

# [A Practical Guide to 'Free Energy' Devices](#)

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## [A Special Engine](#)

The US patent office is always very reluctant to grant any patent where the inventor makes a claim that the device operates in such a way that the output power is greater than the applied input power. This reluctance is primarily based on current scientific teaching, which unfortunately is, at present, out of date and seriously in need of correction. For example, the equations quoted as being "Maxwell's Equations" are not to be found in any book or text written by James Clerk Maxwell. Instead, his real equations were re-written by Oliver Heaviside and those inadequate rewritten equations are presented today as being "Maxwell's" which they most certainly are not. The Heaviside equations exclude the possibility of "free-energy" while the real Maxwell equations do not. If in doubt about this, read Tom Bearden's book "The Final Secret of Free Energy" which can be accessed at [www.web-space.tv/free-energy](http://www.web-space.tv/free-energy) (needs the browser's Refresh button to get past a German-language advertisement page to reach the site).

The motor shown in this presentation makes no claims to spectacular operation, but in spite of that, the designer Leroy Rogers, did admit in an interview that this motor does indeed have a greater output than the applied input, provided that the motor is not left just ticking over. This motor is like the US patent 3,744,252 "Closed Motive Power System Utilising Compressed Fluids" by Van Valkenburg. However, the Rogers patent shown here has the distinct advantage that it uses off-the-shelf motors and readily available hardware and there is nothing really exotic or difficult about the Rogers engine that a person couldn't get from a valve supplier or get a metal fabrication company to construct.

Present day vehicle engines are under-g geared and run at fairly low revs. These same engines operate much more efficiently at higher revs, if they are given different gearing. With the Rogers motor, the air contained in the high-pressure tank is sufficient to drive the pistons up and down. The exhaust air is captured in a buffer tank and is then pumped back into the high-pressure tank by a compressor with much higher gearing and much lower capacity per piston stroke. Because of this, the motor has sufficient torque power to operate the compressor at much higher rpm than the motor itself. This increased compressor efficiency allows the motor to be a self-powered closed system. It is also possible to adapt an existing vehicle engine to operate on compressed air in this manner and this makes the engine lighter and quieter.

Here is a quotation from a news article by Gilbert Lawrence of Toledo, Ohio:

To many American consumers, the following feature may seem difficult to believe - none the less, it is true! This is not just a story of one man's desire to overcome massive odds against himself, but, entwined within his destiny and within his hands he may hold the future destiny of America and the free world. You may never need to ask again "Whatever happened to good old American ingenuity?...Where are the modern day Graham Bells, the Wright brothers, Henry Fords and the likes?"

No doubt we have all heard the expression "Don't look a gift horse in the mouth", but who among us could look a billion dollar plus offer in the face and say - NO! Well, it may sound like a good plot for a television series (we all remember "The Millionaire"), but it is no fiction, it happens to be the truth. "The Big Three" apparently pooled their automotive fortunes and efforts to the tune of over one billion dollars! All they wanted in return were the absolute patent rights owned and already registered to Lee Rogers for an automobile that literally runs on air.

Rogers, a forty-one year old residential contractor from Iona, Florida, had one underlying fear. He had a near obsessive concern that the automotive industry might merely shelve his revolutionary invention and keep it off the market. Rogers might well be right, if all indications prove correct! His idea to operate any regular gasoline designed engine on compressed air could cut America's massive dependence upon foreign oil. Because, as Lee Rogers says, "It's probably the closest thing to a perpetual motion machine that may ever be invented".

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News of Lee Rogers' revolutionary design, reached "Consumer's Guide" editors and immediately we went to work to separate fact from rumour. As I quickly found out, this wasn't an easy task. For some reason there almost seemed to be a "Media Black-Out" when it came to acquiring information on this potential block-busting invention.

How could it be, I asked myself; if in fact as Lee Rogers had stated, his invention was probably the closest thing ever to a perpetual motion machine, that no one, including AP, UPI, NBC, CBS and ABC had not grabbed up this little gem and really ran the distance? For, whatever their fears or reservations, the balance of the media seemingly held back, and given the initiative of time, the Guide continued to forge ahead to expose the inventive genius - or fraud of Lee Rogers.

As the days grew into several weeks, bit by bit, piece by piece, the Rogers story started coming together. Many unanswered questions and doubts were investigated ... and the questions of the sceptics were answered with hard facts.

For example: why did Dr. Larry Bagnall, noted University of Florida Agricultural Engineer, criticise Roger's invention, saying "Rogers might just as well use a horse to turn a windmill". Further, Bagnall stated: "I would roughly estimate that it would take twice as much energy to fill the tanks and compress the air, as the engine could ever produce. After all, Rogers will have to use more fuel to compress the tanks of air, than the auto would normally use". Rogers, not one to be at a loss for words, countered Bagnall's attack with a chuckle, "The compressor will be continually fuelled simply by the power from the engine itself".

As Rogers later stated in an exclusive Consumer's Guide interview, "I work on one problem at a time. First, they told me it was impossible to run an auto engine on just plain 'pure' simple air - and I said Why? After all, all that gasoline does is create a 'hot' explosion, driving the pistons up and down, and the only reason that it's a hot explosion is because it's ignited. So I got to thinking, no reason why the air has to be hot! Why not just regular cool everyday air like you and I breathe?"

"Sounds good", everyone would say, "but it'll never work!" - "Well, I made it work! I proved it! I not only started it and idled it (for many, many hours), but I took 'em for a drive in it. - Now let 'em tell me it can't work!"

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State Rep. Paul Nuckolls, (R) Fort Myers, who just happens to be on the House Agricultural Committee, sees the Rogers invention as a potential revolutionary breakthrough for the farming industry. Without the high cost of fuel, that the farmers are presently faced with, food prices could be slashed.

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Rep. Nickolls' personal aide Jim Siford, stated to The Guide, "I remember the day we all went down to Lee's for a look. A whole group of us were there. We had heard all types of rumours, and Mr Rogers walked out to his garage with us, explaining "it just simply runs on air." One gent was there with us, whom I dare not name, said "if that thing even starts, I'll consider it a miracle!". Well, Mr Rogers opens up the garage door, and there sits a regular looking 1977 Dodge station wagon. After showing us the modifications, Mr Rogers hops in and not only starts her up, he backs down his driveway and waves to us, as he drives off down the street. You could have knocked us all over with a feather".

Consumers Guide interview with inventor Lee Rogers, by Gerry Keefe:

### ***Air-powered auto is a reality!***

Lee Rogers is a resident of Iona, Florida, a small residential area outside Ft. Myers. He believes he's invented a car that runs on compressed air, no fuel, no combustion, just the power of air trying to free itself from the cylinders of a V-8 engine.

Rogers' idea to run an automobile on compressed air was sparked by the energy crunch two years ago. This idea has been fuelled by his technical progress on the engine, and his desire to change the nature of the auto industry, thus freeing the consumer from spiralling gasoline costs, and cut America's umbilical cord with the energy-rich Arab nations.

Lee began by tinkering with his 1977 Dodge Aspen station wagon. He removed all the gasoline components from his car's engine, including the carburetor, spark plugs, gas tank, fuel pump and exhaust system.

The old Dodge was originally fuelled by pressurised air tanks that Rogers had purchased. He has since designed an air compressor that provides a continuous supply of air to the engine. A conversion kit that he developed, attaches to the engine block, pumping pressurised air into the cylinders - and it works!

"Simply, it just runs on air instead of gas", the 41-year old former home builder says of his first invention, "Instead of gas, it just has air going in to drive the pistons up and down. It's so damn simple that nobody believes it".

That includes Jimmy Carter, the Department of Energy, Ralph Nader and the major US car manufacturers, all of whom Rogers has contacted with little or no response.

Rogers contacted the major auto companies last year and tried to interest them in his idea. But, they apparently wrote him off as a nut and ignored his request to come and see his perpetual motion machine.

Apparently, the Big Three believe him now. After a great deal of publicity and documented facts, they have pooled their bargaining efforts and offered him over a billion dollars for his patent.

"Chrysler and General Motors asked me to send it to them, but they didn't believe that I could turn the engine over", Rogers says with amusement. "Hell, I can let it idle eight hours a day or more, take it on a test run and reach speeds up to 80 miles per hour. And when you look at the engine, it has a nice frosty cool appearance to it and is cold to the touch".

"There's a couple of little tricks to my invention which I haven't told nobody. Even my wife doesn't know about them". Like I told Chrysler; "if you had this idea you could be No. 1 instead of being on the brink of bankruptcy". They said ' Well send it to us. we don't expect it to run'. But they want me to practically sign the patent over to them".

And Rogers has his engine patented to the hilt. he has about \$7,000 of his own money in his own invention so far. Mr Rogers fears that if the big auto companies did buy his creation, they might hold back the production of a car that runs for years with no internal combustion or engine tune-ups. "And if they did make this car, where is the average consumer going to get the \$16,000 or \$20,000 to buy one?" Rogers asks.

Lee Rogers plans to build a "converter kit" that will adapt any American built auto, mass produce them and sell them outright. He feels that if he builds and sells them on his own, he can protect his patent, help the consumer, save his country from the Arab oil squeeze and make a comfortable sum of money to live on.

He touts his invention as one solution to smog and the energy crisis, and says that when it is completed it will run as fast as gasoline-powered engines and revolutionise the industry. "Ford Motors told me the engine would never run on air. They said it's designed to run on combustion only, created by a fuel" Rogers adds. "Nobody believed it would work because they said that if it could work, then they would have done it a long time ago!"

In the process of designing and building his perpetual-motion machine, Lee Rogers had to have every part made at various machine shops. Many times the various parts had to be modified, redesigned or completely remade.

"My invention would turn inflation clear around. If enough American people know about it they're going to push for it. The auto companies could have created this ten years ago. Frank Kelly, my neighbour, who has assisted me in the assembly of the engine, and I, can't change the country by ourselves. We need help from everyone to put pressure on the auto industry to give my engine a chance.

Rogers' 1977 Dodge is currently running at 96% horsepower efficiency compared to only 26% for gasoline powered vehicles. Lee Rogers' air-powered conversion kit (when manufactured) would sell for about \$1,000. The kit should be installed by your local mechanic at a nearby gas station. The car keeps it's battery to power the lights and accessories and to start up the air compressor.

Now, assuming that you have bought the conversion kit and had it installed, you are now ready for you initial test run. But first, you must spend \$14 for a tank of nitrogen to charge all four air tanks which are mounted where the gasoline tank used to be. You have the main tank, and the other three are reserves. The compressor is fuelled simply by power from the engine, and as it runs, it is constantly rebuilding it's own air supply. As one tank empties, another is being filled.... and so on. When the charge gets up to 500 psi, the auto is ready for the highway. the nitrogen is a one-time purchase. It also cleans, blows out all oil and gas residue, cleaning the valves, the engine, and everything else right out to the exhaust.

Now, step into the car, turn on the key, give it some air (by stepping on what used to be the gas pedal) and away you go. The whole concept of the perpetual-motion machine is based loosely on the same theory as

an air-gun. The former gas pedal acts like a trigger and gives you various speeds when you press down on it.

### **Current Problem**

What stands between Lee Rogers marketing the converter kits now, or at some time in the near future, is a slight problem which he hopes to solve soon. At low speeds, the auto uses up the air pressure in about 20 minutes. "The engine does not run fast enough at 5 to 15 mph to rebuild the air supply. The engine has to reach about 2,000 rpm for it to be able to remake it's own supply" chuckles Lee and adds "But it's merely a matter of gearing and some slight changes. I'm very close to solving the problem, very close" he adds and grins.

And grin he should. Lee is on the verge of creating complete havoc in the automotive world which for years has been dependent on the oil and gas companies. And should his design work, the hiss of his air exhausts sweeping across the nation will be topped only by the screaming and yelling of the money-hungry oil and gas magnates pulling their hair out.

### **Modern Day Hero**

In this day and age, when heroes are a rarity, Lee Rogers is certainly destined to be a cult hero. The 41-year old building contractor is gaining a cult following with engineers, mechanics and farmers who call day and night and even stop by his house (the location of which, Rogers is trying to keep Top secret).

The usually calm, soft-spoken man sometimes breaks into a hearty laugh when he recalls what some people have gone through to beg a glimpse of the air-powered engine, or just shake the inventor's hand. A farmer flew in from Wisconsin and wanted to buy 18 conversion kits for his tractors. When he arrived, he still had on his bib overalls.

An older couple named Rogers, drove down from North Carolina, simply to congratulate another Rogers. And on and on it goes ... phone calls, visitors, TV, radio and newspaper reporters ... all hoping to catch a glimpse of the Dodge running on air. All this attention has built up to the point where Rogers is finding a little privacy hard to come by.

He has an unlisted phone number, and for some, the journey to see the perpetual-motion machine ends in disappointment. Lee Rogers' attorney has insisted that all viewing by unknowns be halted and that his "secret" be guarded and kept under lock and key.

Years from now, we may be breathing clean air as we sit on our porch in a rocking chair, telling our grandchildren about the legend of Lee Rogers and how he slew the giants of the auto industry with his creation of a perpetual-motion machine that revolutionised the auto industry and just possibly saved mankind from walking the face of the earth with a gas mask and tank of oxygen strapped to his back to breath with.

Here is a slightly re-worded copy of the Lee Rogers patent:

**Patent US 4,292,804**

**6th October 1980**

**Inventor: Leroy K. Rogers**

## **METHOD AND APPARATUS FOR OPERATING AN ENGINE ON COMPRESSED GAS**

### **ABSTRACT**

The present invention relates to a method and apparatus for operating an engine having a cylinder containing a reciprocating piston driven by a compressed gas. The apparatus comprises a source of compressed gas connected to a distributor which conveys the compressed gas to the cylinder. A valve is provided to admit compressed gas to the cylinder when the piston is in an approximately Top Dead Centre position.

In one embodiment of the present invention, the timing of the opening of the valve is advanced so that the compressed gas is admitted to the cylinder progressively further before the Top Dead Centre position of the piston as the speed of the engine increases.

In a further embodiment of the present invention, a valve actuator is provided which increases the length of time over which the valve remains open to admit compressed gas to the cylinder as the speed of the engine increases.

A still further embodiment of the present invention relates to an apparatus for adapting a conventional internal combustion engine for operation on compressed gas.

US Patent References:

|           |            |             |         |
|-----------|------------|-------------|---------|
| 3,881,399 | May., 1975 | Sagi et al. | 91/187. |
| 3,885,387 | May., 1975 | Simington   | 60/407. |
| 4,018,050 | Apr., 1977 | Murphy      | 60/412. |

## **DESCRIPTION**

### **BACKGROUND AND SUMMARY OF THE PRESENT INVENTION**

The present invention is a method and apparatus for operating an engine using a compressed gas as the motive fluid. More particularly, the present invention relates to a apparatus for adapting a pre-existing internal combustion engine for operation on a compressed gas.

Air pollution is one of the most serious problems facing the world today. One of the major contributors to air pollution is the ordinary internal combustion engine which is used in most motor vehicles today. Various devices, including many items required by legislation, have been proposed in an attempt to limit the pollutants which an internal combustion engine exhausts to the air. However, most of these devices have met with limited success and are often both prohibitively expensive and complex. A clean alternative to the internal combustion engine is needed to power vehicles and other machinery.

A compressed gas, preferably air, would provide an ideal motive fluid for an engine, since it would eliminate the usual pollutants exhausted from an internal combustion engine. An apparatus for converting an internal combustion engine for operation on compressed air is disclosed in U.S. Pat. No. 3,885,387 issued May 27, 1975 to Simington. The Simington patent discloses an apparatus including a source of compressed air and a rotating valve actuator which opens and closes a plurality of mechanical poppet valves. The valves deliver compressed air in timed sequence to the cylinders of an engine through adapters located in the spark plug holes. However, the output speed of an engine of this type is limited by the speed of the mechanical valves and the fact that the length of time over which each of the valves remains open cannot be varied as the speed of the engine increases.

Another apparatus for converting an internal combustion engine for operation on steam or compressed air is disclosed in U.S. Pat. No. 4,102,130 issued July 25, 1978 to Stricklin. The Stricklin patent discloses a device which changes the valve timing of a conventional four stroke engine such that the intake and exhaust valves open once for every revolution of the engine instead of once every other revolution of the engine. A reversing valve is provided which delivers live steam or compressed air to the intake valves and is subsequently reversed to allow the exhaust valves to deliver the expanded steam or air to the atmosphere. A reversing valve of this type however does not provide a reliable apparatus for varying the amount of motive fluid injected into the cylinders when it is desired to increase the speed of the engine. Further, a device of the type disclosed in the Stricklin patent requires the use of multiple reversing valves if the cylinders in a multi-cylinder engine were to be fired sequentially.

Therefore, it is an object of the present invention to provide a reliable method and apparatus for operating an engine or converting an engine for operation with a compressed gas.

A further object of the present invention is to provide a method and apparatus which is effective to deliver a constantly increasing amount of compressed gas to an engine as the speed of the engine increases.

A still further object of the present invention is to provide a method and apparatus which will operate an engine using compressed gas at a speed sufficient to drive a conventional automobile at highway speeds.

It is still a further object of the present invention to provide a method and apparatus which is readily adaptable to a standard internal combustion engine, to convert the internal combustion engine for operation with a compressed gas.

Another object of the invention is to provide a method and apparatus which utilises cool expanded gas, exhausted from a compressed gas engine, to operate an air-conditioning unit and/or an oil-cooler.

These and other objects are realised by the method and apparatus of the present invention for operating an engine having at least one cylinder containing a reciprocating piston and using compressed gas as the motive fluid. The apparatus includes a source of compressed gas, a distributor connected to it for conveying the compressed gas to the cylinder or cylinders. A valve is provided for admitting the compressed gas to the cylinder when the piston is in an approximately Top Dead Centre position within the cylinder. An exhaust is provided for exhausting the expanded gas from the cylinder as the piston returns to approximately the Top Dead Centre position.

In a preferred embodiment of the present invention, a device is provided for varying the duration of each engine cycle over which the valve remains open to admit compressed gas to the cylinder, dependent upon the speed of the engine. In a further preferred embodiment of the present invention, an apparatus for advancing the timing of the opening of the valve is arranged to admit the compressed gas to the cylinder progressively further and further before the Top Dead Centre position of the piston, as the speed of the engine increases.

Further features of the present invention include a valve for controlling the amount of compressed gas admitted to the distributor. Also, a portion of the gas which has been expanded in the cylinder and exhausted through the exhaust valve, is delivered to a compressor to be compressed again and returned to the source of compressed gas. A gear train can be engaged to drive the compressor selectively at different operating speeds, depending upon the pressure maintained at the source of compressed air and/or the speed of the engine. Still further, a second portion of the exhaust gas is used to cool a lubricating fluid for the engine or to operate an air-conditioning unit.

In a preferred embodiment of the present invention, the valve for admitting compressed gas to the cylinder is operated electrically. The device for varying the duration of each engine cycle, over which the intake valve remains open, as the speed of the engine increases, comprises a rotating element whose effective length increases as the speed of the engine increases, causing a first contact on the rotating element to be electrically connected to a second contact on the rotating element, for a longer period of each engine cycle. The second contact operates the valve causing it to remain in an open position for a longer period of each engine cycle, as the speed of the engine increases.

Still further features of the present invention include an adaptor plate for supporting the distributor above the intake manifold of a conventional internal combustion engine after a carburettor has been removed to allow air to enter the cylinders of the engine through the intake manifold and conventional intake valves. Another adaptor plate is arranged over an exhaust passageway of the internal combustion engine to reduce the cross-sectional area of the exhaust passageway.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

Preferred embodiments of a method and apparatus for operating an engine according to the present invention will be described with reference to the accompanying drawings in which components have the same reference numbers in each drawing.

**Fig.1** is a schematic representation of an apparatus according to the present invention arranged on an engine.

**Fig.2** is a side view of one embodiment of a valve actuator according to the present invention.

**Fig.3** is a cross-sectional view taken along the line 3--3 in **Fig.2**.

**Fig.4** is a cross-sectional view of a second embodiment of a valve actuator according to the present invention.

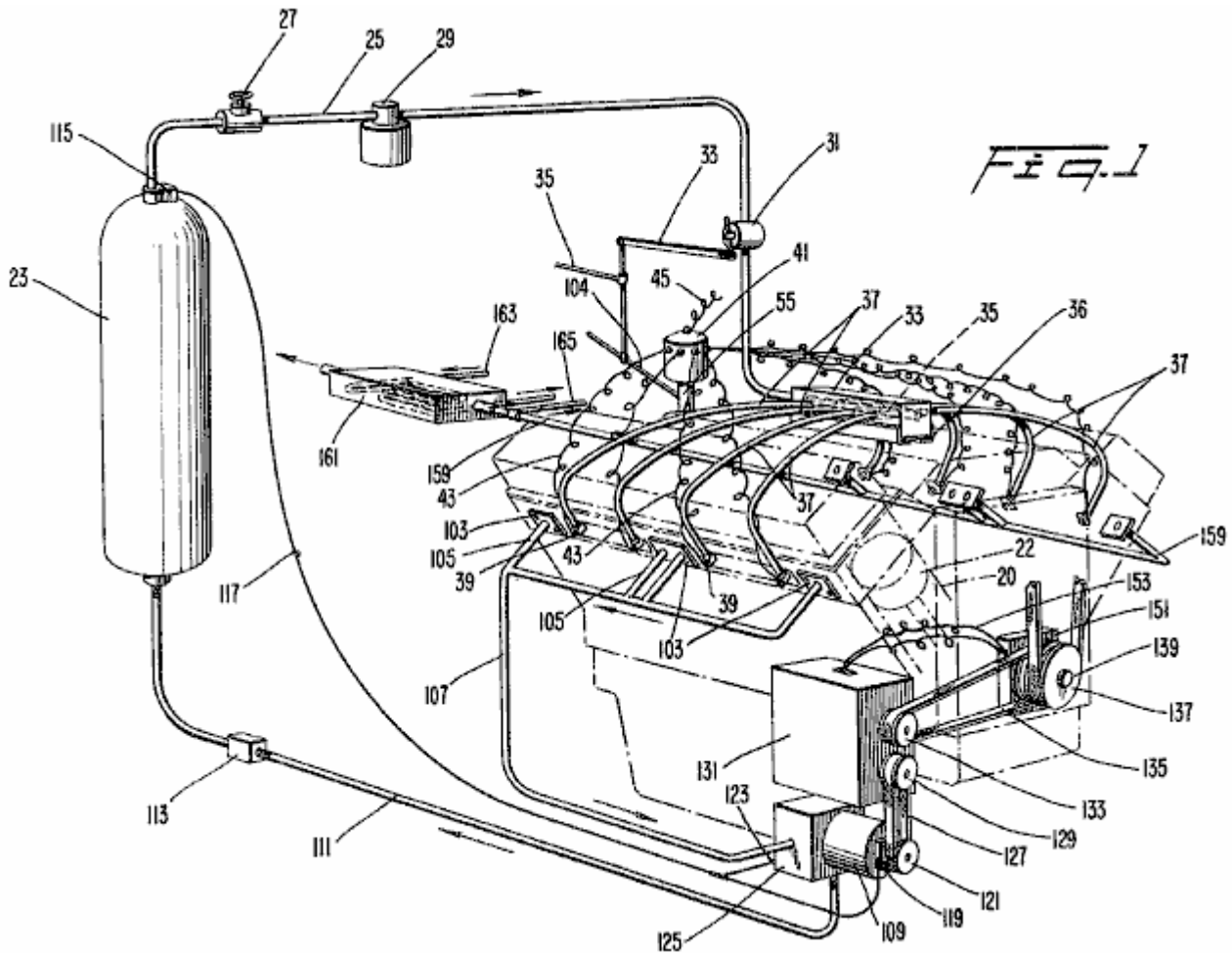
**Fig.5** is a view taken along the line 5--5 in **Fig.4**.

**Fig.6** is a cross-sectional view of a third embodiment of a valve actuator according to the present invention;

**Fig.7** is a view taken along the line 7--7 in **Fig.6**.

**Fig.8** is a cross-sectional view of a gearing unit to drive a compressor according to the present invention.

### **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**



With reference to **Fig.1**, an engine block **21** (shown in phantom) having two banks of cylinders with each bank including cylinders **20** having pistons **22** which reciprocate in them in a conventional manner (only one of which is shown in phantom). While the illustrated engine is a V-8 engine, it will be apparent that the present invention is applicable to an engine having any number of pistons and cylinders with the V-8 engine being utilised for illustration purposes only. A compressed gas tank **23** is provided to store a compressed gas at high pressure. It may also be desirable to include a small electric or gas compressor to provide compressed gas to supplement the compressed gas held in the tank **23**. In a preferred embodiment, the compressed gas is air which can be obtained from any suitable source.

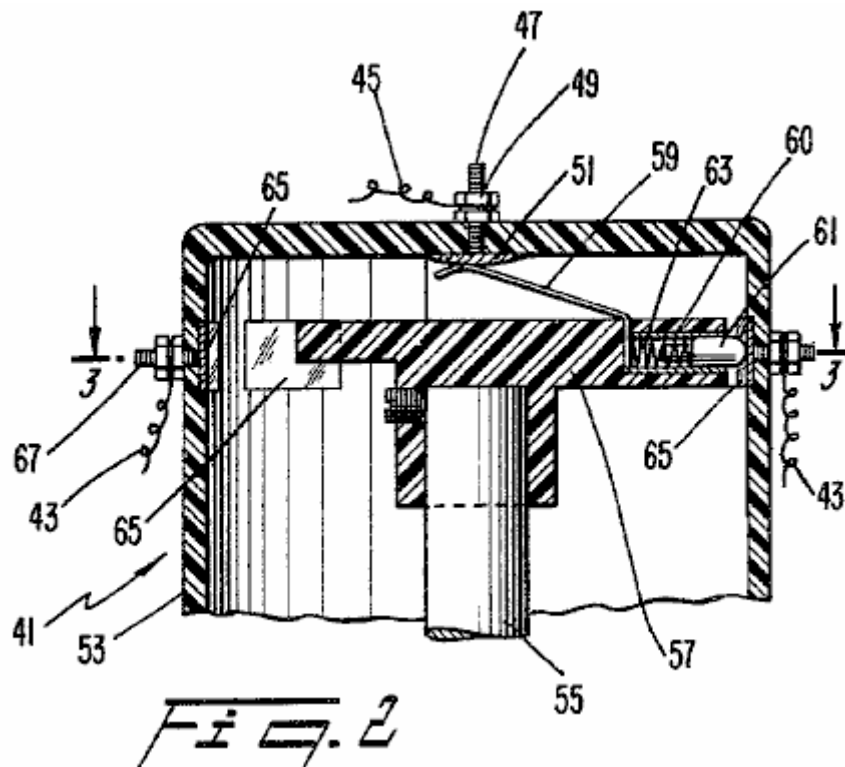
A line **25** transports the gas withdrawn from the tank **23** when a conventional shut-off valve **27** is open. In addition, a solenoid valve **29** preferably operated by a suitable key-operated engine switch (not shown) is also placed in the line **25**. In normal operation, the valve **27** is maintained open at all times with the solenoid valve **29** operating as a selective shut off valve to start and stop the engine **21**.

A suitable regulating valve **31** is arranged downstream of the solenoid valve **29** and is connected by a linkage **33** to a throttle linkage **35** which is operator-actuated by any suitable apparatus such as a foot pedal (not shown). The line **25** enters an end of a distributor **33** and is connected to an end of a pipe **35** which is closed at the other end. A plurality of holes, which are equal to the number of cylinders in the engine **21**, are provided on either side of the pipe **35** along the length of the pipe **35**.

When the present invention is used to adapt a conventional internal combustion engine for operation on compressed gas, an adaptor plate **36** is provided to support the distributor **33** in spaced relation from the usual intake opening in the intake manifold of the engine after a conventional carburettor has been removed. In this way, air is permitted to enter the internal combustion engine through the usual passageways and to be admitted to the cylinders through suitable intake valves (not shown). The adaptor plate **36** is attached to the engine block **21** and the distributor **33** by any suitable apparatus, e.g., bolts.

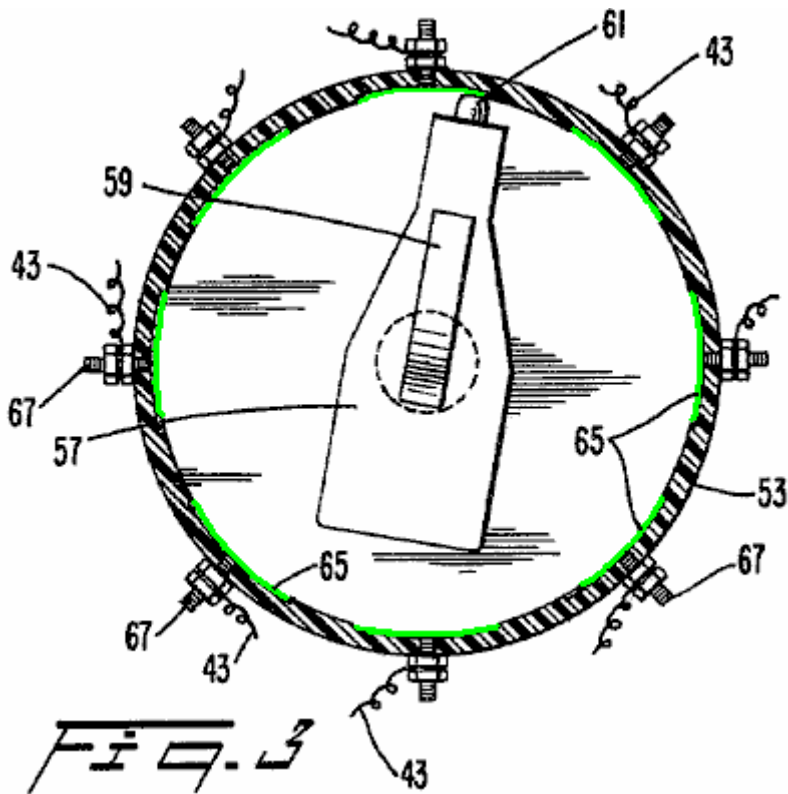
Each of the holes in the pipe **35** is connected in fluid-tight manner to a single line **37**. Each line **37** carries the compressed gas to a single cylinder **20**. In a preferred embodiment, each of the lines **37** is 1/2 inch high pressure plastic tubing attached through suitable connectors to the distributor **33** and the pipe **35**. Each of the lines **37** is connected to a valve **39** which is secured in an opening provided near the top of each of the cylinders **20**. In the case of a conversion of a standard internal combustion engine, the valves **39** can be conveniently screwed into a tapped hole in the cylinder **20** typically provided for a spark plug of the internal combustion engine. In a preferred embodiment, the valves **39** are solenoid actuated valves in order to provide a fast and reliable opening and closing of the valves **39**.

Each of the valves **39** is energised by a valve actuator **41** through one of a plurality of wires **43**. The valve actuator **41** is driven by a shaft of the engine similar to the drive for a conventional distributor of an internal combustion engine. That is, a shaft **55** of the valve actuator **41** is driven in synchronism with the engine **21** at one half the speed of the engine **21**.



A first embodiment of the valve actuator **41** (**Fig.2** and **Fig.3**), receives electrical power through a wire **45** which is energised in a suitable manner by a battery, and a coil if necessary (not shown) as is conventional in an internal combustion engine. The wire **45** is attached to a central post **47** by a nut **49**. The post **47** is connected to a conducting plate **51** arranged in a housing **53** for the valve actuator **41**. Within the housing **53**, the shaft **55** has an insulating element **57** secured to an end of the shaft **55** and rotates with it when the shaft **55** is driven by the engine **21**. A first end of a flexible contact **59** is continuously biased against the conducting plate **51** to receive electricity from the battery or other suitable source. The other end of the contact **59** is connected to a conducting sleeve **60** which is in constant contact with a spring biased contact **61** which is arranged within the sleeve **60**. The contact **61** is pressed by a spring **63** which pushes contact **61** towards a side wall of the housing **53**.

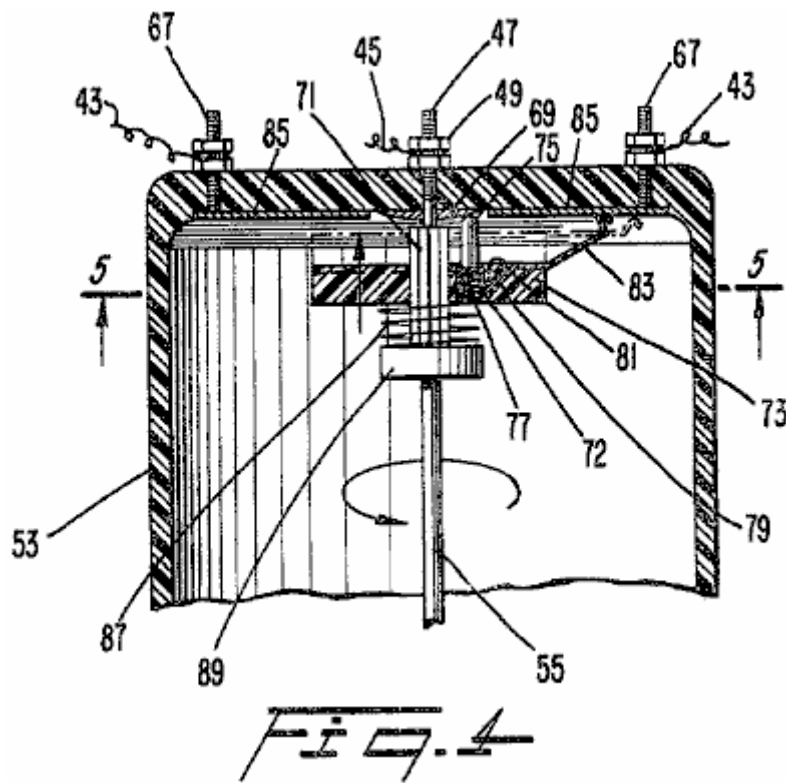




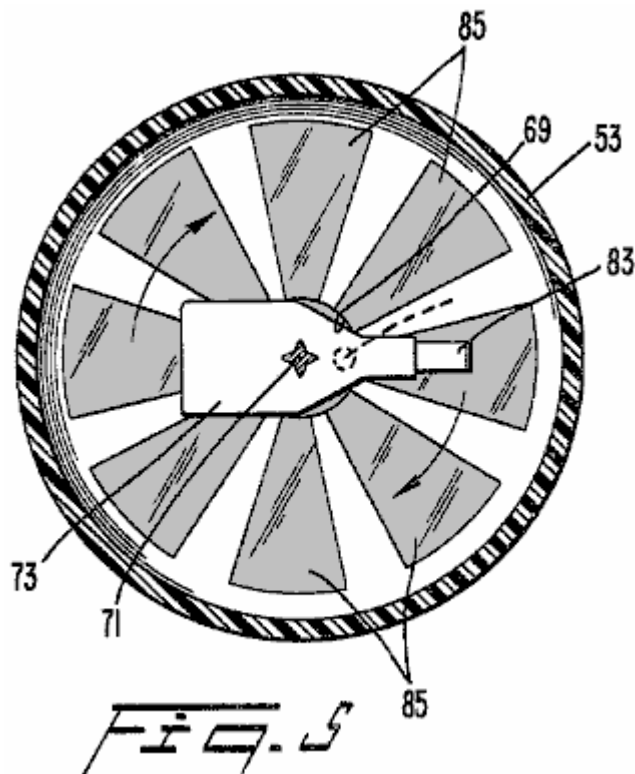
With reference to **Fig.3**, a plurality of contacts **65** are spaced from one another and are arranged around the periphery of the housing **53** at the same level as the spring biased contact **61**. Each contact **65** is electrically connected to a post **67** which extends outside of the housing **53**. The number of contacts **65** is equal to the number of cylinders in the engine **21**. One of the wires **43**, which actuate the valves **39**, is secured to each of the posts **67**.

In operation, as the shaft **55** rotates in synchronism with the engine **21**, the insulating element **57** rotates and electricity is ultimately delivered to successive pairs of the contacts **65** and wires **43** through the spring loaded contact **61** and the flexible contact **59**. In this way, each of the electrical valves **39** is activated and opened in the proper timed sequence to admit compressed gas to each of the cylinders **20** to drive the pistons **22** on a downward stroke.

The embodiment illustrated in **Fig.2** and **Fig.3** is effective in causing each of the valves **39** to remain open for a long enough period of time to admit sufficient compressed gas to each of the cylinders **20** of the engine **21** to drive the engine **21**. The length of each of the contacts **65** around the periphery of the housing **53** is sufficient to permit the speed of the engine to be increased when desired by the operator by moving the throttle linkage **35** which actuates the linkage **33** to further open the regulating valve **31** to admit more compressed gas from the tank **23** to the distributor **33**. However, it has been found that the amount of air admitted by the valves **39** when using the first embodiment of the valve actuator **41** (**Fig.2** and **Fig.3**) is substantially more than required to operate the engine **21** at an idling speed. Therefore, it may be desirable to provide a valve actuator **41** which is capable of varying the duration of each engine cycle over which the solenoid valves **39** are actuated, i.e., remain open to admit compressed gas, as the speed of the engine **21** is varied.



A second embodiment of a valve actuator 41 which is capable of varying the duration of each engine cycle over which each of the valves 39 remains open to admit compressed gas to the cylinders 20 dependent upon the speed of the engine 21 will be described with reference to Fig. 4 and Fig. 5 wherein members corresponding to those of Fig. 2 and Fig. 3 bear like reference numbers. The wire 45 from the electricity source is attached to the post 47 by the nut 49. The post 47 has an annular contact ring 69 electrically connected to an end of the post 47 and arranged within the housing 53. The shaft 55 rotates at one half the speed of the engine as in the embodiment of Fig. 2 and Fig. 3.



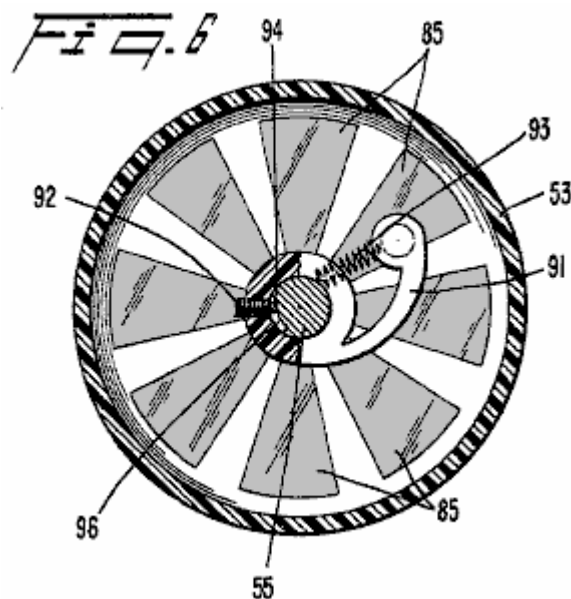
At an upper end of the shaft 55, a splined section 71 receives a sliding insulating member 73. The splined section 71 of the shaft 55 holds the insulating member 73 securely as it rotates with shaft 55 but permits the

insulating member **73** to slide axially along the length of the splined section **71**. Near the shaft **55**, a conductive sleeve **72** is arranged in a bore **81** in an upper surface of the insulating element **73** generally parallel to the splined section **71**. A contact **75**, biased towards the annular contact ring **69** by a spring **77**, is arranged within the conductive sleeve **72** and in contact with it. The conductive sleeve **72** also contacts a conductor **79** at a base of the bore **81**.

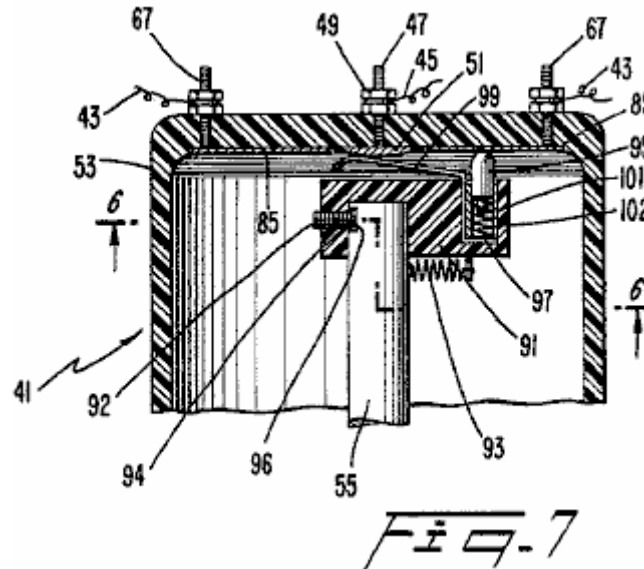
The conductor **79** extends to the upper surface of the insulating element **73** near an outer periphery of the insulating element **73** where the conductor **79** is electrically connected to a flexible contact **83**. The flexible contact **83** connects, one after the other, with a series of radial contacts **85** which are positioned on an upper inside surface of the housing **53**. A weak spring **87** arranged around the splined section **71** engages a stop member **89** secured on the shaft **55** and the insulating element **73** to slightly bias the insulating element **73** towards the upper inside surface of the housing **53** to ensure contact between the flexible contact **83** and the upper inside surface of the housing **53**. As best seen in **Fig.5**, the radial contacts **85** on the upper inside surface of the housing **53** are arranged generally in the form of radial spokes extending from the centre of the housing **53** with the number of contacts being equal to the number of cylinders **20** in the engine **21**. The number of degrees covered by each of the radial contacts **85** gradually increases as the distance from the centre of the upper inside surface of the housing **53** increases.

In operation of the device of **Fig.4** and **Fig.5**, as the shaft **55** rotates, electricity flows along a path through the wire **45** down through post **47** to the annular contact member **69** which is in constant contact with the spring biased contact **75**. The electrical current passes through the conductive sleeve **72** to the conductor **79** and then to the flexible contact **83**. As the flexible contact **83** rotates along with the insulating member **73** and the shaft **55**, the tip of the flexible contact **83** successively engages each of the radial contacts **85** on the upper inside of the housing **53**. As the speed of the shaft **55** increases, the insulating member **73** and the flexible contact **83** attached to it, move upwards along the splined section **71** of the shaft **55** due to the radial component of the splines in the direction of rotation under the influence of centrifugal force. As the insulating member **73** moves upwards, the flexible contact **83** is bent so that the tip of the contact **83** extends further outwards radially from the centre of the housing **53** (as seen in phantom lines in **Fig.4**). In other words, the effective length of the flexible contact **83** increases as the speed of the engine **21** increases.

As the flexible contact **83** is bent and the tip of the contact **83** moves outwards, the tip remains in contact with each of the radial contacts **85** for a longer period of each engine cycle due to the increased angular width of the radial contacts with increasing distance from the centre of the housing **53**. In this way, the length of time over which each of the valves **39** remains open is increased as the speed of the engine is increased. Thus, a larger quantity of compressed gas or air is injected into the cylinders as the speed increases. Conversely, as the speed decreases and the insulating member **73** moves downwards along the splined section **71**, a minimum quantity of air is injected into the cylinder due to the shorter length of the individual radial contact **85** which is in contact with the flexible contact **83**. In this way, the amount of compressed gas that is used during idling of the engine **21** is at a minimum whereas the amount of compressed gas which is required to increase the speed of the engine **21** to a level suitable to drive a vehicle on a highway is readily available.



Shown in **Fig.6** and **Fig.7**, is a third embodiment of a valve actuator **41** according to the present invention. This embodiment includes a curved insulating element **91** having its first end able to pivot, being secured by any suitable device such as screw **92** to the shaft **55** for co-rotation with the shaft **55**. The screw **92** is screwed into a tapped hole in the insulating element **91** so that a tab **94** at an end of the screw **92** engages a groove **96** provided in the shaft **55**. In this way, the insulating element **91** rotates positively with the shaft **55**. However, as the shaft **55** rotates faster, the other end **98** of the insulating element **91** is permitted to pivot outwards under the influence of centrifugal force because of the groove **96** provided in the shaft **55**. A spring **93**, connected between the second end **98** of the element **91** and the shaft **55** urges the second end of the element **91** towards the centre of the housing **53**.



A contact **99** similar to the contact **59** (Fig.2) is arranged so that one end of the contact piece **99** is in constant contact with the conducting plate **51** located centrally within the housing **53**. The other end of the contact **99** engages a conductive sleeve **101** arranged in bore **102**. A contact element **95** is arranged in the conductive sleeve **101** in constant contact with the sleeve **101**. The bore **102** is arranged generally parallel to the shaft **55** near the second end of the curved insulating element **91**. The contact **95** is biased by a spring **97** towards the upper inside surface of the housing **53** for selective contact with each of the plurality of radial contacts **85** which increase in arc length towards the outer peripheral surface of the housing **53** (**Fig.6**).

When the device shown in **Fig.6** and **Fig.7** is operating, as the shaft **55** rotates the curved insulating element **91** rotates with the shaft **55** and the second end **98** of the insulating element **91** tends to pivot about the shaft **55** due to centrifugal force. Thus, as the effective length of the contact **95** increases, i.e., as the curved insulating element **91** pivots further outwards, the number of degrees of rotation over which the contact **95** is in contact with each of the radial contacts **85** on the upper inside surface of the housing **53** increases thereby allowing each of the valves **39** to remain open for a longer period of each engine cycle, which in turn, allows more compressed gas enter the respective cylinder **20** to further increase the speed of the engine **21**.

With reference to **Fig.1**, a mechanical advance linkage **104** which is connected to the throttle linkage **35**, advances the initiation of the opening of each valve **39** such that compressed gas is injected into the respective cylinder further before the piston **22** in the respective cylinder **20** reaches a Top Dead Centre position as the speed of the engine is increased by moving the throttle linkage **35**. The advance linkage **104** is similar to a conventional standard mechanical advance employed on an internal combustion engine. In other words, the linkage **104** varies the relationship between the angular positions of a point on the shaft **55** and a point on the housing **53** containing the contacts. Alternatively, a conventional vacuum advance could also be employed. By advancing the timing of the opening of the valves **39**, the speed of the engine can more easily be increased.

The operation of the engine cycle according to the present invention will now be described. The compressed gas injected into each cylinder of the engine **21** drives the respective piston **22** downwards to rotate a conventional crankshaft (not shown). The movement of the piston downwards causes the

compressed gas to expand rapidly and cool. As the piston **22** begins to move upwards in the cylinder **20** a suitable exhaust valve (not shown), arranged to close an exhaust passageway, is opened by any suitable apparatus. The expanded gas is then expelled through the exhaust passageway. As the piston **22** begins to move downwards again, a suitable intake valve opens to admit ambient air to the cylinder. The intake valve closes and the ambient air is compressed on the subsequent upward movement of the piston until the piston reaches approximately the Top Dead Centre position at which time the compressed gas is again injected into the cylinder **20** to drive the piston **22** downwards and the cycle begins again.

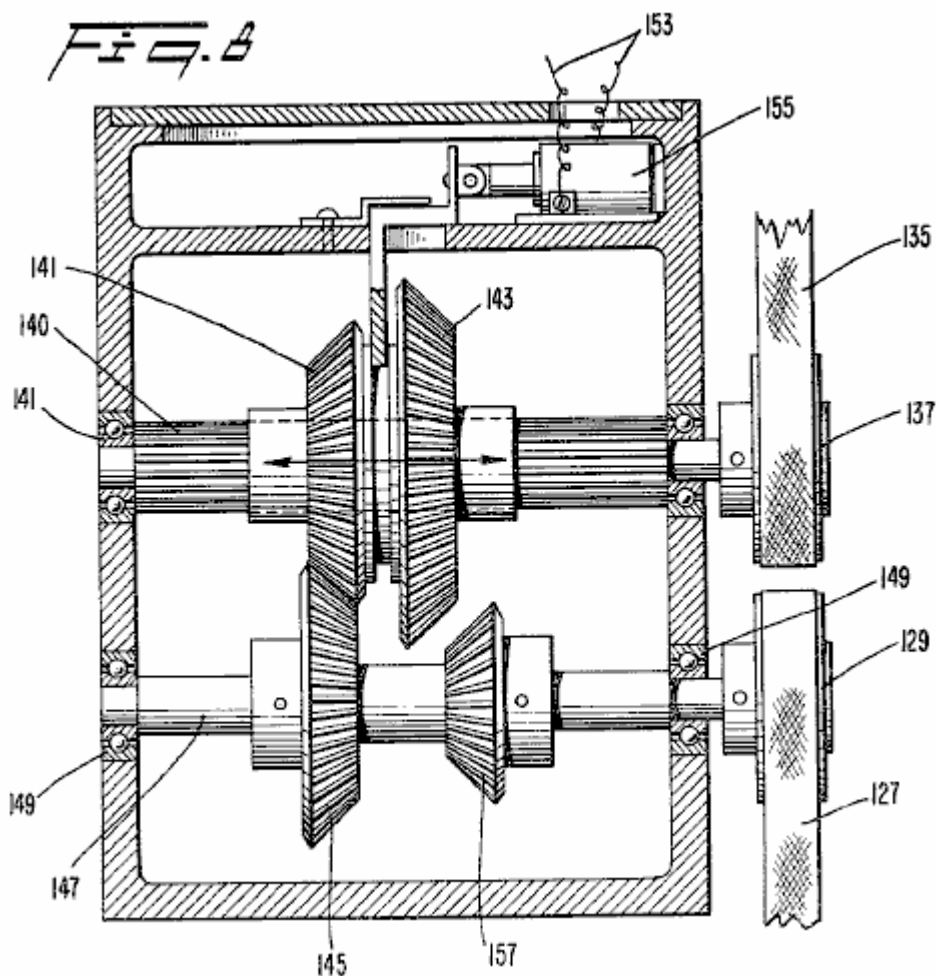
In the case of adapting a conventional internal combustion engine for operation on compressed gas, a plurality of plates **103** are arranged, preferably over an end of the exhaust passageways, in order to reduce the outlet size of the exhaust passageways of the conventional internal combustion engine. In the illustrated embodiment, a single plate having an opening in the centre is bolted to the outside exhaust passageway on each bank of the V-8 engine, while another single plate having two openings in it, is arranged with one opening over each of the interior exhaust passageways on each bank of the V-8 engine. A line **105** is suitably attached to each of the adaptor plates to carry the exhaust to an appropriate location. In a preferred embodiment, the exhaust lines **105** are made from 1.5" plastic tubing.

In a preferred embodiment, the exhaust lines **105** of one bank of the V-8 engine are collected in a line **107** and fed to an inlet of a compressor **109**. The pressure of the exhaust gas emanating from the engine **21** according to the present invention is approximately 25 p.s.i. In this way, the compressor **109** does not have to pull the exhaust into the compressor since the gas exhausted from the engine **21** is at a positive pressure. The positive pressure of the incoming fluid increases the efficiency and reduces wear on the compressor **109**. The exhaust gas is compressed in the compressor **109** and returned through a line **111** and a check valve **113** to the compressed gas storage tank **23**. The check valve **113** prevents the flow of compressed gas stored in the tank **23** back towards the compressor **109**.

A suitable pressure sensor **115** is arranged at an upper end of the tank **23** and sends a signal along a line **117** when the pressure exceeds a predetermined level and when the pressure drops below a predetermined level. The line **117** controls an electrically activated clutch **119** positioned at the front end of the compressor **109**. The clutch **119** is operated to engage and disengage the compressor **109** from a drive pulley **121**. Also, the signal carried by the line **117** activates a suitable valve **123** arranged on compressor housing **125** to exhaust the air entering the compressor housing **125** from the line **107** when the clutch **119** has disengaged the compressor **109** from the drive pulley **121**.

In a preferred embodiment, when the pressure in the tank **23** reaches approximately 600 p.s.i., the clutch **119** is disengaged and the compressor **109** is deactivated and the valve **123** is opened to exhaust the expanded gas delivered to the compressor **109** from the line **107** to the atmosphere. When the pressure within the tank **23** drops below approximately 500 p.s.i., the sensor **115** sends a signal to engage the clutch **119** and close the valve **123**, thereby operating the compressor **109** for supplying the tank **23** with compressed gas.

The pulley **121** which drives the compressor **109** through the clutch **119** is driven by a belt **127** which is driven by a pulley **129** which operates through a gear box **131**. With reference to **Fig.1** and **Fig.8**, a second pulley **133** on the gear box is driven by a belt **135** from a pulley **137** arranged on a drive shaft **139** of the engine **21**. The pulley **137** drives a splined shaft **140** which has a first gear **141** and a second larger gear **143** placed on it, which rotates with the splined shaft **140**. The splined shaft **140** permits axial movement of the gears **141** and **143** along the shaft **140**.



In normal operation (as seen in **Fig.8**), the first gear **141** engages a third gear **145** arranged on a shaft **147** which drives the pulley **129**. The shafts **140** and **147** are arranged in suitable bearings **149** positioned at each end of it. When the speed of the engine **21** drops below a predetermined level, a suitable sensor **151** responsive to the speed of the drive shaft **139** of the engine **21** generates a signal which is transmitted through a line **153** to a solenoid actuator **155** arranged within the gear box **131**. The solenoid actuator **155** moves the first and second gears **141**, **143** axially along the splined shaft **140** to the right as seen in **Fig.8** so that the second, larger gear **143** engages a fourth smaller gear **157** which is arranged on the shaft **147**. The ratio of the second gear **143** to the fourth gear **157** is preferably approximately 3 to 1.

In this way, when the speed of the engine **21** drops below the predetermined level as sensed by the sensor **151** (which predetermined level is insufficient to drive the compressor **109** at a speed sufficient to generate the 500-600 pounds of pressure which is preferably in the tank **23**), the solenoid actuator **155** is energised to slide the gears **143**, **141** axially along the splined shaft **140** so that the second, larger gear **143** engages the fourth, smaller gear **157** to drive the pulley **129** and hence the compressor **109** at a higher rate, to generate the desired pressure. When the speed of the engine increases above the predetermined level, which, in a preferred embodiment is approximately 1500 rpm, the solenoid actuator **155** is deactivated by the sensor **151** thereby moving the gears **143** and **141** to the left as seen in **Fig.8** so that the first gear **141**, engages again with the third gear **145** to effectuate a 1 to 1 ratio between the output shaft **139** of the engine **21** and the pulley **129**.

The other bank of the V-8 engine has its exhaust ports arranged with adapter plates **103** similar to those on the first bank. However, the exhaust from this bank of the engine **21** is not collected and circulated through the compressor **109**. In a preferred embodiment, a portion of the exhaust is collected in a line **159** and fed to an enlarged chamber **161**. A second fluid is fed through a line **163** into the chamber **161** to be cooled by the cool exhaust emanating from the engine **21** in the line **159**. The second fluid in the line **163** may be either transmission fluid contained in a transmission associated with the engine **21** or a portion of the oil used to lubricate the engine **21**. A second portion of the exhaust from the second bank of the V-8 engine is removed from the line **159** in a line **165** and used as a working fluid in an air conditioning system or for any other suitable use.

It should be noted that the particular arrangement utilised for collecting and distributing the gas exhausted from the engine **21** would be determined by the use for which the engine is employed. In other words, it may be advantageous to rearrange the exhaust tubing such that a larger or smaller percentage of the exhaust is routed through the compressor **109**. It should also be noted that since the exhaust lines **105** are plastic tubing, a rearrangement of the lines for a different purpose is both simple and inexpensive.

In operation of the engine of the present invention, the engine **21** is started by energising the solenoid valve **29** and any suitable starting device (not shown), e.g., a conventional electric starter as used on an internal combustion engine. Compressed gas from the full tank **23** flows through the line **25** and a variable amount of the compressed gas is admitted to the distributor **33** by controlling the regulator valve **31** through the linkage **33** and the operator actuated throttle linkage **35**. The compressed gas is distributed to each of the lines **37** which lead to the individual cylinders **20**. The compressed gas is admitted to each of the cylinders **20** in timed relationship to the position of the pistons within the cylinders by opening the valves **39** with the valve actuator **41**.

When it is desired to increase the speed of the engine, the operator moves the throttle linkage **35** which simultaneously admits a larger quantity of compressed gas to the distributor **33** from the tank **23** by further opening the regulator valve **31**. The timing of the valve actuator **41** is also advanced through the linkage **104**. Still further, as the speed of the engine **21** increases, the effective length of the rotating contact **83** (**Fig.4**) or **95** (**Fig.6**) increases thereby electrically contacting a wider portion of one of the stationary radial contacts **85** to cause each of the valves **39** to remain open for a longer period of each engine cycle to admit a larger quantity of compressed gas to each of the cylinders **20**.

As can be seen, the combination of the regulating valve **31**, the mechanical advance **104**, and the valve actuator **41**, combine to produce a compressed gas engine which is quickly and efficiently adaptable to various operating speeds. However, all three of the controls need not be employed simultaneously. For example, the mechanical advance **104** could be utilised without the benefit of one of the varying valve actuators **41** but the high speed operation of the engine may not be as efficient. By increasing the duration of each engine cycle over which each of the valves **39** remains open to admit compressed gas to each of the cylinders **20** as the speed increases, conservation of compressed gas during low speed operation and efficient high speed operation are both possible.

After the compressed gas admitted to the cylinder **20** has forced the piston **22** downwards within the cylinder to drive the shaft **139** of the engine, the piston **22** moves upwards within the cylinder **20** and forces the expanded gas out through a suitable exhaust valve (not shown) through the adapter plate **103** (if employed) and into the exhaust line **105**. The cool exhaust can then be collected in any suitable arrangement to be compressed and returned to the tank **23** or used for any desired purpose including use as a working fluid in an air conditioning system or as a coolant for oil.

When using the apparatus and method of the present invention to adapt a ordinary internal combustion engine for operation with compressed gas it can be seen that considerable savings in weight are achieved. For example, the ordinary cooling system including a radiator, fan, hoses, etc. can be eliminated since the compressed gas is cooled as it expands in the cylinder. In addition, there are no explosions within the cylinder to generate heat. Further reductions in weight are obtained by employing plastic tubing for the lines which carry the compressed gas between the distributor and the cylinders and for the exhaust lines. Once again, heavy tubing is not required since there is little or no heat generated by the engine of the present invention. In addition, the noise generated by an engine according to the present invention is considerably less than that generated by an ordinary internal combustion engine since there are no explosions taking place within the cylinders.

The principles of preferred embodiments of the present invention have been described in the foregoing specification. However, the invention which is intended to be protected is not to be construed as limited to the particular embodiments disclosed. The embodiments are to be regarded as illustrative rather than restrictive. Variations and changes may be made by others without departing from the spirit of the invention. Accordingly, it is expressly intended that all such variations and changes which fall within the spirit and the scope of the present invention as defined in the appended claims be embraced thereby.

## **CLAIMS**

What is claimed is:

1. An apparatus for operating an engine having at least one cylinder and a reciprocating piston therein comprising:

A source of compressed gas;

Distributor means connected with the source of compressed gas for distributing the compressed gas to at least one cylinder;

Valve means for admitting the compressed gas to the at least one cylinder when the piston is in approximately a Top Dead Centre position within the cylinder;

Altering means for increasing the duration of each engine cycle over which the valve means admits compressed gas to the at least one cylinder as the speed of the engine increases; and

Exhaust means for exhausting gas as the piston subsequently approaches approximately the Top Dead Centre position.

2. The apparatus of claim 1 further comprising control means for controlling the amount of compressed gas admitted to the distributor means.
3. The apparatus of claim 1 wherein the valve means is a solenoid valve secured in an opening in the cylinder above the level of the piston at the Top Dead Centre position.
4. The apparatus of claims 1 or 2 further comprising means for advancing the timing of the valve means as the speed of the engine increases such that compressed gas is admitted progressively further before the Top Dead Centre position as the speed of the engine increases.
5. The apparatus of claim 4 wherein the means for advancing the timing comprises a mechanical linkage connected to an operator actuated accelerator linkage.
6. The apparatus of claim 1 wherein a portion of the gas exhausted through the exhaust means is compressed in a compressor driven by an output shaft of the engine and is returned to the source of compressed gas.
7. The apparatus of claim 1 wherein a portion of the gas exhausted through the exhaust means is used to cool transmission fluid for a transmission associated with the engine.
8. The apparatus of claim 1 wherein a portion of the gas exhausted through the exhaust means is used as a working fluid in an air conditioning system.
9. The apparatus of claim 6 further comprising first gearing means interposed between the output shaft of the engine and the compressor for increasing the speed at which the compressor is driven.
10. The apparatus of claim 6 further comprising clutch means attached to the compressor both for disengaging the compressor from the output shaft of the engine when a first predetermined pressure at the source of compressed gas is exceeded and for engaging the compressor with the output shaft of the engine when the pressure at the source of compressed gas drops below a second predetermined pressure.
11. The apparatus of claim 9 further comprising means for both disengaging the first gearing means when a predetermined speed of the engine is exceeded and engaging a second gearing means for driving the compressor at a speed slower than the first gearing means when the predetermined speed of the engine is exceeded.
12. The apparatus of claim 1 wherein the valve means is electrically actuated and wherein the altering means comprises:

A rotating member timed with the at least one cylinder and arranged within a housing;

First and second contacts arranged on a first end of the rotating member and on an inside surface of the housing, respectively;



Means for increasing the distance of the first contact from the rotational axis of the rotating member as the speed of the engine increases such that the first contact moves radially outwards within the housing; and

Said second contact presenting a longer arc length to the first contact as the distance of the first contact from the rotational axis of the rotating member increases.

13. The apparatus of claim 12 wherein the rotating member comprises an curved arm and wherein the means for increasing the distance of the first contact comprises pivotally mounting a second end of the curved arm about the axis of rotation of the rotating member and spring means for biasing the first end of the curved arm towards a radially inward position whereby the first end of the curved arm pivots radially outwards as the speed of the engine increases.
14. The apparatus of claim 12 wherein the rotating member is axially slidably received on a rotating shaft for co-rotation therewith, said shaft having splines with a radial component in the direction of rotation, and wherein the first contact comprises a flexible contact located on an upper surface of the rotating member, said flexible contact being biased against the inside surface of the housing which carries the second contacts whereby as the speed of the engine increases the rotating member is urged axially along the splined shaft towards the inside surface of the housing such that the flexible contact is forced radially outwards along the inside surface.
15. The apparatus of claim 12 wherein the second contact comprises of radially extending conductor arranged on an upper inside surface of the housing, said conductor increasing in arc length as the conductor extends radially outwards from a central portion of the housing.
16. An apparatus for adapting an internal combustion engine for operation with compressed gas, the internal combustion engine having at least one cylinder, a piston reciprocable within the at least one cylinder, intake and exhaust means disposed in the at least one cylinder, and a tapped hole in the at least one cylinder adapted to receive a spark plug, the apparatus comprising:

A source of compressed gas;

Distributor means connected with the source of compressed gas for distributing the compressed gas to the at least one cylinder;

Valve means arranged in the tapped hole for admitting the compressed gas to the at least one cylinder when the piston is in approximately a Top Dead Centre position within the cylinder; and

Altering means for increasing the duration of each engine cycle over which the valve means remains open to admit the compressed gas as the speed of the engine increases.

17. An apparatus as in claim 16 further comprising first adapter plate means for supporting the distributor means above an intake manifold of the engine, which adaptor plate means allows ambient air to enter through the intake manifold.
18. The apparatus of claim 16 further comprising second adapter plate means for reducing the exit area of the exhaust means.
19. A method of operating an engine on compressed gas, said engine having at least one cylinder and a piston reciprocable therein comprising the steps of:

Delivering compressed gas from a source to a distributor;

Distributing the compressed gas to the at least one cylinder;

Admitting compressed gas to the at least one cylinder through an intake valve when the piston is at approximately a top dad centre position;

Increasing the duration of each engine cycle over which compressed gas is admitted to the at least one cylinder as the engine speed increases; and

Exhausting the remaining gas when the piston subsequently reaches approximately the Top Dead Centre position.

- 20.** The method of claim 19 further comprising the step of controlling the amount of compressed gas which is delivered to the distributor.
- 21.** The method of claim 19 further comprising the step of advancing the timing of the opening of the intake valve as the speed of the engine increases.
- 22.** An apparatus for operating an engine having at least one cylinder and a piston reciprocable therein on compressed gas comprising:

A source of compressed gas;

Distributor means connected with the source of compressed gas for distributing the compressed gas to the at least one cylinder;

Electrically actuated valve means secured in an opening in the at least one cylinder for selectively admitting compressed gas to the at least one cylinder when the piston is in approximately a Top Dead Centre position; and

Means for advancing the timing of the valve means as the speed of the engine increases whereby compressed gas is admitted progressively further before the Top Dead Centre position as the speed of the engine increases.