Component: Stewart-Warner Vacuum (Auxiliary) Fuel Feed System

Literature: Durant Motors Model 40 Repair Manual Dated 1929
Dykes Instruction #13 from the 15th Printing Dated 1929
Stewart-Warner Manual Form 3332 dated 2/1927

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The Stewart-Warner Vacuum Fuel Feed System on the'29 Essex is a black tank mounted to the firewall on the passenger side. Its job is to deliver a steady supply of fuel to the carburetor regardless of the angle or position of the car. There are no electrical pumps or apparatus. To do this, it uses the vacuum created by a running engine to draw fuel from the gas tank into its own reserve tank. Gravity then causes fuel to flow from the reserve tank to the carburetor. While I reference the 1927 factory manual, I do so because I can't find a 1929 version. By 1929, the Model number was 373, the tank was upgraded to leverless operation and a glass sediment bowl was added to the bottom. The Durant Motors manual has a section in Chapter 3 that provided the illustrations for the leverless operation.

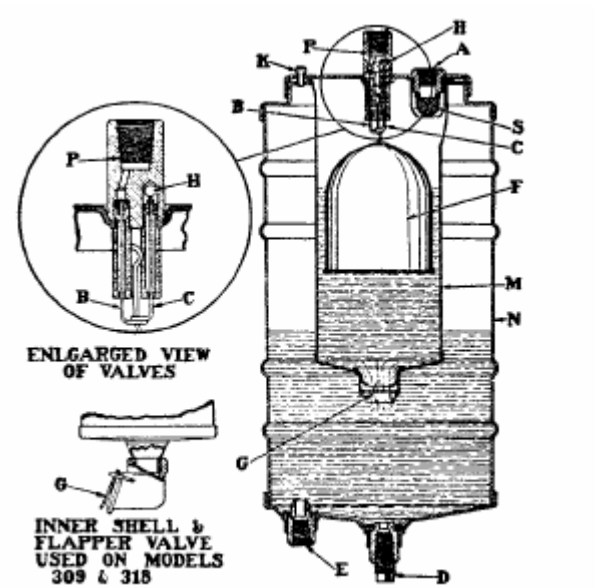


Fig. 63—Vacuum Tank (Leverless Type)

When I first started reading about how these worked, the literature was of no help because I was too new to the 1920's cars to understand what others found clear. Using an instruction guide for a lever system tank just made me wonder if I was missing parts. It wasn't until I went back to the ever trusty Dyke's that the system made sense. The practical information came from reading all of Geoff Clark's posts going back to 2000. I am grateful to him for responding to my questions that in hindsight now seem to be incredibly ignorant. What follows will be a common sense narrative of what I've done personally as opposed to a strict technical explanation; so if you spot errors and/or have a copy of a manual for this leverless system, please let me know.

As shown in Figure 63, the Stewart-Warner tank has two chambers: an inner vacuum chamber shown as "M" and an outer chamber shown as "N". In various manuals, these are referred as an upper and a lower chamber. There is a plate on the top of the tank to which a number of fittings are attached. The four screws both hold it in place and tightly secure the cork gasket underneath that seals the tank.

The upper/inner chamber marked "M" has four openings as follows:

1) Fuel inlet marked "A". There is an "L" shaped brass fitting on the top of the tank that leads to the main fuel tank.
2) In the center of the top plate is a fitting with an upper and lower half: one half going into the upper/inner chamber and the other half going to the outside.

- The part going to the outside has two connections. The threaded connection leads to the intake manifold of the engine using copper tubing and the other one connects to the vacuum operated windshield wiper using rubber tubing. Just below the connection to the wiper is a hole marked “H” in the square side of the fitting. When the vehicle is moving, this venturi opening creates its own vacuum. This extra vacuum boost is especially important when the vehicle is straining and the engine vacuum is low such as when travelling uphill. The other hole on this fitting is the atmospheric opening for valve “B”
- The fitting going to the upper/inner chamber is what replaced all the levers and extra valves from prior years and it has two of the openings to the upper/inner chamber. The vacuum opening is marked “P” and the atmospheric opening is marked “C”. “H” is the venturi opening to the outside and is connected to “C”.

3) The final opening is the flapper valve at the bottom marked “G”.

The outer/lower chamber marked “N” (a.k.a: auxiliary, reserve & shell) has three openings:

1) On the top plate is a nub with a hole in it marked “K”. This is always open to the outside air equalizing pressure with the atmosphere.
2) On the bottom is an opening to the glass sediment chamber which is not shown on Figure 62 but would be located at “D”.
3) On the bottom is a fitting marked “E” which leads first to a shutoff valve before ending at the carburetor.

The Dykes manual (Fig 2B below) describes the car has having two fuel tanks: a main one in the rear and an auxiliary/vacuum tank mounted higher in the car on the firewall. I believe the book made this distinction so owners would understand that the engine draws its fuel from the auxiliary/vacuum tank and that the main tank refills the auxiliary as it runs low. As I was debugging my tank, I drove around on the 1qt of fuel that the Stewart held and refilled it as needed.

The entire assembly is called a vacuum tank because it draws fuel from the main gas tank using the vacuum or suction at the engine’s intake manifold. This suction exists while the engine is being cranked by the starter or running by internal combustion. As the air is withdrawn from the inner/upper chamber “M” through the vacuum process, a pressure imbalance is created in respect to the main fuel tank. Since the atmosphere puts approximately 14.7lbs per square inch of pressure on the gasoline in the main tank, it flows or is sucked into the inner/upper chamber of the Stewart tank whenever vacuum is applied.

The float “F” controls the position of the vacuum stem valve “C”. When the float is at its lowest point, the spring inside the valve “C” is allowed to operate forcing the valve open. This lets in the vacuum/suction from the intake manifold. The atmospheric valve “B” is pulled shut by the vacuum. The vacuum from the intake manifold coming through valve “B” causes the air pressure in the inner/upper chamber “M” to fall and fuel then flows from the main gas tank. In debugging the tank, if there is insufficient vacuum, the “B” valve will remain all or partially open thus stumping you into thinking the problem is something other than the intake vacuum.

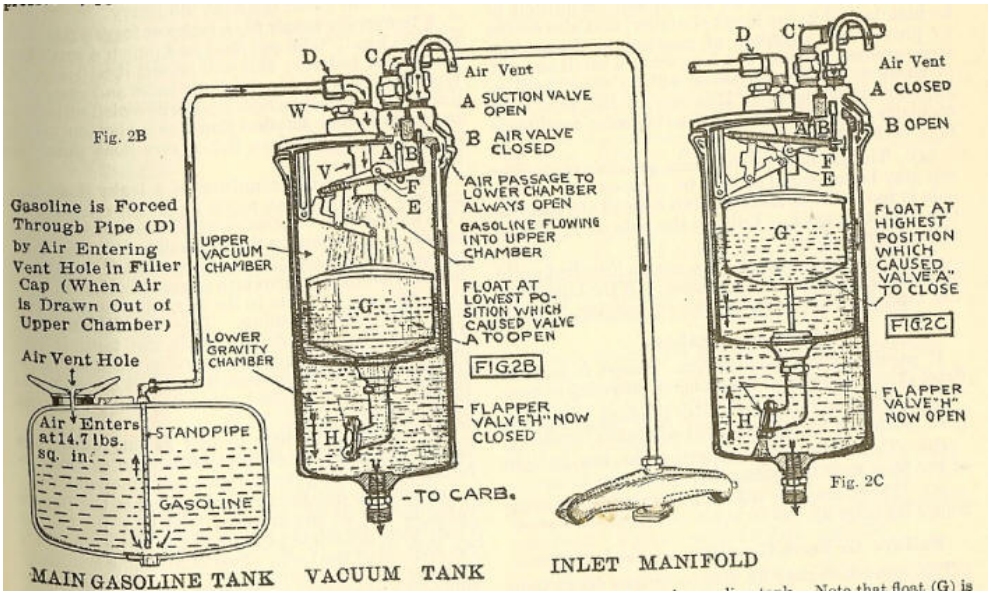
As the fuel level now rises, so does the float. When it reaches the top of the inner/upper chamber “M”, it closes the stem valve “C” thus cutting-off the incoming vacuum. The spring in valve “B” opens to the atmosphere and the pressure in the upper/inner chamber “M” returns to normal. Gravity takes over and fuel to flows through the flapper valve “G” into the outer/lower tank “N” and the float “F” falls again.

There is one more component the fuel has to go through before reaching the carburetor. At the bottom of the outer/lower chamber is the glass sediment chamber. Its purpose is to separate the water and sediment from the fuel before it fouls the carburetor. Since water and sediment are heavier than gasoline, they naturally separate and fall to the bottom of the glass.

If there is fuel in the outer/lower chamber “N”, it will fill-up the glass sediment chamber. There is a thin tube with a spring-operated one-way valve that extends into the sediment chamber and stops about 1/8” from the bottom. This tube is connected to a fitting “E” at the bottom of the lower/outer chamber leading to the carburetor. As a safety measure, when the car was restored, a petcock valve was added to fitting “E” making it possible to manually shutoff fuel flow to the carburetor. Like all such valves, when it is in-line with the fuel line, it is open.

In summary, the upper/inner chamber draws the fuel using engine vacuum from the main tank and then lets that fuel flow into the lower/outer chamber through a one-way flapper valve. Gravity takes the fuel from the lower/outer chamber to the carburetor where the carb float, seat and needle control the rate of flow. For the system to work properly, it needs a strong enough vacuum from the intake manifold, a good seal at the cork gasket so none of the vacuum is lost to the outside, a float with no pinholes and a free-moving flapper valve. The system is simple and effective and once you fully understand how it works, you can’t help but admire the people who thought it up in the age that it was used.

The drawing below comes from Dykes Automobile & Engine Encyclopedia and shows a lever type vacuum tank. It is helpful in visualizing the process so I’ve included it here.



The following description of the component parts from the Durant manual is so well done that I've repeated it here for posterity sake. It is possible that this description is wrong for this car because while it describes a 1929 tank, it references models 309 & 318 without a glass sediment chamber while the 1929 Essex is a #373 with a glass sediment chamber.

> *Except for the inner shell bottom, which is brass, the outer and inner shell and top are made of terne plate, which is sheet steel coated with lead by a special process. All rear gasoline tanks are also made of this.*
>
> *The float "F" is made of brass and nickel-plated. The float stem is made of bronze. The stem extends to the bottom of the fload to which it is attached. This prevents the float from being bent in at the top from jars and putting the stem out of line with the vertical axis of the float.*
>
> *The bends in the float stem cause the valves to be opened and closed as the float reaches the bottom or top of its travel. The valve stern eyes cannot pass these bends, except when the float is held far to one side. This cannot occur after it is assembled in the tank. The float stem, between these bends, moves freely through the valve stem eyes.*
>
> *The valve stems are spring steel, brass plated, but the valves are brass.*
>
> *The "flapper" valve "G" is flat glazed Bakelite. This seats against a ring embossed in the brass bottom of the inner shell. This ring-shaped valve seat is lapped to form an air-tight seat for the Bakelite valve.*

TROUBLESHOOTING

Carburetor Not Getting Fuel

1) Following the K.I.S.S. (Keep it Simple Sam) principle, first confirm that the Marvel V carburetor is getting fuel. The easiest way is to peek into the bowl and see if there is fuel. If it has fuel, then follow the carburetor debugging process.
2) If the car has been equipped with a manual fuel shutoff, make sure it is in the "ON" position. When the lever is parallel with the fuel line, it is "ON"
3) If the fuel flow is on, then visually check the glass sediment filter at the bottom of the tank for the quantity and quality of the available fuel supply.
   - When the upper outer/lower tank is empty, there will still be fuel in the glass sediment chamber. You need to check for an air gap of about 1/8" inch at the very top of the sediment chamber. If you see an air gap, then the tank is certainly empty. I have debugged for all kinds of things thinking that I had ample fuel just because I saw gasoline in 7/8ths of the sediment chamber.
   - Observe the color of the gasoline. If it is urine yellow and you haven't used additives, it has gone bad and the gas should be removed from the fuel system entirely. The proper color is clearish-pink for fresh gas or some other color if you've used a fuel stabilizer.
   - Observe the bottom of the sediment chamber. Since both water and dirt are heavier than gasoline, they will settle to the bottom of the glass chamber. If either of these is present, the glass bowl should be removed and cleaned. See the procedure below and the comments about priming the tank.
4) If the sediment chamber is empty, you aren't getting fuel to this point. Before we try an invasive test, check to see that the vent hole in the fuel tank is open. A quick action of removing then reinstalling the cap will equalize pressure if the tank vent hole is clogged. On the '29, the gas tank vent is only accessible by removing the tank.
5) While you are there, quickly look under the car to see that there isn't a fuel leak. An obvious test but since the old cars often smell of fuel and oil, it may get overlooked.
6) Remove the top and see if there is fuel in the inner/upper chamber "M". If so, then the flapper valve is likely stuck shut and will need to be opened. If there is no fuel in the inner/upper chamber, add a cup or so until you see fuel in the glass sediment bowl. If you don't see any fuel in the bowl but do see fuel in the upper chamber, then either the flapper valve "G" is stuck or the valve leading to the sediment bowl is stuck. In one of Geoff's posts, he says to lightly sand both the face of the flapper and the face of the fitting to which it seats to ensure a tight seal.
7) If fuel flows to the sediment chamber by pouring gas directly into the inner/upper chamber, then the process is to figure why the fuel isn't flowing from the gas tank on its own. First, check the tank visually to see that there is gas. Next, check to see that the engine is producing vacuum by having an assistant crank the starter while your hand is over the end of the carburetor intake. This is the black canister with the vents that face the radiator. If suction is felt here, then some amount of vacuum is being created.
8) If the engine is producing vacuum, check to see that it is reaching the vacuum tank by removing the rubber hose from the wiper port at the top of the tank at the "T" fitting and attaching a vacuum gauge. Have your assistant crank the engine while you test for vacuum. If you have vacuum at this point, then you need to check for sufficiency.
9) Should the engine not be producing enough vacuum due to a cracked manifold, clogged vacuum valve or a leaky fitting, the vacuum stem valve "B" will remain partially or fully open because the vacuum from valve "C" wasn't strong enough. The test for

this case can be made only when the fuel level is low enough for the float to have opened the "C" valve. What you are checking for is the presence of vacuum at the atmospheric opening for valve "B". If air is coming in then the float "F" has opened valve "C" but the vacuum wasn't sufficient to close valve "B" causing either a slow rate of fill or nothing at all.

10) If you've gotten to this point, you are poking around the inside of the tank.
11) Once you've opened the tank, you'll find that the innards are deceptively simple. The three major problems to look for when the tank is open are failure of the top gasket, problem with the flapper or the float:
    - If the gasket doesn't look healthy, it may not be sealing and vacuum may be escaping. If the vacuum escapes past the gasket then it won't create negative pressure and the fuel won't flow from the main gas tank. There are several old car restoration sites that sell just the replacement gasket for about $6.
    - If you hear/feel fuel slosh around inside the float, then you need to repair it. There are instructions in the Stewart manuals for this. Remember … the float is filled with gas and air and it is an explosive combination.
    - Make sure that both of the stems on the float are connected to valves "B" and "C". Take out the inner/upper chamber "M" and check that the flapper valve "G" at the bottom moves freely. When I opened my tank, I found that the entire fitting had somehow unscrewed itself and fallen to the bottom of the inner/lower tank and was resting on the "E" flow valve fitting.

Engine Flooding or Too Much Fuel

1) If the float "F" is filled with fuel, it will keep the vacuum valve "B" open despite the tank being full. The only place for the extra fuel to go is directly into the intake manifold.
2) If the vent tube "K is clogged then as the fuel is drawn by the carburetor, it will create a natural negative pressure situation regardless of the float level and gas will continue to flow from the main tank even though the vacuum valve "B" is closed.
3) If the atmospheric valve "C" is dirty or clogged, it may not seat properly and if stuck in the closed position, will cause the same situation as if vent "K" was clogged. A test tool was available from Stewart-Warner under part # T-46026 for "K" and "B"
4) If the vacuum valve "B" is dirty or clogged, it may not seat properly and if stuck in the open position, will result in a continuous supply of vacuum. The only place for the extra fuel to go is directly into the intake manifold. The literature I've found on the repair of defective valves "B" and "C" call for their replacement at the factory so if someone knows of another method, please let me know.

Slow/No Fuel Flow to Carburator

1) If the vent tube "K" or atmospheric valve "C" is fully clogged but the tank is full, fuel can only flow into the carburetor when air comes in through the carburetor line. If the vent tubes are partially clogged, the fuel will flow but poorly.
2) If the flapper valve is sticky, it may open or not open at various times. One cause for the sticking flapper according to the manufacturer is that a green paste forms from the action of acid and brass. Other causes would be similar to diagnosing carburetor problems: old fuel, bad fuel, and stuff in the fuel.

Procedure: Empty the glass bowl filter on the Stewart-Warner Vacuum Fuel Tank

1. The glass bowl is held in place by a thick black "U" shape metal wire with a knurled nut on the bottom. The purpose of the knurled nut is to increase pressure between the black wire and the glass bowl thus wedging the glass against the bottom of the tank and keeping it in place.
2. When the glass bowl comes off, a certain amount of raw fuel will spill from the bottom of the Stewart tank. Hold a container below the glass bowl as you take it off so the fuel is caught and can be recycled. A thick plastic wanton noodle soup container seems to work well for this.
3. The spring operated on-way valve is supposed to stop the flow of fuel from the outer/lower chamber once the glass sediment chamber is removed.

4. Once removed, the glass can be cleaned inside and out. While I can't confirm that the fit is exact, I am using a $4 replacement glass chamber sold by Mac's Antique Auto Parts (www.macsautoparts.com) under their part number A9162.
5. Check the gasket. Mac's sells both neoprene (A9173N) and cork (A9173) for their glass chamber. Both appear to fit the 1929 Stewart Tank and I am using the cork one on mine.
6. Reassemble in the opposite order taking care to tighten the screw finger-tight.
7. The repair manuals say to crank the engine to create suction and this will refill the vacuum tank. My opinion is that the last thing a 78+ year engine needs is any additional cranking as no oil is flowing to the top of the engine at this point. It is easy enough to remove the top of the tank and refill it with up to 1qt of gasoline and not put the engine to work doing that manually. If you do remove the top, check that gasket as well. While you can purchase a pre-made one from the sites below, I made mine using 1/8" cork gasket material that I purchased from Mr Gasket Company.

As of 11/23/07, the following are sources for Stewart-Warner tank repair and kits:

Hal Houghton (518) 674-2445 www.classicpreservation.com/vactankkits.html
Classic & Exotic Service (248) 269-9414 www.classicandexotic.com
Mac's Antique Auto Parts (716) 210-1340 www.macsauto.com