

## IGNITRON TYPE WL-5555A

The WL-5555A is a sealed, stainless-steel jacketed, water-cooled, mercury-pool tube designed primarily for power rectification. In this service six tubes will rectify 600 kilowatts at 300 volts dc and 500 kilowatts at 600 and 900 volts dc. The WL-5555A is also used for alternating current control at 2400 volts, rms. The WL-5555A features an integral thermostat bracket to permit installation of tube temperature-operated safety control circuitry.

### GENERAL DATA

#### Electrical

|                                                                  |           |         |
|------------------------------------------------------------------|-----------|---------|
| Type of Cathode Excitation . . . . .                             |           | Cyclic  |
| Type of Cathode Spot Starting . . . . .                          |           | Ignitor |
| Number of Electrodes                                             |           |         |
| Main Anodes . . . . .                                            | 1         |         |
| Main Cathodes . . . . .                                          | 1         |         |
| Auxiliary Anodes . . . . .                                       | 1         |         |
| Ignitors . . . . .                                               | 2         |         |
| Arc Drop at 600 Peak Amperes (See Figure 13) . . . . .           | 16.2      | volts   |
| Ignitor Excitation Requirements (See page 2 for ignitor ratings) |           |         |
| Separate-Excitation Source (See Figures 2 and 11)                |           |         |
| Open-Circuit Voltage Range . . . . .                             | 450 - 750 | volts   |
| Short-Circuit Current Range . . . . .                            | 45 - 75   | amp     |
| Anode Firing (2400 Volts, Welding Service),                      |           |         |
| 50 ohms in series with ignitor . . . . .                         | Anode     | volts   |

#### Mechanical

|                                                          |                        |
|----------------------------------------------------------|------------------------|
| Mounting Position . . . . .                              | Vertical, cathode down |
| Envelope Material . . . . .                              | Stainless steel        |
| Length, maximum . . . . .                                | 29-3/4 in              |
| Width, not including water connections . . . . .         | 5-3/4 in               |
| Type of Cooling . . . . .                                | water                  |
| Characteristics for Water Cooling, at continuous average |                        |
| current and rated minimum water flow of . . . . .        | 3 gpm                  |
| Water Temperature Rise, maximum . . . . .                | 5 °C                   |
| Maximum Pressure Drop, at 3 gallons per minute . . . . . | 7 lbs/sq in            |
| Net Weight . . . . .                                     | 25 lbs                 |
| Shipping Weight . . . . .                                | 33 lbs                 |

## MAXIMUM RATINGS

AS A POWER RECTIFIER (6-phase double-wye or 3-phase rectifier) See Note 1.

|                                                     |       |       |         |
|-----------------------------------------------------|-------|-------|---------|
| DC Output Voltage, maximum . . . . .                | 300   | 600   | volts   |
| Maximum Voltage Reduction by Phase Retard . . . . . | 0     | 0     | percent |
| Maximum Average Current Per Tube                    |       |       |         |
| Continuous . . . . .                                | 200   | 150   | amp     |
| Two-Hour Overload . . . . .                         | 300   | 225   | amp     |
| One-Minute Overload . . . . .                       | 400   | 300   | amp     |
| Outlet Water Temperature, maximum . . . . .         | 50    | 40    | °C      |
| Inlet Water Temperature, minimum . . . . .          | 3     | 3     | °C      |
| Minimum Water Flow Ratings                          |       |       |         |
| For Recirculating Cooling . . . . .                 | 3     | 3     | gpm     |
| For Direct Raw Water Cooling (See Note 2) . . . . . | 1     | 1     | gpm     |
| Frequency Range . . . . .                           | 25-60 | 25-60 | cps     |

AS AN AC CONTROL (Two tubes in inverse parallel) See Note 3 and Figure 15.

|                                                     |      |       |
|-----------------------------------------------------|------|-------|
| Maximum Voltage, rms . . . . .                      | 2400 | volts |
| Maximum Demand (See Note 4) . . . . .               | 2400 | kva   |
| Average Current at Maximum Demand . . . . .         | 135  | amp   |
| Maximum Average Current . . . . .                   | 207  | amp   |
| Demand at Maximum Average Current . . . . .         | 1105 | kva   |
| Maximum Averaging Time at 2400 Volts, rms . . . . . | 1.66 | sec   |
| Maximum Surge Current, Peak . . . . .               | 6000 | amp   |
| Maximum Duration of Surge Current . . . . .         | 0.15 | sec   |
| Outlet Water Temperature, maximum . . . . .         | 30   | °C    |
| Inlet Water Temperature, minimum . . . . .          | 10   | °C    |
| Minimum Water Flow . . . . .                        | 3    | gpm   |

## IGNITOR RATINGS

For power rectifier or ac control service  
See page 1 for ignitor excitation requirements

| Maximum Voltage    |             | Maximum Current                  |         |
|--------------------|-------------|----------------------------------|---------|
| Positive . . . . . | Anode volts | Peak . . . . .                   | 100 amp |
| Negative . . . . . | 5 volts     | Root Mean Square . . . . .       | 15 amp  |
|                    |             | Average . . . . .                | 2 amp   |
|                    |             | Maximum Averaging Time . . . . . | 10 sec  |

## Note 1.

These ratings are in accordance with American Standards Association Report C34.1-1949 "Pool Cathode Mercury Arc Power Converters for Railway Substations or Mining Service". For ratings apply to other voltages, voltage reduction by phase retard, or various outlet water temperatures See Figure 14.

## Note 2.

For water flow controlled by a thermostatic valve. At highest ambient water temperature and minimum water pressure, water flow must be enough to insure outlet water below maximum rated temperature.

## Note 3.

Rms demand voltage, current, and kva are all on the basis of full-cycle conduction (no phase delay) regardless of whether or not phase control is used.

## Note 4.

With the use of log-log paper, straight-line interpolation between tabulated points may be used for other tabulated ratings of demand kva versus average anode current.

## MAXIMUM FAULT CURRENT RATINGS

The ratio of rated maximum fault current to rated zero-phase-retard continuous average tube current, occurring during the following intervals after fault initiation, shall not exceed the values tabulated below:

| Interval           | Peak Forward | Peak Reverse |
|--------------------|--------------|--------------|
| 0 to .016 second   | 80           | 185          |
| .016 to .05 second | 80           | 130          |
| .05 to .15 second  | 80           | 92           |
| .15 to .20 second  | 55           | —            |

These fault-current ratios are based on field experience and measurements on commercial rectifiers and are to be construed as a basis for circuit design. The fault current has transient components which account for the higher values for the shorter times. The current corresponding to the last interval is the sustained dc short-circuit tube current. It may be used to calculate the minimum transformer commutating impedance ( $Z_c$ ), referred to the secondary, required to insure proper protection of the tubes.  $Z_c$  is determined by the following formula:

$$Z_c = \frac{\sqrt{2} E_s}{I_{ss}}$$

$E_s$  = line to neutral rms voltage of the dc winding in volts

$I_{ss}$  = sustained dc short-circuit current in amperes

$Z_c$  = commutating impedance in ohms

SELF OR ANODE IGNITOR EXCITATION

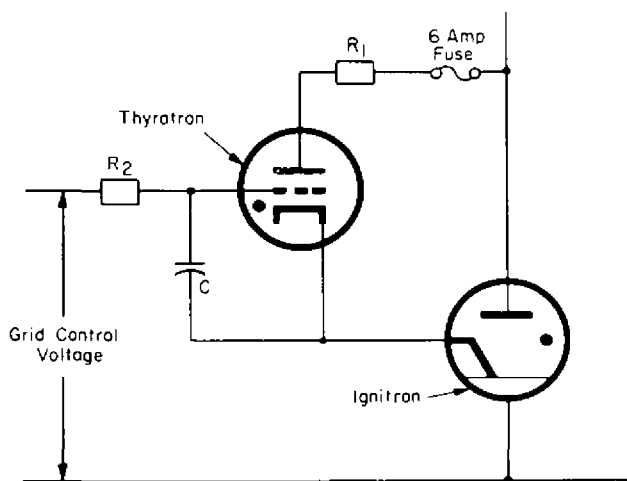


FIGURE 1

SATURATING REACTOR-CAPACITOR SEPARATE EXCITATION IGNITOR CIRCUIT

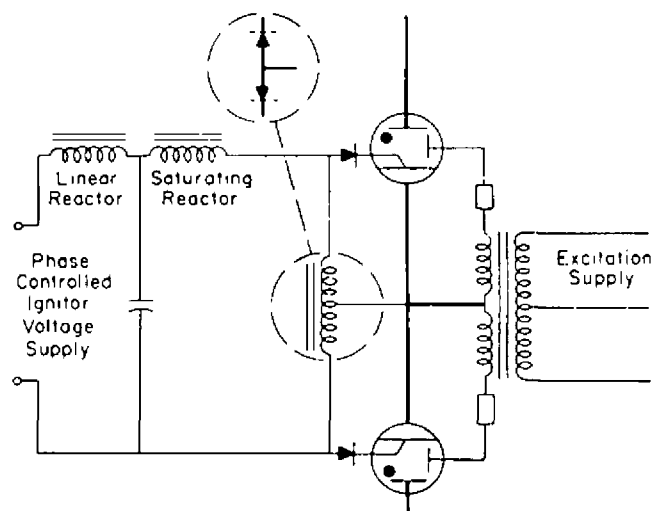


FIGURE 2

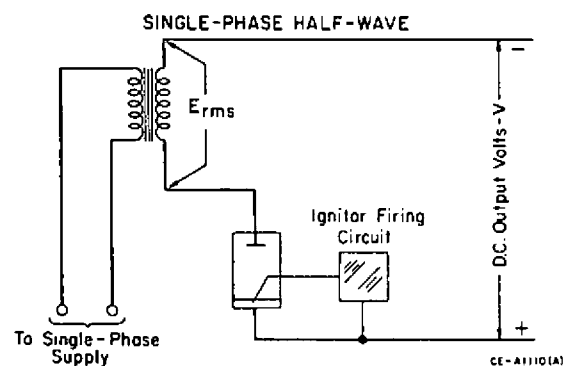


FIGURE 3

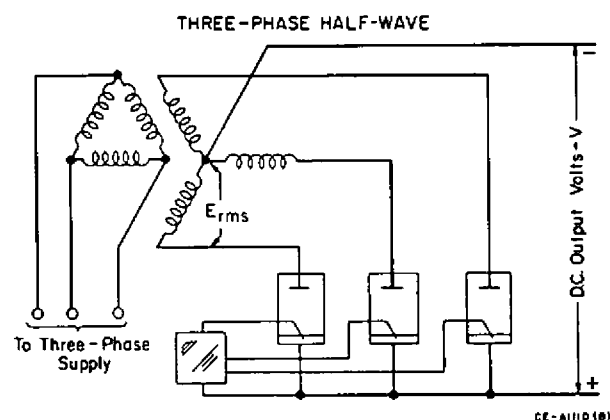


FIGURE 4

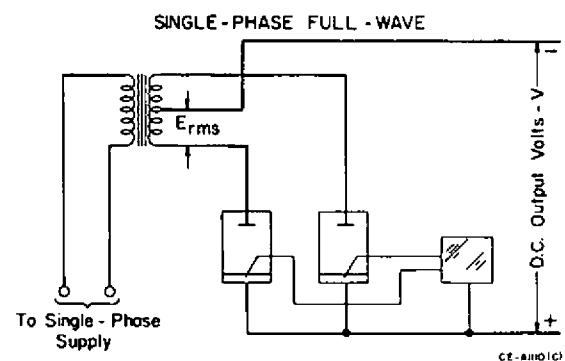


FIGURE 5

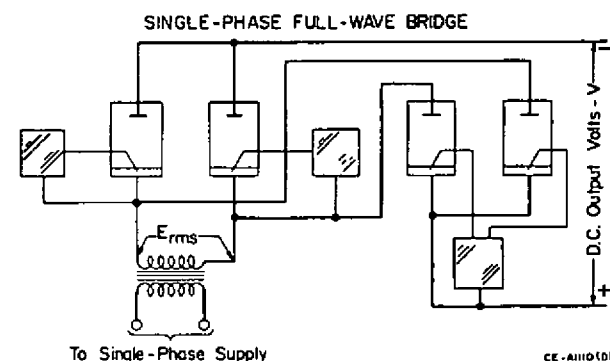


FIGURE 6

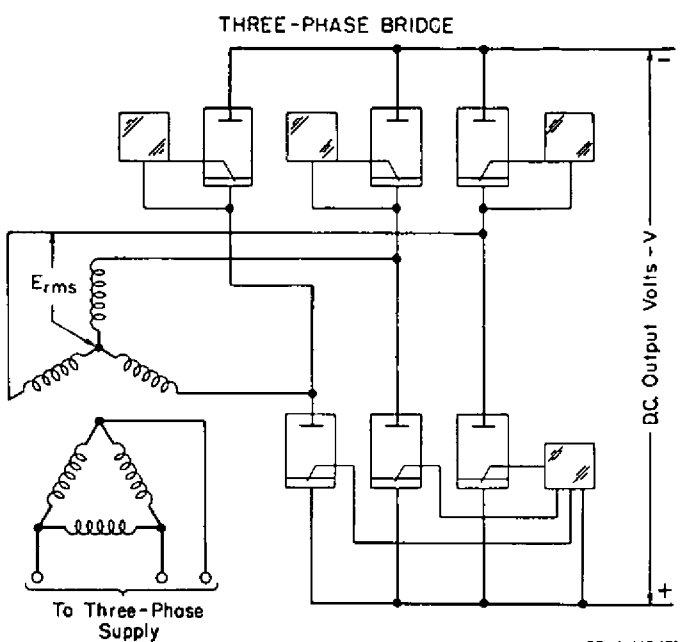


FIGURE 7

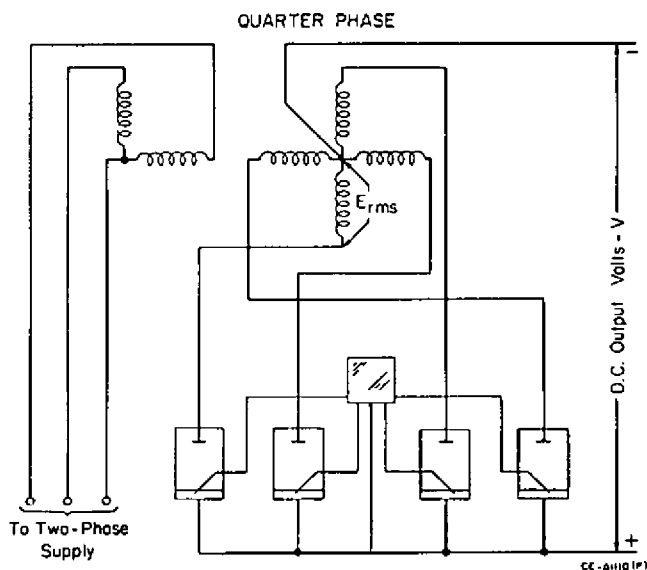


FIGURE 8

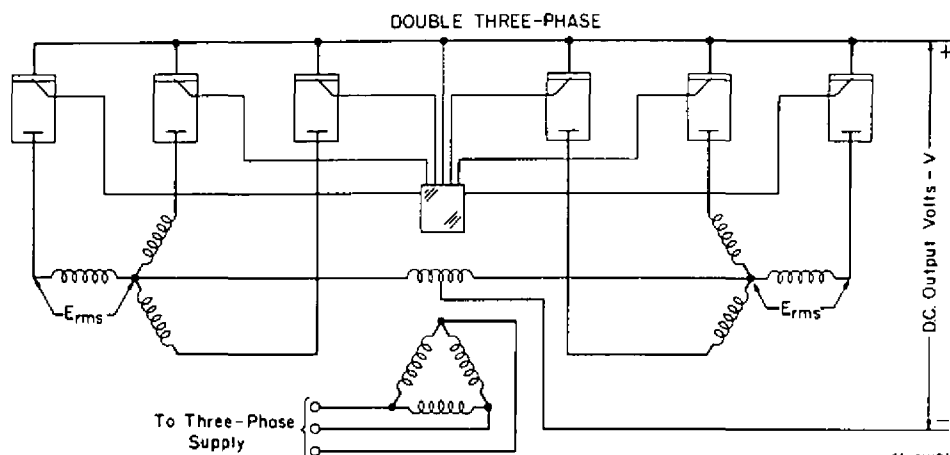


FIGURE 9

The information contained herein is furnished without assuming any obligations. The description and illustration of circuits herein does not convey to the purchaser of tubes any license for circuits under the patent claims of Westinghouse Electric Corporation or others.

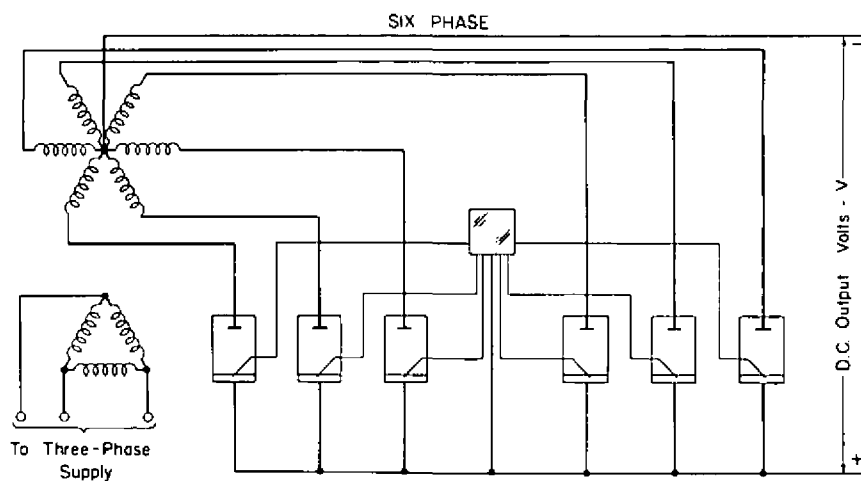


FIGURE 10

|                                      | Symbol         | Fig. 3             | Fig. 4             | Fig. 5             | Fig. 6             | Fig. 7             | Fig. 8            | Fig. 9             | Fig. 10           |
|--------------------------------------|----------------|--------------------|--------------------|--------------------|--------------------|--------------------|-------------------|--------------------|-------------------|
| Transformer Secondary Voltage, rms   | E              | 2.22V              | .854V              | 1.11V              | 1.11V              | .427V              | .785V             | .854V              | .740V             |
| Peak Inverse Voltage                 | E <sub>1</sub> | 1.41E              | 2.45E              | 2.83E              | 1.41E              | 2.45               | 2.83E             | 2.45E              | 2.83E             |
| Peak Inverse Voltage                 | E <sub>1</sub> | 3.14V              | 2.09V              | 3.14V              | 1.57V              | 1.05V              | 2.22V             | 2.09V              | 2.09V             |
| Anode Current, rms                   | I              | 1.57A              | 0.578A             | 0.785A             | 0.785A             | 0.578A             | 0.500A            | 0.289A             | 0.408A            |
| DC Output Voltage, average           | V              | —                  | —                  | —                  | —                  | —                  | —                 | —                  | —                 |
| DC Output Voltage, peak              | V <sub>1</sub> | 3.14V              | 1.21V              | 1.57V              | 1.57V              | 1.05V              | 1.11V             | 1.05V              | 1.05V             |
| Major Ripple Voltage, rms            | V <sub>2</sub> | 1.11V              | 0.177V             | 0.472V             | 0.472V             | 0.04V              | 0.106V            | 0.04V              | 0.04V             |
| Major Ripple Frequency               | f              | f                  | 3f                 | 2f                 | 2f                 | 6f                 | 4f                | 6f                 | 6f                |
| DC Output Current, average           | A              | —                  | —                  | —                  | —                  | —                  | —                 | —                  | —                 |
| Anode Current, peak (resistive load) | A <sub>1</sub> | 3.14A              | 1.21A              | 1.57A              | 1.57A              | 1.05A              | 1.11A             | 0.52A              | 1.05A             |
| Anode Current, peak (resistive load) | A <sub>1</sub> | 3.14A <sub>3</sub> | 3.63A <sub>3</sub> | 3.14A <sub>3</sub> | 3.14A <sub>3</sub> | 3.15A <sub>3</sub> | 4.5A <sub>3</sub> | 3.15A <sub>3</sub> | 6.3A <sub>3</sub> |
| Anode Current, peak (inductive load) | A <sub>2</sub> | —                  | A                  | A                  | A                  | A                  | A                 | 0.5A               | A                 |
| Anode Current, average               | A <sub>3</sub> | A                  | 0.33A              | 0.5A               | 0.5A               | 0.33A              | 0.25A             | 0.167A             | 0.167A            |
| Transformer Primary Volt-Amperes     | —              | 3.49VA             | 1.21VA             | 1.11VA             | 1.11VA             | 1.05VA             | 1.11VA            | 1.05VA             | 1.29VA            |
| Transformer Secondary Volt-Amperes   | —              | 3.49VA             | 1.71VA             | 1.57VA             | 1.11VA             | 1.05VA             | 1.57VA            | 1.48VA             | 1.81VA            |
| Line Volt-Amperes                    | —              | 3.49VA             | 1.21VA             | 1.11VA             | 1.11VA             | 1.05VA             | 1.11VA            | 1.05VA             | 1.05VA            |

## NOTES

Symbols E and V are shown on circuit diagrams. Allowance must be made for voltage drop in tubes, transformer and circuit.

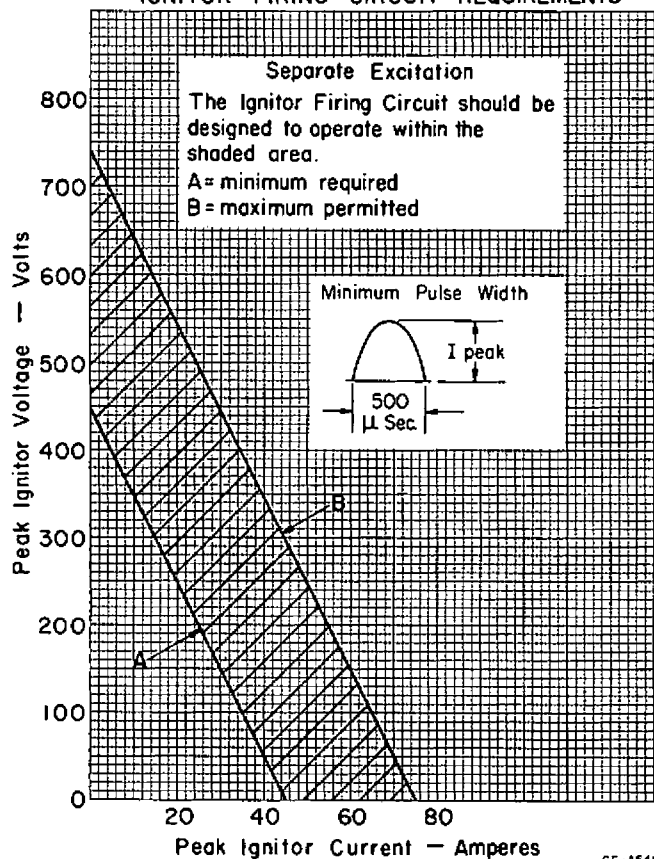
Circuit, Figure 3 results in considerable transformer unbalancing with consequent reduction of kva output.

Peak inverse voltage 2.45E, Figure 9, becomes 2.83E for light loading.

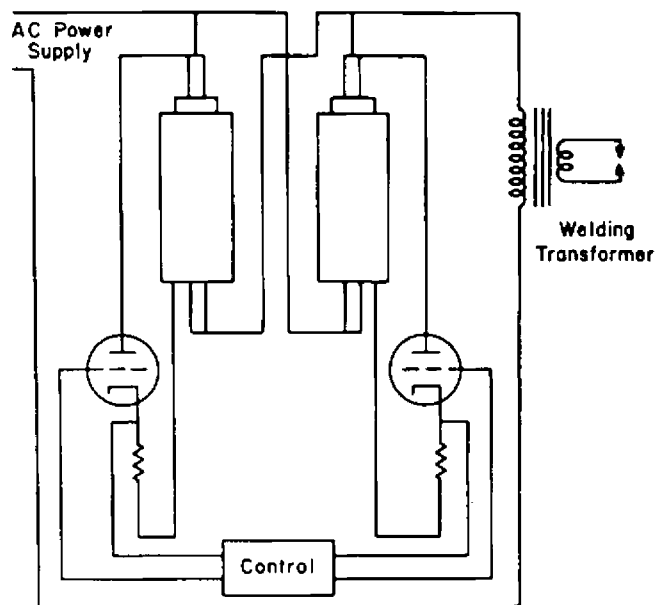
Ratios given are on the assumption that there is no back emf in the load circuit and no phase-back.

Primary volt-amperes required do not include transformer losses which must be considered.

## IGNITOR FIRING CIRCUIT REQUIREMENTS



## CIRCUIT DIAGRAM OF WELDER USING IGNITRONS AND THYRATRONS

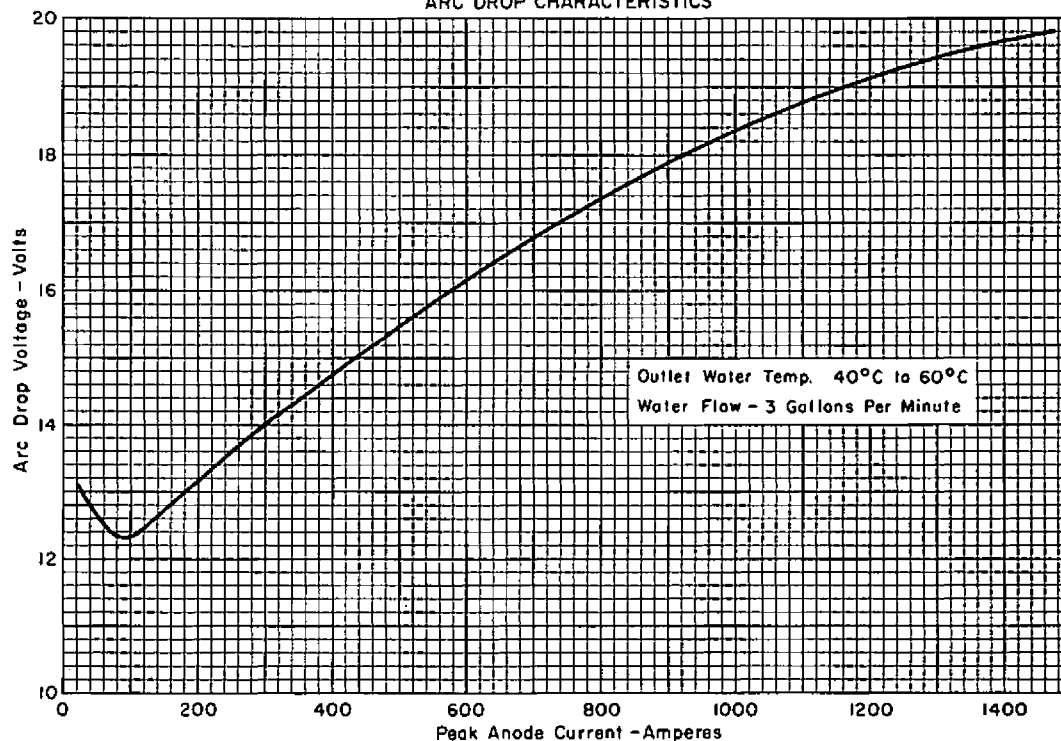


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FIGURE 12

FIGURE 11

## ARC DROP CHARACTERISTICS



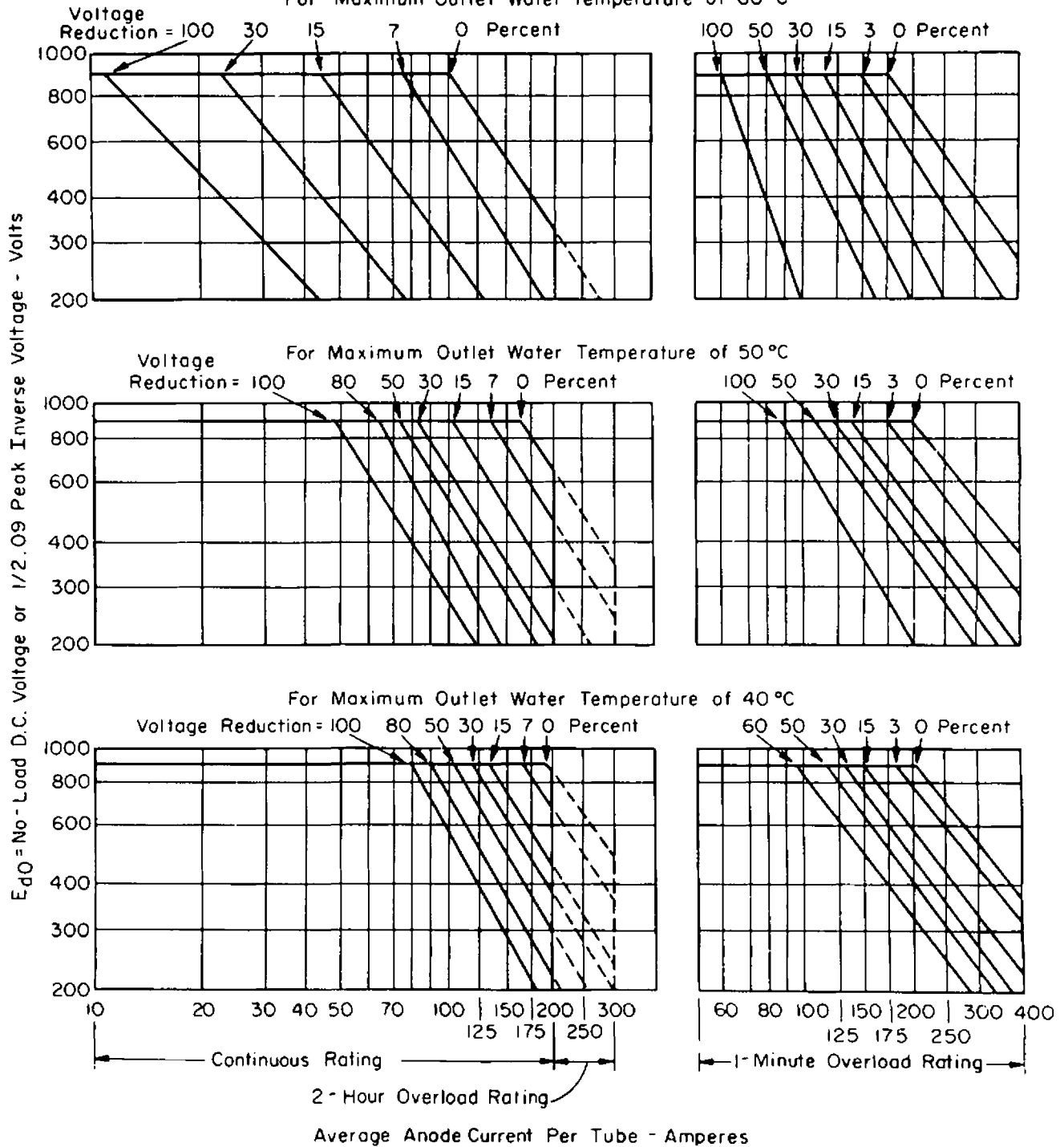
CE-A843

FIGURE 13

## RATING CHART FOR SIX-PHASE DOUBLE - WYE OR THREE - PHASE RECTIFICATION SERVICE

Showing  
D.C. Output Voltage and Current  
Percent Voltage Reduction by Phase Retard

For Maximum Outlet Water Temperature of 60°C



CE-A544

FIGURE 14

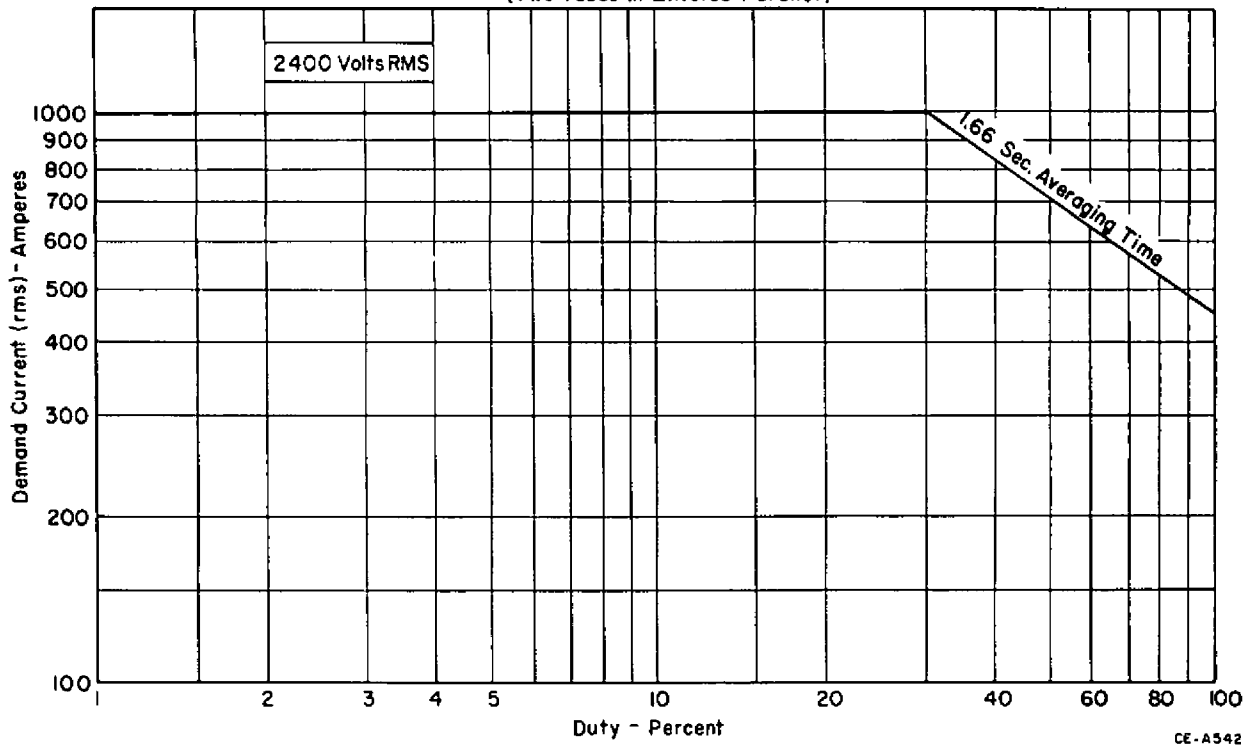
A.C. CONTROL TUBE RATINGS  
(Two Tubes in Inverse Parallel)

FIGURE 15

CE-A542

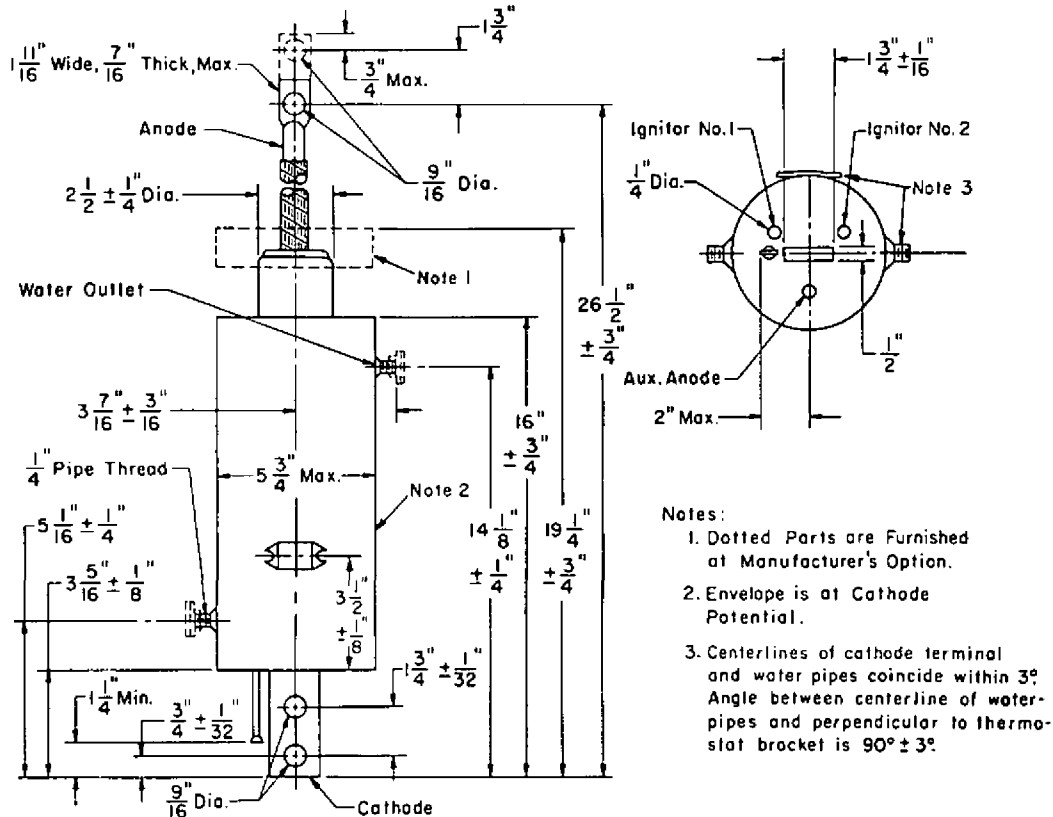


FIGURE 16

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