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Title of Invention

IINTERNAL COMBUSTION ENGINE WITH TUBULAR FUEL INJECTION AND ENHANCED BRAKE PERFORMANCE

Application Information

APPLICATION TYPE	Utility - Provisional Application under 35 USC 111(b)	PATENT #	-
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Documents

TOTAL DOCUMENTS: 4

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
ADS.pdf	8	Application Data Sheet	1226 KB
sb0016pc.pdf	3	Provisional Cover Sheet (SB16)	2723 KB
Jake_Brake_Provisional-APP.TEXT.docx	26	Application body structured text document	3190 KB

Warning: All artifacts (SmartArt, Drawings, Charts, etc) have been replaced with images. Bookmarks were found and have been removed. There may be a lack of antecedent basis in the claims section. Please review and correct if necessary.

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
Binder1.pdf	24	Drawings-only black and white line drawings	4123 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
ADS.pdf	055A08F77442DE9C788DFE5736FE1B6129BB8820795C261AB F988A3FBDAE4AF2070FE9C2D7EB13D3A328B7A55C6E871E7 F13F6E000CA61E473F9080E22264F94
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INTERNAL COMBUSTION ENGINE WITH TUBULAR FUEL INJECTION AND ENHANCED BRAKE PERFORMANCE

FIELD OF DISCLOSURE

An arrangement of valves in an internal combustion engine for permit air to enter a cylinder and exhaust gases to exit the cylinder, or to feed a fuel injector, and can also act as a compression brake with enhanced performance and improved noise characteristics. In accordance with the disclosure, the valves take the form of a hollow tube having at least one hole, the hollow tube being sandwiched by insulators.

BACKGROUND

[0001] Fig. 1 shows a diagram of an internal combustion engine of the conventional art. This conventional engine includes a crankshaft C, an exhaust camshaft E, an inlet camshaft I, a piston P, a connecting rod R, a spark plug S, inlet and exhaust valves V, and cooling water W.

[0002] During intake, the intake valves are open as a result of the cam lobe pressing down on the valve stem. The piston moves downward increasing the volume of the combustion chamber and allowing air to enter in the case of a CI (compression ignited or diesel) engine or an air fuel mix in the case of SI (spark ignition) engines that do not use direct injection. The air or air-fuel mixture is called the charge in any case.

[0003] During exhaust, the exhaust valve remains open, while the piston moves upward expelling the combustion gases. For naturally aspirated engines, a small part of the combustion gases may remain in the cylinder during normal operation because the piston does not close the combustion chamber completely; these gases dissolve in the next charge. At the end of this stroke of the piston, the exhaust valve closes, the intake valve opens, and the sequence repeats in the next cycle. The intake valve may open before the exhaust valve closes to allow better scavenging.

[0004] In the conventional art, the valves are commonly embodied as mushroom or poppet valves, formed of a stem and a tapered plug on one end of the stem, the stem being fitted to seal a hole in the cylinder in a closed position. A spring normally exerts a force against the stem to hold the plug against a seat of the hole, whereas a mechanical force exerted upon the step against the influence of the spring causes the plug to separate from the seat, causing the valve to open and permit gases to pass by the plug and through the hole. The mechanical force is often provided by a camshaft, rotation of which forces the valve open or permits the valve to close depending on the timing required of the valve.

[0005] Many disadvantages arise from the conventional poppet valves. These valves of a conventional drive train require springs, rockers and a camshaft for operation. These disparate parts are expensive to manufacture, require lubrication and cooling mechanisms, and frequently require maintenance. Also, the movement of these number of parts draw energy from the engine, which detracts from the useful horsepower output of the engine.

[0006] In addition, the timing of the opening and closing of poppet valves is normally strictly dictated by the structure of the cam shaft. Although recent innovations in this mechanism have resulted in some limited variations in the timing of such valve openings and closings in operation, such mechanisms remain complex and expensive, at least partly as a consequence of the underlying mechanics of poppet valves.

[0007] Additional disadvantages arise from the noise generated by compression braking or “Jake Braking” of internal combustion engines, particularly of diesel engines. This type of braking causes an extremely load roaring noise that causes this type of braking to be against the law in many municipalities.

[0008] As a result, there is a need for a valve system for an internal combustion engine that alleviates the disadvantages of valve systems of the conventional art.

SUMMARY

[0009] The following presents a simplified summary of the disclosure in order to provide a basic understanding to those of skill in the art. This summary is not an extensive overview of the disclosure and is not intended to identify key/critical elements of embodiments of the disclosure or to delineate the scope of the disclosure. The sole purpose of this summary is to present

some concepts disclosed herein in a simplified form as a prelude to the more detailed description that is presented later.

[0010] Briefly described, an embodiment of the disclosure pertains to an internal combustion engine assembly, that includes a fixed tubular outer insulator, the fixed tubular outer insulator having a first plurality of fixed holes; a fixed tubular inner insulator, the fixed tubular inner insulator having a second plurality of fixed holes; a rotatable tubular valve between the fixed outer insulator and the fixed inner insulator, the rotatable tubular valve having a plurality of holes in a staggered configuration; a fuel injector connected to each of the first plurality of fixed holes of the fixed tubular outer insulator; and a noise suppression device, wherei when the rotatable tubular valve rotates, fuel is given to only one of said fuel injectors at a time.

[0011] In the disclosure, the noise suppression device can be a turbocharger or supercharger configured to inject air into the internal combustion assembly, a particulate filter placed in an exhaust stream, or a selective catalytic reduction systems placed in an exhaust stream.

[0012] In one embodiment, the outer insulator has a hole corresponding to each cylinder in an engine block, the inner insulator has a hole corresponding to each cylinder in an engine block, the outer insulator has a hole corresponding to each cylinder in the engine block, and each hole in the outer insulator is associated with a lubrication port, and further comprising a timing gear at one end of the rotatable tubular valve. Aclearance between the rotatable tubular valve and each of the outer insulator and the inner insulator is between 0.001 inches and 0.003 inches.

[0013] The disclosure, in part, pertains to a valve and fuel injection system for an internal combustion engine, that includes the internal combustion assembly according to the disclosure; an air inlet assembly including a first hollow tube, at least one first hole in the first hollow tube, the at least one first hole being configured to access an air inlet of a cylinder in an engine block, a first tubular outer insulator outside of the hollow tube, the first outer insulator being fixed to a cylinder head, and a first tubular inner insulator inside of the hollow tube; and an exhaust assembly including a second hollow tube, at least second one hole in the second hollow tube, the at least one second hole being configured to access an exhaust of the cylinder in the engine block, a second tubular outer insulator outside of the second hollow tube, the second outer insulator being fixed to the cylinder head, and a second tubular inner insulator inside of the hollow tube. The outer insulator may have a hole corresponding to each cylinder in an engine block, the inner insulator has a hole corresponding to each cylinder in an engine bloc, and the outer insulator has a hole corresponding to each cylinder in the engine block, and each hole in the outer insulator is associated with a lubrication port. The system can further include a timing gear at one end of the rotatable tubular valve. A clearance between the rotatable tubular valve and each of the outer insulator and the inner insulator can be between 0.001 inches and 0.003 inches.

[0014] The disclosure, in part, pertains to an internal combustion engine that can include a noise suppression device; and a fuel injector assembly, including: an inner tubular injection tube; an entry port in the inner tubular injection tube; an outer tubular injection tube fixed to the inner tubular injection tube, the inner tubular injection tube and the outer tubular injection tube be fixed to a cylinder head; an exit port in the outer tubular injection tube; at least one outlet port in the outer tubular injection tube, each outlet port corresponding to a cylinder of an internal combustion engine; a rotatable tubular air intake valve surrounding the fixed outer and inner tubular injection tubes; and at least one injection port in the rotatable tubular air intake valve, each injection port corresponding to the corresponding cylinder of the internal combustion engine.

[0015] In the disclosure, the noise suppression device can include a turbocharger or supercharger configured to inject air into the internal combustion assembly, a butterfly valve placed in an exhaust stream, a particulate filter placed in an exhaust stream or a selective catalytic reduction systems placed in an exhaust stream. In an aspect, the inner tubular injection tube and the outer tubular injection tube are fixed to each other with threads, the exit hole is configured so that fuel is recirculated back to a fuel tank, fuel is pressurized between the inner tubular injection tube and the outer tubular injection tubes, the entry port is a hole or louver, and the exit port is a hole or a louver.

[0016] In an aspect, the inner tubular injection tube and the outer tubular injection tube are fixed to each other with threads, the exit hole is configured so that fuel is recirculated back to a fuel tank, fuel is pressurized between the inner tubular injection tube and the outer tubular injection tubes, the entry port is a hole or louver, and the exit port is a hole or a louver. A timing gear fixed to one end of rotatable tubular air intake valve.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The present disclosure will now be described more fully hereinafter with reference to the accompanying drawings, in which embodiments of the disclosure are shown. However, this disclosure should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the disclosure to those skilled in the art. Like numbers refer to like elements throughout.

[0018] Fig. 1 shows an internal combustion engine of the conventional art.

[0019] Fig. 2 shows an engine with a valve assembly according to an embodiment of the present disclosure.

[0020] Fig. 3 shows details of the rotary valve of an embodiment of the present disclosure.

[0021] Fig. 4 shows an engine combustion cycle of an embodiment of the present disclosure.

[0022] Fig. 5 shows a small engine application of an embodiment of the present disclosure.

[0023] Fig. 6 shows a front and side view of a six cylinder engine according to an embodiment of the present disclosure.

[0024] Fig. 7 shows a valve assembly that includes a compression release engine brake according to an embodiment of the present disclosure.

[0025] Fig. 8 shows a valve and a compression release brake system for a six cylinder diesel engine according to an embodiment of the present disclosure.

[0026] Fig. 9 shows details of a compression release engine brake according to an embodiment of the present disclosure.

[0027] Fig. 10 shows operating positions of a compression release engine brake according to an embodiment of the present disclosure.

[0028] Fig. 11 shows engine oil recirculation.

[0029] Fig. 12 shows lubrication with oil supply ports.

[0030] Fig. 13 shows engine lubrication at the top of the engine.

[0031] Fig. 14 shows the engine lubrication process for the engine brake.

[0032] Fig. 15 shows a fuel injector system of the related art.

[0033] Fig. 16 shows a cross sectional view of a fuel injector valve of the disclosure.

[0034] Fig. 17 shows views of the fuel injector system of the disclosure and its mounting in an internal combustion engine.

[0035] Fig. 18 shows views of the fuel injector valve of the disclosure mounted alongside inlet and exhaust valves of the disclosure.

[0036] Fig. 19 shows cross-sectional views of the fuel injector valve of the disclosure mounted alongside inlet and exhaust valves of the disclosure, and gas flow in the cylinder.

[0037] Fig. 20 shows timed fuel injection according to an embodiment of the disclosure.

[0038] Fig 21 shows central fuel injection according to an embodiment of the disclosure.

[0039] Fig 22 shows another view of central fuel injection according to an embodiment of the disclosure.

[0040] Fig. 23 shows a view of central fuel injection including a louver port according to an embodiment of the disclosure.

[0041] Fig. 24 is a diagram of the noise suppressing options for compression braking of the disclosure.

DETAILED DESCRIPTION

[0042] For simplicity and illustrative purposes, the present disclosure is described by referring mainly to exemplary embodiments thereof. In the following description, numerous specific details are set forth in order to provide a thorough understanding of the present disclosure. However, it will be readily apparent to one of ordinary skills in the art that the present disclosure may be practiced without limitation to these specific details.

[0043] The disclosure relates to a cylinder or engine head with specially designed air intake and exhaust valves formed from a series of hollow tubes, configured to rotate along their respective lengthwise axes, thereby forming smooth bore roller valves. The roller valves are equipped with portholes, two such portholes for each cylinder per roller, depending upon the engine size.

[0044] As the engine piston retreats from the engine head during the intake stroke, the rollers valves spin, exposing the air intake port so the piston can draw air into the cylinder. As the piston returns toward the engine head during the compression stroke, the roller valves rotate to a position that closes the air intake port, trapping the air in the cylinder so that the piston can compress the air in the combustion chamber. Fuel injected into the cylinder mixes with the air and ignites, and the expanding gases resulting from ignition force the piston downward in the power stroke. As the piston travels from top dead center to bottom dead center in this stroke, the exhaust roller valve spins to expose its exhaust port so the piston can force out the exhaust gases in the subsequent exhaust stroke.

[0045] The fundamental source of the engine design of the disclosure is in the heads. The roller valves are fabricated from the cylinder ports, smooth bore for sustaining compression. The roller valves are fitted with concentric insulator tubes, one on the inside and one on the outside of the each roller valve. The roller valve bore is snugged in between the tube to maintain compression while the roller valve spins inside the insulator tubes.

[0046] Regarding lubrication, as the roller valve spins inside the insulator tubes, the roller valves convey lubricating fluids such as engine oil through oil jacket ports running alongside the outer insulator tube. The oil goes through the outer tube and reaches contact with the roller valve, which conveys the oil to lubricate the inner or the outer tube and the outer of the inner insulator tube.

[0047] There are many advantages to the disclosure. Since the engine valves are formed from rollers, this engine uses no camshaft and no push rods. Power for rotating the rollers is provided by a mechanical link to the crankshaft, whereas the timing for opening and closing the ports provided by the roller valves takes place according to gear sprockets, belts, and/or chains that mechanically connect the roller valve with the crankshaft. The result is superior performance with less weight and complexity.

[0048] For example, as a consequence of the use of smooth roller valves as set forth herein, less torque is required from the crankshaft to operate the valves that regulate intake and exhaust, resulting in more useful output power from the engine, more fuel efficiency, less vibration and lower maintenance over conventional engines.

[0049] As is shown in Figs. 2 and 3, a roller valve 10 is a hollow cylinder with a plurality of ports or holes 20 along its circumferential surface, normally one such hole per cylinder of the internal combustion engine. A timing gear 30 is attached to one end of the roller valve for driving the roller valve 10 in rotation. Surrounding the roller valve 10 is an outer insulator 40 (also called a lubrication jacket), which is a hollow tube with a diameter greater than the roller valve 10, and has openings 50 that correspond to each cylinder of the internal combustion engine. At least one lubrication port 60 is associated with each opening 50 of the outer insulator 40. The outer insulator 40 is fixed in the cylinder head 70.

[0050] Inside the roller valve 10 is an inner insulator 80. The inner insulator 80 is a hollow tube with an outer diameter which is smaller than the inner diameter of the roller valve 10. The inner insulator has holes 90 which correspond to the holes in the roller valve.

[0051] The roller valve 10, the outer insulator 40 and the inner insulator 80 form a valve assembly 110. Two valve assemblies 110 can be mounted to the cylinder head 70. In a particular, but non-limiting embodiment, one roller valve assembly is used for air intake and the other valve assembly is used for exhaust.

[0052] In the non-limiting embodiment shown, fuel is injected into the cylinders of the engine using a fuel injector assembly 120. Each cylinder of the internal combustion engine can have a separate fuel injector 130.

[0053] The cylinder head 70 is fitted onto the engine block 140. The cylinder head and the engine block are provided with channels for cooling.

[0054] The four stroke combustion cycle is shown in Fig. 4. During the air intake stroke, the air intake valve 150 is open by having egress to the corresponding hole in the roller valve 10. It should be noted that the outer insulator 40 has the most contact with the cylinder 160 and to the oiling jacket 170. Lubrication is provided by positive pressure from the outer insulator 40 to the roller valve 10 and to the inner insulator 80.

[0055] As the roller valve continues to rotate, the valves remain shut during both the compression stroke and the power stroke, although the holes in the two roller valves are offset. The exhaust valve 155 is open during the exhaust stroke.

[0056] Fig. 5 shows a non-limiting small-engine application of the disclosure. The hollow tube roller valve 200 is surrounded by an outer insulator 210, also called a lubricator. The roller valve 200 encases an inner insulator 220. The roller valve 200, the outer insulator 210, and the inner insulator 220 form a valve assembly 225. The engine head 230 includes a fuel injection port 240 and a spark plug port 250. An insulator end cap 260 insulates the bulkhead 265. The bulkhead 265 separates the exhaust, and air drawn into the engine is separated by the bulkhead 265 to the exhaust outlet.

[0057] The clearances between the roller valve 10, 200 the outer insulator 40, 210 and the inner insulator 80, 220 should be sufficient for adequate lubrication without resulting in excessive oil flow. The clearances approximate those for bearings, and ranges between 0.001 inches and 0.003 inches (clearances less than 0.001 inches provide insufficient oil flow, while the oil flow is two high with clearances over 0.003 inches). Preferred clearances are 0.0017 inches, 0.0018 inches and 0.002 inches.

[0058] Performance can be improved by placing bearings between the roller valve 10, 200 and the outer insulator 80, 210 and/or between the roller valve 10, 200 and the inner insulator 80, 220.

[0059] Fig. 6 shows an embodiment of the present disclosure for a six cylinder engine 300. The roller valve 10, the outer insulator 40 and the inner insulator 80 form a valve assembly 110. Two valve assemblies 110 can be mounted to the cylinder head 70. In this embodiment, one valve assembly 110a is used for air intake and the other valve assembly 110b is used for exhaust.

[0060] The six cylinder engine 300 has cylinders 310 with pistons 315 arranged as shown in Fig. 6. At a first position 320 valve assembly 110a inlets air. At a second position 330, compression occurs with both valve assemblies 110a and 110b being closed. At a third position 340, combustion occurs with both valve assemblies 110a and 110b being closed. At a fourth position 350, the cylinder is exhausted through exhaust valve 110b. At a fifth position 360, air is inlet again for a further compression at position 370.

[0061] Material selection is an aspect which should be considered. For example, at an average rotational speed of 3,600 revolutions per minute, the valves of a gasoline engine open and close 30 times a second. Intake valves run cooler and are washed with fuel vapors which tend to rinse away lubrication. So for intake valves, wear resistance may be more important than high temperature strength or corrosion resistance if the engine is intended to be utilized with any kind of endurance.

[0062] Exhaust valves, on the other hand, run much hotter than intake valves and must withstand the corrosive effects of hot exhaust gases and the weakening effects of high temperatures.

[0063] Consequently, a premium valve material is an absolute requirement on the exhaust side. As combustion temperatures go up, valve alloys that perform adequately in an engine may not have the strength, wear or corrosion resistance to hold up.

[0064] Steel alloys with a martensitic grain structure typically have a high hardness at room temperature (35 to 55 Rockwell C) after tempering, which improves strength and wear resistance. These characteristics make this type of steel a good choice for applications such as engine valves.

[0065] But as the temperature goes up, martensitic steel loses hardness and strength. Above 1,000 °F or so, low carbon alloy martensitic steel loses too much hardness and strength to hold up very well. For this reason, low carbon alloy martensitic steel is only used for intake valves, not exhaust valves. Intake valves are cooled by the incoming air/fuel mixture and typically run around 800 degrees to 1,000 °F, while exhaust valves are constantly blasted by hot exhaust gases and usually operate at 1,200 degrees to 1450 °F or higher.

[0066] To increase high temperature strength and corrosion resistance, various elements may be added to the steel. On some passenger car and light truck engines, the original equipment intake valves are 1541 carbon steel with manganese added to improve corrosion resistance. For higher heat applications, a 8440 alloy may be used that contains chromium to add high temperature strength.

[0067] For many engines (and performance engines), the intake valves are made of an alloy called “Silchrome 1” (Sil 1) that contains 8.5 percent chromium.

[0068] Exhaust valves may be made from a martensitic steel with chrome and silicon alloys, or a two-piece valve with a stainless steel head and martensitic steel stem. On applications that have higher heat requirements, a stainless martensitic alloy may be used. Stainless steel alloys, as a rule, contain 10 percent or more chromium.

[0069] The most popular materials for exhaust valves, however, are austenitic stainless steel alloys such as 21-2N and 21-4N. Austenite forms when steel is heated above a certain temperature which varies depending on the alloy. For many steels, the austenitizing temperature ranges from 1,600 to 1675 °F, which is about the temperature where hot steel goes from red to nearly white). The carbon in the steel essentially dissolves and coexists with the iron in a special state where the crystals have a face-centered cubic structure.

[0070] By adding other trace metals to the alloy such as nitrogen, nickel and manganese, the austenite can be maintained as the metal cools to create a steel that has high strength properties at elevated temperatures. Nitrogen also combines with carbon to form carbo nitrides that add strength and hardness. Chromium is added to increase corrosion resistance. The end product is an alloy that may not be as hard at room temperature as a martensitic steel, but is much stronger at the high temperatures at which exhaust valves commonly operate.

[0071] 21-2N alloy has been around since the 1950s and is an austenitic stainless steel with 21 percent chromium and 2 percent nickel. It holds up well in stock exhaust valve applications and costs less than 21-4N because it contains less nickel. 21-4N is also an austenitic stainless steel with the same chromium content but contains almost twice as much nickel (3.75 percent), making it a more expensive alloy. 21-4N is usually considered to be the premium material for performance exhaust valves. 21-4N steel also meets the “EV8” Society of Automotive Engineers (SAE) specification for exhaust valves.

[0072] SAE classifies valve alloys with a code system: “NV” is the prefix code for a low-alloy intake valve, “HNV” is a high alloy intake valve material, “EV” is an austenitic exhaust valve alloy, and “HEV” is a high-strength exhaust valve alloy.

[0073] Titanium can also as an insert around the holes in the roller valves of the present disclosure. Titanium valves are often coated with molybdenum, chromium or another friction-reducing surface treatment. However, a wide range of materials can be used for coating the roller valve or the brake. These include (sorted by coefficient of thermal expansion x 10-6 in/(in*oF): tungsten (2.5), molybdenum (2.7), chromium (2.7), zirconium (3.2), rhenium (3.4), tantalum (3.6), iridium (3.6), ruthenium (3.6), rhodium (4.6) vanadium (4.7) and titanium (4.8).

[0074] As discussed above, one particular embodiment of the present disclosure provides a compression release engine brake (also known as a “Jake Brake”) typically for use in a diesel engine. The principle of a compression release engine brake is to regulate the exhaust valves so that gases under pressure within the cylinder are caused to be evacuated when the operator intends to slow the vehicle. Compression release braking is typically associated with diesel engines because, unlike throttle-based gasoline engines, diesel engines typically do not throttle intake air when the operator slows down the engine, resulting in an excess of gas pressure in the cylinders. Even though the operator has reduced or eliminated flow of fuel into the engine, the un-throttled air drawn into the engine causes a spring effect upon the pistons in the power stroke, so that the engine slows more gradually and does not contribute as much to slowing the vehicle.

[0075] The conventional compression release engine brake uses an add-on hydraulic system, actuated with engine oil. When activated, the motion of the fuel injector rocker arm is transferred to the engine exhaust valve(s). This occurs very near the top dead center position of the piston and releases the compressed air in the cylinder so that that the compressed air is not available to push against the piston head during the power stroke and thereby energy is not returned to the crankshaft. Energy from the gases in the cylinder is instead released to the surroundings, and the engine becomes an excellent “brake” working against the momentum of the transmission. When used properly, this energy can be used by a truck driver to maintain speed or even slow the vehicle with little or no use of the friction brakes against the wheels. The power of this type can be around the same as the engine power.

[0076] The use of conventional compression release engine brakes, however, often cause a vehicle to make a loud chattering or “machine gun like” exhaust noise, especially vehicles having high flow mufflers, or no mufflers at all, causing many communities in the United States, Canada and Australia to prohibit compression braking within municipal limits. Drivers are notified by roadside signs with legends such as “Brake Retarders Prohibited,” “Engine Braking Restricted,” “Jake Brakes Prohibited,” “No Jake Brakes,” “Compression Braking Prohibited,” “Limit Compression Braking,” “Avoid Using Engine Brakes,” or “Unmuffled Compression Braking Prohibited,” and enforcement is typically through traffic fines. Such prohibitions have led to the development of new types of mufflers and turbochargers to better silence compression braking noise.

[0077] Jake brake (engine brake) noise typically manifests as a loud "blat-blat-blat" staccato sound, measuring around 80–83 dB(A) with proper mufflers, but can exceed 90+ dB(A) without them. Properly muffled rigs produce 80 to 83 dB(A). Unmuffled, straight-pipe exhausts can increase this by 16–22 decibels, creating extreme noise.

[0078] These disadvantages are minimized, in part, by utilizing roller valves according to the present disclosure, because the elimination of tappet valves reduces the chatter and clatter associated with conventional compression release brakes.

[0079] Another approach to suppressing Jake Brake noise is to utilize white noise. White noise suppression works by masking disruptive sounds with a consistent, high-intensity sound that contains all frequencies, reducing the intelligibility of surrounding noise. It acts as a "blanket" of sound to improve focus, aid sleep, or provide privacy in offices by making abrupt, distracting noises less noticeable, rather than reducing the total sound level. White noise increases the overall background noise level to fill in the spectrum, making it harder for the brain to distinguish specific distracting sounds. In the case of Jake Brake noise, Pink or Brown noise can be used, in which a noise generator will generate a deep or “bass-heavy” tone that corresponds to the frequency spectrum of the Jake brake noise. Similar to white noise, pink noise or brown noise is equal power at all of the octaves.

[0080] Another approach to suppressing Jake Brake noise is to inject compressed air into engine during the compression braking cycle. This is not a standard or commercially available mechanical method in engines fitted with conventional valve systems. However, the rotating valves of the disclosure make compressed air injection viable. This can be enhanced by utilizing a butterfly valve to create backpressure in the exhaust manifold.

[0081] The white, pink or brown noise can utilize Active Noise Cancellation (ANC). ANC systems use microphones to analyze incoming sound waves and then produce an inverted sound wave (anti-noise) to cancel the original sound.

[0082] Drivers can mitigate noise through specific behaviors. Jake brakes are loudest at high engine speeds; engaging them at lower RPMs reduces the intensity of the air release. Cylinder selection can also be used for mitigation. The system of the disclosure drivers to engage the brake on only 2 or 4 cylinders instead of all 6, which lowers the overall volume.

[0083] To meet stringent 2010 EPA emissions requirements (diesel particulate filters and selective catalytic reduction systems, DPF + SCR) provides two potential benefits for compression brake noise. The first benefit is that these aftertreatment devices are very good at attenuating noise in the exhaust stream. The second benefit is that aftertreatment systems make tampering with the exhaust system a very complex engineering undertaking which few truck operators are likely to undertake.

[0084] Installing a turbocharger can also suppress Jake Brake noise. When the driver releases the accelerator on a moving vehicle powered by an internal combustion engine, the vehicle's forward momentum continues to turn the engine's crankshaft. Most diesel engines do not have a throttle body, so regardless of the throttle setting, air is always drawn into the cylinders (excluding the valve fitted to certain diesels, such as fire appliances and generators on oil and gas platforms, to prevent diesel engine runaway). The fuel-free air mix that is compressed on the compression stroke now starts to act as an air spring. After the piston reaches maximum compression, the compressed air mixture returns its energy to the piston by pushing the piston back down. The result is that even if the fuel supply to the cylinder is stopped, some energy absorbed during the compression stroke is still returned to the crankshaft. Because of this returned energy, there limitations to the engine braking applied to the vehicle. Utilizing turbocharger can better silence engine noise.

[0085] A turbocharger is a forced induction device that compresses the intake air, forcing more air into the engine in order to produce more power for a given displacement. Turbochargers are distinguished from superchargers in that a turbocharger is powered by the kinetic energy of the exhaust gases, whereas a supercharger is mechanically powered, usually by a belt from the engine's crankshaft.

[0086] Fig. 24 is a diagram of the noise suppressing options for compression braking of the disclosure. Nose from the engine 2402 can be suppressed by a noise generator 2402 which generates noise that suppresses the noise emitted by the engine. Microphone 2406 supplies information to the noise generator so as to generate the optimum frequency and volume of the suppression noise. A turbocharger or supercharger 2408 can force air into the engine to suppress noise. Downstream noise suppression options include a butterfly valve 2410, a diesel particulate filter 2412 and a selective catalytic reduction system 2414. The placement of the downstream options is not limited to the order shown in the drawing figure, and one or all three can be placed downstream of the engine.

[0087] Fig. 7 shows a valve assembly 500 that includes a compression release engine brake in accordance with a particular embodiment of the disclosure. Similar to the previously described roller valve, the valve assembly includes a roller valve 510, a hollow cylinder which is a plurality of holes 520, generally one per cylinder of the internal combustion engine. A timing gear 530 is attached to one end of the roller valve for driving the roller valve in rotation. Surrounding the roller valve 510 is an outer insulator 540, which is a hollow tube with a diameter greater than the roller valve 510, and has openings 550 that correspond to each cylinder of the internal combustion engine. At least one lubrication port 560 is associated with each opening 550 of the outer insulator 540. The outer insulator 540 is fixed in the cylinder head 570.

[0088] Inside the roller valve 510 is an inner insulator 580. The inner insulator 580 is a hollow tube with an outer diameter which is smaller than the inner diameter of the roller valve 510. The inner insulator has holes or ports 590 which correspond to the holes in the roller valve. The inside insulator does not have lubricating ports, just exhaust and engine brake ports.

[0089] The compression release brake incudes a hollow brake tube 610 that is located between the roller valve 510 and the outer insulator 540. The hollow engine brake tube 610 has ports 620.

[0090] To activate engine braking, the brake tube is caused to pivot about its central axis to an open port, and through the spinning louvers set in the exhaust valve tube and out the back of the exhaust valve.

[0091] The engine brake tube 610 can activate in three stages. For each stage there is a ¼ pivot from the off position, ¼ more post are set in position to activate more cylinders to engine brake.

[0092] Hybrid engine braking is activated in one and two stages. The remaining cylinders that are not activated sustain trapped air as a result of the engine brake tube pivot to one or two stages. The engine brake tube cuts off exhaust flow out of the residual cylinders, trapping the air. As a result, the air is compressed, applying a resistance to the crank shaft, assisting engine braking with the exhaust engine braking. The hybrid braking thus utilizes exhaust and air compression.

[0093] Activation of the engine brake requires electromagnetic contact solenoids fastened to the timing gear, and a pressure plate fastened to the engine brake tube end. The solenoid clutch times to the engine brake tube, the tube pivots to the desired position by the drives. The brake tube is stopped by a position cleat solenoid, one for each stage, and simultaneously cuts off the engine brake clutch solenoid.

[0094] Fig. 8 shows a valve and brake system for a six cylinder diesel engine. As can be seen, the hollow tubular brake can have two openings 710 in line for two cylinder braking, four openings 720 in line for four cylinder breaking, or six cylinders 730 in line for six cylinder braking. The openings can be staggered, for example, for braking at cylinders 2 and 6, as shown. However, all iterations can be used, for example, holes for cylinders 1/2, 1/3, 1/4 1/5/, 1/6, 1//2/6. 1/3/6, 1/4/6, 1/5/6, 1/2/5, 1/3/5, 1/4/5, etc.

[0095] As shown in Fig. 9, the brake system includes a timing gear 530, an engine brake clutch solenoid 532, an engine brake pressure plate 533 and engine brake 534 position cleats 536. The brake clutch solenoid can be activated by a switch on the dash of the motor vehicle (not shown). Various levels of braking can be selected. A “Low” setting provides approximately one-third of the total braking horsepower. When the “Medium” setting is selected, approximately two-thirds braking horsepower will be applied. The “High” setting provides a configuration that applies full braking horsepower. Other configurations besides the dash switch may be offered to give control of the on/off function of the engine brake. Options may include a foot-operated pedal, a steering wheel mount, or a shift lever switch.

[0096] The position cleats 536 correspond to each of the braking configurations. For example, if there are 6 configurations, one corresponding to a single or multiple louvers being open to a corresponding cylinder or grouping of cylinders, there can be six position cleats. However, there is no restriction to the number of position cleats, which can be any number of from one to six or greater. The inner insulator 580 terminates in a bridge 537 housing a primary exhaust 538 and an engine brake louvre 539.

[0097] As shown in Fig. 7, the hollow brake tube 610 is located between the roller valve 610 and the outer insulator 540 with an intervening brake exhaust cover 640. During operation, the exhaust brake is open to the cylinder. When not in operation, the exhaust is closed. The position clutch cleats located on the brake enable the solenoid to rotate the brake between several positions. The first position is the off position. The solenoid 532 is used to rotate the brake to the various braking positions (for different combinations of cylinders) shown in Fig. 8. Please note that the engine brake exhaust louvers 650 are set tandem to the main exhaust, as is shown in Fig. 10.

[0098] The engine oil recirculation is shown in Fig. 11. The oil recirculation system includes an oil pump 1001 to help achieve complete oil recirculation 1002 via oil supply valves 1003 protected by a valve cover 1004. An oil pressure regulator 1005 has access to the crank shaft 1006. A oil drain valve 1007 is housed in an oil pan 1008. The engine head 1009 is fitted with an engine blow-by tube 1010.

[0099] As is shown in Fig. 12, the lubrication system includes a central oil supply port 1011 and an oil supply return port 1012 of an oil supply tube 1013, which are connected to an oil intake tubular valve 1014 and an exhaust tubular valve 1015. Oil drain ports 1016 enable lubricant channeling back to the crankcase 1017. The system includes fuel injector 1018. As is shown in Fig. 12, the oil feed is through the top of the valve tubes and drains out the bottom.

[00100] Fig. 13 shows the lubrication at the top of the engine. The lubrication scheme includes an air intake tubular valve 1021, and exhaust tubular valve 1022, oil supply ports 1023, fuel injector ports 1024, an oil supply tube 1025, a bridge connector 1026, an oil supply entry 1027, an oil return port 1028 to achieve an oil supply circuit 1029 in the tube.

[00101] Fig. 14 shows the engine lubrication process for the engine brake 1032, which includes an outer insulator 1031, engine valve 1033, inner insulator 1034, oil supply port 1035, oil jacket ports 1036, an oil drain port 1037, an engine brake pressure plate 1038 and a timing gear 1039.

[00102] The present disclosure yields numerous advantages. The tubular valve and brake system requires fewer parts than a conventional poppet valve system. There are thus fewer costs for assembly and maintenance. Also the engine brake is a simple insert to the tube brake, and the elaborate machinery required by a conventional “Jake Brake” is not necessary. It is also expected that there will be substantial reductions of noise as compared to the conventional engine braking systems. The brake of the disclosure may not need a positioning or locking clutch. The spinning motion may be sufficient to supply the necessary braking power. However, a positioning clutch may still be used to enhance performance.

[00103] Figure 16 shows a cross sectional view of a tubular fuel injector valve of the present disclosure. Figure 17 shows views of the fuel injector assembly and its mounting in an engine along with inlet and exhaust tubular valves. The valve includes a fixed outer insulator 1040, a fixed inner insulator 1042 and a rotatable tubular valve 1044. The fixed outer insulator 1040, the fixed inner insulator 1042 and the tubular valve 1044 are each fitted with ports 1046, 1048. The ports 1050 in the tubular valve 1044 are staggered. As the tubular valve rotates the three ports will align to pass pressurized fuel to the fuel injector. When the ports are not aligned, no fuel will pass the manifold 1056 to the fuel injector 1054. The tubular valve 1044 is fitted with a timing gear 1052 that rotates the tubular valve 1044. Since inner insulator 1042 and the outer insulator 1040 are fixed and do not rotate, they can be fixed in place by threads 1041, 1043, for example.

[00104] The tubular fuel injection assembly 1062 is mounted in the head 1058 over the engine block, 1060. Optionally, the fuel injection assembly 1062 can be mounted between a tubular air inlet valve 1064 and a tubular exhaust valve 1063. As is shown in Figure 18, the tubular assemblies 1062, 1063, 1064 are fitted into the engine block 1066 and sealed by the head.

[00105] Figure 19 shows a cross sectional views of the timed tubular valve and fuel injector assemblies as relates to the gas flow inside the cylinder. Figure 20 shows two options for fuel intake into the fuel injector assembly. One option utilizes louvers 1070 for fuel intake and returning excess fuel. Another option utilizes inlet and outlet ports 1072, 1074.

[00106] In a fuel injector embodiment, the fuel is pumped in at one end of the outer insulator tube 1040. The fuel enters intake louver 1070 which lie at a circumference of one end of the fuel injector tube. As the fuel injector tube spins, the injector ports line up to emit fuel to each cylinder from injection nozzles. The fuel injection is time so that as the fuel is pressure timed to supply the fuel injection system. The excess fuel exits about a secondary circumference louver

1071 around the fuel injector tube. Fuel is then recirculated to the fuel tank. This is a non-modulated engine option.

[00107] FFor timed tubular valve fuel injection, the embodiment includes as smooth bore tube 1078 with small injector ports around the circumference of the injector tube, one port per cylinder, connected to a timing gear. The injection tube is fitted with an inner insulator tube 1076 inside the injector tube. The outer tube 1078 is equipped with injector ports at the bottom of the tube, and each port is to line up with the corresponding port of the fuel injector tube, one port per cylinder.

[00108] Referring to Fig. 16, the fuel injector tube is fitted with an outer insulator tube, similar to the inner insulator tube 1042, just larger compared to the fuel injection tube that is fitted inside the outer insulator tube 1040. The fuel injection tube spins inside the outer insulator tube 1040 and around the inner insulator tube 1042. The fuel injection tube is turned by the timing gear 1052.

[00109] In central tubular valve fuel injection, the process is a simple basic system as compared to timed fuel injection. This system requires no timed fuel injection, i.e., fuel injection timed by an electronic control unit. As is shown in Fig 21, the system of this embodiment is formed from a system of tubes 1080, 1086, one installed inside the other. The inside tube 1080 receives fuel supply from entry port 1082 and transfers the fuel to the outer tube 1086. The entry port 1082 is outside of the outer tube 1086. The outer tube 1086 is equipped with fuel injection ports 1092, one nozzle per cylinder, which lead to the corresponding fuel injection nozzle 1054. Excess fuel supply exits through exit port 1088. The outer tube 1086 and the inner tube 1080 are fixed to each other using threads 1084, 1090 or any other suitable attachment means. As can be seen in Fig. 22, the fixed tubular fuel injection tubes 1080, 1086 are installed through the tubular air intake valve 1094 which runs the length of the intake valve tube, to supply each cylinder are fixed, they are sealed to the rotating tubular air intake valve using a bushing 1098. The tubular air intake valve 1094 tubular air intake valve 1094 is rotating using a timing gear 1096. Staggered fuel injection ports 1098 lead to fuel injectors, one to each cylinder.

[00110] In the process of fuel-air supply, as the fuel injector tube is installed in the tubular air intake system, the fuel is pressurized through the injector tube 1044 priming each injector 1054 with fuel. The fuel then blends with the air supply, causing the mixture of fuel and air. As the tubular intake valve 1044 spins to open a port to the cylinder, the fuel/air mixture is drawn through the port and into the cylinder. As the fuel is pressurized in the injector tube 1044, just as the inner supply tube 1042 has a fuel supply port. The outer injection tube is equipped with a fuel return port 1070, 1074 to recirculate fuel back to the fuel tank.

[00111] Similar to the roller valve embodiment, the clearances between the roller fuel injector valve 1044 the outer insulator 1040 and the inner insulator 1042 should be sufficient for adequate lubrication without resulting in excessive oil flow. The clearances approximate those for bearings, and ranges between 0.001 inches and 0.003 inches (clearances less than 0.001 inches provide insufficient oil flow, while the oil flow is two high with clearances over 0.003 inches). Preferred clearances are 0.0017 inches, 0.0018 inches and 0.002 inches.

[00112] Performance can be improved by placing bearings between the roller fuel injector valve 1044 and the outer insulator 1040 and/or between the roller fuel injector valve 1044 and the inner insulator 1042.

[00113] Fig. 23 illustrates an embodiment where the outer tube 1086 and the inner tube 1080 is fitted with an exit louver 1100, which serves as an exit port, which has a more efficient distribution of the exiting fuel compared to the circular exit port 1088.

[00114] The fuel injection system of the disclosure offers may advantages. The inventive fuel injection system is less expensive than the conventional art, and replacement parts are less expensive as well. Since the inventive fuel injection system is less complicated, less maintenance will be expected as well. In the fuel injection system of the present disclosure, no high pressure rail is needed. However, the fuel injection system of the disclosure is versatile, and can be retrofitted to use conventional fuel injectors.

[00115] Throughout the specification and the embodiments, the following terms take at least the meanings explicitly associated herein, unless the context clearly dictates otherwise. Relational terms such as “first” and “second," and the like may be used solely to distinguish one entity or action from another entity or action without necessarily requiring or implying any actual such relationship or order between such entities or actions. The term “or” is intended to mean an inclusive “or” unless specified otherwise or clear from the context to be directed to an exclusive form. Further, the terms “a,” “an,” and “the” are intended to mean one or more unless specified otherwise or clear from the context to be directed to a singular form. The term “include” and its various forms are intended to mean including but not limited to. References to “one embodiment,” “an embodiment,” “example embodiment,” “various embodiments,” and other like terms indicate that the embodiments of the disclosed technology so described may include a particular function, feature, structure, or characteristic, but not every embodiment necessarily includes the particular function, feature, structure, or characteristic. Further, repeated use of the phrase “in one embodiment” does not necessarily refer to the same embodiment, although it may. The terms “substantially,” “essentially,” “approximately,” “about” or any other version thereof, are defined as being close to as understood by one of ordinary skill in the art, and in one non-limiting embodiment the term is defined to be within 10%, in another embodiment within 5%, in another embodiment within 1% and in another embodiment within 0.5%. A device or structure that is “configured” in a certain way is configured in at least that way, but may also be configured in ways that are not listed.

WHAT IS CLAIMED IS:

1. An internal combustion engine assembly, comprising:

a fixed tubular outer insulator, the fixed tubular outer insulator having a first plurality of fixed holes;

a fixed tubular inner insulator, the fixed tubular inner insulator having a second plurality of fixed holes;

a rotatable tubular valve between the fixed outer insulator and the fixed inner insulator, the rotatable tubular valve having a plurality of holes in a staggered configuration;

a fuel injector connected to each of the first plurality of fixed holes of the fixed tubular outer insulator; and

a noise suppression device,

wherein when the rotatable tubular valve rotates, fuel is given to only one of said fuel injectors at a time.

2. The internal combustion assembly according to claim 1, wherein the noise suppression device is a turbocharger or supercharger configured to inject air into the internal combustion assembly.

3. The internal combustion assembly according to claim 1, wherein the noise suppression device is a butterfly valve placed in an exhaust stream.

4. The internal combustion assembly according to claim 1, wherein the noise suppression device is a particulate filter placed in an exhaust stream.

5. The internal combustion assembly according to claim 1, wherein the noise suppression device is a selective catalytic reduction systems placed in an exhaust stream.

6. The internal combustion assembly according to claim 1, wherein the outer insulator has a hole corresponding to each cylinder in an engine block, the inner insulator has a hole corresponding to each cylinder in an engine block, the outer insulator has a hole corresponding to each cylinder in the engine block, and each hole in the outer insulator is associated with a lubrication port, and further comprising a timing gear at one end of the rotatable tubular valve.

7. The internal combustion assembly according to claim 1, wherein a clearance between the rotatable tubular valve and each of the outer insulator and the inner insulator is between 0.001 inches and 0.003 inches.

8. A valve and fuel injection system for an internal combustion engine, comprising:

the internal combustion assembly according to claim 1;

an air inlet assembly comprising:

a first hollow tube,

at least one first hole in the first hollow tube, the at least one first hole being configured to access an air inlet of a cylinder in an engine block,

a first tubular outer insulator outside of the hollow tube, the first outer insulator being fixed to a cylinder head, and

a first tubular inner insulator inside of the hollow tube; and

an exhaust assembly comprising:

a second hollow tube,

at least second one hole in the second hollow tube, the at least one second hole being configured to access an exhaust of the cylinder in the engine block,

a second tubular outer insulator outside of the second hollow tube, the second outer insulator being fixed to the cylinder head, and

a second tubular inner insulator inside of the hollow tube.

9. The valve and fuel injector assembly according to claim 8, wherein the outer insulator has a hole corresponding to each cylinder in an engine block.

10. The valve and fuel injector assembly according to claim 8, wherein the inner insulator has a hole corresponding to each cylinder in an engine block.

11. The valve and fuel injector assembly according to claim 8, wherein the outer insulator has a hole corresponding to each cylinder in the engine block, and each hole in the outer insulator is associated with a lubrication port.

12. The valve and fuel injector assembly according to claim 8, further comprising a timing gear at one end of the rotatable tubular valve.

13. The valve and fuel injector assembly according to claim 8, wherein a clearance between the rotatable tubular valve and each of the outer insulator and the inner insulator is between 0.001 inches and 0.003 inches.

14. An internal combustion engine comprising:

a noise suppression device; and

a fuel injector assembly, comprising:

an inner tubular injection tube;

an entry port in the inner tubular injection tube;

an outer tubular injection tube fixed to the inner tubular injection tube, the inner tubular injection tube and the outer tubular injection tube be fixed to a cylinder head;

an exit port in the outer tubular injection tube;

at least one outlet port in the outer tubular injection tube, each outlet port corresponding to a cylinder of an internal combustion engine;

a rotatable tubular air intake valve surrounding the fixed outer and inner tubular injection tubes; and

at least one injection port in the rotatable tubular air intake valve, each injection port corresponding to the corresponding cylinder of the internal combustion engine.

15. The internal combustion engine according to claim 14, wherein the noise suppression device is a turbocharger or supercharger configured to inject air into the internal combustion assembly.

16. The internal combustion engine according to claim 14, wherein the noise suppression device is a butterfly valve placed in an exhaust stream.

17. The internal combustion engine according to claim 14, wherein the noise suppression device is a particulate filter placed in an exhaust stream.

18. The internal combustion engine according to claim 14 engine, wherein the noise suppression device is a selective catalytic reduction systems placed in an exhaust stream.

19. The internal combustion engine according to claim 14, wherein the inner tubular injection tube and the outer tubular injection tube are fixed to each other with threads, the exit hole is configured so that fuel is recirculated back to a fuel tank, fuel is pressurized between the inner tubular injection tube and the outer tubular injection tubes, the entry port is a hole or louver, and the exit port is a hole or a louver.

20. The fuel injector assembly according to claim 14 further comprising a timing gear fixed to one end of rotatable tubular air intake valve.

ABSTRACT

An internal combustion engine includes tubular roller valve, a fuel injector assembly and noise suppressor. The fuel injector assembly includes a fixed tubular outer insulator with holes and a fixed inner insulator with holes. A rotatable tubular valve is between the fixed outer insulator and the fixed inner insulator, the rotatable tubular valve having holes in a staggered configuration. A fuel injector is connected to each of the first fixed holes of the fixed tubular outer insulator. When the rotatable tubular valve rotates, fuel is given to only one of the fuel injectors at a time. The noise suppressor can be a turbocharger, a supercharger, a white noise generator, a butterfly valve, a particulate filter or a catalytic converter.

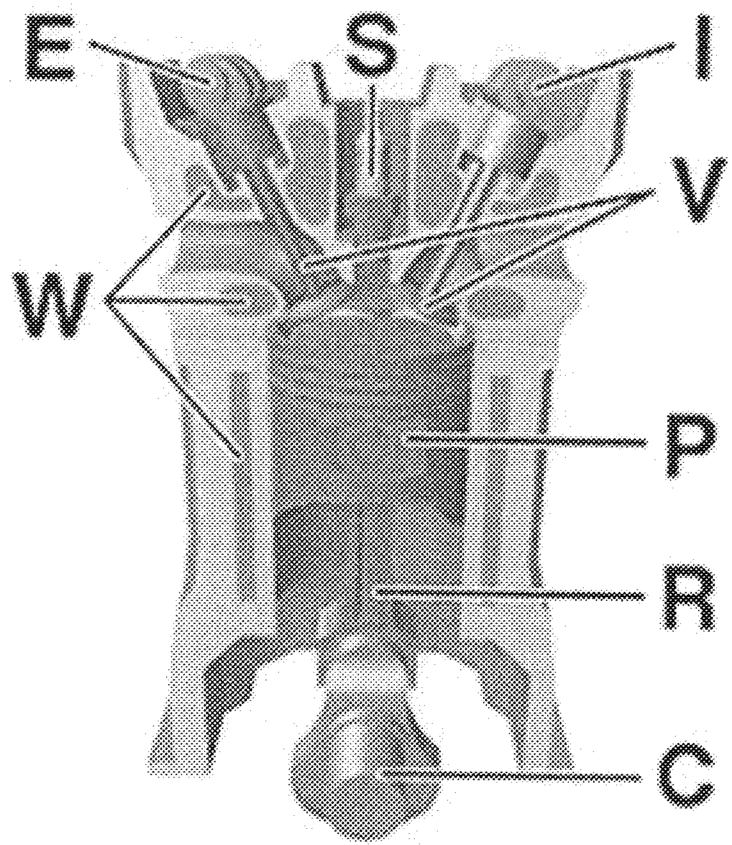


Fig. 1

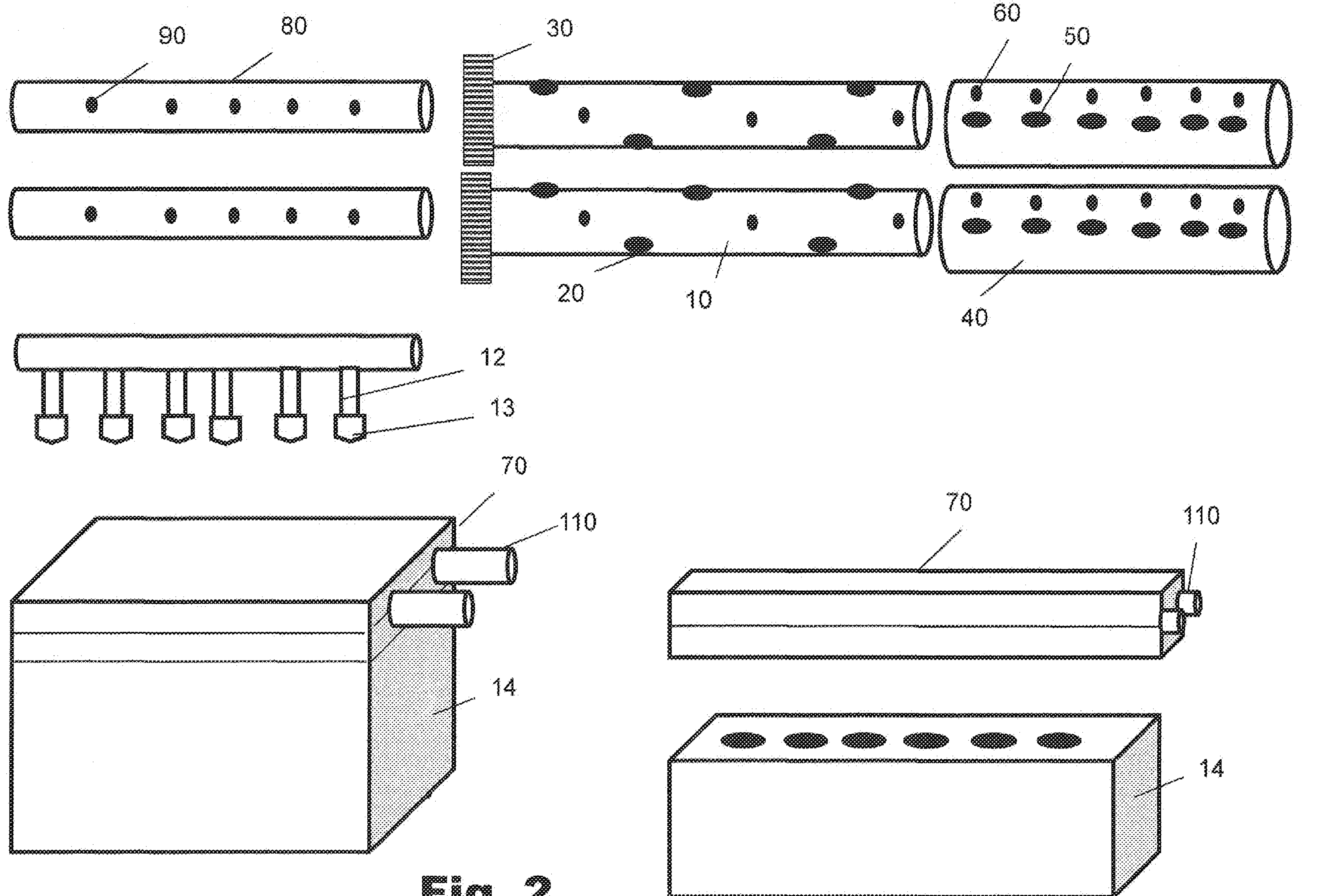


Fig. 2

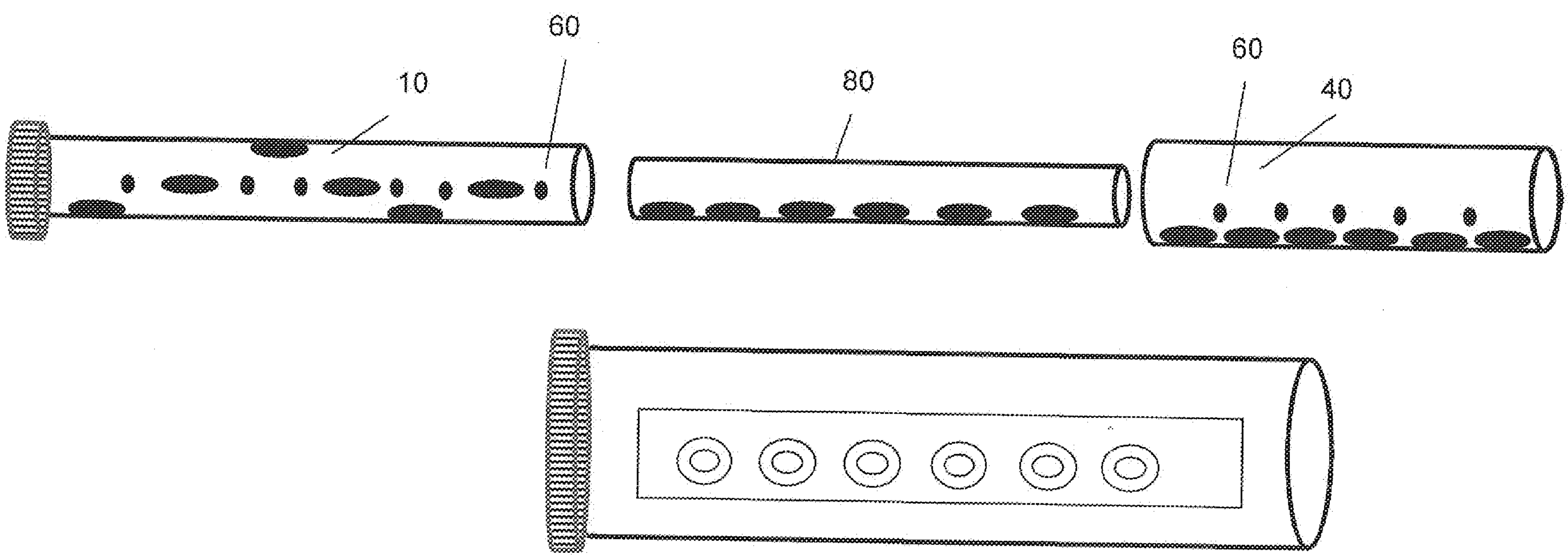


Fig. 3

ENGINE COMPLETE COMBUSTION CYCLE

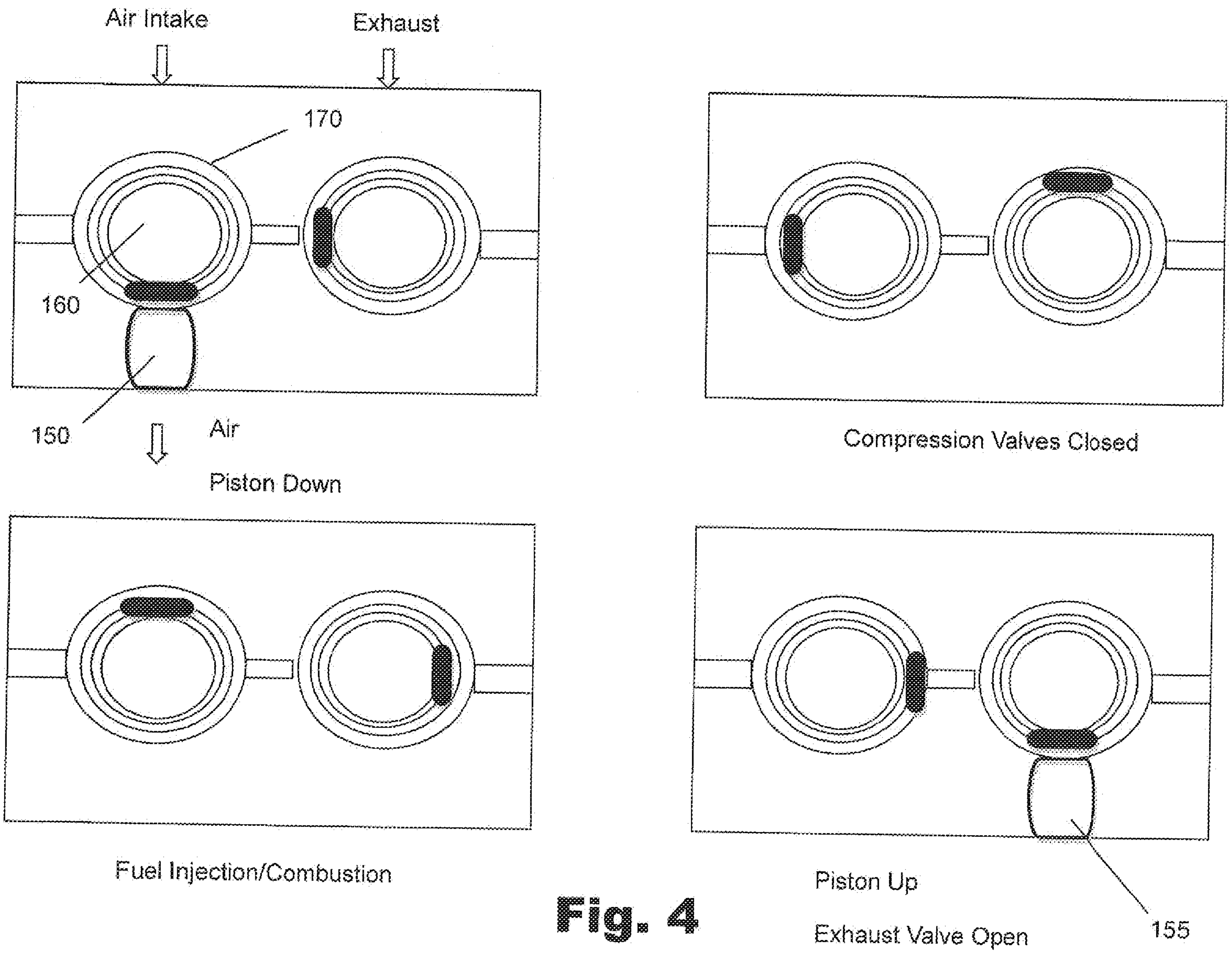


Fig. 4

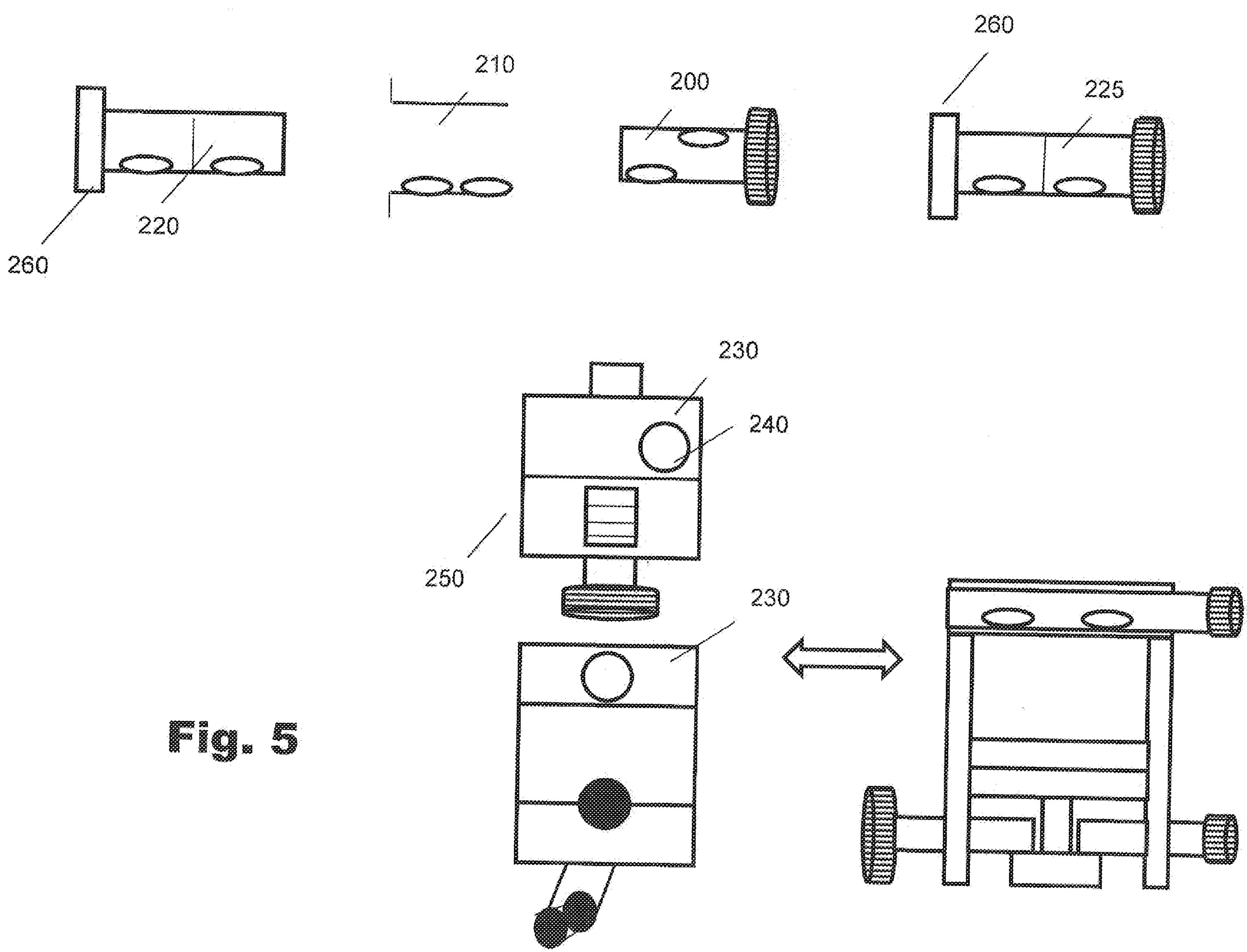


Fig. 5

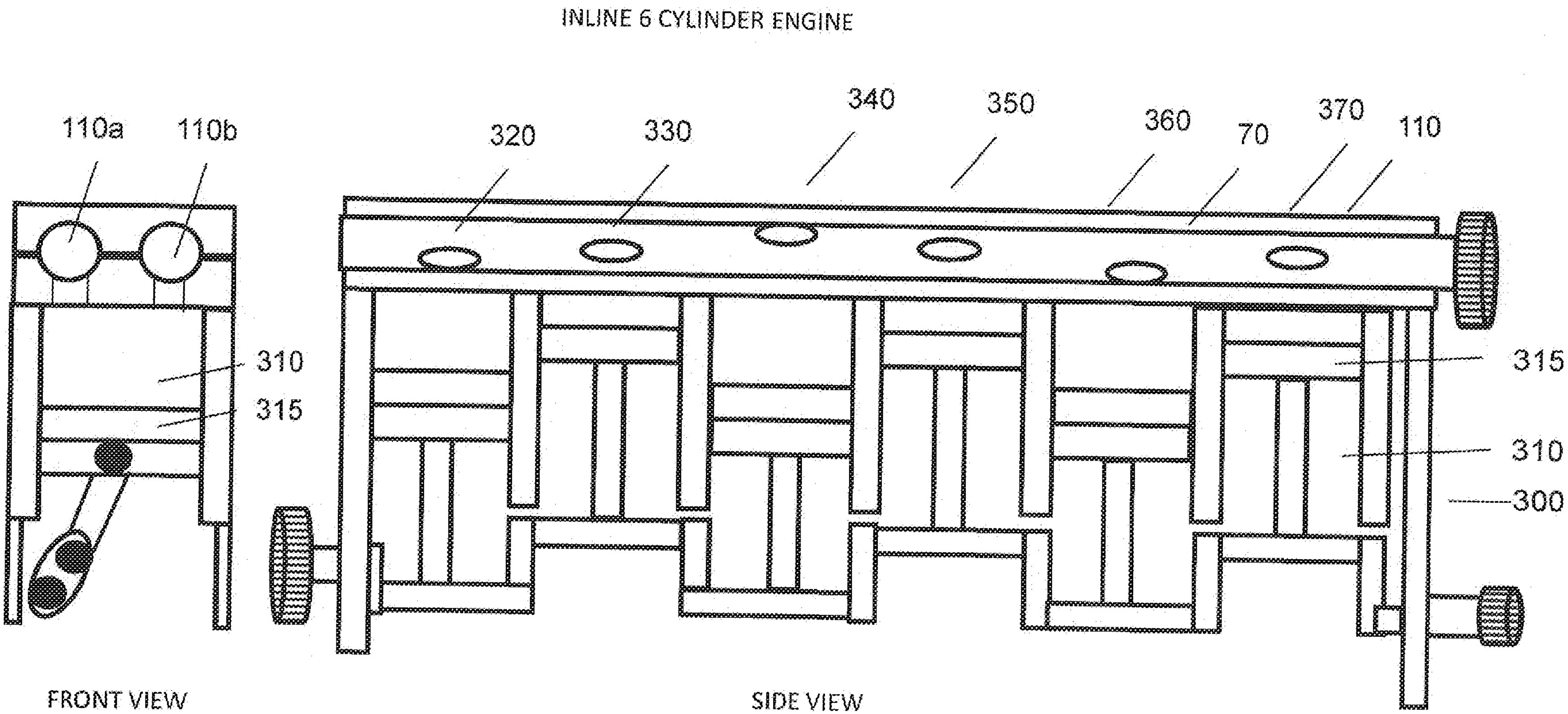

INLINE 6 CYLINDER ENGINE
110a
110b
310
315
320
330
340
350
360
70
370
110
315
310
300
FRONT VIEW
SIDE VIEW

Fig. 6

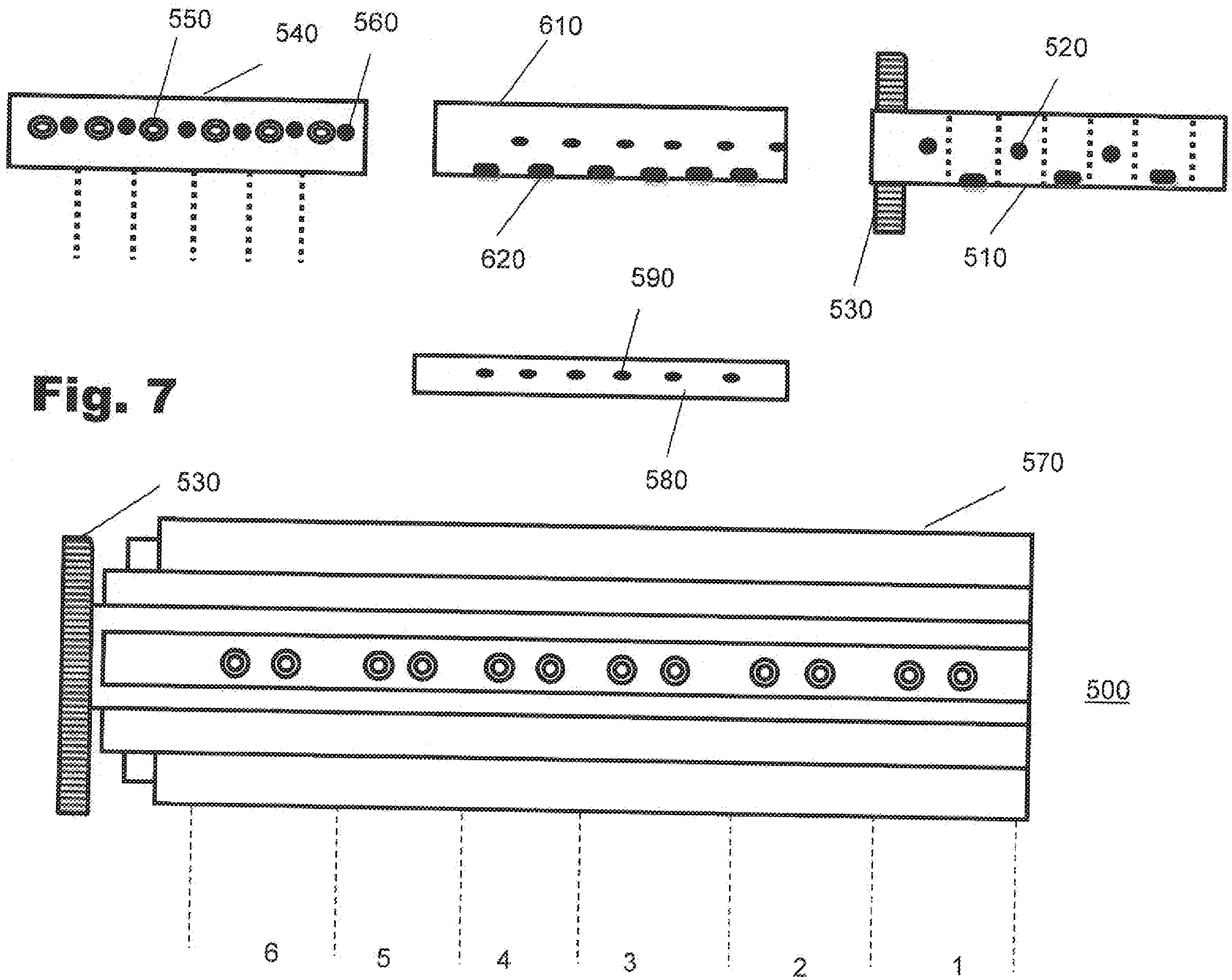


Fig. 7

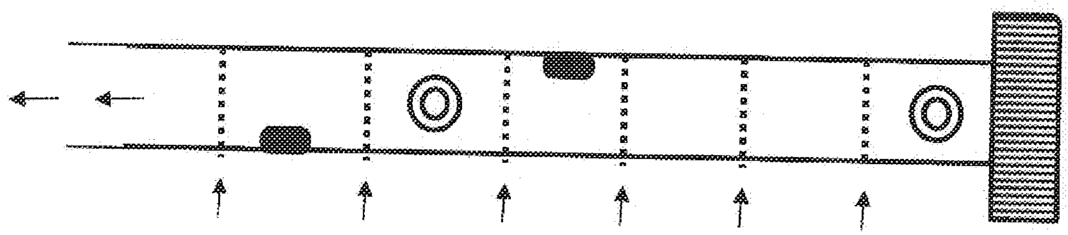
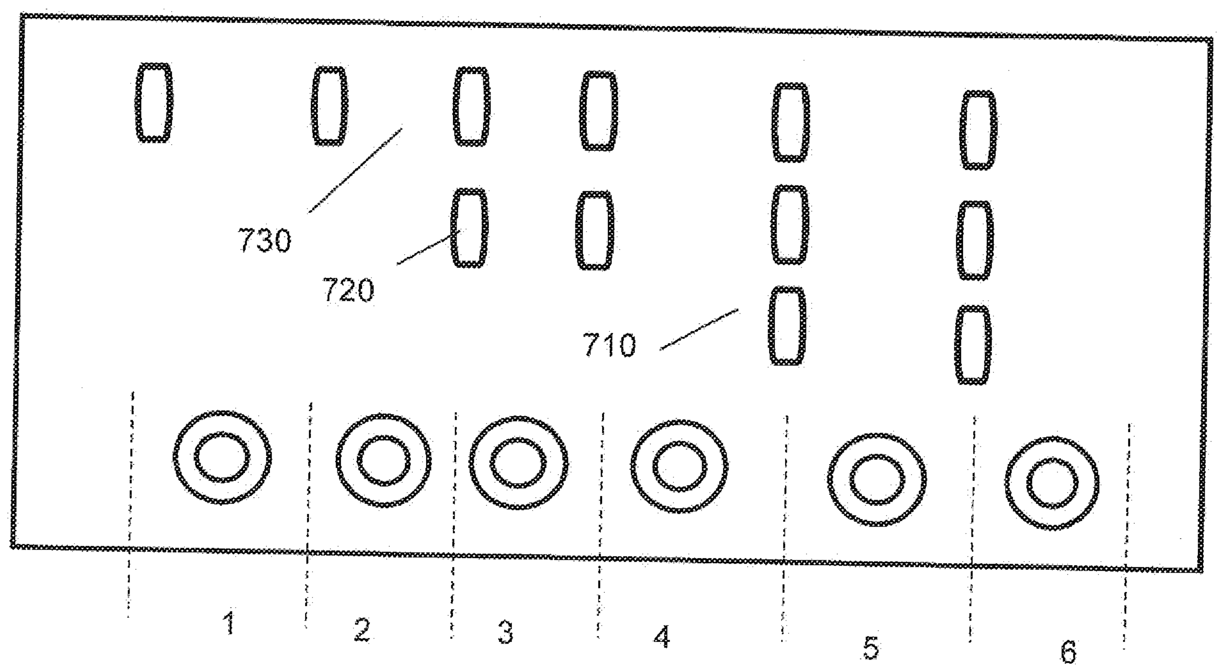


Fig. 8



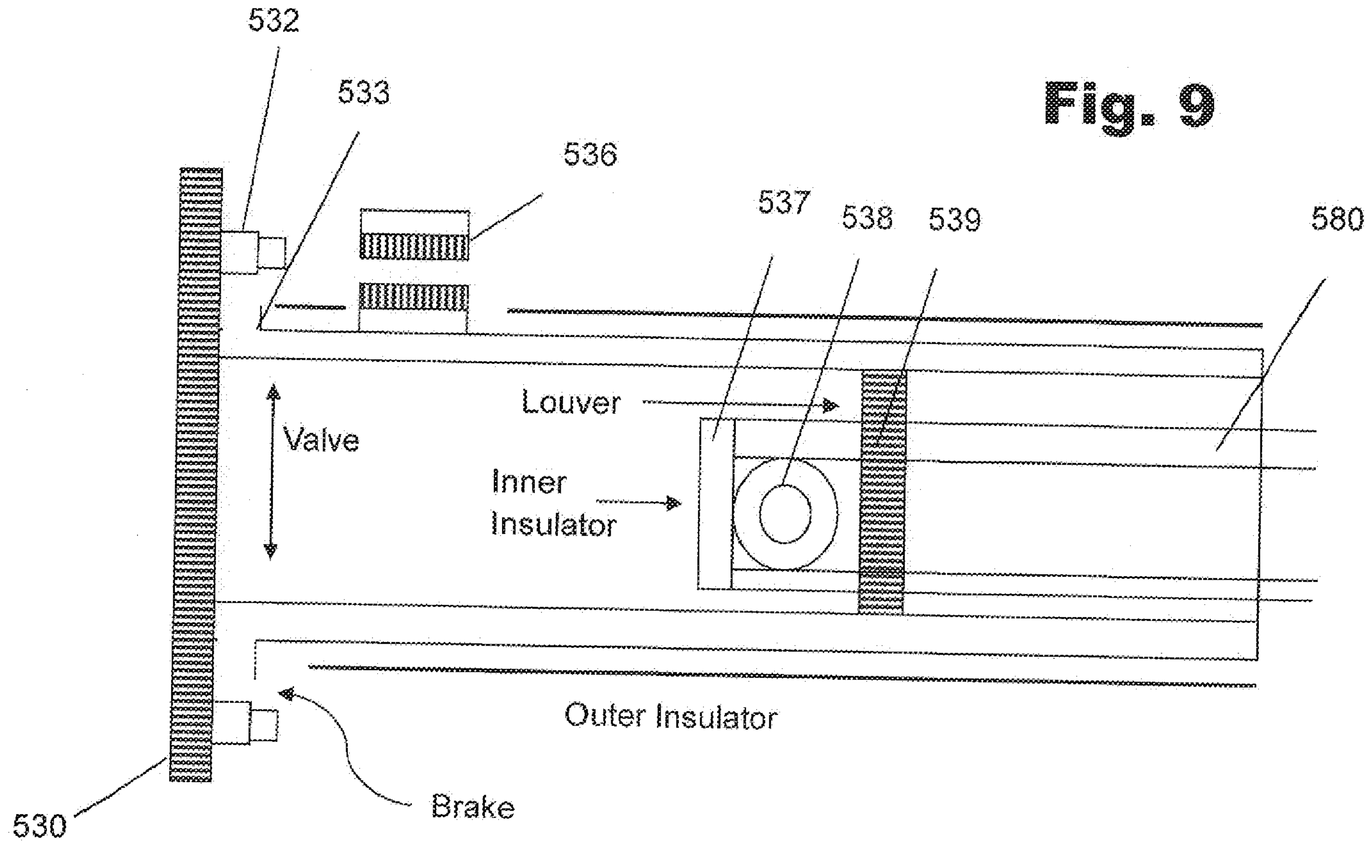

532
533
536
537
538
539
580
Louver
Valve
Inner
Insulator
Outer Insulator
Brake
530

Fig. 9

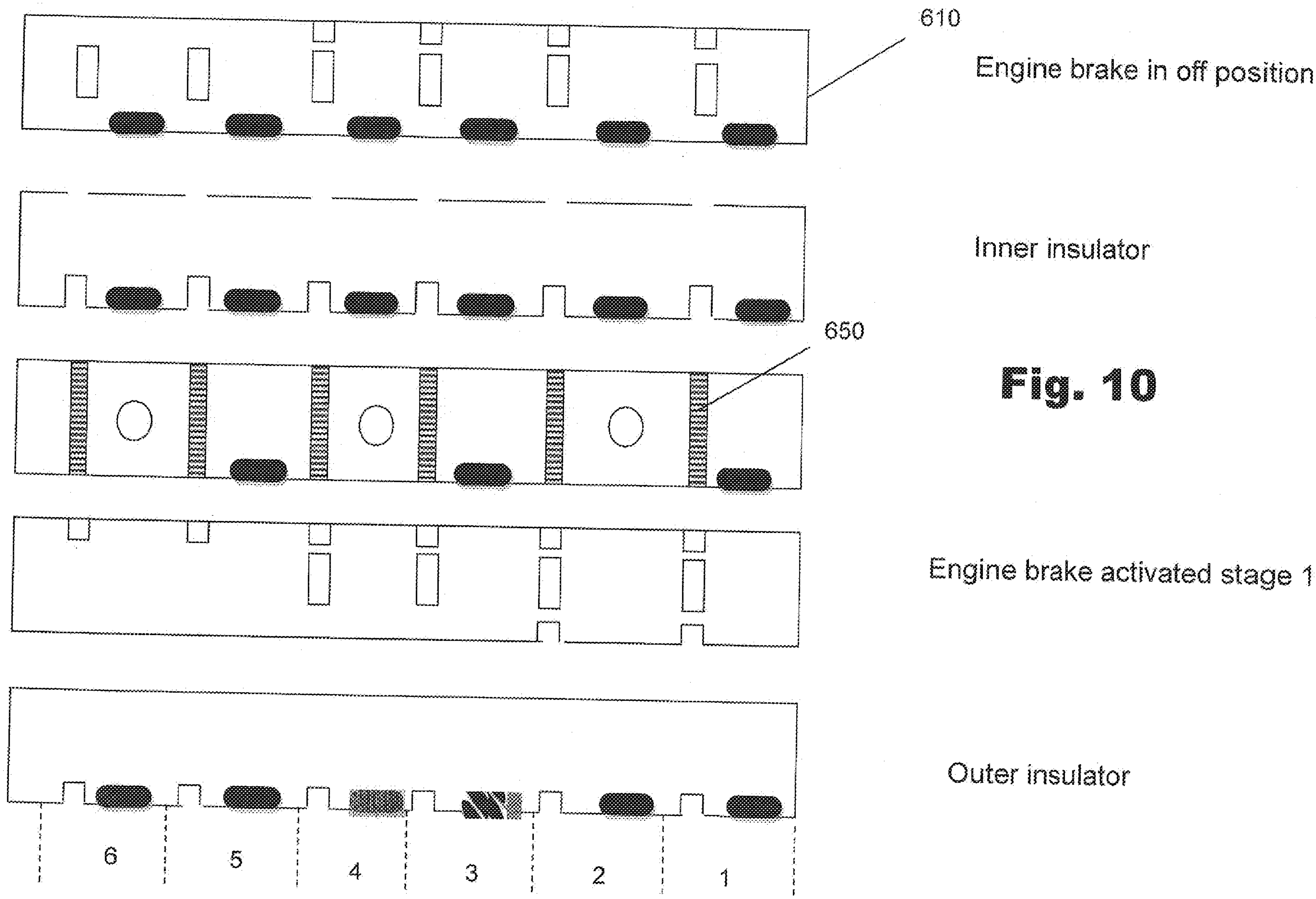

610
Engine brake in off position
Inner insulator
650
Engine brake activated stage 1
Outer insulator
6
5
4
3
2
1

Fig. 10

Engine Oil Circulation Process

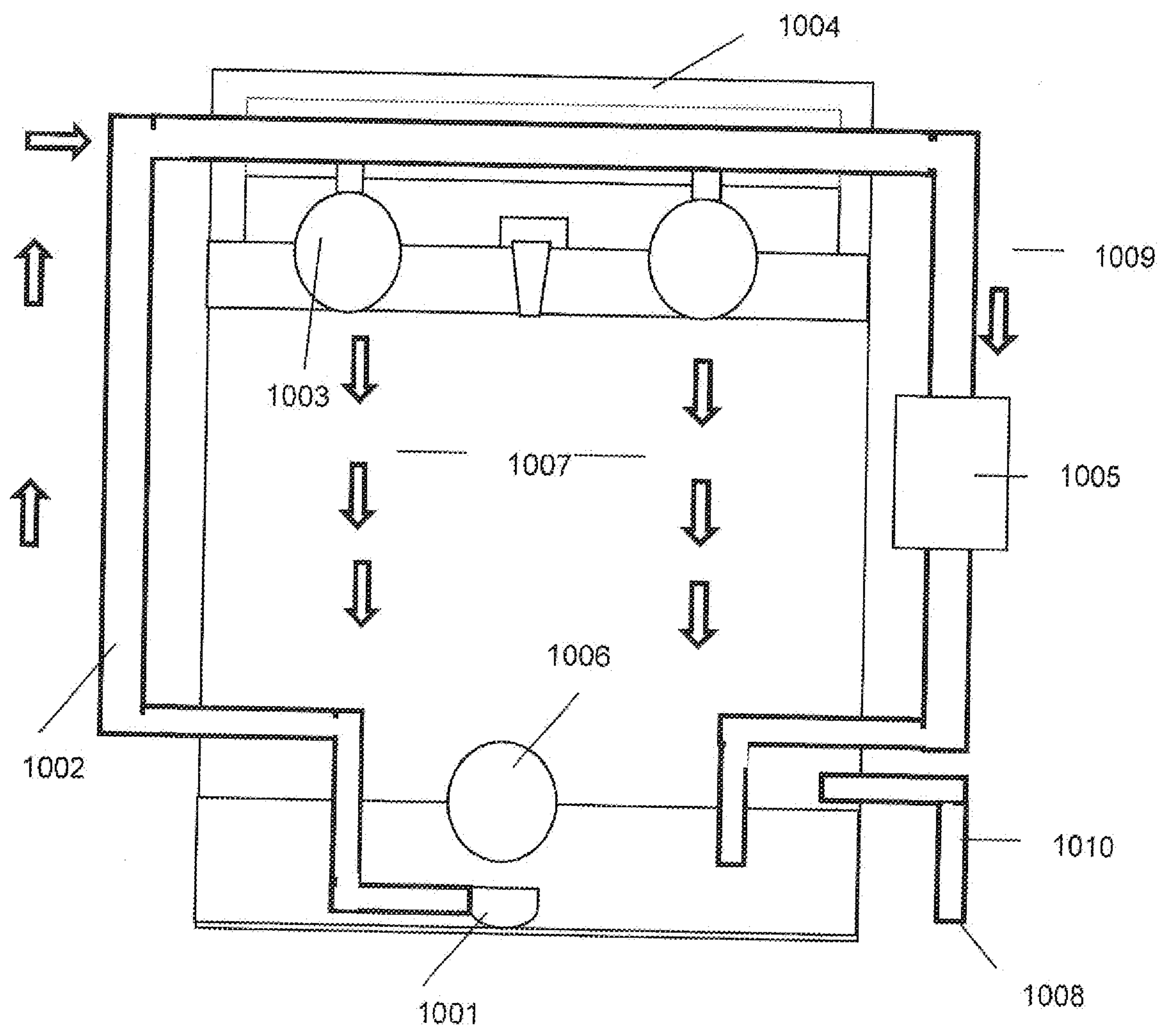


Fig. 11

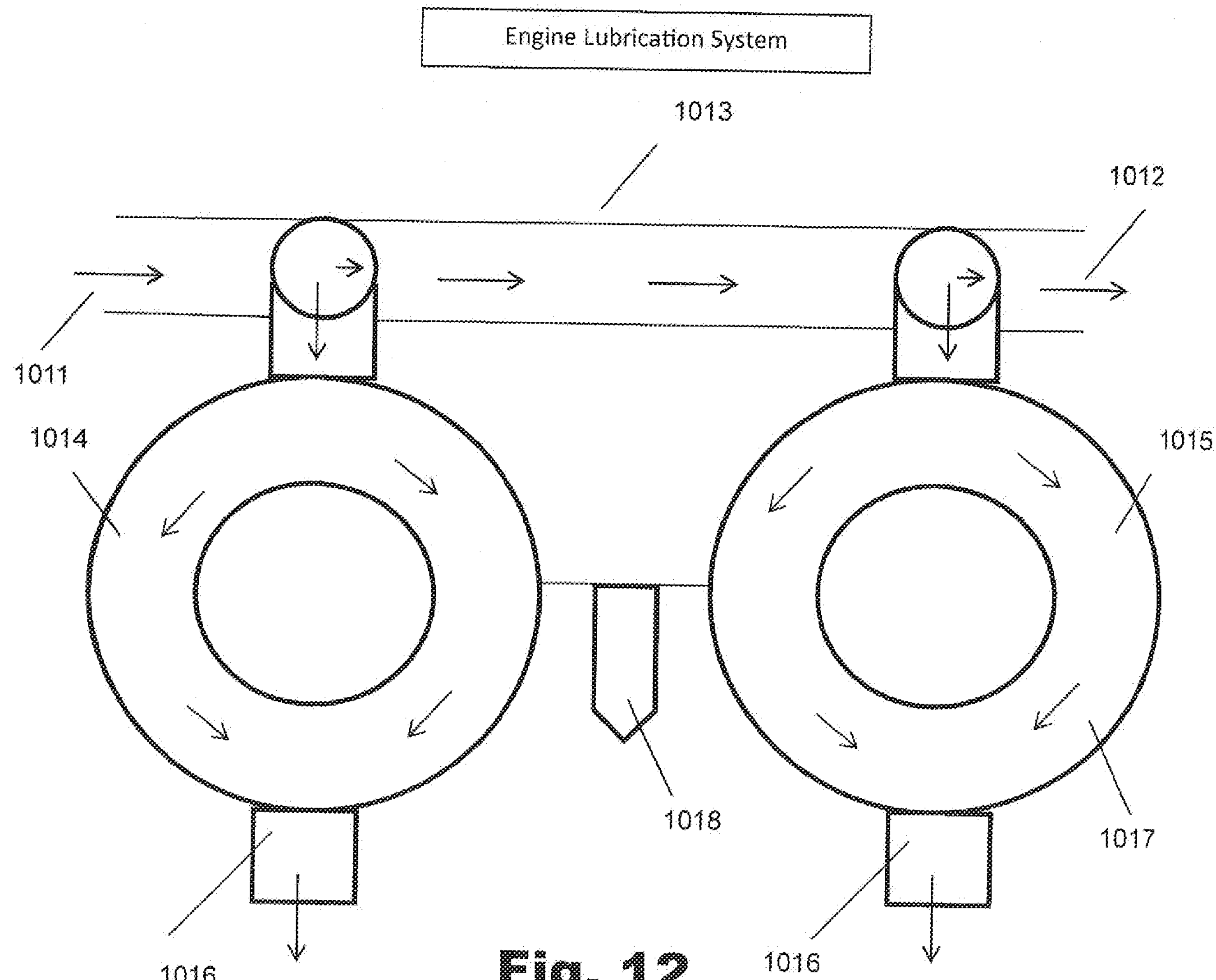

Engine Lubrication System
1013
1012
1011
1014
1015
1018
1017
1016
1016

Fig. 12

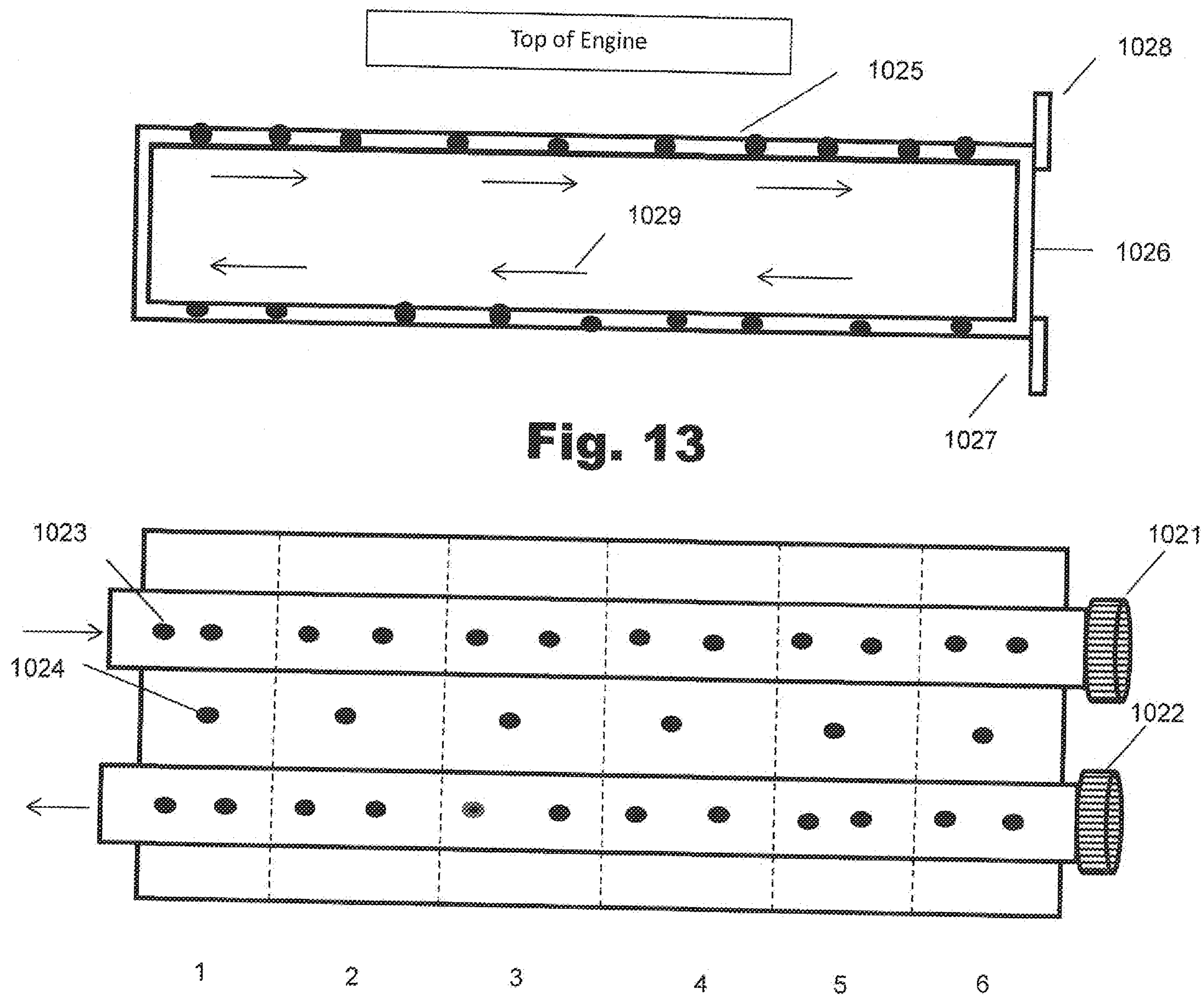

Top of Engine
1025
1028
1029
1026
1027
1023
1021
1024
1022
1
2
3
4
5
6

Fig. 13

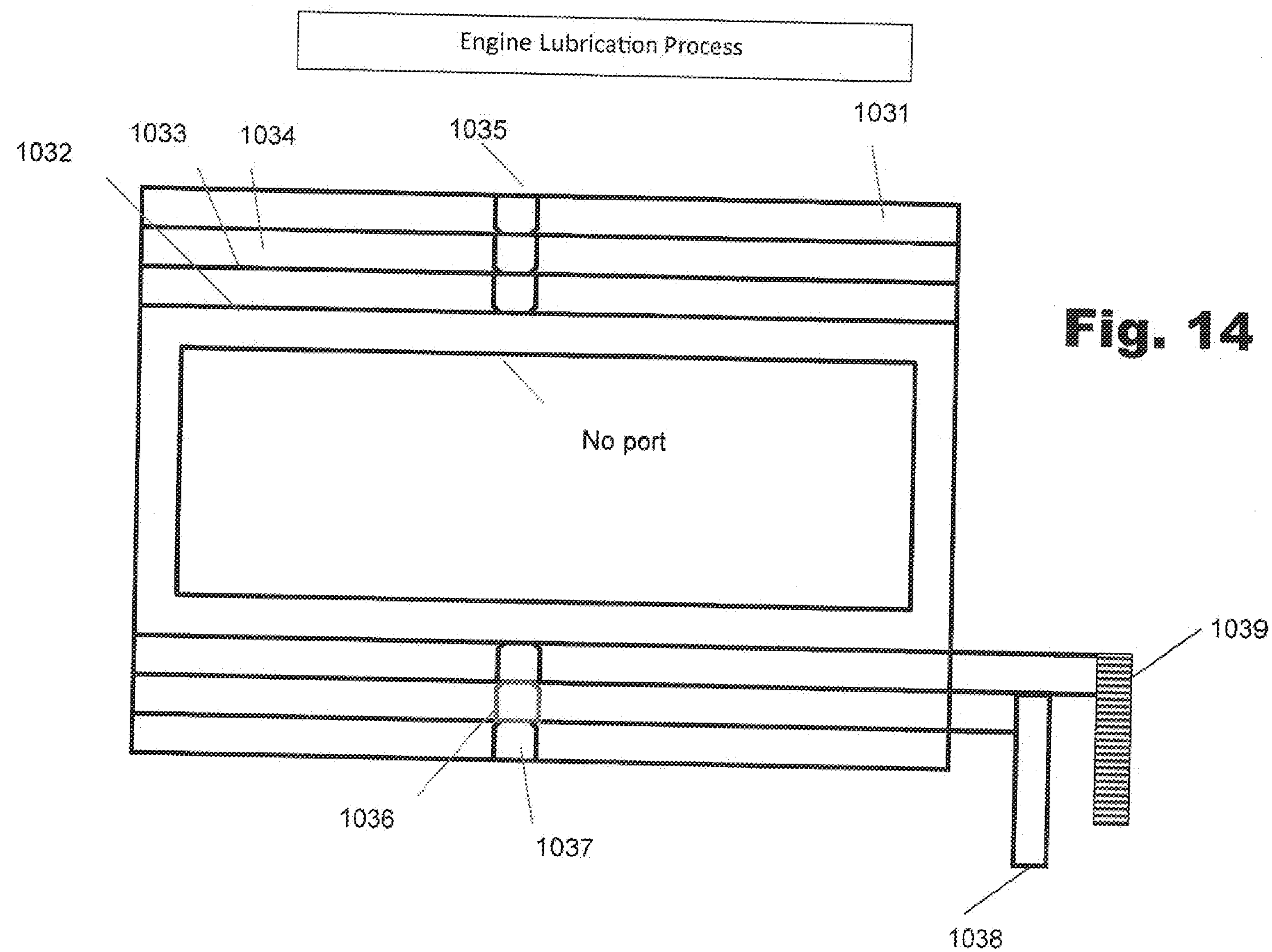

Engine Lubrication Process
1032
1033
1034
1035
1031
No port
1039
1036
1037
1038

Fig. 14

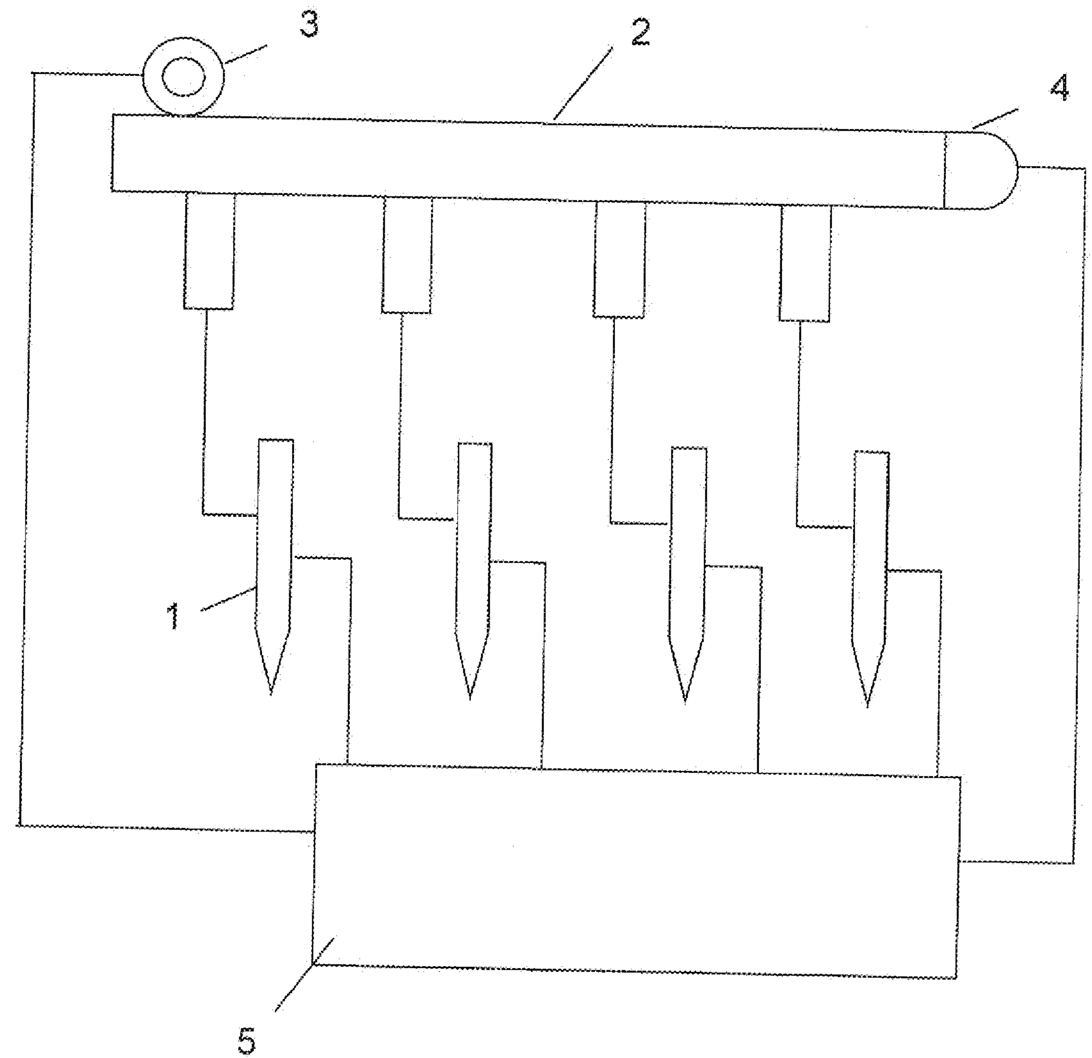


Fig. 15

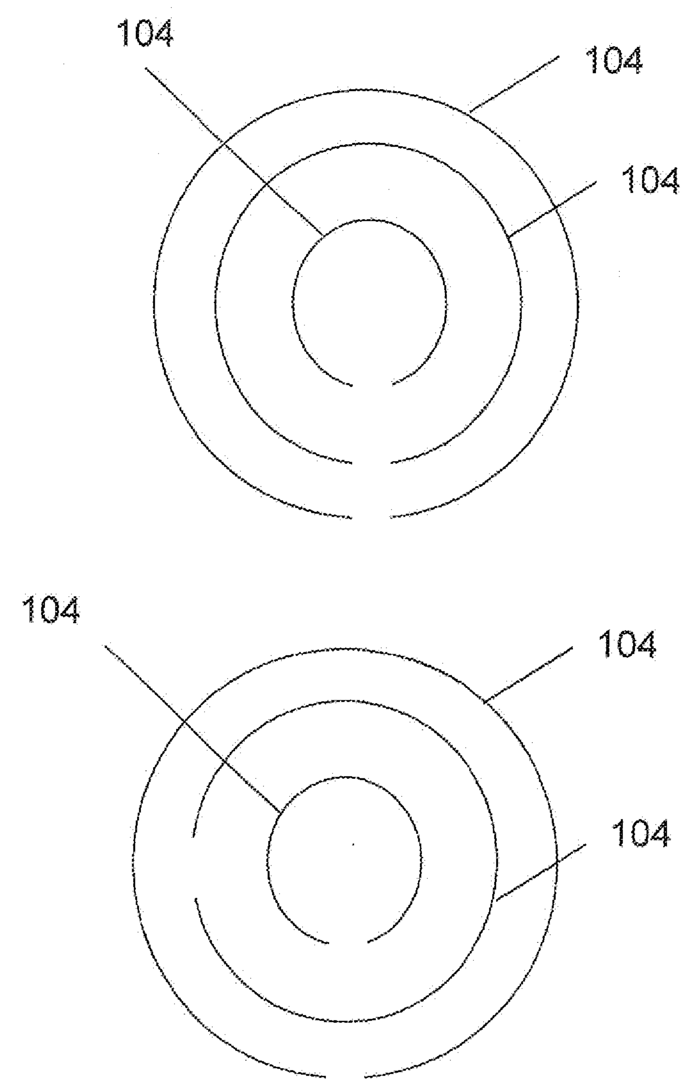


Fig. 16

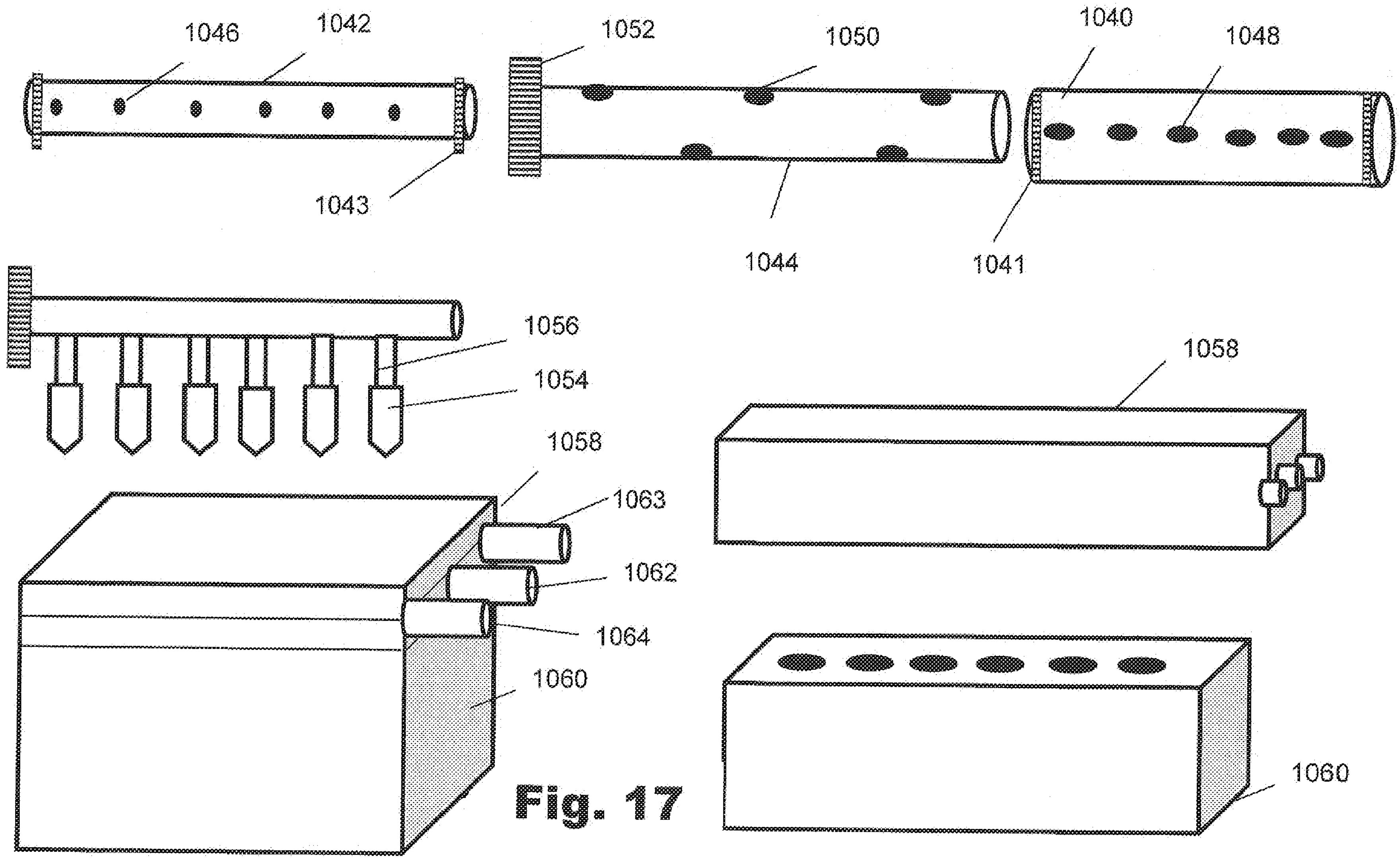

1046
1042
1043
1052
1050
1044
1040
1048
1041
1056
1054
1058
1063
1062
1064
1060
1058
1060

Fig. 17

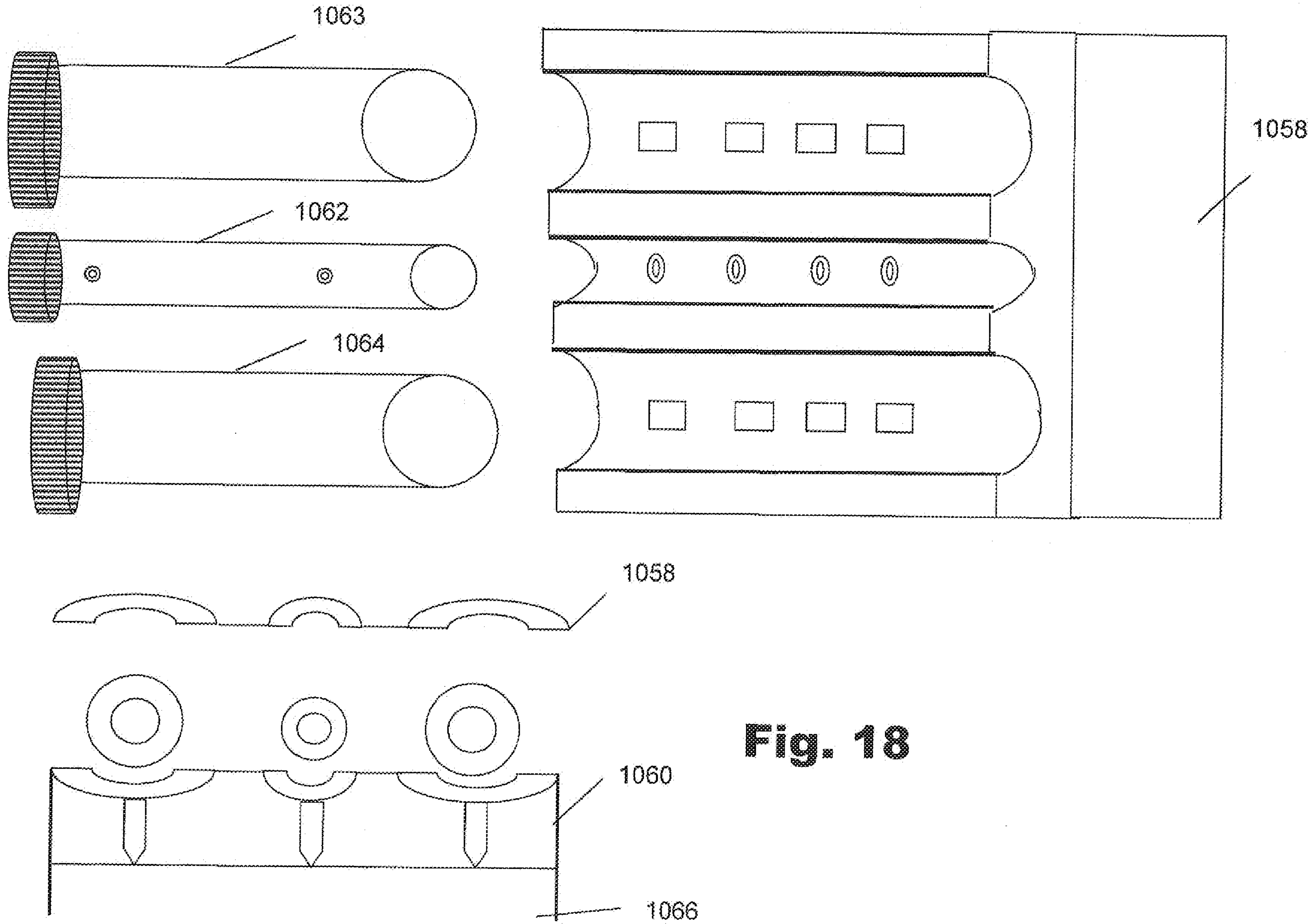


Fig. 18

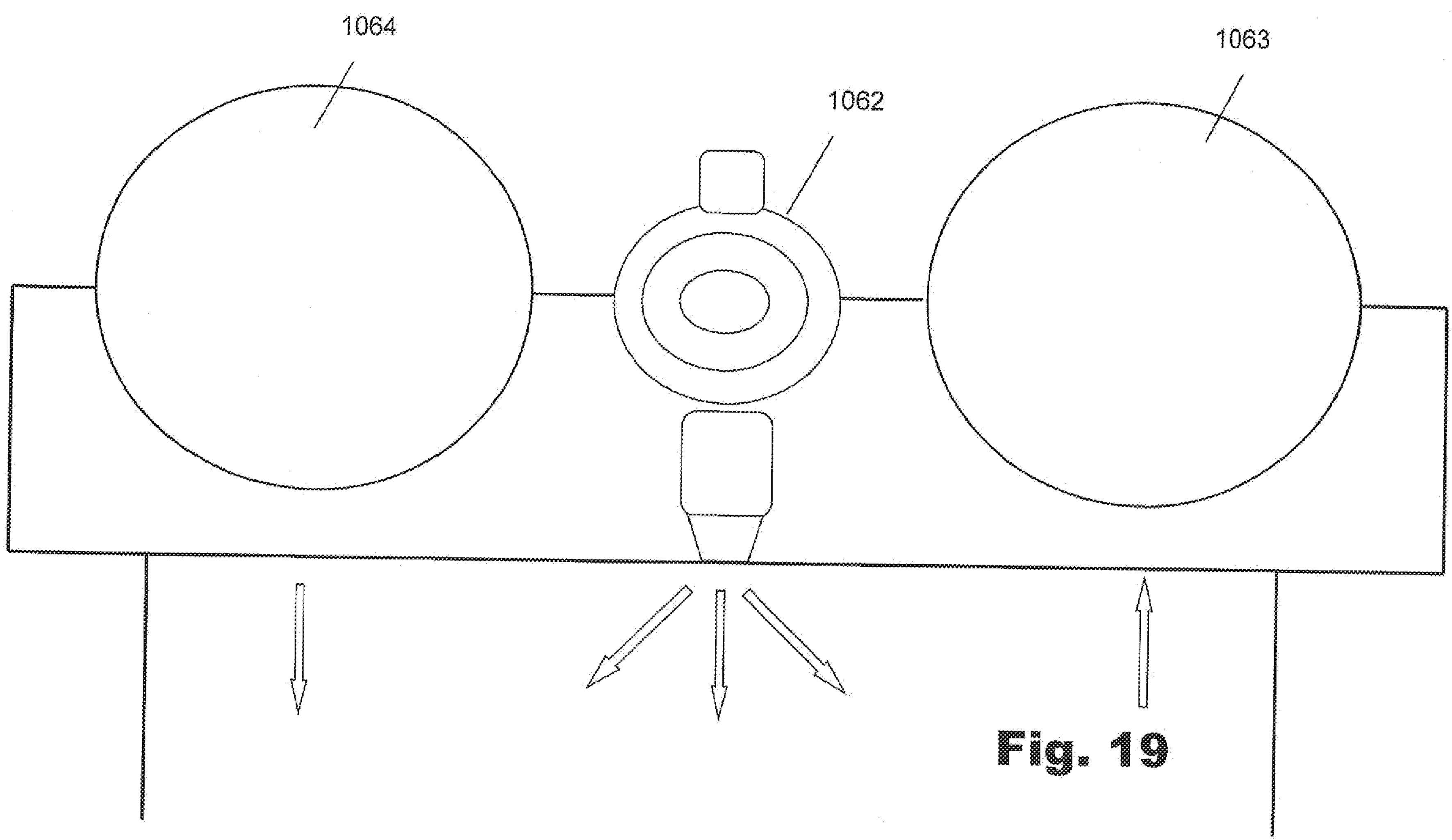


Fig. 19

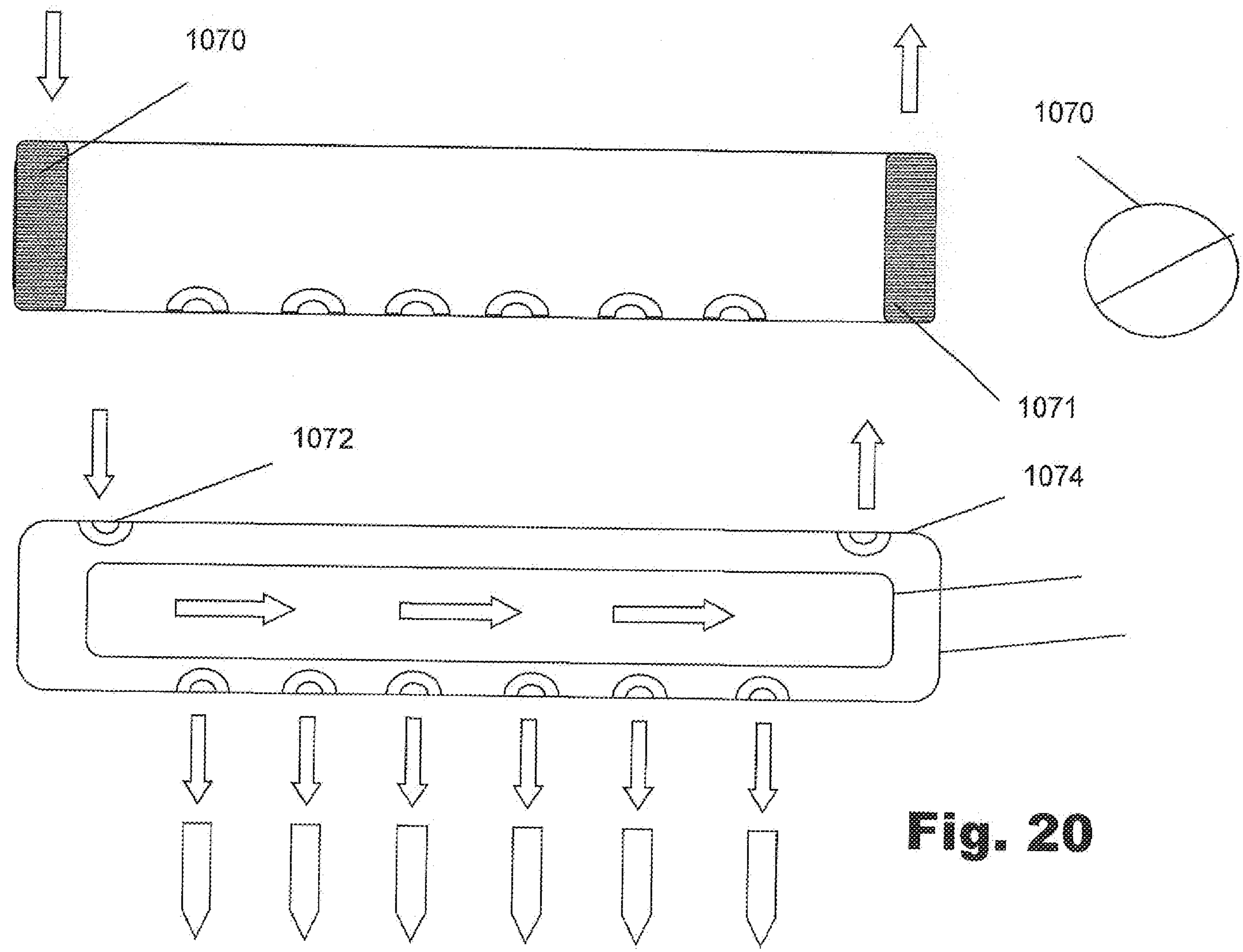


Fig. 20

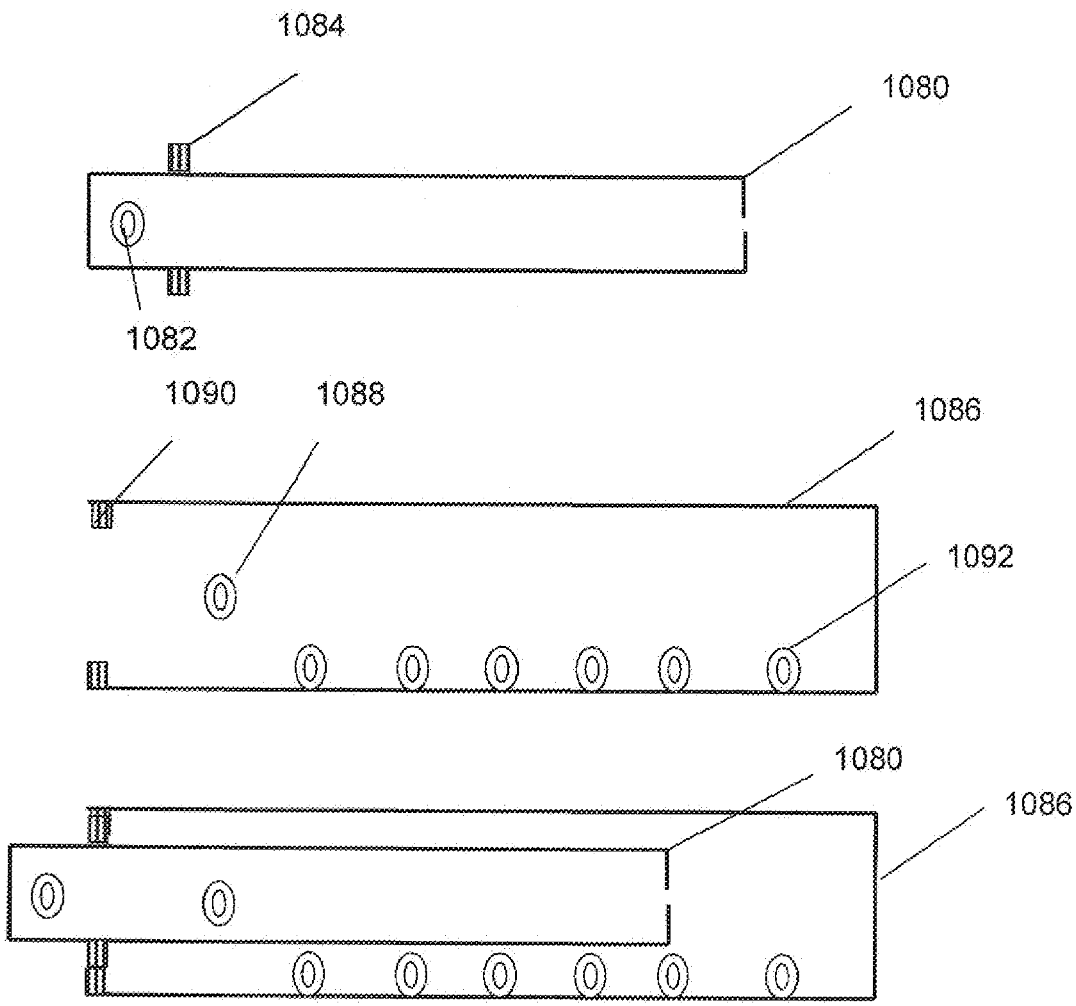


Fig. 21

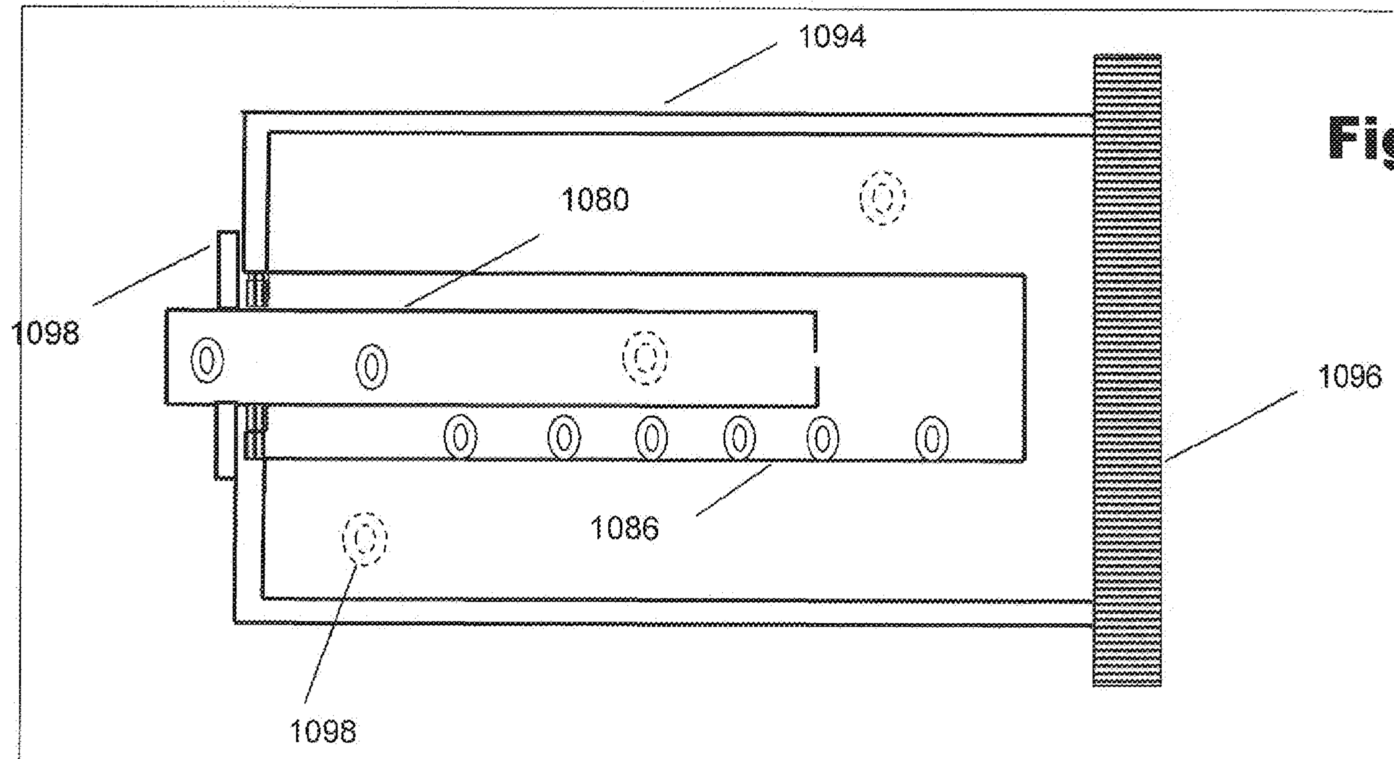


Fig. 22

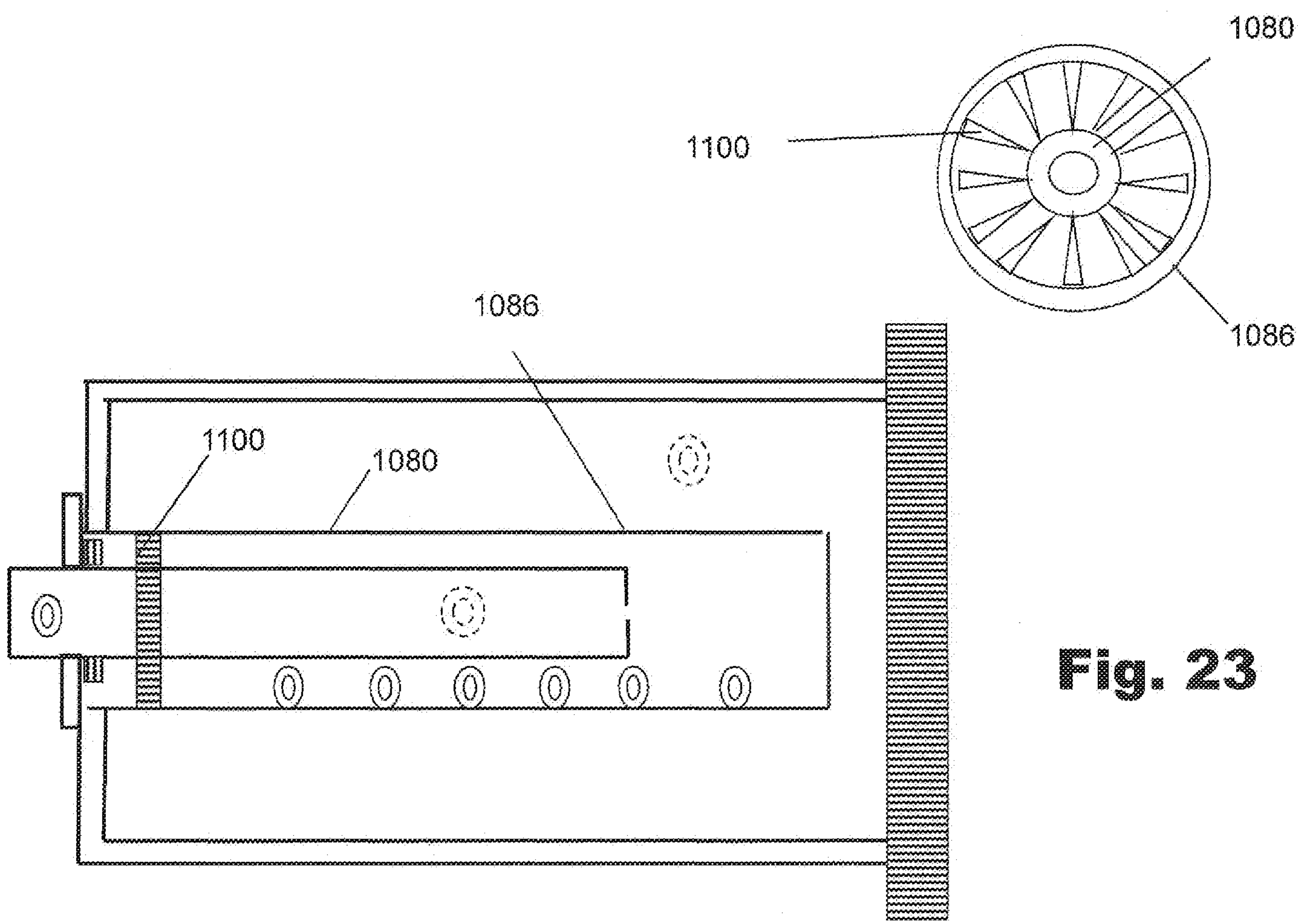


Fig. 23

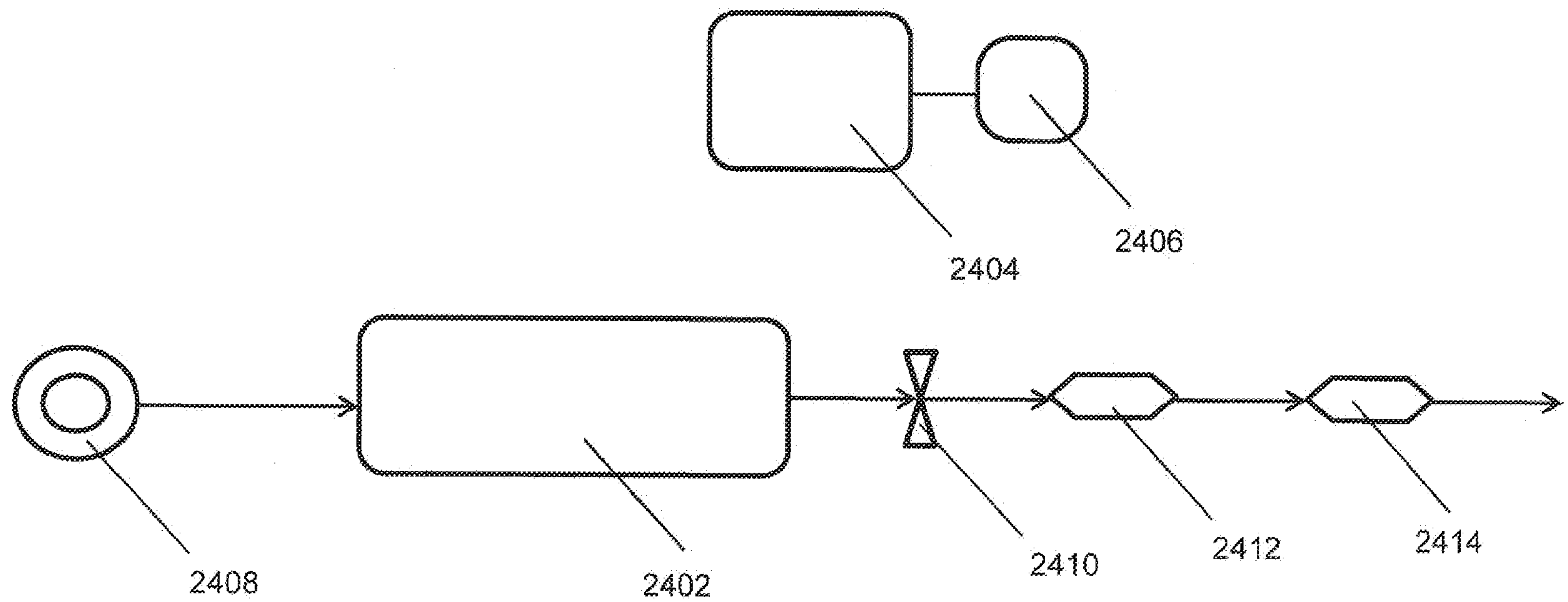


Fig. 24

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
64/033,913	**04/09/2026 11:50:46 AM Z ET**	**1004-1004**

Title of Invention

IINTERNAL COMBUSTION ENGINE WITH TUBULAR FUEL INJECTION AND ENHANCED BRAKE PERFORMANCE

Application Information

APPLICATION TYPE	Utility - Provisional Application under 35 USC 111(b)	PATENT #	-
CONFIRMATION #	3515	FILED BY	Robert Goozner
PATENT CENTER #	75221588	AUTHORIZED BY	-
CUSTOMER #	154187	FILING DATE	-
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Jonathan Tom Tavernier

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 2023	**E202649B52068800**	**Robert Goozner**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
2005	PROVISIONAL APPLICATION FILING FEE	130.00	1	130.00
			TOTAL AMOUNT:	**$130.00**

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C.

371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.