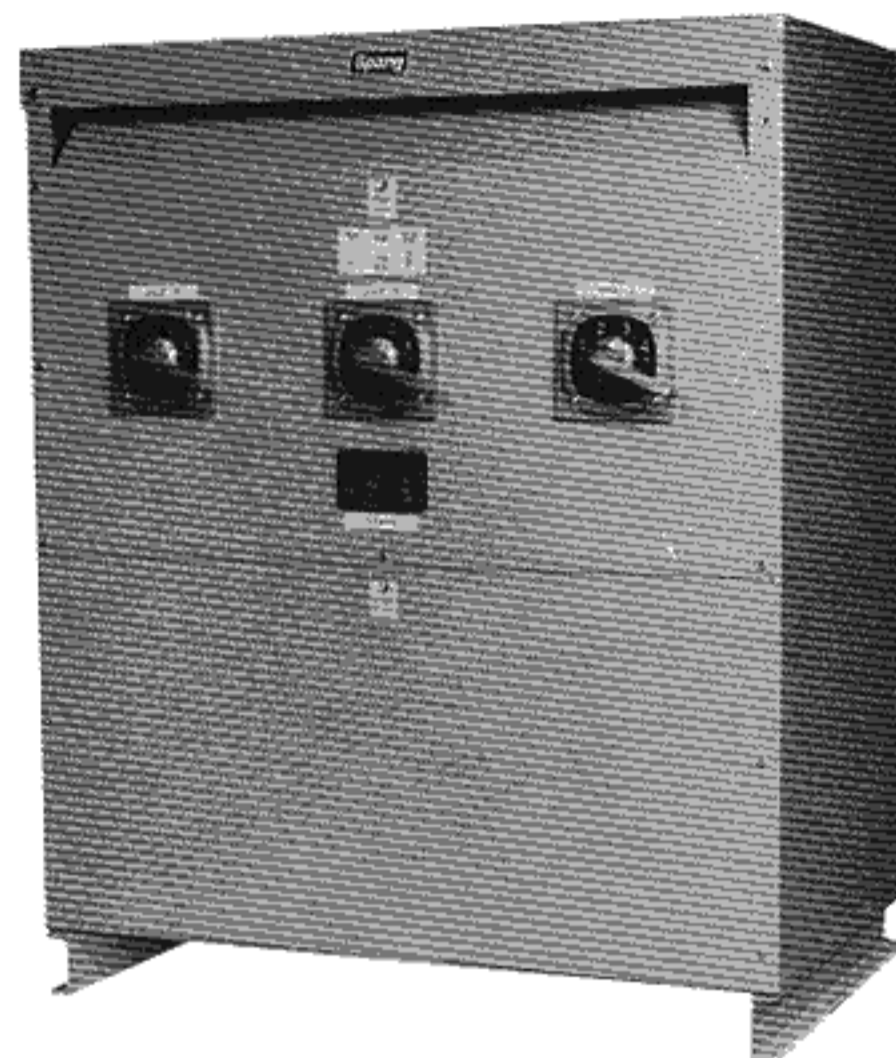


## **FURNACE TRANSFORMERS**



### **Furnace Transformers**

- Silicon Carbide
- Molybdenum
- Graphite
- Salt Bath

### **Scott Connected Transformers**

### **Saturable Core Reactors**

#### **STANDARD FEATURES**

- Single and Three Phase styles through 10,000 kva
- 220°C insulation System
- Designs for 80°C through 150°C temperature rise available
- Low loss grain oriented core construction
- Copper and aluminum conductor designs
- Core and coil or enclosed units available
- 50 hertz, 60 hertz, and 50/60 hertz designs available

SPANG offers a full line of Dry Type Specialty Transformers designed to provide the voltage matching capability and ratings required by a variety of heating elements.

#### **Silicon Carbide Heating Elements**

Silicon carbide heating elements change resistance with age. Over the useable life span of the element, resistance can increase as much as four times. In order to deliver full power to the elements over the resistance range, a means of increasing voltage over a two-to-one range must be provided. Multi-Tapped Furnace Transformers provide this voltage matching capability.

A typical multi-tapped transformer for manual or contactor control might have six (6) coarse and six (6) fine taps to provide a two-to-one output voltage range with 36 steps, each rated at full load kva.

When coupled with proportional power controllers such as Silicon Controlled Rectifier (SCRs) or Saturable Core Reactors, the fine taps can be eliminated. With the SCR proportional control device, five (5) coarse taps provide infinite voltage control over the entire two-to-one range with a high power factor (0.80 or better).

The transformer and taps are designed to deliver full rated power over the operating range. A sixth reduced power tap is provided at 70% of the lowest full power tap voltage for use in start-up and reduced power holding conditions. The transformer is designed for primary proportional control with saturation and losses controlled by use of high quality, grain oriented core steel.

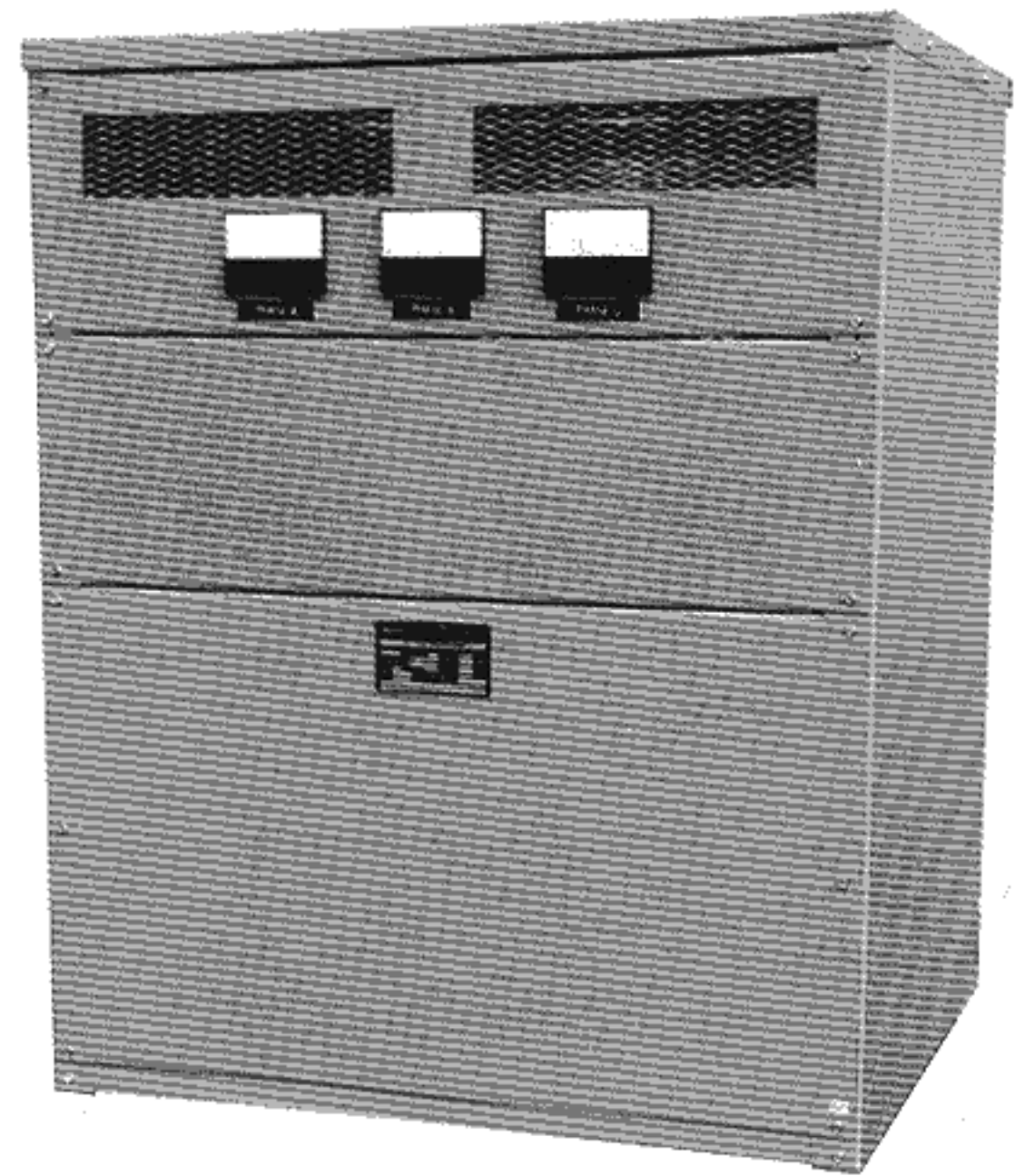
## Molybdenum and Graphite Heating Elements

Molybdenum and graphite elements generally are operated at lower voltages (approximately 50 volts) and associated higher currents. These elements change resistance with temperature. At room temperature their resistance can be as low as 5% of the nominal resistance seen at operating temperatures.

For contactor or manually controlled heating applications, reduced voltage taps are required to avoid overloading the system during the cold element's low resistance stage. For furnaces up to 500 kw, the secondary taps are typically selected at one third, two thirds and full operating voltage. For larger furnaces, finer taps may be desired, such as one quarter increments of operating voltage. Since the current will be higher than nominal when each voltage is first applied, some oversizing of the electrical system, including the transformer, is desirable. For finer control, additional taps may be specified.

SCR control and saturable core reactors offer proportional power control which allows use of a less complicated transformer and simplifies furnace operation. By using a SPANG SCR Power Control Unit with RMS Current Limit and soft start ramp of several seconds, it is possible to bring the furnace up quickly and safely without secondary taps.

Spang Power Electronics Furnace Transformers are available in Single Phase, Three Phase and Scott Connected designs. They can be provided as core/coil units or in a variety of enclosures. Accessories such as tap switches and meters are available. Complete power centers can also be provided including SPANG SCR Power Control Units.



300 kva for Graphite — with Ammeters

### TO ORDER, SPECIFY:

- Load kw
- Heating element type
- Input voltage - phase and frequency
- Output voltages desired or "nominal" voltage required when elements are new and at operating temperature
- Output configuration - single phase, two phase, three phase ( 3, 4, or 6 wire)
- Temperature rise - 80°C, 115°C or 150°C
- Enclosure
- Other features and accessories

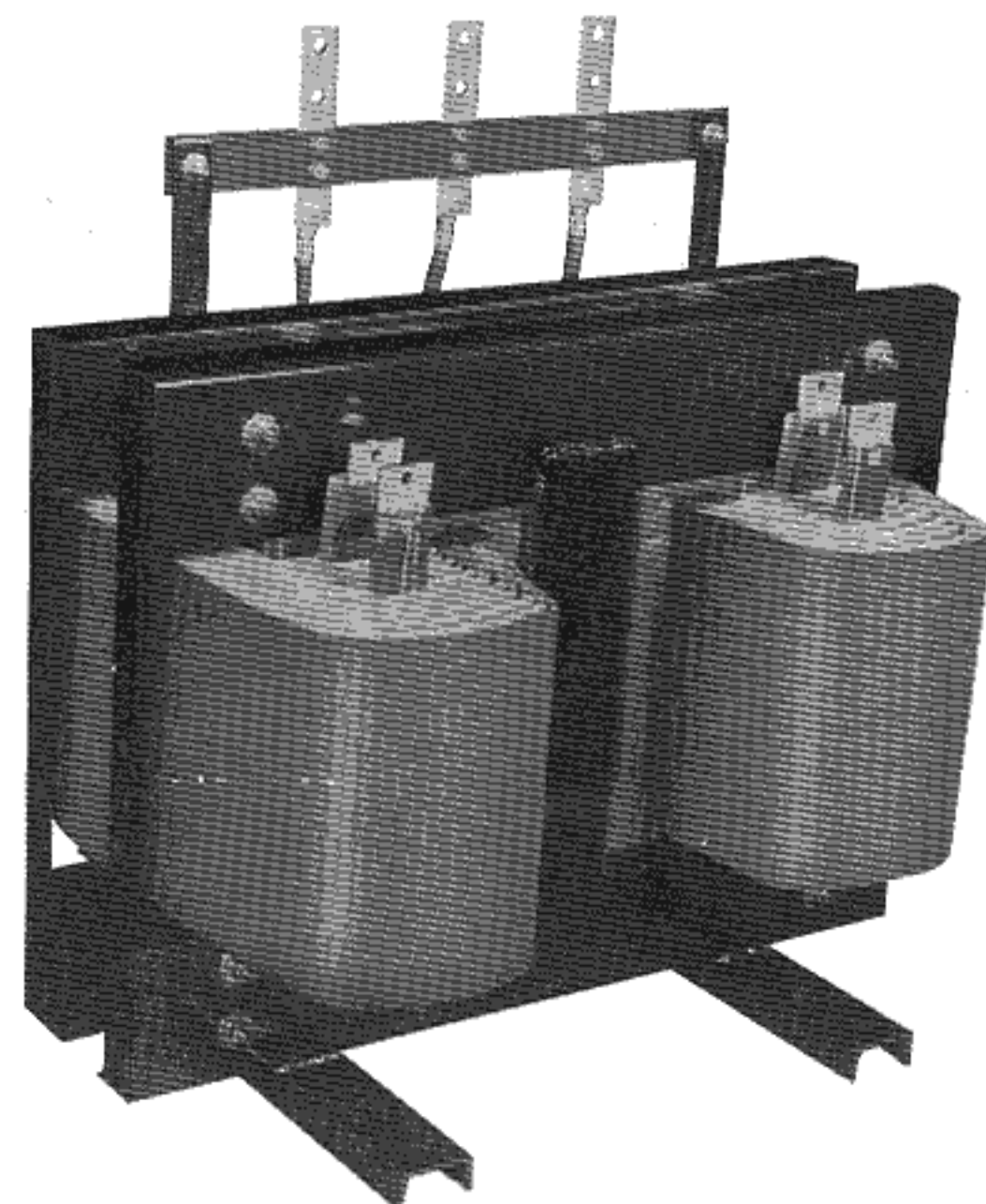
## Scott Connected Transformers—Phase Changers

The majority of electric power is distributed with a three phase network. For two phase loads, particularly existing machinery, balancing a two phase (or two single phase) load on a three phase line requires a three phase to two, phase transformer.

Spang Power Electronics Scott Connected Transformers (phase changers) offer a wide range of three-to-two phase transformation. They provide two phase outputs while drawing balanced power from a three phase input. They can be designed for special purposes such as furnace and glass melting applications.

### TO ORDER, SPECIFY:

- Load kva
- Input voltage, phase and frequency
- Output voltage, two phase (3,4, or 5 wire)
- Temperature rise - 80°C, 115°C, or 150°C
- Enclosure ● Other features and accessories

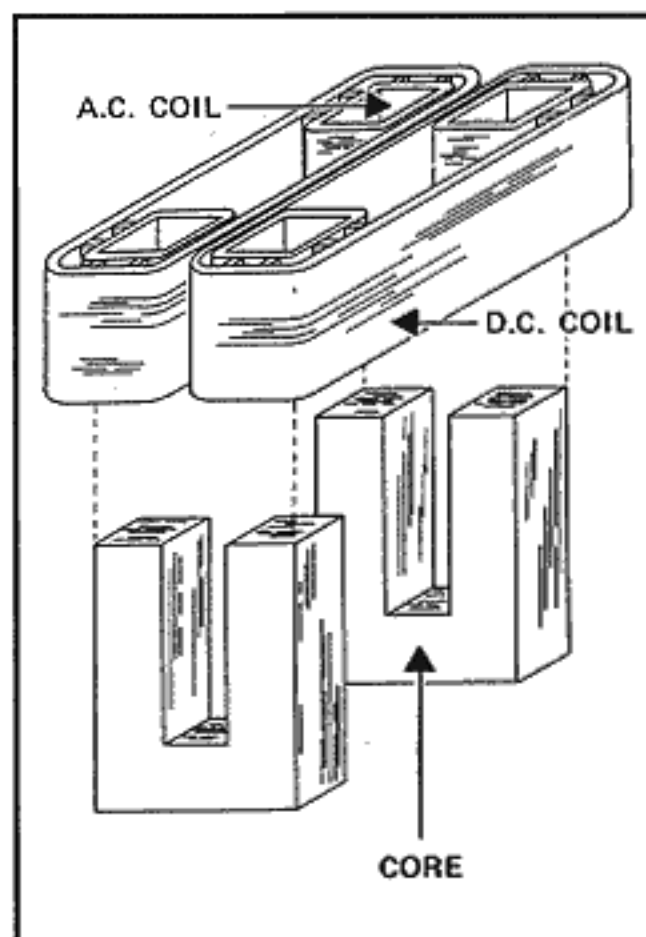


## Saturable Core Reactors

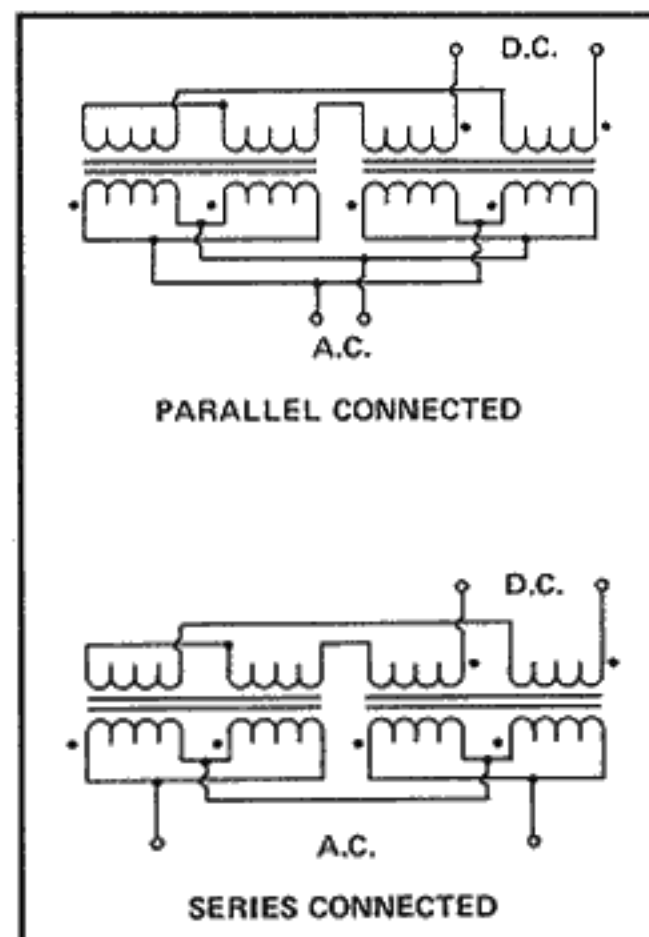
A saturable core reactor is a magnetic device used for proportional control of AC power to resistive heating elements.

Spang Power Electronics Saturable Core Reactors provide this control in a stepless and smooth manner, and only small amounts of DC control power are required. The source of DC power is usually a magnetic amplifier or a silicon controlled rectifier driver (see pg. 33).

A SPANG Saturable Core Reactor operates as a variable impedance controlled by a direct current within the limits of the design voltage and load. With zero DC control current, the reactor is at high impedance and limits load current to 5% of rated. With 100% control current the impedance is reduced allowing rated AC current to the load. With rated AC supply voltage and matched load at unity power factor, the above characteristics can be expressed as: "a zero to 100% change in DC control will provide a load voltage change of approximately 5% to 95% of supply voltage."

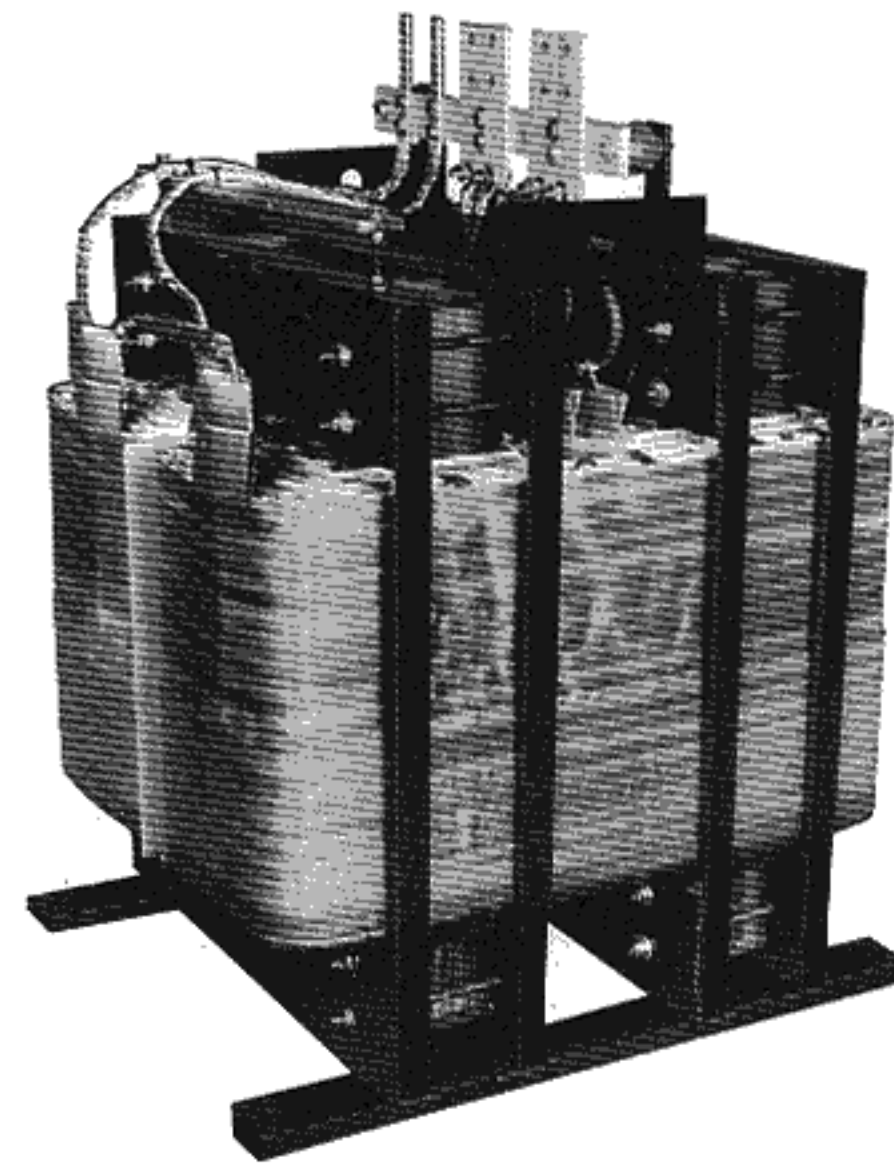


Core and Coil Construction



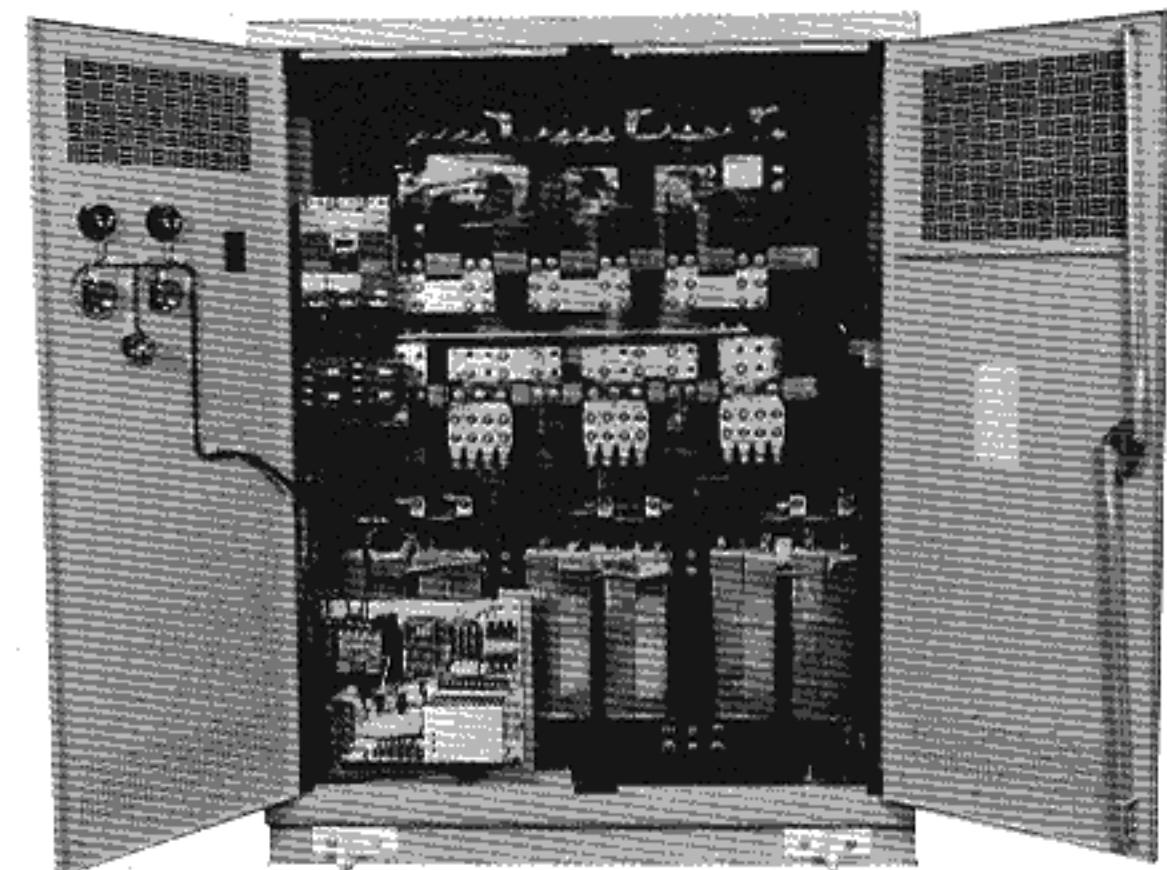
Wiring Diagram

The construction is basically similar to that of two transformers in one structure. The AC windings are on each leg, connected in parallel. They are connected in a bucking configuration so that the AC voltages induced in the DC winding will cancel out. The DC winding encompasses both cores of the structure. With this type of construction, the entire core carries both AC and DC flux, and the mutual inductance of the coils is maximum.



## Saturable Reactor Control Systems

Spang Power Electronics offers complete control systems, factory wired and tested to meet customer specifications. This can include the saturable reactors, driver, transformers, and control equipment with metering. The control cabinet can be adjacent to, or remote from, the reactor.



### TO ORDER, SPECIFY:

- Load kva
- Voltage - normally same as line volts
- Frequency
- Phase
- Load power factor
- DC control voltage