J. L. STUART.

GROMET MAKING AND SETTING MACHINE.

APPLICATION FILED MAY 4, 1920.

1,373,462.

Patented Apr. 5, 1921.

6 SHEETS—SHEET 1.

Fig. 2.

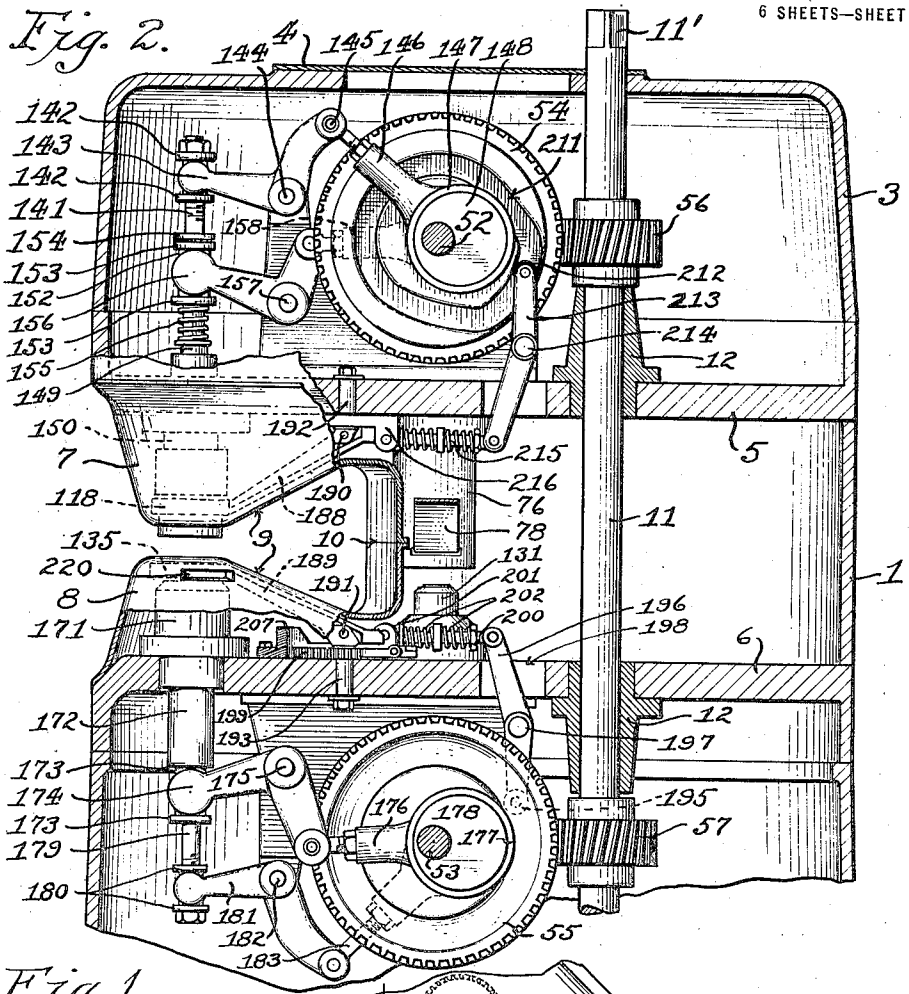
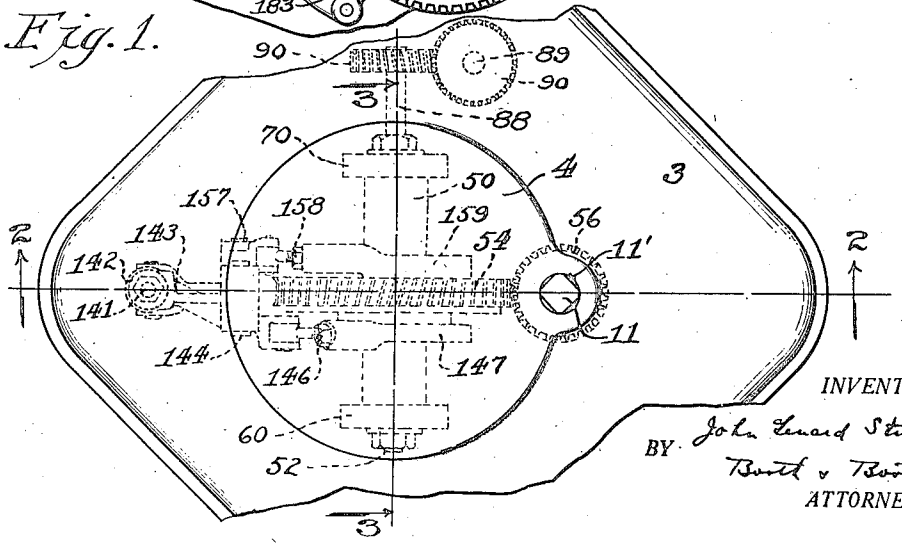


Fig. 1.



INVENTOR.

BY John Leonard Stuart,

Burt & Booth,

ATTORNEYS.

J. L. STUART.

GROMET MAKING AND SETTING MACHINE.

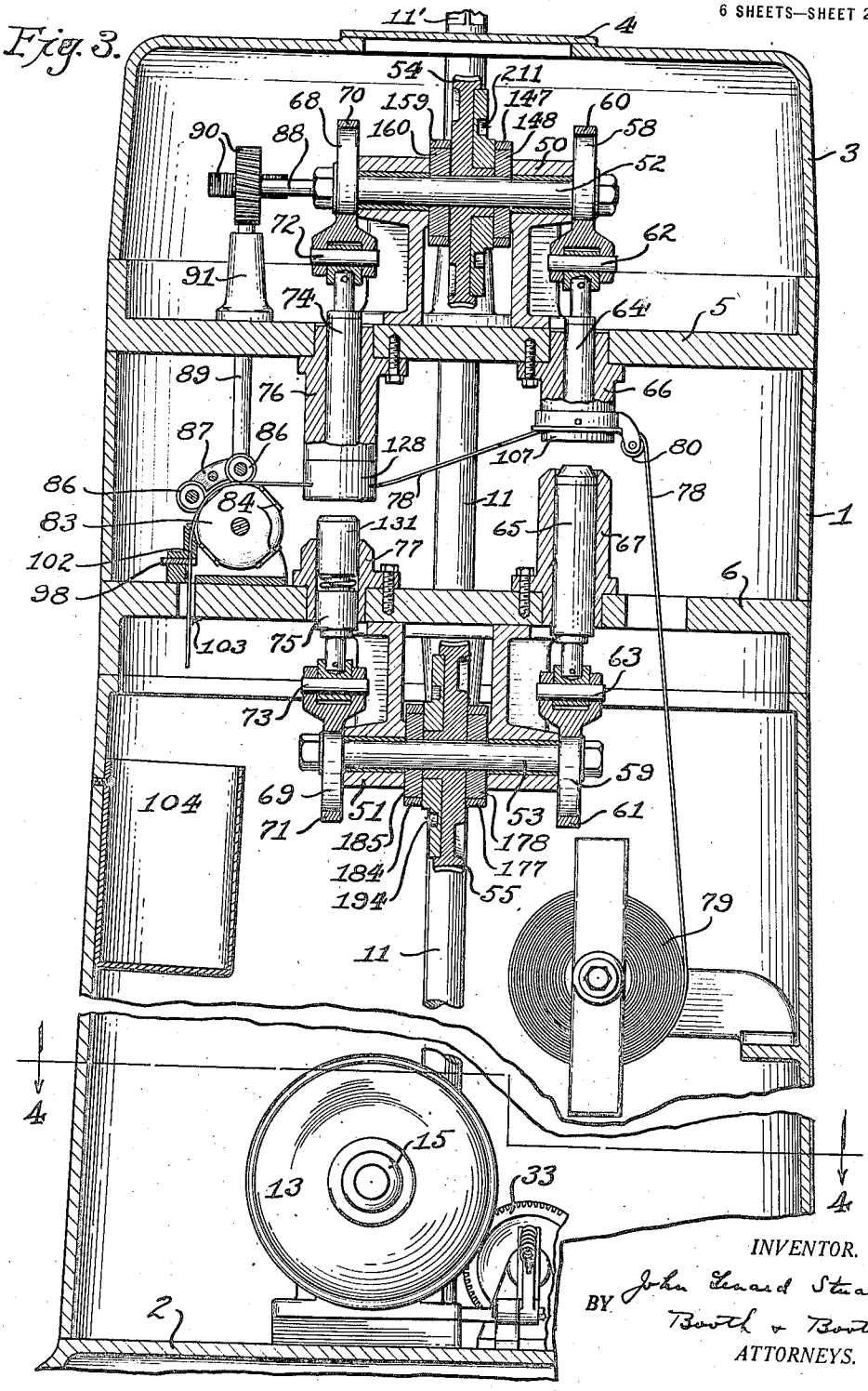
APPLICATION FILED MAY 4, 1920.

1,373,462.

Patented Apr. 5, 1921.

6 SHEETS—SHEET 2.

Fig. 3.



INVENTOR.

BY John Leonard Stuart,

Booth & Booth,

ATTORNEYS.

J. L. STUART.

GROMET MAKING AND SETTING MACHINE.

APPLICATION FILED MAY 4, 1920.

1,373,462.

Patented Apr. 5, 1921.

6 SHEETS—SHEET 3.

Fig. 4

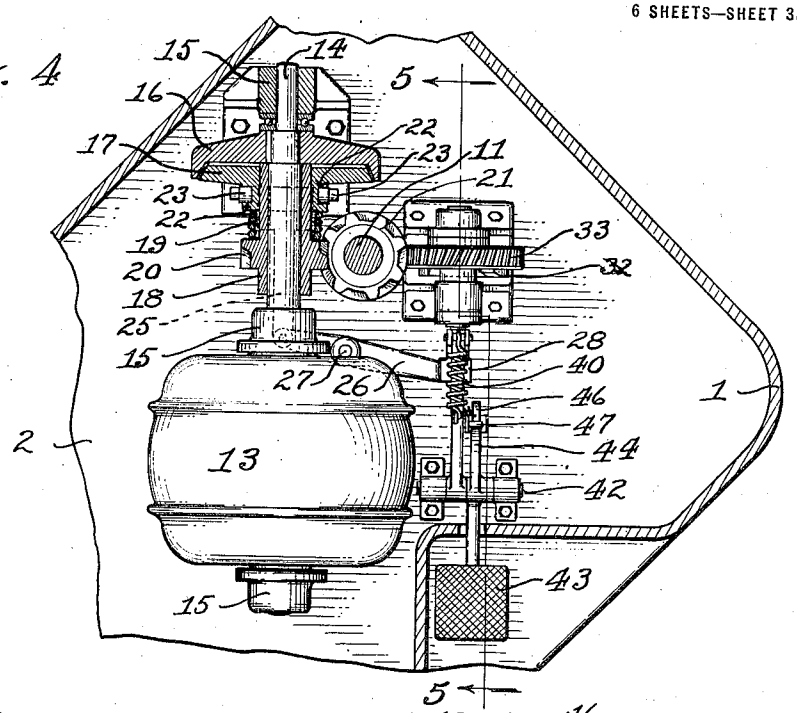


Fig. 5.

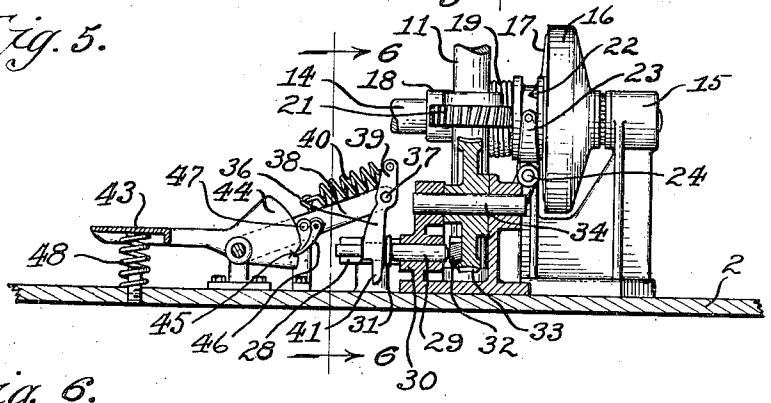
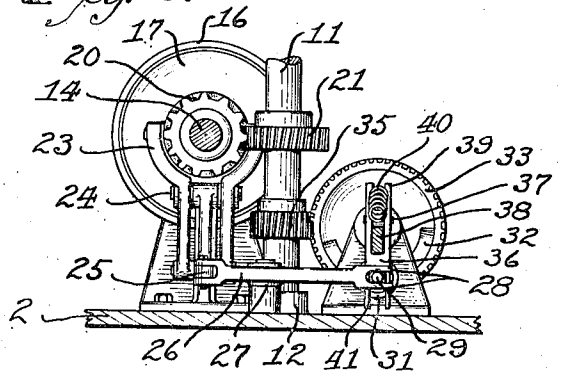


Fig. 6.



INVENTOR.

BY John Lenard Stuart

Routh & Routh,

ATTORNEYS.

J. L. STUART.

GROMET MAKING AND SETTING MACHINE.

APPLICATION FILED MAY 4, 1920.

1,373,462.

Patented Apr. 5, 1921.

6 SHEETS—SHEET 4.

Fig. 7.

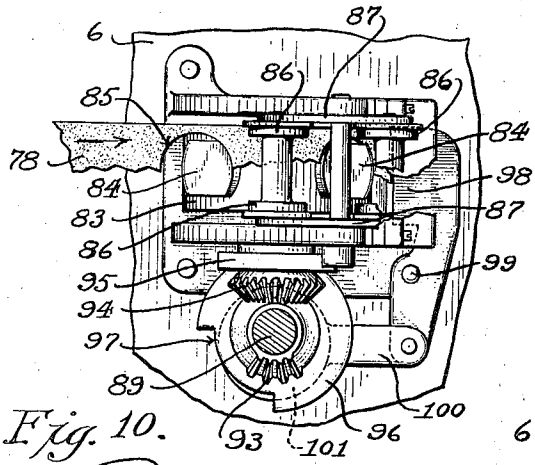


Fig. 8.

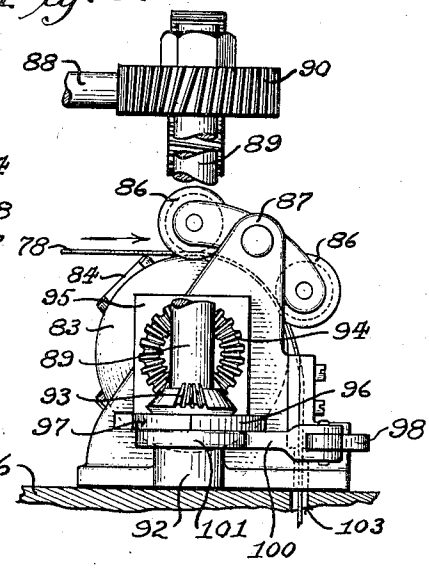


Fig. 10.

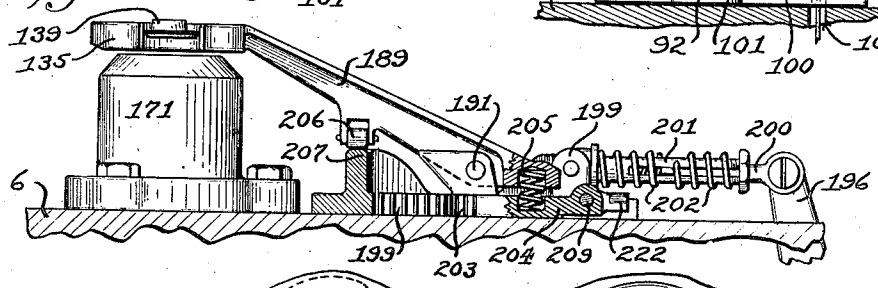
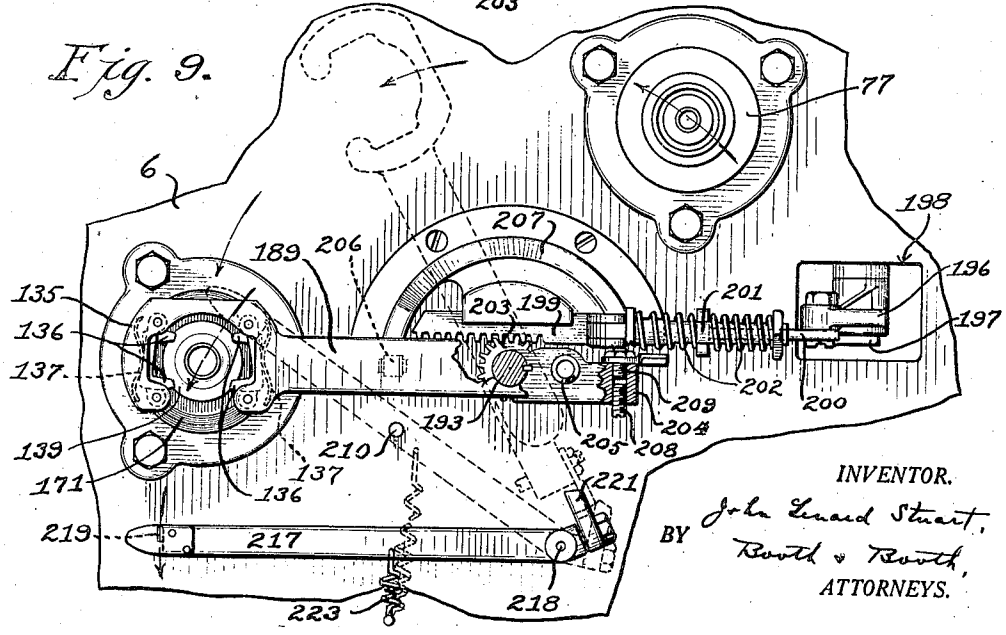


Fig. 9.



INVENTOR.

BY John Linard Stuart,

Booth & Booth,

ATTORNEYS.

J. L. STUART.

GROMET MAKING AND SETTING MACHINE.

APPLICATION FILED MAY 4, 1920.

1,373,462.

Patented Apr. 5, 1921.

6 SHEETS—SHEET 5.

Fig. 11.

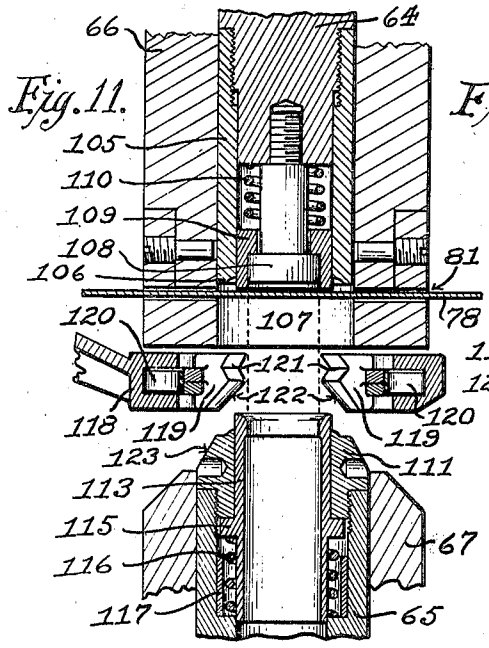


Fig. 12.

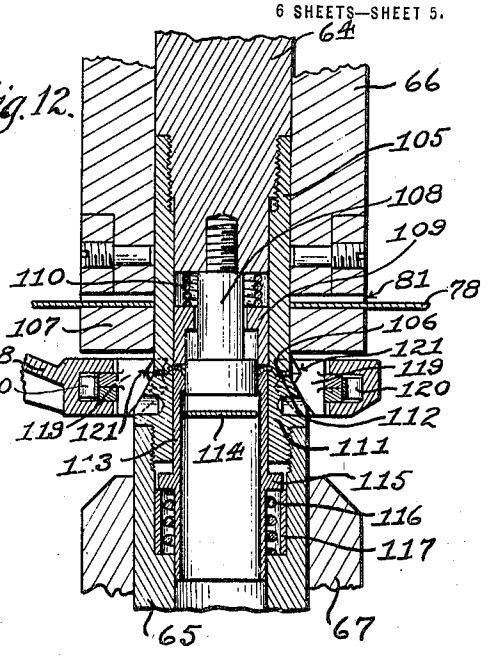


Fig. 13.

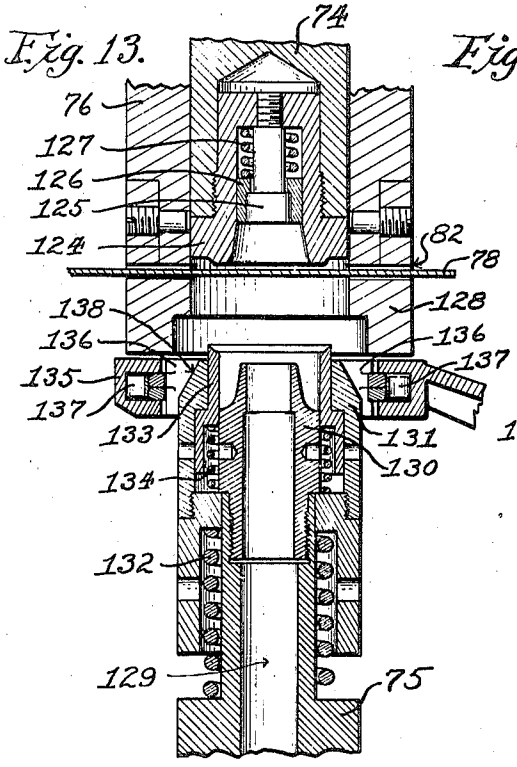
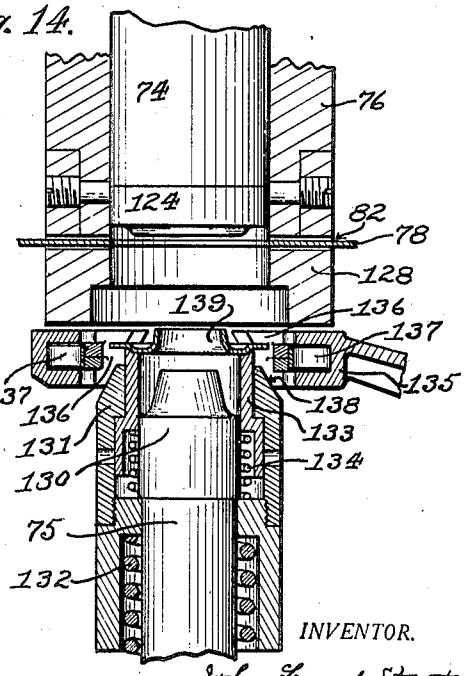


Fig. 14.



INVENTOR.

BY John Leonard Stuart,
Bostel & Bostel,
ATTORNEYS.

J. L. STUART.

GROMET MAKING AND SETTING MACHINE.

APPLICATION FILED MAY 4, 1920.

1,373,462. Patented Apr. 5, 1921.

6 SHEETS—SHEET 6.

Fig. 15.

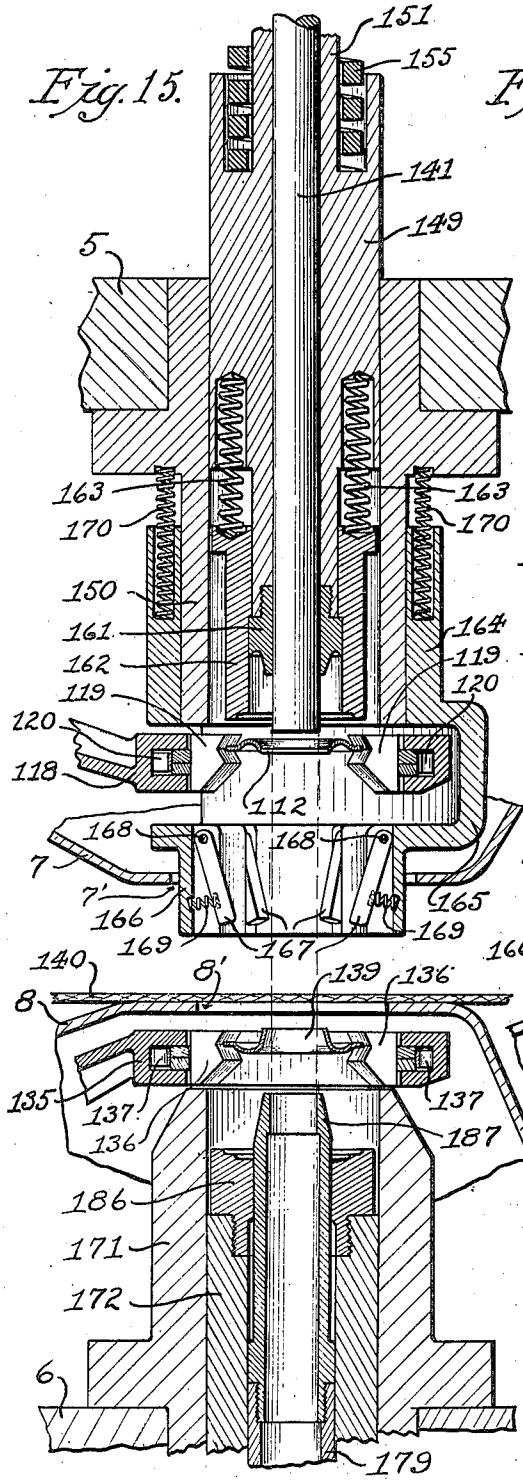
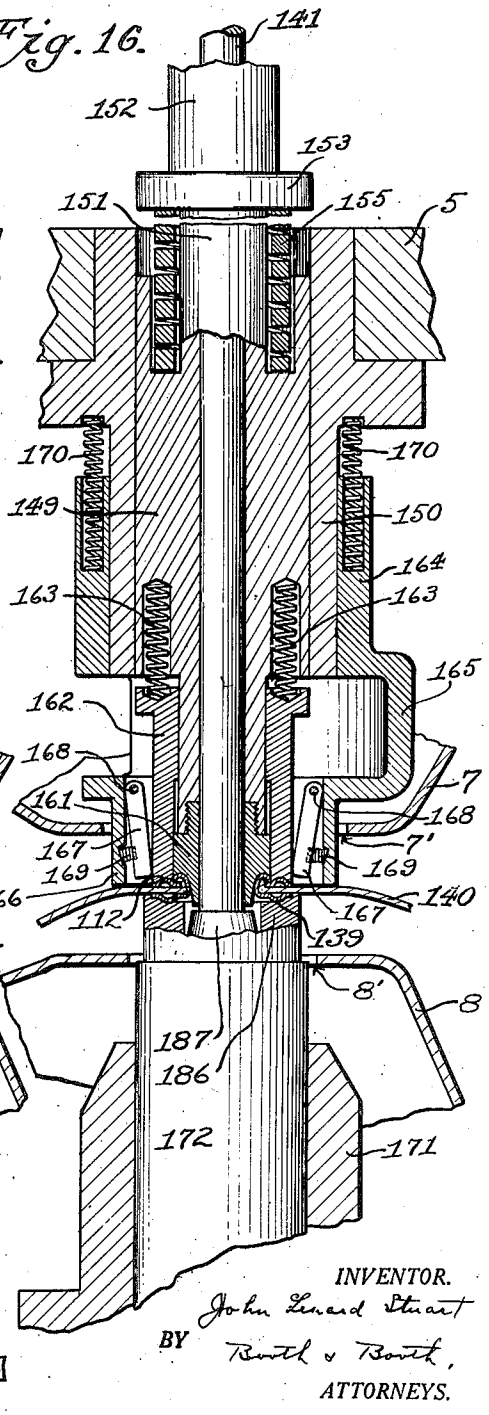


Fig. 16.



INVENTOR.

John Linard Stuart

BY Booth & Booth,

ATTORNEYS.

UNITED STATES PATENT OFFICE.

JOHN LENARD STUART, OF OAKLAND, CALIFORNIA, ASSIGNOR TO STUART MACHINE CO., OF SAN FRANCISCO, CALIFORNIA, A CORPORATION OF CALIFORNIA.

GROMET MAKING AND SETTING MACHINE.

1,373,462. Specification of Letters Patent. Patented Apr. 5, 1921.

Application filed May 4, 1920. Serial No. 378,902.

To all whom it may concern:

Be it known that I, JOHN LENARD STUART, a citizen of the United States, residing at Oakland, in the county of Alameda and State of California, have invented certain new and useful Improvements in Gromet Making and Setting Machines, of which the following is a specification.

My invention relates to a machine for making gromets and setting the same in fabric and other material.

The objects of the invention is to provide a machine of the type described which automatically forms a gromet and a coöperating washer, which punches a hole in the fabric or other material to which the gromet is to be applied, and which sets the gromet and its washer in the hole thus formed. These operations are done automatically and in very rapid succession, and constitute one cycle, having as its result the setting of a complete gromet in the fabric.

The object stated above, and also the basic principles of the present invention, are substantially similar to those set forth in my United States Letters Patent No. 1249238, issued December 4, 1917. However, in my present invention, I have improved upon the machine described in said Patent No. 1249238, and have added features of novelty, to such an extent that the machine illustrated and described herewith is not only more substantially constructed, and therefore more durable, but is capable of completing its required cycle of operations with greater accuracy and very considerably greater speed, than the said former machine.

My invention is herein described and is herewith illustrated as a machine for making and setting gromets, for the reason that such is the principal use for which the machine is designed, but it will be apparent that the machine may be readily adapted to the making and setting of other similar objects, such, for example, as eyelets, without involving any material changes in the essential features of the invention, or departing in any degree from the spirit thereof. Moreover, changes, within the scope of the claims hereto appended, may be made in the form and construction of the machine, for reasons of mechanical or structural practicability, without in any way affecting the principles of the invention.

My invention will now be fully described with reference to the accompanying sheets of drawings, wherein—

Figure 1 is a partly broken top plan view of the machine, showing certain interior parts in dotted lines.

Fig. 2 is a vertical section of the upper portion of the machine, taken approximately on the line 2—2 of Fig. 1, and viewed in the direction of the arrows.

Fig. 3 is a broken vertical section of the entire machine taken approximately on the line 3—3 of Fig. 1, and viewed in the direction of the arrows.

Fig. 4 is a sectional plan of the driving and clutch mechanism, taken in the direction of the arrows on the line 4—4 of Fig. 3.

Fig. 5 is a vertical section of the clutch mechanism, taken in the direction of the arrows on the line 5—5 of Fig. 4.

Fig. 6 is a vertical section of the same, taken in the direction of the arrows on the line 6—6 of Fig. 5.

Figs. 7 and 8 are respectively a fragmental plan, enlarged, and a partly broken fragmental rear elevation, enlarged, of the feed mechanism.

Figs. 9 and 10 are respectively a fragmental part-sectional plan, enlarged, and a fragmental part-sectional side elevation, enlarged, of a portion of the carrier mechanism.

Figs. 11 and 12 are fragmental vertical sections, enlarged, of the washer-forming dies, showing the same in open and closed positions, respectively.

Fig. 13 is a fragmental vertical section, enlarged, of the gromet-forming dies, showing the positions of the parts before the forming of the gromet.

Fig. 14 is a fragmental vertical partial section, enlarged, of the same, showing the positions of the parts after the formation of the gromet.

Fig. 15 is a fragmental vertical section, enlarged, of the setting dies, showing the positions of the parts at the beginning of the setting operation.

Fig. 16 is a fragmental partial section, enlarged, of the same, showing the positions of the parts at the end of the setting operation.

Referring now more particularly to the drawings, the reference numeral 1, Figs. 2, 3

and 4, designates a housing which completely incloses the operating parts of the machine, and also serves as a supporting frame. This housing or frame rests upon a base 2, Fig. 3, and its upper portion 3 is removable, forming a cap for inclosing certain mechanism. Suitable hand-holes are provided in the housing 1 and the cap 3, and these apertures are closed by removable plates or doors, one of which is shown at 4 in Figs. 1, 2 and 3.

The housing 1 supports two spaced horizontal plates 5 and 6, Figs. 2 and 3, which serve to support the dies for forming and setting the gromet and washer and their associated mechanism. A portion of said housing is cut away between said plates, in the region of the dies, to allow the material in which the gromet is set to be placed between the setting dies, and removable upper and lower plates 7 and 8, respectively, Fig. 2, of irregular shape, are positioned to inclose the die mechanism in the open region of the housing. Said plates have alined apertures 7′ and 8′, in their forward portions through which the upper and lower setting dies protrude, and diverge in the rear of said setting dies, as shown at 9, to form an enlarged space behind the dies in which the material may be bunched when the gromet is set at some distance from the edge. Said plates then meet, as shown at 10, thus completely inclosing all the die mechanism except the co-acting ends of the setting dies which protrude through the said apertures in said plates. There is no possibility, therefore, of the material becoming entangled in the mechanism.

The various forming and setting dies are actuated by a vertical driving shaft 11, Figs. 1 to 6, which has suitable bearings 12, Figs. 2 and 6, in the horizontal plates 5 and 6 and the base 2. This shaft is driven, through a clutch mechanism to be presently described, by a suitable source of motive power, shown at 13 in Figs. 3 and 4, as an electric motor. The motor rotates continuously, and is thrown into driving relation with the shaft 11 through operation of the clutch mechanism by the operator. Said clutch mechanism is so constructed, however, as to automatically disengage the motor 13 from said shaft 11 after the completion of one cycle of operations, culminating in the setting of one gromet. The shaft 11 extends through the housing cover 3, and its upper end, as shown at 11′ in Figs. 1, 2 and 3, is suitably formed to receive a wrench or handle, not shown, by means of which said shaft may be rotated, by hand, for the purpose of adjusting the various operating parts of the machine.

The rotating portion of the motor 13 is mounted on a shaft 14, Fig. 4, which is journaled in bearings 15, and has fixed upon it the female member 16 of a cone clutch. The male member 17 of said clutch is mounted upon a sleeve 18, which is journaled upon the motor shaft 14. Said male clutch member 17 is free to slide axially upon said sleeve, but is constrained to rotate therewith by suitable keys or splines, not shown in the drawings. A spring 19 normally holds said male clutch member 17 in engagement with the female clutch member 16. The sleeve 18 carries a spiral gear 20, which meshes with and drives a similar gear 21 fixed upon the vertical shaft 11, said spiral gears transmitting the power of the motor 13 from the clutch mechanism to said vertical shaft.

The hub of the male clutch member 17 is provided with an annular groove 22, Figs. 4 and 5, in which rides a throw-out yoke 23. This yoke is fulcrumed at 24, Figs. 5 and 6, and its lower extremity is pivotally connected with a link 25, Figs. 4 and 6, which lies below and parallel with the motor shaft 14, and which is connected, at its other end, with a lever 26. This lever is fulcrumed at 27, and its free end 28, Figs. 4, 5 and 6, is forked and straddles a rod or pin 29, Figs. 5 and 6, slidably mounted in a suitable bracket 30, Fig. 5.

The pin 29 is provided with a collar 31, Fig. 5, and its inner end bears against a cam face 32 carried by a worm gear 33, which is suitably journaled at 34 and is rotated by a worm 35, Fig. 6, mounted on the vertical shaft 11. Said worm and worm gear are so proportioned that the worm gear 33 makes one revolution for every cycle of operations of the die mechanism.

A bifurcated dog 36, Figs. 5 and 6, straddles the pin 29 between the end 28 of the clutch throw-out lever 26 and the collar 31, and said dog is pivotally connected at 37 with a lever 38. The upper projecting end 39 of said dog is further connected with said lever 38 by a tension spring 40. The lower ends of said dog are cut away to form narrow end portions 41, Fig. 5. The lever 38 is fulcrumed at 42, Figs. 4 and 5, which is also the fulcrum for a pedal 43 extending outside the housing 1 and lying within reach of the operator's foot. The inner end 44 of said pedal is segmental in form, and has a notch 45, Fig. 5, cut in its arcuate end, which is adapted to engage a pawl 46 carried by the lever 38. A stationary pin 47 is positioned to throw said pawl out of the notch 45 when the inner segmental end 44 of the pedal and the lever 38 are raised. A spring 48, positioned beneath the pedal 43, normally holds the same in the position shown in Fig. 5.

The action of the clutch mechanism is as follows: The operator depresses the pedal

43, thus raising the lever 38 and the dog 36 until the wide portions of the latter's ends are raised above the forked end 28 of the clutch lever 26. This allows the end 28 of said lever 26 to move forward, which it does, impelled by the clutch spring 19. This same action of the spring 19 also engages the two co-acting members 16 and 17 of the clutch, and the vertical shaft 11 is set in rotation, rotating the gear 33 with it. When the raised portion of the cam face 32 travels beyond the slidable pin 29, said pin is forced inwardly, that is to the right as viewed in Fig. 5, by the force of the spring 40, acting through the dog 36, as a lever, and the collar 31. Inasmuch as said collar 31 has moved inwardly, while the forked end 28 of the lever 26 has remained stationary, after its initial movement, the dog 36 is permitted to drop down, inserting the wide portions of its ends between said collar 31 and said lever end 28. This dropping of the dog 36 occurs even though the operator may continue to hold the pedal 43 depressed, for the pawl 46 has been thrown out of the notch 45, thus disengaging the lever 38 from said pedal, by contact with the stationary pin 47 at the end of the initial upward movement of said lever 38.

The vertical shaft 11 continues to revolve until the raised portion of the cam face 32 carried by the gear 33 forces the slidable pin 29 to the left, carrying with it the dog 36 and the end 28 of the lever 26, and thus disengaging the clutch. By this time the cycle of operations of the forming and setting dies, to be presently described, is complete, and the vertical shaft 11 comes to rest in the proper position for the beginning of a new cycle. It will be observed that the operation of the machine, although started by the operator by depressing the pedal 43, automatically comes to a stop after the completion of one cycle; and on account of the action of the stationary pin 47 in throwing the pawl 46 out of the notch 45, the machine will stop automatically, at the proper time, even though the operator may hold the pedal 43 depressed. There is no possibility, therefore, of the machine making more than one cycle of operations through the inadvertence of the operator.

Turning now to the description of the gromet and washer forming means, the horizontal plates 5 and 6, Fig. 3, support bearing brackets 50 and 51, the bracket 50 being above the plate 5, and the bracket 51 below the plate 6. Horizontal shafts 52 and 53 are journaled in said brackets 50 and 51 respectively, and worm wheels 54 and 55, Figs. 2 and 3, are fixed upon said shafts, and mesh with worms 56 and 57, respectively, upon the vertical shaft 11, as shown in Fig. 2. Said worms and worm wheels are so proportioned that the horizontal shafts 52 and 53 operate in unison, and each makes one complete revolution during every cycle of operations.

The horizontal shafts 52 and 53 carry eccentrics 58 and 59, respectively, at their right-hand ends as viewed in Fig. 3, which operate, through eccentric straps 60 and 61 and pivotal connections 62 and 63, respectively, vertically reciprocating plungers 64 and 65, the plunger 64 sliding in a guide 66 secured to the upper plate 5, and the plunger 65 sliding in a guide 67 secured to the plate 6. Said plungers 64 and 65 are in mutual vertical alinement, and carry, on their coöperating ends, the washer forming dies to be described in detail presently.

Similarly, said horizontal shafts 52 and 53 have mounted upon them, at their left-hand ends, as viewed in Fig. 3, the respective eccentrics 68 and 69, which operate, through eccentric straps 70 and 71 and pivotal connections 72 and 73, respectively, vertically reciprocating plungers 74 and 75, said plungers being carried in cylindrical guides 76 and 77 secured to the horizontal plates 5 and 6 respectively. Said plungers 74 and 75 are in mutual vertical alinement, and carry the gromet forming dies upon their coöperating ends.

The eccentrics 58, 59, 68 and 69 are so timed upon their respective shafts that the two alined plungers of each pair coöperate in proper relative movement, and further that the forming operations of the two pair do not occur simultaneously, in order that the load on the driving mechanism may be more evenly distributed. However, the difference in time between these two operations, *i. e.* forming the gromet and forming the washer, is comparatively small, since both are fully accomplished during the complete cycle of operations of the machine, and for the purposes of description said two operations may be considered as practically simultaneous.

The gromet and washer are formed from blanks cut by the forming dies themselves from a strip or ribbon 78 of metal. Said ribbon is carried in a coil 79, Fig. 3, suitably supported in the lower portion of the machine, and is led up through the lower horizontal plate 6, over a guide roller 80, through a slot 81, (shown in Figs. 11 and 12), in the plunger guide 66 of the upper washer forming die, thence through a similar slot 82, (shown in Figs. 13 and 14), in the plunger guide 76 of the upper gromet forming die, and finally through a feed mechanism shown in Fig. 3 at the left of the gromet forming dies, and in more detail in Figs. 7 and 8.

Said feed mechanism comprises a feed wheel 83 having radially projecting lugs 84 so spaced and shaped as to engage the holes 85, Fig. 7, in the ribbon 78 formed by the

cutting therefrom of the washer and gromet blanks. Guide rollers 86, Figs. 3, 7 and 8, carried by a bracket 87, hold the ribbon in contact and engagement with said feed wheel 83, and direct its final course downward. The feed wheel 83 is rotated in an intermittent or step movement to advance the ribbon the proper distance at the proper time. This movement of the ribbon, at each step, is sufficient to permit the cutting of two blanks, one for the washer and one for the gromet, and the distance between the washer and gromet forming dies is such that the gromet blank is stamped from the uncut portion of the ribbon between successive holes left by the cutting of the washer blanks.

The feed wheel 83 is rotated by the following mechanism: The upper horizontal shaft 52, Fig. 3, has an extension 88 at its left-hand end, which rotates a vertical shaft 89 through a pair of spiral gears 90. Said vertical shaft passes through a journal 91 secured to the upper horizontal plate 5 and extends downward to the feed mechanism, having a bearing 92, Fig. 8, at its lower end. Near said lower end, the vertical shaft 89 has fixed upon it a segmental bevel gear 93, Figs. 7 and 8, which meshes periodically with a complete bevel gear 94 fixed upon the shaft of the feed wheel 83. Immediately behind said bevel gear 94, and fixed thereto, is a square plate 95, whose flat edges are adapted to contact freely with the upper surface of a horizontal disk 96 fixed upon the vertical shaft 89 immediately below the segmental gear 93. Said horizontal disk has a segmental cut-out portion 97, into which the corners of the square plate 95 may extend when the latter is turned by the segmental bevel gear 93. The square plate 95 and the cut-out disk 96 therefor act as a Geneva-lock mechanism to hold the feed wheel 83 stationary while the blank portion of the segmental gear 93 is passing over the complete gear 94, and to properly locate said complete gear to enable the teeth of the segmental gear to mesh accurately therewith. The feed wheel 83 is thus turned through a quarter-revolution at each complete revolution of the vertical shaft 89, this movement being sufficient to advance the ribbon 78 the required distance. Moreover, this movement is so timed as to occur at the proper time in the cycle of operations of the machine.

The ribbon 78, after passing over the feed wheel 83, is cut into short lengths, to enable more convenient disposal of the waste. For this purpose there is provided a horizontally oscillating knife blade 98, Figs. 7 and 8, pivoted at 99, Fig. 7, and operated by a link 100 from an eccentric 101 mounted on the vertical shaft 89. The blade 98, coöperating with a stationary blade 102, Fig. 3, cuts off the end portion of the ribbon, after each advance movement thereof, the cut off waste falling through an aperture 103 in the plate 6 into a suitable receptacle 104 below.

The washer forming dies are illustrated in detail in Figs. 11 and 12. The upper slidable plunger 64 has secured to its lower end a tubular extension 105 whose lower end 106 passes through an annular die 107 removably secured to the lower end of the guide 66, and coöperates with said annular die to cut the washer blank from the metallic ribbon 78. The plunger 66 also has a central die 108 secured to its lower end within the tubular die 105, and between said dies 105 and 108 is a stripper ring 109 backed by a spring 110 which normally retains said ring in its lowermost position, abutting against a shoulder formed on said central die 108, as shown.

The lower plunger 65 is tubular, and carries at its upper end an annular forming die 111, which coöperates with the face 106 of the upper tubular die 105 to shape the washer, as shown at 112 in Fig. 12. Within said annular die 111 and the upper end portion of the plunger 65 is a tubular die 113, Figs. 11 and 12, which coöperates with the upper central die 108 to cut the core from the center of the washer. This core, shown at 114 in Fig. 12, drops down through the tubular die 113 and the tubular plunger 65. The tubular die 113 has a certain amount of vertical movement with respect to the plunger 65, a flange 115, Figs. 11 and 12, being formed on the outside thereof and being pressed upwardly by a spring 116 against the bottom of the annular forming die 111. A spacer sleeve 117 limits the downward movement of said tubular die 113.

Between the upper and lower plunger guides 66 and 67 is a movable carrier 118, whose function is to receive the formed washer from the forming dies and convey it to the setting die in a manner to be described in detail hereinafter. Said carrier is provided with radially movable jaws 119, pressed inwardly by springs 120, and formed upon their inner surfaces with notches 121, Fig. 11, in which the washer rests. Said jaws are also beveled on their lower and inner edges, as shown at 122, to enable them to be spread apart, to receive the washer, by the tapered outer surface 123 of the lower annular forming die 111.

The relative movements of the washer forming dies may be briefly described as follows: Impelled in the proper timed relation by their respective eccentrics 58 and 59, the plungers 64 and 65 move toward each other. The lower end 106 of the upper tubular die 105, entering the annular die 107, first cuts a circular blank from the ribbon 78. At the same time, the lower plunger 65 has moved up to the position shown in Fig.

12, the forming die 111 separating the carrier jaws 119. The blank then falls upon the upper end of the lower tubular die 113, and as the upper plunger descends, is shaped, as shown in Fig. 12, between the meeting faces of the tubular upper die 105 and the lower annular die 111, the stripper ring 109 and the lower tubular die 113 receding as said members 105 and 111 meet. At the same time, the upper central die 108, entering the lower tubular die 113, punches the central hole in the washer 112.

The parts are now in the positions shown in Fig. 12, the washer 112 being in horizontal alinement with the notches 121 of the carrier jaws 119. The plungers 64 and 65 then begin to separate, and as the upper tubular die 105 and the lower annular die 111 draw apart, the stripper ring 109 and the lower tubular die 113, held together by their respective springs 110 and 116, retain the washer 112 in position until it is engaged by the contracting carrier jaws 119, and until the upper central die 108 has been withdrawn from the central hole in the washer. The plungers 64 and 65 then further separate to the positions of Fig. 11, leaving the washer, not shown in said Fig. 11, within the carrier jaws 119.

The gromet forming dies, illustrated in Figs. 13 and 14, are similar, in principle, to the washer forming dies above described. The upper plunger 74 has fixed to its lower end an annular forming and blank-cutting die 124, Fig. 13, and a central punching die 125, between which is a slidable stripper ring 126, pressed downwardly by a spring 127. Said annular die 124 coöperates with a die ring 128, removably secured to the lower end of the plunger guide 76, to cut a blank for the gromet from the ribbon 78.

The lower plunger 75 has a central bore 129, and secured to its upper end, which is reduced in diameter, is a tubular shaping and cutting die 130, which coöperates with the upper shaping die 124 to draw the central portion of the gromet, and with the central punching die 125 to cut the central hole in said gromet, the waste core being discharged through the bore 129. The upper portion of the plunger 75 is surrounded by a slidable tubular clamping and stripping member 131, pressed upwardly by a spring 132, and within said stripper, and surrounding the tubular die 130, is an inner tubular stripping and clamping member 133, slidable within said outer stripper 131, and pressed upwardly by a spring 134. A carrier 135, similar in every respect with the carrier 118 described above, is positioned below the upper plunger guide 76, and has radially movable jaws 136, pressed inwardly by springs 137, formed similarly to the jaws 119 of said previously described carrier, and adapted to be moved apart by the tapering upper end 138 of the outer stripper 131.

When the plungers 74 and 75 begin to approach each other, the lower plunger 75, moving up, opens the carrier jaws 136 by means of its tapered upper end 138, and the upper plunger 74, moving down, cuts a blank from the ribbon 78 by the entry of the die 124 into the ring 128. The outer portion of the blank is then clamped between the meeting faces of the die 124 above and the inner and outer strippers 133 and 131 below, and firmly held while the lower shaping die 130 continues to move up, compressing the spring 132, and, by entering the upper shaping die 124, draws the central portion of the blank to the desired shape, and finally, by coöperating with the upper central punching die 125, cuts the central hole in the gromet.

Separation of the plungers 74 and 75 first withdraws the central dies 130 and 125, the gromet being still clamped, at its outer edge, between the die 124 above and the strippers 131 and 133 below, and being held in horizontal alinement with the carrier jaws 136. Upon further separation of said plungers, the upper die is completely withdrawn, and the formed gromet is left resting upon the inner stripper 133 of the lower plunger, as shown at 139 in Fig. 14, until the outer stripper 131 drops sufficiently to permit the carrier jaws 136 to close and grip said gromet after which the lower plunger is entirely withdrawn to free the carrier 135.

It is to be noted that both washer and gromet are positively positioned within the jaws of their respective carriers by the action of the strippers of the various dies, so that there is no possibility for said carriers to fail in picking up said washer and gromet. The gromet 139 and the washer 112 are conveyed by their respective carriers 135 and 118, in a manner to be hereinafter described, and are positioned, as shown in Fig. 15, in vertical alinement between the upper and lower setting dies, the gromet being below the lower housing plate 8 and the washer being above the upper housing plate 7. Said gromet and washer are then in position for being set in the fabric or material 140, which is placed by the operator between the adjacent and alined openings 8′ and 7′ of said housing plates 8 and 7 respectively.

In the upper setting die, shown in Figs. 2, 15 and 16, there is a central punch 141, comprising a straight rod having adjustable spaced flanges 142, Fig. 2, on its upper end, between which rides the forked end of a bell-crank lever 143, fulcrumed at 144, and whose other end is connected at 145 with an adjustable link 146 secured to the strap 147 of an eccentric 148, Figs. 2 and 3, mounted on the upper horizontal shaft 52. Surrounding

the central punch 141 is a tubular plunger 149, Figs. 15 and 16, slidably mounted in a guide 150 secured to the upper horizontal plate 5. Said plunger has a shank 151 of reduced diameter at its upper end portion, upon which is a slidable sleeve 152, Figs. 2 and 16, having spaced flanges 153. Said sleeve is limited in its upward movement upon the plunger shank 151 by a collar 154, Fig. 2, and a spring 155, Figs. 2, 15 and 16, limits its downward movement. The flanges 153 of the sleeve 152 are engaged by the forked end of a bell-crank 156, Fig. 2, which is fulcrumed at 157 and connected by an adjustable link 158 with the strap 159, Fig. 3, of an eccentric 160 mounted on the shaft 52 on the other side of the gear 54. The central punch 141 and the plunger 149 therefor have independent movements, and the movement of said plunger is cushioned by the spring 155 to allow for fabrics of different thickness.

The plunger 149 carries, on its lower end, a setting die 161, Figs. 15 and 16, and surrounding this, a slidable tubular stripping and clamping member 162, normally held at the lower limit of its play by springs 163. The guide 150 is surrounded by a vertically movable sleeve 164, having an enlarged portion 165 to receive the carrier 118, and a tubular end portion 166 in which are mounted a series of radially movable fingers 167, said fingers being pivoted at 168 and pressed inwardly by springs 169. The function of said fingers is to prevent the washer 112 from dropping down upon the fabric 140 after its release from the carrier jaws 119, and so becoming misplaced before the setting operation is completed. The sleeve 164, which is pressed downwardly by springs 170, has a limited vertical movement to permit the setting of a gromet in fabrics of different thickness, as will be made apparent hereinafter.

The lower setting die is substantially similar to the upper. A guide 171, Figs. 2 and 15, secured to the lower horizontal plate 6, supports a tubular vertically movable plunger 172 formed with spaced shoulders 173, Fig. 2, upon its lower end. The forked end of a bell-crank 174, pivoted at 175, lies between these shoulders, and the other end of said bell-crank is connected, by an adjustable link 176, with the strap 177, Figs. 2 and 3, of an eccentric 178, mounted on the lower horizontal shaft 53. Within the plunger 172 is a slidable tubular member 179, Figs. 2 and 15, having spaced flanges 180, Fig. 2, on its lower end, between which rides the forked end of a bell-crank 181, pivoted at 182. The other end of said bell crank is connected, by an adjustable link 183, with the strap 184, Fig. 3, of an eccentric 185 mounted on the shaft 53 on the opposite side of the central gear 55.

The plunger 172 carries, at its upper end, the lower annular setting die 186, Figs. 15 and 16 which coöperates with the upper setting die 161 to set the gromet. The central tubular member 179 carries the lower punching die 187, which coöperates with the upper punch 141 to form the hole in the material 140, the waste material from the punching operation falling through said tubular member 179. The upper end of said lower punching die 187 is exteriorly tapered, as shown, and is of such diameter that, although its extreme upper end will pass completely through the central tubular portion of the gromet 139, to enable it to properly coöperate with the upper punch 141 to form the hole in the material 140, yet the central tubular portion of said gromet will be engaged by the portion of enlarged diameter of said lower punching die 187, to enable said lower punching die to temporarily support said gromet during the withdrawal of the carrier 135.

The operation of the setting dies is as follows:—Starting from the positions shown in Fig. 15, the lower punching die 187 moves up, its upper extremity or punching end passing through the central hole in the gromet 139. At the same time, the upper punch 141 moves down, passing through the central hole in the washer 112, and, entering the lower punching die 187, punches the hole in the fabric 140. After said punches have passed through the gromet and washer, and while they are still approaching each other, the carriers 118 and 135 are withdrawn, in a manner and for a purpose to be later set forth, leaving the washer and gromet held in axial alinement by the upper and lower punches 141 and 187 respectively. The washer, upon its release from the jaws of the carrier 118, drops down, upon the central punch 141, and is held in a horizontal position by the fingers 167 until it is forced down upon the fabric by the descending upper stripper 162.

At the same time, the lower punch 187, followed closely by the lower setting die 186, has continued its upward movement, carrying the gromet 139 with it, and lifting the fabric 140 into contact with the lower end of the spring-cushioned sleeve 164. The central tubular portion of the gromet is then forced through the hole in said fabric at the same instant that the washer 112 is forced down thereonto by the upper stripper 182, and the washer and gromet, with the fabric therebetween, are then clamped by the meeting faces of said upper stripper 182 and the lower setting die 186, while the upper setting die 161 continues to move down within its stripper 182, expanding and curling the inner portion of the gromet over the washer, and clamping the cut edge of the fabric therebetween, as shown in Fig. 16. The

lower punch 187 moves downward at the same time to clear the upper setting die. The dies then separate, and return to the positions shown in Fig. 15.

The carriers 118 and 135 are fixed upon the ends of arms 188 and 189, Fig. 2, respectively, and said arms are mounted for vertical oscillatory movement at 190 and 191 and for horizontal oscillatory movement upon spindles 192 and 193, respectively, said spindles being rotatable in the horizontal plates 5 and 6. The upper or washer carrier 118 is thus supported from the upper plate 5, and the lower or gromet carrier 135 from the lower plate 6.

The lower or gromet carrier 135 is actuated from a cam groove 194, Fig. 3, formed in a member secured to the central gear 55 of the lower horizontal shaft 53. This groove is followed by a roller 195, Fig. 2, carried upon the lower end of a lever 196, fulcrumed at 197. The upper end of said lever extends through an aperture 198, Figs. 2 and 9, in the plate 6, and is connected by a spring-cushioned link with a slidable rack-bar 199. Said link, as shown in Figs. 9 and 10, comprises two relatively movable parts 200 and 201, connected with the lever 196 and the rack-bar 199 respectively, the part 200 transmitting its motion to the part 201 through cushioning springs 202.

The rack-bar 199 engages a segmental pinion 203 fixed to the spindle 193 of the carrier arm 189, so that linear reciprocating movement of said rack-bar causes oscillatory movement of said spindle and carrier arm. The spindle 193 also carries an arm 204, which lies under the rear end portion of the carrier arm 189, as shown in Fig. 10, and supports said rear carrier arm portion by a spring 205. The carrier arm 189 carries a roller 206, which travels upon a raised cam track 207, Figs. 9 and 10, and which is held in contact with said track by the action of the spring 205. The contour of said cam track 207 is such that, as the carrier arm 189 is swung around by the movement of the rack-bar 199, the carrier head 135 is first lowered, from its initial position above the lower gromet die guide 77, Figs. 2 and 9, to enable it to pass under the lower housing plate 8, Fig. 2, and is then raised to come into position above the lower setting die guide 171, this being the position shown in full lines in Figs. 9 and 10. In order to correctly locate the carrier with respect to the forming and setting dies, adjustable screws 208 and 209 are provided in the arm 204, Fig. 9, the screw 208 contacting with a stop pin 210 projecting upwardly from the plate 9 to locate the carrier in its position between the forming dies, and the screw 209 contacting with the end of the rack-bar 199, as shown in Fig. 9, to locate said carrier properly between the setting dies.

The operating mechanism and construction of the upper, or washer carrier is similar to that described above. A cam groove 211, Figs. 2 and 3, formed in a member secured to the upper horizontal shaft gear 54, is followed by a roller 212, Fig. 2, carried by one end of a lever 213, fulcrumed at 214, and having its other end connected, by a spring-cushioned link 215, with a rack-bar 216 which operates the carrier arm 188 in a manner identical with that described above with reference to the lower carrier arm 189. The movement of said upper carrier is similar to that of the lower carrier, enabling it to pass from its initial position between the washer forming dies, over the upper housing plate 7, and come to rest below the upper setting die.

There is provided, as a safety device, means for automatically removing the set gromet and washer from the setting dies, in case said gromet and washer should be set upon themselves, without any fabric therebetween. This is necessary to prevent injury to said setting dies and their associated mechanism from the piling up of two or more set gromets between the setting dies, if the machine should be caused to operate through two or more consecutive cycles without any fabric in position to receive the gromet.

This safety ejector device comprises a swinging arm 217, Fig. 9, pivotally mounted at 218 upon the plate 6, and having a finger 219 projecting downwardly from its free end and adapted to engage the set gromet and throw the same off the setting die and out through an aperture 220, Fig. 2, formed in the lower housing plate 8. This arm 217, on its inner end, has a dog 221, pivotally mounted for vertical swinging movement, and adapted to be engaged by a finger 222 secured to and projecting from the rear end of the lower carrier supporting arm 204. Said finger 222 is beveled, as shown in Figs. 9 and 10, so that, upon the rearward movement of the carrier, the dog 221 rides over the finger 222, and the arm 217 is not affected; but upon the forward movement of said carrier, the dog 221 is engaged by the finger 222, and the arm 217 is momentarily drawn back, against the action of a spring 223, Fig. 9, as shown by the dotted lines, and is then released. Upon this release, the spring 223 draws said arm 217 forward rapidly, causing its finger 219 to engage and eject the gromet.

One complete cycle of operations of the machine will now be briefly described. The cycle begins with a formed gromet and washer held by their respective carriers in position between the setting dies. The operator, after placing his fabric in position, depresses the pedal 43, thereby causing the clutch to engage and the vertical drive shaft

11 and the horizontal shafts 52 and 53 to revolve. The first operation performed is the setting of the positioned gromet and washer in the fabric. As soon as the punches 141 and 187 have entered and passed through the washer and gromet, respectively, the carriers return to their respective positions between the forming dies, and a new gromet and washer are formed, by their respective dies, and deposited in said carriers while the setting operation is being completed by the setting dies. As final steps in the cycle, the metallic ribbon is advanced to a fresh place, and, after the setting dies have opened, the carriers move forward again, bringing the new gromet and washer into position ready for the beginning of a new cycle. The clutch is then automatically thrown out, and the machine comes to rest with its various parts positioned as at the beginning of the cycle.

I claim:—

1. In a machine for making and setting gromets, means for forming a gromet; and an associated die for setting the same comprising alined reciprocating members adapted to coact to punch the gromet receiving hole in the work, and independently operated annular dies surrounding said punch members and adapted to coact to set the gromet within said hole.

2. In a machine for making and setting gromets, means for forming a gromet; and an associated die for setting the same comprising alined reciprocating punch members adapted to operate through the gromet in punching the gromet receiving hole in the work, and independently operated annular dies surrounding said punch members and adapted to coact to set the gromet within said hole.

3. In a machine for making and setting gromets, means for forming a gromet; and an associated die for setting the same comprising a pair of alined reciprocating members adapted to coact to punch the gromet receiving hole in the work, an independently operated annular die surrounding one of said punch members, and an independently operated spring-cushioned annular die surrounding the other punch member and adapted to coact with the first mentioned annular die to set the gromet within the said hole.

4. In a machine for making and setting gromets, means for forming a gromet; and an associated die for setting the same comprising a pair of alined reciprocating members adapted to coact to punch the gromet receiving hole in the work, a pair of independently operated annular dies surrounding said punch members and adapted to coact to set the gromet within said hole, and a tubular spring-pressed clamping and stripping member surrounding one of said annular dies in axially movable relation thereto and adapted to coact with the other annular die to clamp the peripheral portion of the gromet during the setting thereof.

5. In a machine for making and setting gromets, means for forming a gromet; an associated die for setting the same comprising a pair of alined reciprocating members adapted to coact to punch the gromet receiving hole in the work, and a pair of reciprocating annular dies surrounding said punch members and adapted to coact to set the gromet within said hole; mechanism for operating said punch members; and mechanism for operating said annular dies in timed relation to the movements of said punch members.

6. In a machine for the described purpose, means for forming a gromet; means for forming a coöperating washer therefor; and associated devices for setting said gromet and washer comprising a pair of alined reciprocating members adapted to coact to punch the gromet receiving hole in the work, and a pair of independently operated annular dies surrounding said punch members and adapted to coact to set the gromet and its coöperating washer.

7. In a machine for the described purpose, means for forming a gromet; means for forming a coöperating washer therefor; and associated devices for setting said gromet and washer comprising a pair of alined reciprocating punch members adapted to operate through said gromet and washer in punching the gromet receiving hole in the work, and a pair of independently operated annular dies surrounding said punch members and adapted to coact to set the gromet and its coöperating washer.

8. In a machine for the described purpose, means for forming a gromet; means for forming a coöperating washer therefor; vertically alined reciprocating die members adapted to punch the gromet receiving hole in the work and to set the gromet and washer therein; carriers for removing said gromet and washer from the forming means and for positioning the same between said setting dies, the gromet being below the work and the washer above; and means for preventing the washer from dropping, when released from its carrier, until forced down upon the work by the setting die.

9. In a machine for the described purpose, means for forming a gromet; means for forming a coöperating washer therefor; vertically alined reciprocating die members adapted to punch the gromet receiving hole in the work and to set the gromet and washer therein; carriers for removing said gromet and washer from the forming means and for positioning the same between said setting dies, the gromet being below the work and the washer above; a tubular mem-

ber positioned below the upper setting die and adapted to receive the washer when released from its carrier; and means carried by said tubular member for supporting said washer until the same is forced down upon the work by the setting die.

10. In a machine for making and setting gromets, means for forming a gromet; means for setting the same; a carrier member for transferring the gromet from said forming means to said setting means; and movable jaws mounted in said carrier member and adapted to receive and hold the gromet therein.

11. In a machine for making and setting gromets, means for forming a gromet; means for setting the same; a carrier member for transferring the gromet from said forming means to said setting means; and radially movable spring controlled jaws mounted in said carrier for receiving and holding the gromet.

12. In a machine for making and setting gromets, means for forming a gromet; means for setting the same; a carrier member for transferring the gromet from said forming means to said setting means; and radially movable spring controlled jaws mounted in said carrier for receiving and holding the gromet, said jaws being adapted to be separated by the forming means to permit the reception of the gromet.

13. In a machine for the described purpose, means for forming a gromet; means for forming a coöperating washer therefor; associated devices for setting said gromet and washer; carrier members for transferring said gromet and washer from their respective forming means to said setting devices; and movable jaws mounted in said carrier members for receiving and holding said gromet and washer.

14. In a machine for the described purpose, means for forming a gromet; associated means for setting the same; and devices for automatically removing the set gromet from the sphere of action of said setting means.

15. In a machine for the described purpose, means for forming a gromet; associated means for setting the same; a carrier member for transferring the gromet from said forming means to said setting means; and devices actuated by said carrier member for ejecting the set gromet from said setting means.

16. In a machine for the described purpose, means for forming a gromet; means for forming a coöperating washer therefor; means for setting said gromet and washer; carrier members for transferring the gromet and washer from their respective forming means to the setting means; and devices for automatically removing the set gromet and washer from the sphere of action of said setting means.

In testimony whereof I have signed my name to this specification.

JOHN LENARD STUART.