

April 13, 1937.

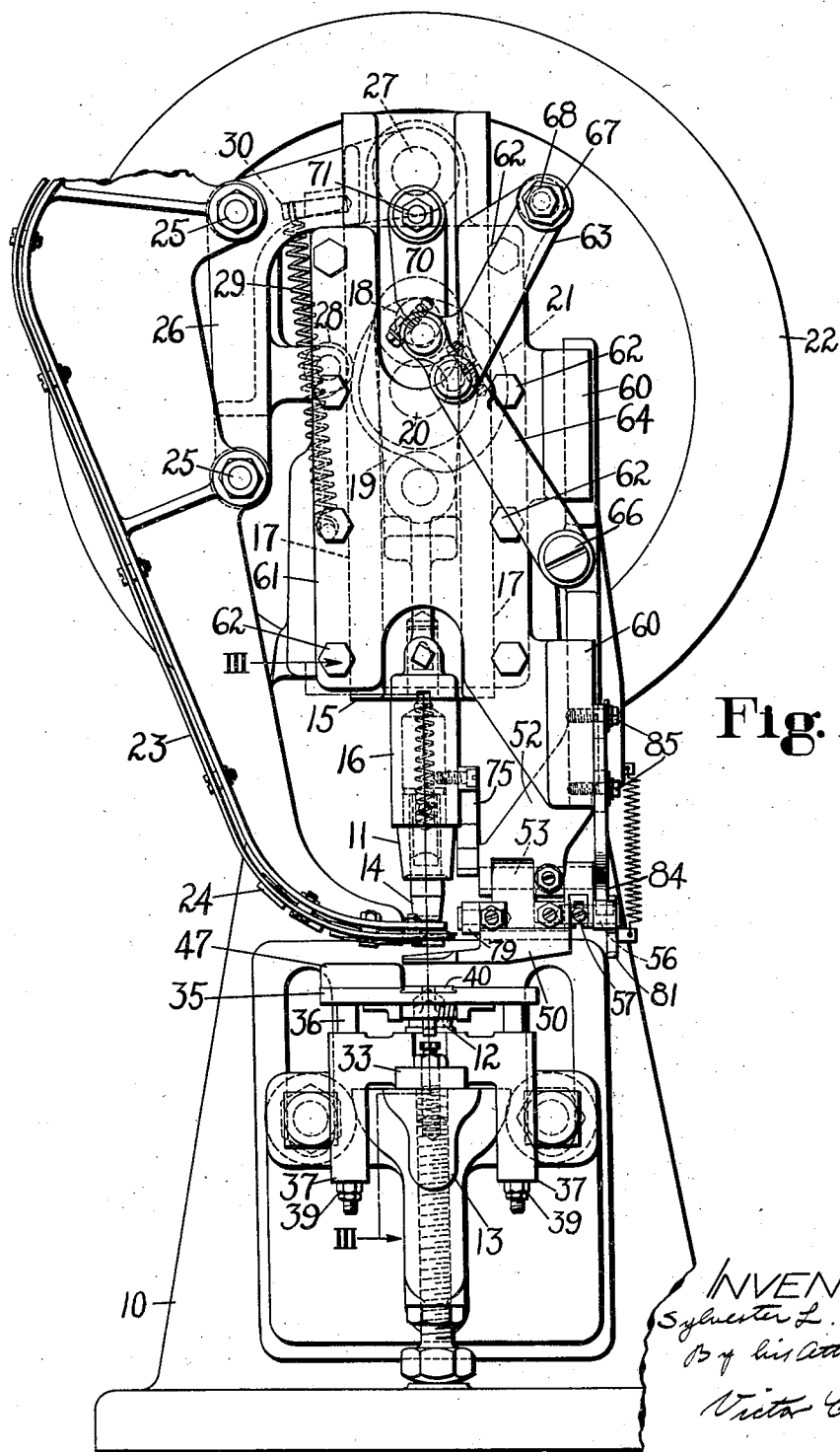
S. L. GOOKIN

2,076,556

METHOD OF AND MACHINE FOR PIERCING AND EYELETTING

Filed Dec. 24, 1934

3 Sheets-Sheet 1



April 13, 1937.

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METHOD OF AND MACHINE FOR PIERCING AND EYELETTING

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3 Sheets-Sheet 2

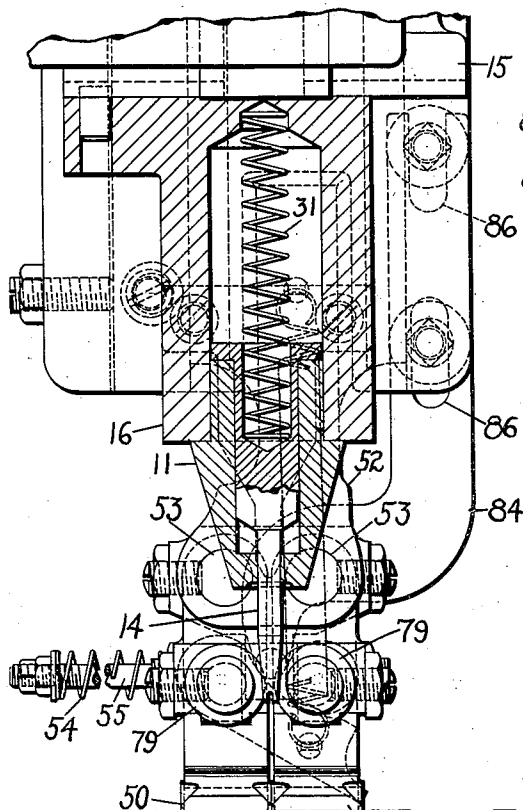


Fig. 3.

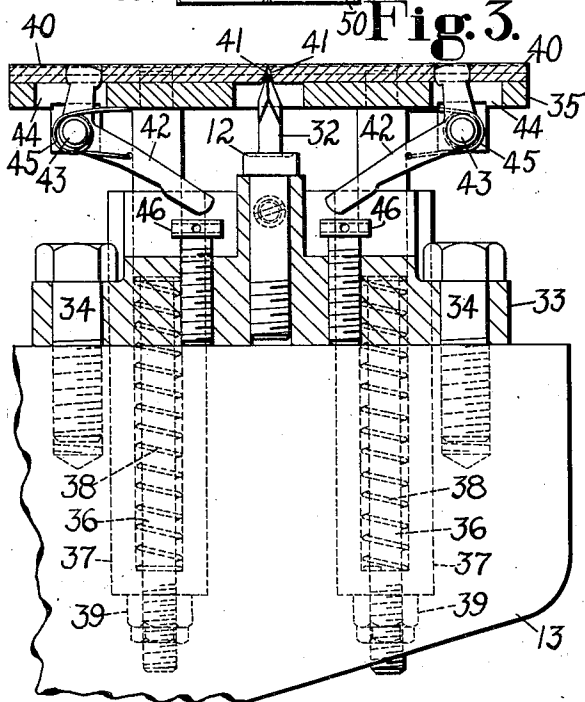
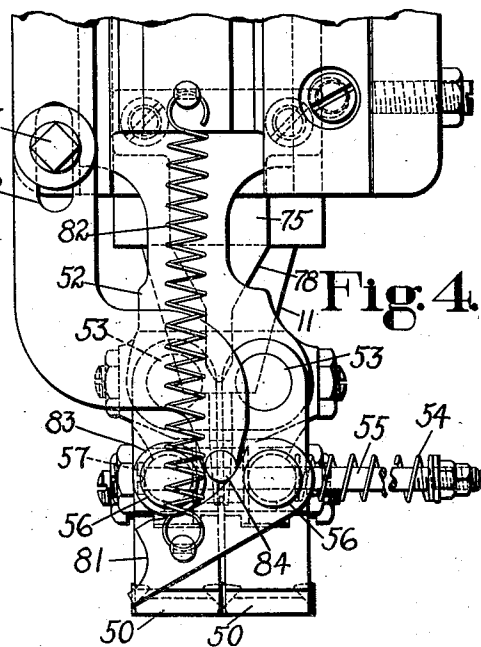


Fig. 4.

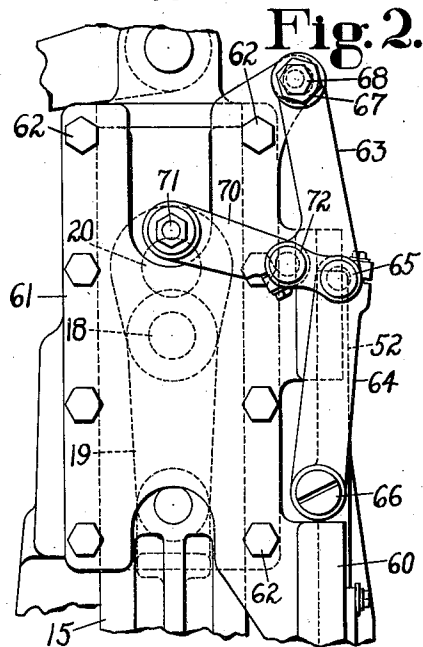


Fig. 2.

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3 Sheets-Sheet 3

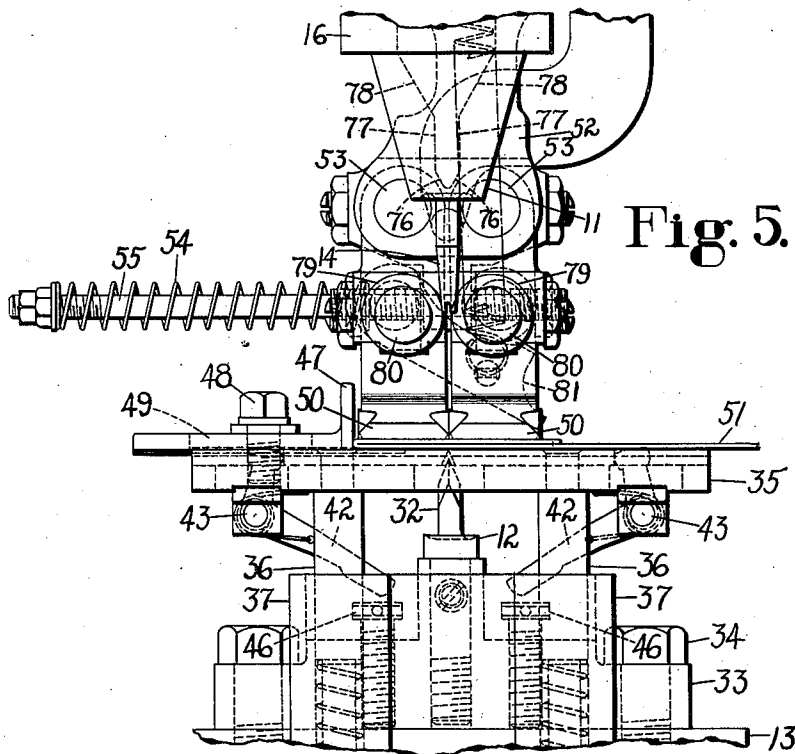


Fig. 5.

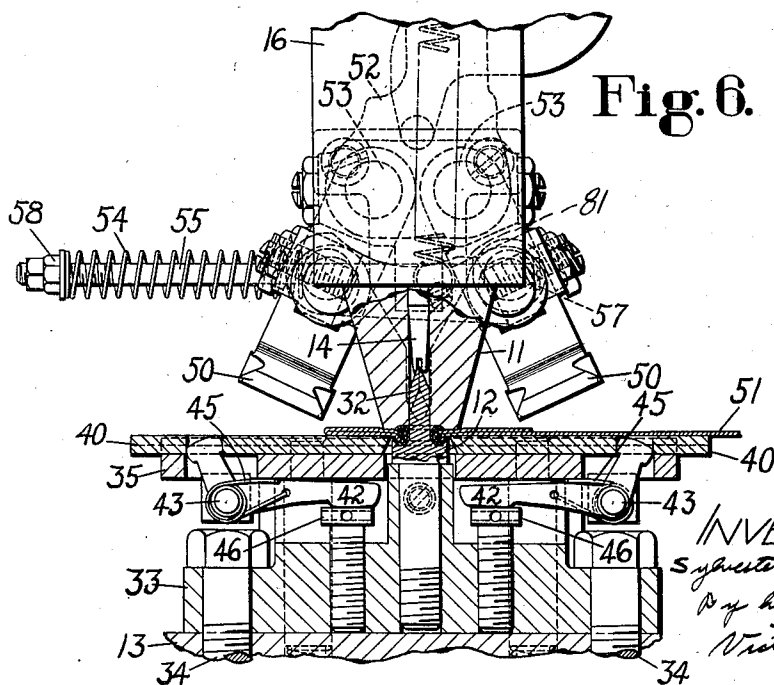


Fig. 6.

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2,076,556

METHOD OF AND MACHINE FOR PIERCING
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Application December 24, 1934, Serial No. 753,886

27 Claims. (Cl. 218—15)

This invention relates to methods of and machines for piercing and eyeletting sheet material, and is herein disclosed with reference to an eyeletting machine having a pointed tool for piercing and dilating an eyelet-receiving hole in sheet-material, instead of a punch of the type that cuts out a pill or disk to form a hole.

When eyelets or grommets are to be inserted and clenched in canvas such as that used for sails and awnings, or even lighter fabrics such as those used for bath-curtains, it is usual not to cut out pills to form the fastener-receiving holes, but to form the holes by puncturing the fabric with a pointed tool that is suitably tapered to spread the fabric with or without severing some of the strands of the fabric. While this practice is desirable to insure security of the fasteners in the fabric, the force required to thrust a pointed piercing tool through tightly woven fabrics of the types mentioned is so great that the point of the tool has a strong tendency to develop wrinkles or puckers in the fabric by gathering too much of the latter adjacent to the fastener-receiving locality. Finally, if an eyelet is inserted and clenched in fabric thus puckered or otherwise distorted, it may, and in many cases does, grip the malformations of the fabric so securely that they become permanent.

Although it has heretofore been proposed to provide eyelet-inserting machines with means for clamping the eyelet-receiving material before and during the actual piercing thereof, the desirability of furnishing backing for the material tangent to the piercing tool and of stretching or tensioning the material away from the tool have not heretofore been recognized.

With regard to these conditions, an object of the present invention is to provide improvements in methods of and means for piercing and eyeletting sheet material without removing any of the material and without gathering or puckering the material adjacent to the operating locality.

One aspect of the present invention consists in separating contiguous areas of a piece of sheet material to stretch or tension a narrow intermediate area, and piercing a hole in the latter area and inserting an eyelet into the hole while the tensioning force is maintained.

As herein illustrated the invention is embodied in a machine organization comprising work-tensioning mechanism provided with cooperative tensioning members arranged initially to engage a surface of the fastener-receiving area of the work, means arranged to operate against those

members to pierce a hole in that area and separate the members laterally, and means arranged to insert a tubular fastener such as an eyelet into the hole.

Preferably, the work-tensioning means comprises at least two pairs of clamping members arranged initially to clamp contiguous areas of the fastener-receiving material including the fastener-receiving area, each pair being arranged to clamp one-half of the fastener-receiving area and to recede from the other pair as the hole is pierced between them, whereby the hole is enlarged or spread by a stretching or tensioning force to facilitate the entrance of the larger portions of the piercing instrument and thereafter the entrance of a fastener. Moreover, the initially contiguous edges of the clamping members remain in tangent relation to the sides of the piercing instrument as it pierces and dilates the hole, thereby maintaining flatness of the material adjacent to the hole.

Various other features of the invention are hereinafter described and claimed.

Referring to the drawings,

Fig. 1 is a front elevation of a fastener-inserting machine in which the present invention is embodied in a preferred form;

Fig. 2 is a front elevation of a toggle mechanism included in Fig. 1 but represented in its other extreme position;

Fig. 3 is a view on a larger scale, partly in section and partly in elevation, of the structure within the range of line III—III of Fig. 1, except that no portion of the raceway is included;

Fig. 4 is an elevation of the assembly in the upper part of Fig. 3 but viewed from the opposite side;

Fig. 5 is an elevation of the work-clamping members in the act of clamping an interposed work-piece and about to impale it on the piercing element; and

Fig. 6 is a similar view, partly in section and partly in elevation, at that point in the cycle of operations when the tools for operating on the fastener are applying their final clenching pressure.

The general organization and many of the features of the illustrated machine are as more fully shown and described in United States Letters Patent No. 2,007,274, granted July 9, 1935 on an application filed in the name of J. A. Johnson. Briefly described, this machine comprises a frame 10, a vertically movable fastener-inserting tool 11, a stationary tool provided with a clenching shoulder 12, and a horn 13 rigidly secured

to the frame 10 to provide a support for the stationary clenching tool. The tool 11, which is of a well-known type commonly used for inserting grommets and eyelets, is provided with a central spring-pressed spindle 14 and is carried toward and from the stationary clenching tool by a slide 15 to which it is connected by a block 16. The slide 15 is arranged in vertical guides 17 in the frame 10 and is reciprocated by a wrist-pin 18 to which it is connected by a link 19. The wrist-pin is carried by a rotary shaft 20 which also carries a raceway-operating cam 21 and is driven by a one-revolution clutch (not shown), the driving member of which is carried by a pulley 22 on which a continuously driven belt may run. The clutch mechanism is of the type that may be set in operation by depressing a treadle and is so organized as to arrest the shaft 20 when the wrist-pin 18 is at top center as shown in Fig. 1. Consequently, each operation of the clutch-controlling treadle will cause the tool-slide 15 to execute one downward stroke and one upward stroke and to come to rest at its highest level.

As shown in Fig. 1 the machine also comprises a raceway 23 the delivery end of which is arranged to present eyelets or grommets 24 to the inserting tool 11. Although the upper portion of the raceway is omitted from Fig. 1 because of lack of space it is to be understood that in its entirety the raceway may be provided with a fastener-supplying hopper in accordance with the disclosure in the aforesaid Johnson application. For present purposes it will be sufficient to point out that the raceway herein shown is mounted upon two horizontal studs 25 projecting from a carrier 26 and that the carrier is arranged to oscillate on a rod 27 secured in bosses formed on the frame 10. A cam-roll 28 mounted on the carrier 26 is maintained in contact with the cam 21 by a tension spring 29 the lower end of which is attached to an anchoring pin projecting from the frame 10 and the upper end of which is attached to a pin 30 affixed to the carrier. As usual in machines of this type the cam 21 is so designed as to cause the delivery end of the raceway to present a fastener when the inserting tool 11 is in the upper stages of its range of travel, and to retract the delivery end during the down stroke of the inserting tool after the tip of the spindle 14 has been inserted into the barrel of the eyelet or grommet presented thereto. The eyelet or grommet is presented flange uppermost when taken by the spindle 14 (see Fig. 5).

Eyelets or grommets of the type herein shown are oblong rather than circular, although it is to be understood that the invention hereinafter described is not limited to fasteners of any particular shape. The wide dimension of the fastener is apparent in Fig. 1 and the narrow dimension is apparent in Figs. 5 and 6. Accordingly, the spindle 14 has a wide dimension apparent in Fig. 1 and a narrow dimension apparent in Figs. 3, 4, 5 and 6. Referring particularly to Fig. 3, the spindle is normally projected from the inserting tool 11 by a spring 31.

The lower tool by which the fasteners are to be clenched is provided with an upstanding pilot 32 (Fig. 3) centrally located with respect to the clenching shoulder 12. This pilot also has a wide dimension (see dotted lines in Fig. 1) and a narrow dimension apparent in Figs. 3, 5 and 6, and its upper end is symmetrically beveled to form a double-acting wedge having a piercing point and oppositely inclined edges converging thereto

for the purpose of cutting a slit or gash in woven fabric or other sheet material capable of being punctured thereby. To avoid dulling the point of the pilot 32, the lower end of the spindle 14 may be provided with a narrow kerf as clearly shown in Figs. 3, 5 and 6, in the last of which the point is nested in the kerf. These figures also include an anchoring block 33 affixed to the horn 13 by bolts 34 and providing a socket in which the stem or shank of the clenching tool is secured.

The anchoring block 33 also provides a mounting for a vertically movable work-supporting plate or table 35 from which four stems or guide-rods 36 project downwardly through corresponding bearing sleeves 37 formed on the block. The lower portions of the stems 36 are of smaller diameter than the upper portions and are surrounded by compression springs 38 that normally sustain the plate or table 35 at its highest level which may be regulated by nuts 39 screwed on the lower ends of the stems. The lower ends of the springs 38 are seated on shoulders at the lower ends of the bearing sleeves 37 but the upper ends of the springs are seated against shoulders formed on the stems 36 at the portions where the larger and the smaller diameters of the stems meet. When the work-supporting plate or table 35 is at its highest level as shown in Figs. 1, 3 and 5, its upper surface is slightly above the level of the point of the piercing element 32, and a work-piece may therefore be placed thereon without any interference from the piercing element.

Two slidable work-clamping members 40, 40 are mortised into the upper surface of the work-supporting plate 35 with complementary tongue-and-groove formations as represented in Fig. 1. Preferably the upper surfaces of the members 40 are slightly above the level of the plate 35 to restrict the clamping pressure of the fastener-receiving material to the areas engaged by those members which are not only movable up and down with the plate 35 but are also movable edgewise toward and from each other. Their movements away from each other are utilized to tension the fastener-receiving material. When the members 40 stand in their initial positions as shown in Figs. 3 and 5 their inner edges abut each other in a vertical plane in register with the point and the work-slitting edges of the piercing element 32. To provide for this relation and to provide also for forcing the members 40 apart with a wedging action, the contiguous ends 41 (Fig. 3) of these members are oppositely beveled in accordance with the tapering formation of the piercing element 32. Consequently, when the table 35 is depressed from its highest level with pressure exerted upon a work-piece the clamping members 40 will be forced apart by the wedging effect of the piercing element 32.

The clamping members 40 are moved toward and from each other by bell-crank levers 42 having trunnions 43 pivotally mounted in bearings carried by the plate 35. One arm of each lever 42 projects upwardly through a slot 44 in the plate 35 and into a hole or socket formed in the corresponding clamping member 40. The clamping members are normally moved toward each other by torsion springs 45 of the safety-pin type, one arm of each spring being seated against the bottom of the plate 35 and the other arm being hooked into a hole formed in the other arm of the lever 42. These levers are utilized also to impart supplemental retractory movement to

the clamping members 40 after the latter have been separated as far as they may be by the piercing element 32. The purpose of the supplemental retraction is to separate the clamping members 40 enough to clear the clenching shoulder 12 of the lower tool when the work-supporting table is depressed to its lowest level as shown in Fig. 6. For this purpose the lower arms of the levers 42 are arranged to be engaged by arresting abutments 46 which, as shown, are screwed into the anchoring block 33 and adapted to be adjusted vertically to regulate the extent of the supplemental retractory movement in accordance with the lateral dimension of the clenching shoulder 12. There is some lost motion between the levers 42 and the arresting abutments 46 when the work-supporting table is near its highest level as shown in Figs. 1, 3 and 5, but while the table is in the early stages of its downward movement the clamping members 40 receive their initial separating movement from the wedging action of the piercing element 32 as above described.

The work-supporting table 35 also carries an edge-gage 47 (Figs. 1 and 5) adjustably secured thereto by a clamping bolt 48, the horizontal shank portion of the gage being provided with a slot 49 to receive the bolt and to afford a range of adjustment.

One of the novel features of the present invention comprises two work-clamping members 50, 50 arranged to cooperate respectively with the clamping members 40, 40. The members 50, 50 are arranged to bear upon contiguous areas of the upper surface of the work and they are not only moved downwardly as hereinafter explained but they are also moved away from each other while moving downwardly and while the clamping members 40, 40 are also moving downwardly and away from each other. When the members 50 are depressed against the work 51 as shown in Fig. 5 they clamp initially that area of the work that is to be pierced and provided with a fastener. Depression of the work-supporting table 35 against the lifting force of the springs 38 is derived from the clamping members 50 through the medium of the interposed work-piece 51 (Figs. 5 and 6) of woven fabric or other sheet material capable of being pierced and provided with fasteners. As shown in these figures the margin of the work-piece is folded to provide a two-ply hem in which the fastener or fasteners are to be inserted.

The work-clamping members 50 are carried by a vertically movable carrier 52 from which they are suspended by individual pivot pins 53, the work-engaging portions of these clamping members being formed to project laterally under the delivery end of the raceway when the parts occupy their initial positions as shown in Figs. 1 and 3. The axes of the pivot pins 53 are horizontal and are so situated that the work-engaging portions of the clamping members 50 may swing in directions virtually the same as those of the respective clamping members 40 with which they cooperate. The work-engaging portions of the clamping members 50 are flat and are normally maintained in abutting edge-to-edge relation by a compression spring 54 that surrounds a tie-rod 55. This rod extends through two pins 56 carried respectively by the clamping members and is provided with a head 57 at one end and with one or more nuts 58 screwed on the other end. The head 57 is seated against one of the pins 56 while the spring 54 is

seated against the other and against one of the nuts 58. The abutting edges of the members 50 lie in register with the point of the piercing element 32 and they are slightly beveled or relieved to permit the point to enter between them and force them apart with a wedging action without being dulled in consequence. The wedging action of the piercing element 32 is sufficient to effect initial separation not only of the clamping members 40 but also of the clamping members 50, but after the latter have been separated in that manner they are separated further (see Fig. 6) to clear an ingoing fastener and the fastener-inserting tool 11. The mechanism for effecting supplemental separation of the clamping members 50 is hereinafter described.

The carrier 52 is arranged to slide up and down in guides 60, 60 formed in a detachable element 61 of the frame 10, the element 61 being utilized also to maintain the slide 15 in its guides 17 and being secured in its operative position by attaching bolts 62. Vertical reciprocations are imparted to the carrier 52 by a toggle mechanism that receives its operating motion from the slide 15 and is organized to depress the clamping members to their lowest level when the fastener-inserting tool 14 is at an intermediate point in its downstroke. As shown in Figs. 1 and 2, the toggle mechanism comprises an upper link 63, a lower link 64 and a pivot pin 65 connecting them and forming the knee-joint. The lower link 64 is connected to the carrier 52 by a pivot-stud 66 while the upper link 63 is connected to the frame member 61 by a stationary anchoring pivot preferably designed to provide a small factor of vertical adjustment. For the latter purpose the upper end of the link 63 is bored to receive a bushing having an hexagonal head 67 adapted to receive a wrench by which it may be turned. An eccentric hole bored through this bushing is occupied by a clamping bolt 68 screwed into the member 61. When the bolt 68 is set up tightly it clamps the bushing against the member 61 without applying any pressure to the toggle link 63, and the latter may therefore swing about the bushing without undue restraint, but when the bolt 68 is relaxed the bushing 67 may be turned to raise or lower the toggle mechanism and both limits of reciprocation of the carrier 52.

The operating movements of the tool-slide 15 are transmitted to the toggle mechanism by a link 70, one end of which is connected to the tool-slide by a pivot-stud 71 and the other end to the link 63 by a pivot-stud 72. The two extreme positions of the toggle mechanism are shown respectively in Figs. 1 and 2.

When the parts occupy their initial positions the clamping members 50 are a considerable distance above the level of the work-supporting table 35 as shown in Figs. 1 and 3 to facilitate introduction and removal of a work-piece. As the tool-slide 15 descends from its highest position it thrusts the spindle 14 through or into the barrel of the fastener 24 then at the delivery end of the raceway, and at the same time operates the toggle mechanism by which the clamping members 50 are depressed. At an early stage in the downward movement of the slide 15, the delivery end of the raceway is retracted and the work-clamping members 50 engage the work-piece as shown in Fig. 5 and thereby clamp it with considerable pressure against the lower clamping members 40. No interruption occurs either in the downward movement of the fastener-inserting tool 11 or in the downward movement of the work-clamping

members 50, but it is to be observed that the latter reach their lowest level when the knee 65 of the toggle mechanism reaches its dead-center position, and that this point in the cycle is reached when the slide 15 has still a considerable distance to travel before reaching its lowest limit. As hereinbefore explained, both the lower clamping members 40 and the upper clamping members 50 are separated laterally by the wedging action of the piercing element 32 and it will, of course, be understood that this initial separation must result in tensioning the work because of the work-clamping pressure maintained by the springs 38 in opposition to the depressing action of the clamping members 50.

The members 50 remain in contact with the sides of the piercing element 32 until the hole in the fastener-receiving material has been completely pierced, to the end that the material adjacent to the hole shall not be puckered or gathered as it would be if the members 50 were retracted from the piercing element before completion of the piercing operation.

Thereafter, the members 50 are retracted from the sides of the piercing element to stretch the work and to clear the ingoing fastener 24 and the tool 11. For this purpose, a supplemental wedge member 75 is affixed to the tool-block 16, as shown in Fig. 1. The profile of this wedge member is represented in dotted lines in Figs. 3, 4, 5 and 6. Referring to Fig. 5, the lower end of this wedge member is provided with oppositely inclined operating surfaces 76. Parallel vertical surfaces 77 extend upwardly from the operating surfaces 76 to another pair of oppositely inclined operating surfaces 78. The two series of surfaces thus provided are arranged to engage antifriction rolls 79, 79 mounted on studs 80 carried respectively by the clamping members 50.

The wedging surfaces 76 produce secondary separation of the members 50 while the bell-crank levers 42 are causing secondary separation of the members 40, and since the work is gripped tightly by both pairs of the clamping members at this stage these members stretch the work sufficiently to relieve its tightness on the piercing pilot 32. Moreover, their grip on the work is increased in consequence of the angular movement of the members 50 which now impress their inner edges more deeply into the upper surface of the work.

At a still later stage, the wedging surfaces 78 engage the rolls 79 and thereby cause a third and final stage of separation of the members 50 (Fig. 6) to enable the tool 11 to pass between them without obstruction. When this final separation of the members 50 occurs a latch 81 carried by one of the members 50 is automatically raised by a spring 82 (Fig. 4) until it reaches the positions shown in Fig. 6. The purpose of this latch is to maintain separation of the members 50 until all the parts have returned to their initial positions. The latch 81 is pivotally mounted on one of the pins 56 and its free end is arranged to engage a collar 83 surrounding the other pin 56 so that in performing its function its effect is like that of a strut.

While the slide or carrier 52 is rising and is about to reach its highest position, the latch 81 strikes an abutment 84 by which its free end is disengaged from the collar 83 (see Fig. 4). The abutment 84 is the lower extremity of a bar affixed to one of the bearings 60 by clamping bolts 85 and is provided with slots 86 which provide for adjusting it vertically so that it may release

the members 50 at the completion of the cycle of operations.

The parts of the machine stand initially in the positions shown in Figs. 1, 3 and 4, the work-supporting table 35 being then slightly above the level of the point of the piercing pilot 32, and the clamping members 50 being at or near their highest level. The fastener-inserting tool 11 is also at or near its highest level and the delivery end of the raceway 23 is in position to support a fastener in register with the spindle 14.

The operator first places a work-piece 51 on the supporting table 35 with the rear edge of the work against the gage 47. When the machine is set in operation, as by depressing a clutch-treadle (not shown), both the slides 15 and 52 descend. When the spindle 14 has entered the fastener the raceway is retracted, and at about the same time the members 50, having engaged the work as shown in Fig. 5, depress the work and the work-supporting table. As the work is being impaled upon the piercing pilot 32 the two pairs of work-clamping members 40 and 50 are wedged apart laterally by the pilot and the work is thus tensioned and maintained in a flat condition.

After the two pairs of clamping members have been separated as far as they may be by the wedging effect of the pilot 32 they are further separated to stretch the material now impaled upon the pilot. The secondary separation of the members 40, 40 is caused by the bell-crank levers 42 in consequence of their engagement with the abutments 46 and the continued downward movement of the work-supporting table which, at this stage, is relatively slow and decelerative because the knee 65 of the toggle is close to its dead-center position. The downward travel of the tool slide 15 is now relatively great, in consequence of which the wedge member 75 causes the secondary stage of separation of the clamping members 50. At this stage the barrel of the fastener is thrust through the material 51 which is now under tension and being stretched. After the barrel of the fastener has entered the material 51, and while the knee-joint 65 of the toggle is at or near its dead-center position the wedging surfaces 78 of the member 75 engage the rolls 79 and thereby cause a third stage of separation of the clamping members 50 to enable the tool 11 to pass between them without obstruction (see Fig. 6). The tool 11 now cooperates with the lower tool to upset and clench the fastener, the clamping members 50 being now locked in their open position by the latching member 81.

When the inserting tool 11 rises to its initial position the work-supporting table 35 also rises under the influence of the compression springs 38, thereby stripping the work from the pilot 32. During the final stage of the upward movement of the slide 52, the latching member 81 is disengaged from the collar 83, and the clamping members 50 are thus released and permitted to close under the influence of the spring 54. All the parts are now in their initial positions as shown in Figs. 1 and 3 and the operation of the machine is automatically arrested by the stopping mechanism.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. That improvement in methods of piercing and eyeleting sheet material which consists in separating contiguous areas of the material lat-

erally and thereby tensioning a narrow intermediate area, piercing a hole in said intermediate area, and inserting an eyelet into the hole while the tensioning force is maintained.

2. That improvement in methods of piercing and eyeletting sheet material which consists in separating contiguous areas of the material laterally and thereby stretching a narrow intermediate area, piercing a hole in said intermediate area while it is in process of being stretched, and inserting an eyelet into the hole before the intermediate area is relieved from the stretching force.

3. That improvement in methods of piercing and eyeletting sheet material which consists in separating contiguous areas of the material and thereby tensioning an intermediate area, piercing and dilating a hole in the area so tensioned, bracing the rim of the hole against the piercing force throughout the piercing and dilating period, and inserting an eyelet into the hole while the tensioning force is maintained.

4. That improvement in methods of piercing and eyeletting sheet material which consists in clamping contiguous areas of said material, separating said areas and thereby tensioning a narrow intermediate area and at the same time piercing a hole in said intermediate area and tangent to said clamped areas, and inserting an eyelet into the hole while the tensioning force is maintained.

5. That improvement in methods of piercing and eyeletting sheet material which consists in clamping two contiguous areas of the material, cutting a slit in the material coincident with the common boundary line of the clamped areas, separating the clamped areas to spread the slit, and inserting an eyelet into the slit while the clamped areas are separated.

6. A fastener-inserting machine comprising work-tensioning mechanism provided with cooperative tensioning members arranged initially to engage a surface of the fastener-receiving area of the work, means arranged to operate against said members to pierce a hole in said area and to separate said members laterally, and means arranged to insert a tubular fastener into said hole.

7. A fastener-inserting machine comprising a tapered and pointed piercing tool, work-tensioning mechanism provided with cooperative members arranged initially to clamp and movable to tension the fastener-receiving area of the work and impale it on said tool, and means arranged to insert a tubular fastener into the hole occupied by said tool.

8. A fastener-inserting machine comprising work-clamping mechanism having laterally separable pairs of clamping members arranged initially to clamp the fastener-receiving area of the work, a tapered and pointed tool arranged to pierce said area and separate said pairs of clamping members laterally, and means arranged to insert a tubular fastener into the hole occupied by said tool.

9. A fastener-inserting machine comprising a movable fastener-inserting tool, a complementary tool having a shoulder for clenching the fastener and having a tapering pilot for piercing the work, and work-tensioning mechanism arranged to impale the work on said pilot and to engage the pilot while doing so.

10. A fastener-inserting machine comprising work-tensioning mechanism having two pairs of clamping members arranged initially to clamp a

fastener-receiving area of a work-piece, and fastener-inserting mechanism having a tapering work-piercing element arranged to engage contiguous edges of said clamping members and thereby force said pairs of clamping members apart laterally with a wedging action to tension the material in process of being pierced.

11. A fastener-inserting machine comprising mechanism arranged to move adjacent portions of an article of sheet-material edgewise away from each other thereby tensioning an intermediate portion, an element of said mechanism being a pointed tool arranged to pierce a hole in the portion so tensioned, and means arranged to insert a tubular fastener into the hole occupied by said tool.

12. A fastener-inserting machine comprising cooperative setting tools one of which is provided with a tapered pilot for piercing a fastener-receiving hole in a work-piece, mechanism for operating one of said tools, and work-tensioning mechanism comprising separable tensioning members arranged initially to sustain one face of the fastener-receiving area of the work against distortion during penetration by said pilot and to be wedged apart by the latter, said work-tensioning mechanism also including means arranged to cooperate with said members to clamp the work.

13. A fastener-inserting machine comprising cooperative fastener-inserting tools one of which is provided with a tapered pilot for piercing a hole to receive a fastener, mechanism for operating one of said tools, and work-tensioning mechanism arranged to be operated in timed relation to said tool-operating mechanism, said work-tensioning mechanism having laterally separable work-clamping members arranged to be wedged apart by said pilot as the latter pierces the work.

14. A fastener-inserting machine comprising a tool-carrier, a fastener-inserting tool carried thereby, a complementary setting tool arranged to cooperate with said fastener-inserting tool and having a tapered pilot for piercing a hole in the work, toggle-mechanism operable by said tool-carrier, and work-clamping mechanism arranged to be operated by said toggle-mechanism to impale the work on said pilot, said toggle-mechanism being constructed and arranged to complete the impaling stroke of said work-clamping mechanism at an intermediate point in the fastener-inserting stroke of said tool-carrier.

15. A fastener-inserting machine comprising a tool-carrier, a fastener-inserting tool carried thereby, a complementary tool provided with a tapered pilot for piercing a hole in the work to receive a fastener, and work-tensioning mechanism comprising yieldable work-supporting means and laterally separable members operable by said tool-carrier to clamp the work against said means, said members being arranged to be wedged apart by said pilot to tension the work as the pilot pierces it.

16. A fastener-inserting machine comprising downwardly yieldable work-supporting means, a tool provided with a fastener-clenching shoulder below the work and with an upstanding tapering pilot for piercing the work, downwardly movable work-depressing means comprising laterally movable members arranged to be wedged apart by said pilot, means arranged to separate said members further after their initial separation by the pilot, and mechanism arranged to insert

a tubular fastener downwardly between said members and into the work on said pilot.

17. A fastener-inserting machine comprising two pairs of work-clamping members each arranged initially to bear on that area of the work in which a fastener-receiving hole is to be pierced, fastener-inserting mechanism comprising relatively movable setting tools one of which includes a tapering pilot formed and arranged to pierce a fastener-receiving hole in said area of the work and to force apart said pairs of work-clamping members, and supplemental means by which said pairs of members are forced further apart to clear said tools.

18. A fastener-inserting machine comprising depressible work-supporting means, a lower setting tool provided with an upstanding tapered pilot initially below said means, mechanism arranged to clamp a work-piece upon said means and depress both to impale the work on said pilot, said mechanism having laterally separable work-clamping members arranged to be wedged apart by said pilot to tension the work being pierced, means arranged to separate said members further after they have been wedged apart by said pilot, and mechanism arranged to insert a fastener into the hole formed and occupied by said pilot.

19. A fastener-inserting machine comprising a plurality of work-clamping couples arranged to grip contiguous areas of a work-piece of sheet-material, a tapering element arranged to force said couples apart laterally and pierce an area of the work-piece from which they are displaced, supplemental means arranged to force said couples further apart, and means arranged to insert a fastener into the hole pierced by said tapering element.

20. In a fastener-inserting machine, in combination, a downwardly movable fastener-inserting tool, a lower tool having a fastener-clenching shoulder and a tapering work-piercing pilot projecting upwardly therefrom, downwardly movable work-depressing means comprising laterally yieldable members arranged to be wedged apart by said pilot as they force the work down on the pilot, and means arranged to effect further separation of said yieldable members after the pilot has caused primary separation of them.

21. In a fastener-inserting machine, in combination, a lower tool having a fastener-clenching shoulder and a work-piercing pilot projecting upwardly therefrom, a downwardly movable fastener-inserting tool, work-depressing means comprising laterally movable members arranged to force the work down on said pilot, means arranged to separate said members so that said fastener-inserting tool may pass between them, means arranged to maintain separation of said members while they are rising to their initial level, and means arranged to close said members after they have risen clear of the work.

22. In a fastener-inserting machine, in combination, a lower tool having a fastener-clenching shoulder and a tapering work-piercing pilot projecting upwardly therefrom, a downwardly movable fastener-inserting tool, downwardly yieldable work-supporting means comprising laterally movable members arranged normally to support the work above said pilot, and downwardly movable means comprising laterally movable members arranged to depress the work

and said work-supporting members below the top of the pilot, said work-supporting members and said work-depressing members being arranged to be wedged apart by said pilot as the latter pierces the work.

23. In a fastener-inserting machine, in combination, a lower tool having a fastener-clenching shoulder and a tapering work-piercing pilot projecting upwardly therefrom, a downwardly movable fastener-inserting tool, downwardly yieldable work-supporting means comprising laterally movable members arranged normally to support the work above said pilot, downwardly movable means comprising laterally movable members arranged to depress the work and said work-supporting members below the top of the pilot, said work-supporting members and said work-depressing members being arranged to be wedged apart by said pilot as the latter pierces the work, supplemental means arranged to separate said work-supporting members far enough to clear said fastener-clenching shoulder, and supplemental means arranged to separate said work-depressing members far enough to clear said fastener-inserting tool.

24. A fastener-inserting machine comprising two cooperative setting tools arranged to operate against opposite ends of a tubular fastener, one of said tools being fixed and having a tapering pilot for piercing a hole in the work to receive the fastener, divided means arranged to engage the work initially in register with said pilot to impale the work thereon, mechanism arranged to cooperate with said divided means to clamp and tension the work, and mechanism for operating the other one of said tools with movement toward and from said fixed tool.

25. A fastener-inserting machine comprising two cooperative tools arranged to operate against opposite ends of a tubular fastener, mechanism for operating one of said tools with movement toward and from the other, one of said tools having a tapering pilot for piercing a hole in the work to receive the fastener, divided means arranged to strip the work from said pilot, and divided means arranged to cooperate with said stripping means to clamp the work while said pilot is piercing a hole therein, both of said divided means being arranged to be wedged apart laterally by said pilot while the latter is piercing the hole.

26. A fastener-inserting machine comprising relatively movable tools arranged to operate against opposite ends of a tubular fastener, one of said tools having a tapering pilot for piercing a fastener-receiving hole in the work, work-tensioning mechanism comprising clamping members two of which are arranged initially to provide backing for that area of the work to be pierced and to be forced apart by entrance of said pilot between them, and supplemental means arranged to force said members further apart to clear one of said tools.

27. A fastener-inserting machine comprising a tool-carrier, a fastener-inserting tool carried thereby, a complementary setting tool having a tapered pilot for piercing a hole in the work, mechanism operable by said tool-carrier, and means operable by said mechanism to impale the work on said pilot with a stroke that terminates prior to the completion of the corresponding fastener-inserting stroke of the tool-carrier.

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