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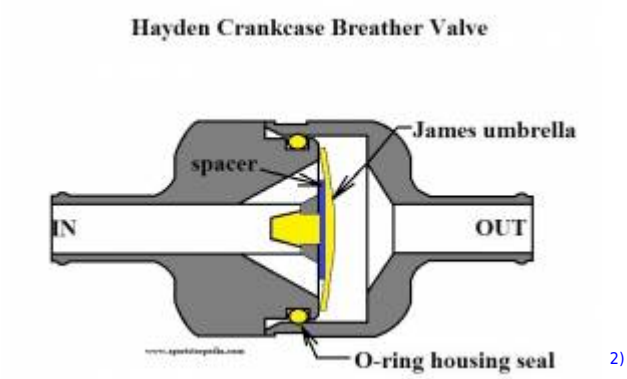
REF: Engine Mechanicals - Sub-04A

Dissecting the Hayden KVP38 Crankcase Breather Valve

The patent for Hayden's Crankvent is here: https://patents.google.com/patent/US5881686A/en

In preamble, the Hayden crankcase breather valve is of good quality.
Most that have tried it are satisfied with it's operation.
The foregoing is to clarify it's operation as it relates to Sportster engine breathing.
The umbrella valve that it uses is the same umbrella that James Gaskets sells for all 1991-1999, Evolution® & Sportster® models.
For that reason, it doesn't seem to be the umbrella that is the 'improvement' (same umbrella that James sells to many, many Sportsters).
The 'improvements' appear to be machined ramps to and from the umbrella, the spacer and the shimming of the umbrella.

The segments of the “Background” information in the patent material are shown in italics below.
Comments on this information is shown in bold below. [1)]



[2)]

A crankcase breather valve for ventilation and pressure control within the crankcase of an internal combustion engine in which pistons stroke upwardly and downwardly in a synchronous movement. The valve is inserted into a breather hose which conducts gases into and out of the crankcase. The valve comprises a resilient valve member, preferably an elastomeric umbrella-type seal, spaced above a seal seat and forming a gap there between through which gases may flow either direction during portions of the pistons' stroke cycle. The valve construction permits three operating modes: firstly to permit the egress of positive pressure gas out of the crankcase and through the gap while the pistons stroke

downwardly; secondly, to permit the ingress of a small amount of gas back through the gap into the crankcase when the crankcase pressure changes from positive to negative; and thirdly to check further ingress of gas into the crankcase at greater crankcase suctions, developed when the piston's are moving upwardly.

The breather valve has 3 functions.

1. **To allow positive gasses to leave the engine.**
2. **To allow a small amount of atmosphere back in.**
3. **To regulate how much atmosphere gets back in.**

On Harley engines produced earlier than 1993, the management of crankcase pressure is performed with a breather gear, driven and timed by the crankshaft. The gear is typically set to open and vent crankcase gases between 10° before top dead center (before TDC) through 75° after bottom dead center (after BDC). The breather gear vents crankcase gas to a separate camshaft chamber where the bulk of the oil mist is knocked out. The de-misted gas is then directed through a breather hose to the air cleaner. Due to the inherent physical limitations, the gear timing venting is not optimal at all engine speeds and throttle conditions. High crankcase pressures still result.

In another aspect, the oil system of Harley engines is also rather unique, being of the dry sump variety and having a separate oil tank. A scavenging pump collects oil from the bottom of the crankcase, routes it through an oil filter and on to an oil reservoir or tank. Oil flows under gravity feed from the oil tank to a feed pump which delivers oil to the engine components. Baffles in the camshaft chamber separate returning oil mist from crankcase gases before the oil collects at the scavenging pump. There are two aspects of this system which are sensitive to crankcase pressure. Firstly, excessive suction in the oil tank, the head space of which is in communication with the crankcase, adversely affects the supply of oil to the feed pump. Secondly, lack of a head of oil at the inlet of the scavenging pump and excessive suction in the crankcase can starve the scavenging pump of oil. In short, the excessive suction can result in oil-related engine failure.

In post-1993 Harley engines the breather hose has been relocated, from the crankcase, to each of the two rocker housings. Crankcase gases and pressure communicate with the rocker housings through the push rod tubes. A one-way check valve mounted within each rocker housing releases excessive crankcase pressure into the housing. The check valve is an “umbrella-type” valve having a port or ports blocked with an elastomeric umbrella valve head. The umbrella is normally closed over the port to prevent inflow of gases into the crankcase. Pressure flexes the umbrella off of the port so as to release gases from the engine. A small bleed hole is provided which permits collected oil to drain back to the crankcase. It is apparent that the bleed hole can also permit some gases to return to the crankcase. In the stock arrangement, a port directs the gases directly into the air cleaner. As an accessory, after-market cross-over tubing can be installed between the two rocker housings. A “tee” in the tubing directs the crankcase gases to a discharge tube and filter which removes oil mist.

Others have utilized crankcase breather valves in the context of conventional 4-stroke engines. The valves are known for reducing oil seal leakage by releasing excess pressure and forming a predominately negative pressure in the crankcase. Several breather valves use the “umbrella-type” valve heads (“umbrella”). For instance, in U.S. Pat. No. 5,067,449 to Bonde and U.S. Pat. No. 5,205,243 to Buchholz, disclose crankcase breather assemblies. An assembly is inserted into a port formed in the crankcase. The assembly incorporates an outer groove which retainably engages a lip formed in the port. The assembly

further incorporates an umbrella which covers and seats over a circular array of ports. The umbrella is normally-closed so as to ensure only one-way flow through the ports. In U.S. Pat. No. 5,027,784, Osawa et al. improved the operability of an umbrella-type valve by interposing a washer between the umbrella and the ports. The washer reduces over-flexing and premature failure of the umbrella. Despite the presence of the washer, Osawa's umbrella still rests in the normally-closed position.

Thus check valves of the umbrella-type are known and they are all of the normally-closed, one-way variety. Accordingly, while these valves permit flow out of the crankcase on over-pressure, they do not permit any gas flow back into the crankcase, except for a small amount of sealing hysterisis.

While the synchronous piston movement in a Harley Davidson engine can benefit from a reduction of maximum crankcase pressure, it must do so while avoiding the creation of excessive crankcase suction which can be associated with loss of oil pump operation. Further, a device which meets the above objectives must do so without modification to the crankcase.

The gear driven breather's last year was 1978.
They left out the '79 style internal reed valve.
They are representing ironhead technology up to 1992.
They also cite excessive suction in the oil tank and lack of an oil head at the scavenge port in the sump as being sensitive to crankcase pressure.
Some points of interest:

- **Pressurized air above the oil in the tank pushes down on the oil below it which is being sucked out from below.**
- **Vacuum in the air above is pulled from above, not below and the oil in the tank is much heavier than the air above.**
- **Crankcase pressure cannot suck oil from the tank unless it's already been compromised by other means.**
  (worn or defective OEM breather valve)
- **The patent is suggesting that too much vacuum (negative pressure) can cavitate the oil pump.**
- **It also says the OEM umbrella is normally closed. But it isn't sealed and we do know they do let air back into the crankcase.**
- **According to the patent information, the drain hole in the breather valve system has a dual purpose.**
  1. **It drains oil that gets past the umbrella.**
  2. **It helps to keep vacuum pressure from rising too high to keep from bursting seals / gaskets. (that may explain the size of the hole as well)**

SUMMARY OF THE INVENTION It has been determined that the pressure-related problems of the simultaneous upward and downward action of the pistons includes not only affects seal-leakage but also impacts on engine power. Further, direct application of conventional one-way flow check valves for releasing crankcase pressure results in undesirable side-effects, namely a loss of power at higher engine speeds and the formation of excessively high crankcase suction. Further, an external in-line device is preferred to avoid modifications to the engine crankcase.

More particularly, a device is provided which is inserted into the existing external breather hose. The device permits a small amount of gas flow back into the crankcase as the pressure in the crankcase

begins to be drawn negative, thereby ultimately avoiding excessively high crankcase suction at the top of the pistons' stroke.

Thus, in a broad aspect of the invention a novel valve is provided for installation on an engine, such as a Harley Davidson motorcycle engine, which has two or more pistons which move simultaneously upwardly and simultaneously downwardly. The valve is installed on a breather hose extending from a port on the crankcase for discharge outside the crankcase. The valve is constructed such that it operates to control the flow of crankcase gases in three modes. Firstly, to permit the egress of positive pressure gas from the crankcase while the pistons are moving downwardly; secondly, to permit the ingress of a small amount of gas back into the crankcase when the crankcase pressure changes from positive to negative; and finally to check the further ingress of gas into the crankcase at greater crankcase suctions when the piston's are moving upwardly.

Preferably, the valve comprises the following construction for implementing the three operating modes. Firstly, the valve comprises an inlet, and outlet and a valve chamber intermediate the inlet and outlet. Within the valve chamber, a valve seat is formed at the discharge of the inlet to the chamber. A resilient member is spaced above the seal seat so as to form a gap through which gases may flow either direction. Accordingly, gas is able to flow from the inlet, past the member and on out of the valve's outlet. Under low pressure differentials across the member, gas will also flow back from the outlet, past the member, through the gap and out of the inlet so as to return to the crankcase. Under higher pressure differentials, the member flexes and blocks the seal seat, preventing further back flow from the outlet to the inlet and allowing the crankcase pressure to become negative. More preferably, the resilient member is an elastomeric umbrella-type valve head, or a flexible reed.

It says the OEM umbrellas result in undesirable side-effects, namely a loss of power at higher engine speeds and the formation of excessively high crankcase suction.
Further, an external in-line device is preferred to avoid modifications to the engine crankcase.
(of course they can't re-design our engines)
But if they increase suction, why does it detail that the (OEM) drain hole actually keeps high vacuum from forming?
Their “novel” breather is being made for engines “such as a Harley Davidson motorcycle engine”.
Their primary arguments is their new valve is external, increases HP “slightly” and keeps down excess vacuum because of the controlled intake of atmosphere before it closes.
They say their new valve also let's a small amount of back pressure to come into the engine.
(“ultimately avoiding excessively high crankcase suction at the top of the pistons' stroke”)
This is the same thing OEM umbrellas do.
The argument against them is their location and the fact that they are under heat there and get hard faster (shorter maintenance intervals).
The krankvent is also under heat as it sits inline from hot CC pressure coming out of the engine.
The major function of the krankvent is to allow air to pass back and forth from inlet to outlet during low pressure differentials.
But on high differentials, the umbrella closes down on suction.
So, according to the patent material, removing or altering the 'spacer' adds higher vacuum upon end of upstroke.
The drawing description says “The 'nitrile' umbrella is available from James Gaskets of

Medesto, Cailf., Part No. 26856-89”.
The OEM umbrella has a slight up and down play in the installed hole.
The Hayden assembly shims the James umbrella to prevent that movement and to adjust the air gap around it.

Various modifications are apparent to those skilled in the art. For instance, variances in the materials of manufacture of the valve head will clearly affect the gap used. Further, use of a reed-type valve, spaced above a seal seat and being enclosed within a housing, can be seen to provide an equivalent valve in these instances.

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1)
Hippysmack of the XLFORUM http://xlforum.net/forums/showthread.php?t=2073932&page=39
2)
drawing by Hippysmack