



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 1 710 394 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 158(3) EPC

(43) Date of publication:

11.10.2006 Bulletin 2006/41

(51) Int Cl.:

F01B 9/02 (2006.01)

F02B 75/32 (2006.01)

(21) Application number: **05710990.2**

(86) International application number:

PCT/RU2005/000003

(22) Date of filing: **11.01.2005**

(87) International publication number:

WO 2005/068780 (28.07.2005 Gazette 2005/30)

(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**

(30) Priority: **20.01.2004 RU 2004101033**

(71) Applicant: **Obschestvo s Ogranichennoi
Otvetstvennostyu
Midera-k
Moscow, 123053 (RU)**

(72) Inventors:

- **VOROBIEV, Radislav Nikolaevich
Moscow, 125364 (RU)**
- **ZELINSKY, Anatoly Mikhailovich
St.Petersburg, 197374 (RU)**

(74) Representative: **Hano, Christian et al
v. Fünér Ebbinghaus Finck Hano
Mariahilfplatz 2 & 3
81541 München (DE)**

(54) **PISTON MACHINE**

(57) A machine proposed for use in energy producing industry as an engine, a pump and a compressor. The machine has a crankcase 1, a cylinder 2, and a piston 3 and a piston rod 4, two crankshafts 6 and 7 rotating in opposite directions. An inner hollow 12 of the piston communicates with a throughgoing axial passage 13 of the piston rod 4 located in the crankcase with the possibility of a reciprocating movement in a suction pipe 14; wherein the passage 13 of the piston rod is formed with a diffuser 27 from the side of the hollow 12 of the piston 3 and with a confuser 28 from the side of the suction pipe 14. Pumping valves 18 are arranged on the cover 5 of the cylinder, and suction valves 16 are arranged on the front wall of the piston; wherein the piston rod 16 and the connecting rods 10 and 11 of the crankshaft 6 and 7 are hingedly connected with a traverse 29. The invention provides a reduction of a waste space and reduction of hydraulic losses.

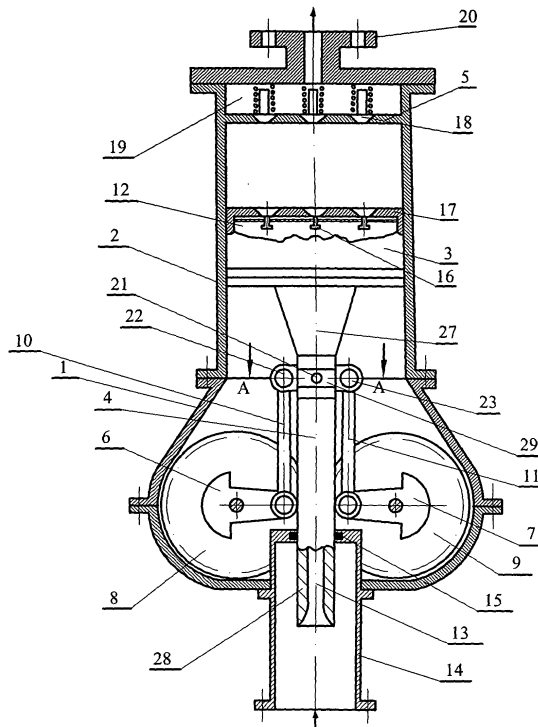


Fig. 1

EP 1 710 394 A1

Description

Technical Field

[0001] The invention relates to a field of machine building and can be used in compressors, pumps and internal combustion engines.

Prior Art

[0002] A piston machine is known, which has a crankcase with a cylinder fixed on it, in which a piston with a piston rod is located, and cover arranged on the cylinder. A link lever system with a cross head is connected with a crankshaft and has a guide in a lower part of the crankcase (Inventor's Certificate of USSR no. 905499, FO1B9/00 1978).

[0003] A disadvantage of the known piston machine is that it does not solve problems of reduction of a waste space that reduces its volume productivity, reducing of hydraulic losses in valves, and also insufficient cooling of the piston of the machine.

[0004] A piston machine is known, which has a crankcase with a cylinder fixed on it, in which a piston with a piston rod is located, and a cover arranged on the cylinder, suction and pumping valves, two parallel crankshafts located symmetrically relative to an axis of the cylinder and connected with each other with a possibility of rotation in opposite direction, a traverse connected to the piston rod of the piston, two connecting rods each of which is connected with its end hingedly with a corresponding crankshaft, and with another end hingedly with a corresponding end of the traverse, while the piston rod of the piston is connected with the traverse hingedly. The machine is provided with a mechanism of turning of the connecting rods relative to the traverse over different angles. The known piston machine can be configured in a variant of a compressor, a pump or an internal combustion engine (Inventor's Certificate of the USSR no. 1224415, FO 1B9/02, FO2B 75/32, 1996, the closest prior art).

[0005] A disadvantage of the known piston machine during its use as a compressor is the presence of a significant waste space and significant hydraulic losses during suction and pumping of a working body due to the location on one cover of the cylinder of suction and pumping valves, increasing a minimal volume between the cover and the piston due to the volume of the valves and reducing areas of flow cross-sections both of suction valves and pumping valves which occupy together the same surface of the cover, which reduces a volume productivity of the piston machine and filling of the cylinder with the working body. Moreover, in the piston machine a sufficient cooling of the piston is not provided.

Summary of the Invention

[0006] A task which is solved in the invention is a cre-

ation of a piston machine which provides a reduction of volume of waste space, a reduction of hydraulic losses during suction and pumping, and a cooling of the machine.

[0007] The task of the creation of the piston machine is solved in that the piston machine has a crankcase with a cylinder fixed on it, in which a piston with a piston rod is located, a cover arranged on the cylinder, suction and pumping valves, two parallel crankshafts located symmetrically relative to an axis of a cylinder and connected with one another with a possibility of rotation in opposite direction, a traverse connected with the piston rod of the piston, two connecting rods each of which is hingedly connected with one end to a corresponding crankshaft, and hingedly connected with another end to a corresponding end of the traverse, and the piston rod of the piston is connected with a traverse hingedly.

[0008] Distinguishing features of the proposed piston machine from the above mentioned closest prior art is the configuration of the piston with the inner hollow, and a piston rod with a throughgoing longitudinal axial passage, connected with an inner hollow of the piston, arrangement of the suction pipe in the crankcase coaxially with the piston rod which extends into the suction pipe with a possibility of reciprocating movement, a connection of the traverse with the piston rod above an entry to the suction pipe, an arrangement of the suction valves on a front wall of the piston, and of pumping valves on the cover.

[0009] The configuration of the piston with an inner hollow, of the piston rod with a throughgoing longitudinal axial passage connected with the inner hollow of the piston, arrangement of the suction pipe in the crankcase coaxially to the piston rod which extends into the suction pipe with a possibility of a reciprocating movement, the connection of the traverse with the piston rod above the entry into the suction pipe, the arrangement of suction valves on the front wall of the piston, the arrangement of the pumping valves on the cover of the cylinder allows to create a minimal value of a waste space of the piston machine (a minimum volume remaining between the cover and the piston), which leads to an increase of a volume productivity of the piston machine with a creation of a minimal volume of the waste space and to increase through flow cross-sections in the suction and pumping valves due to the arrangement of the suction valves on the front wall of the piston, and the pumping valves already on another location - on the cover of the cylinder, which leads to a reduction of hydraulic losses in the piston machine, and during movement of the piston from an upper position to a lower position provides suction of the working body through the coaxial longitudinal axial passage of the piston rod from the suction pipe, a supply of the working body into the inner hollow of the piston and through the suction valves into the cylinder, and from the cylinder during movement of the piston in opposite direction through the pumping valves the supply to a consumer, leading to a cooling of the piston by the sucked working

body and as a result of the whole piston machine. The connection of the traverse with the piston rod above the entry to the suction pipes provides a movement of the piston rod with the piston. The arrangement of the suction valves on the front wall of the piston, and the pumping valves on the cover of the cylinder allows to reduce the volume of the waste space due to the displacement of the suction valves to another location, and increases throughflow cross sections of the suction and pumping valves again due to the location in the same area of a lower number of the pumping valves and in the same area of the same number of the suction valves, which leads to a reduction of hydraulic losses and increase of volume productivity and filling of the cylinder with the working body.

[0010] The possibility of forming of the throughgoing longitudinal axial passage of the piston rod with a diffusor from the side of connection with the inner hollow of the piston and with a confusor from the side of the entry in a discharge pipe allows to reduce losses of pressure during movement of the working body along the longitudinal axial passage due to provision of minimal speeds of flow of the working body during its entry into the passage of the piston rod and exit from the passage of the piston rod into the inner hollow of the piston and therefore to increase filling of the cylinder with a working body.

[0011] It is possible to install the pumping valves on the cover of the cylinder with a possibility of arrangement flush with the surface of the cover from the side of the piston in a closed position, which allows to reduce a volume of a waste space due to the creation of flat surface of the cover from the side of the piston.

[0012] It is possible to install suction valves on the front wall of the piston with a possibility of an arrangement flush with a surface of a front wall of the piston in a closed position, which allows to reduce a volume of a waste space due to the creation of a flat surface of the front wall of the piston.

Brief Description of the Drawings

[0013]

Figure 1 shows a longitudinal cross-section of a piston machine configured as a piston compressor;

Figure 2 shows a top view on a traverse.

Best Mode of Carrying Out the Invention

[0014] A piston machine formed as a piston compressor has a crankcase 1 with a cylinder 2 fixed on it, in which a piston 3 with a piston rod 4 is located, a cover 5 arranged on the cylinder 2, two parallel crankshafts 6 and 7 with counterweights located symmetrically relative to an axis of the cylinder 2 and connected with one another with a possibility of rotation in opposite direction by means of linked cylindrical gears 8 and 9.

[0015] A traverse 29 is connected with the piston rod 4, two connecting rods 10 and 11 each connected with one end hingedly to a corresponding crankshaft 6 or 7, and with another end hingedly connected to a corresponding end of the traverse 29 by means of two ears 25 and 26 with fingers 22 and 23 fixed on them. The piston rod 4 in a zone of connection with the connecting rod has a local square transverse cross-section. The piston rod 4 of the piston 3 is connected with the traverse 29 hingedly by an axle 21.

[0016] The piston 3 is configured with an inner hollow 12. The piston rod 4 is configured with a throughgoing longitudinal axial passage 13 connected with the inner hollow 12 of the piston 3. A suction pipe 14 is connected in the crankcase 1 coaxially with the piston rod 4, which extends into the suction pipe 14 through a seal 15 with a possibility of a reciprocating movement along guides. The traverse 29 is connected with the piston rod above the entry to the suction pipe 14 when the piston 3 is located in a lower position. The suction pipes 16 are arranged on the front wall 17 of the piston 3, while the pumping valves 18 are located on the cover 5. The pumping valves 18 on the cover 5 are hydraulically connected to a receiver 19, which in turn is connected with a discharge pipe 20.

[0017] Suction valves 16 can be arranged on the front wall 17 of the piston 3 with a possibility of location flush with a surface of the front wall 17 of the piston 3 in a closed position.

[0018] The pumping valves 18 can be arranged on the cover 5 with the possibility of location flush with a surface of the cover 5 from the side of the piston 3 in a closed position.

[0019] The throughgoing longitudinal axial passage 13 of the piston rod 4 can be configured with a diffusor 27 from the side of connection with an inner hollow 12 of the piston 3 and with a confusor 28 from the side of entry to the suction pipe 14.

[0020] The suction and pumping valves 16 and 18 can be configured as self-acting automatic valves.

[0021] The pumping valve 18 can be configured as a controlled valve.

[0022] The suction valves 16 on the front wall 17 of the piston 3 can be configured as conical plates which are tightly seated in conical openings in a front wall 17 and have pins and limiters at the end.

[0023] The pumping valves 18 of the cover 5 can be configured with guides in form of conical plates which are seated in conical openings in the cover 5 and have pins that are spring biased toward the cover 5.

[0024] Analogously, the piston machine can be configured in a variant of a four-cycle internal combustion engine, with replacement of the pumping valves by controlled inlet valves and an additional nozzle for injection of fuel directly into cylinder, which additional nozzle is arranged on the cover of the cylinder. The piston machine can be also configured as a pump.

[0025] The piston machine formed as a piston com-

pressor operates in the following manner. During the rotation of the crankshafts 6 and 7 the piston 3 performs a reciprocating movement in the cylinder 2. During the movement of the piston 3 from an upper position to a lower position, the suction valves 16 on the front wall 17 of the piston 3 during its acceleration downwardly are self-opened due to action of inertia forces, thereby remaining on the limiters, and a suction of a working body takes place through the suction pipe 14 and the throughgoing longitudinal axial passage 13 of the piston rod 4 into the inner hollow 12 of the piston 3 and through the openings in the suction valves 16 into the cylinder 2.

[0026] During a further turning of the crankshafts 6 and 7, the piston 3 stops and starts moving upwards, the suction valves 16 are closed due to a creation of acceleration of the piston 3 upwardly. After compression of the working body in the cylinder 2 to a pressure in the receiver 19, a self opening of the pumping valves 18 takes place with overcoming of a force of pressing of their springs, the working body is supplied into the receiver and exits through the outlet pipe 20 to a consumer, and after this the cycle is repeated.

[0027] During movement of the working body through the longitudinal axial passage 13 of the piston rod 4 with the diffuser 27 and confuser 28, losses of pressure of the working body are reduced due to the provision of minimal speeds of flow of the working body during entry into the longitudinal axial passage 13 of the piston rod 4 and during exit from it into the hollow of the piston where the pressure is restored.

[0028] During carrying out of the process of pumping of the working body in the piston compressor with the pumping valves 18 arranged on the cover 5 with the possibility of location flush with the surface of the cover 5 from the side of the piston 3 in the closed position, the volume of waste space is reduced due to the creation of a flat surface of the cover 5.

[0029] During carrying out of the process of pumping of the working body in the piston compressor with the suction valve 16 arranged on the front wall of the piston 3 with the possibility of location flush with the surface of the front wall 17 of the piston 3 in the closed position, a volume of waste space is reduced due to the creation of the flat surface of the front wall of the piston 3.

Industrial Applicability

[0030] The present invention can be used with maximum success in compressors, pumps and internal combustion engines.

Claims

1. A piston machine, containing a crankcase with a cylinder fixed on it, in which a piston with a piston rod are located, a cover arranged on the cylinder, suction and pumping valves, two parallel crankshafts locat-

ed symmetrically relative to the axis of the cylinder and connected with one another with a possibility of rotation in opposite directions, a traverse connected with the piston rod of the piston, two connecting rods each connected with one end hingedly to a corresponding crankshaft and with another end hingedly to a corresponding end of the traverse, and the piston rod of the piston is connected with the traverse hingedly, **characterized in that** the piston is configured with an inner hollow, and the piston rod is configured with a throughgoing longitudinal axial passage connected with the inner hollow of the piston, the suction pipe is arranged in the crankcase coaxially to the piston rod which extends into the suction pipe with the possibility of a reciprocating movement, the traverse is connected with the piston rod above an entry to the suction pipe, the suction valves are arranged on a front wall of the piston, and pumping valves are arranged on the cover.

2. Machine according to claim 1, **characterized in that** the throughgoing longitudinal axial passage of the piston rod is configured with a diffuser from a side of connection with the inner hollow of the piston and with a confuser from a side of entry to the suction pipe.
3. Machine according to claim 1 and 2, **characterized in that** the pumping valves are arranged on the cover with a possibility of location flush with a surface of the cover from the side of the piston in a closed position.
4. Machine according to claim 1 and 2 and 3, **characterized in that** the suction valves are arranged on the front wall of the piston with the possibility of location flush with the surface of the front wall of the piston in a closed position.

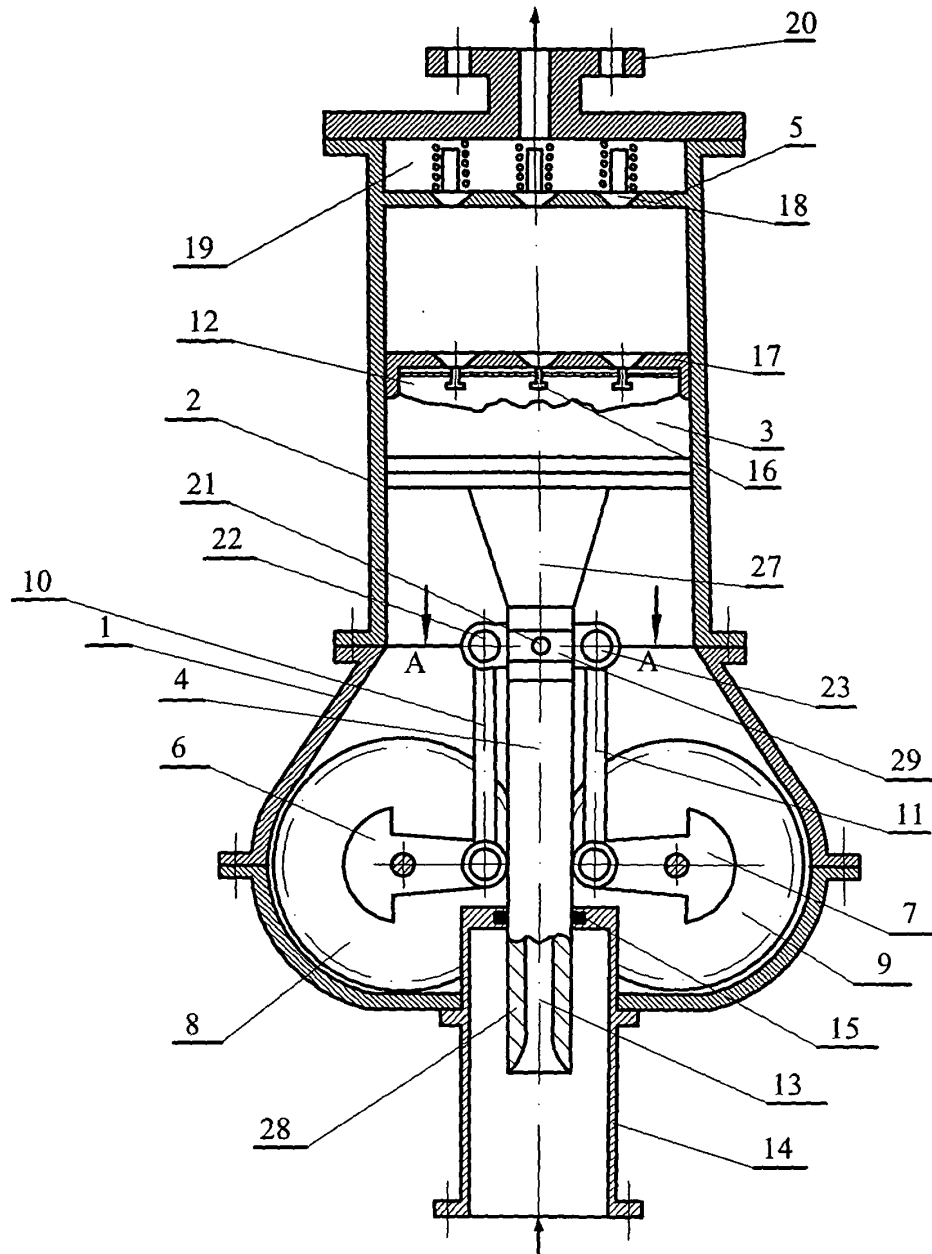


Fig. 1

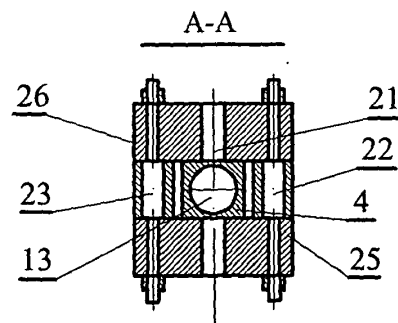


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/RU 2005/000003

A. CLASSIFICATION OF SUBJECT MATTER		
F01B 9/02, F02B 75/32		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
F01B 1/00-9/08, F02B 75/00-75/32 F16H 21/00-21/54		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SU 1224415 A (MOSKOVSKY AVTOMOBILNY ZAVOD IM. I.A.LIKHACHEVA) 15.04.1986	1-4
A	SU 905499 A (DINOV JU.S. et al.) 15.02.1982	1-4
A	US 5682844 A (JOHN A. WITTNER) 04.11.1997	1-4
A	RU 2089739 C1 (CHERNOGOROV Anatoly Dmitrievich) 10.09.1997	1-4
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
<p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"B" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>		
Date of the actual completion of the international search (15.04.2005)		Date of mailing of the international search report (28.04.2005)
Name and mailing address of the ISA/ RU		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

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

- SU 905499 [0002]
- SU 1224415 [0004]