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Gas Powered Thoughts Advice for Gas Helicopter Success from Carey Shurley



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07-30-2011, 04:08 PM

#1 (perma

[carey_shurley](#)
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Join Date: Apr 2004

Walbro Carburetors - So how does this thing work

This thread is going to cover the internals of the Walbro carburetor that almost all gas helicopter engines use. Specifically the or found on the Zenoah PUH and RC format motors (WT643/644 on the PUH and a variety of versions on the RC). The internals a nearly identical from an operation and maintenance perspective.

I'm going to show you whats in there, how it works, what the normal problem areas are and what to do about it.

There are a lot of parts and photos so I'm going to split this into several posts:

- Overview
- Fuel Pump (inlet)
- Fuel Regulator System
- Primer System
- Common Fuel Control Components
- Low Speed System
- High Speed System
- Problems/Maintenance



Walbro WT644 Carburetor

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Carey Shurley
Proprietor - Gas Powered Helicopters



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07-30-2011, 04:29 PM

#2 (perma

[carey shurley](#)
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Join Date: Apr 2004

Walbro - Overview

So lets take a look at our carburetors

Nothing really magic here, their design is virtually identical to the carb that you'll find on any fuel powered yard implement or gas powered RC airplane you may have

They serve the same purpose as the carb on a glow powered model, they mix the fuel with air in precise amounts so that it can fed into the motor for combustion.

They have an internal fuel pump to get fuel to the carburetor, they have a throttle to control the engine speed (by controlling the amount of fuel being mixed) and some versions have a "choke" to make starting the motor easier. One thing that the versions for helicopter use have that the ones on the RC airplanes don't is a primer system to get the fuel into the carburetor faster for startu

These are vacuum fed carburetors, the fuel is not pumped or forced into the motor as with a fuel injection system, the low pressure that's created in the intake side of the motor literally sucks the fuel out of the carburetor. Technically they are known as "diaphragm carburetors". It will become obvious why a little later.

Here are views of a typical carb, in this case a WT-644 which includes both a primer bulb and a "choke" system:



WT644 Intake Side - Choke Open



WT644 Engine Side - Throttle Closed



WT644 - Fuel Primer



WT644 - Fuel Pump Cover

Doesn't look so complicated from the outside does it?

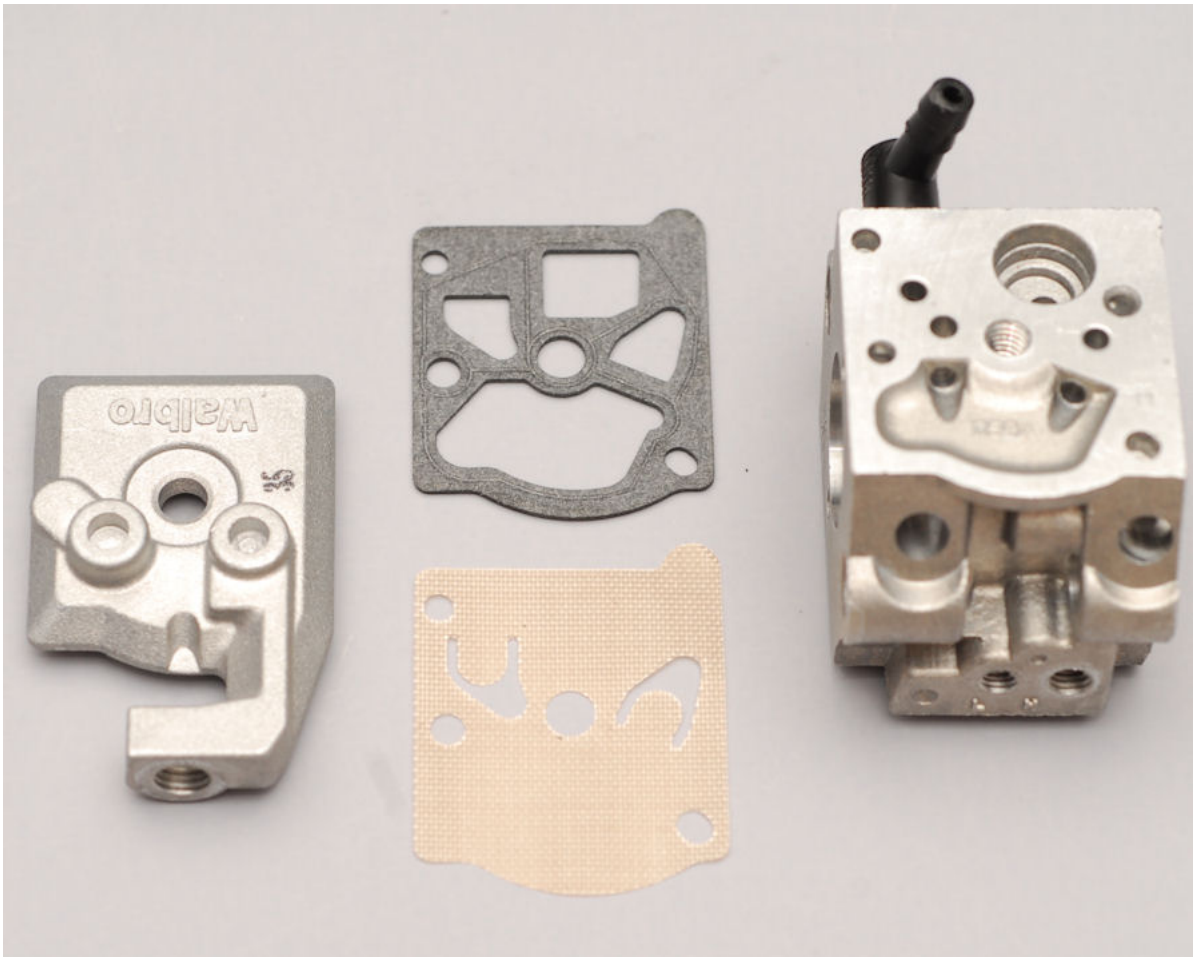
Actually its really not all that complicated but there are quite a few parts in there.

Here's a view of all the parts that can be removed and replaced. There are a couple of parts that can't easily be replaced in the carburetor body itself.



Fuel Pump - So whats under here?

here are all the components of the fuel pump system

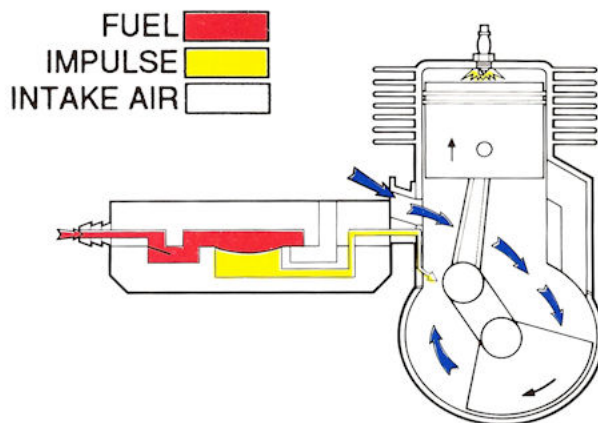


Walbro Fuel Pump system

I'm going to use a combination of diagrams and photos to detail how this works. The diagrams are directly from The official Walbro Service Manual written by Luis J. Salas,

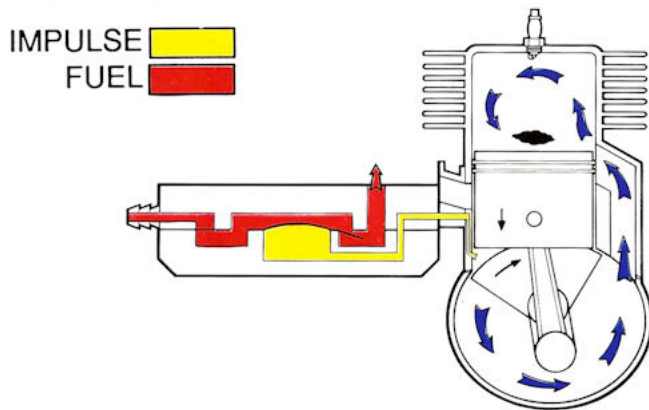
The pump works entirely based on crankcase pulses. As the piston moves up and down the pressure in the crank case pulses positive or negative. As you'll see these pulses are channeled to the pump and cause fuel to flow through a variety of small ports or channels.

here's how the fuel flows when the pump is on its intake pulse (the piston is moving upwards and pulling a vacuum in the case)



Fuel Pump Intake -Diagram from Walbro Service Manual

here's how the fuel flows when the pump is on its discharge pulse (the piston is moving downwards and pressurizing the case)

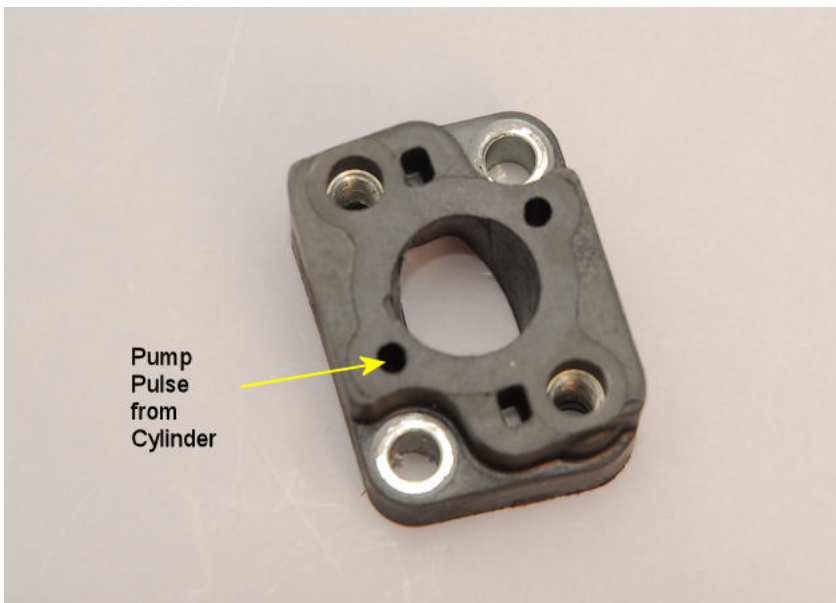


Fuel Pump Discharge -Diagram from Walbro Service Manual

now that you can see the general flow, here's the actual details from a Walbro 644 carb

the pulse is coming from the crankcase through a small hole in the cylinder that you'll see on the face of the where the isolator block mounts.

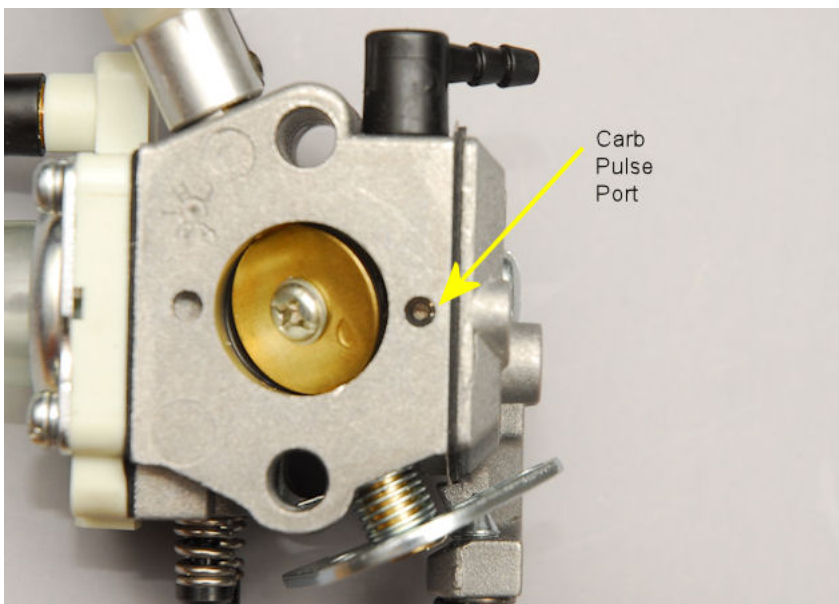
that pulse goes through the hole in the isolator block that it aligns with (the isolator block is unidirectional for ease of assembly)



Carb Isolator Block

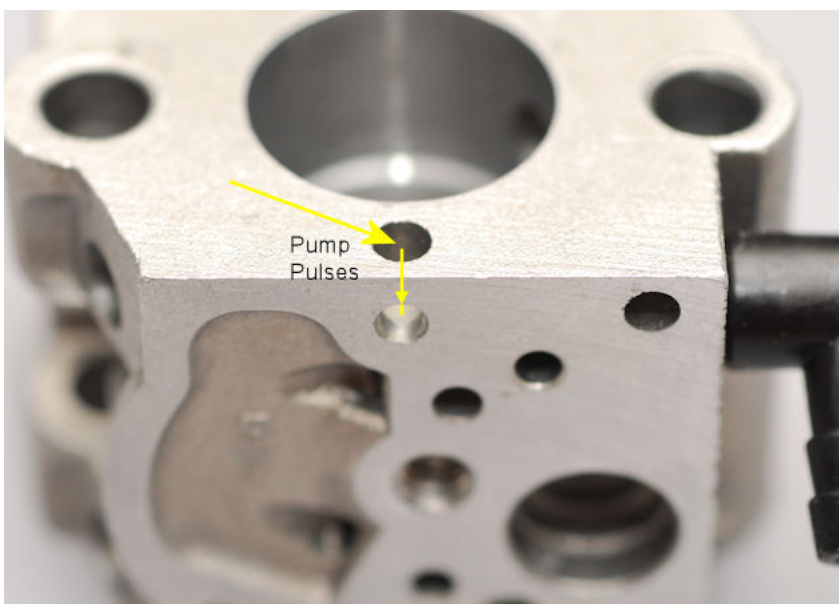
when the carb is installed on the isolator block, it is imperative that the pulse port on the carb is aligned with the port on the isolator block. Otherwise the pump won't get the pulse, won't pump fuel and the motor will only run until it uses up the fuel that you've primed into the carb fuel system

this is also one of the two reasons its important to have a good seal between the isolator block and the carburetor. If this is leaking, you won't the full pulse pressure transferred between the engine and the fuel pump.



Pulse Port Position on Carb - Facing motor side

looking closer at the pulse port on the throttle side of the carb face, you can see that its drilled into the pump body as shown.

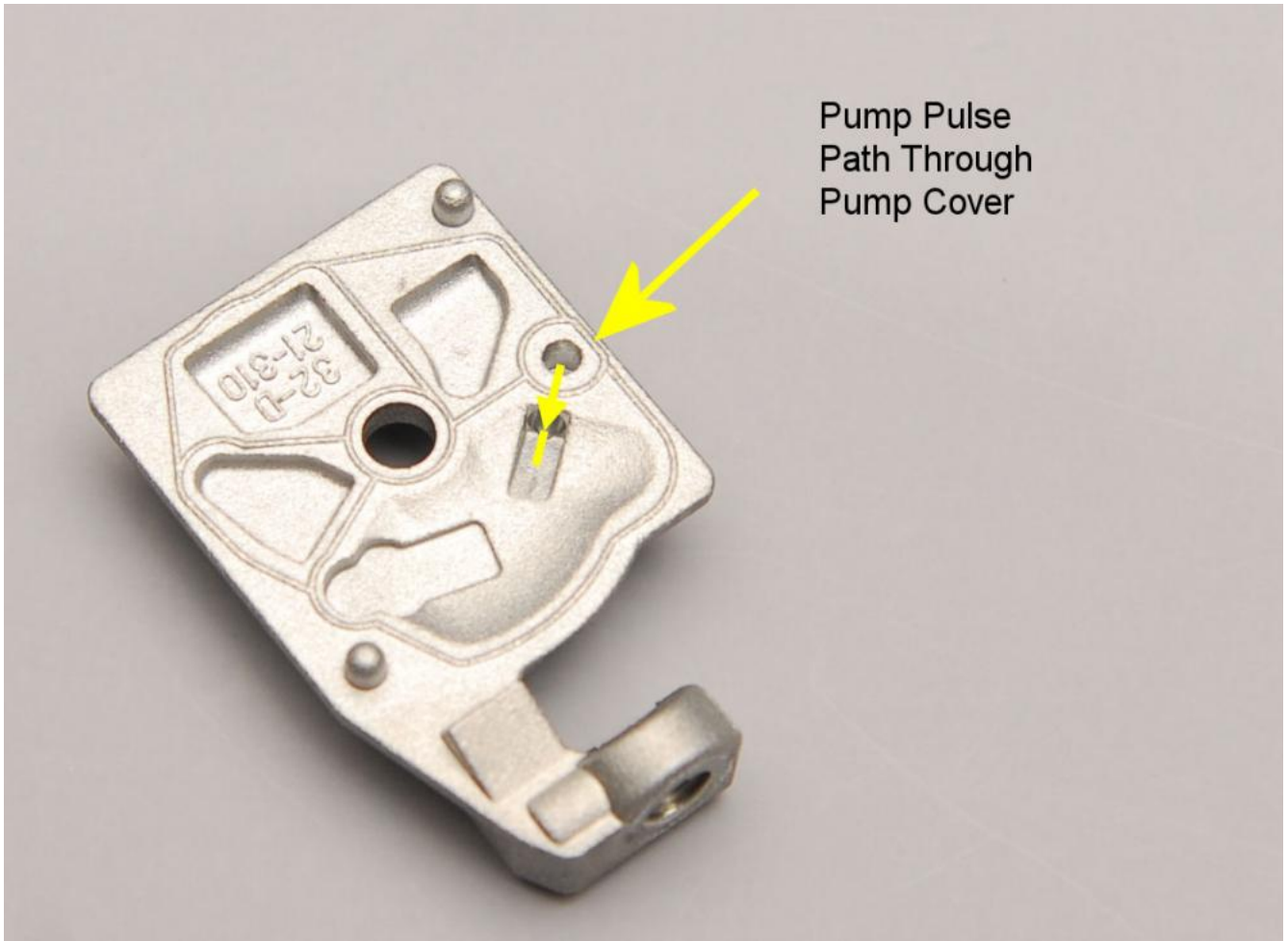


Pulse path to pump

on the pump side of the port it is channeled through this hole in the pump cover and acts on the pump membrane.

You can see the little cavities on this cover that let the pump membrane move as well as the little check valves flap. Each component is sealed into sections by the gasket that sits on top of the pump membrane

As a side note, if for some reason a cylinder doesn't have the pulse port on the intake side, its possible to drill a hole in the pump cover through the round recess above the pulse port and thread in a fuel line inlet nipple. You can then use a fuel line connected to a similar nipple that you can thread into the side of the crankcase (just like the one on the back of a glow motor). Doesn't matter how the pulse gets here, its just has t



Fuel Pump Cover - Recesses/Ports

Here's the pump body side of the carburetor. The recess towards the bottom is the fuel pump reservoir



Pump body face - without pump membrane

So here's the photographic equivalent of the earlier diagrams. As in the diagrams, red indicates fuel flow and yellow indicates engine pulses. engine pulses cause the part of the membrane that covers the fuel reservoir to pulse up and down. As that happens, fuel is pumped through it follows:

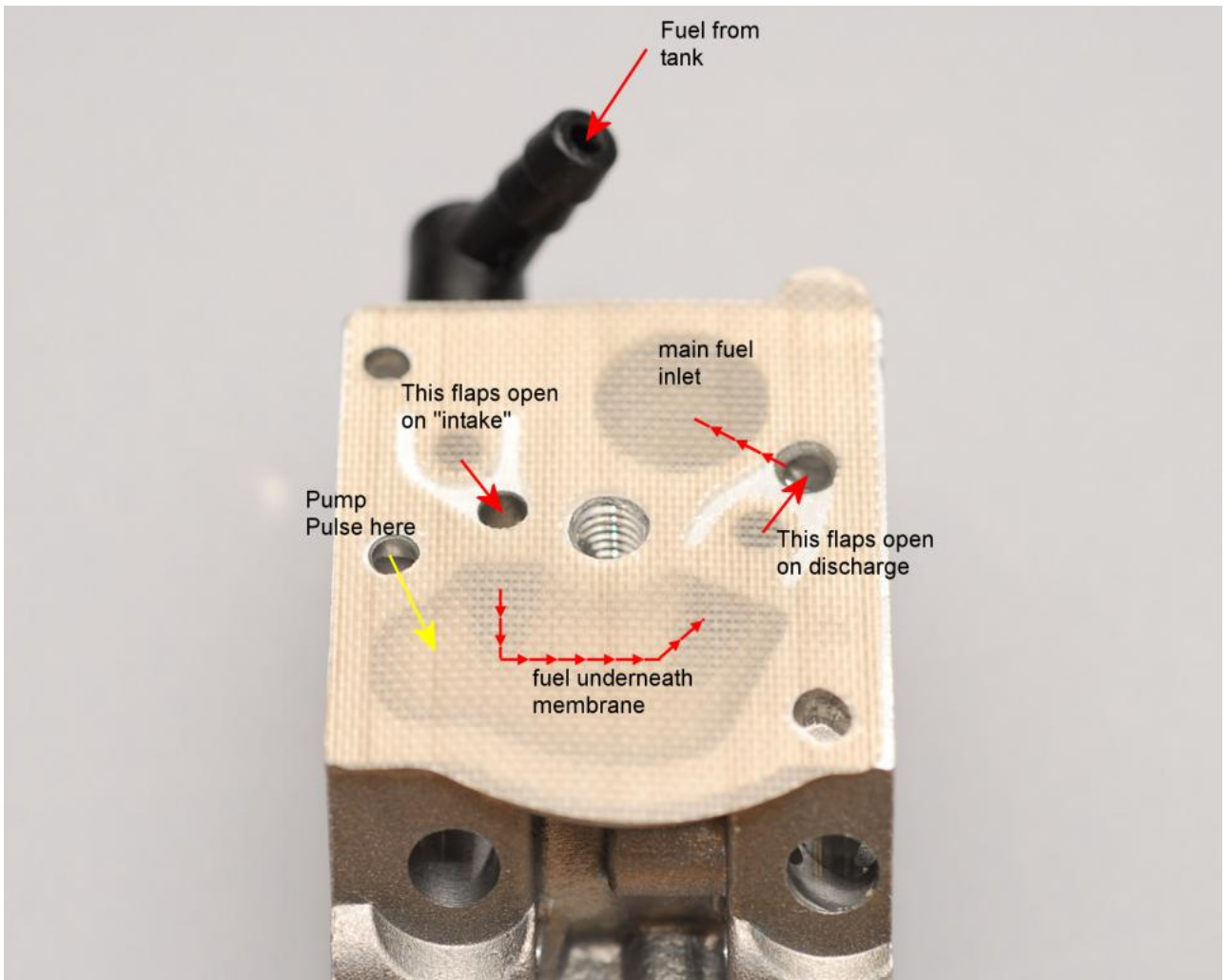
When the pump is on its intake cycle (piston moving up)

1. membrane is pulled outward by vacuum
2. causes inlet check valve to flap open
3. pulls fuel through the fuel inlet from the tank
4. fuel travels through the inlet ports to the fuel reservoir

When the pump is on its discharge cycle (piston moving down)

1. membrane is pushed in by case pressure
2. causes output check valve to open
3. pushes fuel from the reservoir through the output ports
4. fuel travels to the main carburetor input filter

and the cycle repeats. At idle this cycle is happening at almost 60 times a second so even though the membrane doesn't move very far, its moving a lot! Walbro specifies the pump to produce between 5-7 PSI pressure when operating.



Fuel Path through pump

Here's where the fuel needs to wind up. Here's the first time that the fuel is filtered inside the carburetor. More about maintenance later.



Here's where ALL the fuel needs to go

The Bottom Line

although the fuel pump system in these carburetors is based on a simple idea, there are a lot of channels and ports that have to be properly clean and sealed for it to function properly.

next up - The Fuel Regulator system

Attached Thumbnails



Carey Shurley
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07-31-2011, 08:12 PM

#4 (perma

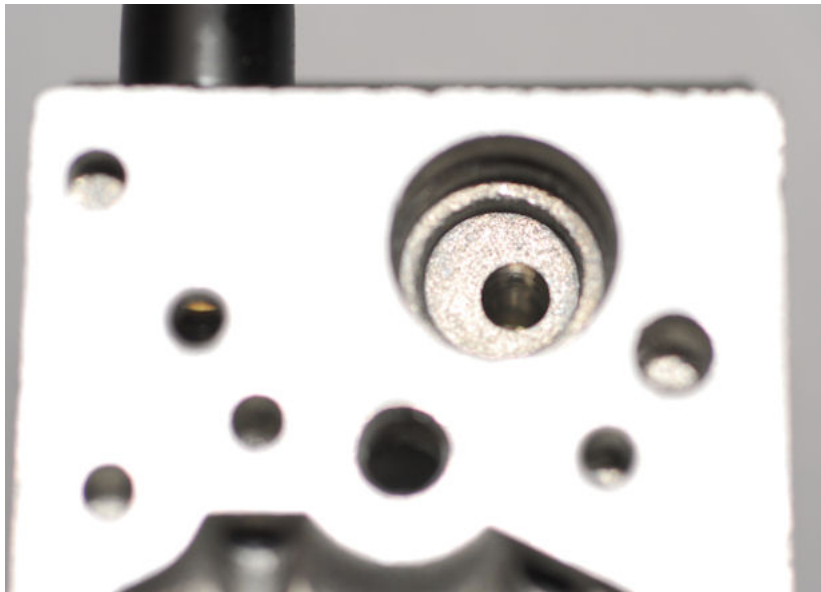
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Fuel Regulator Assembly

Now that you know how fuel gets into the carburetor, lets look at how it gets over to the metering side of the carb and what happens there

Join Date: Apr 2004

The main fuel feed has a small screen that can filter out large particles. The mesh isnt' all that fine. If you look underneath its a drilled port that goes straight through the carb body to the metering side.



Pump side - main fuel feed

So this is the metering or regulating side of the carb. The regulator system is underneath the primer



Regulator side of carb

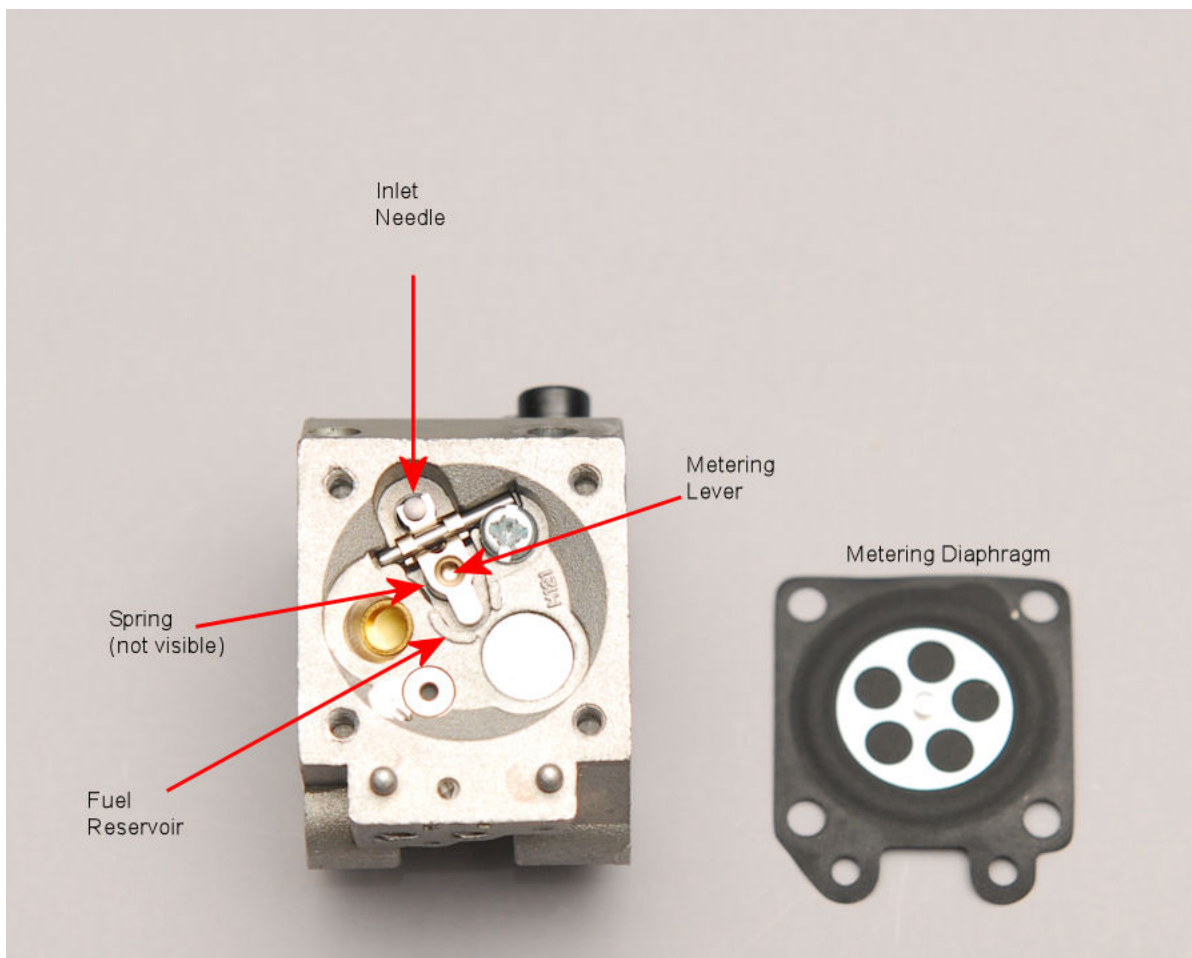
here's the top side of the regulator diaphragm. There should not be any fuel on this side of the diaphragm



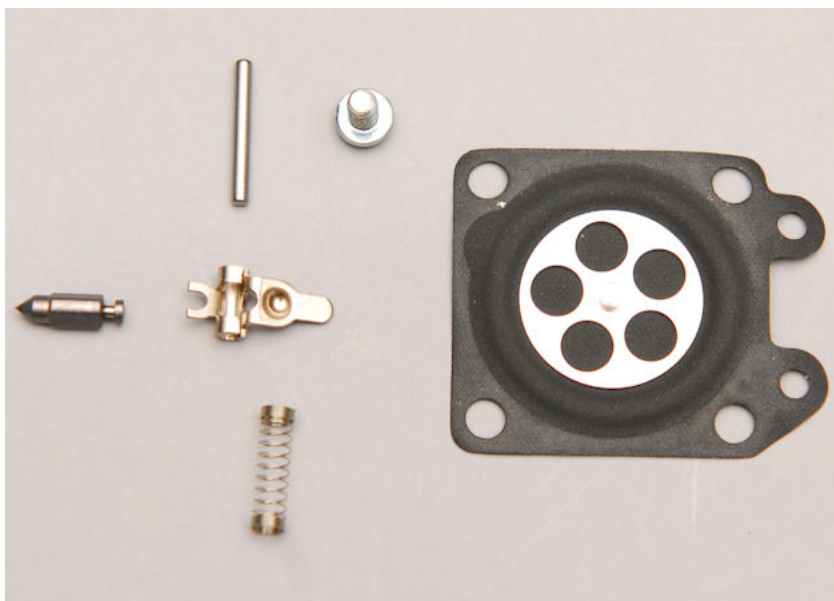
Diaphragm Position

Underneath the diaphragm is the main fuel reservoir for the carburetor. This cavity will contain fuel when the system is primed and the engine is running. The parts of the regulator system are:

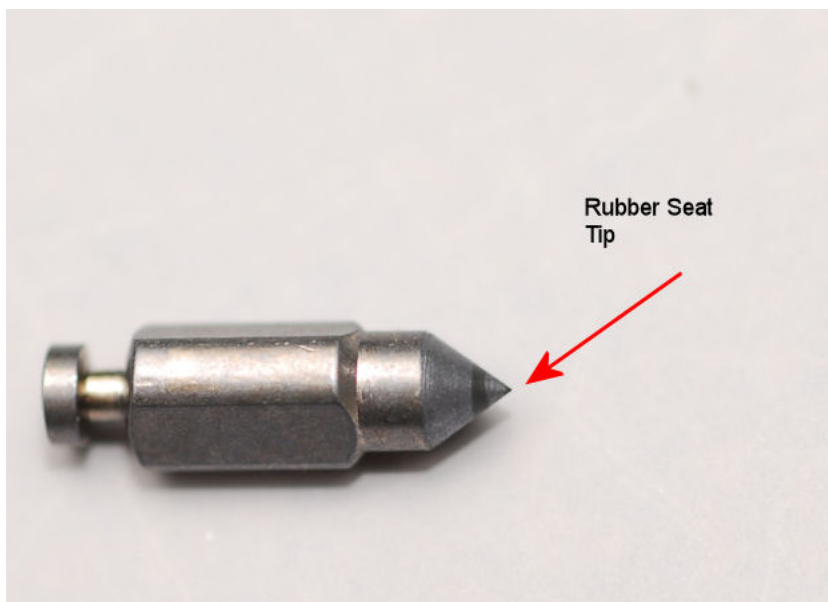
1. the diaphragm - note the metal ring and button
2. the regulator lever
3. the regulator inlet needle
4. the regulator spring
5. mounting shaft/bolt

**Regulator Parts Layout**

Here are the parts separated out so you can see them clearly

**Regulator Components**

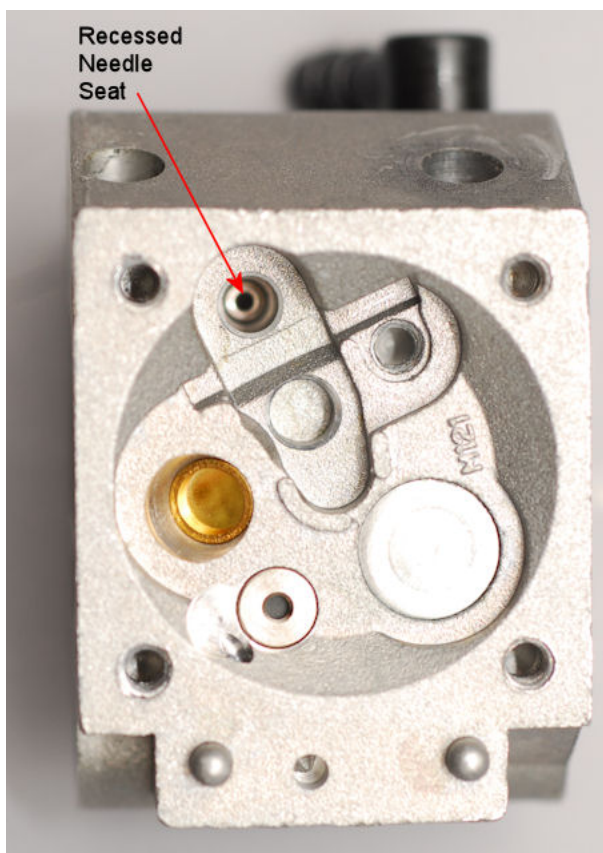
A closeup view of the regulator needle shows that the tip is rubberized to seal



Regulator Needle

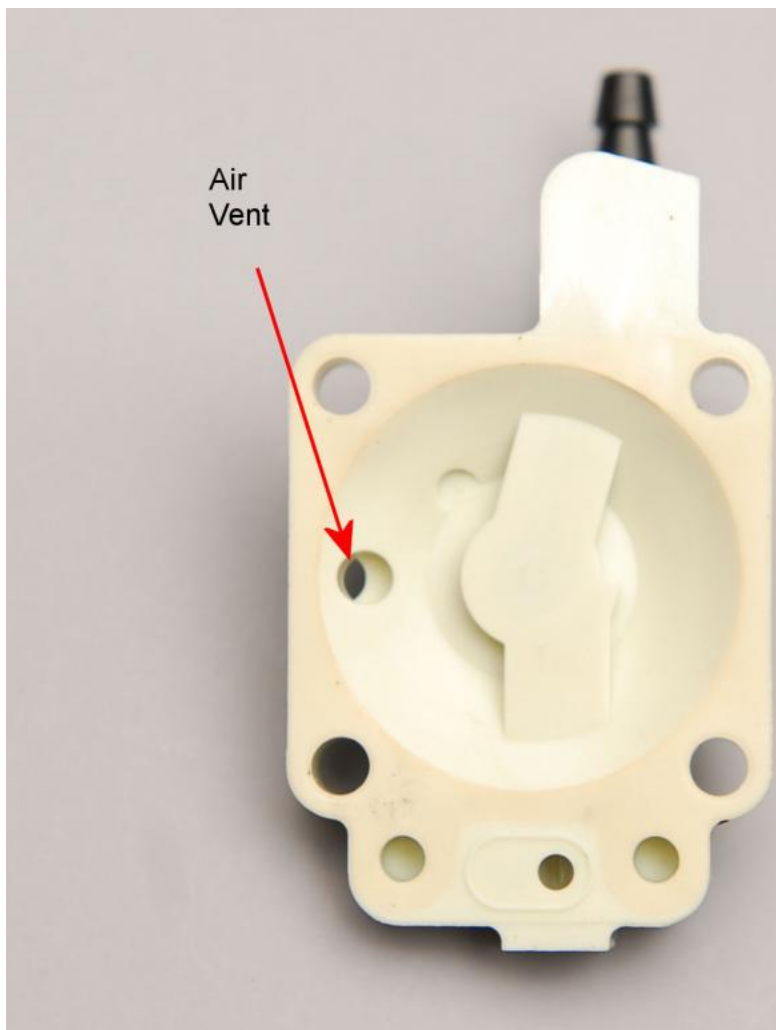
and if you look into the regulator needle cavity you can see a machined seat in the bottom. This is usually either pressed in or machined in. This isn't user serviceable

This is where the fuel is moving from the pump side of the carb to the metering side. Remember the main fuel inlet port on the pump side? This is where it goes.



Needle Seat

Because this is a vacuum based system, the diaphragm moves depending on the amount of fuel being pulled into the motor. the diaphragm was in a completely sealed assembly it wouldn't react correctly to a vacuum. So the dry side has an air vent to outside air. You can see it here on the inside of the primer assembly



Air vent on primer assembly

And here it is on the outside. Its hidden underneath the primer assembly parts. When these motors are installed inside cowlings model airplanes, they often have fuel mixture problems. One reason is that if the cowling doesn't have adequate area for air to go out of it at high speed the air moving into the cowling builds up pressure. The pressure affects the regulator diaphragm because of this hole. On an airplane the fix is to connect a fitting to this vent and run a tube somewhere outside of the cowling to make sure the pressure matches standard atmospheric pressure.



Air vent - external view

Okay so how does all this work?

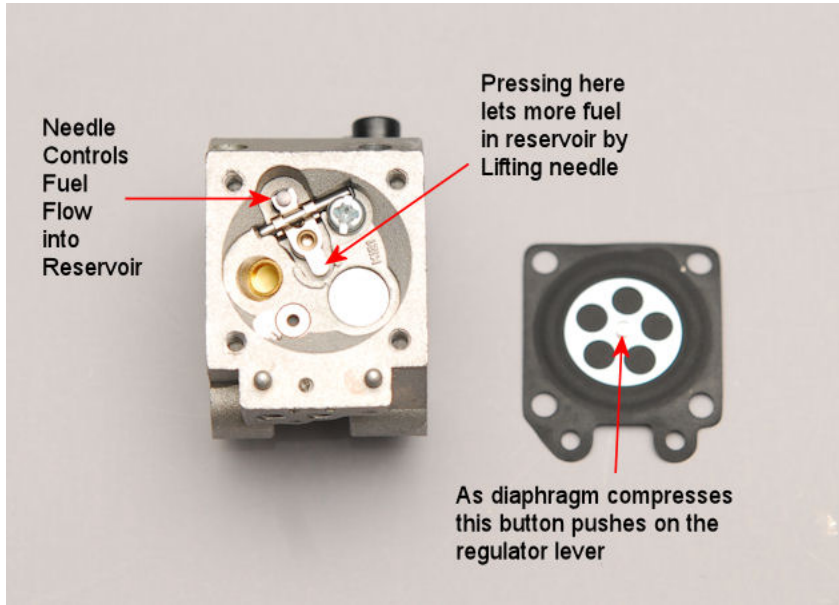
Remember the fuel pump is generating a few PSI of pressure. If there were not some sort of regulating system that fuel would just be pumped into the motor and it would quickly flood out and quit running.

So a regulator is needed to match the amount of fuel available to whats being used (sound familiar? Guess what the fuel regulat on the YS and OS glow motors is doing?). In reality this system does the same thing that a "float" system does in some other carburetors however this is a more compact setup.

when the motor is running, its pulling fuel from the main fuel reservoir on the regulator side of the carburetor through the low and high speed metering circuits into the motor. We'll cover that flow in detail a bit later. For now we're going to focus on what the regulator system is doing.

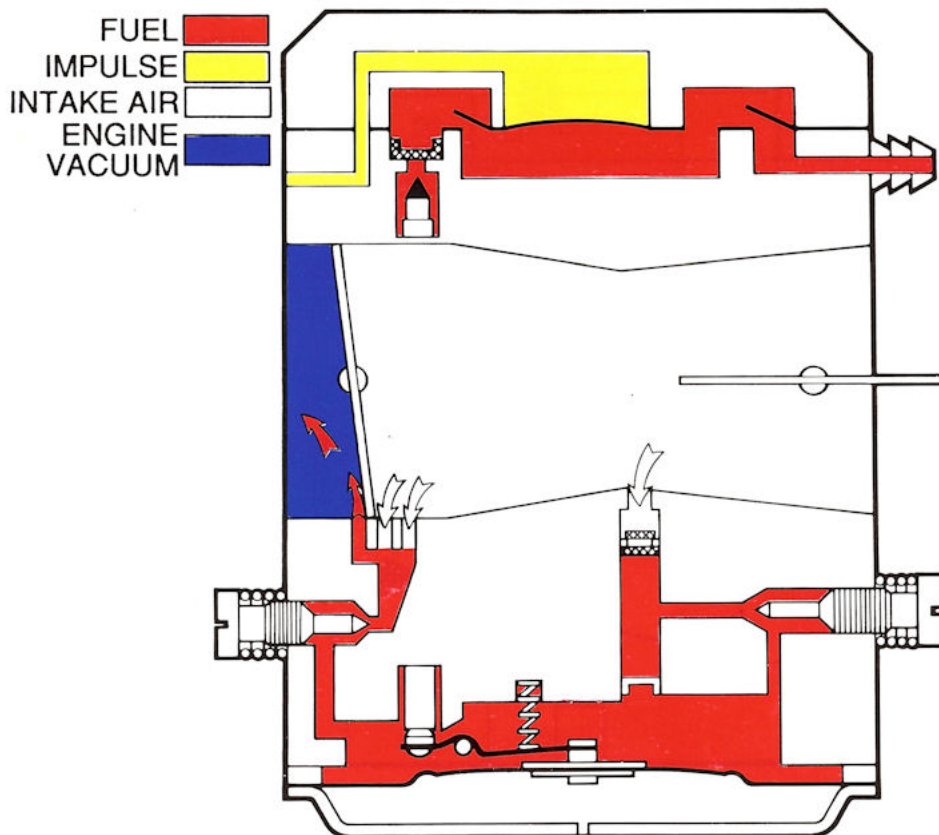
At low speed, not as much fuel is being pulled into the engine. So the regulator needs to let less fuel flow from the pump into the reservoir. There is little fuel being pulled from the reservoir so the diaphragm is relatively relaxed.

when the diaphragm is relaxed, the pin in the center of it is not pushing against the metering lever and the spring underneath the lever is pushing it upwards



Regulator needle operation

As the spring pushes against the lever, it pushes the inlet needle further into the seat and lets less fuel in. Heres a diagram of th pay attention to the diaphragm shape at the bottom of the diagram

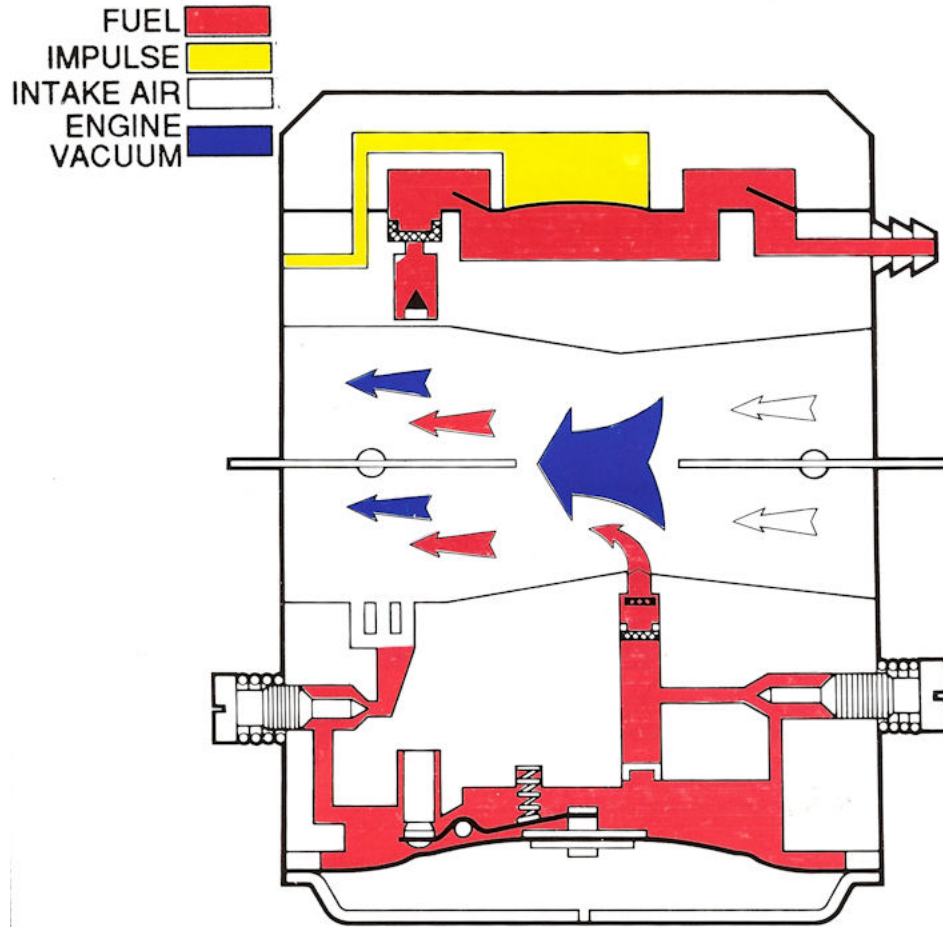


Low speed - regulator needle more closed -Diagram From Walbro Service Manual

At higher speeds, more fuel is being pulled into the engine. So the regulator needs to let more fuel flow from the pump into the reservoir. As fuel is being pulled from the reservoir the diaphragm is pulled further into the reservoir

when the diaphragm is pulled inward, the pin in the center of it is pushing more against the regulator lever

This pulls the inlet needle more away from the seat and lets more fuel in. Here's a diagram of that, again pay attention to the diaphragm shape at the bottom of the diagram



High speed - regulator needle more open -Diagram From Walbro Service Manual

So as you can see, this system is self adjusting. The more fuel the motor is using, the more fuel is being made available to it.

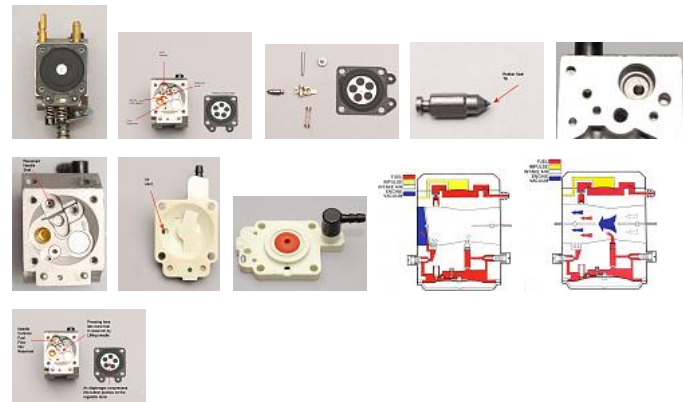
There are some subtle details about this system that have big impacts. As you can see by how the system operates, the flexibility of the diaphragm and the spring tension impact both the ongoing mixture and fuel availability during sudden acceleration.

The Bottom Line

There are more moving parts on this side of the carburetor that all must work correctly for the run as it should

Next up: The Primer System.

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Carey Shurley
Proprietor - Gas Powered Helicopters



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08-01-2011, 08:44 AM

#5 (perma

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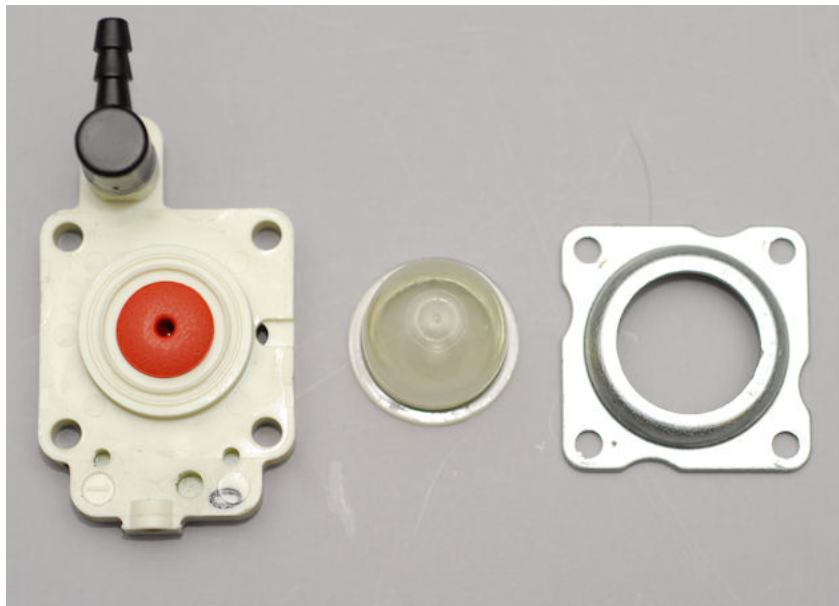
Join Date: Apr 2004

The Primer System

So as you can see, the carburetor has a reservoir that needs to be filled with fuel for the motor to even start. Since it has its own pump, the carb will fill this up as the motor cycles. If you're spin starting, it will draw fuel into the carb on its own. There is also a method used by airplane pilots where you rock the piston up and down using the prop (which sends pulses to the pump) to draw in as well.

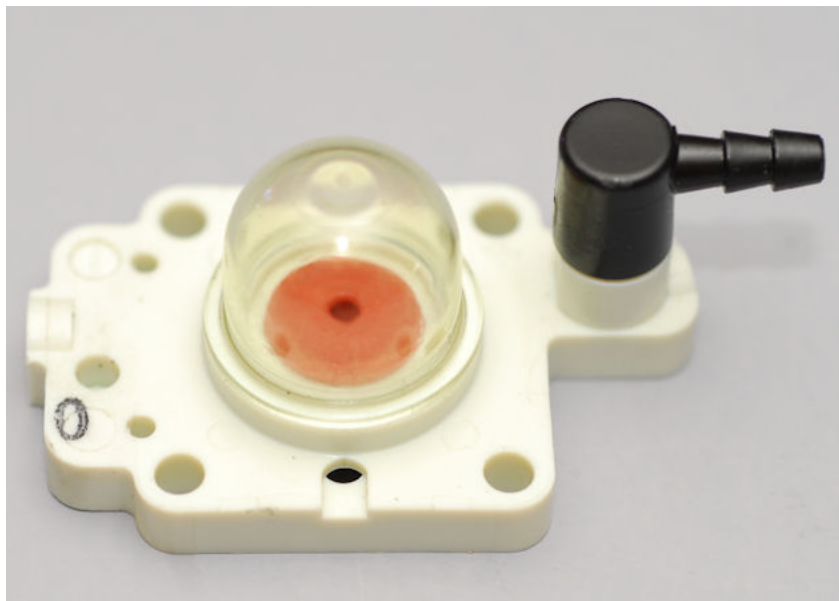
Its more common with gas helicopter carburetors to have a primer system. This allows you to fill the carb up before trying to star the motor. If you're a fan of pull starting it, this is a critical component.

Here's the primer components, they mount on the metering side of the carburetor



Primer parts

its held on by some bolts and a retaining plate but these are the working parts



The primer body and bulb

Seems simple enough, you push and release the bulb until it fills with fuel. But how does that happen?

well, the little red circle is a one-way valve. Pressure can go through it but then it closes off to prevent suction/vacuum from pulling through it.

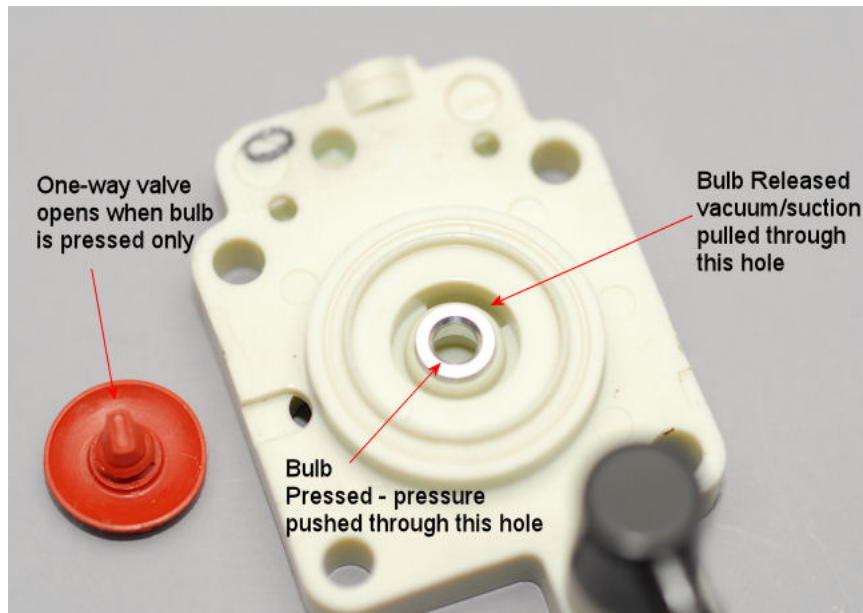
If you look closely at the top of the primer body, you can see that the one way valve fits into a center port BUT THERE IS ANOTHER slotted opening just outside of that.

when you push down on the bulb

- the pressure goes through both of these holes
- the pressure through the slot goes back into the regulator of the carb through ports
- remember the regulator opens on suction/vacuum, so this pressure causes it to seal
- so then the pressure can only go through the one way valve goes out the primer return fitting

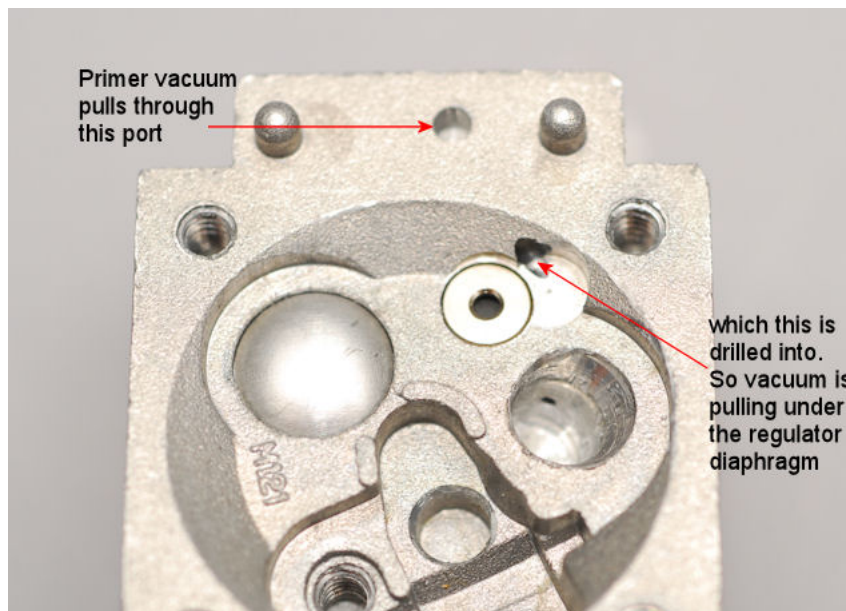
when you release the bulb

- the one way valve closes so suction cannot pull through the primer return
- it CAN however pull through the slot which ports into the regulator



Primer valve and openings

The port on the back of the primer body aligns with this port on the carb body. As you can see it channels underneath the regulator diaphragm



Primer Path

So when you release the primer bulb, vacuum/suction is forming under the regulator diaphragm

- as you remember, vacuum under the diaphragm causes the regulator valve to open drawing fuel from the pump side of the carb
- the vacuum pulls through the regulator valve into the pump body.
- this causes the two flapping valves to pull open and allow fuel to be pulled directly from the fuel inlet line, through the pump through the regulator, through the primer body and out the primer return line.
- because the primer bulb sits on a one-way valve, as it draws fuel into it, the fuel can't escape. Hence the primer bulb is full

Note - there is NO valve between the primer bulb and the regulator. Which means fuel CAN be pulled from the primer bulb back into the carburetor while the motor is running and can completely empty it. SOUND FAMILIAR? This isn't normal but happens a More on that in the Problems/Maintenance section.

And thats how the primer works!

The Bottom Line

the priming system uses the existing fuel pump/regulator assemblies and operation of the carb to simply fill it with fuel preparing to provide fuel to the motor.

next up: Common Fuel Control Components

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Carey Shurley
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08-01-2011, 08:53 PM

#6 (perma

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Common Fuel Control Components

The fuel needs to get from the main fuel reservoir into the carburetor throat so it can get into the motor. There are separate high speed and low speed control systems in the carb which will be covered later but there are also common parts for fuel delivery control.

those will be covered here

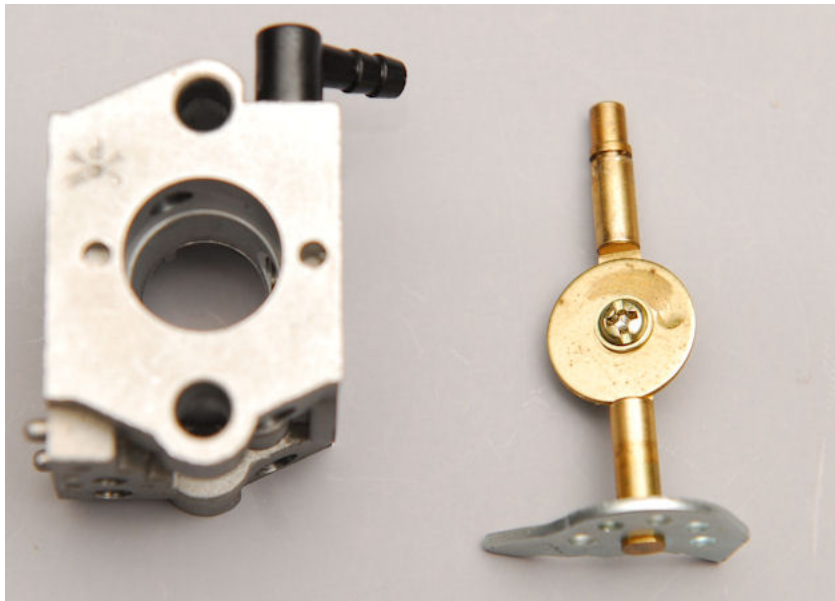
On the motor side of the carburetor is the throttle valve (butterfly). Here you can see it in the carb and in the closed position

Join Date: Apr 2004



Throttle Plate - Closed

And here are the components of that. Note that the throttle plate has a small hole in it. This ensures that even if the throttle is full closed that a small amount of air can still pass through the carburetor. Because of this, depending on the mixture the motor can actually still run with the throttle fully closed



Throttle Plate Parts

And on this side of the carburetor is the "choke" or engine primer plate. You'll see in the low speed control discussion exactly how this works closing this causes much more fuel to be pulled into the motor

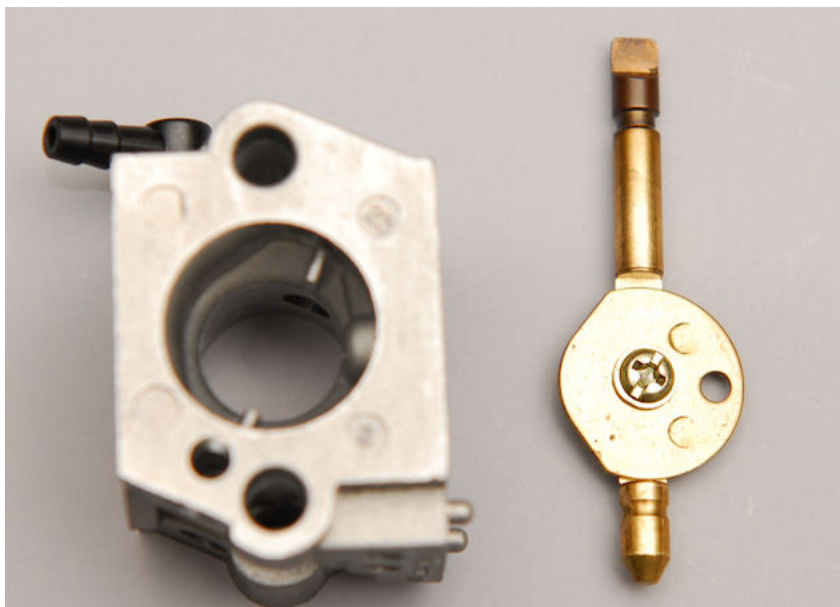
BTW - if you remove the choke shaft, there is a small spring and ball at the bottom of it that acts as a detent. When you remove the shaft those parts will fall out so be ready to capture them. Easy to reinstall.



Choke Plate - Open

And here are the choke parts. Again even fully closed there is a small hole to allow some air to move through. This is needed to ensure fuel flow through the fuel control systems.

NOTE: the two small indentations on the choke plate serve as alignment guides for attaching the plate to the shaft. Because of the shape of the venturi of the carburetor, this plate has to align precisely when installed. When the indentations align with the shaft, the plate will be aligned.

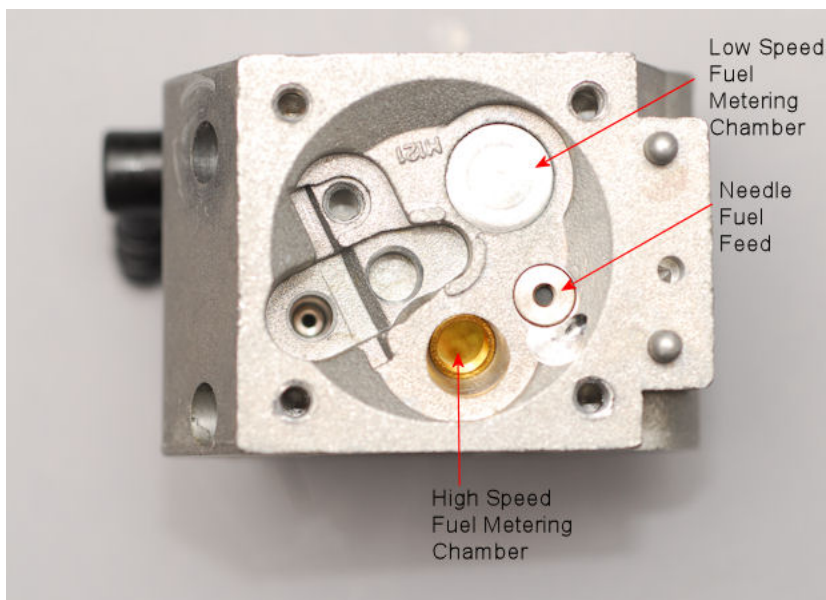


Choke Parts

So in the last section we talked about the main fuel reservoir being filled with fuel. That fuel has to get into the carburetor. Note that there is a low speed and high speed control system visible but they are capped off. If they weren't, the motor could pull unlimited fuel through the ports. In this case it would flood with fuel.

So a more precise way to meter the fuel is needed. That way is implemented in the form of needle valves which can be adjusted allow a precise amount of fuel being allowed to flow

So the fuel has to get from the reservoir to the control needles. It does this by being pulled through the needle feed housing. This is pressed into the carb body and is not serviceable



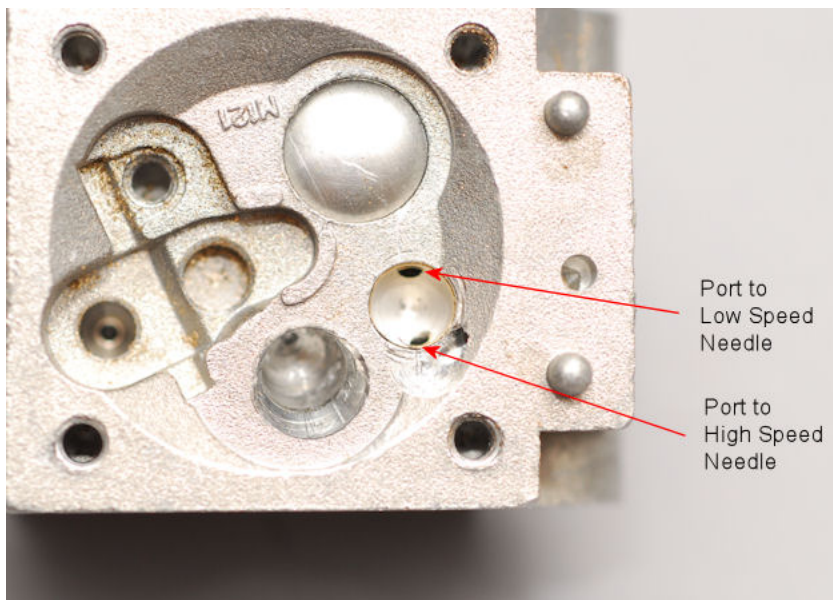
Fuel Circuits

It does however contain the small composite plate. Basically it acts as a one way valve by only letting fuel into the needle feed cavity. If you look at the previous photo you can see this plate just inside the needle feed port



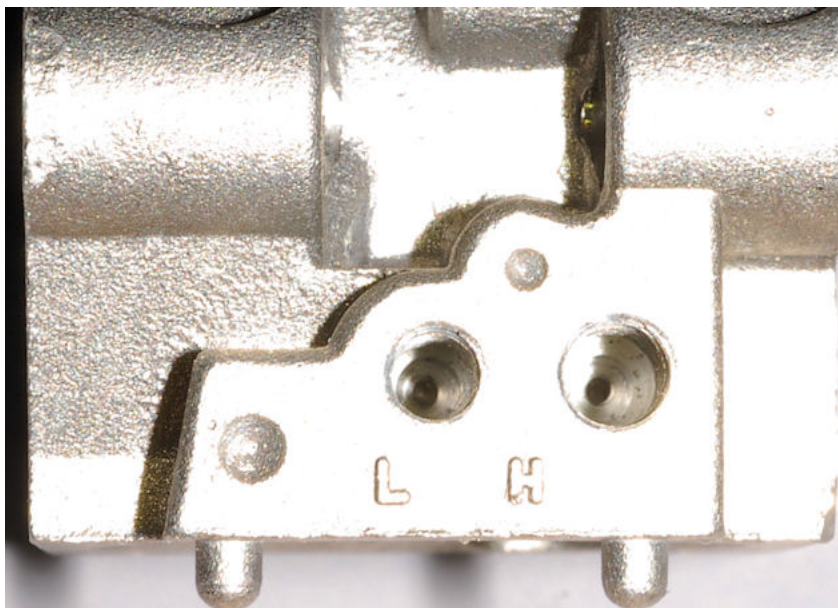
Whats inside the needle feed housing

If you remove this (and this was a destructive process) you can see that at the bottom is two ports, one directed to each of the needle valves



Needle Feed Ports

If you look into the carb body where the high and low speed needles install, you can see that deep inside there are seats machined into each. This is where the needle valves fit. Also the needle feed ports drop into these cavities on the needle side of the seats. Fuel flow control into the rest of the system will be controlled by how open or closed the needles are.



High/Low speed needle seats

Finally, here are the actual metering needles. You can see that the tips fit into the seats inside the carburetor and that they have slightly different shapes which account for different fuel flows.



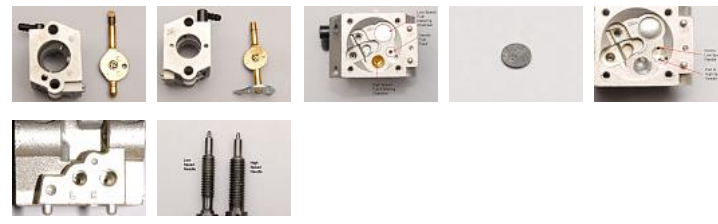
High/Low speed needles

The Bottom Line

these carburetor components provide very fine control over the amount of fuel entering the fuel feed circuits.

Next up: The Low Speed Circuit

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Carey Shurley
Proprietor - Gas Powered Helicopters



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#7 (perma

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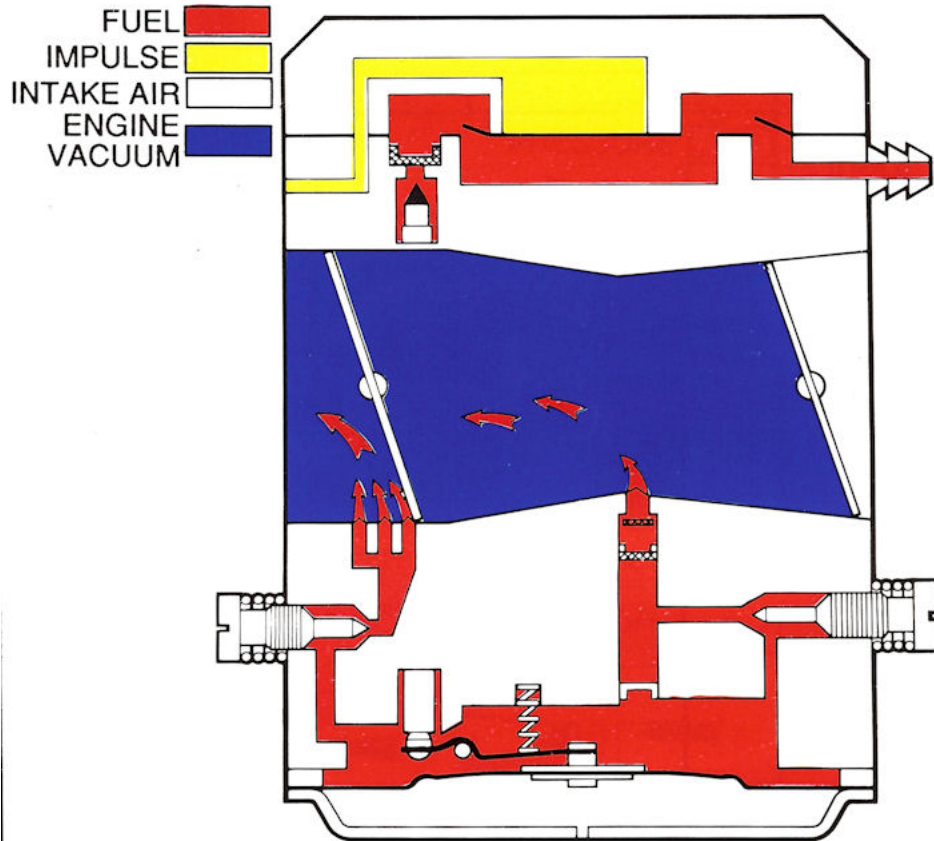
The Low Speed Control Circuit

So here's where the fuel control parts covered in the last section all start to work together.

This carburetor has two basic fuel metering systems, this section will focus on the operation of the low speed fuel control system

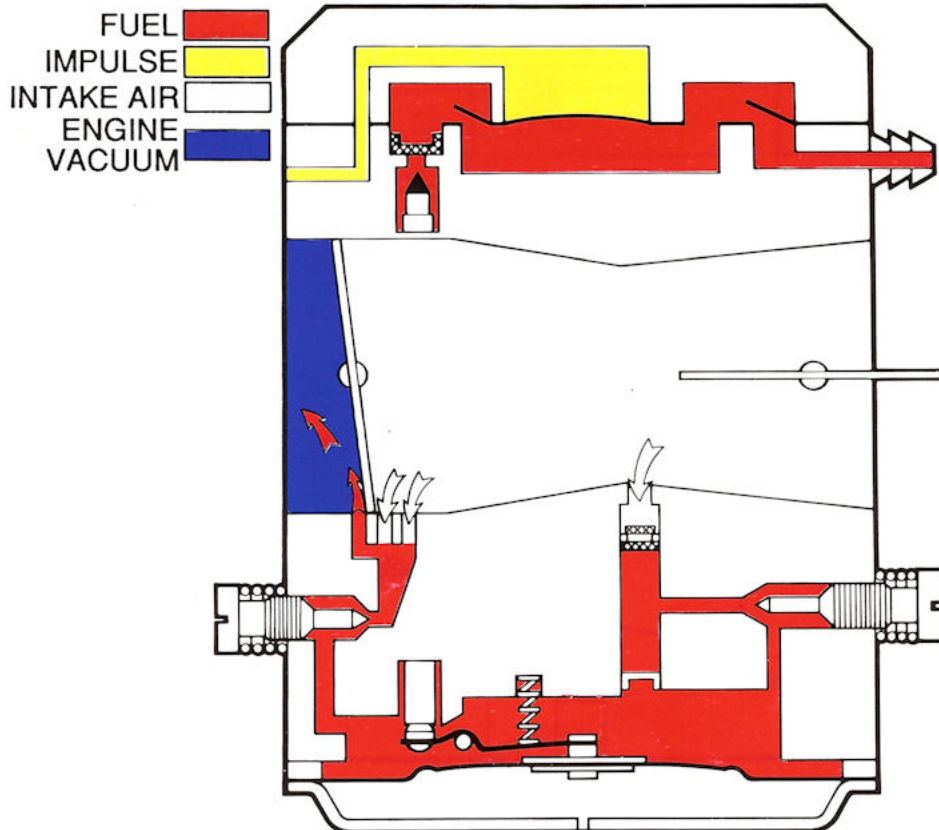
As discussed earlier, this particular carburetor has a "choke" to help prime the motor for starting. In that config, the choke plate is closed as is the throttle (remember its never fully closed off)

Here's the fuel path. With the plates closed a large vacuum is created in the carb throat. This causes fuel to be pulled from all fuel control systems to prime the motor for starting



Fuel Flow Path - Choke Closed (engine prime) - Diagram from Walbro Service Manual

at idle, only one fuel port is "open" and its inside the throttle (see shortly). Here's the fuel flow for the idle configuration



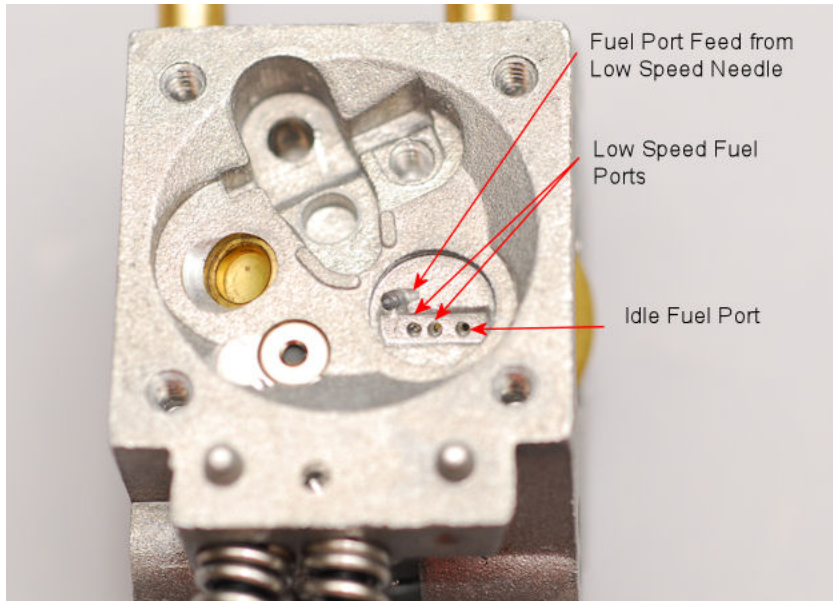
Fuel Flow Path - Engine Idle - Diagram from Walbro Service Manual

Also note that at idle, the air moving through the carburetor actually "backs" into the exposed high speed and low speed ports a acts to push fuel through the idle port.

Here's how the fuel gets there. For this photo I removed the cap over the low speed fuel cavity to expose the ports. BTW, this cap is known as a Welch plug (so named because of an invention by the Welch Car Company). They have to be pryed out and "deformed" back into position. More on this in the problem/maintenance segment.

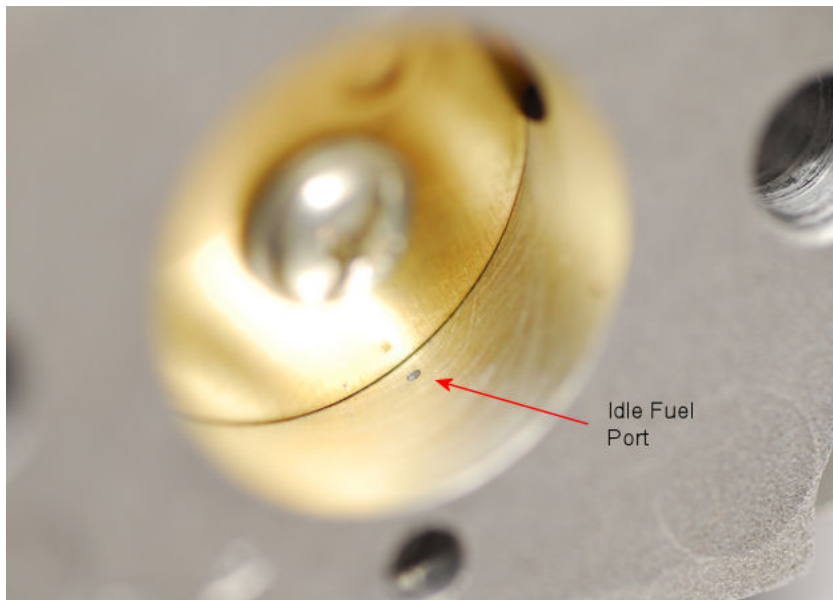
you can see where fuel metered by the needle valve feeds into this cavity and will be waiting under each of these ports.

NOTE - there are no screens here



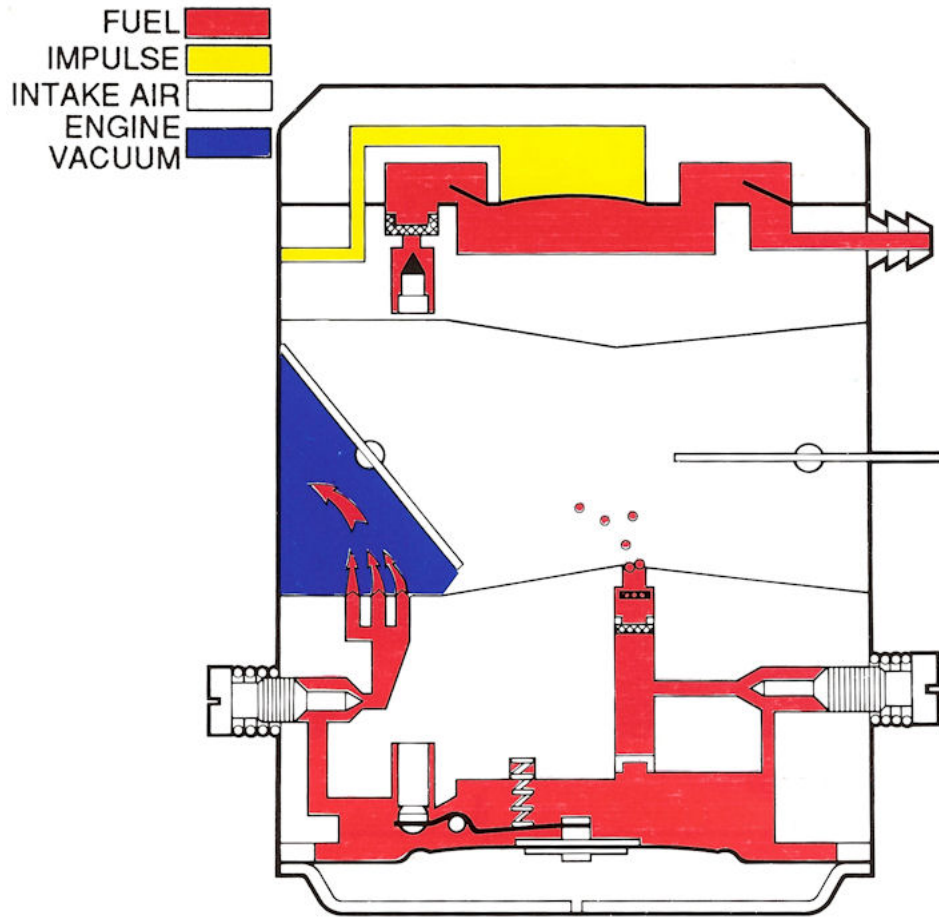
Low Speed Fuel Cavity

At idle, only one of them is exposed to engine vacuum, the idle port. Here you can see that when the throttle is closed, this port still exposed



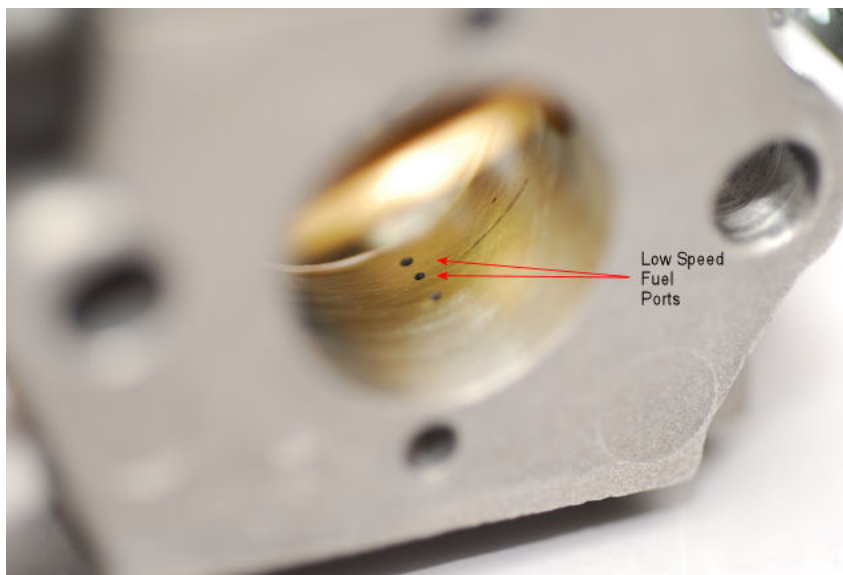
Idle Port in carburetor throat

As the throttle is opened more, the additional low speed ports are exposed as is the high speed port further back in the carb thro. Here you can see the fuel flow for partial throttle openings.



Fuel Flow Path - Partial Throttle - Diagram from Walbro Service Manual

And here are the additional ports inside the carburetor throat.

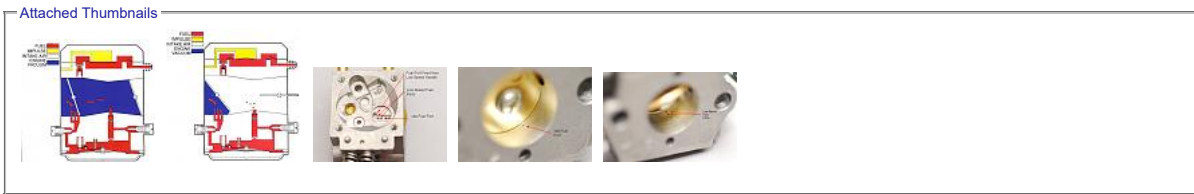


Low Speed ports in carburetor throat

The Bottom Line

The carburetor has a dedicated fuel control system for idle and low speed throttle settings. As the throttle is opened more and engine speed and carb vacuum increases fuel is pulled through the low speed control circuit.

Next up: The High Speed Control Circuit



Carey Shurley
Proprietor - Gas Powered Helicopters



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08-01-2011, 10:01 PM

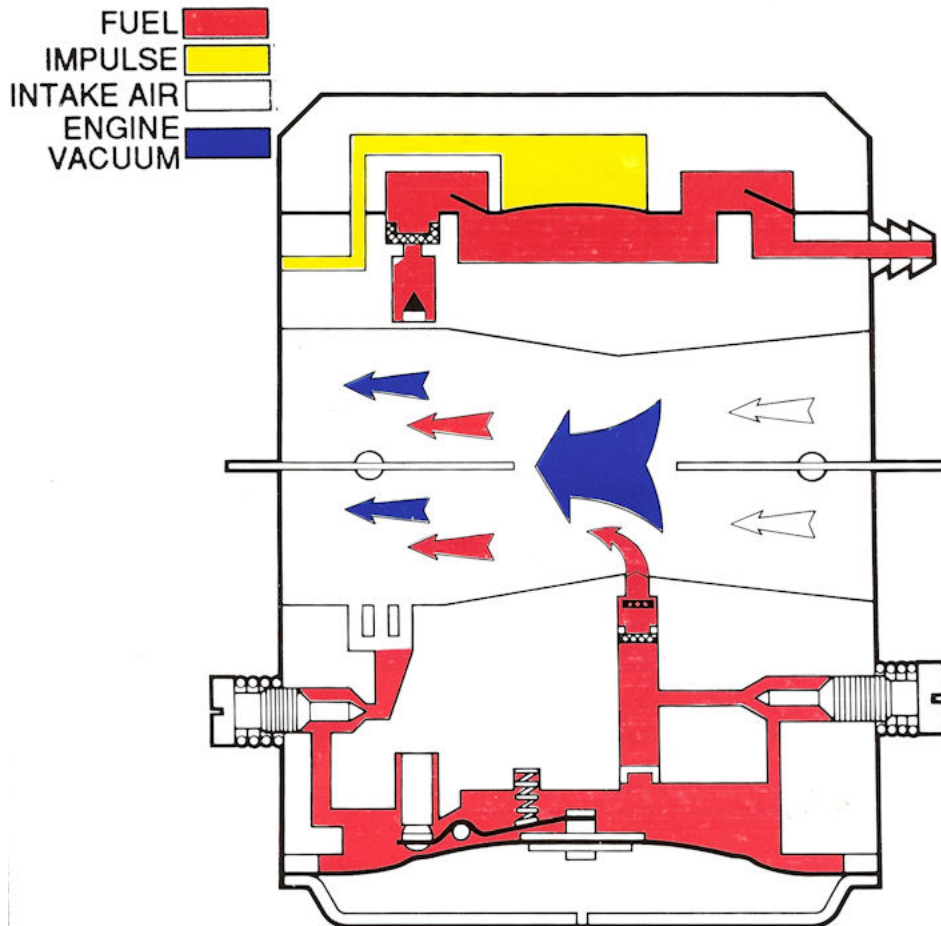
#8 (perma

[carey_shurley](#)
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The High Speed Control Circuit

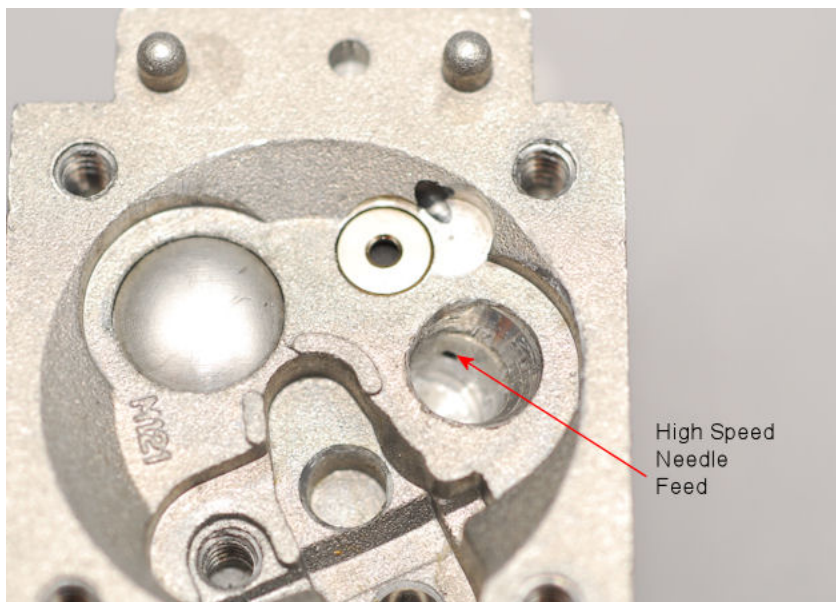
Finally a control system is needed to deliver additional fuel when the engine is operating at high rpm's. The exact throttle opening at which this circuit will begin to deliver fuel will be based on a number of circumstances and needle settings but typically its providing some fuel at half throttle opening and more

Here's the fuel flow for the high speed fuel delivery system



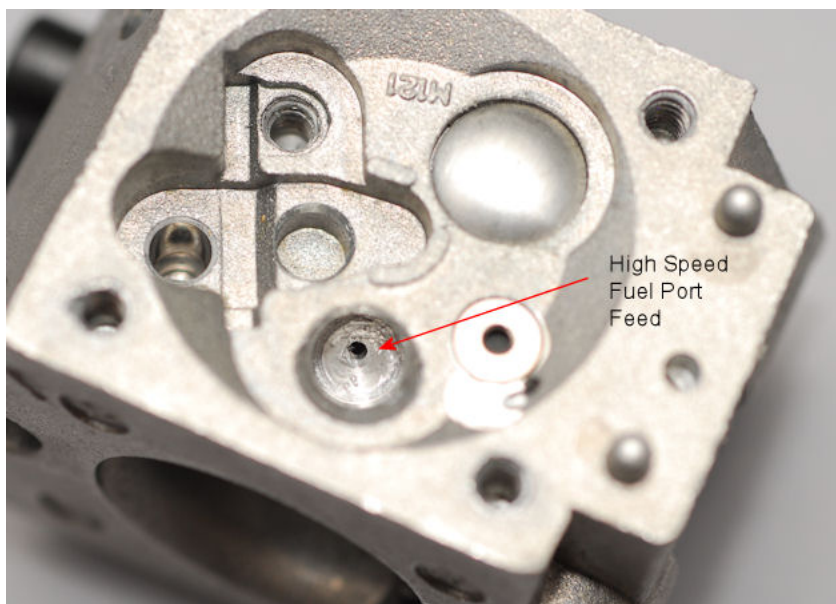
Fuel flow at High speed - Diagram From Walbro Service Manual

The high speed control cavity is covered with a brass plug. This plug must be pryed out and would need to be replaced if removed. Metered fuel is delivered into the high speed port cavity via this hole, which is at the end of the high speed needle valve.



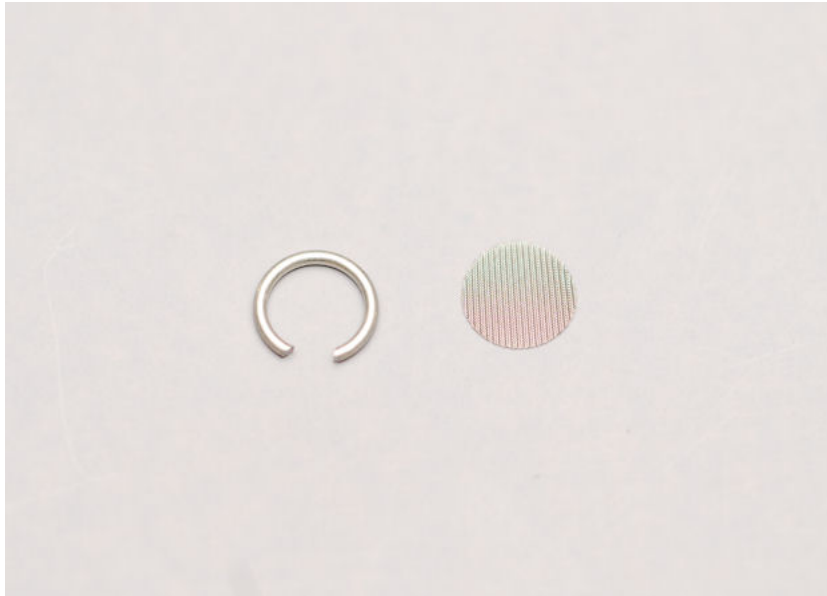
High speed fuel feed from needle valve

and here's where its going. This port is much larger than the low speed circuit ports.



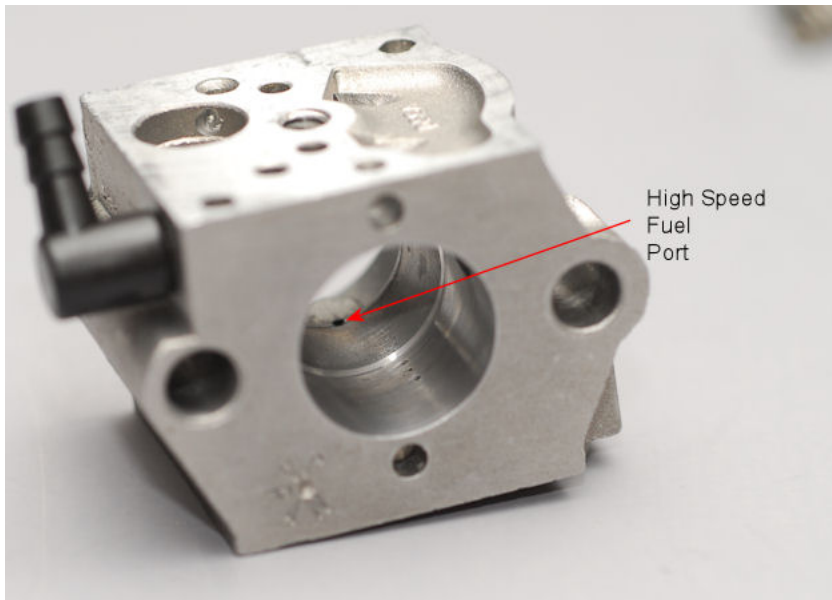
High speed fuel port

Its also covered by a screen. This small screen is held into place with a circular clip. This part is serviceable but very difficult to remove. Its been pointed out to me that it also provides a capillary function to allow fuel to pass through it but not air.



High speed circuit screen and retainer

If you look in the carburetor throat, you can see the high speed fuel port. Its more on the intake side of carburetor in its narrowest part. If you're familiar with the concept of a venturi you'll know why



High speed fuel port in carburetor throat

The Bottom Line

The high speed fuel control system works with the low speed system to delivery fuel to the motor at high speed operation.

So there you have it, we've covered every component of the Walbro carburetor and how it operates. The theory is almost identic to that for a common glow motor carburetor, its just implemented in a more complicated way.

Next up: Problems and Maintenance

[Attached Thumbnails](#)



Carey Shurley
Proprietor - Gas Powered Helicopters



Last edited by carey shurley; 08-05-2011 at 12:37 PM..

08-01-2011, 10:02 PM

#9 (perma

[carey.shurley](#)

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Thread Starter 

Join Date: Apr 2004

Problems/Maintenance

Introduction

As you can see, although the basic purpose of this carburetor is pretty simple but there are a lot of little places where something can go wrong. We'll go over some of the most common here.

But first, I offer the most important advice: Get another carburetor and test it to make sure it works correctly. Then use the primer get all of the fuel out of it, wrap it up and put it in your tool box. You'll see why soon. If you shop around you can get one for about \$35 or roughly the price of a gallon of glow fuel.

My Best Advice

First

Unless you fly your model every day, when you're done flying remove all the fuel from the tank and using the primer bulb pump the carb as dry as possible.

Gasoline is dirty and spoils over time. If it stays in all those little ports and orifices it can leave deposits or gel.

Second

If one day your motor starts exhibiting inexplicable things, after basic diagnostics I usually swap out the carb. If the problem goes away, then you have the option to do some more diagnostics on the problem carb. Meanwhile your model is working correctly again. If it makes no difference then swap the carbs back and store the newer one until another day. This only takes a couple of minutes and can save you a lot of diagnostic time at the flying field.

Dirt/crud - The Main enemy

I'm sure you noticed all the little ports in this carburetor. They are very small, only a small amount of dirt can affect the operation some of them. Although we'll go over how to clean some of them, the most effective maintenance you can do to this carb is to keep it clean as well as the fuel going into it!

Always use a felt clunk in the tank, run a non-interrupted line from the tank to the carb fuel inlet (no T fittings or filters) and don't remove it unless you have to. If you have followed my advice for tank plumbing, there is really no reason to ever remove this line unless your testing the vent or removing unused fuel.

Keep the carb clean especially around the needles. If you disassemble it, do so in a clean area and keep the parts on paper towels or clean rags.

Parts

One of the great things about Walbro carburetors is that there are rebuild kits for them. For the WT-64x series the kit number is K24-WAT. These include new pump diaphragms, gaskets, screens, regulator parts and new welch plugs. The kit applies to several carburetor models so there are multiple versions of many of the parts in the bag. Expect to spend \$10-14 for these kits. Should you really do this? Read on.

The Screen

If the carb has ingested junk, there's a good chance it was caught in the main fuel feed screen. It is easy to get to as we saw earlier as it is in the fuel pump.



Personally I've never seen this have enough junk in it to matter. If you don't use filters or keep things clean it could be clogged up though.

If you see junk in the main fuel feed screen, DO NOT JUST BLOW IT OUT. You'll blow the junk into the port and over into the regulator side. Remove the screen using the edge of an xacto knife or if you MUST blow it out, remove the regulator needle and blow it out from the back side.

What should you do if you suspect a carburetor problem?

so the model is suddenly running "differently" since the last time you started it. Surging, richer, leaner, otherwise misbehaving, so what should you do?

- if your motor has a choke in the air filter, make sure when its open it STAYS open. These things can get loose, move around while the motor is running and cause mayhem.
- check the settings - you should know about what needle settings are right for this model. Make sure they haven't gotten moved somehow
- vent - make sure your tank vent is working correctly. Easiest way to do this is to pump fuel out of the tank using the fuel feed line only. If it starts compressing the tank as in pulling a vacuum, the vent is not working
- fuel clunk - if its a filtered clunk, make sure its clean and fuel flow is good
- check all the fuel lines, including the one in the tank. Make sure they are all connected and in good shape
- look around the carb and the isolator block. If you see oily residue or wet gaskets, you've got a leak somewhere. As we've discussed the entire function of this carburetor is dependent on an expected amount of vacuum. If its not present, it will not function correctly.
- if everything looks dry, pull the carb off and look closer at all the gaskets. If you see something "wet", there is a leak. Replace whichever ones are wet and reinstall the carb, try again
- at this point is where I just put on my spare carb and match the settings. If the problem goes away, its a carb problem of some sort.
- Now you need to determine do you want to fix this or just leave the carb on. A new carb is usually \$35 or so and a carb rebuild kit is \$10-12, plus whatever time you'll spend determining where the problem is.
- the problem here is as you've seen there are a lot of little orifices and ports and channels in this thing, any one of which could cause trouble. Its somewhat painful and time consuming to remove/reinstall the little Welch plugs and the only way to really clean everything is to remove all the user serviceable parts and dunk the carb body in carb cleaner for a while. You can spend a couple hours doing all this
- There is one other exception to this set of diagnostics:

Primer Bulb Empty

If the motor leans out unexpectedly and you look at the carb and see that the primer bulb is empty (or is emptying out in front of your eyes) then before doing anything feel the carb on the inside edge of the regulator side of the carb.

If it is excessively hot look at the cooling shroud to see if its possible for hot air can be blowing on the carb. If it is hot try blocking (I've literally used aluminum foil for this) where that air is coming out and fly the model to see if it stops emptying the primer. If it does, this is the problem you need to address. Some models like the Spectra G include a carb shield that is there for this very purpose.

I have ONLY seen this problem on PUH models, I've personally NEVER seen this happen on an RC format model. The cooling shrouds are usually very different on those motors.

I talked with Luis Salas at Walbro (he's the guy that WROTE the Walbro Service Manual) about why he thinks this happens. He indicated that this was a problem that they did not see regularly so he didn't have a good explanation for why it would happen.

However from digging through the carburetor remember there is a port that runs directly from the primer bulb to the main fuel reservoir. If for some reason there is more vacuum than fuel in the reservoir it can pull it from the primer bulb. This is obviously what is happening, its less clear exactly why. All I can say is that EVERY time I've ever seen this happen, blocking the air flow o the carburetor has resolved it. In my experience even replacing the carburetor hasn't resolved this problem.

If you've had different experiences or resolved it a different way I'd like to hear it.

Start Up

How come the motor races and then slows down when you first start it for the day? So as you've seen there is a separate idle p but its fed from the low speed circuit. Its getting its fuel out of the main fuel reservoir. It takes a few seconds for the pump to get reservoir filled so the mixture is temporarily lean. So this is normal operation, you'll get used to it.

The Bottom Line

The carburetor on your gas helicopter has a lot of ports, channels and orifices. Cleaning them is time consuming and may have mixed results

Personally, if I swap the carb and it works, I'm done. The old carb goes in a box for someday when I'm bored. Frankly I've only h to do this twice ever and I've had a lot of motors and pushed a lot of fuel through them. Most of the time the problems are either fuel pickup, fuel line or leak related.

If you keep the fuel clean and have a careful fueling process you'll rarely have a problem thats actually in the carburetor.

Carey Shurley
Proprietor - Gas Powered Helicopters



Last edited by carey shurley; 11-27-2011 at 09:08 PM..

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08-05-2011, 10:07 AM

#10 (perma

[Zman39](#)

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Join Date: Dec 2006



Wow. Carey, you spent a lot of time on this and I applaud you. Great thread for both new and experienced gasser dudes! I hope many read this thread. I tell people often, most of the "gasser learning curve" is in tuning the engine and understanding what do what on these walbro's.

Thumbs up

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08-05-2011, 04:52 PM

#11 (perma

[mss001](#)

Registered Users

Join Date: Feb 2010



Carey,
The time and dedication you put into serving a relatively small group of gasser enthusiasts is admirable.
Thank you 😊

Trex 450 sport
Radikal G30 - Hanson G26 3D max

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08-05-2011, 07:13 PM

#12 (perma

[carey shurley](#)

Registered Users

Thread Starter



welcome.

although my evil plan is to convince enough people to give these a try so that it is more than a small group.

Join Date: Apr 2004

Carey Shurley
Proprietor - Gas Powered Helicopters

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08-18-2011, 06:05 AM

#13 (perma

[roopmari](#)

Registered Users

Join Date: Aug 2011

Quote:

Originally Posted by [carey shurley](#)

The fuel needs to get from the main fuel reservoir into the carburetor throat so it can get into the motor. There are separate high speed and low speed control systems in the carb which will be covered later but there are also common parts for fuel delivery control.

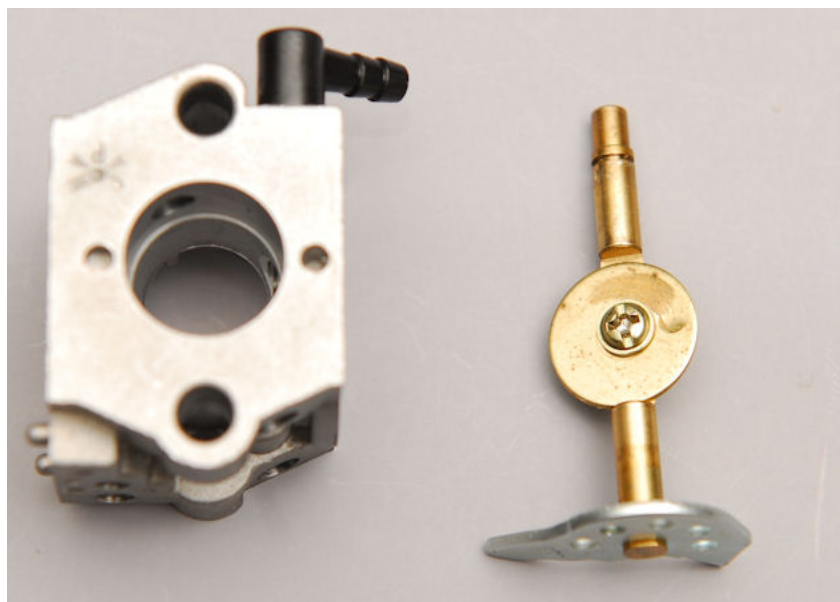
those will be covered here

On the motor side of the carburetor is the throttle valve (butterfly). Here you can see it in the carb and in the closed position



Throttle Plate - Closed

And here are the components of that. Note that the throttle plate has a small hole in it. This ensures that even if the throttle is fully closed that a small amount of air can still pass through the carburetor. Because of this, depending on the mixture the motor can actually still run with the throttle fully closed



Throttle Plate Parts

And on this side of the carburetor is the "choke" or engine primer plate. You'll see in the low speed control discussion exactly how this works closing this causes much more fuel to be pulled into the motor

BTW - if you remove the choke shaft, there is a small spring and ball at the bottom of it that acts as a detent. When you remove the shaft those parts will fall out so be ready to capture them. Easy to reinstall.

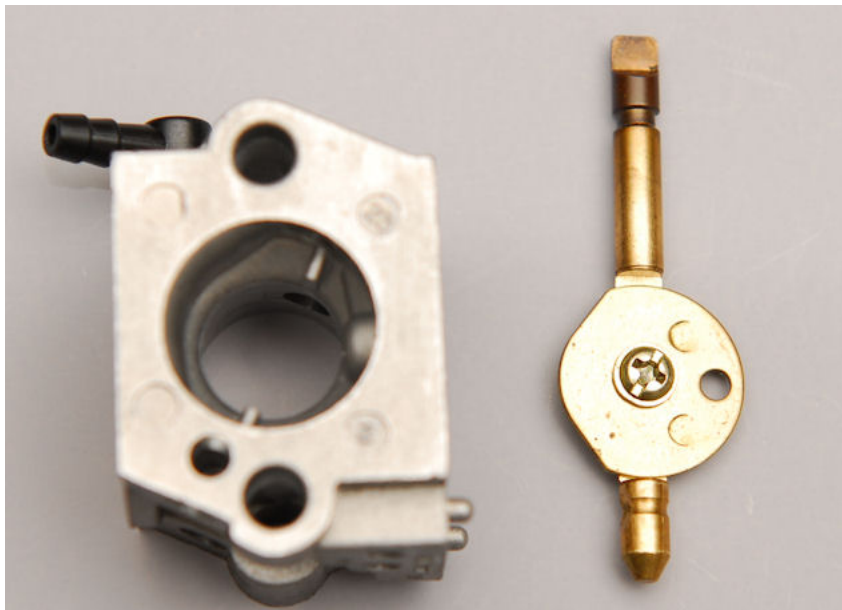


Choke Plate - Open

And here are the choke parts. Again even fully closed there is a small hole to allow some air to move through. This is needed to ensure fuel flow through the fuel control systems.

NOTE: the two small indentations on the choke plate serve as alignment guides for attaching the plate to the shaft.

Because of the shape of the venturi of the carburetor, this plate has to align precisely when installed. When the indentations align with the shaft, the plate will be aligned.

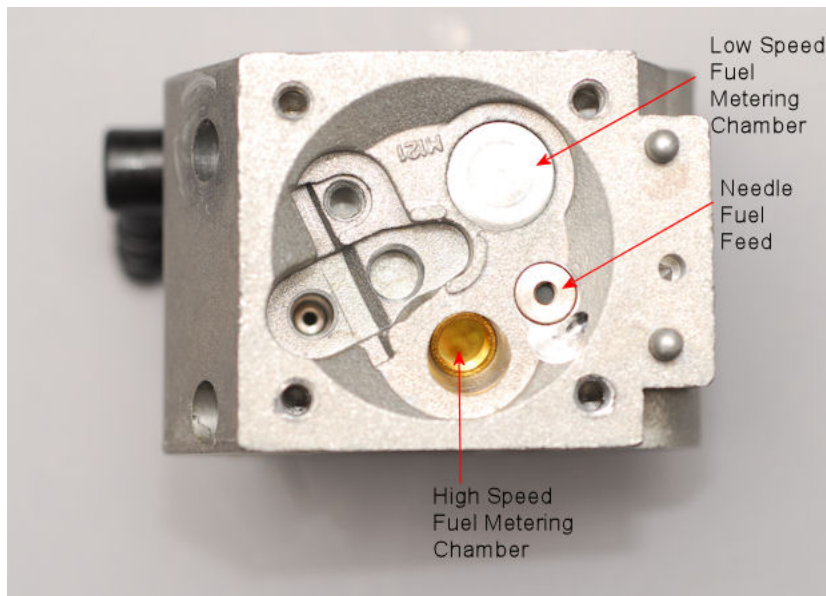


Choke Parts

So in the last section we talked about the main fuel reservoir being filled with fuel. That fuel has to get into the carburetor. Note that there is a low speed and high speed control system visible but they are capped off. If they weren't, the motor could pull unlimited fuel through the ports. In this case it would flood with fuel.

So a more precise way to meter the fuel is needed. That way is implemented in the form of needle valves which can be adjusted to allow a precise amount of fuel being allowed to flow

So the fuel has to get from the reservoir to the control needles. It does this by being pulled through the needle feed housing. This is pressed into the carb body and is not serviceable



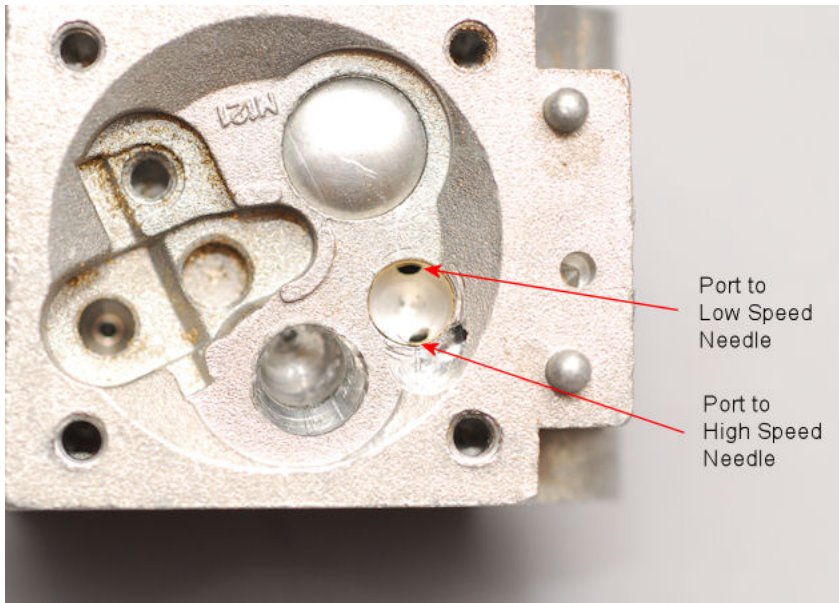
Fuel Circuits

It does however contain the small composite plate. Basically it acts as a one way valve by only letting fuel into the needle feed cavity. If you look at the previous photo you can see this plate just inside the needle feed port



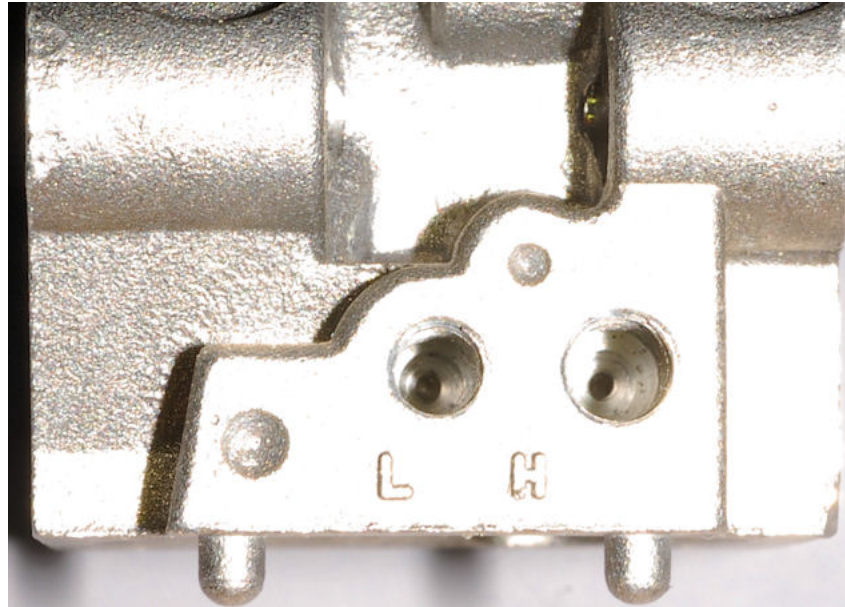
Whats inside the needle feed housing

If you remove this (and this was a destructive process) you can see that at the bottom is two ports, one directed to each of the needle valves



Needle Feed Ports

If you look into the carb body where the high and low speed needles install, you can see that deep inside there are seats machined into each. This is where the needle valves fit. Also the needle feed ports drop into these cavities on the needle side of the seats so fuel flow control into the rest of the system will be controlled by how open or closed the needles are.



High/Low speed needle seats

Finally, here are the actual metering needles. You can see that the tips fit into the seats inside the carburetor and that they have slightly different shapes which account for different fuel flows



High/Low speed needles

The Bottom Line

these carburetor components provide very fine control over the amount of fuel entering the fuel feed circuits.

Next up: The Low Speed Circuit

Hi, I have a walbro WT-643 carburetor. The above details are amazing. For a guy with medium level of knowledge like me (trying to make my engine properly work), it gave me a lot of insight. I have a question.

As per the post of Carley on 08-02-2011, 06:23 AM, if we remove the "high speed fuel metering chamber", "Needle fuel feed", "Low speed fuel metering chamber", we can clean up inside. But that would destroy these three parts. Where can we buy these parts that I need not buy a new carburetor every time I open it up?

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08-18-2011, 07:02 AM

#14 (perma

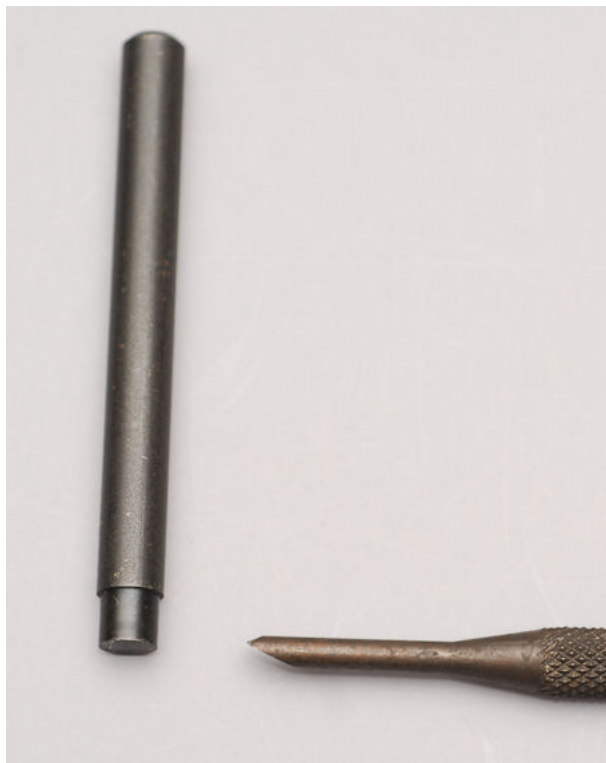
[carey.shurley](#)
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Thread Starter



the chamber "caps" are typically called "welch" plugs. The rebuild kit I referenced has replacements.

walbro supplies two tools that you can use to remove/replace welch plugs and they look like this:

Join Date: Apr 2004



you use the sharp edged tool to "dig" into the caps and pry them out and the flat tool is used to compress the new plugs.

I haven't found that the sharp edged tool works very well and not at all on the brass plug you see. I got them out by drilling a hole in the center and then using a screwdriver to pry them out. HOWEVER.....this puts drill chips in the chamber and maybe in the ports and more importantly if the drill goes THROUGH the cap it will have already damaged the carb body. There is practically no clearance between the two

so thats why I recommended that if you've cleaned the stuff you can get to easily and it still doesn't work correctly, you'll invest far less time to just replace it, they are not expensive.

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Carey Shurley
Proprietor - Gas Powered Helicopters



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12-09-2011, 06:28 AM

#15 (perma

[roopmarri](#)
Registered Users

Thanks

Join Date: Aug 2011

Hi Carey Shurley,
Thanks for your reply. Missed out on this thread for a long time. I'm still struggling with my engine and walbro carburetor. I have questions this time.

1. I have a new carburetor on my heli. But as soon as I start it, the engine whirrs at a very high rpm even though the throttle is full closed. How is it possible? Any solution to make the engine beat normally?
2. Is it possible to get any training anywhere in the world, in the maintenance of this carburetor and engine? Do you offer training anybody? Or can you suggest others who do?

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12-09-2011, 08:54 PM

#16 (perma

[carey_shurley](#)
Registered Users
Thread Starter

does it run at a higher than normal RPM and then slow down? If so thats normal. Takes a sec for all the fuel cavities in the carb fill and the motor richens up

Join Date: Apr 2004

training - nothing format that I'm aware of, I'm pretty sure some videos exist if you search around. At some point I'll start to do a series on various tuning aspects

Carey Shurley
Proprietor - Gas Powered Helicopters



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12-12-2011, 12:47 AM

#17 (perma

[roopmarr](#)

Registered Users

Join Date: Aug 2011



It doesn't slow down at all. As soon as I pull the chord, it just picks up and keeps whirring all the while (not the thumping sound). The clutch doesn't engage during this period though. It puzzles me, because when I tried to increase the throttle, the engine rpr went lower and lower and with further increase in throttle, engine stopped !! I thought that the engine was flooding, so I checked spark plug. It was not wet. It was absolutely fine.

Tuning: That would really be great. Thanks in advance. Really looking forward to it.

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01-06-2012, 01:43 PM

#18 (perma

[mikmerl](#)

Registered Users



This thread is the absolute "Walbro for Dummies"
I have been using these little carbs for years with good results but never had the in depth look that your fantastic tutorial has given me. Thank you for taking the time to do this thread. 👍
Mike

[MattJenner](#) likes this.

"nothing is foolproof because fools are so ingenious"

Logo 600SE, Vario EC135 Benzin, Bell 47g II Benzin, BO 105 big Benzin, Benzin trainer, T-Rex 600NSP V-Bar, 500ESP 3G, 45 Pro, 250, Beam 450,

Join Date: Jan 2009

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01-16-2012, 09:42 PM

#19 (perma

[Toxic AI](#)

Registered Users



you da man!!

Join Date: Oct 2004

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07-22-2012, 03:07 PM

#20 (perma

[Roop](#)

Registered Users

Join Date: Dec 2010

Walbro problem

First of all: Thank you Carey for the very detailed explanation on how these carbs work. Great stuff.

Based on your tutorial I tried to trouble shoot my WT 643 carb. The problem I have is that the fuel tank empties itself through the overflow on the bulb side. Normaly this only happens when I prime the carb with the bulb and when the bulb is full it will spit out some petrol through the overflow. But on my carb it keeps leaking fuel from the overflow. The primer bulb itself does not fill up properly when pushed but fills itself during the flight.

What might be the problem??? Obviously a return valve is leaking but which one???

Thanks for your help!

Robert

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