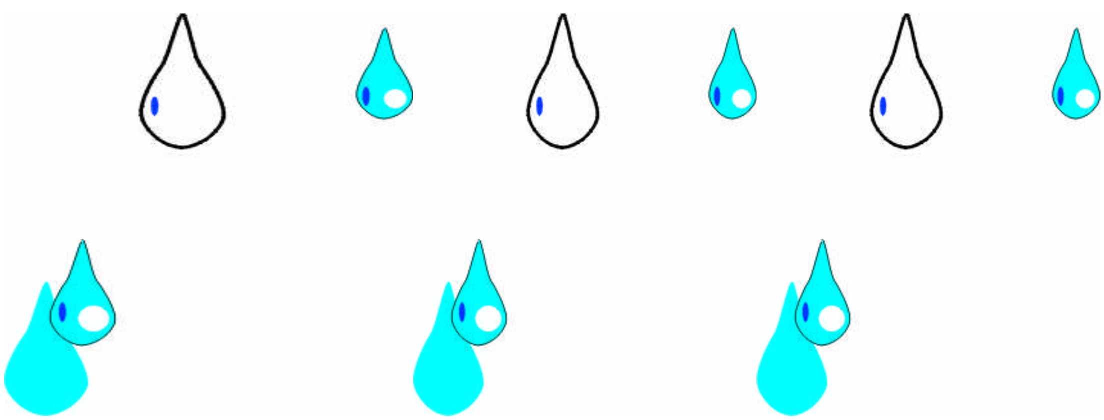
Hydro-Gen

Your
Alternative to soaring fuel prices



- "Hydro-Gen System" pat. Pending

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Congratulations on your decision to purchase this *E-Book*. We have made every effort to keep the price of this *E-Book* as reasonable as possible so that every person can afford it. Getting off the spiraling gasoline price merry-go-round is that important.

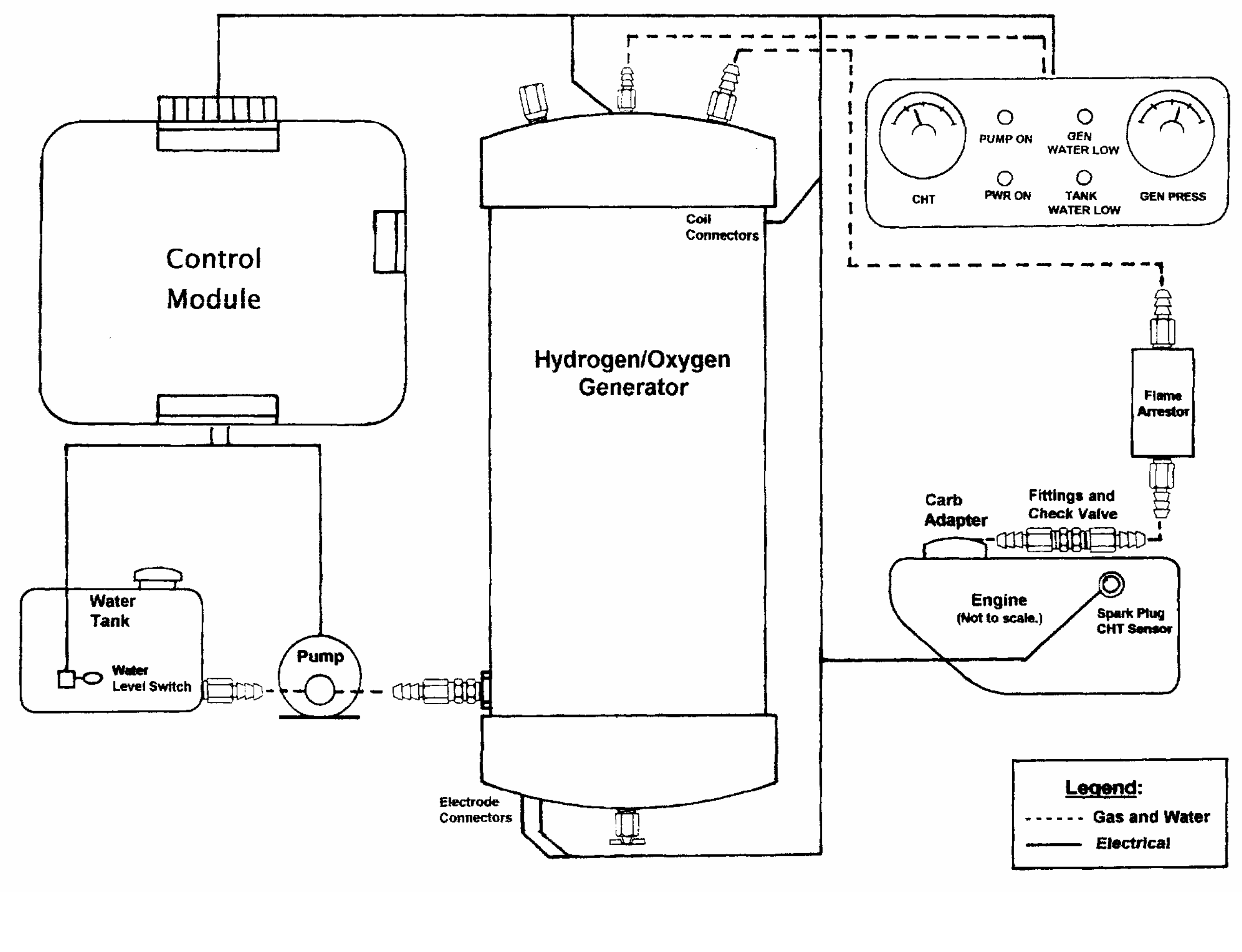
This manual contains a brief explanation of how the *Hydro-Gen System* works. We will go into detail of using *Water* as a fuel. Some of the explanations used may not be clear to some of you. We do get somewhat technical. However, if you follow the instructions laid out here, you can build this *System*. This *E-Book* contains detailed construction *Steps* as well as *Suppliers* for all the parts used. When you get into the *Electronics* of the *System*, if you're not comfortable with doing that section, you can, of course, hire an *Electronics* tech. to help you. We have made every attempt to make this as easy as we can for the average person to understand.

A note of Caution: When you get to the *"Preliminary Testing"* and the *"Final Assembly and Test"* sections, these sections are very detailed and somewhat complex, DO NOT shortcut these procedures. They may seem lengthy and appear to duplicate themselves, but they don't. All of the *Steps* are there for a reason. When you're done, you will have a *"Hydro-Gen System"* tuned to your *Specific Engines* requirements. And your vehicle will be running on Water. Free Water.

The Hydro-Gen System

Congratulations on your decision to purchase plans for the *Hydro-Gen System*. We have made the instructions as easy to follow as we can. We have included several drawings to help you understand and build the system. Throughout the instructions you will find a detailed materials list as well as suppliers for the components. Welcome to the *Hydrogen Fuel System* of our future, that is available now.

***Figure #1* shows the entire *Hydro-Gen System*. While each component is essential to it's operation, the heart of the system is the *Hydrogen/Oxygen Generator,* since it converts water into *Hydrogen/Oxygen* to power your engine. A *Water Tank* and *Pump* store and supply water for the *Generator*. Precise electronic signals from the *Control Module* initiate and sustain the creation of *Hydrogen* and *Oxygen* within the *Generator*. An In-*Dash Gauge* and *Indicator Assembly* allows you to accurately monitor all aspects of the *Hydro-Gen System*. Every part of the *Hydro-Gen System* is ruggedly designed for long life and reliable operation.**



The Hydro-Gen System
Figure #1

Hydrogen/Oxygen Generator

The following synopsis of the *Hydro-Gen System* may be somewhat confusing to those of you who have little knowledge of *Electronics* or *Chemistry,* but do yourself a favor, read it thoroughly. It will help you understand not only how the components work together but you will also understand how important it is to follow the instructions very closely and not take short cuts or use inferior materials.

Figure #2* – The *Hydrogen/Oxygen Generator* housing is a round cylinder constructed from high temperature *CPVC* pipe, a material widely used by the building industry in plumbing and heating systems. *CPVC* pipe is durable and nearly indestructible. It's also a very "friendly" material in that it is easy to work with and can be used to fabricate many other things such as furniture, planters and housings for just about anything. The *Generator* housing contains a *Coil* and two cylindrical *Electrodes* used to generate *Hydrogen* and *Oxygen.* Each *Electrode* is made from *Stainless Steel.

Now, understand that two *Atomically* different forms of *Hydrogen* are produced within the *Generator*. Most of the generated *Hydrogen gas* is *Orthohydrogen,* a very powerful and fast burning gas created by the two *Electrodes.* A precisely controlled high frequency electronic signal from the *Control Module* activates and controls the *Electrodes*. The other form of *Hydrogen gas* produced is *Parahydrogen.* It is created by the *Coil* in the *Generator*, but in much less quantity than the *Orthohydrogen*. A precisely controlled, very low frequency electronic signal from a separate circuit within the *Control Module* activates and controls the *Coil.*

***Parahydrogen* is a less powerful and slower burning gas, but is necessary to prevent precombustion (Commonly called "knocking or pinging"). *Parahydrogen* slows the burning rate of the *Hydrogen/Oxygen* mix, thus boosting its *Octane* level. Such precise control allows you to exactly match your engines *Octane* requirements. To raise *Octane* levels in gasoline, specific additives must be used to slow its burning rate. At best this is a far less accurate method, since it depends on trying to average the *Octane* requirements for millions of engines. Our precise control allows you to match the *Octane* requirements for <u>*your specific engine*</u>.**

The *Hydrogen/Oxygen Generator* is actually an electronic circuit. The two *Electrodes* form a huge *Capacitor,* thousands times larger than *Capacitors* used in typical circuits, with *Water* acting as its dielectric. The *Inner Electrode* is *Negatively* charged, and the *Outer Electrode* is *Positively* charged, by the high frequency *Control* signal. Chemically, each water *Molecule (H2O)* is composed of two *Positively* charged *Atoms* of Hydrogen and One *Negatively* charged *Atom* of *Oxygen.* Since opposites attract, the *Positively* charged *Hydrogen Atoms* are pulled toward the *Inner Electrode*. But, at the same instant, the *Negatively* charged *Oxygen Atoms* are pulled toward the *Outer Electrode*. This action aligns every *Water Molecule* between the *Electrodes,* with the ends of each *Molecule* being pulled in opposite directions. For a brief moment more accurate alignment and increased pulling action upon the *Water Molecules* occurs. But, the *Control* signal pulses keep charging the *Water Capacitor* to higher and higher voltage levels; actually several thousand volts. Suddenly the electrical forces become so great that the *Water Molecules* burst apart (Scientists call this action <u>disassociation</u>) into their *Gaseous* forms of *Hydrogen* and *Oxygen*. If you were able to look into the *Generator,* this action would be obvious because of the formation of millions of tiny *Hydrogen* and *Oxygen* bubbles. As long as the *Control* signal is applied, the *Water Capacitor* remains fully charged; continuously creating *Orthohydrogen* and *Oxygen.*

The *Generator Coil* forms a different electronic circuit. This is an *Inductive Circuit,* meaning it creates a *Magnetic* field as opposed to the *charged* field created by the *Water Capacitor*. The very low frequency *Control* signal (a short pulse) activates the *Magnetic* field of the *Coil*. As soon as the pulse stops, the *Magnetic* field collapses. This then creates an even stronger *Magnetic* field, but a field of opposite *Polarity*. This is how an *Inductive Circuit* works, an action knows as *"Inductive kick".* Each pulse is precisely timed so that immediately after the *Magnetic* field reverses another short pulse arrives. Once again the *Coil* is charged and its *Magnetic* field collapses. But now the continually reversing *Magnetic* field becomes even stronger due to the added energy of each new pulse. Eventually (within a <u>few seconds</u>) the *Coil* reaches its maximum *Magnetic* strength, called its *Saturation Point,* which is extremely high. Most *Molecules* are affected by *Magnetic* fields. Such is the case here. The *Coil's* reversing *Magnetic* fields vibrate the *Water Molecules* so severely that they disassociate into their gaseous forms of *Parahydrogen* and *Oxygen*. Disassociation obviously occurs, as evidenced by the creation of millions of tiny *Hydrogen* and *Oxygen* gas bubbles around the *Coil.*

At this point we've covered everything needed to understand the basic functions of the *Generator.* All the other components of the *Hydro-Gen System* are simply used to precisely control the action of the *Generator*. By varying the strength and frequency of the *Control Module* signals, the rate at which *Hydrogen* and *Oxygen* are created can be varied to match engine requirements at any particular moment. *Water* is supplied by the *Tank* and *Pump,* while a *Level Sensor and Switch* control water level within the *Generator*. For safety, a relief valve protects against excessive pressure buildup within the *Generator*. Separate ports are provided for attaching hoses to route *Hydrogen* gas to the engine and to a gauge to monitor gas pressure within the *Generator*. A drain valve is installed to allow periodic flushing of accumulated minerals and contaminants. The bottom cap is threaded so that the *Generator* can be opened up for inspection and/or repair and for occasional cleaning of the *Electrodes* and *Coil.* Two pairs of *Stainless Steel* rods protrude from the *Generator* body to provide electrical connection of the *Electrodes* and *Coil* to the *Control Module.*

As shown in *Figure#1,* the *Generator* gas output hose connects to a *Flame Arrestor,* which in turn connects to pressure fittings attached to the engine *Carburetor.* The *Flame Arrestor* provides protection against combustion flashback into the *Generator* in the event that the engine backfires. As with the *Generator,* the *Flame Arrestor* body is constructed from *CPVC* pipe. Pressure fittings are readily available at engine high-performance shops. They're designed for converting engines to run on *Propane,* so are perfectly adaptable to the *Hydro-Gen System.*

We recommend installing the *Generator* in the engine compartment. It can be installed anywhere you can find room in the vehicle, even in the trunk if necessary. But, everything is simplified by placing it near the engine since that will minimize the routing of hoses, gauge lines and electrical wiring

Water Tank and Pump

This is probably the simplest part of the whole system. Just about any large container will hold water, but we'll recommend a particular type of tank when we get to the construction phase. There are many ways to save a few $$ while building the *Hydro-Gen*, but if you want a quality product, don't be tempted to cut corners. The whole system is designed to be highly reliable, so don't take the chance of messing it up with cheap parts that are inferior. One example is that we recommend installing a *Water Level Sensor* in the water tank so you can easily monitor water quantity, and these *Sensors* are relatively expensive. If you don't use the *Sensor* you'll have to occasionally compare the miles you've driven versus the quantity of water; all based upon *MPG* of <u>water</u> consumption. Or you can visually check the water level fairly often, but someday, yes someday you'll run the *Water Tank* dry and wish you had spent the extra $ for a *Sensor* and *Indicator*. It's best to use a relatively large *Water Tank*. We recommend a *16-gallon Tank* with translucent level markings, for easy measurement. The size provides a good reserve for long distance trips. We also recommend installing a *6-inch vent tube* into the *Tank* cap to prevent spillage from sloshing water. Because of its size, the only practical location for the *Water Tank* is in the trunk.

You will have to decide on the *Pump* location. If you use the *Self-Priming Pump* we recommend, you can mount it in the engine compartment. If you choose not to, you will have to mount the *Pump* directly onto the *Tank* or very close by, and at a level near the bottom of the *Tank.* Also, if you don't use a *Self-Priming Pump,* the water hose going from the *Pump* to the *Hydrogen/Oxygen Generator* will have to be capable of withstanding at least *66-psi* water pressure. That's the *minimum* recommended *Pump* pressure capacity required to overcome max. Gas pressures of *65-psi* within the *Generator,* with an additional *1-psi* needed to activate the *One-Way Valve* installed on the *Generator* housing. Plus, if you don't use a *Self-Priming Pump*, you'll have to run an extra power lead back to the trunk. For simplicity and reliability, <u>we recommend a *Self-Priming Pump*</u>.

In-Dash Indicators

To permit easy monitoring of the *Hydro-Gen* functions, we recommend two gauges: *Generator Pressure (GEN PRESS)* and *Cylinder Head Temperature (CHT)*. We recommend 4 indicator lights: *GEN WATER LOW, PUMP ON, TANK WATER LOW,* and *PWR ON.* These should be installed in the vehicle dash or on an auxiliary panel. See *Figure #3*

Monitoring the *GEN PRESS* and *CHT* gauges allows you to develop a feel for how the system responds to various driving conditions. They'll also help in tweaking the system to obtain max. Performance and economy. The *GEN WATER LOW* light normally remains *UNLIT*.

As "fuel" *<u>(Water)</u>* is consumed, the *Generator* water level gradually drops until the *GEN WATER LOW* light illuminates. At that point the *Water Pump* should start pumping water, illuminating the *PUMP ON* light. When the *Generator* water level has risen back to normal level, the *GEN WATER LOW* light should go back out. At the same time the *Pump* will stop running, and the *PUMP ON* light will go out. So, under normal operating conditions, both lights should illuminate at the same time, and both lights should go out at the same time. Any other light combination indicates a malfunction.

<u>Control Module</u>

The *Control Module* contains electronic circuits for controlling and/or providing power to all the *Hydro-Gen* electrically operated devices. Separate circuits exist to perform each of the following functions:

- **Provide power to *Generator Electrodes* in the form of a high frequency signal, creating *Orthohydrogen* and *Oxygen.***
- **Provide power to the *Generator Coil* in the form of a very low frequency signal, creating *Parahydrogen* and *Oxygen.***
- **Control power to the *Water Tank Pump* by signals received from the *Generator Water Level Sensor.***
- **Provide busing and terminal points for distributing power to the system gauges, indicators and sensors.**

<u>Generator Electrode Circuit Schematic</u>

Figure #6* shows the schematic diagram for the *Generator Electrode* circuit. Its output is a square wave pulse, which is applied to the cylindrical electrodes of the *Hydrogen/Oxygen Generator* shown in *Figure #1. Figure #4* shows this square wave pulse, which has an *On: Off* ratio of 1:1. Which means that the pulse is turned *On* for as long as it's turned *Off.* The square wave pulse shown in *Figure#5* has *On: Off* ratio of 3:1. That is, the pulse is turned *On* for 3 times as long as it's turned *Off.

The *Generator Electrode* circuit of *Figure #6* is capable of varying its square wave pulse ratio between *1:1* and *10:1*. Each *On: Off* pulse sequence is referred to as a *"cycle"* since each new pulse sequence keeps cycling *On* and *Off* in an identical way. *Figure #4* shows 3 cycles of *On: Off* pulse sequences. If these cycles were all to occur within a time span of one second, we would refer to the pulse as having a frequency of *3 cps (cycles per second).* If 127 cycles were all to occur within a time span of one second, we would refer to the pulse as having a frequency of *127 cps*. Signal frequency is no longer measured in *cps*; instead the more common term is *Hz. (Hertz)*. The symbol *K* is used to denote units of *1,000.* So then, *3 cps* would be *3Hz* and *127 cps* would be *127Hz.* Thus *3,000 Hz* would be *3 KHz* and *127,000 Hz* would be *127 KHz*. The square wave created by the circuit of *Figure#6* can be varied in frequency from approximately *8 KHz to 260 KHz.*

The square wave pulse ratio determines the amount of current sent to the *Generator Electrodes* by the circuit of *Figure#6*. If the ratio is low *(1:1)*, very little current arrives at the *Electrodes*. So the *Generator* produces very little *Hydrogen* and *Oxygen.* If the ratio is high *(10:1)*, maximum current reaches the *Electrodes* and the *Generator* produces *Maximum Gas Volume.*

Varying voltage input from a *Potentiometer* connected via a *10K Resistor* to Pin *#3* of component *LM741* causes the circuit to vary the pulse ratio, and consequently controls the amount of gases produced. The *Potentiometer shaft* connects to the vehicle *Throttle Linkage*, enabling control of *Gas* volume in direct response to voltage changes controlled by the rotation of the *Potentiometer* shaft in relation to *Throttle Position*. A *Trimming Potentiometer* connects *Pins #2* and *#6* of component *LM741*, enabling precise adjustment of the *Throttle Input Signal.* A second *Trimming Potentiometer* connects *Pins #4* and *#7* on component *NE555*, allowing precise pulse width adjustment. The *Electrode* pairs of each *Generator* exhibit a unique frequency of electrical resonance at which optimum gas volume is created. This frequency varies among different *Generators.* Several factors determine resonance frequency such as: *Electrode* size and shape, *Generator* chamber size and shape, spacing between *Electrodes, Coil* parameters and relative positioning as well as pulse amplitude (voltage level). A *Trimming Potentiometer* connected between *Pins #1* and *#2* of component *CD4069* allows the precise frequency to be obtained. By selecting various combinations of *Dipswitch* connections to a bank of 4 *Capacitors*, pulse frequency can be varied between approximately *8KHz* and *260 KHz*.

Generator Coil Circuit Schematic

Figure #7* shows the schematic diagram for the *Generator Coil Circuit*. Its output is a square wave pulse, which is applied to the *Coil* of the *Hydrogen/Oxygen Generator* shown in *Figure #1.

The *Generator Coil Circuit* creates a pulsed signal very much similar to that of the *Electrode* circuit of *Figure #6*; but production of *Parahydrogen* and *Oxygen* by the *Coil* entails totally different operating parameters than does *Orthohydrogen* and *Oxygen* produced by the *Electrodes*. Optimum operating frequency for the *Coil* is much lower, within the range of approximately *16Hz to 25 Hz.*

Coil* frequency directly correlates to the optimum operating frequency of the *Electrode* circuit since its input signal is received directly from *Pin #3* of *Electrode* circuit component *NE555.* The *Electrode* circuit signal is received via the *"Divide by N"* Logic *Circuit*, which produces one output signal in response to a specific number of input signals. For example, if the optimal frequency of the *Electrode* circuit is *19 KHz* and the *"Divide by N"* Logic *Circuit* creates one output pulse for every *1,000* input pulses, the output frequency of the *"Divide by N"* Logic Circuit would be *19 Hz*. That signal is received via *Pin #2* of component NE555, which creates the required square wave pulses. Those pulses are sent via *Pin #3* to the base of Transistor 2N3055, where they are amplified and transmitted to the *Coil.

The volume of *Parahydrogen* and *Oxygen* created by the *Coil* can be precisely regulated by adjusting the pulse width and amplitude *Trimmer Potentiometers* of its associated circuit. *Parahydrogen* acts as an *Octane Booster.* Therefore, the volume required depends entirely upon the operating demands of your engine. Since *Parahydrogen* cools the combustion process, excess volume tends to reduce engine efficiency. With that in mind, the *Coil Circuit* should be adjusted so that enough *Parahydrogen* is created to prevent engine (knocking) precombustion. However, if engine-operating temperature is running on the high side (as determined by the *CHT* gauge) increasing *Parahydrogen* volume is an effective way to lower the operating temperature.

In-Dash Indicators Circuit Schematic

The *In-Dash Indicators* circuit schematic is shown in *Figure #8*. Two gauges and four *Light Emitting Diodes (LED's)* make the *In-Dash Indicators Assembly*. The *Generator* pressure *(GEN PRESS)* gauge connects via a hose to its respective fitting on the *Generator* itself (refer to *Figure #1*). The *Cylinder Head Temp. (CHT)* gauge electrically connects to a sensor placed under an engine spark plug.

When Generator *Water Level Sensor* is activated by low water level, its *12 VDC* signal is sent to *Pin #2* of *Detector LM741* via a *10K Resistor*. *Detector* output from *Pin #6* triggers the base of *Power Transistor E3055T*, completing the circuit to activate the *Water Pump* and illuminate the *"PUMP ON" LED*. The *12VDC* sensor signal also illuminates the *"GEN WATER LOW" LED*. When *Generator* water rises to its normal level, the *Sensor* opens; turning off the *Pump* and both *LEDS.*

When the *Tank Water Level Sensor* is activated by low water level (at 1/3 tank level), its *12VDC* output signal illuminates the *"WATER LOW" LED*. After refueling (adding water), the *Level Sensor* opens, turning off the *LED*. When the *Hydro-Gen System* is turned on, the *"PWR ON" LED* illuminates. The *Generator Electrode Circuit (Figure #6)* activates the *LED.*

Construction of the Generator (Electrodes)

Since engine requirements dictate the volume of *Hydrogen* and *Oxygen* gases that the *Generator* must create, and gas volume is variable, I recommend sizing it as large as is practical to allow reserve capacity. Maximum outside diameter *(O.D.)* of 4-*1/2 "* is already determined by the construction material used for the *Generator Housing (4" CPVC Schedule 80 pipe).* I recommend a minimum height of *10".* Maximum heights depends upon available space within the engine compartment, but for structural integrity, limit the max. height to *18".* Carefully check the engine compartment of your vehicle to ensure that adequate space exists for *Generator* installation. We believe that you'll find that the *10"* height is the easiest to work with. I've included dimensions and material lists for 18*"* also, more than 10" or less than *18"*, you'll have to adjust the dimensions.

NOTE: It may be possible to obtain *the 3-1/2" Outside Dia. Stainless Steel Tubing* with a wall thickness of *.040"*to *.063"* and of *T-304* alloy at a local exhaust and muffler shop, but be very careful. All tube Dimensions, including roundness must be held within *.005"* throughout its entire length. *Do Not* use cheap tubing. If you do, the efficiency of the *Hydro-Gen System* will be severely degraded. If you are unable to obtain good quality tubing locally, we recommend the following source:

Eagle Stainless **Phone: 1-800-528-8650**
Tube & Fabricating Inc. **Local Phone: 508-528-8650**
10 Discovery Way **FAX: 1-800-520-1954**
Franklin, MA 02038 **Local Fax: 508-520-1954**

1. **After determining the *Generator* height, obtain a *3-1/2" O.D. T304 Stainless Steel* tube with a wall thickness of *.040"* and *.063",* 5" shorter than the determined height of the *Generator*. This tube will be used to construct the *Outer Electrode*. Refer to the *Generator* exploded view, *Figure #11* to help in correct construction.**

NOTE: The following *Steps #2, #3, & #4* will be used to determine the *Outside Dia*. for the *Inner Electrode*. This procedure will create a *.045"* gap between the inside wall of the *Outer Electrode* and the outside wall of the *Inner Electrode*. This is the optimum gap for *maximum efficient* production of *Hydrogen* and Oxygen gases with the *Hydro-Gen System.*

2. **Multiply the wall thickness of the *Outer Electrode* by *2* (two) and record the result as dimension *"A".* For example, if the wall thickness were *.050",* dimension *"A"* would be *.100".***
3. **Add *.090"* to dimension *"A"* and record that as dimension *"B".* For example, if dimension *"A"* were *.100",* then dimension *"B"* would be *.190".***
4. **Subtract dimension *"B"* from *3.50" (3-1/2").* Record this as dimension *"C".* For example, if dimension *"B"* were *.190",* dimension *"C"* would be *3.31".***
5. **To construct the *Inner Electrode,* obtain a *Stainless Steel* tube, alloy *T304* with an *O.D.* equal to dimension *"C"* with a wall thickness of *.040"* to *.063"* and of the same length as the one for the Outer *Electrode.***
6. **Refer to *Figure #9*. Drill eight *(8) 1/4"* holes spaced at *45* degrees radially around the diameter of one end of the *Outer Electrode* tube. Locate the hole centers *11/32"* from the edge of the tube. Deburr the holes inside and out after drilling. You'll find that drilling *Stainless Steel* works best if you use a carbide-*tipped* drill bit and light lubricating oil. Drill the holes slowly so as to not burn the drill bit and overheat the *Electrode.***
7. **Repeat *Step #6* to drill eight *(8) 1/4"* holes centered at *11/32"* from the edge of the other tube, the Inner *Electrode.***
8. **Referring to *Figure #9,* drill *1/8"* holes in the *Outer Electrode* around the end of the tube on the same end as the *1/4"* holes. Locate the centers for these holes *3/32"* from the tube edge with the holes spaced at *3/8"* intervals around the tube. Deburr the inside and outside of the holes after drilling.**
9. **Repeat the procedure of *Step #8* to drill *1/8"* around the diameter of the *Inner Electrode*. Drill these holes at the same end as the *1/4"* holes. Deburr the holes inside and out after drilling.**
10. **Thoroughly clean all oil residues from both *Electrodes* using MEK or *Acetone* and a soft clean cloth.**
11. ***Silver Bearing Solder* and flux can be purchased at any large hardware or electrical supply store. *Bare Stainless Steel Welding* rod can be obtained at most *Welding Supply* stores.**
12. **Referring to *Figure #9*, cut *two (2) 3"* lengths from a *3/32"* dia. Bare Stainless Steel Welding Rod, alloy *T-304*. Using a fine file, square the ends and deburr both ends.**
13. **Solder one of the rods to the <u>*OUTSIDE*</u> surface of the *Outer Electrode* as shown in *Figure #9*. Set the rod parallel to the length of the tube with *2"* protruding past the edge of the tube.**
14. **Repeat the procedure of *Step #13* and solder the other rod to the *INSIDE* surface of the *Inner Electrode,* also with *2"* protruding past the tube edge.**
15. **After the *Electrodes* have cooled, thoroughly scrub the solder joints with warm, soapy water using a stiff-bristle brush. Thoroughly rinse the *Electrodes* with warm water and dry with a soft clean cloth.**
16. **Now, take a coffee break. Not beer, you want this Generator to work, don't you?**

<u>Generator Housing</u>

<u>NOTE:</u> Use *CPVC* pipe *<u>(Schedule 80)</u>* only to construct the *Generator Housing*. *<u>DO NOT</u>* use *PVC* pipe, or *CPVC Schedule 40,* since it will not withstand high temperature or pressure like the *Schedule 80* will. *<u>DO NOT</u>* use *CPVC* pipe larger than *4"* since it does not offer an adequate safety margin against rupture when subjected to high temperature and pressure. Careful attention to craftsmanship and detail during construction is essential to ensure safe and reliable operation. Any large plumbing supply store or large hardware store should have all the items you will need. However, if you have a problem finding these items, below is a supplier we recommend that has all the items you will need.

United States Plastic Corp.
1390 Neubrecht Rd.
Lima, OH 45801-3196

Phone: 1-800-537-9724 (7:30am – 7pm EST, Mon-Fri)
FAX Orders: 1-800-854-5498 (24/7)
Cust. Service: 1-800-769-1157 (8am – 5pm EST, Mon-Fri)

List of materials needed:

- **One (1) CPVC 4" threaded pipe nipple, 12" long, Schedule 80 - #30314**
- **One (1) CPVC 1-1/2" pipe, 12" long Schedule 80 - #29018**
- **One (1) CPVC 4" straight coupling, Schedule 80 - #30059**
- **One (1) CPVC 4" cap, Schedule 80 - #30047**
- **One (1) CPVC 4" threaded cap, Schedule 80 - #29147**
- **One (1) 1/8" thick, 24" x 48" CPVC sheet - #45299**
- **One (1) 1" dia. X 6" length CPVC Rod, Schedule 80 – 43183**
- **One (1) pint can CPVC cement - #29053**
- **One (1) pint can of primer - #28292**
- **One (1) 8 oz. Can of pipe joint compound – 16532**

The above materials are for a *Generator Housing* that is determined to be *10"* long.
If you decide you need the longer one *(18")* you will have to also order the following:

- **One (1) CPVC 4" pipe 12" long, Schedule 80 - #29022**
- **One (1) CPVC 4" straight coupling, Schedule 80 - #30059**

We will go thru the steps to build the *10" Housing* and will add the additional steps needed to build the *18" Housing* at the end.

<u>NOTE:</u> *CPVC 4" Schedule 80* pipe has an outside diameter *(O.D.) of 4.5" (4-1/2").*

1. **Using a miter box or a table saw to assure squareness, cut off one of the *12"* pipe nipple threaded ends *2-3/4"* from one end. Dress the cut edges with fine sandpaper or a fine file.**
2. **Measure the inside diameter of the threaded end cap. Securely clamp the *1/8"* thick *CPVC* sheet to a drill press bed. Drill a *1/2"* dia. Hole thru the sheet. Using a *Fly Cutter* (available a large hardware store), cut a disk to the dia. you measured. Check that the disk fits snugly into the end cap. If loose or too tight, cut another disk. Be sure to drill the 1/2" hole in the sheet before you recut another disk.**
3. **Cut a second disk to the same dia as the first one (the one that fits snugly), be sure to also drill a 1/2" hole in the sheet before cutting the second disk.**
4. **Apply primer and then cement to one surface of each disk and join the disks together. Carefully align the edges and wipe the excess cement from the edges. Allow the disks to dry for *1 hour* before continuing.**
5. **Refer to *Figure #10*; bevel the edges of the disk to fit the curved contour of the bottom of the end cap. These disks will not fit all the way to the bottom of the end cap but must be level. Be sure the outer edge of the disk measures between *1/32"* and *1/16"* after beveling.**
6. **Lightly coat the threads of the *Housing* and end cap, and the bottom edge of the housing with *Petroleum Jelly*. Apply primer to the mating surfaces of the disk and end cap. Apply cement to the primed area of the end cap only and install the disk, seating it firmly and evenly. Remove any excess cement from the parts with a soft clean cloth.**

7. **Temporarily thread the end cap onto the *Housing*, seating it slowly, but firmly. After about *15* minutes remove the end cap. `**

<u>NOTE:</u> The end cap will be temporarily threaded onto the *Housing* to assure <u>accurate alignment</u> of the disks when cementing them in place. Do not use excessive cement when installing the disk to prevent bonding of the *Housing* and end cap threads. Be sure the *Petroleum Jelly* coats only the end cap threads.

If you are building the *18" Housing*, complete these steps in place of *Step #1*.

8. **Using a miter box or table saw to assure squareness, cut the threaded pipe nipple *5-1/2"* from one of its threaded ends. Dress the cut edges with fine sandpaper of a fine file.**
9. **Prime the outside mating surface of the cut end of the *5-1/2"* pipe nipple and one of the inside mating surfaces of the coupling. Apply an even layer of cement to the primed surfaces and assemble the parts. Allow drying for at least *10* minutes before continuing.**
10. **Prime the outside mating surface of the *12"* pipe and inside mating surface of the coupling attached to the pipe nipple. Apply an even layer of cement to the primed surfaces and assemble the parts. Allow the parts to dry for at least *30* minutes before continuing.**
11. **Using a miter box or a table saw to assure squareness, cut the pipe assembly near the unthreaded end to form a total pipe length equal to *1/2"* less than the determined *Housing* height. Dress the cut edges with fine sandpaper or a fine file.**
12. **Go back to *Step #2* and continue the same steps as for the *10" Housing.***
13. **Repeat the procedure of the preceding *Steps #2, #3, #4, & #5* for the unthreaded end cap. There's no need to apply *Petroleum Jelly* to any area of the unthreaded end cap. Apply primer to the mating surface of the disk and the end cap. Apply cement to the primed area of the end cap only and install the disk, seating it firmly and evenly. Remove any excess cement that squeezes out from between the parts with a soft clean cloth.**

<u>NOTE:</u> Be sure to carefully measure the inside dia. of the unthreaded end cap before cutting the disks for this cap also.

14. **Seal the *1/2"* hole on the threaded end cap with electrical tape. Use a stiff bristle brush and warm soapy water, thoroughly clean the *Petroleum Jelly* from the threads and all other areas of the end cap and *Housing*. Rinse all the parts with warm water. Re -wash the parts a second time with warm soapy water and then rinse clean. Wipe all parts dry with a clean soft cloth.**
15. **Completely cover the inside surfaces of both end caps with strips of electrical tape. Cut away the tape to open up the *1/2"* hole in each disk.**

<u>NOTE:</u> The cavity in each end cap under the disks will be filled with *Epoxy Cement*. To prevent trapping air bubbles, the caps must remain level while pouring in the *Epoxy* and while it cures. Centering and leveling the curved end caps in the inner cores of large rolls of tape works well (duct tape rolls work well for this).

<u>NOTE:</u> Use only high quality, high temperature, waterproof *Epoxy Cement* to fill the end cap cavities. Using an inferior cement may lead to eventual failure of the *Hydro-Gen Generator*.

<u>NOTE:</u> To this end, we recommend <u>*J-B WELD*</u>. It can be purchased just about anywhere. <u>*J-B WELD*</u> comes in *2 oz*. Tubes (one resin, and one hardener). You will probably need at least one pkg. To fill each end cap cavity. Be sure to have enough <u>*J-B WELD*</u> on hand before starting this step. Once the *Epoxy* is mixed, there's no stopping it from curing. Once it cures, you cannot add more *Epoxy* to it, it will not bond properly.

16. **Mix about a *4 oz. Batch* of *Epoxy* in a disposable container such as a small paper cup. <u>*Slowly*</u> fill the cavity (to avoid trapping air bubbles) to the top of the *1/2"* hole in one of the end caps. If necessary, quickly mix more *Epoxy* to finish the end cap.**
17. **Repeat *Step #16* to fill the cavity in the other end cap.**

<u>NOTE:</u> You'll find that when filling the cavities, tapping on the outside of the end cap will help in filling the cavity.

18. **Allow the *Epoxy* to cure for *24* hours. Remove all electrical tape from the end caps. Remove any *Epoxy* from above the top of the *1/2"* hole until flush with the disk surface by grinding, scraping, sanding or whatever it takes.**
19. **Measure the *Inside* dia. of the *Inner Electrode*. Record this dia. as <u>*Dimension "D".*</u>**

20. **Securely clamp the *1/8" CPVC* sheet to a drill press bed. Using the *Fly Cutter*, cut a disk with the dia. of *<u>Dimension "D"</u>* from the sheet. Check that the disk slides easily into the end of the *Inner Electrode* at the end opposite the soldered rod, being neither loose nor tight. If the disk is either too loose or too tight, recut another disk.**
21. **Subtract *.250" (1/4")* from *<u>Dimension "D"</u>* and record that as *<u>Dimension "E"</u>*. For example, if *<u>Dimension "D"</u>* is *3.21". <u>Dimension "E"</u>* would be *2.96"***
22. **Securely clamp the *1/8" CPVC* sheet to the drill press bed. Using the *Fly Cutter*, cut another disk with the dia. of *<u>Dimension "E".</u>***
23. **Apply primer and then cement to one of the flat surfaces of each disk. Join the disks, centering the smaller disk on the larger disk. Center the disk as carefully as is possible. Clean the excess cement that squeezes out from the edges of the disk.**
24. **Grind a small notch in the outer edge of the larger disk so that the disk's slide easily into the *Inner Electrode* over the soldered rod.**

<u>NOTE:</u> The next two *(2)* steps will be used to cut a flat ring from the *1/8" CPVC* sheet. *<u>DO NOT</u>* unclamp the sheet from the drill press bed until *Step #25* is completed.

25. **Securely clamp the *1/8" CPVC* sheet to the drill press bed, centering the *Fly Cutter* at least *4"* from the edge of the sheet. Cut a *3-1/2"* hole in the sheet.**
26. **Adjust the *Fly Cutter* to a dimension of *3-15/16"*, and cut the ring out.**
27. **Check that the ring slides easily onto the *Outer Electrode* at the end opposite the soldered rod. The ring must be neither too loose nor too tight. If needed, cut another ring.**
28. **Repeat the procedure of *Step #25* and cut a *3-5/8"* hole in the *1/8"* thick *CPVC* sheet.**
29. **Repeat *Step #26* exactly. Check the fit as in *Step #27.***
30. **Apply primer and then cement to one of the flat surfaces of each ring; Join the rings, aligning the outer edges carefully. Clean any excess cement from the outer edges with a clean soft cloth. Allow the rings to dry for at least *30* minutes before continuing.**
31. **Next, grind a small notch into the inner edge of the rings just large enough to allow the rings to clear the soldered rod and the solder joint when you slide it onto the *Outer Electrode.***

<u>NOTE:</u> This next procedure centers the rings within the threaded end cap. Be sure when wrapping the tape that it does not protrude below the edge of the smaller ring at any point. *<u>DO NOT</u>* overlap the tape if you need to add more wraps, butt the tape ends before continuing to wrap more tape.

32. **Using plastic electrical tape, wrap the outer edges of the rings until they slide easily into the threaded end cap. If the rings are too loose, add more tape, if too tight, remove some tape.**

<u>NOTE:</u> Refer to *Figure #12* to gain a better understanding to installing the rings into the threaded end cap. <u>BE CAREFUL</u> to apply primer only to the flat surface of the threaded end cap disk contacted by the smaller ring. <u>DO NOT</u> remove the tape until instructed to do so.

33. **Apply primer to the flat surface of the smaller ring. Using a cotton swab or *Q-tip*, apply primer to the flat surface of the disk in the threaded end cap that will be contacted by the smaller ring. Apply a thin even layer of cement to the primed surfaces and install the ring into the end cap, allowing the taped edges to center the ring. Allow the parts to dry for at least *30* minutes before continuing.**

<u>NOTE:</u> The next step will center the disks completed in *Step #23* within the threaded end cap. Again, be certain that the tape does not protrude below the surface of the smaller disk at any point. <u>DO NOT</u> overlap tape ends if you have to add more tape to the disk. If you need to add more tape, butt the tape ends then continue wrapping. Refer to *Figure #12* for a better understanding of these details.

34. **Using plastic electrical tape, wrap the outer edge of the large disk until the tape creates a snug fit within the inside edge of the ring assembly.**

<u>NOTE:</u> When installing the disks, make sure to offset the notch in the disk by at least *3/4"* from the notch in Rings, as shown in *Figure #12*

35. **Apply primer to the flat surface of the small disk and the flat inside surface of the threaded end cap. Apply an even layer of cement to the primed surfaces and install the disk assembly into the end cap. Align the disks with their notch offset at least 3*/4" from* the ring's notch, as shown in *Figure #12.* Using a large *C-clamp*, lightly clamp the disks and end cap. Allow the parts to dry for at least *8 hours* before continuing.**
36. **Remove all electrical tape from the threaded end cap assembly. Scrape away any excess cement that may have squeezed onto the flat inside surface of the end cap in those areas that will contact the bottom edges of the *Electrodes* and threaded end of the *Housing.***

37. **Drill a *37/64"* hole through the center of the threaded end cap as shown in *Figure #12*. You will be drilling thru the *J-B WELD Epoxy* that was installed earlier. This hole will be threaded later to install the *Drain Cock.***
38. **Next, using a *#41* drill bit, drill two *(2)* holes through the bottom of the threaded end cap at the locations where the notch's are in the disk for the Inner Electrode and the *Outer Electrode,* as shown in *Figure #12.***
39. **Temporarily align each *Electrode* and rod with its respective hole drilled in *Step #38*. Check that each *Electrode* and rod can be installed into the threaded end cap and seated firmly on the cap surface. Make any necessary adjustments to achieve correct seating of the *Electrodes.***
40. **With the *Electrodes* in place, with a marking pen mark a short reference line near the top inside of the *Inner Electrode*. Mark another short reference line near the top inside of the *Outer Electrode*, aligning it with the mark on the *Inner Electrode*. Remove the *Electrodes* from the end cap.**

Coffee break again. Take a break before going to the next step, it is a little delicate.

<u>NOTE:</u> The next step will help to center the *Inner Electrode* within the *Outer Electrode*, Again, <u>*DO NOT*</u> overlap tape ends if you add more tape. Butt the tape ends before continuing to wrap the tape.

41. **Using plastic electrical tape, wrap the top end of the *Inner Electrode* until it fits snugly into the *Outer Electrode.* Allow about *1/4"* of the tape to protrude above the top edge of the *Electrode* to allow easy removal later. Do not remove the tape until instructed to do so.**
42. **Arrange a way to solidly support the threaded end cap while installing the *Electrodes* and while the *Epoxy* cures. Again, centering and leveling the curved caps on the inner cores of a large roll of tape will make this job easier.**
43. **Once again, clean the bottom ends and the rods with *MEK* or *Acetone* using a clean soft cloth.**
44. **Seal the bottom ends of the two (2) holes in the end cap that the Electrodes will penetrate, with short pieces of tape. The tape will be pushed aside as the rods poke thru the end cap when the Electrodes are installed. The tape is there to prevent the Epoxy from dripping out until the Electrodes are installed.**
45. **Mix up about 2-3 oz. Of Epoxy in a disposable container such as a small paper cup. Fill in the slot in the end cap where the Electrodes will seat about 1/2 full.**

<u>NOTE:</u> Be sure to install the Outer Electrode first!!

46. **Using your finger, apply a very thin, but unbroken coat of *Epoxy* completely around the bottom edge (rod end) of the *Outer Electrode*. Form a band of *Epoxy* extending about *1/4"* high from the bottom edge, coating both the inside and outside surfaces of the *Electrode.***

<u>NOTE:</u> The *1/8"* holes around the bottom edges of the *Electrodes* help secure the *Electrodes* to the end cap, because the *Epoxy* will fill in the holes. Install the *Electrodes* slowly into the end cap slot so as not to trap air bubbles inside of the holes.

47. **Install the *Outer Electrode* into the end cap. As the *Electrode* starts to enter the slot, lower it very slowly so that the *Epoxy* has sufficient time to flow into the small *(1/8")* holes drilled around the bottom edge without trapping air bubbles. After the *Electrode* is firmly seated into the end cap slot, remove the tape from the bottom of the end cap where the rod poked thru.**
48. **Apply a thin film of *Petroleum Jelly* to the surface of the tape wrapped around the top of the *Inner Electrode.***
49. **Repeat Steps #46 & #47 to install the *Inner Electrode* into the end cap. Use the alignment marks on the tops of the *Electrodes* to aid in finding the second hole for the rod on the *Inner Electrode*. Remove the tape from the bottom of the end cap where the rod from the *Inner Electrode* poked thru.**
50. **Using *cotton swabs* or *Q-tips* remove any excess *Epoxy* oozing from the eight *(8) 1/4"* holes around the bottoms of the *Electrodes.* If necessary, continue to do this until the holes are clear or the *Epoxy* starts the set. Using a clean soft cloth, clean the *Epoxy* from the rod ends protruding thru the end cap and from the surrounding surface of the end cap.**
51. **Place about five *(5)* pounds of weight on top of the *Electrodes* to help keep them firmly seated on the end cap while the *Epoxy* hardens. Folding a small towel or two and placing them on top of the *Electrodes* with a stack of hardcover books on top, works very well. This will distribute the weight well and the towels will help in setting the books in place on top of the tape that is protruding above the tops of the *Electrodes.***

<u>NOTE:</u> Allow the *Epoxy* to cure for at least <u>*24 hours*</u> at room temperature before removing the weights or disturbing the *Electrode* assembly.

52. **After the assembly has cured for at least <u>*24 hours*</u>, remove the weights from the assembly and remove the tape from between the two *Electrodes.* Using *#400* grit sandpaper, remove any *Epoxy* residue from the rod ends protruding thru the bottom of the threaded end cap.**
53. **This completes the *Electrode* assembly.**

<u>Housing Attachments</u>

1. **Temporarily thread the *Electrode* assembly onto the *Generator Housing*, tightening it firmly. Support the entire assembly on the inner core of a large roll of tape.**
2. **Refer to *Figure # 13*; fabricate *3 Coil* support brackets (using dimensions shown) from the *1/8" CPVC* sheet.**

<u>NOTE:</u> For the most efficient operation, the *Coil* must be located approximately *1/4"* above the tops of the *Electrodes.* Use a shim between the *Electrodes* and each bracket to obtain the correct clearance. Be careful not to cement the shims to the brackets or the *Housing.*

3. **Using two pieces of the *1/8" CPVC* sheet scrap for each bracket, apply the primer and then cement to the brackets and the inside wall of the *Housing* at *120 degree* spacing as shown in *Figure # 13*. After attaching the brackets, allow drying for *30* minutes. Use care so as not to cement the shims in place.**
4. **Remove the *Electrode* assembly from the *Housing.***
5. **Mounting the *Generator* assembly can be done many ways. We have shown one way that is simple and sturdy. If you choose a different mounting, use care to make it sturdy enough to withstand road vibrations.**
6. **Brackets *1/4 "* thick are made from two layers of the *1/8" CPVC* sheet as shown in *Figure #14*. Dress the edges of each strip using sandpaper or a fine file. Form the brackets by applying primer and then cement to the mating surfaces of two strips and then joining them together using care to align the edges. Clean the excess cement from the edges.**
7. **A piece cut from the leftover piece from the straight coupling will be used for part of the *Housing* brackets as well as a *Doubler* to increase the wall thickness of the *Housing* where a hose fitting will be installed.**
8. **Cut a *1-1/2"* wide ring from the end of the coupling, Refer to *Figure # 15*. Using a band sander, sand the side of the ring to form a flat surface approximately *1-1/4"* wide. Sand the side at another point to make a second mount. Cut the two pieces from the ring by cutting where shown. This will form two sections from the ring, each with flat outside surfaces ax. *1-1/2" by 1-1/4".* Dress the edges with fine sandpaper or a fine file.**
9. **As shown in *Figure #15*, attach one or these pieces to each flat bracket, locating the ring section in the middle of the bracket. Apply primer and then cement to both surfaces and the join together. Wipe off any excess cement with a clean soft cloth. Be sure to square the curved surface of each section with the length of the bracket.**
10. **Make a *Doubler* by cutting a section 1-*1/2"* wide from the ring as shown in *Figure #15*. Dress the edges and round the corners slightly with fine sandpaper or a fine file.**
11. **Temporarily thread the end cap onto the *Housing*, seating it firmly. Choose a point anywhere around the *Housing* as shown in *Figure #15*, and mark a spot *1/4"* up from the edge of the end cap. Remove the end cap. Apply primer and then cement to the mating surfaces of the *Doubler* and the *Housing* and attach the *Doubler* to the *Housing* with its lower edge at the spot marked on the *Housing*. Align the edge parallel to the *Housing* bottom edge. Allow the parts to dry for at least *4* hours before continuing.**
12. **Drill a 37*/64"* hole thru the center of the 1-*1/2" x 1-1/2"* Doubler and Housing wall as shown in *Figure #15.* Be sure to drill the square with the *Housing* wall.**

<u>NOTE:</u> Threads will be tapped into this hole to install a barbed hose fitting to connect to the *Check Valve.*

13. **Drill a *1/4"* hole near the end of each bracket (total of 4 holes) at location shown in *Figure #14.* Smooth and round the corners of each bracket slightly with fine sandpaper or a fine file.**

<u>NOTE:</u> Now, the *Check Valve* hose will attach to the barbed fitting that will be installed in the hole you drilled in *Step #12*. Keep this in mind when determining the direction in which you prefer the fitting to be pointing in relation to the *Housing* being mounted on the mounting brackets. We recommend pointing it either to the left or the right to minimize *Generator* space requirements.

14. **Position the brackets as shown in *Figure #14*, and clamp them to a flat surface. Check that the *Housing* seats evenly onto the curved section of each bracket with no gaps between the *Housing* and the curved section. Re-align as necessary.**
15. **Set the *Housing* in the position determined earlier and apply primer and then cement to the mating surfaces of the brackets and the *Housing.* Attach the *Housing* to the brackets being careful to align as required. Support the *Housing* as necessary to keep from rotating or shifting while the cement cures. Allow the parts to dry for at least *2* hours before continuing.**

Unthreaded End Cap

List of Materials:

- **Thread Taps – *1/8" NPTF* and *3/8" NPTF* (Cutting Tool Supply: specify *Greenfield Taps* for *CPVC* pipe, or obtain locally).**
- **Two Barbed *1/8" NPT x 1/8"* Hose Fittings (SMC Part # 253490)**
- **Two *3/8" NPT* Stainless Steel Inline Check Valves (Generant Part #ICV-MM-375-SS-1).**
- **One *3/8" NPT* Pressure Relief Valve (Stra-Val Part #RVA-05, specify pressure setting of *85 psi*).**
- **One *3/8" NPT* Internal Seat Drain Cock (Fastener Hut Part # 230A).**
- **Five *3/8" NPTF x 3/8"* Brass Barb Hose Fittings, Male Pipe Rigid (NPTF Short) (Fastener Hut Part # 10506B-106A).**
- **Four *3/8" NPTF x 3/8"* Brass Barb Hose Fittings, Female Pipe Rigid (Fastener Hut Part # 10506B-206A).**
- **One *35 SS* Series Stainless Steel Top Mount Level Switch, *1/8" NPT* (Norgren Part # 0107-024).**
- **One *LS 11* Plastic Side Mount Level Switch, *PBT, 5/8"-11 UNC* (Norgren Part # 1873-024).**

Suppliers:

Cutting Tool Supply (CTS)
340 W. Gerri Lane
Addison, IL. 60101
Phone: 1-630-543-7171
FAX: 1-630-543-6906

The Specialty Mfg. Co. (SMC)
5858 Centerville Rd.
St Paul, MN. 55127
Phone: 1-651-653-0599
FAX: 1-652-653-0989

Generant
1865 Rt. 23 S, PO Box 768
Butler, NJ. 07405
Phone: 1-973-838-6500
FAX: 1-973-838-4888

Stra-Val
21 Columbus Ave.
Garfield, NJ. 07026
Phone: 1-973-340-9258
FAX: 1-973-340-9933

Fastener Hut Inc.
3781 Glengarry Way NE
Roswell, GA. 30075-2615
Phone: 1-770-480-4617
FAX: 1-770-998-2721

Norgren, c/o Kip Fluid Cont. Inc
72 Spring Lane
Farmington, CT. 06032
Phone: 1-800-722-5547
FAX: 1-860-677-4999

Unthreaded End Cap Details

NOTE: A short length of *CPVC* rod inside the end cap will be used as a spacer for the *Water Level Switch*.

CAUTION: Be sure to use only *NPTF* taps. To prevent possible water and gas leakage, *DO NOT* use *NPT* taps. Both *NPT* and *NPTF* threads will seal properly in *NPTF* tapped holes. Be sure to tap to the correct depth by turning the tap until the *12th* thread from the front of the tap fully enters the hole. Be sure to keep the tap aligned parallel to the sides of the spacer.

1. **Using a miter box or table saw to assure squareness, cut a spacer approx. *2"* long from *1"* dia. *CPVC* rod. Using an *"R"* size drill bit, drill a hole thru the center of the rod its entire length, and parallel to its length. A drill press will be helpful here. Drill a hole thru the center of the end cap with the *"R"* drill as shown in *Figure #16.***
2. **Using a *1/8-27* tap, tap threads into one end of the hole drilled in the spacer. Be sure to keep the tap aligned parallel to the sides of the spacer and to tap to depth of *12* threads from the end of the tap.**

3. **Temporarily thread the *35 SS Water Level Switch* into the tapped hole, seating it firmly. Insert the switch power leads from inside the end cap thru the drilled hole in the end cap. Measure and record the distance from the inside surface of the end cap to the end of the switch center tube.**
   Remove the switch from the rod. Making a square cut, cut the rod as required so that the end of the switch center tube is positioned *3"* from the surface of the end cap, as shown in *Figure #16.*
4. **Apply primer and then cement to the untapped end of the spacer rod and its mating surface inside the end cap. Install the spacer into the end cap being certain to align the hole in the spacer with the hole in the end cap. Using a *Q-tip*, remove any excess glue that may have oozed into the hole.**

Slosh Shield

1. **Using a miter box or table saw to assure squareness, cut a *3-1/16"* long section from *1-1/2" CPVC* pipe. Drill four *(4) 1/8"* holes into the sides of the pipe, spaced at *90-degree* intervals and *1/4"* from the edge as shown in *Figure #17.***

NOTE: Six of the seven disks cut will be used for the *Flame Arrestor.*

2. **Using a *Fly Cutter*, cut seven *(7) 1-57/64"* disks from *1/8"* thick *CPVC* sheet. Drill a *3/8"* dia. hole thru the center of one of the disks.**
3. **Apply primer and then cement to the mating surfaces of the drilled disk and the end of the pipe opposite the four *(4)* holes. Attach the disk to the pipe, being certain to center the disk on the pipe.**

Flame Arrestor

1. **Using a miter box or a table saw to assure squareness, cut a *3"* long section from *1-1/2" CPVC* pipe.**
2. **Using a *Fly Cutter*, cut a *1-1/2"* disk from the *1/8" CPVC* sheet. Check that the disk fits snugly inside the *1-1/2"* pipe. If it doesn't, cut another one adjusting the dia. of the cut. Then cut four *(4)* identical disks.**
3. **Apply primer and then cement to two of the disks and join them together, wiping excess cement from the edges with a clean, soft cloth.**
4. **Repeat *Step #3* with the remaining two disks.**
5. **In this same manner, make two *(2)* stacks of three *(3)* disks each from the six *(6)* disks cut in *Step #2* of the *Slosh Shield* procedure. Cement together, making two *(2)* assemblies. Allow them to dry for *2* hours.**
6. **Drill a *37/64"* hole thru the center of each of the two *(2)* stacked disks.**
7. **Referring to *Figure #18*, drill a total of thirteen *(13) 1/8"* holes thru each of the *1-1/2"* disks at the indicated locations.**
8. **Apply primer to the edge of one of the *1-1/2"* disks and to the inside of the *1-1/2" x 3"* long pipe, applying the primer inside the pipe only for *3/8"*. Apply cement to the primed surfaces and slide the disk into the pipe so that it is inside the pipe *1/8"* as shown in *Figure #18*. Form a small bead of cement around the joint where the disk and the pipe meet, being careful not to get any cement in the thirteen *(13)* holes. Allow drying for at least *2* hours before continuing.**
9. **Pack the inside of the *Flame Arrestor* with coarse *Stainless Steel Wool.***
10. **Repeat the procedure of *Step # 8* with the remaining *1-1/2"* disks in the other end of the tube.**

NOTE: Stainless Steel Wool is available at large supermarkets, or obtain it from the following supplier:

IWP
2575 W. Lemoyne
Melrose Park, IL. 60160
Phone: 1-800-732-9336
FAX: 1-708-345-0810

CAUTION: Again, be sure to use only *NPTF* taps. To prevent possible water and gas leakage, *DO NOT* use *NPT* taps. Both *NPT* and *NPTF* threads will seal properly in *NPTF* tapped holes.
Be sure to tap to the correct depth by turning the tap until the *12th* thread from the front of the tap fully enters the hole.
Be sure to always keep the tap aligned squarely with the surface around the drilled hole.

NOTE: Be sure the two *(2)* stacks of three *(3)* disks joined in the preceding *Step #5* have dried for at least *24* hours. When drilling holes in the following *Step #11*, be sure to keep the drill bits squared with the curved outer surface of the unthreaded end cap. This places the axis of each of the three holes at an angle to the axis of the center hole as shown in *Figure #16.*

11. **Referring to *Figure #16*, drill two *(2) 37/64"* holes thru the top of the unthreaded end cap, each hole located *1-3/4"* from the center hole in the cap. Be sure to keep the drill bit squared with the curved outer surface of the end cap.**
Using an *"R"* size drill bit, drill a hole thru the top of the end cap *1-3/4"* from the center hole in the cap as shown in *Figure #16.*

<u>NOTE:</u> Use extreme care to keep the taps aligned squarely with the surface at each holes location. Since the end caps are curved, each hole will have a different square alignment. Be sure also to tap to the correct depth of *12* threads from the end of each tap.

12. **Tap *3/8-18* threads into the *37/64"* holes at the following locations:**
    - **Two *(2)* holes on top of the unthreaded end cap.**
    - **One *(1)* hole on the bottom of the threaded end cap.**
    - **One *(1)* hole in the *Doubler* on the *Housing* wall.**
    - **One *(1)* hole in each of the two *(2) Flame Arrestor* end caps.**
13. **Tap *1/8-27* threads into the *"R"* size hole closest to the edge on top of the unthreaded end cap.**
14. **Tap threads into the *37/64"* hole in each of the two *(2)* stacks of three disks joined in *Step #5* using a *3/8-18* tap. Apply primer and then cement to the mating surfaces of one of the stacks of disks and the *3" Flame Arrestor* pipe. Attach the disks to the pipe, being sure the tapped end of the hole faces outward. Repeat this procedure for the other stack of disks.**

<u>Water Level Switch Test & Installation</u>

<u>NOTE:</u> You need to verify correct operation of the *Water Level Switch* before installing the *Slosh Shield*. The following steps will help you perform this test. Please follow carefully.

<u>CAUTION:</u> <u>DO NOT</u> attempt to control power to any electrical device directly through the *Water Level Switch.* Doing so will damage or destroy the *Switch.*

<u>NOTE:</u> The *Water Level Switch* contains very high quality <u>*Magnetic Reed Contacts*</u>. It will reliably operate thru literally millions of cycles when connected to a properly designed electronic circuit. Now, the Water Level Switch is usually supplied with *NC* (normally closed) contact configuration. *Step #1* will verify this.

1. **Connect an *Ohmmeter* leads to the switch power leads. Suspend the *Switch* from its power leads and verify that the *Ohmmeter* indicates closed switch contacts. If the contacts are not closed, go to *Step #3.* If they are closed, continue to *Step #2.***
2. **Slowly slide the *Switch Float* upward. Verify that the contacts open at approx. the midpoint of *Float* travel. If the contacts open properly, go to *Step #4*. If the contacts do not open properly, the *Switch* is defective and must be replaced.**
3. **Use a marking pen and mark a small dot on top of the *Switch Float.***

<u>NOTE:</u> The *Switch* probably has *NO* (normally open) contact configuration. <u>Inverting</u> the *Float* changes it to the required *NC* configuration.
Carefully remove the *Float* retaining clip located at the bottom of the center tube. Remove the *Float*, invert it and reinstall the *Float*. Reinstall the retaining clip. Verify that the dot on the *Float* is now at the bottom and repeat the procedure of *Steps #1* and *#2* to verify.

4. **Using a countersink tool, or a large drill bit, form a small bevel in the outer end of the center hole in the unthreaded end cap thru which the *Switch* leads will pass.**

<u>NOTE:</u> As an added precaution against possible water and/or gas leakage, we recommend using pipe joint compound on all threaded *Housing* components.

<u>CAUTION</u>: <u>*DO NOT*</u> apply excessive torque to the *Water Level Switch* threads while installing the *Switch* into its mounting *Spacer*. <u>Excessive</u> torque can damage the *Spacer* threads, causing water and/or gas leakage as well as possible system failure.

5. **Apply a light coating of pipe joint compound to the threads of the *Switch* and mounting *Spacer* according to the directions on the product label. Insert the *Switch* power leads thru the *Spacer* hole and thread the *Switch* into place, seating it firmly.**

<u>NOTE:</u> The following steps are used to verify correct *Switch* operation in response to water level changes.

6. **Get a transparent container (such as a large glass jar) with an outside dia. of approx. *2-1/2" to 3-3/4"* and an inside depth of at least *3-1/2"*. Place the unthreaded end cap on top of the container with the *Switch* inside. Be sure the bottom surface of the end cap seats evenly on top of the container. Position the end cap so that at least one of the large tapped holes projects inside the container and the *Switch Float* is at least *1/4"* away from the container wall. Measure water level with the *Switch Float* in water.**
7. **Connect the ohmmeter leads to the *Switch* leads. Check that the *Switch* contacts are closed. *Very slowly* pour water thru the large tapped hole until the *Switch* contacts just open, and remain open. If the contacts close again, add a slight amount of water and wait several seconds before checking again. Keep repeating this process until the *Switch* remains open. Check that water level is at least *2"* from the top edge of the jar. If the water level is less than *2"* from the top, *Switch* is defective and must be replaced.**
8. **Remove the end cap assembly from the jar and dry as necessary with a soft clean cloth.**
9. **Apply primer and then cement to the mating surfaces of the *Slosh Shield* and the end cap. Attach the *Slosh Shield*, centering it around the *Switch Float*.**

<u>Toroid Coil</u>

NOTE: The *Hydro-Gen Coil* is hand-wound around a *Ferrite Toroid Core* with insulated, high temperature copper wire. Close attention to detail and craftsmanship is essential to building an efficient and reliable *Coil.* There are literally millions of different coil configurations in existence. It's a great area for experimenting since coil design is as much an art as it is science. Believe it or not, there's actually an organization dedicated to the craft, the *International Coil Winding Association*, based in *England.*

Be forewarned that winding any *Coil*, especially a *Toroid Coil*, is a tedious task, but we'll do our best to make the job as easy as possible. This *Coil* is created from *2,000* turns of insulated copper wire wrapped around a circular *Magnetically Sensitive Core*. That means you have to pull each wire wrap thru the *Toroid Core* just as many times.

***Teflon Insulated Copper Magnet Wire* is the only way to go. It handles heat extremes very well and is impervious to just about anything. It isn't cheap, but well worth the investment.**

You can order this wire from *MWS Wire Industries*. They carry over *25,000* different magnet and specialty application wires. Be sure to order *"Double Build"* (extra heavy) insulation, *23 AWG.* You'll need almost *550* feet of this wire. So order *550* feet and you will have enough.

<u>List of Materials:</u>

- **One Ferrite Toroid Coil Core 3.50 OD x 2.00 ID x .500 thick (National Magnetics part # 995).**
- **Copper Magnet Wire, Teflon Coated, Heavy Build, 23 AWG, 550 Ft. (MWS Wire Ind. custom ord.).**
- **Teflo Etching Solution ("FluoroEtch") (Acton Technologies)**
- **One Pkg. Heat Shrink Tubing, assorted sizes (Radio Shack, Catalog # 278-1610).**

<u>List of Suppliers:</u>

National Magnetics Group
1210 Win Dr.
Bethlehem, PA 18017-7061
Phone: 1-610-867-7600
FAX: 1-610-867-0200

MWS Wire Industries
31200 Cedar Valley Dr.
Westlake Village, CA 91362
Phone: 1-818-991-8553
FAX: 1-818-706-0911

Acton Technologies
100 Thompson St
PO Box 726
Pittston, PA 18640
Phone: 1-570-654-0612
FAX: 1-570-654-2810

Radio Shack
(Nationwide stores)

After the *Coil* is completed, you need to coat it with a few thin layers of *CPVC* cement. This way you'll end up with something that will last just about forever, and is practically indestructible. This also makes it very easy to solidly attach inside the *Housing* with *CPVC* cement. As you probably know, getting anything to stick to *Teflon* is almost impossible, except when I try my hand at cooking something. That is why it takes a special chemical etching to allow the *CPVC* cement to adhere. There are several Co.'s that specialize in this process, but the cost is extremely high. Now, there is a safe and easy etching process that can be done at home with great results, in a relatively new product called *"FluoroEtch".* You simply warm *FluoroEtch* to *130* degrees, slosh the *Coil* around in it for about a minute, and then slosh it in *Isopropyl* or *Methyl Alcohol* for a minute or two. Wash the *Coil* in warm soapy water and rinse with warm water then let it air dry. After doing this, just about anything will stick to the *Teflon Coated Coil*, so be very careful with it. We are telling you all this so that when you call *Acton Technologies* you'll sound knowledgeable enough that they won't hesitate selling you the *FluoroEtch.*

1. **We recommend cutting the *Magnetic* wire into four *(4) 100 Ft.* lengths and one *(1) 150 Ft.* length. Otherwise, you'll have to pull *550 Ft* of wire thru the *Core 2,000* times. This works out to just over *104* miles of wire pulled thru the core and a very sore arm as well as probably a tangled mess. By working with *100 Ft* and *150 Ft* lengths, you'll have to make four *(4)* solder splices to the wire, but you can cut your wire pulling down to a more manageable *22* miles. If your concerned about this length, you can go even further with eleven *(11) 50 Ft* lengths, with ten *(10)* solder splices and a length of just *9-1/2* miles. Making the lengths any shorter will require far too much soldering time and bulk. DO NOT try wrapping several times around the *Core* and then pulling the rest thru the *Core.* That will end up bending and straightening the wire many times and will eventually destroy the wire.**
2. **Forming a *3.50" OD x 2.0" ID x .50" Toroid Coil* from *23 AWG* wire requires about *250* turns of wire per wrapped layer. Since the *Coil* builds is size as it's wrapped, each wrap uses an average of about *3"* of wire. So, each *100 Ft* of wire provides about *400* wraps, or slightly over *1-1/2* layers. Therefore, four *(4) 100 Ft* lengths and one *(1) 150 Ft* length will build an *8 Layer Coil* of at least *2,000* turns.**
   NOTE: Save the *150 Ft* wire for the last layer in case you need the extra wire to complete the *8th Layer* without splicing near the *Coil* entry wire. NOW, any time you interrupt the wrapping, you must tightly wrap a strip of plastic electrical tape completely around the *Coil* to secure the last wrap. *Teflon* is extremely slippery stuff, you don't want to come back after a break and find that your wrapped coils have loosened.

NOTE: The first complete wrapping of the *Coil* forms *Layer #1* for the inner core. This is the critical layer since each subsequent layer will automatically position itself by nesting between the wires of the previous wrap.

3. **Referring to *Figure # 19*, slip a *1"* length of small heat shrink tubing about *4"* onto the *Magnet Wire* and apply heat to shrink it in place. If you are right-handed, you'll probably choose to wrap the *Coil* in a clockwise direction, holding the *Core* with your left hand. Then, lay the shrink tubing on top of the *Core*, angled off to the left at about *30* degrees from straight as shown.**
4. **Start the first wire wrap over the shrink tubing at about its midpoint. This will be the start of *Layer #1* for the inner core. Be sure to keep the wire wraps tight against each other in the *Inside* edge of the *Core*, with no overlapping. Keep tension on the wire at all times, with the wire always pointing straight out from the *Core.***
   This first wrap dictates the wire position of each subsequent wrap since each wire will fall into the depression formed between the wires of the preceding wrap. So, if you do a loose sloppy wrap on the first wrap, you'll end up with a sloppy *Coil.* Take your time to do the job right. Continue wrapping until you have completed a full turn of the *Coil*. This completes *Layer #1.* Tightly wrap a strip of plastic electrical tape around the wire and the coil entry wire at the end of *Layer #1.*
5. **Carefully check the position of each wire on the outside edge of the *Core*. If wrapped properly, there will be approx a *.019"* gap between any two wires. But, you can position each wire close enough by using a short piece of *Coil* wire as a feeler gauge. If the gauge wire touches the *Core* surface between any two wires, the gap is too wide, so at least one of the wires is out of position. Using your fingernail or a small blunt instrument slightly shift the wires to close the gap enough to keep the feeler gauge wire from contacting the *Core* surface. After you go around the *Coil* a few times, you should be able to visually detect wires out of position. It is very important to keep the spacing in this first layer as close to this as is possible. Using FluoroEtch, etch the Teflon surface of the wires as explained above.**

6. **Mix about a 1/2 oz. batch of the *Epoxy (J-B WELD)*. Using a small brush, carefully apply a thin layer of *Epoxy* around the *<u>Outer</u>* edge of the *Coil*. Apply with a motion parallel to the wires to prevent wire movement. Be sure the *Epoxy* contacts the *Coil* surface between the wires. Suspend the *Coil* from its wires and allow the *Epoxy* to cure for at least *8* hours.**

7. **Start wrapping *Coil Layer #2,* exercising care to position each wire into the gap formed between the wires of *Layer #1* on the *Inner* and *Outer* edges of the *Coil*. Count and record the number of turns. Continue wrapping until you get within about one *(1)* foot of the wire end. Secure the wire by tightly wrapping plastic electrical tape around the wire and *Coil.***

8. **Coil thickness tapers down between the *Inner* and *Outer* edges. To minimize *Inner Coil* thickness, position wire splices on top or bottom of *Coil*, midway between the edges as shown in *Figure #19.***

9. **Temporarily wrap the wire for two or three more turns and cut it about *1/2"* short of the *Outer* edge. To splice to the next wire length, unwrap the wire and use a sharp knife to scrape away the *Teflon* coating from about *1/2"* of each wire end. Be careful to keep the knife blade perpendicular to the wire.**

10. **Slide a *1/2"* length of heat shrink tubing over the end of the next length of *Coil* wire. Twist the wire ends together for *7 to 8* turns to form a splice. Cut the splice length to about *1/4"* and bend it back toward the *Coil* until it lays flush against the *Coil* wire. Solder the splice, slide the heat shrink tubing until it's centered over the splice and apply heat to shrink the tubing. Let the splice to cool before continuing.**

11. **Remove the plastic electrical tape from the *Coil* and continue wrapping until *Layer #2* is completed. Remember to record the number of turns required to complete *Layer #2.***

12. **Referring to your recorded number of *Coil* turns needed to complete *Layer #2,* determine the number of *Coil Layers* required to complete the *Coil* with a total number of *1,800 to 2,100* turns.**

NOTE: Although the total # of *Coil* turns is not critical, almost all *Coils* require a total of *8* wire *Layers.*

13. **Repeat the procedure of the preceding *Steps #6* thru *#9* until the last *Layer* has been completed. Be sure the last turn ends within a turn or two of the *Coil* entry wire *(Layer #1)*. Cut last wire to about *12".***

14. **Referring to *Figure #19,* temporarily slide a *5"* length of heat shrink tubing over the ends of the *Coil* wires (from *Layer #1* and the last *Layer*). Draw the tubing snugly up against the *Outer* edge of the *Coil* and bend the *Coil* leads back toward the *Coil* at the outer end of the tubing. Tightly wrap each *Coil* wire *4 to 5* times around the tubing about *1"* from the end, twist the wires together for at least *5 or 6* turns. *<u>DO NOT</u>* heat shrink this tubing, it is just temporary.**

15. **<u>CAUTION: USE EXTREME CARE DURING THE NEXT PROCEDURE TO PREVENT DAMAGING THE COIL WIRES.</u>**

16. **<u>TO ASSURE PROPER AND COMPLETE BONDING OF CPVC CEMENT TO THE COIL AFTER ETCHING, DO NOT HANDLE THE COIL WITH BARE HANDS. IF THE COIL MUST BE HANDLED AFTER ETCHING, USE CLEAN COTTON GLOVES.</u>**

17. **Using *FluoroEtch,* while suspending the *Coil* by the heat shrink tubing; etch the surfaces of the *Teflon* coated *Coil* wires. Follow the directions on the product label. If necessary, review the etching procedure explained at the beginning of this section. Always handle the *Coil* by suspending it by the tubing during each phase, from etching thru final warm water rinse. Use clean paper towels to absorb water drips from the bottom of the *Coil* until dripping stops. Allow drying for *4* hours before continuing.**

18. **Using a soft bristle brush, coat the entire surface of the *Coil* with a thin even layer of *CPVC* cement. Use cotton swabs or *Q-Tips* to wipe away excess cement that may be dripping from the bottom of the *Coil* until dripping stops. Allow the cement to air dry for at least one *(1)* hour and then apply a second thin even layer of *CPVC* cement in the same manner.**

19. **Repeat *Step #18* until a total of *5 to 6* layers of *CPVC* cement have been applied to the *Coil*. Allow at least one *(1)* hour drying time between each layer. Allow the final layer of cement to dry for at least eight *(8)* hours before continuing.**

20. **Unwrap the *Coil* wires from the heat shrink tubing and remove the tubing from the wires. Cut a *1"* length of heat shrink tubing large enough to slip snugly over the *Coil* wires and the heat shrink tubing of the *Coil* entry wire. Draw tubing tightly against the *Coil* outer edge and apply heat to shrink the tubing.**

21. **Using a soft bristle brush, apply a thin bead of *CPVC* cement about *1/4"* wide around the *Coil* end of the tubing and surface of the outer *Coil* edge. Allow the cement to air dry for about one *(1)* hour and then apply a second bead of cement over the first bead. Suspend the *Coil* from the end of its wires and allow it to air dry for at least *24* hours before continuing.**

22. **After the cement has dried for *24* hours, cut the *Coil* wires to a length of three *(3")* inches from the *Coil.***

Toroid Coil Installation

NOTE: **We recommend locating the *Coil* electrical connections on the side of the *Housing* directly opposite the *Water Pump Inlet Port.* This will minimize possible *Coil* wire connector fatigue due to the effects of water turbulence at high pump pressure.**

1. **Using a *#41* drill bit, drill two *(2)* holes in the *Housing* at the locations shown in *Figure #20.***
2. **Cut two *(2) 4"* lengths of *3/32"* bare *Stainless Steel Welding Rod*. Make a *90* degree bend in one end of each rod to form a leg *1-1/2"* long, cut the other leg to a length of *3/4"*, as shown in *Figure #20*. Using a file, square off the ends of each rod and deburr the edges.**
3. **Using a sharp knife, scrape the *Teflon* coating from about *1/2"* of each *Coil* wire end. Always keep the knife blade perpendicular to the wire to prevent damage to the wire.**
4. **Wrap one of the *Coil* wire ends around the top of the *1-1/2"* leg of one of the rods for at least *4 to 5* turns. Using *Silver Bearing Solder*, solder the wire to the rod leg. Trim away any excess wire. Form a wire strain relief at the bottom of that leg by wrapping heavy thread for at least *3 to 4* turns around the leg and the wire, secure the thread with a knot at the outside of the rod leg.**
5. **Repeat *Step #4* with the other *Coil* wire end and the other rod.**
6. **Using a soft bristle brush and warm soapy water, clean the soldered areas of the rods and wires. Rinse with warm clean water and allow the thread to air dry for at least one *(1)* hour before continuing.**
7. **Coat the entire length of the long legs of the two rods with a thin even layer of *CPVC* cement. Allow to dry for about *30* minutes, and then apply a second thin even coat of *CPVC* cement. Allow the rods to air dry for one *(1)* hour before continuing.**
8. **Temporarily install the *Coil* on top of its three *(3)* support brackets within the *Housing.* Position the *Coil* with the wires and rods pointing toward the holes drilled in *Step #1*. Temporarily attach three small strips of plastic electrical tape on top of the *Coil* to mark the location of each support bracket.**
9. **Remove the *Coil* from the *Housing* and apply primer to the bottom of the *Coil* at the three marked locations and the top surface of the three support brackets. Coat the top of each support bracket with a heavy layer of *CPVC* cement. Install the *Coil* onto the support brackets, positioning it with the wires and rods pointing toward the two *#41* drilled holes. If necessary, shift the *Coil* slightly to center its outside edges within the *Housing.* Allow the *Coil* assembly to air dry for at least two *(2)* hours before continuing.**

NOTE: **The two *(2) #41* holes in the inside *Housing* wall must be countersunk to a depth sufficient to clear the inside radius of the bend in the rods allowing the long soldered leg of each rod to lay flush against the *Housing* wall with the soldered leg pointing upward. Deburr the inside ends of the holes with a round file or a larger drill. Check to see that the rods fit into the holes with the long leg flush against the inside surface of the *Housing.***

10. **Using *#400* grit sandpaper, polish the surface of the unsoldered leg of each rod. Remove the three strips of plastic electrical tape from the top of the *Coil.* Mix a small amount of *Epoxy (J-B WELD)*, apply a thin coat of *Epoxy* to the unsoldered leg of one rod. Using a toothpick, apply a thin coat of *Epoxy* to the inside of its respective hole in the *Housing.***
11. **Apply primer and then cement to the inside of the *Housing* where the rod will sit. Apply cement also to the soldered leg of the rod. Full insert the rod into its hole in the *Housing* with the long leg pointing straight up. Hold the rod in place for about *5* minutes until the cement dries sufficiently to hold it in place. While the cement continues to fully dry, clean any excess *Epoxy* from the rod end using a soft clean cloth and a solvent like *Acetone* or *MEK.***
12. **Repeat *Step #11* with the other rod. Allow the *Epoxy* to cure for at least eight *(8)* hours before continuing.**

NOTE: Several layers of *CPVC* cement are used to secure the *Coil* to the *Housing* brackets, and the rods and wires to the *Housing* wall and to seal the rods against possible water and/or gas leakage thru the holes in the *Housing*.

13. **Lay the *Housing* on its side and apply a thick layer of *CPVC* cement over the wires and the soldered leg of each rod. Extend the cement layer around the holes where each rod enters the *Housing* wall, forming about a *1/2"* dia. puddle around each hole. Allow the cement to air dry for at least one *(1)* hour before continuing.**

14. **Stand the *Housing* on end. Using a soft bristle brush, apply a thick layer of *CPVC* cement over and around the *Coil* surface above where it contacts each of the support brackets. Be sure the layer extends the width of each bracket. Allow to air dry for at least one *(1)* hour before continuing.**
15. **Repeat *Steps #13* and *#14* at least *4 to 5* times to obtain the desired thick layer of cement. Allow the cement to air dry for at least one *(1)* hour between successive layers.**
16. **After the cement has thoroughly dried and the *Epoxy* has fully cured, use *#400* grit sandpaper to remove *Epoxy* residue from the rod ends.**

Unthreaded End Cap Installation

NOTE: *Generator* function and efficiency is not effected in any way by the circular position of the Unthreaded end cap.

1. **Check that the mating surfaces of the end cap and the top of the *Housing* are clean and free of any debris. Clean the mating surfaces if necessary with a soft clean cloth and a mild solvent such as isopropyl *alcohol.***
2. **After determining the desired position of the end cap, apply primer and then *CPVC* cement to the mating surfaces of the end cap and the *Housing*. Slide the parts together seating them firmly.**
3. **Stand the *Housing* on end to prevent the possibility of excess cement running into the threaded holes in the end cap. Allow the assembly to air dry for at least one *(1)* hour.**

Generator Final Assembly

1. **Cut the two *(2)* rod ends protruding thru the bottom of the threaded end cap to a length of *1/2"*. Using a fine file, square the end of each rod and deburr the edges.**

NOTE: as an added precaution against possible water and/or gas leakage, we recommend using pipe joint compound on all threaded *Generator Housing* components.

2. **Apply a coating of pipe joint compound to all threaded holes in the *Generator Housing* and end caps.**

CAUTION: TO PREVENT DAMAGE TO THREADED HOLES IN CPVC MATERIAL, DO NOT APPLY EXCESSIVE TORQUE TO COMPONENTS WHILE INSTALLING THEM. THREAD DAMAGE CAN CAUSE WATER AND/OR GAS LEAKAGE AND POSSIBLE SYSTEM FAILURE.

3. **Apply a light coating of pipe joint compound to the threads of the *Drain Cock*. Thread the *Drain Cock* into the *37/64"* threaded hole on the bottom of the threaded end cap, seating it firmly. Repeat this procedure to install the remaining components:**
   - **One *(1) 3/8"* Barbed Hose Fitting into *37/64"* hole in the *Housing Doubler*.**
   - **One *(1) 3/8"* Barbed Hose Fitting into *37/64"* hole on top of the *Housing.***
   - **One *(1) 1/8"* Barbed Hose Fitting into *"R"* size hole on top of *Housing.***
   - **One *(1)* Pressure Relief Valve into *37/64"* hole on top of *Housing.***
4. **Using a toothpick, force a small quantity of *Silicone Sealant (RTV Sealant)* into the hole in the end cap thru which the *Water Level Switch* leads pass. Form a small and smooth fillet of *Sealant* around the leads and the end of the hole. Allow the *Sealant* to cure for at least *24* hours before continuing.**
5. **Visually inspect all surfaces and components of the *Housing* and end caps to verify their integrity. Correct any possible defects as required.**
6. **Thoroughly flush the interior of the *Generator Housing* with warm water. Stand the *Housing* on end and allow excess water to drain for at least *15* minutes. Using a soft clean cloth, thoroughly dry the *Housing* exterior and the threads of the *Housing* and the end cap.**
7. **Apply a light coating of pipe joint compound to the *Housing* and end cap threads. Thread the end cap onto the *Housing* and tighten firmly.**

In-Dash Indicator Panel Assembly

NOTE: Personal preference dictates the layout of *Panel Gauges* and *LED* indicators. During assembly, refer to *Figures #6, #7 & #8* for a better understanding of the wiring.

List of Materials:

- **One *(1)* Cylinder Head Temperature Gauge *(CHT)* kit, *2-1/16"* Dia., (includes spark plug mounted thermocouple sensor) *(Bus Boys Part # VDO-310901).***
- **One *(1) 2* – Gauge Custom Console *(Bus Boys Part # VDO-1108720).***
- **One *(1)* Pressure Gauge, *2-1/16"* Dia. *(Auto Meter Products Model # 2360).***
- **Two *(2)* Bulb and Socket Sets, *2 Watt*, *(Auto Meter Products Model # 2357).***
- **Four *(4) LED* Indicators:**
  - **Two *(2)* Green *(Radio Shack Part # 276-304).***
  - **One *(1)* Yellow *(Radio Shack Part # 276-351).***
  - **One *(1)* Red, Blinking *(Radio Shack Part # 276-308).***
- **Three *(3) 55 Ft* Spools *18 ga*. Insulated, Stranded Hookup Wire *(Radio Shack Part # 278-1220).***
- **One *(1) 9* – Position Male Interlocking Connector *(Radio Shack Part # 274-229).***
- **One *(1) 9* – Position Female Interlocking Connector *(Radio Shack Part # 274-239).***
- **Two *(2)* Pkgs. Crimp-On Snap Connectors, (*5* – male & *5* – Female) *(Radio Shack Part # 64-3085 and #64-3086).***
- **One *(1)* Pkg. Assorted Ring Terminals *(Radio Shack Part # 64-3032).***
- **One *(1)* Pkg. Assorted Grommets *(Radio Shack Part # 64-3025).***
- **One *(1) 10 Ft.* length *1/8"* Silicone Braid Reinforced Tubing *(US Plastic Stock # 54051).***
- **Twenty *(20)* Small Stainless Steel Worm Thread Hose Clamps *(Local Hardware Store)***
- **One *(1)* Pkg. Small Nylon Tie-Wraps *(Local Hardware Store).***

Material Sources:

Bus Boys
183 Lake Blvd East
Redding, CA 96003
Phone: 1-530-244-1616
FAX: 1-530-224-0933 (24/7)

Auto Meter Products Inc.
413 W. Elm St.
Sycamore, IL 60178
1-815-895-8141
FAX: 1-815-895-6786

United States Plastic Corp.
1390 Neubrecht Rd.
Lima, OH 45801-3196
Phone: 1-800-537-9724 (7:30am-7pm EST Mon-Fri)
FAX: 1-800-854-5498 (24/7)

Radio Shack
(Stores Nationwide)

NOTE: The quickest and easiest method for mounting gauges and *LED's* is to use a prefabricated console attached to the dash (on top or hanging down). Other methods may work, but we recommend the *VDO-1108720 Custom Console*, which is molded *ABS* plastic.

1. **Temporarily mount the *CHT* and *Pressure Gauges* in the *Console.* Referring to *Figure#2*, determine the best locations for the four *(4) LED's* and place reference marks at those locations on the outside of the *Console.* Drill a *7/32"* hole at each location. To assure proper adhesion of the *Silicone Sealant* to the *Console* interior surface, roughen around the area of the drilled holes with fine sandpaper.**
2. **Temporarily disconnect the *CHT* gauge thermocouple lead and mount the gauge in the *Console.* Apply a light coating of pipe joint compound to the *1/8-27* threads of the *Pressure Gauge* and the *1/8-27* barbed hose fitting. Thread the fitting into the gauge and tighten firmly. Slip the *1/8" Silicone Tubing* fully onto the barbed fitting and secure with two small *Stainless Steel Hose Clamps*. Firmly tighten the hose clamps and mount the *Pressure Gauge* in the *Console.***

NOTE: The shorter of the two *LED* leads is always the *Anode (+)* lead.

3. **Identify the *Anode (+)* lead of each *LED* and cut it to a length of *1"*. Cut four *(4) 3 Ft* lengths of *18* gauge hookup wire and strip *1/2"* of insulation from the end of each wire. Wrap the ends of each wire end around each Anode lead and solder. Slide a *1-1/2"* length of heat shrink tubing over each wire and flush against the *LED* and shrink the tubing.**
4. **Referring to *Figure #3*, identify the *Console* location for each *LED*. Using masking tape, attach an identifying label to each *Anode* wire.**
   - **Green, *PWR ON***
   - **Green, *PUMP ON***
   - **Yellow, *GEN WATER LOW***
   - **Blinking Red, *TANK WATER LOW***
5. **Cut two lengths of hookup wire to use as jumper wires between *Bulbs* and *Sockets* for the *Gauges*. Strip *1/2"* of insulation from the ends of each wire. Solder a wire to one *Socket* center connector. Slide a 1*"* length of heat shrink tubing onto the wire and as far as possible onto the *Socket base*. Shrink the tubing. Cut a *3 Ft* length of hookup wire and strip *1/2"* of insulation from one end. Twist the ends of the soldered jumper wire and the *3 Ft* wire together. Slide a *1"* length of heat shrink tubing onto the wires and solder the wires to the other *Socket* center connector. Slide the tubing as far as possible onto the *Socket base* and shrink the tubing. Label the wire *"Positive" (+).***
6. **Cut a *6"* length of hookup wire. Repeat the procedure of *Step #5* to connect the *6"* wire and jumper wire between the two *Socket base* connectors. Strip *1/2"* of insulation from the end of the *6"* wire.**
7. **Cut the *Cathode* lead of the Green *"PWR ON" LED* to *1-1/2"* long. Cut the *Cathode* lead of the Yellow *"GEN WATER LOW" LED* to *1"* long. Cut an appropriate length of hookup wire to serve as a jumper wire between the *Cathodes* of both *LED's*. Strip *1/2"* of insulation from each end of the wire. Solder the jumper wire to the Yellow *LED Cathode*. Slide a *1-1/2"* length of heat shrink tubing over the wire and flush against the *LED* and shrink the tubing.**

   Twist the stripped ends of the jumper wire and *6"* wire from *Step #6* together. Slide a *1"* length of tubing over the two wires and solder them to the *Green LED Cathode*. Slide the tubing flush against the *LED* and shrink the tubing. Cut a *3 Ft* length of hookup wire and strip *1/2"* of insulation from one end. Solder the wire to the *Green LED Cathode*. Slide a *1-1/2"* length of heat shrink tubing over the wire and as far as possible onto the *LED* lead and shrink the tubing. Label the wire *"Ground"*. Cut the *Cathode* leads of the two remaining *LED's* to *1"* long. Cut two *(2) 3 Ft* lengths of hookup wire and strip *1/2"* of insulation from the end of each wire. Solder the wires to the *LED Cathodes*. Slide a *1-1/2"* length of heat shrink tubing over each wire and flush against the *LED* and shrink the tubing. Label the *Green LED* wire as *"PUMP ON CATHODE"* and the Red LED wire as *"TANK WATER LOW CATHODE"*.

<u>NOTE:</u> *Silicone Sealant* cures by chemical reaction with oxygen and water moisture in the air, which is why its sometimes referred to as *RTV (Room Temperature Vulcanizing)* cement. *Sealant* cure time can be shortened considerably by placing a water-dampened cloth within the *Console* interior and placing the *Console* into a plastic grocery bag (<u>don't</u> seal the bag so that its airtight). This method is especially effective in dry climates.

8. **O.K. time for a coffee break.**
9. **Slide each *LED* into its correct mounting hole in the *Console*. Slide one *LED* about *1/16"* back from the interior surface of the *Console* and apply a small amount of *Silicone Sealant* into the gap between the *LED flange* and the *Console* surface. Slide the *LED* back into place and flush with the *Console* surface. Apply a thick bead of *Sealant* around the *LED flange* and about *1/4"* onto the *Console* surface. Repeat the same procedure for the three remaining *LED's*. Allow the *Sealant* to cure for at least *24* hours before continuing.**
10. **Install the *Bulbs* and *Sockets* into the *Gauges*. Draw the seven *(7) LED* wires and *Bulb Socket* wire together a short distance from the *LED's* and secure the wire bundle with a tie-wrap. Tighten the tie-wrap and cut off the unused portion.**
11. **Drill and/or grind a hole to install a *5/8" ID Grommet* thru the engine firewall at an appropriate location for routing of *Control* wires, *Thermocouple* lead, and *Pressure Gauge* tube. Deburr the hole and install the *5/8" Grommet*. Insert the *Thermocouple* lead thru the *Grommet* from the engine side and reattach it to its *CHT* gauge terminal.**

12. **Permanently attach the *Console* to the *Dash* at the desired location. Secure the wires, *Thermocouple* lead, and *CHT* tube bundle with a tie-wrap placed every *6"* along the length of the bundle. To prevent collapsing the *Pressure Gauge* tube, be sure not to over tighten the tie-wraps.**
13. **Cut the ends of the eight *(8)* wires to the same length and strip *1/4"* of insulation from the end of each wire. Attach each wire to a separate pin of the *9-position Male Interlocking connector* by crimping or soldering. Be sure to carefully label each wire.**
14. **Remove a spark plug from the engine and plug the hole with a soft clean cloth. To assure good electrical contact for the *Thermocouple*, polish the area contacted by the spark plug with *#400* grit sandpaper. Remove the cloth from the spark plug hole. Slip the *Thermocouple* ring over the spark plugs threads and reinstall the spark plug. Tighten the spark plug to its normal torque value.**

Water Tank and Pump

List of Materials:

- **One *(1)* rectangular *Polyethylene Tank*, 16 Gallon, *21" x 14" x 14"* (US Plastic Stock *#8658*).**
- **High-Low Temperature Silicone Tubing, *3/8" ID x 20 Ft*, (US Plastic Stock *#54037*).**
- **Silicone Braid Reinforced Tubing, *3/8" ID x 20 Ft* (US Plastic Stock *# 54055*).**
- **One *(1)* High-Head Pump, *12 vdc, 75 psi* (minimum) (Flojet).**
- **One *(1)* Brass Bushing, *3/4" PTF Male x 3/8" PTF Female* (Fastener Hut Part *# 3220X12X06A*).**
- **One Pkg. Crimp-On Butt Connectors (Radio Shack Part *# 64 –3037*).**

Material Suppliers:

U.S. Plastic Corp.
1390 Neubrecht Rd.
Lima, OH 45801-3196
Phone: 1-800-537-9724 (7:30am / 7pm EST Mon-Fri)
FAX: 1-800-854-5498 (24/7)

Fastener Hut Inc.
3781 Glengarry Way NE
Roswell, GA 30075-2615
Phone: 1-770-480-4617
FAX: 1-770-998-2721

Flojet Corp.
20 Icon
Foothill Ranch, CA 92610
Phone: 1-800-235-6538
FAX: 1-949-859-1153

Radio Shack
(Stores Nationwide)

NOTE: ***Water tank* capacity is not critical, but should be at least *10 gal*. The recommended tank is sturdily constructed, holds *16 gal*. And is furnished with a *3/4" FPT* outlet fitting.**

1. **Apply a thin coat of pipe joint compound to the internal threads of the 3/4" x 3/8" bushing and the threads of a 3/8" barbed hose fitting. Thread the fitting into the bushing and tighten firmly.**
2. **Apply a thin coat of pipe joint compound to the external threads of the bushing and the internal threads of the water tank fitting. Thread the bushing into the tank and tighten firmly.**

NOTE: **The *Water Level Switch* can be installed at the midpoint of either sidewall of the tank. Determine the best location based on the routing of electrical leads, position layout, etc. One Switch lead will be grounded to the vehicle frame and the other lead will be connected to the *Control Module*.**

3. **Drill a *5/8"* hole in the sidewall of the *Water Tank* at the midpoint of its length and *4"* up from the bottom. Rinse the tank out with water to remove any plastic chips from drilling.**
4. **Remove the *Tank cap*. Drill a *37/64"* hole thru the center of the cap and thread the hole with a *3/8-18* tap. Rinse the cap with water to remove all cuttings. Thread a *3/8"* barbed hose fitting into the tapped hole and seat firmly. Cut a *6"* length of *High-Low Temp. Silicone Tubing*. Slip the tubing onto the fitting and secure with two *(2) Stainless Steel Clamps* and tighten firmly.**

CAUTION: DO NOT ATTEMPT TO CONTROL POWER TO ANY ELECTRICAL DEVICE DIRECTLY THRU THE WATER LEVEL SWITCH. DOING SO WILL DAMAGE OR DESTROY THE SWITCH.

5. **Strip *1/4"* of insulation from the ends of the *LS-11Water Level Switch* leads. Connect *Ohmmeter* leads to the *Switch* leads. Pivot the *Switch Float* until flush against the *Switch* body. Verify that the *Ohmmeter* indicates closed *Switch* contacts. If contacts are not closed, the *Switch* is defective and must be replaced.**
6. **Pivot the *Float Switch* away from the body until it is within *10* degrees of its stop. Verify that the *Switch* contacts are open. If the contacts are not open, the *Switch* is defective and must be replaced.**
7. **Using a soft clean cloth, dry the tank sidewall around the *5/8"* hole. Apply pipe joint compound to the threads of the *Switch* body and mounting nut, and their mating surfaces with the tank wall. Install the *Switch* into the tank so the *Float* pivots upward, aligning its pivoting axis parallel to the tank bottom. Firmly tighten the *Switch* mounting nut.**
8. **Attach *Ohmmeter* leads to the *Switch* leads and verify the *Switch* contacts are closed, Plug the tank outlet fitting and fill the tank with water until the *Switch* contacts open. Continue filling the tank until the water level rises an additional *2".* Verify that the *Switch* contacts are still open. Unplug the tank outlet and verify that the *Switch* contacts close when the water level drops to approx. the *1/3* full point, and proceed to *Step #9*. If the *Switch* contacts do not respond to changing water level, check to verify that the *Switch* is properly installed and the *Float* pivots freely. Verify that the *Float* is at least *1/4"* away from any part of the tank. Correct any installation problems. If the *Switch* has been properly in stalled, then it is defective and must be replaced.**
9. **Drain the water from the tank and install the cap, tightening it firmly. Depending on where you plan to install the tank, construct a wood frame approx. *3"* high to secure the tank from sliding around. Cut notches in frame to provide clearance for the tank outlet and the *Switch* mounting nut and wires.**
10. **Locate a convenient spot on the vehicle chassis close to the *Water Tank* and drill a *3/32"* hole for the grounding ring terminal attachment for the *Tank Switch*. Using a clean rag and solvent, remove dirt and debris from around the hole. Remove the paint and/or rust from around the hole. Strip *1/2"* of insulation from end of one *Switch* wire; crimp large ring terminal onto wire. Do not attach terminal.**
11. **If, as recommended the *Water Pump* is installed within the *Engine* compartment, *High-Low Temp. Silicone Tubing* will be used to connect the *Tank* to the *Pump*. If the *Water Pump* is to be installed in the trunk area or farther away from the *Engine*, then the tube connecting the *Pump* to the *Check Valve* will be pressurized (up to *85 psi*) and *Silicone Braid Reinforced Tubing* must be used. If the *Pump* you are using is <u>NOT</u> self-priming, it <u>MUST</u> be installed near the *Tank.***
12. **Determine the length of tubing needed to reach from the *Pump* or *Water Tank* to the *Engine* compartment. If the *Pump* will be located within the *Engine* compartment, go to *Step #14*. If the *Pump* will be located in the trunk or rear of the vehicle, go to *Step #13.***
13. **Mount the *Pump* at the desired location in the trunk or the back of the car. Determine the length of tubing needed to attach the *Pump* to *Tank*. Cut *High-Low Temp. Tubing* to the required length and slide onto the *Tank* fitting. Secure tubing with two *(2)* small *Stainless Steel* hose clamps and tighten firmly. Slide the *Tank* into the wood frame you constructed to hold it in place. Slide two *(2)* small *Stainless Steel* hose clamps onto tubing coming from the *Tank* and slide the tubing onto the *Pump* inlet fitting. Slide hose clamps over the fitting and tighten firmly. Slide *Silicone Braid Tubing* onto the *Pump* outlet fitting. Slide two *(2) Stainless Steel* hose clamps over the fitting and tighten firmly.**
14. **Cut *High-Low Temp. Tubing* to the required length and slide the tubing onto the *Tank* fitting. Secure the tubing with two *(2)* small *Stainless Steel* hose clamps and tighten firmly. Slide *Tank* into wood frame.**
15. **Attach the *Tank* ring terminal to the *3/32"* hole in the chassis with a sheet metal screw. Apply a layer of *Petroleum Jelly* or *Grease* over the terminal and screw to prevent corrosion buildup.**
16. **Strip *1/2"* of insulation from the end of the remaining *Switch* wire and crimp a butt connector onto the wire. Determine the length of hookup wire needed to extend at least *3 Ft* into the *Engine* compartment and cut to length. Strip *1/2"* of insulation from the end of the hookup wire and crimp it to the butt connector. If the *Pump* is to be installed in the trunk or the rear of the vehicle, repeat this procedure to splice an equal length of hookup wire to each *Pump Power* lead.**
17. **Route the *Tank* and *Pump* wires and tubing thru the vehicle. Be sure to install a *3/4" ID Grommet* wherever an access hole must be drilled. Use *Tie-Wraps* about every *6"* to secure the wire and tubing bundle. Use caution to prevent crushing the tubing. Do not over tighten the *Tie-Wraps*.**
18. **Securely mount the *Water Pump* in the *Engine* compartment if the *Pump* is to be installed there. Slide two *(2)* small *Stainless Steel* hose clamps onto the *High-Low Temp. Tubing*. Install the tubing onto the *Pump* inlet fitting and tighten the hose clamps firmly.**

Control Module

Materials List:

The following items are available at *Radio Sack*. The *Part #'s* are *Radio Shack's.*

- **One *#LM471***
- **One *#NE555***
- **One *#CD4069***
- **One bank of four *(4) DIP* switches**
- **Bank of four *(4) Capacitors - .01u, .1u, .03u, 3300pf***

When purchasing these components, take the *Generator Electrode Circuit Schematic* with you and the person at *Radio Shack* will be able to help you with the various resistors and capacitors.

- **One *#NE555***
- **One *#CD4059A***
- **One *#2N3055***
- **One *#1N4007***

Again, take the *Generator Coil Circuit Schematic* with you to *Radio Shack*

- **One *#LM741***
- **One *#E3055T***

Again, take the *In-Dash Indicators Circuit Schematic* with you to *Radio Shack*

In addition the above components, you'll need:

- **One *Universal Component Board* (Radio Shack Part # 276-168).**
- **One *PC Board Kit* (Radio Shack Part # 267-1576).**
- **One *Enclosure 8" x 6" x 3"* (Radio Shack Part # 270-1809).**
- **Two 12-Position Male Interlocking Connectors (Radio Shack Part #274-232).**
- **Two 12-Position Female Interlocking Connectors (Radio Shack Part #274-242).**

NOTE: Since both the *Electrode Circuit (Figure #6)* and the *Coil Circuit (Figure #7)* operate at relatively low frequencies, physical layout of the *Control Module* components is not critical. Mount components using the *Universal Component Board*, or design and create your own *PC Board* layout using the *PC Board Kit* (even includes needed chemical solutions). The recommended *Enclosure* provides protection for the *Control* circuits and is easy to mount. The Electrode, Coil and *Indicator* circuits may be built on the same board or on separate boards, using the side-board mounting feature of the recommended *Enclosure.*

1. **Referring to *Figure #6,* build the *Electrode Circuit* using components as detailed.**
2. **Referring to *Figure #7,* build the *Coil Circuit* using components as detailed.**
3. **Referring to *Figure #8,* build the *Indicators Circuit* using components as detailed.**

NOTE: A hole must be drilled in the *Control Module* enclosure for routing wires to the *9-Position Indicators Panel Connector*. A second hole must also be drilled for routing wires to two *12-Position* connectors for all other system components. Be sure to install an appropriately sized *Grommet* in each hole.

4. **Drill a hole in the *Enclosure* and install a *3/8" ID Grommet*. Cut eight *(8) 1 Ft* lengths of hookup wire and strip *1/2"* of insulation from one end of each wire. Route one wire thru the *Grommet* and solder it to the *Control "Ground" (-)* bus See *Figure #6* and label the wire. Refer to the following *Figures* to solder the seven *(7)* remaining *LED* and *Bulb Socket* wires (be sure to label each wire).**
   - **PWR ON -- *Figure #6***
   - **All other LED's – *Figure #8***
   - **Positive (+) Bulb Socket center connector wire – *Figure #8***
5. **Cut the eight *(8)* wires to equal length and strip *1/4"* of insulation from the end of each wire. Connect the wires to the *9-Position Female Interlocking Connector*. Be sure the wire label at each position corresponds to the wire label at each position of the *9-Position Male Interlocking Connector*. After connecting the wires, secure the wires with a *Tie-Wrap* placed every *3"* along the length of the bundle.**

6. **Drill another hole in the enclosure and install a *1/2" ID Grommet*. Cut nineteen *(19) 1*-foot lengths of hookup wire, strip *1/2"* of insulation from one end of each wire. Solder two *(2)* wires to the appropriate terminals for the *Generator Electrodes (Figure #6),* two *(2)* wires to the appropriate terminals for the *Generator Coil (Figure #7),* one *(1)* wire to the appropriate terminal of the *Pump Circuit (Figure #8),* one *(1)* wire to the appropriate terminal for the *Generator Water Level Switch (Figure #8)*. Solder five *(5)* wires before the fuse connection (battery + side of the power bus, see *Figure #6*) and five *(5)* wires to the negative (-) bus, Solder one *(1)* wire to the *Throttle 10K Resistor (Figure #6)*. Solder two *(2)* wires to the *Tank Water Level Switch (Figure #8)*. Be sure to carefully label all wires.**
7. **Cut the nineteen *(19)* wires to equal length and strip *1/4"* of insulation from the end of each wire. Connect nine *(9)* of the wires to a *12-Position Male Interlocking Connector*. Connect the remaining wires to a *12-Position Female Interlocking Connector*. Secure the wires with a tie-wrap placed about every *3"* along its length.**
8. **Close the enclosure. Attach the *Control Module* under the dash panel and as far forward as practical. Connect the 9-*Position Interlocking Connectors* of the *Module* and the *In-Dash Indicators*.**

NOTE: Two of the connectors are to provide extra positions for future expansion, modifications and design improvements. Be sure to use a *12-Position Male Interlocking Connector* and a *12-Position Female Interlocking Connector* to prevent accidental connections.

Carburetor Adapter

NOTE: Since hundreds of various *Carburetors* exist, we recommend contacting *Impco* to purchase the *Carburetor Adapter*. They deal almost exclusively in gasoline engine fuel conversion systems. They have literally thousands of options available and have been in this business for about *50* years. Describe your vehicles' engine and the *Hydro-Gen System* and ask for their recommendations. In particular, inquire about the possibility of installing a *Beam – Garretson Carburetor Adapter*. Be sure to tell them that this *System* is designed for switching back and forth between *Hydrogen Fuel* and *Gasoline Fuel*.

Material Supplier:

Impco Technologies
16804 Gridley Place
Cerritos, CA 90703
Phone: 1-562-860-6666
FAX: 1-562-860-3088

Throttle Assembly

NOTE: The *Control Throttle* uses a high quality precision potentiometer for reliability and durability. DO NOT substitute a cheaper potentiometer, they may and probably will soon fail or cause problems.

List of Materials:

- **One *Precision Potentiometer, Series 578, 100K* (Clarostat Part # 578 X 1 G 32 P 104 SW).**
- **One *1 Foot* length *CPVC Rod, 3/4" diameter* (US Plastic Part # 43182).**

Material Suppliers:

State Electronics
36 Route 10
East Hanover, NJ 07936
Phone: 1-800-631-8083
FAX: 1-973-887-1940

United States Plastic Corp.
1390 Neubrecht Rd.
Lima, OH 45801-3196
Phone: 1-800-537-9724 (7:30am – 7pm,EST Mon-Fri)
FAX: 1-800-854-5498 (24/7)

NOTE: ***Figure #21*** **depicts a typical throttle assembly. Since hundreds of various throttle linkages are in use, the following setup is offered as a general guideline. The *Potentiometer* mounting bracket is designed to allow *Pot. Centering* (rotating its housing) and precise adjustment of throttle sensitivity (bracket rotation). The throttle linkage sleeve allows precise *Pot. Rotation* limit adjustments (idle to full throttle) when combined with bracket rotation.**

1. **Determine the best location on the engine near the throttle linkage for installing the *Sleeve* and *Arm* assembly and *Pot. Mounting* bracket.**
2. **Fabricate a *Pot. Mounting* bracket with dimensions shown in *Figure #21* from *1/8" CPVC* sheet. If necessary, modify the bracket size and attachment points to suit your vehicle. DO NOT cut the *3/32"* slot until instructed to do so.**
3. **Cut a *1-1/2"* length of *3/4"* dia. *CPVC* rod. Measure the diameter of the existing throttle linkage rod. Drill a hole lengthwise thru the *CPVC* rod to the diameter of the existing throttle linkage rod. Using a thin blade saw, cut the rod in half lengthwise. Using a belt sander, sand a flat surface at least *1/4"* wide onto the outside of one rod half.**
4. **Cut a *1/2" x 1-1/4"* sleeve arm from *1/8" CPVC* sheet. Drill a *7/64"* hole in one end of the arm about *1/4"* from the end. Using a larger drill, bevel each end of the hole about *1/16"* deep. Apply primer and then cement to the mating surfaces of the sleeve arm and the *3/4"* dia. rod half with the sanded surface. Allow the parts to air dry for at least *2* hours and then smooth the cut edges of all parts with fine sandpaper.**
5. **Referring to *Figure #6,* position the shaft of the *100K Throttle Potentiometer (Pot.)* at the midpoint of its range of rotation. Using a marking pen, put an alignment line between the *Pot*, shaft and the bushing at the point shown in *Figure #21*. Using a *#41* drill bit, drill a hole in the shaft at a point in line with the shaft alignment mark and *3/16"* in from the shaft end.**
6. **Temporarily install the *Pot.* Into the *3/8"* hole in the mounting bracket. Cut a *6"* length of *3/32" Stainless Steel Welding Rod* and slide the rod into the hole drilled into the shaft. Align the shaft and bushing marks and rotate the *Pot. Body* so that the rod points upward (parallel with the front edge of the bracket. Place a mark at the point where the anti-rotation pin contacts the bracket. Remove the *Pot.* and rod from the bracket. As shown in *Figure #21,* cut a curved *3/32"* wide slot extending *1/4"* from each side of the marked point. Temporarily install the *Pot.* onto the bracket and check that the anti-rotation pin fits into the slot and moves freely as the *Pot. Body* is rotated. If necessary, file the slot with a small fine tooth file, and clean the edges with fine sandpaper.**
7. **Attach the *Pot*. To the bracket with the furnished nut and lock washer. Temporarily install the rod into the shaft hole. Rotate the *Pot. Body* to align the rod parallel with the front edge of the bracket and firmly tighten the mounting nut. Using a file, square off both ends of the rod and deburr with a fine file. Using *MEK* or *Acetone* clean the *Pot* shaft and rod with a soft clean cloth. Flush the hole in the shaft with *MEK* or *Acetone.***
8. **Mix a small quantity of *Epoxy (J_B WELD)*. Using a toothpick, coat the shaft hole with a thin layer of *Epoxy*. Apply a thin layer of *Epoxy* to one end of the rod and insert it into the shaft hole, allowing it to extend about *1/8"* beyond the end of the hole. Form a small fillet of *Epoxy* around the junction of the rod and shaft at both sides of the shaft. Allow *Epoxy* to cure for *24* hours before continuing.**
9. **Referring to *Figure #21,* attach the sleeve and arm assembly to the *Throttle Linkage* using a small hose clamp at each end. Locate the *Pot*. Directly below the arm with the rod protruding thru the hole in the arm. Position the bracket fore or aft and sideways until the rod is square with the sleeve arm and parallel with the front edge of the bracket when the *Throttle Linkage* is approximately at its midpoint of travel. Position the bracket up or down until the rod rotates thru an angle of approximately *60* degrees each side of center as the *Throttle Linkage* moves thru its full range.**
10. **Using two *(2) 1/4"* bolts, washers, and locknuts, attach the bracket to the *Engine* structure. Here is where you need to adapt the mounting procedure and even possibly the mounting bracket. All engines and carburetors are different so it's impossible to make just one generic mount to fit all applications. Position the bolt in the slot at approximately the midpoint of the slot to allow the *Pot*. to move up or down for precise adjustment. Loosen the bolts slightly and pivot the bracket up and down. Check that the bolt does not bind in the slot at any point. If necessary, file the slot with a fine tooth file until the *Pot* body rotates freely. Clean up the slot with fine sandpaper.**

11. **Check that the *Pot. Rod* does not bind in the arms hole as the *Throttle Linkage* is moved thru its full range of travel. If necessary to eliminate binding, rotate the *Pot.* slightly up or down and/or slide the sleeve assembly fore or aft. Firmly tighten the bracket bolts and sleeve hose clamps.**

Preliminary Assembly and Testing

CAUTION: DO NOT ATTEMPT TO SOLDER WIRES DIRECTLY TO THE FOUR GENERATOR ELECTRODE AND COIL PINS. EXCESS HEAT WILL DAMAGE THE EPOXY BOND, POSSIBLY CAUSING WATER AND/OR GAS LEAKAGE.

1. **Install a male crimp on snap connector on each of the four *Electrode* and *Coil* pins of the *Generator.* Securely install the *Generator* in the *Engine* compartment using *1/4"* bolts, washers and locknuts. Be sure the *Generator* is level with the vehicle frame. If the *Water Pump* is installed in the trunk or rear of the vehicle, go to *Step #3*. If the *Water pump* is installed in the *Engine* compartment, go to *Step #2*.**
2. **Cut a length of *Silicone Braid Tubing* to connect the *Water Pump* outlet to the *3/8"* fitting on the side of the *Generator Housing* near the bottom. Allow some slack in the tubing.**
3. **If the *Water Pump* has an internal check valve, slide two *(2)* small hose clamps onto the water tubing and install onto the *3/8"* barb fitting in the side of the *Generator Housing* near the bottom. Allow some slack in the tubing and firmly tighten the clamps. If the *Pump* does not have an internal check valve, install a check valve in the tubing a few inches from the barb fitting in the side of the *Generator*. Allow some slack in the tubing. Use two *(2)* small hose clamps on each barb fitting and tighten firmly. Be sure to install the check valve so that the flow direction arrow on the valve points toward the *Generator.***
4. **Cut two *(2) 3"* lengths of braid tubing and attach them to each end of a check valve with small hose clamps. Tighten the clamps firmly. Using two *(2)* small hose clamps, attach a valve hose to the *Carb* Adapter on the *Engine* with the valve arrow pointing toward the adapter. Tighten the clamps firmly.**
5. **Using two *(2)* hose clamps, attach the *Flame Arrestor* to the check valve hose. Tighten the clamps firmly. Cut a length of *Silicone Braid Tubing* to connect the *3/8"* barb fitting on top of the *Generator* to the *Flame Arrestor*. Slide four *(4)* small hose clamps onto the tubing and connect the tubing between the *Generator* and *Flame Arrestor*. Allow some slack in the tubing and tighten the clamps firmly.**
6. **Using two *(2)* small hose clamps, attach the *Pressure Gauge Tubing* to the *1/8"* fitting on top of the *Generator*. Allow some slack in the tubing and tighten the clamps firmly.**
7. **Cut four *(4) 5-Ft* lengths of hookup wire and strip *1/2"* of insulation from one end of each wire. Twist the stranded ends of two *(2)* wires together and trim the ends to a length of *3/8"*. Crimp a ring terminal to the spliced wires and attach the terminal to the *Control Power Switch*. Repeat the procedure for the other two wires. Mount the *Switch* at a convenient point on the dash. Route one pair of *Switch* wires to the vehicle positive (+) power bus that is always *"hot"* (the battery side of the bus is shown in *Figure #6*. Cut the wires to length and strip *1/2"* of insulation from the wire ends. Twist the wires together, trim to *3/8"* and crimp a ring terminal to the wire ends. DO NOT attach the terminal, or any other connector to the bus until instructed to do so.**
8. **Cut two *(2) 5-Ft* lengths of hookup wire and splice together with a ring terminal as was done in *Step #7.* Locate a convenient spot in the *Engine* compartment to attach the ring terminal to the vehicle chassis. Drill a *3/32"* hole at that location and attach the terminal and coat the terminal with *Petroleum Jelly* or *Grease* to prevent corrosion.**
9. **Route the two *(2)* wires thru the *Grommet* installed in the *Engine* compartment firewall. Allowing slack in the wires, cut the wires to length to reach the two *12-position* connectors of the *Control Module*. Trim *1/4"* of insulation from the end of each wire and connect each wire to a negative (-) bus position of either of the *12 – Position Interlocking Connectors* (see *Step #6 in the Control Module section).***
10. **Route the remaining pair of *Switch* wires to the connectors and cut the wires to length, allowing some slack in the wires. Connect the wires to the connectors at two of the battery positive (+) power bus positions in the same manner as was done in *Step #9.***
11. **Cut four *(4)* wires of appropriate length to connect the *Generator Coil* and *Electrode* pins to the connectors. Strip *1/4"* of insulation from each wire end and install a female crimp-on snap connector to each wire. Attach the connectors to the *Generator* terminals. Route the wires to the *Control Module* connectors and cut the wire ends to equal length. Strip *1/4"* of insulation from each wire end and connect each wire to the appropriate position of the *Control Module* connectors.**

12. **Referring to *Figure #8*, connect the *Tank Water Level* and *Generator Water Level Switch* wires to the appropriate positions of the *Control Module* connectors. Using butt connectors, splice hookup wire to the *Switch* wires as required to reach the *Control Module* connectors.**
13. **Cut two *(2)* lengths of hookup wire to connect the *Throttle Pot*. to the *Control Module* connectors. Strip *1/4"* of insulation from one end of each wire and solder each wire to the *Pot*. Terminals. Slide a *1"* length of heat shrink tubing onto each wire and over the soldered terminals and shrink the tubing.**
14. **Route the *Pot. Leads* to the *Control Module* connectors and cut their ends to equal length. Strip *1/4"* of insulation from the end of each wire. Connect one *Pot. Lead* to a battery positive (+) power bus connector position. Connect the other lead to the connector position leading to the *10K resistor* lead (see *Figure #6*). Rotate the *Pot. Shaft* to its midpoint position.**

<u>CAUTION:</u> DO NOT CONNECT THE WATER PUMP LEADS, OR ADD WATER TO THE TANK UNTIL INSTRUCTED TO DO SO IN STEP#1 IN THE NEXT SECTION (<u>*Final Assembly and Testing*</u>).

15. **Using an *Ohmmeter*, verify that the *Control Module Power Switch* is in the *OFF* position. If not, place the *Switch* in the *OFF* position.**
16. **Connect the *Switch* ring terminal to the battery positive (+) power bus.**

<u>CAUTION:</u> <u>POWER WILL BE APPLIED TO THE *"Hydro-Gen System"* IN STEP #18. ANY INCORRECT ELECTRICAL OR ELECTRONIC CONNECTION CAN LEAD TO SYSTEM OR COMPONENT FAILURE AND/OR DAMAGE. BE SURE TO DOUBLE-CHECK ALL ELECTRICAL AND ELECTRONIC CONNECTIONS BEFORE APPLYING POWER.</u>

17. **After double-checking all electrical and electronic connections of the *Hydro-Gen System*, correct any connection errors as required. Connect the two *(2) 12 – Position Interlocking Connectors* of the *Control Module* to the matching system connectors. Verify that all system connectors are properly engaged. If still in place, remove the *Control Module* enclosure cover.**

<u>CAUTION: DO NOT ATTEMPT TO START THE ENGINE UNTIL INSTRUCTED TO DO SO. THIS IS A PRELIMINARY TEST TO VERIFY BASIC SYSTEM FUNCTIONING. IF ANY PROBLEM EXISTS</u>, SHUT <u>OFF POWER IMMEDIATELY</u>.

18. **Immediately after applying power, check for the following system responses in the order noted. If any problem exists, shut the power OFF immediately.**
    - ***<u>NO</u>* smoke and/or electrical sparking**
    - ***<u>NO</u>* electrical overheating of any system component.**
    - **On the *Indicator Panel*, check that the *LED's* function as follows:**
        1. ***"PWR ON", "PUMP ON"* and *"GEN WATER LOW" LED's* are lit.**
        2. ***"TANK WATER LOW" LED* is blinking.**
    - **On the *Indicator Panel*, check that the *Gauge* lights are lit.**

    Place the *Hydro-Gen Power Switch* to the *ON* position. Verify that no problem exists. If a problem exists, turn power *OFF* immediately.
19. **If no problem exists, go to *Step #20*. If a problem exists, troubleshoot to locate and repair (or replace) the failed component. After replacement or repair go back to *Step #18.***
20. **Using your fingers as heat sensors, check that no system component is overheating. If *NO* overheating, go to *Step #21*. If there is overheating, turn power *OFF* and go back to *Step #19.***
21. **Check that the vehicle gas pedal is in the full idle position. Connect a *Digital Voltmeter* to pin *#6* of amplifier *LM741* (refer to *Figure #6*) and record the voltage level. If voltage is present, go to *Step #22*. If no voltage exists, a component is defective and must be replaced. After replacing the component, go back to *Step #18.***

<u>NOTE:</u> As the gas pedal is moved from idle to full power, the voltage level at pin *#6* of amplifier *LM741* should increase slightly. Expect an increase of approximately *1 VDC to 4 VDC.*

22. **Move the gas pedal to full power. Record the voltage at pin *#6*. Compare the voltage with that recorded in *Step #21*. If the voltage level has increased by at least *1 VDC*, go to *Step #23*. If the voltage level has not changed at all, a component is defective and must be replaced. After replacing the component, go back to *Step #21.***
23. **Rotate the *20K "Throttle Adjust" Pot.* From stop to stop. Verify that voltage at pin *#6* varies as the *Pot.* is rotated. If voltage varies, go to *Step #24*. If voltage does not vary, a component is defective and must be replaced. After replacing the component, repeat this procedure.**
24. **Set the *"Throttle Adjust" Pot*. To its midpoint of rotation.**

NOTE: The NE555 controller creates a highly stable square wave pulse. As the gas pedal is moved toward full power, the input voltage to the controller from the *LM741* amplifier increases, increasing the pulse width ratio of the controller square wave output at pin *#3.*

25. **Connect an *Oscilloscope* lead to pin *#3* of the *NE555* controller. Verify that a square wave pulse exists and that the pulse width ratio increases as the gas pedal is moved from full idle to full power. If a square wave exists and the pulse ratio increases, go to *Step #26*. If a pulse does not exist or the ratio does not increase as the gas pedal is moved, a component is defective and must be replaced. After replacing the component, repeat this procedure.**
26. **Rotate the *2K "Pulse Width Adjust" Trim Pot*. from stop to stop. Verify that the pulse width changes as the *Pot.* is rotated. If the pulse width changes, go to *Step #27*. If the pulse width does not change, a component is defective and must be replaced. After replacing the component, repeat this procedure.**
27. **Set the *2K Trim Pot*. to its midpoint of rotation.**

<u>NOTE:</u> The frequency of the square wave pulse falls in the range of *15KHz to 20KHz*. The *Trigger Oscillator Circuit* provides variable frequency input pulses to the *NE555* controller in response to adjustment to the *2K Trim Pot.* and *DIP Switch* settings.

28. **Connect the *Oscilloscope* lead to pin *#3* of the *NE555* controller. Verify that the square wave frequency changes as the *Oscillator 2K Pot*. is rotated. If the frequency changes, go to *Step #29*. If the frequency does not change, a component is defective and must be replaced. After replacing the component, repeat this procedure.**
29. **Set the *Oscillator Pot*. to its midpoint of rotation.**

<u>NOTE:</u> Referring to *Figure #7*, the frequency of the *Coil Circuit* is controlled by the *CD4059A Divide by N Counter*, and falls in the range of *15Hz to 20Hz*. Input to the *Counter* is received from the *Electrode Circuit (Figure #6)*. When the frequency of the *Electrode Circuit* is changed, the frequency of the *Coil Circuit* changes accordingly. The *Coil Circuit* is adjusted with the *10K "Pulse Width Adjust" Pot.*

30. **Connect an *Oscilloscope* lead to pin *#8* of the *NE555* controller. Rotate the *"Pulse Width Adjust" Pot.* from stop to stop. Verify that the pulse width changes as the *Pot*. is rotated. If the pulse width changes, go to *Step #31*. If the pulse width does not change, a component is defective and must be replaced. After replacing the component, repeat this *Step.***
31. **Set the "Pulse Width Adjust" Pot. to its midpoint of rotation.**
32. **Connect a *Digital Voltmeter* lead to pin *#8* of the NE555 controller. Rotate the *10K "Strength Adjust" Pot* from stop to stop. Verify that the voltage level changes as the *Pot*. is rotated. If the voltage level changes, go to *Step #33*. If the voltage level does not change, a component is defective and must be replaced. After replacing the component, repeat this *Step.***
33. **Set the *"Strength Adjust" Pot*. to its midpoint of rotation.**
34. **Referring to *Figure #6*, set the *DIP Switches* according to *Oscillator CD4069* manufacturer instructions to obtain a frequency between *15KHz and 20KHz*. Connect an *Oscilloscope* or *Frequency Meter* lead to pin *#6* of *Oscillator CD4069*. Verify that the *Oscillator* frequency is between *15KHz and 20KHz*. If the frequency is not between *15KHz and 20KHz*, adjust the *2K "Frequency Adjust" Pot*. To obtain a frequency within that range. If the correct frequency cannot be obtained, there is a defective component (most likely *CD4069*) in the *Oscillator Circuit*. Locate and replace the defective component and return to this *Step*. If the correct frequency is obtained, go to Step #35.**
35. **Referring to *Figure #7*, and using an *Oscilloscope* or *Frequency Meter*, verify that the frequency of the pulse appearing at the *Collector* of component *2N3055* is from *15 Hz and 20 Hz*. If the frequency is within that range, go to *Step #37*. If the frequency is not within that range, go to *Step #36***
36. **Set the *"Divide by N" Counter* for an *"N"* factor of *1,000* according to the manufacturers instructions. Verify a frequency of *15Hz to 20Hz* at the *Collector* of component *2N3055*. If the frequency is within that range, go to *Step #37*. If the frequency is not within that range, a component is defective and must be replaced. After replacing the component, go back to *Step #35.***
37. **Shut the power *OFF*.**

<u>Cylinder Head Temperature</u>

<u>NOTE:</u> Hydrogen burns slightly hotter than gasoline, so you should expect slightly higher *Cylinder Head Temperature (CHT)*. You must first establish *CHT* reference points by driving first on gasoline. The *Hydro-Gen* uses a very high quality fast-response *CHT* gauge, sensing *CHT* directly from the base of a sparkplug.

1. **Drive your vehicle for at least *15 minutes (30 minutes* in cold weather) on open highway to assure that the engine is up to normal operating temperature. Record *CHT (in degrees Fahrenheit)* under each of the following driving conditions:**
   - **Parked at idle, transmission in neutral, for three *(3)* minutes.**
   - ***25 MPH* in residential areas for at *least two minutes.***
   - ***60 MPH* (or close to full power) on a steep grade for *at least 30 seconds.***

Final Assembly and Testing

1. **If the *Water Pump* is installed in the trunk or in the rear of the vehicle, splice a hookup wire to its positive (+) power lead with a butt connector and connect it to a battery positive (+) power bus connector position. If the *Pump* is installed in the *Engine* compartment, connect it to a battery positive (+) power bus connector position. In like manner, connect the *Pump* negative (-) power lead to connector position leading to *Collector* lead of *E3055T Switch* as shown in *Figure #8.***
2. **Fill the *Tank* with *Water.* Check that there are no water leaks from the *Tank* or any of the fittings. If necessary, correct or repair any leaks.**

NOTE: Your vehicle is now ready to run on *Water* for the first time with the *Hydro-Gen System*. For *Initial Operation,* it's best that the *Engine* is already warmed up to normal operating temperature. Running the *Engine* on gasoline for about *15 minutes* is usually sufficient.

3. **Park your vehicle on a level surface with the parking brake engaged and transmission in neutral. Open the trunk lid or the engine hood, depending on where your *Hydro-Gen Water Pump* is located.**
4. **Following manufacturers' instructions set the *Carburetor Adapter* for *Hydrogen* operation.**

CAUTION; CLOSELY MONITOR THE PRESSURE GAUGE. IF GENERATOR GAS PRESSURE EXCEEDS 70 PSI, SHUT POWER OFF IMMEDIATELY. AS A SAFETY PRECAUTION, PRESSURE EXCEEDING 85 PSI IS VENTED BY THE PRESSURE RELIEF VALVE. DO NOT DEPEND ON THE RELIEF VALVE TO RELIEVE EXCESS PRESSURE. IF ANY SYSTEM PROBLEM EXISTS, SHUT OFF POWER IMMEDIATELY.

NOTE: At idle, *Gas Pressure* should be in the range of *12 PSI to 28 PSI*. At full power, about *28 PSI to 62 PSI*.

5. **Referring to *Figures #6 and #7,* set the *"Throttle Adjust", "Pulse Width Adjust",* (one in each circuit), *"Frequency Adjust",* and *"Strength Adjust" Pots*. To their midpoint of rotation. Immediately after applying power, check for the possibility of any of the following problems. If any problem exists, immediately shut *OFF* power:**
   - **Smoke and/or electrical sparking.**
   - **Generator pressure exceeds *70 PSI.***
   - **Electrical overheating of any system components.**
   - **Gas and/or Water leakage from the *Generator.***
   - **Water leakage from any tubing, fittings or other components.**

   Turn power *ON*. Wait for *Generator* pressure to reach at least *25 PSI*. When pressure reaches *25 PSI, START YOUR ENGINE*. Run the *Engine* at idle speed until instructed to do otherwise. If *Generator* pressure will not reach at least *25 PSI*, go to *Step #7*. Check that none of the problems mentioned in *Step #5* exist. If any exist, immediately shut power *OFF* and go to *Step #6,* if no problems go to *Step #7.*
6. **Verify that the power is *OFF*. A system component has either failed or is defective. Troubleshoot to locate the component, go thru the testing procedures we outlined in the previous section *(Preliminary Assembly and Testing)* to locate the problem. Repair or replace the component and go back to *Step #5***
7. **Shut power *OFF*. Obtain a small bucket or large container. Open the *Generator Drain Cock* and drain until empty. Close the *Drain Cock*. If no water is drained, go to *Step #8*. If at least some water drained, go to *Step #14*.**
8. **Turn power *ON*. Verify that the *Water Pump* runs. If the *Pump* runs, go to *Step #9*. If the *Pump* does not run, turn power *OFF* and go to *Step #25.***
9. **Verify that water is reaching the *Pump* inlet. If water reaches the inlet, go to *Step #13*. If water does not reach the inlet, go to *Step #10*.**
10. **Disconnect the tubing from the *Pump* outlet. Verify that water now reaches the *Pump* inlet. If it does, go to *Step #12.* If not, go to *Step #11*.**

11. **Turn power *OFF*. Check for restrictions in the tubing leading to the *Pump* inlet. If a restriction is located, repair as required, reconnect tubing and go back to *Step #5*. If there is no restriction, then the *Pump* is defective and must be replaced or repaired. After replacing the *Pump*, go back to *Step #5.***
12. **Verify that water is flowing from the *Pump* outlet and turn power *OFF*. If water was flowing, the *Check Valve* is either defective or installed backwards. Replace the *Valve* or reinstall correctly with the *Arrow* pointing towards the *Generator*, reconnect the tubing and go back to *Step #5*. If water was not flowing, the *Pump* is defective and must be repaired or replaced. After repair, go back to *Step #5.***
13. **Disconnect the tubing from the *Pump* outlet. Verify that water now flows from the *Pump* outlet and turn power *OFF*. If water was not flowing, the *Check Valve* is either defective or installed incorrectly. Replace or repair the *Valve.* Be sure the *Arrow* on the *Valve* points towards the *Generator* and go back to *Step #5*. If water was not flowing, the *Pump* is defective and must be replaced or repaired. After repair or replacement go back to *Step #5.***
14. **Turn power *ON*. Verify that there is no water present in the tubing leading from the *Generator* to the *Flame Arrestor*. Turn power *OFF*. If water was present, go to *Step #15*. If water was not present, go to *Step #17.***
15. **Refer to *Figure #8*. Cut the *Generator Water Level Switch* wire connected to the *Control Module* positive (+) power bus within *6"* of the *Generator*. Strip *1/4"* from each end of the cut lead. Connect an *Ohmmeter* lead to the wire exiting the *Generator* and the lead to the vehicle ground (-). Verify that the *Ohmmeter* indicates that the *Switch* contacts are open. If the *Switch* contacts are open, go to *Step #16*. If the *Switch* contacts are closed, the *Switch Slosh Shield* has been incorrectly installed. Referring to *Step #9* in the section titled *"Water Level Switch Test"* remove the *Slosh Shield* and reinstall it. Be sure the *Shield* is accurately centered around the *Switch Float*. Reconnect the *Switch* wires with a butt connector and go back to *Step #5.***
16. **Reconnect the *Switch* wires with a butt connector. A defective component exists in the *Pump Control Circuit.* Replace the defective component and go back to *Step #5.***
17. **Verify that the *Check Valve* in the tubing leading to the *Engine* is installed with the flow *Arrow* pointing toward the *Engine*. If the *Check Valve* is installed correctly, go to *Step #18*. If the *Check Valve* is not installed correctly, remove it, install it correctly and then go back to *Step #5.***
18. **Set the water container on a level surface, mark the water level on the side of the container, and dispose of the water. Close the *Generator Drain Cock.***
19. **Disconnect the gas outlet hose from the top of the *Generator*. Turn the power *ON*, wait for the *Water Pump* to stop running, and shut power *OFF*. Open the *Drain Cock* and drain the water into the container until the *Generator* is empty. Close the *Drain Cock*. Check the water level and dispose of the water. If the water level was higher than the level marked in *Step #18*, go to *Step #20*. If the water level was about the same, go to *Step #26*.**
20. **Reconnect the tubing and disconnect the tubing from the *Carburetor Adapter*. Turn power *ON*, wait for the *Water Pump* to stop running and shut power *OFF*. Open the *Drain Cock* and drain water into the container until the *Generator* is empty. Close the *Drain Cock*. Check the water level and dispose of the water. If the water level was higher than the level marked in *Step #18*, go to *Step #21*. If the water level was about the same, go to *Step #22*.**
21. **The *Carburetor Adapter* (associated parts) is either defective or requires adjustment. Following the manufacturers' instructions, either adjust the *Adapter* or return it to the manufacturer for adjustment or repair. After adjustment or repair, reconnect the tubing and go back to *Step #5*.**
22. **Reconnect the tubing and disconnect the tubing between the *Flame Arrestor* and *Check Valve*. Turn the power *ON*, wait for the *Water Pump* to stop running and shut power *OFF*. Open the *Drain Cock* and drain the water into the container until the *Generator* is empty. Close the *Drain Cock*. Check the water level and dispose of the water. If the water level was higher than the level marked in *Step #18*, go to *Step #23*. If the water level was about the same, go to *Step #24.***
23. **The *Check Valve* is defective. Replace the *Valve*, reconnect the tubing and go back to *Step #5.***
24. **The *Flame Arrestor* has been constructed incorrectly. Remove the *Flame Arrestor* from the tubing, remove its fittings and dispose of the *Flame Arrestor*. Return to the *"Flame Arrestor"* procedure and following the instructions; construct a new *Flame Arrestor*, being more careful and exacting.**
    Allow the *CPVC* cement to air dry for at least *24* hours. Apply a thin coating of pipe joint compound to the tapped threads in the ends of the *Flame Arrestor* and the fittings. Thread the fittings into the new *Flame Arrestor* and tighten firmly. Install the new *Flame Arrestor* into the tubing and go back to *Step #5*

25. **Turn power *OFF*. The most likely candidate for *Pump* failure is the *Pump* itself. Cut the *Pump* negative (-) bus wire and check *Pump* operation while disconnected from the *Control Module*. If the *Pump* still does not run, or draws current in excess of *15 amps* during start up, repair or replace the *Pump.* Reconnect the new *Pump* wires using butt connectors. <u>BEFORE</u> you replace the *Pump*, you might also want to check to see if you blew the main fuse (see *Figure #6*). If, by chance the fuse has blown, replace it and recheck the *Pump*. Then go back to *Step #5***

    If the *Pump* operates normally, reconnect the wire with a butt connector. Check to verify that the *E3055T Switch* (refer to *Figure #8*) has not failed due to *Pump* current overload. If the *Switch* has failed, replace it with a *Switch* of higher current capacity and go back to *Step #5*. If the *Switch* has not failed, cut the *Generator Water Level Switch* wire connected to the *Control Module* positive (+) power bus within about *6"* of the *Generator.* Strip *1/4"* from each end of the cut lead. Connect an *Ohmmeter* lead to the wire exiting the *Generator* and the other lead to vehicle ground (-).

    Verify that the *Ohmmeter* indicates that the *Switch* contacts are closed. If the *Switch* contacts are closed, either the *Pump* is defective or a *Pump Circuit* component is defective (refer to *Figure #8*) or wiring errors exist. Troubleshoot to locate the problem and repair or replace as necessary. After correcting the problem go back to *Step #5*

    If the *Switch* contacts are open, the *Switch Slosh Shield* has been installed incorrectly. Referring to *Step #9* in the section titled *"Water Level Switch Test"*, remove the *Slosh Shield* and reinstall it, being very careful to accurately center the *Slosh Shield* around the *Switch Float*. Reconnect the *Switch* wires with a butt connector and go back to *Step #5.*
26. **Verify that no water is present in the tubing leading from the *Generator* to the *Flame Arrestor*. If water is present, turn the power *OFF* and go back to *Step #15*. If water is not present, read the following notes before going on to *Step #27.***

<u>NOTE:</u> The *Hydro-Gen System* is designed to operate well over a wide range of different electronic settings and adjustments. It is tolerant of just about anything short of gross adjustment errors. However, since each Engine has unique requirements, obtaining *Optimal* performance is mostly a matter of making simple trial and error adjustments.

Here are some general guidelines for gaining *Optimal* performance by the very effective method known as <u>*"tweaking".*</u>

- **At idle, *Generator* pressure should be *12 PSI to 28 PSI*.**
- **At full power, *Generator* pressure should be *28 PSI to 62 PSI.***
- **For each driving or idle condition, be sure *CHT* never exceeds *40* degrees more than the values recorded in *Step #1.***
- **Be sure *CHT* never exceeds *400 degrees*.**

<u>NOTE:</u> *Tweaking* the *Hydro-Gen System* is easier, safer and faster if another person drives while you Tweak.

27. **Park your vehicle with the *Engine* at idle, transmission in neutral, and parking brake set. Wait until the *Generator* pressure stabilizes and go to *Step #30.***
28. **Drive your vehicle at *25 MPH* in a residential area. If the *"Frequency Adjust" Pot*. is rotated *CW* to increase *Generator* pressure, go to *Step #30*. If the *"Frequency Adjust" Pot*. is rotated *CCW* to increase *Generator* pressure, go to *Step #37.***
29. **Drive your vehicle at *60 MPH* (or full power) on a steep grade. If the *"Frequency Adjust" Pot*. is rotated *CW* to increase *Generator* pressure, go to *Step #30*. If the *"Frequency Adjust" Pot*. is rotated *CCW* to increase *Generator* pressure, go to *Step #37.***
30. **Referring to *Figure #6*, rotate the *"Frequency Adjust" Trim Pot*. fully *(CCW)*. Slowly rotate clockwise *(CW)*. If *Generator* pressure starts to increase before rotating about *90%* of total rotation, go to *Step #31*. If pressure does not increase, go to *Step #37*.**
31. **Rotate slowly *CW* until pressure stops increasing. Rotate an additional *10* degrees. Wait until pressure stabilizes and record pressure. Slowly rotate *CCW* until pressure starts to drop.**

    Slowly rotate *CW* until pressure increases to the recorded value. Record that the *"Frequency Adjust" Pot*. is rotated *CW* to increase pressure. If your *Hydro-Gen* is being tuned while idling, go to *Step #32*. If your *Hydro-Gen* is being tuned while driving, go to *Step #43*.
32. **Rotate the *"Pulse Width Adjust" Trim Pot*. fully *CCW*. Slowly rotate *CW*. If pressure starts to increase before rotating about *90%* of total rotation, go to *Step #33*. If pressure does not increase, go to *Step #39*.**

33. **Rotate slowly *CW* until pressure stops increasing. Rotate an additional *10* degrees. Wait until pressure stabilizes and record pressure. Slowly rotate *CCW* until pressure starts to drop. Slowly rotate *CW* until pressure increases to the recorded value. Record that the *"Pulse Width Adjust Pot.* is rotated *CW* to increase pressure. Go to *Step #34.***
34. **If you are *Tweaking* your *Hydro-Gen* with the *Engine* at idle, go to *Step #35*. If you are *Tweaking* your *Hydro-Gen* while driving, go to *Step #36.***
35. **Refer to *Figure #21*. If necessary, adjust *Engine* idle speed by loosening the hose clamps and sliding the arm and sleeve assembly either fore or aft *(Throttle Assembly)*. Tighten hose clamps firmly. If pressure exceeds *28 PSI*, go to *Step #41.* If pressure is *28 PSI* or less, go back to *Step #28*.**
36. **If pressure exceeds *62 PSI*, go to *Step #42*. If pressure is *62 PSI* or less, go to *Step #44*.**
37. **Rotate the *"Frequency Adjust" Pot*. fully *CW*. Slowly rotate *CCW*. If pressure starts to increase before rotating about *90%* of total rotation, go to *Step #38*. If pressure does not increase, rotate the *Pot. CW* so its midpoint and go back to *Step #32*.**
38. **Rotate slowly *CCW* until pressure stops increasing. Rotate an additional *10* degrees. Wait until pressure stabilizes and record the pressure. Slowly rotate *CW* until pressure starts to drop. Slowly rotate *CCW* until pressure increases to the recorded pressure. Record that the *"Frequency Adjust" Pot*. is rotated *CCW* to increase pressure. If your *Hydro-Gen* is being tuned while idling, go back to *Step #32.* If your *Hydro-Gen* is being tuned while driving, go to *Step #43.***
39. **Rotate the *"Pulse Width Adjust" Pot*. fully *CW*. Slowly rotate *CCW*. If pressure starts to increase before rotating about *90%* of total rotation, go to *Step #40*. If pressure does not increase, rotate the *Pot. CW* to its midpoint and go back to *Step #34*.**
40. **Rotate slowly *CCW* until pressure stops increasing. Rotate an additional *10* degrees. Wait until pressure stabilizes and record the pressure. Slowly rotate *CW* until pressure starts to drop. Slowly rotate *CCW* until pressure increases to the recorded pressure. Record that the *"Pulse Width Adjust" Pot*. is rotated *CCW* to increase pressure. Go back to *Step #34*.**
41. **Using a marking pen, place an alignment mark on the *"Frequency Adjust"* and *"Pulse Width Adjust" Pots*. Determine the amount of pressure exceeding *28 PSI*. (For example: if pressure is *32 PSI*, excess pressure is *4 PSI*). Reduce pressure to *28 PSI* by alternately rotating each *Pot*. in the direction recorded a few degrees at a time. Attempt to divide the excess pressure equally between the two *Pots*. For example: if excess pressure is *4 PSI*, attempt to reduce the pressure *2 PSI* with each *Pot*. Go back to *Step #28.***
42. **Using a marking pen, place an alignment mark on the *"Frequency Adjust"* and *"Pulse Width Adjust" Pots.* Determine the amount of pressure exceeding *62 PSI*. (For example: if pressure is *70 PSI*, excess pressure is *8 PSI*.). Reduce pressure to *62 PSI* by alternately rotating each *Pot*. in the recorded direction a few degrees at a time. Attempt to divide the excess pressure equally between the two *Pots*. For example: if excess pressure is *8 PSI*, attempt to reduce pressure *4 PSI* with each *Pot.* Go to *Step #44.***
43. **If the *"Pulse Width Adjust" Pot*. is rotated *CW* to increase *Generator* pressure, go back to *Step #32*. If the *"Pulse Width Adjust" Pot.* is rotated *CCW* to increase *Generator pressure*, go back to *Step #39.***
44. **If you completed *Hydro-Gen* tuning after driving *25 MPH* in a residential area, go to *Step #45.* If you completed *Hydro-Gen* tuning after driving *60 MPH* (or full power) on a steep grade, go to *Step* #67.**
45. **Referring to *Figure #21*, be sure the throttle linkage moves thru its full range of travel from idle to full power without binding of the rod within the arm. Perform the procedure of *Step #66* before proceeding. Drive vehicle at *60 MPH* (or full power) on a steep grade. Listen closely for the sound of *Engine* pre-combustion *(ping)*. If *Engine* pings, go to *Step #46*. If *Engine* does not ping, go to *Step #56.***

<u>NOTE:</u> The procedure of *Steps #45* thru *#65* tune the *Coil Circuit* to create an ideal mixture of *Parahydrogen* (created by the *Coil*) and *Orthohydrogen* (created by the *Electrodes*). Low levels of *Parahydrogen* (too lean) can result in excessively high *CHT*, a common cause of *Engine* pre-combustion *(pinging)*. High levels of *Parahydrogen* (too rich) result in low *CHT*, cooling combustion, decreasing efficiency, and causing *Engine* roughness. *Optimal* mixture is achieved by leaning *Parahydrogen* to the point of creating *"ping"* and then slightly richening until *"ping"* disappears. You will be sequentially *"fine tuning"* two different *Pots*. It's very important to closely monitor *CHT* while leaning to prevent excessively high *CHT*. Refer to *CHT* recorded in *Step #1* for driving *60 MPH* (or full power) on a steep grade. Be sure the *CHT* does not exceed the recorded temp. by more than *40* degrees. <u>NEVER</u> allow the *CHT* to exceed *400* degrees.

46. **Referring to *Figure #7*, rotate the *"Pulse Width Adjust" Pot.* fully *CCW*. If the *Engine "pings"*, go to *Step #47*. If the *Engine* does not *"ping"*, go to *Step #52.***
47. **Rotate the *"Pulse Width Adjust" Pot*. fully *CW*. If the *Engine "pings"*, go to *Step #48*. If the *Engine* does not *"ping"*, go to *Step #53.***
48. **Slowly rotate the *"Pulse Width Adjust" Pot CCW*. If the *CHT* decreases, continue rotating *CCW* until the *CHT* stops decreasing. Go to *Step #49*. If the *CHT* increases while rotating *CCW*, rotate fully *CCW*. Slowly rotate *CW* until the *CHT* stops decreasing. Go to *Step #49***
49. **Rotate the *"Strength Adjust "Pot.* fully *CCW*. If the *Engine* pings, go to *Step #50*. If the *Engine* does not ping, go to *Step #54.***
50. **Rotate the *"Strength Adjust" Pot*. fully *CW*. If *Engine* pings, rotate each *Pot*. to its midpoint and go to *Step #51 ("Pulse Width Adjust"* and *"Strength Adjust" Pots)*. If the *Engine* does not ping, go to *Step #55.***
51. **Turn power *OFF*. Referring to *Figure #7*, the *Coil Circuit* is not producing enough *Parahydrogen.* Replace the *10K* resistor connecting pin *#3* of component *NE555* to the base of component *2N3055* with a *10K Pot*. Adjust the *Pot*. for about *9K* resistance. Go back to *Step #45*. If you reach this *Step* again, adjust the *Pot.* for about *8K* resistance and go back to *Step #45*. If necessary, each time you reach this *Step*, adjust the *Pot*. for about *1K* less in resistance and go back to *Step #45*. If the *Pot.* is eventually adjusted for *2K* or less, a circuit component is defective. Locate and replace the defective component. Adjust the *Pot*. for *10K* resistance. Turn power *ON* and go back to *Step #45.***
52. **Slowly rotate the *"Strength Adjust" Pot*. *CW* until pinging starts. Slowly rotate *CCW* until pinging stops and continue to rotate *CCW* about *5* degrees more. If the *CHT* is more than *40* degrees higher than the value recorded in *Step #1*, continue slowly rotating *CCW* until the *CHT* decreases to *40* degrees above the recorded value. Go back to *Step #29*.**
53. **Slowly rotate the *"Strength Adjust" Pot. CCW* until pinging starts. Slowly rotate *CW* until pinging stops and continue to rotate *CW* about *5* more degrees. If the *CHT* is more than *40* degrees higher than the value recorded in *Step #1*, continue slowly rotating *CW* until the *CHT* decreases to *40* degrees above the recorded value. Go back to *Step # 29*.**
54. **Slowly rotate the *"Strength Adjust" Pot. CW* until pinging starts. Slowly rotate *CCW* until pinging stops and continue to rotate *CCW* about *5* more degrees. If the *CHT* is more than *40* degrees higher than the value recorded in *Step #1*, continue rotating *CCW* until the *CHT* decreases to *40* degrees above the recorded value. Go back to *Step #29*.**
55. **Slowly rotate the *"Strength Adjust" Pot. CCW* until pinging starts. Slowly rotate *CW* until pinging stops and continue rotating *CW* about *5* more degrees. If the *CHT* is more than *40* degrees higher than the value recorded in *Step #1*, continue slowly rotating *CW* until the *CHT* decreases to *40* degrees above the recorded value. Go back to *Step #29.***
56. **Referring to *Figure #7*, rotate the *"Pulse Width Adjust" Pot*. fully *CCW*. If the *Engine* pings, go to *Step #62*. If the *Engine* does not ping, go to *Step #57.***
57. **Rotate the *"Pulse Width Adjust " Pot.* fully *CW*. If the *Engine* pings, go to Step #63. If the *Engine* does not ping, go to *Step #58.***
58. **Slowly rotate the *"Pulse Width Adjust" Pot. CCW*. If the *CHT* increases, continue rotating *CCW* until the *CHT* stops increasing. Go to *Step #59*. If the *CHT* decreases while rotating *CCW*, rotate fully *CCW*. Slowly rotate *CW* until the *CHT* stops increasing. Go to *Step #59.***
59. **Rotate the *"Strength Adjust" Pot*. fully *CCW*. If the *Engine* pings, go to *Step #64*. If the *Engine* does not ping, go to Step #60.**
60. **Rotate the *"Strength Adjust" Pot*. fully *CW*. If the *Engine* pings, go to *Step #65*. If the *Engine* does not ping, rotate each *Pot.* to its midpoint, go to *Step #61. ("Pulse Width Adjust"* and *"Strength Adjust" Pots).***
61. **Turn the power *OFF*. Referring to *Figure #7*, the *Coil Circuit* is producing too much *Parahydrogen*. Replace the *10K* resistor connecting pin *#3* of component *NE555* to the base of component *2N3055* with a *20K Pot.* Adjust the *Pot.* for about *11K* resistance. Go back to Step #45.**
    If you reach this *Step* again, adjust the *Pot.* for about *12K* resistance and go back to *Step #45*. If necessary, each time you reach this *Step* adjust the *Pot.* for about *1K* more resistance and go back to *Step #45*. If the *Pot*. is eventually adjusted for about *18K* resistance or more, a circuit component is defective. Locate and replace the defective component. Adjust the *Pot*. for *10K* resistance. Turn power *ON* and go back to *Step #45.*

62. **Slowly rotate the *"Pulse Width Adjust" Pot. CW* until pinging stops and continue to rotate *CW 5* more degrees. If the *CHT* is more than *40* degrees higher than the value recorded in *Step #1*, and continue slowly rotating *CW* until the CHT decreases to *40* degrees above the recorded value. Go to *Step #66.***
63. **Slowly rotate the *"Pulse Width Adjust" Pot. CCW* until the pinging stops and continue to rotate an additional *5* degrees. If the *CHT* is more than *40* degrees higher than the value recorded in *Step #1*, and continue rotating *CW* until *CHT* decreases to *40* degrees above recorded value. Go to *Step #66.***
64. **Slowly rotate the *"Strength Adjust" Pot. CW* until pinging stops and continue to rotate *CW* an additional *5* degrees. If the *CHT* is more than *40* degrees higher than the value recorded in *Step #1*, continue slowly rotating *CW* until the *CHT* decreases to *40* degrees above the recorded value. Go to *Step #66*.**
65. **Slowly rotate the *"Strength Adjust" Pot. CCW* until the pinging stops and continue to rotate *CCW* an additional *5* degrees. If the *CHT* is more than *40* degrees higher than the value recorded in *Step #1* and continue rotating *CCW* until the *CHT* decreases to *40* degrees above the recorded value. Go back to *Step #29.***
66. **Precise *Throttle* adjustment is very easy using the special features of the *Hydro-Gen Throttle Assembly* (refer to *Figure #21*). Here's the method we recommend:**
    - **A. Disengage the arm from the *Throttle* rod. Rotate the *Pot*. shaft thru the total range of rotation required going from idle to full power. Using a ruler, measure and record the total distance traveled by the tip of the *Throttle* rod as the *Pot.* is rotated.**
    - **B. Rotate the *Pot*. shaft to its midpoint of rotation and position the *Throttle Linkage* at its midpoint of travel. Slide the arm onto the *Throttle* rod and attach the arm and sleeve onto the *Throttle Linkage* with hose clamps.**
    - **C. Raise or lower the *Pot*. by rotating its mounting bracket about the *1/4"* bolt until *Throttle* rod travel is equal to that recorded in paragraph "A" when the *Throttle Linkage* moves thru its full range of travel. If necessary to obtain added distance between the *Pot*. and the arm, the arm and sleeve assembly can be inverted to position the arm above the *Linkage.***
    - **D. To assure smooth operation without binding, be sure the *Throttle* rod is squared with the surface of the arm when the *Linkage* is at its midpoint of travel. If necessary, rotate the *Pot.* body within the limits of the *3/32"* slot and rotate the sleeve about the axis of the *Linkage* until the *Throttle* rod is square with the arm.**
    - **E. Adjust idle to desired speed. Operate the *Throttle* thru several cycles to verify smooth operation without binding.**
    - **F. Firmly tighten mounting bolts, hose clamps, and the *Pot*. retaining nut. With the *Throttle* at idle position, trim the *Throttle* rod to length so that it protrudes about *1/2"* above the arm. Square the rod end with a fine file and deburr with sandpaper.**
    - ***G.* Mix a small quantity of *Epoxy (J-B WELD)* and apply into the *3/32"* slot in the area of the anti-rotation pin to secure the *Pot*. against rotation. Allow the *Epoxy* to cure for *8* hours before moving the *Linkage.***
67. **While driving, verify that the four *(4) LED's* operate as follows:**
    - **Green *PWR ON* lights when power is *ON* and is not lit when power is *OFF*.**
    - **Green *PUMP ON* and yellow *GEN WATER LOW* – both light when the *Water Pump* is running and are not lit at all other times.**
    - **Red *TANK WATER LOW* is not lit when *Tank* water level is more than *1/3* full and lights when water falls below that level.**

    If all four *(4) LED's* operate properly, go to *Step #68*. If not, refer to *Figures #6, #7*, and *#8* and troubleshoot to locate defective component or wiring error. Repair as required and go to Step #68.
68. ***<u>CONGRATULATIONS</u>*, your *Hydro-Gen System* is working perfectly. After about *25* hours of driving, firmly tighten all hose clamps, and linkage connections.**
69. **As you have noticed, we had you do extensive testing of all the components used. That's because, in our testing, we found several "New" components that were "Bad". Do all the procedures we lay out here. You want to find a defective component in testing, not in driving.**
70. **<u>KEEP THIS BOOK AND ALL YOUR NOTES FOR FUTURE USE IF YOU HAVE A PROBLEM OR WANT TO BUILD ANOTHER FOR ANOTHER VEHICLE. DON'T LOSE THIS BOOK.</u>**
71. **Time for a coffee break, this time you can have beer if you want. You are done!!**

Helpful Hints and Tips

MAINTENANCE:

Your *Hydro-Gen System* is practically maintenance-free. Just fill with water and drive. But, normal tap water does contain minerals, which can accumulate within the *Generator* and coat parts inside. The *Electrode gap* will gradually fill with these deposits and efficiency will degrade until insufficient *Hydrogen* and *Oxygen* will be produced to run your Engine. You can prevent this build-up with periodic flushing and cleaning of the *Generator.*

FLUSHING: **Since it's so quick, easy and effective, we highly recommend Flushing the *Generator* at least every two weeks. There's no need to start the *Engine*. Simply open the *Drain Cock* and turn power *ON* for a minute or two. The *Water Pump* will provide plenty of fresh water to do the job. Close the *Drain Cock*, wait for the pump to fill the *Generator* and turn power *OFF*. Be sure to refill the *Water Tank*.**

CLEANING: **A thin layer of minerals will eventually coat the *Generator* parts, and must be periodically removed. How often your *Hydro-Gen Generator* will need cleaning will vary depending on the mineral content of your water and the amount of driving done. To be safe, we recommend cleaning about every month or two. A mildly acidic mineral deposit cleaner works very well (such as: *CLR* or even just *White Vinegar*). There are dozens of products out there to do this. Turn the power *OFF*. Open the *Drain Cock* and drain the *Generator*. Disconnect the outlet tube at the *Flame Arrestor* and close the *Drain Cock*. Wear protective gloves and mix the cleaner according to the manufacturers instructions and pour thru the tube you disconnected (a small funnel will help) until the *Generator* is full. Wait a few minutes or whatever the manufacturer recommends and drain the *Generator* into a small bucket. Repeat this one more time and examine what you drain out of the *Generator* to see that it is clean. If necessary, repeat until clean. Close the *Drain Cock* and reconnect the tubing to the *Flame Arrestor*. Turn the power *ON* and let the *Generator* fill with water. Open the *Drain Cock* and let the *Water Pump* flush the *Generator* for a minute or two. Close the *Drain Cock* and let the *Generator* fill. Turn power *OFF*. Be sure to refill the *Water Tank*.**

COLD WEATHER OPERATION: **If the outside temperatures are going to be below freezing, you can add *Isopropyl Alcohol* to the *Water Tank* to prevent freezing. However, since *Alcohol* changes the dielectric properties of the water, the operating frequency must be changed to maintain efficient operation, by adjusting the *Frequency Adjust Trim Pot*. for peak performance *(Figure #6)*. You might find that it is easier to install an *Engine Tank Heater* in the *Water Tank System* the same as you would for the *Engine*. Heat from a warm vehicle will keep the water from freezing, but when you stop for the night, all you have to do is plug the *Tank Heater* into a *110V* outlet and the *Heater* heats and circulates the water. Follow manufacturers instructions when installing the *Tank Heater.***

STAINLESS STEEL: **The only combustion by-product that your *Hydrogen* powered *Engine* produces is *Water.* Actually, it produces *Hot Water*. Now we all know what water does to steel. Unless your *Engine* already is equipped with *Stainless Steel Valves*, you might want to look into having them installed in the near future. The *Stainless Steel Valves* are fairly inexpensive; the biggest cost will be labor. Almost any high performance shop can install them for you. Now. Understand you do not have to do this right away. Our best guess is if you have reasonable mileage on your Engine with good valves it will probably last for 50,000 to 70,000 miles before you need to look into S.S. valves. Your *Exhaust System* is also subject to rusting. If your *Exhaust System* is fairly old, wait until it rusts thru and then replace with *Stainless Steel* components. If your *Exhaust System* is fairly new, you might want to look into using one of the new *Ceramic Coatings* that are readily available. Currently, there are no *Rust Preventive* additives available that can be added to the water without hurting the performance of the *System*. Now, we realize that the *Stainless Steel Valves* and *Exhaust System* are additional cost, but, not only will the new *Stainless Steel* components last a very long time, but remember, you are now running on *WATER, FREE WATER* not *$$$GASOLINE.***

FUEL INJECTION SYSTEMS: The *Hydro-Gen System* is designed for *Carbureted Engines*, not fuel injection. The technology is not quite there for that yet. But, remember, the early fuel injection systems were *Throttle Body* injection. This system will work with *Throttle Body* systems. In the near future, *Hydrogen Injection Components* will be *"over the counter"*. If you need to convert your full *Fuel Injection Engine* to *Carbureted*, check with your local high performance shop or you can contact *Impco (Impco* address and phone # were listed earlier in this book).

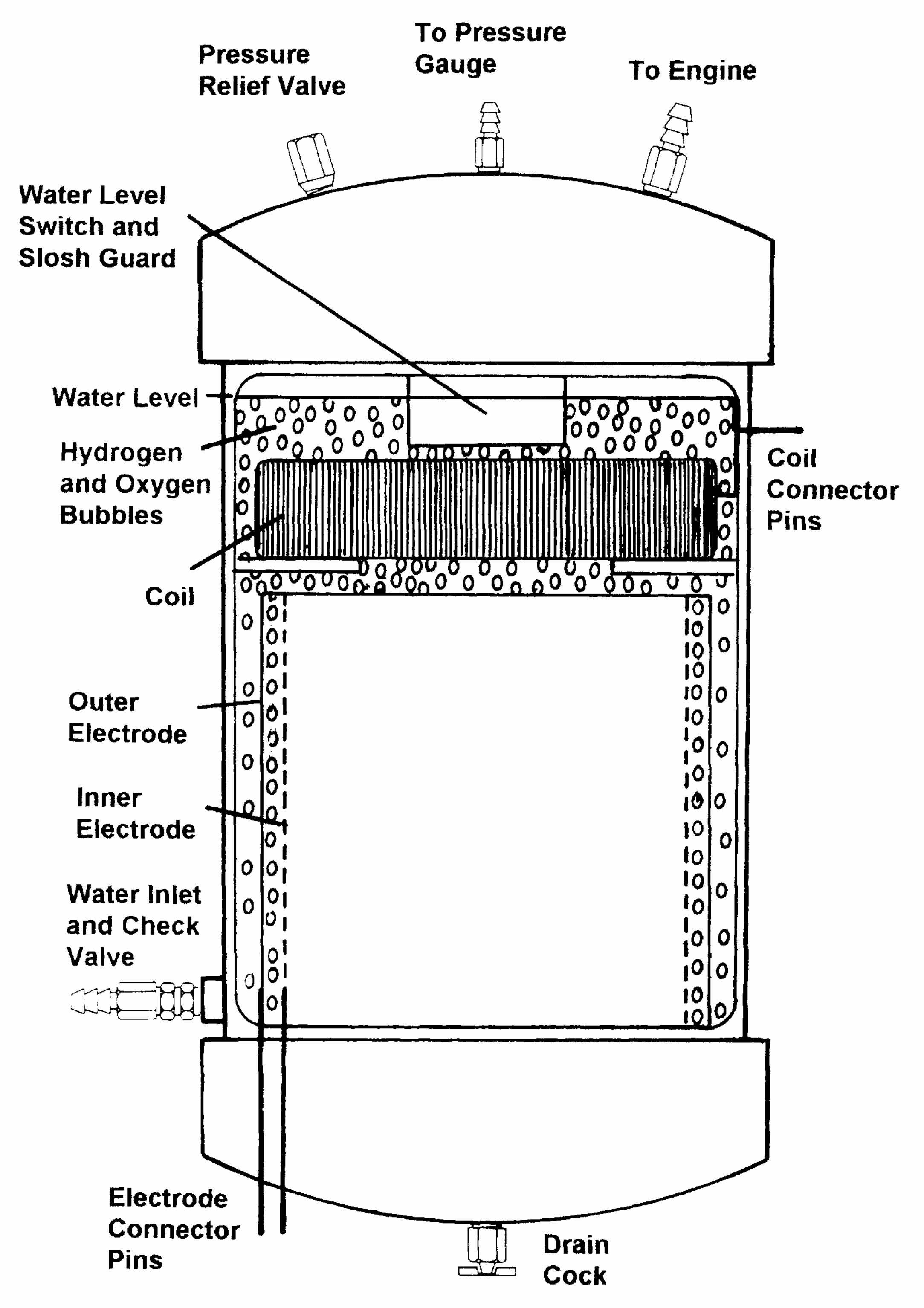
WATCH: Always keep an eye on the gauges, especially the *CHT*. Any abnormal change in the *CHT* usually signals a problem. Stop and check it out as soon as is possible. Again, as we said earlier, keep this book and all your notes in a safe place in the vehicle so that if you need it, you have it. Good Luck!

NOTE: Centurion Eng. expressly states that no warranty or guarantee applies to the Hydro-Gen System. The System has been tested and does work, if you follow all the instructions explicitely. If you deviate from the instructions, your System may not work. You accept responsibility for your System and your vehicle. We are selling the manual only. If, in the process of building and tuning your system you find a better way of building or tuning that will help others in their Systems, e-mail Centurion and we will send an e-mail update to all the purchasers of our manual.

Now for a little Trivia. The concept of Hydrogen powered automobiles isn't new. Way back in 1932 Charles Garrett patented an invention called the "Electrolytic Carburetor". (U.S. Patent 2,006,676).
His original idea is just a little different than what we have today. What has changed is 70+ years of technological advancement, which has made this new design a reality today. Just think, 1932, do you think that the big Oil Companies and the big auto manufacturers did not pursue his ideas?
How about the Vapor Carb invented by Charles Pogue back in the late 1930's that our Military used on our Tanks in Africa in W.W. II that helped defeat Rommel because of extraordinary fuel economy.
Just a little food for thought.

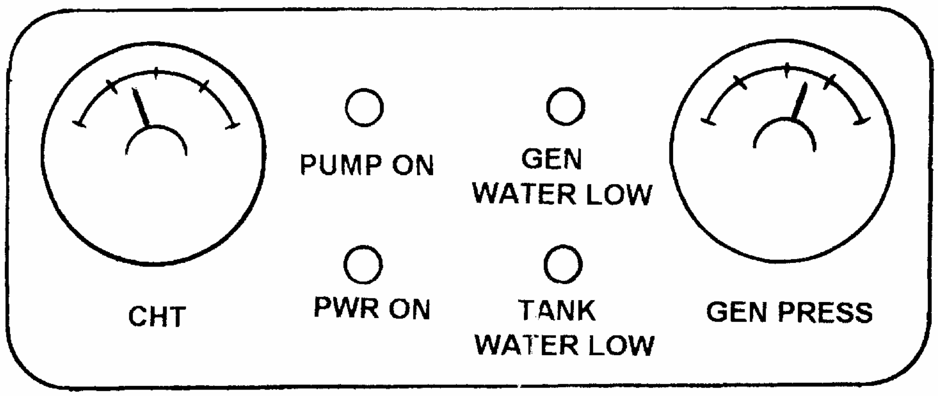
References:

- **U.S. Patent 6,126,794 . "Apparatus for Producing Orthohydrogen and/or Parahydrogen" And "Prototype Vapor Fuel System" by Stephen Chambers.**
- **U.S. Patent 4,936,961. Method for Production of a Fuel Gas" by Stanley Meyer.**
- **"The Gas Saver and HyCo Series" by George Wiseman.**
- **"A Water-Fueled Car" Nexus Magazine, Oct-Nov 1996 by Carl Cella.**
- **"The Dromedary Newsletter" & "SuperCarb Techniques" by C. Michael Holler.**
- **"Where in the World is All the Free Energy" by Peter Lindemann.**



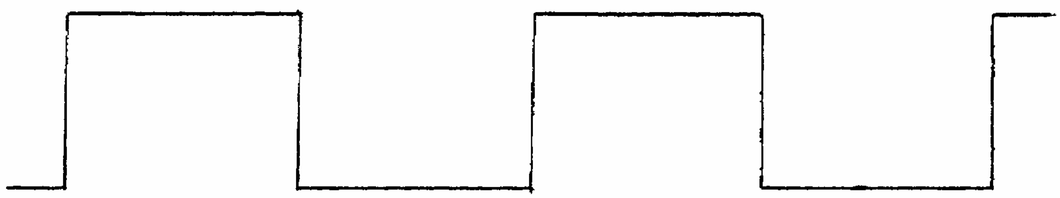
Hydrogen/Oxygen Generator

Figure #2



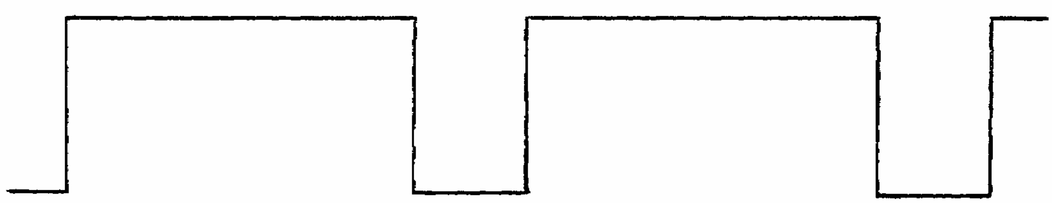
In-Dash Indicators

Figure #3



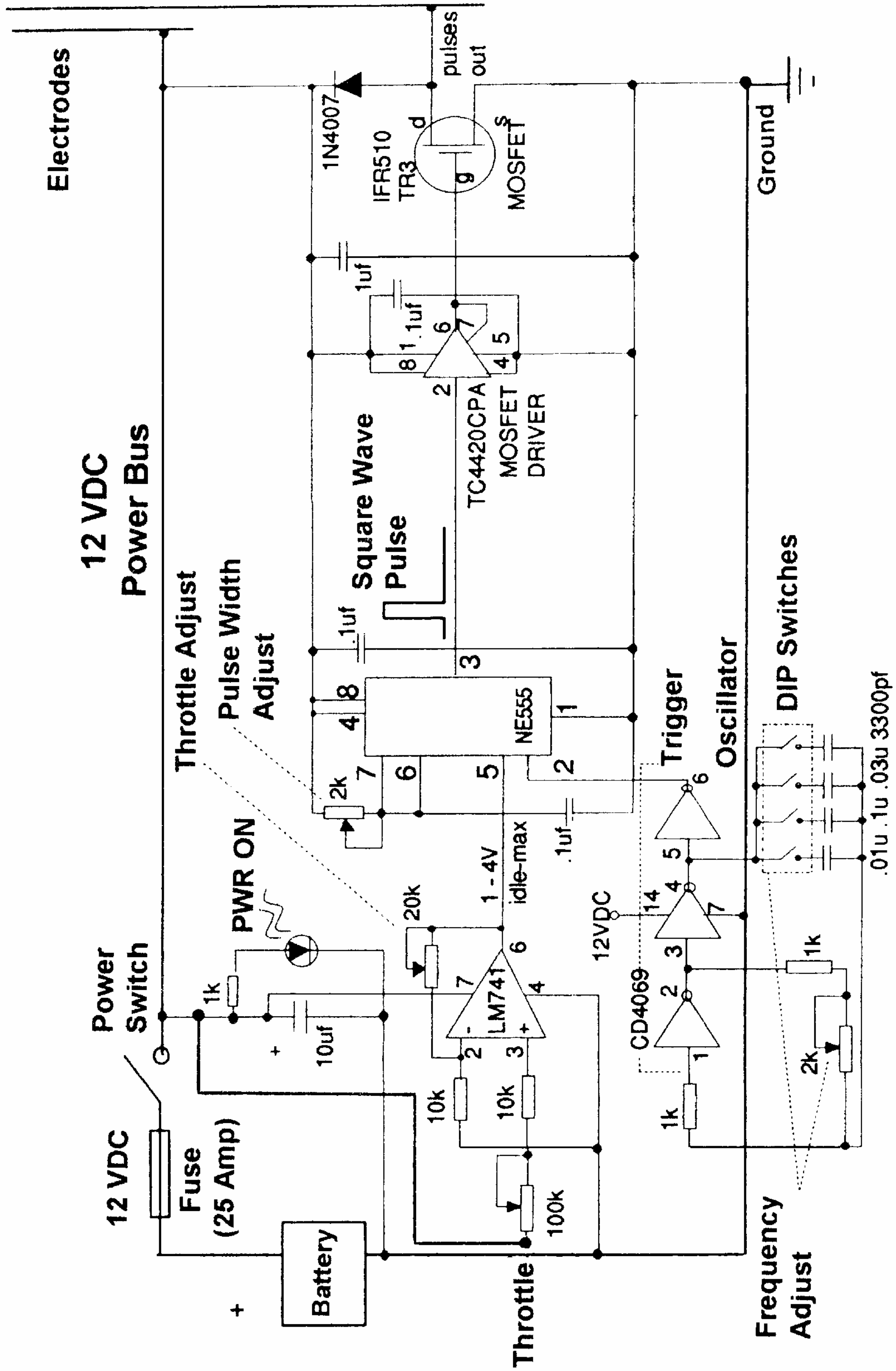
Square Wave - ON:OFF Ratio 1:1

Figure #4



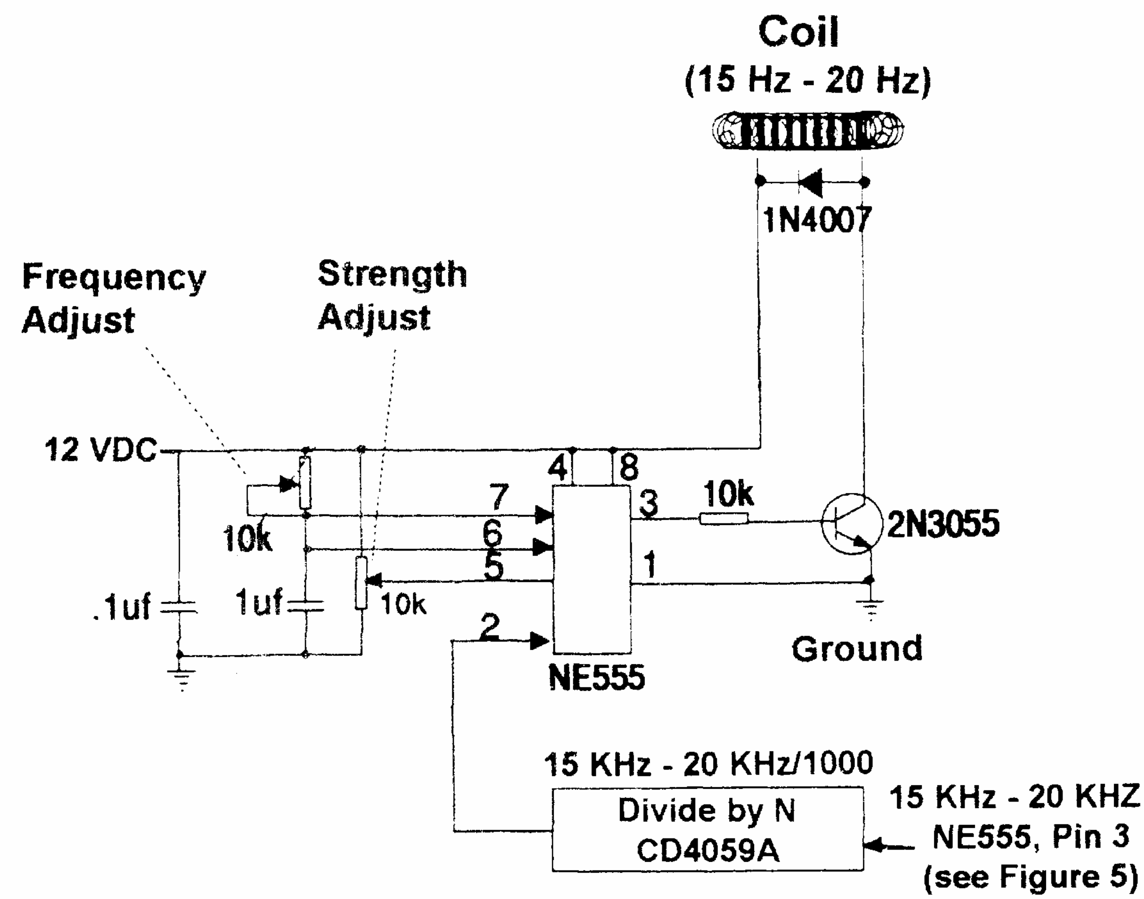
Square Wave - ON:OFF Ratio 3:1

Figure #5



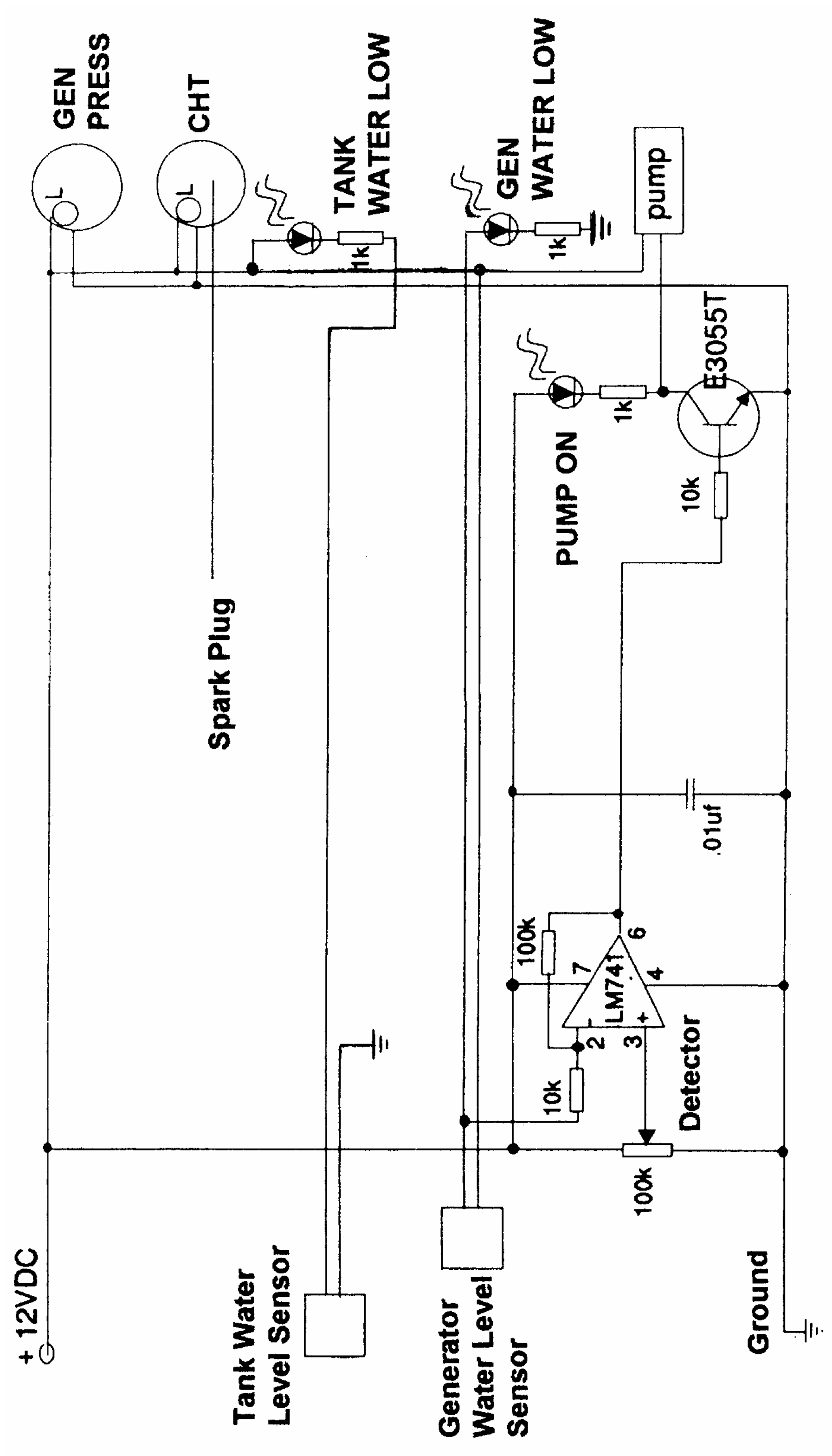
Generator Electrode Circuit Schematic

Figure #6



Generator Coil Circuit Schematic

Figure #7

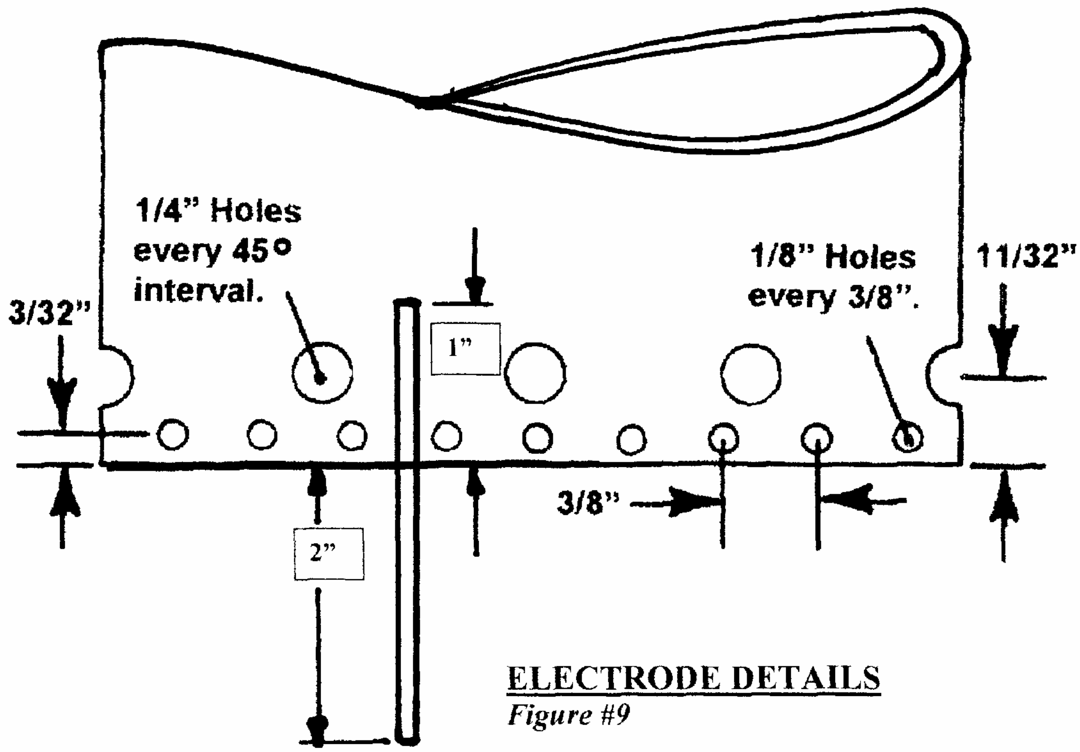


In-Dash Indicators Circuit Schematic

Figure #8

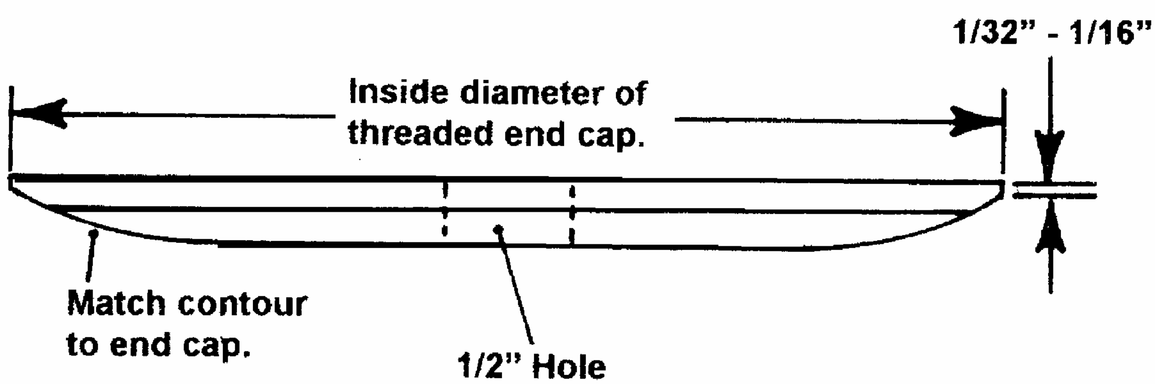
Outer Electrode Shown

(Same dimensions for Inner Electrode.)



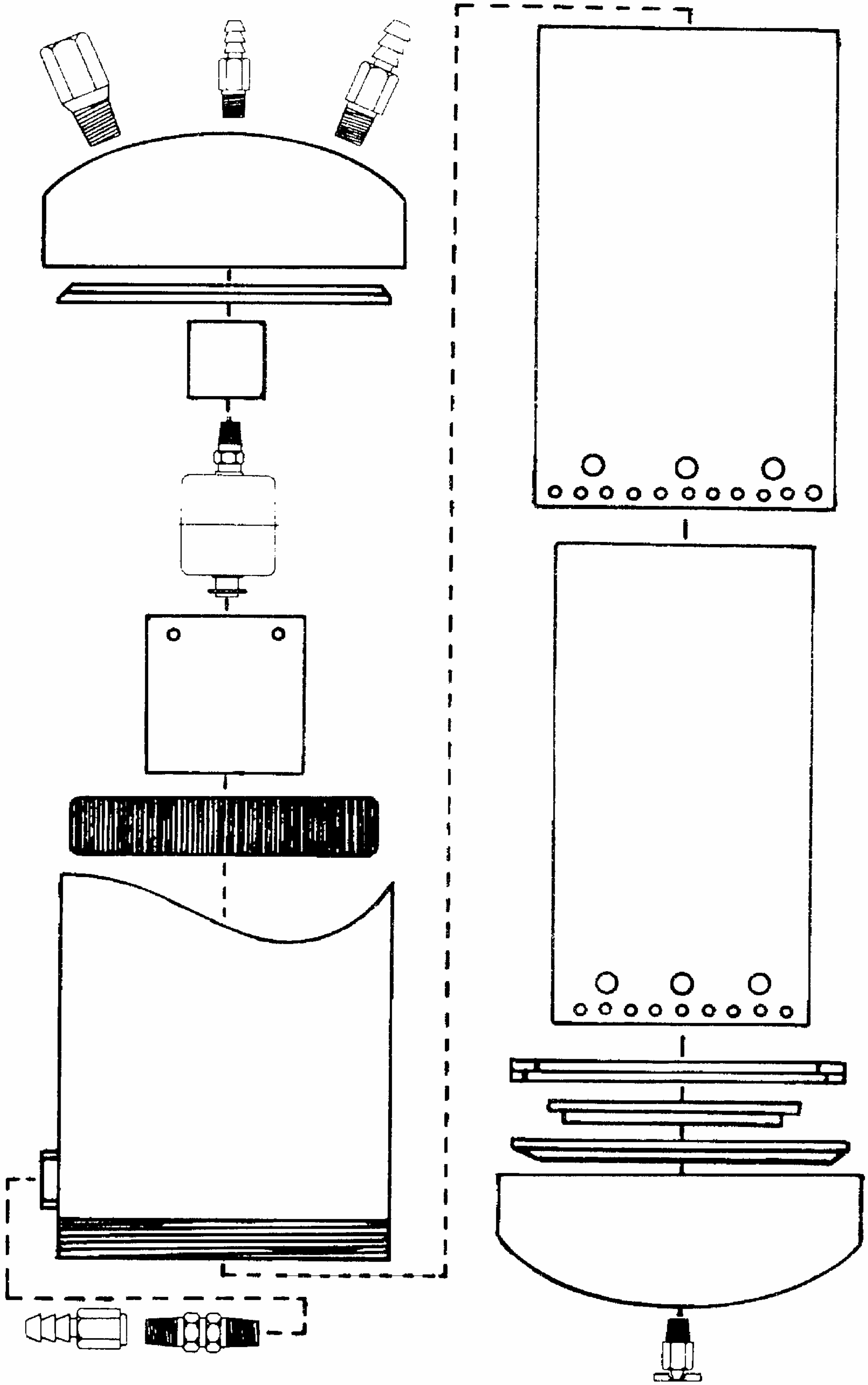
ELECTRODE DETAILS

Figure #9



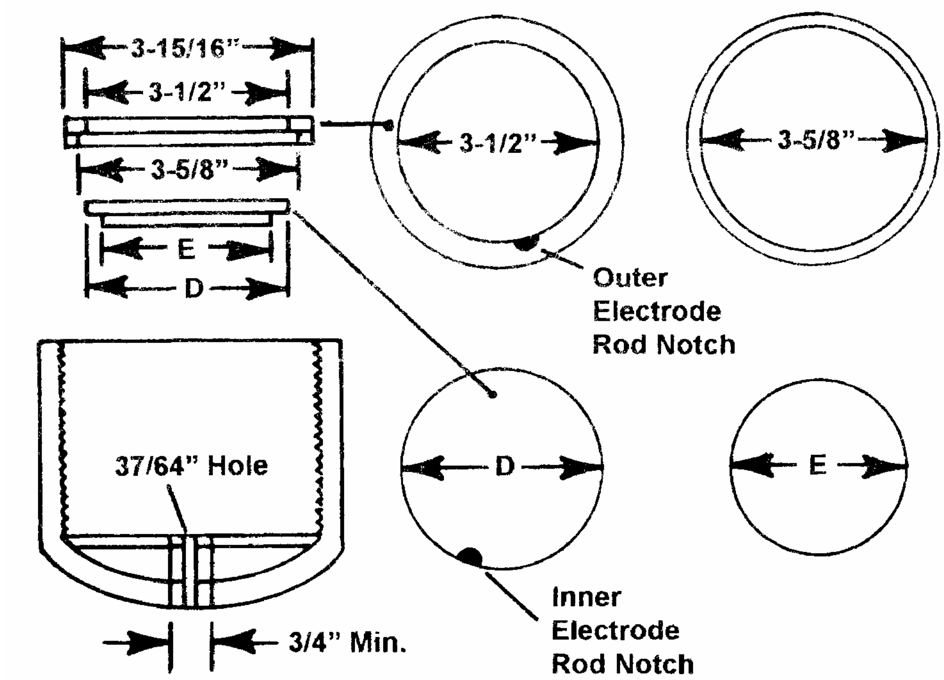
Disk Contour

Figure #10



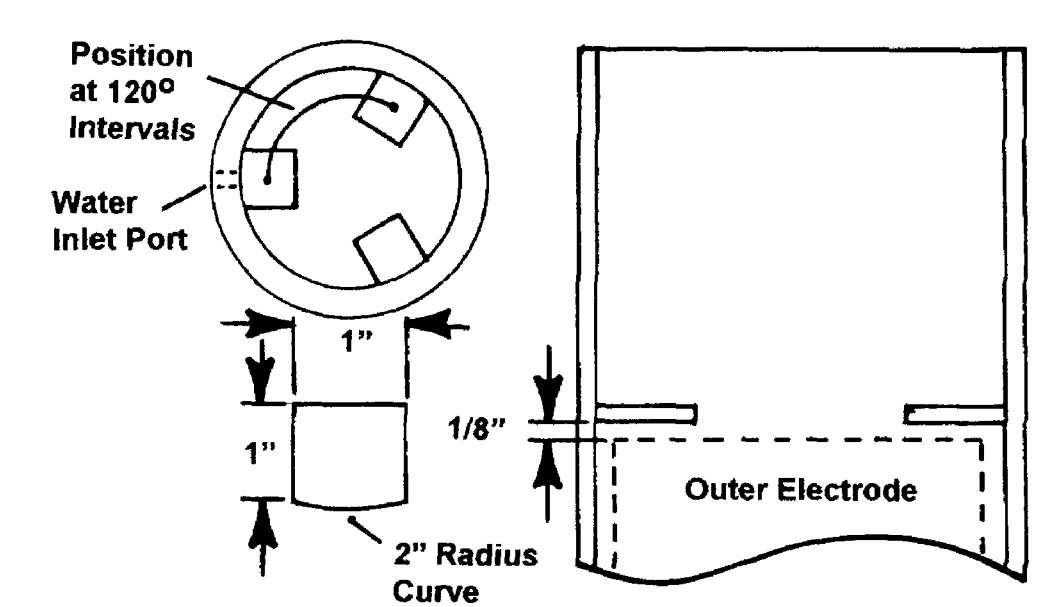
Generator Details

Figure #11



Threaded End Cap Details

Figure #12



Coil Mounting Brackets

Figure #13

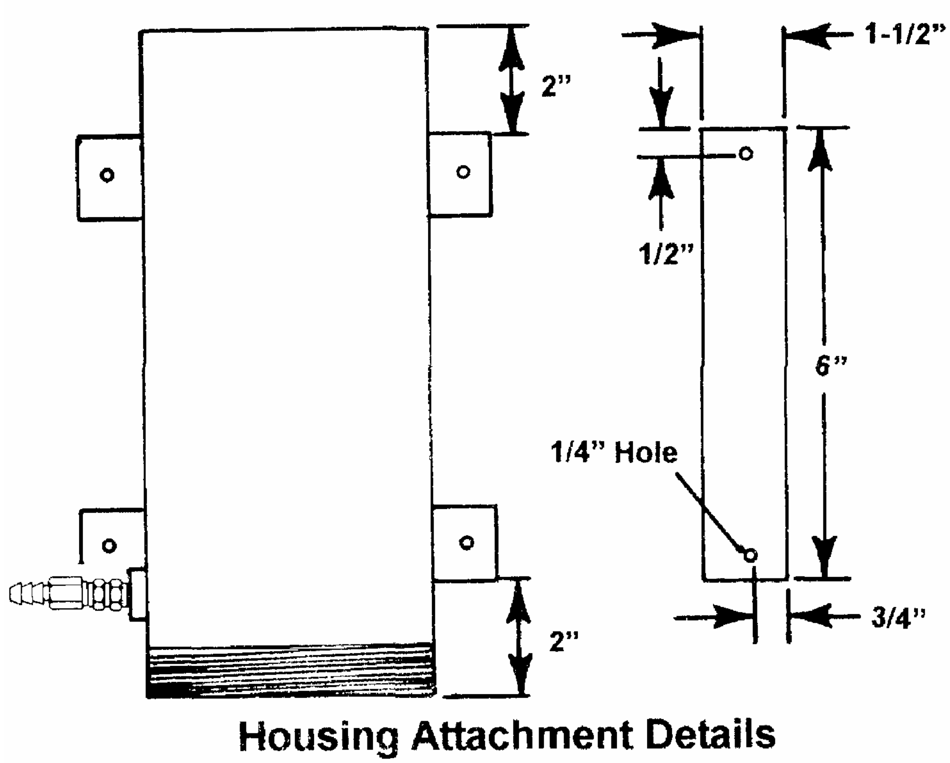


Figure #14

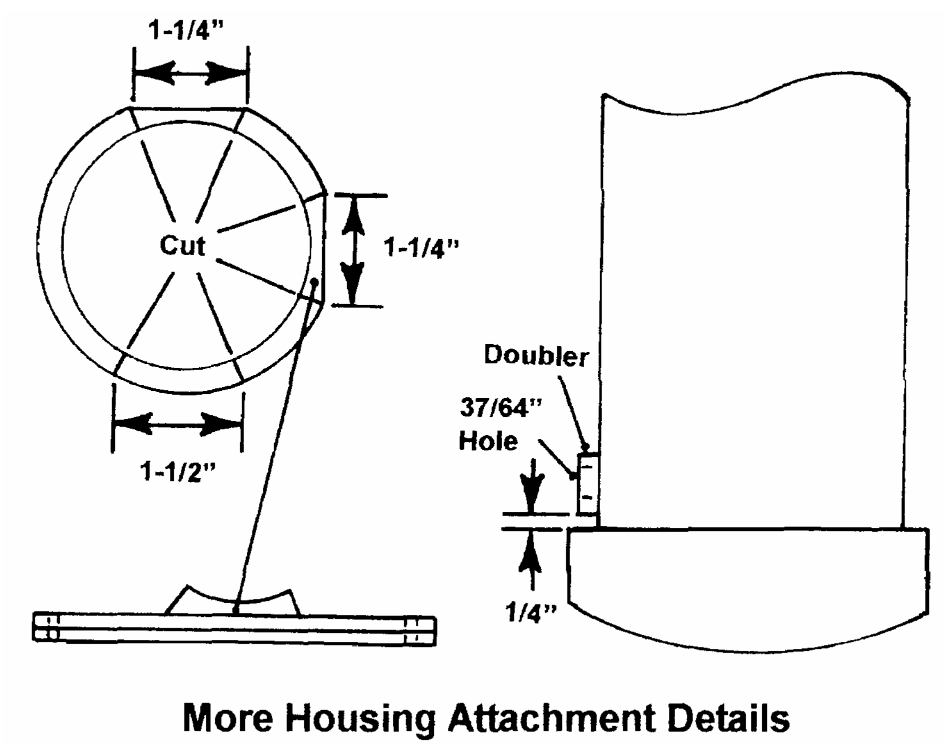
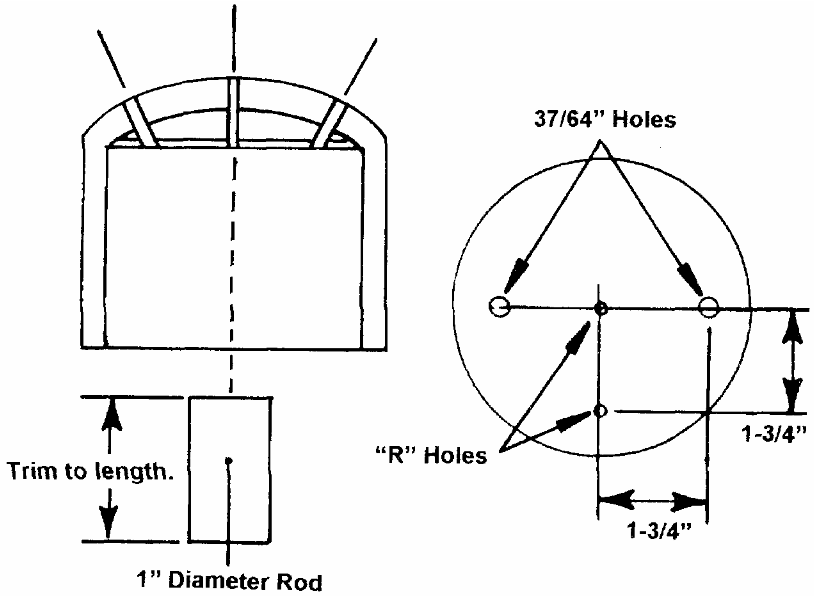
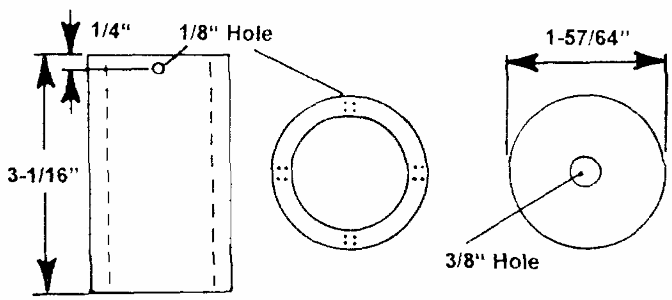


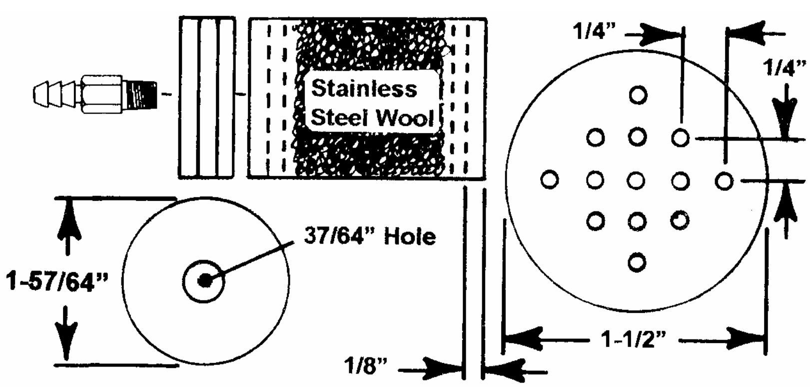
Figure #15



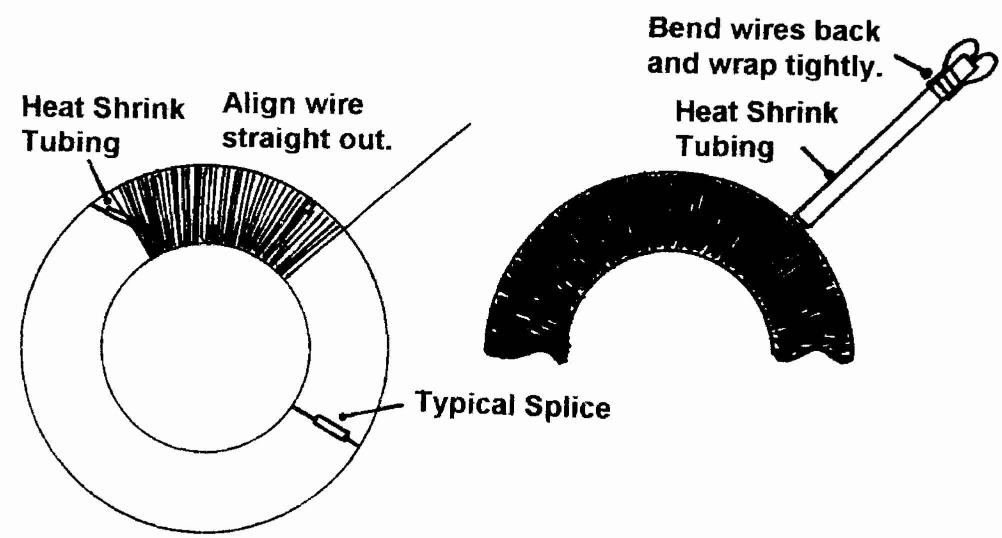
Unthreaded End Cap Details
Figure #16



Slosh Shield Details
Figure #17

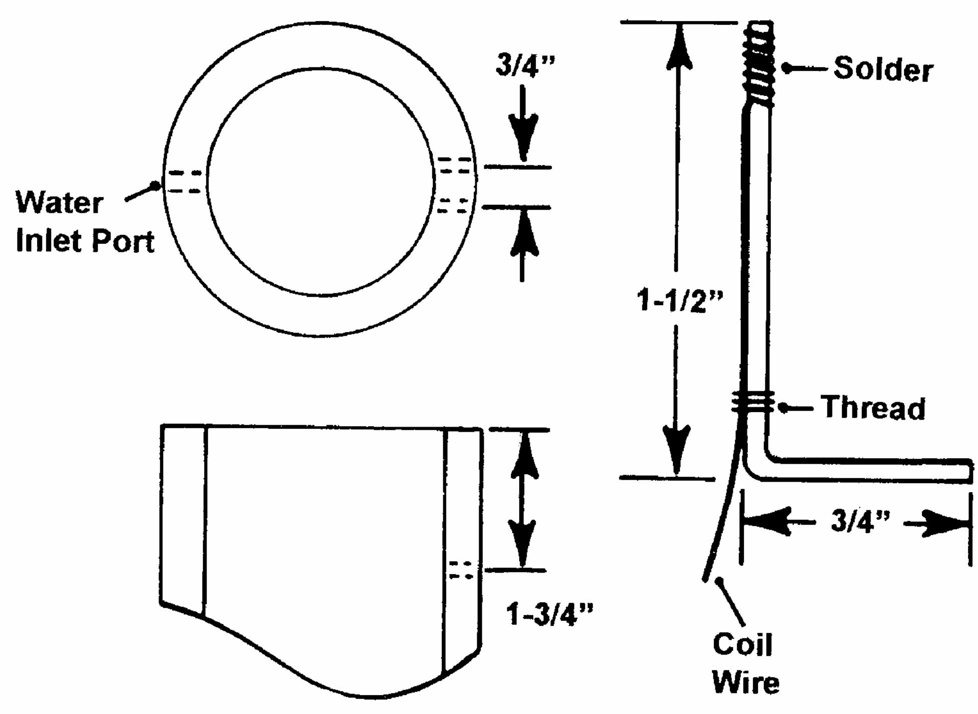


Flame Arrestor Details
Figure #18



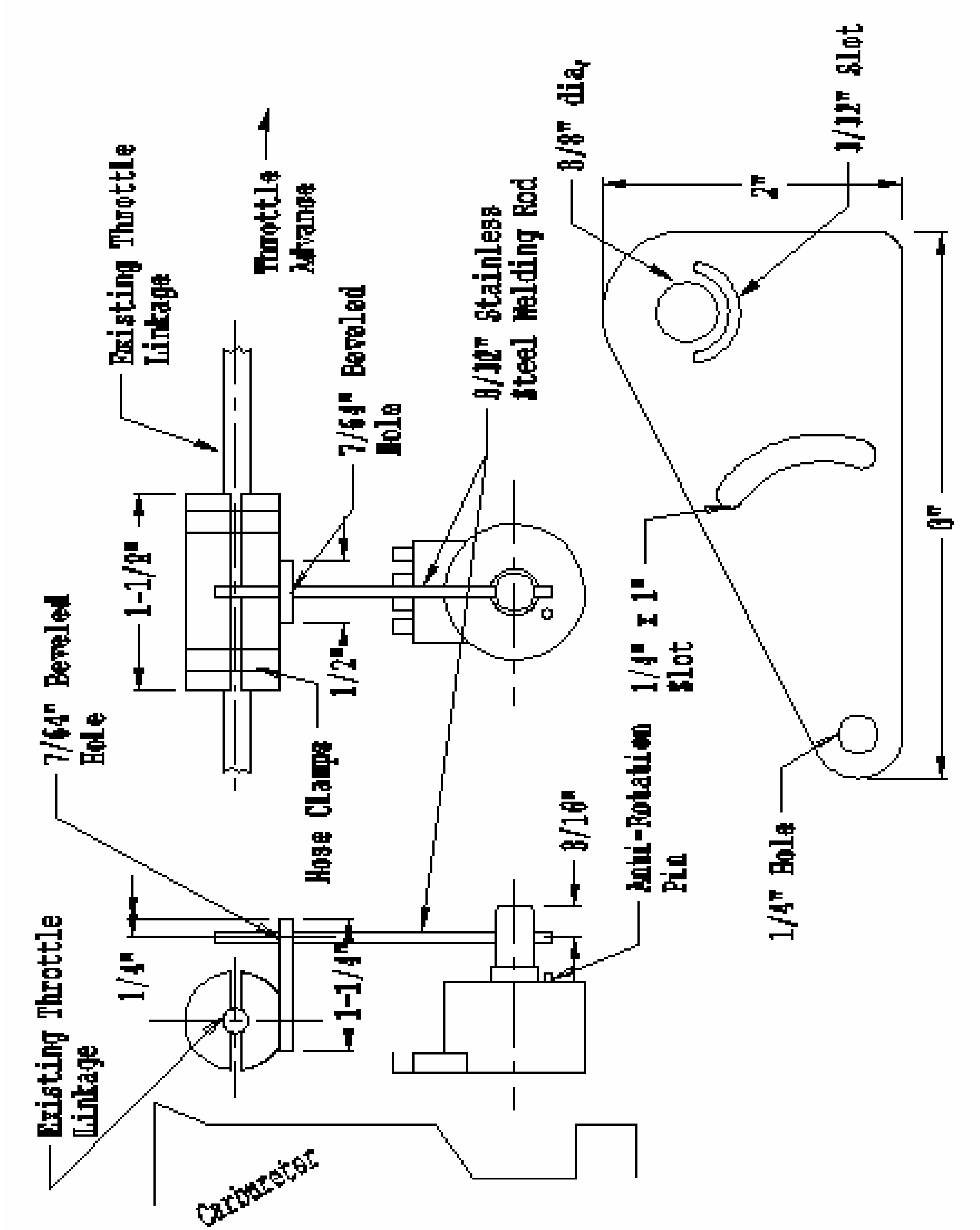
Toroid Coil Details

Figure #19



Toroid Coil Installation

Figure #20



Throttle Assembly Details

Figure #21