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

(11) Publication number: **0 259 280**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **87830318.9**

(22) Date of filing: **04.09.87**

(51) Int. Cl.[4]: **B 21 J 15/06**
B 21 J 15/22

(30) Priority: **05.09.86 IT 498586**

(43) Date of publication of application:
09.03.88 Bulletin 88/10

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR LI LU NL SE

(71) Applicant: **FAR S.n.c. di GENERALI GIACOMO & C.**
Via Marzabotto 16 Quarto Inferiore
I-40057 Granarolo Emilia Bologna (IT)

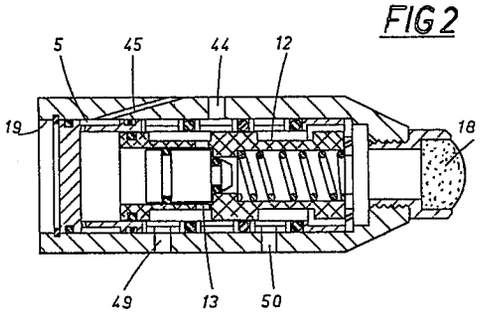
(72) Inventor: **Cariati, Vincenzo**
Via Kharkov, 11
I-40127 Bologna (IT)

(74) Representative: **Pederzini, Paolo**
BUGNION S.p.A. Via Farini n. 37
I-40124 Bologna (IT)

(54) Control valve with integral exhaust, in particular for riveting machines.

(57) The control valve disclosed comprises a hollow outer element (4), stopped at one end and fitted with a silencer (18) at the other and incorporating two air inlet ducts, one normally open, one for control, and two outlet ducts, also, an inner element (7) with an axial bore capable of fluid-tight movement within the outer element, and a piston (15) likewise mobile and fluid-tight internally of the inner element; air supplied to the control inlet causes the piston (15) and the inner element (7) to shift from an at-rest position, toward which they are biased by a spring (14) so that air exhausts by way of the one outlet, into an operative position in which the air exhausts by way of the other outlet.

FIG 2



EP 0 259 280 A2

Description

Control valve with integral exhaust, in particular for riveting machines.

The invention relates to a pneumatic control valve with integral exhaust, in particular for riveting machines.

The prior art embraces machines known as riveters, or riveting guns, designed to render the application of blind rivets (plain or screw shank) simple, safe and practical.

Such riveters are generally hydraulic/pneumatic in operation -i.e. utilizing a source of compressed air which actuates a manually controlled hydraulic unit comprising a rod to which the rivet is held by a clamping mechanism or a matching thread.

Activating the compressed air supply causes the rod to draw back from the rivet; the rivet shank is made fast to the rod, and traction force is thus exerted on the shank, which shifts in relation to the body of the rivet.

Riveting guns of the type in question mostly consist in a handgrip, attached to a single acting hydraulic cylinder at the top, and to a pneumatic cylinder at the bottom.

The hydraulic cylinder is actuated by an oil-filled chamber formed in the grip, inside of which the rod of the pneumatic cylinder is reciprocated; the grip also incorporates ducts that connect with the two chambers of the pneumatic cylinder and serve to make up the control circuit.

Riveting guns of this general design are beset by a drawback, namely, that the air inlet and exhaust circuits are complex to the point of rendering the gun prohibitive in terms of cost.

Another drawback of such guns is that compressed air is exhausted either onto the operator's hand, or at all events, in the direction of the operator's own person.

A source of annoyance typical of riveting guns is that of noise caused by the repeated discharges of air which occur during operation and produce a sharp hissing sound.

Whilst attempts have been made to design muffling features into riveting guns, the end-result obtained is simply further complication of the air circuits. Accordingly, the object of the invention is that of overcoming the drawbacks mentioned above.

The stated object is achieved with a control valve as characterized in the appended claims, the inner element of which incorporates an axial bore that is vented to the atmosphere and thus affords an exhaust outlet.

One of the advantages of the invention is that the riveting gun to which it is applied can be rendered simple in design and construction, since the control valve envisaged requires no complicated circuitry, and is easy to fit.

A further advantage of the valve disclosed is that it can be located remotely from the operator's hand and positioned directionally in such a way as to give no annoyance to the operator.

Another advantage of the valve disclosed is that it has one exhaust outlet only, such that one silencer is sufficent for the purposes of muffling the noise produced by the gun.

The invention will now be described in detail, by way of example, with the aid of the accompanying drawings, in which:

figs 1 and 2, are longitudinal sections through the control valve disclosed, viewed in the at-rest and in the operative position, respectively;

fig 3 is a longitudinal section through a gun of the type used for setting blind rivets, fitted with a valve according to the invention.

With reference to fig 3, it will be observed that a riveting gun, e.g. of the type used to clinch blind rivets, comprises a vertical handgrip 21 attached at one end (top) to a hydraulic cylinder 22, and at the opposite end (bottom) to a pneumatic cylinder 23.

The grip 21 is usually designed anatomically to give the firmest possible hold, and incorporates control means 6 located at front, on a level with the index finger of the operator, consisting in a button 46 and an on-off valve 6.

29 denotes a longitudinal chamber formed inside the grip 21, which is filled with oil, whilst 44, 45, 48, 49 and 50 denote internal ducts by way of which the pneumatic cylinder 23 is connected with a supply of compressed air (not illustrated) and vented to atmosphere, respectively; more exactly, ducts 44 and 48 connect the cylinder with the air supply, whereas duct 45 connects with duct 44 by way of the on-off valve 6, such that air flows from duct 44 to duct 45 whenever the button 46 is depressed to operate the valve 6.

The hydraulic cylinder 22 is disposed substantially parallel to the on-off valve 6, and consists in a barrel 24 accommodating a piston 25 that is fastened rigidly to one end of a rod 26, the opposite end of which carries a clamping assembly 27, located above and forward of the button 46, that lays hold on the shank of the rivet (not illustrated). The clamping assembly 27 comprises a collet 43, which is capable of movement inside and at the forward end of the housing of the clamping assembly. The piston 25 is impinged upon at rear by spring means, for example, a coil spring 31, by which it is biased forwards.

The barrel 24 comprises at least one hole 28 by way of which the chamber 29 in the grip 21 is placed in communication with the chamber 24a of the hydraulic cylinder 22 occupied by the piston rod 26. The rod 26 and the clamping assembly 27 are both axially hollow, the rod 26 extending back into a tube 32 that projects beyond the rear end of the barrel 24 and into a receptacle 33, supported by the barrel itself, which contains the severed rivet shanks. 37 denotes a hole in the rod 26 that connects with duct 44 by way of a flow regulator 38 (not central to the invention, and therefore illustrated in part only). This same hole 37 connects with the tube 32, so that a blast of air can be directed toward the receptacle 33, creating suction by which the shanks of the set rivets are drawn into the receptacle.

The pneumatic cylinder 23 is disposed with its axis substantially vertical, and consists in a barrel 34

slidably accommodating a piston 35 made fast to the bottom end of a rod 30 that passes through the lower part of the grip 21 in a fluid-tight fit and strokes coaxially with and internally of the chamber 29.

36 denotes a tube passing through the piston 35 in a fluid-tight fit, which is attached rigidly to the lower part of the grip 21 and connects with the duct denoted 49.

The grip 21 of the rivet gun illustrated in fig 3 is embodied with a housing 19 located adjacent to the pneumatic cylinder 23 (see figs 1 and 2) and serving to accommodate a control valve 47 according to the invention.

The valve in question (see figs 1 and 2) consists in an outer element 4 and an inner element 7.

The outer element 4 appears substantially as a cup the side wall of which incorporates four ducts 1, 2, 3 and 5 that emerge into its interior at different points along the length of the element 4 itself. The four ducts in question, 1, 2, 3 and 5, connect with respective ducts 44, 49, 50 and 45 in the grip 21.

The duct denoted 50 emerges directly into the upper chamber 23a of the pneumatic cylinder 23 at a point not visible in the view of fig 3, whilst duct 44 connects directly with duct 48 (likewise at a point not visible in the drawings), which in its turn is connected to the compressed air supply.

16 denotes a circumferential chamber located in the the outer element 4 at its open end, the purpose of which will be made clear in due course. The outer element 4 registers in the housing 19 with stopped end outermost, lodged thus immovably, for example, retained by a circlip 39 fitted to the handgrip 21 internally of the housing 19.

The inner element 7 of the valve exhibits an axial bore 10, and two external circumferential undercuts 11 and 12 the first of which, i.e. located nearest the stopped end of the outer element 4 and denoted 11, communicates via holes 13 with an enlarged end section 40 of the axial bore 10; this enlarged end section 40 of the bore accommodates the fluid-tight sliding motion of a piston 15 reciprocated between positions in which the holes 13 are blocked and left free, respectively.

It will be seen from figs 1 and 2 that the piston 15 terminates in an appendage 51 which registers in the narrow part of the bore 10 as the piston reaches the position whereby the holes 13 are blocked (fig 2).

It will be observed from figs 1 and 2 that the inner end of the housing 19 affords a port 41 serving to retain a silencer 18, and is provided with a stop 9 against which the inner element 7 registers, and on which to seat spring means, e.g. a coil spring 14, that serve to bias the inner element 7 against the stopped end of the outer element 4. Held fast inside the housing 19 by the outer element 4, the stop 9 is embodied as a disk exhibiting a set of holes 42, one central, the remainder peripheral; these serve to connect the port 41 with the axial bore 10 of the inner element 7, and the circumferential chamber 16 of the outer element 4, respectively.

The inner element 7 is capable of movement between a first, at-rest limit position (fig 1), in which the holes 13 are left free by the piston 15 and ducts 1 and 3 are connected by the second undercut 12, and an operative limit position, in which the holes 13 are blocked by the piston 15 and ducts 1 and 2 are connected by the first undercut 11. The dimensions of the undercuts 11 and 12 and of the outlet ducts 2 and 3 are such that the first 11 remains connected permanently with duct 2, and the second permanently with duct 3, regardless of the position of the inner element 7. The distance from the second undercut 12 to the relative end of the inner element 7 is such, that whenever the inner element is in the operative position, this undercut 12 and the circumferential chamber 16 are caused to communicate (fig 2).

The duct denoted 5 emerges into the stopped end of the outer element 4 and connects with duct 45, which departs from the on-off valve 6 and runs downstream into the housing; thus, compressed air reaches the control valve 47 only when the on-off valve is open -i.e. when the button 46 is depressed.

Duct 44 is routed through the grip 21 substantially in rectilinear fashion, parallel to duct 45, and connects permanently with duct 48, hence with the compressed air supply (not illustrated).

Operation of a riveting gun as illustrated in fig 3, which is fitted with a control valve 47 according to the invention, will now be described.

In the at-rest configuration (that of figs 1 and 3) the inner element 7 of the control valve 47 remains biased into the at-rest limit position by the spring 21, with the piston 15 clear of the holes 13.

In such a situation, the lower chamber 23b of the pneumatic cylinder 23 connects with the silencer 18 by way of duct 2, undercut 11, holes 13, axial bore 10 and the centre hole 42 of the stop 9, whilst the upper chamber 23a connects with the inlet duct 1 by way of duct 3 and undercut 12. Accordingly, one has higher pressure in the upper chamber 23a than in the lower 23b, and the piston 35 remains at its lower limit; the rod 30 is fully retracted in relation to the chamber 29 in the grip, no oil is directed into the chamber 24a of the hydraulic cylinder, and the hydraulic piston 25 thus remains biased toward the forward limit position by the relative spring 31.

The shank of a rivet is now inserted between the jaws of the collet 43, and offered to the hole in the material to be riveted, whereupon the operator depresses the button 46 of the on-off valve 6 so as to connect ducts 44 and 45. With compressed air now directed into duct 5, the control valve piston 15 shifts forward to block the holes 13, and the inner element 7 is urged against the spring 14 into its operative position (fig 2).

Ducts 1 and 2 are connected by the one undercut 11, whilst the remaining undercut 12 connects duct 3 with the circumferential chamber 16, this connecting in its turn with the silencer 18 via the peripheral holes 42 in the stop 9. The lower air chamber 23b now pressurizes to a higher level than that of the upper 23a, whereupon the piston 35 rises and carries the rod 30 with it, impinging on the hydraulic oil in the chamber 29 of the grip and transferring it into chamber 24a such that the bias spring 31 in the hydraulic cylinder is compressed. The piston rod 26 retracts, and having tightened the collet 43 to the point of gripping the shank of the rivet, exerts the

traction force necessary for its deformation. Once the shank of the blind rivet has been severed in the normal way, the button 46 of the on-off valve will be released to block the flow of air from duct 44 into duct 45. Releasing the button has the effect of cutting off pressure hitherto supplied via duct 5, producing shift of the control valve piston 15 and inner element 7, and thus compressing the spring 14; accordingly, a small discharge of air occurs through the duct 45 and the on-off valve 6, and the bias spring 14 returns the inner element 7 and the piston 15 to their original at-rest positions. Chambers 23a and 23b now connect once more with duct 1 and with the silencer 18, respectively, with the result that the difference in pressure causes the piston 35 of the pneumatic cylinder to return downwards, and the hydraulic piston 25 and rod 26 shift forwards, such that the jaws of the collet 43 are spread. At the same time, negative pressure created internally of the rod 26 and the tube 32 produces suction, and the severed shank of the rivet just clinched is drawn back into the receptacle 33. At this point, the gun is ready to apply another rivet.

The simplification of a riveting gun permitted by incorporation of a control valve 47 according to the invention will be discerned by observing fig 3, from which it can be seen that the pneumatic cylinder 23 is served by just a few simple air ducts, and air is exhausted through the inner element 7 of the control valve 47 itself.

The valve 47 is easily and swiftly installed in the riveting gun, as all that is required is to slot the assembly into the housing 19 and secure it with the circlip 39.

Claims

1) Control valve with integral exhaust, in particular for riveting machines, of the type comprising one inlet (1) and a first and a second outlet (2, 3), characterized in that it comprises
-a substantially cylindrical outer element (4) with an axial bore, stopped at one end, connecting via its remaining open end with a silencer (18), and exhibiting four substantially radial ducts of which three (1, 2, 3) constitute the inlet and the two outlets, and the fourth (5) connects with control means (6) for operation of the valve;
-an inner element (7), capable of fluid-tight shift within the outer element (4), embodied with an axial bore (10) and with two external circumferential undercuts (11, 12) the first of which communicates by way of holes (13) with the axial bore (10), and subject to the action of spring means (14) by which it is biased toward the stopped end of the outer element (4);
-a piston (15), capable of fluid-tight shift within the axial bore (10) of the inner element (7) between respective limit positions in which the holes (13) that connect the axial bore (10) with the relative circumferential undercut (11) are blocked and left clear;
and in that the inner element (7) and the piston (15) are biased by the spring means (14) into an at-rest configuration whereby the first outlet duct (2) connects with the axial bores of the inner and outer elements and the second outlet duct (3) connects with the inlet duct (1), and, whenever the control means (6) are activated to connect the fourth duct (5) of the outer element with the inlet (1), made to assume an operative configuration whereby the first outlet duct (2) connects with the inlet duct (1) and the second outlet duct (3) connects with the axial bores of the inner and outer elements.

2) Control valve as in claim 1, wherein the fourth duct (5) emerges adjacent to the stopped end of the outer element (4), and the remaining open end of the outer element encompasses a circumferential chamber (16) that is connected with the second circumferential undercut (12) of the inner element (7) whenever the operative configuration of the valve is assumed, and wherein the piston (15) is located internally of the inner element (4), accommodated within an enlarged end section (40) of the axial bore (10) positioned adjacent to and directed toward the stopped end of the outer element (4).

3) Control valve as in claim 1, removably accommodated in fluid-tight fashion internally of a housing (19) formed in the body (21) of the machine to which it is fitted, wherein the housing is provided with a ported stop (9) against which the open end of the outer element (4) registers, is connected with the compressed air inlet duct (44), the outlet ducts (49, 50) supplying air to the service, and the duct (45) routed from the control means (6), and is open at the end provided with the stop (9) to permit of accommodating a removable silencer (18).

FIG 1

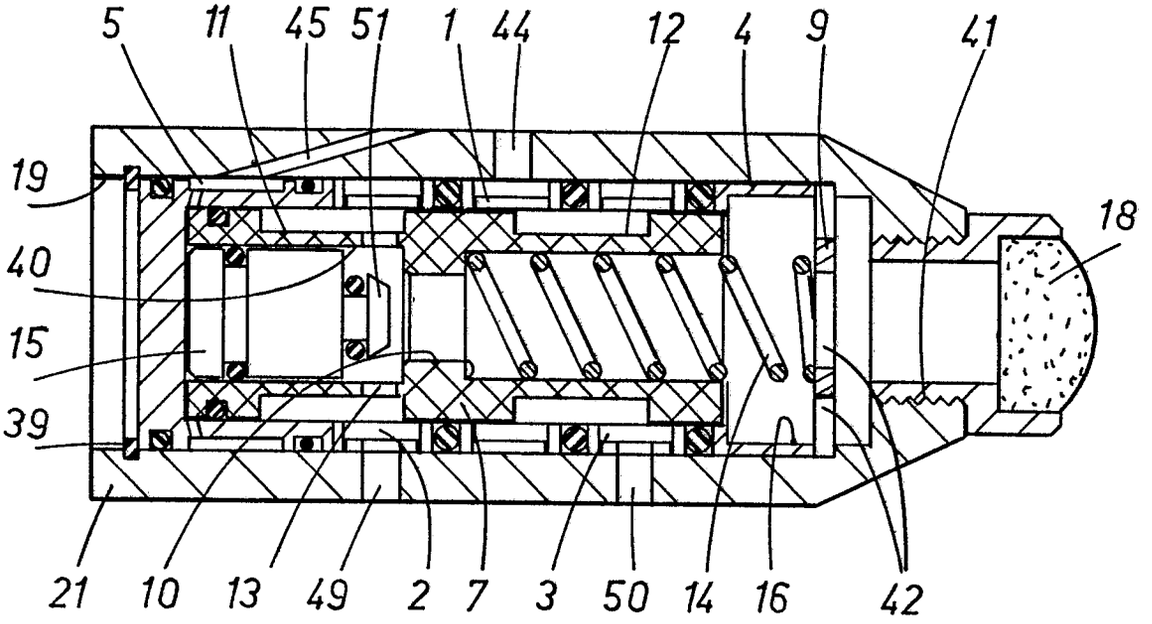

5
11
45
51
1
44
12
4
9
41
19
18
40
15
39
21
10
13
49
2
7
3
50
14
16
42

FIG 2

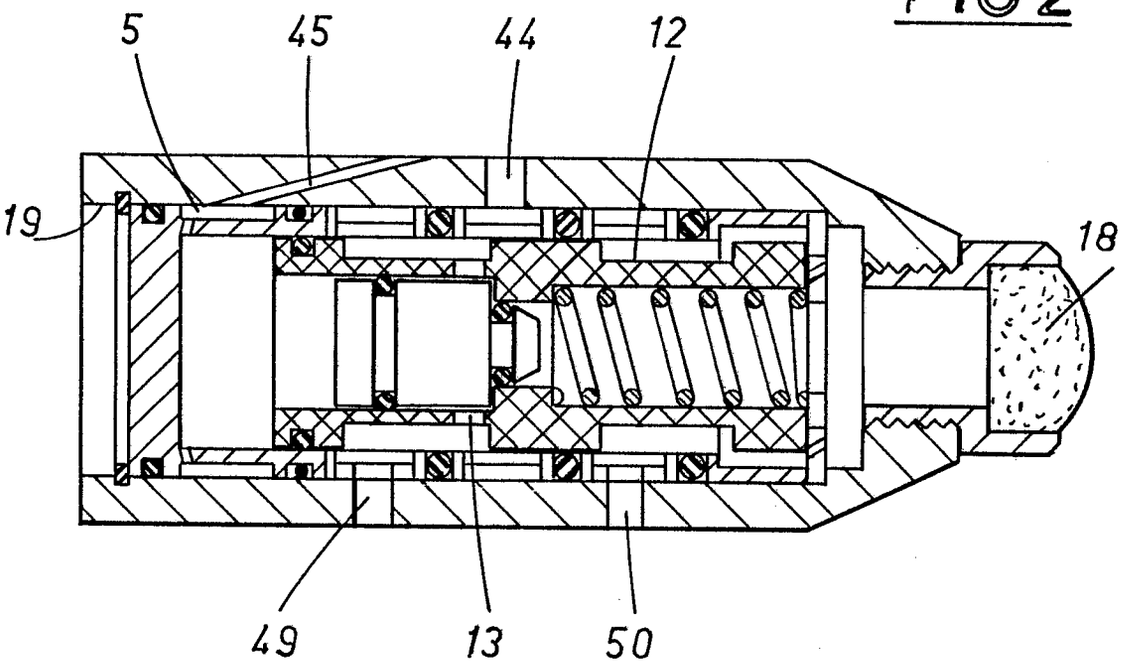
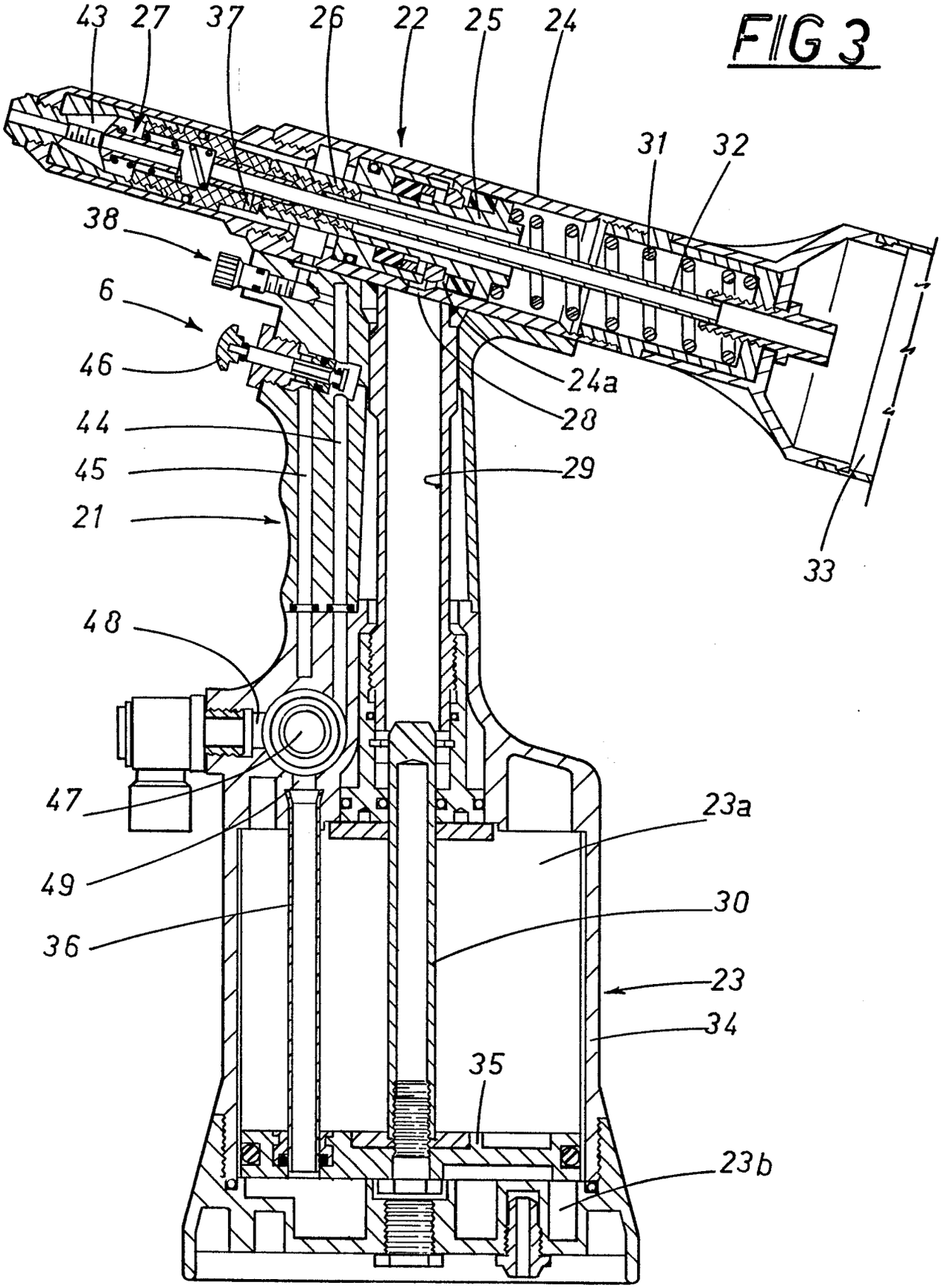

5
45
44
12
19
18
49
13
50

FIG 3


43
27
37
26
22
25
24
31
32
38
6
46
24a
28
44
45
29
21
33
48
47
23a
49
30
36
23
34
35
23b