

May 29, 1956

O. D. FENIMORE

2,747,189

PAMPHLET FORMING MACHINE

Filed July 1, 1954

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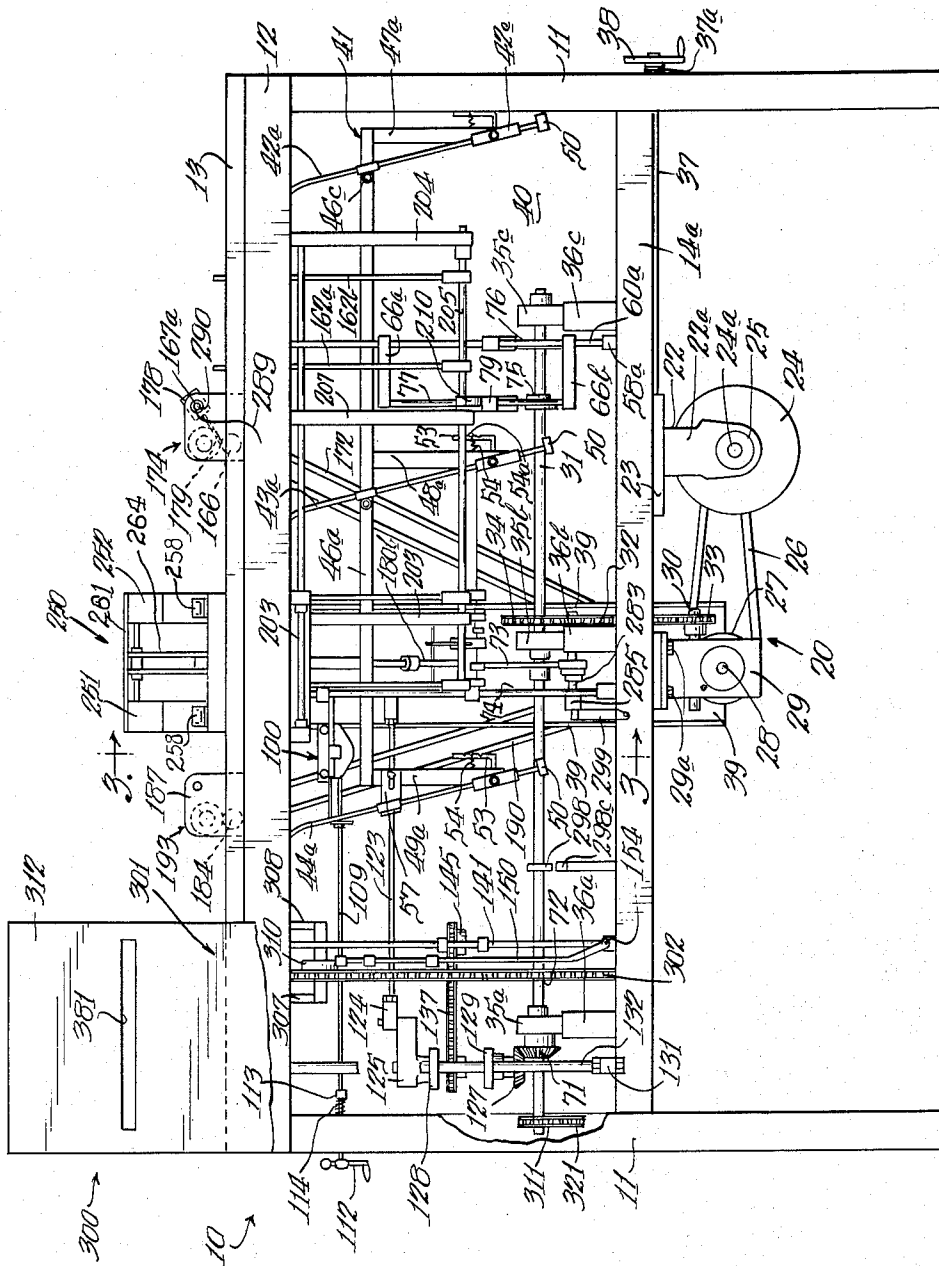


Fig. 1.

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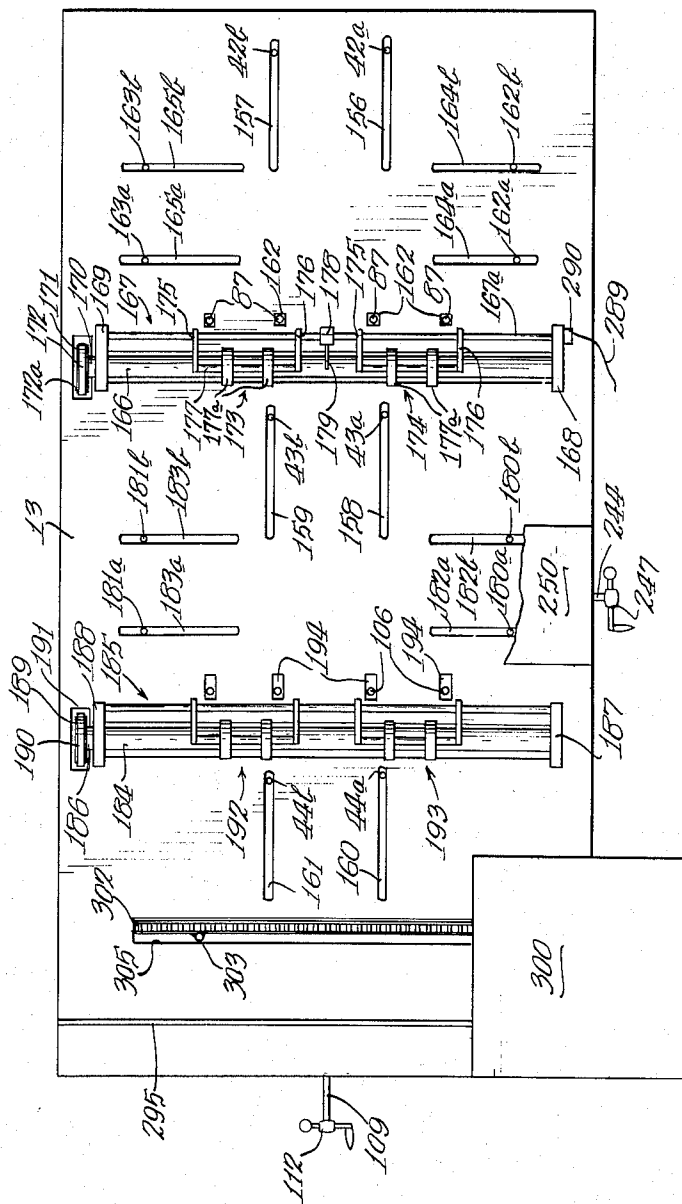
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FIG. 2.



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Fig. 3

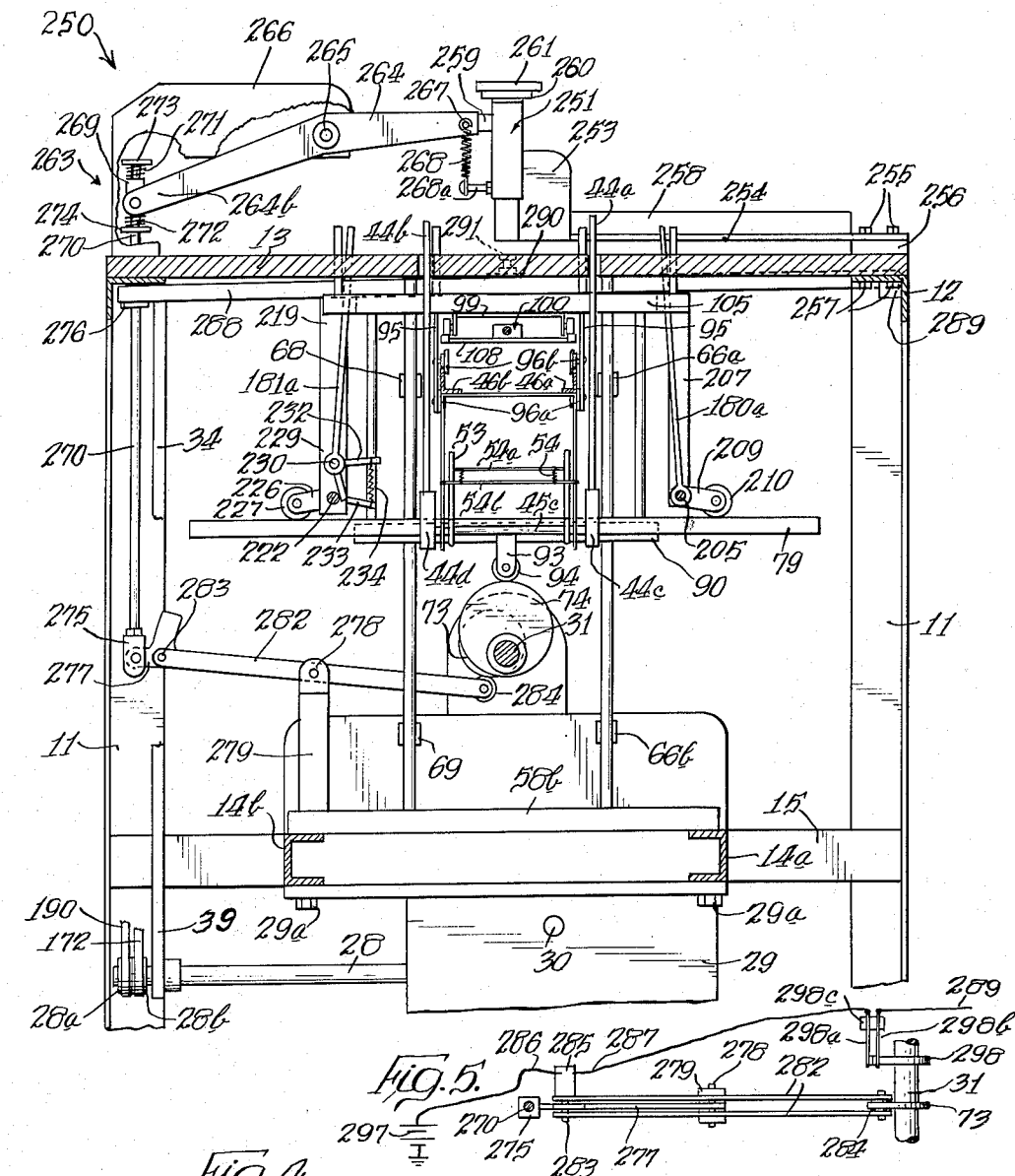


Fig. 5

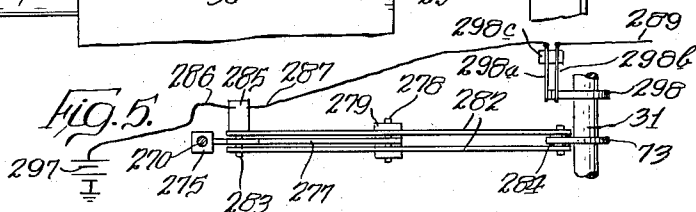
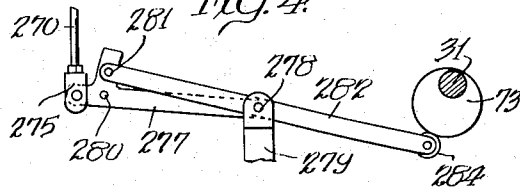


Fig. 4



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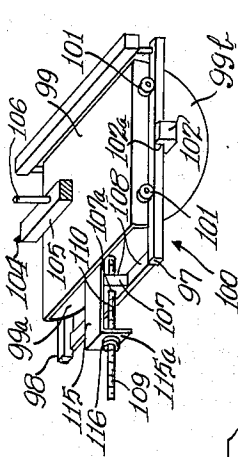
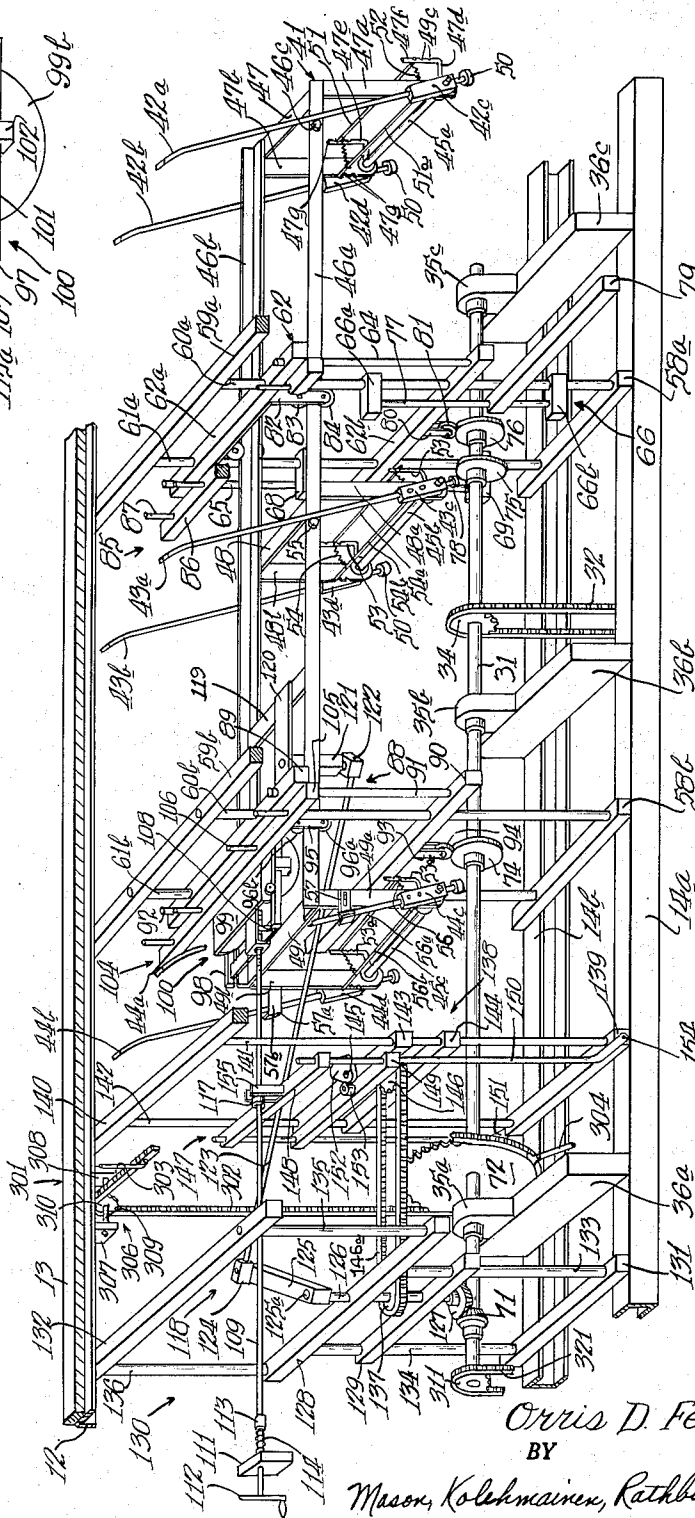


Fig. 6a.

Fig. 6.



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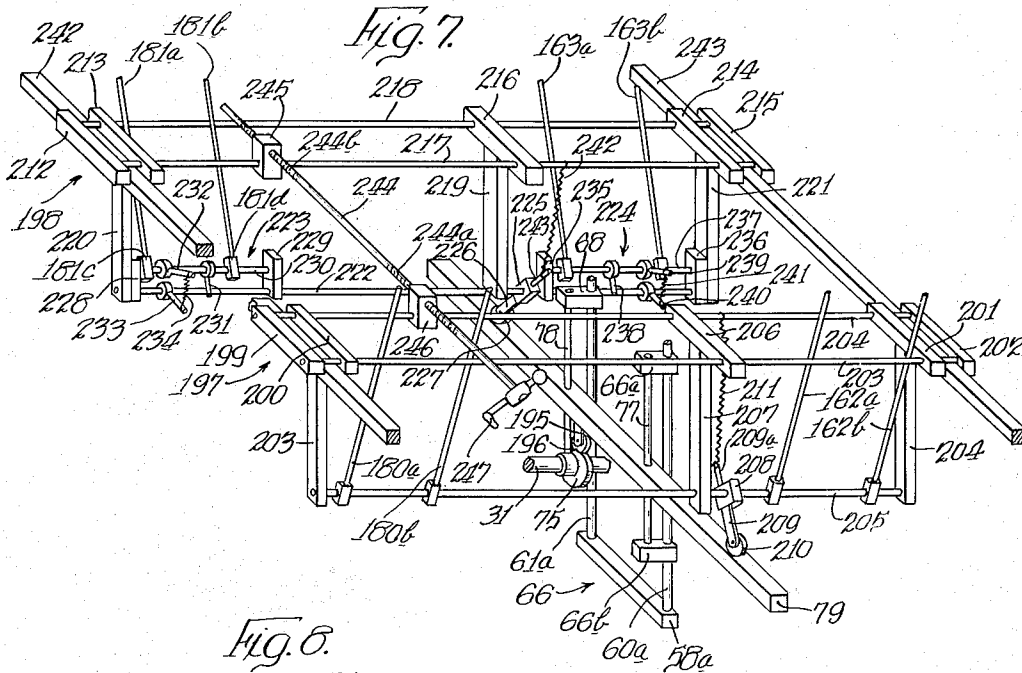
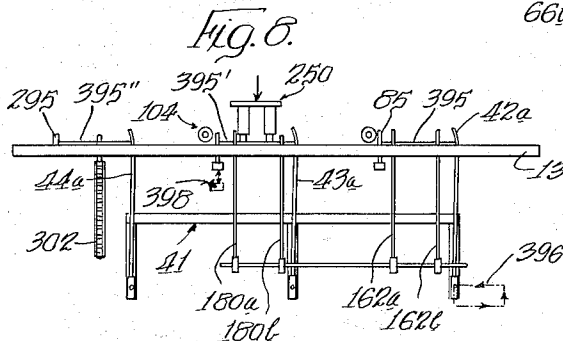
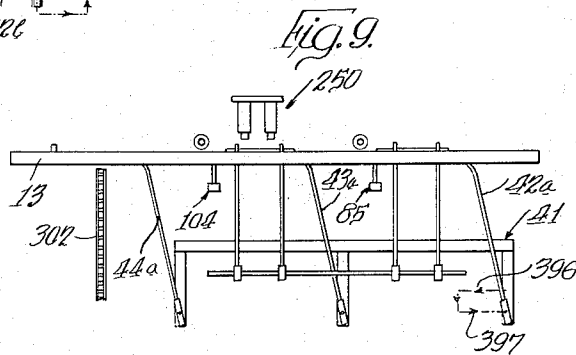
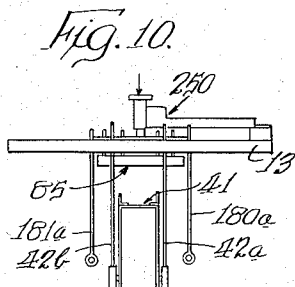
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Fig. 12.

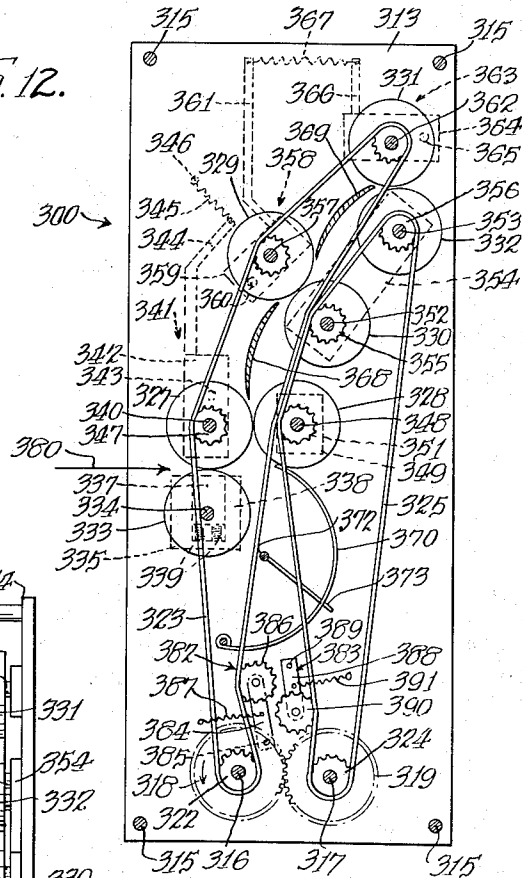
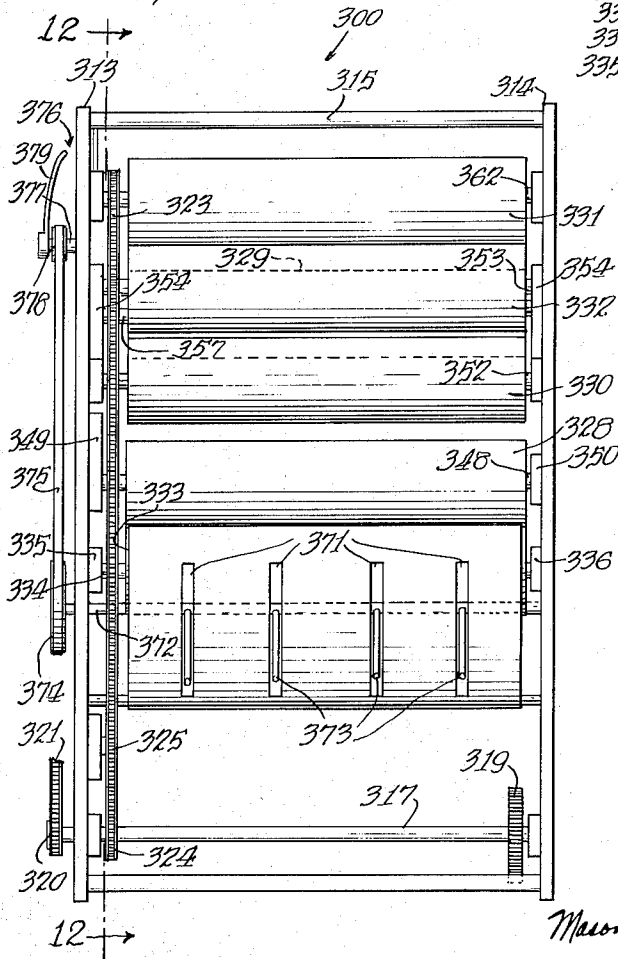


Fig. 11.



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PAMPHLET FORMING MACHINE

Orris D. Fenimore, Woodward, Okla.

Application July 1, 1954, Serial No. 440,779

31 Claims. (Cl. 1—106)

The present invention relates generally to a machine for forming pamphlets and books and more particularly to a machine for joining together stacked sheets of material and thereafter folding the same into pamphlet or booklet form.

One of the principal objects of the invention is to provide a versatile machine of the above indicated character which is capable of being rendered selectively operative to join together stacks of sheets of material or signatures having different thickness and having different dimensions.

Another object of the present invention is to provide improved mechanism for feeding a flat stack of printed material or signatures to a stitching or stapling device where the sheets are joined together and for thereafter passing the joined sheets to a folding mechanism.

A further object of the present invention is to provide a machine of the above indicated character which may be rendered selectively operative to bind together sheet material and signatures of various sizes.

Still another object of the present invention is to provide a booklet or pamphlet forming machine in which stacks of sheet material are fed to a stitching or stapling mechanism for joining the sheets together which machine is capable of handling stacks of sheets or signatures having different lengths and widths without necessitating an adjustment of the position of the stapling or stitching mechanism.

It is likewise an object of the present invention to provide a pamphlet forming machine which may be employed to join together stacks of printed material containing even a relatively few sheets without crumpling or injuring the sheets.

A still further object of the present invention is to provide improved apparatus for feeding stacks of sheet material in succession to a mechanism for stapling or stitching the sheets together in which provision is made for adjusting the feeding mechanism so that alternate stacks of material are stapled or stitched together at different positions.

Still another object of the present invention is to provide a compact, relatively inexpensive pamphlet forming machine including feeding mechanism, a stapling or stitching device and folding means, all actuated from a common drive source.

In accordance with the present invention, the aforementioned and other objects are realized by providing a machine including a substantially enclosed housing having a stapling or stitching mechanism pivotally mounted at a fixed position on its top surface. Stacks of sheet material, which are adapted to be joined together to form a booklet or pamphlet, are successively deposited on top of the housing and are advanced therealong in step by step fashion by a feeding mechanism comprising spaced sets of reciprocating fingers and at least two pairs of feed rollers. The sets of reciprocating fingers are all pivotally mounted on a single supporting structure and each set

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of fingers includes resilient means interposed between the fingers and the supporting structure for returning the fingers to their normal positions when they are pivoted. In order to facilitate the formation of pamphlets from stacks having different thicknesses, provision is made for selectively adjusting the amount of force applied by the resilient means to the fingers when they are pivoted about the supporting structure.

The sets of spaced fingers are reciprocated in unison and are elevated during their advance stroke so that their ends extend above the top surface of the housing whereby each set of fingers engages the rear edge of one of the stacks. The ends of the fingers are lowered below the top surface of the housing during their return stroke in order that the fingers may return to their original positions without interfering with the movement of the stacks of sheet material. The first set of fingers moves each stack along the top of the housing after it is deposited thereon until the stack is confronted by a reciprocating fence for engaging the front edge of the stack in order to align the sheets along their front and rear edges. Transversely movable fingers engage the side edges of the stack in order to complete the alignment. When the fence is lowered below the top surface of the housing, the stack is pushed into contact with the first pair of feed rollers and, from there, it is fed to the second pair of fingers. The second pair of feed fingers moves each stack along the top of the housing until the front edge of the stack engages a second reciprocating fence which is raised into the path of movement of the stacks during each advance stroke of the fingers and which descends below the top surface of the housing during each return stroke of the fingers. The engagement of the front and rear edges of the stack with the second reciprocating fence and with the second set of fingers, respectively, jogs the sheets into alignment and momentarily holds the stack in fixed position with respect to the top of the housing. While the stack is held in this manner, sets of transversely movable fingers positioned on opposite sides of the housing are moved toward each other and into engagement with the two side edges of the stack. When the sheets are completely aligned by the action of the second fence, the second pair of fingers, and the transversely movable fingers, the stapling or stitching mechanism is automatically actuated to bind the sheets together. After the sheets are bound they are fed to the second pair of feed rollers which function to pass the joined sheets to a third set of fingers for application to a folding mechanism where the stack is folded into pamphlet or booklet form.

The position of both sets of transversely movable fingers on the housing may be controlled by manually operated adjusting means which functions to move these fingers towards or away from each other in unison in order to permit the machine to handle sheets having different dimensions. Means are provided for automatically moving the second fence back and forth in the direction of movement of the stacks at a rate equal to one-half the rate of reciprocation of said fingers so that successive stacks of sheets are joined together at different positions thereby facilitating storage and shipment of the pamphlets formed by the machine. The position of the second fence may also be adjusted by a manually operated control mechanism in order to enable the machine to form pamphlets from sheet material of different dimensions.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof will best be understood by reference to the following detailed description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a side elevational view of a machine em-

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bodying the present invention but having its side panels removed better to illustrate the working parts of the machine;

Fig. 2 is a plan view of the machine shown in Fig. 1, having a portion of the top cover broken away;

Fig. 3 is an enlarged cross sectional view looking in the direction of the arrows 3—3 in Fig. 1;

Fig. 4 is a broken away view illustrating certain portions of the mechanism for actuating the stapler or stitching apparatus as viewed looking endwise of the machine;

Fig. 5 is a plan view of the apparatus shown in Fig. 4;

Fig. 6 is an enlarged perspective view partially broken away and illustrating the details of the feeding mechanism of the machine shown in Fig. 1;

Fig. 6A is an enlarged broken away perspective view showing the details of the structure for staggering the staples applied to successive stacks of sheets by the stapling mechanism;

Fig. 7 is an enlarged perspective view showing the structure for operating the transversely movable fingers of the machine shown in Fig. 1;

Figs. 8, 9 and 10 are schematic diagrams illustrating the sequence of operation of the feeding mechanism and the stapling mechanism of the machine shown in Fig. 1;

Fig. 11 is an enlarged front elevation view of the folding mechanism of the machine shown in Fig. 1 having its housing removed; and

Fig. 12 is a cross-sectional view of the mechanism shown in Fig. 11, taken along a line substantially corresponding to the line 12—12 in Fig. 11.

Referring now to the drawings and more particularly to Figs. 1, 3 and 6 thereof, the present invention is there illustrated as embodied in a machine including a rigid housing generally indicated by the reference character 10. The housing 10 supports a drive assembly generally designated as 20, a feed mechanism generally indicated as 40, a binding device 250 for joining stacks of sheet material together and a folding apparatus 300, all of which are cooperatively related in a manner which will become evident as the description proceeds. Briefly, the drive assembly functions to actuate the feed mechanism, the binding device and the folding apparatus so that stacks of sheet material are fed along the top of the machine in step by step fashion, are joined together and are then folded into pamphlets or booklets and discharged from the machine.

As best illustrated in Fig. 1, the housing 10 includes a framework comprising four upright legs 11, only two of which are visible in Fig. 1, for supporting at its four corners a rectangular framework 12 having secured thereto in any suitable manner as, for example, by spaced screws (not shown in the drawings), a flat cover plate or top surface 13 for the housing 10 along which the stacks of sheet material are advanced in a manner to be described more fully hereinafter. For the purpose of supporting a pair of horizontally disposed, parallel, channel shaped, frame members 14a and 14b upon which a majority of the working parts of the machine are carried, the legs 11 have secured thereto in any suitable manner a pair of identical end bars 15, best shown in Fig. 3 of the drawings and extending across opposed ends of the housing. The horizontal frame members 14a and 14b extend longitudinally of the housing 10 between the two end bars 15 to which they are attached in any suitable manner, as by welding. In order to protect the machine operator by preventing his limbs and clothing from becoming entangled in the working parts of the machine, the four legs 11 and the bars 15 may carry panels or covers for the ends and sides of the housing 10 although in the drawings these panels have been omitted to facilitate the illustration of the invention.

The drive assembly 20 includes a drive source 24, illustrated in Fig. 1 as an electric motor, mounted upon a substantially U-shaped bracket 22 carried by a motor support carriage 23. The motor support carriage 23 is

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mounted for movement longitudinally of the housing upon the parallel frame members 14a and 14b, the reason for which will become evident as the description proceeds. For the purpose of rotatably journalling the ends of motor shaft 24a, each of the downwardly extending legs 22a of the U-shaped bracket 22 carries a bearing assembly 25, although only one such assembly is visible in Fig. 1. The end of the motor shaft 24a which cannot be seen in Fig. 1 has mounted thereon a pulley (not shown in the drawings) for driving, through a flexible belt 26, a pulley 27 mounted upon a shaft 28 extending parallel to the motor shaft 24a and rotatably supported within a gear housing 29.

For a purpose which will subsequently become evident, the shaft 28, as best shown in Fig. 3, extends from the gear housing 29 through a bearing assembly carried on supporting structure 39 suspended from the framework 12 in order to support on its outer end a pair of pulleys 28a and 28b. The gear housing 29 is mounted, by means of bolts 29a, in fixed position on the underside of the parallel frame members 14a and 14b. This housing includes suitable gearing such as a worm gear and a worm wheel which serves as a speed reduction mechanism for driving a shaft 30 extending perpendicularly to the shaft 28 at a speed considerably less than the speed of rotation of the motor shaft 24a, the gearing being omitted from the drawings since it is conventional. The gear housing 29 also includes appropriate bearings (not shown) for journalling both of the shafts 28 and 30.

For the purpose of interconnecting the shaft 30 with an elongated main drive shaft 31 extending longitudinally of the housing 10, there is provided a chain 32 in engagement with both a drive sprocket 33 carried on one exposed end of the shaft 30 and a driven sprocket 34 mounted intermediate the ends of the main drive shaft. A plurality of bearing assemblies 35a, 35b and 35c respectively affixed to spaced pillow blocks 36a, 36b and 36c carried on the frame members 14a and 14b, journal the main drive shaft 31 and maintain it in proper position within the housing 10. In order to actuate the feeding mechanism 40, the stapling device 250 and the folding apparatus 300 in a manner to be subsequently described in detail, the main drive shaft 31 has mounted thereon at spaced positions a drive sprocket 311, a bevel gear 71, a drive sprocket 72, and a plurality of cams 73, 74, 75 and 76.

In order to adjust the variable speed pulley mounted on the end of motor shaft 24a not visible in Fig. 1, suitable mechanism is provided for selectively moving the motor support carriage 23 along the frame members 14a and 14b in a direction toward or away from the fixedly positioned gear housing 29. This mechanism, as shown in Fig. 1, comprises an elongated rod 37 having one end connected to but rotatably supported within the motor support carriage 23 and having mounted upon its other end a manually rotatable handle or wheel 38, for turning the rod. A portion of the rod adjacent the handle 38, as indicated at 37a, is threaded so as to engage fixed structure on one of the end bars 15, whereby, when the handle 38 is turned, the rod 37 moves longitudinally of the housing 10 in a direction dependent upon the direction of rotation of the handle. Obviously, movement of the rod 37 induces a corresponding movement of the motor support carriage 23, thereby to adjust the tension on the belt 26 and increase or decrease speed of rotation of the shaft 31 by an amount which is a direct function of the amount and direction of rotation of the handle 38.

Reference is now made to Figs. 1, 2 and 6 for a description of the feed mechanism 40 which includes a supporting framework or structure generally indicated as 41 and a plurality of spaced pairs of fingers, these pairs of fingers being designated 42a and 42b, 43a and 43b, and 44a and 44b, respectively, and being mounted for pivotal movement about the framework upon spaced pivot rods 45a, 45b and 45c. The framework 41 comprises a pair

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of spaced parallel angle bars 46a and 46b extending longitudinally of the housing 10 and interconnected by a plurality of spaced, substantially U-shaped brackets 47, 48 and 49. These brackets have their base portions fastened to both of the angle bars 46a and 46b and each has a pair of downwardly extending legs for supporting the pivot rods 45a, 45b and 45c. Thus, for example, the pivot rod 45a extends through opposed leg portions 47a and 47b of the bracket 47 and has secured to its exposed ends collars 42c and 42d respectively carried by the fingers 42a and 42b. In order to provide balance for the fingers, the lower end of each finger is provided with a suitable counterweight 50. The pivot rod 45a also has fixedly secured thereto at spaced positions adjacent the legs 47a and 47b of the bracket 47 a pair of identical, substantially L-shaped spring retaining members 47c and 47d. Upstanding legs 47e and 47f of the L-shaped members 47c and 47d, respectively, are each provided with a plurality of spaced grooves 49c, the grooves in these legs being aligned in pairs in order to receive a rod 51 carrying a spring 52 at each of its ends. The legs 47a and 47b of the bracket 47 are also provided with a plurality of spaced grooves 47g, the grooves of these legs also being aligned in pairs in order to accommodate a rod 51a having its ends secured to the springs 52. The springs 52 are of the tension type and function to store energy when the fingers 42a and 42b are pivoted from their normal positions shown in Fig. 6 about the framework 41 in a clockwise direction in a manner to be subsequently described in detail. In order to vary the amount of energy stored in the springs 51 when the fingers 42a and 42b are pivoted for a purpose which will soon become apparent, the position of the springs may be adjusted by selectively moving the rods 51 and 51a into registry with suitable pairs of the grooves 49c and 47g, respectively. The energy stored in the springs 52 when they are stretched is employed to return the fingers to their normal positions by rotating these fingers in a counter-clockwise direction as viewed in Fig. 6 from the positions which they assume when pivoted. The counter-clockwise rotation of the fingers 42a and 42b is limited by engagement of each of these fingers with a stop 46c extending laterally from each of the angle bars 46a and 46b, only one of these stops being visible in Fig. 6.

In similar manner, the pivot rod 45b extends through opposed legs 48a and 48b of the bracket 48 and into engagement with collars 43c and 43d respectively carried by the fingers 43a and 43b. The pivot rod 45b also carries at spaced positions adjacent each of the legs 48a and 48b, L-shaped members 53, each having a grooved upright arm. Parallel rods 54a and 54b having their ends interconnected by springs 54 are respectively retained within a suitable aligned pair of grooves on the upright arms of the members 53 and within aligned grooves in the legs 48a and 48b of the bracket 48. The position of these rods may be adjusted within different pairs of these grooves in order to adjust the tension on the springs 54 in the manner previously described. Stops 55 extending laterally from the angle bars 46a and 46b are respectively provided for limiting the movement of the fingers 43a and 43b.

The rod 45c carrying the fingers 44a and 44b has associated therewith structure identical to that provided for the other two sets of fingers 42a and 42b and 43a and 43b which structure has previously been described. Thus, the fingers 44a and 44b are provided with collars 44c and 44d mounted on the ends of the pivot rod 45c which extend beyond legs 49a and 49b of the bracket 49. L-shaped members 53a carried by the pivot rod 45c are provided with aligned pairs of grooves for receiving a rod 56a while similar grooves in the legs 49a and 49b of the bracket 49 accommodate a rod 56b, the two rods 56a and 56b being interconnected at their ends by springs 56. As previously described, the position of these rods 56a and 56b on the upright arms of the members 53a and on the

legs 49a and 49b, respectively, may be varied to adjust the tension on the springs 56. Due to the fact that the angle bars 46a and 46b do not extend beyond the fingers 44a and 44b, stops 57 for limiting the movement of the fingers 44a and 44b are secured to the legs 49a and 49b of the bracket 49. Each of these stops comprises an arm member 57b extending generally in the direction of the angle bars 46a and 46b and having a flange portion 57a directed laterally of the arm member and into the path of movement of the fingers 44a and 44b. The stops 57 limit the rotation of the fingers 44a and 44b in a counterclockwise direction, in an obvious manner.

Referring now to Fig. 6 for a description of the structure for supporting the framework 41 within the housing 10 it will be seen that this structure includes a pair of spaced horizontal bars 58a and 58b each extending transversely of the housing 10 and each having its ends secured to the side bars 14a and 14b. A similar pair of bars 59a and 59b each have their ends secured to the side members of the framework 12 at the top of the housing and each extends transversely of the housing 10 in alignment with and parallel to the bars 58a and 58b, respectively. A pair of parallel vertical rods 60a and 61a extend between the parallel bars 58a and 59a and, in like manner, a pair of vertical rods 60b and 61b extend between the parallel bars 58b and 59b. A rectangular frame 62 comprising horizontal bars 62a and 62b and vertical rods 64 and 65 is adapted to be moved up and down at a predetermined rate upon the rods 60a and 61a.

For the purpose of actuating the transversely movable fingers in a manner to be subsequently described in detail, there is provided a second framework 66, comprising offset blocks 66a, 66b, 68 and 69, vertical support rods 77 and 78 and horizontal bar 79, which framework is mounted for reciprocal movement in a vertical direction upon the vertical rods 60a and 61a. A major portion of the framework 66 together with structure which it actuates has been omitted from Fig. 6 of the drawings in the interest of clarity, the details of this structure being shown in Fig. 7 and being described in detail hereinafter. For the purpose of raising and lowering the framework 62, the horizontal bar 62b carries intermediate its ends a bifurcated bracket 80 for supporting a cam follower 81 upon a small supporting pin interconnecting the bifurcations. The cam follower 81 rides upon the periphery of the cam 76 mounted upon the main drive shaft 31 and functions to alternately elevate and lower the framework 62 in an obvious manner. In order to support the framework 41 and to facilitate the raising and lowering of this framework simultaneously with the elevation and descent of the framework 62, the horizontally extending rod 62a has mounted thereon a pair of spaced, identical, downwardly extending support arms 82 each rotatably supporting a pair of cooperable rollers 83 and 84 respectively engaging the upper and lower surfaces of the angle bars 46a and 46b. A reciprocating fence 85 comprising a horizontally extending bar 86 and a plurality of upright finger-like elements 87, is secured to the bar 62a with the result that this fence is raised and lowered as the framework 62 is reciprocated in a vertical direction.

To provide additional support for the framework 41, a second rectangular framework 88, comprising horizontal bars 89 and 90 interconnected by vertical support rods 91 and 92, is mounted for reciprocal movement upon the vertical rods 60b and 61b. Horizontal bar 90 carries a bifurcated support bracket 93 at approximately its center for the purpose of mounting a cam follower 94 which rides upon the periphery of the cam 74 and functions to raise and lower the framework 88 as this cam is rotated. The horizontal bar 89, like the bar 62a, carries a pair of downwardly extending support arms 95 each of which extends along the side of one of the frame members 46a and 46b and each of which is provided with a pair of rollers 96a and 96b in engagement with the upper and lower surfaces of the frame member adjacent thereto.

The bar 89 also carries a pair of spaced parallel rail members 97 and 98 which are fixedly secured to the bar but are, of course, raised and lowered with the framework 88. As best shown in Fig. 6A, these rails support a carriage 100 including a substantially flat top plate 99 and a pair of sides 99a and 99b extending downwardly from the top plate along the inside of the rails 97 and 98, respectively. In order to facilitate the movement of the carriage 100 upon the rails, each of the sides 99a and 99b supports a pair of spaced rollers 101 in engagement with the top surface of the rails. In order to maintain the carriage 100 in operative engagement with the rails 97 and 98, each of the sides 99a and 99b also includes a channel bar or guide 102 having a groove or channel 102a therein through which one of the rails 97 or 98 extends. A fence 104, comprising a horizontally extending bar 105 secured to the top plate 99 and a plurality of spaced, upright, finger-like elements 106, is secured to the carriage for movement therewith. For the purpose of supporting a collar 107 having a threaded central bore 107a therein, there is provided a support arm 108 extending laterally of the rail 97 and permanently affixed thereto.

In order to adjust the position of the carriage 100 upon the rails 97 and 98, there is provided an elongated rod 109 having a threaded end portion 110 in engagement with the bore 107a in the collar 107. The rod 109 extends longitudinally of the housing through a support member 111 secured to the end pieces of the framework 12 and, upon the exposed end of the rod, there is mounted a control wheel or handle 112 by which the rod may be turned to any desired position. A spring retaining collar 113 carried by the rod 109 functions to position between the collar and the support member 111 a spring 114 encircling the rod. In order to facilitate rotation of the rod 109 as well as longitudinal movement of this rod with respect to the housing 10, the support member 111 may be provided with suitable bearings for rotatably supporting the rod. In order to attach the rod 109 to the carriage 100, there is provided an arm 115 secured to the underside of the top plate 99 and having a downwardly extending flange 115a carrying a bearing assembly 116 which rotatably journals the rod 109 but at the same time affixes the flange 115a to the rod for movement when the latter is adjusted. It now becomes apparent that, when the rod 109 is turned by means of the handle 112, the threaded end portion 110 of the rod functions in the manner of a lead screw and, in cooperation with the collar 107, moves the rod longitudinally of the housing in a direction dependent upon the direction of rotation of the handle. The longitudinal movement of the rod 109 obviously induces corresponding movement of the carriage 100 upon the rails 97 and 98, thereby to move the fence 104 longitudinally of the housing 10. The rod 109 also carries a collar 117 at a position intermediate its ends for a purpose which will subsequently become apparent.

In order to provide for the reciprocation of the framework 41 longitudinally of the housing 10, there is provided a reciprocating means indicated generally by the reference character 118 and including a support 119 extending between the side members 46a and 46b of the frame 41. A brace 120 connected between the support 119 and the base of the bracket 49 carries on its underside at a position intermediate its ends an offset 121, the latter being provided at its lower end with a rotatable coupling 122. A reciprocating rod 123, having one end attached to the rotatable coupling 122 and having its other end secured to a similar rotatable coupling 124 carried by a connecting element 125, functions to impart the movement of this connecting element to the framework 41. Specifically, the connecting element is secured, as indicated at 125a, for rotation with a vertically extending shaft 126 which shaft carries at its lower end a bevel gear 127 in engagement with the bevel gear 71

mounted on the main drive shaft 31. In order to support the shaft 126 within the housing 10, this shaft is journaled within suitable bearing elements carried by horizontal bars 128 and 129 of a framework 130. This framework comprises, in addition to the bars 128 and 129, a horizontal bar 131 extending between the frame members 14a and 14b, a horizontal bar 132 interconnecting the side members of the framework 12, a first pair of vertical support rods 133 and 134 interconnecting the bars 128, 129 and 131, and a second pair of vertical support rods 135 and 136 offset from the first and interconnecting the bars 128 and 132. A drive sprocket 137 is mounted upon the shaft 126 at a position between the horizontal bars 128 and 129 for a purpose which will soon become apparent.

For the purpose of reciprocating the carriage 100 upon the rails 97 and 98 at a rate correlated with the rate of reciprocation of the framework 41 by the reciprocating means 118, there is provided a reciprocating mechanism indicated generally by the reference character 138. This reciprocating mechanism includes a rigid framework comprising a horizontal bar 139 extending between the frame members 14a and 14b, a horizontal bar 140 extending between the side members of the framework 12, a pair of vertical support rods 141 and 142 interconnecting the horizontal bars 139 and 140, and a pair of spaced horizontal supports 143 and 144 mounted in fixed positions intermediate the ends of the vertical support rods 141 and 142. A small stub shaft 145 extends between the bars 143 and 144 and carries a sprocket 146 at approximately its center. A chain 146a in engagement with the sprocket 137 and the sprocket 146 imparts the rotation of the shaft 126 to the stub shaft 145.

For the purpose of pivoting a framework 147, comprising horizontal bars 148 and 149 and vertical supports 150 and 151, about the horizontal bar 139, there is provided a cam 152 secured to the end of the shaft 145. Specifically, the cam 152 engages a cam follower 153 carried at approximately the center of the horizontal bar 149 in order to pivot the framework 147 about pivot pins 154 extending from the opposed ends of the horizontal bar 139 and through portions of the vertical rods 150 and 151. When the frame 147 is pivoted in a counter-clockwise direction as viewed in Fig. 6, a bifurcated guide member 155, which is carried at approximately the center of the horizontal bar 148 and straddles the rod 109, engages the collar 117 and moves the rod 109 to the left, thereby compressing the spring 114 between the collar 113 and the structure 111 and, at the same time, moving the carriage 100 upon the guide rails 97 and 98. When the cam follower 153 engages the reduced portion of the cam 152, the spring 114 returns the rod 109 to the right until it occupies the position shown in Fig. 6 with the result that the carriage 100 is likewise moved to the right.

To facilitate an understanding of the invention, a brief summary of the operation of the mechanism thus far described will now be made with particular reference to Figs. 1, 2 and 6. From the foregoing explanation, it will be apparent that the drive assembly 20 functions continuously to rotate the main driveshaft 31 at preselected constant speed in order to rotate the various cams, sprockets and the bevel gear 71 attached to this shaft. The cams 74 and 76 are identical in shape and are positioned in spaced but aligned positions upon the shaft 31; i. e., the raised portion of the cam 74 will contact the cam follower 94 at exactly the same time that the raised portion of the cam 76 contacts the cam follower 81. When the cam followers 81 and 94 are simultaneously in engagement with the enlarged portions of the cams 76 and 74, respectively, the framework 41 is elevated and the pairs of fingers 42a and 42b, 43a and 43b, and 44a and 44b are raised in unison whereby their upper ends extend through longitudinal slots formed in the cover plate 13 and best shown in Fig. 2. More particularly,

the fingers 42a and 42b, when raised, extend upwardly through slots 156 and 157, respectively, and engage the rear edge of a stack of sheet material when the stack is deposited upon the top 13 of the housing as shown in the diagrammatic illustration of Fig. 8. Although, in the embodiment of the invention illustrated, the stacks are adapted to be manually placed upon the top of the housing, it will be apparent from the ensuing description that if desired, suitable mechanism may be readily provided for depositing these stacks automatically. The fingers 43a and 43b, when raised, extend upwardly through elongated longitudinal slots 158 and 159 and, in the event that successive stacks of material have been placed upon the top 13 of the housing 10, these fingers also engage the rear edge of a stack of sheet material. Similarly, the fingers 43a and 43b extend upwardly through elongated longitudinal slots 160 and 161 in the top cover 13 when raised and these fingers also may engage the rear edge of a stack of sheet material. Simultaneously with the raising of the framework 41, the reciprocating mechanism 118 functions to move the framework and the pairs of fingers from the position which they occupy in Fig. 6 to the left, this movement being effected by the rotation of the connecting element 125 to move the rod 123. As the framework 41 is moved to the left, the pairs of fingers move within their associated elongated slots and push the stacks along the top 13 of the housing. The engagement of the cam follower 81 with the enlarged portion of the cam 76 has another very important effect, in that, it raises the fence 85 carried by the framework 62 whereby the finger-like elements 87 of this fence extend upwardly through spaced but aligned openings 162 in the cover 13. Although the fence 85 is raised and lowered simultaneously with the elevation and descent of the framework 41, this fence is not reciprocated longitudinally of the housing due to the fact that the frame 62 remains rigid while the reciprocating framework 41 is moved along the rollers 83 and 84. Thus, as the stack of sheet material engaged by the fingers 42a and 42b is moved to the left as viewed in Fig. 2, the front edge of the stack is confronted by the raised finger-like elements 87 of the fence 85 with the result that the sheets in the stack are jogged into alignment. The fence 85 functions to hold the stacks in fixed position on top 13 of the housing 10 whereby the continued movement of the frame 41 to the left causes the fingers 42a and 42b to pivot the rod 45a about the legs of the bracket 47. The fingers 42a and 42b are pivoted in a clockwise direction as viewed in Fig. 6 in order to increase the tension on the springs 51.

While the stack is held between the fingers 42a and 42b and the finger-like elements 87, the cam 75 mounted on the main driveshaft 31 functions to move opposed pairs of finger-like elements 162a and 162b and 163a and 163b toward each other in a manner to subsequently be described in detail in order to align the sheets in the stack along their side edges. As will be apparent from Fig. 2, the ends of the opposed pairs of fingers 162a and 162b extend through a pair of transverse parallel slots 164a and 164b in the top of the cover 13 while the ends of the pair of fingers 163a and 163b extend through a pair of parallel transverse slots 165a and 165b, respectively. After the stack of sheets is aligned along all four edges by cooperation between the transversely movable fingers, the fence 85 and the reciprocating fingers 42a and 42b, the cam follower 81 is moved into engagement with a reduced portion of the cam 76 thereby lowering the frame 62 and the fence 85 as well as the framework 41. Due to the fact that the fingers 42a and 42b extend upwardly above the top surface of the cover 13 for a greater distance than the finger-like elements 87 of the fence 85, when tops of the elements 87 are lowered below the top surface of the cover 13, the upper ends of the fingers 42a and 42b remain exposed above this cover. When the elements 87 of the fence 85 are lowered below the top

13 of the housing, the energy stored in the springs 51 is released to pivot the fingers 42a and 42b in a counter-clockwise direction as viewed in Fig. 6 with the result that the stack of sheet material is flipped or kicked into engagement with a pair of feed rollers 166 and 167 which are positioned at the top of the housing and are rotatably supported within a pair of spaced and aligned end plates 168 and 169. The roller 166 is mounted upon a roller shaft 170 extending through the plate 169 and having mounted upon its exposed end a pulley 171. In order to rotate the feed roller 166 the pulley 171 is connected by means of a belt 172 to the pulley 28a mounted upon the end of the shaft 28 extending beyond the supporting structure 39. To eliminate the possibility of the machine operator becoming entangled with the belt 172, this belt passes through an opening 172a in the top 13 of the housing and extends downwardly through the housing and into engagement with the pulley 28a.

The idler roller 167 actually comprises a supporting rod 167a extending transversely of the housing between the end plates 168 and 169 and carrying thereon a pair of spaced identical idler carriages 173 and 174. Each of these carriages includes a pair of parallel arm members 175 and 176 connected at one end to and extending laterally of the rod 167a and interconnected at their remote ends by an axle 177. The axle supports a pair of idler rollers 177a in engagement with the upper surface of the feed roller 166 thereby to maintain the stacks in engagement with the feed roller as they are fed from the fingers 42a and 42b. For a purpose which will subsequently become evident, the rod 167a also carries a metallic, electrically conducting brush 178 carrying a contact arm 179 which is adapted to contact the top cover 13 in the absence of stacks passing between the feed roller 166 and the idler roller 167. When the stacks are flipped or kicked by the fingers 42a and 42b into engagement with the rollers 166 and 167, these rollers function in conventional manner to move the stacks through the rollers to a position where they may be picked up by the fingers 43a and 43b during the next succeeding elevation and reciprocation of the framework 41. After the stack has been passed through the feed rollers 166 and 167, the cam followers 81 and 94 engage the reduced portions of the cams 76 and 74, respectively, and the fingers are lowered below the top surface 13. When the fingers have completed their descent, the reciprocating mechanism 118 moves the framework 41 to the right until this framework again occupies the position shown in Fig. 6, at which time one complete reciprocation has occurred and the cams 74 and 76 have undergone one complete revolution.

As previously indicated, during the next succeeding elevation of the framework 41 by the cams 74 and 76, the fingers 43a and 43b engage the rear edge of the stack and move it toward the left as viewed in Fig. 2 until the front edge of the stack is engaged by the finger-like elements 106 of the fence 104. Upon the engagement of the front edge of the stack with these finger-like elements, the fingers 43a and 43b are pivoted about the bracket 43 in order to place the springs 54 under tension. At this time the cam 75 actuates pairs of transversely movable fingers 180a and 180b and 181a and 181b to move these pairs of fingers toward each other until they engage the side edges of the stack. The fingers 180a and 180b extend upwardly through transversely extending parallel slots 182a and 182b, respectively, in the cover 13 while the fingers 181a and 181b extend upwardly through transversely extending slots 183a and 183b, respectively. The pairs of fingers 180a and 180b and 181a and 181b cooperate with the finger-like elements 106 and the reciprocating fingers 43a and 43b to align the stack along all four of its edges and to hold the stack momentarily in fixed position while the sheets of the stack are joined together by the stapling mechanism 250 in a manner to

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be subsequently described in detail. After the sheets have been joined together, the framework 88 is lowered by the cam 74, thus moving the elements 106 of the fence 104 below the top surface of the cover 13. The fingers 43a and 43b are then pivoted in a counterclockwise direction as viewed in Fig. 6 by the springs 54 in order to push the joined sheets of the stack into engagement with a second pair of feed rollers 184 and 185 carried upon the top of the housing 10. The feed roller 184 is mounted upon a shaft 186 having its ends rotatably journaled within a pair of spaced and aligned end plates 187 and 188. The end of the shaft 186 extends beyond the end plate 188 in order to receive a pulley 189 connected, by means of a drive belt 190 extending through an aperture 191 in the top cover 13, to the pulley 28b mounted on the end of the shaft 28. Since the shaft 28 is continuously rotated by the drive assembly 20, it is apparent that the drive feed rollers 166 and 188 of the feed mechanism are rotated continuously. The idler roller 185 is similar to the roller 167, and includes a pair of spaced carriages 192 and 193 which are identical in every respect to the carriages 173 and 174 previously described.

When the joined sheets of the stack are fed by the fingers 43a and 43b to the rollers 184 and 185, these rollers function in conventional manner to move the stack along the top of the housing to a position from which it may be advanced by the fingers 44a and 44b upon the next succeeding reciprocation of the framework 41. The fingers 44a and 44b, when elevated and reciprocated longitudinally of the housing in the manner previously described, move the joined sheets along the top of the housing to a position from which they are fed to the folding mechanism 300 as described more fully herein-after.

Since the pairs of fingers 42a—42b, 43a—43b and 44a—44b are of lightweight construction such as aluminum, the pivoting of these fingers when the stacks are confronted by the fences 85 and 104 is effected with ease. Thus, even though only a few sheets of material are contained in the stack, the combined effect of the lightweight construction and the resilient and pivotal mounting for the fingers upon the framework 41 prevents the sheets from being crumpled.

Those familiar with the art to which the present invention pertains will readily recognize that the stapling or stitching together of a plurality of sheets causes a characteristic bulge or deformation to occur at the position where the sheets are joined together. These bulges or enlarged portions of the stack cause the pamphlets formed by folding the joined sheets to be thickened along the fold, thereby introducing problems in the handling, storage and shipment of the pamphlets, particularly if these pamphlets are stapled or joined together at uniform positions with respect to their upper and lower edges. To obviate these problems, it is desirable that successive stacks be stapled together at different positions in order to stagger the bulges or raised portions thereby to reduce the overall height of a pile of pamphlets when the same are piled together for shipment or storage. To this end, the reciprocating mechanism 138 reciprocates the carriage 100 upon the rails 97 and 98 in order to alter the position of the fence 104 with respect to the stapling mechanism which is mounted in fixed position upon the top 13 of the housing. Thus, as the cam follower 153 of the framework 147 rides upon a reduced portion of the cam 152, the carriage 100 occupies the position shown in Fig. 6. When, however, the cam 152 rotates until its enlarged portion engages the cam follower 153 the carriage 100 is moved to the left to move the finger-like elements 106 of the fence 104 along spaced longitudinal slots 194 in the top 13 of the housing. The shaft 145 upon which the cam 152 is mounted is rotated at a rate equal to one-half the rate of rotation of the main driveshaft 31, this particular speed ratio being effected by means of the tooth ratio between the sprockets 137 and

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146. Thus, for each complete reciprocation of the framework 41 the cam 152 completes only 180 degrees of rotation and, accordingly, during successive reciprocations of the framework 41 the fence 104 is alternately moved from its extreme right position to its extreme left position as viewed in Fig. 2. Therefore, when the first stack of sheets is fed by the fingers 43a and 43b to the fence 104 the stapling mechanism will join these sheets or signatures together while the fence occupies its extreme right hand position. However, by the time the next succeeding stack of sheets is advanced by the fingers 43a and 43b, the fence 104 will have been moved to its extreme left and the stapling mechanism obviously joins the sheets together at a different position with respect to the front edge of the stack. Obviously the reciprocation of the fence 104 in a longitudinal direction continues as long as the driveshaft 31 is rotated.

Turning now to Fig. 7 for a description of the mechanism for actuating the pairs of transversely movable fingers 162a and 162b, 163a and 163b, 180a and 180b, and 181a and 181b it will be seen that this mechanism includes the horizontal bar 79 which is adapted to be reciprocated up and down upon the vertical rods 77 and 78 of the framework 66. As previously indicated, most of the mechanism shown in Fig. 7 was eliminated from Fig. 6 in the interest of clarity. However, it will be recognized that the small portion of the main driveshaft 31 carrying the cam 75 as well as the arm 79 and part of the framework 66 as shown in both Fig. 6 and Fig. 7 and, as a result, the manner in which the two mechanisms are assimilated is believed evident, particularly in view of the complete assembly shown in Fig. 1. The rod 77 extends between the offsets 66a and 66b rigidly affixed to the vertical support rod 60a, whereas the vertical rod 78 extends between the offsets 68 and 69 permanently affixed to the vertical support rod 61a. The horizontal bar 79 has secured to its underside at a position near its center a bifurcated support 195 having a cam follower 196 mounted between the bifurcations. The cam follower 196 rides upon the periphery of the cam 75 in order to raise and lower the horizontal bar 79. A pair of frameworks indicated generally by the reference characters 197 and 198 are movably mounted upon opposite sides of the housing 10 and are adapted to be actuated by the vertical reciprocation of the horizontal bar 79. The framework 197 comprises a first pair of spaced bars 199 and 200, a second pair of spaced bars 201 and 202 located at appreciable distance from the first pair, and a pair of longitudinally extending support rods 203 and 204 interconnecting both of the pairs of bars. A support block 206 carrying a downwardly extending arm 207 connects the rods 203 and 204 in order to increase the rigidity of the structure. The bars 200 and 201 each have mounted thereon a downwardly extending arm, these being designated 203 and 204, respectively, and cooperating with the bar 207 to support a pivot rod 205 rotatably mounted within their lower portions. Collars respectively carried by the fingers 162a, 162b, 180a, and 180b are fixedly mounted upon the pivot rod 205. In addition to these fingers, the rod 205 has permanently affixed thereto a block 208 carrying a roller supporting element 209 having mounted on its lower end a roller 210. An arm 209a is connected at one end to the block 208 and has a spring 211 connected between its other end and the rod 204. Thus, when the horizontal bar 79 is raised by the cam 75 the roller 210 moves along the bar and pivots the rod 205 about the spaced supports 203, 204 and 207. When the rod 205 is pivoted the fingers 162a and 162b and the fingers 180a and 180b carried thereby are moved out of engagement with the rod 203 and toward the rod 204. The rod 204 functions as a stop to limit the pivotal movement of the two identified pairs of fingers. When the rod 205 is rotated in the manner just described, tension is exerted on the spring 211 whereby, when the horizontal bar 79 is lowered by the cam 75, the fingers 162 and 162b and

180a and 180b are returned to their original positions shown in Fig. 7.

The framework 198, like the framework 197, includes a pair of parallel spacer bars 212 and 213, a second pair of parallel spacer bars 214 and 215, a support member 216, and a pair of parallel horizontal support rods 217 and 218 interconnecting all of the spacer bars and the support member 216. The support member 216 has suspended therefrom a downwardly extending arm 219 while the bars 213 and 214 have suspended therefrom support arms 220 and 221, respectively. The lower end of the arms 219, 220 and 221 rotatably support a horizontal pivot rod 222 which carries a pair of identical finger supporting carriages generally indicated by the reference characters 223 and 224 and also carries a block 225 rigidly affixed to the rod. A roller supporting element 226 having mounted thereon a roller 227 in engagement with the upper surface of the horizontal bar 79 extends downwardly from the block 225. A spring retaining finger 242 extends upwardly from the block 225 and has connected between its outer end and the rod 217, a tension spring 242 which functions to return the pairs of fingers 163a and 163b and 181a and 181b to their normal positions shown in Fig. 7 after they have been pivoted. The carriage 223 includes a pair of spaced support blocks 228 and 229 each affixed at one end to the rod 222 and interconnected at their other ends by a finger supporting rod 230. The rod 230 has mounted thereon a stop element 231 adapted to engage the rod 222 in order to limit the pivotal movement of the fingers 181a and 181b, the latter being attached to the rod 230 by means of collars 181c and 181d. A spring holding finger 232 mounted upon the rod 230 cooperates with a similar spring holding finger 233 mounted upon the rod 232 to hold a spring 234 which functions to apply pressure through the fingers 181a and 181b to one of the side edges of the stacks. In order to vary the pressure thus applied to the stacks, the fingers 232 may be provided with aligned pairs of grooves into which the ends of the spring 234 are fitted. The carriage 224 is identical to the carriage 223 just described and comprises supporting blocks 235 and 236, pivot rod 237 carrying the fingers 163a and 163b, and a stop element 238. Spring holding members 239 and 240 respectively mounted upon the rod 237 and the rod 222 accommodate the opposed ends of a spring 241 for the purpose indicated above.

It now becomes apparent that when the horizontal bar 79 is raised by the cam 75, the rollers 210 and 227 are moved along the top surface of this bar, thereby to pivot both of the rods 205 and 222 and move the pair of fingers 162a and 162b towards the fingers 163a and 163b to engage the side edges of one stack of sheet material as the latter is moved into engagement with the fence 85. When the rods 205 and 222 are pivoted in the manner just described, the pairs of fingers 180a and 180b and 181a and 181b are likewise moved toward each other to engage the side edges of a stack of sheet material held in position between the fence 104 and the fingers 43a and 43b. The pivoting of the rods 205 and 222 also exerts tension upon both of the springs 211 and 242. When the pairs of fingers are moved toward each other the fingers 163a and 163b engaging one of the side edges of the stack applies sufficient pressure to align the sheets in that stack but these fingers are prevented from crumpling or bending the sheets, even though only a relatively few sheets are contained in the stack, by the action of the stop 238 which limits the movement of the fingers and by the variable force applied to the fingers by the spring 241. In similar manner, the stop 231 and the spring 235 prevents the fingers 181a and 181b from crumpling or bending the sheets of the stack held between the fence 104 and the fingers 43a and 43b.

When the cam follower 196 engages the reduced portion of the cam 75, the horizontal bar 79 is lowered and the energy stored in the springs 211 and 242 is released,

thereby to maintain the rollers 210 and 227 in engagement with the top surface of the bar 79. The pivot rods 205 and 222 are thus pivoted in opposite directions until the fingers carried by these rods are returned to their normal positions in engagement with the support rods 203 and 218.

It is frequently desirable to join together and form pamphlets from different size sheet material or signatures in order to form pamphlets having different lengths and widths. It may be necessary to form pamphlets ranging in folded size from 6" by 3" booklet to 9" by 12" and, furthermore, as previously indicated, it may be desired to form a pamphlet containing any given number of sheets ranging from a relatively small number to one of considerable magnitude. In order to facilitate the formation of pamphlets of different size, the frameworks 197 and 198 are mounted for movement toward and away from each other upon horizontal support bars 242 and 243 having their ends secured to the side members of the framework 12. Specifically, the parallel bars 199 and 200 of the framework 197 straddle the bar 242 and, to facilitate the movement of the framework 197 along this bar, the surfaces of the bars 199 and 200 in engagement with the bar 242 may be provided with suitable rollers in the form of ball bearings. In like manner, the spaced bars 201 and 202 straddle the bar 243 and may be provided with ball bearings between the engaging surfaces for facilitating the movement of the framework 197. The pair of bars 212 and 213 and the pair of bars 214 and 215, respectively, straddle the bars 242 and 243 to permit the movement of the framework 198 along these bars transversely of the housing 10. To effect the movement of the frameworks 197 and 198 toward and away from each other, there is provided an elongated rod 244 having spaced, oppositely threaded portions 244a and 244b. The threaded portion 244a engages a threaded bore extending through a block 245 affixed to support rod 217 while the threaded portion 244a engages a threaded bore extending through a block 246 affixed to the rod 204. The end of the rod 244 carries a suitable adjusting handle 247 for rotating the rod and moving the frameworks 197 and 198 along the bars 242 and 243 in opposite directions. The end of the rod 244 near the handle 247 may be rotatably journaled within suitable structure carried by the side member of the framework 12, this structure being omitted from the drawings but functioning to prevent movement of the rod 244 transversely of the housing 10. When the handle 247 is turned the threaded portions 244a and 244b of the rod 244, which, as previously indicated, are threaded in opposite directions, function in the manner of lead screws to move the blocks 245 and 246 and the frameworks 198 and 197 to which they are respectively attached toward or away from each other, the direction of movement of these frameworks being dependent, of course, upon the particular direction in which the handle 247 is turned. The position of the frameworks 197 and 198 and the position of the transversely movable fingers is adjusted with respect to the housing in accordance with the width of the sheets being handled, thereby facilitating the use of the machine of the present invention to join together stacked sheets having different dimensions.

Referring now to Figs. 1 and 3 for a description of the stapling mechanism 250 for joining the sheets of the stacks together, it will be seen that this mechanism includes a pair of staplers 251 and 252 of conventional construction and spaced one from the other in the direction of movement of the stacks. If desired, the stacks of sheets may be stitched together by the use of suitable stitching mechanism in place of the staplers 251 and 252 illustrated. The staplers 251 and 252 are each mounted upon supporting structure 253 carried at one end of a pair of rigid bars 254 each having its other end fastened to the framework 12 by means of bolts 255 or

other suitable fastening means. The bolts 255 extend through an offset block 256 which serves to raise the staplers 251 and 252 above the level of the top surface of the housing, through the cover 13, and through the frame 12 to receive nuts 257 on their threaded ends. Feeding troughs 258 of conventional construction containing a supply of staples for each of the staplers 251 and 252 are mounted upon the bars 254 and function to supply staples to be driven through the stacks. The staplers 251 and 252 are each adapted to be actuated by pressing down upon an operating cap 260.

To provide for the simultaneous actuation of the staplers 251 and 252, a bar 261 extends across the cap 260 of both of the staplers, which bar is adapted to be actuated in a downward direction by means of actuating mechanism indicated generally by the reference character 263. The mechanism 263 includes a bifurcated lever 264 pivotally mounted upon a pivot rod 265 which extends between a pair of support arms 266 rigidly supported upon the framework 12. For the purpose of moving the bar 261 in a downward direction when the lever 264 is pivoted about the rod 265 in a manner to be subsequently described, an actuating lever 259 is mounted upon a pivotal rod 267 extending between the adjacent ends of the bifurcated lever 264. In order to return the lever 264 to its original position after it has been pivoted, the rod 267 is provided at each end with a spring 268, the latter having its other end secured to spring retaining bolt 268a mounted upon each of the staplers 251 and 252. The end 264b of the bifurcated lever 264 carries a collar 269 which is adapted to encircle a connecting rod 270. A compression spring 271 encircles the connecting rod and is retained between the collar 269 and a lip 273 affixed to the upper end of rod 270 while a similar spring 272 encircling the connecting rod is retained between the lower end of the collar 269 and a lip 274 secured to the rod. The connecting rod 270 extends downwardly through suitable aligned openings in the side member of the framework 12 and in the cover 13 and carries on its lower end a coupling attachment 275. The connecting rod 270 also carries at a position intermediate its ends a collar 276 the purpose of which will be explained in detail hereinafter. The coupling 275 pivotally mounts one end of a connecting arm 277 the other end of which is pivotally mounted upon a pivot pin 278 carried by a support member 279 extending upwardly from the frame member 14b. The arm 277 is provided with an aperture 280 which is normally aligned with a similar aperture 281 in the end of a cam carrying arm 282, the latter being mounted for pivotal movement upon the pin 278. Normally the aligned apertures 280 and 281 accommodate a pin 283 in order to provide a rigid connection between the arms 277 and 282. The arm 282 carries upon its end a cam follower 284 in engagement with the periphery of the cam 73.

In order to prevent the stapler 251 and 252 from being actuated in the absence of a stack of sheet material beneath the staplers, the pin 283 is controlled by means of a solenoid 285 which is mounted upon support 299 on the frame member 14a (Fig. 1) and is energized by a suitable electrical control circuit. This electrical control circuit may, for example, comprise a conductor or lead 286 connected from the solenoid to a low voltage source of potential schematically illustrated and indicated by the reference character 297 in Fig. 5. A second solenoid lead 287 is preferably connected to a contact point 298a which cooperates with a cam operated contact point 298b to prevent arcing in a manner to be described hereinafter. The cam operated point 298b is electrically connected by means of a wire 289 (Figs. 2 and 5) to an electrical contact 290 mounted upon the end of shaft 167a of the idler roller assembly 167. The set of contact points is mounted upon supporting structure 298c carried by the frame 14a (Figs. 1 and 5) which contact points are closed at pre-

determined spaced intervals by a cam 298 mounted on the main driveshaft 31. It will be recalled that the shaft 167a, which is formed of electrically conducting material, carries, upon a mounting 178, a steel brush 179 in engagement with the roller 166 when there are no stacks fed between the feed rollers 166 and 167. The set of cam operated points 298a and 298b connected in series with the brush 179 and the solenoid 285 prevents the brush 179 from arcing against roller 166 when the sheet material breaks the contact. To this end, the time relationship between the advancement of the feed fingers by the framework 41 and the rotation of the cam 298 is such that the signatures enter the rollers 166 and 167 just prior to the closing of the contact points 298a and 298b and leave the rollers just subsequent to the breaking of these contacts.

As indicated above, in the absence of signatures passing between the rollers 166 and 167, electrical contact is established between the brush 179 and roller 166 electrically grounded to the housing 10. At the same time that the brush 179 is in engagement with the roller 166, the cam 298 forces the points 298a and 298b into contact thereby to complete the circuit between the source 297 and the solenoid 285. As a result the solenoid 285 is energized and the pin 283 is pulled from the aligned apertures 280 and 281. Before this electrical circuit is broken by the movement of the sheets past the feed rollers 166 and 167, the cam 73 pivots the arm 282 to the point where the apertures 280 and 281 are no longer in alignment with the result that the pin 283 cannot be reinserted into the apertures when the solenoid is deenergized. Thus, when the pin 283 is withdrawn from the apertures 280 and 281 the movement of arm 282 by the cam 73 does not affect the arm 277 since the arm 282 merely pivots about the pin 278 to the position shown in Fig. 4 without operating the stapler 250.

When, however, signatures are again fed between the rollers 166 and 167 the brush 179 is lifted from the roller 166, the electrical circuit to the solenoid 285 is broken, and the arm 278 is moved back to the position shown in Fig. 3 with the result that the pin 283 returns to its normal position in engagement with the aligned apertures 280 and 281.

With the pin 283 in engagement with the aligned apertures in the arms 277 and 282, the engagement of the cam follower 284 with the enlarged portion of the cam 73 induces rotation of the rigid arms 277 and 282 about the pivot pin 278 in a clockwise direction as viewed in Fig. 3. The described rotation of the arms 277 and 282 raises the connecting rod 270 and pivots the lever 264 about the pivot rod 265. When the lever 264 is pivoted in this manner the lever 259 is pushed in a downward direction as viewed in Fig. 3 in order to bring the bar 261 into simultaneous engagement with both of the caps 260 for actuating the staplers 251 and 252. In addition to actuating both of the staplers the movement of the lever 264 compresses the springs 268 in order to store energy for returning the lever to its original position at the completion of the stapling operation. When the connecting rod 270 is raised to drive the staplers downward and push the staples through the sheet material, the collar 276 engages a lever 288 hinged, as indicated at 289, to the framework 12. The lever arm 288 carries a supporting bar 290 at approximately its center which bar is provided with a pair of spaced clenching elements 291 for the purpose of bending the end of the staples after they have been driven through the stacks of sheet material. Obviously, each of the clenching elements 291 is located beneath one of the staplers 251 and 252 and both function simultaneously to bend the staples when the lever arm 288 is pivoted about the hinge 289. When the lever 264 drives the staplers 251 and 252 through the sheets of paper this lever becomes rigid and the further movement of the connecting rod 270 in an upward direction in order to pivot the lever arm 288 about the hinge 289 is effected

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by providing the compression spring elements 271 and 272 on either side of the collar 269. More particularly, when the arm 264 becomes rigid the connecting rod 270 may still be raised for a small distance by compressing the spring 272 in order to raise the collar 276 for a sufficient distance to pivot the lever arm 288 and clench the ends of the staples.

As previously indicated, after the sheets have been stapled together by the stapling mechanism 250 they are passed by the fingers 43a and 43b to the feed rollers 184 and 185 which function to move the joined stacks along the top 13 of the housing to a position where they can be advanced by the fingers 44a and 44b during the next succeeding reciprocation of the framework 41. The fingers 44a and 44b then moves the stack along the top of the housing until its front edge contacts a barrier 295 mounted in fixed position upon the top 13 as best shown in Fig. 2. The stacks are then moved transversely of the housing 10 and into the folding apparatus 300 by means of a feeding mechanism generally indicated by the reference character 301 and including a chain 302 continuously driven by the drive sprocket 72 carried by the main driveshaft 31. As best illustrated in Fig. 6, the chain 302 carries a pair of outwardly extending spaced fingers 303 and 304 which, during certain portions of their movement, protrude upwardly through a transversely extending elongated slot 305 in the top cover 13 of the housing. The chain 302 engages a pair of identical idler sprocket assemblies 306 positioned on opposite sides of the housing 10 and suspended from the framework 12 although only one of these assemblies is visible in Fig. 6, the other assembly being deleted from the drawing to facilitate the illustration of the invention. The idler assembly 306 includes a pair of spaced supporting blocks 307 and 308 attached to the framework 12 and functioning to rotatably support the ends of a sprocket carrying shaft 309. The shaft 309 has mounted thereon at a position between the supporting blocks 307 and 308 an idler sprocket 310 in engagement with the chain 302. The chain 302 is continuously driven from the driveshaft 31 and thus the fingers 303 and 304 are successively brought into registry with the slot 305, the spacing between these fingers obviously being such that the entry of each of the fingers into the slot 305 is coordinated with the movement of the stacks against the barrier 295 by the fingers 44a and 44b. Specifically, the timing between the movement of the fingers 303 and 304 and the reciprocation of the framework 41 is such that one of the fingers will be positioned at the upper end of the slot 305 as viewed in Fig. 2 at the instant that the fingers 44a and 44b deposit a stack of sheet material against the barrier 295. The continued movement of the finger brings it into engagement with the side edge of the stack, thereby to move the stack transversely of the housing and into the folding apparatus 300.

Reference may now be had to Figs. 11 and 12 for a description of the folding apparatus 300 which functions to fold the joined together sheets of each stack into pamphlet or booklet form and discharges the formed pamphlets from the machine. The folding apparatus 300 is housed within a substantially enclosed casing 312 best shown in Fig. 1 which is adapted to be mounted upon the housing 10 in any suitable manner as, for example, by suitable supports secured to the side bar 14a and by attaching members carried on the framework 12, but these supports and attaching members are not shown in the drawings. The folding apparatus may be of any well known construction but is illustrated as a type known in the art as a "break over folder" due to the manner in which the stacks are folded as will be described in detail hereinafter. Included within the housing 312 is a supporting structure comprising a pair of side plates 313 and 314 maintained in spaced parallel relationship by spacer rods 315 connected between each corner of the plates.

The side plates 313 and 314 rotatably support the ends

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of a pair of shafts 316 and 317 extending parallel to each other, the shaft 316 having mounted thereon a gear 318 which meshes with a gear 319 secured to the shaft 317. The shaft 316 extends beyond the side plate 313 and receives upon its outer end a drive sprocket 318 in engagement with a drive chain 321 which extends downwardly through the housing 10 and engages the sprocket 311 on the main driveshaft 31, thereby to impart the rotation of the main driveshaft to the parallel shafts 316 and 317 of the folding apparatus. The shaft 316 also carries a sprocket 322 for the purpose of driving a chain 323 and, in similar manner, the shaft 317 carries a sprocket 324 for driving a chain 325.

For the purpose of feeding the stacked sheets to a plurality of spaced pairs of feed rollers, respectively designated 327 and 328, 329 and 330, and 331 and 332, there is provided a feed roller 333 cooperating with the folding roller 327 of the first pair to pass the stacks therebetween. In order to facilitate the passage of stacks of different thickness between the rollers 327 and 333, the roller 333 may be supported upon a shaft 334 having its opposite end portions retained within resilient shaft supporting assemblies 335 and 336 respectively, supported from the side plates 313 and 314. These assemblies are of identical construction and contain a bearing 337 supported within a bearing support plate 338 by means of a pair of compression springs 339. The roller 327, on the other hand, is mounted upon a shaft 340 having its opposed ends rotatably supported within identical bearing assemblies 341 pivotally mounted upon the side plates 313 and 314. Specifically, the bearing assembly 341 includes a bearing support block 342 pivotally carried upon a pivot pin 343 and provided with an arm member 344.

For the purpose of pivoting the bearing assembly 341 about the pin 343 in order to apply pressure between the first pair of folding rollers 327 and 328, there is provided a spring 345 having one end connected, as indicated at 346, to the side plate and having its other end connected to the arm 344. A sprocket 347 mounted upon the shaft 340 and engaging the chain 323 functions to rotate the roller 327 for the dual purpose of feeding stacks of sheet material between the rollers 327 and 333 and for folding or creasing the stacks between the rollers 327 and 328. The spring 345 tends to rotate the bearing assembly 341 in a counterclockwise direction as viewed in Fig. 12 in order to force the feed roller 327 into engagement with the folding roller 328. The roller 328 is mounted upon a roller shaft 348 having its ends supported within bearing assemblies 349 and 350 respectively mounted upon the side plates 313 and 314. To impart the rotation of the shaft 317 to the feed roller shaft 348, the latter shaft carries a sprocket 351 in engagement with the chain 325.

The feed rollers 330 and 332 are respectively mounted upon feed roller shafts 352 and 353 having their end portions rotatably supported within common bearing carrying plates 354 affixed to the side plates 313 and 314. Sprockets 355 and 356 respectively, carried by the shafts 352 and 353, engage the chain 325 in order to rotate these shafts and to drive the feed rollers which they carry. The feed roller 329 is mounted upon a shaft 357 having its opposed ends journaled within identical bearing assemblies 358 each mounted upon one of the side plates 313 and 314. The bearing assembly 358 comprises a bearing block 359 pivotally mounted upon a pivot pin 360 and including an arm 361 extending upwardly therefrom. The folding roller 331 is mounted upon a shaft 362 having its opposite ends supported by a pair of pivotal bearing assemblies 363 each carried by one of the side plates 313 and 314. The bearing assembly 363 comprises a bearing block 364 mounted for pivotal movement about a pin 365 and having an arm 366 extending upwardly. For the purpose of pivoting the bearing assembly 363 about the pivot pin 365 in a counterclockwise direction as viewed in Fig. 12, and for pivoting the bearing assembly 358 about the pivot pin 360 in a clockwise direction, a spring

367 is interposed between the end portions of the arms 361 and 366. The spring 367 obviously functions to force the folding roller 331 into engagement with the folding roller 332 and to force the folding roller 329 into engagement with the folding roller 330.

An arcuate shaped baffle 368 is fixedly mounted between the side plates 313 and 314 for the purpose of guiding the folded pamphlet into the folding rollers 329 and 330 after it has passed between the rollers 327 and 328. A second arcuate shaped baffle 369 fixedly mounted upon the side plates 313 and 314 guides the folded pamphlets from the folding rollers 329 and 330 into engagement with the folding rollers 331 and 332. A baffle 370 fixedly mounted upon the side plates 313 and 314 receives the flat pamphlets as they are fed between the rollers 327 and 333. The baffle 370 is so shaped that it has a somewhat semi-circular cross section and is provided with a plurality of parallel slots 371 best shown in Fig. 11.

For the purpose of adjusting the folding mechanism 300 to facilitate the folding of stacks of sheets of different size, there is provided a support rod 372 rotatably supported by the side plates 313 and 314 and having mounted thereon a plurality of spaced fingers 373 each extending through one of the slots 371 in the baffle 370. To provide for manual adjustment of the rod 372, this rod carries upon its end a pulley 374 connected, by means of a belt 375, to a hand operated adjusting mechanism 376. This adjusting mechanism includes a stub shaft 377 carrying a pulley 378 in engagement with the belt 375 and also carrying a manually operable handle 379 for rotating the stub shaft. It will be apparent that the belt 375 transfers the rotation of the handle to the rod 372 and alters the position of the fingers 373 within the slots 371.

It now becomes apparent that as the flat stacks of sheet material are fed to the folding mechanism between the rollers 327 and 333, the leading edge of the stack is directed by the baffle 370 in a downward direction until this edge comes into contact with the fingers 373. When the edge of the stack thus contacts the fingers, further movement of the sheets of material through the feed rollers 327 and 333 in the direction indicated by the arrow 380 causes the sheets to buckle or bend centrally and to rise until the central bent portion is grasped between the folding rollers 327 and 328. The position of the fingers 373 in the slots 371 may be altered by the adjusting mechanism 376 in order to insure that the flat stack will buckle exactly at its center. Furthermore, the mechanism 376 may be adjusted to facilitate the folding of stacks of different size along their centers when it is desired to employ the machine for forming pamphlets from stacks having different dimensions. When the stacks are bent or buckled and passed through the folding rollers 327 and 328 they are creased or folded along their centers at a position corresponding to the location of the aligned staples inserted by the staplers 251 and 252. The creased or folded stacks are then directed by the baffle 368 into engagement with folding rollers 329 and 330 which function to further crease or fold the stacks and pass the same to the third pair of feed rollers 331 and 332. After the stacks have undergone a final folding operation by passage between the folding rollers 331 and 332 they are expelled through a suitable opening 381 in the casing 312, this opening being illustrated in Fig. 1.

The folding apparatus illustrated is well adapted to handle stacks of different thickness due to the resilient mounting of one roller of each pair. Thus, for example, very thick stacks which pass between the rollers 327 and 333 merely force the roller 333 downwardly against the springs 339 while thick stacks passing between folding rollers 327 and 328 merely pivot the roller 327 against the action of the spring 345. In like manner, the passage of thick pamphlets through rollers 329 and 330 and through rollers 331 and 332 merely pivots the rollers 329 and 331 against the action of the spring 367. The use

of three pairs of folding rollers to crease the pamphlets in three distinct operations insures a crisp, accurate fold even for very thick stacks of sheets.

In order to maintain the proper tension upon the chains 323 and 325 driving the folding rollers, there is provided an idler assembly 382 pivotally mounted upon the side plate 313 and engaging the chain 323 together with an idler assembly 383 pivotally mounted upon the plate 313 and engaging the chain 325. The idler assembly 382 includes an arm 384 mounted upon a pivot pin 385 and carrying a sprocket 386. The sprocket 386 is maintained in engagement with the chain 323 by means of a spring 387 having one end connected to the side plate 313 and having its other end connected to the arm 384. The spring 387 obviously tends to induce a counterclockwise movement of the bearing assembly 382 about the pin 385 and maintains the teeth of the sprocket 386 in constant engagement with the chain 323. In similar manner, the idler assembly 383 comprises an arm member 388 pivotally mounted upon a pin 389 and carrying a sprocket 390. In order to apply tension to the belt 325 by forcing the idler assembly 383 into engagement with this chain, there is provided a spring 391 having one end connected to the arm 388 and having its other end connected to the side plate 313.

From the foregoing detailed description it will be apparent that in the operation of the machine of the present invention stacks of sheets material are successively placed in flat horizontal position upon the top cover 13 of the housing 10 at a position near one end of the housing. Since it is common practice to form several hundred pamphlets of given thickness and predetermined dimensions to fulfill a single order during one operation of the machine, the various adjustable mechanisms of the machine of the present invention are first manually set to correspond to the thickness and dimensions of the pamphlets being formed. Specifically, the positions of the springs 51, 54 and 56 interposed between the pairs of feed fingers and the supporting structure 41 are first adjusted in accordance with the thickness of the pamphlets being formed. The position of the pairs of transversely movable fingers is then adjusted by rotating the handle 247 to correspond to the desired width of the pamphlets being formed. Next the position of the fence 104 with respect to the stapling mechanism 250 is adjusted by rotating the handle 112 to set the machine to correspond with the height of the pamphlets being formed. If necessary, the belt 26 is tightened by rotating the handle 38 in order to provide the proper drive speed for the moving parts of the apparatus. After all of these adjustments have been made the machine is placed in operation by starting the motor 24 which, through the drive assembly 20, rotates the main drive shaft 31 and turns the feed rollers 166 and 184. With the main driveshaft 31 in operation, the cams 74 and 76 raise the framework 41 so that the fingers 42a and 42b extend above the top surface 13 of the housing and engage the rear edge of the first stack of sheet material placed upon the machine. When the framework 41 is moved to the left in the direction of the arrow 396 in Fig. 8, the fingers 42a and 42b move the stack from a position at the right of the housing until the front edge of the stack engages the fence 85 as indicated at 395. While the stack is in engagement with the fence 85, the cam 75 actuates the pairs of transversely movable fingers 162a and 162b, 163a and 163b, 180a and 180b, and 181a and 181b. The pairs of fingers 162a and 162b and 163a and 163b contact the side edges of the stack and thus the stack is aligned along all four edges. Since at this time only one stack has been placed upon the housing 10, the pairs of transversely movable fingers 180a and 180b and 181a and 181b do not engage a stack of sheets beneath the stapling mechanism 250. The fence 85 functions to hold the stack in position on the top of the housing while the framework 41 continues to move to the left thereby to pivot the fingers 42a and 42b about the framework against the

action of the springs 51. Due to the absence of stacks passing between the feed rollers 166 and 167, the solenoid 285 is energized and the pin 283 is withdrawn from the arm members 282 and 277 with the result that the cam 73, during the first complete revolution of the shaft 31, does not actuate the stapling mechanism 250 but instead merely causes the arm 282 to be pivoted about the pin 278 to the position shown in Fig. 4. When the fence 85 is lowered by the cam 76 as shown in Fig. 9, the fingers 42a and 42b are pivoted by the springs 51 in a counterclockwise direction to push the stack into engagement with the feed rollers 166 and 167. The movement of the stack through these feed rollers breaks the connection between the contact arm 179 and the housing 10 and thus leaves the pin 283 inserted through the arms 277 and 282 of the stapling mechanism. The stack is passed through the feed rollers 166 and 167 to a position where it is engaged by the fingers 43a and 43b when the framework 41 is next raised by the cams 74 and 76.

As indicated above, during the second revolution of the main driveshaft 31, the framework 41 is raised from the position shown in Fig. 9 so that the fingers 43a and 43b engage the stack passed by the feed rollers 166 and 167, while the fingers 42a and 42b engage the rear edge of a second stack of sheets which has, in the interim, been deposited upon the top of the housing 10. The fingers are then advanced by the movement of the framework 41 in the direction indicated by the arrow 396 in Fig. 9 until the stack is contacted by the fence 104 at the position indicated 395'. The stack engaged by the fingers 42a and 42b is, at the same time, contacted by the fence 85 and thus the two stacks are held in fixed position while the cam 75 actuates the two opposed pairs of transversely movable fingers. The pairs of fingers 162a and 162b and 163a and 163b engage the side edges of the stack held by the fence 85 while the pairs of fingers 180a and 180b and 181a and 181b engage the side edges of the stack held by the fence 104. The cam 73 now actuates the stapling mechanism 250 and drives a pair of staples through the stack of sheets held by the fence 104. At the completion of the stapling operation the cams 74 and 76 cause the fences 85 and 104 to descend below the top 13 of the housing with the result that the fingers 42a and 42b push the stack which they engage into the feed rollers 166 and 167 while the fingers 42a and 43b push the stack which they engage into the feed rollers 184 and 185. The framework 41 is then returned to its original position shown in Fig. 9 by movement of the framework in the direction of the arrow 397. Thus far it can be seen that driveshaft 31 has undergone two complete revolutions while the shaft 145 mounting the cam 152 has completed a single revolution. Thus, when the first stack is joined together by the stapling mechanism 250 at the position marked 395', the fence 104 is in the position shown in Fig. 8.

When the driveshaft 31 begins its third revolution the cams 74 and 76 again raise the framework 41 with the result that the fingers 42a and 42b engage the rear edge of a third stack of sheet material deposited upon the housing, the fingers 43a and 43b engage the rear edge of the second stack of sheet material, and the fingers 44a and 44b engage the rear edge of the first stack of sheet material. When the framework 41 is now moved in the direction indicated by the arrow 396, the fingers 44a and 44b move the stack to the position marked 395" where the front edge of the stack is engaged by the barrier 295, the fingers 43a and 43b move the second stack until its front edge engages the fence 104, and the fingers 42a and 42b move the third stack until its front edge is engaged by the fence 85. The pairs of transversely movable fingers are now actuated by the cam 75 in the manner previously described and the stapling mechanism 250 joins the second stack together. The framework 41 is now lowered by the cams 74 and 76 to move the fences 85 and 104 below the surface of the housing so that the fingers

42a and 42b can push the third stack into engagement with the feed rollers 166 and 167 while the fingers 43a and 43b push the second stack of sheets into engagement with the feed rollers 184 and 185. At this time the finger 303 carried by the chain 302 engages the side edge of the stack and moves it transversely of the housing into engagement with the feed rollers 327 and 333 of the folding mechanism 300. The folding mechanism functions in the manner described to form the stack sheets into a pamphlet or booklet and discharges the same from the machine. By the time the second stack of sheets has reached the fence 104, the cam 152 has moved this fence to the left to the position indicated by the arrow 398, with the result that the staples driven through the second stack of sheets by the stapling mechanism 250 are applied at a different position from the staples driven through the first stack. The above described operation continues as long as stacks of sheet material are successively deposited upon the top of the housing.

From the foregoing explanation it will be apparent that the present invention provides a rugged, compact, relatively inexpensively constructed machine for forming pamphlets or booklets from stacks of sheet material or signatures. Furthermore, it can be seen that the machine of the present invention is extremely versatile since it is capable of being rendered effective, by a few relatively minor adjustments, to handle stacks of material having different dimensions.

While a particular embodiment of the invention has been shown and described, it will be understood, of course, that the invention is not limited thereto since many modifications may be made, and it is, therefore, contemplated by the appended claims to cover any such modifications as fall within the true spirit and scope of the invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In a machine of the above described character, the combination of a rigid support having a sheet receiving surface, means including at least one sheet engaging member for engaging the rear edges of stacks of sheet material and advancing the stacks along said sheet receiving surface, an element carried by said support, means for positioning said element in the path of movement of each of said stacks when said stacks are advanced whereby said element engages the front edge of said stacks and the stacks are held between said element and said sheet engaging member in order to align the sheets in the stacks along their front and rear edges, means including transversely movable fingers for simultaneously engaging both of the side edges of said stacks when the stacks are held between said element and said sheet engaging member in order to align the sheets along their side edges, and manually operable means for adjusting the position of said element along said sheet receiving surface to enable the machine to form pamphlets from sheets of different size.

2. In a machine of the above described character, the combination of a rigid support having a top surface, means including a plurality of spaced fingers for engaging the rear edges of stacks of sheet material in order to advance the stacks along said top surface, an element carried by said support, means for raising said element into the path of movement of each of said stacks when said stacks are advanced whereby said element engages the front edge of said stacks and the stacks are held between said element and said fingers in order to align the sheets in the stacks along their front and rear edges, means including transversely movable fingers for simultaneously engaging both of the side edges of said stacks when the stacks are held between said element and said fingers in order to align the sheets along their side edges, and manually operable adjusting means for simultaneously moving said transversely movable fingers towards or away from each other to enable the machine to form pamphlets from sheets of different size.

3. In a machine of the above described character, the

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combination of a frame including a top surface, supporting structure disposed within said frame, means including a plurality of spaced sets of fingers pivotally mounted on said supporting structure for engaging the rear edges of stacks of sheet material and advancing the stacks along said top surface in step by step fashion, resilient means interposed between said fingers and said supporting structure, means for engaging the front edge of said stacks when said stacks are advanced in order to pivot said fingers about said supporting structure and store energy in said resilient means, and means for passing said stacks from one set of fingers to the next succeeding set of fingers, said last named means including mechanism to release the energy stored in said resilient means.

4. In a machine of the above described character, the combination of a frame including a top surface, supporting structure disposed within said frame, means including a plurality of spaced sets of fingers pivotally mounted on said supporting structure for engaging the rear edges of stacks of sheet material and advancing the stacks along said top surface in step by step fashion, resilient means interposed between said fingers and said supporting structure, means for engaging the front edge of said stacks when said stacks are advanced in order to pivot said fingers about said supporting structure and store energy in said resilient means; means for passing said stacks from one set of fingers to the next succeeding set of fingers, said last named means including mechanism to release the energy stored in said resilient means; and means for selectively varying the amount of energy stored in said resilient means to enable the machine to form pamphlets from stacks of different thickness.

5. In a machine of the above described character, the combination of a frame including a sheet receiving surface, supporting structure, means including at least one sheet engaging member pivotally mounted on said supporting structure for engaging the rear edges of stacks of sheet material and advancing the stacks along said sheet receiving surface in step by step fashion, resilient means interposed between said sheet engaging member and said supporting structure, means for engaging said stacks when they are advanced in order to pivot said sheet engaging member about said supporting structure and store energy in said resilient means, and manually operated means for adjusting the relative position of said resilient means between said sheet engaging member and said supporting structure in order to vary the energy stored in said resilient means, thereby enabling the machine to form pamphlets from stacks of different thickness.

6. In a machine of the above described character, the combination of a housing including a top surface, supporting structure disposed within said housing, a plurality of spaced members carried by said supporting structure, means for reciprocating said supporting structure longitudinally of said housing in order to advance said members along the top of said housing when the supporting structure is moved in one direction and to return said members to their original positions when the supporting structure is moved in the opposite direction, means for raising said supporting structure while said members are being advanced and for lowering said structure while said members are being returned to their original positions, said members engaging the rear edge of said stacks when the supporting structure is in raised position whereby to move the stacks along the top surface of said housing in step by step fashion as said members are advanced, spaced elements carried by said housing, and means for raising and lowering said elements simultaneously with the raising and lowering of said supporting structure whereby when raised said elements engage the front edge of said stacks in order to align the sheets in the stack as said members are advanced.

7. In a machine of the above described character, the combination of a frame including a sheet receiving sur-

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face, supporting structure, means including at least one sheet engaging member pivotally mounted on said supporting structure for engaging the rear edges of stacks of sheet material and advancing the stacks along said sheet receiving surface in step by step fashion, resilient means interposed between said sheet engaging member and said supporting structure, means for engaging said stacks when they are advanced in order to pivot said sheet engaging member about said supporting structure and store energy in said resilient means, and manually operable means for selectively varying the amount of energy stored in said resilient means to enable the machine to form pamphlets from stacks of different thickness.

8. In a machine of the above described character, the combination of a housing including a top surface, supporting structure disposed within said housing, a plurality of spaced members pivotally mounted on said supporting structure for advancing stacks of sheets in step by step fashion along the top surface of said housing, means for reciprocating said supporting structure longitudinally of said housing in order to advance said members along said housing when the supporting structure is moved in one direction and to return said members to their original position when the supporting structure is moved in the opposite direction, means for raising said supporting structure while said members are being advanced and for lowering said structure while said members are being returned to their original positions, said members engaging the rear edge of said stacks when the supporting structure is in raised position, spaced elements carried by said housing, means for raising and lowering said elements simultaneously with the raising and lowering of said supporting structure whereby when raised said elements engage the front edge of said stacks thereby to align the sheets in the stack between said elements and said members, and resilient means interposed between said members and said supporting structure for storing energy when said elements engage the front edge of said stacks and pivot said members about said supporting structure, the stored energy in said resilient means being released when said elements are lowered thereby to push said stacks along the top of said housing.

9. In a machine of the above described character, the combination of a housing including a top surface, supporting structure disposed within said housing, a plurality of spaced fingers pivotally mounted on said supporting structure for advancing stacks of sheets in step by step fashion along the top surface of said housing, means for reciprocating said supporting structure longitudinally of said housing in order to advance said fingers along said housing when the supporting structure is moved in one direction and to return said fingers to their original position when the supporting structure is moved in the opposite direction, means for raising said supporting structure while said fingers are being advanced and for lowering said structure while said fingers are being returned to their original positions, said fingers engaging the rear edge of said stacks when the supporting structure is in raised position, spaced elements carried by said housing, means for raising and lowering said elements simultaneously with the raising and lowering of said supporting structure whereby when raised said elements engage the front edge of said stacks in order to align the sheets in the stack when said fingers are advanced, resilient means interposed between said fingers and said supporting structure for storing energy when said elements engage the front edge of said stacks and thereby pivot said fingers about said supporting structure, the stored energy in said resilient means being released when said elements are lowered thereby to push said stacks along the top of said housing, and means for selectively varying the amount of energy stored in said resilient means in accordance with the thickness of the stacks thereby to enable the fingers to advance stacks of different thickness.

10. In a machine of the above described character, the

combination of a housing including a top surface, supporting structure disposed within said housing, a plurality of spaced fingers pivotally mounted on said supporting structure for advancing stacks of sheets in step by step fashion along the top surface of said housing, means for reciprocating said supporting structure longitudinally of said housing in order to advance said fingers along said housing when the supporting structure is moved in one direction and to return said fingers to their original position when the supporting structure is moved in the opposite direction, means for raising said supporting structure while said fingers are being advanced and for lowering said structure while said fingers are being returned to their original positions, said fingers being raised to a position above the top surface of said housing in order that they engage the rear edge of said stacks when the supporting structure is in raised position, spaced elements carried by said housing, means for raising and lowering said elements simultaneously with the raising and lowering of said supporting structure whereby said elements engage the front edge of said stacks and align the sheets in the stack when said fingers are advanced, and resilient means interposed between said members and said supporting structure for storing energy when said elements engage the front edge of said stacks and thereby pivot said members about said supporting structure, the top of said elements being lowered below the top surface of said housing prior to the lowering of said fingers below said top surface whereby the energy stored in said resilient means is released to push said stacks along the top surface of said housing.

11. In a machine in the above described character, the combination of a housing including a top surface, spaced pairs of feed rollers carried by said housing and located along the top surface, supporting structure disposed within said housing, a plurality of spaced fingers pivotally supported on said supporting structure, means for reciprocating said supporting structure longitudinally of said housing in order to advance said fingers along said housing when the supporting structure is moved in one direction and to return said fingers to their original positions when the supporting structure is moved in the opposite direction, means for raising said supporting structure while said fingers are being advanced and for lowering said structure while said fingers are being returned to their original positions, a first group of said fingers engaging the rear edge of one of said stacks at a position adjacent one end of the housing each time the supporting structure is raised thereby successively to move stacks along the top surface of said housing to a position adjacent the first pair of feed rollers when said fingers are advanced, said first pair of feed rollers passing the stacks to a second set of said fingers said second set of fingers moving the stacks to a position adjacent the second pair of feed rollers when the fingers are advanced, an element carried by said housing at a position adjacent the second pair of feed rollers and movable into and out of the path of movement of said stacks, means for raising and lowering said element simultaneously with the raising and lowering of said supporting structure whereby said element engages the front edge of said stack when it is raised in order to align the sheets in the stack as said fingers are advanced, resilient means interposed between the fingers of said second group of fingers and said supporting structure for storing energy by pivoting said second group of fingers on said supporting structure, the stored energy in said resilient means being released when said element is lowered in order to push said stacks into engagement with said second pair of feed rollers.

12. In a book or pamphlet forming machine of the type including mechanism for joining a stack of sheets together, the combination of a frame having a top surface; means for successively advancing stacks of sheets in step by step fashion along said top surface, said means including a plurality of spaced groups of fingers for moving

said stacks to different positions along said top surface, an element reciprocably mounted on said frame, and means for raising and lowering said element simultaneously with the movement of said stacks whereby when said element is raised into the path of movement of said stacks the sheets in the stack are aligned between one of said groups of fingers and said element and the sheets are held in position to be joined together by said mechanism; and means for automatically moving said element in the direction of movement of said stacks at a rate correlated with the movement of said stacks whereby successive stacks of sheets are joined together at different positions.

13. In a book or pamphlet forming machine of the type including mechanism for joining a stack of sheets together, the combination of a housing having a top surface; means for successively advancing stacks of sheets in step by step fashion along said top surface, said means including a plurality of spaced groups of fingers for moving said stacks to different positions along said top surface, an element reciprocably mounted on said housing, and means for raising and lowering said element simultaneously with the movement of said stacks whereby when said element is raised into the path of movement of said stacks the sheets in the stack are aligned between one of said groups of fingers and said element and the sheets are held in position to be joined together by said mechanism; means for automatically moving said element in the direction of movement of said stacks at a rate correlated with the movement of said stacks whereby successive stacks of sheets are joined together at different positions; and manually operated means for adjusting the position of said element relative to said mechanism to enable the machine to join together stacks of sheets having different dimensions.

14. In a book or pamphlet forming machine of the type including mechanism for joining a stack of sheets together, the combination of a frame having a top surface; means for successively advancing stacks of sheets in step by step fashion along said top surface, said means including a plurality of spaced groups of fingers for moving said stacks to different positions along said top surface, an element reciprocably mounted on said frame, and means for raising and lowering said element simultaneously with the movement of said stacks whereby when said element is raised into the path of movement of said stacks the sheets in the stack are aligned between one of said groups of fingers and said element and the sheets are held in position to be joined together by said mechanism; and means for automatically and reciprocably moving said element in the direction of movement of said stacks at a rate equal to one half the rate of reciprocation of said element whereby successive stacks of sheets are joined together at different positions.

15. In a book or pamphlet forming machine of the type including mechanism for joining a stack of sheets together, the combination of a frame having a top surface; means for successively advancing stacks of sheets in step by step fashion along said top surface, said means including a plurality of spaced groups of fingers for moving said stacks to different positions along said top surface, an element reciprocably mounted on said frame, and means for raising and lowering said element simultaneously with the movement of said stacks whereby when said element is raised into the path of movement of said stacks the front and rear edges of the sheets in the stack are aligned between one of said groups of fingers and said element and the sheets are held in position to be joined together by said mechanism; means including transversely movable fingers for simultaneously engaging both of the side edges of said stacks when the stacks are held in position to be joined together in order to align the sheets in the stack along their side edges; and means for automatically moving said element in the direction of movement of said stacks at a rate correlated with the

movement of said stacks whereby successive stacks of sheets are joined together at different positions.

16. In a book or pamphlet forming machine of the type including mechanism for joining a stack of sheets together, the combination of a frame having a top surface; means for successively advancing stacks of sheets in step by step fashion along said top surface, said means including a plurality of spaced groups of fingers for moving said stacks to different positions along said top surface, an element reciprocally mounted on said frame, and means for raising and lowering said element simultaneously with the movement of said stacks whereby when said element is raised into the path of movement of said stacks the sheets in the stack are aligned between one of said groups of fingers and said element and the sheets are held in position to be joined together by said mechanism; means including transversely movable fingers for simultaneously engaging both of the side edges of said stacks when the stacks are held in position to be joined together in order to align the sheets in the stack along their side edges; means for automatically moving said element in the direction of movement of said stacks at a rate correlated with the movement of said stacks whereby successive stacks of sheets are joined together at different positions; and manually operated means for adjusting the position of said element relative to said mechanism to enable the machine to join together stacks of sheets having different dimensions.

17. In a book or pamphlet forming machine of the type including mechanism for joining a stack of sheets together, the combination of a frame having a top surface; means for successively advancing stacks of sheets in step by step fashion along said top surface, said means including a plurality of spaced groups of fingers for moving said stacks to different positions along said top surface, an element reciprocally mounted on said frame, and means for raising and lowering said element simultaneously with the movement of said stacks whereby when said element is raised into the path of movement of said stacks the sheets in the stack are aligned between one of said groups of fingers and said element and the sheets are held in position to be joined together by said mechanism; means including transversely movable fingers for simultaneously engaging both of the side edges of said stacks when the stacks are held in position to be joined together in order to align the sheets in the stack along their side edges; manually operable adjusting means for simultaneously moving said fingers toward or away from each other to adjust the machine to form pamphlets from stacks having sheets of different size; means for automatically moving said element in the direction of movement of said stacks at a rate correlated with the movement of said stacks whereby successive stacks of sheets are joined together at different positions; and manually operated means for adjusting the position of said element relative to said mechanism to enable the machine to join together stacks of sheets having different dimensions.

18. In a book or pamphlet forming machine of the type including mechanism for joining a stack of sheets together, the combination of a housing having a top surface; means for successively advancing stacks of sheets in step by step fashion along said top surface, said means including supporting structure disposed within said housing, mechanism including a first group of fingers carried by said supporting structure for moving each of said stacks along said top from a first position adjacent one end of said housing to a second position, a second group of fingers carried by said supporting structure for moving said stacks in succession from said second position to a third position; an element reciprocally mounted on said housing at said third position, and means for raising and lowering said element simultaneously with the movement of said stacks whereby when said element is raised into the path of movement of said stacks the sheets in the stack

are aligned between said second group of fingers and said element; means including opposed members movable transversely of said housing for engaging the side edges of the sheets of said stacks while they are held between the second groups of fingers and said element in position to be joined together by said mechanism; and means for automatically moving said element in the direction of movement of said stacks at a rate correlated with the movement of said stacks whereby successive stacks of sheets are joined together at different positions.

19. In a machine of the above described character, the combination of a housing including a top surface, a shaft extending longitudinally of said housing and carried thereby, means for driving said shaft, supporting structure reciprocally mounted in said housing, a plurality of spaced fingers carried by said supporting structure for advancing stacks of sheet material in step by step fashion along the top surface of said housing, means rotated in synchronism with said shaft for reciprocating said supporting structure in order to advance said fingers along said housing when the supporting structure is moved in one direction and to return said fingers to their original positions when the supporting structure is moved in the opposite direction a plurality of spaced apart cams mounted on said shaft, means including at least one cam follower carried by said supporting structure and engaging a first of said cams for raising said supporting structure while said fingers are being advanced and for lowering said structure while said members are being returned to their original positions, said fingers engaging the rear edge of said stacks when the supporting structure is in raised position thereby to move the stacks along the top surface of the housing as said fingers are advanced, an element carried by said housing, and means for raising and lowering said element simultaneously with the raising and lowering of said supporting structure whereby when raised said element engages the front edge of said stacks in order to align the sheets in the stack when said fingers are advanced, said last named means including at least one additional cam follower in engagement with a second said cams.

20. In a machine of the above described character, the combination of a housing including a top surface, a shaft extending longitudinally of said housing and carried thereby, means for driving said shaft, supporting structure reciprocally mounted in said housing, a plurality of spaced fingers carried by said supporting structure for advancing stacks of sheet material in step by step fashion along the top surface of said housing, means rotated in synchronism with said shaft for reciprocating said supporting structure in order to advance said fingers along said housing when the supporting structure is moved in one direction and to return said fingers to their original positions when the supporting structure is moved in the opposite direction, a plurality of spaced apart cams mounted on said shaft, means including at least one cam follower carried by said supporting structure and engaging a first of said cams for raising said supporting structure while said fingers are being advanced and for lowering said structure while said fingers are being returned to their original positions, said fingers engaging the rear edge of said stacks when the supporting structure is in raised position thereby to move the stacks along the top surface of the housing as said fingers are advanced, an element carried by said housing, means for raising and lowering said element simultaneously with the raising and lowering of said supporting structure whereby when raised said element engages the front edge of said stacks in order to align the sheets in the stack when said fingers are advanced, said last named means including at least one additional cam follower in engagement with a second of said cams, and mechanism for joining said sheets together while the stack is held between said element and said fingers, said mechanism including a follower in engagement with a third of the cams mounted on said shaft.

21. In a machine of the above character, the combination of a frame including a top surface, reciprocable supporting structure disposed within said frame, means including a plurality of spaced fingers pivotally mounted on said supporting structure and in engagement with the rear edge of a stack of sheet material for advancing the stack along said top surface by reciprocating said structure, means for engaging the front edge of said stack when it is advanced in order to align the front edge of the stack and to pivot said fingers about said supporting structure, and resilient means carried by said supporting structure for resisting the pivoting of said fingers.

22. In a book or pamphlet forming machine of the type including mechanism for joining a stack of sheets together, the combination of a frame having a sheet receiving surface, means including at least one sheet engaging member for successively advancing stacks of sheets in step by step fashion along said sheet receiving surface, sheet positioning means for engaging said stacks when they are advanced so that the sheets of each stack are aligned between the sheet engaging member and the sheet positioning means in position to be joined together, and means for reciprocating the sheet positioning means in synchronism with the step by step advancement of said stacks in order to position successive stacks at different locations along said sheet receiving surface whereby the successive stacks will be joined together at different positions.

23. In a book or pamphlet forming machine, the combination of, a frame having a top surface; means for successively advancing stacks of sheets along said top surface; mechanism carried by said frame for joining the sheets of said stack together when they are advanced to a position beneath said mechanism, said mechanism including two at least partially co-extensive arm members having normally aligned apertures therein, and a pin inserted through said aligned apertures; and means for rendering said mechanism ineffective in the absence of stacks being advanced to said position, said last named means including at least one electrical contact supported from said frame and positioned in the path of movement of said stacks, a solenoid for moving said pin, and an electrical circuit including said solenoid and said contact for energizing said solenoid to withdraw said pin from said aligned apertures whenever there are no stacks in engagement with said contact.

24. In a book or pamphlet forming machine, the combination of, a frame having a top surface; means for successively advancing stacks of sheets along said top surface; mechanism carried by said frame for joining the sheets of said stack together when they are advanced to a position beneath said mechanism, said mechanism including two at least partially coextensive arm members having normally aligned apertures therein, and a pin inserted through said aligned apertures; means for withdrawing said pin from said aligned apertures in order to render said mechanism ineffective, and means for actuating the pin withdrawing means whenever there are no stacks being advanced to said position.

25. In a machine of the above described character, the combination of a frame including a sheet receiving surface, reciprocable supporting structure, means including at least one sheet engaging member pivotally mounted on said supporting structure and in engagement with the rear edge of a stack of sheet material for advancing the stack along said sheet receiving surface by reciprocating said structure, means for engaging the front edge of said stack when it is advanced in order to align the front edge of the stack and to pivot said sheet engaging member about said supporting structure, and resilient means carried by said supporting structure for resisting the pivoting of said member.

26. In a machine of the above described character, the combination of a frame including a sheet receiving surface, supporting structure, means including at least one sheet engaging member pivotally mounted on said sup-

porting structure and in engagement with the rear edge of a stack of sheet material for advancing the stack along said sheet receiving surface, means for engaging said stack when it is advanced in order to pivot said sheet engaging member about said supporting structure, and resilient means for resisting the pivoting of said member.

27. In a book or pamphlet forming machine, the combination of, a frame having a sheet receiving surface, means for successively advancing stacks of sheets along said sheet receiving surface; mechanism for joining the sheets of said stack together when they are advanced to a position adjacent said mechanism, said mechanism including two arm members, said mechanism also including means for locking said arm members together for joint movement as long as stacks are advanced to said position adjacent said mechanism, and means for rendering the locking means ineffective thereby to permit independent movement of said arm members and to prevent actuation of said mechanism in the absence of stacks being advanced to said position.

28. In a machine of the above described character, the combination of a housing including a sheet receiving surface, a shaft carried within said housing, a plurality of spaced driving elements mounted on said shaft, means for driving said shaft, supporting structure reciprocably mounted in said housing, a plurality of sheet engaging members carried by said supporting structure for advancing stacks of sheet material in step by step fashion along the sheet receiving surface of said housing, means including a first of said driving elements for reciprocating said supporting structure in order to advance said sheet engaging members along said housing when the supporting structure is moved in one direction and to return said sheet engaging members to their original positions when the supporting structure is moved in the opposite direction, means including a second of said driving elements for raising said supporting structure while said sheet engaging members are being advanced and for lowering said structure while said sheet engaging members are being returned to their original positions, an element carried by said housing, means including a third of said driving elements for raising and lowering said element simultaneously with the raising and lowering of said supporting structure whereby when raised said element engages the front edge of said stacks in order to align the sheets in the stack when said sheet engaging members are advanced, and mechanism including a fourth of said driving elements for joining said sheets together while the stack is held between said element and said sheet engaging members.

29. In a machine of the above described character, the combination of a housing including a sheet receiving surface, a shaft carried within said housing, a plurality of spaced driving elements mounted on said shaft, means for driving said shaft, means including a first of said driving elements and at least one sheet engaging member for advancing stacks of sheet material in step by step fashion along said sheet receiving surface, means including a second of said driving elements for moving said sheet engaging member into and out of engagement with said stacks, mechanism including a second of said driving elements for joining the sheets of stacks together, sheet positioning means for engaging the stacks as they are advanced in order to hold the sheets in alignment as they are joined together by said mechanism, means including a third of said driving elements for moving said sheet positioning means into and out of the path of movement of said stacks, and means including a fourth of said driving elements for folding said sheets after they have been joined together by said mechanism.

30. In a machine of the above described character, the combination of a housing including a sheet receiving surface, a shaft carried within said housing, a plurality of spaced driving elements mounted on said shaft, means for driving said shaft, reciprocable sheet engaging means

carried by said housing, means including a first of said driving elements for reciprocating said sheet engaging means in order to advance the stacks along said sheet receiving surface in step by step fashion, means including a second of said driving elements for moving said sheet engaging means into engagement with the stacks during movement thereof in a stack advancing direction and for withdrawing said sheet engaging means out of engagement with said stack during its movement in the opposite direction, mechanism including a third of said driving elements for joining the sheets of said stack together, and means including a fourth of said driving elements for folding said stacks after the sheets have been joined together by said mechanism.

31. In a machine of the above described character, the combination of a support having a sheet receiving surface, means including at least one sheet engaging member for engaging the rear edges of stacks of sheet material and advancing the stacks along said sheet receiving surface, an element carried by said support, means for positioning said element in the path of movement of each of said

stacks when said stacks are advanced whereby said element engages the front edge of said stacks and the stacks are held between said element and said sheet engaging member in order to align the sheets in the stacks along their front and rear edges, means including transversely movable fingers for simultaneously engaging both of the side edges of said stacks when the stacks are held between said element and said sheet engaging member in order to align the sheets along their side edges, manually operable adjusting means for moving said fingers towards or away from each other to enable the machine to form pamphlets from sheets of different width, and manually operable means for adjusting the position of said element along said sheet receiving surface to enable the machine to form pamphlets from sheets of different length.

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