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REF: Engine Mechanicals - Sub-07E

Further Study of Internal Engine Pressure

It's important to note there are 2 different but similar breathing systems in ironheads; (1957-1976) and (1977-1985).
However different, the 2 breathing systems are more similar than different.
When they spilt the two, 77-up still uses the same principles as 76<. They both rely on vacuum/pressure cycles to scavenge oil and make the engine breath.
Downstroke still pushes oil to the pump in both. Upstroke still creates splash lube in both.
76<, the crankcase breaths out the timed breather into the gearcase then spills out the vent.
77>, the crankcase breaths to the gearcase thru holes in the cam wall then out the one way valve in the cover.
If anything they freed up the crankcase by allowing oil and air to expel to different holes.

All HD cases already pull a vacuum especially highest at idle. That vacuum just can't get too high. How high is the question. [1)]
At present there is little information known regarding how much vacuum Ironhead Sportster engines create.
The only way to know for sure on any specific engine is to test it manometer and see where it's at.
The U-tube slack tube (manometer) sees both positive and negative pressures and measures the average pressure in the system.

It seems most seem to believe that reducing the case pressure is a good thing.
However, let's look at actual pressures.
We think of the volume under the pistons in terms per the full downstroke / upstroke volume. We also have to include speed and time.
The pressure changes from positive to negative so fast, there is no time to consider what downstroke just did due to upstroke happening.

The crankcase evolves to an average pressure during operation (lower on low RPM, higher on high RPM).
So the pistons are constantly descending with different average pressures under them (both negative and positive).
As RPM rises, the swings in pressure changes should decrease (more average, mean pressure).

- The advantage of 'maintaining' a certain vacuum range in the crankcase (not simply lowering it for no reason);
  - Keeping oil leaks at bay, lowering the chance of wetsumping, creating splash lube, achieving better ring seal and possibly keeping pumping losses minimal.
- The advantage of maintaining a certain positive air pressure range in the crankcase;
  - Better oil scavenging and keeping down pumping loss at high RPM.

76< engines breath and scavenge from the same hole.
They may be more sensitive to wetsumping than later models because of this. The air can't jump ahead of the oil to the rotary breather.
Oil is thicker and doesn't compress. What does that do to air pressure behind it?
77> engines breath and scavenge from different holes.
Makes for a more free flowing internal system.

We know downstroke pushes oil toward the oil pump. Excess vacuum slows that process, can back up oil and cause wetsumping.
But, if the underside of the pistons are slight negative, it helps the rings seat without as much vibration and turbulence.
As a rule, rings sit on their own springiness when pistons go up and are forced against the wall by the combustion pressure that is allowed to pass behind them. [2)]
Hence, a very small or inexistent amount of blowby should occur on combustion stroke.
A small amount of blow by is only possible on the way up on exhaust stroke if vacuum is too high underneath pistons.
If vacuum underneath the pistons is too low, worn rings, too much end gap, reverse happens, top end will suck up oil from underneath the pistons.

So a slight vacuum is a good thing.
Downstroke is relieved somewhat underneath due to the breather opening and beginning vacuum on decent.
Upstroke is not affected as much until after vacuum starts to build.

The 57-76 timed breather doesn't close on BDC but rather farther upstroke.
It presets how much vacuum the pistons are allowed to create and how long they have to expel air pressure.
So the rising piston isn't hindered by vacuum until after mechanical and perpetual motion has been exerted on the it.
In in 76< engines, you are limited to what air you can expel thru the breather gear before upstroke happens with the gear still open.
That's a factory preset time although mods have been made to the breather gear to change the opening/closing times generally by racers.
And since the breather doesn't close until after upstroke begins, a certain amount of atmosphere pulls back into the crankcase thru the breather until it closes.
So 57-76 engines have two different sources to pull from (the crankcase itself and atmosphere from the vent tube).
Once the breather valve closes, the gearcase returns to atmosphere.
In regard to modding the breathing system;
Note: Adding a one way valve to the atmosphere vent with a timed breather should create more vacuum.
Atmosphere is normally pulled back into the timed breather until it closes up the piston travel.
The one way valve blocks the air drainback function starting from BDC instead and does tax the pistons (more than OEM) by making them work harder on the way up.
(more like 77-up vacuum and can contribute to less oil scavenge and wet sumping if vacuum gets too high).
But there is that lapse in time since it gets cued from the valve instead of the piston.
The actual working pressure would need to be tested to make sure vacuum doesn't get too high .

In contrast, the 77-up breather closes when the last piston is at bottom dead center (BDC).
Is that extra vacuum taxed to the piston?

The better the gaskets and seals, the more vacuum you can run.
Oil leaks from high vacuum depend on gasket / seal limits and condition as well as construction, among time and heat.
Rubber swells, cork saturates, heat soaks and breaks up, case seal can be sucked out, etc.
There is also a point where vacuum will hinder oil scavenge. Guys using vacuum pumps also use multi-stage oil pumps for that reason.

Positive air pressure can also blow gaskets/ seals if it gets too high.
The air may be acting as a spring against the pistons if it's not coming out as fast as the pistons are moving down.
And it's not all air pressure as it is an oil/air mix.
Downstroke pushes oil to the pump and expels crankcase pressure.
We take that as the volume under the pistons but that is not the whole story.
Varying degrees of ring blowby is also part of the downstroke pressure (in RPM as well as ring/cylinder wear specific amounts).

The higher the RPM, the more oil you're pumping into the engine and draining into the crankcase but the more you're also pumping out.
With the feed side of the oil pump smaller, oil pumps out, air expels, more oil enters etc.
Oil in the bottom takes up it's portion of the normal air space and will change overall pressure also.

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1)
Hippysmack of the XLFORUM
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thefrenchowl of the XLFORUM
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