Westinghouse

Single Anode Ignitron
4-, 6- and 9-Inch Anode Tubes

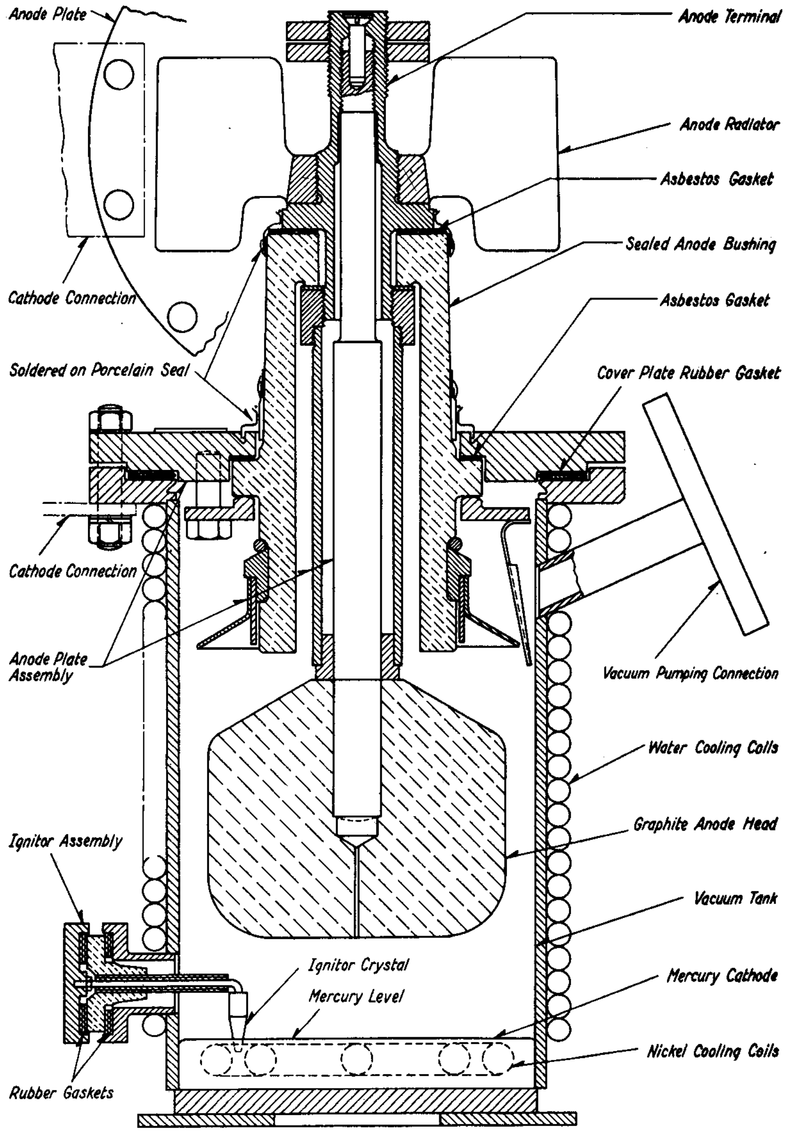

FIG. 1 – SINGLE ANODE METAL TUBE IGNITRON

GENERAL:

The Ignitron is a mercury arc rectifier consisting of a single anode, a single mercury pool cathode and a special ignitor enclosed in a steel tank. The ignitor functions differently from other starting and excitation systems in that it establishes a cathode spot on the mercury cathode at the desired instant each cycle, thereby allowing power to flow during the positive portion of the cycle. The arc is permitted to become extinguished entirely at the end of each conducting period.

When positive potential is applied to an anode of a mercury arc rectifier, current will not flow until a cathode spot has been established on the mercury pool. This spot can be formed by partially immersing certain crystal substances in the mercury pool and passing current through this substance into the cathode. The order of magnitude of the current taken by the crystal is a peak of 30 amperes, and an average of 1/2 to 1/4 ampere. The voltage at which the arc strikes is of the order of 50 to 100 volts. A small rectifier tube in series with the ignitor prevents reverse currents from passing through the crystal during periods of reverse potentials on the Ignitron rectifier. If voltage control is desired, the grid of the auxiliary rectifier is controlled, thereby changing the time of establishing the cathode spot and consequently changing the pick-up time of the anode.

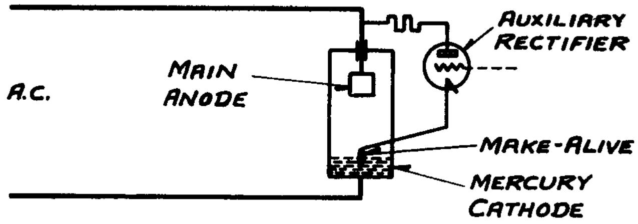

FIG. 2 – SCHEMATIC DIAGRAM OF IGNITRON FOR USE AS A RECTIFIER

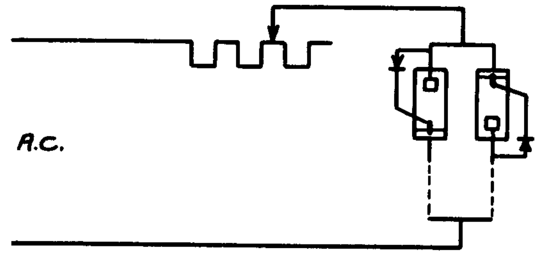

FIG. 3 – SCHEMATIC DIAGRAM OF A PAIR OF IGNITRONS FOR USE AS A CONTROLLED SWITCH

CONSTRUCTION:

The Ignitron consists of a steel cylinder, the lower portion of which forms the mercury pool cathode. The upper flange, tank bottom, ignitor assembly tube and pumping connection are welded to the tank by the atomic hydrogen process to form vacuum tight joints. The anode is made of graphite and is held in place by a copper rod that conducts the power current from the terminal to the graphite head. The anode assembly is insulated from the Ignitron tank by a porcelain bushing. The porcelain bushing is mounted in the anode plate, its vacuum joints being made by solder to porcelain seals, and the assembly is bolted to the upper tank flange. The vacuum joint between the anode plate and upper flange is made by a rubber gasket that is protected with a special iron "V" ring.

In the larger size tubes the cathode mercury is cooled by passing water through an immersed nickel tube in the cathode pool. The Ignitron tube is cooled by copper tubing wrapped over the entire side wall. In the smaller tubes which are built without the immersed nickel tubes in the mercury pool, the copper tubing extends over the bottom. This tubing is soldered to the steel shell to obtain good thermal contact. This type of cooling not only affords better thermal efficiency, but makes the cooling system non-corrosive.

DEGASSING:

When the interior of an Ignitron has been subjected to atmospheric pressure, it should be degassed before placing in normal operation. Ignitrons for welding service need only a short period of degassing.

In degassing, it is preferable to use a low voltage source of sufficient current capacity to load the Ignitrons at full load current. Figures 2 and 3 show typical connections for an Ignitron operating as a rectifier and a welder. If low voltage is not available, full voltage may be used, but caution should be observed to apply the load gradually at first so that high pressures are avoided.

After the mercury vapor vacuum pump has been energized for approximately 3/4 to 1 hour, then 1/4 full load current should be applied to the rectifier for 1 hour. Following this, the load should be increased to 1/2 full load for 1 hour; 3/4 full load for 1 hour and full load for 1 hour. The water outlet temperature should be approximately 40 degrees C.

At the end of 1 hour's operation at full load, if the load is steady the Ignitrons are sufficiently degassed for normal operation; however, if the load is not steady, this indicates high gas pressure in the tubes and full load should be continued until steady operation is obtained.

SERVICE OPERATION:

The method of operation of Ignitrons depends upon the application and may be slightly different for each installation. In general, it is only necessary to have a good vacuum and to have cooling water flowing before energizing the mercury vapor vacuum pump or tubes. The flow of cooling water must be adjusted so that the discharge does not exceed 40 degrees C. under maximum load conditions.

TROUBLES AND MAINTENANCE

A. Loss of Vacuum

If erratic operation is experienced, and it is certain that the control apparatus is in perfect order, it may be due to loss of vacuum. An unusual sound of the rotary pump gives an indication of a large leak. By alternately opening and closing the hand valve, the sound of the pump will indicate whether the leak is in the pumping connections or tubes.

A leak in the Ignitron tubes or pumping connections may be located by filling the suspected apparatus with either dry nitrogen or air (dry nitrogen is less likely to cause deterioration of the interior surfaces) to a pressure not exceeding 20 pounds per square inch and painting the suspected locations with liquid soap and observing if bubbles appear.

If an Ignitron is discovered to be leaking, a spare should be installed and the leaky tube returned to the factory for repair. Both soldering to porcelain and atomic hydrogen welding are much more conveniently done under factory conditions than in the field.

B. Ignitor Failure

If the Ignitron fails to ignite, it may be due to failure of the crystal to touch the mercury. This can be determined by ringing through from the ignitor terminal to the tank. If no circuit exists the crystal should be readjusted by slightly changing the position of the ignitor flange. If this does not make a circuit, the ignitor should be removed, inspected and repaired, or a new one inserted if necessary.

OVERHAUL

When it is necessary to remove the anode plate the mercury in the cathode should be inspected. If the mercury is only slightly oxidized it should be skimmed off; however, if the mercury is quite dirty, it should be replaced.

The quantity of mercury to be added depends upon the size of the Ignitron tube, as follows:

4" Anode Tube 7/16" of mercury in cathode
6" Anode Tube 1" of mercury in cathode
9" Anode Tube 1" of mercury in cathode

The mercury level in the cathode should be increased or decreased to correspond to the above values, any time the Ignitron is opened. If the mercury level is different from the above values, the mercury vapor vacuum pump should be inspected for its correct quantity of mercury.

When an Ignitron is opened the dirty parts should be cleaned. All interior parts should be handled only with clean cotton gloves. Metal parts may be cleaned with a sand blast, sand paper or wire brush. The graphite may be smoothed off with sand paper. If parts are burned or broken they should be replaced.

The only periodic maintenance required by the Ignitron tubes is the cleaning of insulating surfaces and flushing out the water circuit if the cooling water deposits sediment or scale.

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