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

(11) Publication number: **0 498 980 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **91301189.6**

(51) Int. Cl.5: **F04B 39/10**, F04B 39/00

(22) Date of filing: **14.02.91**

(43) Date of publication of application:
19.08.92 Bulletin 92/34

(84) Designated Contracting States:
DE ES FR GB IT NL

(71) Applicant: **DRESSER-RAND COMPANY**
Baron Steuben Place
Corning New York 14830(US)

(72) Inventor: **Bennitt, Robert Arthur**
24 Seneca Trace
Painted Post, New York 14870(US)

(74) Representative: **Hutchins, Michael Richard et al**
Graham Watt & Co. London Road Riverhead
Sevenoaks, Kent TN13 2BN(GB)

(54) Valve assembly, for use with a straight-cylinder having a gas-compression chamber.

(57) The invention provides, in combination with a straight-cylinder, gas-compression chamber (12) having end closures; e.g. centrally-threaded end closures (14, 16) a gas control vlave (30), comprising:

a ported, valve seat (56);

a ported, valve guard (36);

a ported, valve plate (48) interposed between said seat (56) and guard (36); and

a bolt (32), for mounting of said seat (56), guard (36) and plate (48) thereon, having (a) external threads formed thereon, and (b) an annular shoulder (34) formed thereabout; wherein

said seat (56), guard (36), and plate (48) are centrally apertured;

said guard (36) is set about said bolt (32), and against said shoulder (34);

said seat (56) is (a) internally threaded, (b) threadedly engaged with said bolt (32) threads, and (c) has replaceable sealing means (68) engaged with the periphery (66) thereof; and

said valve (30) is confined (e.g. reciprocably) within said gas-compression chamber, sealingly engaged with the inner surface of said chamber, and said bolt (32) being for example threadedly engaged with one of said centrally-threaded end closures of said chamber.

The seat (56) and guard (36) can be circular; and can include a dampening plate (40) interposed between the valve plate (48) and valve guard (36). The valve guard (36) and dampening plate (40) can have mutually confronting peripheral surfaces wherein the peripheral surface of the guard (36) is circular; and the peripheral surface of the dampening plate (4) is trochoidal.

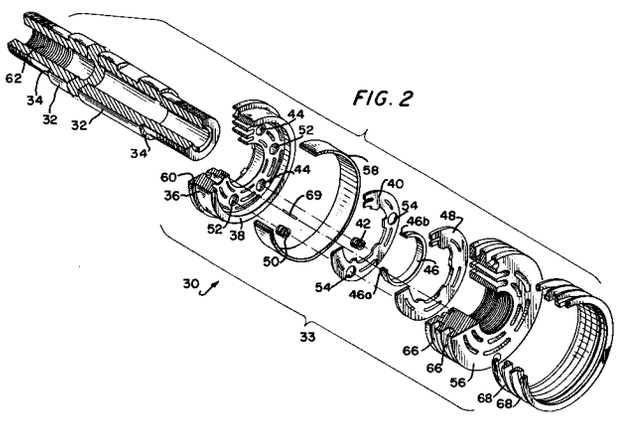

FIG. 2

EP 0 498 980 A1

This invention pertains to valves, i.e., gas-control valves, and valve assemblies for use in, and in combination with, straight-cylinder, gas-compression chambers, and in particular to such valves and valve assemblies in which the same are configured for confinement within such straight-cylinder, gas-compressicn chambers, but one configuration of valve serves for either gas inlet or gas discharge, and said one valve configuration is piston-ringed in order that the same serves as well as a gas-compressing piston when reciprocably disposed within such an aforesaid cylinder.

Prior art gas compressors, typically, employ both inlet and discharge valves, and gas compressing pistons, and commonly the valves are externally mounted to the gas-compressing chamber.

It is an object of this invention to set forth a novel valve assembly, for use in combination with a straight-cylinder, gas-compression chamber, in which the discharge valve embodiments thereof serve, as well, as gas-compressing pistons.

It is also an object of this invention to disclose a gas-control valve, in combination with a straight-cylinder, gas-compression chamber, which serves as either gas inlet or gas discharge, and which is piston-ringed, or otherwise peripherally sealed with replaceable seals, to function, also, as a gas-compressing piston.

Particularly it is an object of this invention to set forth, in combination with a straight-cylinder, gas compression chamber having centrally-threaded end closures, a gas-control valve, comprising a ported, valve seat; a ported, valve guard; a ported, valve plate interposed between said seat and said guard; and a bolt, for mounting of said seat, guard and plate thereon, having (a) external threads formed thereon, and (b) an annular shoulder formed thereabout; wherein said seat, guard and plate are centrally apertured; said guard is set about said bolt, and against said shoulder; said seat is (a) internally threaded, (b) threadedly engaged with said bolt threads, and (c) has replaceable sealing means engaged with the periphery thereof; and said valve is reciprocably confined within, and sealingly engaged with the inner surface of, said gas-compression chamber.

Another object of this invention is to set forth, in combination with a straight -cylinder, gas-compression chamber having centrally-threaded, end closures, a gas -control valve, comprising a ported, valve seat; a ported, valve guard; a ported, valve plate interposed between said seat and guard; and a bolt, for mounting of said seat, guard and plate thereon, having (a) external threads formed thereon, and (b) an annular shoulder formed thereabout; wherein said seat, guard and plate are centrally apertured; said guard is set about said bolt, and against said shoulder; said seat is (a) internally threaded, (b) threadedly engaged with said bolt threads, and (c) has replaceable sealing means engaged with the periphery thereof; and said valve is confined within said gas-compression chamber, sealingly engaged with the inner surface of said chamber, and said bolt is threadedly engaged with one of the centrally-threaded end closures of said chamber.

Yet another object of this invention is to disclose a valve assembly, for use in combination with a straight-cylinder, gas-compression chamber, comprising a bolt; said bolt having (a) external threads formed thereon at opposite ends thereof, and (b) annular shoulders formed thereabout, intermediate said threaded ends; a pair of ported, valve seats; a pair of ported valve guards; and a pair of ported valve plates; wherein each seat and guard has one of said valve plates interposed therebetween; said seats, guards and valve plates are centrally apertured; each guard is set about said bolt, and against one of said shoulders; and each seat is (a) internally threaded, (b) threadedly engaged with one of said opposite ends of said bolt, and (c) has replaceable sealing means engaged with the periphery thereof.

Further objects of this invention, as well as the novel features thereof, will become more apparent by reference to the following description, taken in conjunction with the accompanying figures, in which:

Figure 1 is a perspective, partially cross-sectioned illustration of a straight -cylinder, gas-compression chamber, in which the novel valves and valve assemblies are confined;

Figure 2 is a perspective, exploded view of the novel valve assembly, albeit showing but one of the two discharge valves thereof;

Figure 3A is a perspective, exploded view of one of the inlet gas-control valves;

Figure 3B shares the view of Figure 3A, representing the other of the inlet gas -control valves; figures 2, 3A and 3B also being partially cross-sectioned;

Figure 4 is a plan view of the valve plate and dampening plate of the novel valve; and

Figure 5 is an enlarged, cross-sectional view, taken through a limited, center portion of a discharge valve according to the invention.

As shown in Figure 1, a straight cylinder 10 defines therewithin a gas-comprssion chamber 12. Ends of the cylinder have centrally-threaded end closures 14 and 16. The end closures are held fast to the ends of the cylinder 10 by means of tie bolts 18 (only two of the four thereof being visible). The cylinder 10 has gas inlet ports 20 formed therein for admission of gas via inlet conduits 22 (shown only in phantom). The cylinder also has a gas discharge port 24 formed therein intermediate the

ends thereof.

End closure 14 threadedly receives the central bolt of an inlet valve 26, whereas end closure 16 threadedly receives the central bolt of an inlet valve 28. Therebetween, reciprocably mounted within the chamber 12, is the novel valve assembly 30.

Figure 2 shows the valve assembly 30 in greatly englarged detail. It comprises a bolt 32 which is hollow, and which has external threads formed thereon at opposite ends thereof. The assembly comprises a pair of valve sets 33; as one is identical to the other, only one such set is shown. The bolt 32 has shoulders 34 formed thereabout, and spaced apart, adjacent to the opposite ends thereof. Assembled, each shoulder 34 receives a ported, valve guard 36 thereagainst, the guard being centrally apertured. The guard 36 has a peripheral wall 38 in which is received a dampening plate 40. Compression springs 42, which are nested in blind holes 44 formed in the guard 38, bear against the underside of the dampening plate. A guide ring 46, which has a reduced diameter portion 46a at one end thereof, is received in the apertured center of the dampening plate 40. Ring 46 is provided to limit the lift of the dampening plate 40. Set about the bolt 32 is a valve plate 48, it too being centrally apertured, slidably to receive the guide ring therewithin. Compression springs 50, which also are nested in blind holes 52 formed in the guard 36, are in penetration of holes 54 formed therefor in the dampening plate 40, and bais the valve plate 48 away from the guard 38. The dampening plate 40, biased away from the guard 36 by springs 42, cooperates with the springs 50 to dampen an impact of the valve plate 48 with the guard 36. PlAte 40 intercepts plate 48 when the latter closes toward guard 36. A centrally apertured and threaded valve seat 56 is threadedly engaged with the threads at one end of the bolt 32. With its threaded engagement with the bolt 32, the seat 56 clamps together the guard 36, plate 40, guide ring 46, and valve plate 48; too, it holds in position a rider ring 58 which is set about the wall 38 and against a lip 60 which circumscribes the guard. 36.

The guide ring 46 keeps the dampening plate 40 distanced from the valve seat 56, however the plate 48 freely translates along the outer surface of the ring 46. The ring 46 sets against the seat 56 at one end thereof, and the opposite end of ring 46 sets against the guard 36. An outer shoulder 46b, formed on the ring 46, limits the lift of the plate 40 to the minimal depth of the reduced diameter portion 46a, in that the plate 40 closes against the shoulder 46b.

As is quite conventional, and as can be seen in the figures, and in particular Figure 5, the guard 36, dampening plate 40 and valve plate 48, have mutually aligned ports formed therein to permit the flow of gas directly therethrough. The valve seat 56, too, is ported; however the ports therein are not in alignment with the ports in guard 36, plate 40, and plate 48. Rather, the ports in valve seat 56 are occluded by the plate 48. Plate 48 must remove from the seat 56 to permit fluid flow through the seat 56. When When assembly 30 translates to the right (with reference to Figure 1) a gas pressure, built up in the chamber 12 between Assembly 30 and inlet valve 28, causes plate 48 to remove from the seat 56; this allows the pressured gas to pass through the aforesaid porting in plate 48, plate 40 and guard 36, for exit thereof through the discharge port 24. When the assembly 30 translates to the left (Figure 1), the plate 48 closes against the seat 56 and, consequently, a vacuum pressure is created between assembly 30 and inlet valve 28. This causes an ingestion of gas, via port 20, into chamber 12. Valve assembly 30, with both valve sets 33 emplaced thereon, is reciprocable in chamber 12 and, consequently, one of the sets 33 is closed while the other is open to the flow therethrough of gas. Bolt 32 is threaded internally, at 62, threadedly to receive the threaded end of a piston rod 64. The latter is so-called, in that the valve assembly 30 functions as a dual-headed piston. The valve seat 56 has a pair of grooves 66 formed therein and thereabout. The grooves 66 receive piston rings 68 herein to effect a sealing engagement thereof with the inner surface of the chamber 12. By this expedient, with identical valve sets 33 on opposite ends of the bolt 32, the valve sets serve as the pistons, and are wholly confined within the chamber, functioning as well as the discharge valves. An alignment pin 69 is received in holes provided therefor in guard 36 and seat 56, at ends of the pin 69, and the pin penetrates the plates 40 and 48, to keep all cited components properly aligned.

In Figures 3A and 3B, same or similar index numbers, as those shown in Figure 1 and 2, denote same or similar elements.

Figure 3A depicts an inlet valve which is received in the end closure 16, and it is identical, in all respects except one, to valve set(s) 33 of Figure 2. Instead of bolt 32, it has a bolt 32a. The latter is of short length and is hollow. The hollow interior accommodates the reciprocation of the piston rod 64. The porting of components shown in Figure 3A is such (and, again, identical to the valve sets 33) as to close against the flow fo gas as the valve assembly 30 approaches, and to open as the valve assembly moves away therefrom.

In Figure 3B is depicted another inlet valve, albeit the one received in the end closure 14. Save for the central bolt 34b, it too is identical to valve sets 33. Whereas bolt 32a of Figure 3A is hollow, to receive the piston rod 64, bolt 34b is of solid

cross-section. For simplicity Figures 3A and 3B share the depiction of the components of each inlet valve; the only difference therebetween reside in the center bolts 32a (Figure 3A) and 32b (Figure 3B). They are otherwise identical.

Figure 4 illustrates a particularly novel feature of the valve sets 33, the same being a plan view of the dampening plate 40 and valve guard 36. The inner periphery fo the wall 38 is truly circular, whereas the confronting periphery of the dampening plate is trochoidal. Consequently, chordal voids 70 are formed between the aforesaid peripheries to enhance gas flow therethrough. The voids 70 present large, open areas, between the peripheral wall 38 of guard 36 and the plate 40, to allow gas to course freely therethrough into the outermost ports in guard 36. The trochoidal configuration of the dampening plate 40 defines portions of the plate with relatively narrow and wide sectors. The holes 54, provided in plate 40 for the springs 50, are formed in the wider sectors of the plate, as shown in Figure 4.

Claims

1. In combination with a straight-cylinder, gas compression chamber having end closures, a gas-control valve, comprising:

a ported, valve seat;

a ported, valve guard;

a ported, valve plate interposed between said seat and guard; and

a bolt, for mounting of said seat, guard and plate thereon, having (a) external threads formed thereon, and (b) an annular shoulder formed thereabout; wherein

said seat, guard, and plate are centrally apertured;

said guard is set about said bolt, and against said shoulder;

said seat is (a) internally threaded, (b) threadedly engaged with said bolt threads, and (c) has replaceable sealing means engaged with the periphery thereof:

said valve is reciprocably confined within, and sealingly engaged with the inner surface of, said gas-compression chamber;

said seat and guard are circular; and including

a dampening plate interposed between said valve palte and said valve guard; and wherein

said valve guard and said dampening plate have mutually confronting peripheral surfaces;

said peripheral surface of said guard is circular; and

said peripheral surface of said dampening plate is trochoidal.

2. A gas-control valve, according to claim 1, wherein:

said valve seat has a plurality of grooves formed therein and about the periphery thereof; and

piston rings are set in said grooves.

3. A gas-control valve, according to claim 1, wherein:

said bolt is hollow.

4. A gas-control valve, according to claim 1, wherein:

said bolt is hollow, and has internal threads formed therein.

5. A gas-control valve, according to claim 4, further including:

a piston rod, threaded at an end thereof, threadedly engaged with said internal threads of said hollow bolt, and in penetration of one of said end closures.

6. A gas-control valve, according to claim 1, further including:

means interposed between said valve guard and said valve plate biasing said valve plate toward said valve seat; and

said biasing means is in penetration of said dampening plate.

7. In combination with a straight-cylinder, gas-compression chamber having centrally-threaded, end closure, a gas-control valve, comprising:

a ported, valve seat;

a ported, valve guard;

a ported, valve plate interposed between said seat and guard; and

a bolt, for mounting of said seat, guard and plate thereon, having (a) external threads formed thereon, and (b) an annular shoulder formed thereabout; wherein

said seat, guard, and plate are centrally apertured;

said guard is set about said bolt, and against said shoulder;

said seat is (a) internally threaded, (b) threadedly engaged with said bolt threads, and (c) has replaceable sealing means engaged with the periphery thereof; and

said valve is confined within said gas-compression chamber, sealingly engaged with the inner surface of said chamber, and said bolt is threadedly engaged with one of said centrally-threaded end closures of said chamber.

8. A gas-control valve, according to claim 7,

wherein:
said bolt is hollow.

9. A gas-control valve, according to claim 7, wherein:
said bolt is solid in cross-section.

10. A valve assembly, for use in combination with a straight-cylinder, gas -compression chamber, comprising:
a bolt;
said bolt having (a) external threads formed thereon at opposite ends thereof, and (b) annular shoulders formed thereabout, intermediate said threaded, opposite ends;
a pair of ported, valve seats;
a pair of ported, valve guards; and
a pair of ported, valve plates; wherein
each seat and guard has one of said valve plates interposed therebetween;
said seats, guards, and valve plates are centrally apertured;
each guard is set about said bolt, and against one of said shoulders; and
each seat is (a) internally threaded, (b) threadedly engaged with one of said opposite ends of said bolt, and (c) has replaceable sealing means engaged with the periphery thereof; wherein
said seats and guards are circular; and including
a dampening plate interposed between each said valve plate and valve guard;
each said valve guard and dampening plate have mutually confronting, peripheral surfaces;
said peripheral surface of each of said guards is circular; and
said peripheral surface of each of said dampening plates is trochoidal.

11. A valve assembly, according to claim 10, wherein:
said bolt is hollow, and has threads formed therein.

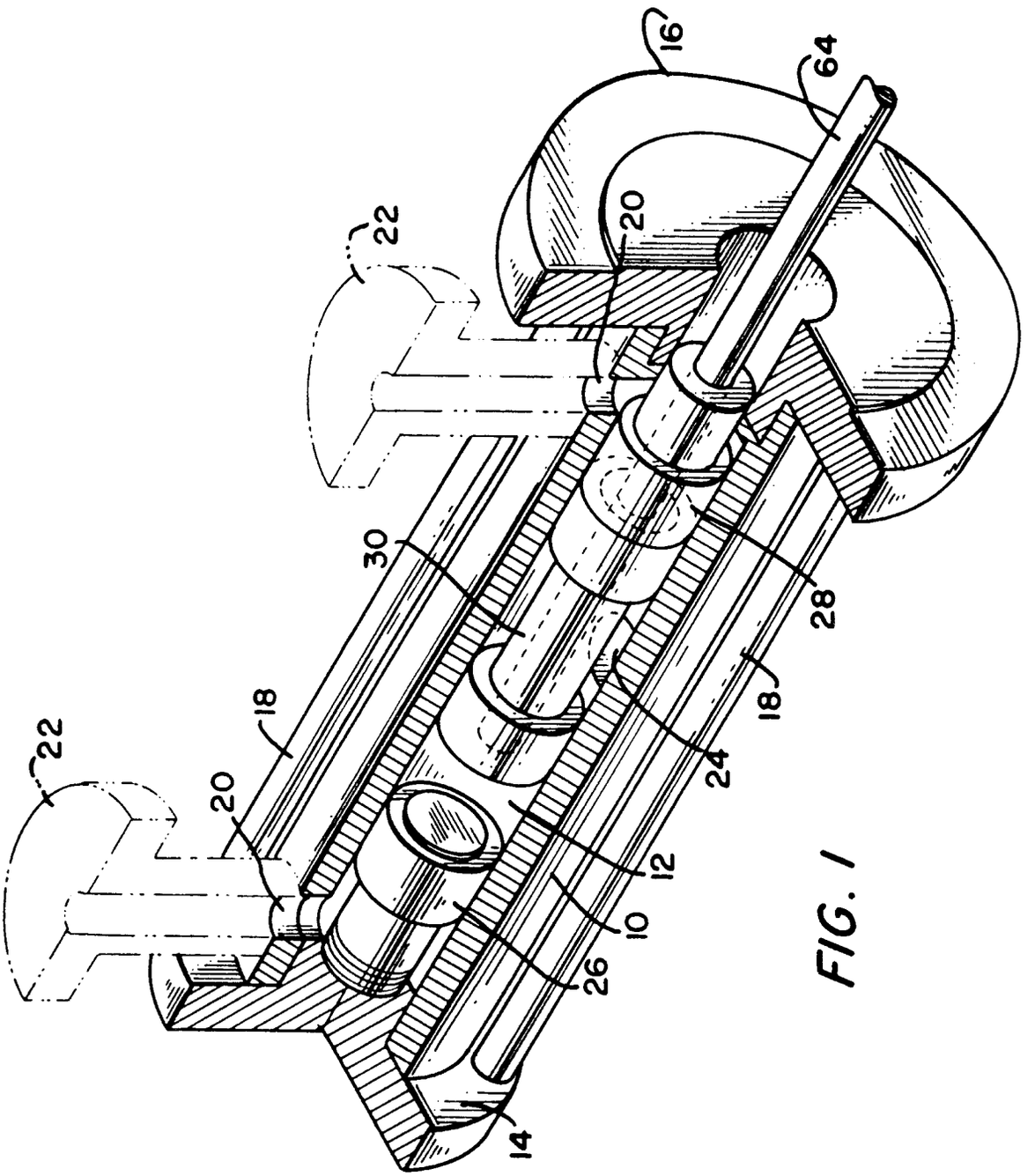

FIG. 1

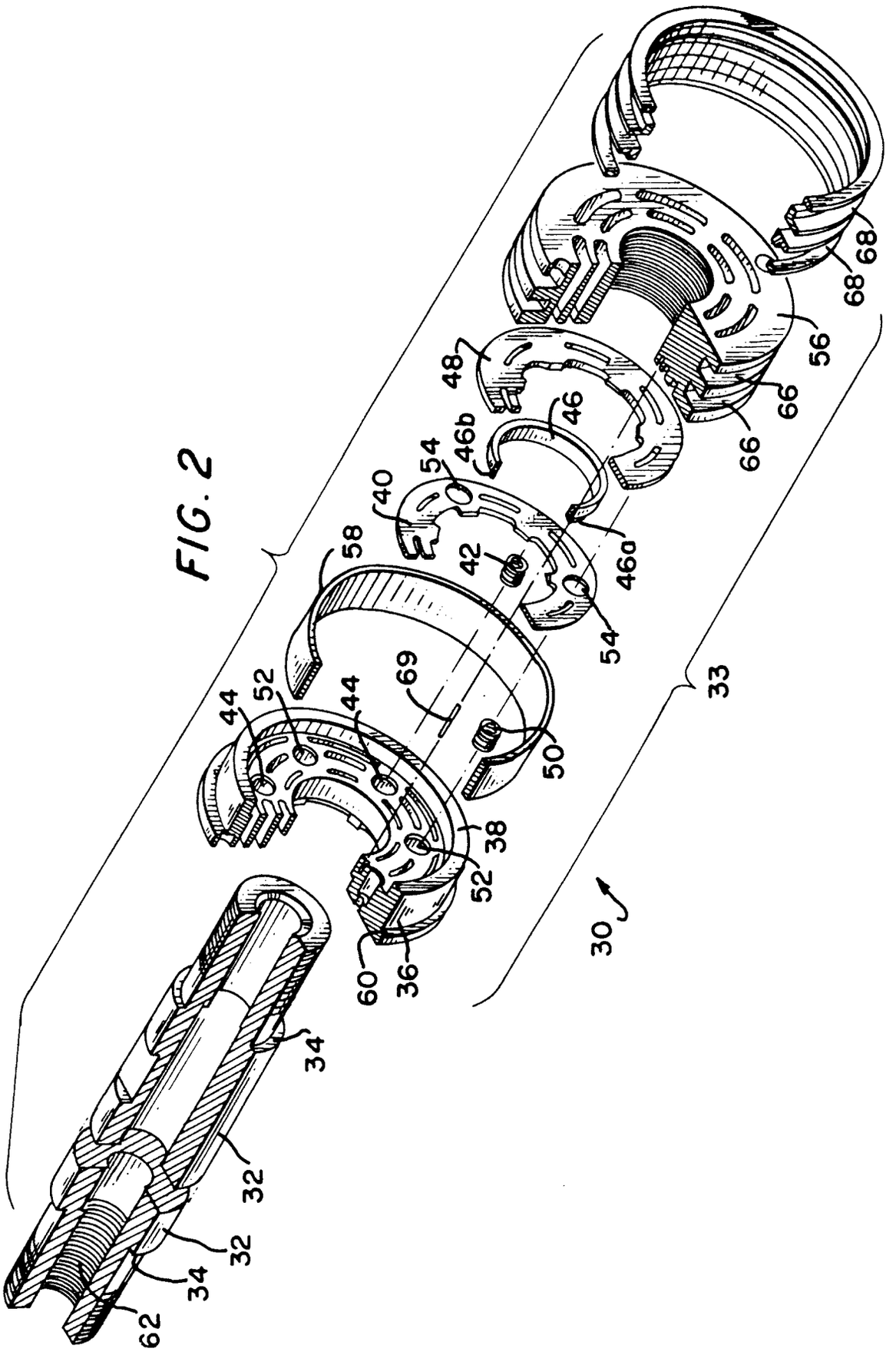
62
34
32
32
34
60
36
52
38
50
69
44
52
44
58
40
54
42
46b
46a
54
46
48
66
66
56
68
68
33
30

FIG. 2

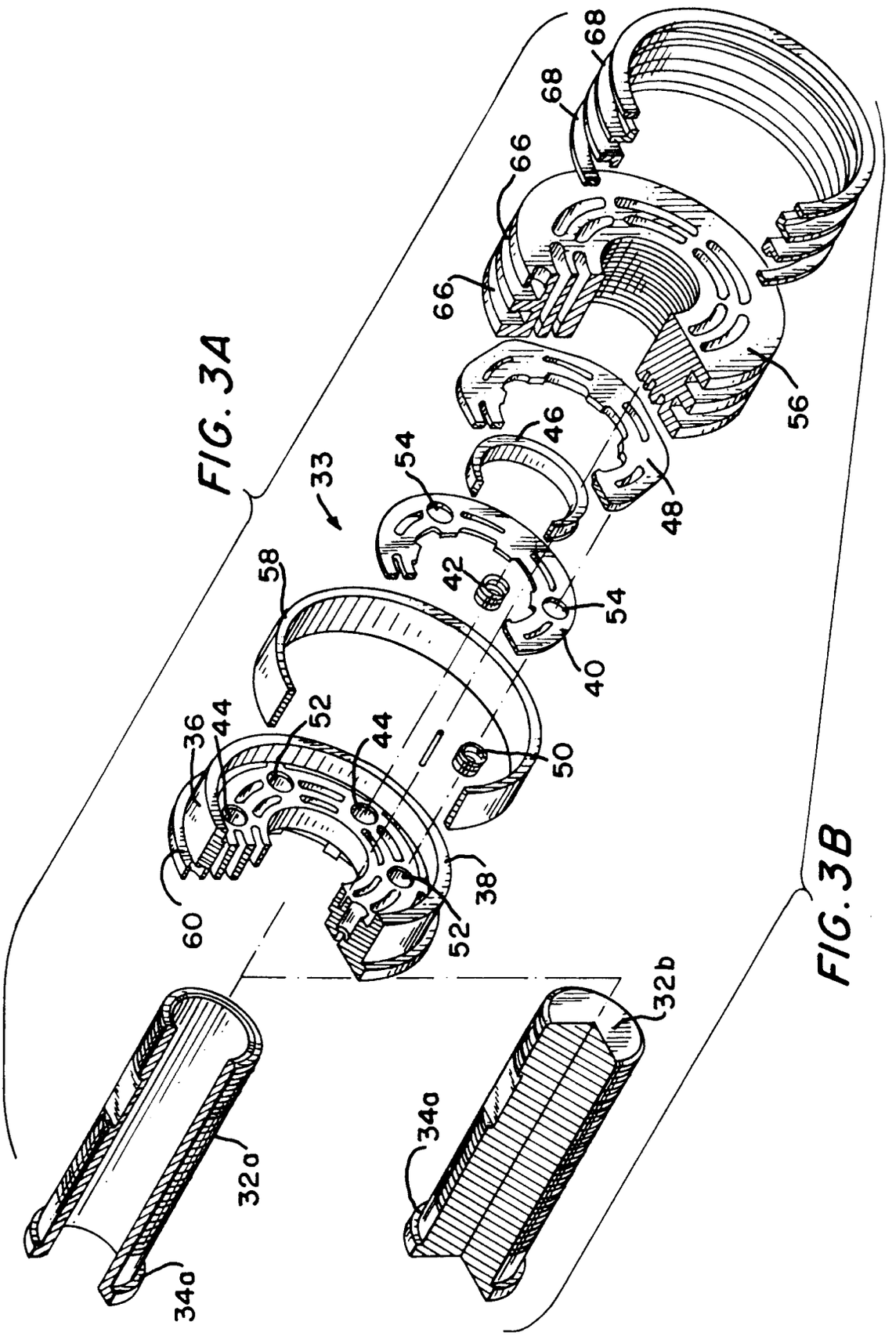
FIG. 3A
FIG. 3B
33
36
38
40
42
44
46
48
50
52
54
56
58
60
66
68
32a
32b
34a
34a

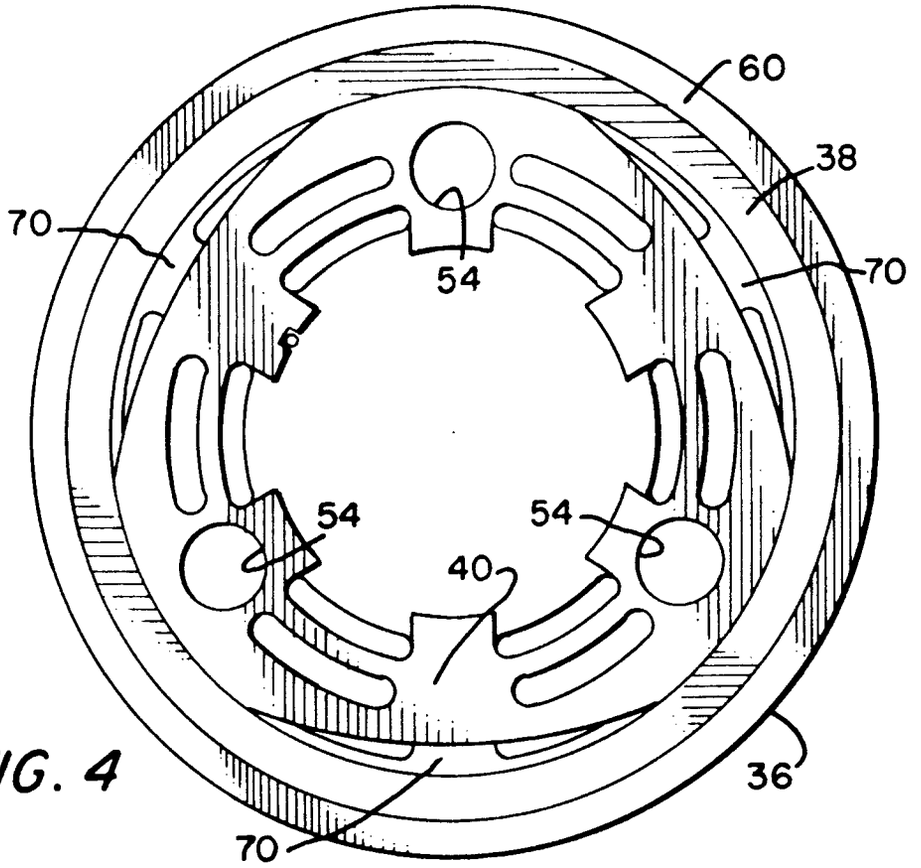

FIG. 4

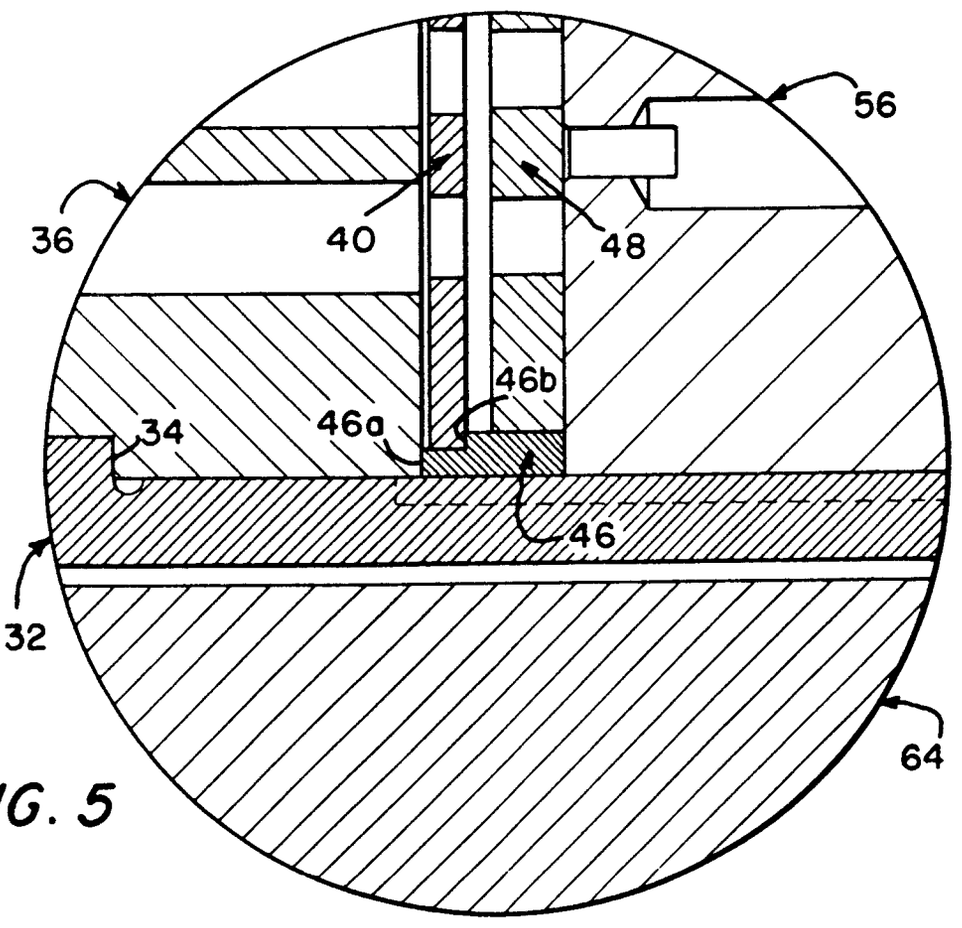

FIG. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 30 1189

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
E	US-A-5 011 383 (DRESSER-RAND COMP.) * the whole document *	1-11	F04B39/10 F04B39/00
A	EP-A-0 300 994 (ENFO) * column 4, line 60 - column 5, line 13; figure 3 *	1,6,7,9	
A	EP-A-0 300 989 (ENFO) * column 3, line 62 - column 4, line 60; figures 1,2 *	1,7,9	
A	US-A-1 602 193 (GARBER) * page 1, line 67 - page 2, line 35; figures *	1-5,7,8,10,11	
A	DE-A-2 017 248 (ENFO) * page 3, paragraph 4 - page 4, last paragraph; figures *	1,6	
A	DE-C-688 429 (SCHABETSBERGER) * page 2, line 31 - line 87; figure *	1,2,7	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	CH-A-467 956 (BAUER) * column 2, line 39 - column 4, line 34; figure 1 *	1	F04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	25 OCTOBER 1991	VON ARX H.P.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)