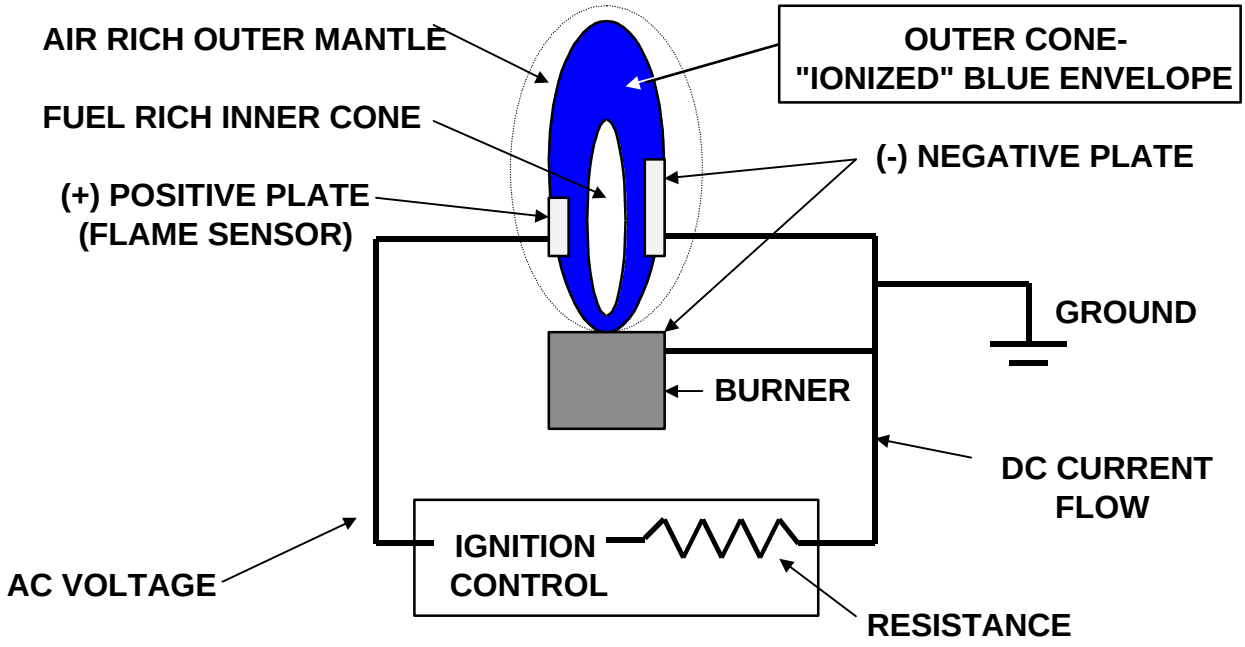
FLAME RECTIFICATION

PRINCIPLES OF OPERATION

THE PROCESS OF BURNING A FUEL GAS THAT HAS BEEN MIXED WITH AIR CAN BE DESCRIBED AS A CONTROLLED EXPLOSION. WITH A CONSTANT SUPPLY OF GAS, THESE SERIES OF CONTROLLED EXPLOSIONS CAUSE THE ATMOSPHERE OF THE FLAME TO BECOME ELECTRICALLY CHARGED, OR "IONIZED". WHEN LOOKING AT WHAT MAKES UP THE ACTUAL FLAME, WE NOTICE THAT THERE ARE THREE BASIC AREAS. THE INNER CONE IS MADE UP OF MOSTLY UNBURNED GAS. SURROUNDING THIS INNER CONE IS THE MOST IMPORTANT AREA WHICH IS AN ENVELOPE THAT IS DARK BLUE IN COLOR. IN THIS AREA THE FLAME HAS THE GREATEST LEVEL OF IONIZATION. FURTHER BEYOND THIS BLUE CONE CAN BE FOUND THE THIRD SECTION OF THE FLAME WHICH CONTAINS MOSTLY AIR.

WHAT MAKES THE IONIZED BLUE ENVELOPE SO UNIQUE IS THAT IT CAN ACTUALLY CONDUCT ELECTRICAL CURRENT. IMAGINE TAKING A WIRE AND CUTTING IT SO THAT YOU NOW HAD TWO EXPOSED ENDS. NEXT, PLACE EACH END OF THE WIRE ON OPPOSITE SIDES OF THE SAME FLAME. IF YOU WERE THEN TO APPLY AC VOLTAGE TO THE WIRES, THE FLAME WOULD BECOME PART OF THE ELECTRICAL CIRCUIT. ALTERNATING CURRENT, KNOWN AS AC, WOULD FLOW THROUGH THE FLAME AND THE WIRES. THIS IN ITSELF WOULD NOT DO US MUCH GOOD BECAUSE THE SAME THING WOULD HAPPEN WHEN YOU SIMPLE TOUCH THE TWO WIRES TOGETHER.

IF INSTEAD OF USING JUST WIRE YOU WERE TO PUT PLATES OF METAL ON THE ENDS OF THE WIRES YOU WOULD INCREASE THE ABILITY TO CONDUCT THE CURRENT THROUGH THE FLAME. IF YOU WERE TO GO ONE STEP FURTHER AND MAKE ONE PLATE VERY LARGE WHILE KEEPING THE OTHER RELATIVELY SMALL, A UNIQUE CHARACTERISTIC WOULD OCCUR TO THE CURRENT AS IT PASSES THROUGH THE FLAME. THE CURRENT WOULD TEND TO FLOW IN ONLY ONE DIRECTION AS IT MADE ITS WAY THROUGH THE FLAME. THE RESULT WOULD BE THAT THE CURRENT WOULD NOW BE DIRECT CURRENT, OR DC. WE CALL THIS EFFECT FLAME RECTIFICATION SINCE THE CURRENT IS RECTIFIED FROM AC TO DC. THE FIGURE BELOW SHOWS THIS ARRANGEMENT:



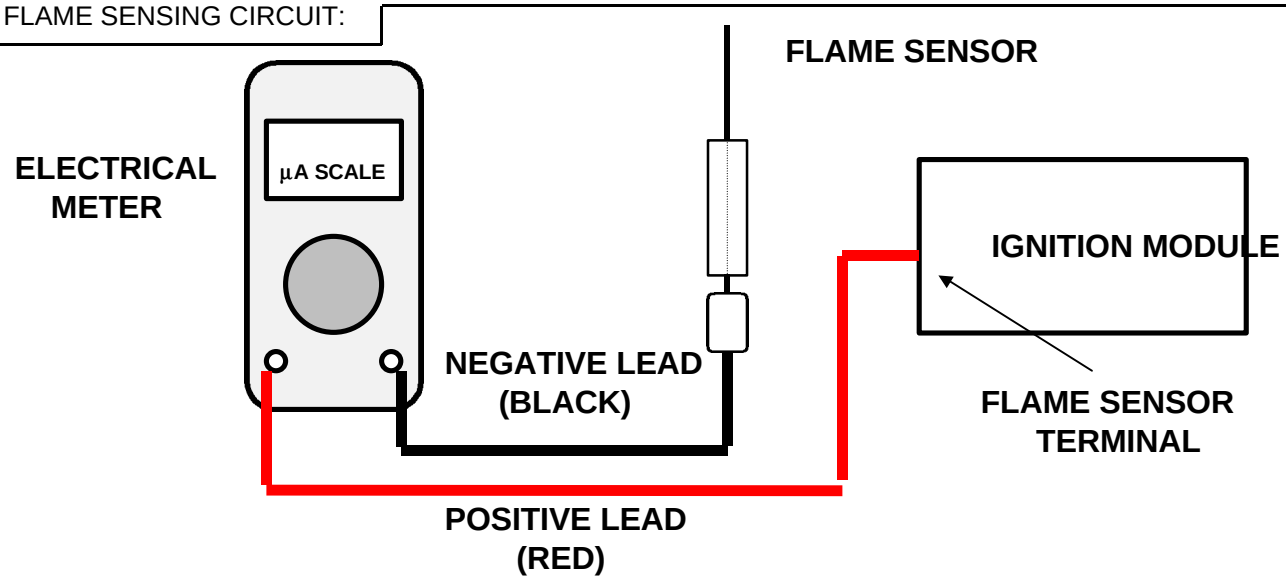
IN THIS TYPE OF CIRCUIT, THE SMALL PLATE IDENTIFIED IN THE DRAWING IS THE ACTUAL FLAME SENSOR. THE LARGER PLATE IS THE PILOT HOOD OR BURNER ITSELF. NOTICE THAT THE SIDE OF THE CIRCUIT THAT IS OPPOSITE OF THE FLAME SENSOR IS ALSO GROUNDED. PROPER ELECTRICAL POLARITY AND GROUNDING ARE CRITICAL TO THIS TYPE OF FLAME SENSING SYSTEM.

FLAME CURRENT MEASUREMENT

BEFORE PROCEEDING WITH MEASURING FLAME CURRENT THE FOLLOWING CHECKS MUST BE MADE TO THE ELECTRICAL SYSTEM:

- MEASURE THE LINE VOLTAGE INTO THE UNIT. IT MUST BE WITHIN 10% OF THE NAMEPLATE VOLTAGE
- IF THE UNIT IS A SINGLE PHASE APPLIANCE, CHECK FOR PROPER POLARITY. THIS MUST BE DONE BY MEASURING FOR VOLTAGE BETWEEN THE HOT POWER LEAD AND GROUND. IT SHOULD BE WITHIN 10% OF THE NAMEPLATE RATING. NEXT MEASURE BETWEEN THE NEUTRAL POWER WIRE AND GROUND TO BE SURE NO VOLTAGE IS PRESENT.
- IF THE IGNITION CONTROL UTILIZES LOW VOLTAGE FOR THE FLAME SENSING CIRCUIT, MAKE SURE THAT THE LOW VOLTAGE TRANSFORMER IS WIRED PROPERLY AND THAT THE CONTROL VOLTAGE IS WITHIN 10% OF ITS RATING.
- CHECK ALL OF THE GROUND WIRE CONNECTIONS IN THE UNIT TO MAKE SURE THEY ARE CLEAN AND TIGHT.

THE FOLLOWING DIAGRAM SHOWS HOW TO PROPERLY HOOK UP A DC CURRENT METER TO THE FLAME SENSING CIRCUIT:



NOTES: 1. THE METER MUST BE CAPABLE OF MEASURING MICRO AMPS (µA). ONE µA IS ONE MILLIONTH OF AN AMP (.000001 AMP). SOME IGNITION MODULES USE MINIMUM FLAME CURRENT SETTINGS AS LOW AS 0.10 µA. A 20 µA SCALE IS RECOMMENDED.

2. WHEN LOW MICRO AMPS (µA) READINGS ARE OBSERVED, CLEAN THE FLAME SENSOR WITH STEEL WOOL. **NEVER USE SAND CLOTH.** MAKE SURE THAT THE SENSOR IS POSITIONED PROPERLY IN THE FLAME BEFORE RE-TESTING.

3. CONDEMN THE IGNITION MODULE ONLY AFTER FOLLOWING ALL OF THE ABOVE STEPS AND NOTES.

MINIMUM FLAME CURRENT REQUIREMENTS			
MANUFACTURER	**MODEL**	**CONTROL VOLTAGE**	**MINIMUM CURRENT**
FENWALL	05-14*	120 VOLTS	5.0 µA
JOHNSON CONTROLS	G60	120 VOLTS	0.7 µA
JOHNSON CONTROLS	G60	25 VOLTS	0.7 µA
JOHNSON CONTROLS	G65 / G66 / G67	24 VOLTS	0.2 µA
JOHNSON CONTROLS	G770 /G775 / G776	24 VOLTS	0.15 µA
JOHNSON CONTROLS	G951*DB-1401 & 1402	24 VOLTS	0.1 µA
JOHNSON CONTROLS	G951ADB-1403	120 VOLTS	0.2 µA
WHITE-RODGERS	50D47 / 50E47 / 50F47	25 VOLTS	2.0 µA
WHITE-RODGERS	50A50 - 209/230		.30 µA
WHITE-RODGERS	50A50 - 241		.15 µA