

[54] **PRESSURE INTENSIFIER CYLINDER**

[76] Inventor: **Donald Joseph Beneteau**, 1293
Front Rd., Amherstburg, Ontario,
Canada

[22] Filed: **June 1, 1973**

[21] Appl. No.: **365,958**

Related U.S. Application Data

[63] Continuation of Ser. No. 188,184, Oct. 12, 1971,
abandoned.

[30] **Foreign Application Priority Data**

Oct. 30, 1970 Canada 96957

[52] U.S. Cl. **219/89, 60/560**

[51] Int. Cl. **B23k 11/00**

[58] Field of Search 60/547, 560, 565, 583,
60/595; 219/89

[56] **References Cited**

UNITED STATES PATENTS

1,970,999	8/1934	Ferris et al.	60/565
2,032,185	2/1936	Sciaky	60/567
2,127,265	8/1938	Martin	219/89
2,169,423	8/1939	Kessler et al.	60/560
2,827,766	3/1958	Hufford	60/560
2,832,882	4/1958	Bieri	219/89
3,253,412	5/1966	Torossian	60/534
3,276,206	10/1966	Calkins	60/560

3,426,530.	2/1969	Georgelin	60/560
3,500,641	3/1970	Meekings	60/588

FOREIGN PATENTS OR APPLICATIONS

26,411	2/1954	Finland	219/89
812,962	1/1936	France	219/89

Primary Examiner—Martin P. Schwadron

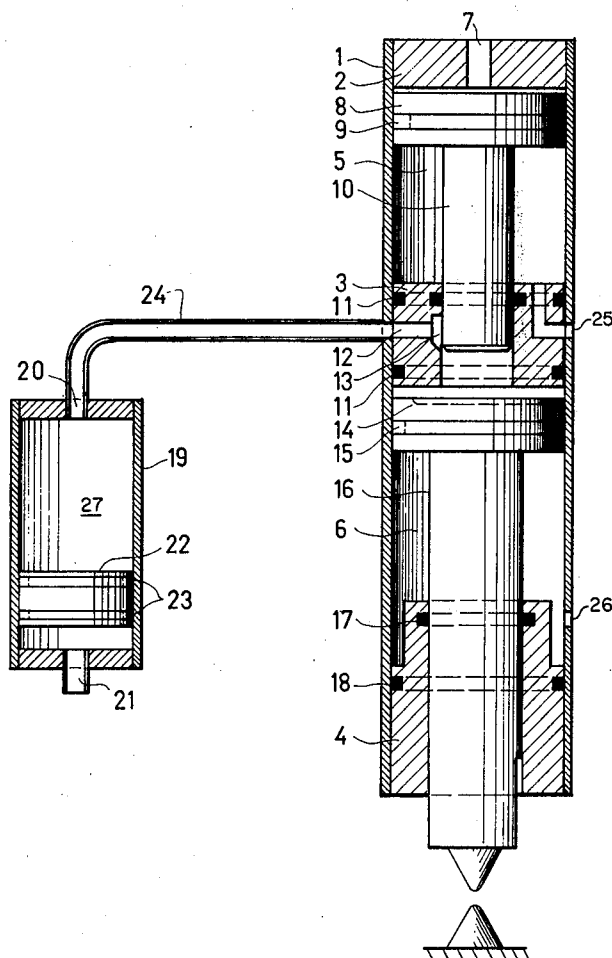
Assistant Examiner—H. Burks, Sr.

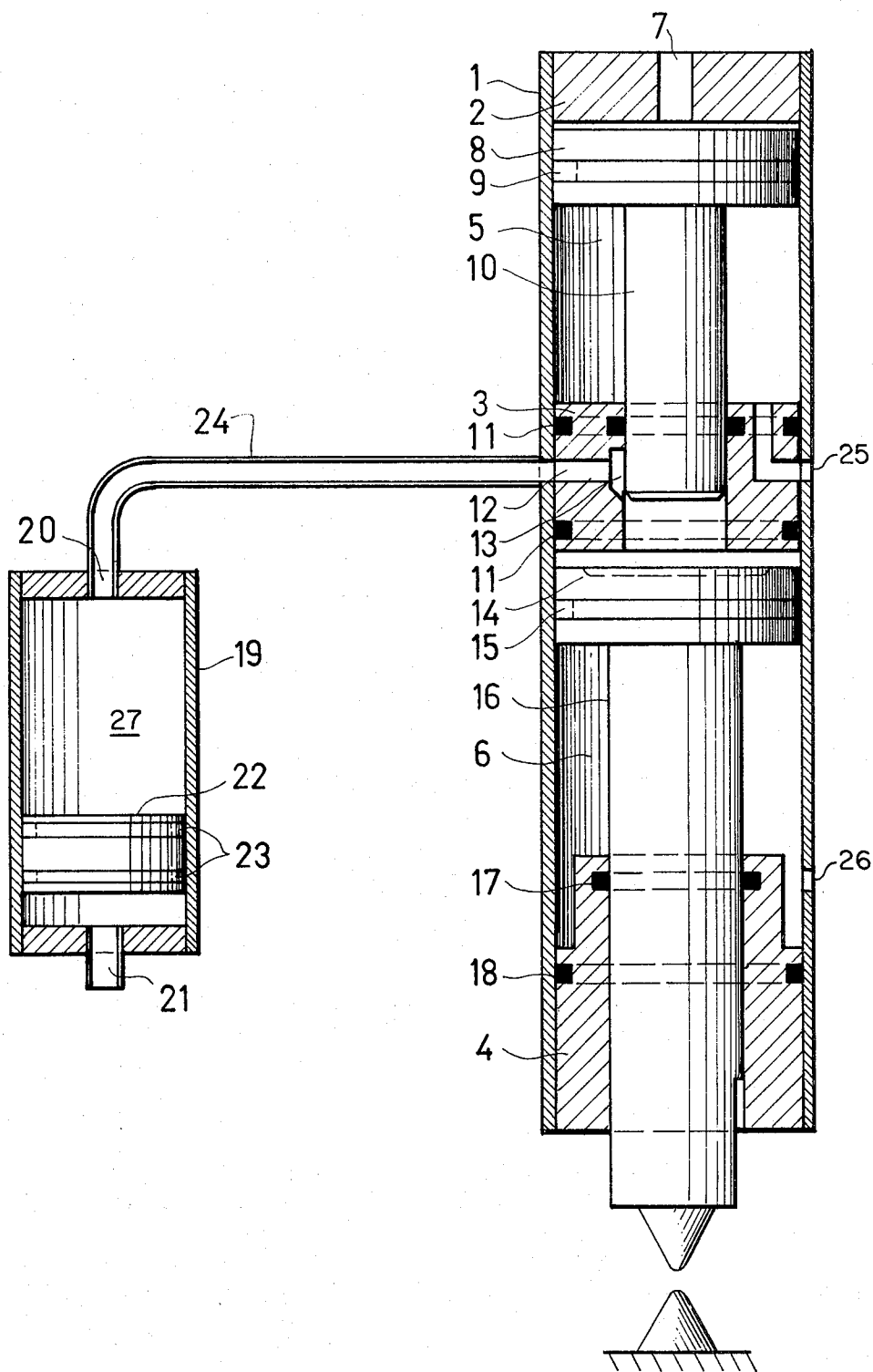
Attorney, Agent, or Firm—Allen D. Gutchess, Jr.

[57] **ABSTRACT**

This invention consists of a combined pneumatic and hydraulic cylinder the purpose of which is to provide a very high pressure, particularly in the process of resistance welding, without the necessity of having a very large cylinder nor a high pressure line. In the invention, the cylinder is comparatively small in size and is equipped with two pistons and piston rods, one above the other. The lower piston is at first activated by compressed hydraulic fluid until it makes contact with the work. The upper piston which is activated by compressed air travels toward the lower piston so that its piston rod entraps the pressurized hydraulic fluid above the lower piston, and proceeds to add its own pressure to the pressure already acting upon the lower piston. The entire action is controlled by a delayed action valve and a four-way valve.

9 Claims, 1 Drawing Figure





INVENTOR.
DONALD J. BENETEAU
BY *Chas. Krasov*
Attorney

PRESSURE INTENSIFIER CYLINDER

This is a continuation of application Ser. No. 188,184 filed Oct. 12, 1971, now abandoned.

This invention consists of a combined pneumatic and hydraulic cylinder for use primarily in conjunction with electric resistance welding machines where a high pressure is required on the electrode at a comparatively short stroke. The above conditions can be found in connection with such operations as piercing, forming, clinching, clamping, etc.

The primary object of this invention is to provide a comparatively small cylinder which will meet the above requirements, thus replacing a very large and highly pressurized cylinder which would otherwise be required.

The above mentioned advantage and many others which will become obvious from the following description are accomplished in the invention by providing a novel and effective pressure intensifier mechanism consisting of two separate pistons within one cylinder, one of said pistons applying the pressure to the electrode, while the other intensifies the pressure by applying additional pressure to the first mentioned piston.

In describing the invention reference will be made to the attached drawing in which,

FIG. 1 is a diagrammatic view of the invention shown partly in section.

In the drawings is shown a cylinder 1 having the upper end thereof closed by a fixed plug 2 and the bottom end closed by a fixed plug 4. Inside, the cylinder is divided into two compartments, i.e., an upper compartment 5 and a lower compartment 6, by means of a fixed plug 3.

The upper plug 2 is provided with a centrally located entry 7, through which compressed air is supplied to act upon the upper piston 8 which is contained in the compartment 5. The piston 8 will be referred to as the intensifier piston. The piston 8 is also provided with an annular seal 9 and a piston rod 10. The said piston rod extends part way into the plug 3 through a sliding fit hole in the said plug. Annular seal 11 is provided in the plug 3 to seal the piston rod 10 and the plug 3 against leakage.

An entry 12 for hydraulic fluid passes through the wall of the cylinder 1 and into the plug 3 and terminates in a small chamber 13. The plug 3 is also provided with a compressed air entry 25 to provide pressure for the return stroke of the intensifier piston 8.

The lower compartment 6 is provided with a piston 14 having an annular seal 15 and a piston rod 16 which extends through the plug 4 to the outside of the cylinder 1. An annular seal 17 prevents leakage around the piston rod 16, and a similar seal 18 prevents leakage at the wall of the plug 4.

An auxiliary component to the above described cylinder 1 consists of a combination air and hydraulic cylinder 19. This cylinder is enclosed at both ends and it contains a piston 22 which is provided with annular seals 23. A centrally located entry 21 at one end of the cylinder provides compressed air to one face of the piston 22. The chamber 27 above the opposite face of the said piston is filled with hydraulic fluid which has an exit 20 at the other end of the cylinder 19. This exit is connected by a pipe 24 to the entry 12 in the cylinder 1.

A compressed air inlet 26 provides compressed air for the return stroke of the piston 14. The cylinders 1 and 19, which are controlled by means of a standard four way valve (not shown in the drawings) are operated in the following manner. Air pressure is applied to the piston 22 through the entry 21. The said piston compresses the hydraulic fluid in the chamber 27 sending the said fluid through 24 into 13 where it acts upon the piston 14 to make contact with and apply pressure to the metal to be welded, by means of its piston rod 16. After contact has been made, compressed air is sent through 7 forcing the pressure intensifier piston 8 to move downward towards the piston 14, so that its piston rod 10 closes off further entry of hydraulic fluid and provides the additional pressure to the fluid already contained above the piston 14 and consequently to the point of contact.

The following calculation to verify the above mentioned results is shown purely by way of example and it is not intended to limit the invention to the dimensions used in the problem.

As the intensifier piston advances, the hydraulic fluid chamber is sealed off, after which the internal pressure is increased in direct proportion as per the following formula:

Area of Intensifier piston $\times$ Area of Lower piston
Area of Intensifier Piston Rod.

Assume Diameter of Intensifier piston to be 1 15/16 inches

Then Area of Intensifier piston = 2.96 sq. in.

Assume Diameter of Lower piston to be 2 inches

Then Area of Lower piston = 3.14 sq. in.

Assume Diameter of Intensifier piston rod to be three-fourths inch

Then Area of Intensifier piston rod = .442 sq. in.

Assume the compressed air supply to be at 100 PSI.

Then substituting the figures in the above formula, the resulting pressure at the welding point will be,

$$\frac{2.96 \times 3.14}{.442} \times 100 \text{ PSI} = 2100 \text{ PSI}$$

The length of the high pressure stroke is directly proportional to the travel of the intensifier piston, after the hydraulic fluid chamber has been sealed off, divided by the result of the

$$\frac{\text{Area of the Lower piston}}{\text{Area of the Intensifier piston rod}} = \frac{3.14}{.442} = 7.1$$

Thus, assuming a 1.5 inches travel after fluid chamber is shut off, the length of the high pressure stroke would be

$$\frac{1.5}{7.1} = .211''$$

The return of both pistons to their starting position is more or less a standard installation consisting of a four-way air valve in combination with a time delay valve which would exhaust the chamber above the intensifier piston and the cylinder 19.

Besides the advantage of the small physical size of the invention and the elimination of very high air pressure lines and the consequent high cost of control equipment and maintenance, other advantages are gained by the use of this invention, as follows:

a. The low initial contact pressure of the electrode as compared to its final high pressure, tends to reduce considerably, damage caused by the occurrence known as mushrooming.

b. The small amount of seal friction due to the particular design of the invention allows a very high speed of pressure application.

c. Since hydraulic fluid initially advances the piston rod to the contact point, the full usable high pressure store is available at any position within the travel of the rod.

d. High pressure lines being eliminated by the use of this invention, the dangers characteristic of such an installation are thereby eliminated, making this invention a valuable safety factor for the personnel working at or near high pressure welding equipment.

Having described the invention, what I claim is:

1. A compact pneumatic and hydraulic cylinder structure, utilizing low pressure lines, said apparatus comprising cylindrical wall means, upper end wall means at the upper end of said cylindrical wall means closing off said upper end of said wall means and forming a compressed air inlet communicating with an upper portion of said cylindrical wall means, a pressure intensifying piston having an annular seal around its periphery and a central piston rod affixed thereto and extending therebelow from the side of said piston opposite said upper wall means, fixed wall means inside said cylindrical wall means and spaced at an intermediate portion thereof to divide said cylindrical wall means into an upper chamber and a lower chamber, said fixed wall means being the sole means of separation between said upper and lower chambers, said fixed wall means having a central bore therethrough receiving said piston rod, said fixed wall means also having annular sealing means associated with said central bore in sealing engagement with said piston rod, said fixed wall means also forming a supply passage communicating with an intermediate portion of said bore below said sealing means, means above said intermediate fixed wall means and below said intensifying piston for returning said piston to a position adjacent said upper wall means, a source of hydraulic fluid under pressure communicating with said supply passage for maintaining a full quantity of hydraulic fluid in said lower chamber, means for applying air under pressure to said hydraulic fluid to maintain the hydraulic fluid under pressure, a second piston located in said lower chamber below said fixed wall means and the hydraulic fluid, said second piston having an annular seal around its periphery and a second piston rod extending therebelow from the side of said piston opposite said fixed wall means, lower end wall means closing off the lower end of said lower chamber and having a central bore through which said second piston rod extends to the exterior of said cylindrical wall means, said lower wall means having annular sealing means associated with its central bore in sealing engagement with said second piston rod, and means forming a compressed air inlet communicating with a lower portion of said lower chamber below said second piston to return said second piston to a position adjacent said fixed wall means.

2. A compact pneumatic and hydraulic pressure intensifying cylinder structure, utilizing low pressure lines, comprising a cylindrical body, one end of which is closed by a fixed end plug containing a pneumatic inlet; a pressure intensifying piston having an annular seal

around its periphery and a central piston rod located below the said fixed plug; a fixed intermediate plug inside said cylindrical body and spaced from said end plug, said intermediate plug containing a central hole extending therethrough for the passage of said intensifier piston rod and provided with a hydraulic fluid entry which terminates in a fluid chamber opening into said central hole for supplying, replenishing, and maintaining a constant required quantity of hydraulic fluid in said fluid chamber; means above said intermediate plug to urge said intensifier piston upwardly for the return of the intensifier piston; a second piston located below said intermediate plug, having an annular seal around its periphery and a centrally located piston rod which extends to the outside of the said cylindrical body; an additional fixed end plug at the other end of said cylindrical body provided with a central hole therethrough for the passage of said second piston rod, and an annular seal around the interior of said last-named hole; means forming a pneumatic entry in the wall of the cylindrical body for the return of said second piston; and the relative location of the above components being such that after hydraulic pressure has been applied to the said second piston, the pressure intensifying piston, acted upon by the pneumatic pressure, causes its piston rod to shut off and enclose the pressurized fluid above said second piston so that the combined pressure on the intensifier piston and that of the hydraulic fluid on the second piston become the final pressure on said second piston.

3. A method of welding two bodies together by electrical resistance welding, said method comprising engaging one of said bodies through an electrode by means of a piston rod having a piston located in a first chamber above said one body by applying hydraulic fluid to said first chamber above said first piston to move said piston and said piston rod downwardly until said one body is engaged, applying additional pressure to said one body through the electrode by means of a second piston having a second, downwardly extending second piston rod, said second piston being located in a second chamber immediately above said first chamber, by applying air under pressure to said second chamber above said second piston to urge said second piston and said second piston rod downwardly, to apply additional pressure to the hydraulic fluid in the first chamber above said first piston to cause said first piston rod to move downwardly while applying substantially uniform pressure to said one body through the electrode during the welding operation and even as weld metal quickly vaporizes.

4. A method of welding two bodies together by electrical resistance welding according to claim 3 characterized further by supply air under pressure below both of said pistons in both of said chambers after the weld is completed to return both of said pistons upwardly to their original positions and ready for another welding cycle.

5. A compact pneumatic and hydraulic cylinder structure according to claim characterized by said lower wall means forming an annular recess with said cylindrical wall means, and said compressed air inlet forming means communicates with said annular recess.

6. A compact pneumatic and hydraulic cylinder structure according to claim 1 characterized by said cylindrical wall means being of one-piece construction

5

and of substantially uniform inner and outer diameter throughout its length.

7. A compact pneumatic and hydraulic cylinder structure according to claim 1 characterized by said means for returning said piston to a position adjacent said upper wall means comprises means forming a compressed air inlet communicating with the lower portion of said upper chamber below said intensifying piston.

8. A compact pneumatic and hydraulic pressure intensifying cylinder structure according to claim 2 characterized by said additional fixed end plug forming an

6

annular recess with said cylindrical body, said pneumatic entry communicating with said annular recess.

9. A compact pneumatic and hydraulic pressure intensifying cylinder structure according to claim 2 characterized by a remote source of hydraulic fluid, means communicating between said remote source and said hydraulic fluid entry, and means for applying air under pressure to the hydraulic fluid to place the hydraulic fluid under pressure.

* * * * *

15

20

25

30

35

40

45

50

55

60

65

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,875,365 Dated April 1, 1975

Inventor(s) Donald Joseph Beneteau

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In column 4, line 40, after "downwardly" insert
a hyphen.

In column 4, line 60, after "claim" insert --1--.

Signed and sealed this 20th day of May 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,875,365 Dated April 1, 1975

Inventor(s) Donald Joseph Beneteau

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In column 4, line 40, after "downwardly" insert
a hyphen.

In column 4, line 60, after "claim" insert --l--.

Signed and sealed this 20th day of May 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks