April 6, 1948. E. F. TUTTLE 2,439,323

RIVETING MACHINE

Filed Feb. 1, 1943 2 Sheets-Sheet 1

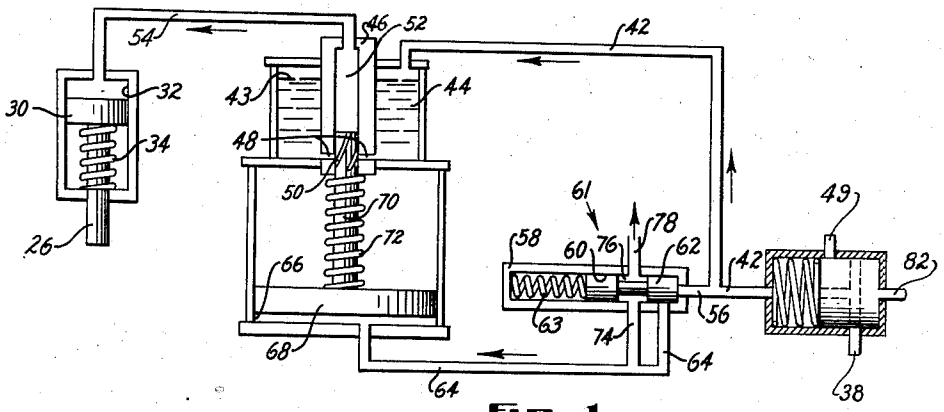


Fig. 1

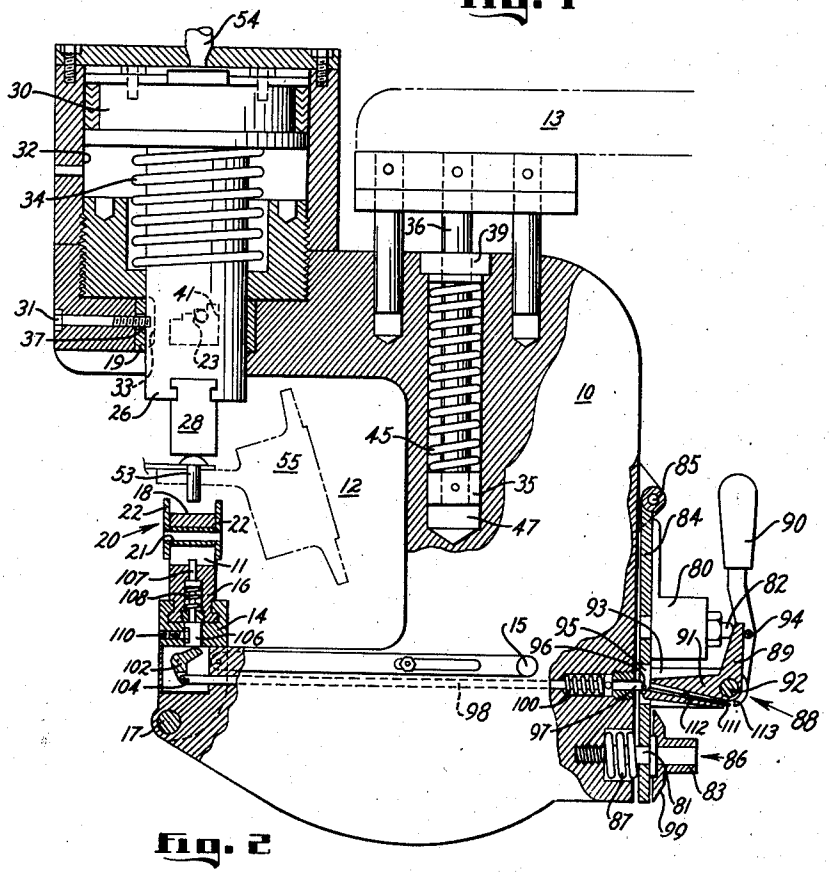


Fig. 2

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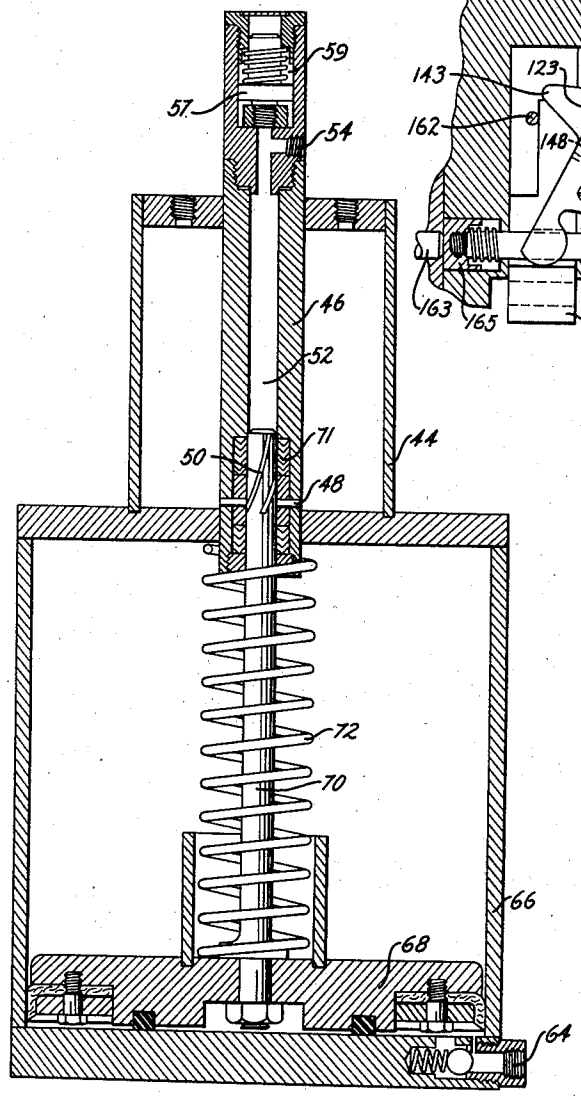


Fig. 3

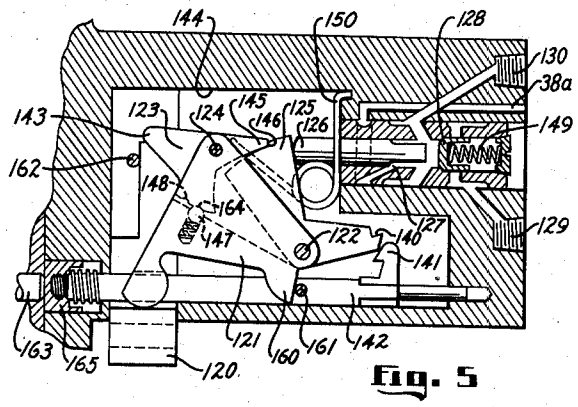


Fig. 5

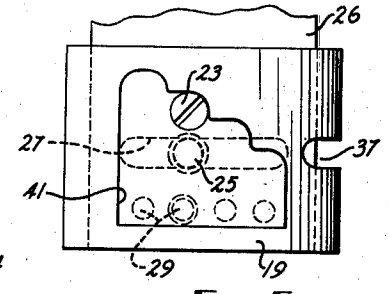


Fig. 6

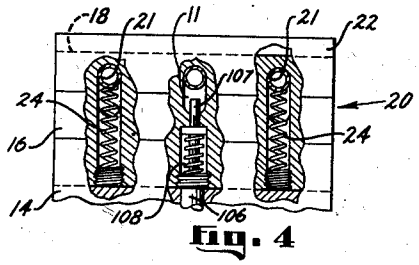


Fig. 4

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RIVETING MACHINE

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Application February 1, 1943, Serial No. 474,405

9 Claims. (Cl. 78—48)

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This invention relates to a riveting machine and particularly to a stationary hydraulically operated riveting machine.

It is an object of the invention to provide a riveting machine in which by one act of the operator and in automatic sequence an initial light setting pressure is applied to bring the dies into contact with the rivet head and shank, followed by a very heavy pressure adequate to upset the shank of the rivet, and in which this sequence is effected by a simple inexpensive and reliable mechanism.

Thickness of the bucked head is the best determinant for the regulation of the riveting action. If the bucked head is too thick, it is of correspondingly smaller diameter and may be pulled into the bore of the riveted article. If the bucked head is too thin, the peripheral overlying flange portion of the head will break off or bend, permitting the rivet to become loose or disengaged from the riveted bodies.

Furthermore, if several rivets are to be upset at one operative cycle of the machine, obviously, thickness of the bucked heads, rather than attainment of a given degree of pressure, determines the duration of the period of effective pressure application. Otherwise the set of the machine must be changed whenever the number of rivets per pressure application is changed and care must be exercised that the work be placed for engagement of the same number of rivets at each operation.

Multiple riveting is therefore not practicable unless the riveting operation is regulated by thickness of the squash. Multiple riveting saves time and obviates the "clinching" or lateral displacement of the bucked head which occurs when a single rivet is bucked at an angle other than a right angle.

It is therefore another object of the invention to provide a riveting machine which will upset the rivets with a predetermined thickness of the upset material or "squash" overlying the riveted article, irrespective of the length of the shank projecting beyond the face of the adjacent riveted article prior to the riveting operation, and irrespective of any variations in the riveting pressure applied to different rivets by the machine.

It is still another object of the invention to provide in a riveting machine an automatic mechanism for accomplishing the last recited object which is simply constructed, dependable and accurate in operation and may be readily adjusted to vary the thickness of squash.

It is still another object of the invention to provide manual and remote controls of a pressure cycle correlated to the thickness of the squash, which are convenient to operate, require little attention by the operator, and which provide for emergency termination of the pressure cycle.

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It is also an object of the invention to provide one such control for a riveting machine, which will, as a result of one movement of a control member, set up and complete the operative cycle and also by a movement of the same control member terminate a partially completed operative cycle to meet an emergency situation, the control after either control movement being reset for the next operative cycle.

Other objects and advantages of the invention will appear upon an understanding thereof gained from this description, the accompanying drawings and the appended claims.

In the drawings which are for illustrative purposes only,

Figure 1 is a schematic view showing the pressure fluid circuits of a machine embodying the invention.

Figure 2 is a side elevation partly in section of the work handling portion of a machine embodying the invention.

Figure 3 is a vertical sectional view of the pressure booster.

Figure 4 is an enlarged elevational view of the pressure pad and associated parts.

Figure 5 is a diagrammatic view of an alternative system for the control of the riveting heads of the machine.

Figure 6 is an elevational view of the sleeve for regulating the length of stroke of the ram.

In Figure 2 of the drawing a C frame 10 provides a work receiving throat 12 and mounts below the throat a riveting buck holder 14 pivoted to the frame at 17 to swing outwardly from the throat 12. The holder 14 carries an anvil or riveting buck 16, having an upper anvil face 18 and being vertically slotted at 11 to accommodate the tie pins 21 which connect the side plates 22 of a pressure pad 20 which engages the under surface of the lower one of two or more sheets of metal or other articles to be riveted together. As seen in Figure 4, a plurality of stiff springs 24 seated in bores in the buck 16 and bearing upwardly against the tie pins 21, urge the pressure pad toward the upper limit position shown in Figure 2, in which the tie pins 21 bear against the upper ends of the slots 11 in the buck 16. The buck holder 14 is releasably held in operative position by a manually operable slide 15 pivotally connected at one end to the buck holder 14 and fixed to the C frame for limited longitudinal

movement through the groove formed therein and the lock pull operating therein. It will be seen that movement of the slide 15 to the left, as viewed in Figure 2, will pivotally move the buck holder and the elements associated therewith from beneath the ram, while return movement of the slide will pivotally move the buck holder and its elements back into the operative position shown in Figure 2.

A ram 26 is vertically slidably mounted on the frame 10 above the buck 16, carrying at its lower end a rivet set 28 which is movable downward between the plates 22 toward the anvil face 18. The ram 26 is forced downwardly by a hydraulic piston 30 within a hydraulic cylinder 32 carried by the frame 10. A spring 34 retractively lifts the ram 26, when the hydraulic pressure in the cylinder 32 is released.

The C frame 10 is suspended from a carriage 13 which travels horizontally in a direction perpendicular to the section plane of Figure 2. A heavy spring 45, disposed under compression between a ring 39 fixedly seated in the upper end of a bore 47 in the C frame, and a collar 35 on the lower end of a rod 36 dependently secured to the carriage, in effect counterbalances the weight of the C frame and does not hinder an upward movement of the C frame when acted upon by an upwardly directed force.

As best seen in Figure 6, an insert sleeve 19 formed with a stepped aperture 41 cooperates with a radial pin 23 on the ram 26 to variably limit the length of stroke of the ram to correspond with work articles of different thicknesses. The work stroke of the ram should be just long enough for any given job to permit ready and convenient insertion of the work articles between the rivet set and buck. Greater length involves loss of time for both machine and operator and consequently an increase in the cost of operation.

Rotation of sleeve 19 to bring the pin 23 in vertical alinement with a selected stepped shoulder of the aperture 41 is accomplished by a lever 25 on the sleeve 19 moving in a splot 27 in the frame 10. Detent devices 29 yieldably retain the sleeve 19 in any desired one of its positions of adjustment. A bolt 31 passing through a horizontal slot 37 in the sleeve 19 engages a vertical slot 33 in the ram 26 to prevent relative rotational movement of the ram and frame 10.

The fluid pressure circuits for the operation of the piston 30 are shown schematically in Figure 1. A three way valve 40 connects either conduit 49 leading from a source of pneumatic pressure or exhaust conduit 38, with a conduit 42. Conduit 42 connects with an inlet opening at the top of a pressure reservoir 44 filled with oil or other suitable hydraulic pressure medium to a level 43 near the top of the reservoir. The chamber 52 of a secondary pressure booster cylinder 46 within the reservoir communicates with the reservoir chamber 44 through ports 48 in the wall of the cylinder 46.

When valve 40 is moved to the pressure position in which conduit 49 is in communication with conduit 42 air flows as indicated by the arrows into conduit 42 and the reservoir 44 from which oil is thereby forced through ports 48 into chamber 52 and thence by a conduit 54 to the chamber of the cylinder 32 causing the piston 30 and ram 26 to move downward. Referring to Figure 2, the side plates 22 of the pressure pad 20 engage the under surface of the lower of two work articles 55 which are to be riveted together, bringing the work articles into close pressural contact. Thereafter rivet set 28 engages the manufactured head of a rivet or rivets 53 placed in rivet holes in the two work articles 55. As soon as this latter engagement is effected the air pressure in the circuit rises. When it reaches a predetermined pressure, as for example 50 pounds, a piston 62 of a piston valve 61 in a bore 60 in a valve casing 58 moves the piston valve to the left against the action of a retrieving spring 63 in response to air pressure acting upon the right end face of the piston 62 through the branch conduit 56. The valve piston 62 uncovers the end of a conduit 64 through which air then flows to the chamber of a primary booster air cylinder 66 in which a piston 68 reciprocates, a cross connection 74 leading from conduit 64 through valve casing 58 to an exhaust conduit 78 being closed at this time by piston 62.

A plunger 70 is pushed upwardly against the retrieving action of a spring 72 by the piston 68 into the chamber 52 of the secondary booster cylinder 46, cutting off the inlet ports 48. The plunger is formed with spiraled grooves 50 through which oil flows from ports 48 into cylinder chamber 52 when the plunger is in its lowermost position.

When ports 48 are cut off, a very high pressure, as for example 5700 p. s. i., will be generated in chamber 52 by reason of the now higher pneumatic pressure in conduits 42, 56 and 64 and the pressure-multiplying effect of the relative areas of piston 68 and plunger 70. The high pressure thus brought to bear on piston 30 squashes the shank end of rivet 53 to form a squashed head, fastening together the articles 55. The work articles 55 may, especially when large and heavy, be held horizontally stationary, as by a jig. In such a case, as soon as the rivet set 28 contacts the manufactured head of the rivet 53 and applies pressure thereto, the rivet set 28 and ram 26 are held against further downward movement. The C frame 10 and buck 16 are then moved upwardly by hydraulic action during the rivet squashing action.

As shown in Figure 3, the plunger 70 when in its lowermost position extends upwardly from the level of the ports 48 sufficiently to have its upper end above the uppermost chevron of the packing 71. This arrangement protects the chevrons from destructive action by the annular edge of the plunger at the upper end of the flanges. The spiral character of the grooves 50 minimizes cutting action on the packing chevrons by the edges of the grooves 50.

A buffer chamber 59 having a downwardly spring pressed piston 57 moderates the pressure in chamber 52 during the initial stages of the upward movement of the plunger 70 to protect the chevrons from the damaging effect of the application of the otherwise excessive pressure to the chevrons through the spiral grooves 50.

Reverting to Figure 1, when the valve 40 is turned, in a manner to be presently explained, to the release position shown in Figure 1, connecting conduit 42 with the exhaust conduit 38, piston 62 is moved to the right by the force of spring 63 acting against the exhaust pressure in 56, the piston 62 shutting off conduit 64 from conduit 56 and the annular port 76 connecting conduit 74 with exhaust conduit 78. Piston 68 is now returned to its lowermost position by the spring 72 and downward movement of the plunger 70 opens ports 48 permitting the spring 34 to retract the ram 26.

Valve 40, shown schematically in Figure 1, is

housed in a valve structure 80 which is mounted on a plate 84 hinged at 85 to the frame 10 as shown in Figure 2. The plate 84 is adjustably spaced from the frame 10 by an adjusting device 86 comprising, a threaded shank 81 engaging a threaded bore in the frame 10, a knob 83 for rotating the shank and a spring 87 for holding the plate 84 against the knob. Manual rotation of the knob 83 varies the spacing of plate 84 from frame 10.

The valve 40 is conveniently represented schematically in Figure 1, and comprises a slidable valve element connected to reciprocate with the plunger pin 82 shown in Figures 1 and 2 of the drawings. The valve is spring loaded to take the release position shown in schematic Figure 1. The pin 82 is shown in Figure 2 in the pressure position in which conduit 42 is connected with conduit 43 leading from the source of pneumatic pressure. When in the release position the pin 82 projects substantially further to the right than it does when in the position shown in Figure 2.

The pin 82 is pressed inwardly against the spring loaded valve by an arm 89 of a bell crank lever 88 which is pivoted to a shaft 92 carried by a bracket 93 extending outwardly from the plate 84. The lever arm 89 is pushed inwardly against the pin 82 by a pin 94 on a manual lever 90 which is also pivoted upon the shaft 92.

The other arm 91 of the bell crank lever 88 extends into a slotted opening 95 in the plate 84 to present a catch face 96 to engage from beneath the tip end 97 of a latch rod 98 one end of which extends into the slotted opening 95 from the opposite direction. The latch rod 98 is slidably mounted in the frame 10 and loaded by the spring 100 to assume the extreme position shown in Figure 2 of the drawing as determined by contact of the upper arm of a bell crank lever 102 with the lower end of a plunger 106 having a longitudinally extending groove formed therein for receiving the one end of a stop screw 110. The lower arm of the lever 102 pivoted at 104 to the other end of the latch rod 98. The stop screw 110 limits travel of the plunger 106 and prevents its accidental removal from the die holder 14. A pin 107 slides in a bore in the buck 16 in axial alignment with the plunger 106, and is held by a spring 108 to an uppermost position in which it projects into the central slot 11.

The plunger 106 may be depressed by downward movement of that one of the tie bars 21 of the pressure pad 20, which contacts the upper end of the pin 107, causing it to engage and move downwardly the plunger 106. When the pressure pad 20 is depressed a predetermined distance under the pressure of the rivet set 28 transmitted to the pressure pad through the work articles 55 and resisted by the springs 24 as shown in Figure 4, the plunger 106 withdraws the latch rod 98 just far enough to clear the catch face 96, permitting clockwise movement of the lever 88 and allowing the spring loaded valve 40 to assume the release position. At this position of the pressure pad 20, the vertical spacing between the upper edges of the flanges 22 and the bucking face 18 is the thickness of the squashed rivet heads.

A dial 99 on the periphery of the knob 83 and scaled to indicate variations in the position of the pressure plates 22 relative to the bucking plate surface 18 in thousandths of an inch indicates to the operator the correct position of the knob for any desired thickness of squash.

In operation, the handle 90 is pushed to the left to place valve 40 in pressure position, and

latch it in that position. It remains in pressure position until the rivet head or heads have reached the desired thickness, at which juncture the latch rod 98 automatically trips the bell crank lever 88, allowing the spring loaded valve 40 to move to the release position.

A small rod 111 is longitudinally movable in a passageway 112 in the arm 91, one end of the rod 111 lying close to the end 97 of the latch rod 98 and the other end of the rod 111 lying close to a shoulder 113 on the handle 90. To stop the riveting operation after its initiation, and before the end thereof, as in case of emergency, the operator pulls to the right on handle 90, causing rod 111 to push latch rod 98 to the left against the action of spring 100 and releasing bell crank lever 88 which in turn allows valve 40 to assume the release position. The handle 90 after it has been pushed to the left is held against a rightward gravity movement with respect to the latched bell crank lever 88 by engagement of the shoulder 113 with the adjacent end of rod 111.

Whether valve 40 is released automatically or manually, the device is properly set thereafter for the initiation of the next riveting operational sequence.

In the control described above, a lever is manually thrown in one direction from an inoperative position to a latched operative position. The hand is removed from the lever and the operational sequence is automatically performed without further act by the operator. At the end of the operation the manual lever is automatically returned to the initial inoperative position. For emergency control the sequence may be interrupted and terminated by throwing the lever in the opposite direction from that of its initial movement.

Figure 5 shows another control in which the operator pushes a spring retrieved lever to a position and holds it there until the operative sequence is automatically completed, whereupon he allows the retrieving spring to return the lever to its initial position ready for the next riveting operation. In case of emergency he takes the manual pressure from the lever, allowing it to return to its initial position before the completion of the cycle. In that case the rivet set is elevated before the completion of the application of the squashing pressure and the lever is left in position for the next riveting operation.

This control is carried out by the mechanism shown in Figure 5. A button 120, when pushed upward, causes lever 121 to rotate about its pivotal support at 122 and by means of latch 123 pivoted to the lever 121 at 124 to push lever 125 also pivotally mounted at 122 against the valve pin 126. Rightward movement of the valve pin 126 closes an exhaust port 127 leading to a conduit 38a corresponding to the conduit 38 of Figure 1, and opens valve 128 permitting air to flow from inlet 129 to outlet 130 through passages as shown and thus initiating the operational sequence of the pneumatic-hydraulic circuit described in connection with Figures 1 and 3.

The lever 125 is held in the open valve position by a catch 140 which latches under a latch 141 secured upon a trip rod 142. To effect a full operative cycle, the button 120 is pushed through an overtravel after lever 125 has moved valve pin 126, the lug 143 on latch 123 striking a stationary surface 144 and rocking the latch 123 anticlockwise to disengage the latch trigger 145 from the shoulder 146 on the lever 125, which is now held in the open valve position by the

latch 141. The latch 123 is held in its newly assumed position in which it will not engage the lever 125, by a spring pressed detent ball 147 mounted on lever 121 which seats in a left hand notch 148 in the latch 123. When the pressure pad release device 163 pushes rod 142 to the right, releasing lever 125, this lever is free to turn anti-clockwise, allowing valve 128 and valve pin 126 to be moved to the left by valve spring 149, shutting off air pressure from the pneumatic-hydraulic circuit and opening the exhaust port 127. The juncture at which the release device 163 trips the lever 126 is adjustable by rotation of the adjusting nut 165.

Should it be desired to stop the rivet squeezer at any time before completion of the upsetting stroke, the button 120 is released, permitting spring 150 to turn lever 121 anti-clockwise through an arc and depress button 120 to its initial position. As lever 121 thus moves, a projection 160 thereon strikes a pin 161 on rod 142, causing rod 142 to move rightwardly and disengaging latch 141 from catch 140, thus permitting valve 128 and valve pin 126 to remove pressure from the pneumatic-hydraulic system. At the same time lug 143 strikes stationary pin 162 turning the latch 123 in a clockwise direction to the position in which the trigger 145 is again ready to engage shoulder 146 and holding it in that position by the engagement of detent ball 147 with right hand notch 164.

One preferred embodiment of the invention is the machine shown and described herein. The invention may be embodied in other machines and is therefore not to be limited to a particular machine but is to be given the definition of the following claims.

I claim:

1. In a riveting machine, the combination of: a frame; a hydraulically actuated ram on the frame for pressing downwardly upon a rivet head; a stationary bucking plate carried by the frame below the ram for upsetting the shank of a rivet; a vertically movable under support for the work articles to be riveted, said support being spring held on said frame to an upper limit position; a control valve for the downward actuation of said ram loaded to take the non-actuating position; a latching device for holding the valve in the actuating position; and means operable upon a downward movement of said support for a predetermined distance for releasing said latching device.

2. The combination defined in claim 1 in which said latching device comprises a movable arm separably contacting the said valve, a detent for engaging said arm to hold it in a position in which it holds said valve in open position, and a means for disengaging said detent operable upon a downward movement of said support for a predetermined distance.

3. The combination defined in claim 1 in which said latching device comprises a movable arm separably contacting the said valve, a detent for engaging said arm to hold it in a position in which it holds said valve in open position, and a means for disengaging said detent operable upon a downward movement of said support for a predetermined distance, and in addition thereto a manual lever separably contacting said arm for moving said arm to detent engaged position.

4. The combination defined in claim 1 in which said latching device comprises a movable arm separably contacting the said valve, a detent for engaging said arm to hold it in a position in which it holds said valve in open position, and a means for disengaging said detent operable upon a downward movement of said support for a predetermined distance, and in addition thereto a manual lever separably contacting said arm for moving said arm to detent engaged position, said lever and movable arm being coaxially pivotally mounted on the frame; and means operable by a movement of said lever away from said arm for disengaging said detent.

5. The combination defined in claim 1 and in addition thereto: a manual lever for moving said valve to the open position when said lever is moved in one direction.

6. The combination defined in claim 1 and in addition thereto: a manual lever for moving said valve to the open position when said lever is moved in one direction and means operable upon movement of said lever in the opposite direction for releasing said latching means.

7. In a riveting machine, the combination of: axially relatively movable members for engaging the shank and head respectively of a rivet set in position in work articles for upsetting the rivet shank; hydraulically operated means for applying pressure to said members to upset the rivet shank; a work article engaging member axially movable relative to said shank engaging member and loaded to move relative to said shank engaging member in a direction toward the rivet head engaging member; a control valve structure for actuating said hydraulically operated means to apply said pressure, said structure having a valve loaded to take the non-actuating position and being secured at an adjustably spaced relation from a frame part of said machine, and provided with a movable valve operating member; a lever for moving said valve operating member to open said valve, and a latching means for said lever comprising a catch and a latch, one of which is mounted on said valve structure and the other of which is mounted on said frame, the frame mounted one of which being releasingly actuated in correlation with movement of said article engaging member relative to said shank engaging member in a direction away from said rivet head engaging member, and the juncture of the release of said latch and catch member being dependent upon the said spacing of said valve structure and frame.

8. In a riveting machine, the combination of: axially relatively movable members for engaging the shank and head respectively of a rivet set in position in work articles for upsetting the rivet shank; means for applying pressure to said members to upset the rivet shank; a work article engaging member axially movable relative to said shank engaging member and loaded to move relative to said shank engaging member in a direction toward the rivet head engaging member; a control device for energizing said pressure applying means in a first position and de-energizing said pressure applying means in a second position; means loading said control device in the second position; a member movable between a first and second position and separably engaging said control device for moving said control device to the first position thereof against the action of said loading means when said member moves to the second position thereof; a latch for holding said movable member in its first position and releasable in response to a movement of a predetermined extent of said article engaging member relative to said shank-engaging member in a direction away from said rivet-head engaging mem-

ber; and a control lever arranged by a given movement in one direction to move said movable member from released to latched position when said member is in released position and by substantially the same movement in the same direction to unlatch said member when it is in latched position.

9. In a riveting machine, the combination of: axially relatively movable members for engaging the shank and head respectively of a rivet set in position in work articles for upsetting the rivet shank; means for applying pressure to said members to upset the rivet shank; a work article engaging member axially movable relative to said shank engaging member and loaded to move relative to said shank engaging member in a direction toward the rivet head engaging member; a control device for energizing said pressure applying means in a first position and de-energizing said pressure applying means in a second position; means loading said control device in the second position; a member movable between a first and second position and separably engaging said control device for moving said control device to the first position thereof against the action of said loading means when said member moves to the second position thereof; a latch for holding said movable member in its first position and releasable in response to a movement of a predetermined extent of said article engaging member relative to said shank-engaging member in a direction away from said rivet-head engaging member; and a control lever arranged by a given movement to move said movable member from released to latched position when said member is in released position and by a like retrograde movement to unlatch said member when it is in latched position.

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