

(19)



(11)

EP 1 869 322 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
28.11.2012 Bulletin 2012/48

(51) Int Cl.:
F04B 39/04 ^(2006.01) **F04B 25/00** ^(2006.01)
F04B 53/14 ^(2006.01) **F04B 39/00** ^(2006.01)

(21) Application number: **05714646.6**

(86) International application number:
PCT/CA2005/000408

(22) Date of filing: **18.03.2005**

(87) International publication number:
WO 2006/096957 (21.09.2006 Gazette 2006/38)

(54) **OIL-LESS COMPRESSOR WITH SEAL-DUST PROTECTION**

ÖLFREIER VERDICHTER MIT DICHTUNGSSTAUBSCHUTZ

COMPRESSEUR AUTOLUBRIFIANT AVEC PROTECTION CONTRE LA POUSSIERE

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR**

- **HRISTU, Florin**
Kettleby, Ontario L0G 1J0 (CA)
- **RACKHAM, Ralph**
Toronto, Ontario M5M 1G1 (CA)

(30) Priority: **17.03.2005 PCT/CA2005/000395**

(43) Date of publication of application:
26.12.2007 Bulletin 2007/52

(74) Representative: **Mola, Edoardo et al**
Studio Torta S.p.A.
Via Viotti, 9
10121 Torino (IT)

(73) Proprietor: **M.T.M. S.r.l.**
Cherasco (CN) (IT)

(56) References cited:
EP-A- 0 340 150 EP-A- 0 833 054
AU-A- 6 808 381 CA-A1- 2 238 237
GB-A- 2 400 891 US-A- 3 204 864
US-A- 4 889 039 US-A- 5 030 065

(72) Inventors:
• **VOICU, Traian**
Richmond Hill, Ontario L4S 2K4 (CA)

EP 1 869 322 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

FIELD OF THE INVENTION

[0001] This invention relates to an oil-less compressor that delivers high-pressure gas to a storage reservoir. In particular, it relates to a home refuelling appliance for refuelling motor vehicles that operate on gaseous fuels. Compressor able to do so are disclosed for example in US 4 889, 039 in AU 680 8381 A, in EP-A-0883054 and in EP-A-0340 150;

BACKGROUND TO THE INVENTION

[0002] A number of applications exist which require gas to be compressed to a high-pressure, e.g. 20; 68 MPa (3000 psi), without introducing traces of lubricants into the compressed gas. AU 6808381 in the closest prior art. Thus, natural gas fuelled motor vehicles may require an oil-less compressor to compress gas for delivery to a tank or reservoir carried by the vehicle. This is one, preferred, example of an application of the present invention.

[0003] In the past, natural gas fuelled motor vehicles have generally been refuelled at commercial refuelling facilities. Provision has also existed for home refuelling systems that produce compressed natural gas from the low-pressure natural gas lines available at residential sites. Particularly in the case of a home refuelling appliance, it is desirable for such units to be installed for long term, unattended operation. An oil-less compressor provided with features of the invention would be especially suited for both of these applications, but the invention has general application wherever an oil-less compressor having dry seals that produce contaminating dust is employed.

[0004] . In a high pressure oil-free gas compressor compression is preferably maintained through dry seals based upon the use of polymeric ring materials. A disadvantage of this system is that the polymeric ring materials generate dust which is potentially damaging to the bearings in the compressor mechanism. A need exists for a system which will reduce the wear and damage that can arise within the compressor from the formulation of such dust. This invention addresses that need.

[0005] The invention in its general form will first be described, and then its implementation in terms of specific embodiments will be detailed with reference to the drawings following hereafter. These embodiments are intended to demonstrate the principle of the invention, and the manner of its implementation. The invention in its broadest and more specific forms will then be further described, and defined, in each of the individual claims, which conclude this Specification.

SUMMARY OF THE INVENTION

[0006] The invention relates to an oil-less compressor, and particularly to a multi-stage compressor for refuelling

gas-powered vehicles. Accordingly, the invention in one aspect addresses a gas compressor assembly which comprise

[0007] a) a gas compressor having at least a first stage with at least one cylinder with dry seals having a piston mounted therein with a piston rod connected to the piston and extending into a crank case cavity;

[0008] b) a crank mechanism which is located in the crank case cavity connected to operate the piston rod; and

[0009] c) a low-pressure gas supply inlet for connection to a source of gas and delivery of gas to said first stage; and

[0010] d) a high-pressure gas discharge outlet for delivery of compressed gas to an external reservoir;

[0011] said compressor assembly further comprising a dust control enclosure having a sidewall through which the piston rod passes, said dust control enclosure forming a barrier between the dry seals and the crank mechanism that substantially limits dust from the dry seals accessing the crank mechanism.

[0012] The dust control enclosure is preferably in the form of a sleeve which when fitted forms a cap with penetrations through its sidewalls which have dust-excluding seals through which the rod(s) pass. Such seals are preferably in the form of washer-like rings made of felt-like material. This arrangement effectively confines dust generated by deterioration of the sealing rings to remain on the piston and cylinder sides of the dust control enclosure.

[0013] According to a further variant of the invention, the low pressure gas supply inlet delivers gas to the crank case cavity, and the first stage of the compressor takes its intake of gas to be compressed from the crank case cavity on the piston side of the dust control enclosure.

[0014] The compressor unit of the invention in a preferred variant is a multi-stage compressor, e.g. a four stage compressor having pairs of opposed, linearly reciprocating, pistons. The pistons are preferably driven in pairs by Scotch yokes as a specific type of crank mechanism, actuated by a shaft extending from the crank case cavity to a motor. According to this system, the piston rods move in a straight line.

[0015] In order to minimize the extent to which ring dust can enter the bearings of the Scotch yokes, the dust control enclosure is installed within the crank case portion of the compressor. This enclosure, preferably made of substantially rigid polymeric plastic material, may be in the form of a sleeve which, when mounted on the bearing housing flange, forms a cap or cup that surrounds the crank mechanism. This cap has sidewalls through which the piston rods pass as they extend inwardly to connect to the Scotch yokes. It is at these penetrations through the sidewalls of this enclosure that dust-excluding seals in the form of washers made of felt-like material are preferably installed.

[0016] Because line gas enters the first stage of the compressor by flowing first through the crank case cavity

before following a gas flow path to the piston side of the dust control enclosure, and because the first stage takes its intake of gas to be compressed from the region outside the dust control enclosure, a pressure differential exists within the compressor unit. The region around the Scotch yokes benefits from an overpressure of up to nearly the line gas pressure e.g. 1,38 to 3,45 kPa (0.2 to 0.5 psi) with respect to the pressure outside the dust control enclosure, on the piston seals side where ring dust forms. Thus a continuous flow of dust-free incoming gas sweeps through this higher-pressure region before entering the first compression stage. This flow operates to help exclude dust from entering the region around the Scotch yokes.

[0017] The foregoing summarizes the principal features of the invention and some of its optional aspects. The invention may be further understood by the description of the preferred embodiments, in conjunction with the drawings, which now follow.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Figure 1 is a pictorial representation of a gaseous fuel motor vehicle parked in a garage having a home refuelling appliance according to the invention mounted on its inner wall.

[0019] Figure 2 is a schematic depiction of the principal components of the appliance with the front shroud/cover of the housing removed, including the unitary motor/compressor assembly, its casing, control circuits, other support elements including various sensors.

[0020] Figure 3 is a cross-sectional side view of the appliance of Figures 1 and 2 exposing the compressor and motor assembly and showing the location of the dust control enclosure in cross-section in relation to the first and third stage cylinders in the compressor.

[0021] Figure 4 is an enlarged view of Figure 3 showing the compressor in detail.

[0022] Figure 5 is perspective view depicting the dust control enclosure with holes to allow penetration by piston rods within the motor/compressor assembly of Figure 3.

[0023] Figure 6 is a top view of the enclosure of Figure 5.

[0024] Figure 7 is a cross-sectional side view of the enclosure of Figure 6.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0025] In Figure 1 the home refueling appliance 1 is shown mounted on a garage wall with the high-pressure discharge hose 2 connected to a car, the inlet hose 3 connected to a source of gas, and the electrical cord 4 plugged into a standard household receptacle.

[0026] The compressor unit of the invention in a preferred variant is a multi-stage compressor 5, e.g. a four stage compressor 5 having pairs of opposed, linearly reciprocating, pistons 50, shown in Figures. The pistons

50 are preferably driven in pairs by Scotch yokes 51 actuated by a drive/crank shaft 52 extending from the motor 27 into the crank case cavity 14. The compressor unit is provided with a low-pressure gas supply inlet 59 for connection to a source of gas and a high-pressure gas discharge outlet 70 for delivery of compressed gas to an external reservoir.

[0027] Figure 3 schematically depicts the unit operating in compression mode. Gas 6 which has been fed into the interior crank case volume 14 of the casing 26 is drawn into the first 28 of a series of four compression stages of compressor 5. The gas 6, which typically has a pressure of between about 1,38 to 3,45 kPa (0.2 and 0.5 psi), is drawn into the interior casing volume 14 by the suction created by the first compression stage 28.

[0028] On leaving the first stage 28, the gas 6 passes through a desiccant bed 7 contained within an absorption chamber 29. Upon exiting the absorption chamber 29, the dried gas continues into the condenser 30 which is, at this stage, passive. Exiting the condenser 30, the gas 6 proceeds to the next, second stage 32 of the compressor 5 for completion of the compression process.

[0029] The compressor 5, motor 27 and motor control circuitry 45 are all located within the casing 26, (counting the compressor block as part of the casing). The main logic controller 46, fed power from a power supply, is able to activate the motor 27, and govern its speed in the variable speed version, through motor control circuitry 45. The wall of the casing 26 acts as heat sink for the heat produced by the motor controller circuitry 45 and as a shield against outgoing electromagnetic emissions.

[0030] On start-up, low motor speeds are adopted to reduce otherwise high start-up current drains on the electrical supply system. This enables the unit to operate off of a standard household voltage, e.g. 110-120 volt, moderately fused electrical supply system. After start-up, the initial process of compression can be effected with a high motor speed. Once higher pressures have been established in the motor vehicle fuel reservoir, motor speed is reduced in order to moderate ring wear and limit power consumption. This procedure is especially suited to oil-less compressors 5 as the wear rate of the sealing rings 53 within the compressor cylinders 54 of such units increases when the compressor system is operated at high speed against a high-back pressure.

[0031] Additionally, the speed of the electric motor 27 may be controlled to avoid natural resonant frequencies arising from its mechanical components that would otherwise increase the noise and vibration generated by the unit.

[0032] As shown in Figures 3 and 4, the pistons 50 mounted in their respective cylinders 54 are each provided with dry seals 53. The pistons 50 are connected each by a piston rod 57 to the Scotch yoke crank mechanism 51 located in the crank case cavity 14. The piston rods 50 pass through the sidewall 55 of the dust control enclosure 56 which forms a barrier between the dry seals 53 on the pistons 50 and the crank mechanism 51,

excluding dust from the dry seals 53 accessing the crank mechanism 51.

[0033] The dust control enclosure 56 as shown in Figures 5, 6, and 7 is in the form of a sleeve fitted to the bearings support 58, shown in Figures 3 and 4, to form a cap installed within the crank case portion 14 of the compressor 5. This enclosure 56 is provided with penetrations 60 through its sidewalls 55 which have dust-excluding dust seals 71. The rods 57 pass through these dust seals 71 as they extend inwardly to connect to the crank mechanism 51. Such dust seals 71 are preferably in the form of washers made of felt-like material that are compatible with the compressor environment. The dust control enclosure 56 is preferably made of semi-rigid polymeric plastic material with similar compatibility. The dust control enclosure 56 as shown is mounted on the bearing housing flange.

[0034] The low-pressure gas supply inlet 59 delivers gas 6 to the crank case cavity 14 where the Scotch yoke mechanism 51 is present. The first stage 28 of the compressor 5 takes its intake of gas 6 to be compressed from the crank case cavity 14 on the piston side of the dust control enclosure 56 through first cylinder supply valve 72 fitted within the piston 50. Because gas 6 enters the first stage 28 of the compressor 5 by flowing first through the crank case cavity 14 within the region of the dust control enclosure and then through a partially constricted passageway 80 linking both sides of the dust control enclosure, and because the first stage 28 takes its intake of gas 6 to be compressed from the region outside the dust control enclosure 56, a pressure differential generally exists within the compressor unit between these two regions. Thus a continuous flow of dust-free incoming gas 6 sweeps through this higher-pressure region of the crank case cavity 14 before entering the first compression stage 28. This flow operates to help exclude piston seal dust from remaining in the crank mechanism 51. Further gas flow to the next stage 32 and subsequent stages occurs through sealed conduits.

[0035] Additionally, the cool and dust-free arriving gas flow coming from the low-pressure gas supply inlet 59 passes first around the crank mechanism 51 components in the crank case volume 14 contained by the dust enclosure to provide cooling. This is advantageous as the Scotch Yoke drives generate significant heat due to bearing friction.

[0036] Similarly, for the second stage 32 and further stages, if present, the dust enclosure 56 minimizes the presence of dust in the crank case cavity by reason of the barrier that it provides and the general pressure differential that is maintained.

[0037] The Scotch yoke mechanism 51 is able to serve two opposed cylinders located in a common plane. When four cylinders are employed, the second pair of cylinders is in a second plane. Accordingly, the further penetrations or openings 60A in the dust control enclosure 56 needed to accommodate the further piston rods 50 are off-set from the first pair of openings 60.

[0038] On this basis a system is provided that protects the crank mechanism from dust arising from the dry seals.

CONCLUSION

[0039] The foregoing has constituted a description of specific embodiments showing how the invention may be applied and put into use. These embodiments are only exemplary. The invention in its broadest, and more specific aspects, is further described and defined in the claims which now follow.

[0040] These claims, and the language used therein, are to be understood in terms of the variants of the invention which have been described. They are not to be restricted to such variants, but are to be read as covering the full scope of the invention as is implicit within the invention and the disclosure that has been provided herein.

Claims

1. A gas compressor assembly comprising:

a gas compressor (5) having at least a first stage (28) with at least one cylinder (54) with a piston (50) having a polymeric ring dry seals (53);

a) a piston rod (57) connected to said piston (50) and extending into a crank case cavity (14) of a casing (26);

b) a crank mechanism (51) located in the crank case cavity (14) to operate said piston rod (57);

c) a low pressure gas supply inlet (59) for connection to a source of gas and delivery of gas to said first stage (28); and

d) a high-pressure gas discharge outlet (70) on said gas compressor for delivery of compressed gas to an external reservoir;

characterized in that said piston (50) supports an inlet valve means (72) to connect said gas supply inlet (59) and said crank case cavity (14) to gas discharge outlet (70) through said piston (50) and **in that** said compressor assembly further comprising a dust fixed control enclosure (56) placed within the crank case cavity (14); said dust fixed control enclosure (56) being fixed to a support (58) to form a cup that surround the crank mechanism (51); said cup having a sidewall (55) having a penetration (60) through which the piston rod (57) passes, said dust control enclosure (56) forming a fixed barrier between the polymeric ring dry seals (53) and the crank mechanism (51) that excludes dust from the polymeric ring dry seals from accessing the crank mechanism (51).

2. A gas compressor assembly as claimed in Claim 1 wherein the low pressure gas supply inlet (59) delivers gas to the crank case cavity (14) in the region of the crank mechanism (51) on the crank shaft side of the dust control enclosure (56) and the first stage of the compressor takes its intake of gas to be compressed from the crank case cavity (14) on the piston side of the dust control enclosure (56) through a cylinder supply valve (72), there being a gas flow path extending from the region of the crank mechanism (51) to the portion of the crank case cavity (14) on the piston side of the dust control enclosure (56) whereby a pressure differential may be formed in operation across the barrier formed by the dust control enclosure. 5 10 15
3. A gas compressor assembly as claimed in Claims 1 or 2, **characterized in that** the dust control enclosure (56) further comprises a dust-excluding dust seal (71) placed on said penetration (60) in said side-wall (55) and surrounding said piston rod (57). 20
4. A gas compressor assembly as claimed in Claim 3, **characterized in that** said dust seal (71) is in the form of washers comprising a felted material. 25
5. A gas compressor assembly as claimed in any one of the preceding Claims, **characterized in that** the compressor is a multi-stage compressor having a piston rod (50) for each stage and penetrations (60) in the dust control enclosure (56) for each piston rod (57). 30
6. A gas compressor assembly as claimed in Claim 5, **characterized in that** the crank mechanism (51) comprises two or more Scotch yokes connected to a shaft extending into the crank case cavity (14). 35
7. A gas compressor assembly as claimed in Claim 6 wherein the compressor is a four stage compressor having pairs of opposed, linearly reciprocating, pistons (50). 40

Patentansprüche 45

1. Gaskompressoranordnung mit:

einem Gaskompressor (5) mit wenigstens einer ersten Stufe (28) mit wenigstens einem Zylinder (54) mit einem Kolben (50), der trockene Polymer-Ringdichtungen (53) aufweist; 50

- a) einer Kolbenstange (57), die mit dem Kolben (50) verbunden ist und sich in einen Kurbelgehäuseraum (14) eines Gehäuses (26) hineinerstreckt; 55
- b) einem Kurbelmechanismus (51), der in

dem Kurbelgehäuseraum (14) angeordnet, um die Kolbenstange (57) zu betätigen;
 c) einem Niederdruckgas-Zuführeinlass (59) zum Anschluss an eine Gasquelle und zur Abgabe des Gases an die erste Stufe (28); und
 d) einem Hochdruckgas-Abgabeauslass (70) auf dem Gaskompressor zur Abgabe des komprimierten Gases an ein äußeres Reservoir;

dadurch gekennzeichnet, dass der Kolben (50) ein Einlassventileinrichtung (72) trägt, um den Gaszuführeinlass (59) und den Kurbelgehäuseraum (14) über den Kolben (50) mit dem Gas-Abgabeauslass (70) zu verbinden, und dass die Kompressoranordnung ferner ein fest montiertes Staubkontrollgehäuse (56) umfasst, das innerhalb des Kurbelgehäuseraums (14) angeordnet ist, wobei das fest montierte Staubkontrollgehäuse (56) an einem Träger (58) befestigt ist, um eine Schale zu bilden, welche den Kurbelmechanismus (51) umgibt; wobei die Schale eine Seitenwand (55) hat, die eine Durchdringung (60) aufweist, durch welche die Kolbenstange (57) hindurchpasst, wobei das Staubkontrollgehäuse (56) eine feste Barriere zwischen den trockenen Polymer-Ringdichtungen (53) und dem Kurbelmechanismus (51) bildet, welche Staub, der von den trockenen Polymer-Ringdichtungen herrührt, von einem Zugriff auf den Kurbelmechanismus (51) ausschließt.

2. Gaskompressoranordnung nach Anspruch 1, in welcher der Niederdruckgas-Zuführeinlass (59) auf der Kurbelwellenseite des Staubkontrollgehäuses (56) Gas an den Kurbelgehäuseraum (14) im Bereich des Kurbelmechanismus (51) liefert und die erste Stufe des Kompressors ihren Eintritt von zu komprimierendem Gas aus dem Kurbelgehäuseraum (14) auf der Kolbenseite des Staubkontrollgehäuses (56) über ein Zylinder-Zuflussventil (72) erhält, wobei dadurch ein Gasströmungsweg vorliegt, der sich von dem Bereich des Kurbelmechanismus (51) zu dem Bereich des Kurbelgehäuseraums (14) auf der Kolbenseite des Staubkontrollgehäuses (56) erstreckt, wodurch im Betrieb eine Druckdifferenz quer zur Barriere gebildet werden kann, die durch das Staubkontrollgehäuse gebildet wird.

3. Gaskompressoranordnung nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das Staubkontrollgehäuse (56) ferner eine Staub ausschließende Staubdichtung (71) umfasst, die auf der Durchdringung (60) an der Seitenwand (55) angeordnet ist und die Kolbenstange (57) umgibt.

4. Gaskompressoranordnung nach Anspruch 3, **da-**

durch gekennzeichnet, dass die Staubdichtung (71) in Form von Dichtungsringen mit einem verfilzten Material vorliegt.

5. Gaskompressoranordnung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Kompressor ein Mehrstufenkompressor ist, der eine Kolbenstange (50) für jede Stufe und Durchdringungen (60) in dem Staubkontrollgehäuse (56) für jede Kolbenstange (57) aufweist. 5 10
6. Gaskompressoranordnung nach Anspruch 5, **dadurch gekennzeichnet, dass** der Kurbelmechanismus (51) zwei oder mehr Kreuzschleifen umfasst, die mit einer sich in den Kurbelgehäuseraum (14) erstreckenden Welle verbunden sind. 15
7. Gaskompressoranordnung nach Anspruch 6, in welcher der Kompressor ein Vierstufenkompressor ist, der ein Paar einander gegenüberliegender, sich linear hin und her bewogender Kolben (50) aufweist. 20

Revendications

1. Ensemble compresseur de gaz comprenant : 25

un compresseur de gaz (5) présentant au moins un premier étage (28) avec au moins un cylindre (54) avec un piston (50) doté d'un joint sec annulaire en polymère (53) ; 30

- a) une tige de piston (57) reliée audit piston (50) et s'étendant dans une cavité de boîte de manivelle (14) d'un carter (26) ; 35
- b) un mécanisme de manivelle (51) situé dans la cavité de boîte de manivelle (14) pour actionner ladite tige de piston (57) ;
- c) une entrée d'alimentation de gaz basse pression (59) pour être reliée à une source de gaz et fournir du gaz audit premier étage (28) ; et 40
- d) une sortie d'évacuation de gaz haute pression (70) sur ledit compresseur de gaz pour fournir du gaz comprimé à un réservoir externe ; 45

caractérisé en ce que ledit piston (50) porte des moyens de soupape d'admission (72) pour connecter ladite entrée d'alimentation de gaz (59) et ladite cavité de boîte de manivelle (14) à la sortie d'évacuation de gaz (70) par ledit piston (50) et **en ce que** ledit ensemble compresseur comprend en outre une enceinte fixée de captage de poussière (56) placée dans la cavité de boîte de manivelle (14) ; ladite enceinte fixée de captage de poussière (56) étant fixée sur un support (58) de sorte à former une coupelle en-

tourant le mécanisme de manivelle (51) ; ladite coupelle présentant une paroi latérale (55) dotée d'une pénétration (60), par laquelle la tige de piston (57) passe, ladite enceinte de captage de poussière (56) formant une barrière fixée entre les joints secs annulaires en polymère (53) et le mécanisme de manivelle (51) qui empêche la poussière des joints secs annulaires en polymère d'accéder au mécanisme de manivelle (51).

2. Ensemble compresseur de gaz selon la revendication 1, dans lequel l'entrée d'alimentation de gaz basse pression (59) fournit du gaz à la cavité de boîte de manivelle (14) dans la région du mécanisme de manivelle (51) sur le côté du vilebrequin de l'enceinte de captage de poussière (56) et le premier étage du compresseur prend son admission de gaz à compresser de la cavité de boîte de manivelle (14) sur le côté du piston de l'enceinte de captage de poussière (56) par une soupape d'alimentation de cylindre (72), une voie de passage de gaz s'étendant de la région du mécanisme de manivelle (51) à la partie de la cavité de boîte de manivelle (14) sur le côté de piston de l'enceinte de captage de poussière, une pression différentielle pouvant être formée en fonctionnement sur la barrière formée par l'enceinte de captage de poussière. 50
3. Ensemble compresseur de gaz selon la revendication 1 ou 2, **caractérisé en ce que** l'enceinte de captage de poussière (56) comprend en outre un joint étanche à la poussière (71) placé sur ladite pénétration (60) dans ladite paroi latérale (55) et entourant ladite tige de piston (57). 55
4. Ensemble compresseur de gaz selon la revendication 3, **caractérisé en ce que** ledit joint étanche à la poussière (71) se présente sous la forme de rondelles comprenant un matériau feutré.
5. Ensemble compresseur de gaz selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le compresseur est un compresseur à étage multiple doté d'une tige de piston (50) pour chaque étage et de pénétrations (60) dans l'enceinte de captage de poussière (56) pour chaque tige de piston (57).
6. Ensemble compresseur de gaz selon la revendication 5, **caractérisé en ce que** le mécanisme de manivelle (51) comprend deux ou plusieurs commandes à coulisse reliées à un arbre s'étendant dans la cavité de boîte de manivelle (14).
7. Ensemble compresseur de gaz selon la revendication 6, dans lequel le compresseur est un compresseur à quatre étages doté de paires de pistons al-

ternatifs linéairement (50) opposés.

5

10

15

20

25

30

35

40

45

50

55

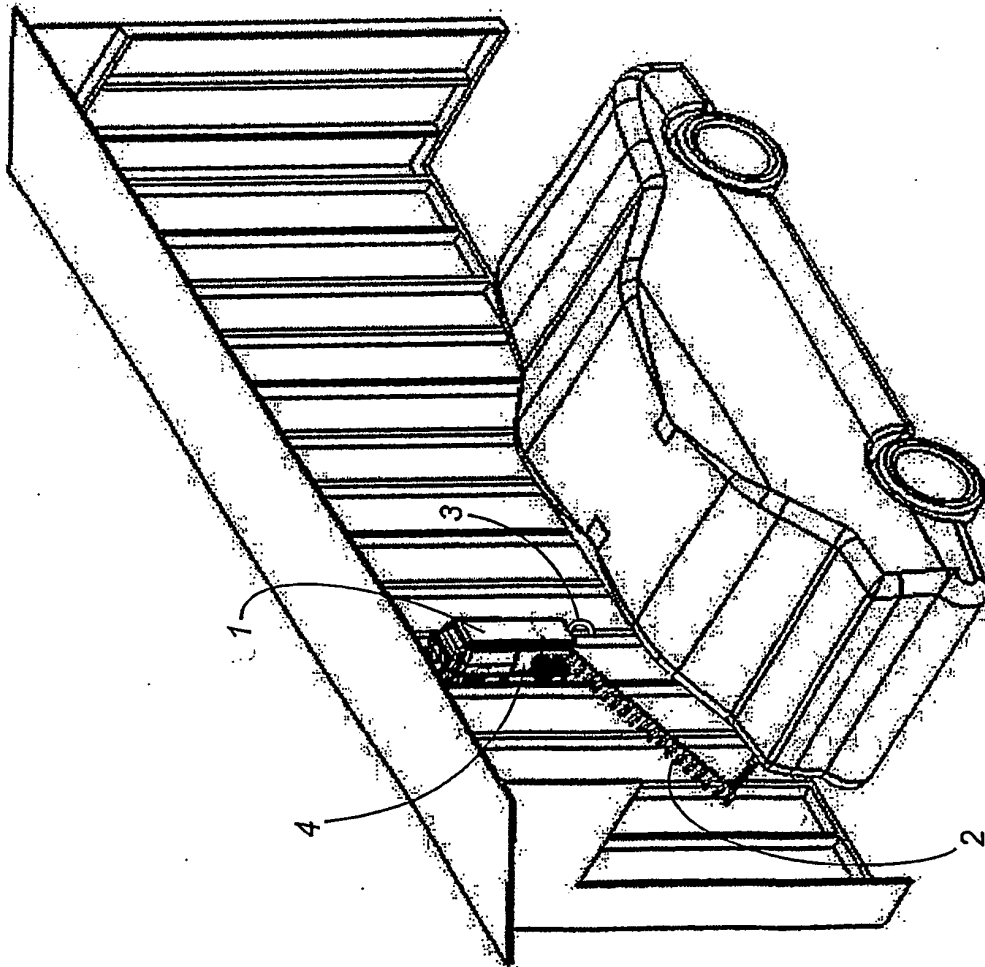


FIG. 1

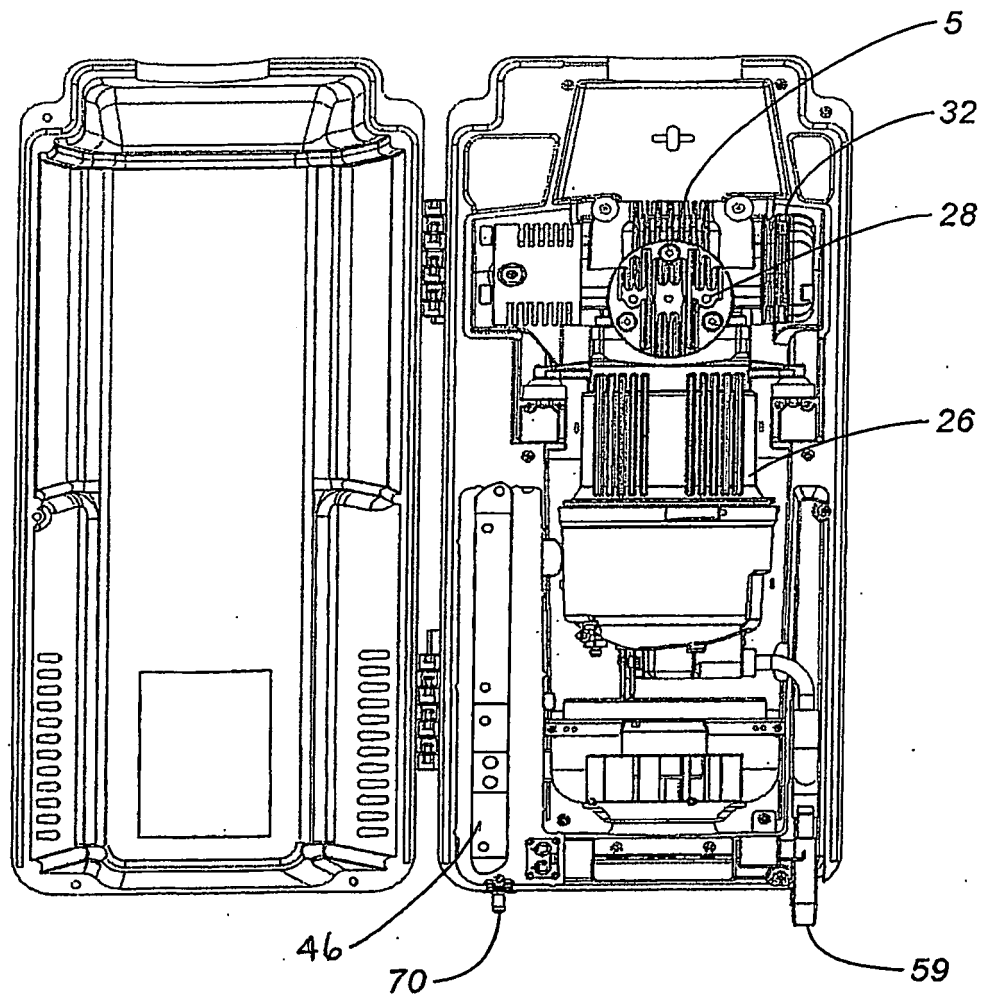


FIG. 2

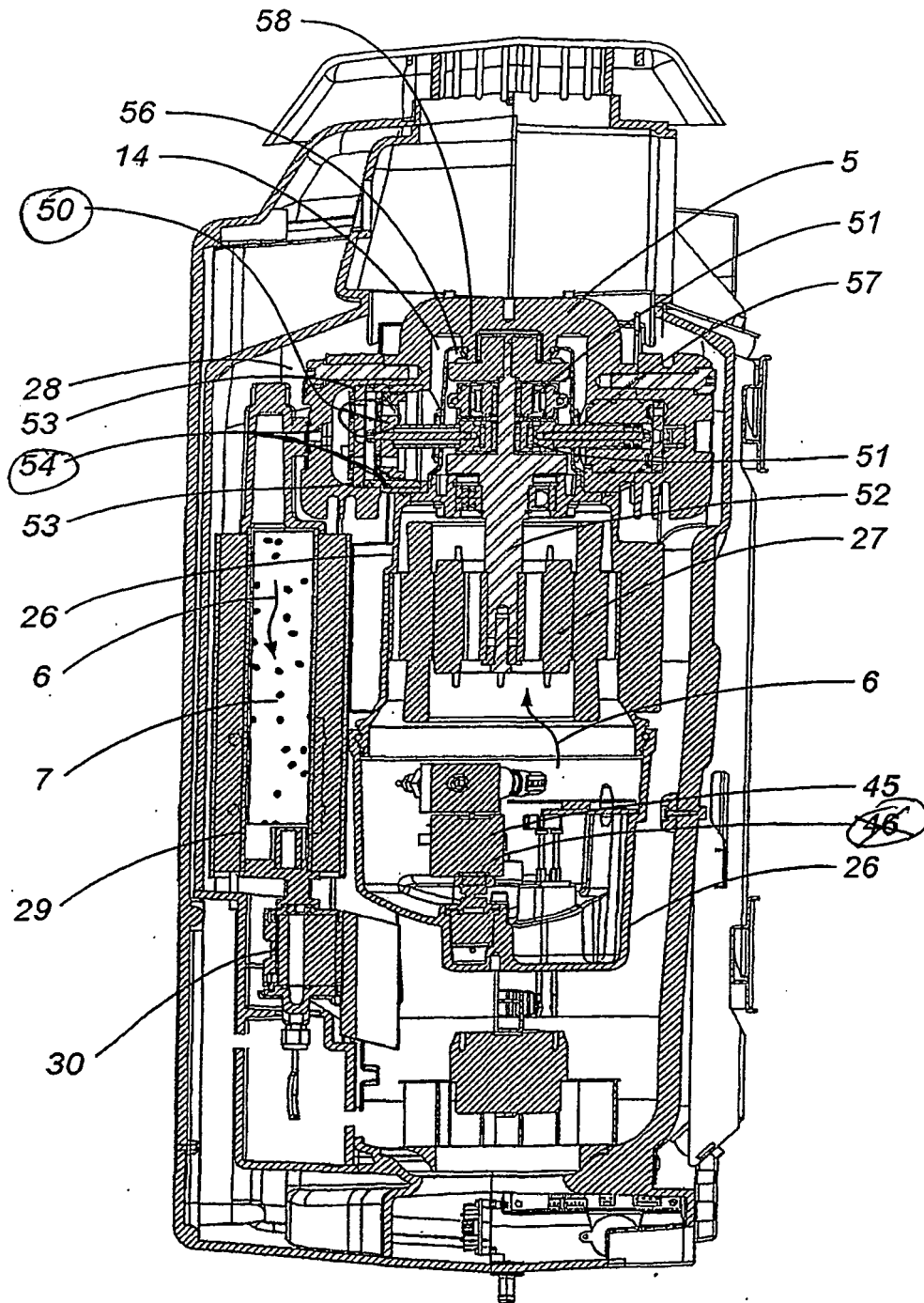


FIG. 3

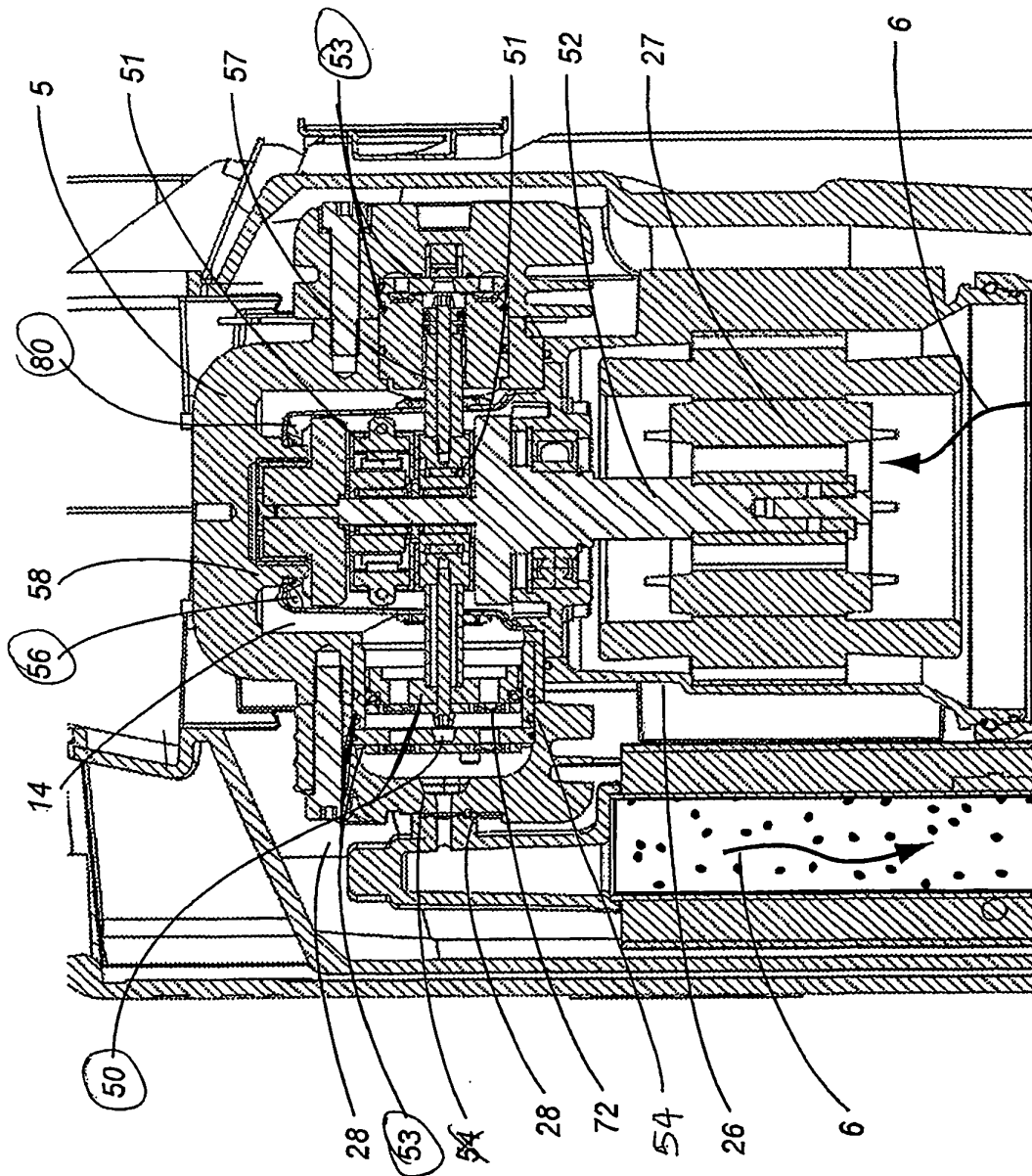


FIG. 4

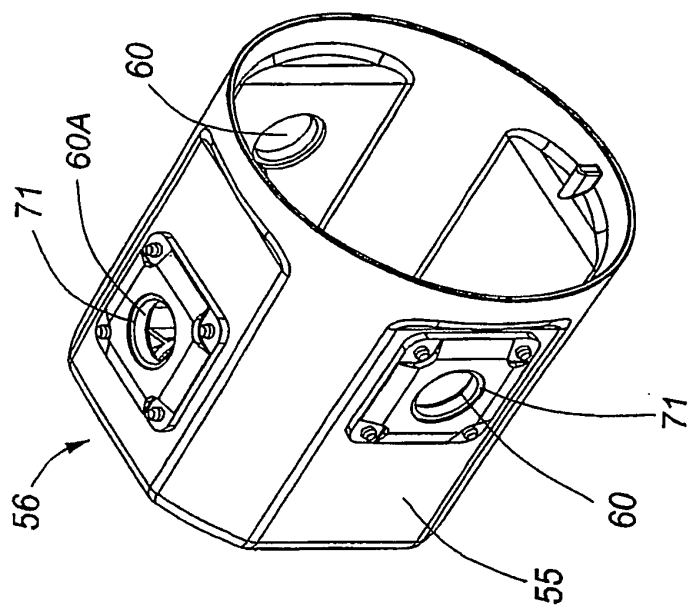


FIG. 5

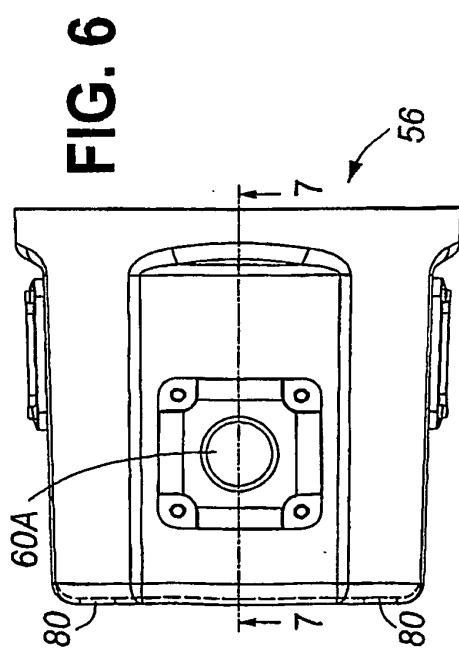


FIG. 6

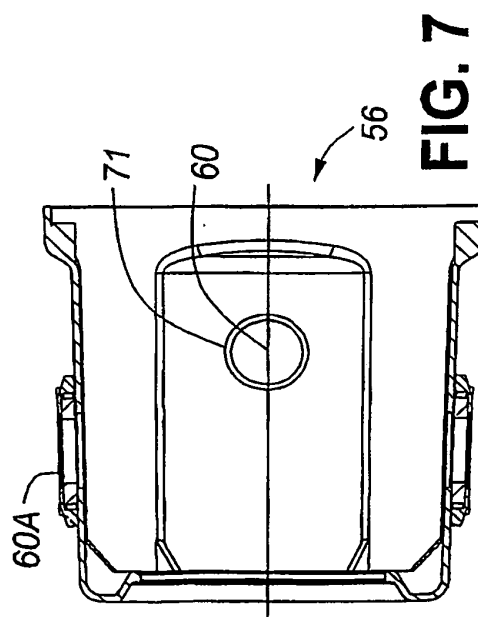


FIG. 7

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 4889039 A [0001]
- AU 6808381 A [0001]
- EP 0883054 A [0001]
- EP 0340150 A [0001]
- AU 6808381 [0002]