Sept. 30, 1941. A. T. LUNDGREN ET AL 2,257,267

PERCUSSIVE TOOL

Filed May 6, 1938 3 Sheets-Sheet 1

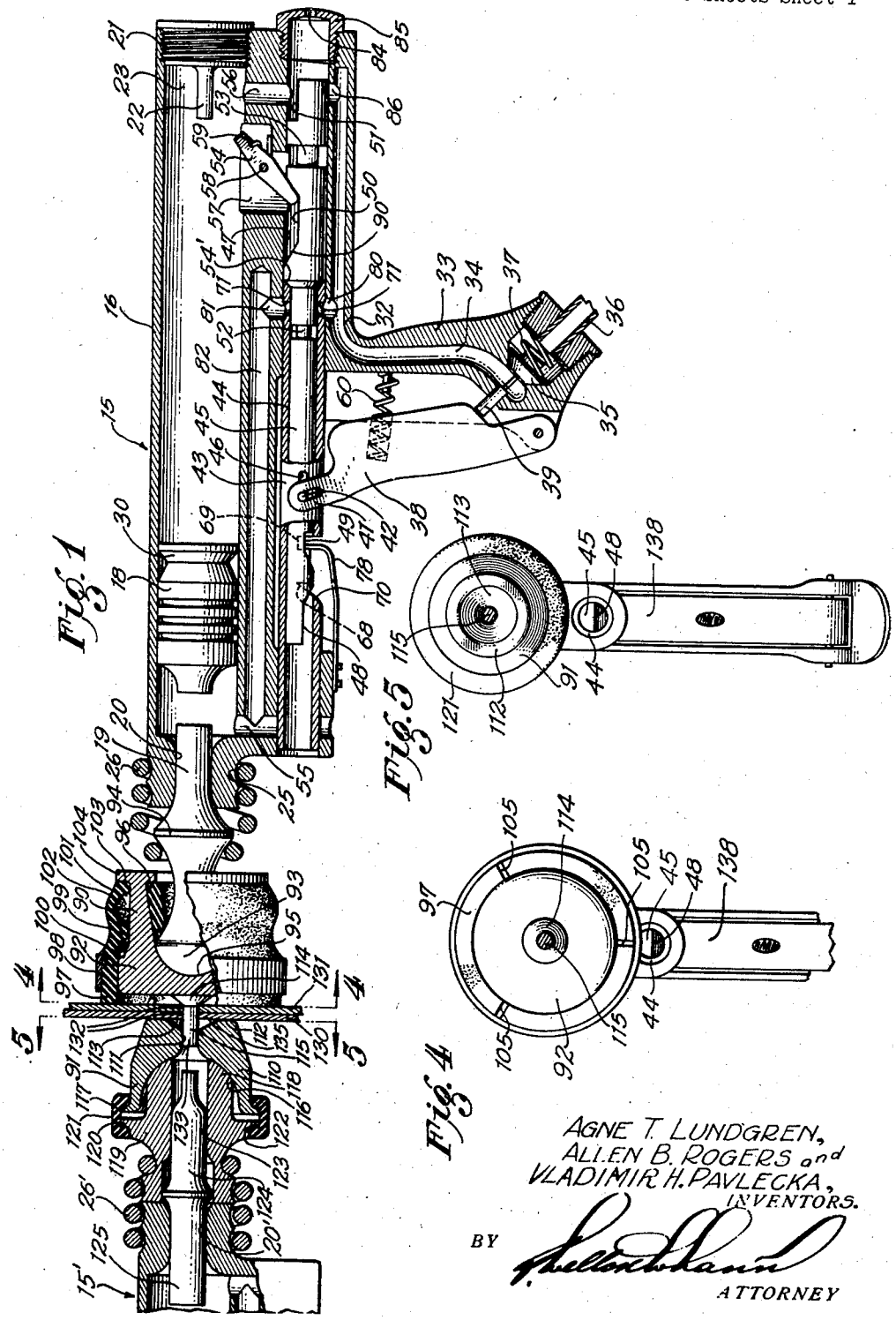


Fig. 1

Fig. 5

Fig. 4

AGNE T. LUNDGREN,
ALLEN B. ROGERS and
VLADIMIR H. PAVLECKA,
INVENTORS.

BY

ATTORNEY

Sept. 30, 1941. A. T. LUNDGREN ET AL 2,257,267

PERCUSSIVE TOOL

Filed May 6, 1938 3 Sheets-Sheet 2

Fig. 2

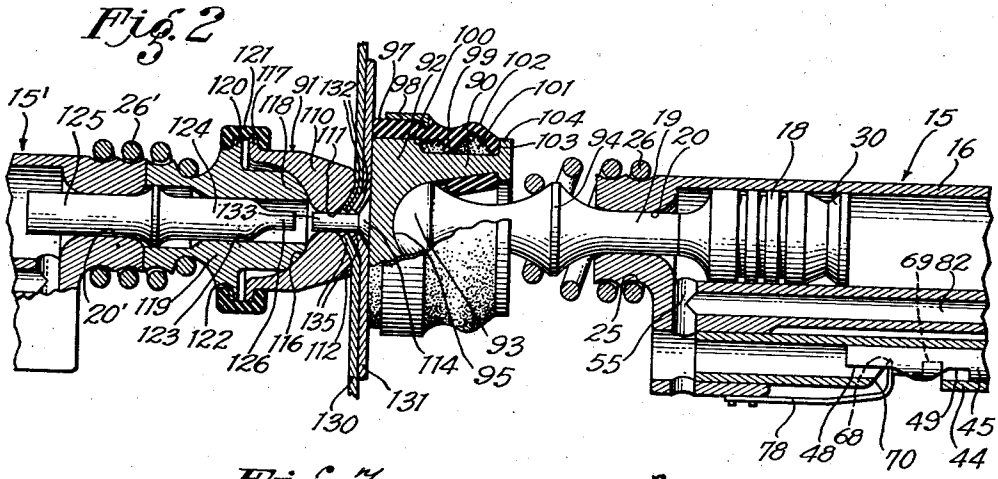


Fig. 3

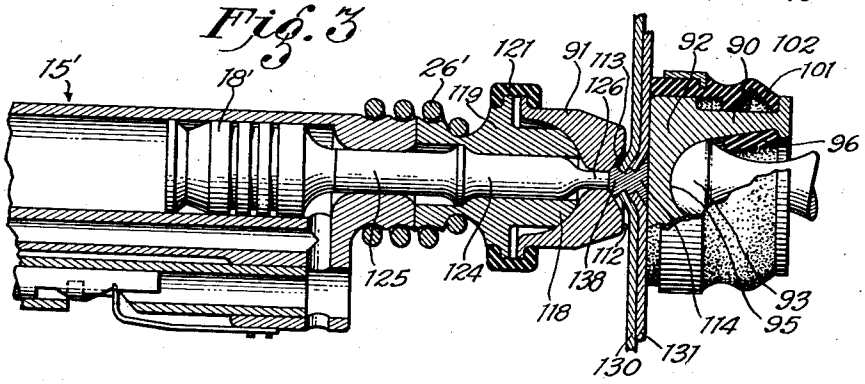
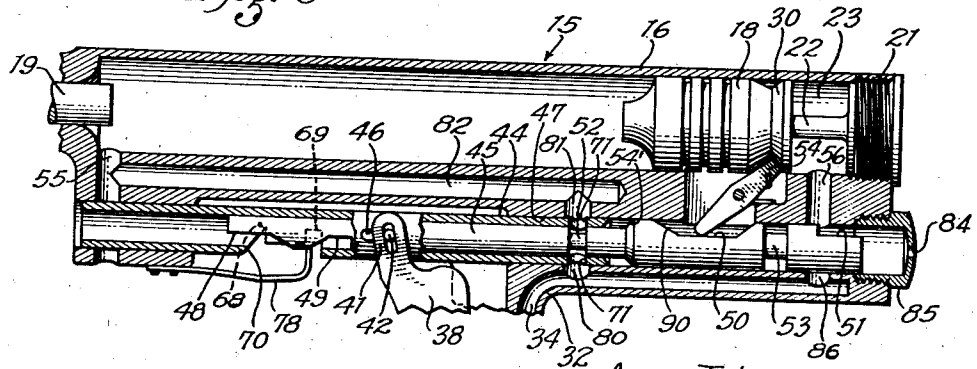


Fig. 6



AGNE T. LUNDGREN,
ALLEN B. ROGERS and
VLADIMIR H. PAVLECKA,
INVENTORS.

BY

ATTORNEY

Sept. 30, 1941. A. T. LUNDGREN ET AL 2,257,267

PERCUSSIVE TOOL

Filed May 6, 1938 3 Sheets-Sheet 3

Fig. 7

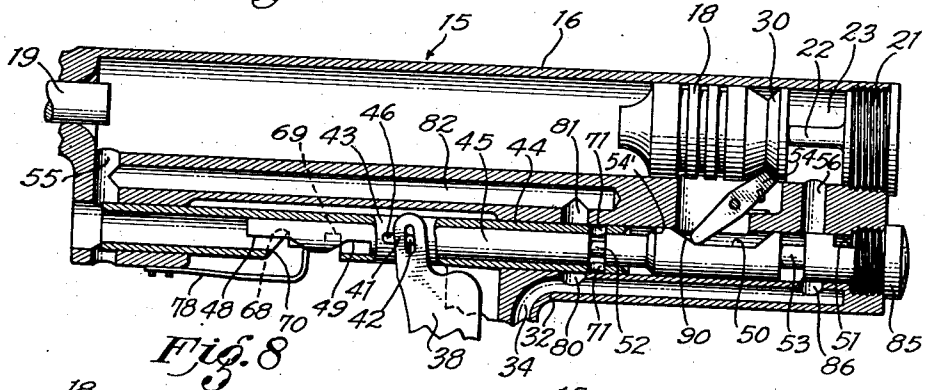


Fig. 8

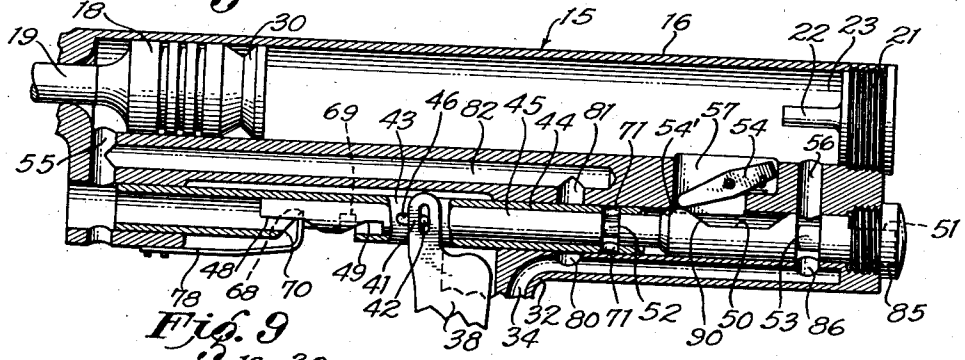
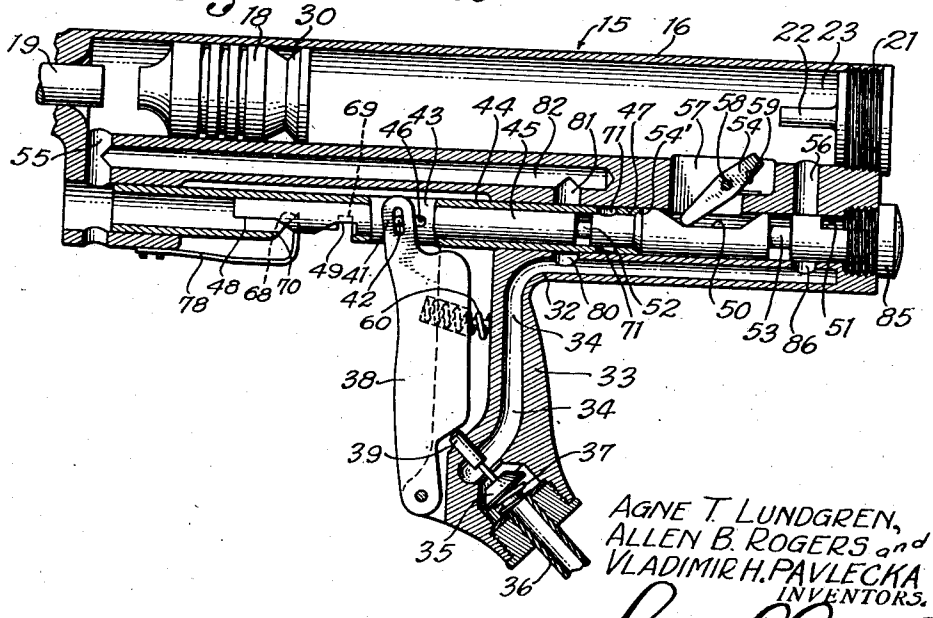


Fig. 9



AGNE T. LUNDGREN,
ALLEN B. ROGERS and
VLADIMIR H. PAVLECKA
INVENTORS.

BY

ATTORNEY

Patented Sept. 30, 1941

2,257,267

UNITED STATES PATENT OFFICE

2,257,267

PERCUSSIVE TOOL

Agne T. Lundgren, Trollhattan, Alvsborgs Lan, Sweden, and Allan B. Rogers and Vladimir H. Pavlecka, Santa Monica, Calif., assignors to Douglas Aircraft Company, Inc., Santa Monica, Calif., a corporation of Delaware

Application May 6, 1938, Serial No. 206,364

11 Claims. (Cl. 121—21)

This invention relates in general to fluid pressure actuated percussive tools and in particular to single impact riveting hammers particularly adapted to flush riveting.

In certain industries, such, for example, as the airplane industry, metal sheets are secured together by flush-riveted joints. It is found that for many purposes the most suitable flush-riveted joint is that wherein rivets having heads of the counter-sink type have such heads seated in recesses, herein referred to as "dimples," formed by bending inward the annular metal portions of the overlying sheets surrounding the openings through which the shank of the rivet passes, as distinguished from the ordinary type of counter-sink which is formed by cutting away sufficient of the metal of one or more of the sheets to form a recess which will receive part or all of the rivet head.

It is an object of the present invention to provide simple and effective means for forming a flush-riveted joint wherein the rivet head is received in a dimple formed by impacting the head of the rivet while the assembly of overlying sheets are bucked from the back in such a manner and with such cooperative bucking means that the head of the rivet thus impacted will deflect the edge portions of the sheets surrounding the rivet holes inwardly and thereby form a dimple in cooperative relation to the rivet head.

It is a further object of the invention to provide means of simple and effective character for forming a flush-riveted joint of the type set forth in the preceding paragraphs, which will consistently position the heads of the rivets in co-planar alignment with the surface of the front sheet of the assembly of over-lying sheets included in the flush-riveted joint.

An important object of this invention is to provide a single-acting riveting hammer which produces an impact greater than heretofore attainable with a riveting hammer having a piston of the same weight and diameter, a stroke of the same length, and an air supply at the same pressure.

Another object is to provide a riveting hammer for use in flush riveting which produces a single impact of sufficient force to impact-dimple a plurality of metal sheets into nested relation with the head of a rivet.

Another object is to provide a riveting hammer for use in flush riveting which produces a single impact of sufficient force to upset the shank of a rivet into concentrically sealing relation with the surrounding metal, as well as in securing relation with the dimpled portions of the sheets.

Another object of the invention is to provide a riveting hammer having means for restraining forward movement of the hammer piston until a fluid pressure is built up behind the piston approximately equal to the pressure in the fluid supply line with which the device is connected.

Another object is to provide the riveting hammer with a differentially operable pressure transfer valve together with means operable by the valve for restraining and releasing the piston.

Another object is to provide the riveting hammer with a manually operable main valve, a pressure transfer valve that is differentially responsive to operation of the main valve, and means releasably restraining the piston at the breech of the cylinder, this releasing means operating in a timed relation to the transfer valve.

Another object is to provide means for maintaining a pressure in back of the hammer piston of a riveting hammer at approximately the pressure in the air supply line during the work stroke of the piston and to provide means for reducing to a minimum the back pressure in front of the piston of a riveting hammer during the work stroke of the piston.

Another object is to provide means for automatically returning the piston of a riveting hammer from the front to the rear of the cylinder preparatory to the work stroke of the piston.

Another object is to provide a riveting hammer which operates with maximum economy for the reason that the loss of air therefrom is minimized.

Another object is to provide a riveting hammer with a driving head which is adapted to the seating of the rivet and to the upsetting of the shank where the sheets being joined together are sufficiently resilient to permit upsetting by impacting the rivet head together with a portion of the outer sheet, and that is also adapted to bucking the rivet and to holding the rivet head flush with the surface of the outer sheet in the operation wherein upsetting is accomplished by impacting the shank.

Another object is to provide a riveting hammer with a driving head having means for automatic parallel alignment of the work surface with the surface of the outer sheet.

Another object is to provide a riveting hammer with a driving head having means for preventing slippage while being held against the work.

Another object is to provide a riveting hammer with a bucking head which is adapted to bucking the sheets while the rivet is being seated and

which is adapted to the upsetting operation where upsetting is accomplished by impacting the shank.

Another object is to provide a riveting hammer with a bucking head having means for automatically co-planarly aligning the surface of the rivet head with the surface of the outer sheet while the hammer is being used as a bucking tool during the rivet seating operation.

A further object of the invention is to provide a method of flush-riveting of the general character discussed in the foregoing, wherein the head of a rivet is impacted so as to seat the same in nested relation to dimpled sheets, and pressure against the rivet head is sustained after the impacting thereof and during the upsetting of the rivet shank so as to expand the same into circumferential sealing engagement with the edges of the sheets forming this perforation and so as to form a head on the rear end of the shank.

Some further objects and advantages will appear in the following part of the specification.

Referring to the drawings which are for illustrative purposes only,

Fig. 1 is a fragmentary sectional view showing how two riveting hammers, embodying a part of our present invention, may be cooperatively employed in the practice of our method of flush-riveting, one being in position for seating the rivet and the other in position for aligning the rivet and bucking the sheets.

Fig. 2 is a fragmentary view showing the driving head, of the riveting hammer used to seat the rivet, fully extended by an impact blow of the hammer piston, and the rivet seated in a dimpled recess in the sheets as the result thereof.

Fig. 3 is a fragmentary sectional view illustrating the further steps of upsetting the rivet shank into intimate contact with the surrounding metal.

Fig. 4 is a fragmentary view in the direction of arrows 4—4 in Fig. 1.

Fig. 5 is a view in the direction of arrows 5—5 in Fig. 1.

Fig. 6 is a fragmentary partly sectioned view showing the cooperating parts in position to accomplish movement of the piston hammer to the rear end of the cylinder.

Fig. 7 is a fragmentary partly sectioned view showing the cooperating parts in position to restrain a piston hammer from forward movement and build up a fluid pressure behind the same.

Fig. 8 is a fragmentary partly sectioned view showing the cooperating parts of the hammer in position to release the hammer piston and apply the whole force of the impelling fluid to the same during its impacting stroke.

Fig. 9 is a fragmentary partly sectioned view showing the cooperating valve parts in the respective positions assumed thereby as they return to initial position, such as illustrated in Fig. 6.

As shown in Fig. 1, the embodiment of the invention chosen for the purpose of illustration comprises a riveting hammer 15 having a cylinder 16 in which a conventionally packed hammer piston 18 is adapted to be reciprocated so as to strike the shank 19 of a selected die or head, held in the socket opening 20 at the front end of the cylinder 16. The cylinder 16 is closed at its breech by a head 21 having a stop 22, and the muzzle end of the cylinder is provided with threads 25 to receive a spring 26 adapted to hold the shank 19 in the operative position shown. The function of the stop 22 is to provide, as shown in Figs. 6 and 7, a chamber 23 in which air pressure may be built up prior to the forward movement of the piston hammer 18.

As shown in Figs. 1 and 9, the hammer 15 is provided with a piston grip 33 forming part of a metal body 32 which extends downwardly from the cylinder 16 and has therein an air passage 34 into which air is admitted through a spring seated main valve for a suitable air connection 36, the spring 37 of the main valve 35 operating to continuously exert a force to close the valve. A pivoted trigger 38 is mounted on the handle 33 in such position that when it is depressed, or, in other words, moved from its position of Fig. 1 towards its position in Fig. 9, it will engage the stem 39 of the main valve and open the same. The upper end of the trigger 38 has forks 41 adapted to engage a pin 42 which projects laterally from an air distributor or transfer valve mechanism 43 disposed below and substantially in alignment with the barrel 16.

The transfer valve 43 comprises two cooperating valve members, namely, a sleeve 44 and a shuttle valve 45 disposed within the sleeve 44, the pin 42 being secured in the shuttle valve 45 and projecting through longitudinal slots 46 in the sleeve valve 44. The two valve members 44 and 45 are slidably fitted into a bore 47 in the metal body 32 of the hammer device 15. Two recesses 48 and 49 are cut away from the bottom of the shuttle valve 45, and two recesses 50 and 51 are cut away from the top thereof. In addition, the shuttle valve 45 is provided with two annular recesses, or passages, 52 and 53. The forward portion of the shuttle valve 45 is smaller in diameter than the rear portion, forming a shoulder 54. The sleeve valve 44 fits over the forward portion of the shuttle valve 45 and two notches 68 and 69, and an opening 70 in the exposed portion of the sleeve valve 44 exposes the shuttle. Diametrally aligned ports 71 are formed in the sleeve valve 44.

A valve spring latch 78 is provided to keep the sleeve valve 44 from moving with the shuttle valve 45 during part of the trigger movement. The free end of the valve spring latch 78 bears against the shuttle valve 45 either through notch 68 or notch 69 in the bottom of the sleeve valve 44. A friction device of some kind could be used to retard the movement of the sleeve valve 44, in place of this latch 78, but the latch is preferred by the inventors.

The cylinder 16 is provided with front and rear air ports 55 and 56, connecting the respective ends thereof with the bore 47 in which the distributor valve 43 is slidable. Ahead of the inlet port 56 there is an opening 57 extending from the cylinder space to the bore 47, in which opening a pawl 54 is mounted on a transverse pivot 58 so that it may be rotated vertically to such position that its rear end will engage an annular recess 30 in the piston hammer 18, when the same is at the rear end of the cylinder. A spring 59 is provided to rotate the pawl 54 into the recess and to there hold it until it is disengaged by the action of the shuttle valve 45, to be hereinafter explained.

The complete cycle of operation of our riveting hammer 15 will now be described. Figs. 1, 6, 7, 8, and 9 show the positions of the piston 18, the pawl 54, the sleeve valve 44, and the shuttle valve 45 at five stages during the complete cycle. In Fig. 1 all of the ports are in effect closed, and the main valve is likewise closed. When operating pressure is applied to the trigger 38 it will be first moved into the position in which it is shown

in Fig. 6. This moves the pin 42 back in the slots 46, thereby moving the shuttle valve 45 independently of the sleeve valve 44 into the first position wherein the annular passage 52 will connect the ports 71, the lower of which ports 71 is in communication through a port 80 with the air passage 34. The stem 39 of the valve 35 will be now depressed and air will enter the passage 34 and will travel through port 80, passage 52 and port 71 to an opening 81 which connects with the far end of an air passage 82 leading to the exhaust port 55. This air will enter the forward end of the cylinder 16 and will move the piston 18 rearwardly from the position in which it is shown in Fig. 1 to its position of Fig. 6. The piston 18 will now be engaged and latched in such rearward position by the pawl 54. Air contained in the cylinder 16, behind the piston 18, may pass out through the inlet port 56 and through an opening 84 in a plug 85 which is threaded into the rear end of the bore 47.

Movement of the trigger 38 from its position of Fig. 6 to its position of Fig. 7 moves both the sleeve valve 44 and the shuttle valve 45 simultaneously into a new position wherein the ports 71 and the passage 52, respectively, of the sleeve valve 44 and the shuttle valve 45 will be offset rearwardly from the ports or openings 80 and 81, and the passage 53 in the shuttle valve 45 and a port 86 which connects the rightward end of the bore 47 with the rightward end of the air passage 34, so that air will pass under pressure from the passage 34 through the annular passage 53 and the inlet port 56 into the space 23, thereby permitting an air pressure to be built up in this space and against the rear face of the piston 18. It will be noted that at this time the piston 18 is restrained from forward movement by the pawl 54.

Further movement of the trigger 38 simultaneously moves the sleeve valve 44 and the shuttle valve 45 from their position of Fig. 7 to their position of Fig. 8, to bring the annular valve passage 53 of the shuttle valve 45 into fully open communication with the inlet port 56 and the air port 86, and at the same time bringing a shoulder 99, formed at the front end of the depression 50, into engagement with the lower end of the pawl 54, to rotate such pawl into retracted position thereof, as shown in Fig. 8, and against the yieldable force of the spring 59, thereby releasing the piston 18 so that the air pressure in the rear end of the cylinder 16 may drive the same forwardly at high velocity into engagement with the inner end of the shank 19.

Upon release, the trigger 38 is moved toward its initial position by a spring 60. The first return movement of the trigger 38 will be transmitted through the pin 42 to the shuttle valve 45, to move the same forward in the sleeve valve 44, thereby disaligning the annular passages 52 from the ports 71, as shown in Fig. 9, so that as further forward movement of the trigger toward its initial position in Fig. 1, will simultaneously move the sleeve valve 44 and the shuttle valve 45 past the ports 80 and 81 in disaligned position whereby no air will be permitted at this time to pass from the passage 34 into the passage 82. Thereafter the parts of the device will remain substantially in the position in which they are shown in Fig. 1. A further single actuation of the piston 18 will require merely a single rearward movement of the trigger 38 through the positions described relative to Figs. 1, 6, 7, 8, and 9.

From the above description of the riveting hammer and its operation, it is apparent that the piston 18 will travel to the front of the cylinder and strike the pin 19 at comparatively high velocity, for three reasons. First, the piston is held at the rear of the cylinder 16 long enough to permit the pressure in that portion of the cylinder behind the piston to build up to substantially the pressure in the air supply line, so that the pressure against the piston tending to impel the same forwardly will be at a maximum value at the beginning of the stroke. Second, the piston is not released until the pressure in the air passage 34 has been built up to substantially the pressure in the supply line 36 and until the inlet valve 35 and the inlet port 56 have been opened to full extent so that when the piston 18 is finally released a large volume of air at high pressure is provided against the back of the piston throughout its entire forward stroke. And third, since the piston 18 is not released until the exhaust port 55 has been fully opened, as shown in Fig. 8, it is also apparent from the foregoing description of our riveting hammer and its operation, that the loss of air through leakage is reduced to a minimum. Although it is possible to arrange the cooperative transfer valve element so that the piston 18 will be returned to the rear end of the cylinder 16 immediately upon release of the trigger 38, we prefer the arrangement shown whereby the piston is returned on the first rearward movement of the trigger 38, for the reason that when the operator hears the piston strike the stop 22 he knows that the tool is ready for operation before the trigger is pulled all of the way back to released position.

The driving heads 90 and the bucking head 91 are basically the same. Each has a swivelable contacting member resiliently held against a spherical end portion of a member fastened to the muzzle of the hammer by means of a spring 26. In the practice of our new riveting method two of the riveting hammers 15 are employed in opposed relation, as shown in Figs. 1, 2, and 3, one being for the purpose of driving or impacting the driving head 90 against the head of a rivet while the sheets being riveted are bucked by the bucking head 91 carried by the other of the hammers, the drive head 90 being then employed to buck the head of the rivet during the upsetting of the rivet shank.

The driving head 90 comprises an anvil 92 which is mounted on the semi-spherical forward end 93 of the shank 19 which has a collar 94 to serve both as a stop to keep the stem from being inserted too far into the muzzle opening 20 and has a shoulder to be engaged by the coil spring 26 which resiliently holds the stem 19 in operative position. The anvil 92 has a recess 95 which receives the head 93 of the shank 19 and a rubber bushing 96 is placed in the recess 95 adjacent the rear face of the head 93 to hold the parts in engagement and permit a swivel movement of the head 90 on the shank 19.

To resist slippage when in use, the head 90 is provided with a rubber collar 97 having a shrouding ring 98. If no opposite longitudinal forces are being applied to move the anvil 92 forward with reference to the collar, flange 99 of the collar engages the shoulder 100 of the anvil, which shoulder 100 defines the forward end of an annular recess 101 in the anvil 92. The rear portion of the collar 97 comprises a rubber spring 102 which fits into the annular recess 101. When the front edge of the rubber collar 97 is brought into

engagement with the work, as in Fig. 1, and the anvil 92 is then moved forwardly, the rubber collar 97 will, in effect, move rearward on the anvil 92 in the manner indicated in Fig. 2. At this time there will be an expansion of the rearward portion 102 of the rubber collar 97 owing to the fact that the rear edge 103 thereof is restrained from rearward movement by the shoulder 104 at the rear end of the annular channel 101. The friction of rubber on the metal prevents slippage of the head from position. There are a number of grooves 105 in the front end of the collar 97 for passage of air from the space between the front face of the anvil 92 and the work to which the device is applied.

The bucking head 91 includes a bucking anvil 110 having an axial opening 111, an annular front face 112 perpendicular to the axis of the opening 111, and a conical recess 113 the angle of which corresponds to the angle of the head 114 of a flush rivet 115 with which the bucking head 91 is to be used. The bucking anvil 110 has a rearwardly faced substantially semi-spherical socket 116 and a radial flange 117. The socket 116 receives the rounded nose 118 of a tubular fitting 119 having an annular flange 120 disposed adjacent to the flange 117. A rubber collar 121 having an internal groove 122 is placed over the adjacent flanges 117 and 120, to hold the parts 110 and 119 together, but to permit a limited swivelling movement of the part 110 relative to the part 119.

The fitting 119 is held against the muzzle of a riveting hammer 15' of the same type as the hammer 15, previously described, by means of a spring 26'. The opening 123 of the fitting 119 has therein an axially slidable stem 124, the rear end 125 of which projects through the muzzle opening 20' into the front end of the barrel of the riveting hammer 15' so as to be in a position to be engaged by the piston 18' of such hammer 15'. The front end of the stem 124 is provided with a cylindrical nose 126 adapted to enter the opening of the bucking anvil 110 when the stem 124 is driven forwardly by the piston 18' of the riveting hammer 15', as shown in Fig. 3. If the stem is moved forward when the bore 111 of the bucking anvil 110 is not in axial alignment therewith, the nose 126, upon entering the bore or opening 111, will rotate the anvil 110 into alignment with the stem 124, owing to the fact that the inner end of the bore 111 is flared so as to direct the nose 126 into the bore 111 without damaging the stem 124 or the bucking anvil 110.

In Figs. 1, 2, and 3 sheets 130 and 131 are shown, such sheets having aligned openings 132 to receive the shank 133 of the rivet 115. This rivet 115 is first placed, as shown in Fig. 1, and the driving head 92 is placed thereagainst, preferably in centralized relation. The bucking head 110 is then placed so that its bore 111 will receive the rear end of the rivet shank 133, the riveting hammer 15 being held substantially perpendicular to the sheets 130 and 131. Should there be some disalignment of the riveting hammer 15' from true perpendicular position, the bucking head 110 will swivel on the nose 118 of the fitting 119 so that the annular face 112 of the bucking head 110 will rest tightly against the face of the sheet 130, and the axis of the bore 111 will then be perpendicular to the sheets 130 and 131, and such bore 111 will hold the shank of the rivet 115 in this perpendicular relation, so that the outer face of the rivet head 114 will be parallel to the outer face of the sheet 131. The riveting hammer 15 may be then actuated so that the piston 18 thereof will strike the stem 19, as shown in Fig. 2, thereby driving the head 90 toward the bucking head 91 so as to impact the head 114 of the rivet 115 into nested relation to the sheets 130 and 131, the sheets bending inwardly into the depression 113 of the anvil 110, the annular portions 135 of the sheets 130 and 131 surrounding the openings 132, thereby forming depressions, or dimples, in centralized relation to the opening, the head 114 being received in the dimple of the sheet 131, with the flat, front face of such head 114 flush with the face of the sheet 131. The upsetting of the rivet shank is accomplished in the following manner and as illustrated in Fig. 3. The head 90 supported by the riveting hammer 15 is held firmly against the rivet head 114 so that it now becomes a bucking means for such head 114, and the riveting hammer 15' is actuated so as to cause the piston 18' thereof to strike the stem 124 and drive the same forward, with the result that the stem 133 of the rivet 115 will be ejected from the bore 111 and will be expanded or upset so as to completely fill the openings in the sheets 130 and 131, and so that the extreme portion thereof will be expanded to form a conoidal button head 138. The blow delivered to the shank of the rivet by the stem 124 likewise slightly deforms or spreads the rivet head 114 so that it will eventually completely fill the depression or dimple which it occupies in the sheet 131.

Where the sheets being joined are of a flexible character, the rivet shank may be upset by first moving the nose 126 of the stem 124 into advanced position in the bore 111, so that such nose 126 will rest against the rear end of the shank 133. Then an impact may be applied through the drive head 90 to the head of the rivet 115 by actuating the riveting hammer 15, this impact simultaneously deflecting the sheets 130 and 131, and moving the rivet 115 bodily toward the bucking head, with the result that the shank of the rivet will be expanded in the openings of the sheets 130 and 131 and a conoidal button head 138 will be formed in the recess 113 of the bucking anvil 110. This latter method is fully described in co-pending application, Pavlecka et al., Serial No. 203,946, filed April 29, 1938.

Although we have shown and described a simple and practical embodiment of our invention, it will be recognized that various parts or elements thereof may be replaced by other parts of equivalent function without departing from the spirit of the invention; therefore, the invention is not limited to the details of the disclosure hereinbefore made, but should be accorded the full scope of the hereto appended claims.

We claim as our invention:

1. In an air hammer of the character described, the combination of: a cylinder; a piston movable in said cylinder from the rear to the front end thereof to deliver an impact; means for feeding a propulsion fluid to said cylinder to move said piston from a position remote from the front end thereof to the front end of said cylinder; and means for holding said piston in a position spaced from the rear end of said cylinder so that a pressure accumulation chamber is thereby formed between the rear face of said piston and the rear end of said cylinder and restraining forward movement of said piston until a heavy pressure has been built up in said pressure accumulation chamber.

2. In an air hammer of the character de-

scribed, the combination of: a cylinder; a piston movable in said cylinder from the rear to the front end thereof to deliver an impact; means for supplying a propulsion fluid to said cylinder to move said piston from a position remote from the front end thereof to the front end of said cylinder; a latch for holding said piston in a position spaced from the rear end of said cylinder so that a pressure accumulation chamber is thereby formed between the rear face of said piston and the rear end of said cylinder and restraining forward movement of said piston so that a fluid pressure may be built up in said pressure accumulation chamber; and means for releasing said latch.

3. In an air hammer of the character described, the combination of: a cylinder having a front port, a rear port, and an air inlet space; a piston in said cylinder; means for connecting said air inlet space to a source of air under pressure; and valve means for controlling the feeding of air from said air inlet space to said ports, said means comprising a valve actuating means and a pair of slidably associated valve members movable forward by said valve actuating means through consecutive stages so as to first connect said air inlet space with said front port so as to deliver air through said front port to move said piston rearward in said cylinder, then to disconnect said air inlet space from said front port and connect said air inlet space to said rear port to build up a pressure behind said piston, and then to fully open said air inlet space to said rear port so that the full pressure of air from said source of air under pressure may propel said piston forward in said cylinder while said front port is opened to the exterior, said valve members being then returnable to their initial position without connecting said front port to said air inlet space and so as to disconnect said rear port from said inlet space.

4. In an air hammer of the character described, the combination of: a cylinder having a front port and a rear port; a hammer piston in said cylinder; means for connecting the air hammer to a source of fluid pressure; and means for controlling the entry of fluid under pressure to said cylinder, said control means having a front valve constructed so as to first admit fluid through said front port so as to move said piston rearward in said cylinder and to then cut off fluid from said front port restraining means to hold said piston in the rearward portion of said cylinder and a rear valve operatively connected to said front valve to then introduce fluid through said rear port to build up a fluid pressure behind said piston and to supply a large volume of fluid under substantially full pressure of said fluid source through said rear port to said cylinder to impel said piston forcibly to the front end of said cylinder, said control means having a part to release said restraining means after fluid has been introduced through said rear port, and said front valve means having means to open the front end of said cylinder to the exterior after said piston has been moved to the rear end of said cylinder.

5. In an air hammer of the character described, the combination of: a cylinder having a front porch and a rear port; a hammer piston in said cylinder; means for connecting the air hammer to a source of fluid pressure; a member movable from an initial position to a final position; and means movable by said member for controlling the entry of fluid under pressure to said cylinder, said control means comprising a valuable member constructed so that upon first movement of said member it will first admit fluid through said front port and at the same time connect said rear port to the exterior so as to move said piston rearward in said cylinder, then upon further movement of said member cut off fluid from said front port and introduce fluid through said rear port to build up a fluid pressure behind said piston and upon still further movement of said member, supply a large volume of fluid under substantially full pressure of said fluid source through said rear port to said cylinder to impel said piston forcibly to the front end of said cylinder, said valve member being arranged to the front end of said cylinder to the exterior after said piston has been moved to the rear end of said cylinder.

6. In an air hammer of the character described, the combination of: a cylinder; a piston movable in said cylinder from the rear end thereof to the front end thereof to deliver an impact; a latch engaging said piston so as to hold the same in a position retracted from the front end of said cylinder; valve means operable to admit a propulsion fluid into the space in said cylinder behind said piston; and means operating in consequence of the operation of said valve means to release said latch after said propulsion fluid has been admitted to the space behind said piston.

7. In an air hammer of the character described, the combination of: a cylinder; a piston movable in said cylinder from the rear end thereof to the front end thereof to deliver an impact; a latch engaging said piston so as to hold the same in a position retracted from the front end of said cylinder; valve means operable to admit a propulsion fluid into the space in said cylinder behind said piston; a manually movable member for operating said valve means; and means arranged to receive movement in consequence of the movement of said member to operate said valve means, for releasing said latch.

8. In an air hammer of the character described, the combination of: a cylinder; a piston movable in said cylinder from the rear end thereof to the front end thereof to deliver an impact; a latch engaging said piston so as to hold the same in a position retracted from the front end of said cylinder; valve means operable to admit a propulsion fluid into the space in said cylinder behind said piston; a movable control member connected so as to operate said valve means during a part of its movement, said control member having a further movement after the operation of said valve means; and means arranged to receive movement in consequence of said further movement of said control member, to release said latch.

9. In an air hammer of the character described, the combination of: a cylinder part; a piston part movable in said cylinder part from the rear end thereof to the front end thereof to deliver an impact, one of said parts having a shoulder; a releasable latch member extending from the other of said parts into engagement with said shoulder to hold said piston in a position near the rear end of said cylinder; a valve to deliver fluid under pressure to the space between said piston and the rear end of said cylinder; a member operable to open said valve; and means operable by said member to release said latch member.

10. In an air hammer of the character described, the combination of: a cylinder; a piston

movable in said cylinder from the rear end thereof to the front end thereof to deliver an impact; mechanical restraining means engaging said piston and said cylinder so as to hold said piston in a position near the rear end of said cylinder; a valve to deliver fluid under pressure to the rear face of said piston; a member operable to open said valve; and means operable by said member to release said restraining means after said valve is initially opened.

11. In an air hammer of the character described, the combination of: a cylinder having front port means and rear port means; a hammer piston movable in said cylinder; a valve operating member movable from a first position through a second position to a third position; a fluid pressure supply; valve means operable by said valve operating member, said valve means disconnecting said fluid pressure supply from both of said port means when said operating member is in said first position, said valve means having front valve parts operable by movement of said operating member from the said first position to said second position to connect said fluid pressure supply to said front port means whereby fluid pressure will be applied to the front face of said piston, and to cut off the supply of fluid from said front port means and open said front port means when said operating member is moved from said second position to said third position, and said valve means having rear valve parts operative to connect said fluid pressure supply to said rear port means when said operating member is moved from said second position to said third position so that fluid pressure will be applied to the rear face of the said piston.

AGNE T. LUNDGREN,
ALLAN B. ROGERS.
VLADIMIR H. PAVLECKA.

CERTIFICATE OF CORRECTION.

Patent No. 2,257,267. September 30, 1941.

AGNE T. LUNDGREN, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, first column, line 70, claim 5, for the word "porch" read --port--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of November, A. D. 1941.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.