



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
13.02.2008 Bulletin 2008/07

(51) Int Cl.:
F01C 1/08 (2006.01) F01C 11/00 (2006.01)
F02B 53/08 (2006.01)

(21) Application number: **07113270.8**

(22) Date of filing: **26.07.2007**

(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 LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **31.07.2006 CN 200610104010**
25.10.2006 US 585942

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(54) **Rotary positive displacement control system and apparatus**

(57) A rotary positive displacement control system and apparatus includes a transmission assembly, at least a compression assembly and buffer assembly, and an expansion assembly, the buffer assembly disposed between the compression and expansion assembly. The compression assembly includes multiple compression rotors with lobes intermeshing with each other, and the expansion assembly including expansion rotors with lobes intermeshing with each other. An intake and exhaust port respectively located at the compression assembly and expansion assembly. The buffer assembly has a buffer chamber being able to efficiently lead compressed gases to the expansion assembly; meanwhile, residual gases can be discharged from a first and second exhaust slots both disposed on the expansion assembly. The buffer chamber can adjust air compression ratio during process of compression to completely mix vortexes and fuel generated from a high-pressure air stream; after explosions and expansion, power output is transmitted through transmission shafts directly.

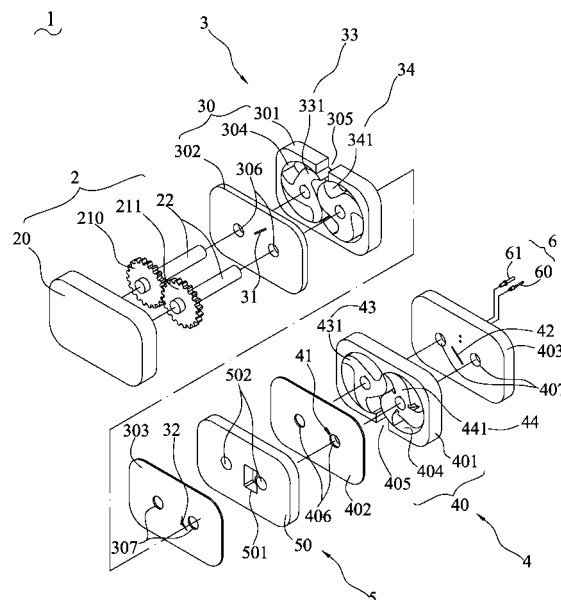


FIG.1

Description

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

[0001] The present invention relates to a rotary positive displacement control system and apparatus, and particularly to a rotary positive displacement system and apparatus operating by ways of a periodic process of suction, expansion, compression, exhaust, and can be adapted to engines, vacuum pumps, internal combustion machines, compressors and rotary positive displacements.

2. RELATED ART

[0002] Generally, a concept of supercharging is that force air into an intake port of a sealing chamber which is equipped with multiple rotors rotating continuously and meshing with each other, in which air flows through a transmitting chamber and is compressed after rotation of the rotors and turns to be high pressure air, then air is discharged from the exhaust port. Due to such operation cycle, air is of high compression ratio. The character of high compression ratio can be used to apparatuses like engines, vacuum pumps, internal combustion machines and compressors and so on for improving working performance, lowering oil consumption, and reducing air pollution. Related structure of supercharging apparatus has been disclosed in numerous prior arts, such as U.S. Pat. Nos. 4,008,693, 4,321,897, 4,512,302, 4,813,388, 4,825,827, 5,329,900, 6,129,067, 6,481,410.

[0003] However, in prior arts there are still some disadvantages to the periodic operation process of suction, expansion, compression and exhaust. Those disadvantages lower the working performance of the apparatuses. That is, in prior arts, during periodic operation process, residual gases remain because of incomplete exhaust, even though the apparatus runs with a rotary positive displacement cannot avoid remaining residual gases. As a result, the apparatus cannot have a well efficiency in providing power and a longer lifespan. Moreover, power output of some apparatuses, such as engines, is transmitted through crankshafts, while the quality of the crankshafts will affect process of operation; if the crankshafts are of poor quality, the accuracy of dynamic balance is no longer accurate, which will cause unstable performance, shorten lifespan, and increase unnecessary power consumption.

SUMMARY OF THE INVENTION

[0004] Accordingly, an object of the present invention is to provide a rotary positive displacement control system and apparatus, which can completely discharge residual gases and transmit power without crankshafts, that is, a rotary positive displacement control system and ap-

paratus of the present invention can provide high pressure air during process of compression and can directly transmit combustion expansion power in order to increase operation efficiency and enhance power output.

[0005] Another object of the present invention is to provide a rotary positive displacement control system which can be axially or radially extended or can be extended with whole system.

[0006] To achieve the above-mentioned objects, a rotary positive displacement control system and apparatus of the present invention includes a transmission assembly, at least a compression assembly, a buffer assembly and an expansion assembly, the buffer assembly disposed between the compression and expansion assembly. The compression assembly includes multiple compression rotors with lobes intermeshing with each other, and the expansion assembly includes expansion rotors with lobes intermeshing with each other. An intake and exhaust ports are respectively located at the compression assembly and expansion assembly. A first and second intake slots are respectively disposed on opposite sides of the compression assembly, wherein the first intake slot is corresponding to an initial seal zone where the compression rotors initially intermesh with each other. The second intake slot is defined within three curves, including: an arc of a base circle of one of the compression rotors (said arc drawn with a minimum radius of the compression rotor), a profile curve of the lobe of the compression rotor being tangent to said arc of the base circle, and a maximum curve of the adjoining compression rotor drawn with a maximum radius thereof and being tangent to said arc of the base circle.

[0007] The expansion rotor of the expansion assembly has a first concavity corresponding to the first exhaust slot, the first concavity being defined by following steps:

as the intermeshing expansion rotors rotate up to a combustion area, designate a point Q at circumference of the base circle of one of the expansion rotors, the point Q corresponding to the combustion area, and draw a line QO by connecting the point Q and a center O of the base circle; then rotate the expansion rotor backwards till a recess of the lobe is against a tip of a lobe of an adjoining expansion rotor where a point S is defined as an intersection of the tip and the recess of the lobe, and a point P is defined as an intersection of a projecting curve of the lobe of the adjoining expansion rotor and the recess of the lobe, and then respectively connect the point S and P to the center O, whereby an angle SOP and angle SOQ are formed and subject to change on rotation of the expansion rotors. Take the angle SOP as two times large as the angle SOQ, then make an angle bisector of the angle SOP intersect the profile of the expansion rotor at a point R to form an angle bisector OR; connect point R and S to form a curve SR; draw an arc about the center O to intersect a line SO and line RO to form an arc C; whereby, the

first concavity is defined within an area of the curve SR, the arc C, the line SO and line RO.

[0008] The buffer assembly has a buffer chamber being able to efficiently lead compressed gases to the expansion assembly; meanwhile, residual gases can be discharged from a first and second exhaust slots both disposed on the expansion assembly. The buffer chamber can adjust air compression ratio during process of compression.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Figs. 1 and 2 are respectively a perspective exploded view and perspective assembled view of the first embodiment of the present invention;

[0010] Figs. 3A to 3H are schematic views illustrating a process of operation of a compression assembly of the first embodiment;

[0011] Figs. 4A to 4F are schematic views illustrating a process of operation of a buffer assembly of the first embodiment;

[0012] Figs. 5A to 5C are schematic views illustrating a process of operation of an expansion assembly of the first embodiment;

[0013] Fig. 6 is a perspective exploded view of the second embodiment of the present invention;

[0014] Figs. 7A to 7D are schematic views illustrating a process of operation of a compression assembly of the second embodiment;

[0015] Figs. 8A to 8C are schematic views illustrating a process of operation of a buffer assembly of the second embodiment;

[0016] Figs. 9A to 9C are schematic views showing illustrating a process of operation of an expansion assembly of the second embodiment;

[0017] Fig. 10 is a perspective exploded view of the third embodiment of the present invention;

[0018] Figs. 11A to 11C are plane views of the fourth embodiment of the present invention mainly illustrating a base, a second casing and a third casing of a buffer assembly;

[0019] Fig. 12 is a plane view of the fourth embodiment of the present invention illustrating compression rotors intermeshing with each other;

[0020] Fig. 13 is a plane view of the fourth embodiment of the present invention illustrating expansion rotors intermeshing with each other;

[0021] Figs. 14A to 14F are schematic views of the fourth embodiment of the present invention illustrating a process of operation of exhausting, intaking and ignition; and

[0022] Figs. 15 to Figs. 17A and B another embodiment illustrating compression rotors and expansion rotors arranged in different phasing angle.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] With respect to Fig. 1, the first embodiment of the present invention applied to an engine 1, the engine 1 includes a transmission assembly 2, a compression assembly 3, an expansion assembly 4, a buffer assembly 5, and a supply assembly 6, wherein the transmission assembly 2 includes an axial base 20, a plurality of transmission members pivotally mounted on the axial base 20; in the first embodiment the transmission members are a first gear 210, a second gear 211 being engaged with each other, and a plurality of transmission shafts 22 being parallel to each other for carrying the first and second gears 210, 211.

[0024] The compression assembly 3 includes a sealing first chamber 30, a first intake slot 31 and a second intake slot 32, wherein the sealing first chamber 30 includes a first housing 301 sealed by a first casing 302 and a second casing 303 from opposite sides of the first housing 301, the first housing 301 having a compression chamber 304 which accommodates a plurality of compression rotors 33, 34 intermeshing with each other and respectively pivotally mounted to the transmission shafts 22. Each compression rotor 33, 34 has three identical projecting lobes being evenly spaced around the compression rotor 33, 34. An intake port 305 is defined on the first housing 301 and communicates with the compression chamber 304 for taking air in. The first and second casings 302, 303 respectively have a plurality of coupling holes 306, 307 corresponding to the transmission shafts 22 carrying the first and second gears 210, 211 thereon.

[0025] Referring to Fig. 3A, the first intake slot 31 is corresponding to an initial seal zone 90 where the compression rotors 33, 34 initially intermesh with each other.

[0026] Referring to Figs. 3E to 3G, a profile of the second intake slot 32 is defined within three curves, comprising: an arc of a base circle 340 of one of the compression rotors 34 (said arc 340 drawn with a minimum radius of the compression rotor 34), a profile curve 342 of the lobe 341 of the compression rotor 34 being tangent to said arc of the base circle 340, and a maximum curve 330 of the adjoining compression rotor 33 drawn with a maximum radius thereof and being tangent to said arc of the base circle 340.

[0027] Referring back to Fig. 1, the expansion assembly 4 includes a sealing second chamber 40, a first exhaust slot 41 and a second exhaust slot 42, wherein the sealing second chamber 40 includes a second housing 401 sealed by a third casing 402 and a fourth casing 403, the second housing 401 having an expansion chamber 404 which accommodates a plurality of expansion rotors 43, 44 intermeshing with each other and respectively pivotally mounted to the transmission shafts 22, each expansion rotor 43, 44 has three identical projecting lobes 431, 441 being evenly spaced around the expansion rotor 43, 44, the lobes 431, 441 projecting in counter direction to the lobes 331, 341 of the compression rotors 33, 34.

A rotating direction of the compression rotors 33, 34 and expansion rotors 43, 44 are the same, of which a rotating ratio is 1:1. An exhaust port 405 is disposed on the second housing 401 and communicates with the expansion chamber 404 for discharging air. The third and fourth casings 402, 403 respectively have a plurality of coupling holes 406, 407 corresponding to the transmission shafts 22 carrying the first and second gears 210, 211 thereon.

[0028] Referring to Figs. 4A to 4C, a first concavity 45 is defined on the lobe 441 of the expansion rotor 44. A profile of the first concavity 45 is defined by following steps: As shown in Fig. 4A, when the intermeshing expansion rotors 43, 44 rotate to a combustion area 91, designate a point Q at circumference of the base circle of one of the expansion rotors 44 (as shown in Fig. 4B); the point Q is corresponding to the combustion 91 as shown in Fig. 4A, and draw a line QO by connecting the point Q and a center O of the base circle, then rotate the expansion rotor 44 backwards till the recess of the lobe 441 is against a tip of a lobe 431 of an adjoining expansion rotor 43 where a point S is defined as an intersection of the tip and the recess of the lobe 441, and a point P is defined as an intersection of a projecting curve of the lobe 431 of the adjoining expansion rotor 43 and the recess of the lobe 441, and then respectively connect the point S and P to the center O, whereby an angle SOP and angle SOQ are formed and subject to change on rotation of the expansion rotors 43, 44. Referring to Fig. 4C, take the angle SOP as two times large as the angle SOQ, then make an angle bisector of the angle SOP intersect the profile of the expansion rotor 44 at a point R to form an angle bisector OR, and connect point R and S to form a curve SR; draw an arc about the center O to intersect a line SO and line RO to form an arc C; whereby, the first concavity 45 is defined within an area of the curve SR, the arc C, the line SO and line RO.

[0029] Referring to Figs. 4A and 4E, the first exhaust slot 41 is defined within an area of the arc C, the line QO and SO, and a segment of the profile of the expansion rotor 44 being taken as the combustion area 91 appears.

[0030] Referring to Fig. 5C, the second exhaust slot 42 is disposed on the sealing second chamber 40 with respect to a ultimate seal zone 92 where the compression rotors 43, 44 ultimately intermesh with each other for discharging residual gases.

[0031] Referring bank to Fig. 1 in combination with Fig. 3H, the buffer assembly 5 is disposed between the compression and expansion rotors 3, 4 and has a base 50 having a first buffer chamber 501 corresponding to the second intake slot 32 and the first exhaust slot 41, and a plurality of coupling holes 502 being respectively coaxial to the coupling holes 306, 307, 406, 407.

[0032] The supply assembly 6 includes a fuel injection means 60 and a spark plug 61 both disposed on the fourth casing 403 with respect to the ultimate seal zone 92 where the expansion rotors 43, 44 ultimately intermesh with each other; accordingly, a gasoline engine is produced. (While the supply assembly includes only a fuel

injection means 60, a diesel engine ejecting directly interiorly is produced). Furthermore, in the present embodiment, the fuel injection means 60 and the spark plug 61 are disposed in the expansion chamber in a radial or axial direction with respect to a seal zone where the expansion rotors intermesh with each other.

[0033] Referring to Figs. 3A to 3D, the present invention in operation, negative pressure area is generated in the compression chamber 304 as the compression rotors 33, 34 begin rotating, and air is sucked in from the intake port 305 (as shown in Fig. 3B). Due to the shape of the compression rotors 33, 34, a seal zone 90 is generated as the compression rotors 33, 34 rotate initially. The seal zone 90 will become vacuum if there is no air filled in. In order to avoid the vacuum situation, air can be admitted from the first intake slot 31 into the seal zone 90 (as shown in Fig. 3A). During the process of rotation of the compression rotors 33, 34, filled air is transported as two parts which will mix together and be compressed in the end of transporting (as shown in Fig. 3C). Meanwhile, air will be discharged through the second intake slot 32 into the first buffer chamber 501 (as shown in Fig. 3D). Particularly, opening of the second intake slot 32 is determined by the compression rotor 32, that is, the second intake slot 32 is close because it is covered due to rotation of the compression rotors 33, 34; in turn, the second intake slot is open, and air is admitted into the first buffer chamber 501. On the other hand, in order to prevent the second intake slot 32 from being opened too early, which may cause compression ratio of the first buffer chamber 501 higher than that of the compressed air, and air returns to the compression chamber 304, a shape and location of the second intake slot 32 are taken into account.

[0034] Referring to Figs. 3E to 3G, the present invention in manufacture, first, rotate the compression rotors 33, 34 to a position where compression ratio of the compressed air and the first buffer chamber 501 is the same (as shown in Fig. 3E), then the second intake slot 32 will open as the compression rotors 33, 34 keep rotating, and air will be forced into the buffer chamber 501, therefore, the profile curve 342 of the lobe 341 of the compression rotor 34 indicates an appropriate location to decide opening of the second intake slot 32. Above all, the second intake slot 32 cannot be located at left side of a path of rotation the maximum curve 330, otherwise air will return to the compression chamber 304. Furthermore, the second intake slot 32 cannot be located inside the arc of the base circle 340 of the compression rotors 34 (said arc 340 drawn with a minimum radius of the compression rotor 34) because the second intake slot 32 will always be covered and lose functions thereof. Accordingly, the shape and location of the second intake slot 32 can be defined by the above-described three curves: the arc of the base circle 340 of the compression rotors 34, the profile curve 342 being tangent to the arc 340, and the maximum curve 330 of the compression rotor 33.

[0035] Referring to Fig. 3H, the first buffer chamber 501 communicates with the second intake slot 32 and

the first exhaust slot 41 and can maintain air pressure as a pressure value which is slightly bigger than a pressure value resulted from actual explosion. When the compression rotors 33, 34 keep rotating, the compressed air will be discharged into the first buffer chamber 501 to keep a high pressure value. On the other hand, when the first exhaust slot 41 is open, pressure from the first buffer chamber 501 will force air flowing rapidly into the expansion chamber 404.

[0036] Accordingly, when the air flows into the expansion chamber 404, the fuel supply means injects fuel to mix with the compressed air, meanwhile, the spark plug is ready to be ignited to make explosions. In case the first exhaust slot 41 is not close during the explosions, air will flow back to the buffer chamber 501, and such result is not expected. Referring to Figs. 4C to 4F, when the expansion rotors 43, 44 rotate as shown in Fig. 4D, the tip of the lobe 431 of the expansion rotor 43 is against the first concavity 45; as a result, an opening to the first concavity 45 is formed around the tip of the lobe 431. In process of rotation (as shown in Fig. 4B), the tip of the lobe 431 is positioned at the point S, an edge of the first concavity 45, and the expansion rotors 43, 44 intersect at point P, whereby, a close area SRP is formed. Keep rotation, the first concavity 45 overlaps with the first exhaust slot 41, and the compressed air flows from the buffer chamber 501 into the combustion area 91. Before explosion, the first concavity 45 travels across the first exhaust 41 (as shown in Fig. 4E), at the same time, the combustion area 91 is spaced away the buffer chamber 501, and the fuel injection means 60 injects fuel to mix with the compressed air, the spark plug 61 igniting mixed air in the combustion area 91 to cause explosions. By means of vaporization of fuel and vortexes generated from a high-pressure air stream, air and fuel can be mixed completely. The explosions cause combustion gas being expanded and impel rotation of the expansion rotors 43, 44.

[0037] Referring to 5A to 5C, after explosions, residual gas is divided into two parts and discharged from the below exhaust port 405 (as shown in Figs. 5A and 5B). Due to the shape of the expansion rotors 43, 44, the ultimate seal zone 92 is generated at the time ultimate discharge occurs, and wasted gas can be completely discharged from the second exhaust slot 42 (as shown in Fig. 5C)

[0038] Moreover, number of the intermeshing compression and expansion rotors can be increased to three to enhance power of the engine and to maintain power transmitting in stable; accordingly, number of transmission shaft is also three. Fig. 6 illustrates the second embodiment of the present invention applied to an engine 1' as it is used in the first embodiment. The engine 1' includes the transmission shaft 2', the compression assembly 3', the expansion assembly 4', the buffer assembly 5' and the supply assembly 6'; a marked difference of the first and second embodiments is number of the compression and expansion rotors in the second embod-

iment is increased, which influences location of the intake port, the first and second intake slot, the exhaust port, the first and second exhaust slot. Referring to Fig. 7A to 7D, the transmission assembly 2' includes the first, second and third gears 210', 211', 212'. The compression assembly 3' includes the first, second and third compression rotors 33', 34', 35', intermeshing with one another and rotating in a direction of an arrow. The intake port 305' is located above where the compression rotors 33', 34' intermesh with each other. The intake port 305' is located under where the compression rotors 34', 35' intermesh with each other. The first intake slots 31', 31" are respectively disposed on the initial seal zone 90' where the compression rotors 33', 34' and 34', 35' initially intermesh with each other. The second intake slot 32', 32", as shown in Fig. 7D, are disposed on the second casing 303' corresponding to the middle compression rotor 34', wherein the increasing second intake 32' is formed by duplicating and rotating the second intake 32' about the center of the compression rotor 34'. The profile of the second intake slot 32', 32" is generated by the same ways as described before in the first embodiment.

[0039] Referring to Figs. 8A to 8C, the expansion assembly has the expansion rotors 43', 44', 46' intermeshing with one another and rotating in a direction of an arrow as same as the direction of the compression rotors 33', 34', 35'. However, lobes of the expansion rotors 43', 44', 46' disposed in counter direction to lobes of the compression rotors 33', 34', 35'. The exhaust port 405' is located under where the expansion rotors 43', 44' intermesh with each other. The exhaust port 405' is located above where the expansion rotors 44', 46' intermesh with each other. The first exhaust slots 41', 41" are disposed on the third casing 402' corresponding to the expansion rotor 44', wherein the increasing first exhaust slot 41" is formed by duplicating and rotating the first exhaust slot 41'. The profile of the first exhaust slots 41', 41" is generated by the same ways as described before in the first embodiment. The second exhaust slots 42', 42" are respectively disposed on the ultimate seal zone 92' where the expansion rotors 43', 44' and 44', 46' ultimately intermesh with each other.

[0040] Further referring to Fig. 10, the third embodiment of the present invention includes multiple sets of the rotary positive displacement control system 1 of the first embodiment coupled with one another, each set of the rotary positive displacement control system 1 having the fuel injections assembly 6 to improve power output. On the other hand, the present invention can be varied by adjusting number of the compression and the expansion rotors to be in a ratio of 1:2 and adding one more set of the compression assembly and the buffer assembly to maintain discharge in stable. Moreover, the compression rotors 33, 34 and expansion rotors 43, 44 have the same lobe number and rotor thickness or have the same rotor thickness but different number of the lobes, for example, the thickness of the compression and expansion rotors is the same, but the number of the lobes can be

3, 4 or 5 and so on; alternatively, the thickness of the rotors can be different but the number of the lobes is the same or both the number of lobes and the rotor thickness are different to each other and the number of lobes configured at a ratio of 1:2 between the compression and expansion rotors 33, 34 and 43, 44, for example, the compression rotor and the expansion rotor have the same thickness, but the compression rotor has three lobes while the expansion rotor has six lobes, or both the number of lobes and rotor thickness are different to each other.

[0041] Further referring to Figs. 11A to 11B, the fourth embodiment of the present invention, the differences among the present embodiment and the above-mentioned first to third embodiments are shown in Fig. 11A, the base 50" with respect to the second intake slot 32 (as labeled in Fig. 1) further including a second buffer chamber 511", 501" respectively have two communicating openings 508", 509" and 518", 519", functions of the two pairs of communication openings are the same as that of the second intake slot 32 (as labeled in Fig. 1). The second casing 303" as shown in Fig. 11B has the second intake 32" communicating with the first buffer chamber 501", and a first extension hole 321" communicating with the second buffer chamber 511". The third casing 402" as shown in Fig. 11C has the first exhaust slot 41" communicating with the first buffer chamber 501", and a second extension hole 411" communicating with the second buffer chamber 511".

[0042] Referring to Fig. 12, each lobe of the compression rotor 34" defines a second second concavity 45" thereon, the second concavity 45" is defined by the same way as the first concavity 45. An exhaust leading channel 38" is defined on the adjoining compression rotor 33" intermeshing with the compression rotor 34" of the second concavity 45", the exhaust leading channel 38" including a first opening 381" and a second opening 382" communicating with the first opening 381", wherein the first opening 381" is defined on outer edges of the lobes of the compression rotor 33", and the second opening 382" is defined on inner regions of the base circle of the compression rotor 33" (as labeled 340 in Fig. 3E). Similarly, as shown in Fig. 13, an intake leading channel 49" is defined on the adjoining expansion rotor 43" intermeshing with the expansion rotor 44" of the first concavity 45, the intake leading channel 49" including a first opening 491" and a second opening 492" communicating with the first opening 491", wherein the first opening 491" is defined on outer edges of the lobes of the expansion rotor 43", and the second opening 492" is defined on inner regions of the base circle (referring to Fig. 4A) of the expansion rotor 43".

[0043] Further referring to Figs. 14A to 14F, to conduct the process of compressing and exhausting air, first, adjust the two intermeshing compression rotors 33", 34" to a position where pressure is suitable for communicating with the first and second buffer chambers 501", 511" and

is able to compress air (as shown in Fig. 14A). When the compression rotors 33", 34" rotate, air is flowing into the first extension hole 321" from the second opening 382" of the exhaust leading channel 38" and then is exhausted (as shown in Figs. 14B and 14C); in the mean time, air is flowing through the second intake slot 32" from the second concavity 45" of the compression rotor 34" and then is exhausted. As air compression is completed, the second intake slot 32" is veiled by the compression rotor 34", the first extension hole 321" is veiled by the compression rotor 33". In other words, air is exhausted from the exhaust leading channel 38" and the second concavity 45" while the compression rotors 33", 34" are rotating. At the time that air is being compressed and exhausted as illustrated in Figs. 14D to 14F, the expansion rotors 43", 44" are driven simultaneously, and from the first opening 491" of the intake leading channel 49" of the expansion rotor 43" air is flowing through the second extension hole 411", and from the first concavity 45 of the expansion rotor 44" air is flowing through the first exhaust slot 41" and into the combustion area 91" (as shown in Fig. 14E). As air exhaust is completed, the first exhaust slot 41" is veiled by the expansion rotor 44", the second extension hole 411" is veiled by the expansion rotor 43" (as shown in Fig. 14F), whereby air is apart from the combustion area 91" to be ignited to explode.

[0044] Accordingly, it makes clear from the illustration of the fourth embodiment that after adding the second buffer chamber 511", the second concavity 45", the first and the second extension holes 321", 411", the exhaust leading channel 38" and the intake leading channel 49", the loads of the compression rotors 33", 34" and the expansion rotors 43", 44" are significantly decreased, so the performance is increased and can provide better efficiency and performance than the aforementioned first, second, third embodiments.

[0045] Further referring to Fig. 15 to Fig. 17A and 17B, the compression rotors 33, 34 and the expansion rotors 43, 44 in the aforementioned embodiments can be arranged in different phase angle, such as 0 degree and 30 degree, 0 degree and 48 degree, 0 degree and 60 degree, namely, the compression rotors and the expansions can be arranged in different phase angle depending on the practical use.

[0046] It is understood that the invention may be embodied in other forms without departing from the spirit thereof. For example, the base of the buffer assembly, the first chamber of the compression assembly, and the second chamber of the expansion assembly of the present invention can be configured unitarily or partially unitarily, or use the present invention to vacuum pumps, internal combustion machines, compressors and so on. Thus, the present examples and embodiments are to be considered in all respects as illustrative and not restrictive, and the invention is not to be limited to the details given herein.

Claims

1. A rotary positive displacement control system and apparatus, comprising a transmission assembly, a compression assembly, a buffer assembly and an expansion assembly, wherein the transmission assembly includes an axial base, a plurality of transmission members pivotally mounted on the axial base and gearing with each other, and a plurality of transmission shafts for carrying the transmission members;
the compression assembly including a sealing first chamber which defines a compression chamber therein and has an intake port communicating with the compression chamber for taking air in, multiple compression rotors pivotally mounted to the transmission shafts and accommodated in the compression chamber, the compression rotors intermeshing with each other, each compression rotor having at least one lobe, a first intake slot, and a second intake slot respectively disposed on opposite sides of the first chamber, wherein the first intake slot is corresponding to an initial seal zone where the compression rotors initially intermesh with each other;
the buffer assembly disposed between the compression assembly and the expansion assembly and having a base and a first buffer chamber corresponding to the second intake slot;
the expansion assembly including a sealing second chamber which defines an expansion chamber therein and having an exhaust port communicating with the expansion chamber for discharging air, a first exhaust slot disposed thereon and corresponding to the buffer chamber, multiple expansion rotors pivotally mounted to the transmission shafts and accommodated in the expansion chamber, the expansion rotors intermeshing with each other, each expansion rotor having at least one lobe, the lobe disposed in counter direction to the lobe of the compression rotors and having a first concavity corresponding to the first exhaust slot, and a second exhaust slot disposed on the sealing second chamber and corresponding to a ultimate seal zone where the compression rotors ultimately intermesh with each other.
2. The rotary positive displacement control system and apparatus as claimed in claim 1, wherein the plurality of transmission members comprise at least a first gear, a second gear, and transmission shafts for carrying the gears, each gear being engaged with each other.
3. The rotary positive displacement control system and apparatus as claimed in either claim 1 or claim 2, wherein a profile of the second intake slot is defined within three curves, comprising: an arc of a base circle of one of the compression rotors (said arc drawn with a minimum radius of the compression rotor), a profile curve of the lobe of the compression rotor being tangent to said arc of the base circle, and a maximum curve of the adjoining compression rotor drawn with a maximum radius thereof and being tangent to said arc of the base circle.
4. The rotary positive displacement control system and apparatus as claimed in claim 3, wherein the sealing first chamber is comprised of a first housing having the compression chamber and the intake port thereon, and a first casing and a second casing sealing the first housing respectively from opposite direction, the first and second casings having coupling holes corresponding to the transmission shafts.
5. The rotary positive displacement control system and apparatus as claimed in any preceding claim, wherein the compression and expansion rotors are identical in shape and have the same lobe number and rotor thickness or have the same rotor thickness but different number of the lobes, for example, the thickness of the compression and expansion rotors is the same, but the number of the lobes can be 3, 4 or 5 and so on; alternatively, the thickness of the rotors can be different but the number of the lobes is the same or both the number of lobes and the rotor thickness are different to each other and the number of lobes configured at a ratio of 1:2 between the compression and expansion rotors, for example, the compression rotor and the expansion rotor have the same thickness, but the compression rotor has three lobes while the expansion rotor has six lobes, or both the number of lobes and rotor thickness are different to each other.
6. The rotary positive displacement control system and apparatus as claimed in claim 5, wherein when the number of the lobes of the compression and expansion rotors is at a ratio of 1:2, one more set of the compression assembly and the buffer assembly is required for maintaining exhaust.
7. The rotary positive displacement control system and apparatus as claimed in claim 4, wherein the sealing second chamber includes a second housing having the expansion chamber and the exhaust port thereon, and a third casing and a fourth casing both sealingly assembled on opposite sides of the second housing, the third and fourth casings having coupling holes corresponding to the transmission shafts.
8. The rotary positive displacement control system and apparatus as claimed in claim 7, wherein the first concavity of the lobe of the expansion rotor is defined by following steps:

as the intermeshing expansion rotors rotate up

- to a combustion area, designate a point Q at circumference of the base circle of one of the expansion rotors, the point Q corresponding to the combustion area, and draw a line QO by connecting the point Q and a center O of the base circle; then rotate the expansion rotor backwards till a recess of the lobe is against a tip of a lobe of an adjoining expansion rotor where a point S is defined as an intersection of the tip and the recess of the lobe, and a point P is defined as an intersection of a projecting curve of the lobe of the adjoining expansion rotor and the recess of the lobe, and then respectively connect the point S and P to the center O, whereby an angle SOP and angle SOQ are formed and subject to change on rotation of the compression rotors. Take the angle SOP as two times large as the angle SOQ, then make an angle bisector of the angle SOP intersect the profile of the expansion rotor at a point R to form an angle bisector OR; connect point R and S to form a curve SR; draw an arc about the center O to intersect a line SO and line RO to form an arc C; whereby, the first concavity is defined within an area of the curve SR, the arc C, the line SO and line RO.
9. The rotary positive displacement control system and apparatus as claimed in claim 8, wherein a profile of the first exhaust slot is defined within an area of the arc C, the line QO and SO, and a segment of the profile of the expansion rotor being taken as the combustion area appears.
 10. The rotary positive displacement control system and apparatus as claimed in any preceding claim, a profile of the second intake slot is defined within three curves, comprising: an arc of a base circle of one of the compression rotors (said arc drawn with a minimum radius of the compression rotor), a profile curve of the lobe of the compression rotor being tangent to said arc of the base circle, and a maximum curve of the adjoining compression rotor drawn with a maximum radius thereof and being tangent to said arc of the base circle, wherein the additional second intake slot is added as number of the compression rotor is more than two.
 11. The rotary positive displacement control system and apparatus as claimed in any preceding claim, further duplicating the second exhaust slot by rotating about the center O as number of the compression rotor is more than two.
 12. The rotary positive displacement control system and apparatus as claimed in any preceding claim, further comprising a supplying assembly including a fuel injection means and a spark plug both disposed in the expansion chamber in a radial or axial direction with respect to a seal zone where the expansion rotors intermesh with each other.
 13. The rotary positive displacement control system and apparatus as claimed in any preceding claim, further comprising a fuel injection means disposed in the expansion chamber with respect to a seal zone where the expansion rotors intermesh with each other.
 14. The rotary positive displacement control system and apparatus as claimed in any preceding claim, further comprising a power transmitting assembly including at least a motor pivotally mounted to the transmission assembly.
 15. The rotary positive displacement control system and apparatus as claimed in claim 2, wherein the transmission assembly is coupled with multiple control systems in series in longitudinal direction.
 16. The rotary positive displacement control system and apparatus as claimed in claim 15, wherein each control system includes a fuel injection means and a spark plug both disposed in the expansion chamber in a radial or axial direction with respect to a seal zone where the expansion rotors intermesh with each other.
 17. The rotary positive displacement control system and apparatus as claimed in claim 15, wherein each control system includes a fuel injection means disposed in the expansion chamber in a radial or axial direction with respect to a seal zone where the expansion rotors intermesh with each other.
 18. The rotary positive displacement control system and apparatus as claimed in claim 1 or 9, further comprising a second concavity formed on the compression rotor corresponding to the second intake slot, the second concavity defined by the same way as the first concavity of the lobe of the expansion rotor, an exhaust leading channel defined on the adjoining compression rotor intermeshing with said compression rotor of said second concavity, the exhaust leading channel including a first opening and a second opening communicating with the first opening.
 19. The rotary positive displacement control system and apparatus as claimed in claim 18, wherein an intake leading channel defined on the adjoining expansion rotor intermeshing with said expansion rotor of said concavity, the exhaust leading channel including a first opening and a second opening communicating with the first opening.
 20. The rotary positive displacement control system and

apparatus as claimed in claim 19, wherein the base further has a second buffer chamber corresponding to the second intake slot.

21. The rotary positive displacement control system and apparatus as claimed in claim 20, wherein each of the first and second buffer chambers has two communicating openings. 5
22. The rotary positive displacement control system and apparatus as claimed in claim 21, wherein the first opening of the exhaust leading channel is defined on outer edges of the lobes of the compression rotor, and the second opening is defined on inner regions of the base circle of the compression rotor. 10 15
23. The rotary positive displacement control system and apparatus as claimed in claim 22, wherein the first opening of the intake leading channel is defined on outer edges of the lobes of the expansion rotor, and the second opening is defined on inner regions of the base circle of the expansion rotor. 20
24. The rotary positive displacement control system and apparatus as claimed in claim 23, wherein the second casing having a first extension hole communicating with the second buffer chamber. 25
25. The rotary positive displacement control system and apparatus as claimed in claim 24, wherein the third casing having a second extension hole communication with the second buffer chamber. 30
26. The rotary positive displacement control system and apparatus as claimed in any preceding claim, wherein the compression rotor and the expansion rotor can be arranged in different phase angle. 35
27. The rotary positive displacement control system and apparatus as claimed in claim 18, wherein the compression rotor and the expansion rotor can be arranged in different phase angle. 40

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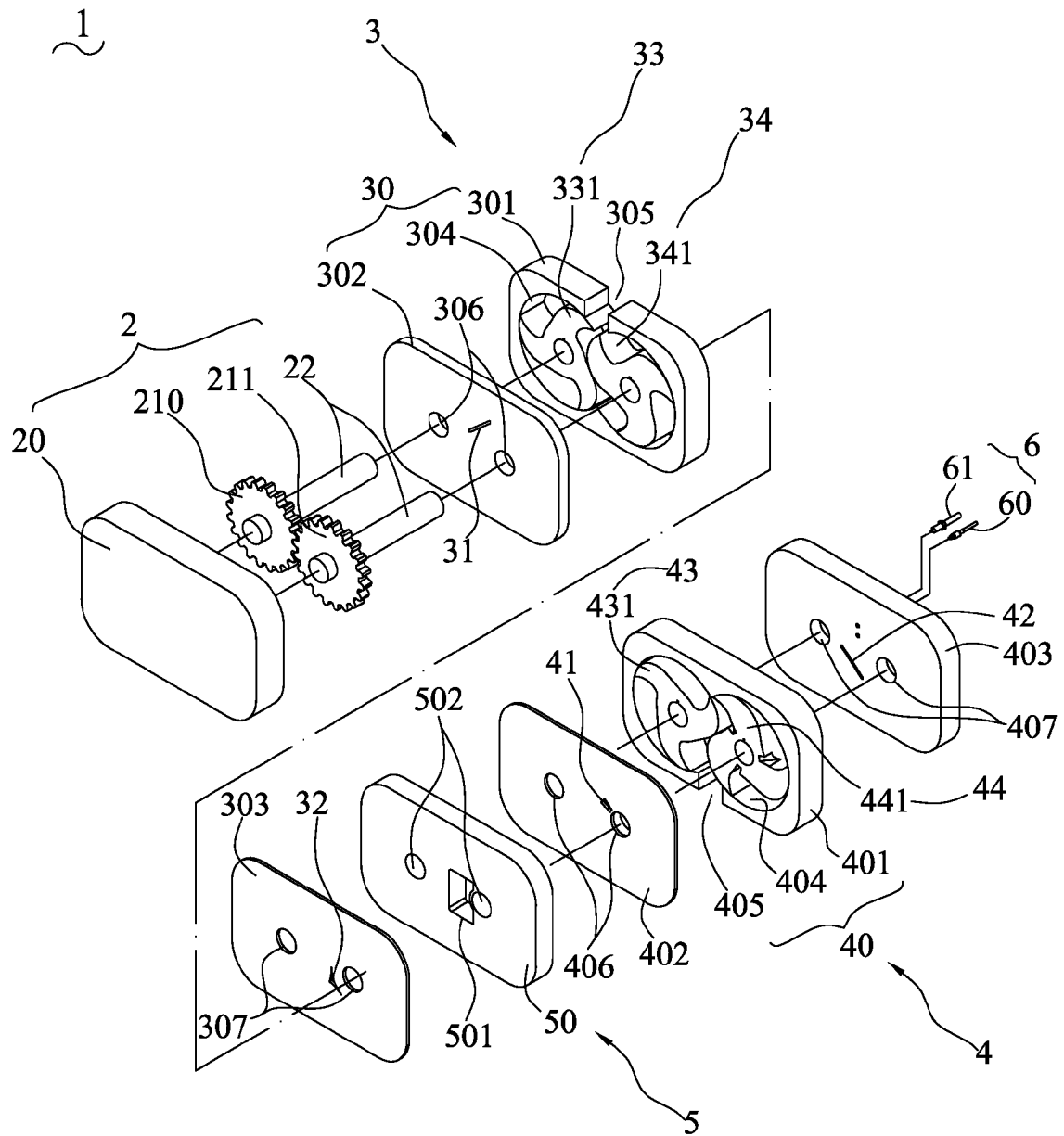


FIG.1

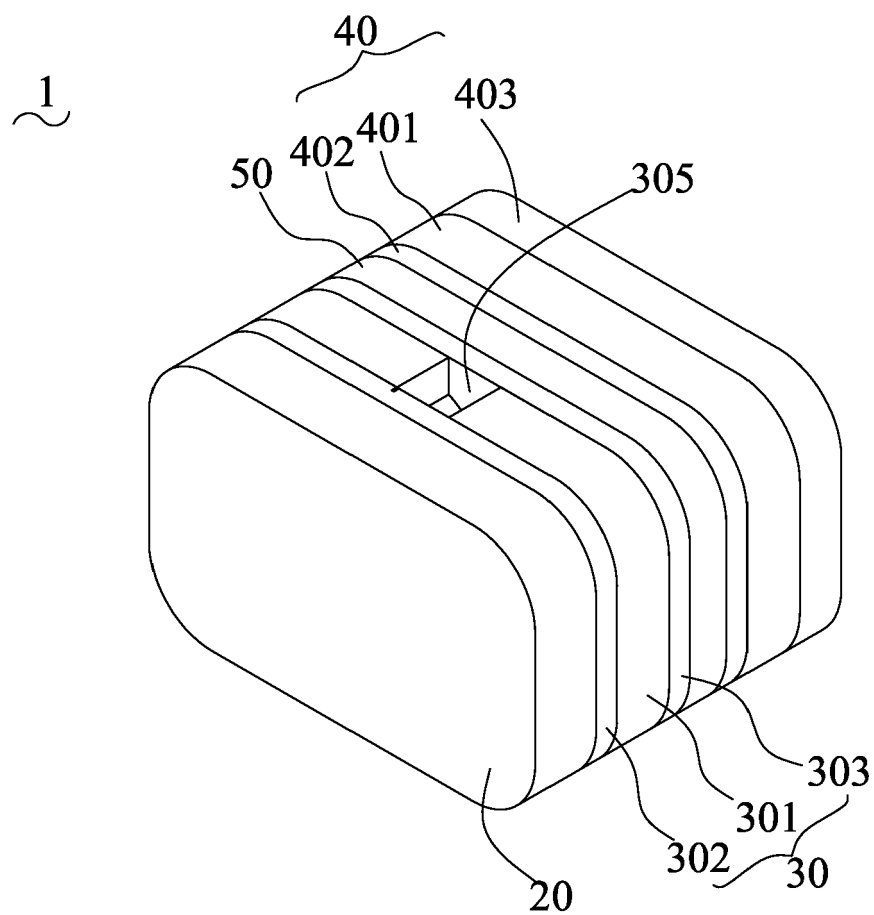


FIG.2

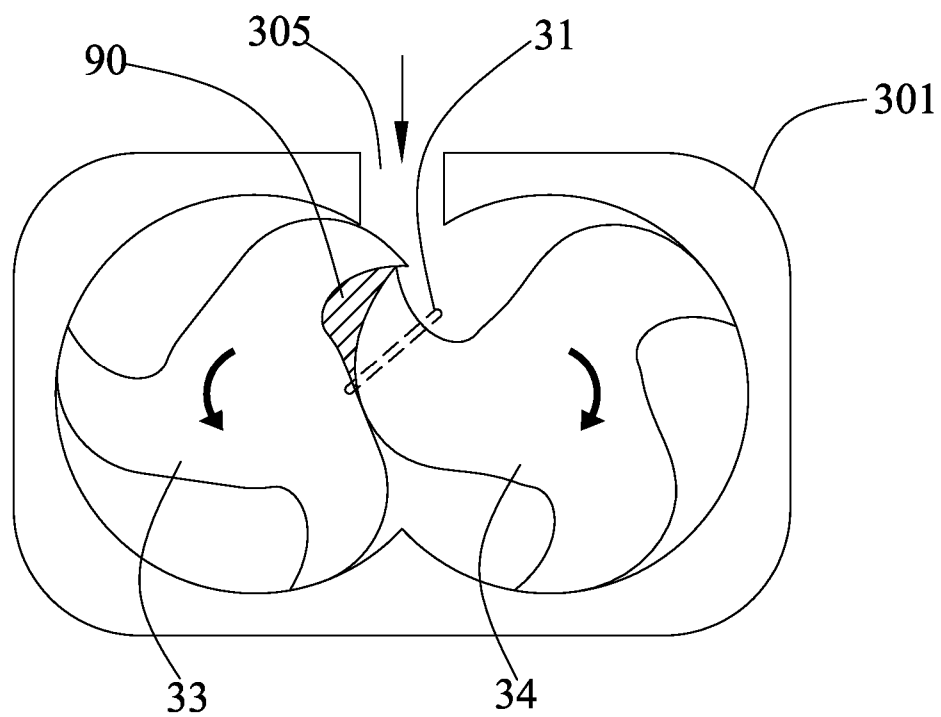


FIG. 3A

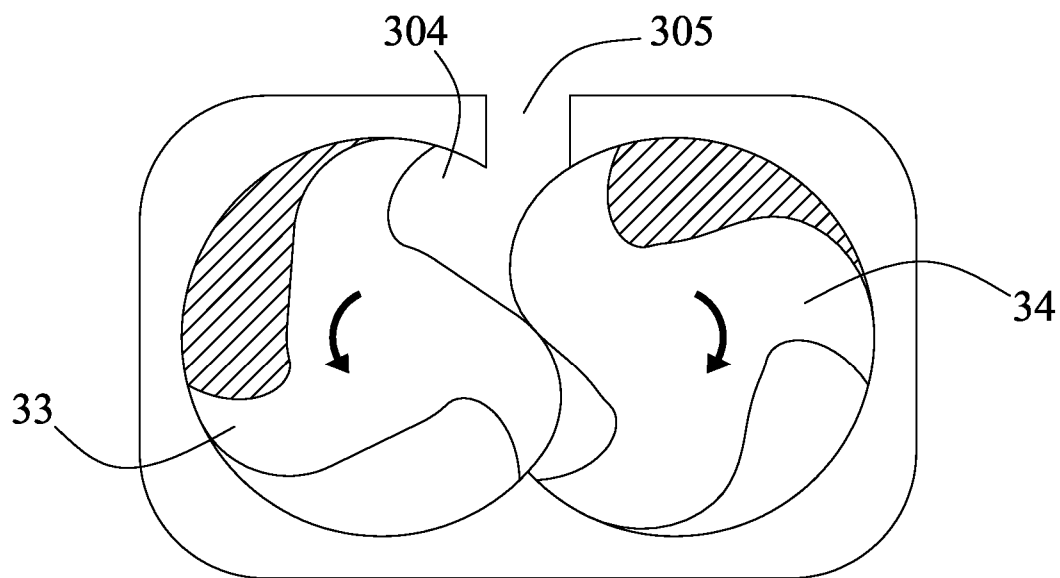


FIG. 3B

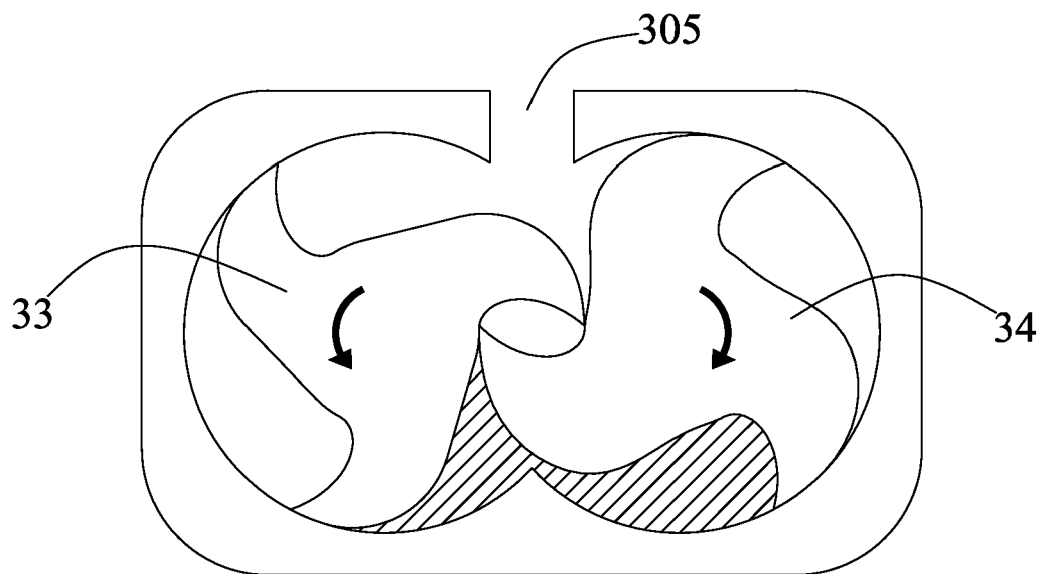


FIG. 3C

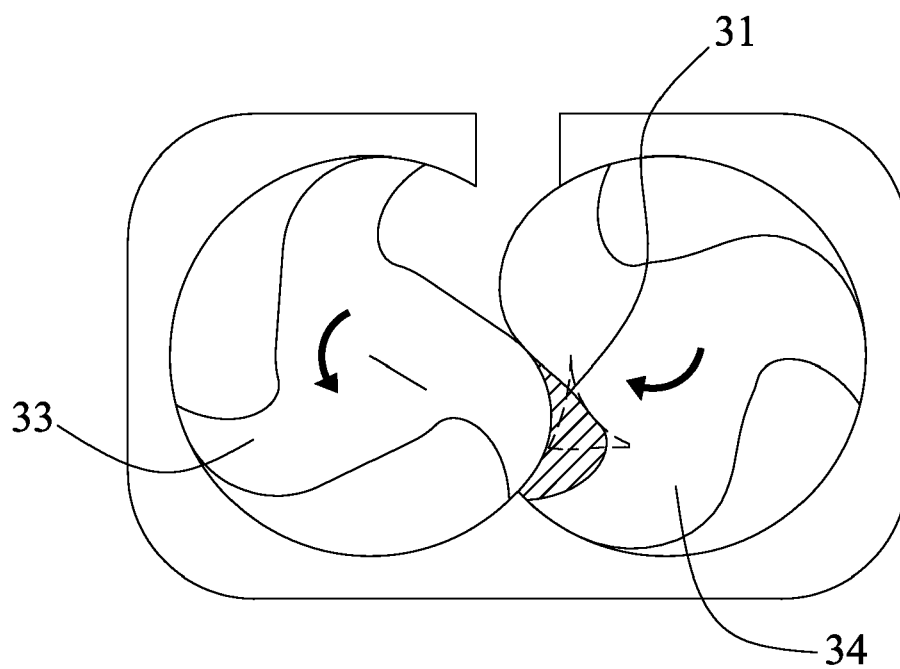


FIG. 3D

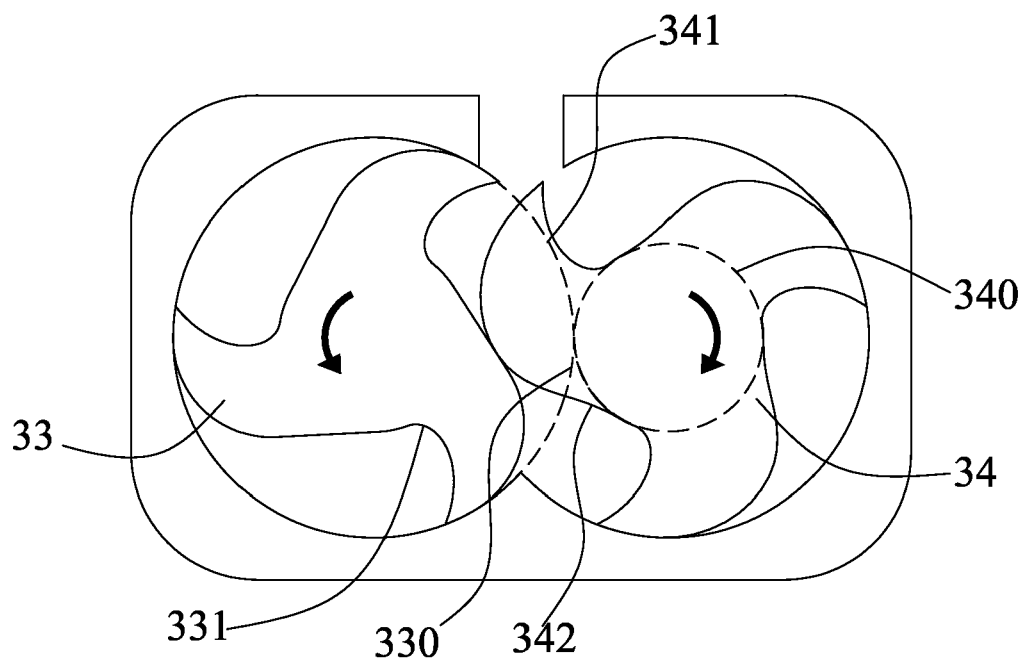


FIG. 3E

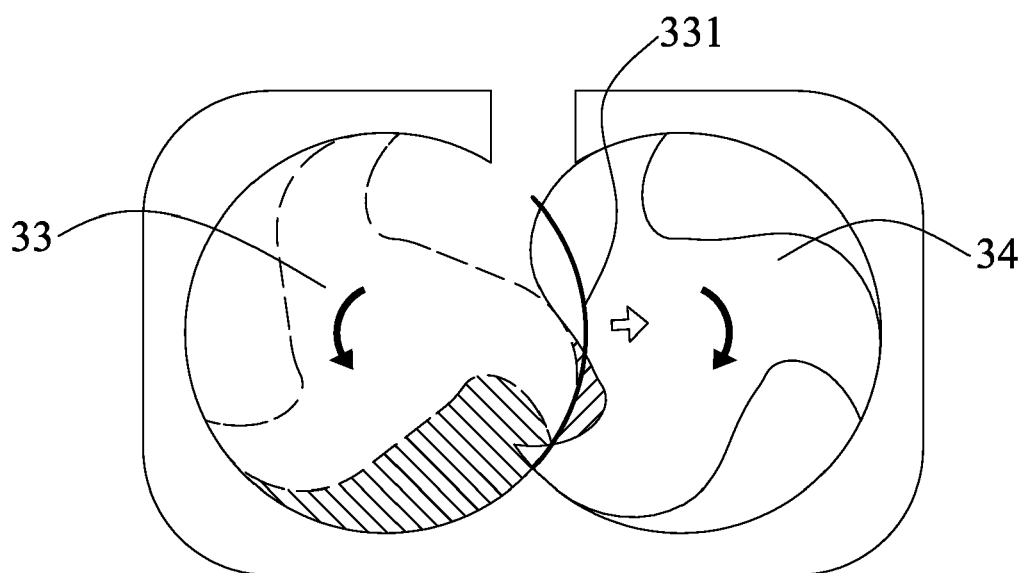


FIG. 3F

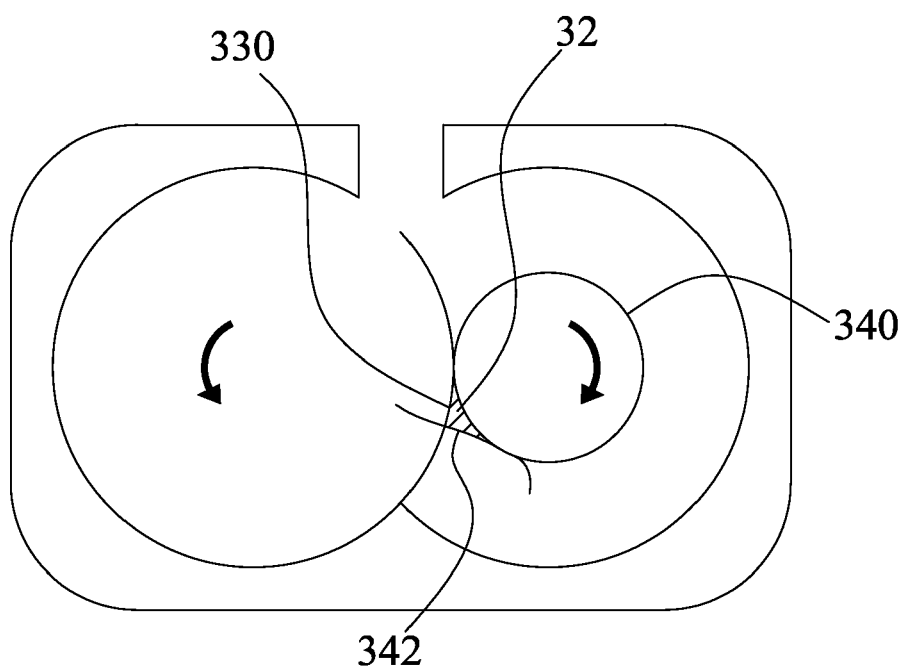


FIG. 3G

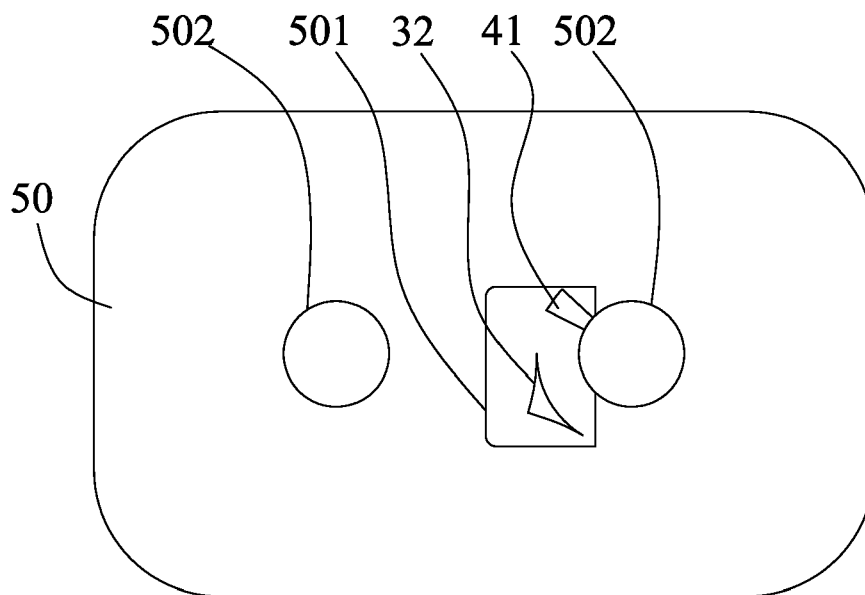


FIG. 3H

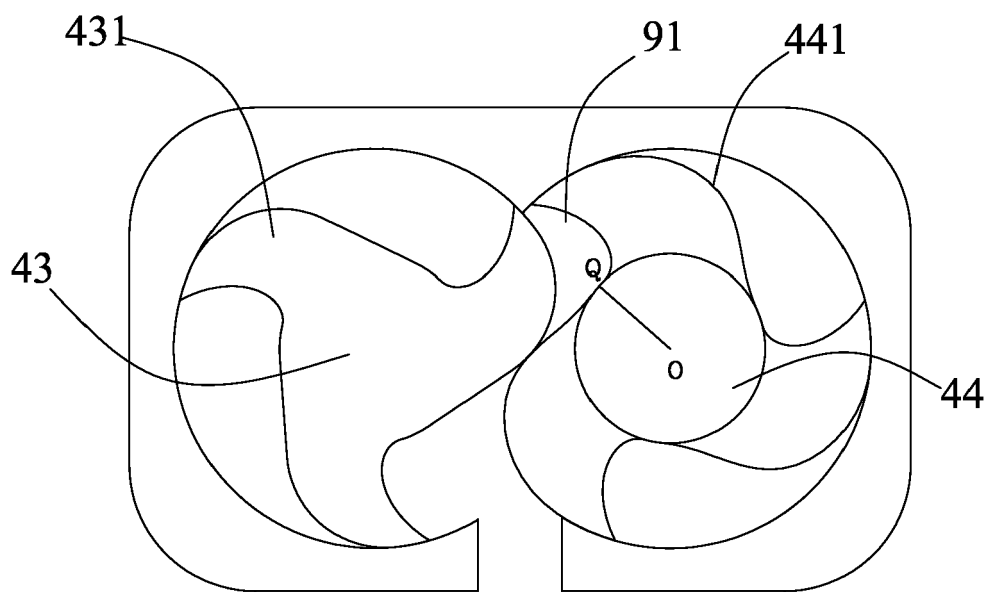


FIG. 4A

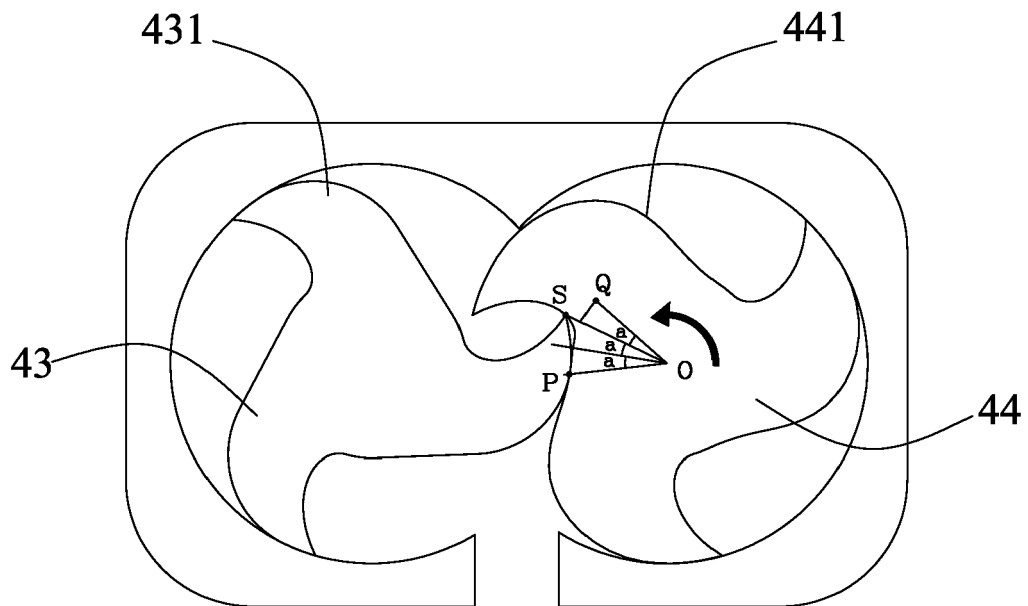


FIG. 4B

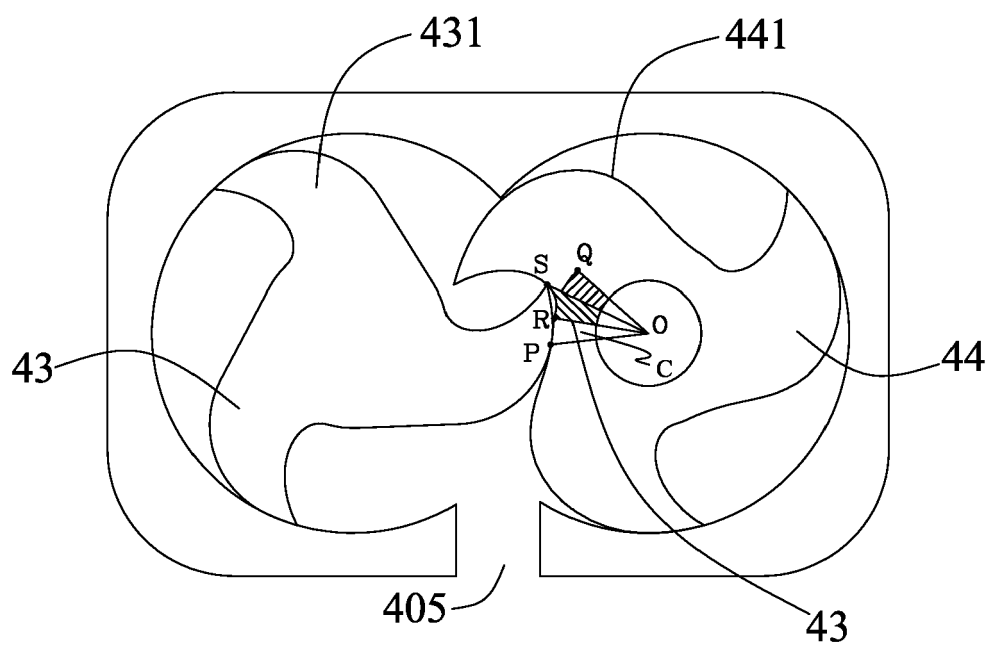


FIG. 4C

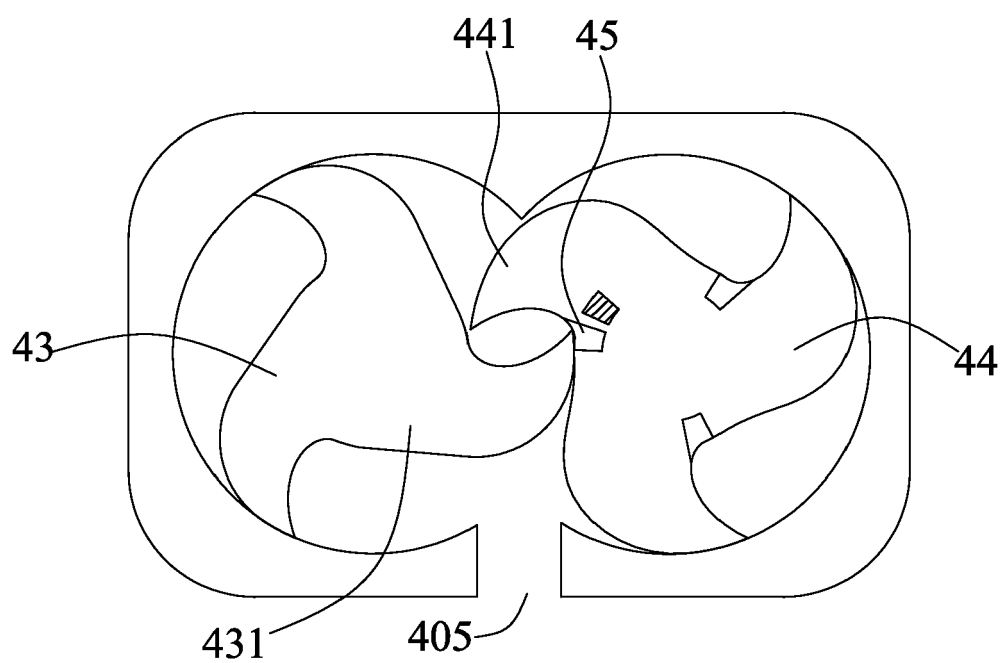


FIG. 4D

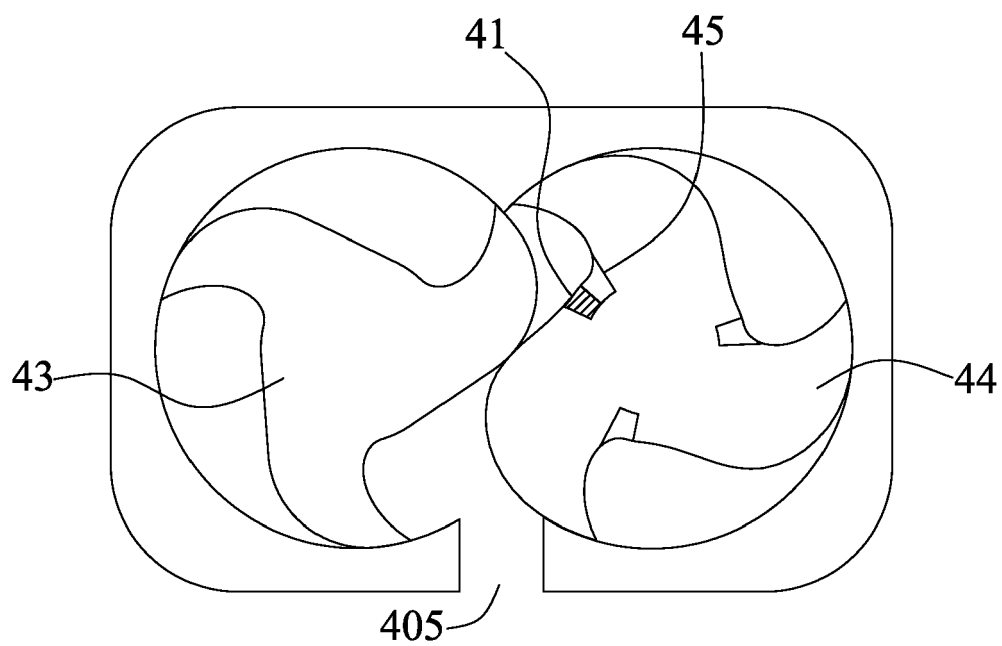


FIG. 4E

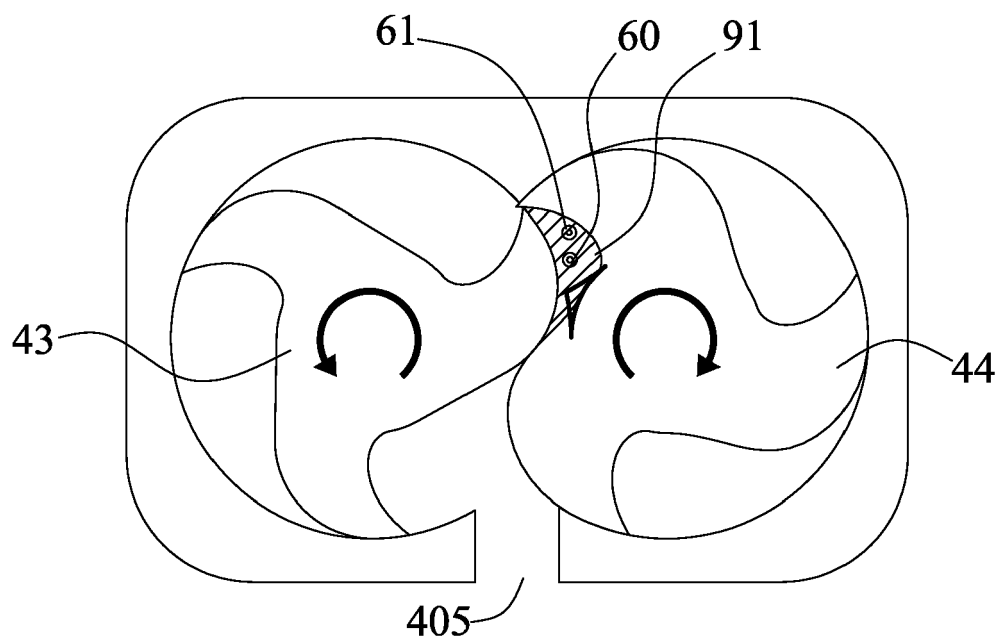


FIG. 4F

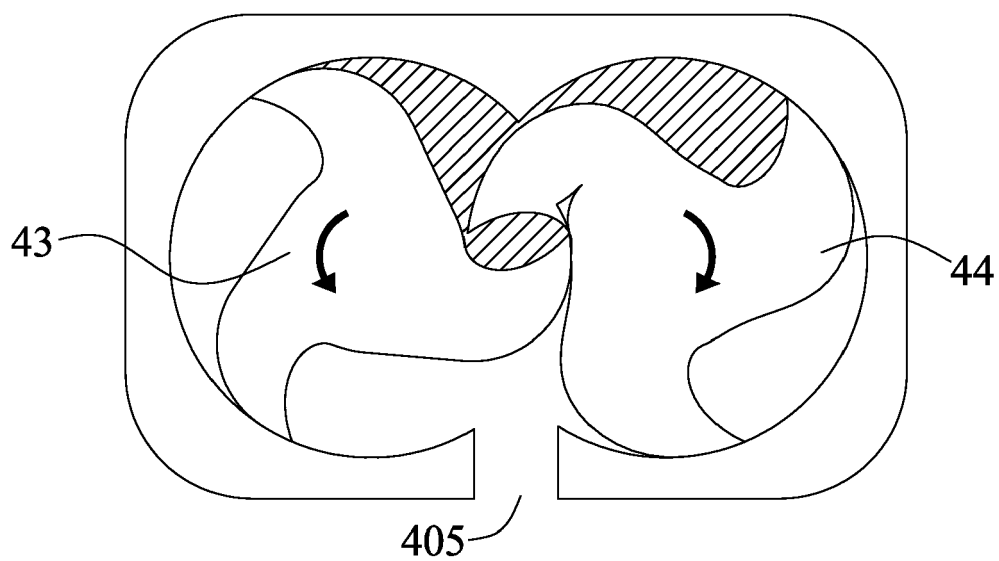


FIG. 5A

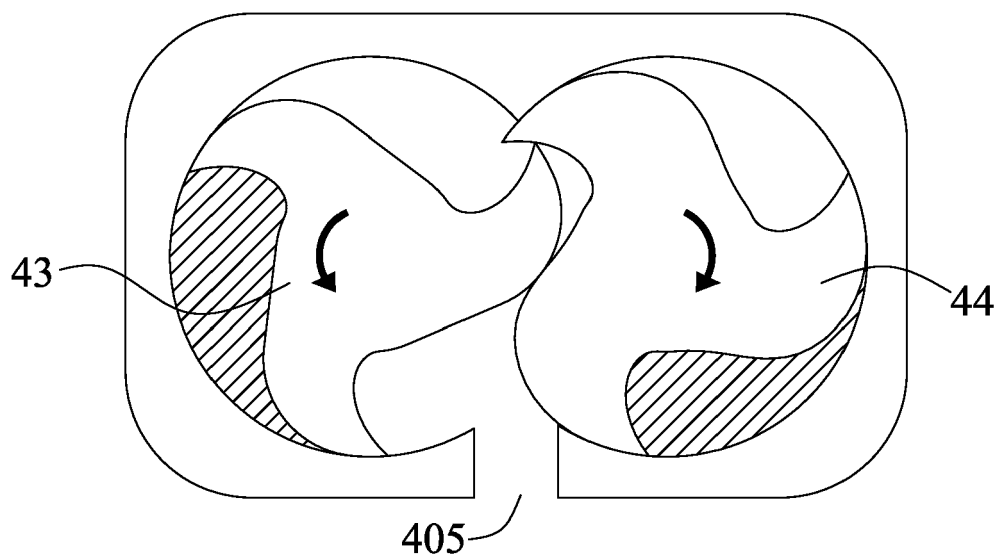


FIG. 5B

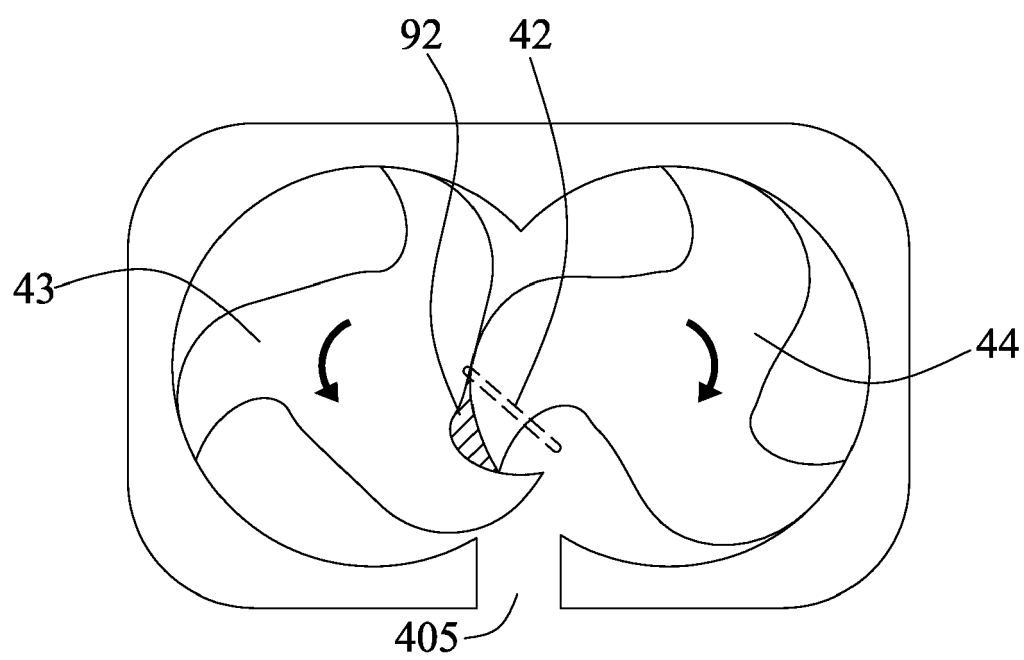


FIG.5C

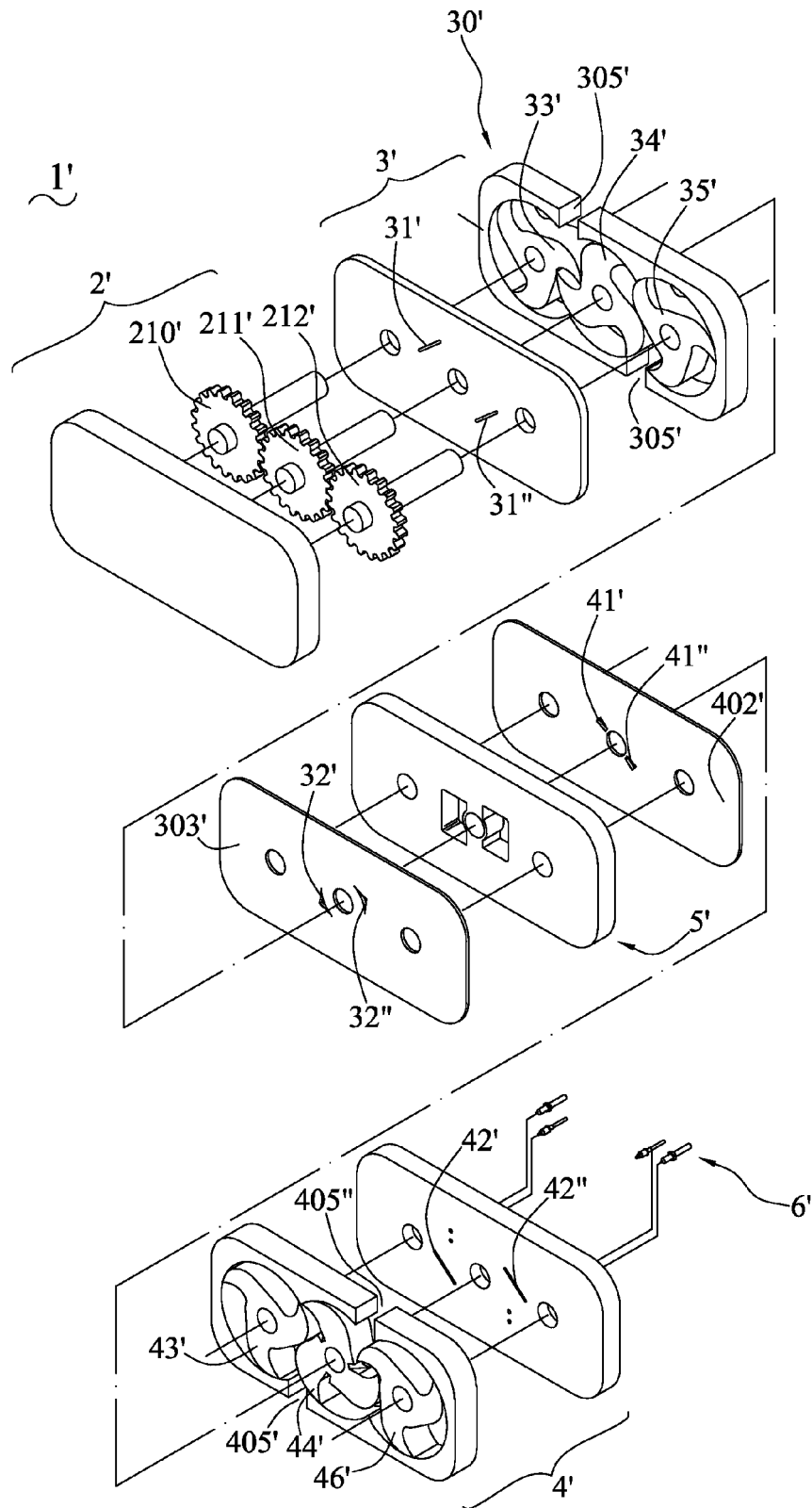


FIG.6

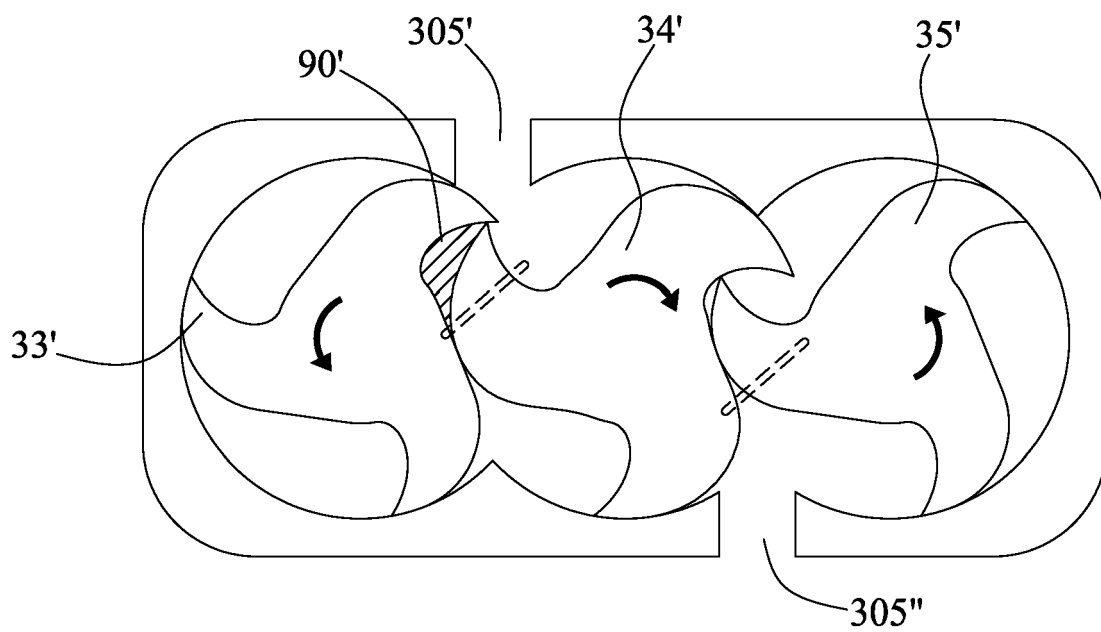


FIG. 7A

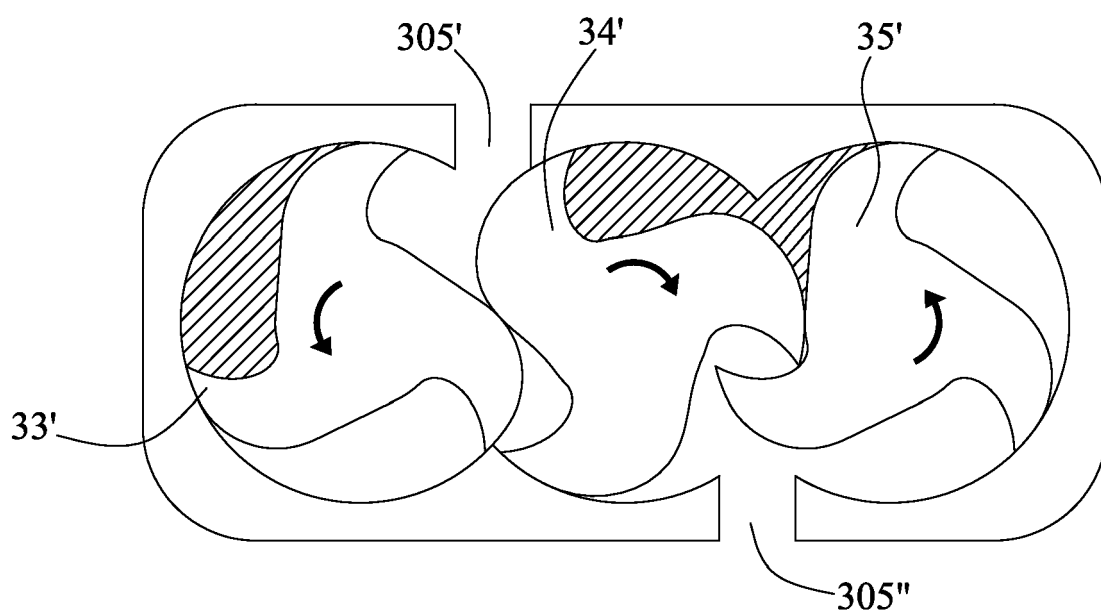


FIG. 7B

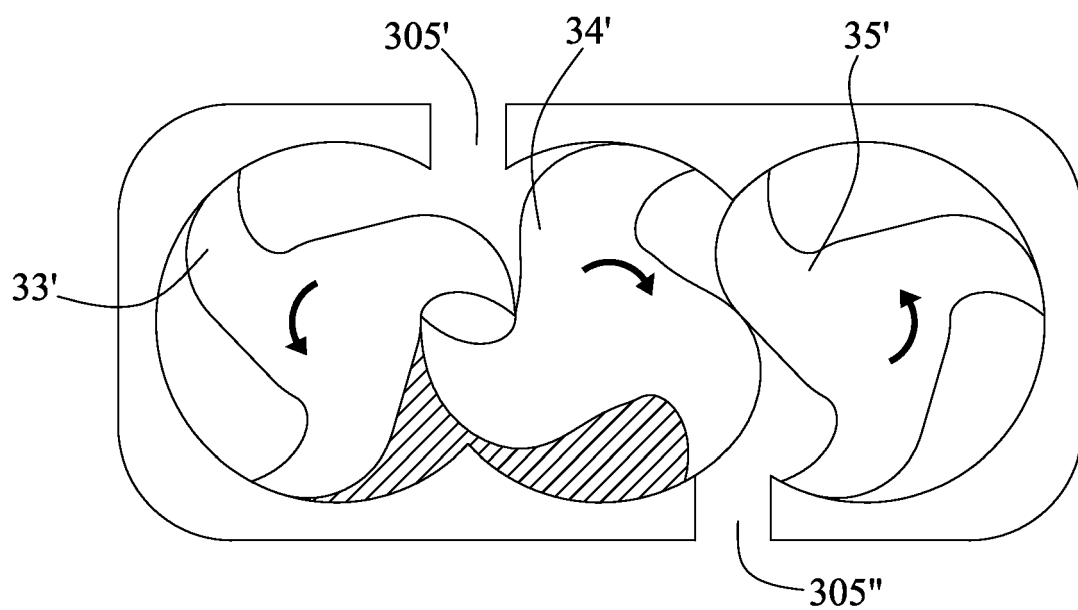


FIG. 7C

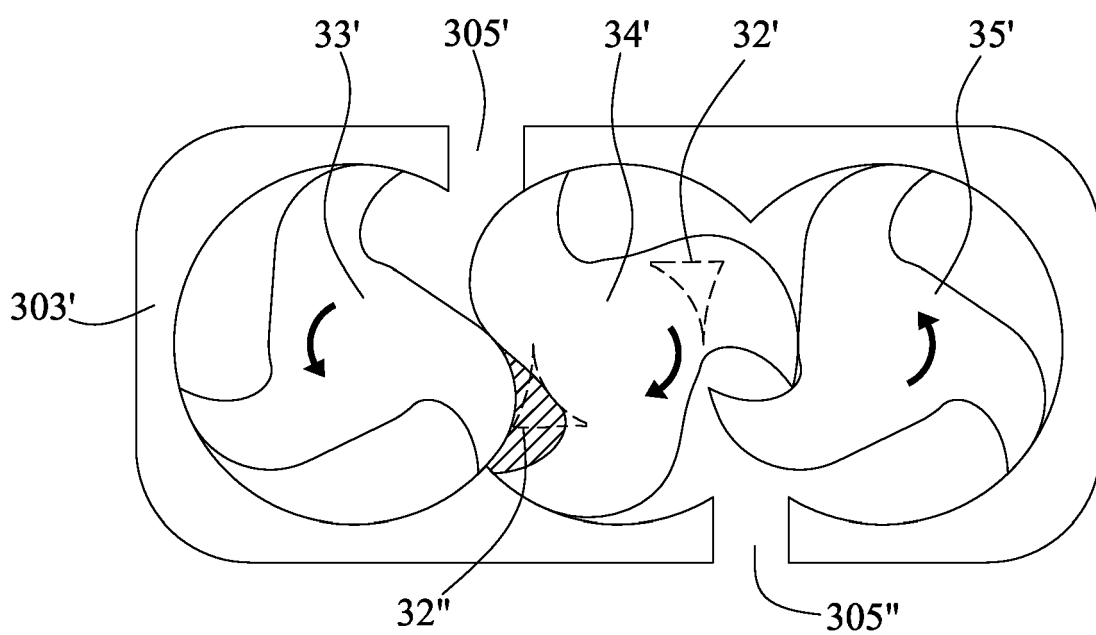


FIG. 7D

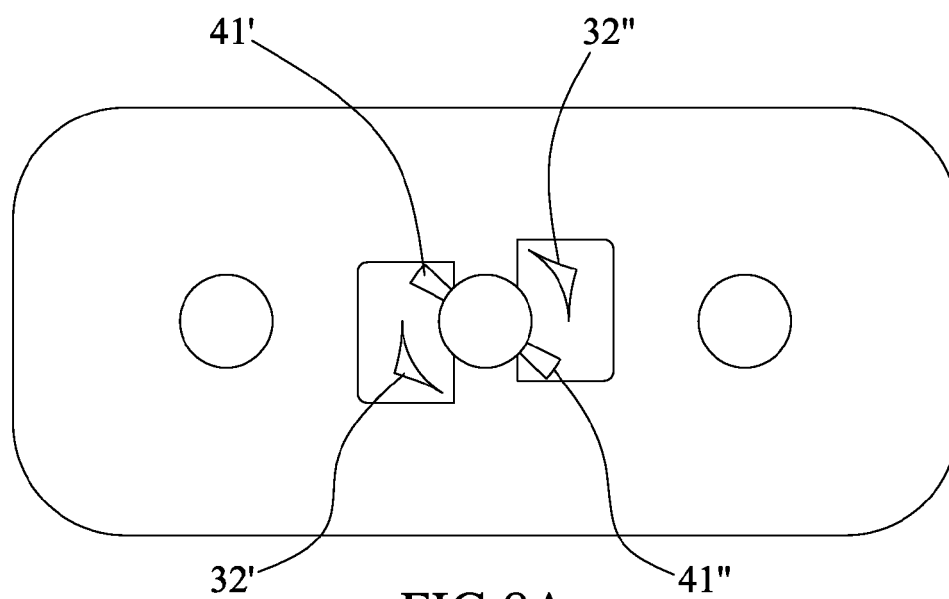


FIG. 8A

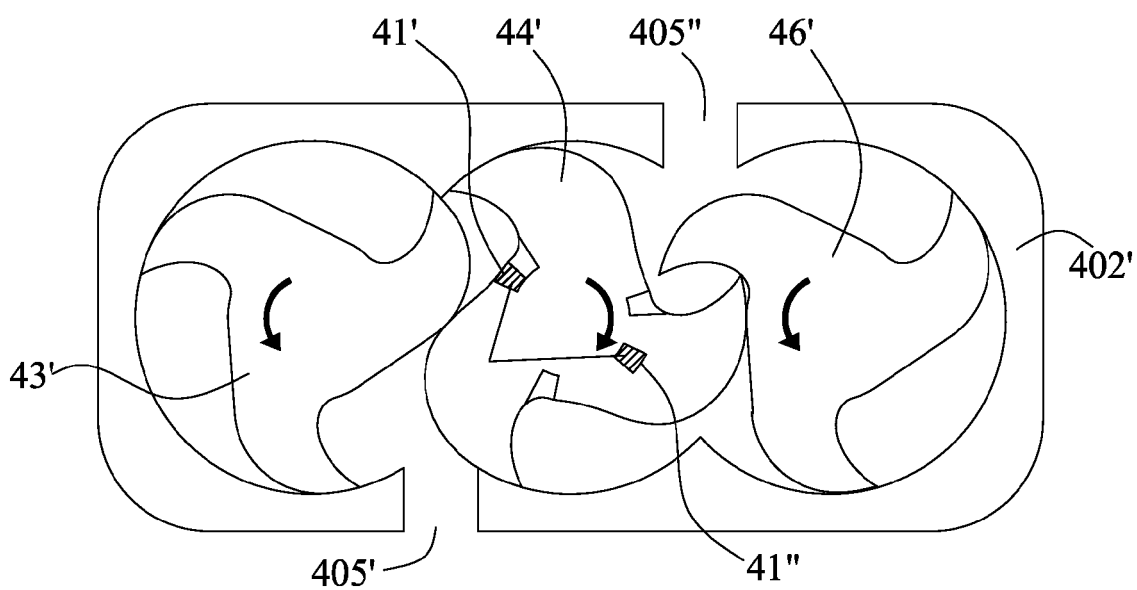


FIG. 8B

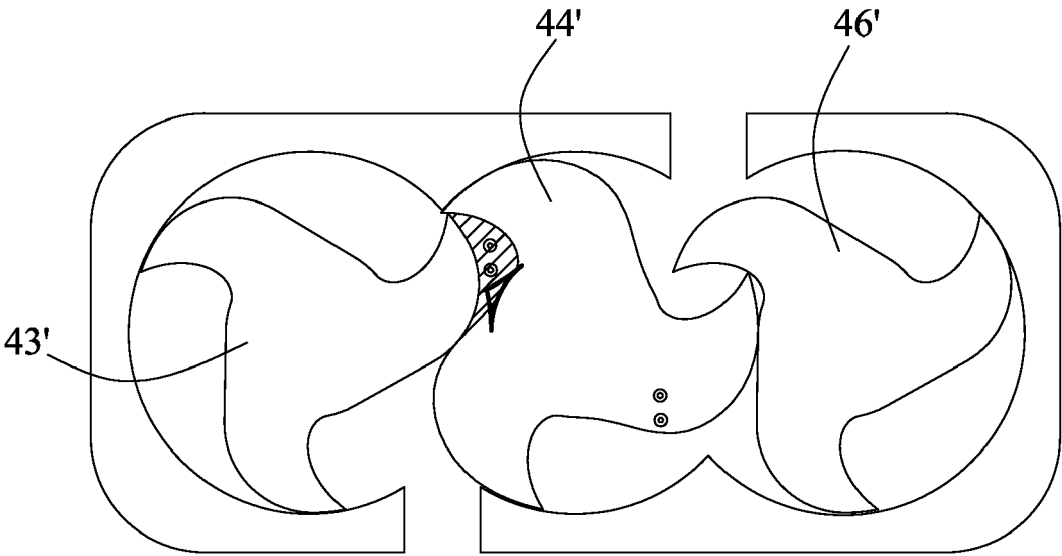


FIG. 8C

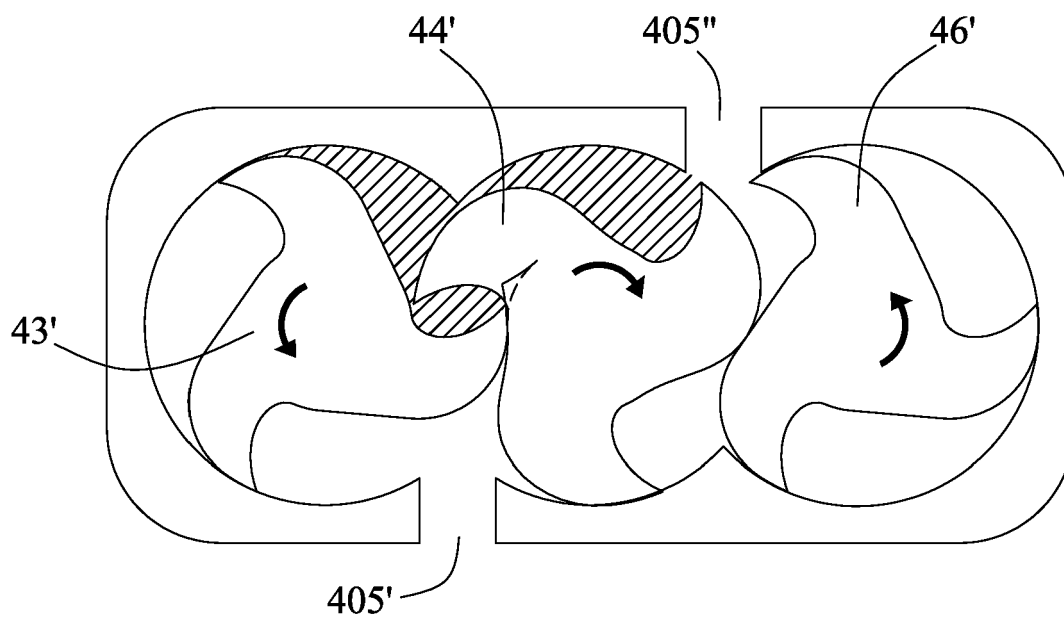


FIG. 9A

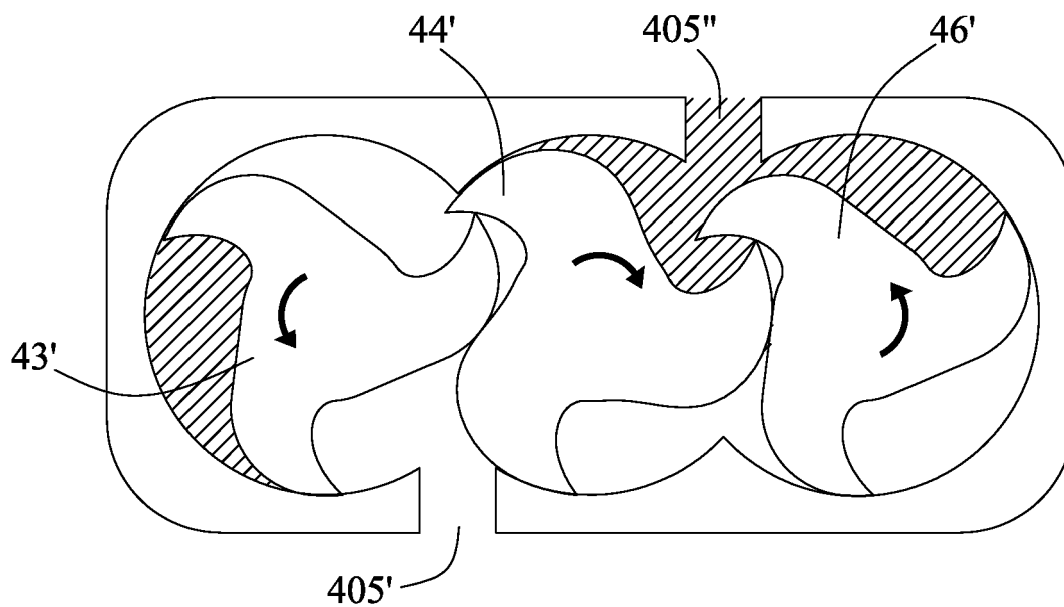


FIG. 9B

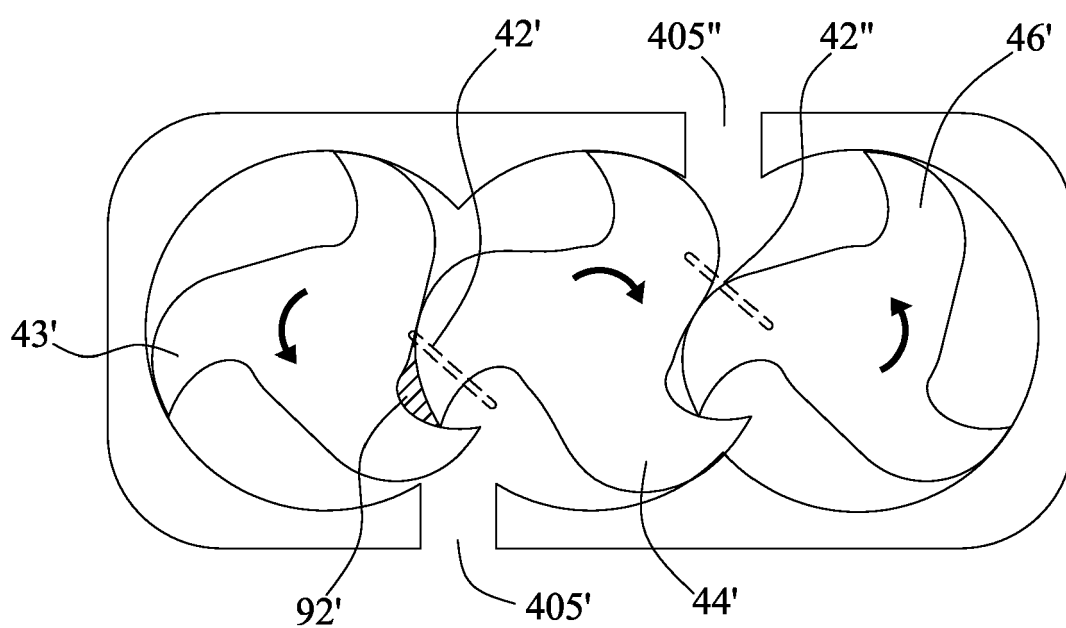


FIG.9C

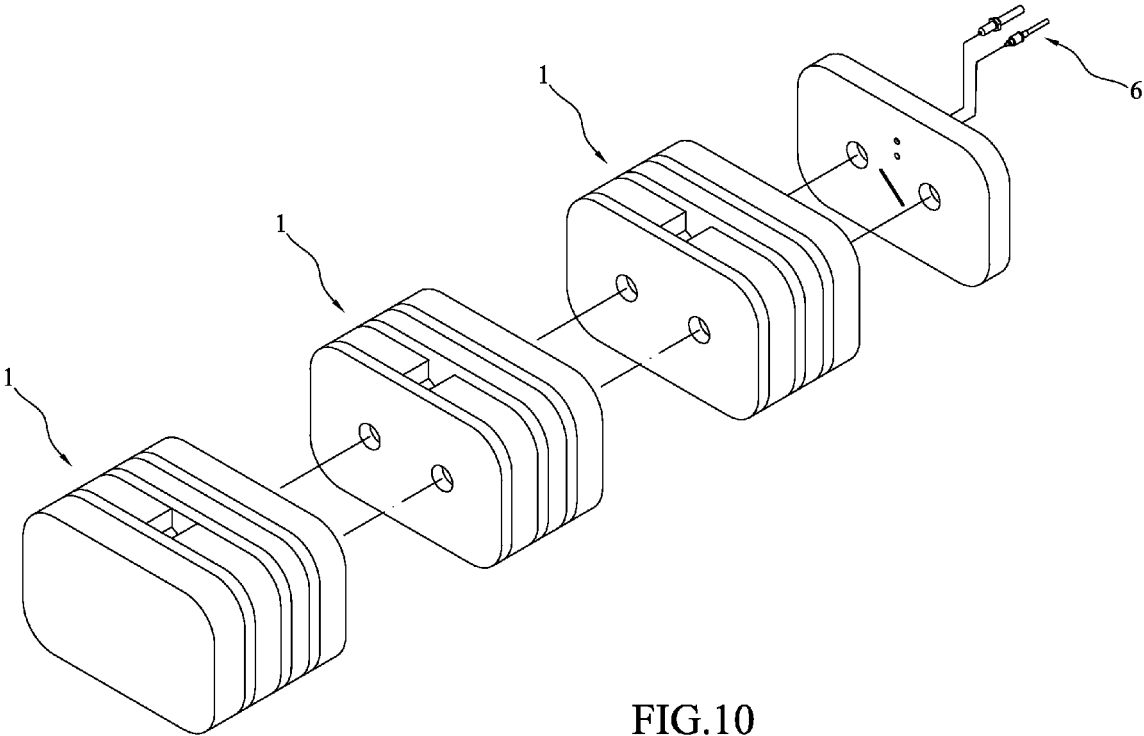


FIG.10

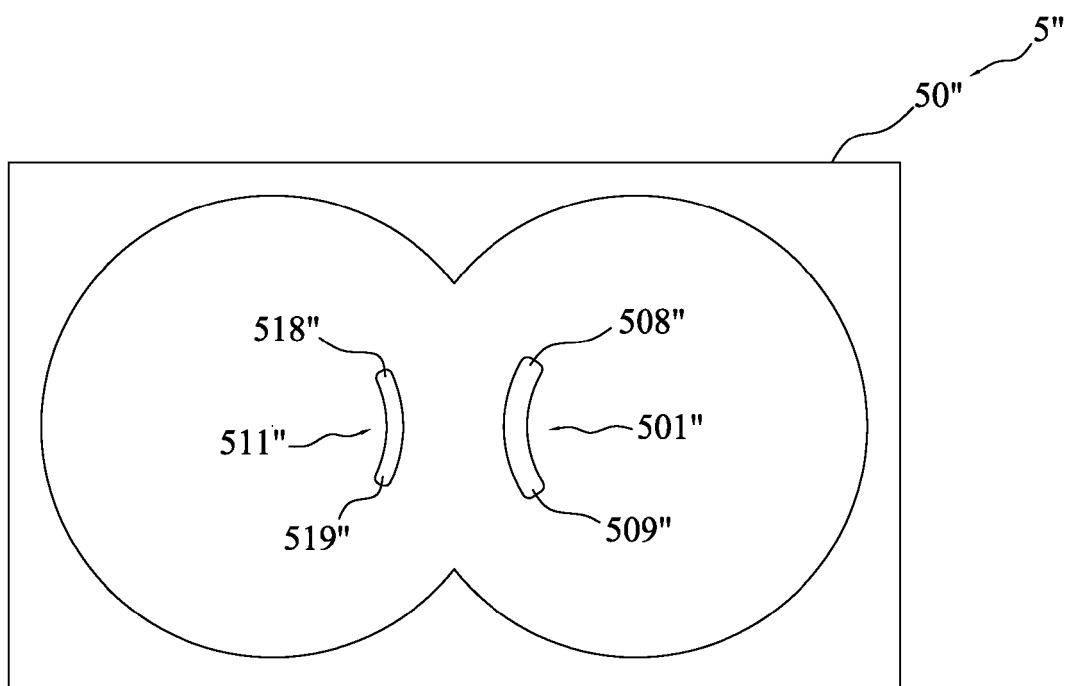


FIG.11 A

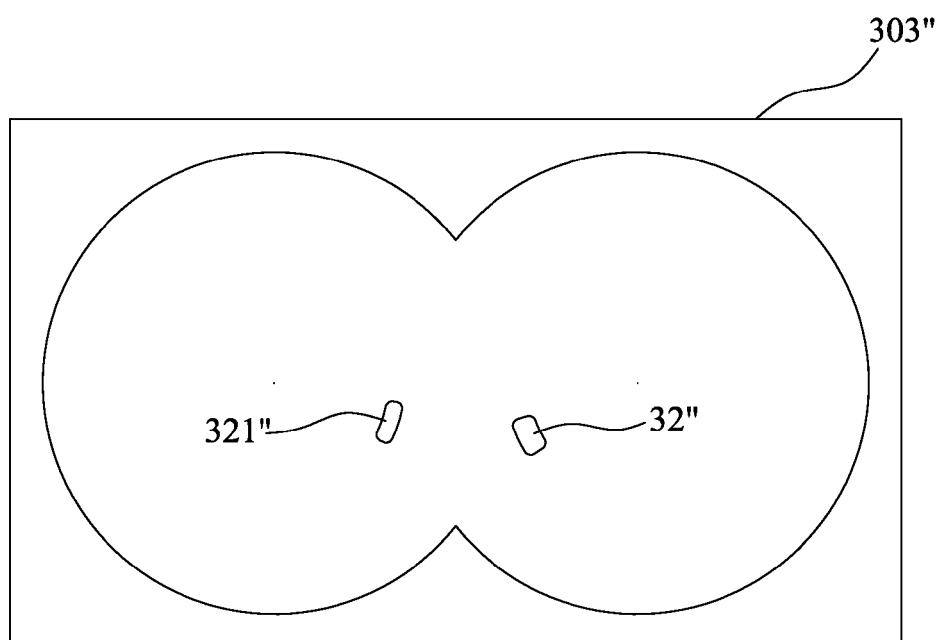


FIG.11B

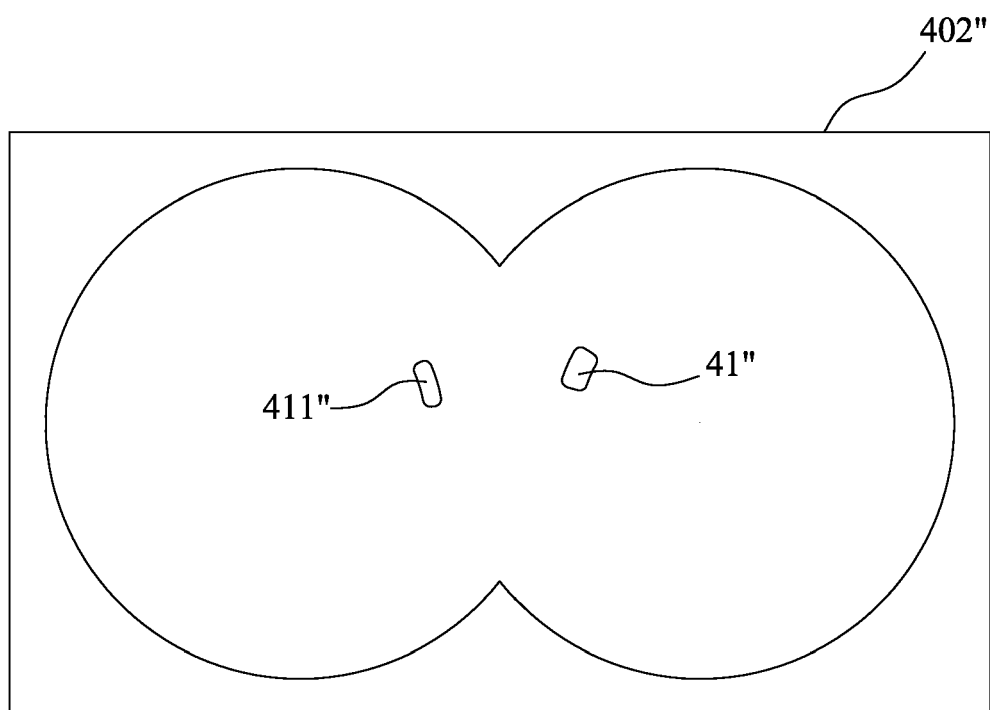


FIG.11C

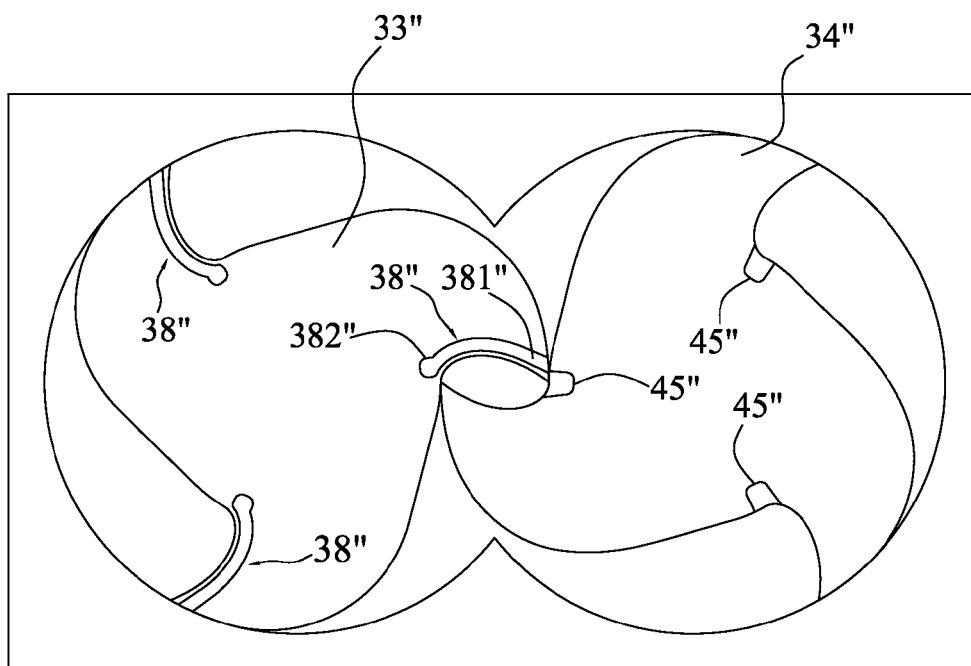


FIG.12

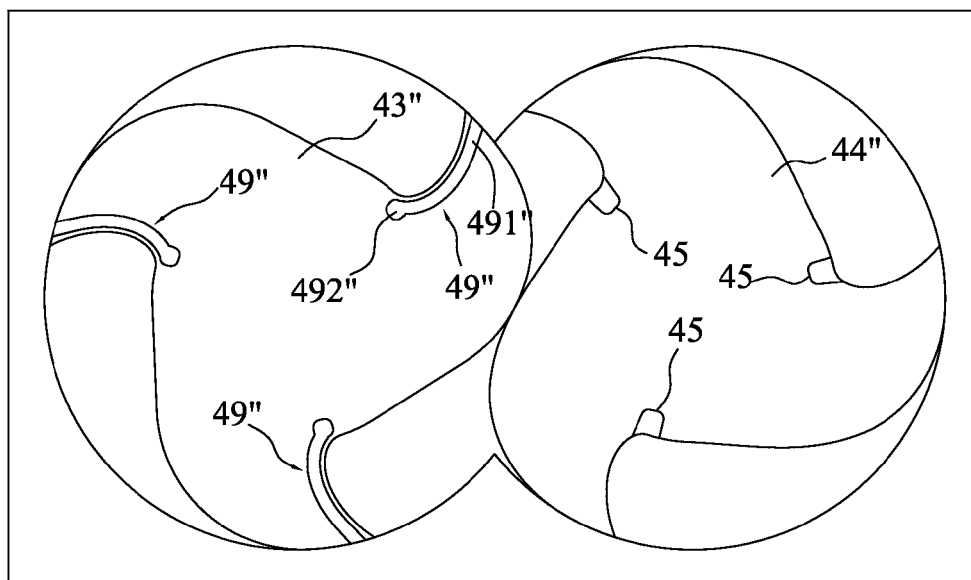


FIG.13

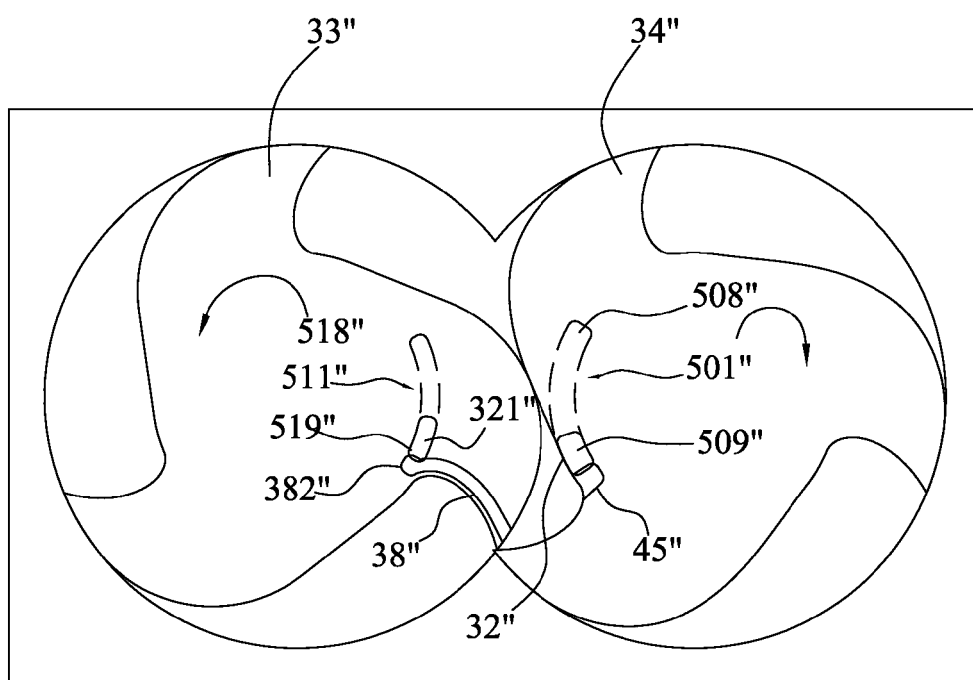


FIG.14A

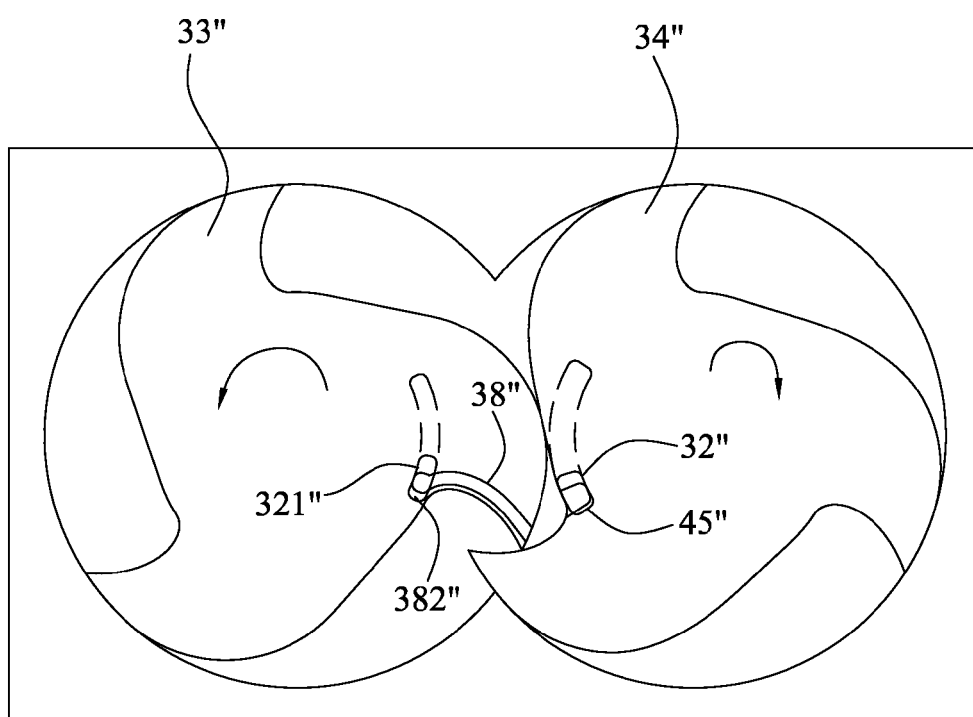


FIG.14B

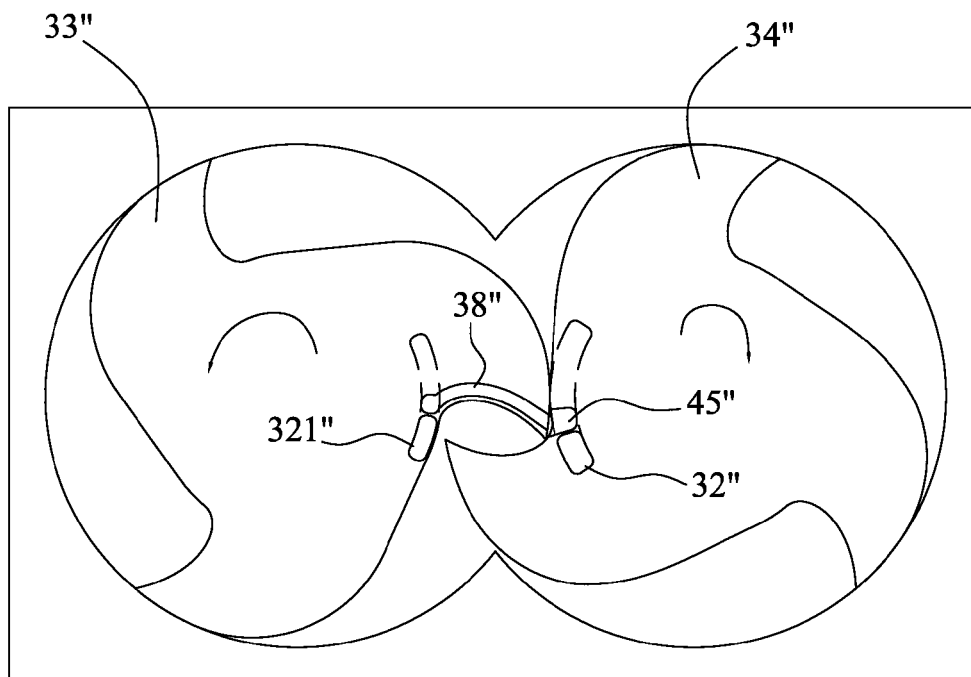


FIG.14C

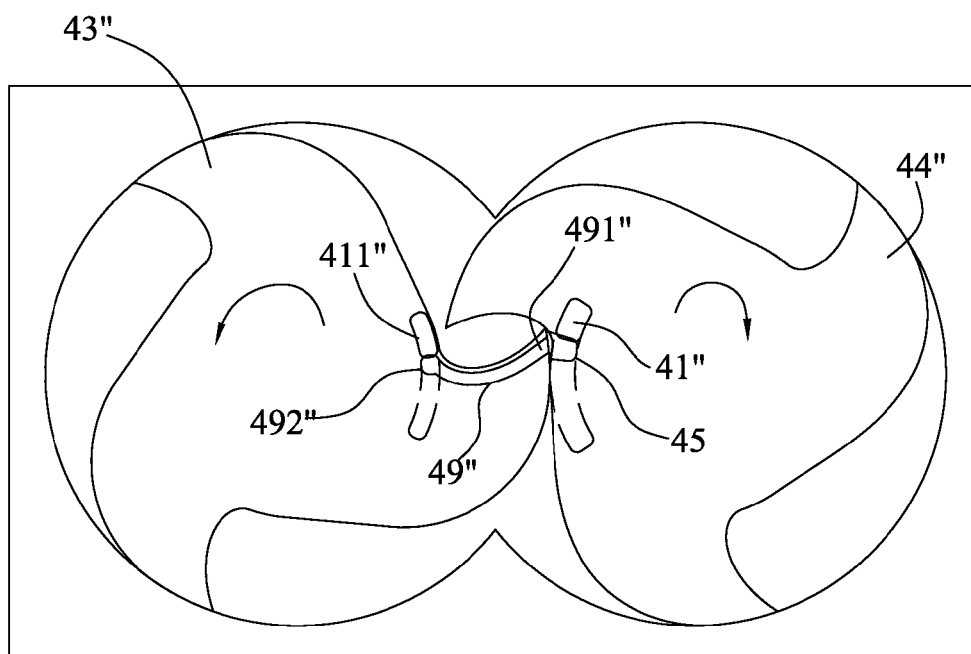


FIG.14D

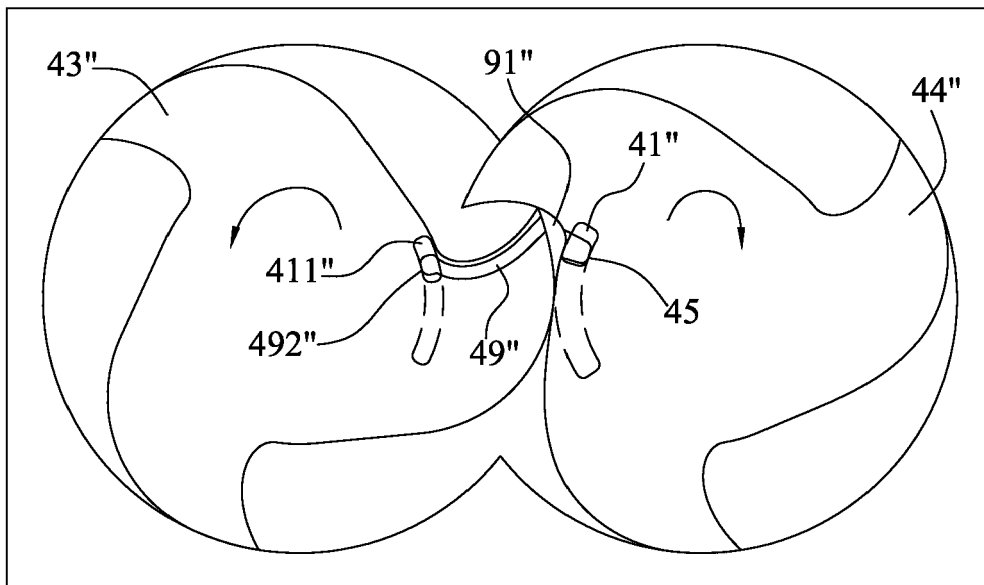


FIG. 14E

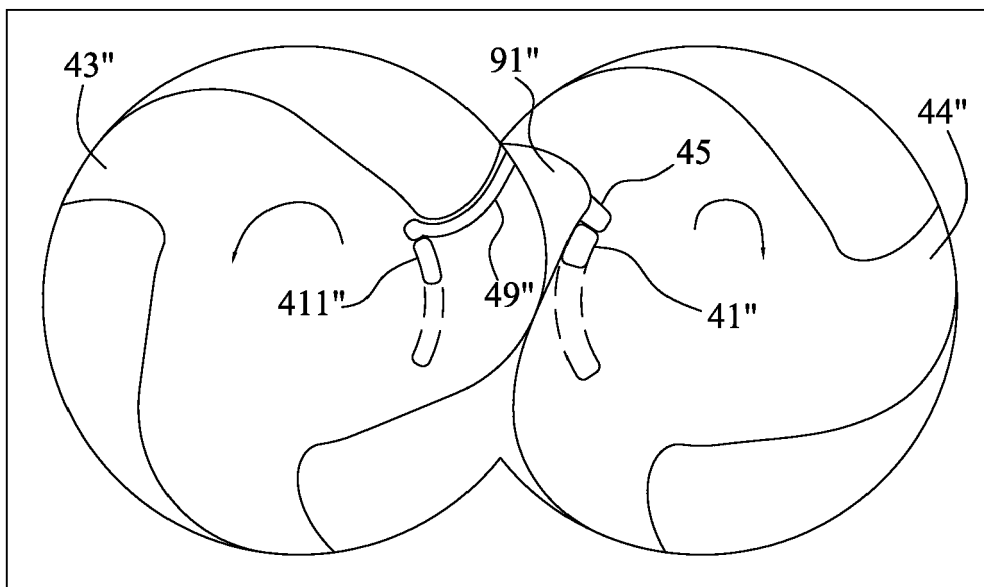


FIG. 14F

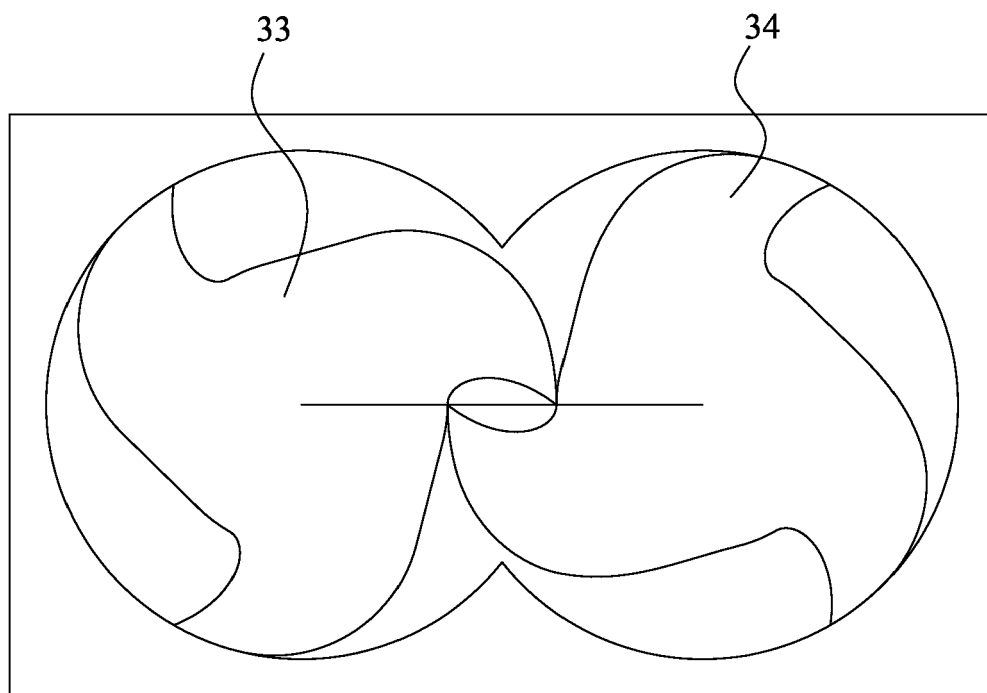


FIG.15A

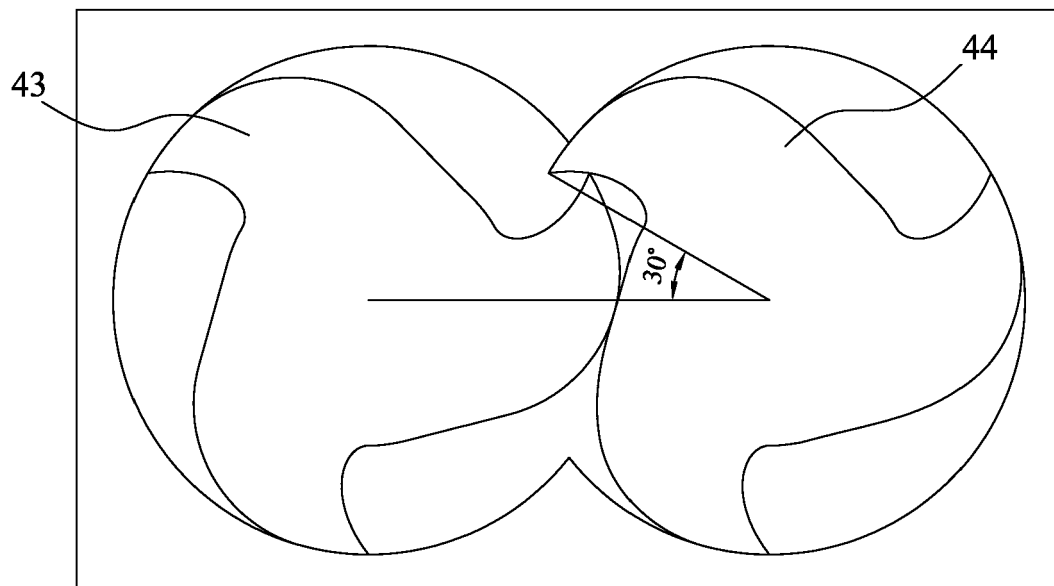


FIG.15B

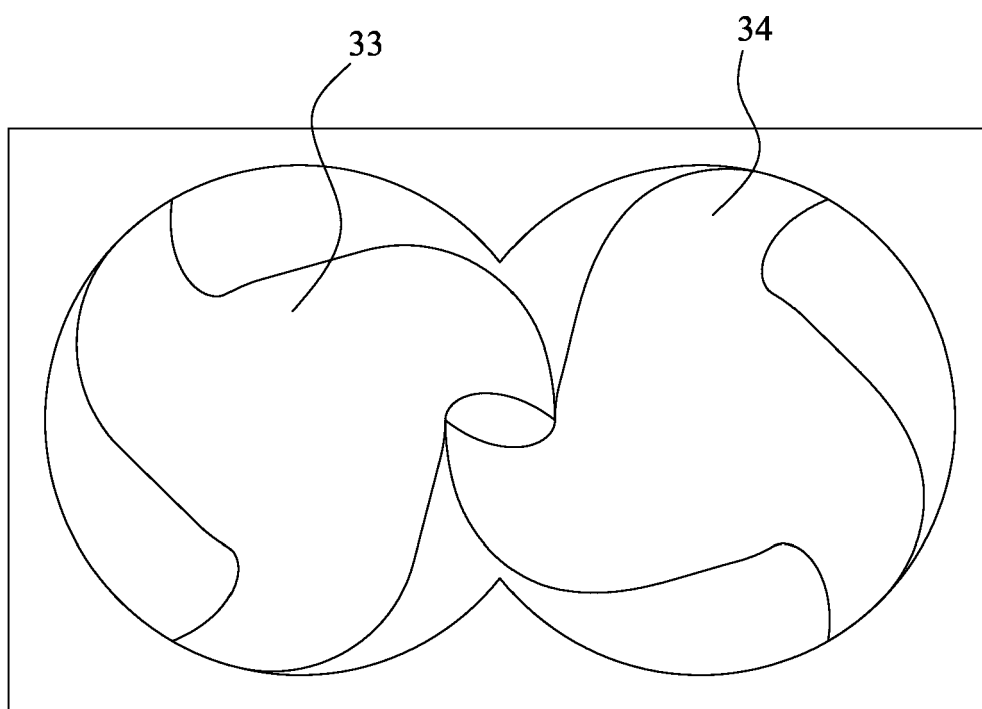


FIG. 16A

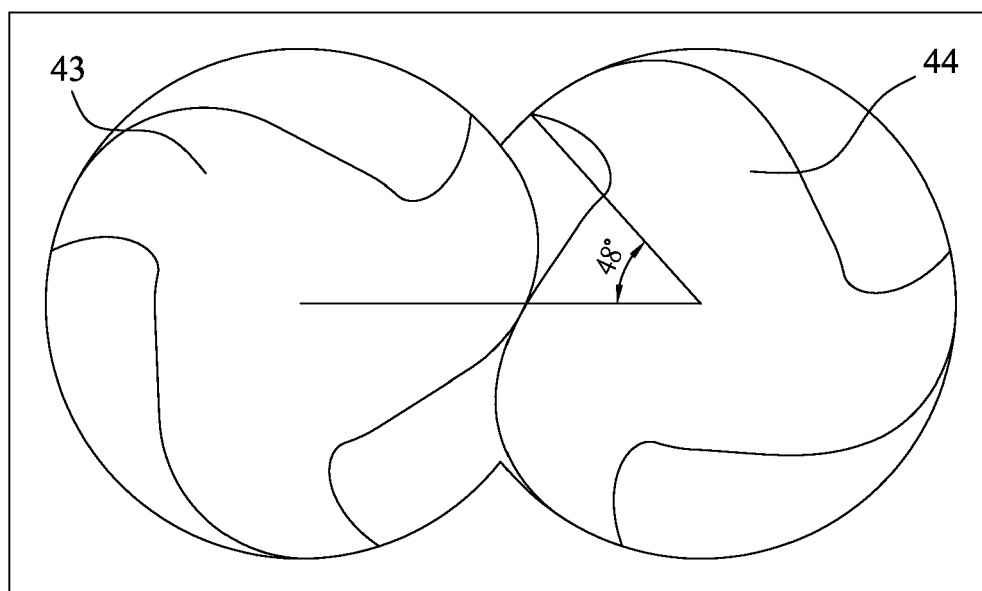


FIG. 16B

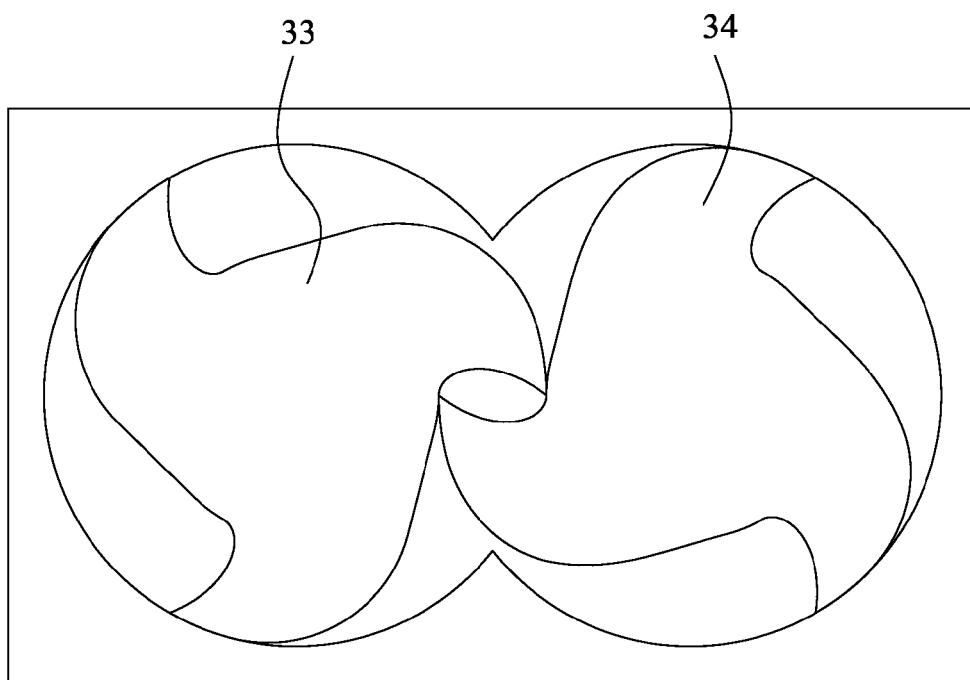


FIG.17A

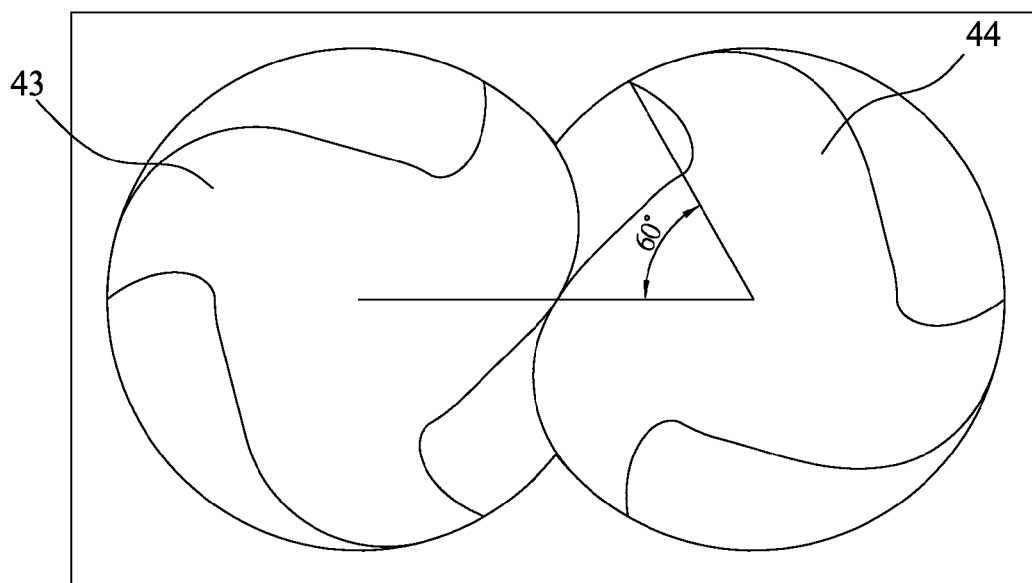


FIG.17B

REFERENCES CITED IN THE DESCRIPTION

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