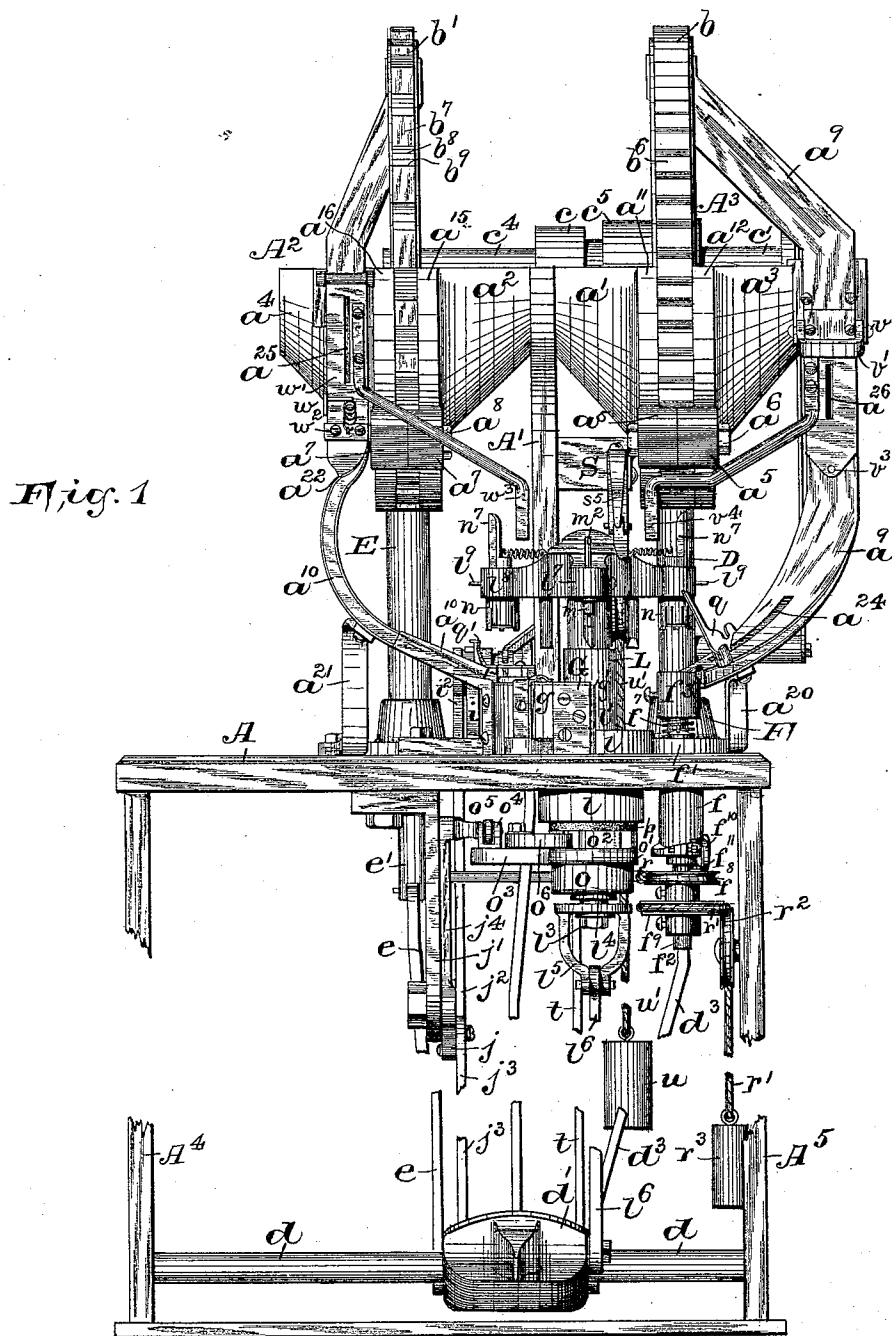


12 Sheets—Sheet 1.

No. 486,896.

Patented Nov. 29, 1892.



**INVENTOR:**

Wm. H. Canfield, Jr.  
B. Mortimer Truswell.

Charles Radcliffe,  
BY *Fred<sup>d</sup>. Fraentzel*, ATT'Y.

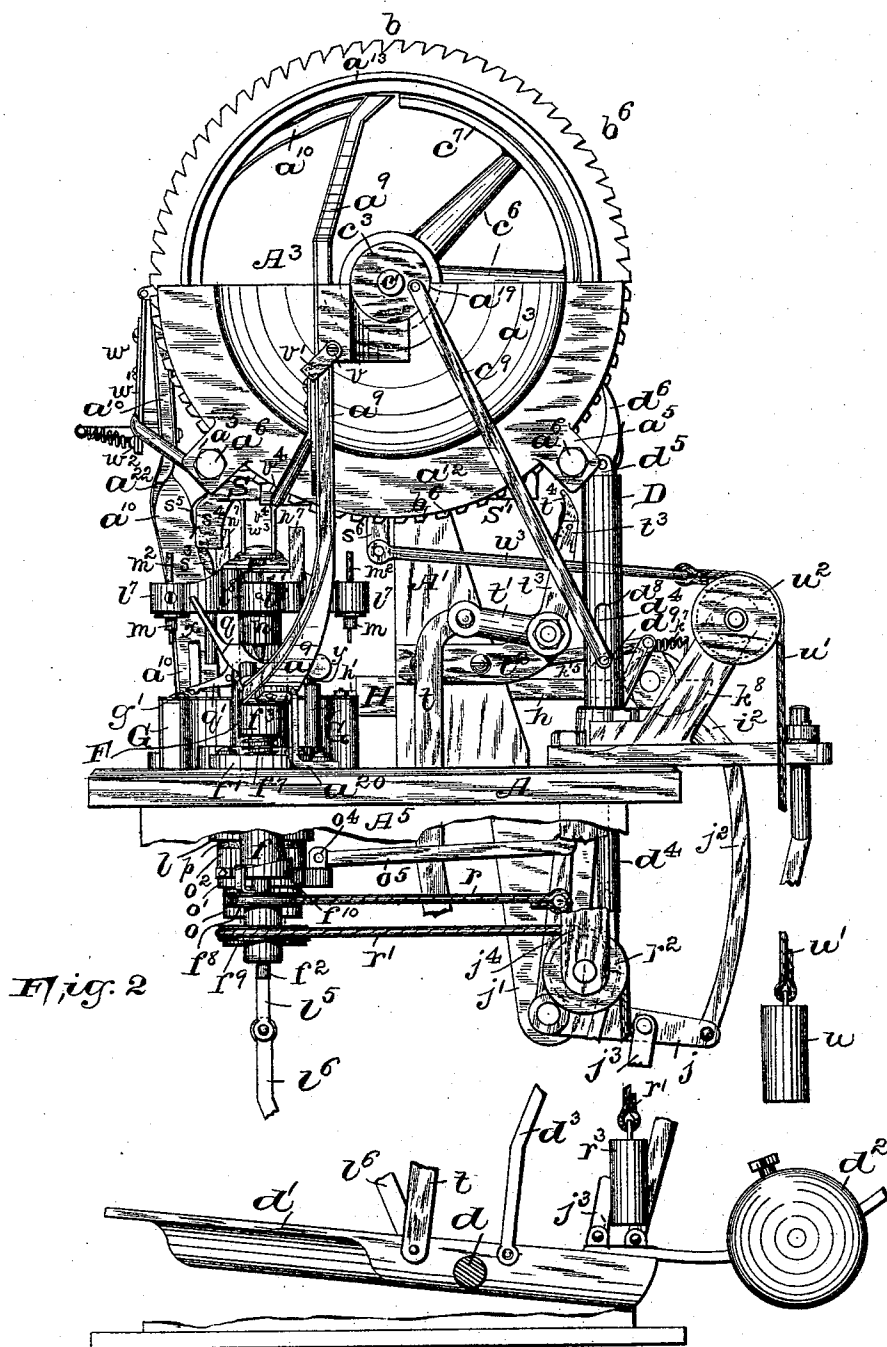
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12 Sheets—Sheet 2.

C. RADCLIFFE.  
BUTTON ATTACHING MACHINE.

No. 486,896.

Patented Nov. 29, 1892.



**WITNESSES:**

Wm. H. Bangfield, Jr.  
B. Mortimer Russell.

**INVENTOR:**

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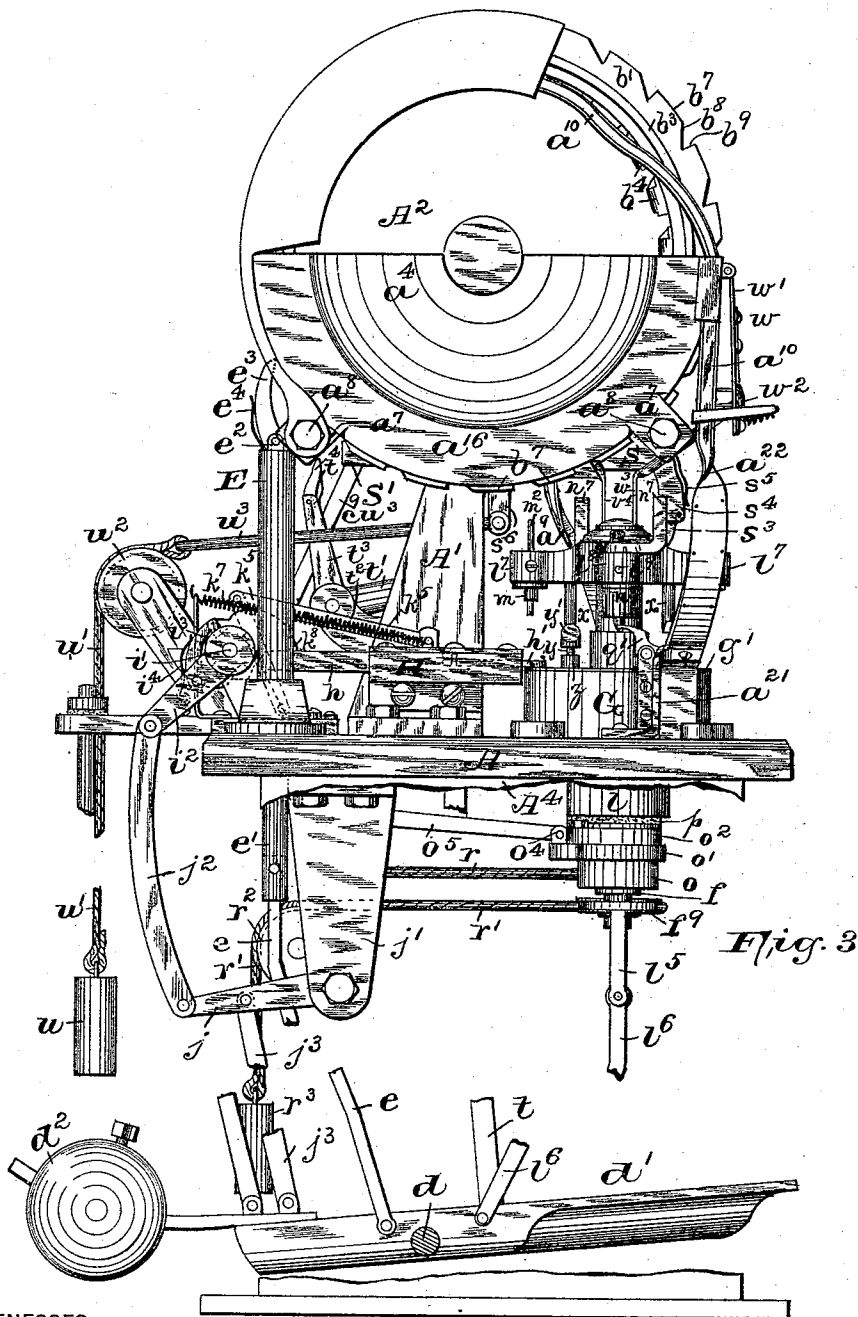
(No Model.)

12 Sheets—Sheet 3.

C. RADCLIFFE.  
BUTTON ATTACHING MACHINE.

No. 486,896.

Patented Nov. 29, 1892.



WITNESSES:

*Wm. H. Sanford Jr.*  
*B. Mortimer Russell*

INVENTOR:

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(No Model.)

12 Sheets—Sheet 4.

C. RADCLIFFE.  
BUTTON ATTACHING MACHINE.

No. 486,896.

Patented Nov. 29, 1892.

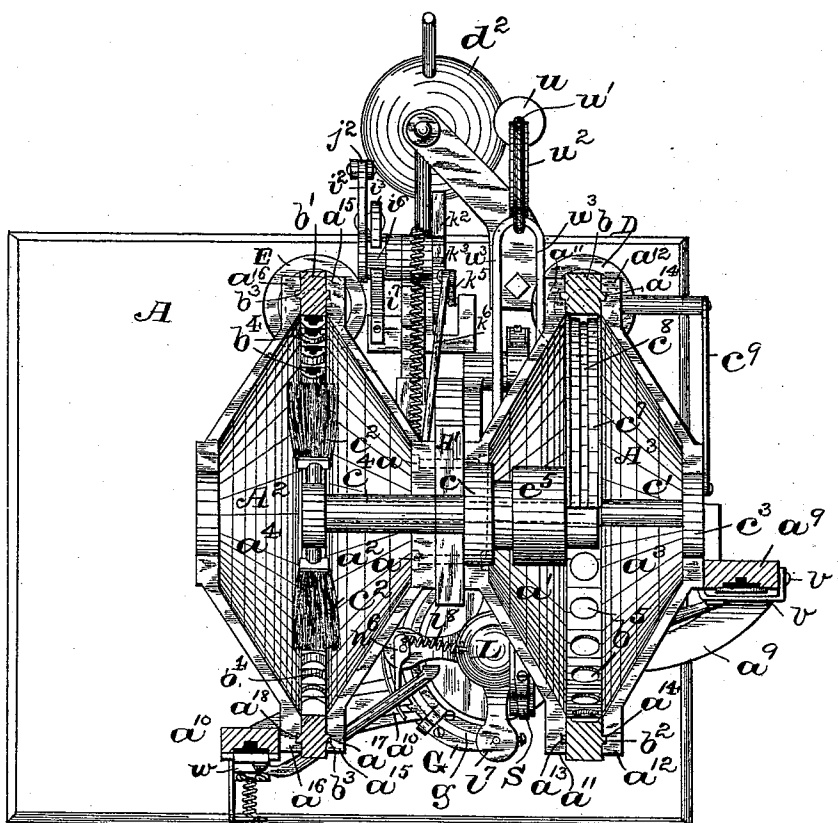


Fig. 4

**WITNESSES:**

Mrs. H. Gamfield, Jr.  
B. Mortimer Purdell.

INVENTOR:

Charles Radcliffe,  
BY Fred C. Fraintzel, ATT'Y.

(No Model.)

12 Sheets—Sheet 5.

C. RADCLIFFE.  
BUTTON ATTACHING MACHINE.

No. 486,896.

Patented Nov. 29, 1892.

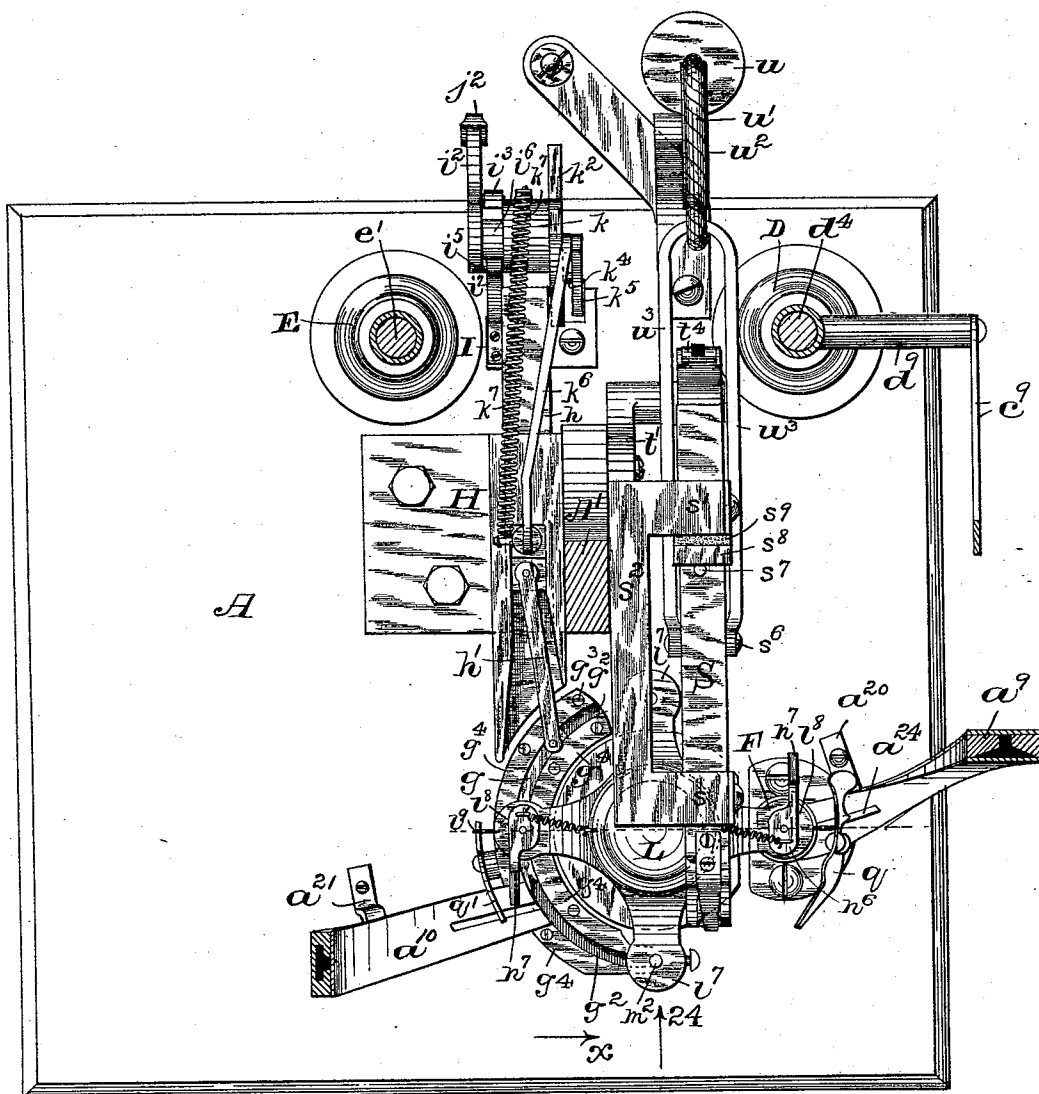


Fig. 5

**WITNESSES:**

Wm. H. Bamfield, Jr.  
B. Mortimer Trusdell.

INVENTOR:

*Charles Radcliffe*

BY *Fred C. Graentzel*, ATT'Y.

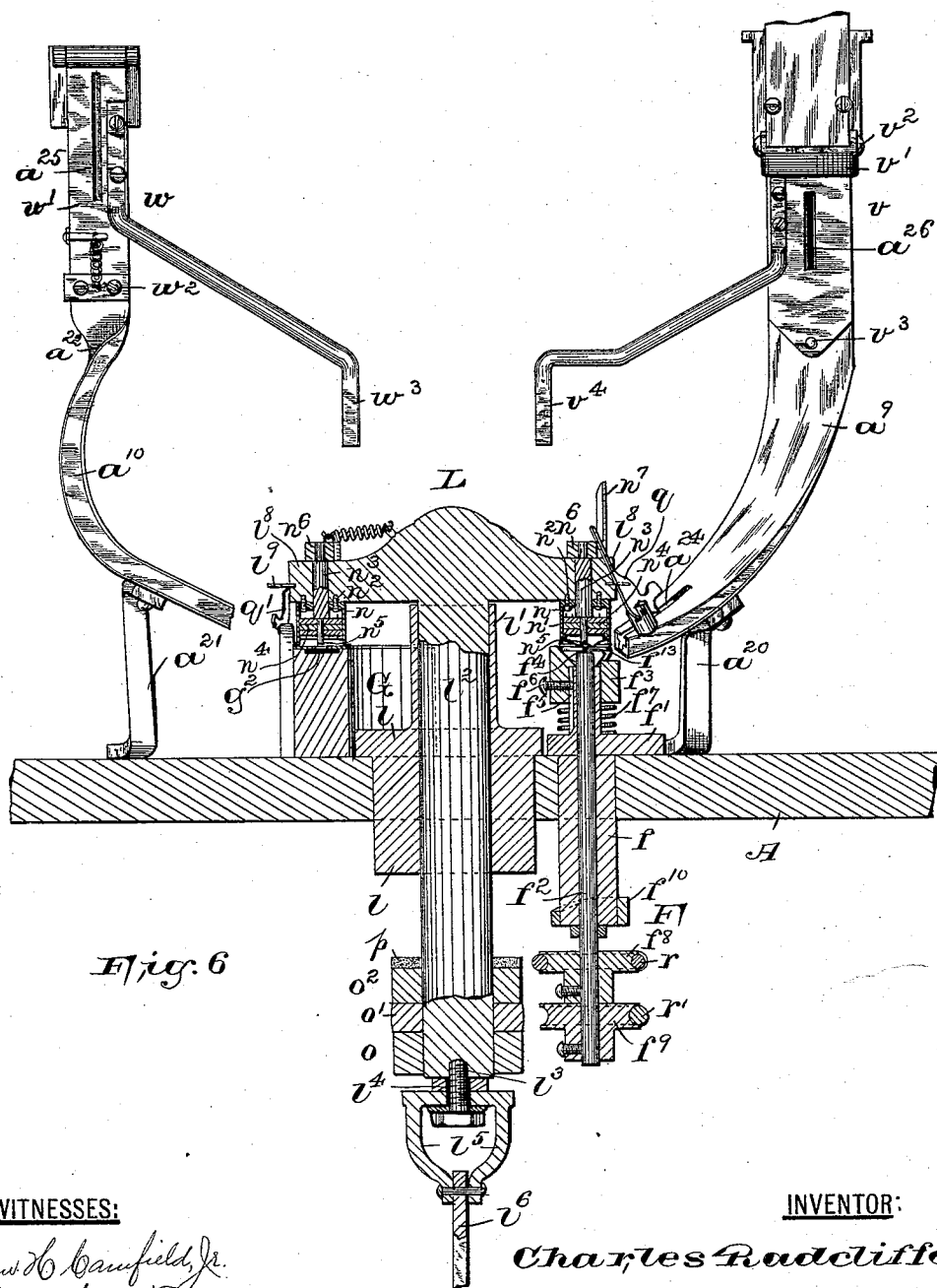
(No Model.)

12 Sheets—Sheet 6.

C. RADCLIFFE.  
BUTTON ATTACHING MACHINE.

No. 486,896.

Patented Nov. 29, 1892.



WITNESSES:

*Wm H. Canfield, Jr.*  
*B. Mortimer Russell.*

INVENTOR:

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BY *Fred C. Graentzel,* ATT'Y.

(No Model.)

12 Sheets—Sheet 7.

C. RADCLIFFE.  
BUTTON ATTACHING MACHINE.

No. 486,896.

Patented Nov. 29, 1892.

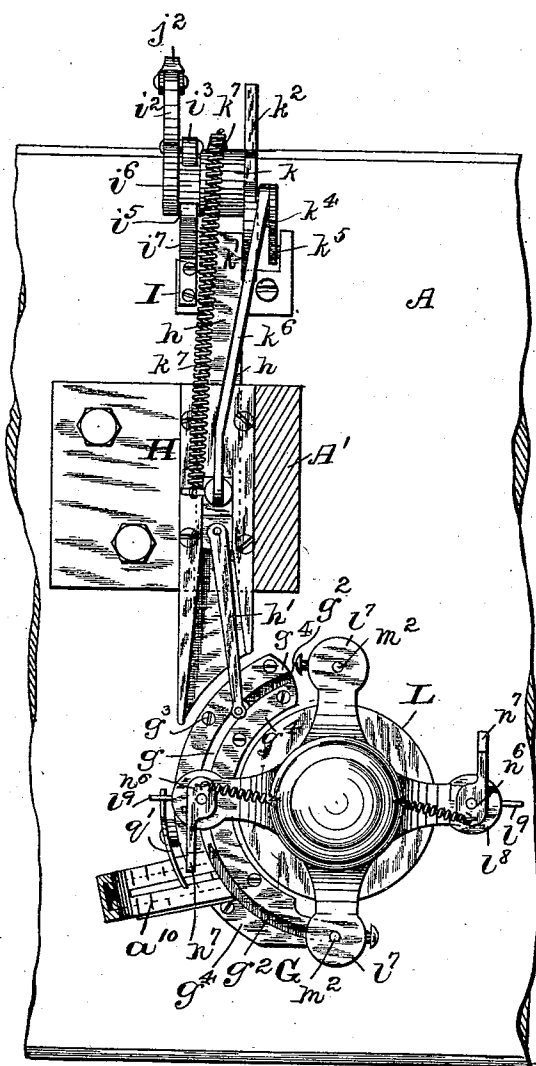


Fig. 7

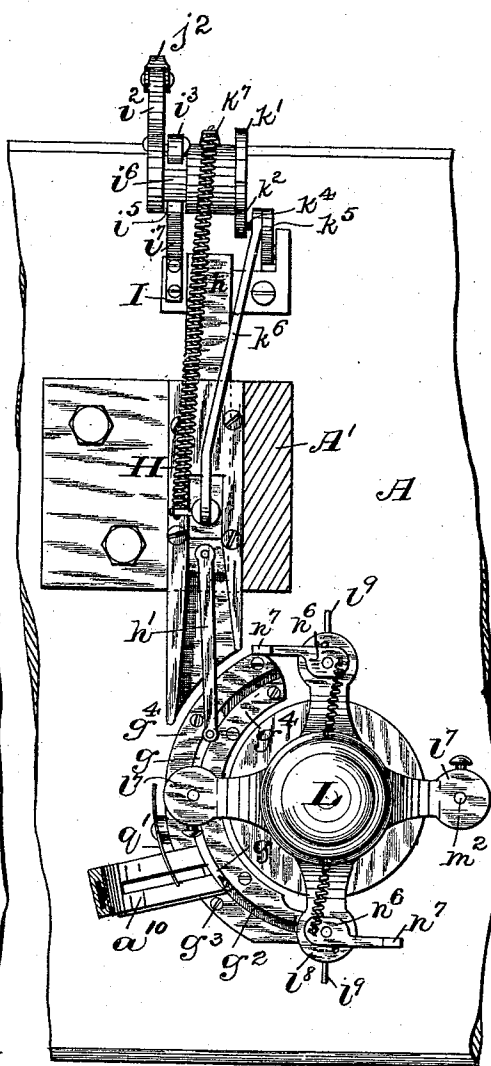


Fig. 8

WITNESSES:

Wm. H. Bamfield, Jr.  
B. Mortimer Russell.

INVENTOR:

Charles Radcliffe,  
BY Fred C. Fraentzel, ATT'Y.

C. RADCLIFFE.  
BUTTON ATTACHING MACHINE.

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Patented Nov. 29, 1892.

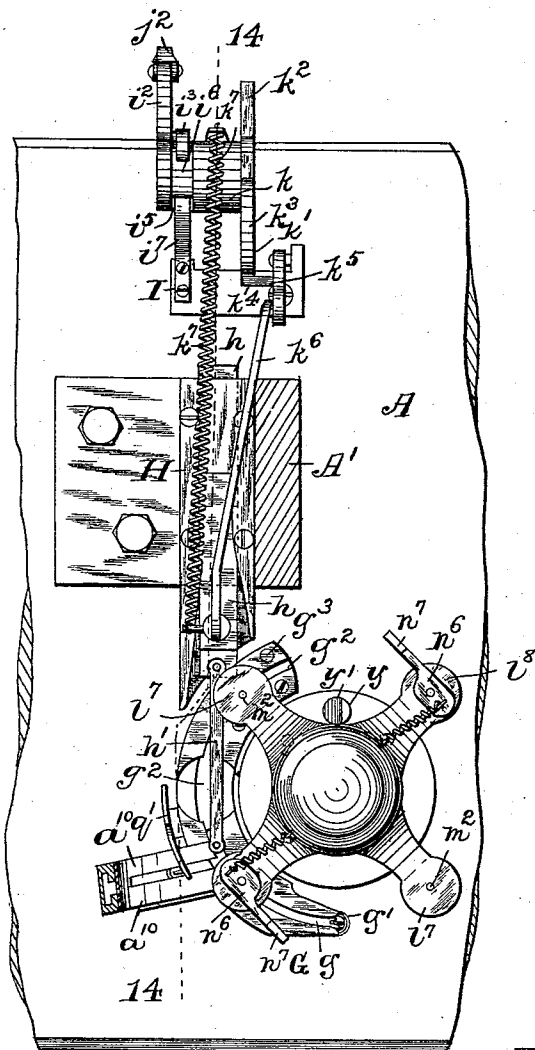


Fig. 9

WITNESSES:

Wm. H. Campfield, Jr.  
B. Mortimer Trussell.

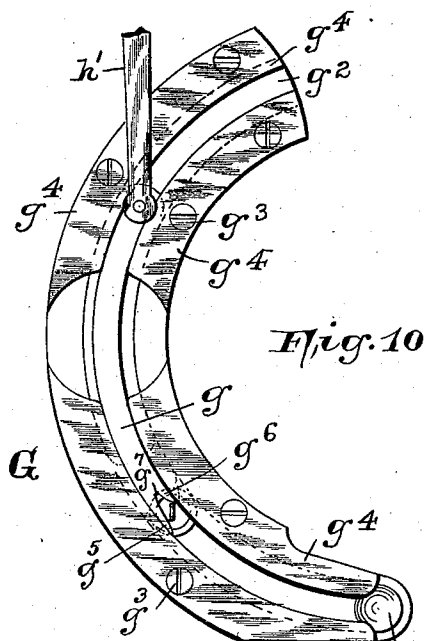


Fig. 10

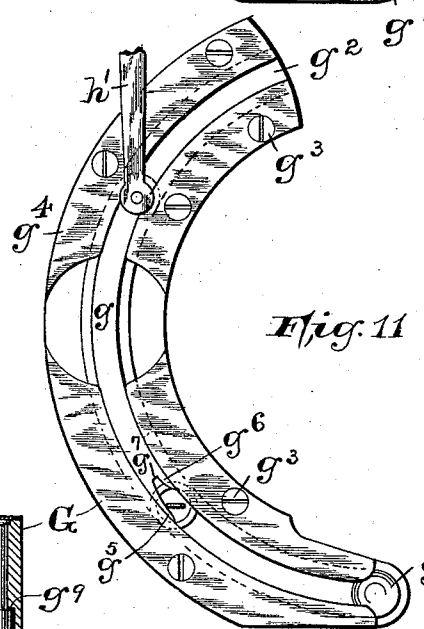


Fig. 11

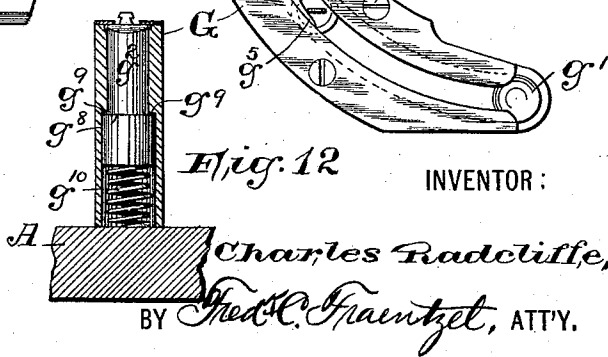


Fig. 12

INVENTOR:

Charles Radcliffe,

BY Fred C. Fraunhofer, ATT'Y.

(No Model.)

12 Sheets—Sheet 9.

C. RADCLIFFE.  
BUTTON ATTACHING MACHINE.

No. 486,896.

Patented Nov. 29, 1892.

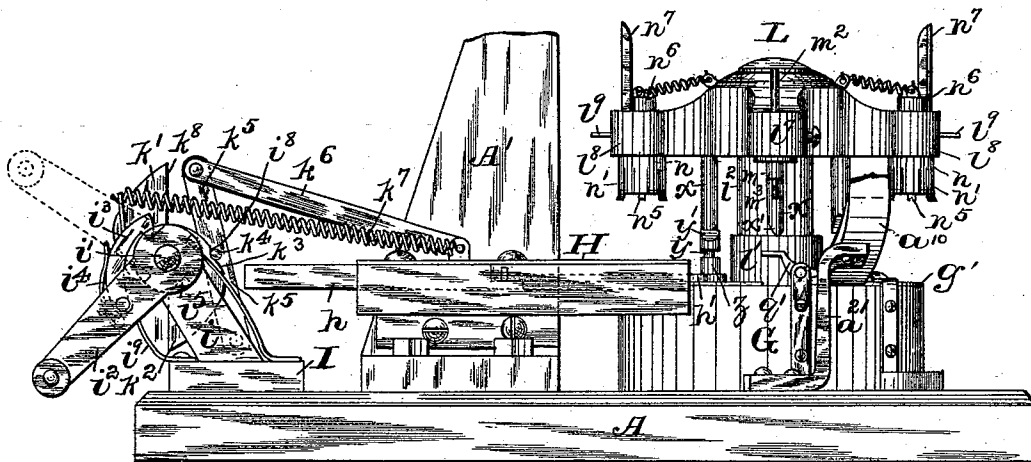


Fig. 13

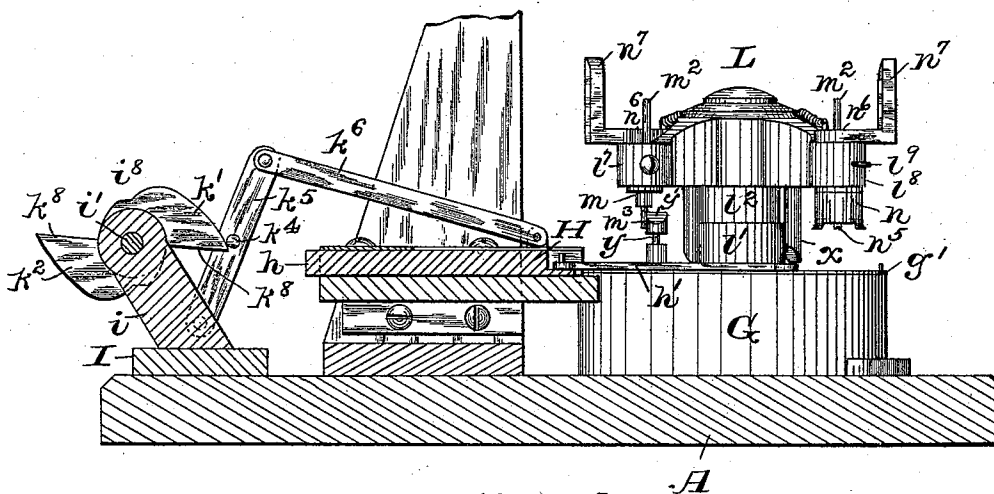


Fig. 14

**WITNESSES:**

Wm. H. Canfield, Jr.  
W. Mortimer Trusdell.

INVENTOR:

*Charles Radcliffe,*

BY *Fred C. Fraentzel*, ATT'Y.

(No Model.)

12 Sheets—Sheet 10.

C. RADCLIFFE.  
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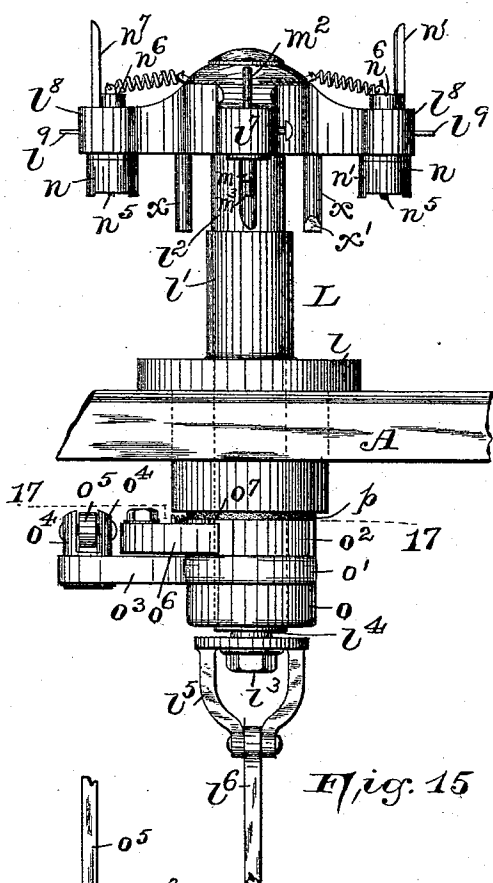


Fig. 15

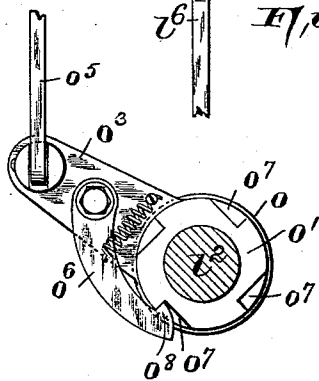


Fig. 17

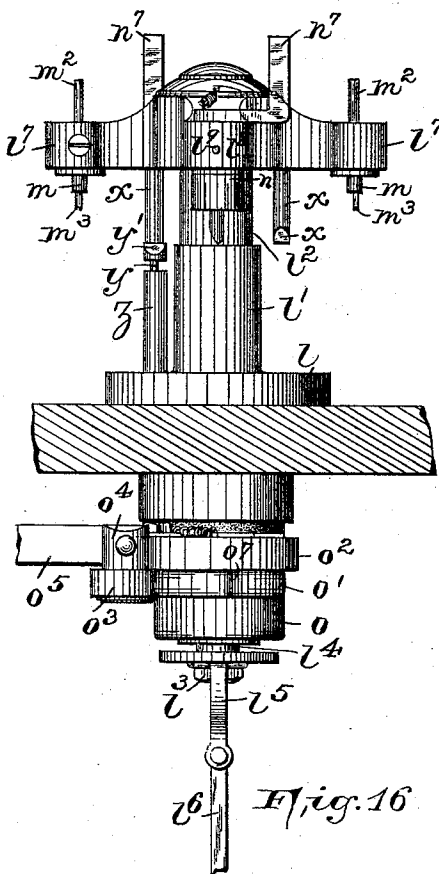


Fig. 16

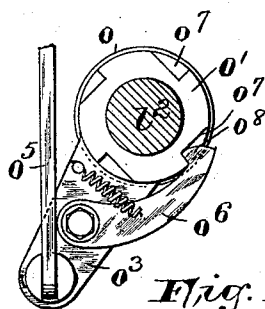


Fig. 18

WITNESSES:

Wm. H. Canfield Jr.  
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(No Model.)

12 Sheets—Sheet 11.

C. RADCLIFFE.  
BUTTON ATTACHING MACHINE.

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Patented Nov. 29, 1892.

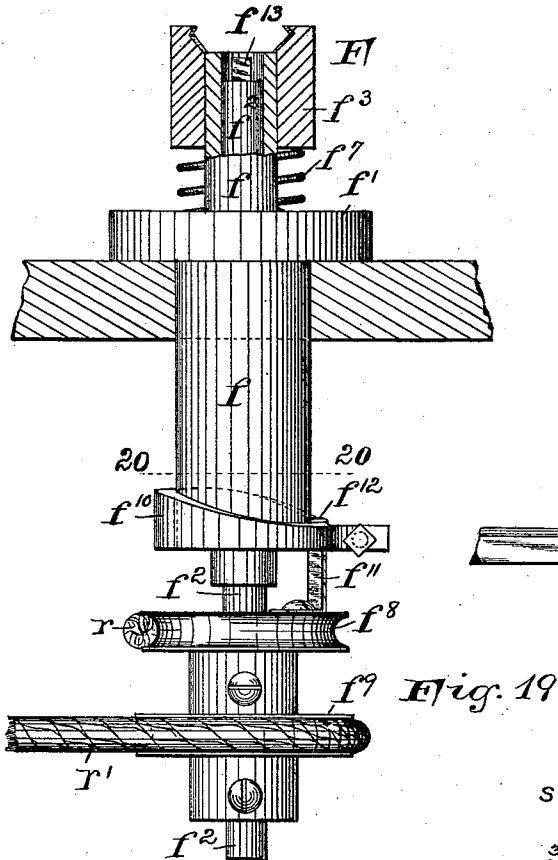


Fig. 19

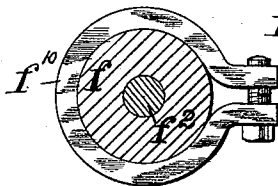


Fig. 20

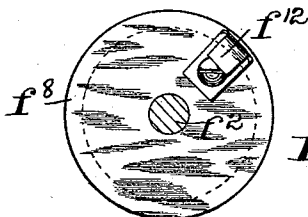


Fig. 21

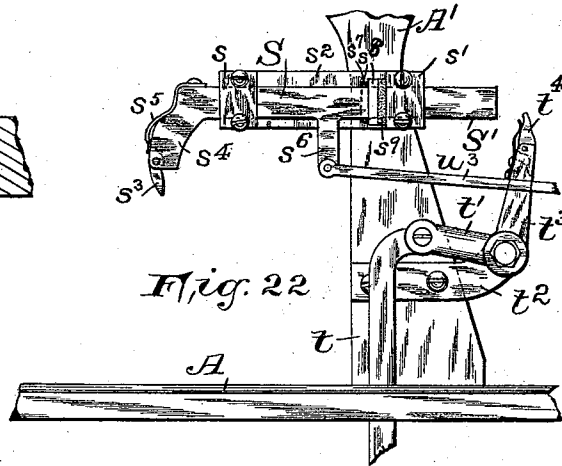


Fig. 22

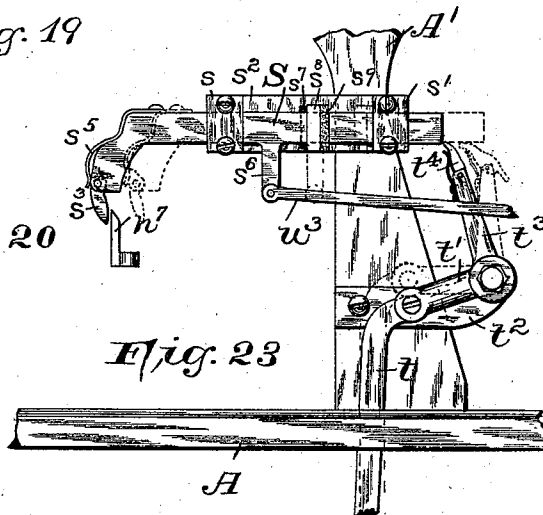


Fig. 23

WITNESSES:

Wm. H. Campfield, Jr.  
B. Mortimer Trussell.

INVENTOR.

Charles Radcliffe,  
BY Fred C. Fraentzel, ATT'Y.

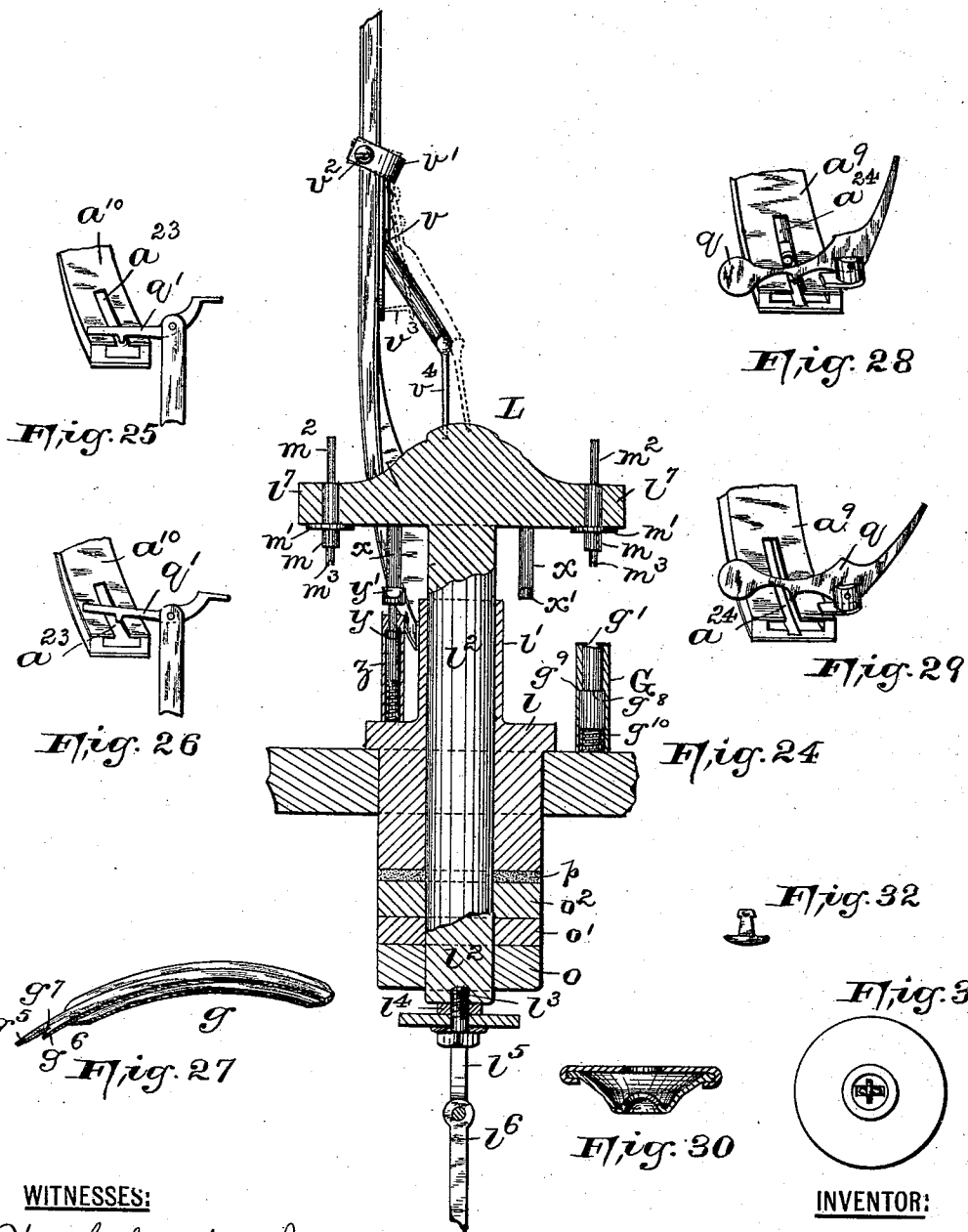
(No Model.)

12 Sheets—Sheet 12.

C. RADCLIFFE.  
BUTTON ATTACHING MACHINE.

No. 486,896.

Patented Nov. 29, 1892.



**WITNESSES:**

Wm. H. Bangfield, Jr.  
B. Mortimer Trussell.

**INVENTOR:**

Charles Radcliffe,  
BY Fred C. Fraentzel, ATT'Y.

# UNITED STATES PATENT OFFICE.

CHARLES RADCLIFFE, OF NEWARK, NEW JERSEY.

## BUTTON-ATTACHING MACHINE.

SPECIFICATION forming part of Letters Patent No. 486,896, dated November 29, 1892.

Application filed June 29, 1892. Serial No. 438,409. (No model.)

### *To all whom it may concern:*

Be it known that I, CHARLES RADCLIFFE, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Button-Attaching Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

In an application for Letters Patent of the United States filed by myself January 13, 1892, Serial No. 417,928, is illustrated a button-attaching machine, of which the machine illustrated in the drawings accompanying this specification and described in the present specification, which forms the subject of my present invention, is an improvement.

That portion of the machine to which this invention particularly relates is the mechanism for automatically feeding the back-plates of the form of button illustrated, more especially in my Patent No. 474,969, patented May 17, 1892, beneath the cloth and automatically forcing the post on the back-plate through the material, and also by means of a step-by-step mechanism feeding a button-shell directly above the point of the post, forcing the latter through a rectangular slot or opening in the hub of the shell, bending the arms or side projections on said post across said rectangular opening, and thereby forming a complete button firmly attached to the material.

In my previous application, Serial No. 417,928, some of these operations had to be performed by hand; but in my present form of machine all of the operations follow in consecutive order, and are all performed automatically by the operations of the several mechanisms comprised in the machine.

The main object of my present invention therefore is to provide a machine for automatically uniting the ready-made back portions with the front portions, insert the one through the cloth, firmly attaching the several parts of the button, and thereby producing a finished button.

With this object in view the invention therefore consists of certain arrangements and combinations of parts, such as will be hereinafter more fully described and finally embodied in the clauses of the claims, and comprising therein, principally, the following mechanical devices: two pockets or receivers arranged upon a standard, a step-by-step mechanism in each pocket for feeding the back-plates in the one pocket into a certain chute or raceway and feeding the shells in the other pocket into a second chute or raceway, a slide or back-plate guide upon which the back-plates are fed, provided with a sliding fork for rotating the post on the back-plate into its proper position upon a spring-actuated holding-plate or support at the free end of the guide, and means for operating said sliding fork, a pivotally-supported device adapted to rotate intermittently and provided with punches for forcing the end of the post on the back-plate through the cloth, and also provided with shell-holding chucks, a hunting device for automatically rotating the shell, whereby the shell may be picked up by one of the chucks, and when a chuck has been rotated above the post on the back-plate the shell held in the jaws of the chuck presents the rectangular opening in its hub properly to the post, means for producing a short turn or revolution of a spindle in the chuck on the supporting device, whereby the oppositely-extending arms on the post of the back-plate are bent at right angles across the opening in the hub of the shell, mechanism for causing an up-and-down movement of said punch and chuck holding device while it rotates intermittently on its vertical support, and, finally, the several forms of mechanism for operating the above-mentioned mechanical devices, and thereby producing a compact and automatically-operating button-attaching machine.

The invention is illustrated in the accompanying sheets of drawings, in which—

Figure 1 is a front view of the machine embodying my present invention, and Figs. 2 and 3 are the two side views of the machine, the operating parts in each of these views occupying their normal inoperative positions, which they assume when the machine is ready for delivering the several parts of the

button down into and through the respective chutes or raceways to their proper places in the machine, where said parts are secured together upon the material; and Fig. 4 is a plan or top view of the machine. Fig. 5 is a top or plan view of the back-plate feeding-guide, the punch and shell holding chuck-supporting device, and the several mechanisms for operating these parts, certain parts of the machine—such as the standard to which the two pockets or receivers are secured, the chutes, and the devices for operating the step-by-step feeding mechanisms in the two pockets or receivers—being illustrated in horizontal section. Fig. 6 is an enlarged vertical section of the punch and shell-chuck supporting device, clearly illustrating the arrangement and construction of the shell-holding chucks, and a hunter for rotating or hunting the shell into its proper position before being picked up by the chuck, said view also illustrating the positions and arrangements of the shell-feeding chute and the back-plate feeding-chute. Figs. 7, 8, and 9 are plan views of the back-plate guide provided with a sliding fork and the punch and chuck supporting device in their respective operating positions during the several operations of the machine, said views also clearly illustrating the mechanism for pushing the sliding fork forward and causing the return thereof to its normal starting-point. Figs. 10 and 11 are enlarged detail views of the back-plate guide and its sliding fork, to clearly illustrate the manner of forcing and rotating the flat post on the back-plate into its proper position upon a spring-actuated holding plate or support at the free end of the guide, and Fig. 12 is a vertical section across said end of the guide, taken centrally through said holding plate or support to more clearly show the action of the spring-actuated post therein against the lower side of the back-plate, which is consequently pressed against the inner sides of the overlapping guide portions of the back-plate guide, and thereby held in place. Fig. 13 is a side view of the mechanism for causing the step-by-step movement of the forked slide in the back-plate guide, the parts being illustrated in their normal positions; and Fig. 14 is a vertical section of these parts after they have been operated, said section being taken on line 14 14 in Fig. 9, both of said views illustrating the relative positions of the punch and chuck supporting device. Fig. 15 is a front view of the punch and shell-chuck supporting device, and Fig. 16 is a side view of said device. Fig. 17 is a horizontal section taken on line 17 17 in said Fig. 15; illustrating a device provided with a spring-actuated pawl or dog adapted to slip over the surface of a toothed or notched sleeve during the downward movement of said punch and shell-chuck supporting device; and Fig. 18 is a like view of said device in operative engagement with said toothed or notched sleeve, whereby on the return and upward move-

ment of said punch and chuck supporting device the latter is caused to rotate one-quarter of a turn. Fig. 19 is an enlarged detail view of the hunter and its operating mechanism for rotating a shell-hunting spindle and producing an up-and-down movement thereof. Fig. 20 is a horizontal section taken on line 20 20 in Fig. 19, and Fig. 21 is a top view of a pulley and a follower adapted to move over a cam-shaped collar or eccentric-hub to cause an up-and-down movement of the hunting-spindle. Figs. 22 and 23 are detail views of a tripping mechanism in its normal and its operative positions, respectively, for causing a slotted spindle in the shell-holding chuck provided with a handle or crank to make one quarter turn or rotation when the shell of the button is forced over the post on the back-plate, and thereby bend the prongs or arms on said post across the rectangular opening in the hub of the shell to secure the parts of the button together upon the cloth. Fig. 24 is a vertical section of the punch and chuck supporting device, taken on line 24 24 in Fig. 5, looking in the direction of arrow *x* in said figure. Figs. 25 and 26 are detail views of the lower end of the back-plate chute or raceway and a pivoted stop-piece in its normal and its raised positions, respectively, to retain the back-plate within the raceway or to permit one back-plate to be deposited upon the back-plate guide at the proper time. Fig. 27 is a perspective view of the sliding fork for rotating and pushing the deposited back-plate forward within the back-plate guide. Figs. 28 and 29 are detail views of the lower end of the shell-conveyer or raceway and a pivoted stop-piece used in connection therewith to retain the conveyed shell within the raceway or to permit the lowest shell to drop upon the hunter. Fig. 30 is an enlarged vertical section of the button-shell. Fig. 31 is a top view of the same, and Fig. 32 is an enlarged front view of the back-plate and its post employed to make the button to be secured upon the cloth by means of the herein-described machine.

In said above-described views similar letters of reference are employed to indicate corresponding parts.

In the above-described drawings, A designates any suitable stand or table provided with the mechanisms for feeding the back-plates, one at a time, to the slide and forcing the head of the post through the material, and provided, also, with mechanism for feeding the shells, one at a time, directly above the head of the post, placing a shell directly upon the post to cause its head and the oppositely-projecting holding-prongs thereon to enter a rectangular opening in the shell, and means for twisting and turning said prongs on the post at right angles or approximately so across said opening in the hub of the shell.

A' is a standard secured in any convenient manner upon said table or support. On the opposite sides of the upper end of said stand-

and A' are secured by means of screws or bolts a, as indicated in dotted lines in Fig. 4, or in any other well-known manner, the half-sections a' and a<sup>2</sup>, respectively, which, with the half-sections a<sup>3</sup> and a<sup>4</sup> and the toothed rings b and b' form two pockets or receivers A<sup>2</sup> and A<sup>3</sup>. Said half-sections a<sup>2</sup> and a<sup>4</sup> are provided with downwardly-projecting lugs a<sup>5</sup> and the two sections are secured together by means of bolts a<sup>6</sup>, thereby forming the pocket or receiver A<sup>2</sup>. The half-sections a' and a<sup>3</sup> are provided with similarly-arranged lugs or ears a<sup>7</sup> and are secured together by means of bolts a<sup>8</sup>, thereby forming the pocket or receiver A<sup>3</sup>. The semi-circular flanges a<sup>11</sup> and a<sup>12</sup> of the half-sections a' and a<sup>3</sup>, respectively, forming the pocket or receiver A<sup>3</sup>, are provided with grooves a<sup>13</sup> and a<sup>14</sup>, respectively, and between the said grooves is fitted a ring b, having annular projections b<sup>2</sup> on its opposite sides, which fit loosely into said grooves a<sup>13</sup> and a<sup>14</sup>, whereby said ring can be made to rotate between said half-sections a' and a<sup>3</sup>, as will be clearly evident from Fig. 4. The half-sections a<sup>2</sup> and a<sup>4</sup> are each provided with similarly-arranged flanges a<sup>15</sup> and a<sup>16</sup>, respectively, provided on their inner surfaces with the grooves a<sup>17</sup> and a<sup>18</sup>, respectively, and between said half-sections a<sup>2</sup> and a<sup>4</sup> is arranged the ring b', having on its opposite sides the annular projections b<sup>3</sup>, extending into said grooves a<sup>17</sup> and a<sup>18</sup>, whereby said ring b' is free to move between said half-sections a<sup>2</sup> and a<sup>4</sup>, forming the pocket A<sup>3</sup>. To one of said half-sections, as a', is secured in any convenient manner a bearing c, in which is arranged a shaft c', projecting at one end into the back-plate-receiving pocket A<sup>2</sup> and provided with a hub or collar from which extend the brushes c<sup>2</sup>, for sweeping the back-plates into the small holding-pockets b<sup>4</sup>, suitably placed and secured on the inner rim of the ring b'. The other end of said shaft c' is provided with a wheel c<sup>3</sup>, which is loosely arranged in a semicircular cut-away portion a<sup>19</sup> in the half-section a<sup>3</sup>, as will be clearly seen from Figs. 2 and 4. Upon said shaft c, extending from said brush-holding collar and extending through the stationary bearing c is a sleeve c<sup>4</sup>, to which is secured a boss c<sup>5</sup>, provided with several arms c<sup>6</sup>, connected by means of a rim c<sup>7</sup>, having in its outer periphery a groove c<sup>8</sup>, which terminates directly in front of a shell-conveying chute a<sup>9</sup>. Adjacent to said boss c<sup>7</sup> I may arrange a collar provided with brushes for sweeping the shells of the buttons into circular recesses b<sup>5</sup>, from which the shells are fed up into the groove c<sup>8</sup> in the stationary rim c<sup>7</sup> to be fed into the said chute or raceway a<sup>9</sup>, as will be understood from Figs. 1, 2, and 4. The ring b is provided in its outer periphery with equally-spaced teeth b<sup>6</sup>, and in order to give said ring a step-by-step movement a hollow or tubular standard D is secured to the table A, as shown.

The standards or frames A<sup>4</sup> and A<sup>5</sup> of the table are connected by means of a rod d, upon which is secured a treadle d', provided at the

rear with an arm, and a weight d<sup>2</sup> and pivotally attached to said treadle is a rod d<sup>3</sup>, secured to the end of a rod or post d<sup>4</sup>, which extends up through the table A and into the standard D, as will be evident from Figs. 1 and 2. The upper end of the standard D is provided with ears d<sup>5</sup>, between which is pivoted upon a pin a jaw or dog d<sup>6</sup>, adapted to be forced against the teeth b<sup>6</sup> on the ring b by means of a spring d<sup>7</sup> in normal engagement with the back of the dog d<sup>6</sup>, as will be clearly seen from Fig. 2. In the upper end of the said standard D is a slot or opening d<sup>8</sup>, into which projects the end of a pin d<sup>9</sup> on the rod d<sup>4</sup>, whereby the latter is capable of an up-and-down movement, but cannot rotate within said standard D. When the operator presses upon the treadle d', the jaw d<sup>6</sup> slides down over the next tooth b<sup>6</sup> in the periphery of the wheel b, and when the foot is removed from the treadle the weight d<sup>2</sup> causes the treadle to assume its normal position, (illustrated in Fig. 2,) while at the same time the jaw or dog pushes against the tooth b<sup>6</sup> and causes the ring b to partially rotate and drop a shell into the conveyer or raceway a<sup>9</sup>.

The mechanism for producing the step-by-step movement of the ring b' between the half-sections a<sup>2</sup> and a<sup>4</sup> is similar to that just described in connection with the ring b. Said ring b' is provided with the desired number of teeth b<sup>7</sup>, having the inclined portions b<sup>8</sup> and the straight portions b<sup>9</sup>. Arranged upon the table or support A is a tubular standard E, and pivotally secured to the treadle d' on the opposite side to which the rod d<sup>3</sup> is secured is a rod or lever e, which is pivotally connected with the lower end of the rod e'. This rod extends up through the table A and through the hollow standard E and projects therefrom at the top. Said end is provided with ears e<sup>2</sup>, between which is the pivoted jaw or dog e<sup>3</sup>. Said dog or jaw is normally forced against the teeth b<sup>7</sup> on the ring b' by means of a spring, and when working the treadle d' to operate the ring b in the pocket or receiver A<sup>3</sup> the jaw or dog e<sup>3</sup> on the rod e' operates the ring b' to force the back-plates into the chute or raceway a<sup>10</sup>. These parts assume their normal inoperative positions as soon as the operator removes his foot from the weighted treadle. Thus it will be seen that both rings b and b' are operated by one movement of the treadle, whereas in my previous improvement on a button-attaching machine, Serial No. 417,928, I employed two separate treadles for operating the rings b and b' at different times.

As will be seen from Figs. 1, 2, and 3, I have secured upon the table A, by means of a foot-piece a<sup>20</sup>, the peculiarly-twisted shell conveyer or chute a<sup>9</sup>, hereinabove mentioned, and in close proximity to the free end of the rim c<sup>7</sup>, and especially the shell-conveying groove c<sup>8</sup>, supported by the arms c<sup>6</sup> on the stationary sleeve on the shaft c'. The lower end of said chute terminates directly to one side of a shell-hunting device F, as clearly illustrated in

Figs. 1, 2, and 6, and the operation of which will be more fully described hereinafter.

From Figs. 1, 3, and 6 it will be seen that a second conveyer, chute, or raceway  $a^{10}$  is secured by means of a foot-piece  $a^{21}$  to the table A, extending up into the pocket or receiver  $A^2$  and its upper end projecting beneath the pockets  $b^4$  on the inner periphery of the ring  $b'$ , while the lower end of the chute or raceway terminates at one side of a grooved back-plate guide G, having a sliding fork  $g$  for hunting and forcing the deposited back-plate in the groove in said guide G to a spring-actuated holding plate or support  $g'$  at the forward end of said guide, as will be seen from Figs. 1, 5, 7, 8, and 9, and the operation of which will be described more in detail hereinafter. As will be seen from Fig. 2, the standard D is provided with an opening  $d^3$ , through which projects the pin  $d^9$ , which is secured in the rod  $d^4$ . Said pin  $d^9$  is connected with the wheels  $c^2$  by means of a link  $c^9$ , whereby when the treadle  $d'$  is depressed and the rods  $d^4$  and  $e'$  move upward to operate the rings  $b$  and  $b'$  the shaft  $c'$  receives an oscillatory movement, and hence the brushes in the pockets or receivers  $A^2$  and  $A^3$  move back and forward as the operator works or releases the treadle to force the back-plates into the pockets  $b^4$  and the shells into the recesses  $b^5$ .

I will now describe the manner and operation of feeding the back-plates provided with the upright posts from the pocket or receiver  $A^2$  through the chute or raceway  $a^{10}$  to the back-plate-conveying guide G and the operation of the forked slide  $g$  therein to properly rotate the deposited back-plate and to force said back-plate forward upon the spring-actuated holding-plate or support  $g'$ . As has been previously stated, the toothed ring  $b'$  between the half-sections  $a^2$  and  $a^4$  and rotating therebetween is provided with a series of back-plate holding or carrier pockets  $b^4$ , which are of the same or a similar construction as the pockets described and illustrated in connection with my improved form of button-attaching machine, for which I have applied for a patent thereon, Serial No. 417,928. The back-plates of the button are thrown into the pocket or receiver  $A^2$ , and by operating the treadle  $d'$  the ring  $b'$  is caused to move between the half-sections  $a^2$  and  $a^4$ , whereby the brushes  $c^2$  cause each pocket  $b^4$  to pick up one of the back-plates, bringing the same directly above the upper and open end of the chute or raceway  $a^{10}$  and discharging the back-plate upon this end of the chute with the post on the back-plate projecting downward. Said chute or raceway, however, is provided with a twist  $a^{22}$ , as will be seen from Fig. 1, whereby when the back-plate passes down the chute its position therein becomes reversed and the back-plate is deposited upon the upper surface of the back-plate-conveying guide G, with its post in a vertical or upright position ready to be hunted or rotated and pushed forward upon the spring-actuated holding plate or

support ready to be forced through the material or cloth. Said conveying-guide G, as will be seen from Figs. 5, 9, 10, 11, 13, and 14, consists, essentially, of a base-plate  $g^2$ , on the upper surface of which are secured by means of screws  $g^3$  or in any other well-known manner two circular plates  $g^4$  in such a manner to form an open space into which the back-plate slides from the chute upon the upper surface of said base-plate  $g^2$ . Between said plates  $g^4$  is arranged and moves loosely therein the sliding fork  $g$ , provided at its forward end with the prongs or fingers  $g^5$  and  $g^6$ , forming a V and terminating in a narrow open space  $g^7$ , into which the flat post on the back-plate is finally forced as it comes in sliding contact with either side of the two prongs or fingers  $g^5$  and  $g^6$ , as will be clearly evident from Figs. 10 and 11, and the back-plate is thereby properly guided and placed in its true position upon the spring-actuated holding plate or support  $g'$ . Said plate or support  $g'$  is preferably concave in the top to more properly retain the back-plate, and moves slightly up and down in an opening in the forward end of the base-plate  $g^2$ . Said support is post-shaped, as will be seen from Fig. 12, and is of larger diameter at the bottom to form an offset  $g^8$ , which abuts against an offset  $g^9$  in the opening in said base-plate and thereby limits its upward movement. A coil-spring  $g^{10}$  is arranged beneath said post  $g'$ , as shown, and the forwardly-forced back-plate, after it has been placed in the concave surface in the top of said post, is sufficiently held therein by being projected up against the inner surfaces of the two plates  $g^4$ , and is held in this position until the button has been completed and has been firmly attached to the cloth, when it can then be slipped from the end of the conveying-guide G, as will be evident.

The mechanism for causing the forward and return movements of the sliding fork  $g$  consists of a cross-head  $h$ , moving in suitable guides H, secured to the table A. At one end of said cross-head is pivoted a link  $h'$ , which is also pivotally connected at its other end with the rear end of said sliding fork  $g$ . Directly back of said guides H, secured on the table, is a suitable plate I, having an upwardly-extending arm or post  $i$ , in which is pivoted the cross-head operating mechanism. As will be seen from Figs. 3, 5, 7, 8, 9, and 13, in said post or arm  $i$  I have arranged a pin  $i'$ , which can be operated by means of a crank-arm  $i^2$ , connected by means of a suitable system of levers with the treadle  $d'$ . These levers consist, essentially, of a crank  $j$ , pivotally secured on a support or bracket  $j'$ , secured to and projecting down from the bottom of the table A, and connecting said crank-arm  $i^2$  and the crank  $j$  is a link  $j^2$ , while a rod  $j^3$  connects the crank  $j$  with the treadle  $d'$ . Thus when the treadle is pressed down by the operator the crank-arm  $i^2$  moves upward, carrying with it a spring-actuated pawl or dog  $i^3$ , which is thereby forced into engage-

ment by the action of its spring  $i^4$  with the next uppermost of the four notches  $i^5$  on a sleeve or collar  $i^6$  on said pin  $i^7$ , the crank-arm  $i^2$  having reached that position indicated in dotted outline in Fig. 13, a spring  $i^7$ , which engages with one of the notches  $i^5$ , being employed to prevent the turning of said collar on the pin  $i^7$  in the opposite direction. As soon as the treadle  $d'$  is caused to return to its normal inoperative position said arm  $i^2$  returns to its first position, as indicated in said Fig. 13, the pawl or dog  $i^3$  causing said collar to turn backward on the pin  $i^7$ , whereby it operates a second collar  $k$  on the same pin, having two peculiarly-shaped cams  $k'$  and  $k^2$ , as will be seen more especially from Fig. 14. During the rotation of said collars  $i^6$  and  $k$  the cam-surface  $k^3$  of either one of said cams  $k'$  and  $k^2$  rides against a pin  $k^4$  on a lever or arm  $k^5$ , pivoted on said arm or post  $i$ . The upper end of said lever or arm  $k^5$  is pivotally connected with a connecting-rod  $k^6$ , attached to said cross-head  $h$ , as clearly shown. When either of the cams  $k'$  or  $k^2$  is in engagement with the pin  $k^4$  in that position illustrated in Fig. 13, then the sliding fork  $g$  has moved to the position illustrated in Fig. 5, bringing the forked end directly in front of the end of the chute or raceway  $a^{10}$ . At this point the pin  $k^4$  on the lever  $k^5$  rests within a depression  $i^8$ , whereby the forwardly-sliding movement of the sliding fork  $g$  is for a moment interrupted, while a back-plate is being deposited in front of its forked end; but immediately the curved surface of the cam-surface  $k^3$  again begins to move the arm or lever  $k^5$  to that position indicated in Fig. 14, at the same time causing the sliding fork  $g$  to move forward in the guide  $G$  to the position illustrated in Fig. 9, thereby depositing the hunted back-plate upon the holding plate or support  $g'$ . As soon as the cam has passed the pin  $k^4$  a long coiled spring  $k^7$ , secured at one end to a post on the cross-head and at its other end to a spring-arm  $i^9$ , as shown in Fig. 13, and owing to the straight surface  $k^8$  on the cams said spring  $k^7$  causes a very quick return of the sliding fork from the forward end of the back-plate guide  $G$ , leaving the back-plate in its proper position upon the holding plate or support  $g'$ , and the punch on the punch and-chuck-supporting device comes down to force the post through the cloth. While the sliding fork  $g$  and its operating mechanism connected therewith return to their normal starting positions, a second back-plate drops down upon the surface of the guide  $G$  between the two plates  $g^4$ , ready to be hunted or turned into the proper position and to be pushed forward by the sliding fork in the manner just described.

As will be seen from Figs. 10 and 11, the back-plate guide  $G$ , consisting of the base-plate  $g^3$  and the side pieces  $g^4$ , is properly curved, thereby producing a circular groove or way in which the properly adjusted or hunted back-plate is brought in its proper po-

sition beneath the punches and chucks of the machine.

I will now describe the construction and operation of the punch and chuck supporting device. This device is clearly illustrated in Figs. 6, 15, 16, 19, and 24. The device consists of the following parts: In the table or bed  $A$  of the machine is arranged in a hole the punch and chuck supporting device  $L$ , consisting of a tubular post  $l$ , having a flange by means of which it is secured to the table and provided with an upwardly-extending pipe-shaped end  $l'$ . Loosely arranged in said tubular post is a vertical shaft or spindle  $l^2$ , provided at its upper end with a supporting device carrying on its under side, as in the present machine, two oppositely-located punches  $m$  and two intermediately-arranged and oppositely-placed shell-distributing chucks  $n$ . The lower end of said vertical shaft  $l^2$  is provided in the bottom with a set-screw  $l^3$  and a washer  $l^4$ , and on the bolt-head of said screw is arranged a yoke  $l^5$ , to the lower end of which is pivotally attached a rod  $l^6$ , connected with the treadle  $d'$ , as will be clearly seen from Fig. 1. It will thus be seen that the shaft  $l^2$  and hence the supporting device at the top thereof can be made to move up and down, thereby bringing either a punch down upon the cloth to force the post on the back-plate through the material or bringing a chuck and its shell down upon the post, as will be described hereinafter. Said supporting device consists, essentially, of four oppositely-projecting arms  $l^7$  and  $l^8$ , as shown in Figs. 7 and 8.

The punches  $m$ , as will be seen more especially from Fig. 24, are inserted in holes or perforations in the arms  $l^7$ , each punch being provided with an enlargement  $m'$ , which fits tightly against the under surface of the arm  $l^7$ , and they are securely held in said arms by means of set-screws, bolts, or in any other well-known manner. The upper ends  $m^2$  of said punches are slightly smaller in diameter and project above said arms  $l^7$ , as shown, while the lower ends have a slotted or cut-away portion  $m^3$ , which when the vertical shaft or spindle  $l^2$  and its arms  $l^7$  and  $l^8$  are lowered, as just stated, come down upon the cloth over the point of the previously-placed back-plate, the head or upper portion of the post on the back-plate thereby being forced through the material and passing into the slotted end  $m^3$  of the punch, as will be readily understood. As will be seen from Figs. 15, 16, and 24, on the lower portion of said vertical shaft or spindle  $l^2$  I have arranged the three rings or collars  $o$ ,  $o'$ , and  $o^2$ , and above the upper ring  $o^3$  is a ring  $p$ , of soft material—such as felt—to lessen the shock and to deaden the noise when these parts come together on the return stroke of the shaft or spindle  $l^2$  after the operator has removed his foot from the treadle  $d'$ . As soon as the arms  $l^7$  and  $l^8$  have returned to their normal position the next step in the operation is to rotate them one-quarter of a turn

to bring one of the shell-holding chucks  $n$  to its position above the post on the back-plate in order that the shell can be secured on the post now forced through the cloth. In order to do this, the ring  $o'$  has formed thereon an arm  $o^3$ , provided with lugs or ears  $o^4$ , which are capable of rotation in a perforation in the free end of said arm  $o^3$ . Between said lugs or ears  $o^4$  is pivotally arranged the end of a connecting-lever  $o^5$ , which is connected at its opposite end with a crank-arm  $j^4$ , connected with the arm  $j$  and operated by the rod  $j^3$  when the treadle  $d'$  is depressed. Thus when by means of these devices the arm  $o^3$  is rotated in a horizontal plane from its position indicated in Fig. 17 to that shown in Fig. 18 a spring-actuated pawl or dog  $o^6$  passes from one of the four notches  $o^7$  in the ring  $o'$  to the next notch, (see Fig. 18,) and upon the return of the vertical shaft  $l^2$  and its connected parts to the position illustrated in Fig. 16 said pawl or dog  $o^6$ , provided with a hook end  $o^8$ , causes a quarter-turn of the said shaft  $l^2$ , and hence brings one of the shell-chucks to the position previously occupied by the punch  $m$ , as will be understood from said Fig. 16. This device is again operated by means of the treadle  $d'$ , the shell placed upon the post of the back-plate, and upon the return of the several parts when the treadle is released the next punch is rotated into its position ready to force the post on another back-plate through the cloth. Thus a punch and then a shell-chuck follow in consecutive order. During the operation of the punching-rod  $m$ , while the shaft or spindle  $l^2$  moves downward, one of the shell-receiving chucks is also passed or forced down upon the shell-hunter F, onto which a shell from the chute or raceway  $a^9$  has been in the meanwhile deposited. The shell-chucks are cup-shaped, being provided with the spring-actuated sides  $n'$ , and are secured to the arms  $l^3$  by means of pins or screws  $n^2$ . A spindle  $n^3$ , provided with suitable guide-plates  $n^4$  and a slotted end  $n^5$ , the purpose of which will be more fully described hereinafter, is rotatively arranged in each chuck  $n$ . The upper end of each spindle  $n^3$  projects through and above the upper surface of the arm  $l^3$ , being provided with a hub  $n^6$ , from which extends an upwardly-projecting handle or finger  $n^7$  for rotating the spindle  $n^3$  by means of a tripping device, (illustrated in Figs. 22 and 23,) for the purpose to be described hereinafter.

I will now describe the manner of feeding the shells of the button down into the chute or raceway  $a^9$  and upon the hunter F. The receiving-pocket  $A^3$  and the shell-conveying ring  $b$ , rotating between the half-sections  $a'$  and  $a^3$ , are of the same construction as the shell pocket and ring described and claimed in my previous application, Serial No. 417,928, and I will therefore not describe them further here. As soon as the shells of the buttons drop into the chute  $a^9$  they are fed down against a stop-piece  $g$ , pivoted upon the lower end of the chute, which stop-piece normally

stands in the position illustrated more especially in Fig. 6, and has a stop-point which extends down into a slot or opening  $a^{24}$  in the chute  $a^9$ . When the shaft or vertical spindle  $l^2$  and its arms  $l^7$  and  $l^8$  have been lowered to force the punch down over the post on the back-plate, and thereby insert the same through the cloth, and when the shell-chuck has picked up the previously-deposited shell from the hunter F and the several parts now begin to start their quarter-rotation, a small pin  $l^9$ , one on the end of each arm  $l^8$ , comes in contact with the stop-piece  $g$ , thereby lifting its stop-point out of the slot  $a^{24}$  in the chute  $a^9$  and allowing another shell to drop down upon the hunter F to be rotated or hunted. At the same time the pin  $l^9$  on the opposite arm  $l^8$  engages with a similarly-pivoted stop-piece  $g'$  on the chute or raceway  $a^{10}$ , having a slot  $a^{23}$  therein, and lifts the stop-point out of said slot to permit a new back-plate to pass down upon the guide G in front of the sliding fork  $g$ . The arrangement and construction of the stop-pieces  $g$  and  $g'$  will be clearly understood from Figs. 25, 26, 28, and 29.

The construction and operation of the hunter F are as follows: Said hunter, as will be seen from Figs. 1, 6, and 19, consists of a tubular post  $f$ , provided with a flange  $f'$  for arranging the same in a hole or opening in the table A. Upon the upper end of a hunting-spindle  $f^2$ , arranged in said tubular post  $f$ , is a shell-receiver  $f^3$ , provided in the top thereof with a socketed portion  $f^4$  for the reception of the shell sliding from the end of the chute  $a^9$ . Said receiver  $f^3$  is arranged upon the upper end of said post or spindle  $f$  in such a manner that when the spring-actuated sides  $n'$  of one of the shell-chucks  $n$  are brought firmly down against said shell-holder or receiver  $f^3$  the latter will move downwardly on its tubular post  $f$  and the spindle  $f^2$  will force the hunted shell into the shell-chuck, as will be clearly understood from said Fig. 6. To permit the downward movement of said shell-holder or receiver  $f^3$  on the post  $f$ , said post is slotted in one side, as at  $f^5$ , and a guiding-screw or pin  $f^6$  in the holder  $f^3$  projects into said slot  $f^5$ . A coiled spring  $f^7$ , which becomes slightly depressed when the holder  $f^3$  is forced downward, causes said holder to return to its normal position as soon as the chuck  $n$  leaves the top of said holder with a button-shell between its spring-actuated sides  $n'$ . Before the button-shell can be forced into the jaws  $n'$  of the holding-chuck  $n$  it must be first "hunted"—that is, its rectangular opening or slot in the hub must be rotated or turned in such a manner in order that when the chuck, with its shell, has been rotated above and brought down upon the previously-arranged back-plate in the back-plate guide G its opening in the hub will come directly above the flat post on said back-plate and allow the pointed ends or projections on the post to enter said opening and pass into

the hub of the shell. The spindle  $f^2$  is employed for hunting or rotating the shell in its holder  $f^3$ , so as to bring the slot or opening in said shell in its proper position to be received by the chuck. In order to rotate and at the same time to cause an up-and-down movement of the spindle  $f^2$ , I have secured on the lower end portion of said spindle two pulleys  $f^8$  and  $f^9$ , which are firmly secured to said spindle by means of set-screws. To said pulley  $f^8$  is firmly attached the end of a cord or rope  $r$ , which is secured at its other end to the crank-arm  $j^4$ , as shown in Fig. 2. To the pulley  $f^9$  I have attached a cord or rope  $r'$ , which passes over a second pulley  $r^2$ , arranged in a bearing secured on the bottom of the table A, and has a weight  $r^3$  on its end. The cords  $r$  and  $r'$ , as will be seen from said Fig. 2, are wound in opposite directions around the pulleys  $f^8$  and  $f^9$ . During the operation of the treadle  $d'$  the cord or rope  $r$  becomes slack and the weighted rope  $r'$  acts on its pulley  $f^9$ , which causes the rotation of the spindle  $f^2$  within its tubular post  $f$ . In order to cause the up-and-down movement of said spindle within its tubular post  $f$ , I have secured at or near the lower end of said post  $f$  a cam-hub  $f^{10}$ , and upon the pulley  $f^8$  I have arranged a post  $f^{11}$ , having on its upper end a lip, which projects above said hub  $f^{10}$ , and the end  $f^{12}$  of which rides upon the cam-surface of the hub when the spindle  $f^2$  is rotated by the action of the weighted cord or rope  $r'$  on the pulley  $f^9$ , thereby causing said spindle to receive a rotating and at the same time an up-and-down movement, as will be evident. Said spindle  $f^2$  is provided at its upper end with a flat end piece or portion  $f^{13}$ , as will be seen from Fig. 6, and more especially from Fig. 19.

No matter in what position the opening in the hub of the shell has been placed in the socketed portion  $f^4$  of the shell-holder  $f^3$ , as soon as the rotating spindle moves upward this flat end piece  $f^{13}$  in rotating finally finds its way into the rectangular slot or opening in the hub of the shell, which is thereby compelled to rotate with spindle until the flat end piece withdraws from its hunting engagement with said slot in the hub, when the spindle once more moves downward, thereby leaving the hunted shell in its proper position to be picked up by one of the chucks  $n$ , and finally to be carried to its place above the end of the guide G to be finally fastened and connected with the post on the back-plate.

In Figs. 22 and 23 I have illustrated a tripping device, which during the operation of the treadle and intermediately-arranged mechanism is forced in engagement with the upwardly-extending post or finger  $n^7$  on the spindle or post  $n^3$  in the chuck  $n$  as soon as the shell therein has been placed on the post on the back-plate on the end of the guide G. Said mechanism consists, essentially, of a sliding arm S, adapted to reciprocate in guides  $s$  and  $s'$ , arranged on a plate  $s^2$ , which is se-

cured in any convenient manner to the standard A' on the table A of the machine. Said sliding arm S is provided at its forward end with a downwardly-depending finger  $s^3$ , pivotally secured in a recessed portion in the curved end  $s^4$  of said arm, and a flat spring  $s^5$ , secured to said arm, exerts a pressure upon the upper end of said finger  $s^3$ . As will be seen from Fig. 3, when the treadle  $d'$  is pushed down a lever or rod  $t$  is caused to exert a pull upon a crank-arm  $t'$ , pivoted in a bearing  $t^2$  on said standard A', thereby causing the arm  $t^3$ , provided with a spring-actuated finger  $t^4$  in its end, to force the sliding arm S forward to the position indicated in Fig. 23, the finger  $s^3$  being easily forced over the end of the rod  $n^7$ , while the chuck  $n$  is placing its button-shell over the post on the back-plate. At the same time the pivoted finger  $t^4$  on the arm  $t^3$  passes beneath the lower surface  $S'$  of the arm S, and the said sliding arm is returned to its starting position with great rapidity by a weight  $u$ , attached to a rope  $u'$ , passing over a pulley  $u^2$  and connected with a yoke  $u^3$ , pivotally attached in the bearings  $s^6$  on said sliding arm S, as will be seen more especially from Fig. 5. Thus it will be clearly evident that on the return-stroke of the slide or arm S the finger  $s^3$  is suddenly forced into operative contact with the end of the post  $n^7$ , and as said finger cannot now slide over said post and as said post is arranged on the pivot  $n^6$  (see Fig. 6) the spindle  $n^3$  will be suddenly rotated and its slotted end  $n^5$  will securely turn the oppositely-extending projections of the head of the post on the back-plate across the slot or opening in the hub in the shell, as clearly illustrated in Fig. 31, and the several parts of the machine return to their initial positions to begin their operations afresh and complete and secure a second button to the material. After the slide or arm S, which may be provided with a pin  $s^7$  and a plate  $s^8$ , which acts as a stop against a packing-ring  $s^9$ , has returned to its starting position (indicated by the dotted lines in Fig. 23) and the treadle  $d'$  returns to its original starting position then the finger  $t^4$  on the arm  $t^3$  freely slides under and against the surface  $S'$  on the slide S to assume its operative position. (Illustrated in Fig. 22.) As will be seen from Figs. 6 and 24, each chute or raceway  $a^9$  and  $a^{10}$  may be provided with an extra back-plate or shell-retaining device  $v$  and  $w$ , respectively. The device  $v$  on the shell-conveying chute  $a^9$  consists of a suitable plate  $v'$ , pivoted by means of pins or screws  $v^3$  to the chute and has pins  $v^3$ , which normally project through a hole or opening in the front of the chute, as will be evident from said Fig. 24. When the upwardly-projecting post or pin  $n^2$  on the punching-spindle  $m$  comes in contact with a finger or rod  $v^4$  on a rod  $v^5$ , secured to the device  $v$ , the plate  $v'$  and its pin  $v^3$  move outward, as indicated in dotted outline in said Fig. 24, and thereby permit a shell to pass

farther down into the chute or raceway until its further progress is arrested by the stop-piece in the bottom of the chute. In the chute  $a^{10}$  is also arranged a back-plate retaining device  $w$ , which consists, essentially, of a plate  $w'$ , provided at the lower end and on the back thereof with one or two pins  $w^2$ , as shown in Fig. 3, which enter holes in the chute and thereby retain the back-plates in the upper part of the chute. The plate  $w'$  is operated by an arm  $w^3$ , with which the finger or post  $m^2$  on the punch comes in contact at the proper time, as it is rotated against said arm by the intermittent movement of the punch and chuck supporting device, to allow a back-plate to pass down into the lower portion of the chute or raceway  $a^{10}$ , where its progress is arrested by the stop-piece  $q'$  in the bottom of the chute. Both of the chutes  $a^9$  and  $a^{10}$  may be provided with openings or slots  $a^{26}$  and  $a^{25}$  to present the shells and back-plates to view and by means of which they can be easily reached with a pointed instrument in case they become jammed within the chute.

By the present form of machine I have devised a simple and operative device in which the back-plates and their posts are fed from one receiving-pocket  $A^2$  and the shells of the buttons are fed from a second receiving-pocket  $A^3$  to the proper position in the machine, the post on the back-plate forced through the cloth, and the shell of the button secured to the post, and the finished button thus firmly secured to the cloth is finally removed from the machine and the operation of attaching and completing another button can be repeated.

From the above description it will be seen that the several mechanisms are all operated from one treadle  $d'$ .

The operations are briefly as follows: A shell of the button is picked up from the hunter by one of the two chucks employed, while a back-plate, already in position, is forced by one of the punches through the cloth, and on the return of the treadle another back-plate is released from its chute or raceway and held at the lower end thereof ready to be delivered upon the back-plate guide. The next operation, by means of a second pressure upon the treadle, is to fasten the shell upon the post just forced through the cloth. On the return of the treadle to its normal position a second back-plate has been hunted and forced forward and a second shell has been deposited upon the hunter and properly rotated, and, finally, by again depressing the treadle this second back-plate is forced through the cloth, while the second shell is being picked up by the other chuck, as will be clearly understood from an inspection of the several drawings. Thus it will be seen that the operations—first of a punch; second, that of a chuck; then that of a second punch; then that of another chuck, and so on—follow in consecutive order, caused by each operation

of the one treadle and the respective and intermediately-arranged operating mechanisms.

In order to prevent any undue backward movement of the arms  $l'$  and  $l^8$ , I have arranged upon the arms  $l'$ , as will be seen from Figs. 15, 16, and 24, two downwardly-extending pins  $x$ , each having a chamfered end  $x'$ , which during the forward movement of the arm  $l'$  passes over the chamfered end  $y'$  of a spring-actuated pin or post  $y$  in a socket  $z$ , as shown more specially in said Fig. 24. This construction allows of the rotation of said punch and chuck supporting device in its forward direction only and prevents all backward movement.

Of course it will be evident that the precise form and arrangements of parts herein shown are not absolutely essential to my improvements, and they may be varied within the limits of mechanical skill without departing from the scope of my present invention.

Having thus described my invention, what I claim is—

1. The combination, in a machine for attaching buttons, of a base or table, a standard on said table, oppositely-arranged pockets or receivers on said standard, chutes or raceways leading from each pocket or receiver, a rotatively-arranged punch and shell-chuck carrying device, the chucks of which are adapted to pick up a button-shell, a back-plate guide in connection with the one chute upon which the back-plate of a button is fed, devices for placing the back-plate properly and forcing the same to the forward end of said back-plate guide, and mechanism for causing an up-and-down and a rotative movement of said punch and shell-chuck carrying device, substantially as and for the purposes set forth.

2. The combination, in a machine for attaching buttons, of a base or table, a standard on said table, oppositely-arranged pockets or receivers on said standard, chutes or raceways leading from each pocket or receiver, a rotatively-arranged punch and shell-chuck carrying device, a shell-hunting device upon which the button-shells are fed from the one chute and properly placed in position therein and from which the chucks on said carrying device pick up a hunted shell, a back-plate guide in connection with one chute, upon which the back-plate of a button is fed, devices for placing the back-plate properly and forcing the same to the forward end of said back-plate guide, and means for causing an up-and-down and a rotative movement of said punch and shell-chuck carrying device, substantially as and for the purposes set forth.

3. The combination, in a machine for attaching buttons, of a base or table, a standard on said table, oppositely-arranged pockets or receivers on said standard, chutes or raceways leading from each pocket, a back-plate guide in connection with one chute, upon which the back-plate of a button is fed, a

slide in said back-plate guide having a forked end adapted to engage with the post on the back-plate and properly arrange the post in said guide, a rotatively-arranged punch and shell-chuck carrying device provided with a punch for forcing the post on the back-plate through the material, means for removing said punch from the post on the back-plate and placing a shell in the chuck upon said device, a shell hunting or receiving post into which the shells are fed, and devices for properly rotating or hunting the button-shell within said post before being picked up by the chuck, substantially as and for the purposes set forth.

4. The combination, in a machine for attaching buttons, of a base or table, a standard on said table, oppositely-arranged pockets or receivers on said standard, chutes or raceways leading from each pocket, a back-plate guide in connection with one chute upon which the back-plate of a button is fed, a slide in said back-plate guide having a forked end adapted to engage with the post on the back-plate and properly arrange the post in said guide, a rotatively-arranged punch and shell-chuck carrying device provided with a punch for forcing the post on the back-plate through the material, means for removing said punch from the post on the back-plate and placing a shell in the chuck upon said device, devices for properly rotating or hunting the button-shell before being picked up by the chuck, and a tripping device adapted to engage with a lever on a spindle rotating in and extending through said chuck to bend the points on the post on said back-plate across a rectangular opening in the hub of the shell, substantially as and for the purposes set forth.

5. The combination, in a machine for attaching buttons, of a base or table, a standard on said table, oppositely-arranged pockets or receivers on said standard, chutes or raceways leading from each pocket or receiver, a back-plate guide in connection with one chute, upon which the back-plate of a button is fed, a slide in said back-plate guide having a forked end adapted to engage with the post on the back-plate and properly arrange the post in said guide, a rotatively-arranged punch and shell-carrying device provided with a punch for forcing the post on the back-plate through the material, means for removing said punch from the post on the back-plate and placing a shell in the chuck upon said device, and devices for properly rotating or hunting the button-shell before being picked up by the chuck, consisting, essentially, of a spindle rotating in a tubular post having a movable shell-receiver into which the end of said spindle adapted to hunt the deposited shell projects, and means connected with the end of the spindle to cause its rotation and also the up-and-down movement thereof, substantially as and for the purposes set forth.

6. The combination, in a machine for at-

taching buttons, of a back-plate holding pocket or receiver  $A^2$ , a chute or raceway extending therefrom, means in said receiver or pocket adapted to rotate and feed the back-plates into said chute, mechanism for operating the same, a back-plate guide having a guiding slot or opening therein into which a back plate is fed one at a time, a reciprocally-moving forked slide in said guiding-slot having outwardly-projecting fingers for guiding the back-plate and hunting the same, and mechanism for forcing said forked slide forward in the back-plate guide and cause the sudden return of the same to its starting position, substantially as and for the purposes set forth.

7. The combination, in a machine for attaching buttons, of a back-plate holding pocket or receiver  $A^2$ , a chute or raceway extending therefrom, means in said receiver or pocket adapted to rotate and feed the back-plates into said chute, mechanism for operating the same, a back-plate guide having a guiding slot or opening therein into which a back-plate is fed one at a time, a reciprocally-moving forked slide in said guiding-slot having outwardly-projecting fingers for guiding the back-plate and hunting the same, and mechanism for forcing said forked slide forward in the back-plate guide and cause the sudden return of the same to its starting position, consisting, essentially, of a cross-head sliding in suitable guides, a link connecting one end of said cross-head with the end of said sliding fork, a lever connected with the opposite end of the cross-head, and a cam mechanism for operating said lever and causing the movement of said cross-head and sliding fork connected therewith, substantially as and for the purposes set forth.

8. The combination, in a machine for attaching buttons, of a back-plate-holding pocket  $A^2$ , consisting of stationary half-sections secured together by means of lugs and forming a space between said half-sections, a back-plate-conveying ring adapted to rotate between said half-sections and forming part of said pocket, said ring being provided with back-plate-retaining pockets on its inner periphery and having an outer toothed periphery, means for operating said ring to produce a step-by-step movement thereof, a chute or raceway leading from said pocket, and a back-plate guide having a reciprocally-moving slide therein provided with a forked end, substantially as and for the purposes set forth.

9. The combination, in a machine for attaching buttons, of a back-plate-holding pocket  $A^2$ , consisting of stationary half-sections secured together by means of lugs and forming a space between said half-sections, a back-plate-conveying ring adapted to rotate between said half-sections and forming part of said pocket, said ring being provided with back-plate-retaining pockets on its inner periphery and having an outer toothed periphery, means for

operating said ring to produce a step-by-step movement thereof, a chute or raceway leading from said pocket, and a back-plate guide having a reciprocally-moving slide therein  
5 provided with a forked end, consisting of fingers  $g^5$  and  $g^6$ , forming a narrow space  $g^7$  between them, into which the deposited back-plate is forced to be properly placed in the forward end of the back-plate guide, substantially  
10 as and for the purposes set forth.

10. The combination, in a machine for attaching buttons, of a back-plate-holding pocket  $A^2$ , consisting of stationary half-sections secured together by means of lugs and  
15 forming a space between said half-sections, a back-plate-conveying ring adapted to rotate between said half-sections and forming part of said pocket, said ring being provided with back-plate-retaining pockets on its inner periphery and having an outer toothed periphery, means for operating said ring to produce  
20 a step-by-step movement thereof, and a back-plate guide having a reciprocally-moving slide therein provided with a forked end, and a  
25 back-plate-holding plate or support in the forward end of said back-plate guide, consisting of a spring-actuated post  $g^2$ , arranged in a socketed portion of said guide and provided in the top thereof with a concave portion  
30 into which the back-plate is forced by the action of said sliding fork, substantially as and for the purposes set forth.

11. The combination, in a button-attaching machine, of a back-plate-holding pocket or  
35 receiver, a chute or raceway extending therefrom, mechanism for feeding the back-plates from said pocket or receiver into said chute, a back-plate guide  $G$  and a sliding fork thereon adapted to be moved forward and backward,  
40 the lower end of said chute terminating above said guide, mechanism for causing a reciprocatory movement of said sliding fork, whereby the deposited back-plate is properly hunted and is forced to the forward end of  
45 the back-plate guide  $G$ , and a holding plate or support in said end having a concave surface in the top thereof, and a spring for forcing said plate upwardly to retain the back-plate when the sliding fork has returned to  
50 its starting-point, substantially as and for the purposes set forth.

12. In a button-attaching machine, the combination of a hunter  $F$ , having a rising and  
55 falling and a rotating slotted spindle, with means, substantially as described, for rotating said spindle and causing the same to rise and fall, consisting, essentially, of a pulley  $f^9$ , secured to the spindle, and a weighted cord  
60 for causing its rotation, a second pulley  $f^8$  and cord operating to cause the rotation of said spindle during the return stroke of the treadle of the machine, an eccentric or cam-shaped hub on a tubular post, a post  $f^{11}$  on  
65 said pulley  $f^8$ , provided with a finger in sliding engagement with said eccentric or cam-shaped hub, whereby during the rotary movement of

said spindle the latter is also caused to move up and down, substantially as and for the purposes set forth.

13. In a button-attaching machine, the combination of a hunter  $F$ , having a rising and  
70 falling and a rotating slotted spindle, with means, substantially as described, for rotating said spindle and causing the same to rise and fall, consisting, essentially, of a pulley  $f^9$ ,  
75 secured to the spindle, and a weighted cord for causing its rotation, a second pulley  $f^8$  and cord operating to cause the rotation of said spindle during the return stroke of the treadle of the machine, an eccentric or cam-shaped hub on a tubular post, a post  $f^{11}$  on  
80 said pulley  $f^8$ , provided with a finger in sliding engagement with said eccentric or cam-shaped hub, whereby during the rotary movement of said spindle the latter is also caused  
85 to move up and down, and a spring-actuated shell-holder arranged in sliding contact at or near the top of said tubular post in which the spindle rotates and slides, substantially as and for the purposes set forth.  
90

14. In a machine for attaching buttons, the combination, with a base or support, a guide  
95  $G$ , a sliding fork on said guide, and means for conveying a back-plate in front of said sliding fork, of a rod or lever  $h'$ , connected at the back with said fork, a cross-head connected with said rod  $h'$ , a rod  $k^6$ , pivotally arranged on an arm  $k^5$ , having a pin or stud  $k^4$  thereon,  
100 and cams engaging with said pin to cause a forward movement of said cross-head and the sliding fork, and a spring connected with said cross-head to cause the return of the several mechanisms, substantially as and for the purposes set forth.

15. In a machine for attaching buttons, the combination, with a base or support, a guide  
105  $G$ , a sliding fork on said guide, and means for conveying a back-plate in front of said sliding fork, a rod or lever  $h'$ , connected at the back with said fork, a cross-head connected with said rod  $h'$ , a rod  $k^6$ , pivotally arranged on an arm  $k^5$ , having a pin or stud  $k^4$  thereon,  
110 and cams engaging with said pin to cause a forward movement of said cross-head and the sliding fork, a spring connected with said cross-head to cause the return of the several mechanisms, and means for operating said  
115 cams, consisting of a crank-arm  $i^2$ , having a lever operated by means of the treadle of the machine, and a spring-actuated dog or clutch  
120 pivotally connected with said crank-arm, adapted to engage with notches in a collar connected with said cams, substantially as and for the purposes set forth.

16. In a button-attaching mechanism, the combination of a back-plate guide provided  
125 with a sliding fork and means for operating the same, consisting, essentially, of a crank-arm  $i^2$ , provided with a spring-actuated dog or pawl  $i^3$ , a sleeve or collar  $i^6$ , having notches  
130 into which the jaw of said dog or pawl is forced, a set of cams on a collar connected

with said collar  $i^6$ , a pin  $k^4$  on a pivoted lever  $k^5$ , and an intermediately-arranged system of levers for operating and causing a sliding movement of said fork, substantially as and for the purposes set forth.

17. In a button-attaching machine, a punch and shell-chuck carrying device consisting of oppositely-projecting arms  $l^7$  and  $l^8$ , said arms  $l^7$  being provided with punches for forcing the head on a back-plate post through the material, consisting of rods  $m$ , having slotted ends  $m^3$ , and projecting fingers or ends  $m^2$  above said arms  $l^7$ , and said arms  $l^8$  being provided with shell-holding chucks having spring-actuated sides  $n'$ , and a spindle in each chuck, and means for causing an up-and-down movement and at the same time an intermittent circular movement of said punch and shell-chuck holding device, substantially as and for the purposes set forth.

18. In a button-attaching machine, a punch and shell-chuck carrying device consisting of oppositely-projecting arms  $l^7$   $l^8$ , said arms  $l^7$  being provided with punches for forcing the head on a back-plate post through the material, consisting of rods  $m$ , having slotted ends  $m^3$ , and projecting ends  $m^2$  above said arms  $l^7$  and said arms  $l^8$  being provided with shell-holding chucks having spring-actuated sides  $n'$  and a spindle in each chuck, and means for causing an up-and-down movement and at the same time an intermittent circular movement of said punch and chuck holding device, consisting, essentially, of rings  $o$ ,  $o'$ , and  $o^2$ , arranged on a post  $l^2$  on said punch and shell-chuck holding device, an arm  $o^3$ , and means for operating the same, connected with said ring  $o'$ , a spring-actuated pawl or dog on said arm  $o^3$ , adapted to engage with notches in said ring  $o^2$  to cause the intermittent circular movement of said punch and shell-chuck supporting device, and a lever  $l^6$ , provided with a yoke  $l^5$ , loosely connected with the end of said post  $l^2$ , for causing the up-and-down movement of said device, all arranged substantially as and for the purposes set forth.

19. In a button-attaching machine, in combination, a base or table, a standard  $A'$  thereon, a back-plate-receiving pocket  $A^2$  and a shell-receiving pocket  $A^3$ , chutes or raceways leading from each pocket, a rotatively-arranged punch and shell-chuck carrying device, the chucks of which are adapted to pick up a button-shell, a back-plate guide in connection with the one chute upon which the back-plate of a button is fed, devices for placing the back-plate properly and forcing the same to the forward end of said back-plate guide, mechanism for causing an up-and-down movement and a rotative movement of said punch and shell-chuck carrying device, pivoted stop-pieces  $q$  and  $q'$ , used in connection with the lower slotted ends of said chutes, and pins on said punch and shell-chuck holding device, adapted to engage with and raise said stop-pieces to release a back-plate or

shell, substantially as and for the purposes set forth.

20. In a button-attaching machine, the combination, with a back-plate or a shell-pocket, a chute or raceway having a slotted lower end, and a pivotally arranged stop-plate connected therewith, having a stop portion adapted to project down into said slotted end of the chute or raceway, substantially as and for the purposes set forth.

21. In a button-attaching machine, the combination, with a pocket  $A^2$ , a chute or raceway  $a^{10}$ , curved double, as at  $a^{22}$ , whereby the back-plate, which has entered said chute with its post projecting downwardly, passes out therefrom at the bottom of the chute with the post in an upright position, a slot in the lower portion of said chute, and a pivoted stop-piece provided with a finger adapted to project down into said slot, substantially as and for the purposes set forth.

22. In a button-attaching machine, the combination, with a pocket  $A^2$ , a chute or raceway  $a^{10}$ , curved double, as at  $a^{22}$ , whereby the back-plate, which has entered said chute with its post projecting downwardly, passes out therefrom at the bottom of the chute with the post in an upright position, a slot in the lower portion of said chute, a pivoted stop-piece provided with a finger adapted to project down into said slot, and a pivoted back-plate-retaining device  $w$  near the upper end of said chute, substantially as and for the purposes set forth.

23. In a button-attaching machine, in combination, a base or table, a standard  $A'$ , a shell-holding pocket  $A^3$ , a chute or raceway extending therefrom, a shell-hunting device secured on said table directly in front of the lower end of said chute or raceway, means in said hunting device for rotating a shell therein, and a chuck for picking up the shell from said hunting device, substantially as and for the purposes set forth.

24. In a button-attaching machine, in combination, a base or table, a standard  $A'$ , a shell-holding pocket  $A^3$ , a chute or raceway extending therefrom, a shell-hunting device secured on said table directly in front of the lower end of said chute or raceway, means in said hunting device for rotating a shell therein, and a chuck for picking up the shell from said hunting device, said chuck being provided with a slotted spindle and means for partially rotating the same, substantially as and for the purposes set forth.

25. In a button-attaching machine, in combination, a base or table, a chute or raceway extending therefrom, a shell-hunting device secured directly in front of the lower end of said chute and consisting of a tubular post  $f$ , arranged in the table or support of the machine, a rising and falling spindle having a rotative movement arranged in said post, a movable and spring-actuated shell-receiver on the upper portion of said post, pulley-wheels

on said spindle for rotating the same, an eccentric hub on said post, and means on one of said pulley-wheels on the spindle engaging with said eccentric or cam-shaped hub to cause the rising and falling movement of the spindle, and a punch and shell-chuck supporting device having punches *m* and shell-retaining chucks *n*, said device rotating and moving up and down in a bearing plate or support and provided with a spindle *l*<sup>2</sup>, and means on the end of said spindle for causing an intermittent circular motion of the device, and also a rising and falling movement, substantially as and for the purposes set forth.

26. In a button-attaching machine, the herein-described punch and shell-chuck carrying device, consisting of a bearing-plate *l*, a spindle *l*<sup>2</sup>, having arms *l*<sup>7</sup> and *l*<sup>8</sup> at its upper end, punches *m*, provided with slotted ends *m*<sup>3</sup>, arranged in said arms *l*<sup>7</sup>, and shell-holding chucks *n* in said arms *l*<sup>8</sup>, consisting of spring-actuated sides *n*<sup>7</sup>, a rotating spindle *n*<sup>3</sup> in each chuck having a slotted end and rotating in bearing-plates *n*<sup>4</sup> in said chucks, a hub *n*<sup>6</sup> on the upper end of the spindle *n*<sup>3</sup>, having a finger *n*<sup>7</sup>, mechanism adapted to engage with said finger *n*<sup>7</sup> and thereby partly rotate said spindle *n*<sup>3</sup>, and mechanism for causing an intermittent circular motion and also an up-and-down movement of said spindle *l*<sup>2</sup>, substantially as and for the purposes set forth.

27. In a button-attaching machine, the herein-described punch and shell-chuck carrying device, consisting of a bearing-plate *l*, a spindle *l*<sup>2</sup>, having arms *l*<sup>7</sup> and *l*<sup>8</sup> at its upper end, punches *m*, provided with slotted ends *m*<sup>3</sup>, arranged in said arms *l*<sup>7</sup>, and shell-holding chucks *n* in said arms *l*<sup>8</sup>, consisting of spring-actuated sides *n*<sup>7</sup>, a rotating spindle *n*<sup>3</sup> in each chuck having a slotted end and rotating in bearing-plates *n*<sup>4</sup> in said chucks, a hub *n*<sup>6</sup> on the upper end of the spindle *n*<sup>3</sup>, having a finger *n*<sup>7</sup>, mechanism adapted to engage with said finger *n*<sup>7</sup> and thereby partly rotate said spindle *n*<sup>3</sup>, and mechanism for causing an intermittent circular motion and also an up-and-down movement of the spindle *l*<sup>2</sup>, consisting, essentially, of collars *o*, *o*<sup>1</sup>, and *o*<sup>2</sup>, one of which is provided with a crank *o*<sup>3</sup>, having a spring-actuated dog or pawl adapted to engage with notches in the collar *o*<sup>2</sup>, a lever *o*<sup>5</sup>, connected with said crank *o*<sup>3</sup>, and a system of levers and cranks for operating said lever *o*<sup>5</sup> from the treadle of the machine, substantially as and for the purposes set forth.

28. In a button-attaching machine, the herein-described punch and shell-chuck supporting device, having shell-chucks *n*, each provided with a spindle *n*<sup>3</sup>, slotted in the lower end, a hub *n*<sup>6</sup> on the top of each spindle provided with a spring-actuated finger *n*<sup>7</sup>, and a tripping device *S* for rotating said spindle, consisting, essentially, of a slide working in bearings or guides *s* and *s*<sup>1</sup> and means for causing a forward movement of said slide in its guides, a spring-actuated finger *s*<sup>3</sup> on the forward end of said slide, adapted to slip over

the end of the finger *n*<sup>7</sup> during the forward stroke, but firmly engaging with said finger during the return stroke and thereby rotating the spindle in the chuck, and a weighted rod *u*<sup>3</sup> for causing the return of the slide *S* to its starting position, substantially as and for the purposes set forth.

29. In a button-attaching machine, the combination, with a slide *S*, arranged in guides *s* and *s*<sup>1</sup> and having a spring-actuated tongue or finger *s*<sup>3</sup>, and ears *s*<sup>6</sup>, to which are secured a rod *u*<sup>3</sup>, of an arm *l*<sup>3</sup>, provided with a spring-actuated finger *l*<sup>4</sup>, pivotally arranged on a support *t*<sup>2</sup>, and a crank *l*<sup>7</sup> and lever or rod *l* for operating the same, substantially as and for the purposes set forth.

30. In a button-attaching machine, the combination, with a back-plate guide *G*, having a socketed post *z*, and a spring-actuated pin *y* therein provided with a chamfered end, and a punch and shell-chuck supporting device having an intermittent circular movement, said device being provided with downwardly-extending pins *x*, having chamfered ends *x*<sup>1</sup>, adapted to pass over the chamfered ends *y*<sup>1</sup> on said rod or pin *y* to prevent a backward movement of said punch and chuck supporting device, substantially as and for the purposes set forth.

31. In a button-attaching machine, the combination of the herein-described punch and shell-chuck supporting device *L*, having arms *l*<sup>7</sup> and *l*<sup>8</sup>, and outwardly-extending pins *l*<sup>9</sup>, with chutes *a*<sup>9</sup> and *a*<sup>10</sup>, provided with pivoted stop-pieces *q* and *q*<sup>1</sup>, with which said pins *l*<sup>9</sup> engage to operate them and thereby release a back-plate or shell during the intermittent rotation of the punch and shell-chuck supporting device, substantially as and for the purposes set forth.

32. In a machine for attaching buttons, in combination, a shell-holding pocket or receiver *A*<sup>3</sup>, consisting of stationary half-sections, a shell-conveying ring adapted to rotate between said half-sections and forming part of said pocket, provided with shell-retaining recesses, a mutilated wheel in said pocket provided in its rim with a shell-conveying groove, said ring having a toothed periphery, and means for operating said ring, a shell-hunting device, a chute for conveying the shells from said pocket to said shell-hunting device, said device being provided with a shell-hunting spindle and a sliding shell-receiver, a punch and shell-chuck supporting device having chucks thereon adapted to move down upon said shell-receiver on the hunting device and pick up a hunted shell, a back-plate guide having a back-plate holder in its forward end, above which the chuck is rotated and brought down upon the same to place its shell over the post on the back-plate, a slotted spindle in said chuck adapted to engage with the prongs or projections on said post, and a hub and finger *n*<sup>7</sup> on said spindle for turning the spindle and bending the prongs or projections on the back-plate post

across the slot or opening in the button-shell, substantially as and for the purposes set forth.

33. In a button-attaching machine, in combination, a shell-holding pocket or receiver  
 5 A<sup>3</sup>, consisting of stationary half-sections, a shell-conveying ring adapted to rotate between said half-sections and forming part of said pocket, provided with shell-retaining recesses, a mutilated wheel in said pocket provided in its rim with a shell-conveying groove  
 10 k, said ring having a toothed periphery, and means for operating said ring, a shell-hunting device, a chute for conveying the shells from said pocket to said shell-hunting device, said device being provided with a shell-hunting spindle and a sliding shell-receiver, a punch and shell-chuck supporting device having chucks thereon adapted to move down upon said shell-receiver on the hunting device and pick up a hunted shell, a back-plate guide having a back-plate holder in its forward end, above which the chuck is rotated and brought down upon the same to place its shell over the post on the back-plate, a slotted  
 25 spindle in said chuck adapted to engage with the prongs or projections of said post, a hub and finger n<sup>7</sup> on said spindle for turning the spindle and bending the prongs or projections on the back-plate across the slot or opening in said button-shell, and a reciprocally-moving slide S, adapted to engage with the finger n<sup>7</sup> to rotate the spindle, substantially as and for the purposes set forth.

34. In a machine for attaching buttons, the combination of a shell-holding pocket or receiver, a chute or raceway extending therefrom, mechanism for feeding the shells from said pocket into said chute, a hunter provided with a hunting-spindle having a rotating and an up-and-down movement, a punch m, and a shell-chuck n, and means connected with said punch and chuck for bringing the chuck against the hunted shell and picking it up, substantially as and for the purposes  
 45 set forth.

35. In a machine for attaching buttons, a chuck n, arranged on a supporting device having an intermittent circular movement and also an up-and-down movement, said  
 50 chuck comprising therein spring-actuated jaws or sides n', a slotted spindle, and a lever or finger n<sup>7</sup> for turning said spindle, substantially as and for the purposes set forth.

36. In a machine for attaching buttons, in combination, a back-plate guide G and mechanism for feeding a back-plate to the forward end of said guide, and a shell-conveying chuck n, arranged on a supporting device having an intermittent circular movement and also an  
 60 up-and-down movement, said chuck comprising therein spring-actuated jaws or sides n', a slotted spindle, and a lever or finger n<sup>7</sup> for turning said spindle, substantially as and for the purposes set forth.

37. In a machine for attaching buttons, in combination, a back-plate guide G and mechanism for feeding a back-plate to the forward

end of said guide, and a shell-conveying chuck n, arranged on a supporting device having an intermittent circular movement and also an  
 70 up-and-down movement, said chuck comprising therein spring-actuated jaws or sides n', a slotted spindle, and a lever or finger n<sup>7</sup> for turning said spindle, and means at the end of said back-plate guide G for retaining the back-plate and its post in position to permit the slotted spindle to enter upon said post, substantially as and for the purposes set forth.

38. In a button-attaching machine, the herein-described punch and shell-chuck supporting device L, consisting of spindle l<sup>2</sup>, having oppositely-extending arms l<sup>7</sup> and l<sup>8</sup>, and slotted punches and shell-chucks on said arms, said chucks comprising therein spring-actuated jaws or sides n', a slotted spindle and  
 85 a lever or finger n<sup>7</sup> for turning said spindle, a collar o', having an arm o<sup>3</sup>, provided with a spring-actuated dog, and a collar o<sup>2</sup>, having notches with which said dog engages to rotate said spindle l<sup>2</sup> and its connected parts  
 90 intermittently, means for operating said arm o<sup>3</sup>, and a rod l<sup>6</sup> and yoke l<sup>5</sup>, connected with the end of the spindle l<sup>2</sup> to produce an up-and-down movement of the same, substantially as and for the purposes set forth.

39. In a button-attaching machine, the herein-described punch and shell-chuck supporting device L, consisting of a spindle l<sup>2</sup>, having oppositely-extending arms l<sup>7</sup> and l<sup>8</sup>, and slotted punches and shell-chucks on said  
 100 arms, said chucks comprising therein spring-actuated jaws or sides n', a slotted spindle and a lever or finger n<sup>7</sup> for turning said spindle, a collar o', having an arm o<sup>3</sup> provided with a spring-actuated dog, and a collar o<sup>2</sup>, having  
 105 notches with which said dog engages to rotate said spindle l<sup>2</sup> and its connected parts intermittently, means for operating said arm o<sup>3</sup>, consisting of a rod o<sup>5</sup>, pivoted crank-arms j<sup>4</sup> and j, and a rod j<sup>3</sup>, operated by the treadle of the machine, and a rod l<sup>6</sup> and yoke l<sup>5</sup>, connected with the end of the spindle l<sup>2</sup> to produce an up-and-down movement of the same, substantially as and the purposes set forth.

40. In a button-attaching machine, the combination, with the standard A', of two pockets A<sup>2</sup> and A<sup>3</sup>, secured on opposite sides of said standard, each provided with feeding devices for feeding certain parts of a button to devices for securing them to a piece of cloth,  
 120 a hub secured to the wall of one pocket, a sleeve in said hub, and a shaft in said sleeve provided with brushes extending down into said pockets, and means at the one end of said shaft for producing an oscillatory movement of said shaft, chutes or raceways leading from each pocket, a rotatively-arranged punch and shell-chuck carrying device, the chucks of which are adapted to pick up a button-shell, a back-plate guide G in connection with one chute upon which the back-plate of a button is fed, devices for placing the back-plate properly and forcing the same to the forward end of the said back-plate  
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guide, consisting of a sliding fork and a  
spring-actuated holding-plate or back-plate  
support, and mechanism for causing the op-  
eration of said punch and chuck holding de-  
5 vice, and means for causing the sliding move-  
ment of said sliding fork, substantially as  
and for the purposes set forth,

In testimony that I claim the invention set  
forth above I have hereunto set my hand this  
18th day of June, 1892.

CHARLES RADCLIFFE.

Witnesses:

FREDK. C. FRAENTZEL,  
HARRY RADCLIFFE.