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2 April 2022
CAD II
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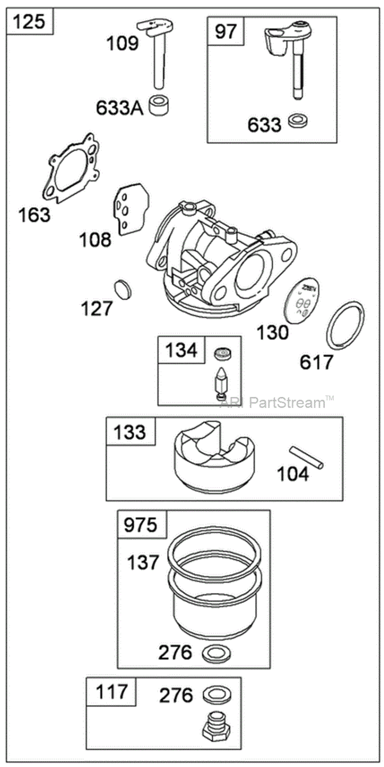
Project 2 Writeup - CAD II

For Project 2, I chose a simple float-style carburetor from a Briggs and Stratton 725EX lawnmower to model in Solidworks. This part is necessary for the mixing of air and fuel before the mixture enters the combustion chamber, and is a popular form of fuel delivery for small engines due to its mechanical simplicity and ability to operate without computer programming. As engines require a certain ratio of air to fuel, a carburetor can efficiently regulate the delivery of fuel with a proper ratio so that the engine runs correctly (as opposed to running lean on low fuel, or rich with a higher fuel concentration). This is accomplished by a series of mechanical parts working alongside each other, dependent on certain functions of each part. For example, as gasoline/premixed oil enters the carburetor bowl through the fuel inlet, the subsequent rise in fuel level causes the plastic float to rise as well. This action lifts a metering pin that is attached to the float, which regulates the flow of fuel that is exiting the carburetor.



Exploded Diagram of a 725EX Carburetor (2)

Shown above is a related diagram of the carburetor chosen for this project, with corresponding part numbers. Below, a table can be found with corresponding part numbers and a short description for ease of understanding.

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PART #	PART NAME	SHORT DESCRIPTION
109	Major Valve Stem (Offset)	Actuates the major butterfly valve to allow air & fuel mix to pass to combustion.
97	Minor Valve Stem (Throttle)	Direct connection to throttle pedal to actuate intake butterfly valve.
108	Major Butterfly Valve	Controls flow of air/fuel to the combustion chamber.
130	Minor Butterfly Valve (Throttle)	Smaller valve that primarily allows air through the carburetor venturi.
134	Metering Pin	Controlled by the float, allows more/less fuel to travel to the atomization chamber.
133	Fuel Bowl Float	Dependent on fuel level, actuates metering pin for fuel delivery control.
104	Float Pin	Retains fuel float to the body of the carburetor, so it remains fixed.
137	Fuel Bowl Gasket	Allows the fuel bowl to retain fuel safely with a watertight seal.
276	Banjo Bolt Gasket	Allows the banjo bolt to have a seal with the base of the fuel bowl.
117	Banjo Bolt	Used for transferring excess pressurized fuel safely through the intake stalk of the carb.
125	Carburetor Body	Where air and fuel are mixed, and then delivered to the combustion chamber(s).
975	Fuel Bowl	Intermediate fuel storage as gasoline moves through the system.

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The earliest known example of a carburetor can be traced back to 1885, when Karl Benz designed and built a simple carburetor to test a gasoline-driven vehicle (1). It was composed of two valves and an intermediate body for fuel to be delivered into, and operated on Bernoulli's Principle ("the faster air moves, the lower its static pressure, and higher the dynamic pressure is") to move the air/fuel mixture to the engine itself. As the carburetor became the first viable method for fuel delivery in almost all early automobiles, numerous variations sprung from many engineers who had different needs. Wick carburetors, variable venturi carbs, and fixed venturi carbs were all brought to the forefront of the design world - carburetors had to be able to perform under a variety of different conditions and atmospheric pressure, and these demands necessitated more efficient designs. As technology and automotive design progressed, these simple carburetors would develop into large, 20lb hunks of mechanical engineering that could deliver an unheard-of amount of fuel with astonishing precision.

As society moved forward, technology followed. Carburetors were now powering consumer motorcars, stock racecars, construction equipment, dirt bikes, and could be found in any tinkerer's garage. Of course, the extreme increase in available automobiles that promised fuel economy as well as high horsepower caused development and research to skyrocket. Many companies rose to the occasion, but Holley Performance Products (3) has maintained its relevance ever since it entered the automotive world. Holley's long-term vision for vehicles far surpassed standard carburetors, as a new method of fuel delivery promised infinite tuning opportunities and much more precise fuel delivery - multi-point fuel injection systems. As the world moved towards MFI and developed today's incredibly advanced direct injection (found in most modern vehicles)(4), carburetors slowly fell out of relevance for heavy machinery and fast cars. Now, with its overwhelming simplicity compared to fuel injection, carburetors are a popular choice for hobbyists, classic car enthusiasts, and dirt bike riders.

Personal Inquiry

I chose to model this carburetor in part due to the complexity of its geometry, as well as a chance to practice using dial calipers & thinking creatively with no true idea of how I would accomplish the model successfully. I wanted to pick a challenging part with various edges, chamfers, and otherwise difficult sections to translate into Solidworks to test my current ability. I have always wanted to disassemble a carburetor, and after receiving this project, I couldn't resist! I practically begged Professor Nettles to let me do this part in my project proposal, and I wanted to test the limits of my skills in Solidworks - and this part did exactly that.

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As a student in Mechanical Engineering Technology, I will be expected to be creative, problem-solving, hands-on, and above all, self-motivated. My experience with all things automotive (rebuilding a 4.0L inline six engine in my garage over a summer, reviving a car that hasn't moved for 7 years, etc) has driven me to explore potential options within the automotive field, including manufacturing, part design, and advanced machine knowledge - since I wish to pursue a career that will allow me to try all of these things, I wanted to at least test my ability with a relatively simple part (compared to a fully-built Holley Double Pumper carburetor), as I would love to do something just like this project for my entire career.

When developing the plan for modeling this part, I did the easiest thing that came to mind - find a cheap third-party replica of the carburetor, purchase it, and disassemble it for ease of measurement. I have practiced that method for many part purchases, and I was able to acquire a knock-off part for $40 less than the OEM carburetor ($10 vs $50). Not much research was necessary outside of the planning phase, as a carburetor has only one purpose and relatively simple inner geometry on such a small scale; such as a lawnmower carb. When I received the part in the mail, I would sketch the faces of complex components on grid paper & make note of measurements that would be important for reference later on in the build. Each piece of the part required careful attention, as some measurement would confirm a 0.075" inner diameter on a seemingly microscopic feature. Each small sketch was important to my understanding of how the part works as a whole, and helped me visualize hidden features that were otherwise impossible to measure accurately. Being able to hold the part itself and position it in the ways that I saw on my screen was invaluable, and contributed greatly to my understanding of how the part was assembled.

While struggling to work with each component of the carburetor, I found difficulty in measuring features that were either too small for the caliper jaws to hold, or sunken in too deep for the calipers to even reach close enough to guess a value. One idea that I had to help me overcome this limitation was a mechanical pencil - the lead of the pencil can be extended from a fixed point, and can be used to measure the depth of certain features that would be otherwise impossible to measure correctly. The pencil lead was soft enough to be easily manipulated, and was invaluable to finding the correct diameter for the carburetor venturi. As I worked through each problem posed by complex geometry, I found myself visualizing components as if they held invisible planes that could be used as reference for features within that same component. I used this to my advantage to interpolate locations of specific extruded cuts or bases, as sometimes the calipers just couldn't reach what I wanted to measure. By visualizing these planes and making small references, I was able to glide through some fairly tough sections that I would have ignored completely before taking CAD II.

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References

(3) “Holley History: 50 Years of Fuel Delivery.” *Holley Performance Parts*, Holley Racing, https://www.holley.com/blog/post/holley_history_50_years_of_fuel_delivery/.

(1) “Karl Benz - New World Encyclopedia.” *Visit the Main Page*, New World Encylocpedia, 12 Apr. 2018, https://www.newworldencyclopedia.org/entry/Carburetor.

(2) “Lawn-Boy 10642, 20in Lawnmower Carburetor Diagram.” *Jack's Small Engines*, https://www.jackssmallengines.com/jacks-parts-lookup/manufacturer/lawn-boy/walk-behind-mowers/10642-20in-mulching-rear-bagging-lawn-mower-2009-sn-290000001-290999999/electric-starter-assembly-briggs-and-stratton-124t05-0216-b1.

(4) “Multipoint Fuel Injection System - IJERT.” *MPFI Seminar*, IJERT, https://www.ijert.org/research/multipoint-fuel-injection-system-IJERTV2IS110123.pdf.