ECE 470 POWER SYSTEMS I
Lab # 4 Transmission Feeder Simulation

The objective of this lab is to demonstrate the relationships between Real Power, Power Factor, and Receiving-end Voltage, when the Sending-end Voltage is held constant.

PRE-LAB

Review the material from the Hampden manual regarding the operation of the synchronous machine as a motor and as a generator; and the dynamometer as a separately-excited motor and as a generator.

Review the lab procedure and devise where to place the metering in each part of the lab. **Show these diagrams to the instructor at the start of the lab.**

LAB PROCEDURE

Get your circuits approved before starting.

1. Using your amended figure 1, connect the dynamometer as a separately-excited motor and use it to drive the synchronous machine as an alternator. **Be sure the transmission line is open.** Place the Yokogawa meter to measure power drawn from the alternator.

2. With the transmission line open, drive the dynamometer at rated speed and adjust the alternator's field to produce rated voltage at 60 Hz. Display the voltage on the oscilloscope and confirm the values of voltage magnitude and frequency.

3. Observe the effect of varying load (P&Q) on voltage magnitude and frequency.

4. Place the oscilloscope across the transmission line, i.e. subtract CH1 and CH2, so that the differential voltage between the supply and the alternator is displayed on the screen. Is the shape of the waveform correct?

5. Synchronize the alternator. Qualitatively observe the effect that changing each field current (alternator and dyno) has on voltage magnitude, frequency and P&Q drawn from the alternator.

6. Switch everything off. Re-configure the machines as a synchronous motor driving a separately-excited generator with the resistive (DC) load bank. The AC load bank should be placed in parallel with the synchronous motor, as shown in figure 2. The Yokogawa meter should now measure power and voltage at the receiving end of the transmission line.

7. Set the following: transmission line open and maximum length, both load banks off, and motor in the IND START position. Then close the transmission line and switch the synchronous motor to SYNC RUN.

8. (a) Vary the active power demanded by the load from zero to ~ 600 W, by changing the resistors in the AC and DC loads and adjusting the field on the DC generator.

(b) For each value of active power in (a), adjust the reactive power demanded by the load to produce supply power factors of 0.9 lag, unity, and 0.9 lead. Do this by changing the inductors and capacitors in the AC load bank (coarse) and by varying the excitation (fine) of the synchronous motor. For each combination of P&Q, measure V_S and V_R. Plot $|V_R|$ vs. P, with pf as a constant .

Sample Data ($|V_S|$ = 208 V)

V_R	pf	WATT
204	0.895	118
193	0.906	230
185	0.893	316
180	0.885	352
180	0.911	368
210	Unity	60
207		122
204		242
196		388
190		528
215	0.898	134
215	0.899	206
215	0.891	340
214	0.907	448
212	0.903	596

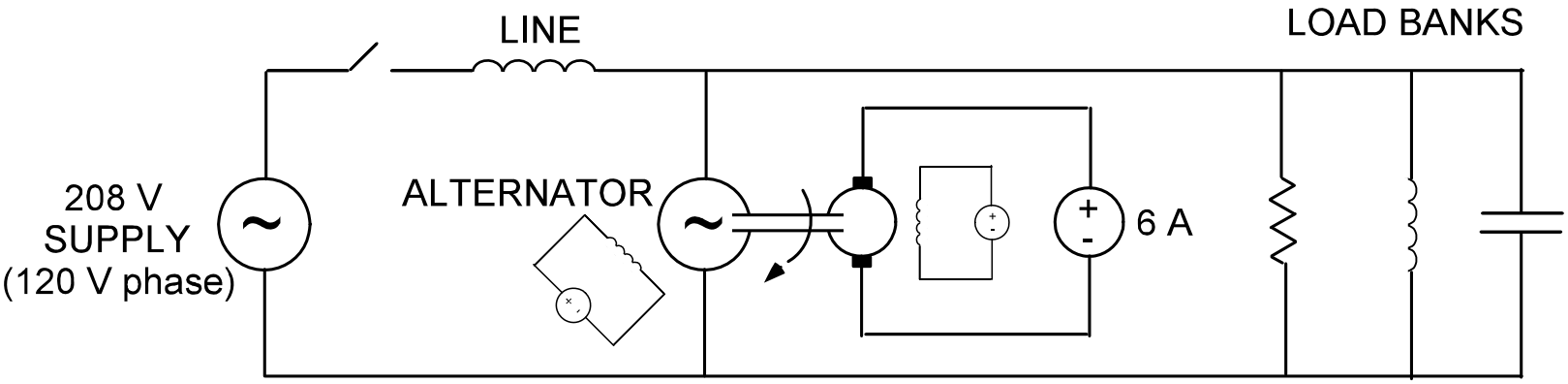

Figure 1 - Synchronous Machine as an Alternator

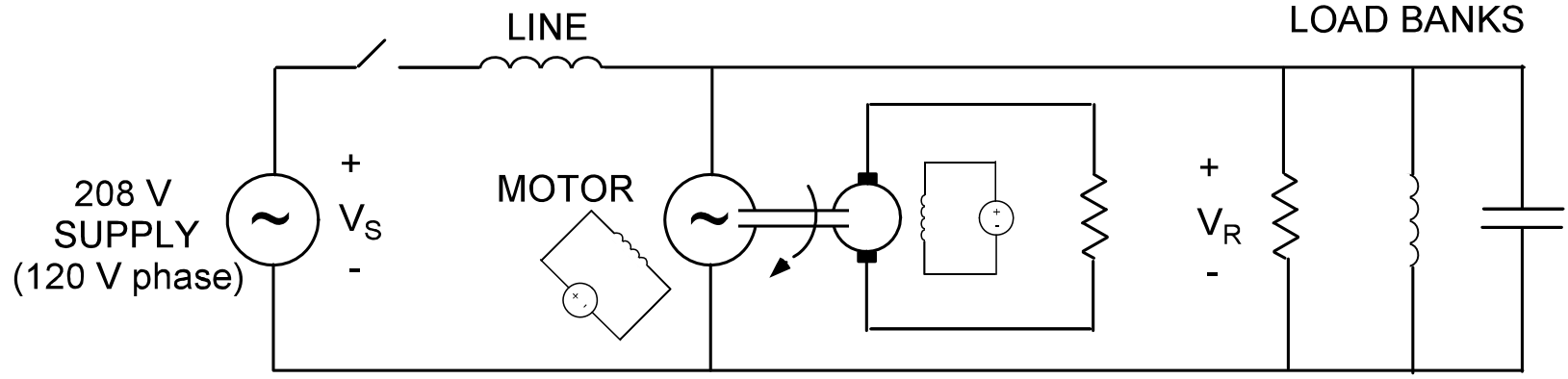

Figure 2 - Synchronous Machine as a Motor