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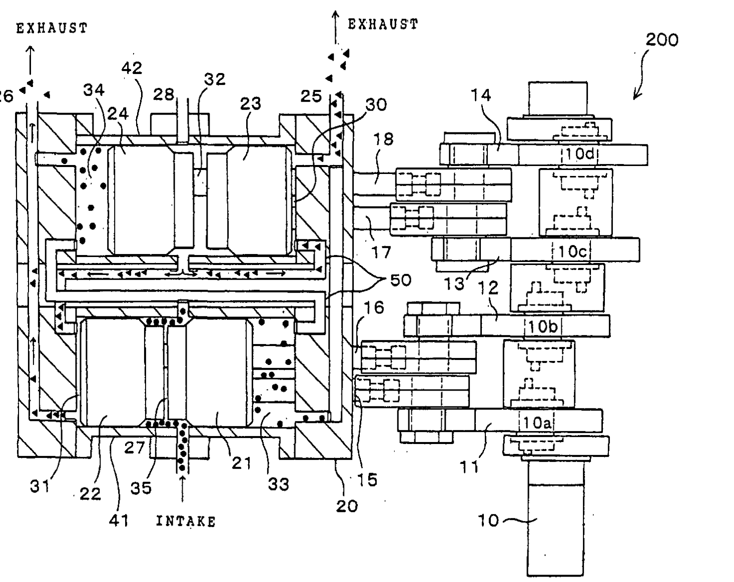
(54) **PISTON TYPE GAS COMPRESSOR, AND PISTON TYPE GAS PRESSURE DRIVE ROTATION DEVICE**

(57) A piston type gas compressor pressure drive rotation device characterized by comprising a plurality of cylinder members 41, 42 each having a closed bore, first piston members 22, 24 and second piston members 21, 23 slidably fitted into the bore of the cylinder members 41, 42, a connecting mechanism for connecting the first piston members 22, 24 and second piston members 21, 23 to the same crank shaft 15 via a slider crank mechanism, and an intake and exhaust control mechanism for controlling the intake and exhaust of gas into and out of the bore of the cylinder members 41, 42, wherein the first piston members 22, 24 and second piston members 21, 23 perform a reciprocating slide motion in the bores of the cylinder members 41, 42 with the rotation of the crank shaft 15 connected by the connecting mechanism via the slider crank mechanism, while the intake and exhaust control mechanism sends the gas, which is taken into the bores of the plurality of the cylinder members 41, 42, into the bore of one cylinder member 41 or 42 by utilizing the reciprocating slide motion of the first piston members 22, 24 and second piston members 21, 23, and compresses the gas fed to the bore.

Fig.2



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Description

[Technical Field]

[0001] The present invention relates to a device (hereinafter, referred to as "gas compressor") having a structure for compressing air or other gases (hereinafter, referred to as "gas compressing structure"); and more particularly which is characterized in that, by means of the compression strokes sharing both cylinders, the cylinders can be downsized with almost the same compression volume as is usual. Further, an object of this invention is to provide a piston type gas compressor and a piston type gas pressure drive rotation device capable of producing high velocity rotation and high pressure, characterized in that good balance of rotation and hence high velocity rotation are achieved, wherein the crank radius in the case of high pressure compression via two-step compression mechanism equals the difference between a pair of crank radii and hence is reduced.

[Background Art]

[0002] As gas compressor there has heretofore been suggested various ones, among which there are generally, inter alias, the ones, which are of piston type, and the ones, which are of screw type. A screw type can produce a large compression time at one time and hence produce high pressure, but has poor rotational balance and hence cannot produce high velocity rotation. On the other hand, a screw type has good rotational balance and hence can produce high velocity rotation, but can produce only a small compression volume at one time and hence has difficulty in producing high pressure.

[0003] Namely, if a piston type could perform high velocity rotation, then a piston type would be extremely preferable as gas compression structure, as compared with a screw type, which can produce only a small compression volume at one time. However, as described above, a piston type has a problem of having poor rotational balance, thus hampering high velocity rotation.

[0004] Further, as a gas compression structure for solving the above problems, the applicant has devised (invented) a air compression structure comprising a input shaft and a auxiliary shaft, which are arranged side-by-side, wherein there is provided slider of each of a slider crank mechanism on the input shaft side and at least one slider crank mechanism on the auxiliary shaft which slider crank mechanism constitutes a pair with the slider crank mechanism on the input shaft side in a state, where piston members repulsed by a pressure mutually are provided to the slider and reciprocated in the same direction while facing mutually in the same cylinder to compress air; and the outer diameter of the front end of the piston members is smaller than the inner diameter of the cylinder so that there can be formed a gap portion between the inner diameter of the cylinder and the outer diameter of the front end of the piston members. A first compressed layer blocked at least one out of both side ends of the cylinder and formed between the bottom of the piston member and the side end inner surface of the cylinder and a second compressed layer formed between the upper surface of the piston members faced with each other, exhaust ports provided with exhaust valves and intake ports provided with intake valves on each cylinder side surface staying near the first compressed layer and the second compressed layer and exhaust ports provided with exhaust valves are provided and the exhaust port of the first compressed layer is connected with the intake port of the second compressed layer by a communicating member. (refer to Japanese Laid-Open Patent Publication No. 2000-297747).

[0005] Further, the air compression structure described above makes it possible to produce compressed air with a minimum of energy. However, there is one problem that this air compression structure causes the reciprocating motion of the piston to be distributed to a pair of crank shafts provided on both sides of the cylinder member through which this piston is fitted, hampering the further increase or enhancement of the rotational torque and rotational velocity of each crank shaft as well as the downsizing of the entire air compression structure.

[0006] Further, as described above, another problem is that the reciprocating motion of the piston is transmitted to distinct crankshafts respectively disposed on either side of the cylinder member, hampering the realization of the higher velocity rotation and the further downsizing.

[0007] On the other hand, it is also desired to realize a rotation device, which does not consume fossil resources. Here, as a rotation device using energy which does not consume fossil resources, there can be mentioned a gas pressure-driven type rotation device, which generate rotations using, compressed gas. However, for the same reason as with the case described above, there has been a problem that the realization with a piston type which can produce a large compression volume at one time is desirable, while a piston type has poor rotational balance and hens cannot produce high velocity rotation.

[0008] In view of the above, the present invention is one which is achieved to solve the above problems, and has for its object to provide a compact piston type gas compressor which can produce high pressure with the help of a small amount of energy and is capable of high torque and high velocity rotation, and a piston type gas pressure drive rotation device which can rotate by clean energy and is further capable of high torque and high velocity rotation.

[Disclosure of the Invention]

[Means for Solving the Problems]

(Claim 1)

[0009] To achieve this objective, a piston type gas compressor according to claim 1 comprises: a plurality of cylinder members each of which has a closed bore; first piston members and second piston members slidably fitted into the bore of the each cylinder member; a connecting mechanism for connecting the first piston members and second piston members to the same crank shaft respectively, via a slider crank mechanism; and an intake and exhaust control mechanism for controlling the intake and exhaust of gas into and out of the bore of ach cylinder member, wherein said first piston members and second piston members perform a reciprocating slide motion in the bores of said respective cylinder members in accordance with the rotation of the crank shaft connected by the connecting mechanism via slider crank mechanism; while the intake and exhaust control mechanism feeds the gas, which has been taken into the bores of the plurality of cylinder members, into the bore of one cylinder member by utilizing the reciprocating slide motion of said first piston members and second piston members, and compresses the gas fed to said bore.

[0010] According to this piston type gas compressor according to claim 1, the rotation of the crank shaft causes the first piston members and second piston members, which are connected to the crank shaft via slider crank mechanism owing to connecting mechanism, to reciprocate within the bore of each corresponding cylinder. Here, the intake and exhaust of gas into and out of the bore of each cylinder member is controlled through the intake and exhaust control mechanism. At the same time, as the reciprocating slide motion of the first and second piston members, the gas that has been taken into the bores of a plurality of cylinder members is fed into the bore of one cylinder member. Further at the same time, the gas that has been fed into this bore is further compressed.

(Claim 2)

[0011] There is provided a piston type gas compressor according to claim 2 in a piston type gas compressor according to claim 1, in which the connecting mechanism comprises first piston shaft members whose one ends are firmly fixed to the respective first piton members and second piston shaft members whose one ends are firmly fixed to the respective second piston members and which are arranged side-by-side with the first piston members; and a through-hole penetrated through said first piston members, through which the second piston shaft members, arranged side-by-side with the first piston members, are capable of being slidably fitted, in which the first piston members and second piston members are connected to the same crank shaft arranged on the side of the first piston members via the first piston shaft members and second piston shaft members.

(Claim 3)

[0012] There is provided a piston type gas compressor according to claim 3 in the piston type gas compressor according to claim 2, in which the connecting mechanism comprises first crank arms for connecting the first piston shaft members to the crank shaft and second crank arms for connecting the second piston shaft members to the crank shaft in a state, where the radius of rotation of the first crank arms is larger than that of the second crank arms.

(Claim 4)

[0013] There is provided a piston type gas compressor according to claim 4 in the piston type gas compressor according to claim 3, in which the outer circumference diameter of each head of the first piston members and second piston members is made smaller than that of the corresponding bottom portion thereof.

(Claim 5)

[0014] There is provided a piston type gas compressor according to claim 5 in the piston type gas compressor according to claim 3 or 4, in which the first crank arms and the second crank arms are made to differ in each crank angle.

(Claim 6)

[0015] There is provided a piston type gas compressor according to claim 6 is in accordance with a piston type gas compressor described in any one of claims 1 to 5, in which the intake and exhaust control mechanism comprises an intake mechanism for causing a first intake gap and a second intake gap to take in gas alternately in a state, where the first intake gap is composed of a first gap formed between the end wall portion of the bore of one cylinder member and the bottom portion of either of the first piston member or the second piston member fitted into said bore, and a second gap formed between the end wall portion of the bore of the other cylinder member and the bottom portion of either of a first piston member or second piston member fitted into the bore, and where the second intake gap is composed of a third gap formed between the end wall portion of the bore of the one cylinder member and the other of the first piston member or second piston member, and a forth gap formed between the end wall portion of the bore of the other cylinder member and the bottom portion of the other of the first piston member or second piston member fitted into said bore; a gas feed mechanism for feeding the gas, which has been taken into the first intake gap via the intake mechanism, into a fifth gap formed between the head of the first piston members and the head of the second piston members fitted into the bore of one cylinder member, while feeding the gas, which has been taken into the second intake gap, into a sixth gap formed between the head of the first piston members and the head of the second piston members fitted into the bore of the other cylinder member; and an exhaust mechanism for alternately exhausting the gas that has been fed into the fifth gap via the gas feed mechanism, and the gas that has been fed into the sixth gap.

(Claim 7)

[0016] There is provided a piston type gas compressor according to claim 7 in the piston type gas compressor according to claim 6, in which the first gap is formed between the end wall portion of the bore of one cylinder member and the bottom portion of the first piston member fitted into the bore; the second gap is formed between the end wall portion of the bore of the other cylinder member and the bottom portion of the second piston member fitted into the bore; the third gap is formed between the wall face of the bore of the one cylinder member and the bottom portion of the second piston member fitted into said bore; and the fourth gap is formed between the end wall portion of the bore of the other cylinder member and the bottom portion of the first piston member fitted into the bore.

(Claim 8)

[0017] There is provided a piston type gas compressor according to claim 8 in the piston type gas compressor described in any one of claims 1 to 7, in which there is provided a phase difference of 180 degrees or 120 degrees between a reciprocating slide motion of the first piston members and second piston members fitted into the bore of one cylinder member and that of the first and second piston members fitted into the bore of the other cylinder member.

(Claim 9)

[0018] There is provided a piston compressor according to claim 9 is capable of high velocity rotation, which has first piston members and second piston members faced mutually on a line within the same cylinder so as to compress gas by reciprocating the first and second pistons in the same direction, in which there is provided a mechanism in which a piston shaft for reciprocating the first piston members causes the second piston member to be penetrated, so that both piston shafts are put together on one side to reciprocate; and
a structure in which each of piston shafts with a machinery body having dual cylinders arranged side-by-side and piping and pressure valve integrated together, the machinery body constituting one set, is connected via crank connecting rod with crank mechanisms, the crank mechanisms differing in crank angle and crank radius, so as to be able to perform crank rotational motion and piston reciprocating motion well balanced, wherein building of both a single machinery and a multiple machinery is possible.

(Claim 10)

[0019] There is provided a piston type gas pressure drive rotation device according to claim 10 comprises a plurality of cylinder members each of which has a closed bore; first piston members and second piston members slidably fitted into the bore of the each cylinder member; an intake and exhaust control mechanism for controlling the intake and exhaust of gas into and out of the bore of said each cylinder member so as to make the first piston members and second piston members slidably reciprocating motion; and a connecting mechanism for connecting the first piston members and second piston members to the same crank shaft having a slider crank mechanism so as to convert the reciprocating slide motion of both the first piston members and second piston members in accordance with the control of the intake and exhaust control mechanism into one rotational motion; wherein the intake and exhaust control mechanism feeds compressed gas into the bore of one cylinder member while feeding the gas that has expanded in the bore into the bores of the plurality of cylinder members.

(Claim 11)

[0020] There is provided a piston type gas pressure drive rotation device according to claim 11 in a piston type gas pressure drive rotation device according to claim 10, in which the connecting mechanism comprises first piston shaft members whose one ends are firmly fixed to the first piston members, and second piston shaft members whose one ends are firmly fixed to the second piston members, and the second piston shaft members are arranged side-by-side with the first piston members, and a through-hole penetrated through the first piston members, through which the second piston shaft members, arranged side-by-side with the first piston members, are capable of being slidably fitted, in which the first piston members and second piston members are connected to the same crank shaft disposed on the side of the first piston members via the first piston shaft members and second piston shaft members.

(Claim 12)

[0021] There is provided a piston type gas compressor according to claim 12 in the piston type gas pressure drive rotation device according to claim 11, in which the connecting mechanism comprises first crank arms for connecting the first piston shaft members to the crank shaft and second crank arms for connecting the second piston shaft members to the crank shaft in a state, where the radius of rotation of the first crank arms is made larger than that of the second crank arms.

(Claim 13)

[0022] There is provided a piston type gas pressure drive rotation device according to claim 13 in the piston type gas pressure drive rotation device according to claim 12, in which the outer circumference diameter of each head portion of the first piston members and second piston members is made smaller than that of the corresponding bottom portion thereof.

(Claim 14)

[0023] There is provided a piston type gas pressure drive rotation device in the piston type gas pressure drive rotation device according to claim 12 or 13, in which said first crank arms and said second crank arms are made to differ in each crank angle.

(Claim 15)

[0024] There is provided a piston type gas pressure drive rotation device according to claim 15 in the piston type gas pressure drive rotation device described in any one of claims 10 to 14, in which the intake and exhaust control mechanism comprises an intake mechanism for causing a fifth gap and sixth gap to take in gas alternately in a state, where the fifth gap is formed between head portion of the first piston members and second piston members fitted into the bore of one cylinder member constituting the cylinder members, and where the sixth gap is formed between head portion of the first piston members and second piston members fitted into the bore of the other cylinder member constituting said cylinder members; a gas feed mechanism for feeding the gas, which has been taken into the fifth gap via the intake mechanism, by distributing the gas between both gaps, into a first gap formed between the end wall portion of the bore of the one cylinder member and the bottom portion of either of the first members or the second piston members fitted into said bore, and a second gap formed between the head portion of the bore of the other cylinder member and the bottom portion of either of the first piton members or the second piston members fitted into the bore, while feeding the gas, which has been taken into the sixth gap via the intake mechanism, by distributing the gas between both gaps, into a third gap formed between the end wall portion of the bore of one cylinder member and the bottom portion of the other of the first piston members or the second piston members fitted into the bore, and a fourth gap formed between the head portion of the bore of the other cylinder member and the bottom portion of the other of the first or the second piston member fitted into said bore; and an exhaust mechanism for exhausting the gas fed into the first gap and second gap via the gas feed mechanism, as well as the gas fed into the third gap and fourth gap.

(Claim 16)

[0025] There is provided a piston type gas pressure drive rotation device in the piston type gas pressure drive rotation device according to claim 15, in which the first gap is formed between the end wall portion of the bore of one cylinder member and the bottom portion of the first piston member fitted into the bore; the second gap is formed between the end wall portion of the bore of the other cylinder member and the bottom portion of the second piston member fitted into the bore; the third gap is formed between the wall face of one cylinder member and the bottom portion of the second piston member fitted into the bore; and said fourth gap is formed between the end wall portion of the bore of the other cylinder member and the bottom portion of the first piston member fitted into said bore.

(Claim 17)

[0026] There is provided a piston type gas pressure drive rotation device according to claim 17 in the piston type gas pressure drive rotation device described in any one of claims 10 to 16, wherein there is provided a phase difference of 180 degrees or 120 degrees between the reciprocating slide motion of the first piston members and second piston members fitted into the bore of one cylinder member, and that of the first piston members and second piston members fitted into the bore of the other cylinder member.

[Effects of the Invention]

(Claim 1)

[0027] According to a piston type gas compressor described in claim 1, there can be achieved an effect of being able to compress gas in two steps, namely, to obtain high-compressed gas with the help of a small amount of energy, because the reciprocating slider motion of the first and second piston members each fitted into the bore of each corresponding cylinder member causes the intake and exhaust control mechanism to feed the gas that has been taken into the bores of the plurality of cylinder members into the bore of one cylinder member, and at the same time to further compress the gas that has been fed into this bore.

[0028] Further, there can be attained an effect of being able to further reduce a required amount of energy for gas compression, and at the same time to downsize the entire structure as compared with the case of the rotation of each piston member via two different crank shafts, because there is configured such that the rotation of one crank shaft is made to perform the reciprocating slide motion of both of the first and second piston members.each fitted into the bore of each corresponding cylinder member.

(Claim 2)

[0029] According to a piston type gas compressor described in claim 2, in addition to the effects achieved by a piston type gas compressor described in claim 1, there can be further achieved an effect of being able to construct a connecting mechanism constituted by a simple and highly efficient mechanism in terms of connecting operations, because first piston shaft members whose one end portions are firmly fixed to first piston members and second piston shaft members whose one end portions are firmly fixed to second piston allow first and second piston members to be connected to the same crank shaft disposed on the side of first piston members.

(Claim 3)

[0030] According to a piston type gas compressor described in claim 3, in addition to the effects achieved by a piston type gas compressor described in claim 2, it is envisaged that the radius of rotation of first crank arms which constitutes a connecting mechanism is made larger than that of second crank arms which likewise constitutes a connecting mechanism, thereby making it possible to make the slide length of the reciprocating slide motion of the first piston members larger than that of the second piston members, and also to make the size of a pair of gaps which are formed between the end wall portion of the bore of each cylinder member and a pair of piston members fitted into this bore, respectively, smaller than the size of the gap formed between the pair of piston members. This affords an effect of being able to further enhance or increase the intake volume into the bore of cylinder members and the compressibility within the bore of each cylinder.

(Claim 4)

[0031] According to a piston type gas compressor described in claim 4, in addition to the effects achieved by a piston type gas compressor described in claim 3, there can be further achieved an effect of being able to form a gap between the outer circumference diameter of first or second piston members and a side circumferential wall of the bore without impairing sealing properties, because the outer circumference diameter of each head portion of first and second piston members is made smaller than that of the corresponding bottom portion thereof. This makes it possible to make the slide length of the reciprocating slide motion of first piston members larger than that of second piston members.

(Claim 5)

[0032] According to a piston type gas compressor described in claim 5, in addition to the effects achieved by a piston type gas compressor according to claim 3 or 4, it is envisaged that the first and the second crank arms are made to differ in crank angle, thereby making it possible to provide a phase difference between a phase of the reciprocating slide motion of first piston members and that of second piton members. This affords an effect of being able to further increase the intake volume into the bore of each cylinder member and the compressibility within the bore of each cylinder member.

(Claim 6)

[0033] According to a piston type gas compressor described in claim 6, in addition to the effects achieved by a piston type gas compressor described in any one of claims 1 to 5, it is further possible to perform the intake of gas into the bore of both of one and the other cylinders, respectively, and at the same time to compress and feed into either of one or the other cylinder the gas that has been taken into the bores of both the cylinder members, utilizing the reciprocating slide motion of both of first and second cylinder members. This affords an effect of being able to efficiently compress gas, utilizing the reciprocating slide motion of both the cylinder members.

(Claim 7)

[0034] According to a piston type gas compressor described in claim 7, in addition to the effects achieved by a piston type gas compressor described in claim 6, there can be further achieved an effect of being able to prevent from deteriorating, the rotational balance of the crank shaft which causes the piston members to rotate. This is because a first gap is formed between the end wall portion of the bore of one cylinder member and the bottom portion of a first piston member fitted into the bore; a second gap is formed between the end wall portion of the bore on the other cylinder member and the bottom portion of a second piston member fitted into the bore; a third gap is formed between the end wall portion of the bore of the one cylinder member and the bottom portion of the second piston member; and a fourth gap formed between the end wall portion of the bore of the other cylinder member and the bottom portion of the first piston member fitted into the bore, so that there can be provide a phase difference between the reciprocating slide motion of the first piston member fitted into the one piston member and that of the first piston member fitted into the other piston member.

(Claim 8)

[0035] According to a piston type gas compressor described in claim 8, in addition to the effects achieved by a piston type gas compressor described in any one of claims 1 to 7, there can be achieved an effect of being able to prevent the rotational balance of the crank shaft from deteriorating, because there is provided a phase difference of 180 degrees or 120 degrees between the reciprocating slide motion of each piston member fitted into the bore of one cylinder member and that of each piston member fitted into the bore of the other cylinder member and corresponding to the respective piston member within the one cylinder member.

(Claim 9)

[0036] According to a piston type gas compressor described in claim 9, there is achieved a structure in which reciprocating mechanisms of the piston shafts are put together on one side, and the high pressure compression load of the cylinder of each volume is compressed through the difference of the length of crank shaft radii, so that a slight amount of a difference in rotational angle is provided between the cranks so as to effectively reduce the high pressure compression load to the last. Further, the residual pressure air after exhaust of the residual high pressure compressed air will act as equivalent to the repellent force of a magnet, and hence will aid in the rotation, because repellent force will act on the larger radius according the difference in crank radii. Further, because it is well balanced on the whole, high velocity rotation similar to that of a conventional gasoline engine can be realized with a compact mechanism.

(Claim 10)

[0037] According to a piston type gas pressure drive rotation device, because the intake and exhaust control mechanism causes compressed gas to be fed into the bore of one cylinder member, and at the same time causes the gas that has expanded within said bore to be distributed into the bores of a plurality of cylinder members, the expansion force of this compressed gas causes the first and second piston members to perform reciprocating slide motion. That is, it becomes possible to push the first and second piston members utilizing the expansion force of the compressed gas in two steps. Therefore, there can be achieved an effect of being able to reduce the required amount of energy for the rotation of the crankshaft.

[0038] Further, because the connecting mechanism allows a pair of pistons each fitted into each corresponding cylinder to be connected both to one same crank shaft, the energy of each piston member required for the rotation of the crank shaft can be divided into a plurality of cylinder members. This makes it possible to achieve an effect of being able to further reduce the energy required for the rotation of the crankshaft and to downsize the entire structure.

(Claim 11)

[0039] According to a piston type gas pressure drive rotation device described in claim 11, in addition to the effects achieved by a piston type gas pressure drive rotation device described in claim 10, there can be further achieved an effect of being able to construct a connecting mechanism constituted by a simple and highly efficient mechanism in terms of connecting operations, because the first piston shaft members whose one ends are firmly fixed to the first piston members and the second piston shaft members whose one ends are firmly fixed to the second piston members allows the first and second piston members to be connected to the same crank shaft disposed on the side of the first piston members.

(Claim 12)

[0040] According to a piston type gas pressure drive rotation device described in claim 12, in addition to the effects achieved by a piston type gas pressure drive rotation device described in claim 11, it is envisaged that the rotational radius of the first crank arms which constitute a connecting mechanism is made larger than that of the second crank arms which constitute likewise a connecting mechanism, thereby making it possible to make the slide length of the reciprocating slide motion of the first piston members larger than that of the second piston members, and to enlarge the size of a pair of pistons each formed between the end wall portion of the bore of each cylinder portion and a pair of piston members fitted into this bore and at the same time to enlarge the amount of displacement of a gap formed between the pair of these piston members. This makes it possible to achieve an effect of being able to enhance the coefficient of expansion of compressed gas, that is, of being able to enhance the rate of exploitation of expansion force of this compressed gas.

(Claim 13)

[0041] According to a piston type gas pressure drive rotation device described in claim 13, in addition to the effects achieved by a piston type gas pressure drive rotation device described in claim 12, there can be further achieved an effect of being able to form a gap between the outer circumferential diameter of the first or second piston members and the side circumferential wall of the bore without impairing sealing properties, because the outer circumferential diameter of each head of the first and second piston members is made smaller than that of the corresponding bottom portion thereof. That allows the slide motion length of the reciprocating slide motion of the first piston members to be made larger than that of the second piston members, allowing the coefficient of expansion of compressed gas to be further enhanced.

(Claim 14)

[0042] According to a piston type gas pressure drive rotation device described in claim 14, in addition to the effects achieved by a piston type gas pressure drive rotation device described in claim 12 or 13, there can be further achieved an effect of being able to provide a phase difference between the phase of the reciprocating slide motion of the first piston members and that of the second piston members. This allows the coefficient of expansion to be further enhanced.

(Claim 15)

[0043] According to a piston type gas pressure drive rotation device described in claim 15, in addition to the effects achieved by a piston type gas pressure drive rotation device described in any one of clams 10 to 14, it is envisaged that compressed gas is fed into the fifth and sixth gaps, thereby making it possible to cause the first and the second piston members each fitted into each corresponding cylinder to slide upon utilizing the expansion force of this compressed gas, and at the same time to distribute the gas, which has expanded within the fifth gap, into the first and second gaps, while further distributing the gas, which has expanded within the sixth gap, into the third and the fourth gaps, thereby making it possible to achieve an effect of being able to further cause respectively the first or the second piston members fitted into each corresponding cylinder member to slide utilizing the expansion force of the gas. Further, there can be achieved an effect of being able to enhance the rotational balance and rotational speed of the crankshaft, because gas feeding into the fifth and the sixth gaps is performed alternately.

(Claim 16)

[0044] According to a piston type gas pressure drive rotation device described in claim 16, in addition to a piston type gas pressure drive rotation device described in claim 15, it is envisaged that a first gap is formed between the end wall portion of the bore of one cylinder member and the bottom portion of the first piston member fitted into the bore; a second gap is former between the end wall portion of the bore of the other cylinder member and the bottom portion of the second piston member fitted into the bore; a third gap is formed between the end wall portion of the one cylinder member and the bottom portion of the second piston member fitted into the bore; a fourth gap is formed between the end wall portion of the bore of the other cylinder member and the bottom portion of the first piston member fitted into the bore, thereby making it possible to achieve an effect of being able to provide a phase difference between the reciprocating slide motion of both the piston members fitted into the one piston member and that of both the piston members fitted into the other piston member. With that, there can be achieved an effect of being able to realize the further enhancement of the rotational balance and rotational speed of the crankshaft.

(Claim 17)

[0045] According to a piston type gas pressure drive rotation device described in claim 17, in addition to the effects achieved by a piston type gas pressure drive rotation device described in any one of claims 10 to 16, it is envisaged that there is provided a phase difference of 180 degrees or 120 degrees between the reciprocating slide motion of each piston member fitted into the bore of one cylinder and that of each piston member fitted into the bore of the other cylinder member and corresponding to the respective piston members within the other, thereby making it possible to achieve an effect of being able to realize the further enhancement of the rotational balance and rotational speed of the crank shaft.

[Best Modes for Carrying out the Invention]

[0046] The present invention relates to a piston type gas compressor and to a piston type gas pressure drive rotation device, but these can be realized with the same structure (of course, it is needless to say that there can be provided appropriate differences between both for enhancing the performance). Namely, despite one mechanism (structure), this can become a device for compressing gas utilizing rotational force, or a device for producing rotation utilizing compressed air. Therefore, the piston type air compression structure described in the application (basic application) upon which the priority claim of the present application is based, includes the both, and in the present application the description will be made distinguishing between a piston type gas compressor and a piston type gas pressure drive rotation device for the ease of understanding of the invention.

[0047] Further, the air of the air compressor represents merely an example of compressed gas, and it will be explicitly indicated that the gas is not limited to air but includes, for example, nitrogen, oxygen, argon, etc.

[0048] The embodiments of the present invention now will be described in detail hereinafter with reference to the accompanying drawings, but these are to be construed to show merely representative examples. So far as the bounds of this purport are not surpassed, the present invention is not restricted by the examples described below. Namely, the technical scope of the present invention is in any way not restricted by the embodiments themselves described below.

(Examples)

[0049] Fig. 4 is a perspective view of cylinder member 40, which is component of a piston type gas compressor 100 to be of an example of the invention. As shown in

Fig. 4, cylinder member 40 is constituted by both of a first cylinder member 41 and a second cylinder member 42, and the first cylinder member 41 is connected to the second cylinder member 42 via air feed pipe 50.

[0050] Figs. 6 to 8 are detailed plan views of the piston type gas compressor 100 as described above, but in Figs. 1 and 2, cylinder member 40 is shown partially in cross section for the ease of understanding of the invention.

[0051] Crank mechanism 10 as shown in Figs. 6 to 8 is assumed to have a maximum forward position of 180 degrees and a maximum backward position of 360 degrees on a horizontal line, measured counterclockwise with respect to a center of crank rotation.

[0052] First crank mechanism 10a has 7.1 mm radius/180 degrees, second 10b 4.9 mm radius/165 degrees, third 10c 4. 9 mm radius/345 degrees, and fourth 10d 7.1 mm radius/360 degrees. This has crank mechanism well balanced.

[0053] Specifically, there is provided a phase difference of 180 degrees between first crank mechanism 10a and fourth crank mechanism 10d and between second crank mechanism 10b and third crank mechanism 10c, and further there is also provided a phase difference between first crank mechanism 10a and second crank mechanism 10b (namely, between the piston members arranged within the same cylinder member).

[0054] It is possible to transform rotational motion of the crankshaft 15 smoothly into the reciprocating slide motion of piston members. This makes it possible to enhance the rotational balance and rotational speed of crankshaft 15. These all contribute to the enhancement of the efficiency of gas compression.

[0055] Crank mechanism 10a is connected to crank connecting rod 11, piston shaft member 15 and second piston member 21; crank mechanism 10b is connected to crank connecting rod 12, piston shaft member 16 and first piston member 22; crank mechanism 10c is connected to crank connecting rod 13, piston shaft member 17 and second piston member 23; and crank mechanism 10d is connected to crank connecting rod 14, piston shaft member 18 and first piston member 24. This causes the reciprocating motion to be well balanced against the rotational motion.

[0056] Piston shaft members 15, 17 respectively connected to second piston members 21, 23 are put together on one side via transparent hole provided within and penetrating through first piston members 22, 24, respectively. Therefore, with only one rotational system, it can cause the two piston members arranged in each cylinder member to perform reciprocating slide motion. This contributes to the simplification of the structure.

[0057] Machinery body 20 having dual cylinders arranged side-by-side and air passage and pressure valve integrated together is constituted by first cylinder member 41 having provided therein second piston member 21 and first piston member 22, and second piston member 42 having provided therein second piston member 23 and first piston member 24.

[0058] Crankshaft 10's counterclockwise rotation causes second piston member 21, first and second piston members 22 and 23, and first piston member 24 to reciprocate within cylinders according to each crank radius. With this, volumetric cylinders (spaces) 31, 33, and 35 sandwiched between second piston member 21 and first piston member 22 are created within one cylinder volume, and perform air compression motion. Further, also within the other cylinder volume, volumetric cylinders 30, 32, and 34 sandwiched between second piston member 23 and first piston member 24 are created, which then perform air compression motion. Compression strokes are produced effectively utilizing volumetric cylinders 30, 31, 32, 33, and 34 created within dual cylinders.

[0059] Crank mechanism 10a's counterclockwise rotation of 0 to 180 degrees causes air from the intake and exhaust opening 26 to be taken into volumetric cylinders 33, 34 depending on accompanied crank mechanisms' rotations.

[0060] Next, crank mechanism 10a's rotation of 180 to 360 degrees causes air from volumetric cylinders 33, 34 to be compressed and enclosed into volumetric cylinder 35 depending on accompanied crank mechanisms' rotations.

[0061] Crank mechanism 10a's second rotation of 0 to 180 degrees causes compressed air within volumetric cylinder 35 to be once again compressed and then exhausted from intake and exhaust opening 27 depending on accompanied crank mechanisms' rotations. In this, crank radius is in 7.1 mm - 4.9 mm = 2.2 mm.

[0062] This stroke shares both cylinders and is performed alternately. Namely, in the other cylinder, air from intake and exhaust opening 25 is taken into volumetric cylinders 30, 31. The air is then compressed and enclosed into volumetric cylinder 32, and subsequently once again compressed and exhausted from intake and exhaust opening 28.

[0063] Fig. 3 shows gas flow. As shown in Fig. 3, the gas taken into cylinder 31 and the gas taken into cylinder 30 are displaced into cylinder 32, because cylinder 31 and cylinder 30 (gaps between the bottom portion of piston members 22 23 and the corresponding cylinder members 41, 42) are reduced in volume due to the slide motion of piston members 22, 23 toward the end wall portion of respective cylinder members 22, 23.

[0064] Namely, because the gas within cylinder 31 and the gas within cylinder 30 are displaced into cylinder 32, twofold gas compression is possible at this step.

[0065] Here, because, as described above, first crank mechanism 10a and second crank mechanism 10b are made to differ in length (namely, length of crank arm), there can be provided a phase difference between first piston member 22 and second piston member 21, both performing slide motion in the same direction. That is, there can be provided a difference between the distance between the head portion of first piston member 22 and second piston member 21 when these heads have been displaced away from each other on one hand and that when they have approached each other on the other. This allows the gas that has been fed into cylinder 32 via air feed pipe to be compressed accompanied with the slide motion of first piston member 22 and second piston member 21.

[0066] As would be apparent from the above description and the accompanying drawings, in a piston type gas compressor 100, first cylinder member 41 corresponds to one cylinder member as recited in claims, and second cylinder member 42 corresponds to the other cylinder. Volumetric cylinder 31 corresponds to first gap as recited in claims, volumetric cylinder 30 corresponds to second gap, volumetric cylinder 33 corresponds to third gap, volumetric cylinder 34 corresponds to fourth gap, volumetric cylinder 35 corresponds to fifth gap, and volumetric cylinder 32 corresponds to sixth gap. A pair of volumetric cylinders 30, 31 corresponds to first intake gap as recited in claims, and volumetric cylinders 33, 34 correspond to second intake gap. Intake and exhaust openings 25, 26 correspond to intake mechanism, intake and exhaust openings 27, 28 correspond to exhaust mechanism, intake and exhaust openings 25, 26 and intake and exhaust openings 27, 28 correspond to intake and exhaust mechanism, and air feed pipe 50 corresponds to intake mechanism and gas feed mechanism.

[0067] Fig. 5 is a view showing a piston type gas compressor 100 attached with power tool. Thus, according to this piston type gas compressor 100, the force at the level of power tool 500 would be enough to obtain sufficient compressed air.

[0068] Of course, this piston type gas compressor 100 is not limited to dual cylinder type but could be of multicylinder type. As a concrete example, triple-cylinder type or quadruple-cylinder type could be implemented, and a multiple of two or 4 is preferable.

[0069] Next, referring to Figs. 1, 2, and 9 to 12, there will be described a piston type gas pressure drive rotation device 200 to be of the present invention.

[0070] Same parts as those in a piston type gas compressor 100 are designated with same reference symbols, and will not be described. Only different parts will be described.

[0071] As shown in Figs. 1 and 2, a piston type gas pressure drive rotation device 200 is constituted by almost as same the structure as that of the piston type gas compressor. The different point is that piston shaft members 15, 17 connected to second piston members 21, 23 are disposed on either side of the piston shaft members 16, 18 connected to first piston shaft members 22, 24 in such a way as to put the shaft members 16, 18 between piston shaft members 15, 17. Therefore, reciprocating slide motion in this case can be made smooth, as compared with the case of piston shaft members each consisting of one peace.

[0072] Further, the intake and the exhaust of gas into and out of each cylinder 41, 42 are reversed. Namely, intake and exhaust openings 25, 26 constitute an intake opening respectively in a piston type gas compressor 100, but constituting an exhaust opening in a piston type gas pressure drive rotation device, while, intake and exhaust openings 27, 28 likewise constitute respectively an exhaust opening. As for volumetric cylinders 30, 31, 32, 33, 34, and 35, the intake and the exhaust of gas are reversed with respect to piston type gas compressor 100. Therefore, feeding compressed gas into cylinders 32 and 35 can cause crankshaft 15 to rotate.

[0073] As would be apparent from the above description and the accompanying drawings, in piston type gas pressure drive rotation device 200, first cylinder member 41 corresponds to one cylinder member as recited in claims, second cylinder member 42 corresponds to the other cylinder member. Volumetric cylinder 31 corresponds to a first gap as recited in claims, volumetric cylinder 30 corresponds to a second gap, volumetric cylinder 33 corresponds to a third gap, volumetric cylinder 34 corresponds to a fourth gap, volumetric cylinder 35 corresponds to a fifth gap, and volumetric cylinder 36 corresponds to a sixth gap. Intake and exhaust openings 25, 26 correspond to an exhaust mechanism, intake and exhaust openings 27, 28 correspond to an intake mechanism, intake and exhaust openings 25, 26 and intake and exhaust openings 27, 28 correspond to an intake and exhaust control mechanism, and gas feed pipe 50 corresponds to a gas feed mechanism.

[0074] Further, Fig. 10 is a view of a tool to which the present invention is applied. As shown in the drawing, a simple tank would be enough to obtain sufficient rotational force.

[0075] Adaptation of this to four-cylinder, sixth-cylinder, etc. makes it possible to apply to vehicles, as shown in Figs. 11 and 12. In this, sun light energy can be concomitantly used.

[Brief Description of the Drawings]

[0076]

Fig. 1 is a detailed plan view of a piston type gas pressure drive rotation device according to the present invention;

Fig. 2 is a detailed plan view of a piston type gas pressure drive rotation device according to the present invention;

Fig. 3 is a view showing a gas flow of the piston type gas compressor;

Fig. 4 is a perspective view of cylinder members constituting the piston type gas compressor;

Fig. 5 is a photographic picture of a test model illustrative of an air compression structure according to the present invention (embodiment);

Fig. 6 is a detailed plan view showing a piston type gas compressor according to the present invention;

Fig. 7 is a detailed plan view showing a piston type

gas compressor according to the present invention;
Fig. 8 is a detailed plan view showing a piston type gas compressor according to the present invention;
Fig. 9 is a view showing the gas flow of said piston type gas pressure drive rotation device;
Fig. 10 is a view showing the state where the piston type gas pressure drive rotation device is applied to a tool;
Fig. 11 is a view showing the state where the piston type gas pressure drive rotation device is applied to a vehicle; and
Fig. 12 is a view showing the state where the piston type gas pressure drive rotation device is applied to a vehicle.

[Terminology]

[0077]

10:	Crank mechanism
10a:	Crank mechanism (7.1 mm radius/180 degrees)
10b:	Crank mechanism (4.9 mm radius/165 degrees)
10c:	Crank mechanism (4.9 mm radius/345 degrees)
10d:	Crank mechanism (7.1 mm radius/360 degrees)
11:	Crank connecting rod
12:	Crank connecting rod
13:	Crank connecting rod
14:	Crank connecting rod
15:	Piston shaft member
16:	Piston shaft member
17:	Piston shaft member
18:	Piston shaft member
20:	Machinery body having dual cylinders arranged side-by-side and air passage and pressure valve integrated together
21:	Second piston member
22:	First piston member
23:	Second piston member
24:	First piston member
25:	Intake and exhaust opening
26:	Intake and exhaust opening
27:	Intake and exhaust opening
28:	Intake and exhaust opening
30:	Volumetric cylinder
31:	Volumetric cylinder
32:	Volumetric cylinder
33:	Volumetric cylinder
34:	Volumetric cylinder
35:	Volumetric cylinder
40:	Piston member
41:	First piston member
42:	Second piston member

Claims

1. A piston type gas compressor comprising:

a plurality of cylinder members each of which has a closed bore;
first piston members and second piston members slidably fitted into the bore of said each cylinder member;
a connecting mechanism for connecting said first piston members and second piston members to the same crank shaft respectively, via a slider crank mechanism; and
an intake and exhaust control mechanism for controlling the intake and exhaust of gas into and out of the bore of said each cylinder member,

wherein said first piston members and second piston members perform a reciprocating slide motion in the bores of said respective cylinder members in accordance with the rotation of the crank shaft connected by said connecting mechanism via slider crank mechanism;
while said intake and exhaust control mechanism sends the gas, which has been taken into the bores of the plurality of cylinder members, into the bore of one cylinder member by utilizing the reciprocating slide motion of said first piston members and second piston members, and compresses the gas fed to said bore.

2. A piston type gas compressor according to claim 1, wherein said connecting mechanism comprises first piston shaft members whose one ends are firmly fixed to the first piston members, and second piston shaft members whose one ends are firmly fixed to the second piston members, and second piston shaft members are arranged side-by-side with said first piston members; and a through-hole penetrated through said first piston members, through which the second piston shaft members, arranged side-by-side with said first piston members, are capable of being slidably fitted,

in which said first piston members and second piston members are connected to the same crank shaft arranged on the side of said first piston members via said first piston shaft members and second piston shaft members.

3. A piston type gas compressor according to claim 2, wherein said connecting mechanism comprises first crank arms for connecting the first piston shaft members to the crank shaft and second crank arms for connecting the second piston shaft members to the crank shaft in a state, where the radius of rotation of said first crank arms is made larger than that of said second crank arms.

4. A piston type gas compressor according to claim 3, wherein the outer circumference diameter of each head of the first piston members and second piston members is made smaller than that of the corresponding bottom portion thereof.

5. A piston type gas compressor according to claim 3 or 4, wherein said first crank arms and said second crank arms are made to differ in each crank angle.

6. A piston type gas compressor described in any one of claims 1 to 5, wherein said intake and exhaust control mechanism comprises:

an intake mechanism for causing a first intake gap and a second intake gap to take in gas alternately in a state, where said first intake gap is composed of a first gap formed between the end wall portion of the bore of one cylinder member and the bottom portion of either of the first piston member or the second piston member fitted into said bore, and a second gap formed between the end wall portion of the bore of the other cylinder member and the bottom portion of either of a first piston member or second piston member fitted into said bore, and where said second intake gap is composed of a third gap formed between the end wall portion of the bore of said one cylinder member and the other of the first piston member or second piston member, and a forth gap formed between the end wall portion of the bore of said other cylinder member and the bottom portion of the other of the first piston member or second piston member fitted into said bore;
a gas feed mechanism for feeding the gas, which has been taken into the first intake gap via said intake mechanism, into a fifth gap formed between the head of the first piston members and the head of the second piston members fitted into the bore of one cylinder member, while feeding the gas, which has been taken into said second intake gap, into a sixth gap formed between the head of the first piston members and the head of the second piston members fitted into the bore of the other cylinder member; and
an exhaust mechanism for alternately exhausting the gas that has been fed into the fifth gap via said gas feed mechanism, and the gas that has been fed into the sixth gap.

7. A piston type gas compressor according to claim 6, wherein said first gap is formed between the end wall portion of the bore of one cylinder member and the bottom portion of the first piston member fitted into said bore;

said second gap is formed between the end wall portion of the bore of the other cylinder member and the bottom portion of the second piston member fitted into said bore;

said third gap is formed between the wall face of the bore of said one cylinder member and the bottom portion of the second piston member fitted into said bore; and

said fourth gap is formed between the end wall portion of the bore of said other cylinder member and the bottom portion of the first piston member fitted into said bore.

8. A piston type gas compressor described in any one of claims 1 to 7, wherein there is provided a phase difference of 180 degrees or 120 degrees between a reciprocating slide motion of the first piston members and second piston members fitted into the bore of one cylinder member, and that of the first piston members and second piston members fitted into the bore of the other cylinder member.

9. A piston type gas compressor capable of high velocity rotation, which has a first piston members and second piston members faced mutually on a line within the same cylinder so as to compress gas by reciprocating the first and second pistons in the same direction, comprising:

a mechanism in which a piston shaft for reciprocating the first piston members causes the second piston member to be penetrated, so that both piston shafts are put together on one side to reciprocate; and
a structure in which each of piston shafts with a machinery body having dual cylinders arranged side-by-side and piping and pressure valve integrated together, said machinery body constituting one set, is connected via crank connecting rod with crank mechanisms, said crank mechanisms differing in crank angle and crank radius, so as to be able to perform crank rotational motion and piston reciprocating motion well balanced,

wherein both of single machinery and multiple machinery can be built.

10. A piston type gas pressure drive rotation device comprising:

a plurality of cylinder members each of which has a closed bore;
first piston members and second piston members slidably fitted into the bore of said each cylinder member;
an intake and exhaust control mechanism for controlling the intake and exhaust of gas into and out of the bore of said each cylinder member so as to make said first piston members and second piston members slidably reciprocating motion; and

a connecting mechanism for connecting the first piston members and second piston members to the same crank shaft having a slider crank mechanism so as to convert the reciprocating slide motion of both the first piston members and second piston members in accordance with the control of the intake and exhaust through said intake and exhaust control mechanism into one rotational motion;

wherein the intake and exhaust control mechanism feeds compressed gas into the bore of one cylinder member while feeding the gas that has expanded in said bore into the bores of the plurality of cylinder members.

11. A piston type gas pressure drive rotation device according to claim 10, wherein said connecting mechanism comprises first piston shaft members whose one ends are firmly fixed to the first piston members, and second piston shaft members whose one ends are firmly fixed to the second piston members, and the second piston shaft members are arranged side-by-side with said first piston members; and a through-hole penetrated through said first piston members, through which the second piston shaft members, arranged side-by-side with the first piston members, are capable of being slidably fitted, in which said first piston members and second piston members are connected to the same crank shaft disposed on the side of said first piston members via said first piston shaft members and second piston shaft members.

12. A piston type gas pressure drive rotation device according to claim 11, wherein said connecting mechanism comprises first crank arms for connecting the first piston shaft members to the crank shaft and second crank arms for connecting the second piston shaft members to the crank shaft in a state, where the radius of rotation of said first crank arms is made larger than that of said second crank arms.

13. A piston type gas pressure drive rotation device according to claim 12, wherein the outer circumference diameter of each head portion of the first piston members and second piston members is made smaller than that of the corresponding bottom portion thereof.

14. A piston type gas pressure drive rotation device according to claim 12 or 13, wherein said first crank arms and said second crank arms are made to differ in each crank angle.

15. A piston type gas pressure drive rotation device described in any one of claims 10 to 14, wherein said intake and exhaust control mechanism comprises:

an intake mechanism for causing a fifth gap and sixth gap to take in gas alternately in a state, where said fifth gap is formed between head portion of the first piston members and second piston members fitted into the bore of one cylinder member constituting the cylinder members, and where said sixth gap is formed between head portion of the first piston members and second piston members fitted into the bore of the other cylinder member constituting said cylinder members;

a gas feed mechanism for feeding the gas, which has been taken into the fifth gap via said intake mechanism, by distributing said gas between both gaps, into a first gap formed between the end wall portion of the bore of the one cylinder member and the bottom portion of either of the first piston member or the second piston member fitted into said bore, and a second gap formed between the head portion of the bore of said other cylinder member and the bottom portion of either of the first piston member or the second piston member fitted into said bore, while feeding the gas, which has been taken into the sixth gap via said intake mechanism, by distributing the gas between both gaps, into a third gap formed between the end wall portion of the bore of one cylinder member and the bottom portion of the other of the first piston member or the second piston member fitted into said bore, and a fourth gap formed between the head portion of the bore of the other cylinder member and the bottom portion of the other of the first or the second piston member fitted into said bore; and

an exhaust mechanism for exhausting the gas fed into the first gap and second gap via said gas feed mechanism, as well as the gas fed into the third gap and fourth gap.

16. A piston type gas pressure drive rotation device according to claim 15, wherein

said first gap is formed between the end wall portion of the bore of one cylinder member and the bottom portion of the first piston member fitted into said bore;

said second gap is formed between the end wall portion of the bore of the other cylinder member and the bottom portion of the second piston member fitted into said bore;

said third gap is formed between the wall face of one cylinder member and the bottom portion of the second piston member fitted into said bore; and

said fourth gap is formed between the end wall portion of the bore of the other cylinder member and the bottom portion of the first piston members fitted into said bore.

17. A piston type gas pressure drive rotation device described in any one of claims 10 to 16, wherein there is provided a phase difference of 180 degrees or 120 degrees between the reciprocating slide motion of the first piston members and second piston members fitted into the bore of one cylinder member, and that of the first piston members and second piston members fitted into the bore of the other cylinder member.

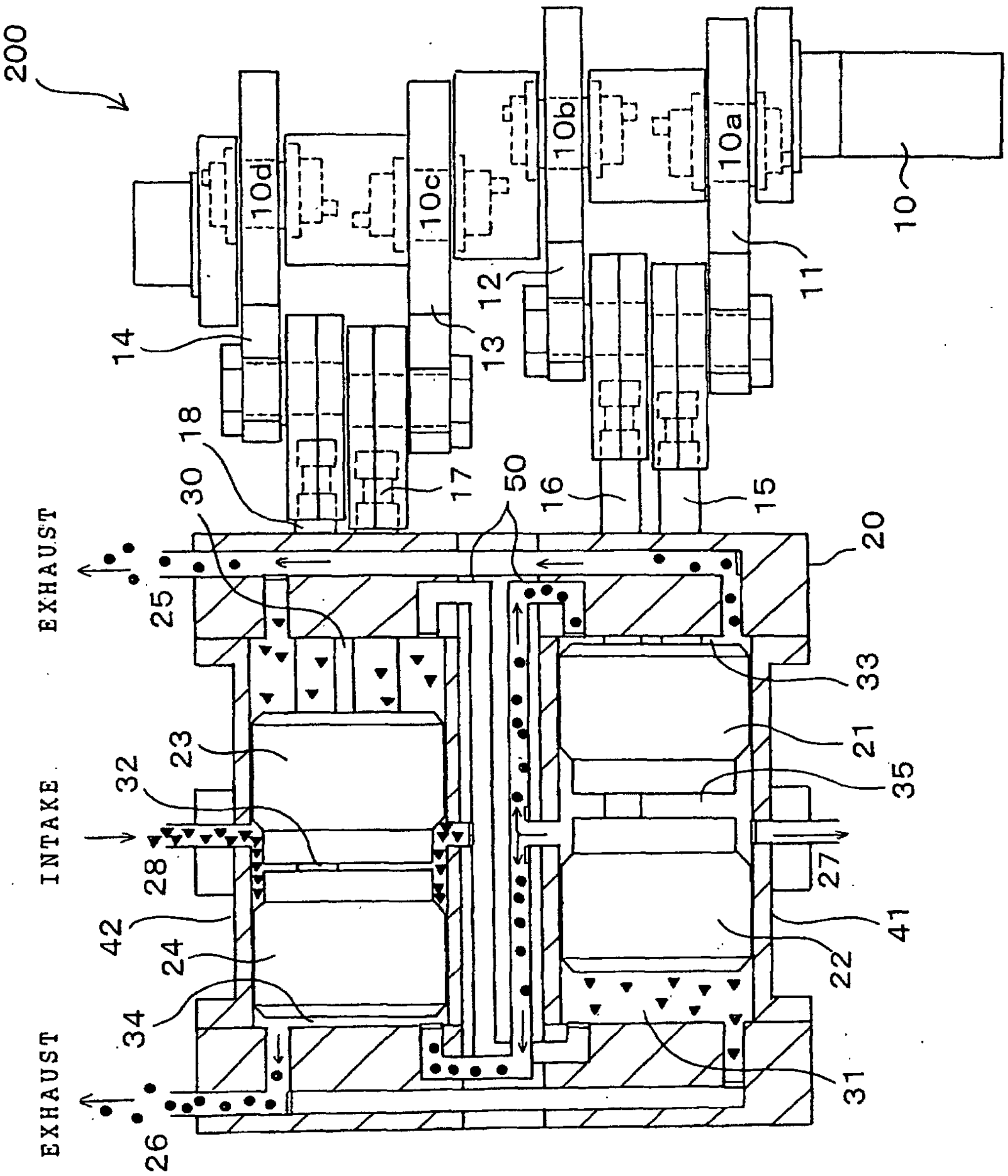
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Fig.1

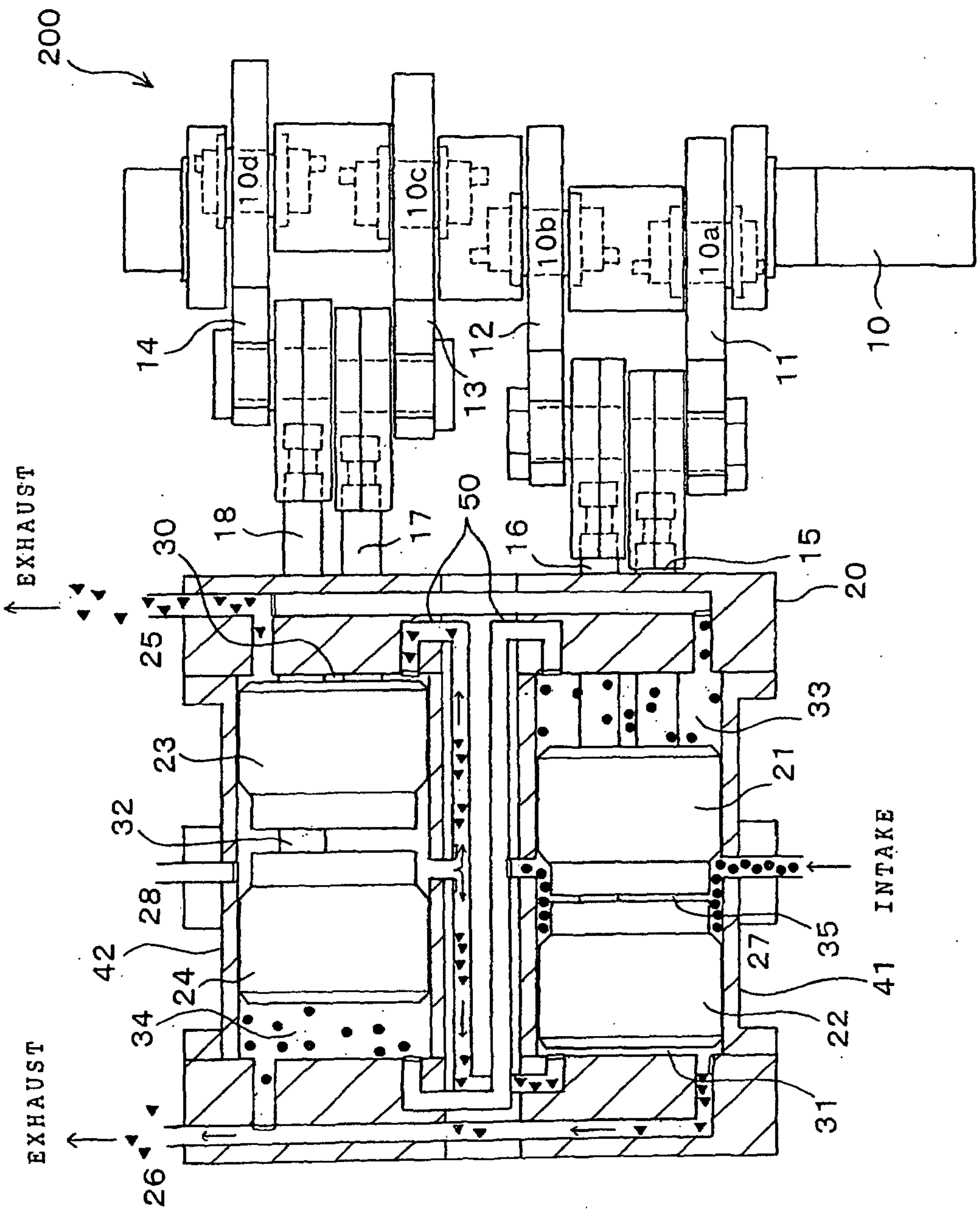
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Fig.2

Fig.3

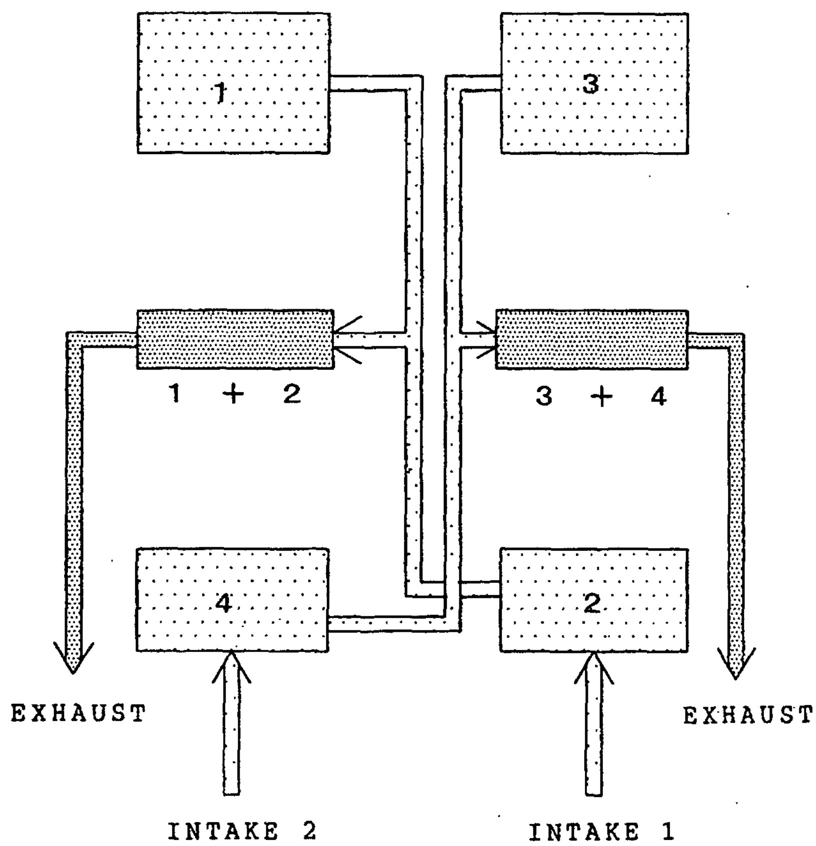


Fig.4

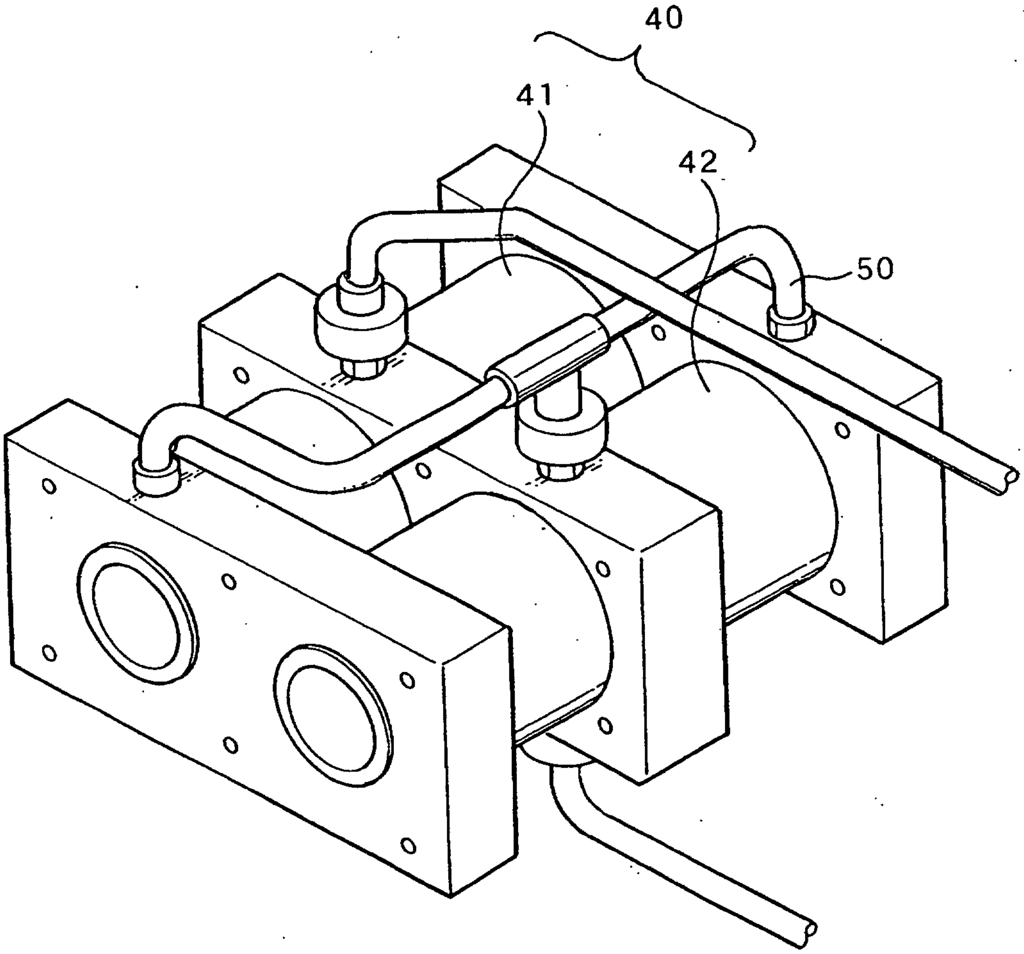
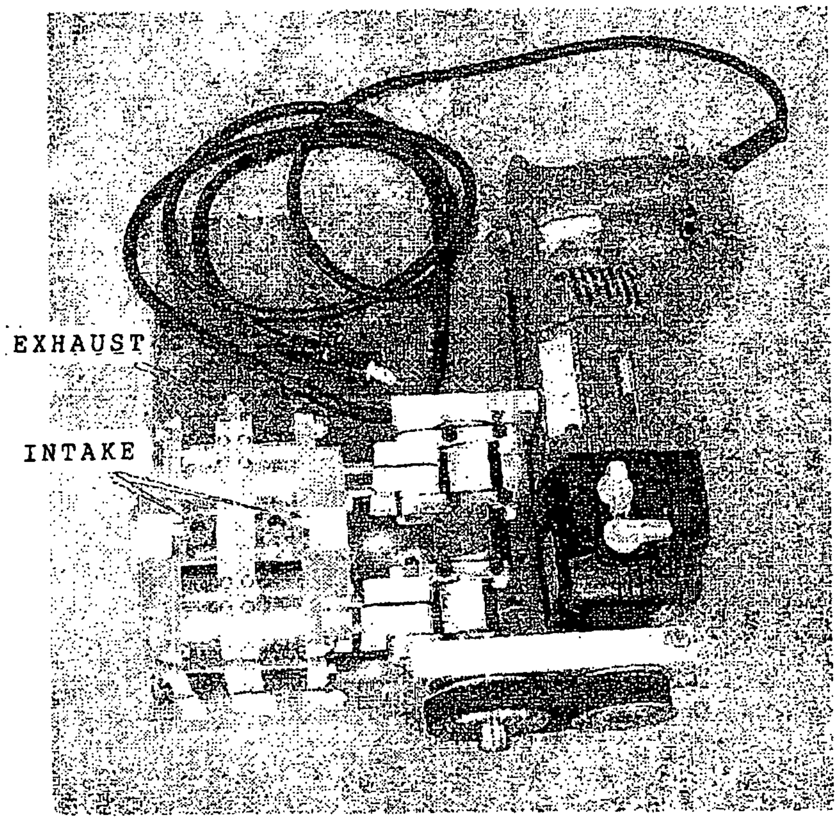


Fig.5



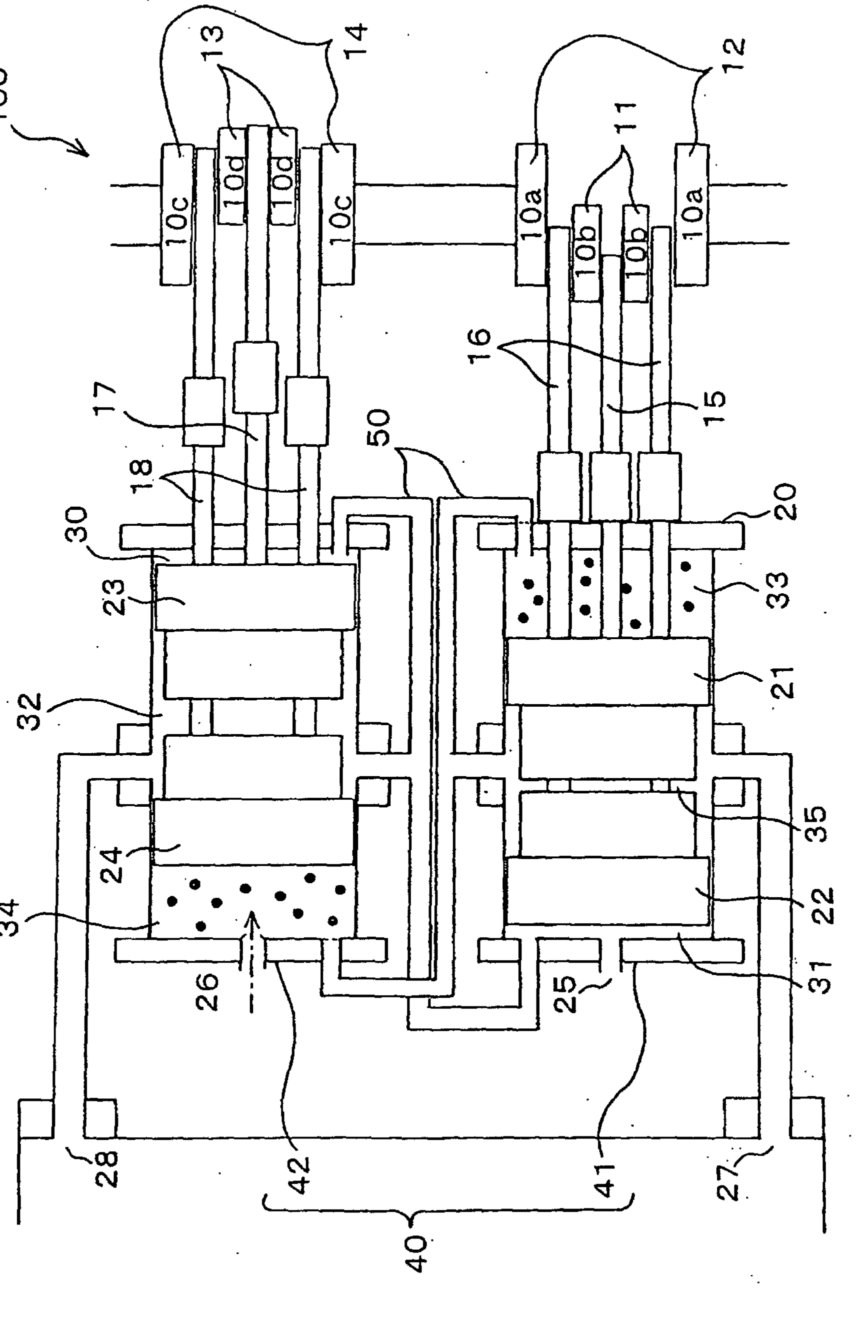

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Fig.6

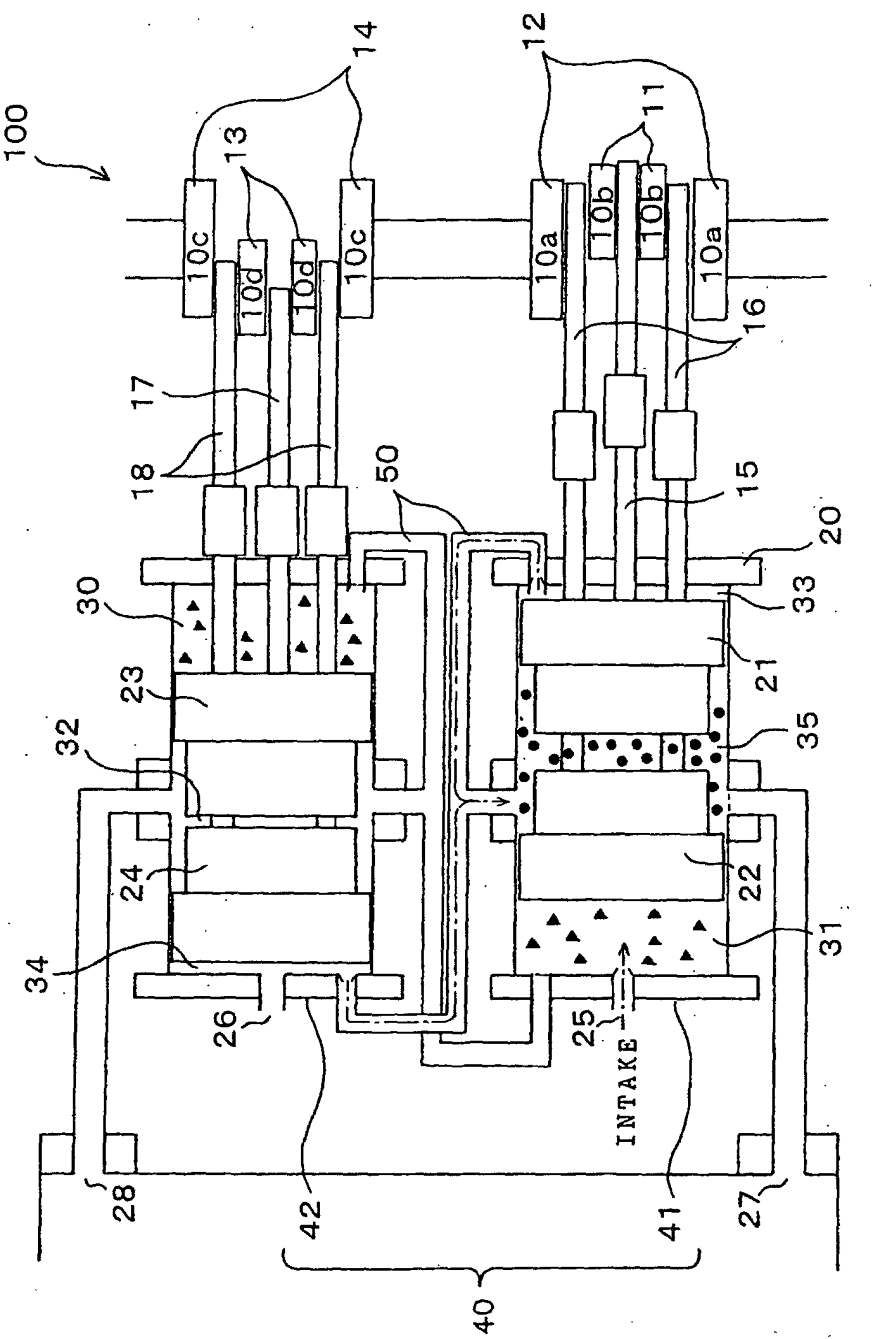
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Fig.7

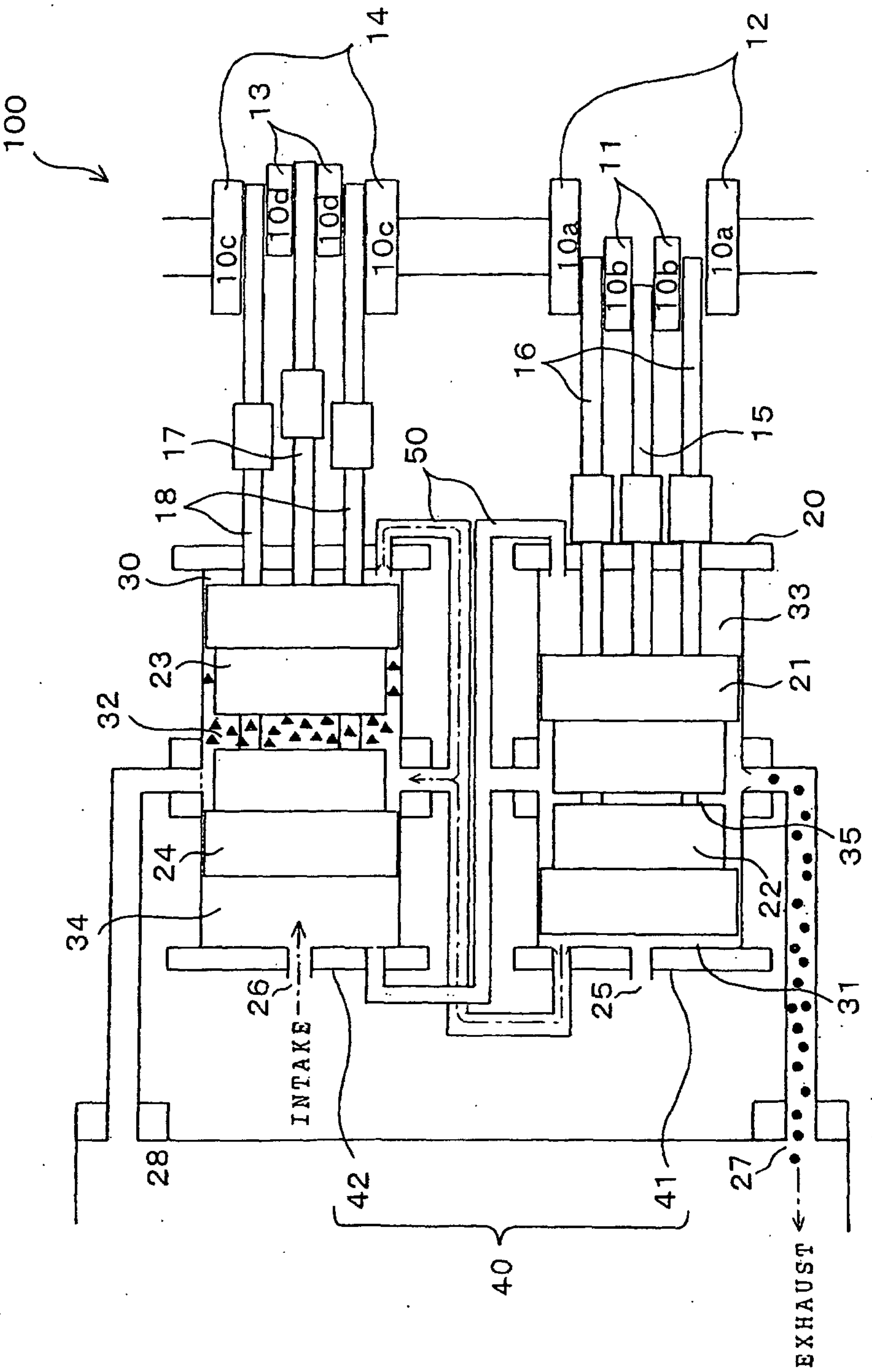
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Fig.8

Fig.9

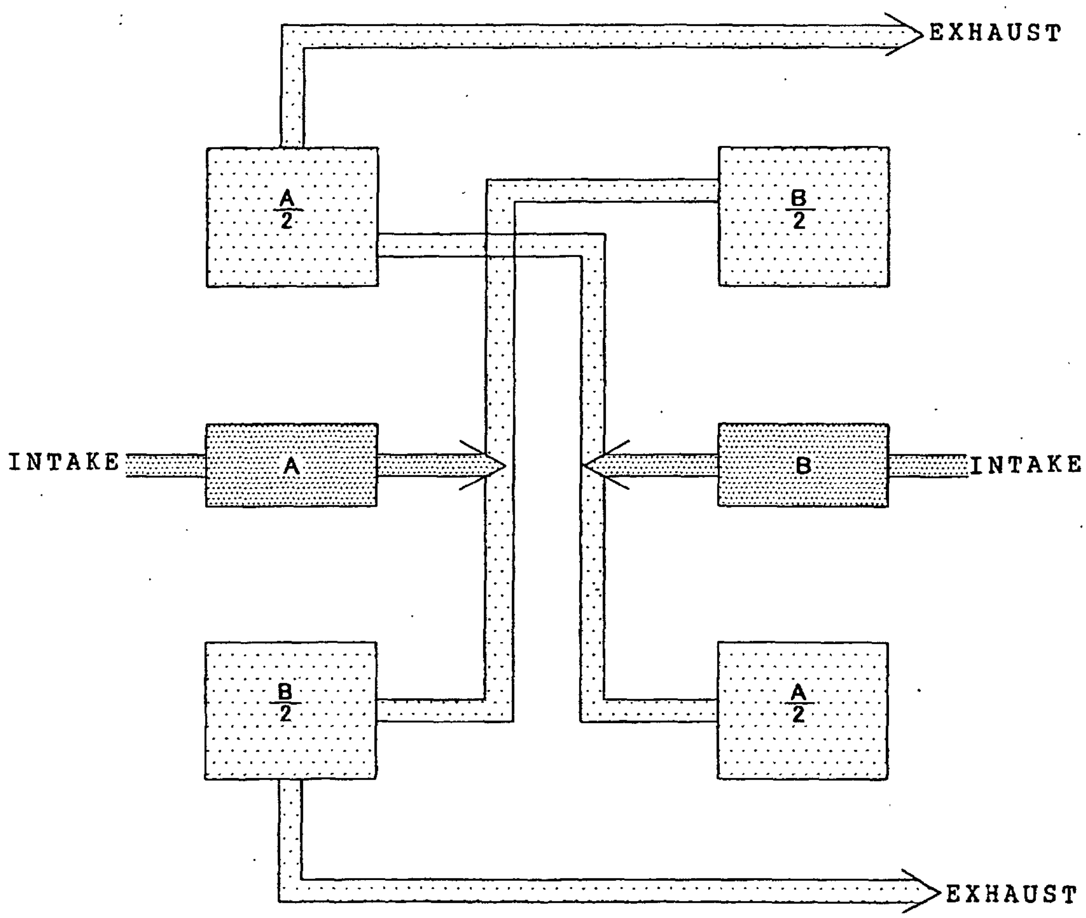
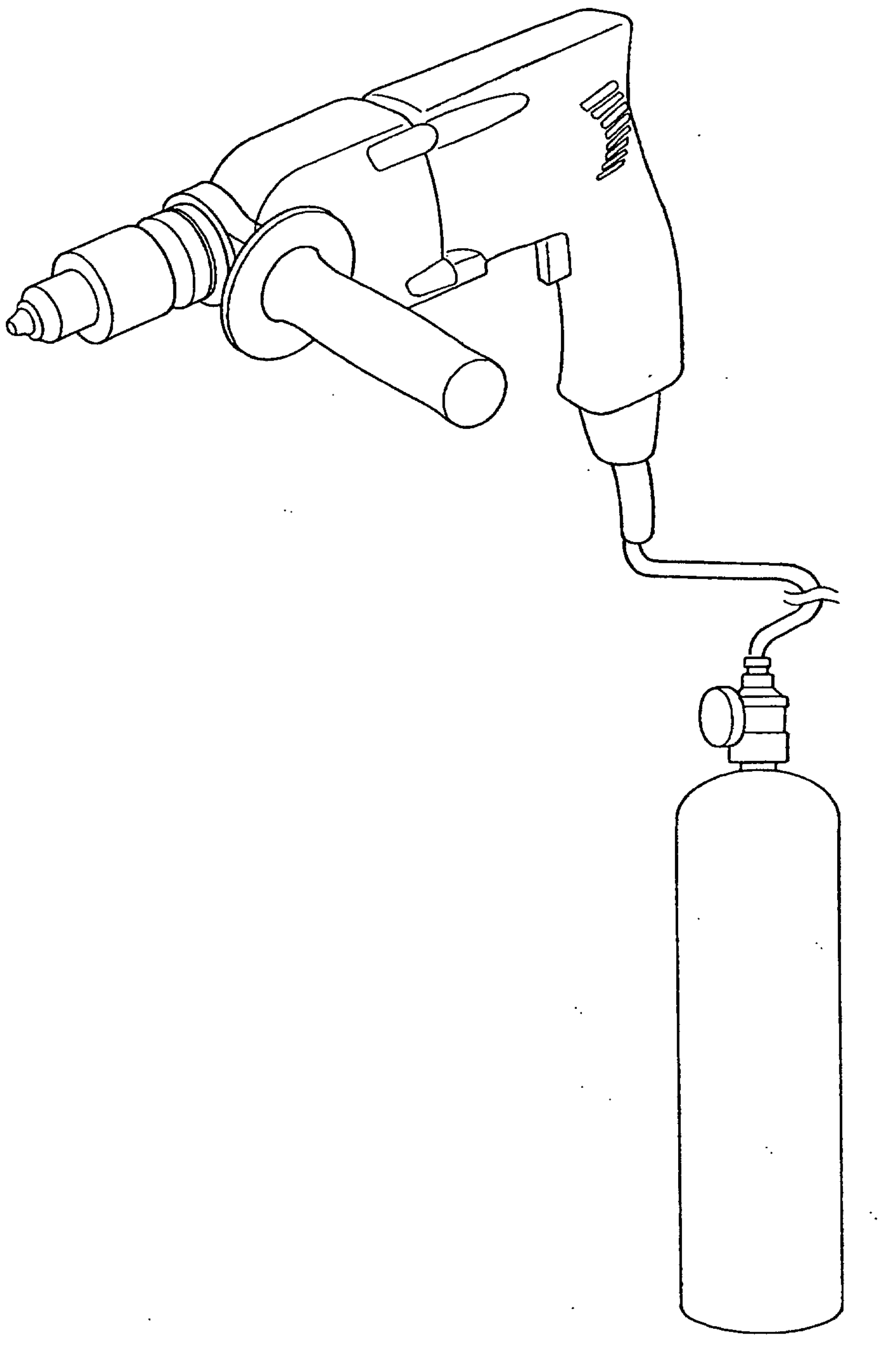


Fig.10



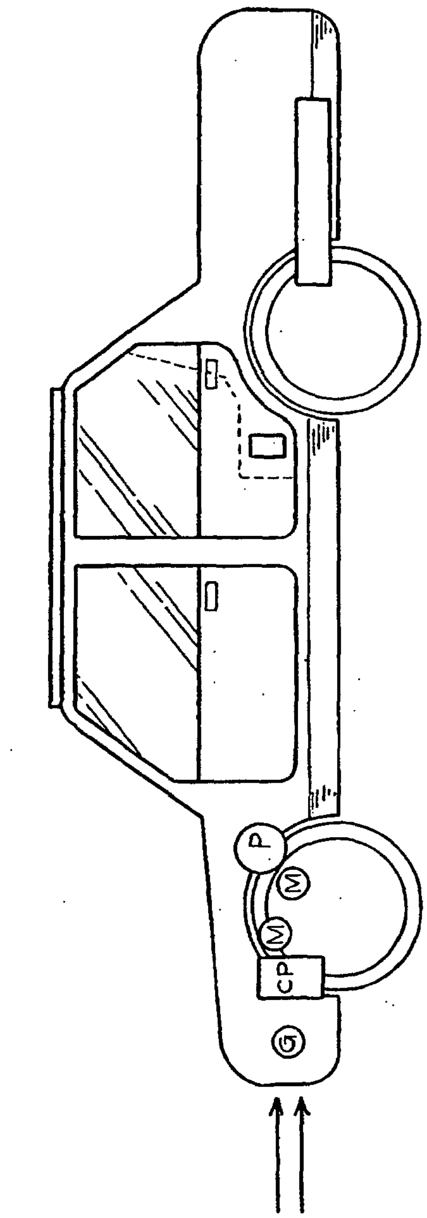
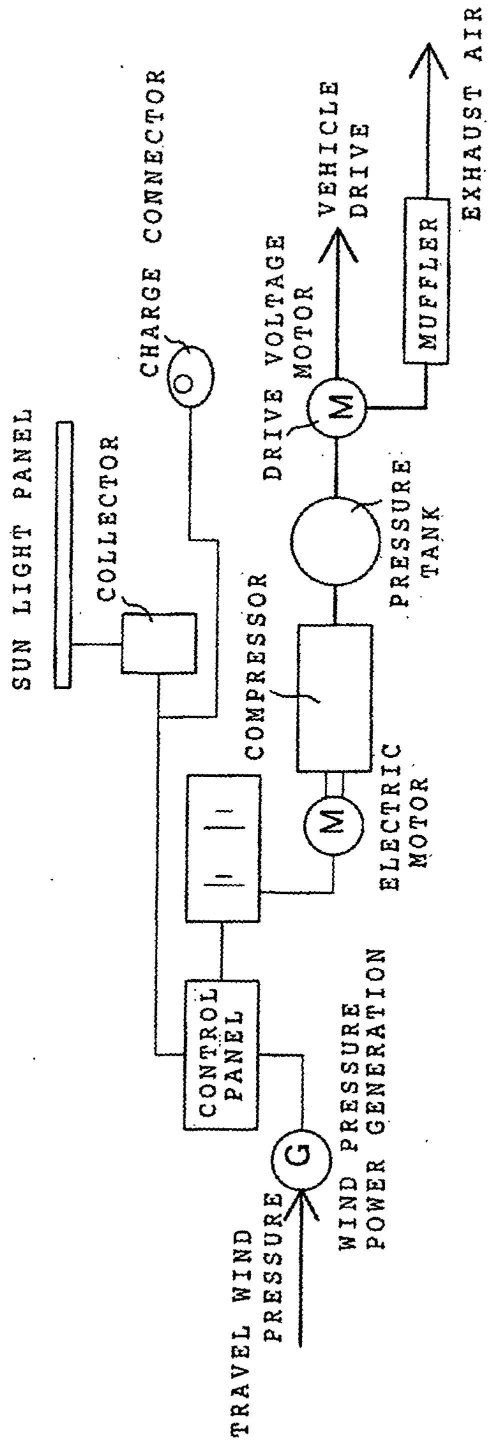


Fig.11

Fig.12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WIND PRESSURE POWER GENERATION

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/09777

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] F04B27/00, F01B7/18

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)
Int.Cl[7] F04B27/00, F04B37/12, F01B7/18, F01B7/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Toroku Jitsuyo Shinan Koho	1994-2003
Kokai Jitsuyo Shinan Koho	1971-2003	Jitsuyo Shinan Toroku Koho	1996-2003

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	JP 4-17827 Y2 (Mitsubishi Electric Corp.), 21 April, 1992 (21.04.92), Full text; Figs. 1 to 2 (Family: none)	1-9
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 21880/1990 (Laid-open No. 112583/1991) (Yoshio MORONUKI), 18 November, 1991 (18.11.91), Full text; Fig. 1 (Family: none)	1-9

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:
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"E" earlier document but published on or after the international filing date
"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)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"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
"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
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 January, 2003 (07.01.03)	21 January, 2003 (21.01.03)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/09777

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5341725 A (James B. Dick), 30 August, 1994 (30.08.94), Column 6, lines 21 to 57; Fig. 4 & AU 674761 A & AU 6967294 A & CA 2165199 A & DE 69401943 A1 & EP 704027 B1 & JP 9-503570 A & WO 94/29601 A1	10-17
A	JP 62-261602 A (Sanden Corp.), 13 November, 1987 (13.11.87), Full text; Figs. 1 to 4 (Family: none)	10-17
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