto are upright frame members 13, 14, 15, 16, 17, 20, 21, 22 and 23. There are two top frame members 18 and 19, each of which interconnect the upper ends of the upright frame members to complete a supporting frame upon which the several parts of the machine are carried. Near the front of the machine and set back somewhat from the front upright plane thereof are two spaced upright rack members 25 and 26. Enmeshed with the respective upright rack members 25 and 26 are pinion gears 27 and 28, respectively. A horizontally disposed crossbar 29 carries adjacent to its opposite ends the gears 27 and 28, respectively, in such manner that the gears 27 and 28 may rotate relative to the crossbar 29 as they move up and down on the rack members 25 and 26. The crossbar 29 has an offset portion 29a extending thereupon below the upper portion of the bar 29 so as to provide a longitudinal channel as seen in FIGURE 7.

There is a rack member 30 secured to and carried by the bar 29 so as to move longitudinally therewith. A pinion gear 31 splined to shaft 110 and enmeshed with rack 30 moves the rack back and forth as the shaft 110 is rotated. This rack member 30 has a series of portions 30a extending therefrom at intervals therealong, the portions 30a being in the form of spaced blocks extending horizontally from the rack member 30. These portions 30a have extending upwardly therefrom a neck portion 30b which protrudes through the longitudinal slot in a bar 34, which bar 34 is longitudinally disposed relative to the rack member 30 and just above the portions 30a. A bar 32 extends longitudinally of the bar 34 and is spaced upwardly therefrom to accommodate the neck portions 30b. The bar 32 is secured by screw bolts 33 to the portions 30a of the rack member 30 so as to support the bar 32 on the bar 34 and at the same time to permit a relative sliding motion between the bar 32 and the bar 34. It is thus seen that the bar 34 is carried by the portions 30a and is held in sliding engagement therewith by the bar 32 and screw bolts 33 extending through the slot of the bar 34 into the portions 30a.

There are a plurality of blocks 34a secured to the bar 34 in such manner as to be suspended downwardly therefrom at locations intermediate of the portions 30a. Thus the portions 30a and blocks 34a are alternately disposed along the length of the bars 32 and 34. By reason of the sliding interfit of the bars 32 and 34 the blocks 34a may move longitudinally of the bars toward and away from the respective portions 30a and within limits.

Screw bolt 35, having a knurled outer end, is threadably engaged in the outer downturned end of the bar 34 in such manner that the inner end of the bolt 35 engages the next adjacent portion 30a, as seen in FIGURES 5 and 6. By turning the screw bolt 35 in one direction all of the portions 30a and the rack member 30 are moved relative to the bar 34 and the blocks 34a suspended therefrom.

Carried by each block 34a in openings provided therein are pin members 37 which extend longitudinally of the carrier. Abutting each pin member 37 so as to resiliently press it in one direction is a coil spring 36, so biased as to urge the pin members 37 to the right as seen in FIGURES 5 and 6. In alignment with each pin member 37

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there is a button member 38 carried by a portion 30a, each button member 38 being retained in position by a ball retainer 39 in such manner as to permit rotation of the button member 38 on its axis. The pin members 37 are also rotatable on their respective axis so that the pin members 37 and button members 38 may rotate upon their common axes.

Upon a pile of paper such as pile 42 being suspended in a vertical plane in the machine for the die-cutting operation, the pile of paper 42 is hung from the carrier by means of tabs 40 which are tightly engaged between the respective pin members 37 and button members 38. The tabs 40 are preferably of a cardboard or heavy material which are cemented in slots 81 formed in pile 42 of paper by means of a cementitious or adhesive material 41. By the turning of bolt 35 the plurality of springs are pressed and the plurality of pin members 37 are urged against the respective button members 38 so as to tightly compress the several tabs 40 therebetween and thus to firmly engage the tabs 40 to the carrier at a plurality of points along the length of the carrier. To release the pile 42 from the carrier after blanks 43 are cut therefrom, the bolt 35 may be turned to release the tabs from between the opposing button members 38 and pin members 37.

Extending longitudinally of the frame 11 and supported by the members thereof is a hydraulic cylinder 45 connected by lines 45a and 45b at its opposite ends to a source of controlled fluid under pressure. Extending forwardly and axially of the cylinder is a die-carrying piston member 46 adapted to reciprocate upon reciprocation of the piston within the cylinder 45. Non-rotatively mounted on the piston member 46 is a ring gear 47, whereby rotation of the ring gear 47 rotates the piston member 46 and parts carried thereby.

Mounted on the forward end of the piston member 46 is a ram plate 87 which reciprocates and rotates with the piston member 46. By pivot pin 83 carried by the plate 87 a die plate 86 is connected to the ram plate 87 in such manner that the die plate 86 reciprocates with the piston member 46 and ram plate 87, and it may also rotate therewith upon the interlocking of the plate 86 with the plate 87.

A cutting die 48 is secured to the die plate 86 so as to reciprocate therewith and also to rotate therewith. The cutting die has an opening extending therethrough which conforms to the shape of the blank, such as an envelope blank, to be cut from a pile of paper. The die 48 has walls defining the shape of the envelope to be cut, and the forward edges of these walls are formed to a knife edge so as to cuttily penetrate the pile of paper.

Upon each penetration of the cutting die 48 into a pile of paper there is formed within the hollow opening of the die a plurality of blanks tightly compressed within the die. There is provided means for ejecting the cut blanks from the die so as to clear the die for the next cutting operation.

An ejector 51, in the form of a cylindrical block, is mounted upon the free end of an arm 52 so as to swing therewith. The arm 52 is carried at the end of piston stem 53 in a plane normal to its axis and swings as the stem rotates. The arm 52 and ejector 51 swing between the withdrawn position shown in full lines and the ejecting position shown in broken lines in FIGURES 2 and 3.

A hydraulic cylinder 55 for actuating the stem 53 is carried by supports 56 and 57, which in turn are carried by the frame 11. The hydraulic cylinder 55 is connected by fluid lines 55a and 55b at its opposite ends to a controlled source of fluid under pressure for reciprocating the piston within the cylinder 55 and the piston stem 53 extending therefrom.

Connected to the forward end of the cylinder 55 is a threaded member 90 which threadably engages the piston stem 53 in such manner that upon reciprocation of the piston stem 53 it is caused to rotate by a screw action and

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thus to cause the arm 52 and ejector 51 carried thereby to swing and also to reciprocate between their extreme positions illustrated. Thus upon actuation of the cylinder 55 to cause reciprocation, there is also provided a rotative action to the piston stem 53 which swings the ejector 51 in an arc at the same time. A coil spring 54 concentrically mounted on the stem 53 resiliently urges the stem 53 to an extended position, that is, to the position shown in full lines in FIGURE 3. Upon actuation of the piston in the cylinder 55 the stem 53 is retracted against the bias of the spring 54, which causes the arm 52 and ejector 51 to move toward the cylinder 55 and at the same time to swing to the ejecting position shown in dotted lines in FIGURE 3.

The timing mechanism of the machine is so set that when the die 48 containing the cut blanks is in the position shown in dotted lines in FIGURE 3, then the cylinder 55 is actuated to cause the ejector 51 to move so as to eject the cut blanks from the hollow die 48 and to move the cut blanks rearwardly. A pair of parallel supporting rods 58 and 59 are so positioned as to support the successive increments of cut blanks 60 as they are ejected from the die 48 by the ejector 51. The cut blanks 60 may be removed from the supporting rods 58 and 59 at a position remote from the ejector.

My machine incorporates an anvil or cutting board 62 which has a cutting surface disposed in an upright plane. The anvil 62 is circular or disc-like in form and is rotatable on a shaft 63 carried by the frame 11. As seen in FIGURE 1 the shaft 63 is rotated by means of an electric motor 65, there being a belt 64 in driving engagement on a pulley mounted on the shaft 63 and a pulley mounted on the motor shaft. The motor 65 is timed or synchronized so as to intermittently rotate the anvil 62 and thus to provide a fresh cutting surface against which the die engages upon penetration of a pile of paper. Preferably the cutting surface of the anvil 62 is composed of a hard wood adapted to meet the cutting edge of the die.

For preparing the pile of paper from which envelope blanks are to be cut there is provided a table 67 having a top portion 68. A pile or stack 42 of sheets of paper is placed upon a movable supporting base 69 carried by roller 71 on the table top 68. Thus the supporting base 69 may be rolled to the right and to the left as seen in FIGURE 1. Suitable joggling plates or boards are utilized for aligning or making even the edges of the paper making up the pile 42. At the forward end of the table 67, that is, to the right side of the table as seen in FIGURE 1, there is a frame 72 reciprocal in an up and down direction relative to the table 67. This frame 72 has a horizontally disposed plate 70 interconnecting the upper ends of the arms of frame 72, the plate 70 being movable with the frame 72. When in the uppermost position, as for example in the position shown in FIGURE 1, the plate 70 acts as a joggling board against which the pile 42 may be pushed for alignment. The plate 70 also acts as a guard for the cutters mounted therebelow. The details of the frame 72 and parts carried thereby are better seen in FIGURE 9. A shaft 73 disposed in a horizontal plane is carried by the frame 72 so as to move up and downwardly therewith. Non-rotatively mounted on the shaft 73 are a plurality of cutters 74 which rotate with the shaft 73. The planes of the cutters 74, respectively, are in upright planes normal to the axis of the shaft 73. An electric motor 76 is carried on the frame 72 so as to move up and downwardly therewith. A belt 75 drivingly engages the shaft 73 and the motor shaft so that the motor 76 rotates the shaft 73 and the cutters 74 mounted thereon.

To raise and lower the frame 72 and parts carried thereon there is provided an elevating shaft 77 manually rotatable by means of a handle 78 mounted on the end thereof. Adjacent to the opposite ends of the shaft 77 there are non-rotatively mounted pinion gears 80 so as to rotate with the shaft 77. These gears 80 are enmeshed

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with toothed racks 79 carried by the upright legs of the table 67 so that rotation of the gears 80 raise and lower the frame 72 relative to the table 67. The frame carrying the rotary cutters also includes a crosspiece 82 upon which the upright portions of the frame 72 are mounted. This crosspiece 82 carries a bracket upon which the motor 76 is mounted. At the opposite ends of the crosspiece 82 there are end portions 82a which are disposed in sliding engagement with the legs of the table 67. These portions 82a have T-shaped portions 82b which interfit with slots in the legs of the table 67 so as to retain the crosspiece 82 and frame carried thereby in an upright plane and next adjacent to the end of the table. The toothed racks 79 are secured to the portions 82b so as to move up and downwardly therewith, thus rotation of the handle 78 by a rack and pinion action raises and lowers the part 82 with all parts carried thereon in accordance with the direction of rotation of the handle 78.

My invention includes a novel method of suspending a pile such as a pile of paper in an upright plane. A preferred way of seizing and suspending the pile 42 is provided by my method and machine. By moving the base 69 forwardly to position the pile 42 against the plate 70 the front edge of the pile 42 is properly aligned. Thereafter the handle 78 is rotated so as to move the cutting frame upwardly to the position shown in broken lines in FIGURE 1. Here the plate 70 has been raised, and the cutters 74 while being rotated by means of the motor 76 slice through the sheets of material in the pile 42 at the location of each cutter 74. This leaves in the pile 42 along its front edge a plurality of slits 81. The cutters 74 have removed a small portion of the paper in the pile 42 as they cut or saw therethrough, and this leaves the slits 81 of appreciable width, extending from top to bottom of the pile and extending partially into the body of the pile.

After the slits 81 have been cut in the pile, then the handle 78 is rotated so as to lower the cutting frame with the cutters 74 and plate 70 to their lowermost position, that is, below the level of the top of the base 69. In this position the plate 70 is protecting the operator from the top of the cutters 74 and the slits 81 are exposed. At this point in the operation the tabs 40 are inserted in the slits 81 with a suitable cement or adhesive on the ends of the tabs 40 which are positioned within the slits 81. These tabs 40 are of cardboard or other suitable material which is strong enough to support the pile but at the same time would not interfere with the die if the die should happen to strike one of the tabs. A quick-setting cement or adhesive is used, of which a number are readily available, so that the tabs 40 are soon firmly adhered to the pile 42. The planes of the tabs 40 are normal to the plane of the pile 42.

With the pile 42 positioned and the tabs 40 cemented in place by the cement 41 as described, then the several tabs 40 are secured to the carrier by clamping each tab 40 between a pin member 37 and a button member 38, as shown in FIGURE 6. This is done by lowering the carrier to its proper relative position while the pile is in a horizontal plane on the base 69. When the screw bolt 35 is in its retracted position the tabs 40 may readily be inserted between the pin member 37 and button member 38. Upon tightening up of the screw bolts 35 all of the pin members 37 are pressed firmly against the button members 38. By reason of the mounting of several pin members 37 and button members 38, they may freely rotate on their common axis, even while the tabs 40 are firmly pressed and engaged between the respective pin members 37 and button members 38. After the tabs 40 are all thus firmly clamped in position the carrier may be raised and the pile 42 thus suspended in a vertical plane, its weight being carried by the plurality of the tabs 40 secured thereto.

For rotating the piston member 46 which carries the dies 48 there is provided a long gear 83 journaled on

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supports 84 and 85 carried by the frame. The gear 83 is enmeshed with the gear 47 non-rotatively mounted on the reciprocal piston member 46 so that the rotation of the gear 83 correspondingly rotates the piston member 46.

For actuating the gear 83 there is provided a fluid cylinder 92 disposed upright in the machine and having fluid lines 92a and 92b connected to its opposite respective ends. The piston of the cylinder 92 carries an actuating arm 94. At the end of the arm 94 next adjacent to the gear 83 there is an upright toothed rack 95 enmeshed with the gear 83 so that raising and lowering of the rack 95 provides corresponding rotation to the gear 83. Disposed on an axis parallel to the axis of the cylinder 82 is a limit control device 93 of cylindrical form and having limit stops positioned at locations on its cylindrical surface as required. This control device 93 is supported in position by a supporting arm 96 extending out from the upright frame member 17 of the frame. The end of the arm 94 opposite from the rack 95 is positioned to engage limit stops on the cylindrical surface of the limit control device 93 in accordance with the elevation and rotational position of the device 93. By setting the stops at the desired location on the cylindrical surface of the device 93 rotational movements of the gear 83 and hence of the piston member 46 may be programmed for pre-control as desired.

For raising and lowering the paper-gripping arm which seizes and suspends the pile 42 there is provided a cylinder assembly 98 disposed on an upright axis, the cylinder assembly 98 having a fluid line 98a and a fluid line 98b connected to its opposite ends and to a source of controlled fluid pressure. A piston stem 98c of the cylinder assembly 98 is connected to the crossbar 29 of the pile-carrying assembly so as to raise the pile-carrying assembly upon reciprocation of the piston stem 98c. A limit control device 99 of cylindrical form, carried by a support 102, has its axis disposed close to and parallel to the axis of the cylinder assembly 98. An actuating arm 100 carried from the lower end of a rod 101, which in turn is secured to the top of the piston stem 98c so as to reciprocate therewith, is adapted to engage bosses or projections 99a positioned at desired locations on the cylindrical surface of the control device 99. These bosses or projections 99a provide limit stops to movement of the piston stem 98c and hence to the movement of the pile carrier raised and lowered thereby through a programmed cycle. Thus by rearranging the stops on the control devices the movements of the actuating cylinders may be controlled and predetermined.

For providing transverse movement of the pile suspending arm 29 and parts carried thereby there is provided cylinder assembly 104 disposed horizontally. This cylinder assembly 104 has disposed parallel to it and actuated by the piston of the cylinder assembly 104 a rack member 106 whereby actuation of the cylinder assembly 104 moves the rack member 106 in a longitudinal direction parallel to the cylinder assembly. Fluid lines 104a and 104b connected to the opposite ends of cylinder assembly 104 are connected to a controlled source of fluid pressure. The rack member 106 is enmeshed with the pinion gear 107 whereby motion of the rack member 106 rotates the gear 107. The gear 107 in turn is enmeshed with a gear 108, and this gear 108 is in turn enmeshed with a gear 109, providing a train of gears between the rack 106 and gear 109. The gear 109 is non-rotatively connected to a shaft 110 whereby reciprocation of the rack 106 by actuation of the cylinder assembly 104 rotates the shaft 110.

A stop or limit device 105 of cylindrical form is disposed parallel to the cylinder assembly 104, the cylindrical surface of the control device 105 being provided with a plurality of projections or bosses 105a, adapted to be engaged by an arm 103 carried by and extending from the rack 106. The movements of the cylinder assembly 104 and rack 106 are thus programmed to move

in a cycle between limits determined by the control device 105.

On one end of the device 105 there is a beveled gear 111 mounted to rotate therewith. On the lower end of the control device 99 there is another beveled gear 112 adapted to rotate therewith. The beveled gears 111 and 112 are enmeshed whereby the device 105 and device 99 rotate in synchrony.

A shaft 113 is non-rotatively connected to the beveled gear 112 and control device 99 whereby rotation of the shaft 113 rotates both gear 112 and the control device 99. Also by reason of the interengagement of the gears 112 and 111 the rotation of the shaft 113 also rotates the control device 105. The shaft 113 is intermittently rotated in step progression by a ratchet and detent assembly 114. A rod 115 connected to the assembly 114 actuates the assembly 114 upon reciprocation of the rod 115 along its axis. The rod 115 in turn is connected to a cam assembly actuated in synchrony with other operations of the machine.

Another ratchet and detent assembly 116 is connected to a shaft 117 extending axially of and connected to the control device 93. The rod 118 connected to the assembly 116 actuates the assembly 116 intermittently on reciprocation of the rod 118 by a cam mechanism operated with the other parts of the machine whereby a control device 93 is rotated in relationship to the operation of other elements of the machine.

The hollow die 48 carried on the die plate 86, which in turn is pivotally connected to the ram plate 87, is normally in the position shown in full lines in FIGURES 1, 2 and 3. A stop member 89 carried by the plate 87 prevents the die plate with die 48 secured thereto from swinging on the pivot 88 beyond the limit imposed by the stop member 89. To retain the plate 86 in the position shown in full lines in FIGURES 1, 2 and 3 and hence to align the die 48 with the piston member 46, a catch member 124 engages in a slot or niche in the plate 86 whereby when the catch member 124 is in the slot or niche the plate 86 and the die 48 carried thereby are held against rotation on the pivot 88. This catch member 124 is carried by a crescent-shaped support 123 extending partly around the periphery of the plate 87. The crescent-shaped support 123 is movable along a line parallel to the axis of the piston member 46, and upon being moved in one direction moves the catch member out of the slot in the plate 86 so as to release the plate 86 from the catch member 124. When moved in an opposite direction the catch member 124 is biased to moving into the slot or niche in the plate 86 upon the slot or niche being aligned with the catch member 124.

To move the crescent-shaped support 123 a rod 121 secured thereto extends rearwardly from the support 123 in a line parallel to the axis of the member 46. A piston and cylinder assembly 120 attached to the rod 121 and carried by the upright 22 of the frame 11 is provided to reciprocate the rod 121. A fluid line 122 connected to the cylinder 120 and to a controlled source of fluid pressure actuates the cylinder 120. Thus at the required interval in the operation of the machine the die 48 is released so that it may swing from its position shown in full lines in FIGURES 1, 2 and 3 to its position shown in dotted lines in FIGURES 1 and 2 where it is located for ejection of paper blanks from the die by the ejector 51.

For actuating the several parts and controlling the movements thereof there is illustrated in FIGURE 11 in diagrammatical form a relatively simple mechanism. A constant-speed electric motor 126 rotates a shaft 127. This shaft 127 rotates a cam mechanism 128 which in proper order reciprocates rods 115 and 118. Rod 115 actuates the ratchet and detent assembly 114 and rod 118 actuates the ratchet and detent assembly 116. The same shaft 127 also rotates the rotor or movable parts of a valve mechanism 129 shown in block form. This valve mechanism 129 is connected to a source of fluid under pressure

such as hydraulic fluid from a pump through a conduit 130. A return conduit 131 returns the hydraulic fluid from the mechanism 129 to a sump or reservoir for re-pumping through the valve mechanism. Connected to suitable ports in the valve mechanism 129 are fluid lines 45a, 45b, 55a, 55b, 92a, 92b, 98a, 98b and 122. These lines are connected to the several hydraulic cylinders of the machine previously described. By proper setting of the valve mechanism 129 and cam mechanism 128 and by setting the location of the projections or bosses on the several cylindrical control devices described the several moving parts of the machine are operated in required sequence and in synchrony.

It is understood, of course, that other programming and control devices may be utilized for actuating the several working parts of the machine and for controlling and timing the operations of the machine in correct sequence and proper synchrony.

In the operation of my machine a pile 42 of paper is placed on the base 69 and the forward edge portion of the pile 42 is slit as described. The cardboard tabs 40 are cemented in place in the slits and these tabs are gripped by the paper carrying arm. The paper carrying arm is then moved upwardly to suspend the pile of paper in a vertical plane. The suspended pile 42 is moved transversely and vertically through a series of movements whereby envelope blanks are at different locations on the pile, such as locations indicated by the outlines 43 in FIGURE 4. The die 48 is reciprocated to cause the die to penetrate the pile at each one of these locations in sequence so as to die cut a plurality of blanks from the pile in each penetrating movement. After each cutting of a plurality of blanks by the die, the die is swung to its ejecting position where the envelope blanks are ejected by the ejector 51. The die is then swung back in line with the actuating ram 45 and again reciprocated. In each reciprocating movement, however, the die is rotated to some extent by the gear 83 rotating the gear 47 so that the die may be turned and thus obtain a maximum number of blanks from a pile such as, for example, as indicated by the eight outlines 43 shown in FIGURE 4. The cutting motion of the die remains the same but the pile 42 is shifted relative to the axis of the die so that the die is aligned with a different location, such as the location indicated by one of the outlines 43, in each die-cutting cycle.

The buckling and warping of the pile upon each penetration of the cutting die corrects itself after each withdrawal of the die by reason of its suspension from the pile in a vertical plane, whereby the weight of the pile causes it to resume its place in an upright plane after each withdrawal of the die. By reason of the thickness of the blade of the die, penetration of the die into the pile causes such a bulging, buckling and distortion of the pile as to require it to resume its position in a flat plane before the next die-cutting operation, however, by the unique machine and method hereby described this resumption of the shape of the pile 42 to a flat plane ready for the next penetration of the die is assured by the suspension of the pile from its upper edge in a vertical plane. Inasmuch as the tabs 40 are relatively small and made of cardboard or other suitable material, they do not take up much of the area of the pile, as would a metal clamp, for example. Also because of the material of the tabs the die would not be injured if it should happen to strike one of the tabs 40, whereas the edge of the die would be injured if it should strike a metal clamp or other hard, rigid means for clamping and suspending the pile.

Through the use of this machine and method, greater efficiency and speed are obtainable in die cutting blanks from a pile of sheet material such as paper. Also the safety factor is increased, as the operator's hands are not required to be close to the die-cutting operation, and it also provides for economy in the blanking operation.

Other advantages and benefits will be readily appreciated

by those having a knowledge of the problems and shortcomings of the present machines and methods used for die cutting blanks from a pile of sheet material.

The present disclosure includes that contained in the appended claims as well as that of the foregoing description.

Although this invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form of the machine and the method has been made only by way of example, and that numerous changes in the details of construction and the combination and arrangement of parts and of the steps of the method may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. The method of cutting blanks from a pile of sheets of paper or the like comprising the steps of suspending a pile of said sheets from one edge of the pile to hang freely in a vertical plane, providing vertically disposed backing, recurrently pressing a cutting die into said pile and against said backing without comprising said pile below said one edge at different locations to cut blanks therefrom at each of said locations, and shifting said pile horizontally and vertically in said vertical plane to align the die with successive of said different locations between recurrent pressing actions of said cutting die into said pile while permitting the uncompressed pile to adjust itself by gravity to the distortions caused by the pressing of the cutting die into said pile.

2. The method of claim 1 and including the step of ejecting cut blanks from the cutting die after each cutting action during the interim before the next cutting action.

3. Apparatus for forming blanks for envelopes or the like from a pile of a plurality of papers, comprising in combination, a supporting frame, first means for holding said pile together along a side thereof, second means carried by said frame and engaging said first means for raising said first means to suspend said pile downwardly by gravity in an upright plane from said side of the pile, an anvil member carried by said frame, the cutting face of said anvil member being disposed in a substantially upright plane, piston and cylinder means carried by said frame and adapted to reciprocate by fluid power a cutting die toward and away from said anvil member upon actuation of said piston and cylinder means, the piston and cylinder assembly being disposed to align the axis of the cutting die carried thereby normal to the upright plane of the cutting face of said anvil member, third means for moving said second means through a series of horizontal and vertical movements to shift said pile relative to said axis of the said cutting die to consecutively position the cutting die carried by said assembly in a plurality of different locations on said pile for cutting blanks therefrom, and controlling means for synchronizing the reciprocations of said piston and cylinder means and the operations of said third means to cause consecutive cutting of blanks from said pile by the cutting die being pressed into the pile by the piston and cylinder means against said anvil member consecutively at each of said locations.

4. Apparatus for forming blanks for envelopes or the like from a pile of a plurality of papers, comprising in combination, a supporting frame, first means for holding said pile together along a side thereof, second means carried by said frame and engaging said first means for raising said first means to suspend said pile downwardly by gravity in an upright plane from said side of the pile, an anvil member carried by said frame, the cutting face of said anvil member being disposed in a substantially upright plane, piston and cylinder means carried by said frame and adapted to reciprocate by fluid power a cutting die toward and away from said anvil member upon actuation of said piston and cylinder means, the piston and cylinder assembly being disposed to align the axis of the

cutting die carried thereby normal to the upright plane of the cutting face of said anvil member, third means for moving said second means through a series of horizontal and vertical movements to shift said pile relative to said axis of the said cutting die to consecutively position the cutting die carried by said assembly in a plurality of different locations on said pile for cutting blanks therefrom, ejecting means for ejecting cut blanks from said cutting die after each cutting operation, and controlling means for synchronizing the reciprocation of said piston and cylinder means, the operation of said third means, and the ejecting by said ejecting means to cause consecutive cutting of blanks from said pile by the cutting die being pressed into the pile by the piston and cylinder means against said anvil member consecutively at each of said locations and to cause the ejection of cut blanks from the cutting die after each cutting operation.

5. Apparatus for cutting blanks for envelopes or the like from a plurality of sheets of material arranged in a pile, comprising in combination, a supporting frame, suspension means carried by said frame for holding said pile along a side thereof and suspending the pile from said side in an upright plane, anvil means carried by said frame and having a cutting-bed surface disposed in an upright plane, a cutting die having a cutting edge disposed in an upright plane and having an open space bounded by said cutting edge in which blanks are accommodated upon being cut, first actuating means carried by said frame and carrying said cutting die for reciprocating said cutting die toward and away from said cutting-bed surface along a line of movement normal to the plane of said cutting-bed surface, second actuating means for moving said suspension means through a series of movements relative to said cutting die and said anvil means to carry said suspended pile between said cutting edge and said cutting-bed surface to a plurality of positions, said positions being located relative to the lateral extent of said pile for the cutting of blanks from the pile at each of said positions, and control means for timing the operations of the first actuating means and second actuating means to provide for consecutive cutting of blanks from the said pile at each of said positions in series, the suspension of said pile in an upright plane permitting the pile to buckle and laterally expand upon each cutting operation at a said position and to resume its suspended position in said upright plane after each said cutting operation.

6. Apparatus for cutting blanks for envelopes or the like from a plurality of sheets of material arranged in a pile, comprising in combination, a supporting frame, suspension means carried by said frame for holding said pile along a side thereof and suspending the pile from said side in an upright plane, anvil means carried by said frame and having a cutting-bed surface disposed in an upright plane, a cutting die having a cutting edge disposed in an upright plane and having an open space bounded by said cutting edge in which blanks are accommodated upon being cut, first actuating means carried by said frame and carrying said cutting die for reciprocating said cutting die toward and away from said cutting-bed surface along a line of movement normal to the plane of said cutting-bed surface, second actuating means for moving said suspension means through a series of movements relative to said cutting die and said anvil means to carry said suspended pile between said cutting edge and said cutting-bed surface to a plurality of positions, said positions being located relative to the lateral extent of said pile for the cutting of blanks from the pile at each of said positions, ejecting means for ejecting cut blanks from said cutting die after each cutting operation by the movement of the cutting die toward said cutting-bed surface, and control means for timing the operations of the first actuating means, of the second actuating means, and of the ejecting means to provide for consecutive cutting of blanks from said pile at each of said positions

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in series and for the ejection of cut blanks after each cutting operation, the suspension of said pile in an upright plane permitting the pile to buckle and laterally expand upon each cutting operation at a said position and to resume its suspended position in said upright plane after each said cutting operation.

7. Apparatus for cutting blanks for envelopes or the like from a pile of paper by a cutting die penetrating the pile whereby the cut blanks are stacked within the cutting die and the remainder of the pile is buckled and warped by the penetration of the cutting die into the pile, comprising first means for suspending a said pile from a side thereof to assume a position in an upright plane under the force of gravity free of compression below said side, second means shifting said first means through a series of horizontal and vertical movements in said upright plane to vary the consecutive positions of the said pile in said upright plane, third means movable along a line substantially normal to said upright plane for recurrently pressing a cutting die against said pile disposed in said upright plane in each of said positions to cut a stack of blanks therefrom, and fourth means for providing in an upright plane a resistant backing to said pile for opposing the pressing of said cutting die, said suspended pile being free to resume under force of gravity its unbuckled and unwarped position in said upright plane upon retraction of the cutting die from said pile.

8. Apparatus as defined in claim 7 and including fifth means for ejecting the stack of cut blanks from the cutting die after each cutting operation by said third means.

9. In apparatus for die-cutting blanks from a pile of sheets of paper, the combination of first means for suspending a said pile from along a side thereof to cause the pile to hang freely from said side by gravity in an upright plane and uncompressed below said side, second means providing a backing surface adjacent said pile and in an upright plane, third means for pressing a cutting die along a line of movement normal to said upright plane against said pile backed by said second means to die-cut blanks from the pile by penetration of said cutting die, said pile recovering from the distortion caused by the penetration of the cutting die by the force of gravity on the suspended pile, fourth means for recurrently shifting said pile in said upright plane sequentially to align different areas of said pile with said cutting die, and fifth means for alternating the operation of said third means and said fourth means.

10. Apparatus for die-cutting blanks for envelopes or the like from a pile of sheets tending to buckle and distort upon penetration of the cutting die into the pile, comprising in combination suspension means for suspending a said pile from a side thereof to cause the pile to hang freely by gravity from said side in an upright plane, first actuating means for recurrently moving a said cutting die along a line of movement disposed normal to the upright plane of said pile and against said pile to penetrate the same and to withdraw therefrom, thereby cutting a stack of blanks from the pile on each said penetration, second actuating means for recurrently shifting said pile in said upright plane to different locations relative to said line of movement to position the cutting die at a plurality of positions about the lateral extent of the pile for the cutting of blanks at each of said positions, and means for correlating the movements of the first and second actuating means to provide for a cycle of cutting operations by the cutting die upon movement of the first actuating means at each of said positions upon the shifting of the pile by said second actuating means consecutively through said positions.

11. Apparatus as claimed in claim 10, and including ejecting means correlated with said first and second actuating means for ejecting blanks cut by the cutting die from said cutting die upon withdrawal of the cutting die from the pile by said first actuating means.

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12. In apparatus for die cutting a plurality of blanks for containers or the like from a pile of sheets, the combination of first means for holding said pile of sheets suspended freely from a side thereof in assembled side-by-side relationship and in an upright plane during the die-cutting operation, second means adapted to move a cutting die in a line of motion substantially normal to said upright plane and against and away from said pile to recurrently penetrate said pile on each motion against said pile, third means for shifting said pile laterally in said upright plane relative to the said line of motion of said second means in the interval between penetrating movements of said second means to align uncut portion of the pile with said line of motion of said second means, and fourth means for synchronizing the movements of said second means and said third means.

13. The combination as defined in claim 12 and including fifth means for ejecting after each movement of the cutting die away from the pile the cut blanks from the cutting die.

14. Apparatus for cutting blanks from a pile of sheet material with a cutting die having the internal cross-sectional shape of the blanks to be cut, comprising in combination first means for suspending a pile of sheet material to hang vertically by its weight from the upper edge thereof free of compression below said upper edge, second means for providing a vertical backing adjacent to the rear side of the suspended pile, third means for moving a cutting die in a line of motion normal to the vertical plane of said pile forwardly into said pile and against said second means to cut blanks of said shape upon the penetration of the cutting die into the pile and for successively withdrawing the cutting die in said line of motion from said pile with the cut blanks in said cutting die, fourth means for shifting, after each withdrawing motion of the third means and clearance of the cutting die from said pile, the said first means laterally relative to the line of motion of said third means to successively move uncut areas of said pile into alignment with said cutting die for successive cutting of blanks thereby, fifth means for ejecting cut blanks from the cutting die after each forward movement of the third means and the cutting of blanks by the cutting die, and sixth means for synchronizing the movements of said third, fourth and fifth means.

15. Apparatus as defined in claim 14, and including seventh means for recurrently moving said second means laterally of the line of movement of said third means for changing the area of the second means against which the cutting die is moved.

16. In apparatus of the class described, the combination of first means for reciprocating in a substantially horizontal line of movement a cutting die adapted to cut and receive a plurality of blanks from a pile of sheet material penetrated by the cutting die, second means for suspending said pile by its weight from an upper edge portion thereof in a vertical plane in the line of movement of said cutting die and free of compression below said upper edge portion, third means for resisting movement of said pile in said line of movement away from said cutting die during the cutting operation, and fourth means movable after each withdrawing movement of the cutting die from the said pile by said first means for shifting said pile in said vertical plane relative to said horizontal line of movement to align successively uncut portions of the pile with said cutting die prior to the next penetration of the pile by said cutting die.

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