CHAPTER 5

MEA'S DISTRIBUTION SYSTEM

5.1 Introduction

This chapter intends to describe MEA's distribution system, how it looks like, components of the network system, problems of the meshed network system and the collection of input data for the SIMPOW package program.

5.2 MEA's distribution system

MEA is responsible for providing customers electricity within the Bangkok area, Nontaburi area and Samutprakan area (figure 5.1).The total area (about 3,192 sq.km.) is divided into 12 districts as follows :

- Watlieb district
- Klongtoey district
- Yannawa district
- Bangkapi district
- Samutprakan district
- Bangpee district
- Samsaen district
- Thonburi district

- Ratburana district
- Nontaburi district
- Bangyai district
- Minburi district

All districts have a radial low volt distribution system except for Watlieb district where there is meshed secondary network system on 400 V level. Watlieb district is divided into three areas (figure 5.2) as follows :

- Bang khun prom area 2.66 sq.km. (supply by Bang khun prom substation)
- Watlieb area 2.99 sq.km. (supply by Watlieb sybstation)
- Sapandam area 2.90 sq.km. (supply by Sapandam substation)

Total area 8.55 sq.km.

Number of customers ~ 70,440 customers

The meshed character of the network secondary causes difficulties in calculating power flows and this is the reason for this thesis study on the network area.

To facilitate the computation, the thesis will study only part of "Sapandam area". The studied part consists of : (figure 5.3)

number of nodes	183
number of lines	221
number of transformers	37
number of shunt impedances	37
number of loads	77

5.3 The MEA secondary network

The MEA secondary network system consists of underground cables as radial feeder connecting a substation to transformers rated 500 KVA. The main grid (400 V level) in the Watlieb district is arranged as a meshed network so each customer at the secondary of the transformers can receive electricity at least two ways.

5.4 Components of the network system

5.4.1 Substation

There are three substations in the studied network area as follows: Watlieb substation, Sapandam substation and Bang khun prom substation. The protection system at a substation consists of:distance relays and neutral displacement relays (ND) for protection of the feeder (69 kV).

There are also differential relays, sudden pressure relays, buchholz relays for protection of transformers and other indicator equipments such as oil level gauges, oil temperature indicator and pressure relief valve.

The feeders (12 kV) are protected by overcurrent (OC), earth fault (EF) relays, under frequency relay and automatic load restoration (ALR).

5.4.2 Underground cable (12 kV)

The used size of underground cables are cu. 500 MCM, 350 MCM, 4/0 and 2/0 AWG which are PILC type (paper insulated lead covered)

At present has been used 240 sq.mm. and 70 sq.mm. XLPE (cross link polyethylene)

5.4.3 Network transformer station

5.4.3.1 12 kV disconnecting and grounding switch

The 12 kV disconnecting and grounding switches are oil switch 2 way, 3 pole, 3-position (ON-OFF-GROUND) 15 kV class, rating 400 A 50 cycles minimum momentary and 15,000 amps.rms. for 4 second which connect or release the 12 kV feeder in case of maintenence. (figure 5.4)

5.4.3.2 Network transformer

The network transformer is secondary network type. It is oil filled placed on a platform. The 12 kV disconnecting and grounding switch connects one side of transformer and the other side is connected to the network protector. (figure 5.4)

Electrical characteristic of network transformer

- Rated 500 KVA 12,000 volts 3 phases 50 Hz.
- Low voltage 416 Y/240 volts 3 phases - 4 wire

- Rated voltage — 12 KV/11.7 KV/11.4 KV/11.1 KV
  10.8 KV/delta - 416 Y/240 volts
- Impedance — 4.5% to 4.7% at 75° C.
- Voltage regulation — not over 4% at 80% power factor
- Excitation loss (no load loss) — at least 920 watts, rated voltage.

5.4.3.3 Secondary capacitor banks

A secondary shunt power capacitor bank is connected at each network transformer. Rating of the capacitor bank is 75 KVAR 600 V. (figure 5.5)

5.4.3.4 Network protector

The network protector is an automatic divice connecting the secondary side of the transformers to the main grid. (figure 5.6)

5.4.4 Secondary network maingrid

The main grid is mostly overhead. There are network fuses size F4 (750 A) connected to all junctions of the main grid for protection of the line when a low voltage faults occurs. So the reliability of secondary network is good. (figure 5.7)

5.5 Problem of the meshed network system

5.5.1 Problem of planning

The planning engineer needs to know the power flow , but the meshed network system makes it difficult to calculate power flow due to lack of data.This thesis will use the SIMPOW software package, executed on VAX-2000 computer to try to find some kind of a solution to this problem. This thesis will make load flow analysis on only part of MEA network system in "Sapandam area" to serve as a guideline for planning and operation in future.

5.6 Collection of input data

As input data for the SIMPOW program package it is necessary to know about :

- Loads
- Lines and feeders
- Transformers
- Shunt impedances

The input data will be modelled by standard system models available in SIMPOW. The models are described in chapter 4.

5.6.1 Load data

The loads of MEA network system are active power (P) and reactive power (Q) which are estimated from consumer meter readings. These estimated loads are used as input data in the SIMPOW package program.

5.6.2 Lines and feeders data

The feeders (12 kV) of MEA network used cable size 500 MCM (X), 350 MCM (P), 4/0 (P), 2/0 (P), 240 sq.mm. (X) and 70 sq.mm. (X). Impedance (ohm/km.) is shown in table 5.1.

The lines (400 V) used line size #185, impedance (ohm/km.) = 0.1787+j0.232.

5.6.3 Transformers data

The transformers rated 500 KVA, 12 KV/416/240 V 3 phase 4 wire, impedance 4.5% to 4.7% at 75° C.

The transformers data for input data of the SIMPOW program as follows :

- Base power in MVA (SN) = 0.500 MVA
- Primary voltage (UN1) = 12 KV
- Secondary voltage (UN2) = 400 V.
- Short circuit resistance between winding 1 and 2 in pu. of transformer base power and the nominal voltage (ER12) = 0.013
- Short circuit reactance between winding 1 and 2 in pu. of transformer base power and the nominal voltage (ER12) = 0.049

5.6.4 Shunt inpedance

All transformer of MEA network system are connected to shunt capacitor rated 75 kVAR 600 Volts.

The shunt capacitance used as input data to the SIMPOW program package is :

Q = -0.075 MVAR UN = 400 Volts.

Table 5.1

Cable impedance

Size of cable	Impedance (Ohm/km.)
500 MCM(P)	0.089 + j0.116
500 MCM(X)	0.092 + j0.104
350 MCM(P)	0.122 + j0.118
350 MCM(X)	0.130 + j0.109
4/0 (P)	0.103 + j0.086
2/0 (P)	0.308 + j0.092
400 Sq.mm.(X)	0.058 + j0.091
240 Sq.mm.(X)	0.0904 + j0.0974
70 Sq.mm.(X)	0.3143 + j0.1174
35 Sq.mm.(X)	0.6146 + j0.1311

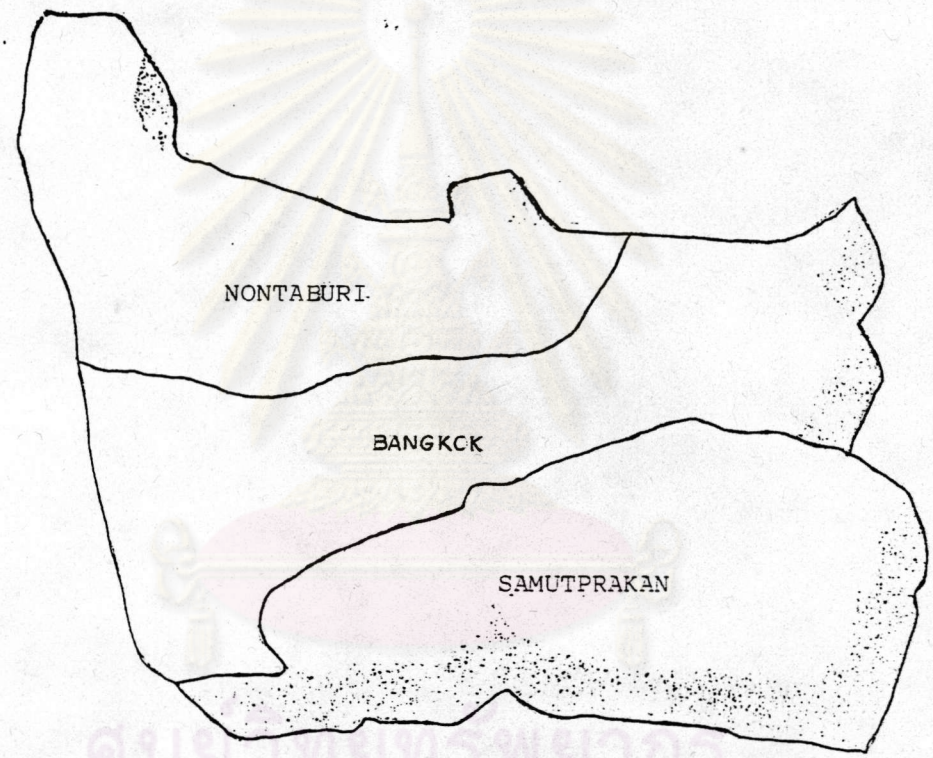


Figure 5.1

MEA's responsible area

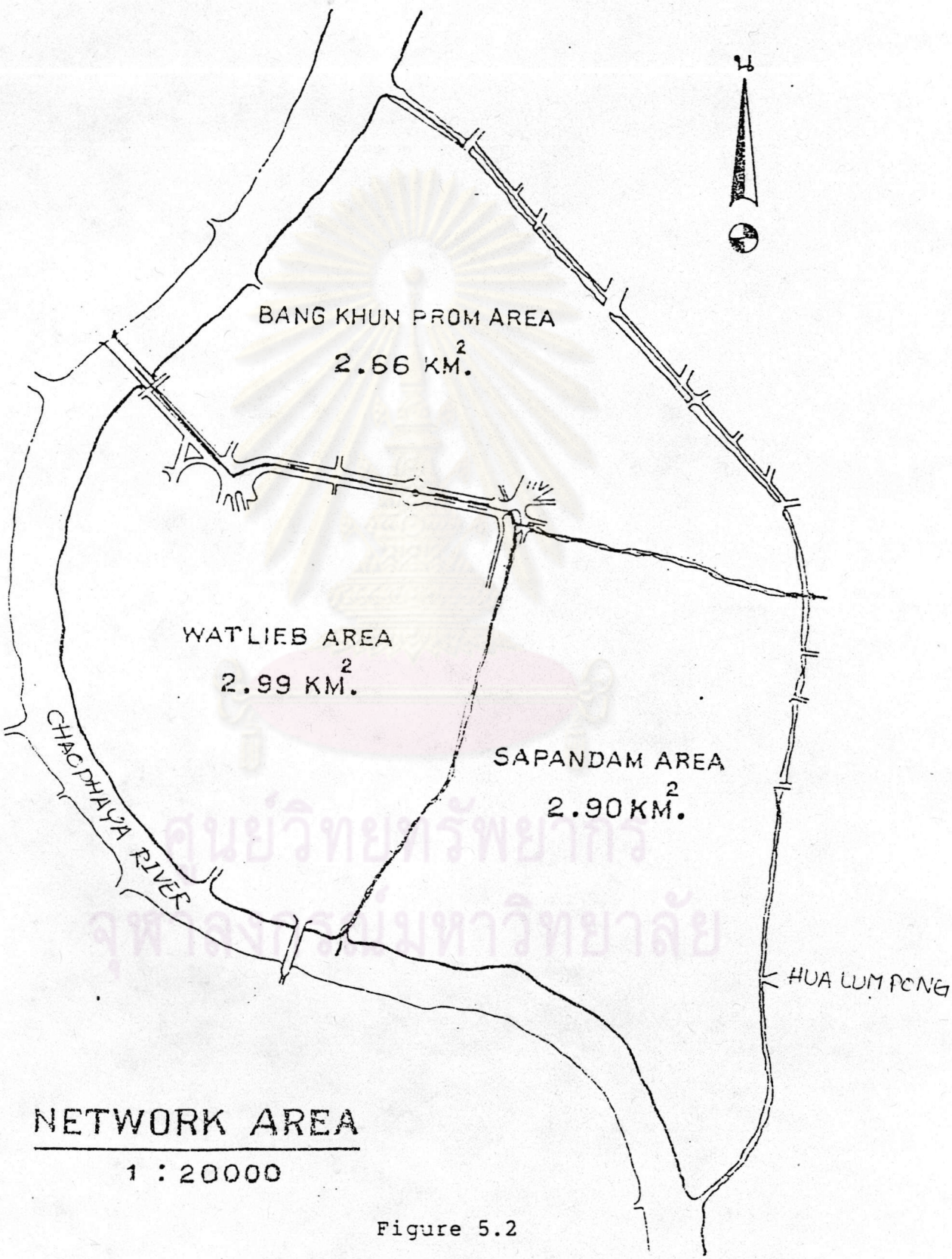


Figure 5.2

Watlieb district

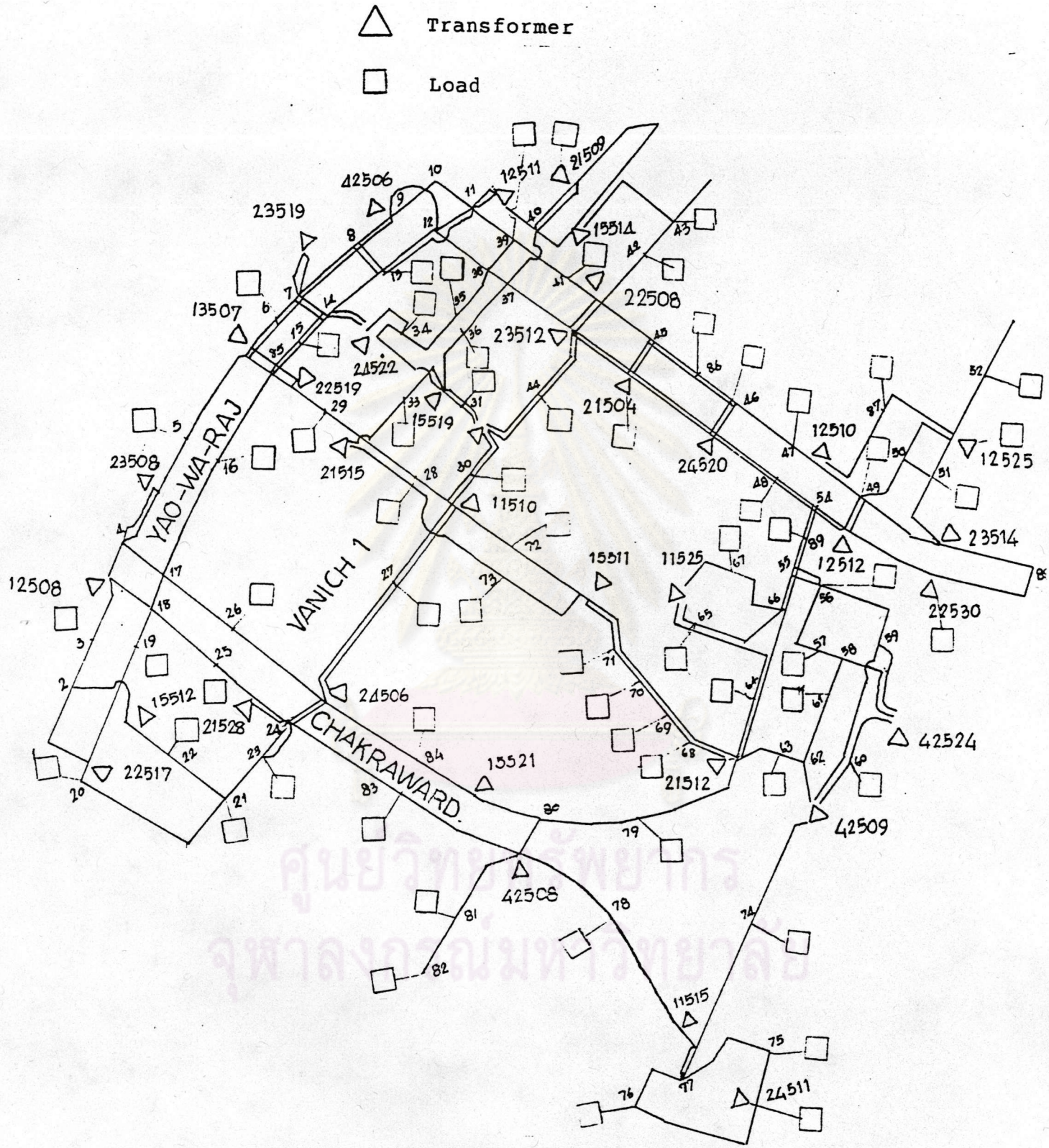


Figure 5.3

The studied area in "Sapandam area"

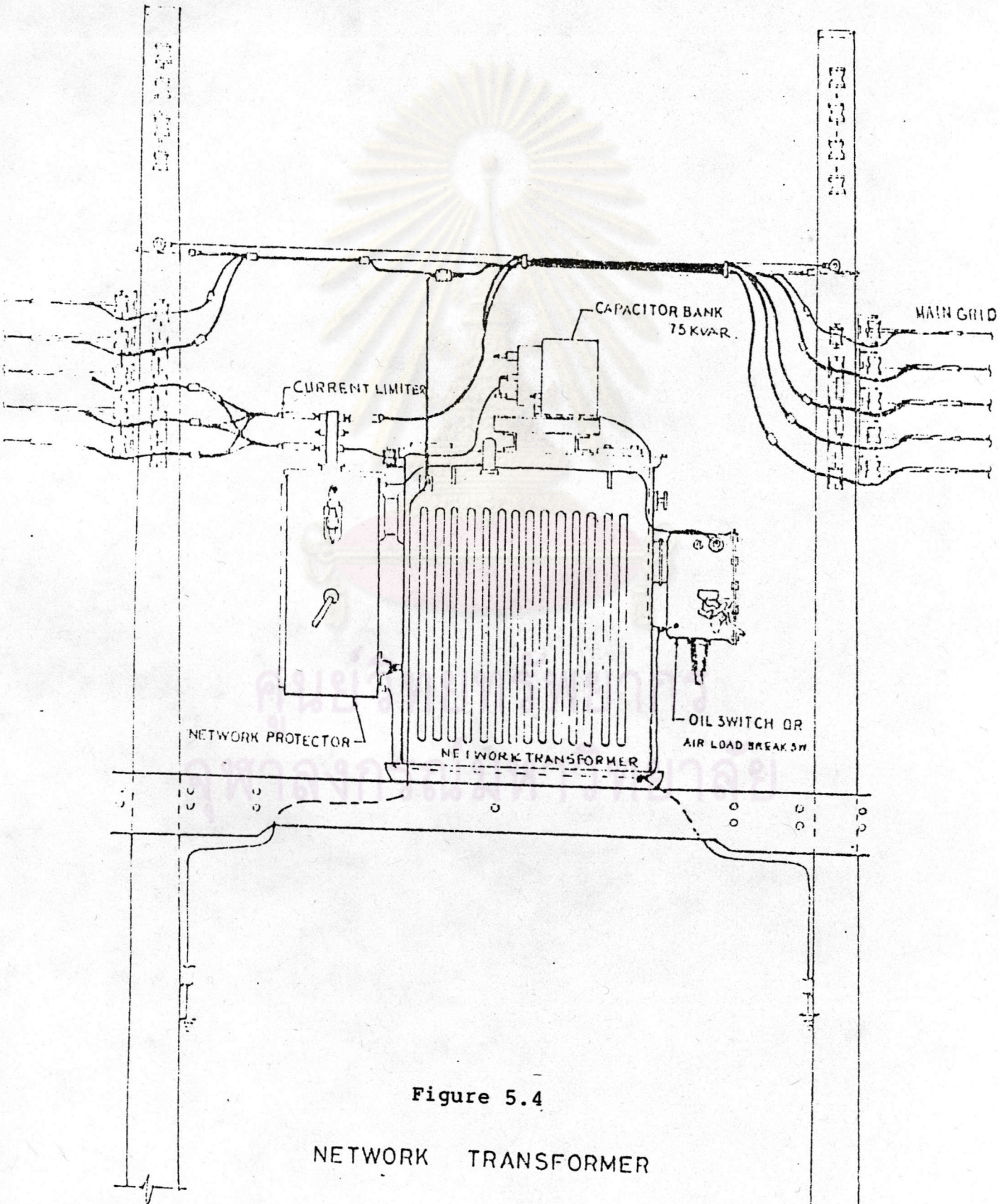


Figure 5.4

NETWORK TRANSFORMER

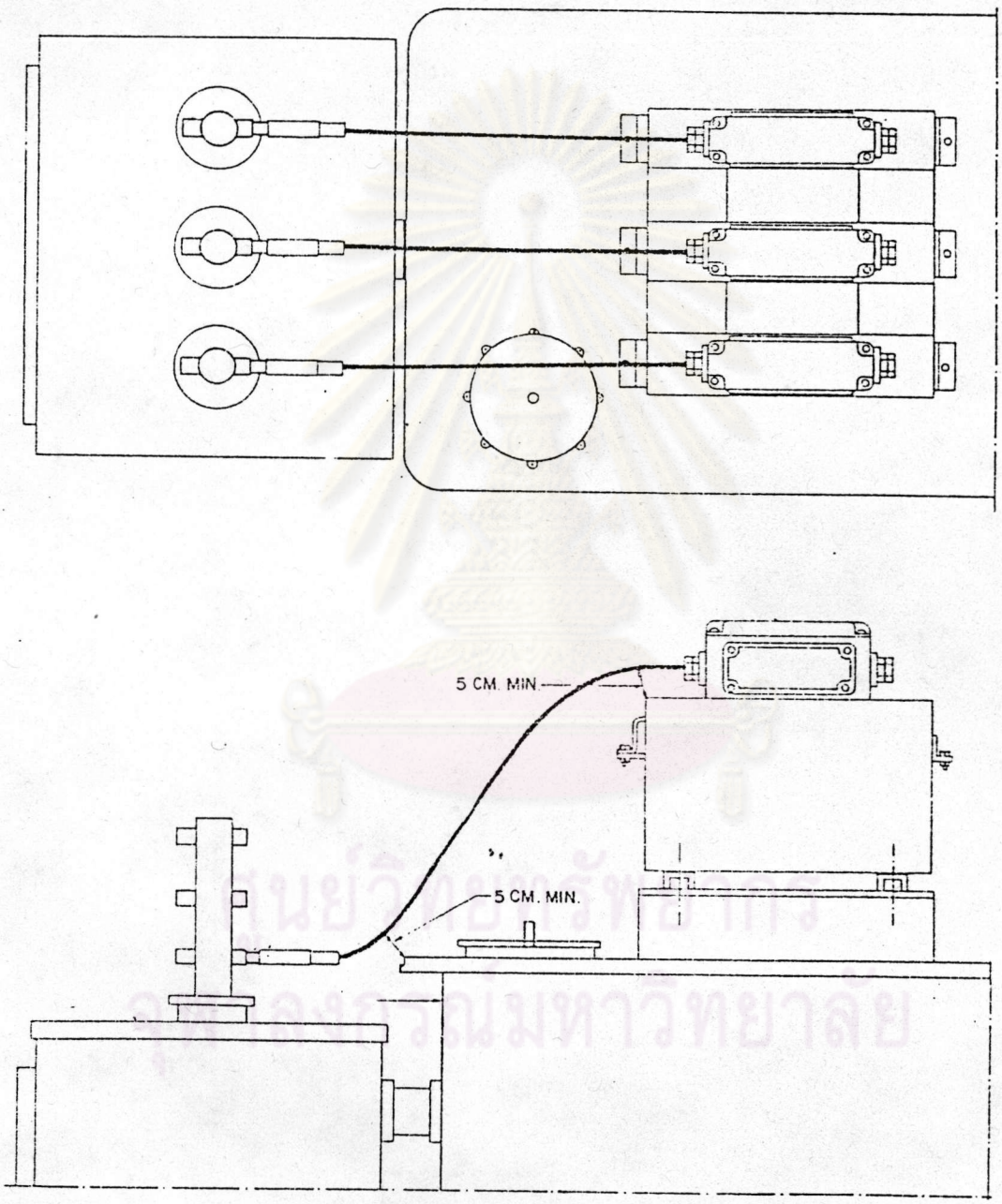
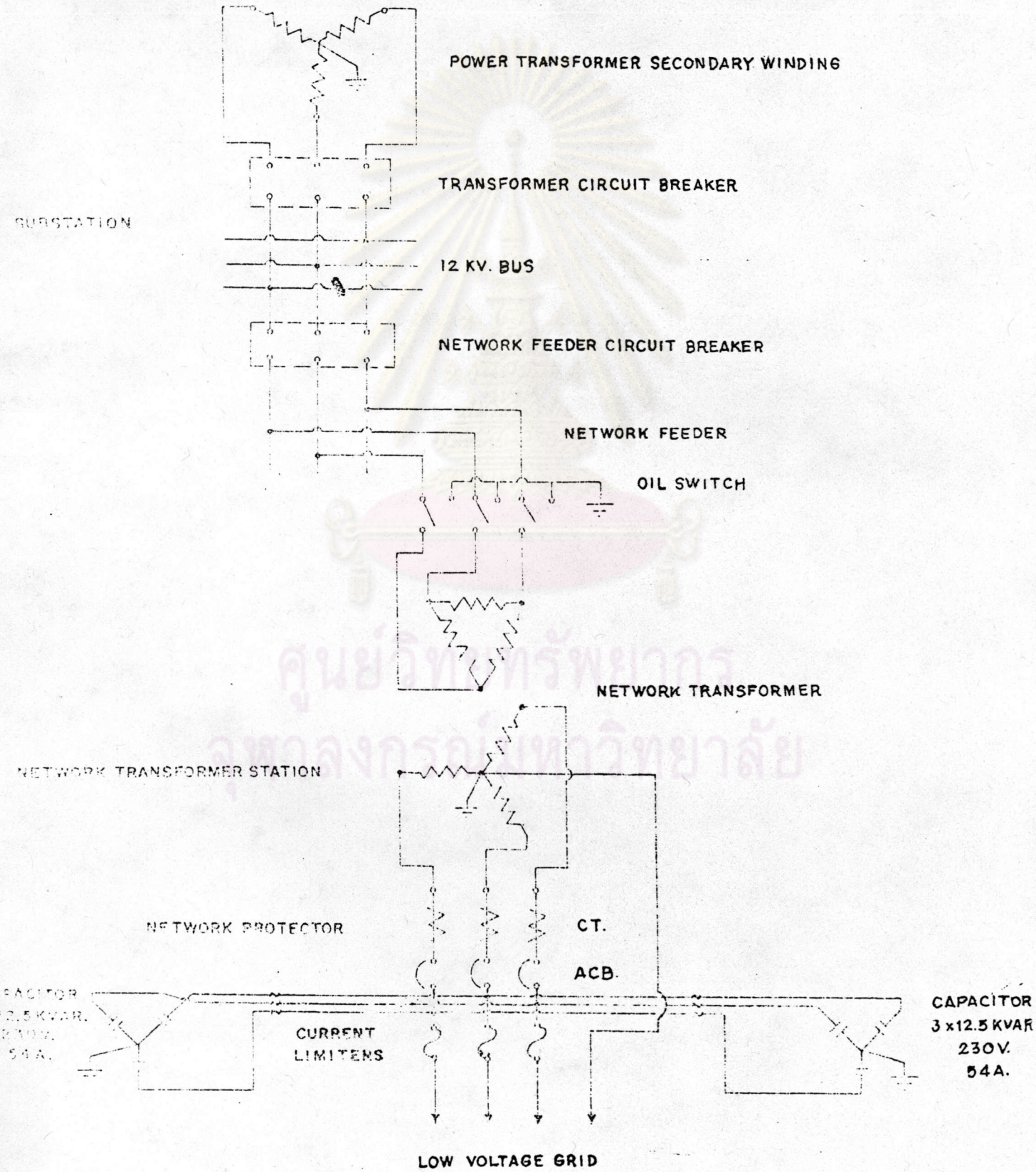


Figure 5.5

LOW VOLTAGE FIXED CAPACITOR
3 x 25 KVAR
INSTALLED ON NETWORK TRANSFORMER

Figure 5.6

SCHEMATIC NETWORK POWER SUPPLY DIAGRAM



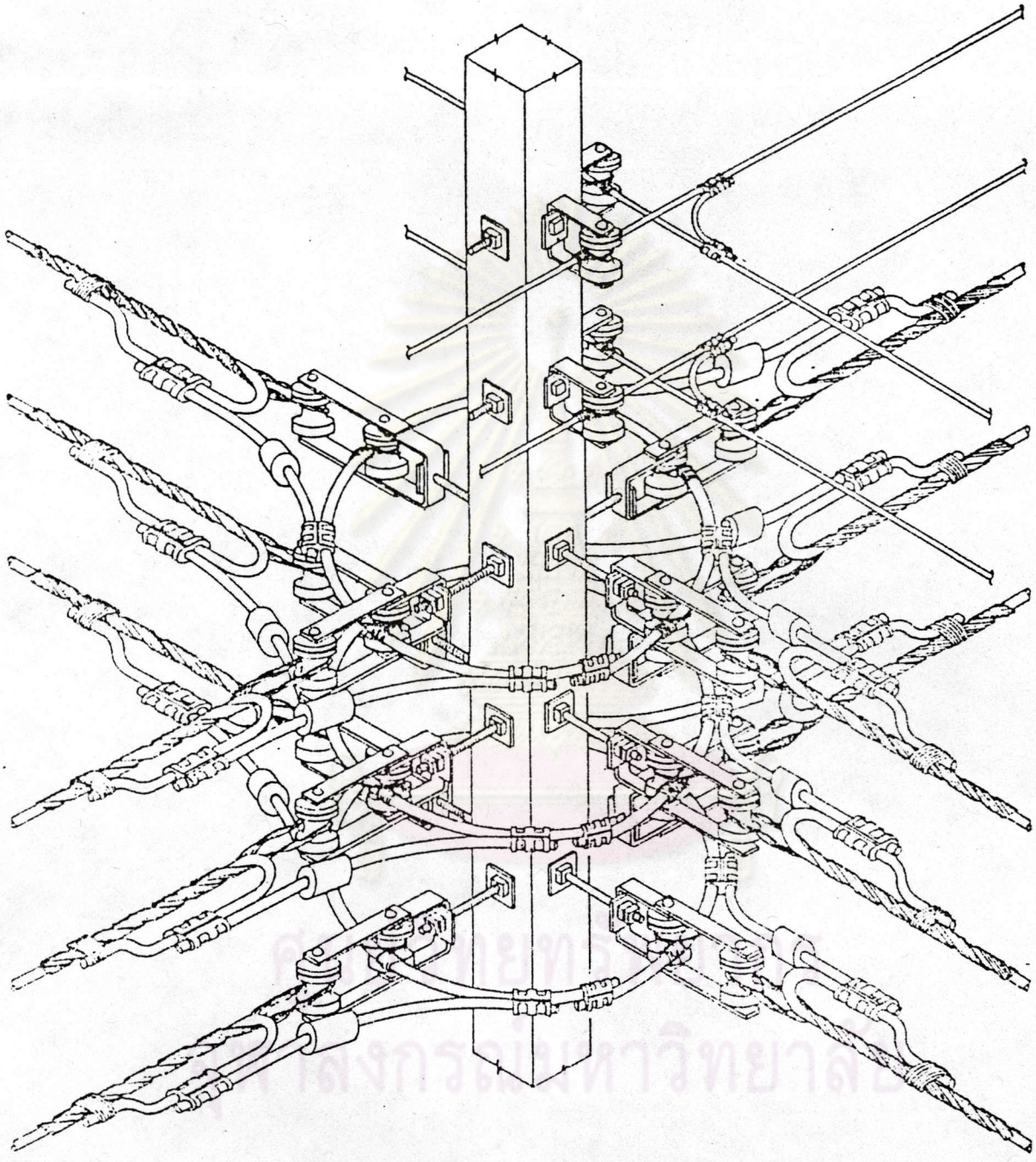


Figure 5.7

FOUR-WAY FUSED JUNCTION
SECONDARY NETWORK MAINS