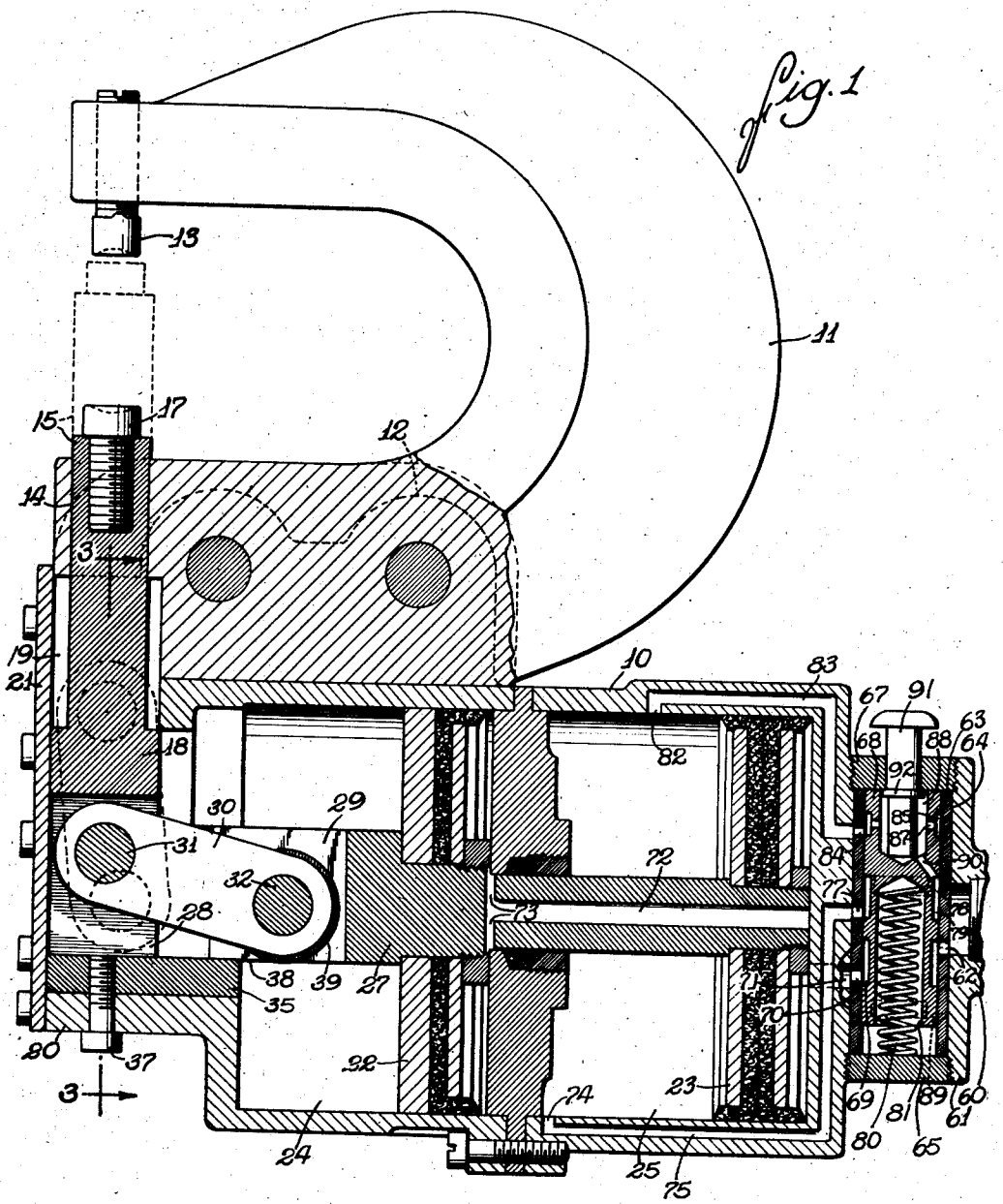
March 16, 1943. E. H. SHAFF 2,313,843

RIVETING TOOL

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Fig. 1



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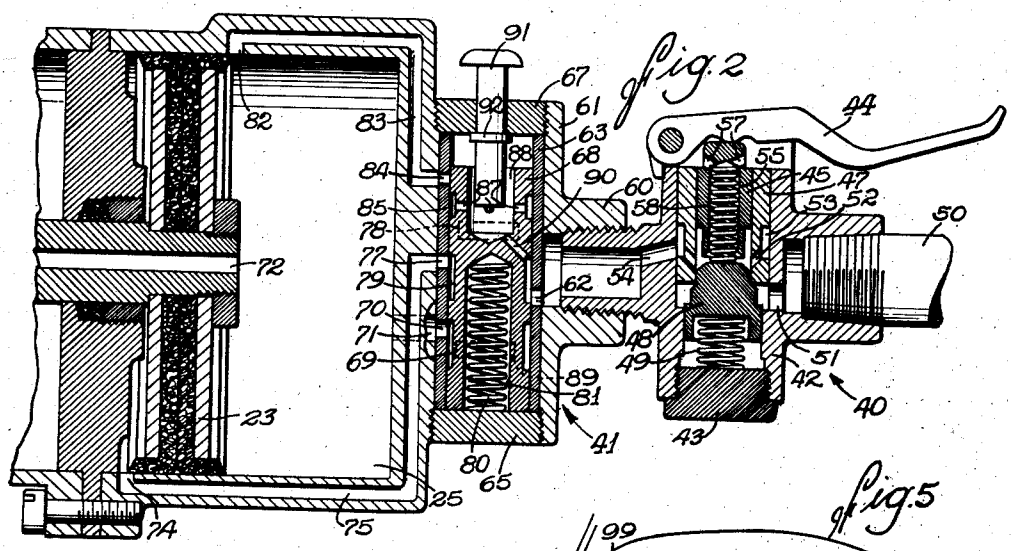


Fig. 2

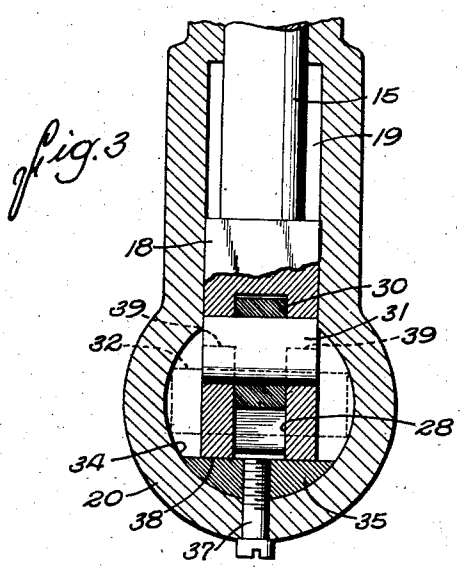


Fig. 3

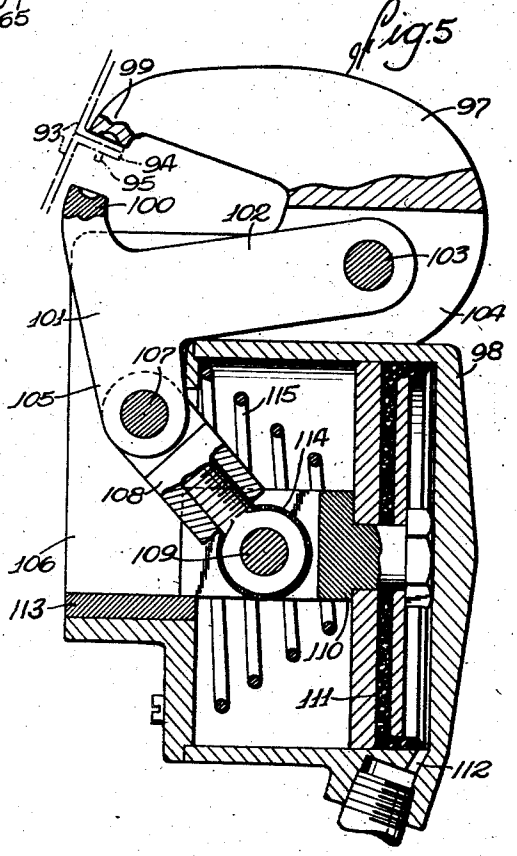


Fig. 5

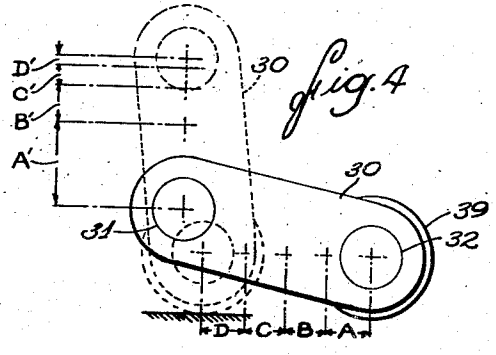


Fig. 4

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RIVETING TOOL

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Application November 4, 1937, Serial No. 172,681

7 Claims. (Cl. 78—48)

This invention relates to improvements in riveting tools and more particularly concerns yoke-type compression riveters.

A general object of the invention is to provide a novel riveting tool of this type which is more compact and requires fewer parts than similar prior tools, which has a more direct driving connection between the driving means and the ram, and in which the working parts are relieved of operating strains to which prior tools have been subject.

Another object is to improve such a riveting tool by replacing the conventional toggle link connection between the driving means and the ram by a direct thrust connecting link which is just as effective to increase the power ratio between the force of the piston thrust and the compression force of the ram and which operates in a more efficient and simplified manner.

Another object resides in the provision of novel means for entirely relieving the driving piston assembly of side thrust during operation.

Another object is to provide improved means for governing the pressure fluid actuated driving piston assembly to operate the ram selectively through a complete working cycle including a compression stroke and an instantaneously succeeding return stroke.

Another object is to provide a novel yoke-type riveting tool including a unique, unusually compact and powerful operating arrangement of the ram, rivet sets and driving means permitting the tool to be used in places having very limited working room.

Another object is to provide improved means for adjusting the rivet sets.

Other objects and advantages will become apparent from the following description taken in connection with the accompanying drawings in which:

Figure 1 is a fragmentary elevational view, partially in axial section of a riveting tool embodying features of the invention.

Fig. 2 is a fragmentary axial sectional view of the rear portion of the tool, showing certain parts in the relative positions assumed at the end of the power stroke in the cycle of operation.

Fig. 3 is a fragmentary sectional view taken along line 3—3 of Fig. 1.

Fig. 4 is a diagrammatic elevational view illustrating the operation of the driving link between the ram and the piston rod.

Fig. 5 is a sectional elevational view partly in axial section of a modified form of the invention.

While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawings and will herein describe in detail, the preferred embodiments, but it is to be understood that I do not thereby intend to limit the invention to the specific forms disclosed, but intend to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

One form of the invention selected for the purpose of illustration (Fig. 1) includes an elongated, chambered housing or barrel 10 near one end of which is a conventional riveting yoke 11 having one arm anchored rigidly between spaced parallel ears 12 projecting laterally of the barrel. The outer arm of the yoke carries an adjustable, stationary anvil or rivet set 13, while the attached arm of the yoke has a bore 14 in the forward end thereof serving as the bearing guide for an elongated reciprocal compression ram 15 carrying a rivet set 17. The ram has an inner end or base portion 18 preferably of rectangular cross-section which slides within a suitable forwardly opening recess 19 formed within a reduced front nose portion 20 upon the barrel 10. A closure plate 21 is bolted over the recess 19 and serves as a bearing for the base portion 18 of the ram.

Power for driving the ram 15 is generated by any suitable driving means, such means being shown herein as comprising a suitable pressure fluid actuated piston assembly, including a pair of pistons 22 and 23 arranged in tandem and reciprocably mounted within partitioned front and rear piston chambers 24 and 25, respectively, in the barrel 10 on an axis which herein is at substantially right angles to the path of movement of the ram 15. The pistons have a common axial plunger or piston rod 27 which extends beyond the front piston 22 a sufficient distance to underlie the base 18 of the ram 15 when the pistons are in forward position.

By the present invention the ram base 18 is connected to the forward end of the piston rod 27 without the toggle link assembly heretofore conventionally employed for this purpose. Herein, slots 28 and 29, respectively, are provided in a common axial plane in the base 18 and the forward end of the piston rod 27 to provide bifurcations to receive the front and rear ends of a direct thrust, flattened link 30 of suitable length connected therein by pivot pins 31 and 32, respectively. Strain in starting the tool is relieved by locating the pivot pin 31 on an off center axis relative to the axis of the piston rod 27 in the direction of the compression stroke of the ram 15, thus causing the link 30 to be inclined toward the ram from the piston rod axis during the inoperative position of the tool. As a result, forward movement of the pistons will, through the medium of the link 30, simultaneously initiate movement of the ram in the compression stroke without undue side thrust upon the base 18 of the ram, such slight side thrust as may arise

being absorbed by the closure plate 21 acting as a bearing.

As the pistons move forwardly and the ram 15 moves outwardly in the compression stroke, the inclination of the driving link 30 gradually increases relative to the axis of the piston rod 27, until at the end of the forward stroke the link extends almost perpendicularly to said axis. Coincident with such change in inclination of the driving link, there is a gradual change in the relative distances of travel of the pistons and the ram 15, the ram traveling substantially twice as far as the pistons during the first quarter of the compression stroke and only about one-fourth as far as the pistons during the last quarter of the compression stroke. This change is graphically illustrated in Fig. 4, where the distance traveled by the pistons, using the axis of the pivot pin 32 as a center, has been shown as divided into four equal steps, A, B, C, and D; and the corresponding distances traveled by the ram 15, using the axis of the pivot pin 31 as a center, has been shown as divided into four steps A', B', C', and D'. In this manner, while the driving force and the speed of the pistons remain constant throughout the power stroke, the speed of the ram, although greater at the beginning of its compression stroke will gradually decelerate with a directly proportional increase in compression, exerting in the final position of the compression stroke a force about four times as great as the forward thrust of the pistons.

As the ram 15 exerts increasing compression upon the rivet, there is an equal and opposite back pressure only a fraction of which is absorbed by the forward thrust of the pistons, the remainder being transmitted as a side thrust to the piston rod 27 tending to distort the same off center. Means is therefore provided by the present invention for relieving the piston rod 27 of such distorting force, such means herein comprising a cylindrical bearing bore 34 in the forward nose portion 20 coaxial with and slidably receiving the bifurcated forward end of the piston rod. Preferably the bore and rod are shaped cylindrically.

Since the principal thrust is always toward the side of the piston rod 27 opposite the ram 15, there will be a tendency toward greater wear on this side. To avoid such wear, however, a hardened metallic thrust plate 35 formed as a chordal section of the bore 34 is secured in place as by a bolt 37 to engage the thrust side of the piston rod which is formed with a flattened bearing face 38.

Preferably means is provided to avoid frictional resistance between the thrust plate 35 and the piston rod bearing face 38 as the thrust pressure increases, herein including a pair of rollers 39 mounted one on either side of the link 30 with the pivot pin 32 as an axle. The diameter of the rollers is such as to carry the peripheries almost flush with but slightly beyond the bearing face 38 of the piston rod to ride upon the thrust plate during at least the last part of the power stroke of the pistons. Thus, there will be a minimum of power loss due to friction even through great pressures and side thrust may be generated in operation. Moreover, the piston assembly will be maintained entirely free of side thrust distortion and wearing of the parts will be kept to a minimum.

Another feature of the invention resides in an improved operation controlling and governing system for the tool, including a pressure fluid control valve mechanism 40 which is selectively manually operable, and an automatic piston-operation-cycle governor 41. The valve mechanism and governor operate in series between the source of motivating pressure fluid supply and the piston chambers 24 and 25.

The control valve mechanism 40 (Fig. 2) is of the type which will not only permit the passage of live motivating pressure fluid such as compressed air to actuate the driving pistons but will also relieve the piston actuating system of any remaining pressure fluid at the end of a working cycle. Said valve mechanism is therefore constructed as a self-contained unit housed within an axially bored casing 42, one end of which is closed by a screw plug 43. Pivotally mounted upon the opposite end of the casing is a rearwardly extending operating handle lever 44 which intermediate its end engages the outer end of an inwardly movable plunger 45. The plunger is slidably mounted within a fixed sleeve bushing 47 which at its inner end coacts with a valve member 48 held sealingly thereagainst by a compression spring 49. When the valve 48 is forced open by pressing the handle against the end of the plunger 45, pressure fluid delivered from a suitable source through a conduit 50 and an inlet port 51 will pass to the interior of the bushing 47. Thence the pressure fluid passes through a generally radial series of apertures 52 into a peripheral groove 53 which communicates with an outlet port 54.

Any back pressure in the system ahead of the valve 48 when closed is vented to atmosphere, the plunger 45 being constructed to form a relief valve having an inwardly opening axial relief bore 55 which is open to atmosphere through ports 57 near the outer end thereof. When the handle 44 is depressed the inner end of the plunger bears in sealing engagement against the head of the valve member 48 and closes the bore 55. A light compression spring 58 within the relief bore 55 seats upon the forward face of the valve member 48 and acts to separate the inner end of the plunger 45 therefrom when the handle 44 is released, thus opening the bore 55 and effecting a passage to atmosphere via the bore and the ports 57.

After the pressure fluid leaves the control valve mechanism 40 by way of the outlet port 54, it is delivered to the cycle governor 41 through a nipple 60 upon a casing 61 within which the governor mechanism is contained at the rear of the barrel 10. The governor operates to direct the pressure fluid to actuate the pistons 22 and 23 in proper continuous sequence forward and back, that is in successive power and return strokes, and at the end of the return stroke positively halts further operation of the tool until reconditioned, as will be more fully described hereinafter. Thus, the tool will operate only through a single cycle each time the control valve handle 44 is depressed and will not accidentally repeat, a repetition of the operating cycle requiring release and reactuation of said handle.

From the nipple 60 the pressure fluid passes through an inlet port 62 into a barrel 63 which is fixedly secured within a bore 64 in the governor casing 61 by means of closure disks 65 and 67 threaded into the opposite ends of the bore. Within the barrel is a longitudinally reciprocable governor plunger or piston valve body 68 which has a peripheral groove 69 registering with the inlet port 62 and with a discharge port

70 to direct the pressure fluid to a delivery duct 71 communicating with the back of the rear piston chamber 25. There the pressure fluid becomes effective to drive the rear piston 23 forwardly and in part passes through an axial passage 72 and distributor ports 73 in the piston rod 27 to the back of the front piston chamber 24 for driving the piston 22.

During the driving or power stroke of the pistons air in front of the piston 22 is exhausted to atmosphere through suitable openings (not shown). At the same time air in front of the rear piston chamber 23 is exhausted through a port 74 at the forward end of the piston chamber 25 and travels through a passage 75 formed in the side and rear walls of the barrel 10 and communicating through a port 77 in the valve barrel 63. The exhausting air escapes to atmosphere from one side of the valve barrel through an exhaust port 78 which is maintained in communication with the port 77 by a peripheral groove 79 in the valve body 63.

Throughout the power stroke of the pistons, the valve body 68 is held by suitable resilient means such as a compression spring 80 in what may be termed a normal or initial position (Fig. 1). For this purpose the spring 80 seats at one end against the closure disk 65 and projects into an axial bore 81 provided therefor in the adjacent end of the valve body 68, the force of the spring normally holding the opposite end of the valve body in abutment with the closure disk 67.

When the pistons have substantially reached the forward end of the power stroke, the rear piston 27 uncovers a port 82 located at a predetermined intermediate point of the side wall of the rear piston chamber 25. Live pressure fluid immediately passes through such port and into a passage 83 which communicates by way of a port 84 in the wall of the valve barrel 63 and a peripheral groove 85 and ports 87 with a chamber or pocket 88 formed as a short axial bore in the end of the valve body 68 which opposes the closure disk 67. Upon reaching the pocket 88, the live pressure fluid is trapped and develops sufficient force to compress the spring 80 and push the valve body 68 away from the closure disk 67 and into endwise abutment with the closure disk 65. As a result, the peripheral groove 79 is carried out of register with the exhaust port 78 and registers with the pressure fluid inlet port 62 while the groove 69 is carried out of register with the inlet port 62 and registers with an exhaust port 89 in the wall of the valve barrel 63 (Fig. 2). Thus, the live pressure fluid will pass through the port 77, passage 75 and port 74 to the forward end of the rear piston chamber 25 to return the piston to starting position.

At the end of the return stroke, the pistons are halted by continuously maintaining the fluid pressure trapped in the pocket 88 and between the adjacent end of the valve body 68 and the closure disk 67 until the source of pressure fluid supply is shut off by the control valve 48. To this end a small pressure fluid duct 90 communicates between the pocket 88 and the grove 79 in the valve body, and the port 84 is arranged to be closed as soon as the groove 79 registers with the live pressure fluid port 62. Thus, the pressure pocket will remain active as long as live pressure fluid is admitted into the governor from the beginning of the return stroke of the piston, and at the end of the return stroke the tool will automatically come to a halt, because the valve body 68 is held against return to its initial position.

To repeat the operating cycle it is then necessary to release the handle 44 to close the control valve 48, and open the relief valve 45 which will vent any pressure fluid remaining ahead of the control valve, including that within the pressure pocket 88. Instantaneously thereafter, the spring 80 pushes the valve body 68 back to the initial position, thus reconditioning the cycle governor for a repetition of the cycle of operation.

Should the rivet sets 13 and 17 be too closely adjusted or an obstruction encountered to halt the power stroke of the pistons before the intermediate port 82 is uncovered by the forward piston 23, the tool will stall. Means is therefore provided for manually shifting the valve body 68 in opposition to the compression spring 80 to effect return of the pistons and release of the rivet sets. Herein a release pin 91 is mounted slidably in the closure disk 67 and projects into the pocket 88 to be pushed inwardly for shifting the valve body 68. Intermediate its ends the pin has a retaining collar 92 which serve during normal operation as a pressure fluid seal to avoid leakage around the shank of the pin through the closure disk 67.

The modified form of the invention shown in Fig. 6 has been devised with the particular view of entering limited working spaces where riveting tools of this type have not been permissible heretofore. For example, in riveting together a pair of plates 93 having quite narrow attachment flanges 94 as is common, for instance, in the aircraft industry, the customary form of riveting yoke as shown in Fig. 1, does not permit close enough approach to the plates to engage the rivet 95. However, while retaining the same principle of operation as described in connection with the tool of Fig. 1, the novel modified form of the tool includes a riveting yoke 97 which is mounted upon a body or barrel 98 and has a forwardly projecting nose 99 providing a fixed rivet set. Coactive with the fixed set is a movable rivet set 100 formed as a head upon a hammer-like ram or jaw 101 which has a rearwardly projecting arm 102 pivotally connected by a pin 103 within a longitudinal slot 104 formed in the attached leg of the yoke. Opposite the rivet set 100 the hammer ram 101 has a heel 105 which is movable between a pair of parallel guides 106 (only one of which is shown). The heel is pivotally connected by a pivot pin 107 to the forward end of a driving link 108. The opposite end of the link 108 extends into the barrel 98 and is pivotally connected by a pin 109 in the bifurcated forward end of a piston rod 110 which projects forwardly from a driving piston 111. As shown, the driving link 108 is formed in two parts threadedly connected for longitudinal adjustment to adjust the spacing of the rivet sets. It will be observed that the rivet sets are so located and placed on such an axis relative to the axis of the barrel that the sets may approach close to the faces of the plates 93 without interference from any other projecting parts of the tool.

Pressure fluid for actuating the piston 111 is delivered to the rear of the barrel through a bore 112, and as the piston rod 110 is driven forwardly the link 108 functions to drive the hammer ram 100 in practically the same manner as the previously described link 30 (Fig. 4). The principal difference is that instead of moving in a straight line perpendicular to the axis of the piston rod 110, the forward pivot 107 of the ram will travel in a slight forward arc on the radius of the ram pivot pin 103. Distortion of the piston rod 108 by

side thrust is avoided by a thrust plate 113 which engages the thrust side of the piston rod and which at the peak of the thrust is engaged by anti-friction rollers 114.

Use of merely the control valve assembly 40 will suffice for controlling and governing operation of this tool, the piston placing a spring 115 under compression during the power stroke and the tool stalling at the end of such stroke. Then when the valve control handle 44 is released, the compressed spring 115 will force the piston back and the spent pressure fluid will exhaust through the relief valve 45.

From the foregoing it will be apparent that the invention provides a riveting tool construction which embodies simplifications and improvements rendering the tool more compact and lighter in weight; more positively controllable; and more efficient in operation due to factors such as reduction in power losses from friction, freedom from distorting thrust strains upon moving parts, and more gradual development of riveting compression. Furthermore, such a tool is provided which is capable of riveting under conditions of limited working clearance for which prior tools of this type have not been available.

I claim as my invention:

1. A tool of the character described comprising, in combination, means carrying a stationary tool member, a ram having a tool member mounted for movement in a fixed path toward the stationary tool member, driving means for said ram including a pressure fluid actuated piston having a forwardly projecting piston rod movable rectilinearly at an angle to said path of movement of said ram, and a single connecting link between said piston rod and said ram, said link comprising two parts threaded together for relative longitudinal extension or contraction in adjusting the length of the link and controlling the spacing of said tool members.

2. In combination in a power tool of the character described, a stationary tool member and a support therefor comprising a relatively massive body having a slot in its base portion, a substantially hammer-shaped movable tool member including an elongated arm having means at its front portion cooperative with said stationary tool member for placing a work piece under compression between the members, said arm extending rearwardly within said base slot and having its rear end pivotally secured therein, a heel on the forward end portion of the arm opposite said compression means, reciprocable power means guided for movement on an axis extending in generally the same direction as said arm, and a single link pivotally connected to said heel and to said power means for swinging said arm hammer-like to carry said compression means toward and away from said stationary tool member in the reciprocations of said power means.

3. A portable riveting tool comprising, in combination, a housing providing a cylinder, a bracket carried by said housing and adapted to support a stationary tool, a tool carrier movable in a direction transversely of the axis of the cylinder, a piston in said cylinder, a piston rod, a link connecting said tool carrier with the piston rod, said cylinder having a forward extension providing a bearing surface engaged by the forward end of said piston rod in the retracted position of the piston, and a roller on the piston rod spaced rearwardly from the forward end of the rod and engageable with said bearing surface after an initial advancing movement of the piston.

4. A portable riveting tool comprising, in combination, a cylinder having a piston therein and a piston rod extending forwardly from the piston, a bracket mounted on said cylinder and adapted to support a stationary tool, said cylinder having coaxial therewith a forward extension of reduced diameter, said forward extension and said bracket providing a guideway extending in a direction perpendicular to the axis of the cylinder, a ram mounted for sliding movement in said guideway, a link connecting the forward end of the piston with the lower end of said ram, the forward end of said link being enclosed by said extension, and a bearing plate secured in the lower portion of said cylindrical extension for guiding and supporting the forward end of the piston.

5. A portable riveting tool comprising, in combination, a cylinder having a piston therein and a piston rod extending forwardly from the piston, a bracket mounted on said cylinder and adapted to support a stationary tool, a movable tool carrier mounted for movement in a path extending in a direction transversely of the axis of the cylinder, a link pivotally connecting the forward end of the piston with the lower end of said carrier, the pivotal connection between the link and the piston including a head on the piston and a pivot pin on the head, a roller carried by said pin, and means providing a bearing surface spaced forwardly from said roller in the retracted position of the piston, said head slidably engaging with said bearing surface in the initial portion of the advancing stroke of the piston.

6. A portable riveting tool comprising, in combination, a cylinder having a piston therein, and having coaxial therewith a cylindrical extension of reduced diameter, a bracket mounted on one side of the cylinder and adapted to support a stationary tool in laterally spaced relation relative to the cylinder, a plate closing the forward end of said cylindrical extension and cooperating therewith and with said bracket to provide a guideway extending transversely of the axis of the cylinder, a ram slidable in said guideway and adapted to carry a movable tool, and a link connecting the forward end of said piston with the lower end of said ram.

7. A portable riveting tool comprising, in combination, a cylinder having a piston therein, and having coaxial therewith a cylindrical extension of reduced diameter, a bracket mounted on one side of the cylinder and adapted to support a stationary tool in laterally spaced relation relative to the cylinder, a plate closing the forward end of said cylindrical extension and cooperating therewith and with said bracket to provide a guideway extending transversely of the axis of the cylinder, a ram slidable in said guideway and adapted to carry a movable tool, and a link connecting the forward end of said piston with the lower end of said ram, said extension having a bearing plate slidably engaged by the forward end of the piston in the retracted position of the latter, and a roller on the rear end of said link engageable with said bearing plate in the forward movement of the piston.

ERNEST H. SHAFF.