ADS 37 CFR 1.76 Technical Disclosure

Pressure Lifted Valve

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U.S. Patent and Trademark Office
U.S. DEPARTMENT OF COMMERCE
Alexandria, VA 22313

Project:	**PROVISIONAL PATENT APPLICATION under 37 CFR § 1.53(c)**	
Subject:	**Pressure Lifted Valve for Internal Combustion Engines**	
	ECS Document Number	**12032021**
Reference 1:	**USPTO Customer Number**	**185781**
Reference 2:	**USPTO Application Number**	**63323425**
Reference 2:	**Application Data Sheet 37 CFR 1.76 Pressure Lifted Valve**	
Purpose:	**Definition of Pressure Lifted Valve (PLV) invention for patent claim.**	
Date:	**March 24, 2022**	**(USPTO Receipt Date 03-24-2022)**

Prepared for: **USPTO EFS submission.**

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Abstract

This patent application presents an alternative to camshaft driven spring loaded stem valves employed in the internal combustion engine (ICE). The **Pressure Lifted Valve** (PLV), introduced here, is designed for use as an exhaust port. The PLV is an improvement over camshaft driven stem valves for maximizing fuel efficiency and turbo performance. The PLV opens by force of cylinder head pressure when triggered and closes with no opposing forces. It offers accelerated exhaust gas purge. The PLV can optimize fuel efficiency by variation of timing, duration, and overlap. It is external to the combustion chamber allowing unlimited design of piston topography. PLVs are mechanically independent of other valves and can short the power stroke during no-load condition to maintain turbo speed. The PLV, paired with the **Axial Engine Valve** (AEV) significantly enhances turbo-charging. **(The AEV is the subject of a separate patent application)** Additionally, the PLV can employ cylinder deactivation strategies engaging all cylinders.

The PLV details are presented in **3D Solid Model CAD** drawings and text. The invention is the product of a quest for a valve system controlled by digital electronic signal, offering flexible dynamic control of the combustion cycle.

Exhaust port PLVs paired with intake port AEVs create a digital electronic controlled combustion cycle engine (DE3C). The PCM fired PLV achieves the four design goals listed below. The PLV can be camshaft driven and achieve design goals 1 and 2, however, camshaft limitations apply. PLVs can also be used as intake valves, where a single throttle body ducts air into a multi-cylinder plenum. DE3C technology extends the life of the internal combustion engine relative to advancing electric technologies. The PLV driven by either camshaft or linear force device can improve many applications of the internal combustion engine.

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Design Goals – Pressure Lifted Valve

1. Increase the fuel efficiency of the internal combustion engine.
2. Reduce the internal rotating friction of the ICE.
3. Reduce the number of components in the ICE.
4. Achieve digital electronic control of the combustion cycle.

Section 1. Pressure Lifted Valve (PLV) Presentation

A. Definition

The Pressure Lifted Valve is a mechanical assembly positioned at the head of an ICE cylinder. It acts as the exhaust port. There are two sections, upper and lower. The upper section is the trigger, and the lower is the port. The sections are atmospherically isolated. The trigger section contains a radial array of ball bearing locks, lock seats, and a release sear. Downward motion of the sear and armature assembly expands the locking ball bearings radially outward into their seats. There is no opposing force of spring, compression, or combustion during the valve closing stroke. The force of combustion against the lower section port is held by the ball locks. At point of release the port blows open. The sear and PLV armature can be driven by any high acceleration linear actuator: Voice Coil Actuator (VCA), solenoid, pneumatic cylinder, cam drive, or rotary device.

B. Description of Example Engine Application

The PLV is applicable to all internal combustion engines of any number of cylinders, cylinder orientations, and fuel types. For purpose of patent illustration, a 90 degree V8 engine (eight cylinders) is depicted. The example borrows the metrics of the Ford 4.6 Liter modular V8 engine, 90.2 mm bore, x 90 mm stroke. The dimensions depicted for the valve characteristics are specific to this 4.6 liter engine example and have no specific import to the overall invention design.

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C. The Pressure Lifted Valve (PLV), graphic presentation.

Figure 1. The PLV. 35 mm port diameter. Mechanical assembly, without actuator.

A. Component Parts

1. **body**
2. **armature**
3. **sear**
4. **35 mm diameter valve body**
5. **lock ball seats (6)**
6. **chrome steel ball bearings, 6.35 mm diameter (6)**

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Figure 2. PLV body, rendered and line drawn.

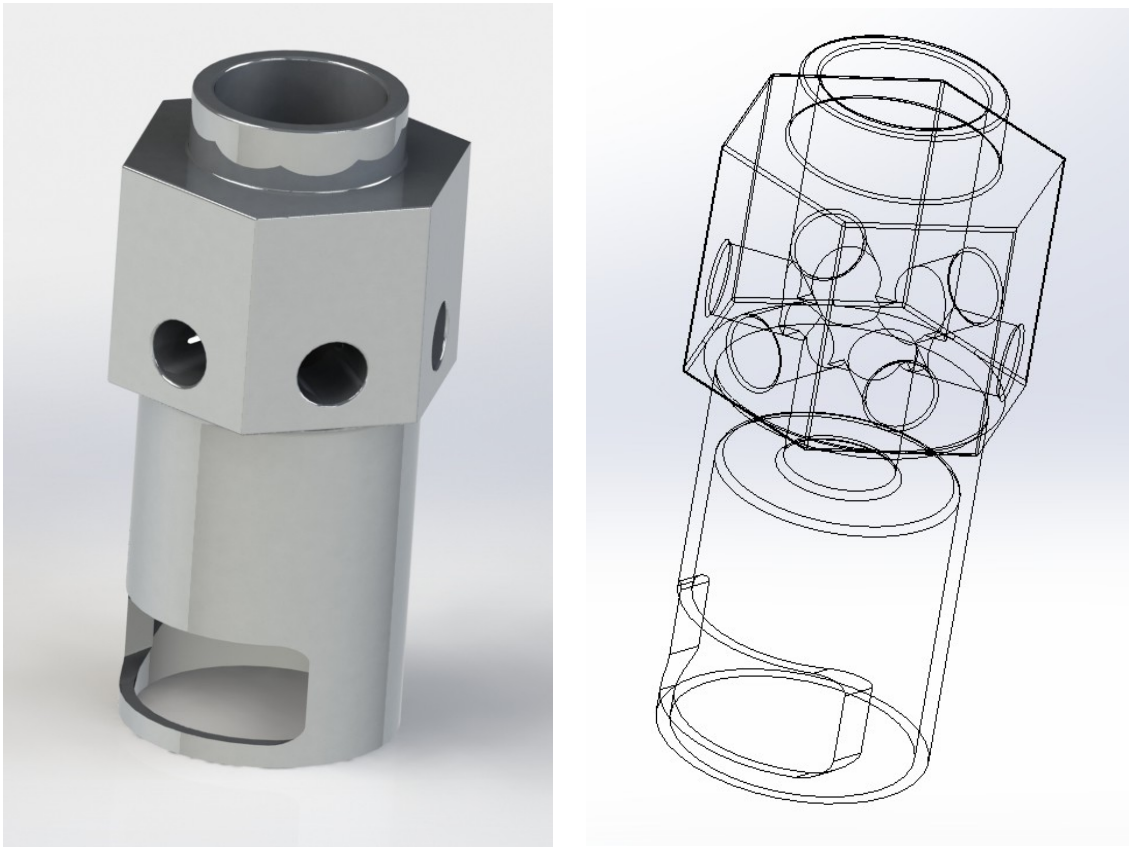

Figure 3. PLV sear.

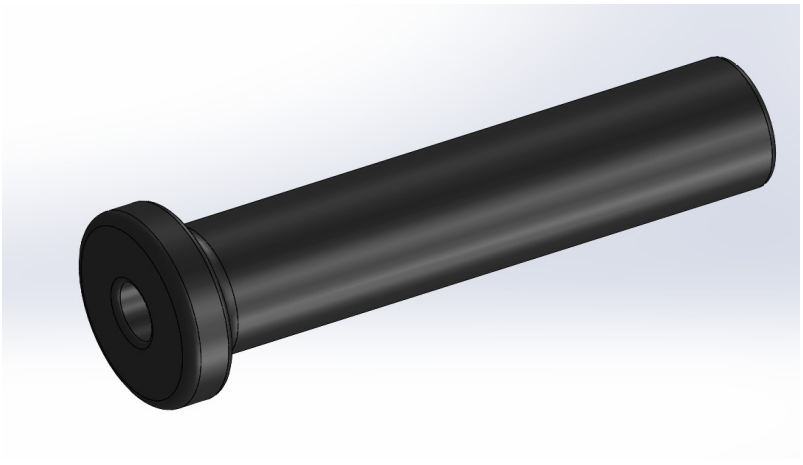

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Figure 4. PLV armature.

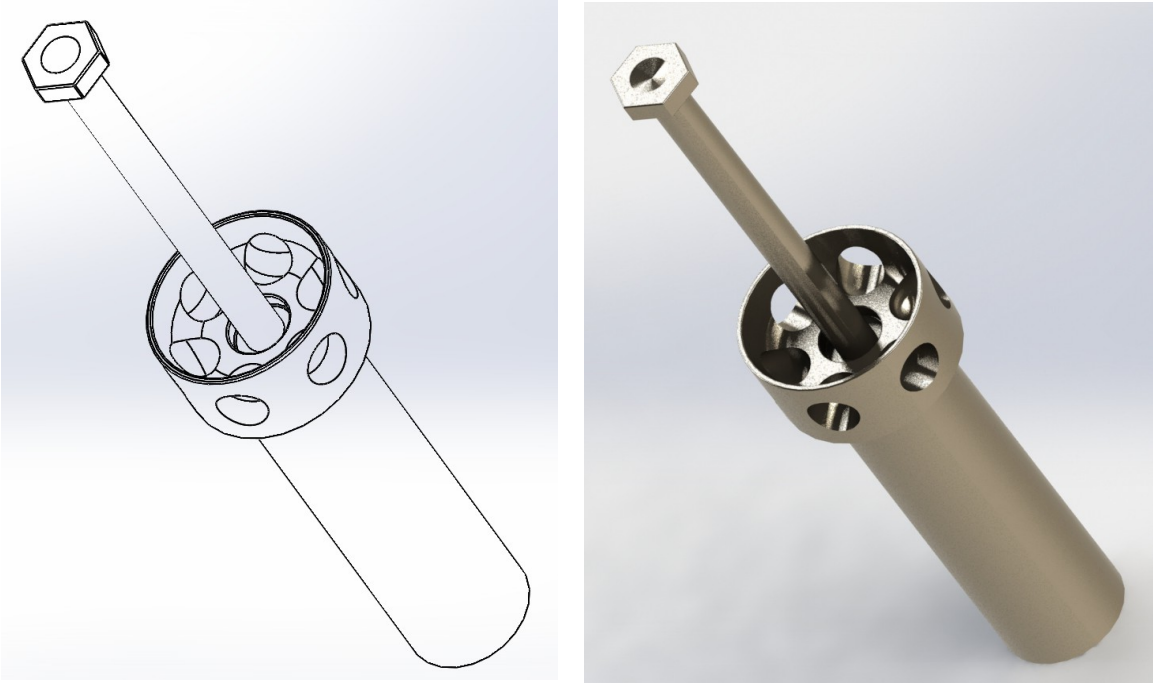

Figure 5. 35 mm diameter valve body. Single part (left) and cross section (right).

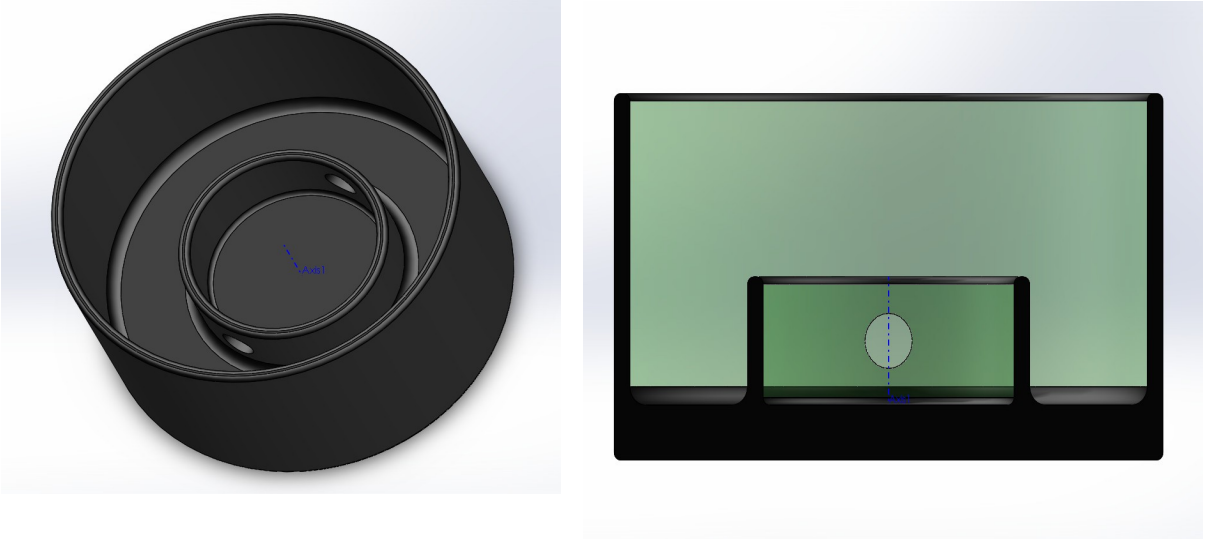

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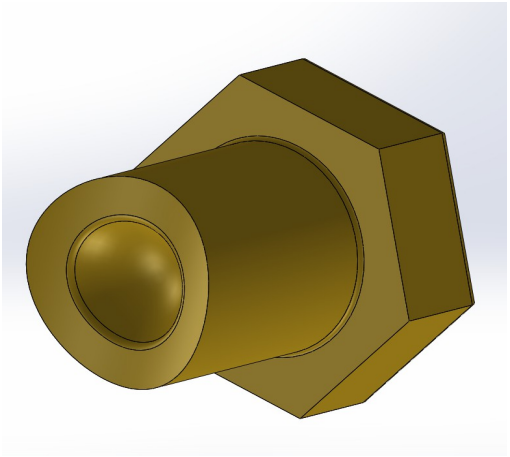
Figure 6. Lock-ball seat and Grade 25 chrome steel 6.35 mm ball bearing.



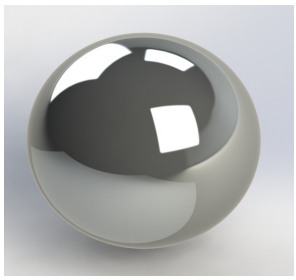
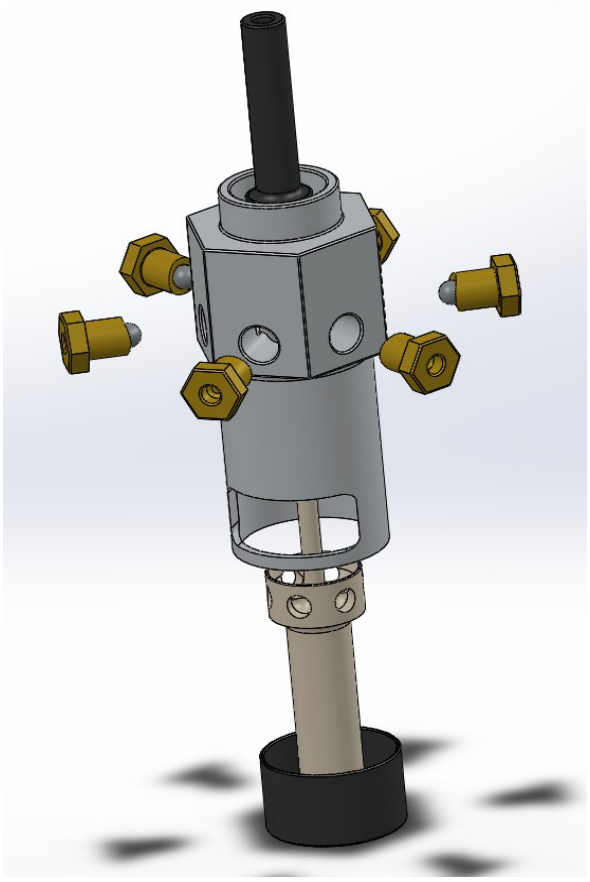


Figure 7. Exploded assembly. Solid and transparency views.



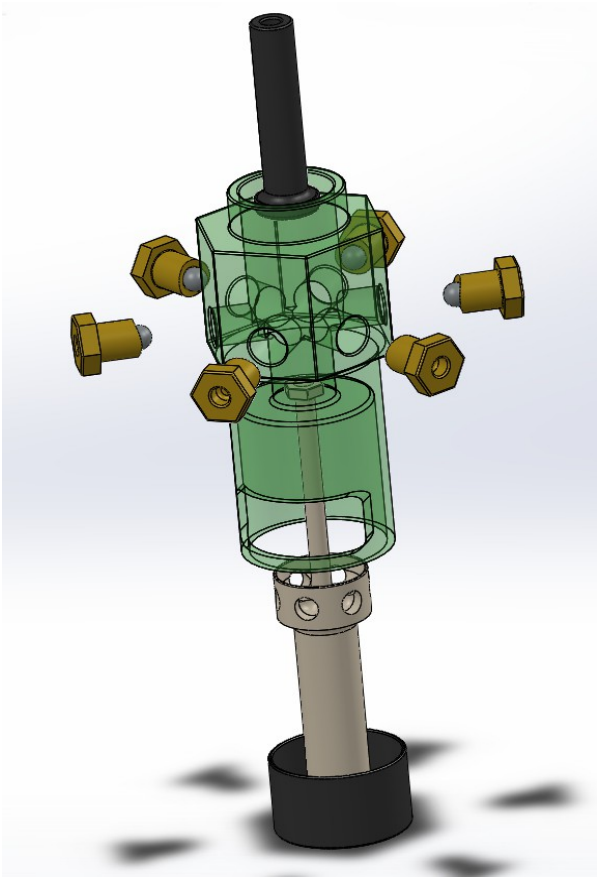


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Figure 8. Closed valve trigger section detail. Ghost and rendered views.

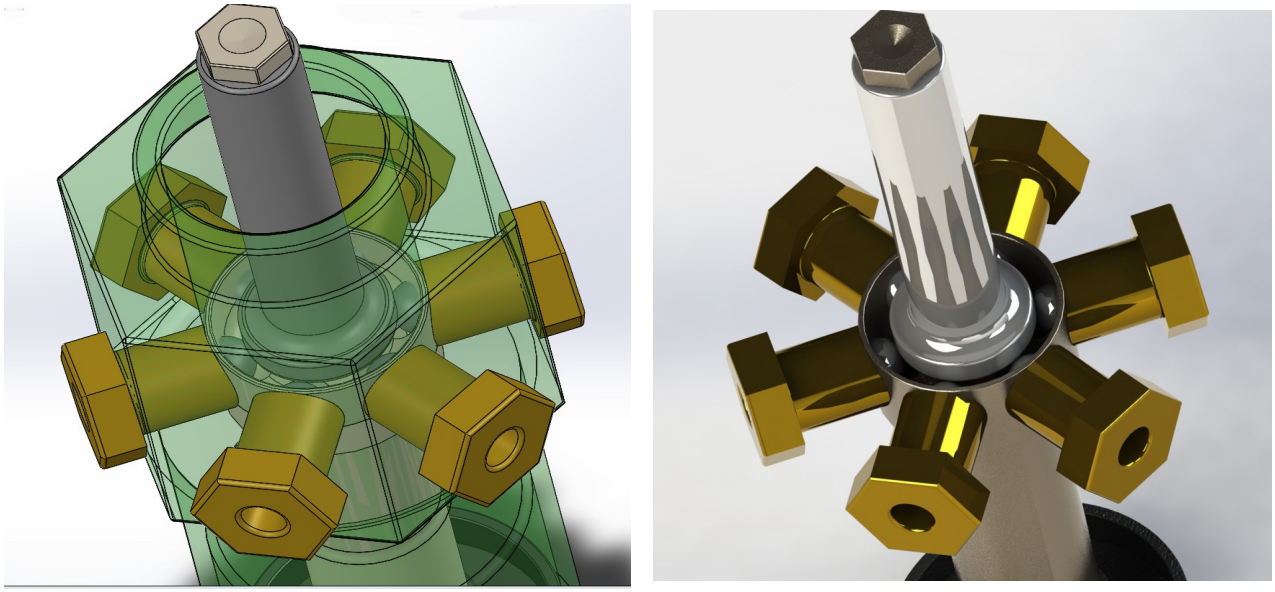

Figure 9. Open valve detail. Two views.

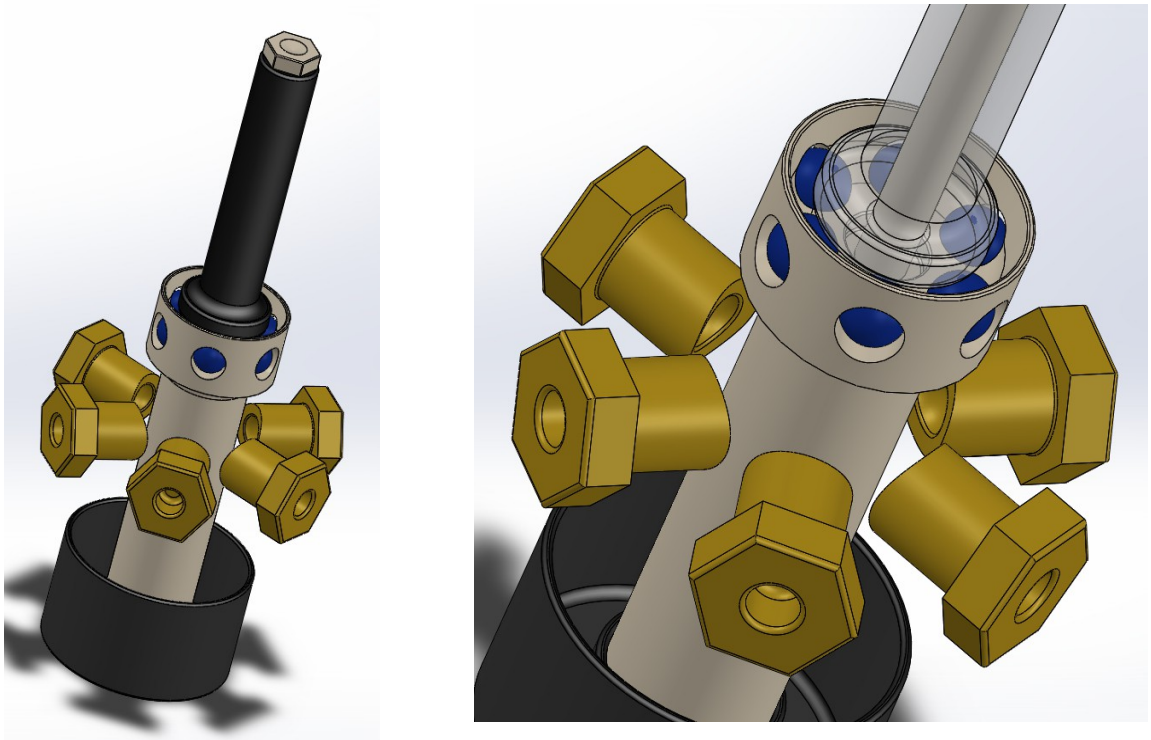

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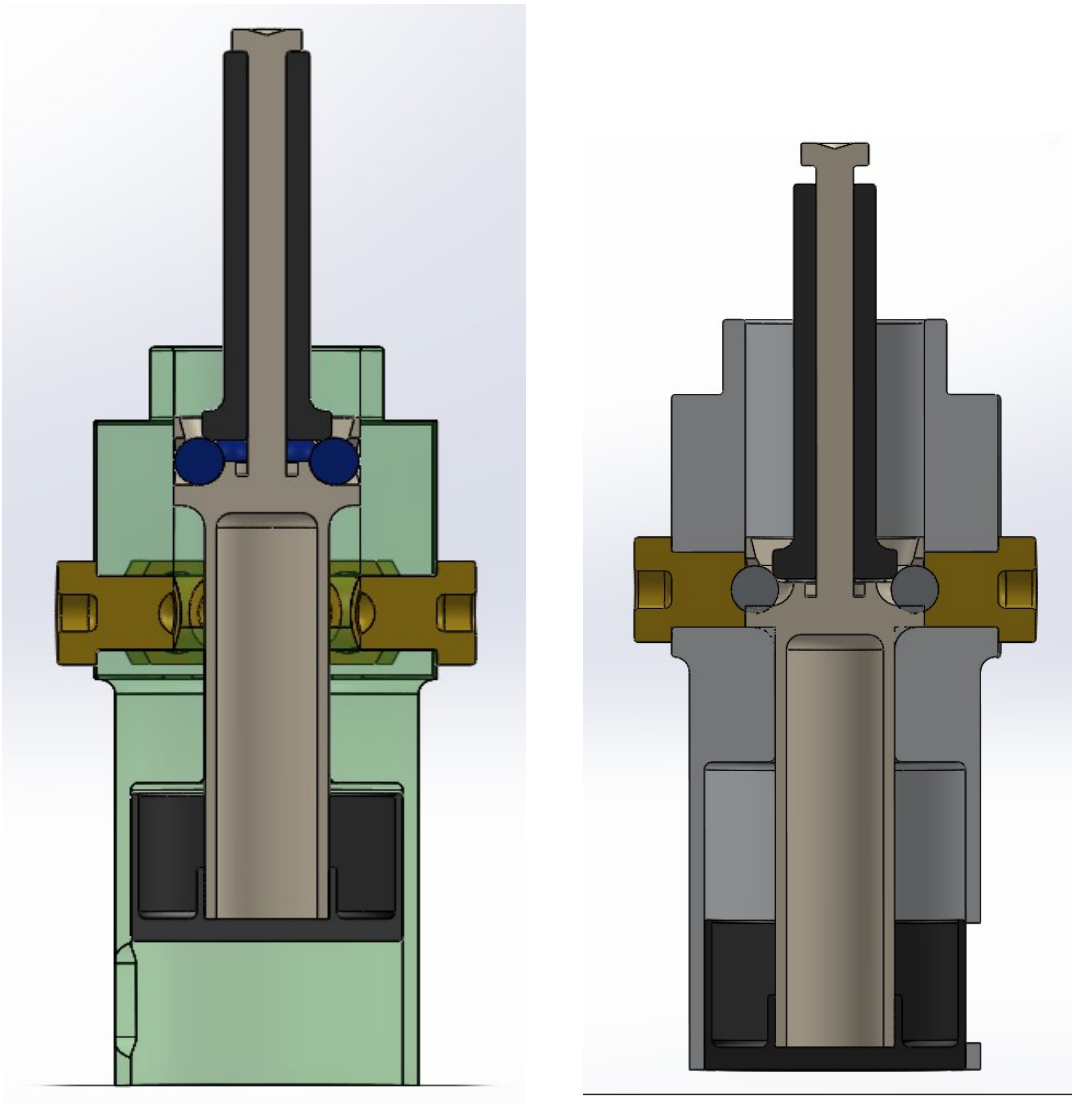
Figure 10. Two section views, PLV Open and PLV Closed.



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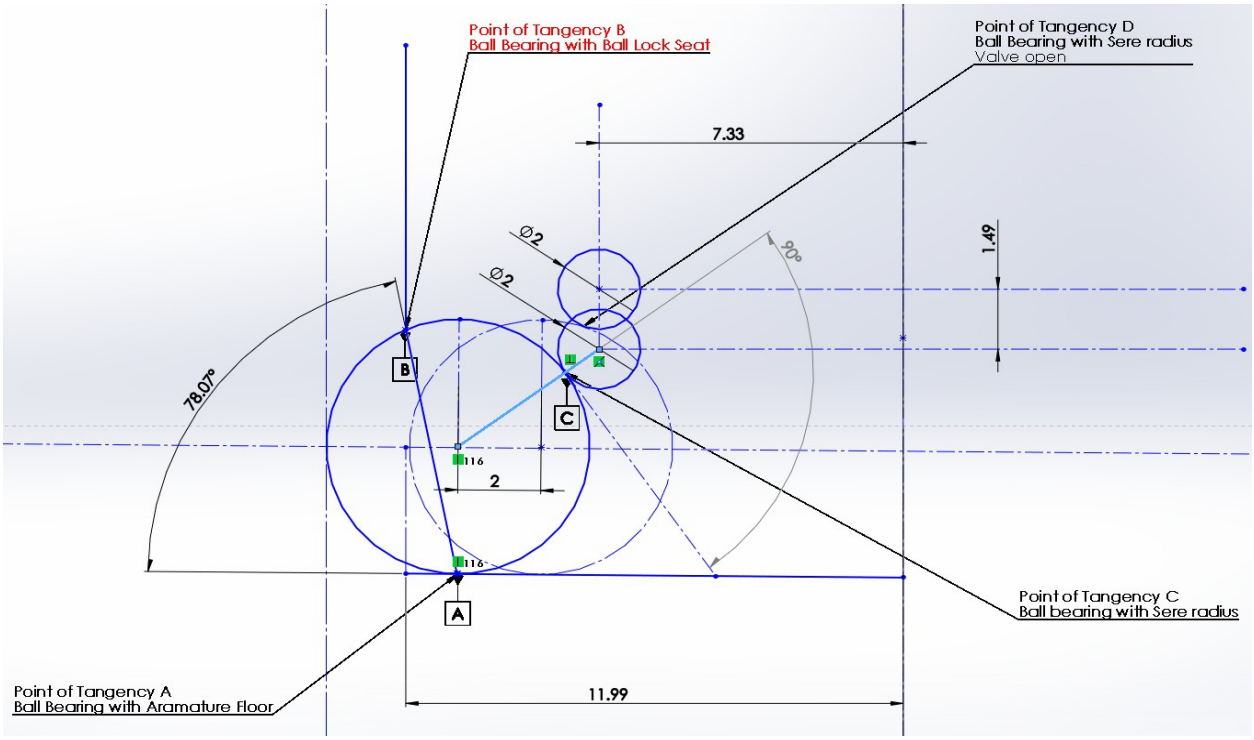
Section 2. PLV Description *This section is material to patent examination.*

Figure 11. Under center ball bearing lock force diagram.



Theory of Operation

The hot shoe fits the chamber lip with close tolerance and seals the exploding air-fuel gas. The force of combustion is held by the lock ball bearings nested in the lock ball seats. The ball bearings must displace inward to allow pressure to lift the valve open. The inward drive of the lock ball is stopped by the trigger sear. The sear edge radius contacts the ball, at tangent point [C] in **Figure 11**. The straight line [AB] represents the combustion force vector. The sear has the leverage of being under-center. Point [C] is below point [B]. Therefore a relative small downward force at point [C] will counter the lateral component of a high upward force at point [B]. The armature floor at point [A] can be shaped to bias the 2 mm inward ball travel.

When the trigger sear retracts at any position of the power stroke, the lock ball bearings are free (within 2mm of lateral travel). The combustion gasses blow the valve open. In this 4.6 liter engine example, the stroke is 19 mm. The valve body seal lip is 3.5 mm. The port window is 15.5 mm (.610”). This is a high performance engine lift. A smaller port window with shorter stroke will suffice for a fuel efficiency maximized ICE.

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In **Figure 11.** above, the PLV lock ball inward displacement is 2.0 mm from the hold position. The trigger sear upward displacement is 1.49 mm from the hold position. These small displacements lend themselves to high speed, high repetition cycles. The PLV is designed with removable lock ball seats to allow for cost effective part hardening. The seats are replaceable. The depth of the ball cavity in the seat can increase to compensate for an upward scale of horsepower. A deeper seat achieves a higher lock force. The radius of the ball cavity is slightly larger than that of the ball bearing. A radius on the ball cavity to seat face edge will facilitate inward movement of the lock ball upon upward movement of the sear.

Cam driven stem valves follow a trigonometric curve. The exit area is narrow early and late in the open and close stage. Exiting gasses must bend around the circular face of the stem valve. There is a valve stem and guide in the exhaust duct path. By contrast, the PLV features explosive breach of the combustion chamber. The exit path and duct are unobstructed. A greater percent of exhaust gas mass is purged early in the exhaust stroke relative to the stem valve. This feature creates a higher exhaust mean gas velocity (mgv). This higher mgv can be strategically employed to benefit turbo-charger performance and a next level of ICE fuel efficiency. DE3C technology combined with turbocharging eliminates the turbo-charger waste gate, and harnesses any excess plenum pressure. The high mgv turbocharger is the subject of another patent and depends upon DE3C technology.

End Section 2, PLV description.

Section 3. Cam Driven PLV. *This section is material to patent examination.*

A. Component parts specific to PLV mechanical cam drive.

Figure 12. PLV Cam drive cam.

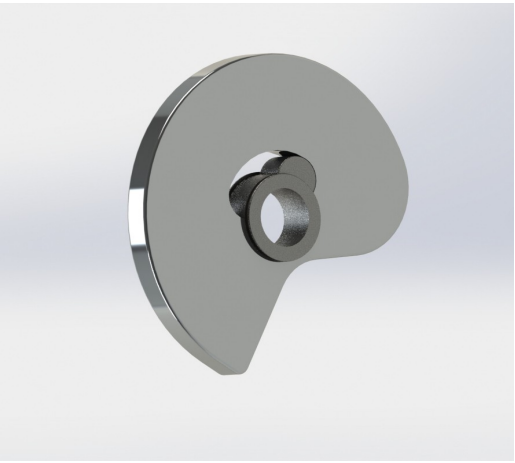

Figure 13. PLV Cam follower.

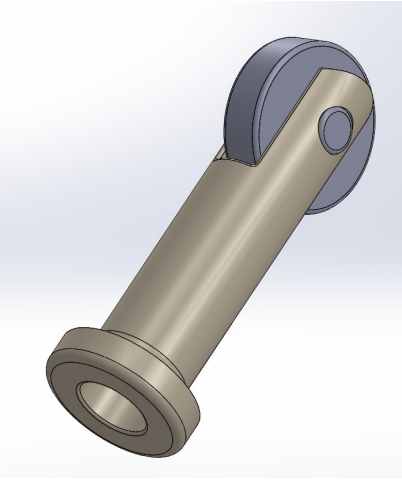

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Figure 14. PLV Cam body.

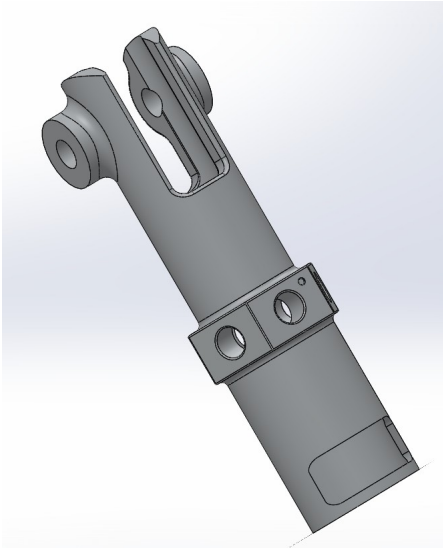


Figure 15. PLV Cam armature.

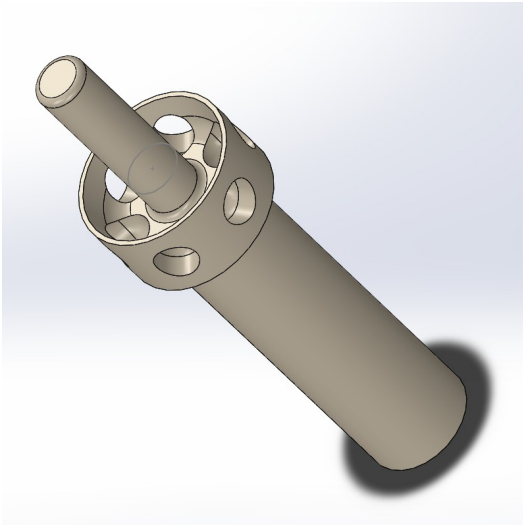
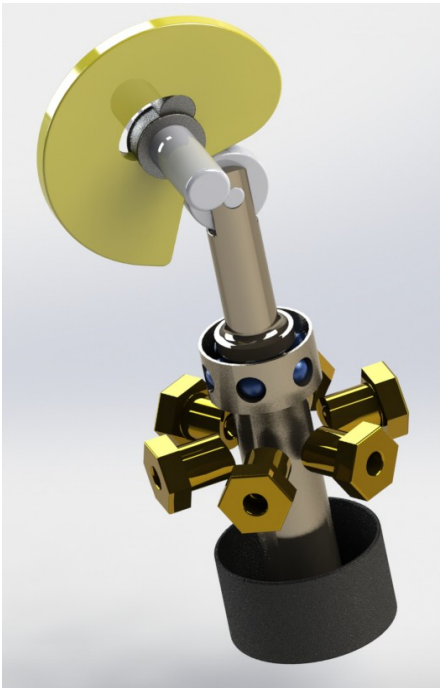


Figure 16. PLV Cam internal views open and closed.



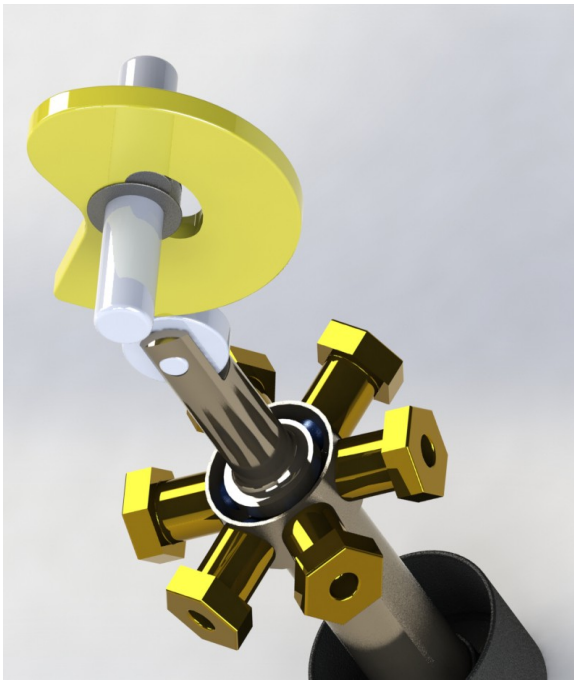


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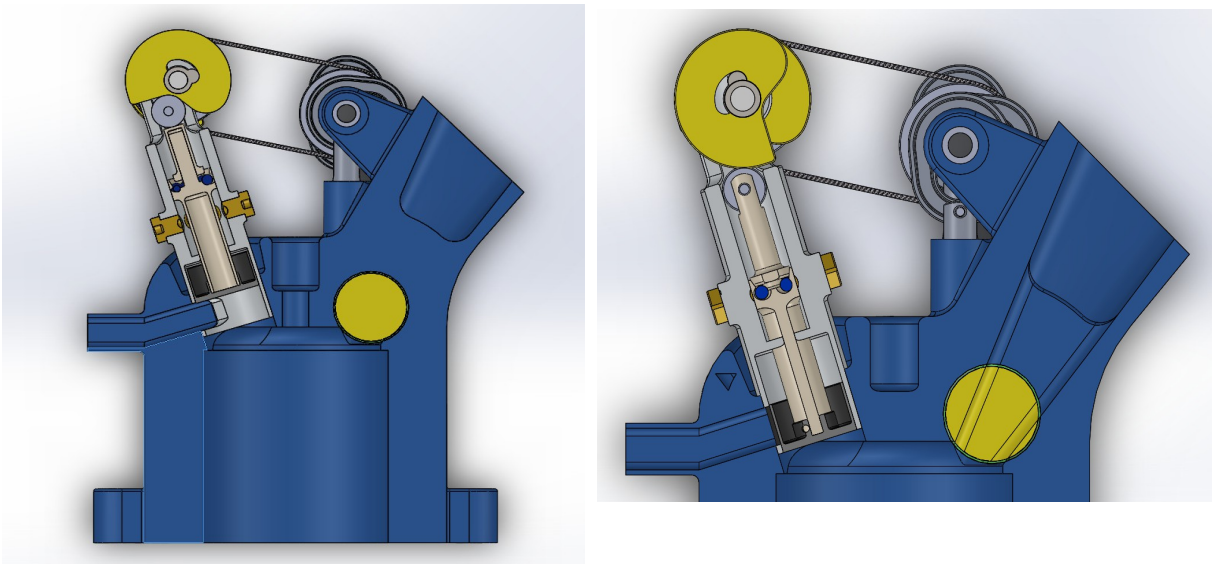
Figure 17. PLV Cam section views open and closed.



B. PLV Cam Drive Description.

1. The cam driven PLV is a straightforward adaptation of the linear actuator version. In Figure 12. above, the rotating cam is two parts, a drive hub and profile body. The profile body has a 90 degree free travel arc. This arc permits the high breach acceleration of the armature to overrun the cam position.
2. The upper section armature arbor is a larger diameter for increased strength. A spring force is inserted in the cam follower body and armature arbor concentric fit. This force is upward against the cam profile body. The force biases follower lift in advance of armature lift. Inert gas can be used vice a spring for reduced mass and faster action.
3. The cam center of rotation is offset 15 mm from the valve body axis center. This allows the follower roller to snap to maximum travel at the open valve point of cam rotation.

Concluding Statement.

Cam drive of PLV and AEV equipped ICEs offers benefit for steady state power applications: diesel-electric rail, diesel road transport, tractor, power generation, reciprocation engine aircraft, and marine power.

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Section 3. Utility Patent Claims.

1. I claim the invention of a linear acting valve opened by force of cylinder head pressure, at a point of trigger, in an internal combustion engine. The device is named Pressure Lifted valve.

2. I claim the invention of a linear acting valve, with upper control section and a lower port section, in a fixed ported valve body, for intake of air/fuel mixture into and or exhaust gas export out from an internal combustion engine.

3. I claim the use of a dynamic expanding and contracting radial array of ball bearings that lock and release a valve body holding cylinder head pressure in an internal combustion engine.

4. I claim the use of a radial array of individual ball bearing seats that hold each ball bearing in place by force of a common centered movable body (sear).

5. I claim the use of a linear actuator to operate the subject Pressure Lifted Valve. This patent claim includes electric current, electromagnetic, gas, pneumatic, or hydraulic powered linear devices.

6. I claim the use of an angular index actuator to operate the subject Pressure Lifted Valve. This patent claim includes electric current, electromagnetic, gas, pneumatic, or hydraulic powered rotary devices..

7. I claim the use of mechanical cam drive to operate the subject Pressure Lifted Valve.

List of Illustrations follows.

Very Respectfully Submitted,

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