

Jan. 26, 1937.

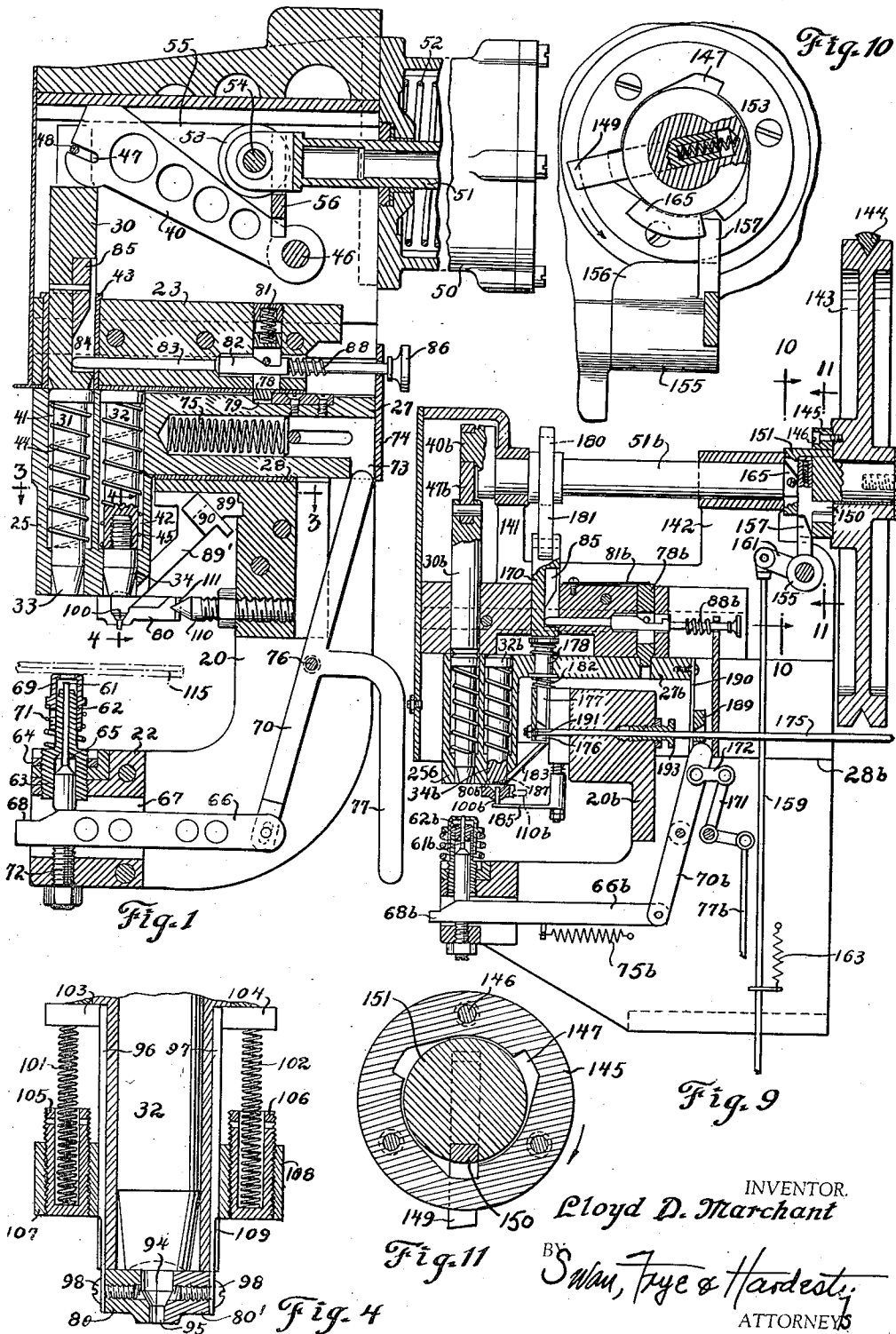
L. D. MARCHANT

2,069,042

AUTOMATIC PUNCHING AND RIVETING MACHINE

Filed March 26, 1934

3 Sheets-Sheet 1



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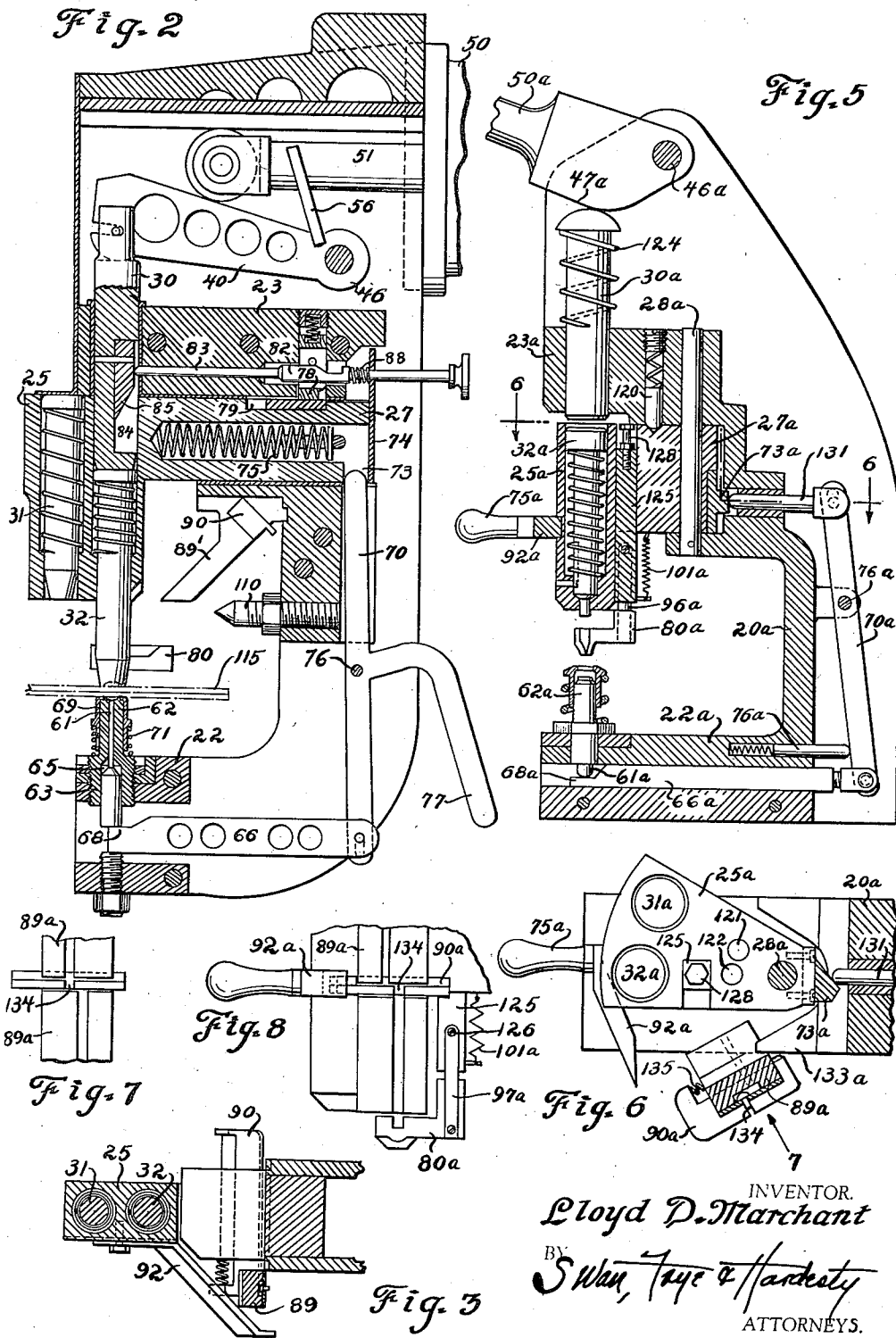
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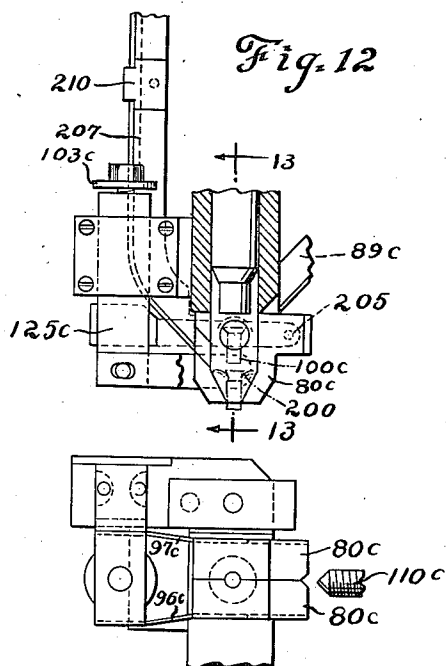


Fig. 14

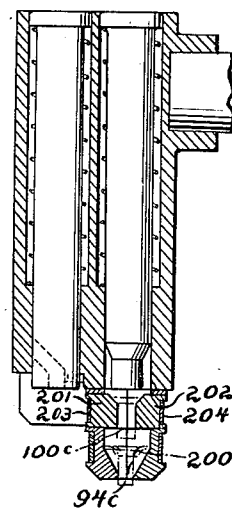


Fig. 13

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UNITED STATES PATENT OFFICE

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AUTOMATIC PUNCHING AND RIVETING
MACHINE

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28 Claims. (Cl. 78—49)

This invention relates to punching and riveting processes, and to automatic machines for performing such process. More particularly the invention aims to provide greatly simplified and very compact apparatus of novel and improved form, preferably although not necessarily incorporated in a single machine, whereby the operations of punching and riveting may be performed rapidly and in quick succession upon work which need not be disturbed in the interim. The invention also contemplates the provision of means for fitting and upsetting the rivets so accurately and positively that a more perfect riveted joint may be attained than has heretofore been possible, and enabling the successful joining in this way of materials not heretofore considered rivetable.

Another object of this invention is the provision in such a machine of improved means for positively locating and holding the operating portions of the machine in accurate alignment and proper positioning during performance of the work.

A further object is the provision in such a machine of novel means for holding the work in desired location during the performance of each operation thereupon and the interval therebetween, but which requires no clamping of the work in place and automatically releases the work upon completion of the operations thereupon.

An important object of the invention is also the provision of a machine of the type indicated, so accurate and reliable in the performance of these operations that the rivets may not only be fitted more closely than has heretofore been possible, but are held in full contact throughout the length of their stems with the aperture in the material worked upon, thereby greatly increasing the holding efficiency of the rivets and reducing the danger of fracturing the work, as well as making possible the riveting of materials which heretofore could not be safely riveted, such as synthetic resins in thin panels, and other relatively brittle and frangible materials.

Another important object of the invention is the incorporation in such machines of an improved laterally movable turret head carrying separate punching and riveting elements, together with novel means for shifting the head and controllably actuating the punching and riveting elements in proper order with relation to the work to be performed and in response to the performance of desired operations in given sequence.

A still further object is the provision of means

for automatically and positively aligning the turret head when indexed, to accurately locate the punching and riveting elements with respect to the work and dies, and for automatically shifting the turret from the punching to the riveting position when the former operation is completed.

Still another object is the provision of means for resetting or cocking the turret head and connected parts upon the completion of each riveting operation, which resetting means may be manually controllable, if desired, in a manner adapted to eliminate all danger of jamming the machine in the event an imperfect rivet or imperfections in the work should prevent completion of any individual operation.

It is also an object to provide such an improved machine with mechanism whereby wire stock may be fed and the rivets automatically formed therefrom by the machine.

Individual improvements of both apparatus and for methods of punching and riveting are contemplated as still further objects of my invention.

Among important objects should also be mentioned the provision of means yieldably resisting both the rivet-inserting and upsetting pressure applied to the work during the riveting operation, to thereby hold the elements to be riveted tightly together and prevent undesired distortion of the rivet or flashing out of the stem thereof between sections of the material being worked upon.

Other objects and advantages will be apparent from the following description, wherein reference is made to the accompanying drawings illustrating preferred embodiments of my invention, and wherein similar reference numerals designate similar parts throughout the several views.

Figure 1 is a substantially central vertical sectional view of a combined punching and riveting machine incorporating and adapted to carry out the principles of my invention and illustrating the compactness of construction made possible thereby, the device shown being of portable proportions, and illustrated with its working parts in position and ready for performance of the punching operation, but prior to commencement thereof.

Figure 2 is a similar view showing the turret shifted to riveting position and that operation in the process of being performed upon work indicated in dot-dash lines.

Figure 3 is a horizontal section taken substantially on the line 3—3 of Figure 1 and looking in the direction of the arrows.

Figure 4 is in enlarged detail vertical section taken substantially on the line 4—4 of Figure 1 and looking in the direction of the arrows.

Figure 5 is a view similar to Figure 1 of a somewhat modified construction.

Figure 6 is a horizontal section taken substantially on the line 6—6 of Figure 5 and looking in the direction of the arrows.

Figure 7 is a fragmentary side elevation of the selector and rivet feeding mechanism, taken as if looking in the direction indicated by the arrow 7 of Figure 6.

Figure 8 is a view similar to Figure 7 showing ing additional details of the selector and appurtenant parts, the selecting element being shown in another position.

Figure 9 is a view similar to Figure 1 of another modified embodiment adapted to form rivets from wire stock, and so eliminate the necessity of supplying the machine with finished rivets, incorporating as well means for punching the work, feeding the rivet blanks thereinto, and upsetting both ends of the rivets.

Figure 10 is a detail vertical section of the clutching mechanism employed in the embodiment of Figure 9, taken substantially on the line 10—10 of Figure 9 and looking in the direction of the arrows.

Figure 11 is a similar detail section taken substantially on the line 11—11 of Figure 9 and looking in the direction of the arrows.

Figure 12 is a view similar to Figure 4, fragmentarily showing a head construction of modified form incorporating means for feeding and fitting washers or the like beneath the heads of the rivets as the latter are installed, all operations being automatic.

Figure 13 is a section taken substantially on the line 13—13 of Figure 12 and looking in the direction of the arrows; and

Figure 14 is a bottom plan view of the modified portions shown in Figures 12 and 13.

First embodiment: Frame and turret construction

Referring now to the construction shown in Figures 1 to 4, which will be seen to be adapted for embodiment in compact and portable apparatus, reference character 20 designates generally a frame, roughly of C-form, having a forwardly projecting base portion 21 carrying table 22 which underlies the similarly projecting frame head portion 23, between which and the table is arranged a slidable turret head 25 supported by a turret shaft 27, which may be round or square, as desired, though if round, preferably prevented from turning as by a key pin 76. The turret supporting shaft extends through an apertured bearing sleeve 28 carried by the frame. The head portion 25 carries a punching head 31 and a riveting head 32, both vertically reciprocable toward and from the table 22 and a spring 75 trapped in the turret shaft urges the turret toward the left or riveting position.

The overhanging portion 23 of the frame also supports a driving ram 30 with which either head 31—32 may be aligned by moving the turret to a predetermined position, the heads 31—32 being fitted in vertical apertures 41—42 which extend completely through the turret to expose their tops, in a manner permitting engagement of whichever working head 31—32 is in alignment therewith by the bottom of the driving ram. Driving ram 30 is projectable through its supporting bearing sleeve 43 and into whichever turret head aperture 41—42 is in registry therewith,

to force down the working head therein. It will be seen that when the driving ram is fully elevated it is clear of the turret, which is then freed to permit its sliding movement, while in descending, the driving ram enters one of the apertures 41—42 to lock the turret in place. Springs 44—45 yieldably hold the plungers or working heads 31—32 elevated.

A latch piece 78 is projectable into an aperture 79 in the top of the turret shaft 27 under the influence of a spring 81 to hold the head retracted and in punching position, such latching means being carried by the upper portion 23 of the frame. The latch piece is retractable by a transversely slidable cam 82 mounted on a rod 83 which projects into the path of cam 85 fitted in an aperture 84 in the ram. Cam 85 is adapted to move the rod 83 and latch releasing cam 82 to the right, to release the latch (unless it is already released) as will be apparent from Figure 1. The latch is also manually releasable, as by means of a knob 86 carried by the rear extremity of the rod 83, which rear rod extremity is attached to the cam and projects freely through a plate 74 secured over the back end of and projecting upwardly from the turret shaft 27. Fitted over the rearward extension of the rod 83 is a compression spring 82 of such length that when the turret is in the riveting or projected position, it is compressed by the plate 74 to urge the latch actuating cam 82 toward the latch engaged position in which it offers no interference with projection of the latch bolt 78.

The ram is actuable by a lever 40 pivoted in the upper portion of the frame as upon pin 46 and having a slotted nose portion 47, the slot engaging a cross pin 48 carried by the upper end of the ram 30, while the rounded bottom of the nose is adapted to bear downwardly against the top of the ram, which is slotted to receive it. The shown method of driving the ram, which will be seen to be entirely optional, however, further contemplates the use of an air motor, which may be of conventional or any desired construction. Only the cylinder 50, piston rod 51 and return spring 52 thereof are shown, the details being considered unnecessary of elaboration herein, inasmuch as they form no part of my present invention. The cylinder 50 forming the housing of the air motor is secured to the rear face of and near the top of the frame and the piston rod 51 projects into the chamber 55 formed in the upper section of the housing and which houses the upper end of the ram, lever 40 and connected elements. The end of rod 51 carries a driving roller 53, horizontally actuable by the air motor and which when forced to the left, (as viewed in the drawings) rolls along and bears downwardly against the top surface of lever 40, the nose portion of which is thereby driven downwardly against the upper end of the ram. When air under sufficient pressure is fed to the cylinder 50, the driving roller is moved to the left to force down the ram, while when the air pressure is relieved or reversed, the roller moves to the right under the influence of return spring 52. Provision is made for lifting the lever and so the ram upon such return movement of the piston rod, an upwardly projecting arm in the form of a fork 56 being secured to the lever 40 and projecting into engagement behind the roller pin 54 in such manner that retraction of the roller by the rod 51 causes the pin 54 to move the forked lever 56 in the same direction and so lift the

lever 40 and ram 30, through the agency of cross pin 48.

Carried by the bottom end of the plunger 31 is a punching die 33 having a suitable (undesigned) aperture therein through which slugs formed thereby may escape, while a suitably cupped riveting die 34 is carried by the bottom end of plunger 32. The dies may be secured to the plunger heads by being screwed thereinto, in the manner shown.

Work backing elements

Cooperating punch and dolly or anvil portions are carried by the table 22, in alignment with the working axis of reciprocation of the plungers, which in the construction shown coincides with the axis of the ram. The punch, designated 61, slidably interfitted with the dolly 62, which is shown provided with an enlarged base portion 63 screwed into the table 22 and locked therein as by set screw 64. The dolly is axially apertured to slidably receive the punch, and such apertured portion is enlarged as at 65 for the shank of the punch. A combined actuating cam and backing member 66 for the punch is slidable in a lateral aperture 67 in the table portion of the frame, and extends beneath the shank of the punch, which projects below the dolly and into the aperture 67, as shown. When the backing member 66 is moved to the left, in which position it is shown in Figure 1, the bottom of the punch shank may rest against the top of the backing member, which thus maintains the punch in a position in which it projects up over the dolly, while when the backing element is moved to the right, as shown in Figure 2, only its reduced forward portion 68 lies beneath the punch shank, permitting downward movement of the punch to a position in which its upper end aligns with and forms a cooperating portion of the cupped anvil surface of the dolly. It will be seen that the aperture 65 in the dolly which permits reciprocal movement of the punch is extended upwardly sufficiently to permit upward movement of the punch above the position shown in Figure 1, and far enough to project above the combined stripper resistance element 69 to serve as a pilot for the work in a manner which will presently appear.

Vertical adjustment of the backing element 66, and so of the working positions of the punch, may be effected by an adjusting screw 72 projecting upwardly into the space 67 through the bottom of the table section of the frame and arranged to take the thrust delivered through the backing member. The backing member is shifted by turret movement, being coupled thereto by a lever 70 centrally pivoted in the frame, as at 76, and at its lower extremity pivoted to the projecting rear end of the backing element, while its upper end is rockably projected into an aperture in the turret shaft formed by a slot 73 therein, which slot is closed at its rear end by plate 74. Spring 75 which urges the turret to the left simultaneously urges backing element 66 to the right, as viewed in the drawings, which is also the riveting position of the latter and both of these elements may be moved in the opposite direction to reset them in the first or punching position by means of a cocking handle 77, shown as integral with lever 70.

The stripper and resistance element 69 is shown as a cupped member having a clearance opening therein slidably fitted over the dolly and yieldably urged upwardly by a compression spring

71 trapped therebeneath and fitted about it and the dolly. Its upward movement is limited by stop and retaining pin 53. By opposing downward movement of the work during the riveting the element 69 holds the parts being joined tightly together, insuring full and permitting firm insertion of the rivet before upsetting begins, and preventing backflow of the rivet stem or flashing out thereof between the pieces being joined. The imposition of such resistance or back pressure acting upon the work constitutes a vital feature of my improved riveting process. It will of course be realized that element 69 also strips the work from the punch, although not until the descending rivet forces the punch out of the work.

Rivet feed

Means for feeding the rivets to and holding them in proper position to enter the work may include a track portion 89, supplied with rivets from any suitable source (not shown). A selector 90 cooperates with the track, and also may be of conventional or any desired construction and arranged to feed the rivets one at a time to a lower track section 89' through which they travel to a pair of holding shoes 80 positioned beneath the riveting head. The selector element 90 is actuated upon each rearward movement of the turret head 25 by a cam 92 secured to the side thereof in the manner best shown in Figure 3.

The shoes may be of the form shown in Figures 1 and 4, comprising separate and separable halves 80-80' complementarily fitted together and shaped to provide an upper head supporting cup 94 having inclined sides which act as cams to force the shoe sections apart as a rivet head is forced therethrough. Downwardly from the cup extends a stem-receiving aperture 95 of slightly lesser diameter than the stems of rivets to be held. The shoe elements 80-81 are carried by leaf springs 96-97 which yieldably urge them together. The springs 96-97 are carried by and project downwardly from the sides of the turret on opposite sides of and in alignment with the path of travel of the riveting head 32, the shoes being shown so secured to the projecting lower ends of the springs, as by screws 98, as to hold the rivet supporting portions 94-95 coaxial with the plunger. The assembly comprising springs and shoes is vertically slidable with respect to the head, but urged upwardly by compression springs 101-102 which bear upwardly against spring abutments 103-104 secured to the tops of leaf springs 96-97, and downwardly against cupped abutment members 105-106, exteriorly threaded and screwed into receptacles formed as ears 107-108 projecting from the sides of the turret head 25. The limit of downward movement of the shoes may be adjusted by turning the abutment elements 105-106 to vary the height to which they project above the ears 107-108. The lower extremities of springs 96-97 are preferably relieved as at 109 to permit free outward movement of the shoes, at least to a slight extent, even when in raised position, such slight separation being for the purpose of permitting the stems of the rivets to enter the aperture 95, and being effected by a pointed spreader member 110 which projects from the frame sufficiently to be forced partly between the shoes when the turret is fully retracted, as shown in Figure 1. Entry of the pointed extremity of the spreader member is facilitated by chamfering the rear ends of the meeting faces of the shoes to form a V'd groove, as at 111.

Operation

When the head is retracted by means of the cocking lever 77, the selector is actuated, as above stated, and a rivet drops into the shoes, the stem extending downwardly in the manner indicated in Figure 1 at 100. Stock to be riveted is placed over the backing assembly formed by the interfitted punch dolly and resistance element, in the manner indicated in Figure 1 in dot-dash lines at 115. The air motor is then energized and the ram 30 and plunger 31 forced down, driving first the work and then the die head over the punch. Upon completion of the punching operation the air motor is de-energized and the punching die again rises to the position shown in Figure 1. During the punching stroke however, cam 25 has actuated cam 32 and released latch element 73, so that the turret head is free to move forward under the influence of spring 75 as soon as the ram is clear of the turret. As the pressure of the punching die is removed, the work is moved upwardly slightly by the stripper 59, but the punch stays in and moves upwardly with the work, in which it is held by friction. The punch accordingly acts as a pilot to positively hold the work against disalignment. As soon as the ram is clear of the turret head the latter moves forward, and in such forward movement of the turret, as soon as the shoes 33' clear the spreader member 110, springs 36—37 urge the shoes together, to clamp the rivet. Such forward movement of the turret, accompanied by rearward movement of the backing element 66 to the riveting position shown in Figure 2 is of course quickly accomplished as soon as the ram clears the turret after completing the punching stroke, and the riveting head is thereby aligned with the ram.

The air motor is then again energized to force down the riveting head in the manner indicated in Figure 2. The pressure exerted upon the tops of the shoes by the riveting plunger carries them down with the plunger as far as stops 105—106 will permit, which is ordinarily to a position close to the work, in fact the stops could be omitted and the shoes allowed to contact the work if desired, as will be seen to be the practice followed in embodiments subsequently to be described. When the shoes have reached the bottom of their travel, the plunger 32, continuing downwardly, spreads the shoes far enough apart to force the head therethrough and the rivet into the aperture in the work, the stem of the rivet driving the punch from the aperture in descending until the bottom of the punch shank strikes face portion 68 of backing element 66, at which time the top of the punch is properly positioned to form part of the anvil and cooperate in the upsetting of the now projecting lower end of the stem of the rivet, which is of course upset by the continued pressure exerted by the plunger 32 which causes a final downward movement of the rivet together with the work, element 61 opposing such final downward movement and holding the work sections together.

When the head is in the forward riveting position shown in Figure 2, the tendency of plate 74 to urge the latch releasing cam 32 toward latch-released position cannot become effective to release the latch until ram 30 again rises, after completion of the riveting stroke, far enough to permit rod 33 to enter the cam slot 34 in the ram. It will be seen that by virtue of this construction, however, latch element 73 is ready to enter the

cooperating latch opening 79 in the turret shaft as soon as the turret head has been moved back to reset it in the punching position. When cocking lever 77 the apparatus is pulled forward in the initial position shown in Figure 1, the punch being raised by the forward movement of the backing member 66, while the latching element 73 snaps into latch aperture 79 as the head reaches the end of its travel to hold the machine cocked. As the head approaches such retracted position, also, during cocking, cam 92 actuates the cylinder 90 and another rivet is fed to the shoe assembly, by which it is held until another riveting operation is ready to be performed. Selecting means will be described in greater detail in conjunction with the description of another embodiment, although various forms are already well known.

Swinging head embodiment: Construction

In Figures 5 to 7 inclusive a somewhat modified construction is shown in which the turret head is arranged to rotate rather than reciprocate in a rectilinear path. Similar parts have been given like reference numerals to those applied to analogous portions of the first embodiment, with the addition of the distinguishing character "a" to each. This form of my invention is shown equipped with actuating means for the punching and riveting heads 31a—32a respectively in the form of a manually operable handle 50a pivoted in the top of frame 28a, as upon pin 46a, and provided with a cam portion 47a which may be forced against the top of ram 30a by actuation of the handle to throw the ram downwardly against the top of whichever of the operating plungers 31a—32a may lie beneath it. Such plungers are carried in a turret 25a shown as manually rotatable in either direction through a partial revolution by means of a handle 75a, although the turret might obviously be rotatable, continuously or otherwise, through either a complete revolution or any lesser angular path of travel. The supporting portion 27a lying close to the axis of the sectoral turret is pivotally mounted on a pin 28a, from the axis of which plungers 31a and 32a and ram 30a are equidistant, so that the plungers may be swung into registry with the ram by swinging the turret, as will be readily apparent from the drawings upon an inspection of Figures 5 and 6. A detent 120 cooperating with suitable depressions 121—122 formed in the top of the turret yieldably maintains the latter in either position to which it may be moved, that is, with either of the working heads or plungers 31a—32a in alignment with the ram. The working heads and their spring retracting means may be, as shown, of similar construction to those disclosed in conjunction with the first embodiment. Repetitive description is accordingly thought unnecessary. An additional retracting spring 124 may be provided for the ram 30a, as shown, tending to lift the ram clear of the turret to permit swinging movement thereof as soon as the handle is raised sufficiently.

A rivet-holding shoe assembly generally designated 30a may be provided, which also may be of analogous construction and supported by similar leaf springs 96a, the springs being secured at their lower extremities to the sides of the shoe elements and at their upper extremities to the sides of a vertically slidable carrier 125, as by screws 126. The carrier is normally urged upwardly by a spring, as 101a acting in tension, secured at its upper end to the bottom of the turret and at its lower extremity to the shoe carrier.

Carried by the fixed portion of the frame on the riveting side of the head, as by the bracket 133, is a rivet track 89a which may be fed from any suitable hopper or other source (not shown). A lower section 89'a of the track is spaced below and slightly offset from the upper section, and a selector 90a is reciprocable in the slot formed by the gap between them and provided with a rivet-carrying slot 134 proportioned to accommodate only a single rivet, whereby when the selector is reciprocated to move the carrier slot 134 from registry with the upper or magazine section of the rivet track into registry with the lower or feed section 89'a, a single rivet is removed from the former section and dropped into the latter, whence it falls into the shoe assembly 80a in the manner previously described. The spring 135 yieldably holds the selector in the position in which its feeding slot 134 aligns with the upper section of the track to adapt it to receive a rivet therefrom, while when the head is moved from the riveting position to the punching position, as by means of the handle 75a, a cam 92a carried by the turret engages the nose of the selector, forcing it back sufficiently to feed a rivet in the manner described.

The backing element 66a is slidably mounted in the table portion 22a of the frame in analogous position to that of the first embodiment, and is actuable by a cam 73a carried by the turret and projecting rearwardly from the axis thereof into engagement with a follower 131 articulated at its rear extremity to lever 78a, which is centrally pivoted in the frame as upon pin 76a, while its lower end is pivotally connected to the rearwardly projecting extremity of the backing element 66a, which is urged toward the retracted position in which the punch is backed by the reduced portion 68a by a spring-pressed plunger 27a which also urges the follower 131 into engagement with the cam. The cam is so developed and the interfitting punch 61a and anvil 62a are so proportioned to the backing element that when the head is swung to punching position, that is, plunger 31a, aligned with the ram, the punch is held in properly projected position by the higher top surface of backing element 66a for the punching operation, as in the previous embodiment, while when the head is swung to the riveting position shown in Figures 5 and 6, the backing element is sufficiently retracted so that only its reduced end portion 68a lies beneath the punch shank, whereby the latter may move downwardly sufficiently to cooperate with and form in effect a part of the anvil for upsetting the rivet during the riveting operation.

Operation

It will be seen that in this embodiment, also, the head may only be removed when the ram is raised to clear the turret, and that when so raised, swinging the turret to the punching position to register plunger 31a with the ram automatically feeds a rivet into the shoes, where it rests during the performance of the punching operation, which is effected by simply forcing down the handle 50a. When the handle is released, and the ram 30a raised clear of the turret by the spring 124, the turret may be shifted to the riveting position by means of the handle 75a, although it will be obvious that a spring equivalent to the spring 75 of the first embodiment might be provided for this purpose. When the handle and ram are again forced downwardly, riveting plunger carries the shoe assembly

down with it, and forces the rivet through the shoes, which are thereby forced apart, and into the work. Vertical drift is also preferably allowed the punch to permit it to remain in the work to hold the latter in alignment until penetration thereof by the rivet. In entering the work the rivet similarly pushes the punch to lowered position to adapt it to form part of the upsetting dolly.

Wire-fed automatic rivet forming embodiment working portions

In Figures 8, 9, and 10 I have shown another somewhat modified construction incorporating some features similar to those of the first described embodiment, to which analogous features like reference numerals have been given with the addition of the distinguishing character "b".

This embodiment of my invention may incorporate a sliding turret head as 25b, the carrying or shaft portion 27b of which is slidably supported in slots as 28b formed in the sides of the frame 20b, although the turret shaft is shown as of inverted U-section. The turret is underhung by a table portion 22b which supports in similar position an assembly comprising an interfitting punch 61b, dolly 62b, and combined resisting and stripping element 69b. The punch is backed by top of the main, thicker portion of backing element 66b when the turret is in retracted (punching) position, and by the lower, end portion 68b, which permits the punch to move to a similar lowered position, when the turret is in the other (riveting) position. The turret head may, as shown, be urged toward the forward riveting position by the same spring 76b which tends to retract the backing member 66b.

Drive

The ram 30b is driven by crank 40b acting through pitman 47b. Crankshaft 51b is journaled in bearing brackets 141-142 projecting upwardly from the frame, and carries at its other end a driving pulley 143 which may also serve as a flywheel, and which may be driven from any suitable external source of power (not shown) as through a clutch. The driving element is formed by a driving ring 145 secured to the hub of the pulley, as by screws 146, and provided with internal notched teeth as 147 (Figure 10). The driven element of the clutch is formed by an enlarged portion 151 fast on and shown as integral with the shaft and loosely fitted into the driving ring 145, from which it projects, however. A slidable dog 149 is laterally and radially reciprocable in the projecting portion of driven element 151 and provided with a pawl arm 150 extending into the ring and radially movable into and out of engagement with the notched teeth 147 in the ring to make and break the driving connection between the pulley and shaft. A spring 153 normally urges the dog into such engagement by forcing the plunger outwardly, and it will be understood upon an inspection of Figures 10 and 11 that when all the dog is way out and pawl 150 accordingly engaged with one of notches 147, the end of the body of the dog 149 projects from the driven element 151.

Normally in but movable out of the orbit of such projecting portion of the dog is a clutch-operating element 155 having a cam portion 156 which, when it is in normal position, in the path of travel of such projecting portion of the dog,

acts to push the latter inwardly and so break the driving connection as the projecting portion of the dog moves into engagement therewith upon completion of a single turn, in the manner indicated in Figure 10. A blocking portion 157 is also being provided which acts as a positive stop for the projecting dog, which may be caught by the same and so held in position on the completion of a revolution. The dog controlling element 156—157 is swingable into and out of the orbit of the dog by means of a pull-rod 159 connected to a crank arm 161, which projects from the dog element and may be operated by pedal or other suitable means (not shown). A spring, as 163, may be provided to return the dog releasing portion 156 and locking portion 157 to a position in which they lie in the orbit of projecting portion 149 of the dog, and a cam, as 165, may also be carried by the driven clutch element 151 and arranged to contact blocking portion 157 as the dog nears the completion of a revolution to positively force controlling element 156—157 back into the path of the projecting dog portion, to thereby insure de-clutching after the completion of a single turn, even though rod 159 may still be under yieldable tension from the single turn operating means.

Operation of driving and working portions

It will thus be seen that assuming the pulley 143 to be constantly driven, drawing down upon the pull-rod 159 swings controlling element 156—157 clear of the dog, which is then forced outwardly by spring 153. The drive is immediately taken up and the crankshaft turned. If the pressure applied to pull-rod 159 is released before the completion of such turn, element 156—157 lies in wait for the projecting dog portion 149, cam portion 156 first pushing in the dog to break the drive, after which blocking portion 157 provides a positive stop therefor, while if the pressure upon the pull-rod is not released quickly enough, cam 165, which positioned in advance of the projecting portion of the dog, considering the direction of rotation of the parts, as is shown in Figure 9, engages portion 157, and positively returns it to blocking position, thereby also returning portion 156 to cam-actuating position and insuring stopping of shaft 51b as the turn is completed.

The operation of the turret, work-backing and plunger portions, being similar to those already described, need not again be considered, although it will be seen that a somewhat modified resetting means is shown comprising a pull-rod 77b actuatable pedally or in any other suitable manner, and connected to the lever 70b which connects the turret head and backing element by a bell-crank 171 and link 172. The latching element 78b is, in this form of my invention, driven toward released position by a cam 85b carried by the stock cutter actuating ram 170, but as this ram is driven downwardly during each punching stroke, the operation will be seen to be substantially the same.

Rivet formation and rivet stock feed

Rivet stock is fed into the machine from the rear in the wire form. The wire, designated 175, may be supplied from a reel or other suitable source (unshown), and is passed through the rear of the frame to enable its projection into a cutter channel 176. Vertically reciprocable in the channel 176 is a cutter 177 adapted to be forced downwardly by a plunger 178 which lies

beneath the cutter ram 170 when the head is in retracted position, so that when such ram is pushed down, as by the eccentric 180 acting through strap 181, the cutter severs the projecting end of the rivet wire. The eccentric is of course fast upon shaft 51b, and a return spring 182 is provided to raise the cutter when the pressure of the ram and connecting plunger is released. As stated above, such cutting stroke may be performed simultaneously with the punching stroke. The rivet blank so severed, shown at 100b, falls down the track 183 and into the shoe assembly, generally designated 80b, the form of which may correspond generally to the shoe assemblies previously described, the shoes being held apart by a spreader member 110b when the head is retracted, such blank falls freely thereinto. A vertically adjustable stop 185 is provided to limit downward movement of the rivet blank and prevent its falling from the shoes while spread. As the head is moved forward after completion of the punching operation, the shoe sections are yieldably forced together as soon as they clear the spreader to clamp the blank and hold it in the shown position.

The riveting die head 34b carried by the riveting plunger 32b is cupped as at 187 to upset the top of the blank, while the cup in the dolly, the bottom of which is formed by the punch when in lowered position, is contoured to upset the lower end of the blank, the latter being of such length as to project the required distance from each side of the work to provide the necessary stock for forming such heads.

A feeding dog 189 is carried by the rear end of the turret shaft 27b, to which it is secured by a downwardly extending leaf spring 190, which permits lateral swinging of the dog. The spring 190 is of such length and stiffness that when substantially vertical, which is its normal relaxed position, the pointed bottom extremity of the feeding element 189 is forced against the rivet stock hard enough to bite into the same and drag it forwardly with the turret as the latter advances, thereby feeding the rivet wire into the cutting aperture 176 until stopped by the adjustable stop screw 191, by which the length of severed blanks may be regulated. Thereafter as forward movement of the turret head and so of feeding element 189 continues, the latter drags over the wire, flexing the spring 190. An additional stop, as 193, may be provided on the rear face of the frame for forcing the element 189 back to the dragging angle to relieve its pressure against the stock when the head has advanced sufficiently.

Combined rivet and washer feeding modification

In Figures 11 to 13 inclusive I have shown a somewhat modified holding shoe and feeding construction so arranged that a washer may be fed into the shoe beneath the rivet, to be clamped beneath the head of the latter when set. In this embodiment the shoe sections, designated 80c and 80'c, are carried by laterally extending leaf spring elements, 96c—97c, secured to a vertically movable carrier 125c in such manner that when the turret head is fully retracted they may be slightly spread by the spreader 110c to permit free entry of a rivet and washer, but are pressed together against the stem of an inserted rivet and a held washer when free of the spreader. The shoes, which are elongated vertically, are so cupped, as at 94c, as to hold a washer 200, in

the lower portion thereof, while yieldably impressed holding elements 201—202 slidably mounted in the upper portion of the shoes are adapted to yieldably engage and hold a rivet in the manner best shown in Figure 12. Detents 201—202 are urged together by leaf springs 203—204, which are secured to the rearwardly projecting portions of the shoes, as by screws 205. The rivet track 89'c is arranged to feed rivets into the space above the detents 201—202 in such manner that they fall into the position indicated in dot-dash lines at 100c, while the washer track 207 is arranged, as best shown in Figure 11, at 200. Suitable selecting mechanism, as 210, may be provided for regulating the feeding of washers, and it will be apparent that the washers and rivets may be fed simultaneously, if desired, or in any order, inasmuch as they fall into separate holding portions of the shoes, where they are held until the riveting operation. It will also be apparent from the foregoing and the analogous operation of equivalent parts, that upon descent of the riveting plunger 32c, the rivet is first carried through the washer, and the assembled washer and rivet then carried down into the work, the shoe assembly descending with the carrier 125c to a desired point determined by stop washer 103c, after which the shoes are spread and the rivet and washer assembly released after being forced completely through the shoes and the stem has entered the work.

A yieldable resisting element 69c acts to hold the work together by opposing downward movement of the work during the final portion of the riveting operation in like fashion.

While it will be apparent that the illustrated embodiments of my invention herein disclosed are well calculated to adequately fulfill the objects and advantages primarily set forth, it is to be understood that the invention is subject to variation, modification and change within the spirit and scope of the subjoined claims.

What I claim is:

1. In a machine of the character described, a frame, a slidably interfitted punch and anvil assembly, one movable to project more or less with respect to the other, a turret movable to align different portions thereof relatively to said assembly, working elements carried by the turret and different ones of which are alignable with the assembly when the head is in different positions, said working elements being slidable in the turret toward and from the punch and anvil assembly, means carried by the frame for moving the working elements toward said assembly, including a portion movable into engagement with the turret in a direction transverse to the direction of movement of the turret to lock the latter against movement when one of said working elements is being so moved toward the punch and anvil assembly, and means for changing the effective distance with which one element of said punch and anvil assembly projects relatively to another, whereby when the punch projects sufficiently it may be used for punching, and when sufficiently retracted the assembly may be used for upsetting.

2. In a riveting machine including a dolly, a supporting portion spaced from the dolly, and a working head reciprocable in the supporting portion toward and from the dolly, means for applying rivets to work interposed between the head and dolly comprising a rivet holder having a holding portion adapted to be opened and closed and arranged to frictionally engage and hold a

rivet when closed and release it when opened, said holder being reciprocable with the head, means for feeding rivets to the holder, means for partially opening said holding portion when said head and holder have been moved to a predetermined position away from the dolly, to facilitate the entry of rivets into said holder, and means for opening said holding portion when the head and holder have been moved into desired proximity to the dolly to allow the rivet to pass out of the holder.

3. In a riveting machine, a frame, an upsetting dolly carried by the frame, a riveting head also carried by the frame and reciprocable toward and from the dolly and in a lateral path, said head also having an upsetting end portion, means for exerting pressure upon work interposed between the head and dolly during reciprocation of the former toward the latter, means for holding rivet blanks in desired position between the head and dolly and in alignment with the path of travel of the former, said holding means being reciprocable with the head in its movement toward the dolly to support such rivet blanks until forced into the work by the head, whereby an unheaded rivet blank which is longer than the thickness of work interposed between said head and dolly may be projected into a suitably disposed aperture in the work upon movement of the head toward the dolly, and continuation of such movement upsets the blank upon both sides of the work, and whereby the pressure exerting means prevents spreading of the blank between sections of laminated work, said holding means also being laterally movable with the head and means for partially opening said holding means to facilitate entry of a rivet therewith responsive to lateral movement of said head and holding means to a predetermined position.

4. In a machine of the character described, a frame, a slidably interfitted punch and anvil assembly, one movable to project more or less with respect to the other, a turret movable to align different portions thereof relatively to said assembly, working elements carried by the turret and different ones of which are alignable with the assembly when the head is in different positions, said working elements being slidable in the turret toward and from the punch and anvil assembly, means carried by the frame for moving the working elements toward said assembly, including a portion movable into engagement with the turret in a direction transverse to the direction of movement of the turret to lock the latter against movement when one of said working elements is being so moved toward the punch and anvil assembly, means for changing the effective distance with which one element of said punch and anvil assembly projects relatively to another, including a blocking element arranged behind said punch and anvil assembly to prevent movement of at least one of the elements thereof away from the turret, and means for moving said blocking element, whereby when the punch projects sufficiently it may be used for punching, and when sufficiently retracted the assembly may be used for upsetting.

5. In combination with apparatus as set forth in claim 1, a shiftable actuating member connected to and actuable by movement of the turret for changing the effective distance with which one element of said punch and anvil assembly projects relatively to another, when the turret is moved from one position to another.

6. In a combined punching and riveting ma-

chine, a fixed work-backing dolly member, a punch projectable from said dolly member, a riveting head element, a punching die head element, means for aligning either of said elements and the dolly member, means for reciprocating said elements toward and from said member, the punch and punching die head being adapted to interfit when one is so reciprocated relatively to the other, and means including a portion extending upon opposite sides of the punch and carried by and yieldably projecting beyond the dolly element farther than the operative position of the punch toward the aligned one of said members, yieldably projecting portion being movable back toward the dolly by advancement of either of said head elements, for exerting pressure upon work interposed between said element and member during both the punching and riveting operations.

7. In a combined punching and riveting machine, work-backing means carried by the frame including an upsetting dolly element and a punching element, said elements being interfitted and one reciprocable relatively to the other, a turret carried by the frame movable in a lateral path and spaced from the work-backing means, a punching head carried by the turret and reciprocable toward and from the work backing means, a riveting head carried by the turret and reciprocable toward and from the work backing means, means for moving the turret to align either of said heads with the work backing means, and means responsive to movement of the turret for moving one of said elements relatively to the other.

8. In a riveting machine, a frame, an upsetting dolly carried thereby, a turret laterally movable relatively to the dolly, a riveting head carried by the turret and longitudinally reciprocable therein toward and from the dolly, said head being also movable into and out of alignment with the dolly by moving the turret, rivet holding means carried by the turret and extending beneath and reciprocable with the head, said rivet holding means having a releasable portion, means for partially releasing said portion of the holding means when the turret is in one position, means for feeding rivets to said rivet holding means, when said portion is so partially released to enable free entry of rivets into the holding means, and means for still further releasing said holding means to permit passage of a rivet therefrom when the head is reciprocated into engagement with work interposed between the head and dolly.

9. In a machine of the character described, a supporting frame portion, a reciprocable riveting head carried by said frame portion, a substantially coaxial upsetting dolly toward and from which the head is reciprocable, means for feeding rivets and washers or the like to the space between the head and dolly when the former is retracted, and holding means arranged between the head and dolly but releasable and movable out of interfering interposition, said holding means having separate releasable holding means for receiving and simultaneously holding a rivet and a washer or the like supplied by said feeding means and maintaining such rivet and washer in substantial axial alignment with the dolly and head, with the rivet nearer the latter, whereby upon movement of the head toward the dolly the rivet is first forced into the washer, and both rivet and washer are then driven into engagement with work interposed between the head and dolly.

10. In a riveting machine, a frame, an upsetting dolly carried by the frame, a riveting head also carried by the frame and reciprocable toward and from the dolly, said head also having an upsetting end portion, yieldable presser means for exerting pressure upon work interposed between the dolly and head substantially in the line of movement of the latter, means for holding a rivet blank in desired position between the head and dolly and in alignment with the path of travel of the former, said holding means being reciprocable with the head in its movement toward the dolly and releasable to permit entry of a held blank into the work when driven thereinto by the head, means for partially opening said holding means to facilitate entry of a rivet blank thereinto when the head is in one position, auxiliary holding means for preventing unwanted movement of a rivet blank out of the holding means when the latter is so partially opened, means for feeding wire into the machine, and means timingly connected to the head for severing the wire into blanks longer than the thickness of work interposed between head and dolly, means for feeding such blanks to the holding means prior to completion of operative movement of the head toward the dolly, and means for freeing the holding means and rivet blank of said partial opening means and of said auxiliary holding means whereby movement of the head and holding means toward the dolly feeds the blank into suitably apertured work appropriately positioned relatively thereto, and continuation of such movement upsets the blank upon both sides of the work, and whereby pressure exerted by said presser member prevents undesired distortion of the blank between sections of laminated work.

11. In a machine of the character described, a frame, interfitted punching and upsetting elements carried by the frame and movable to project more or less one from another, a turret spaced from and laterally movable relatively to the assembly comprising said interfitted elements, punching and riveting heads carried by the turret and selectively alignable with such assembly by movement of the turret, said punching and riveting heads being reciprocable in the turret toward and from said assembly when aligned therewith, means for driving said heads including a portion adapted to enter the turret to lock the same against movement, and means connecting said turret and at least one of said elements to change the relative positioning of the latter in response to movement of the turret.

12. In a machine of the character described, a frame, interfitted punching and upsetting elements carried by the frame, one being movable to cause one to project more or less from the other, a turret carried by the frame and movable laterally of the assembly comprising such interfitted punching and upsetting elements, spaced punching and riveting heads carried by and reciprocable in the turret toward and from said assembly and alignable with said assembly by movement of the turret to different positions, each of said heads being mounted in an aperture extending completely through the turret, and means for driving said heads, comprising a plunger adapted to enter the turret and to be forced into engagement with a rear portion of whichever of said heads is aligned with said assembly, whereby to actuate said head and lock the turret against lateral movement.

13. In a machine of the character described, a

frame, interfitted punching and upsetting elements carried by the frame, one being movable to vary the projection of one beyond the other, a turret carried by the frame and movable laterally of the assembly comprising such interfitted punching and upsetting elements, spaced punching and riveting heads carried by and reciprocable in the turret toward and from said assembly and alignable with said assembly by movement of the turret to different positions, means tending to move the turret from one position to another, means for driving said heads including a portion adapted to block movement of the turret during driving of a head, and additional latching means for holding the turret against undesired movement and releasable by actuation of said driving means whereby the turret is freed for movement under the influence of said means tending to move it upon withdrawal of said blocking portion after actuation thereof but may be held against undesired movement before actuation of the driving means.

14. In a combined punching and riveting machine, a frame, working means carried thereby operable on a substantially fixed axis, including a punch and dolly assembly, a turret carried by the frame and spaced from and movable laterally to align different portions thereof with said working means, work-forming means comprising spaced punching and riveting heads carried by the turret and alignable with and reciprocable toward and from said punch and dolly assembly, and means for reciprocating said heads toward and from said assembly and aligning the same therewith, including a plunger slidable in the frame and into and out of the turret, and yieldable means urging work away from said assembly and toward whichever of said heads may be aligned therewith for exerting pressure upon work interposed therebetween during movement of the heads toward the assembly.

15. In a riveting machine, a frame, an upsetting dolly carried by the frame, a riveting head also carried by the frame and reciprocable toward and from the dolly, said head also having an upsetting end portion, yieldable presser means for exerting pressure upon work interposed between the dolly and head substantially in the line of movement of the latter, means for holding rivet blanks in desired position between the head and dolly and in alignment with the path of travel of the former, said holding means being reciprocable with the head in its movement toward the dolly and releasable to permit entry of a held blank into the work when driven thereinto by the head, means for partially opening said holding means to facilitate entry of a rivet blank thereinto when the head is in one position, auxiliary holding means for preventing unwanted movement of a rivet blank out of the holding means when the latter is so opened, and means for freeing the holding means and rivet blank of said partial opening means and of said auxiliary holding means whereby an unheaded rivet blank which is longer than the thickness of work interposed between said head and dolly may be projected into a suitably disposed aperture in the work upon movement of the head toward the dolly, and continuation of such movement upsets the blank upon opposite sides of the work, and whereby pressure exerted by said presser means prevents undesired distortion of the blank between sections of laminated work.

16. In a riveting machine or the like, a supporting frame portion, a reciprocable riveting

head carried by said frame portion, an upsetting dolly arranged to cooperate with the head, and feeding and temporary holding means comprising separate feeding tracks for rivets and for washers or the like, said tracks terminating between the head and dolly, and holding means also arranged between the head and dolly and reciprocable with the former and having separate releasable holding means for holding a rivet and washer in substantial axial alignment with and between said head and dolly.

17. In a machine of the character described, a frame, interfitted punching and upsetting elements carried by the frame and movable to project more or less one from another, a turret spaced from and laterally movable relatively to the assembly comprising said interfitted elements, punching and riveting heads carried by the turret and selectively alignable with such assembly by movement of the turret, said punching and riveting heads being reciprocable in the turret toward and from said assembly when aligned therewith, and means for driving said heads including a portion adapted to enter the turret to lock the same against movement.

18. In a combined punching and riveting machine, a frame, a work backing and treating portion carried by the frame, a turret spaced from and laterally movable relatively to said work backing portion, working heads carried by the turret and alignable with the work backing portion by movement of the turret to different positions and reciprocable in the turret toward and from such portion when aligned therewith, and means for driving said working heads including a plunger carried by the frame and movable into the turret and into connection with whichever of said heads is aligned with the work backing and treating portion to drive such head and positively locate the turret against lateral displacement.

19. In a combined punching and riveting machine, a frame, work backing and treating means comprising interfitted and relatively reciprocable punch and dolly members carried by the frame, means including a cam for moving one of said members relatively to the other, a turret, riveting and punching heads carried by the turret and movable toward and from the punch and dolly members, means for moving the turret to align either of said heads with the punch and dolly members, and means connecting the turret and cam for controlling the relative positioning of the punch and dolly members in response to the position of the turret.

20. In a machine of the character described a frame, a work-backing portion carried thereby, a head also carried by the frame spaced from and laterally movable with respect to the work backing portion to bring different parts of said head in alignment with said portion, working elements carried by and movable with said head and alignable with the work-backing portion when the head is moved to different positions, and driving means for said working elements including a plunger element carried by the frame and movable into and out of engagement with the head in a direction transverse to that in which the head is movable and connectible and disconnectible with the aligned one of said working elements when so moved, to drive such element, said plunger thereby locating the head against undesired lateral movement during driving of said element, and releasing the head to permit such movement when released therefrom.

21. In a machine of the character described, a frame, a work-backing portion, interfitted anvil and punch members carried by the work-backing portion and one movable relatively to the other
 5 to cause one to project more or less from the other toward a head carried by the frame and laterally movable to align different parts thereof with the punch, working elements carried by the head and movable to and from alignment with
 10 the punch by movement of the head, said working elements also being movable toward and from the punch, driving means carried by the frame for moving the working elements toward and from the punch, including a portion movable
 15 into and out of engagement with the head to position the same against movement upon actuation of said driving means and free the head to permit lateral movement thereof upon release of said driving means, and means responsive to
 20 movement of the head to different positions for moving the punch to change its position with respect to the anvil.

22. In a machine of the character described, an anvil portion, a head movable laterally to different positions relatively to the anvil portion, punching and riveting elements reciprocable in the head toward and from the anvil portion and alignable therewith by lateral movement of the head, operating means for said punching and
 30 riveting elements, uni-directional driving means for moving the head laterally from one position to another, restraining means for preventing actuation of the head responsively to said last mentioned means, means responsive to operation of
 35 said operating means for releasing said restraining means to permit movement of the head, and personally operable cocking means for returning the head.

23. In combination with apparatus as set forth in claim 1, a shiftable backing cam member actuable with movement of the turret to move one element of said punch and anvil assembly to and hold the same in different predetermined positions with respect to the other.

45 24. In combination with apparatus as set forth in claim 1, a shiftable backing cam member actuable with movement of the turret to move one element of said punch and anvil assembly to and hold the same in different predetermined positions with respect to the other, at least one of
 50 said elements of the punch and anvil assembly being longitudinally slidable toward and from the turret and working elements, and the backing cam member being transversely movable behind the slidable element and having portions of different effective thickness engageable therewith.

25. In a combined punching and riveting machine, a work-backing dolly element, a riveting

head element, a punching head element, means for aligning either of said two last mentioned elements and dolly element, means for reciprocating said head element and dolly element one
 5 toward another, one being relatively fixed and another movable toward and from the same during the punching and riveting operations, and means including a portion yieldably projecting from the relatively fixed element toward the
 10 movable element, said yieldably projecting portion being movable with the latter during advancement of such element toward the relatively fixed element, to engage work interposed between said relatively movable elements and hold the
 15 same against the advancing movable element.

26. A punching and riveting machine construction as set for in claim 25 in which the head elements are movable toward and from the dolly element and comprise a punching die and a riveting die, and the dolly includes a body and a
 20 punch extensible beyond the body over which the advancing punching die may telescope, the portion yieldably projectable toward the head elements being carried by the dolly surrounding the punch and projectable therefrom farther than
 25 the operative position of the punch.

27. A punching and riveting machine construction as set forth in claim 25 in which the head elements are movable toward and from the dolly element and comprise a punching die and a riveting die, and the dolly includes a body and a
 30 punch extensible beyond the body over which the advancing punching die may telescope, the portion yieldably projectable toward the head elements being carried by the dolly and projectable therefrom farther than the operative position of
 35 the punch, and having parts lying on either side of the punch, the punch being freely movable to extend farther than the yieldable element.

28. In a riveting machine including a frame, an anvil portion, a head movable in the frame laterally with respect to the anvil portion, punching and riveting elements reciprocable in the head toward and from the anvil portion and alignable therewith by lateral movement of the
 45 head, operating means for so reciprocating said last mentioned punching and riveting elements, locking portions actuable with the operating means to lock the head against lateral movement during reciprocation of the punching and riveting
 50 elements, one-directional driving means for moving the head laterally from one position to another, personally operable cocking means for returning the head after movement thereof by said one-directional driving means, and latching
 55 means engageable with the head for holding the same against movement, said latching means being releasable by reciprocation of one of said elements.

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