June 17, 1958 E. A. WOLFBAUER 2,839,665

PNEUMATICALLY OPERATED WELDER HEAD CONSTRUCTION

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FIG. 1

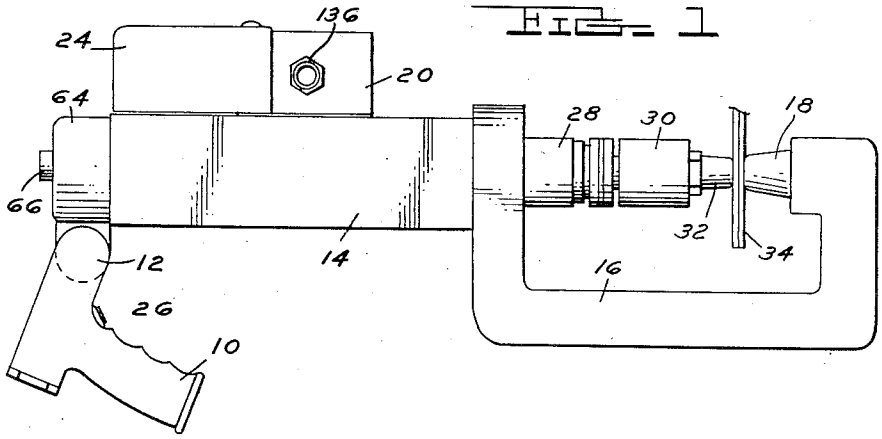



FIG. 6

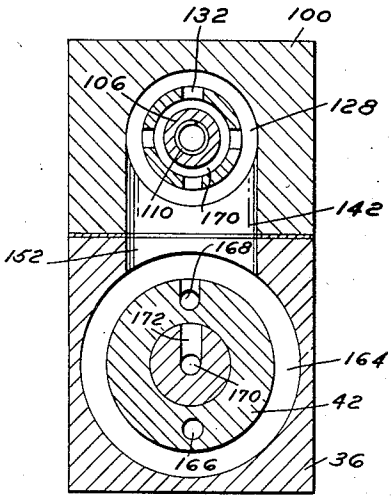
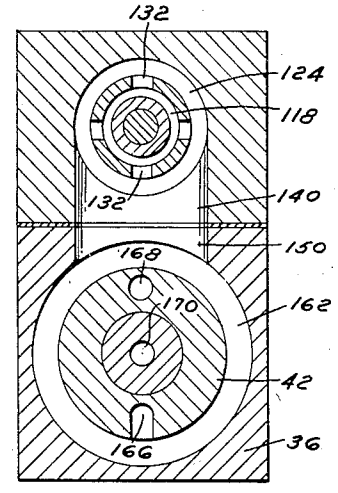



FIG. 7




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FIG. 2

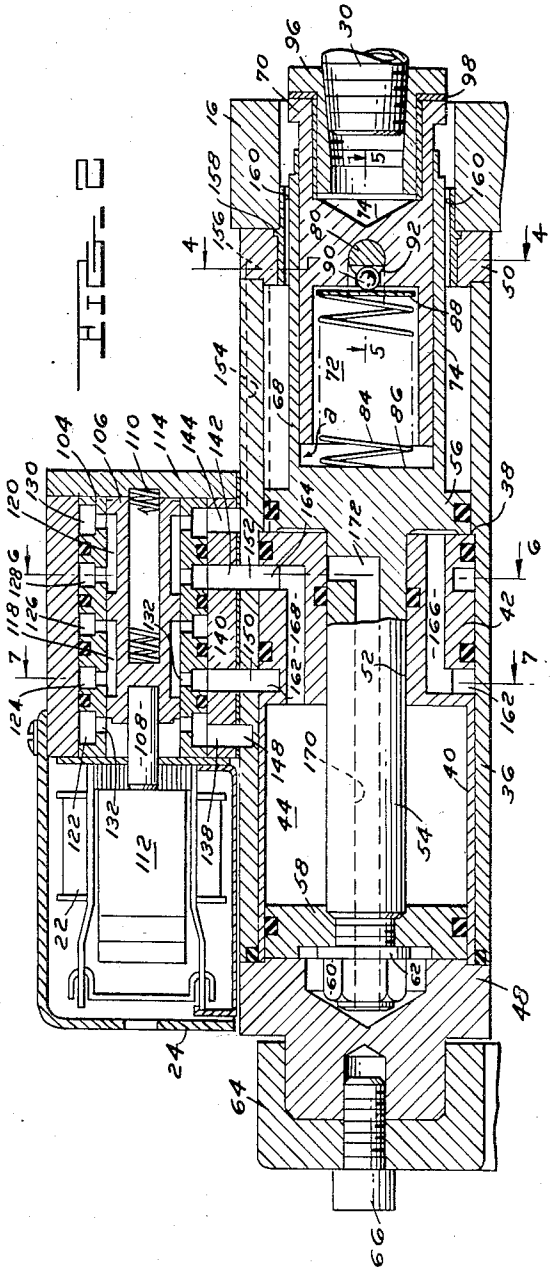


FIG. 4

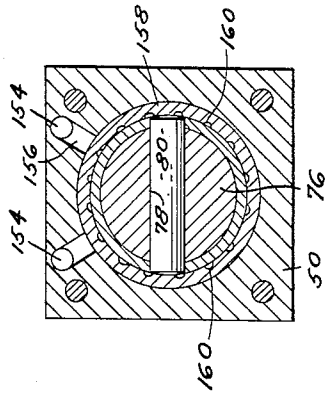
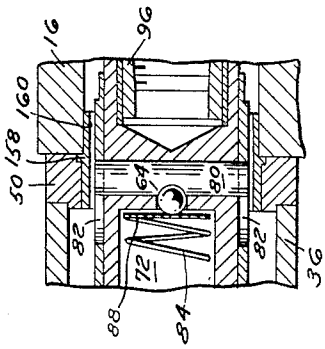


FIG. 5

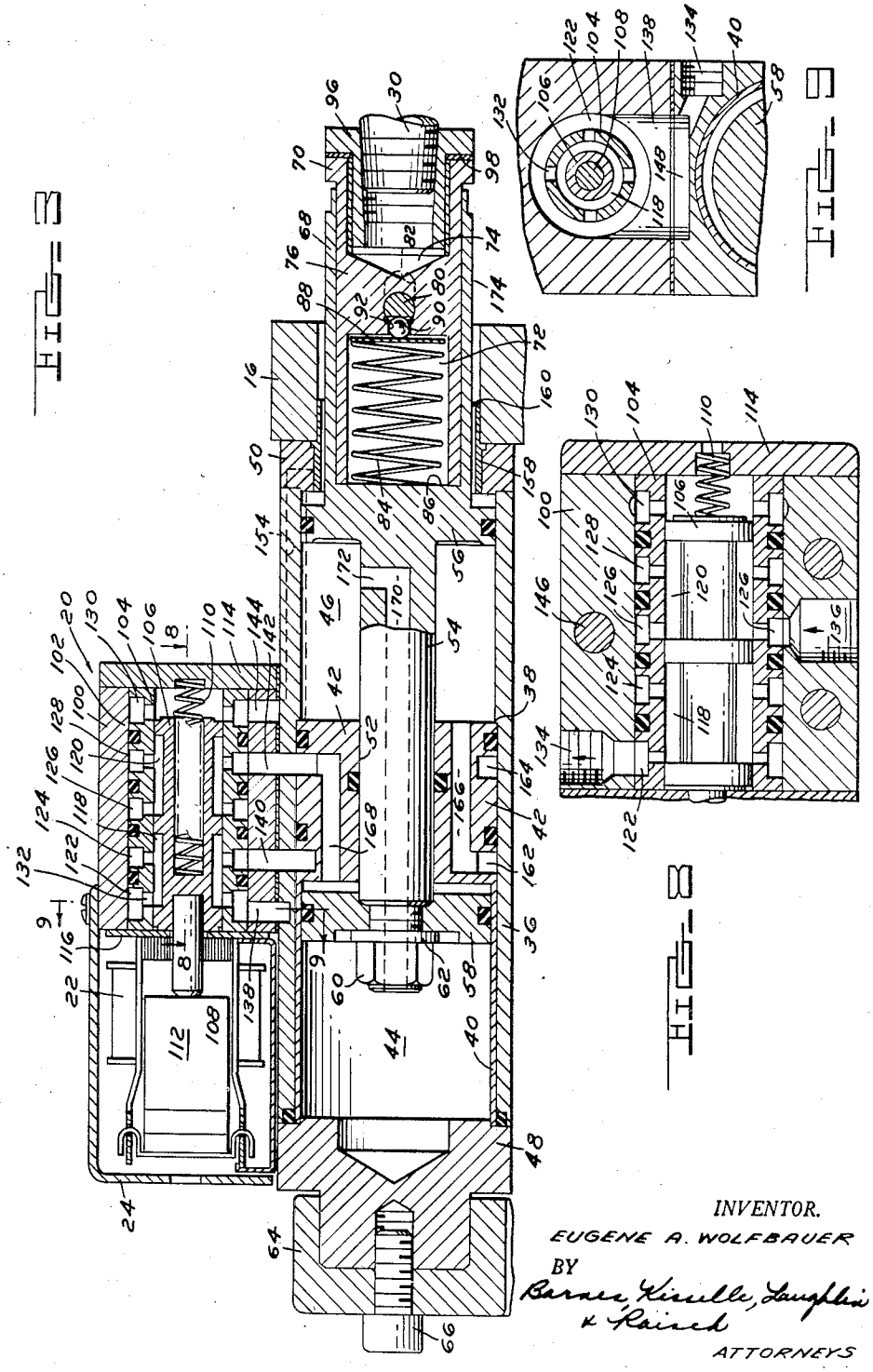


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2,839,665

# PNEUMATICALLY OPERATED WELDER HEAD CONSTRUCTION

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Application February 28, 1955, Serial No. 490,845

12 Claims. (Cl. 219—89)

This invention relates to pneumatically operated welders and has more particularly to do with a pneumatic cylinder arrangement for actuating the movable electrode of the gun.

It is an object of this invention to provide a pneumatic welder in which the electrode holder which projects through one end of the pneumatic cylinder is constantly lubricated by the oil normally carried in the compressed air line to which the gun is connected.

A further object of the invention resides in the provision of a novel arrangement of a follow-up spring between the electrode holder and the piston employed for reciprocating the electrode and also a novel arrangement for connecting the electrode holder with the piston.

In the drawings:

Fig. 1 is a side elevational view of a pneumatic welding gun construction in accordance with the present invention.

Fig. 2 is a fragmentary sectional view of the cylinder, piston and valve portions of the gun, the parts being shown in the positions they occupy when the piston starts on its work stroke.

Fig. 3 is a view similar to Fig. 2 and showing the parts in the positions they occupy when the piston starts its retracting stroke.

Fig. 4 is a sectional view taken along the line 4—4 in Fig. 2.

Fig. 5 is a sectionaal view taken along the line 5—5 in Fig. 2.

Fig. 6 is a sectional view taken along the line 6—6 in Fig. 2.

Fig. 7 is a sectional view taken along the line 7—7 in Fig. 2.

Fig. 8 is a sectional view taken along the line 8—8 in Fig. 3.

Fig. 9 is a sectional view taken along the line 9—9 in Fig. 3.

As shown in Fig. 1, the gun of this invention includes a pistol grip handle portion **10** pivotally mounted on the rear end of an air cylinder **14**. On the front end of cylinder **14**, there is fixedly mounted a yoke **16** on which is arranged an electrode **18**. On the body of cylinder **14**, there is arranged an air valve **20** actuated by a solenoid **22** contained within a sheet metal housing **24**. A push button switch **26** on handle **10** is arranged to energize solenoid **22** through a control panel not shown. As is conventional, the control panel includes adjustments for regulating the duration of the weld cycle, etc. Within and projecting from cylinder **14**, there is arranged a piston assembly **28** which supports an electrode holder **30** on which an electrode **32** is mounted. Electrodes **32** and **18** are axially aligned so that work pieces **34** may be arranged therebetween and welded when the electrodes are brought together and welding current caused to flow therethrough. It is understood, of course, that one side of the welding current source is connected to electrode **32** and the other side of the welding current source to the electrode **18**. The manner in which solenoid **22** is energized by means of switch **26** and the manner in which the welding current is caused to flow between the two electrodes are conventional and therefore not illustrated.



The cylinder arrangement of the present gun is constructed generally along the lines of that shown in the United States Patent to Folmer, No. 2,661,599, dated December 8, 1953. The cylinder **14** includes a tubular body **36** formed with an internal annular shoulder **38**. Within tubular body **36**, there is arranged a sleeve **40** having an end wall **42** which abuts against shoulder **38** and divides the interior of the cylinder into two chambers **44** and **46**. An end cap **48** is secured to the rear end of body **36**, and a second end cap **50** is secured to the front end of body **36**. The end wall **42** is fashioned with a central bore **52** which slidably receives a piston rod **54**. Rod **54** is formed integrally with a piston **56** disposed in chamber **46** and has mounted at one end thereof a piston **58** which is slidably arranged in chamber **44**. Piston **58** is retained on the end of rod **54** by means of a nut **60** and a lock washer **62**. A circular hub **64** is rotatably adjustable on end cap **48** and is secured thereto by a screw **66**. Hub **64** pivotally supports handle **10** as at **12**. The end of piston rod **54** adjacent piston **56** is formed as a tubular extension **68** which projects outwardly through the front end cap **50**. Within extension **68**, there is slidably arranged an electrode holder sleeve **70** provided with a cylindrical socket **72** at its inner end and with a cylindrical socket **74** at its outer end. Sockets **72** and **74** are separated by an intermediate radial wall **76** having a cross bore **78** in which a pin **80** is received. The opposite ends of pin **80** project outwardly beyond the cylindrical outer surface of sleeve **70** and are received in axially elongated openings **82** formed in the cylindrical side wall of extension **68**. Within cavity **72**, there is arranged a compression spring **84** which normally urges the electrode holder sleeve **70** axially outwardly of extension **68**. One end of spring **84** bears against the face **86** of piston **56** and the other end bears against a washer **88** seated against the end wall of socket **72**. Pin **80** is retained in position by means of a round steel ball **90** enclosed within an axial bore **92** communicating with the bore **78** in wall **76**. Ball **90** is urged by spring **84** to seat in a depression **94** positioned centrally between the ends of pin **80**. Within socket **74** of sleeve **70**, there is arranged a bushing or adapter **96** in which the electrode holder **30** is threaded or otherwise secured. Bushing **96** is electrically insulated from sleeve **70** as by insulating material **98**. With the arrangement thus far described, it will be appreciated that as the piston rod **54** is actuated outwardly of the cylinder on its work stroke, the work **34** is initially clamped between electrodes **18** and **32**; and as the rod **54** continues to move outwardly, spring **84** is compressed and sleeve **70** is permitted to slide axially inwardly of extension **68** from the position shown in Fig. 2 to that shown in Fig. 3. This relative movement which, in the arrangement shown is equal to the distance *a* in Fig. 2, is permitted by the elongated openings **82** in the side wall of extension **68**.

Valve **20** includes an outer body part **100** having an axial bore **102** in which is arranged a bearing sleeve **104**. A spool valve **106** is slidably arranged within bearing sleeve **104**. Valve **106** has a pin **108** projecting from one end thereof and a spring **110** normally biases the valve to the position shown in Fig. 3 wherein the free end of pin **108** abuts against the movable armature **112** of the solenoid **22**. When the solenoid is energized, armature **112** moves to the right as viewed in Figs. 2 and 3 and acts through pin **108** to compress spring **110** and thereby shift valve **106** from the position shown in Fig. 3 to the position shown in Fig. 2. The valve body is closed at its front end by a wall **114** and at its rear end by a wall **116**. Valve **106** is formed with spaced grooves **118**

and 120 around its outer surface. Bearing sleeve 104 is also formed around its outer surface with a plurality of axially spaced grooves 122, 124, 126, 128 and 130. These grooves in bearing sleeve 104 are each connected with the inner bore of the sleeve by a plurality of radial openings 132. The relative position of grooves 118 and 120 of spool 106 on the one hand and grooves 122, 124, 126, 128 and 130 on the other hand is such that when the solenoid is deenergized as shown in Fig. 3, groove 118 in valve 106 connects with grooves 122 and 124 in bearing sleeve 104; and groove 120 in spool 106 communicates with grooves 126 and 128 in bearing sleeve 104. When solenoid 122 is energized so as to shift valve 106 from the position shown in Fig. 3 to that shown in Fig. 2, groove 118 on valve 106 communicates with grooves 124 and 126 while groove 120 communicates with grooves 128 and 130.

Referring now to Fig. 8, it will be seen that groove 122 in bearing sleeve 104 communicates with an outlet port 134 at one side of body 100 and that groove 126 communicates with an air inlet port 136 at the opposite side of body 100. The bottom face of body 100 is provided with slots 138, 140, 142 and 144 which are aligned respectively with grooves 122, 124, 128 and 130. Body 100 is mounted on the top face of cylinder 14 by means of screws 146 (Fig. 8) and slots 138, 140 and 142 register respectively with elongated recess 148 and transversely elongated slots 150 and 152 formed in the wall of the portion 36 of cylinder 14 on which the valve structure is secured. Slot 144 registers with one end of a pair of passageways 154 which extend forwardly in body 36 and radially inwardly as at 156 in end cap 50 so as to communicate with the space in chamber 44 between end cap 50 and piston 56. End cap 50 is provided with a bearing 158 in which the extension 68 is slidably received. Bearing 158 is fashioned around its inner periphery with a series of axially extending grooves 160 which open to atmosphere at one side thereof and which communicate with the space between the end cap 50 and piston 56 at the other end thereof.

In order to actuate the piston assembly for the work and retracting stroke of electrode 32, the wall 42 of sleeve 40 which divides the cylinder into the two chambers 44 and 46 is fashioned with annular grooves 162 and 164 around the outer surface thereof. Grooves 162 and 164 register respectively with slots 150 and 152 in the top wall of body 36 of the cylinder. Groove 162 communicates with chamber 46 by means of an axially extending passageway 166 and groove 164 communicates with chamber 44 through an axially extending passageway 168. In addition, piston rod 54 is fashioned with an axial bore 170 having a radial outlet 172. In the retracted positions of pistons 56 and 58, outlet 172 of axial passageway 170 is closed by the axial bore 52 in wall 42. As the pistons move on their work stroke, that is, in the direction from left to right as shown in Figs. 2 and 3, outlet 172 is uncovered and communicates with chamber 46. As is clearly shown in the drawings, O-rings of the conventional type are employed where necessary to obtain the proper sealing between the moving parts.

In operation, assuming that solenoid 22 is deenergized as shown in Fig. 3 and it is desired to effect a weld on the work shown at 34, the gun is arranged with respect to the work as shown in Fig. 1 and the switch 26 is depressed to energize solenoid 22. Armature 112 moves toward the right as shown in Fig. 2 and valve 106 is shifted to the position shown in Fig. 2. In this position of the valve, compressed air from inlet port 136 flows into annular groove 126, through groove 118 on valve 106, into groove 124 and from groove 124 through slots 140 and 150, into the annular groove 162 on wall 42 and then through axial passageway 166 into the portion of chamber 46 lying between piston 56 and wall 42. Pressure is thus applied to piston 56 to cause the piston to move outwardly or towards the right as shown in Figs. 2 and 3. As soon as the piston moves towards the right sufficiently to uncover outlet 172, the compressed air also flows from chamber 46 through passageway 170 to the portion of chamber 44 lying between piston 58 and end cap 48. Thus, pressure is applied to one side of both pistons on the work stroke. Continued movement of the pistons and rod 54 in an outwardly direction after electrode 32 contacts the work causes spring 84 to be compressed as previously described. Shortly after electrode 32 contacts the work, the flow of welding current through the two electrodes is initiated and is maintained for the desired interval of time to effect a proper weld. It will be observed that by reason of the relatively large extent that the sleeve 70 can move inwardly relative to the extension 68, the distance denoted *a* in Fig. 2, the flow of welding current can be initiated before the pistons reach the end of their work stroke; and during this interval of time, the spring 84 will maintain the electrode 32 in pressure contact with the work and will effect a proper weld. As a matter of fact, the arrangement is such that the hold period during which time the welding current is caused to flow may be less than the time required for the pistons to complete the working stroke. Spring 84 will serve to maintain the electrode 32 in firm contact with the work; and thus, the periods between successive weld cycles can be shortened considerably because it is not necessary to wait until the pistons reach the end of their working stroke before the weld is completely effected. In addition, the relatively long spring prevents bouncing of the electrode when it contacts the work, thus preventing arcing. At the same time, it compensates for variations in the timing of the various phases of each cycle which invariably occur such as result, for example, from variations in the current to the control panel. After a predetermined interval of time, solenoid 22 is automatically deenergized and valve 106 is pivoted from the position shown in Fig. 2 to the position shown in Fig. 3. In this position of the valve, it will be noted that air from the inlet port 136 flows through groove 126 in bearing sleeve 104, then through groove 120 in valve 106 into groove 128 and then through slots 142 and 152, into the axial passageway 168 and from passageway 168, into the portion of chamber 44 between wall 42 and piston 58. The pistons are thus retracted.

Referring again to the work stroke of the pistons, it will be appreciated that as the pistons move outwardly in their respective chambers, air in the portions of the chamber on the back side of the pistons must be exhausted. Thus, the air in chamber 46 between piston 56 and end cap 50 is discharged directly through the grooves 160 in bearing 158. The air in chamber 44 between piston 58 and wall 42 flows through passageways 168 and 164 in wall 42 through slots 152 and 142 into annular groove 128, then through groove 120 in valve 106, through annular groove 130, then forwardly through axial passageway 154 and into the portion of chamber 46 between piston 56 and end wall 50. Thus, the air that is exhausted from both chambers is caused to be discharged through grooves 160. Since this air picks up oil particles both in the compressor and as it flows through the lubricated parts of the valve structure, the oil in the air will effectively lubricate the outer bearing surface 174 of extension 68. Grooves 160 are relatively small and prevent the ingress of foreign matter into chamber 46. At the same time, bearing 158 wipes the bearing surface 174 of extension 68; and this bearing surface is therefore maintained relatively clean and in a well lubricated condition. The discharge of air from the outer ends of grooves 160 also prevent weld flash from adhering to bearing 158 and bearing surface 174.

On the return strokes of the pistons, the air in chambers 44 and 46 is directed to the exhaust port 134 through passageway 166 and annular groove 162 in wall 42, then through slots 150 and 140 to groove 124 and from groove

124 through groove 118 in spool 106 and then outwardly of the body through annular groove 122.

I claim:

1. In combination, a cylinder having a wall at each of its opposite ends, piston means in said cylinder having a rod connected thereto and extending outwardly through one of said end walls, said one end wall being provided with an opening therethrough in which said rod is slidably received in bearing engagement, said opening being defined in part by a plurality of circumferentially spaced circular segment surfaces embracing the outer surface of the rod, the portion of said opening between said segment surfaces being spaced radially outwardly from the outer surface of the rod to provide a clearance space for the passage of air therethrough, means for introducing air under pressure into said cylinder alternately on opposite sides of said piston means to reciprocate the rod, whereby when said rod moves outwardly of said one end wall, air from within the cylinder is exhausted through said clearance space and the rod is thereby lubricated by any oil contained in said air under pressure.

2. The combination called for in claim 1 wherein said clearance space is sufficiently small to prevent the ingress of foreign matter into said cylinder.

3. In combination, a cylinder having a wall at each of its opposite ends, piston means in said cylinder having a rod connected thereto and extending outwardly through one of said end walls, said one end wall being provided with an opening therethrough in which said rod is slidably received in bearing engagement, said opening being defined in part by a plurality of circumferentially spaced circular segment surfaces embracing the outer surface of the rod, the portion of said opening between said segment surfaces being spaced radially outwardly from the outer surface of the rod to provide a clearance space for the passage of air therethrough, means for introducing air under pressure into said cylinder alternately on opposite sides of said piston means to reciprocate the rod, whereby when said rod moves outwardly of said one end wall, air from within the cylinder is exhausted through said clearance space and the rod is thereby lubricated by any oil contained in said air under pressure, said opening being provided by an annular bearing in said end wall embracing said rod, said bearing having a plurality of axially extending, circumferentially spaced grooves around the inner periphery thereof, said grooves providing said clearance space.

4. In combination, a cylinder having a wall at each of its opposite ends and having an intermediate wall dividing the cylinder into two chambers, a piston in each chamber, means extending through said intermediate wall in fluid-tight relation therewith and connecting said pistons together for movement in unison in said cylinder, one of said pistons having a rod connected therewith and extending axially through one of said end walls, said one end wall having an opening therein through which said rod extends, there being a relatively small clearance space provided between said rod and said opening to permit the passage of air therethrough and means connecting said clearance space with each of said chambers on at least one side of the piston therein.

5. The combination called for in claim 4 including means for admitting compressed air to said chambers to effect movement of said pistons whereby as the pistons move in one direction, the air is exhausted from each chamber on one side of the pistons through said clearance space and the rod is thereby lubricated by the oil normally carried in the stream of compressed air.

6. The combination called for in claim 5 including an annular bearing in said one end wall, said annular bearing providing said opening through which said rod extends, said bearing embracing said rod and having a plurality of axially extending, circumferentially spaced grooves around the inner periphery thereof forming said clearance space.



7. The combination called for in claim 5 wherein said means for admitting compressed air to said chambers include a valve body mounted on said cylinder and having a plurality of passageways therein communicating with said chambers and a valve shiftably mounted in said valve body, said valve being shiftable to selectively connect said passageways in said valve body with said chambers to reciprocate said pistons.

8. In combination, a cylinder having a wall at each end thereof and an intermediate wall dividing the cylinder into two chambers, a piston in each chamber, means extending through said intermediate wall and connecting said pistons together for movement in unison, one of said pistons having an extension thereon which extends axially through the adjacent end wall of the cylinder, said last mentioned end wall having an opening therein in which said extension is slidably received, there being a clearance space provided in said opening to permit the discharge of air between said rod and said opening, said clearance space extending axially through said end wall and communicating with the atmosphere on one side of the wall and with the adjacent chamber in said cylinder on the other side of the wall, means for connecting the other chamber with said clearance space, said last mentioned means comprising a valve body mounted on said cylinder and having a pair of passageways therein, one of said last mentioned passageways communicating with said clearance space and the other passageway communicating with said other chamber and a spool valve in said valve body shiftable to connect and disconnect said passageways.

9. The combination called for in claim 8 wherein said intermediate wall has a pair of passageways therein, one of said last mentioned passageways communicating with one of said chambers and the other of said last mentioned passageways communicating with the other of said chambers, said valve body having an inlet port for compressed air and an exhaust port, said valve being shiftable in said valve body to connect one of said passageways in said intermediate wall alternately with said exhaust port and said inlet port and the other passageway in said intermediate wall alternately with said inlet port and said clearance space.

10. In a welder, the combination of a cylinder, a piston in said cylinder having a rod portion extending outwardly through one end of the cylinder, said rod portion being of tubular shape, an electrode holder telescopically engaged within said tubular rod portion, means interconnecting said rod portion with said holder to permit limited relative axial movement therebetween to an extent substantially greater than the normal follow-up distance through which an electrode is required to move in a welding operation due to fusion at the point of welding and a compression spring acting between said rod portion and said holder and tending to project said holder outwardly of said rod portion.

11. In a welder, the combination of a cylinder, piston means in said cylinder having a rod portion extending outwardly through one end of the cylinder, means for admitting fluid under pressure to said cylinder on opposite sides of said piston means to reciprocate said piston means and rod portion, said rod portion being tubular in shape, an electrode holder telescopically received within said rod portion, said rod portion having a pair of diametrically aligned openings therein, a pin extending transversely through and slidably received in said electrode holder and having its opposite ends received within said openings in said rod portion, said openings having an axial dimension greater than the diameter of said pin, whereby said holder is permitted to move axially relative to said rod portion, said pin having a recess at the center portion thereof, a ball bearing seated in said recess and

a spring interposed between said rod portion and said ball bearing for urging said holder in a direction outwardly of said rod portion.

12. The combination called for in claim 11 including a washer interposed between said ball bearing and one end of said spring.

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