

TUNGSTEN

INERT GAS

WELDING

Tungsten Inert Gas Welding Introduction

For Quiz Purposes:

Read Unit 30 - 19 to 20 and demonstration notes.

Origins and Terminology:

Tungsten Inert Gas (TIG) Welding: The original term for the TIG welding process was "Heli-Arc" because of the inert gas - helium which was used with this type of welding. Heli-arc began in the late 1940's and by the early 50's (the Korean Conflict), heli-arc was introduced into industry. As the process was improved upon, argon was used as the shielding gas because of its heavier atomic weight and therefore its ability to stay in the weld zone more effectively.

The most proper current name for this welding process is Gas Tungsten Arc Welding (GTAW); however, it has also been known as "high freq." welding in the trades because of using high frequency electricity.

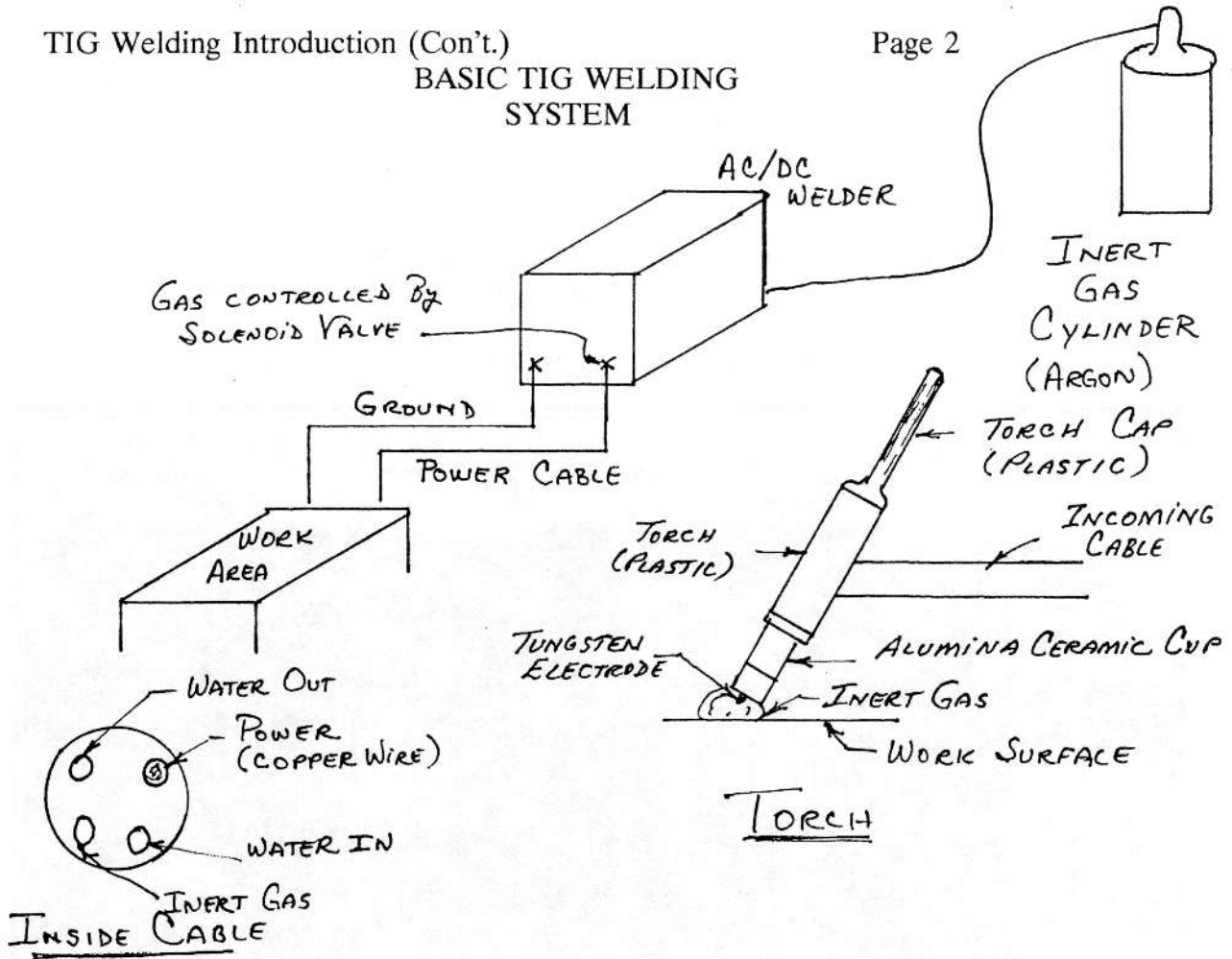
Metallic Inert Gas (MIG) Welding: This is an entirely different process and will be dealt with in a subsequent unit. Do not confuse MIG with TIG.

TIG Welding: This process uses a non-consumable electrode to help establish a high frequency current arc in an inert gas environment. Filler rod is then added into the weld zone by a separate wire feeder machine or by hand feeding.

Non-Consumable Electrodes: The electrode is not used up in the welding process. (The melting point of tungsten is 6,125 degrees.) There are different alloy compositions in the color coded electrodes.

- Green - Pure tungsten - used for welding aluminum. This electrode tends to push the heat outward to the edges of the liquid pool as the weld is in progress. This is beneficial when welding a conductive metal such as aluminum.
- Yellow - 1% Thoriated - Thorium raises melting temperature of the tungsten. This electrode is a general purpose electrode, but we don't use it in this lab.
- Red/Purple - 2 % Thoriated - To be used on stainless, chrome-moly., and copper alloys. It is not to be used on aluminum as it will tend to give off sparkles and will leave small pits on the aluminum surface. The sparkles tell of thorium burnout.
- Brown - Zirconium - To be used on titanium and has still a higher melting point. It is also used in welding operations where high purity is a necessity. This is an expensive electrode compared to the others.

BASIC TIG WELDING SYSTEM



Inert Gas: A gas on the chemical elements chart that does not easily mix or chemically combine with any other gases or elements. This gas is colorless, odorless, and tasteless. This gas protects the weld in a gas bubble or envelope. The envelope prevents the atmosphere we live in from getting to the weld and contaminating it.

Inert Gases: Argon, Helium, Krypton, Xenon, Radon, and Neon.

Helium was the first gas to be used with the process; however, it didn't stay in the weld zone because of its light atomic weight. Therefore, it took more gas to prevent contamination of the weld. In our laboratory we use **Argon** as the shielding gas.

High Frequency Electricity: TIG welding requires the use of high frequency (accelerated alternating current) to do the work. The electrical current used in this process is upwards of 200,000 cycles per second - the normal AC wall current in the United States is 60 cycles per second. The accelerated current helps in two ways for this welding process:

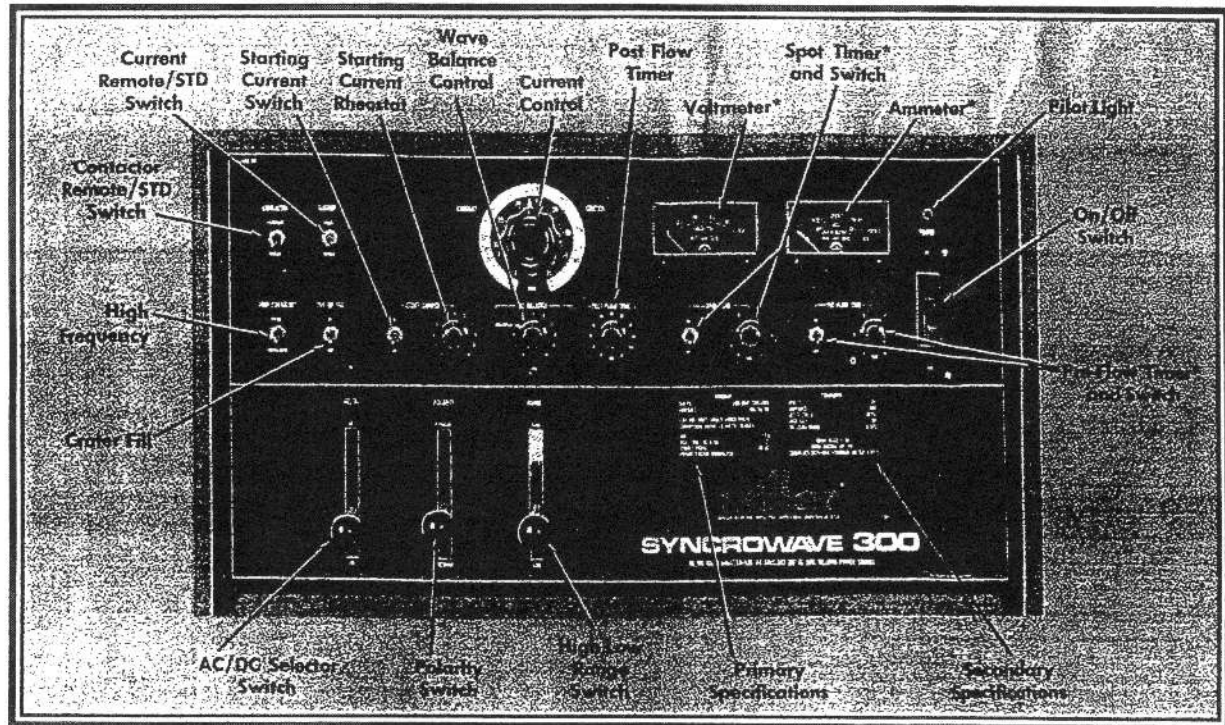
- Helps establish the arc by jumping the arc gap to the metal surface. The operator doesn't need to touch the work surface with the electrode.

- For aluminum and its alloys, the high frequency current establishes a very hot uniform, non-directional arc necessary for welding.

Metals Weldable with Process:

*Aluminum, Cast Iron, Copper and its alloys, *Stainless Steel, Steel Alloys including Chrome-Moly, and Magnesium (which we don't try in this lab.)

* These are the most common metals welded in this lab. with the TIG welder.



Control Panel of TIG Welder in Lab.

Parts & description of Purpose:

First Row of Controls -

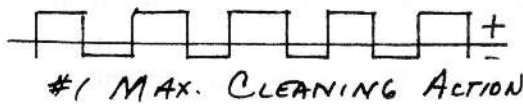
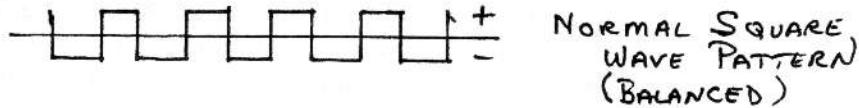
- **Contacter** - Set to "**remote**" because the foot pedal is remote or away from the machine control panel. This switch provides the full amount of current dialed on the Current Control Knob while the arc is being established. then cuts out and you must depress the foot control to provide the amount of current needed to do the weld.
- **Current Switch** - Set to "**remote**" also because of the foot control being away from the panel. "Panel" is for industrial settings where the welding operator is running the automatic production equipment from the "panel."

- **Current Control** - Set this before entering the booth. The white band is the high range, the black band is the low range determined by the lever knob in the third row down of controls. Set the current control knob for about 20% more current than what is believed to be needed. Don't set this control higher than 20% because it affects the "Contactor" and the burst of current crossing the arc gap to start the welding process. Also, the higher the amperage setting made, the more difficult to get a precise control of the necessary welding heat from the foot pedal. (With a high setting, a slight movement of the foot pedal is a major difference in the heat provided for the welding process.
- **Voltmeter** - While welding, an observer should see this meter running about 18 - 21 volts. The voltage varies by the size of the arc gap being used. A large arc gap will require more voltage for the arc to be maintained, a smaller gap will take less.) A proper arc gap will be 18 - 21 volts.
- **Ammeter** - Again an observer can see the amperage actually used vs. the amperage dialed on the "Current Control" knob. If the indicator fluctuates, the operator is varying the foot control.
- **Power Light** - Do not use the welder if this light fails to come on. Call instructor immediately. The "power light" is electrically connected to all circuit boards in the machine and is a way of checking that the system is functioning correctly before it is used.

Second Row of Controls -

- **High Frequency Switch** - A three position switch. **Start** position is for all metals except aluminum. **Off** position is for using the machine in standard arc welding, and **Continuous** is for continuous high frequency as used for aluminum and aluminum alloys. If the switch is to "Start" there will be a burst of high frequency current to help establish the arc, then the high frequency will cut out leaving a quiet DC arc. "Continuous" means the high frequency will continuously be on for aluminum welding.
- **Crater Fill** - At the end of all welds there is a dished out crater. This occurs in TIG from the force of the arc. "Crater Fill" can be used to eliminate this problem at the end of a weld. Run all the welds first without "Crater Fill." Put "Crater Fill" to "In" and repair all the craters at the end of the welds.
- **Start Current Switch and Knob** - The "Contactor" and this switch work together. This switch controls the size of arc gap the current will jump to start the arc. Set this switch and knob for 1 1/2 to 2. To set it higher may cause the arc to jump a gap so large the operator is not expecting this to happen - it becomes dangerous.

- **AC Balance Switch and Knob** - This machine produces a "square" high frequency wave pattern. Below you see a normal pattern, a setting of "1" on the knob, and a setting of #10 on the knob. If the setting is "1" the arc will have a maximum cleaning affect on the base metal surface. A "10" setting would give a maximum penetration affect to the depth of the weld on the base metal.



- **Post Flow Timer** - Use a ratio of 10 - 1 on this control. For every 10 amperes set on the "Current Control" knob, give the "Post Flow Timer" 1 second increase in time. This controls the length of time the inert gas will flow after breaking off the arc. The advantages of a post flow of gas are:
 - Cool down the torch
 - Cool the tungsten electrode in an inert environment - prevents surface oxidation which will contaminate the upcoming welds.
 - Keeping the torch over the end crater of the weld during post flow time allows the end of the weld to solidify in an inert environment.
- **Power Switch** - Turns power on/off.

Third Row of Controls -

- **AC, DC Lever** - Allow selection of AC or DC current. AC is used for aluminum and aluminum alloys. DC is used for all other metals. If set at AC, the "High Frequency" switch must be set at "Continuous," if set at DC, the "High Frequency" switch must be set at "Start."
- **Polarity Lever** - This relates to "DC" current only. It allows for the selection of DCSP (Direct Current Straight Polarity) or DCRP (Direct Current Reverse Polarity). DCRP is to put a ball on the end of the tungsten electrode to probably then be used for aluminum welding. DCSP is used for welding on all metals except aluminum. **NEVER LEAVE THIS LEVER ON "REVERSE," EXCEPT WHEN PUTTING A BALL ON THE ELECTRODE!** This is usually for a matter of two - three seconds actual "on" time. Failure to slide the lever off the DCRP position will result in serious meltdown damage inside the torch. This will happen in a matter of seconds! As soon as finished balling the electrode, get this control off DCRP!

- **Range Lever** - This relates to the "Current Control" knob. "High" position provides for use of the White band, "Low" position uses the Black band.

DEMONSTRATION NOTES AND THOUGHTS

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TIG Welding Introduction (Cont.)

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