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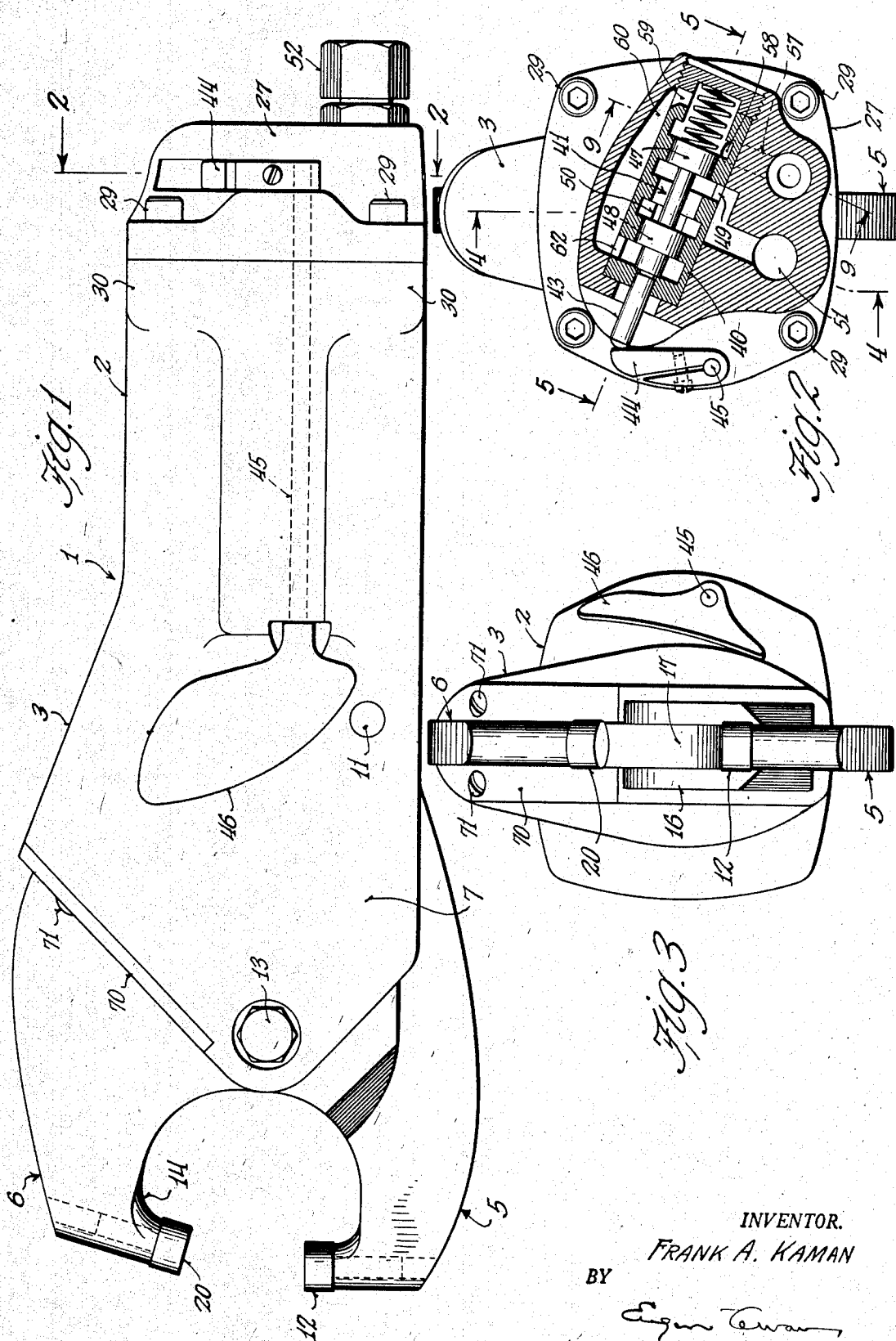
F. A. KAMAN

2,387,449

SQUEEZE RIVETER

Filed Aug. 17, 1942

4 Sheets-Sheet 1



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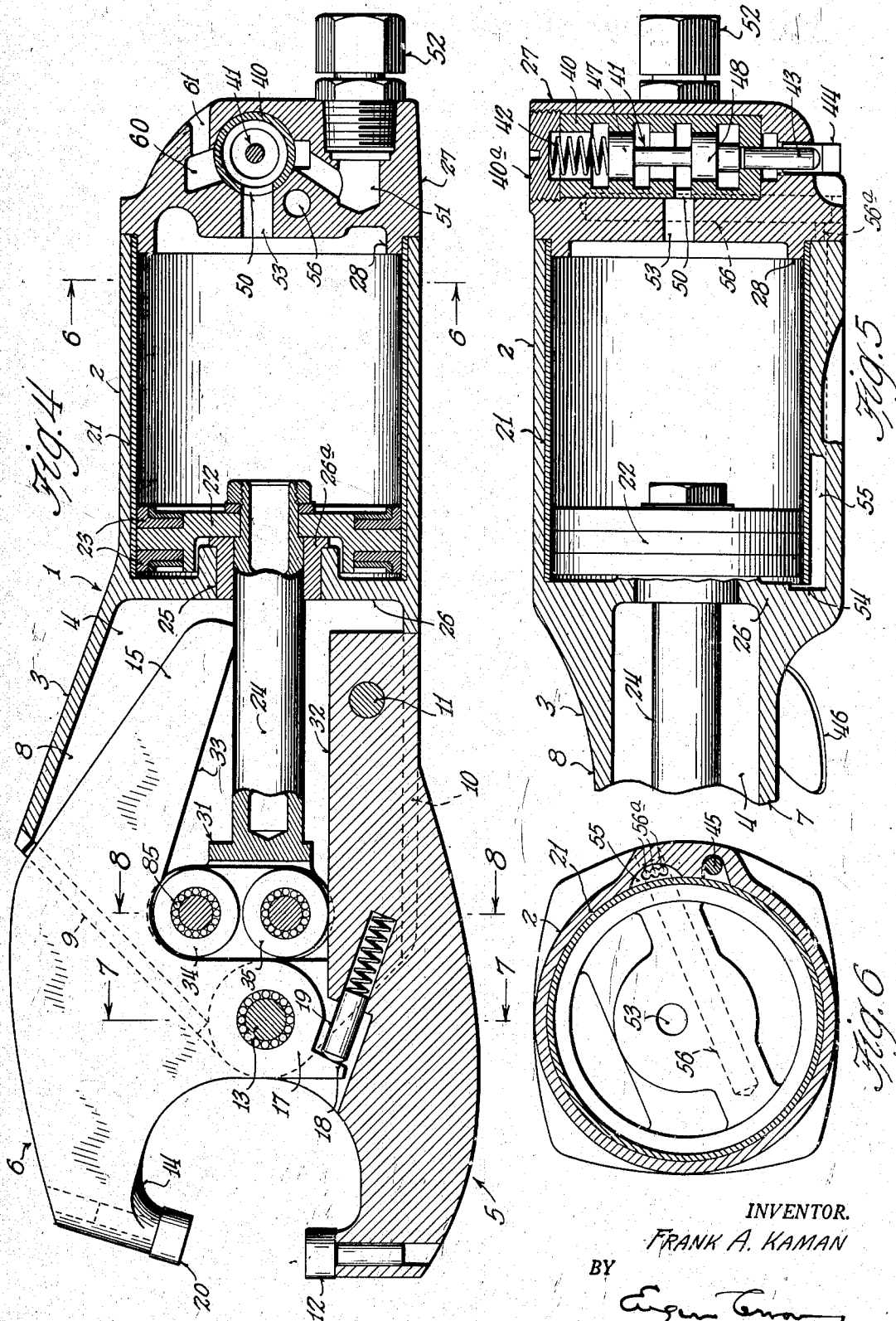
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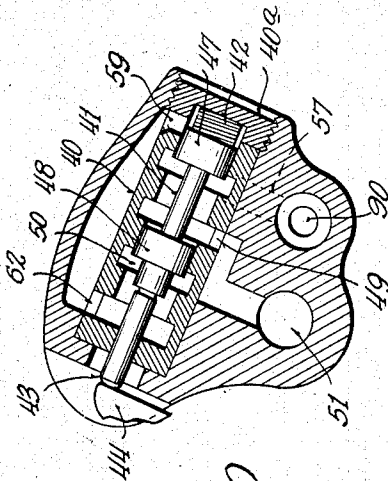
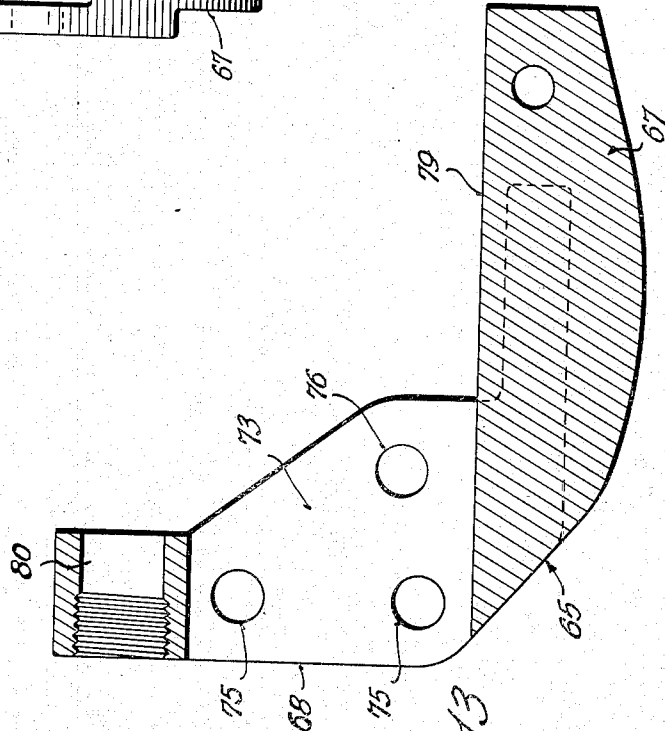
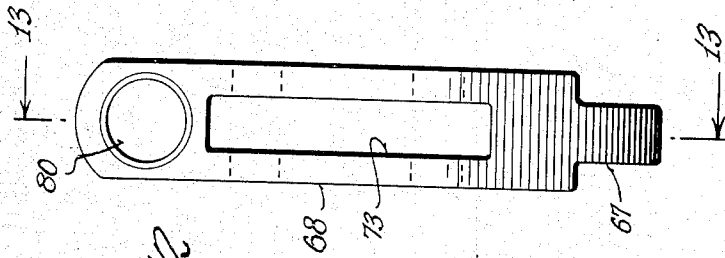
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4 Sheets-Sheet 4



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SQUEEZE RIVETER

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2 Claims. (Cl. 78—31)

This invention relates to portable power operated riveting tools of the compression or squeeze riveter type for cold riveting operations as commonly employed in the airplane industry for driving and clamping aluminum, Duralumin and like rivets.

The principal object and purpose of my invention is to provide a riveting tool in which a single riveting lever is employed to drive and set the rivets to increase both the efficiency of the tool and the operator by avoiding the heavier and larger tools which embody the more complicated and expensive lever and toggle arrangements as heretofore.

A further object of my invention is to utilize the main or power cylinder of the tool to reciprocate the driving head for the lever on its return stroke to avoid the need for an auxiliary cylinder attached to the main cylinder for this purpose to add to the overall length and weight of the tool and to avoid the use of springs for the return, the compression of which deducts power from the power stroke of the tool.

A further object of my invention is to provide a tool construction in which different riveting heads may be interchangeably used with the tool casing and its power cylinder and piston by replacing one riveting head containing its single riveting lever as a unit by another to convert the tool for holding in either of two positions with respect to the rivet being operated upon.

A further object of my invention is to provide an effective and efficient single lever squeeze riveter portable tool embodying the features of construction hereinafter described and claimed.

In the accompanying drawings:

Fig. 1 is a side elevational view of my improved riveting tool;

Fig. 2 is a cross-sectional view with parts in elevation taken on line 2—2 of Fig. 1 to show the control valve at the rear end of the tool;

Fig. 3 is a front view of the tool with the movable and fixed jaws in open position of the movable jaw constituting the riveting lever;

Fig. 4 is a longitudinal sectional view of the complete tool with parts in elevation taken on line 4—4 of Fig. 2;

Fig. 5 is a fragmentary longitudinal sectional view of the motor end of the tool with parts in elevation taken on line 5—5 of Fig. 2;

Fig. 6 is a cross-sectional view taken on line 6—6 of Fig. 4;

Fig. 7 is a fragmentary cross-sectional view taken on line 7—7 of Fig. 4 to detail the fulcrum mounting for the movable jaw;

Fig. 8 is a similar sectional view taken on line 8—8 of Fig. 4 to detail the mounting for the rollers on the driving head to be hereinafter described;

Fig. 9 is a cross-sectional view taken on line 9—9 of Fig. 2 showing the pressure relief valve for the power cylinder;

Fig. 10 is a view showing the control valve shifted to its position opposite to that shown in Fig. 2;

Fig. 11 is a longitudinal sectional view showing the tool of the previous figures converted into one having a yoke and a riveting plunger at its front end;

Fig. 12 is a front view of the yoke supporting frame embodied in converted form; and

Fig. 13 is a sectional view of said frame taken on line 13—13 of Fig. 12.

The tool illustrated in Figs. 1 to 10, comprises a support in the form of a cast aluminum housing or outer casing 1 shaped to provide a cylinder section 2 at the rear end of the tool and a forwardly extending hollow section 3 providing a chamber 4 at the front end of the tool, said chamber serving to accommodate and support the fixed and movable jaws of the tool and the driving head for imparting the desired relative riveting movement thereto.

The fixed jaw is marked 5 and the movable jaw is marked 6. The forward section 3 is formed to provide laterally spaced side walls 7, 8 integral with the cylinder section 2 and divided at the front end of the tool by a slot-like opening having interconnected upper and lower portions 9 and 10, respectively, through which the jaws extend to have their outer ends available for a riveting operation as shown in Figs. 1, 3 and 4. The fixed jaw 5 is mounted in and fills the lower slot 10, being secured in place by a cross-bolt 11 anchored at its ends in the side walls 7, 8. The outer end of the fixed jaw 5 beyond the front end of the housing 1 carries an anvil element 12 as shown.

The movable jaw 6 is in the form of a lever fulcrumed intermediate its ends in the housing section 3 on a fulcrum pin 13 extending between and anchored at its ends in the side walls 7, 8 as detailed in Fig. 7. Said lever 6 has its riveting end portion 14 extending beyond the housing section 3 through the upper slot 9 and its actuating end portion 15 within the housing section 3 to the rear of the slot 9 as shown in Fig. 4.

The fixed jaw 5 is also held in place by the fulcrum pin 13, the fixed jaw at this point having an upwardly extending bifurcated portion 16 en-

gaged by the pin 13 and embracing a depending intermediate portion 17 on the lever 6 at the fulcrum 13 as shown in Fig. 4. Said depending portion 17 is provided with a rearwardly facing abutment 18 against which acts a spring biased plunger 19 carried by the fixed jaw 5 to move the lever to its normal or open position as shown in Figs. 1, 3 and 4. The lever 6 extends beyond the front end of the housing 1 to substantially the same extent as the fixed jaw 5 and there carries a rivet set 20 for cooperation with the anvil in a riveting operation.

The cylinder section 2 is fitted with a cylindrical bushing 21 to reciprocally mount a piston 22 having peripheral packings 23 to seal the piston against leakage from its opposite sides. This provides a double acting piston for the power and return strokes of the driving head to be later described without the need for an auxiliary cylinder to increase the overall length of the tool and add weight as heretofore.

A piston rod 24 is rigidly connected to the piston 22 and extends therefrom into the chamber 4 through an opening 25 in the front header 26 for the cylinder 2. The header 26 is cast integral with the housing 1 and carries a bushing 26a in the opening 25 to slidably support the rod 24 and seal the cylinder against leakage about the rod.

A rear header 27 preferably in the form of an aluminum casting provides a closure cap for the rear end of the cylinder 2 and its bushing 21. Said cap mounts the control valve for the tool and has a flange 28 to seat both the cylinder 2 and its bushing 21 as shown in Fig. 4. The cap 27 is clamped to the cylinder 2 by a number of cap screws 29, the cylinder casting having bosses 30 to receive the screws as indicated in Figs. 1 and 2. The cap 27 is within the outside dimensions of the cylinder 2 to aid in reducing the overall width of the tool and permit the cylinder section 2 to be grasped and serve as a handle for the tool.

The driving head 31 is fixed to the outer end of the piston rod 24 on the same side of the fulcrum 13 as the actuating end 15 of the lever 6 and a stationary track-way 32 which the fixed jaw 5 provides on the support 1 for the driving head. The track-way 32 extends towards the fulcrum 13 in parallel relation to the straight line movement which the piston rod 24 has towards and from said fulcrum.

The actuating end portion 15 of the lever 6 has a cam surface 33 in opposition to the track-way 32 and in angular relation thereto in the normal or open position of the lever 6 as shown in Fig. 4. The driving head 31, by rollers to be presently referred to, engages the cam surface 33 and the trackway 32, respectively, being reciprocated therebetween by the piston rod 24. Hence, when the driving head 31 is moved away from the fulcrum 13 the lever 6 is swung about said fulcrum on its riveting stroke, that is, the rivet set 20 is moved towards the anvil 12. This will force the lever 6 against the rivet supported on the anvil to up-set and head the stem of the rivet and tightly clamp together the plates through which the rivet extends. In this action, the driving head 31 moves the cam surface 33 outwardly from the track-way 32 and the power of the lever 6 is increased enormously as the cam surface approaches parallelism with the track-way. This follows from the lessening of the effective angle between the cam surface and the track-way as the cam surface is moved away

from the track-way and the outward travel of the point of contact of the riveting head with the lever. This multiplies the leverage exerted by the lever 6 on the rivet and sufficient power is developed to complete the riveting action in one stroke of the lever.

As will be noted from Fig. 4, the lever 6 at the start of its riveting stroke has its cam surface 33 at the greater angle to the track-way 32 and the driving head 31 is at its closest position to the fulcrum 13. Hence, in the movement of the driving head 31 away from the fulcrum, the initial swinging movement imparted to the lever 6 rapidly engages the riveting end of the lever with the rivet so that the remaining or following stroke of the lever may be considerably slower to set and clamp the rivet with increasing power as heretofore pointed out.

The fixed jaw 5 and the lever 6 are preferably made of steel to take the wear of the driving head 31 and support the pressure of the lever on the track-way 32.

The driving head 31 carries a pair of upper and lower rollers 34, 35 to facilitate the driving contact of the driving head with the cam surface 33 and the track-way 32, respectively. The rollers 34, 35 are also made of steel and are journaled at their ends between the side walls 36, 36 of the driving head 31, the latter being in U-shape form to receive and mount the rollers. The trunnion ends 37, 37 of the rollers extend into elongated slots 38, 38 in the side walls 36, 36 and these slots are in right angular relation to the piston rod 24. This allows for self adjustment of the rollers as a unit as the rollers travel along the cam surface 32 and the track-way 33 towards and from the fulcrum 13. Spacer plates 39, 39 engage the trunnion ends of the rollers 34, 35 to maintain them in unitary relation and out of contact with each other under the pressure of the riveting lever 6. The rollers 34, 35 may be held in place in the driving head by suitable fasteners engaging their trunnion ends. The structure just above described is detailed in Fig. 8, and it will be noted from this showing that the plates 39, 39 overlap the side portions of the cam and track-way surfaces, respectively, to maintain the driving head 31 from lateral displacement therefrom.

The valve mechanism heretofore referred to controls the supply of pressure fluid, such as compressed air, to the opposite ends of the cylinder 2 to reciprocate the piston therein. Said valve mechanism in the embodiment shown comprises a bushing 40 mounted within the cap casting 27 in crossing relation to the cylinder 2. A valve member 41 is slidably mounted in the bushing 40 and is normally urged by a spring 42 into the position shown in Fig. 2. Here, the valve member 41 has its actuating stem 43 projected to its fullest extent from the cap 27 and the actuating lever 44 has been rocked to its outermost position as shown in Fig. 2. This rotates the rod or shaft 45 to which the lever 44 is attached to the position holding the thumb piece 46 at the forward end of the shaft 45 outward from the tool casing 3 as shown in Fig. 3. The shaft 45 is rotatably mounted in a bore made in the cylinder 2 and the adjoining part of the cap 27 as indicated by the dotted lines in Fig. 1.

With the valve member 41 in the position shown in Figs. 2 and 5, the annular guides and valve elements 47, 48 on the valve member 41 uncover the bushing ports 49 and 50, respectively. Port 49 connects with the main live air supply passage 51 in the cap casting 27 leading from the

air hose attaching coupling 52 on the rear side of the cap. The port 50 connects with a passage 53 in the cap 27 and which passage opens directly into the rear end of the cylinder 2. Hence, with the valve member 41 in the position shown in Fig. 2, live air is admitted into the rear end of the cylinder 2 to drive the piston 22 forwardly allowing the lever 6 to be moved to its normal or open position. The plunger 19 takes care of this movement, the rollers 34, 35 being moved forwardly towards the fulcrum 13 by the pressure fluid on the rear side of the piston 22.

The dead air at the front end of the cylinder 2 is exhausted through a port 54 in the front header 26 and the connected passages 55, 56 in the cylinder 2 and the cap 27, respectively, as shown in Fig. 5. As shown in Fig. 6, a plurality of passages 56a, 56a in the cap 27 connects the passage 55 in the cylinder 2 with the passage 56 in the cap. The cap passage 56 is at one side of the bushing 40 and is connected by a cross passage 57 with a bushing port 58 which at this time is uncovered by the valve element 47 as shown in Fig. 2. This element 47 also uncovers a bushing port 59 which connects with the exhaust cavity 60 formed within the cap 27 and connected to the atmosphere by the main exhaust port 61 as shown in Fig. 4.

The operator holds the tool with one hand grasped about the cylinder 2 with his thumb opposite the thumb-piece 46. Now when this thumb-piece is pressed inwardly, the valve member 41 is moved in the direction of its spring 42 compressing it and carrying the valve element 47 to the inner end of the bushing 40 to close the exhaust port 59 and open the port 58 to the main inlet port 49. Now live air pressure enters the front end of the cylinder on the front side of the piston 22 through the cap passages 57 and 56 and the cylinder passage 55 and the front port 54. The piston 22 is now forced rearwardly to actuate the lever 6 on its riveting stroke. This carries the rollers 34, 35 away from the fulcrum 13 causing the upper roller 34 to act on the cam surface 33 to move the lever 6. The valve member 41 is now in the position shown in Fig. 10. It is to be pointed out in connection with the operation of the tool that the piston 22 is moved forwardly to open the jaws and is moved rearwardly to close the jaws, the parts automatically coming to rest with the jaws in open position as soon as the operator releases the thumb-piece 46 following a riveting stroke of the lever. The spring 42 returns the valve member 41 to its normal position and the plunger 19 returns the lever 6 to its open position and keep the lever in contact with the driving head 31.

On a riveting stroke of the lever 6, the rear side of the piston 22 exhausts through the passage 53, bushing port 50, bushing 40, bushing port 62, and exhaust cavity 60 as shown in Fig. 10. Releasing the pressure on the thumb piece 46, the air flow is reversed and the riveting lever 6 is automatically returned to its normal or open position.

In Figs. 11 to 13 I have shown the tool of the previous figures converted into one equipped with a C-type of yoke 63 and a cooperating riveting plunger 64 whereby the tool may be used to engage rivets with the tool body held in general alignment with the axis of the rivet instead of at right angles thereto. To so convert the tool, the fixed and movable jaws 5 and 6 are replaced by a yoke-frame 65 and a cooperating single riveting lever 66. The yoke-frame 65 is of the right

angular form shown in Fig. 13 and is mounted at the front end of the tool casing 1 with the lower horizontal section 67 of the yoke-frame secured in the lower slot 10 of the casing section 3 by the cross-bolt 11 in the same manner as the stationary jaw 5. The upright front portion 68 of the yoke-frame 65 is forward of the casing section 3 and the space therebetween is filled by an adapter member 69 which takes the place of the guard 70 in the tool of the previous figures at the movable jaw 6 about the upper slot 9. The screws 71, 71 which secure the guard 70 in place are replaced by longer screws 72 which secure the adapter 69 in place as shown in Fig. 11.

The upright portion 68 of the yoke-frame is provided with a slot 73 in which the base or rear end of the yoke 63 is secured by cross-bolts 74, 74, the yoke-frame section 68 having aligned bolt holes 75 as shown in Figs. 12 and 13.

The single riveting lever 66 in the converted construction is of the character shown in Fig. 11. The lever 66 is fulcrumed at one end on the fulcrum pin 13, the upright portion 68 of the yoke-frame 65 having aligned openings 76 to mount the pin 13. The actuating end portion 77 of the lever 66 is on the same side of the fulcrum 13 as the driving head 31 and has a cam surface 78 to be engaged thereby, the same as the cam surface 33 on the lever 6. It is to be understood that the driving head 31, piston rod 24 and piston 22 are retained in the converted tool. The lower horizontal portion 67 of the yoke-frame 6 has a track-way 79 for the driving head 31 the same as the track-way 32 in the previous tool.

The upright portion 68 of the yoke frame 65 has a bore 80 into which screws a bushing 81 which slidably mounts the plunger 64 in line with the outer end of the yoke 63. A spring 82 presses the inner headed end 83 of the plunger 64 against a rounded section 84 on the lever 66, the section 84 being intermediate the ends of the lever and transmitting the pressure thereof to the plunger on a riveting stroke of the tool.

The rest of the tool mechanism is retained in the converted combination, and the valve mechanism when operated serves to reciprocate the piston 22 in the cylinder 2 to swing the lever 66 on its riveting stroke when the driving head 31 is moved away from the fulcrum 13 and to return the lever 66 to its normal position when the driving head 31 is moved towards the fulcrum. In the first action, the plunger 64 is projected forwardly to set and clamp the rivet between the yoke 63 and the outer end of the plunger, the power of the lever 66 increasing as its cam surface 78 approaches parallel with the track-way 79. On the return stroke of the driving head, the spring bias on the plunger 64 returns the lever 66 to its normal position and maintains said lever against the driving head.

The rollers 34, 35 on the driving head 31 may be mounted in anti-friction bearings 85 and a similar mounting is provided for the riveting lever on its fulcrum pin 13 as shown.

The relief valve 88 for the power cylinder 2 is shown in Fig. 9. Here, the valve 88 is of the ball type normally closed by a spring 89 against a port 90 connected with the cap passage 57 which leads to the front end of the cylinder 2. The pressure of said spring on the valve 88 is adjustable by a screw plug 91 having an axial passage 92 connected to the atmosphere as shown in Fig. 9. The plug 91 may be kerfed on its outer end for engagement to adjust the tension of the spring 89. In this respect, the cylinder pressure

for a riveting stroke of the riveting lever 6 or 66 may be set to that required for the character of rivet material being operated upon. The tool may be set for hard and soft rivets.

A screw cap 40a closes the bore in which the bushing 40 is located and this cap also provides a seat for the valve spring 42.

The tool structure shown and described embodies the salient feature of a single riveting lever. This simplifies the construction in the riveting action in that it provides for the direct application of the power of the lever to the rivet in the tool form, shown in Figs. 1 to 10 and through a riveting plunger in the converted form shown in Figs. 11 to 13. In both forms the driving head acts directly on the lever and this provides for a tool of shorter length and less weight for ease in handling and balance. Moreover, this arrangement enables the cylinder section of the tool to be kept within a diameter for convenient grasping by the hand of the operator with the thumb of the operator extending towards the front end of the tool and within accessible range of the thumb piece 46 for operating the control valve.

Then also with the tool casing formed and open at its front end as herein disclosed the riveting heads of Figs. 1 to 10 and Figs. 11 to 13, respectively may be interchangeably used as replaceable units with the same casing and contained power cylinder, piston and control valve. In this respect, the jaws of the one form may be removed by taking out the holding pin 11 and its fulcrum 13 and be replaced by the yoke 63, yoke frame 68, lever 66 and adapter 69, the pins 11 and 13 being again used to hold the unit in place and provide the fulcrum for the lever. In this the riveting heads are interchangeable units enabling the tool to be converted into the one form or the other as herein disclosed. It is to be understood that different yokes may be applied to the yoke-frame for taking care of rivets of different lengths.

The details of construction and arrangement of parts shown and described may be variously changed and modified without departing from the spirit and scope of my invention, except as pointed out in the annexed claims.

I claim as my invention:

1. In a mechanical movement, a support, a lever comprised of angularly disposed arm portions and fulcrumed at a fixed point on the support through one of said arm portions, a track-way on the support in spaced relation to the other arm portion, the latter having a cam surface overlying the track-way and in angular relation thereto in the normal position of the lever, a reciprocable member mounted on the support and movable towards and from the fulcrum of said lever, means on the support for reciprocating said member, a driving head attached to said member and located between said cam surface and the track-way, roller elements and spacer means therefor floatably mounted on the driving head for self-adjustment as a unit relatively thereto, said spacer means holding the roller elements in engagement with the cam surface and the track-way, respectively, and out of peripheral contact with each other, and means for holding the lever against its roller element on the driving head.

2. A portable power operated squeeze riveting tool comprising, a support, fixed and movable jaws mounted on the support for substantially co-planar relative movement, said movable jaw being in the form of a lever having angularly disposed arm portions and fulcrumed on the support through one of said arm portions, said fixed jaw including a track-way and an anvil on opposite sides of said fulcrum, said first-named arm portion having a rigid portion movable with the lever towards the anvil on the riveting stroke of the lever to engage and upset a rivet backed up by the anvil, a power actuated driving head between said cam surface and the track-way and movable towards and from the fulcrum of the lever, roller elements and spacer means therefor floatably mounted on the driving head for movement as a unit relatively thereto, said spacer means holding the roller elements in engagement with cam surface and the track-way, respectively, and out of peripheral contact with each other, and means for holding the lever against its roller element on the driving head in its movement towards and from the fulcrum.

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