(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 787 563 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
17.04.2002 Bulletin 2002/16

(51) Int Cl.[7]: **B25B 27/00**, B21J 15/06

(21) Application number: **97830027.5**

(22) Date of filing: **29.01.1997**

(54) **Hydropneumatic riveting gun**

Hydropneumatisches Nietwerkzeug

Riveteuse hydropneumatique

(84) Designated Contracting States:
DE FR GB IT

(30) Priority: **31.01.1996 IT BO960045**

(43) Date of publication of application:
06.08.1997 Bulletin 1997/32

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(56) References cited:
EP-A- 0 478 162
GB-A- 2 152 421

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EP 0 787 563 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present invention relates to a hydropneumatic riveting gun according to the preamble of claim 1 (see GB-2 152 421). The invention relates in particular, but not exclusively, to a hydropneumatic riveting gun for threaded rivets. In this description, express reference will be made to threaded rivets without thereby restricting the scope of the inventive concept.

[0002] In the field of fastening equipment and tools, in particular for the application of rivets and threaded rivets, the use of hydropneumatic riveting guns or machines is well known. These riveting machines are equipped with a handle having a single-acting hydraulic cylinder and a pneumatic cylinder to drive the hydraulic cylinder, both cylinders being built into the top and bottom sections of the handle, respectively.

[0003] The stem of the hydraulic cylinder acts directly on a rivet holder. When applying threaded rivets, the rivet holder comprises a rod or pin with a threaded end onto which the rivet can be screwed.

[0004] The application of the rivet occurs basically as follows: once the rivet has been engaged by the rivet holder, a first cutoff valve is opened by pulling the trigger on the gun handle; the opening of the first cutoff valve allows an external source of compressed air to be applied to a lower chamber of the pneumatic cylinder so as to push the piston in the pneumatic cylinder itself upwards. As the piston travels upwards, its stem runs through an oil filled chamber located inside the handle and connected with the hydraulic cylinder. Under the pressure of the piston stem as it moves through the oil chamber, the oil is forced into the thrust chamber of the hydraulic cylinder in such a way as to cause a short but powerful backward movement of the piston of the hydraulic cylinder against the force applied by a return spring. The pulling force applied to the rivet by this backward movement permits the upsetting of a portion of the rivet on the parts to be joined.

[0005] When the trigger is released, the source of compressed air is connected automatically with an upper chamber of the pneumatic cylinder, the pneumatic piston moves down and the return spring of the hydraulic cylinder pushes the hydraulic piston forward, thus returning to the initial configuration.

[0006] When applying threaded rivets, the trigger also acts on a second pushbutton controlling a second valve which applies the source of compressed air to a pneumatic motor attached to the hydraulic cylinder casing and dynamically linked to the rivet holder. After being supplied with compressed air, the pneumatic motor turns the threaded rod of the rivet holder, thus disengaging it from the rivet that has just been upset in place.

[0007] Means are also envisaged to adjust the working stroke of the hydraulic piston in order to control the tightness of the rivet on the parts joined. These means usually include a piston limit stop that can be positioned axially using a lock nut. During use, the limit stop is initially placed in such a way as to allow the shortest possible stroke of the hydraulic piston; a first rivet is upset in place and its tightness on the parts to be joined is checked. The required tightness can then be obtained by turning the lock nut to increase the piston stroke.

[0008] Hydropneumatic riveting guns have several advantages over conventional air-operated riveters; in particular, they are more powerful, reliable and longer-lasting.

[0009] A drawback to using them, however, is that if the working stroke of the hydraulic piston is not set correctly, the tightness of the rivets may be incorrect and the rivet holder may even break.

[0010] This may become a real problem especially when applying threaded rivets since the threaded end of the rivet holder rod to which the rivets are screwed may easily break.

[0011] It is also known from document GB-A-2152421 a hydropneumatic riveting gun comprising a handle, a hydraulic cylinder mounted by the handle, and a rivet holding means mechanically and dynamically connected to the said hydraulic cylinder. Moreover, the document shows a pneumatic cylinder mounted by the handle and equipped with a piston running inside the casing of the pneumatic cylinder between a rest position and a work position and defining together with the cylinder a lower expansion chamber that can be connected with a source of fluid under pressure.

[0012] The lower chamber is connected by means especially designed to set the pressure in the said lower chamber to a predefined value when the chamber is connected with the source of fluid under pressure.

[0013] The object of the present invention is to provide a hydropneumatic riveting gun that is simple and economical in construction and that is capable of overcoming the abovementioned drawback.

[0014] The present invention is further defined in the characterizing portion of claim 1.

[0015] An advantage of the present invention is that it permits quick and easy adjustment of the rivet tightening force.

[0016] Further characteristics and advantages of the invention are apparent from the detailed description which follows with reference to the accompanying drawings which illustrate a preferred embodiment of the invention and in which:

- Figure 1 is a side view, of the riveting gun disclosed, with some parts cut away;
- Figure 2 is a schematic view from below of the gun illustrated in Fig. 1;
- Figure 3 is an enlarged detail view of the gun illustrated in Fig. 1, showing a valve forming part of the pressure reducing means.

[0017] With reference to the accompanying drawings, the numeral 1 indicates as a whole a hydropneumatic riveting gun comprising a handle 2, at the top of which

there is a single-acting hydraulic cylinder 3 located and operating inside a casing 20, mounted by the handle 2, and at the bottom of which there is a double-acting pneumatic cylinder 4 inside which a piston 42, with a stem 40, moves.

[0018] As mentioned above, the hydraulic cylinder 3 has a stem (not illustrated) which acts on a rivet holder.

[0019] With reference to Fig. 1, which illustrates a preferred embodiment of a hydropneumatic riveting gun for threaded rivets, the rivet holder consists of a rod or pin 5 coaxially integral with the stem of the hydraulic cylinder 3. The rod 5 is housed in a sleeve 6 mounted on the casing 20 of the hydraulic cylinder 3 to which it is dynamically and coaxially linked. The rod 5 has a threaded end 5a which protrudes from the front of the sleeve 6 and onto which a threaded rivet, not illustrated in the drawing, can be screwed.

[0020] As explained in the introductory part of this description, the operation of the hydraulic cylinder 3 makes it possible to fix in place a rivet that has been screwed onto the threaded end 5a of the rod 5.

[0021] The numeral 19 indicates a ring nut used to adjust the stroke of piston of the hydraulic cylinder 3 by axially positioning a limit stop, of a known type and not illustrated in Fig. 1, inside the casing 20 of the hydraulic cylinder 3, which acts directly to stop the piston in the cylinder 3.

[0022] The handle 2 has a trigger 7 consisting basically of a lever of type one whose arms are used to operate two cutoff valves 8 and 9 which drive the pneumatic motor 10 and the pneumatic cylinder 4, respectively.

[0023] The pneumatic motor 10 is mounted by the casing 20, coaxially at the rear end of the hydraulic cylinder 3, and it is dynamically linked in a known manner (not illustrated) to the rod 5. By opening the valve 8, the user can operate the motor 10 to turn the rod 5 in one direction to screw the rivet onto the rod 5 and then in the other direction to unscrew it once the rivet has been fixed in place. In some cases, the rivet can be screwed on automatically by placing the rivet on the threaded end 5a and pressing on it lightly.

[0024] On the handle 2 there is a fitting 11 which, as explained in more detail below, is connected to an external source of fluid under pressure, preferably air, which is not illustrated and which flows through the cutoff valves 8 and 9.

[0025] The inside of the handle 2 forms a chamber 12 full of hydraulic oil, communicating (in a manner not illustrated) with the hydraulic cylinder 3 and in which the stem 40 of the pneumatic cylinder 4 piston 42 runs.

[0026] The cylinder 4 also comprises a cylindrical casing 41 at the bottom of which there is attached a base 44 which, together with the casing 41 and the piston 42, defines a lower chamber 4b. Inside the casing 41, the piston 42 which runs along the lining of the casing 41 from a working position, where it actuates the hydraulic cylinder 3, to a rest position, from where it started before being driven along the working stroke, separates the chamber 4b from an upper chamber 4a which, in relation to the piston 42 itself, is on the side opposite the chamber 4b.

[0027] The chamber 4b, as will be explained in more detail below, constitutes the expansion chamber for the air under pressure from the external source, enabling the piston 42 to effect its working stroke to drive the hydraulic cylinder 3. The base 44 is attached to the bottom of the casing 41 by means of a cover 43 which is screwed directly onto the casing 41.

[0028] The handle 2 is also equipped with a distributor valve 13 of known type connected to the compressed air ducts, some of which are shown in Fig. 1, labelled 21, 22, 23, 24 and 17. These ducts connect the chambers 4a and 4b of the pneumatic cylinder 4 with the compressed air source and with the atmosphere.

[0029] The duct 21 is connected directly, in a manner not illustrated in Fig. 1, with the duct 22 which leads to the source of compressed air, again through the valve 13. The duct 21 is also connected, through the valve 9 in a manner not illustrated, with the duct 23 which is in turn connected with the distributor valve 13 through a branch duct 23a which leads into the valve 13 on the side axially opposite that visible in Fig. 1. Therefore, when the valve 9 is opened, the duct 23 is crossed by the same flow of air under pressure as the duct 21. The distributor valve 13 is preferably of the type described in Italian utility model patent No.208.712, by the same Applicant.

[0030] The distributor valve 13 is structured in such a way that, under rest conditions, chat is to say, when the cutoff valve 9 is closed, the duct 24 connects the upper chamber 4a with the compressed air source and with the atmosphere; these conditions being reversed when the cutoff valve 9 is opened, that is to say, the lower chamber 4b is connected with the compressed air source through the duct 17. In this case, the difference in pressure that is created between the chamber 4b and the chamber 4a pushes the piston 42 along the lining inside the cylindrical casing 41 to its working position opposite to that illustrated in Fig. 1.

[0031] According to the present invention, the base 44 of the pneumatic cylinder 4 has a recess 14 in it to accommodate a pressure regulator 30.

[0032] The pressure regulator 30, of known type, comprises a first fitting 31, for high pressure, a second fitting 32, for reduced pressure, and a screw 34 for regulating the reduced pressure, equipped with a stop nut 35. The screw 34 is located in a place that can be easily accessed by an operator. With reference to Figs. 1 and 2, the out end of the reducer 30 is connected through the second fitting 32 to a rapid release valve 36, illustrated in an enlarged view in Fig. 3.

[0033] The base 44 of the pneumatic cylinder 4 also has a duct 15 made in it whose opposite ends lead into the lower chamber 4b and into the reduced pressure fitting 32 through the valve 36 (Fig. 3).

[0034] In the base 44 there is also a compartment 16 which is connected directly to the high pressure fitting 31 on the side facing the reducer 30 and into which the duct 17 leads on the opposite side, the duct running through the inside of the cylindrical casing 41 and crossing the chambers 4a and 4b and the piston 42 through airtight seals, the piston sliding on the surface of the duct 17 through an airtight seal (18).

[0035] The duct 17 ends in the compartment 16 and crosses the base 44, air leakage being prevented by a seal 18 placed between the duct 17 and the base 44.

[0036] As mentioned above, when the cutoff valve 9 is opened, the compressed air source is connected with the duct 17 and, hence, with the compartment 16. The pressure in the compartment 16 is reduced by the reducer 30 to a preset optimum value for the operation of the gun 1. Usually and preferably, the pressure is reduced to a value below 6 bars. The reduced pressure is applied to the lower chamber 4b through the duct 15.

[0037] In other terms, thanks to the reducing valve 30, the pressure in the lower chamber 4b remains at a constant value less than the pressure supplied by the compressed air source, irrespective of the pressure upstream of the reducer 30 and of the flow rate through the reducer itself.

[0038] Obviously, this is true when the valve 9 is open. This regulated pressure value can be varied, in a known manner, by acting on the adjustment screw 34. When the valve 9 is open, the pressure in the lower chamber 4b is greater than the pressure in the upper chamber 4a which communicates with the atmosphere through distributor valve 13. As a result, the piston 42 and its stem 40 are raised, thus compressing the oil in the chamber 12 to drive the hydraulic cylinder 3.

[0039] The thrust on the pneumatic piston 42 and, hence, the thrust transmitted by the latter to the hydraulic cylinder 3 cannot exceed a preset upper limit value. This has several advantages. For example, the hydraulic cylinder 3 and its stem 5 last longer because they always operate at their ideal pressure. Also, riveting performance is constant because the cylinder 3 operates under a constant pressure and not with a limit stop. Moreover, compressed air consumption is reduced.

[0040] The valve 36 consists of a body 37 which, on the side opposite the side that which is in contact with the reducer 30, presents a rapid release nosepiece 38 that is connected directly with a release hole 33. In addition, at the second fitting 32, the valve body 37 has a first hole 25 and, at the duct 15, a second hole 26. Inside the valve body 37, between the nosepiece 38 and the second fitting 32, there is a shutter 39 with a lip seal 29 round its perimeter. The shutter 39 can slide inside the valve body 37 between two limit positions, the first to close the nosepiece 38 and the second to close the first hole 25. The first position occupied by the shutter 39 is illustrated with a dashed line in Fig. 3.

[0041] When the flow of compressed air reaches the second fitting 32, the shutter 39 is moved towards the position in which it closes the nosepiece 38 and the air can reach the lower chamber 4b through the duct 15. In this case, the lip seal 29, whose free end is located at the edge of the hole 26, is moved by the air flow allowing the air to reach the chamber 4b and to push the piston 42 upwards along its working stroke.

[0042] When the valve 9 is opened and drives the distributor valve 13, the duct 24 is connected with the compressed air source so that the upper chamber 4a is filled with air and the piston 42 pushed downwards, forcing the air out of the lower chamber 4b through the duct 15. Once it has gone past the second hole 26, the air flow from the duct 15, by pressing on the lip seal 29, forces the shutter 39 to move to its first limit position in which it closes the first hole 25, leaving the nosepiece 38 open to allow the air that was previously in the lower chamber 4b to be rapidly released to the atmosphere.

Claims

1. A hydropneumatic riveting gun comprising a handle (2), a hydraulic cylinder (3) mounted by the handle (2), rivet holding means (5, 5a) mechanically and dynamically connected to the said hydraulic cylinder (3), a pneumatic cylinder (4) with a casing (41), mounted by the handle (2) and equipped with a piston (42) running inside the casing (41) of the pneumatic cylinder (4) between a rest position and a work position and defining together with the cylinder a lower expansion chamber (4b) that can be connected with a source of fluid under pressure and designed to drive the piston (42), which, during its working stroke, in turn drives the hydraulic cylinder (3), a pressure regulator (30) especially designed to set the pressure in the said lower chamber (4b) to a predefined value when the chamber is connected with the source of fluid under pressure;
characterized in that, downstream of the pressure regulator (30), there is a rapid release valve (36) designed to allow the fluid to be supplied at a reduced pressure by the regulator (30) to the lower chamber (4b) so as to keep at the preset value the pressure inside the chamber (4b) that drives the piston (42) along its working stroke and to allow the fluid inside the chamber (4b) to be forced out to the atmosphere during the movement of the piston (42) towards its rest position.

2. The riveting gun according to claim 1, **characterized in that** the said pressure regulator (30) is located between a first fitting (31), for high pressure, connected to the source of fluid under pressure, and a second fitting (32) for reduced pressure, connected with the said lower chamber 4b.

3. The riveting gun according to claim 1 **characterized in that** the regulator (30) is fitted with a screw

(34) on the outside which can be turned to regulate the reduced pressure.

4. The riveting gun according to claim 2 **characterized in that** the valve (36) comprises a valve body (37) equipped with a rapid release nosepiece (38) connected with a release hole (33), the said valve body (37) having a first hole (25) connected with the said second fitting (32) and a second hole (26) connected with a duct (15) leading into the said lower chamber (4b); there being, between the nosepiece (38) and the first hole (25), a shutter (39) which has a lip seal (29) round its perimeter and which, moved by the fluid under pressure, runs between two limit positions, the first to close the nosepiece (38) allowing the compressed air to flow into the lower chamber (4b), and the second to close the first hole (25), thus allowing the air inside the chamber (4b) to be released to the atmosphere.

5. The riveting gun according to one of the claims 2 or 4 **characterized in that** the pressure regulator (30) and the rapid release valve (36) are located in a recess (14) made in the base (44) under the pneumatic cylinder (4), the said base (44) also having in it a compartment (16) into which a duct (17) that supplies fluid at high pressure leads, the said duct (17) being in turn connectable to the source of fluid under pressure and crossing both the base (44) and the piston (42) through airtight seals (18), the piston (42) being able to slide on the surface of the duct (17) through an airtight seal (18), and the said compartment (16) being connected with the said first fitting (31).

Patentansprüche

1. Hydropneumatisches Nietwerkzeug, enthaltend einen Griff (2), einen in dem Griff (2) montierten Hydraulikzylinder (3), Mittel (5, 5a) zum Halten der Nieten, die mechanisch und dynamisch an den genannten Hydraulikzylinder (3) angeschlossen sind, einen von dem Griff (2) getragenen Druckluftzylinder (4) mit einem Gehäuse (41), versehen mit einem Kolben (42), der sich im Inneren des Gehäuses (41) des Druckluftzylinders (4) zwischen einer Ruheposition und einer Arbeitsposition bewegt und zusammen mit dem Zylinder eine untere Expansionskammer (4b) bildet, die mit einer unter Druck stehenden Strömungsquelle in Verbindung gebracht werden kann und dazu bestimmt ist, den Kolben (42) zu betätigen, welcher während seines Arbeitshubes wiederum den Hydraulikzylinder (3) betätigt, einen Druckregler (30), speziell dafür vorgesehen, den Druck in der genannten unteren Kammer (4b) auf einen voreingestellten Wert zu regulieren, wenn die Kammer mit der unter Druck stehenden Strömungsquelle verbunden ist; **dadurch gekennzeichnet, dass** stromabwärts des Druckreglers (30) ein Schnellablassventil (36) vorhanden ist, um es der Strömung zu erlauben, mit einem durch den Regler (30) reduzierten Druck der unteren Kammer (4b) zugeführt zu werden und den voreingestellten Wert des Druckes im Inneren der Kammer (4b) zu halten, welcher den Kolben (42) entlang seinem Arbeitshub führt, und um es der Strömung im Inneren der Kammer (4b) zu erlauben, während der Bewegung des Kolbens (42) zu seiner Ruheposition hin in die Atmosphäre herausgepresst zu werden.

2. Nietwerkzeug nach Patentanspruch 1, **dadurch gekennzeichnet, dass** der genannte Druckregler (30) zwischen einem ersten Anschluss (31) für Hochdruck, verbunden mit der unter Druck stehenden Strömungsquelle, und einem zweiten Anschluss (32) für reduzierten Druck, verbunden mit der genannten unteren Kammer (4b), angeordnet ist.

3. Nietwerkzeug nach Patentanspruch 1, **dadurch gekennzeichnet, dass** der Regler (30) an seiner Aussenseite mit einer Schraube (34) versehen ist, welche gedreht werden kann, um den reduzierten Druck zu regulieren.

4. Nietwerkzeug nach Patentanspruch 2, **dadurch gekennzeichnet, dass** das genannte Ventil (36) einen Ventilkörper (37) enthält, ausgestattet mit einem schnell ablassenden Nasenstück (38), das an eine Ablassbohrung (33) angeschlossen ist, wobei der genannte Ventilkörper (37) eine erste Bohrung (25) aufweist, die mit dem genannten zweiten Anschluss (32) verbunden ist, sowie eine zweite Bohrung (26), verbunden mit einer Leitung (15), die in die genannte untere Kammer (4b) führt; wobei sich zwischen dem Nasenstück (38) und der ersten Bohrung (25) ein Verschluss (39) befindet, welcher an seinem Umfang eine Lippendichtung (29) hat, und welcher sich, angetrieben von der unter Druck stehenden Strömung, zwischen zwei Grenzposition bewegt, und zwar einer ersten zum Verschliessen des Nasenstücks (38) und es der Druckluft erlaubend, in die untere Kammer (4b) zu strömen, und einer zweiten zum Verschliessen der ersten Bohrung (25) und es somit der Luft im Inneren der Kammer (4b) zu erlauben, in die Atmosphäre abgelassen zu werden.

5. Nietwerkzeug nach den Patentansprüchen 2 oder 4, **dadurch gekennzeichnet, dass** der Druckregler (30) und das Schnellablassventil (36) in einer Vertiefung (14) angeordnet sind, die in die Basis (44) unter dem Druckluftzylinder (4) eingearbeitet ist, wobei die genannte Basis (44) ebenfalls einen

Hohlraum (16) enthält, in welchen eine Leitung (17) mündet, welche die unter Hochdruck stehende Strömung führt, wobei die genannte Leitung (17) wiederum an die unter Druck stehende Strömungsquelle anschliessbar ist und die Basis (44) wie auch den Kolben (42) mit Hilfe von luftdicht abschliessenden Dichtungen (18) durchläuft, wobei der Kolben (42) in der Lage ist, an der Oberfläche der Leitung (17) durch eine luftdicht abschliessende Dichtung (18) zu gleiten, und wobei der genannte Hohlraum (16) mit dem genannten ersten Anschluss (31) verbunden ist.

Revendications

1. Riveteuse hydropneumatique comprenant une poignée (2), un cylindre hydraulique (3) supporté par la poignée (2), des éléments de maintien des rivets (5, Sa) reliés mécaniquement et dynamiquement audit cylindre hydraulique (3), un cylindre pneumatique (4) avec une enveloppe (41) supporté par la poignée (2) et doté d'un piston (42) qui se déplace entre une position de repos et une position de travail à l'intérieur de l'enveloppe (41) du cylindre pneumatique (4) et qui définit, en association avec le cylindre, une chambre d'expansion inférieure (4b) pouvant être reliée à une source de fluide sous pression pour actionner le piston (42) lequel, pendant sa course de travail, transmet à son tour le mouvement au cylindre hydraulique (3), et un régulateur de pression (30) en mesure de maintenir la pression à une valeur prédéterminée à l'intérieur de la chambre inférieure (4b) lorsque celle-ci est en communication avec la source du fluide sous pression ; ladite riveteuse hydropneumatique étant **caractérisée en ce qu'**un clapet de décharge rapide (36), monté en aval du régulateur de pression (30), permet à ce dernier d'alimenter le fluide à une pression réduite dans la chambre inférieure (4b) de manière à maintenir la pression dans la chambre (4b) à la valeur prédéterminée pendant la course de travail du piston (42) et à forcer la sortie du fluide de la chambre (4b) dans l'atmosphère pendant la course de retour du piston (42) à sa position de repos.

2. La riveteuse selon la revendication 1, **caractérisée en ce que** ledit régulateur de pression (30) se trouve entre un premier raccord (31) de haute pression relié à la source de fluide sous pression et un second raccord (32) de pression réduite relié à ladite chambre inférieure (4b).

3. La riveteuse selon la revendication 1, **caractérisée en ce que** ledit régulateur de pression (30) présente à l'extérieur une vis (34) permettant le réglage de la valeur de la pression réduite.

4. La riveteuse selon la revendication 2, **caractérisée en ce que** le clapet (36) comprend un corps (37) doté d'un tube (38) de décharge rapide relié à un orifice de décharge (33), ledit corps (37) ayant un premier orifice (25) communiquant avec ledit second raccord (32) et un second orifice (26) communiquant avec un conduit (15) qui arrive dans ladite chambre inférieure (4b) ; entre le tube (38) et le premier orifice (25) se trouve un obturateur (39) qui est muni d'un joint à lèvre (28) sur tout son périmètre et qui, sous l'action du fluide sous pression, se déplace entre deux positions limites, à savoir, une position de fermeture du tube (38) pour permettre le passage de l'air comprimé dans la chambre inférieure (4b) et une position de fermeture du premier orifice (25) de sorte que l'air à l'intérieur de la chambre inférieure (4b) peut s'échapper dans l'atmosphère.

5. La riveteuse selon l'une quelconque des revendications 2 ou 4, **caractérisée en ce que** ledit régulateur de pression (30) et ledit clapet de décharge rapide (36) sont logés dans une cavité (14) réalisée dans la base (44) sous le cylindre pneumatique (4), ladite base (44) présentant également un logement (16) à l'intérieur duquel arrive un conduit (17) qui alimente le fluide à haute pression et peut à son tour être raccordé à la source de fluide sous pression en traversant, par l'intermédiaire de joints (18) étanches à l'air, la base (44) et le piston (42), ledit piston (42) étant en mesure de se déplacer sur la surface du conduit (17) à travers un joint étanche à l'air (18) et ledit logement (16) étant relié audit premier raccord (31).

FIG 1

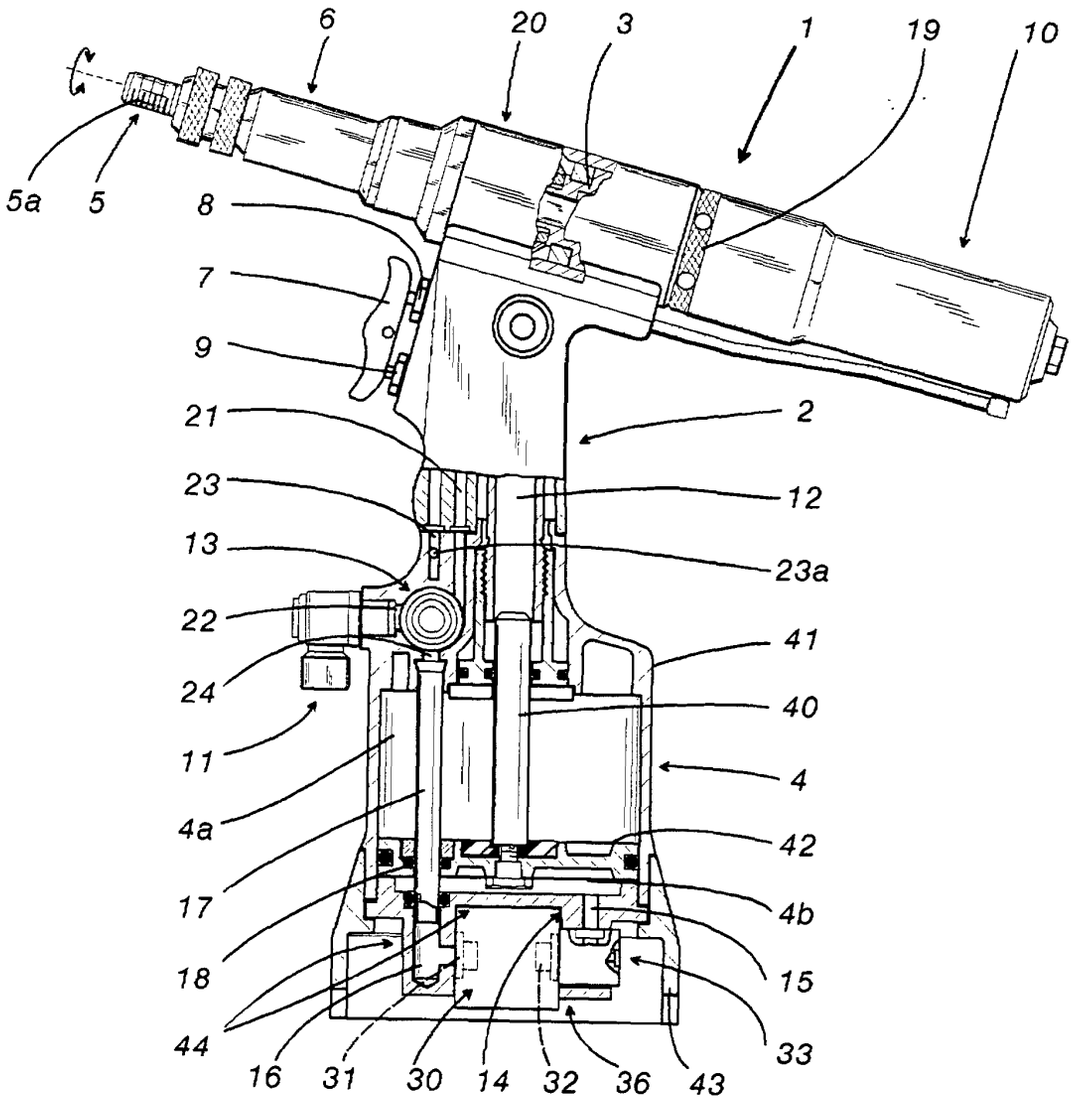


FIG 2

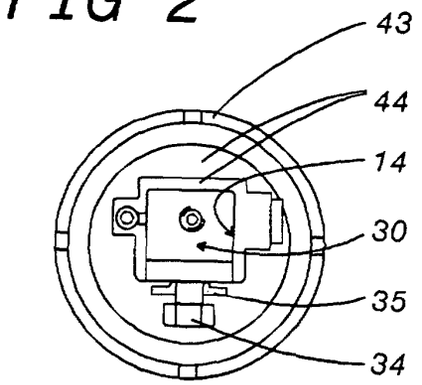


FIG 3

