ARC TRANSMITTERS

While rumaging through my attic a few days ago I came across the Log Book which I compiled while a student in the U.S. Navy Radio School located at the Great Lakes Training Station in the latter part of 1918. The course in radio at that time was of thirty-two weeks duration and approximately eight hours per day was consumed in equal periods of theory, code instruction and drilling.

One week was devoted to a single subject. We started with magnetism, followed by electro-magnetism, static electricity, storage batteries, motors, generators, etc., up through the delicate art of mastering radio as it existed at that time.

Thumbing through the log I came upon the subject "ARC TRANSMITTERS," a method of high-powered transmission of an era which is no longer mentioned and probably many of the present day "hams" as well as professional operators never knew existed.

Before continuing I would like to list a few peculiarities of the arc transmitter. As an example, the current and voltage of an arc lamp do not obey Ohm's Law which states that an increase in voltage causes a corresponding increase in current. In an arc lamp an increase in current will cause a decrease in voltage. In the arc characteristic curve it is shown that a decrease in current causes an increase in voltage across the electrodes. The critical point or working point is that part of the curve where a small decrease in current causes a large increase in voltage. Carbon does not obey the usual law of resistance as regards to temperature rise. In any metal conductor as the temperature rises, the resistance rises but as the temperature of the carbon rises its resistance decreases.

The arc transmitters, which were ponderous affairs as shown in Fig. #1, were installed in many U.S. Naval shore stations and aboard the larger ships of the navy. The pedestal of the transmitter contained four massive coils. The series field coils for a 15 KW arc converter contained a total of 536 turns of wire. The windings consisted of 139 feet of No. 2 Narnished Cambric insulated wire that weighed 40 pounds and 1,982 feet of No. 4 Doble Cotton Covered wire weighing 254 pounds. The core weighed 116 pounds making a total weight for the pedestal alone 410 pounds.

The arc chamber could be opened by a heavy door for the purposes of cleaning and changing the electrodes. The positive electrode was made of copper in a rectangular bar form about two or three inches wide and three quarters of an inch thick and was hollow inside to allow water to flow into it. The negative electrode was a round carbon rod, its diameter about an inch in thickness. The back of the chamber and the door were also hollow to allow water to circulate through them for cooling purposes. Mounted on top of the chamber was a lubricating type cup which contained about a pint of alcohol and the outlet of the cup could be adjusted to allow a drop of fluid to drip into the chamber at intervals thus to create a hydro-carbon vapor. The vapor created by the alcohol gave the arc greater performance efficiency.

The various accessories of the transmitter were placed into operation by the use of a ten point controller, the exact type used to operate many of the street cars of yesteryear. As the controller handle was turned towards the tenth point, various pieces of apparatus were placed into operation such as the water pump motor, the solenoid for the transmitting key and finally the motor-generator. The generator section of this unit was one of seven horse-power and delivered 550 volts D.C. This voltage could be varied by a rheostat connected in series with the shunt field of the generator. A small geared-down 1/60 HP motor rotated the carbon electrode very slowly so the disintegration was uniform and the tapered end of the carbon electrode kept its original shape.

In order to strike the arc, a button on the assembly on the front door was shoved in and this action pushed the carbon electrode against the copper anode. When the button was released a strong spring pulled the carbon back again drawing an arc between the two electrodes. After the arc was struck the space between the electrodes was adjusted for maximum radiation output by turning a flanged wheel either left or right. The flanged wheel was also part of the assembly on the front door of the chamber.

When the arc transmitter was in operation and the operator wished to transmit he used a key which activated a solenoid and when the key was closed the solenoid shorted out 100 meters of the antenna inductance. As soon as the arc was struck an undamped wave was radiated by the antenna. This was known as the "Back Wave" and many operators were fooled into trying to copy it when transmission took place only to find they were copying a form of gibberish. To copy the actual transmission the operator had to tune his receiver 100 meters below the "Back Wave."

Out on the deck beside the radio room was a large tank of fresh water. When the transmitter was in operation this water was pumped by a centrifugal pump, circulating the water in and out of the copper anode, through the front door of the chamber, around the carbon cathode, through the rear of the chamber and back into the tank. Fig. #2 shows the circulating system.

Also there were two separate coils of pipe within the tank. Live steam could be passed through one coil to keep the water from freezing in the winter time while the other coil was connected to sea water to cool the tank in summer.

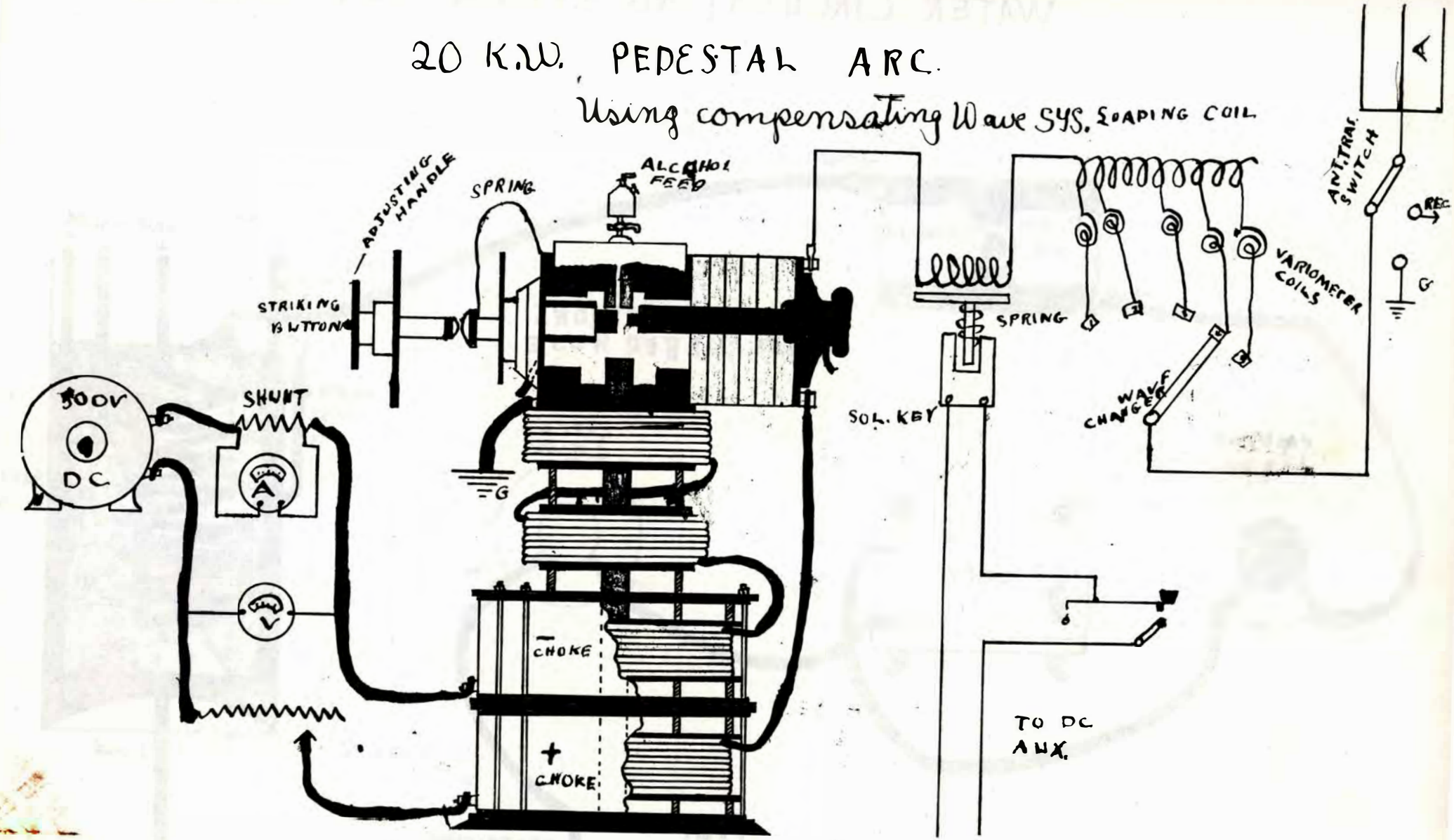
Figure #3 shows the schematic of a later improvement in arc transmission. This was a Federal Poulsen Arc Transmitter which included a third electrode which grounded the anode through a series of resistances. However, when the key was depressed a solenoid pulled the third electrode away from the anode allowing the signal to travel to the antenna. When the key was open a spring returned the third electrode to its original position thus grounding the "Back Wave."

My first experience with an arc transmitter was in January 1920 when I went to sea on the U.S.S. Pennsylvania. At that time she had on board the Commander-in-Chief of the Atlantic fleet and as a result we were busy boys in the radio room. Prior to and after that it was spark transmitters on destroyers.

--Wilmer B. Giese, 1569-P

20 K.W. PEDESTAL ARC.

Using compensating Wave SYS. LOADING COIL



÷ 20 K.W. PEDESTAL ARC. ÷

FIG. #1

WATER CIRCULATING SYSTEM FOR ARC SET.

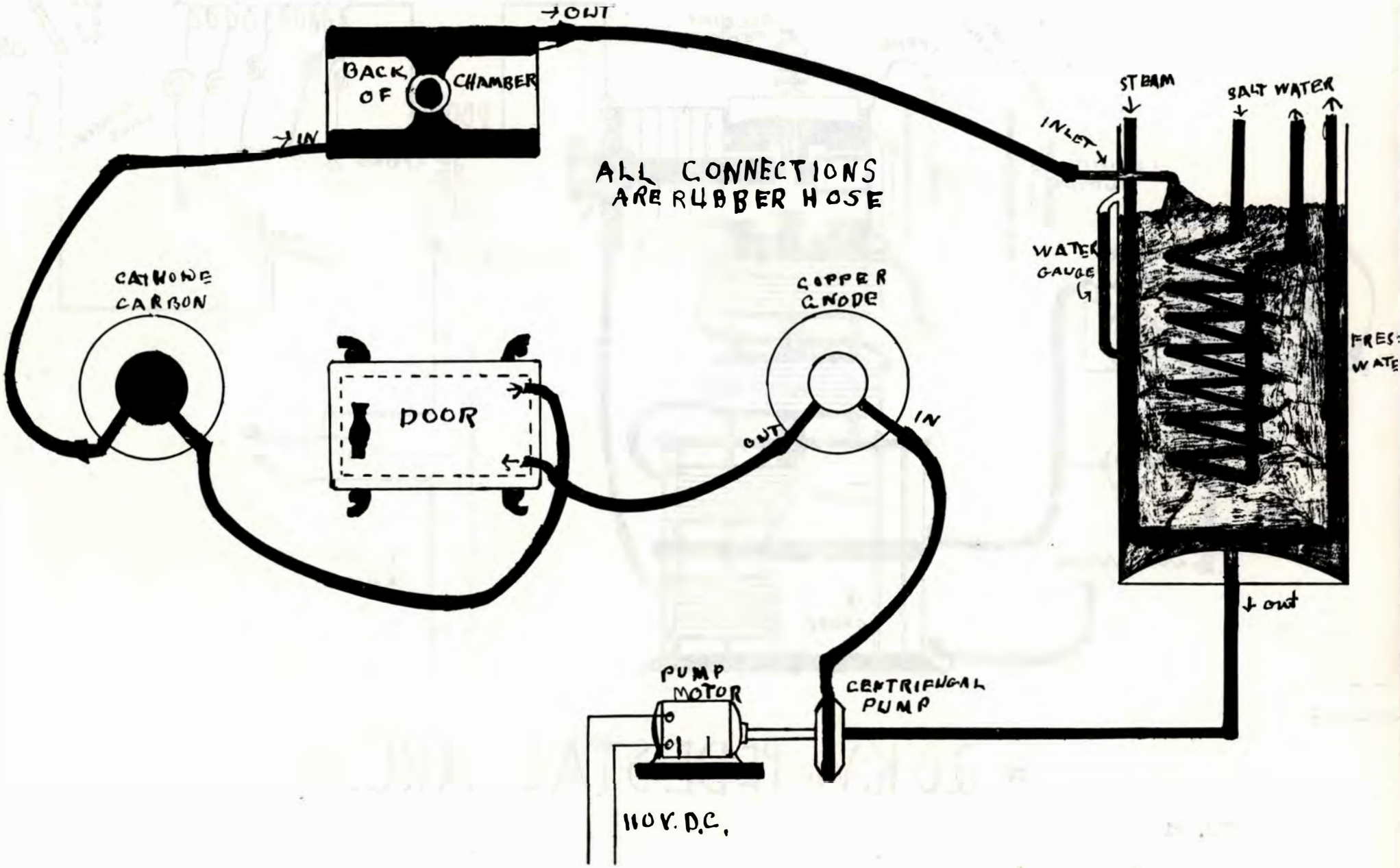


FIG. # 2

WATER CIRCULATING SYSTEM FOR ARC SET.

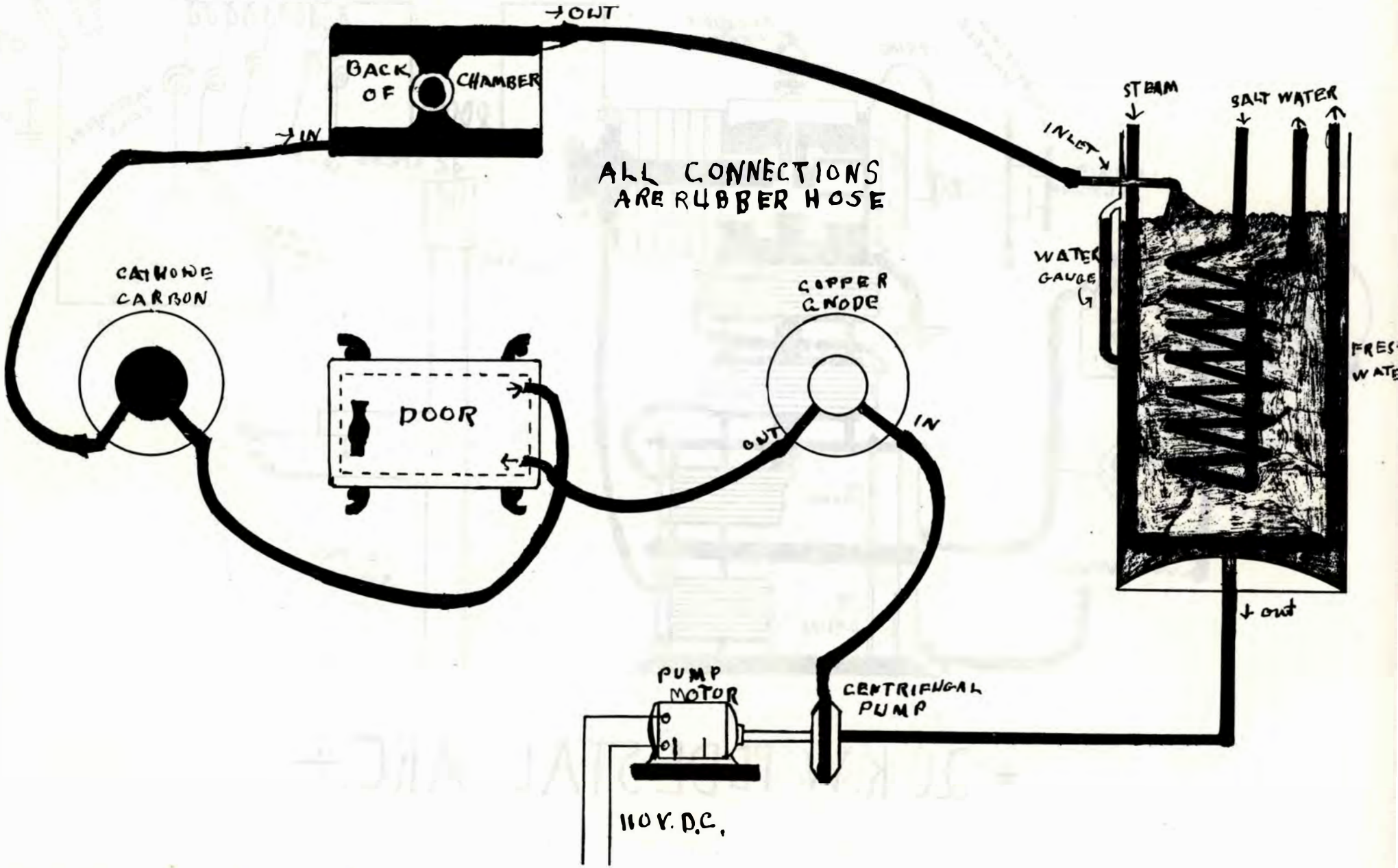
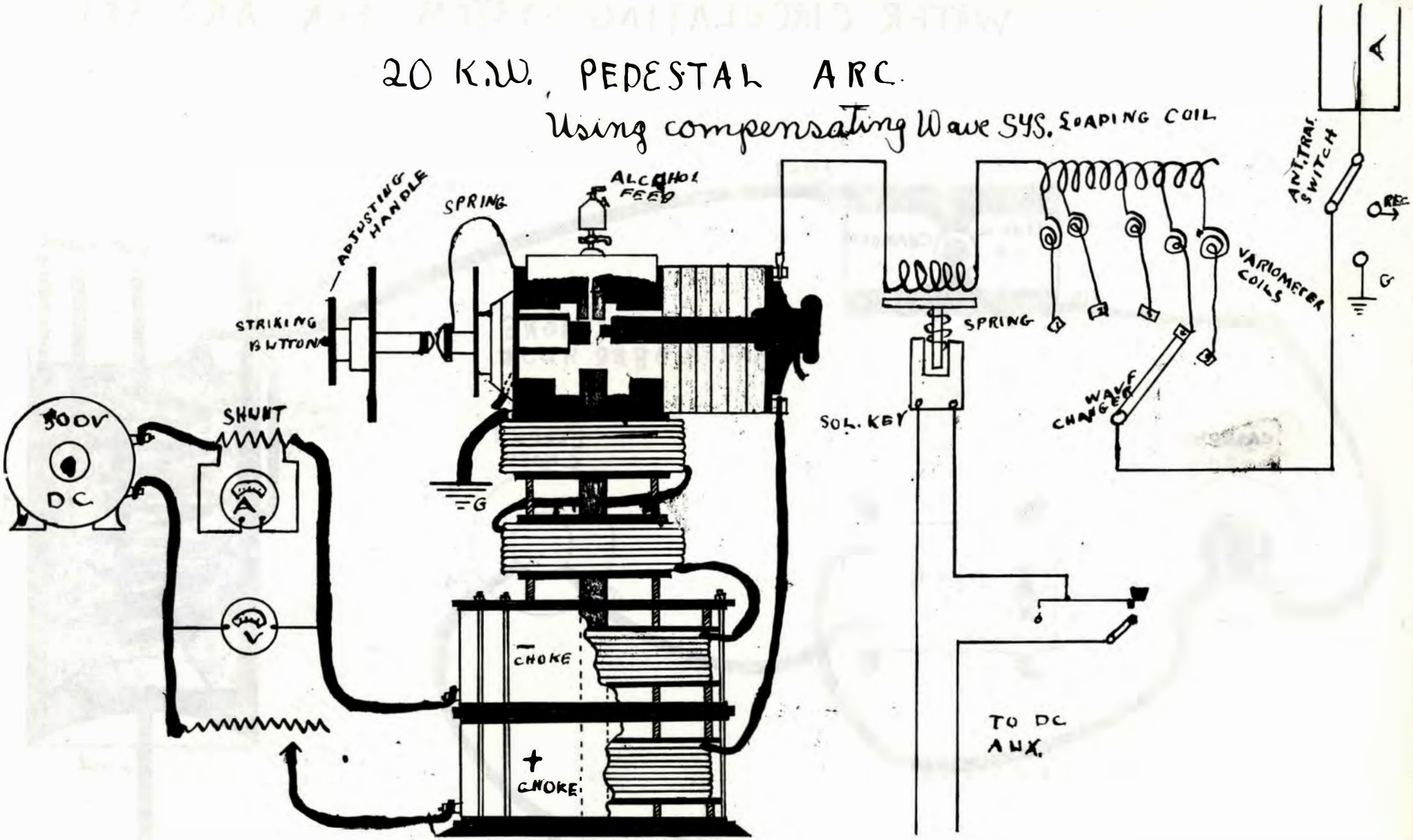


FIG. # 2

20 K.W. PEDESTAL ARC.

Using compensating Wave SYS. LOADING COIL



÷ 20 K.W. PEDESTAL ARC.÷

FIG. # 1.

-: FEDERAL POULSEN ARC TRANSMITTER :-

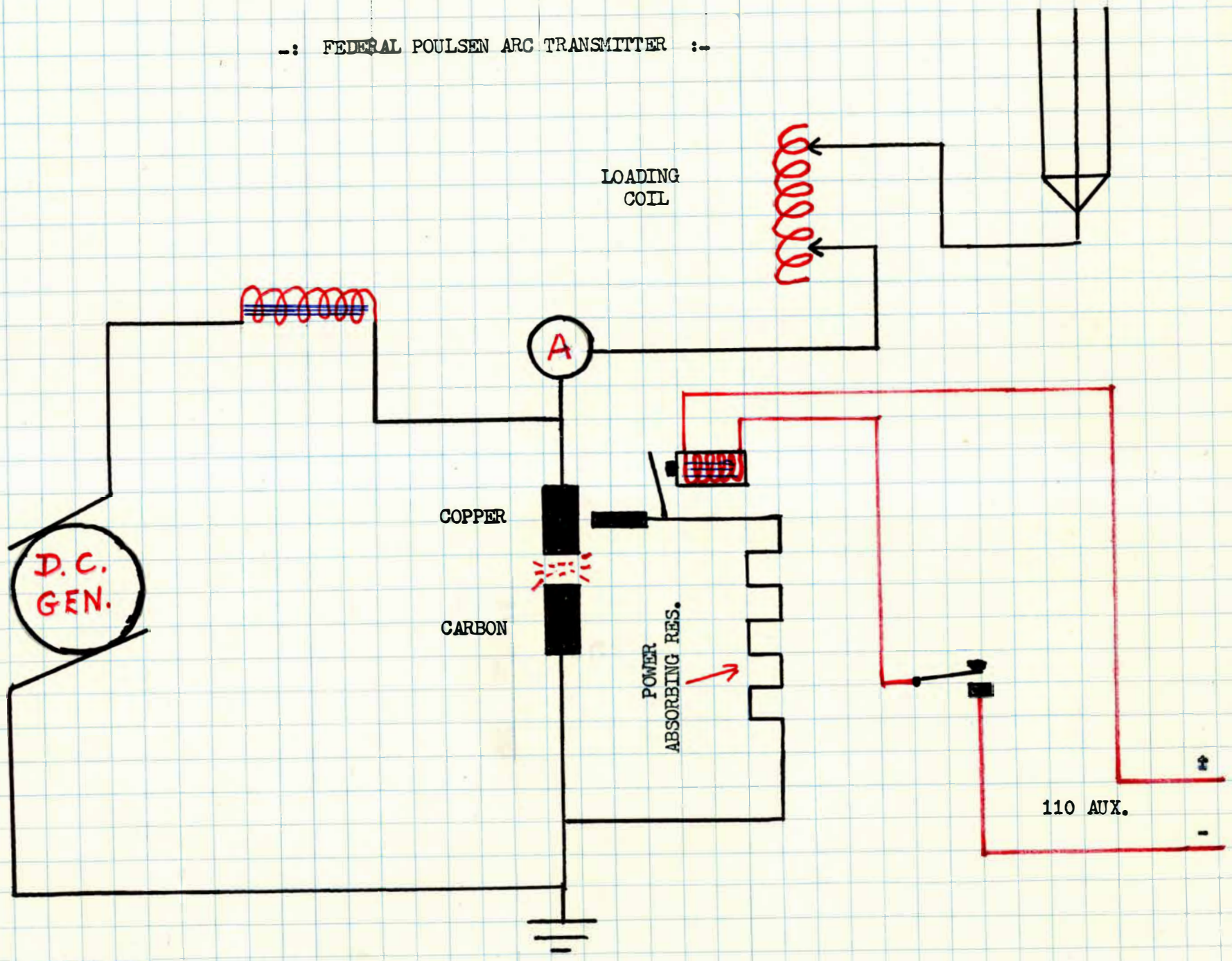


FIG. #3