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Appendix A

Heat Transfer Area

The required heat transfer area, A, for a heat exchanger is calculated from

$$A = \frac{Q}{U.\delta T_{lm}}$$

Where Q = amount of heat transfer

U = overall heat transfer coefficient

δT_{lm} = log mean temperature difference

$= (\delta T_2 - \delta T_1) / \ln(\delta T_2 / \delta T_1)$

δT_1 and δT_2 are defined as ahown in Figure A-1

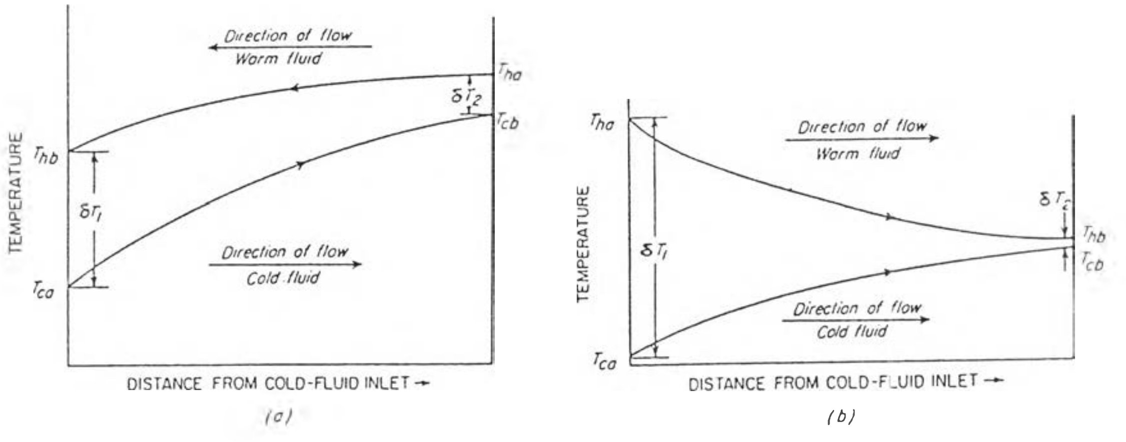


Figure A-1 Temperature differences in (a) countercurrent and (b) parallel flow

Appendix B

Overall Heat Transfer Coefficients

Typical estimates of the overall heat transfer coefficients, U, (including fouling and wall resistances) that are used in preliminary design are listed below [38: 487].

System	U, BTU/hr.ft^2.°F
Condensing vapor to boiling liquid	250
Condensing vapor to flowing liquid	150
Condensing vapor to gas	20
Liquid to liquid	50
Liquid to gas	20
Gas to gas	10
Partial condenser	30

Appendix C

Utility Costs

The rate of various industrial utilities, as of in January 1979, are as follows [37: 881] :

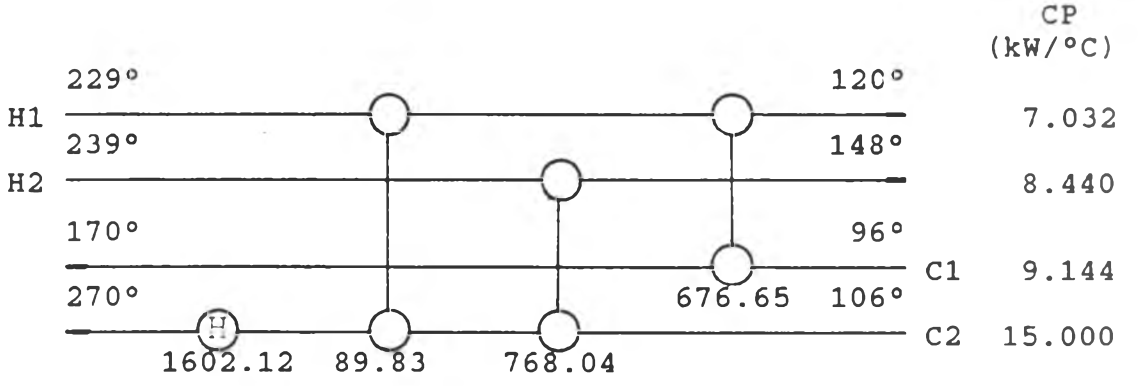
UTILITY	Cost
Steam	
500 psig	US$ 2.00-2.40/1000 lb
100 psig	1.00-2.00/1000 lb
exhaust	0.05-0.089/1000 lb
Cooling water	
well	0.06-0.30/1000 gal.
river or sea	0.04-0.12/1000 gal.
tower	0.04-0.16/1000 gal.

Appendix D

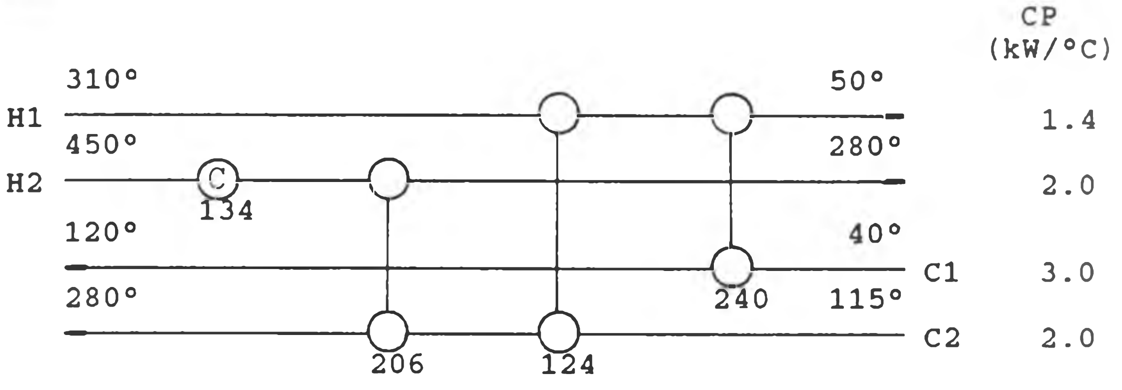
Summary of The Designed Networks

D1. Unrestricted matching

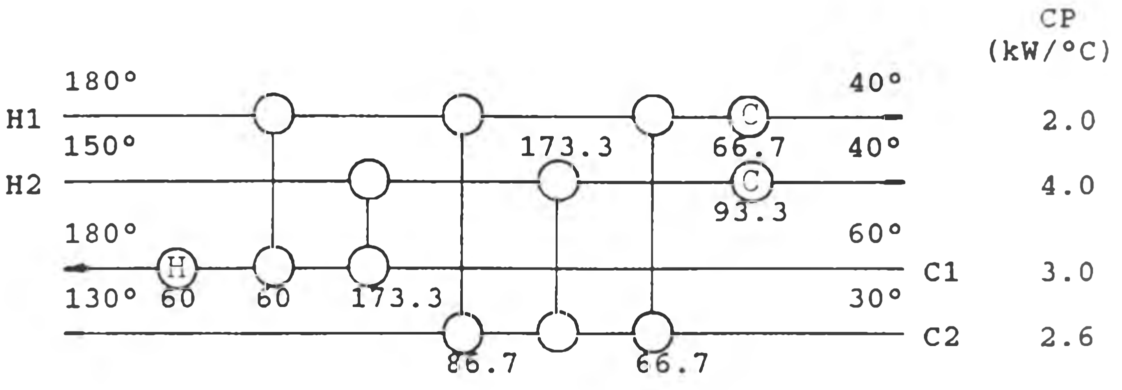
D1.1 [33: 153]



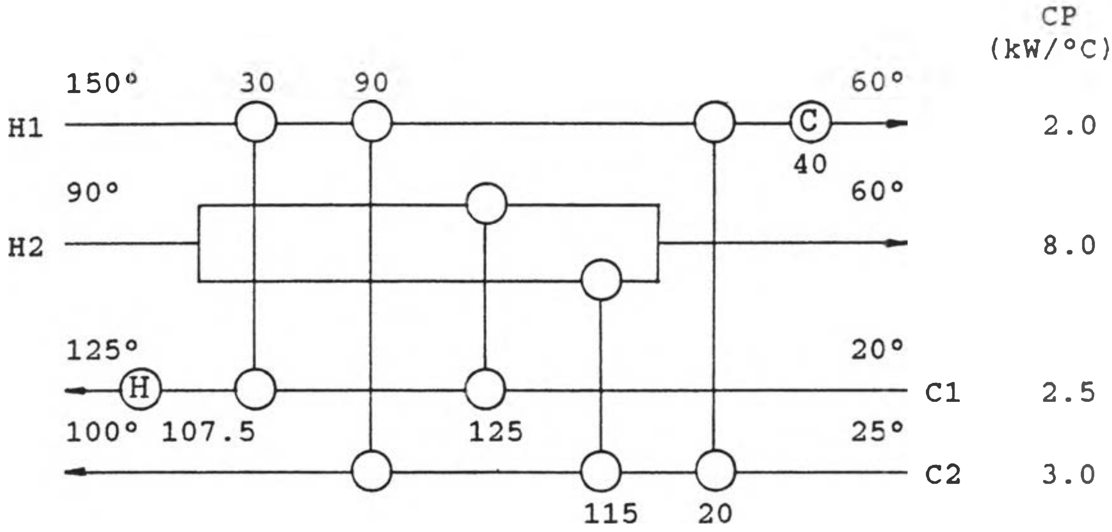
D1.2 [39:319]



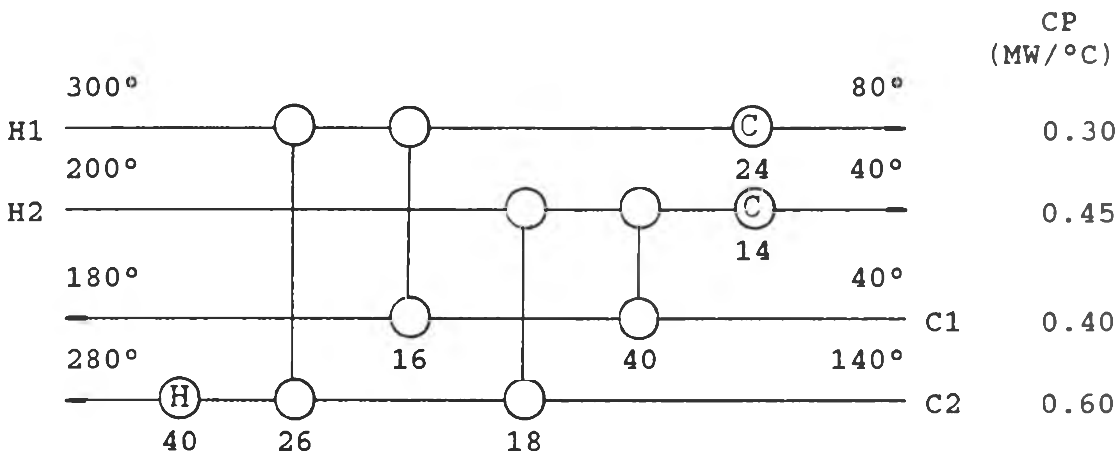
D1.3 [21: 76]



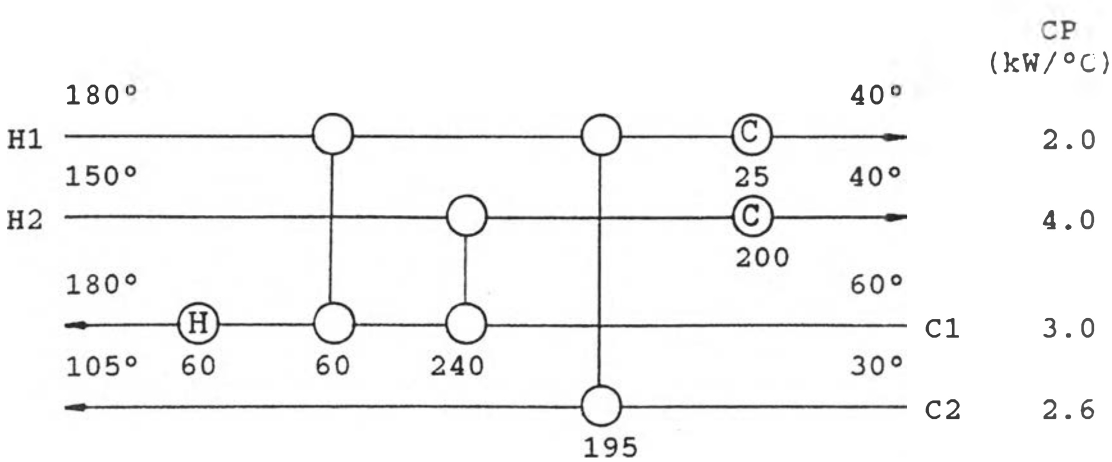
D1.4 [26: 745]



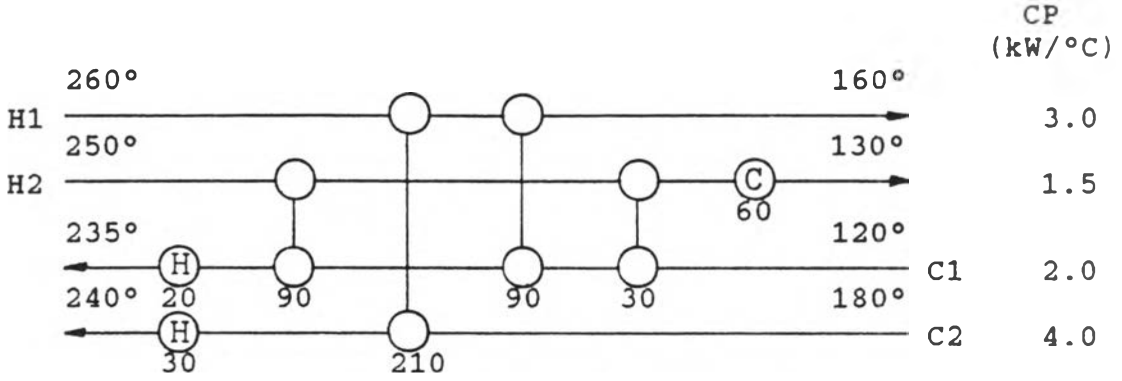
D1.5 [6: 742]



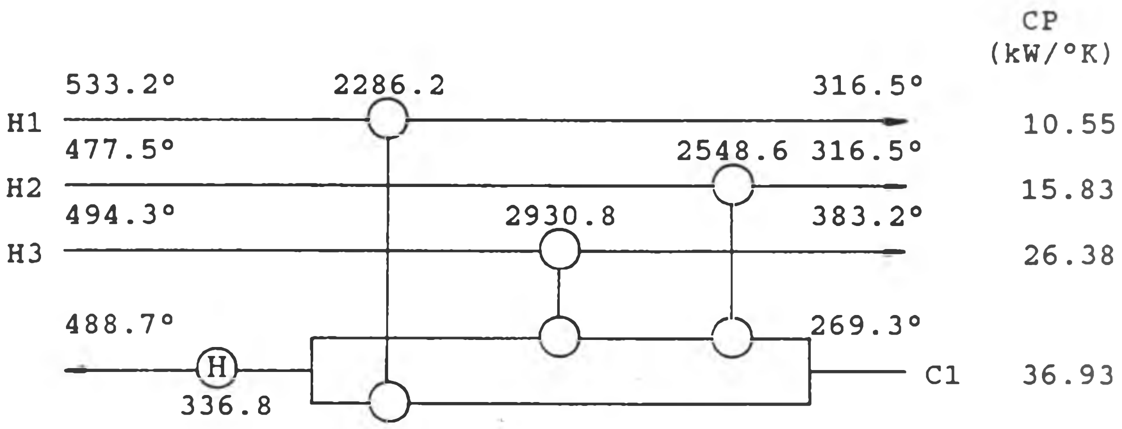
D1.6 [16: 633]



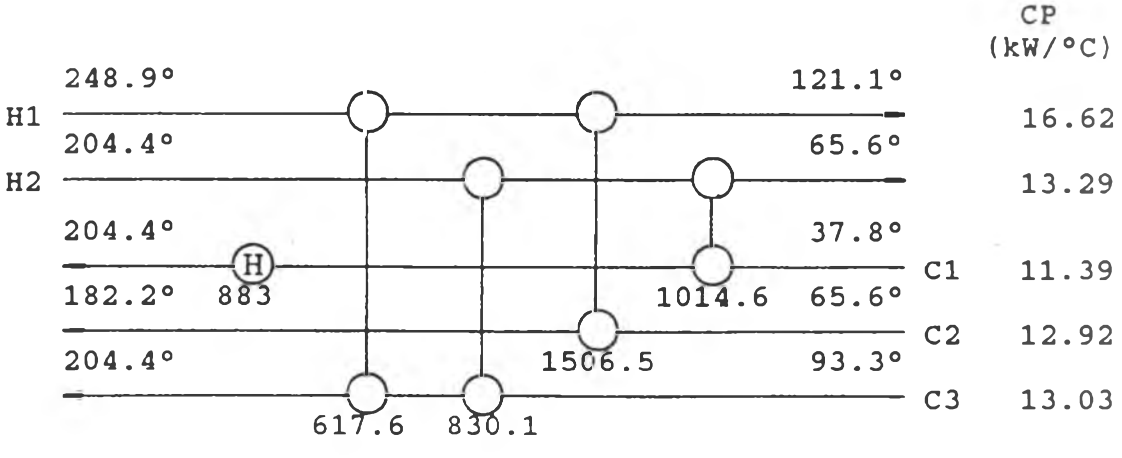
D1.7 [1: 56]



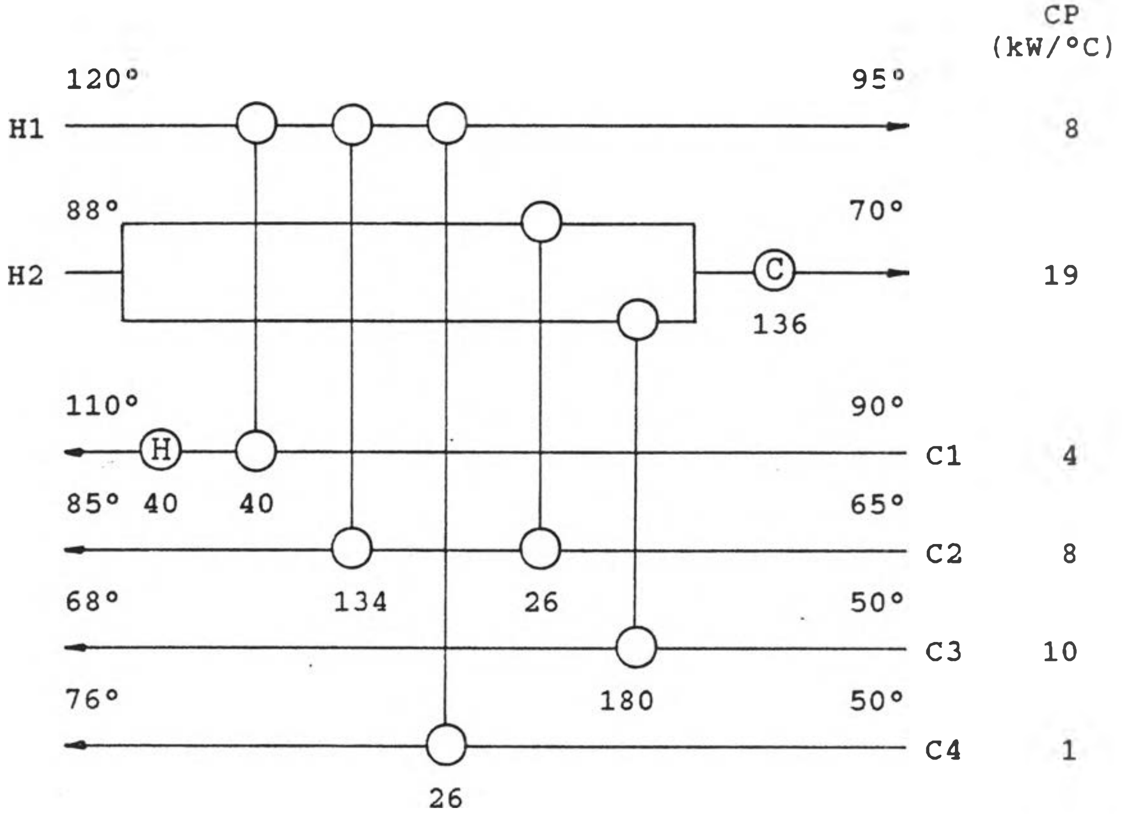
D1.8 [21: 67]



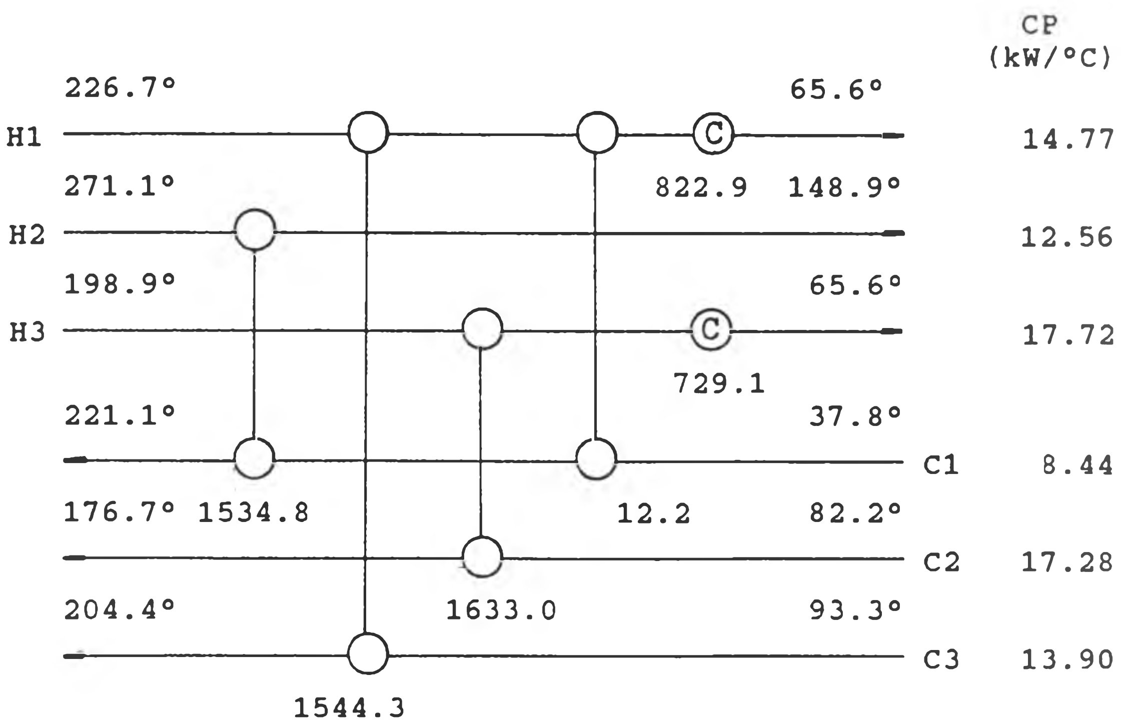
D1.9 [17: 1]



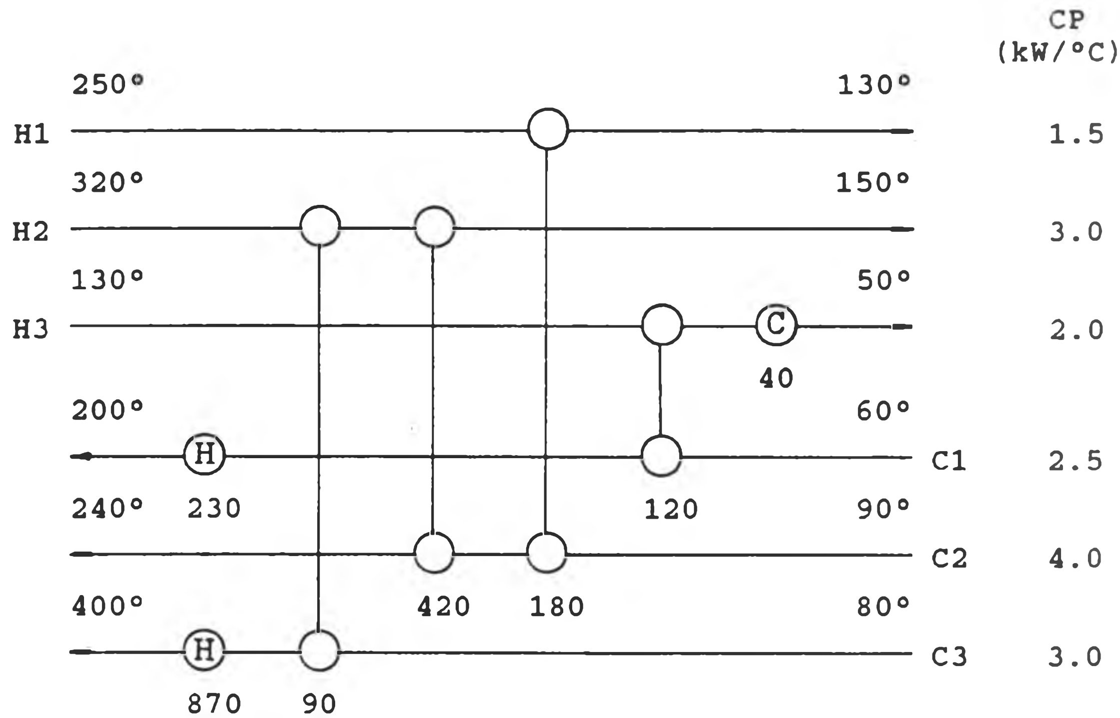
D1.10 [27: 601]



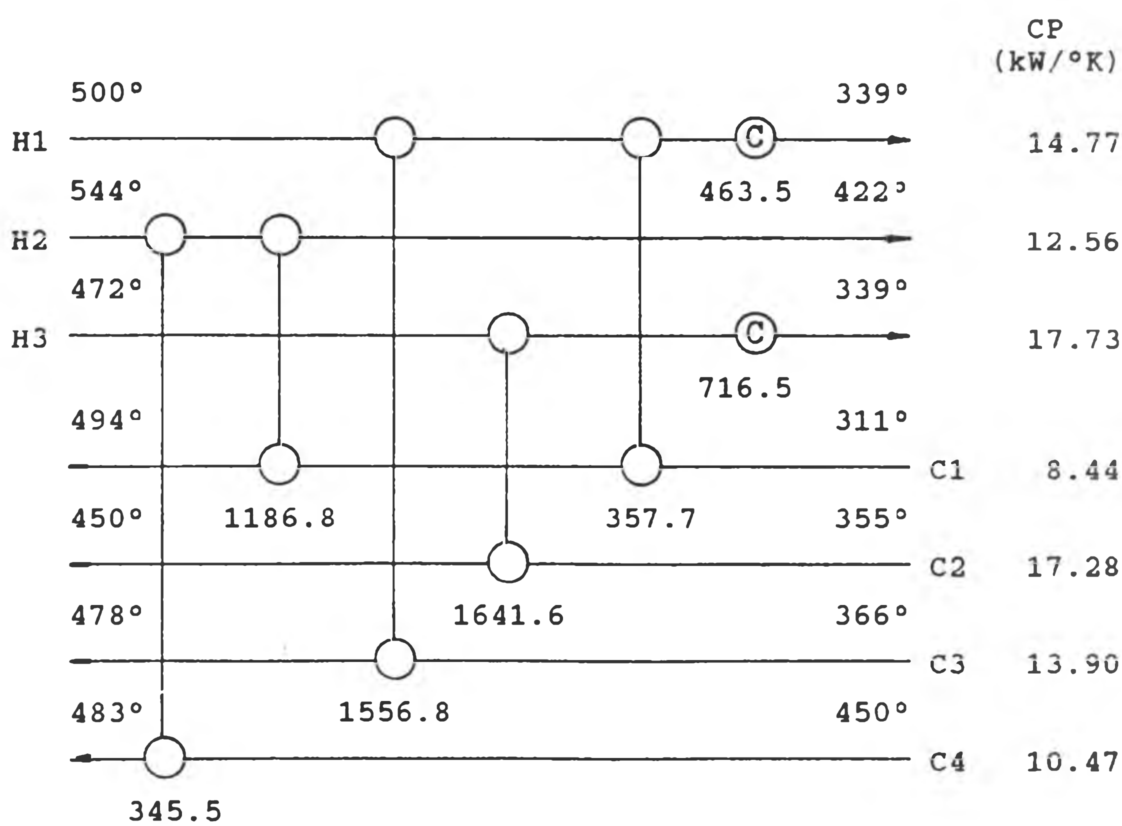
D1.11 [17: 1]



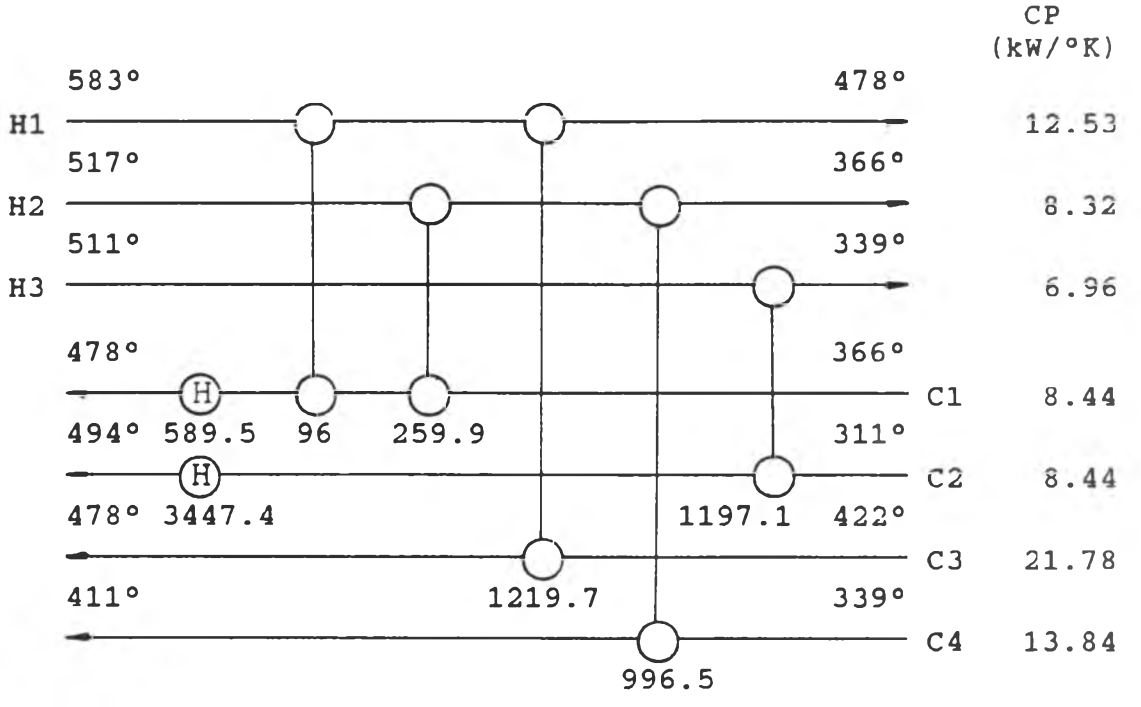
D1.12



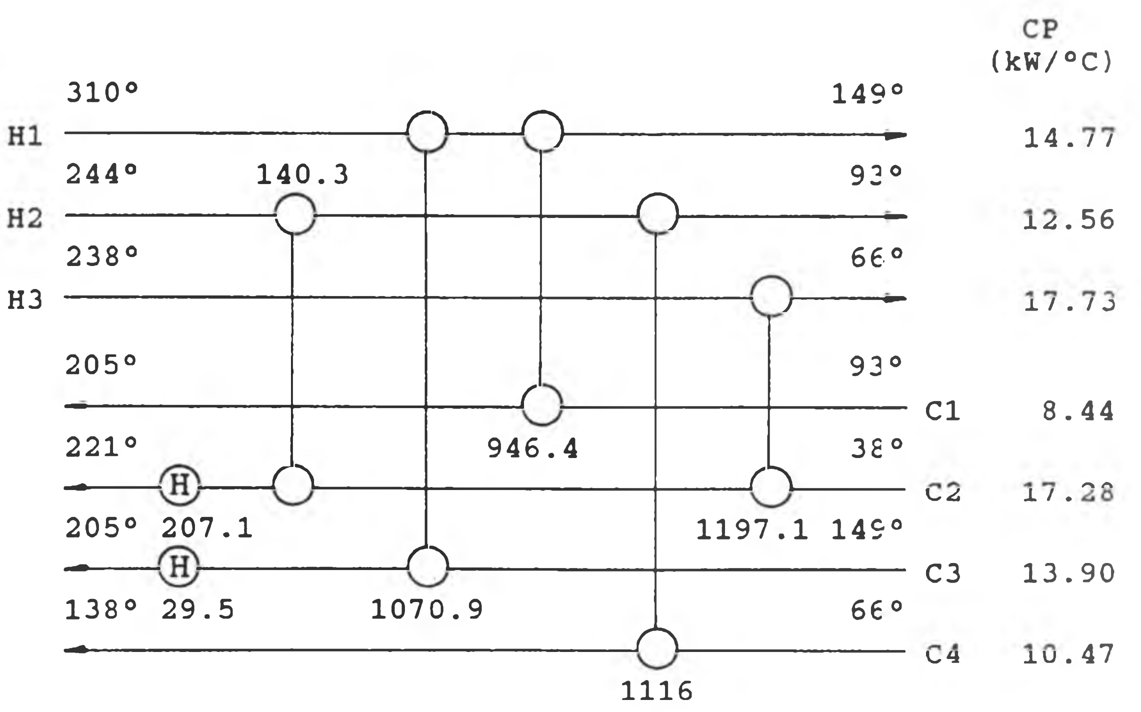
D1.13 [16:633]



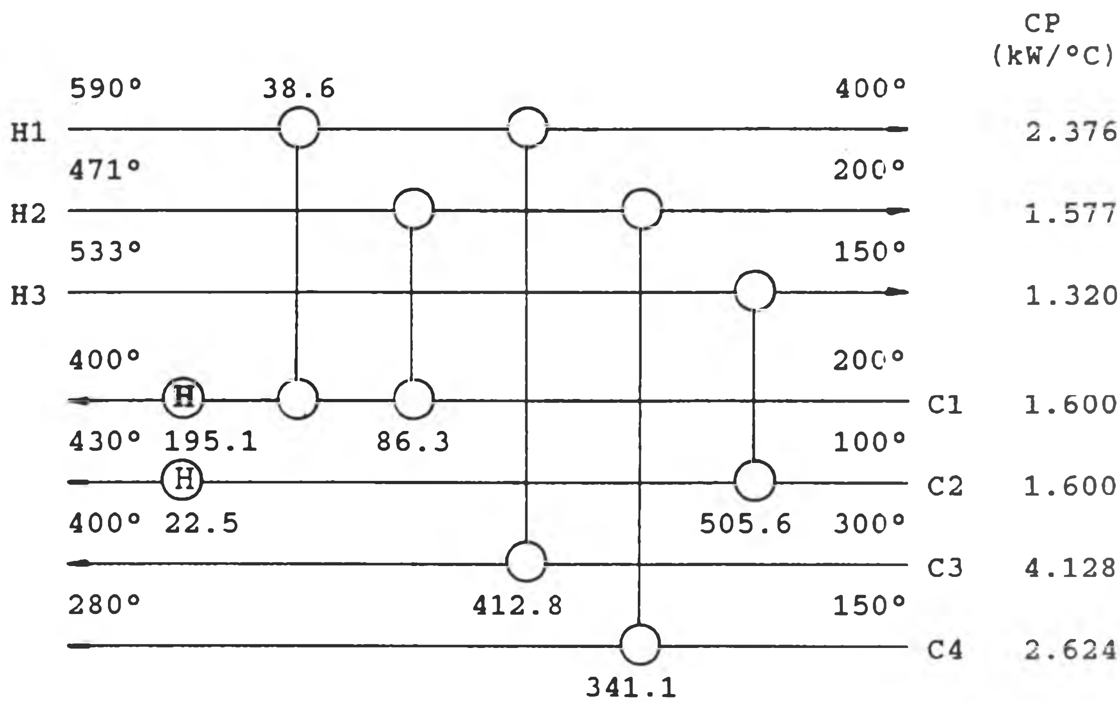
D1.14 [16: 633]



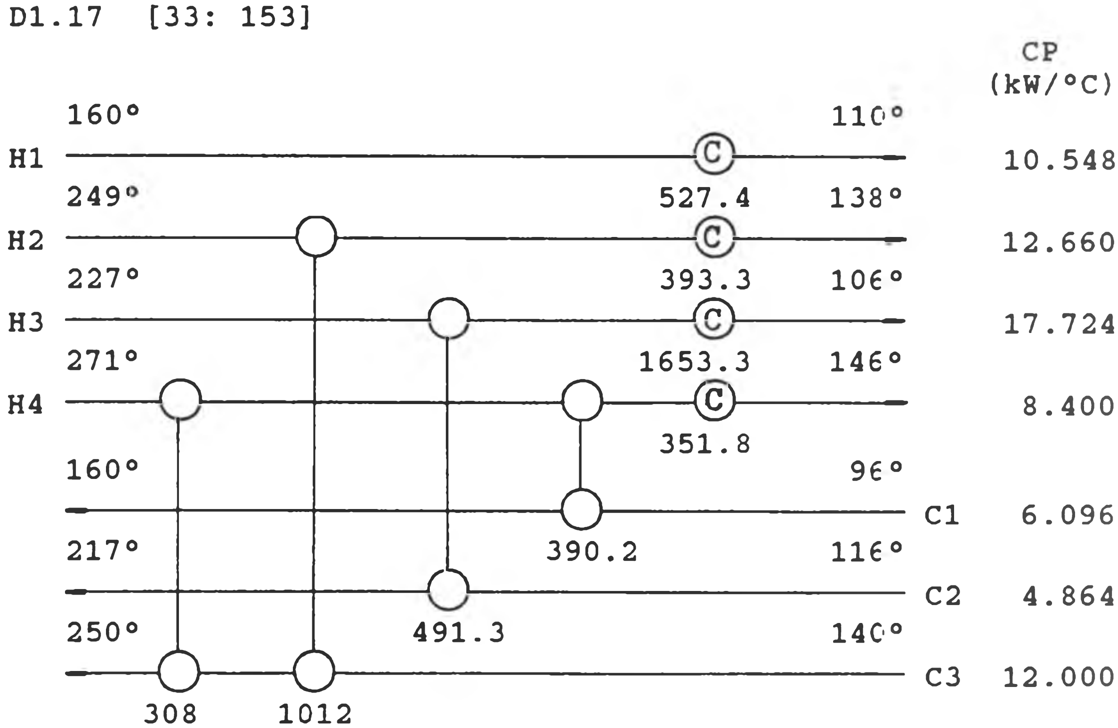
D1.15 [32: 1723]



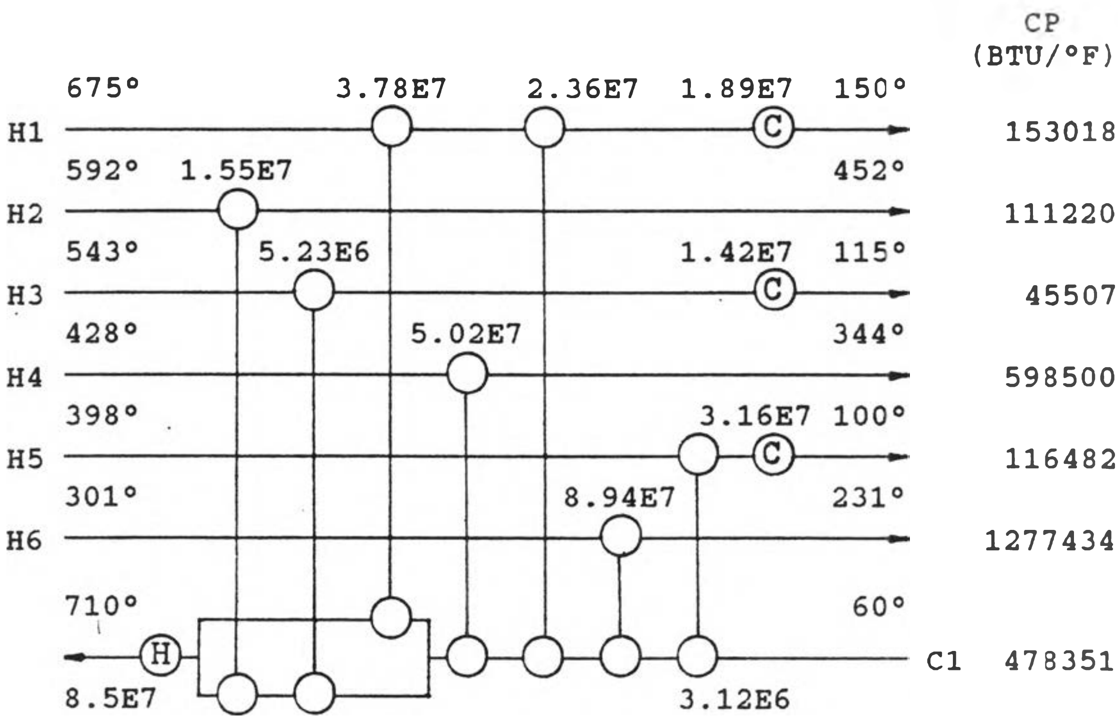
D1.16 [25: 50]



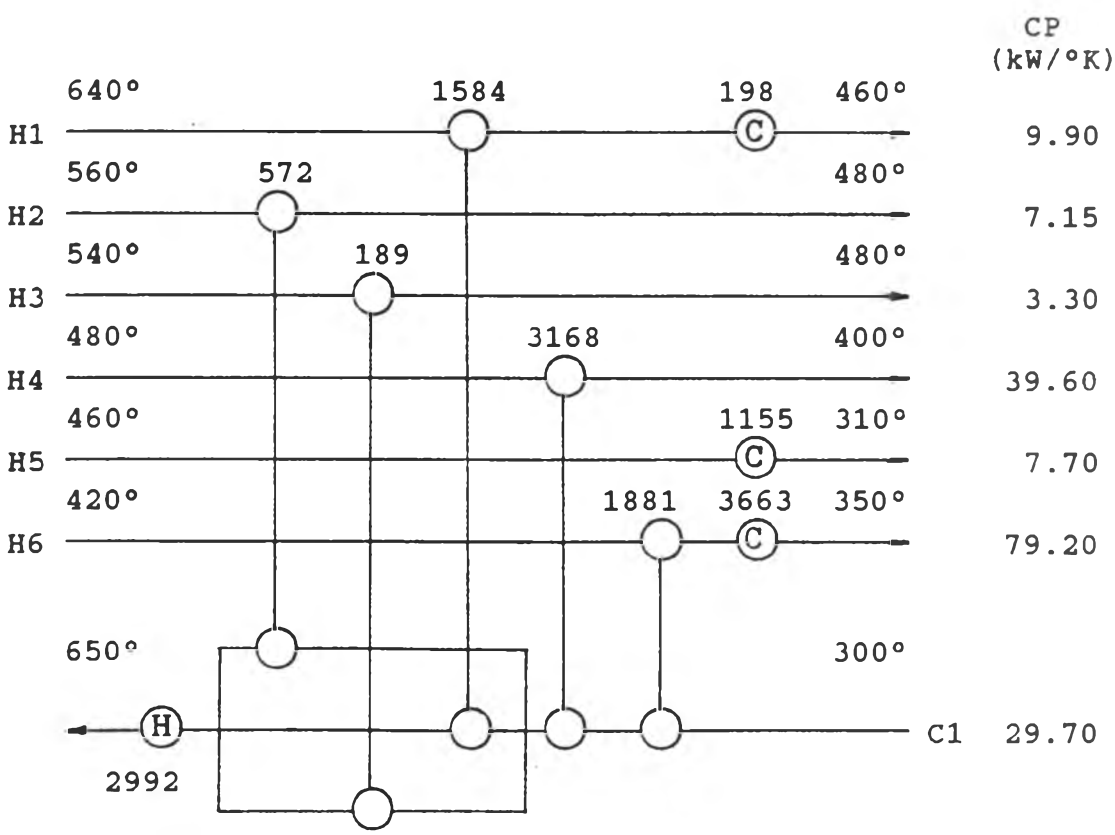
D1.17 [33: 153]



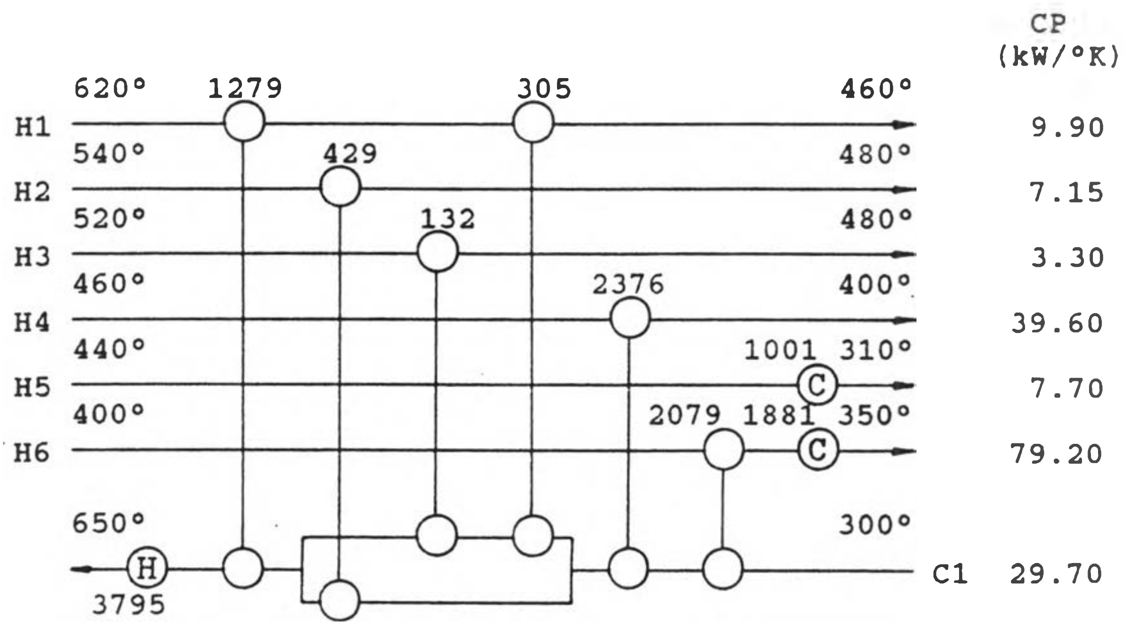
D1.18 [15: 1]



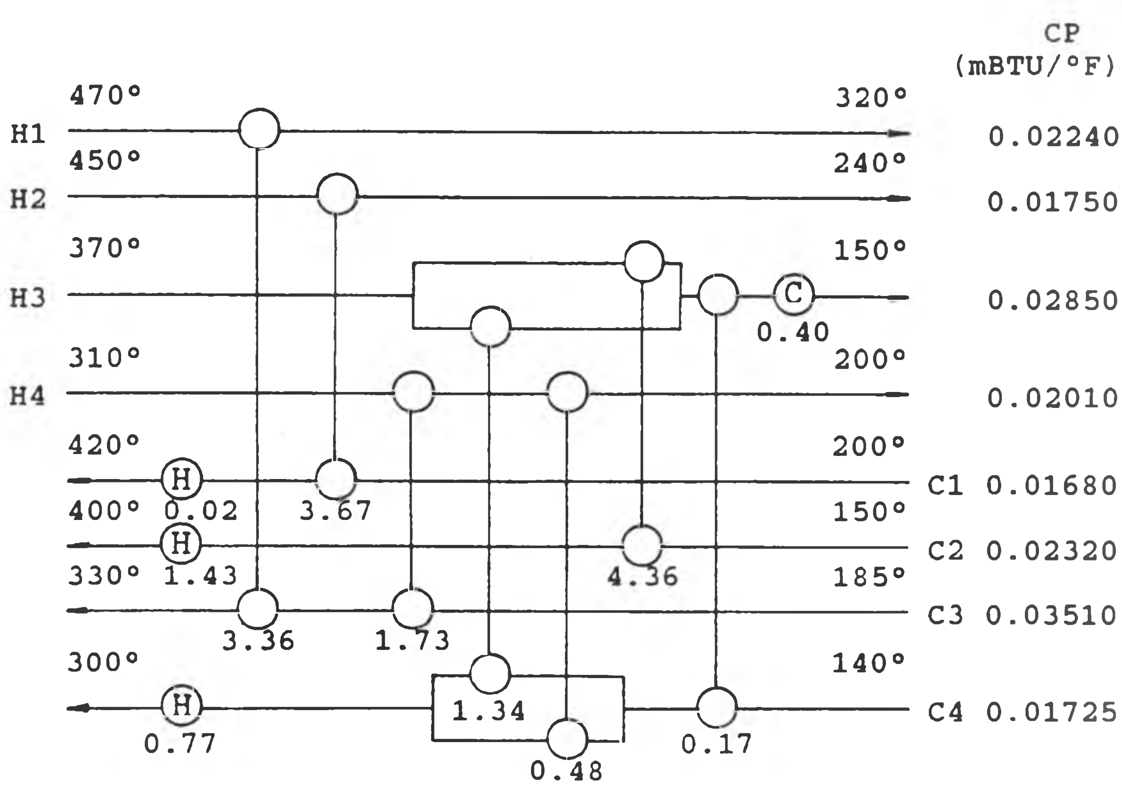
D1.19 [34: 123]



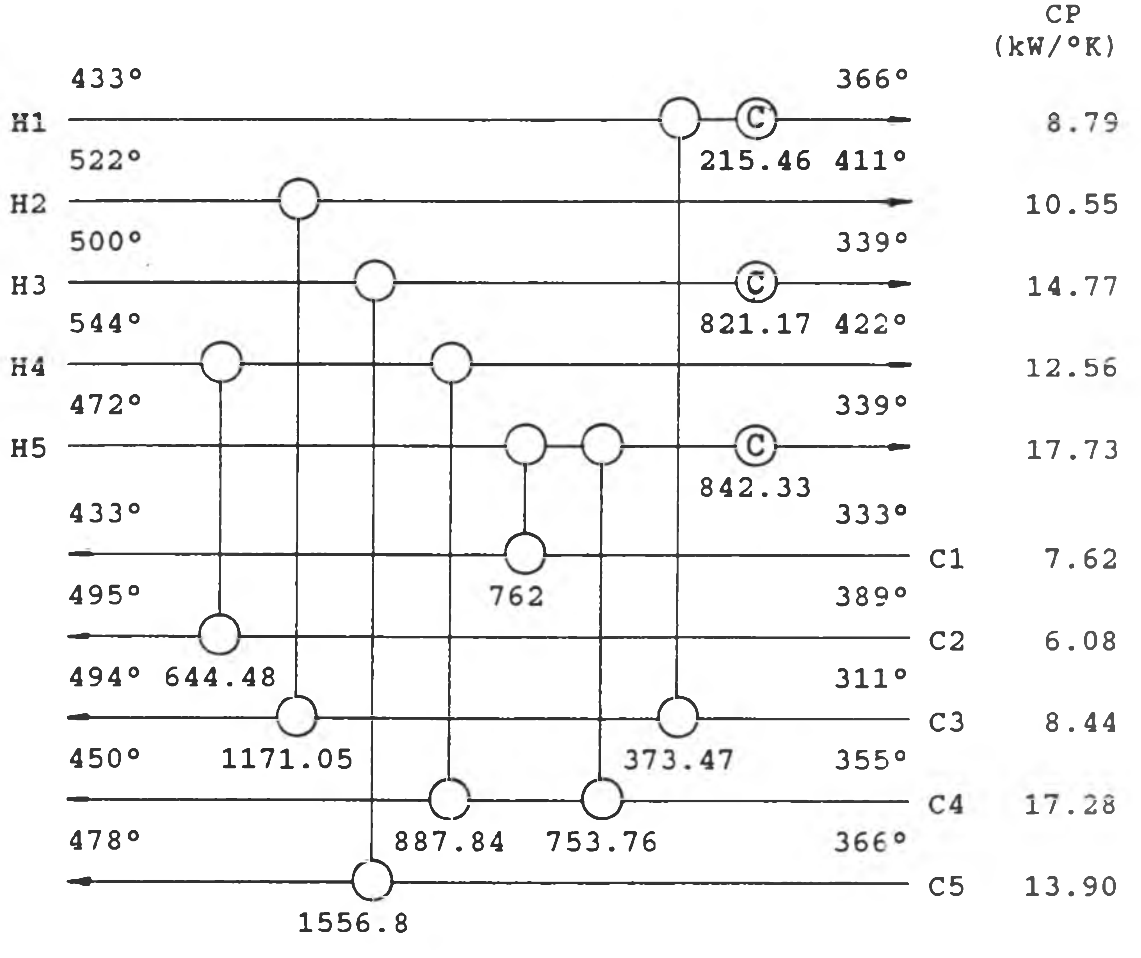
D1.20 [34: 132]



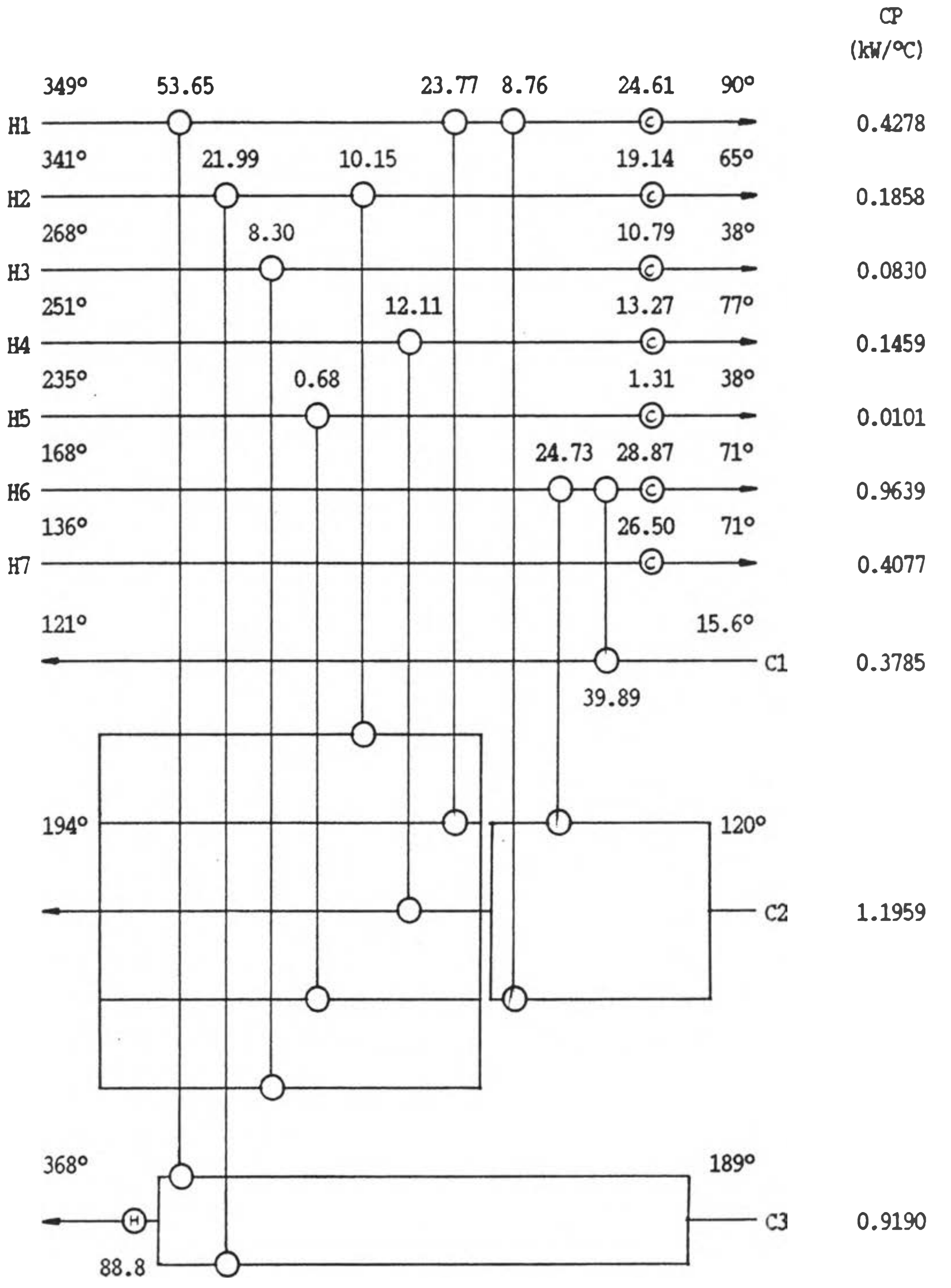
D1.21 [15: 1]



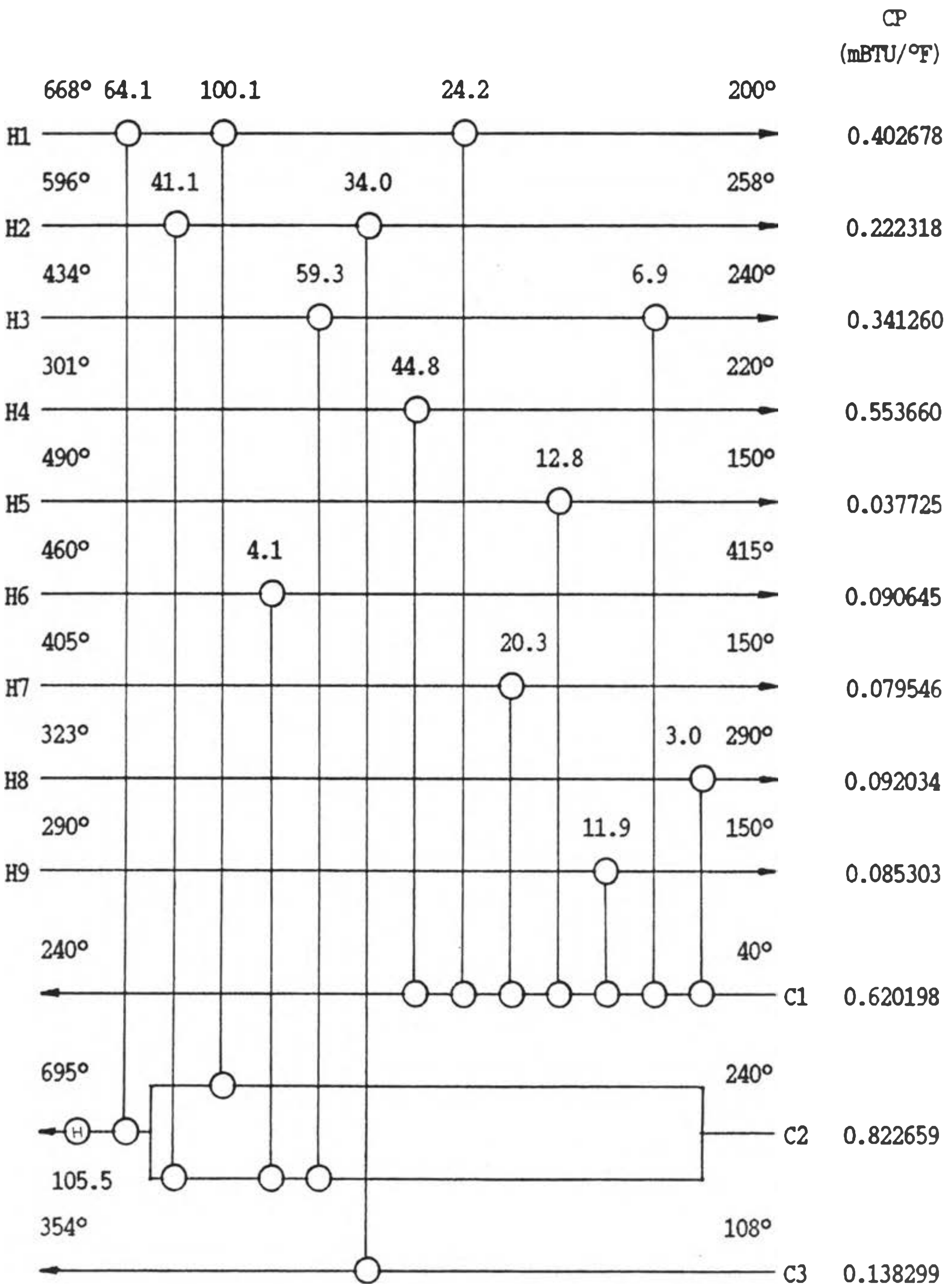
D1.22 [17: 1]


CP
(kW/°K)
433°
366°
H1
8.79
215.46
411°
522°
H2
10.55
500°
339°
H3
14.77
821.17
422°
544°
H4
12.56
472°
339°
H5
17.73
842.33
433°
333°
C1
7.62
762
495°
389°
C2
6.08
494°
644.48
311°
C3
8.44
450°
1171.05
373.47
355°
C4
17.28
478°
887.84
753.76
366°
C5
13.90
1556.8

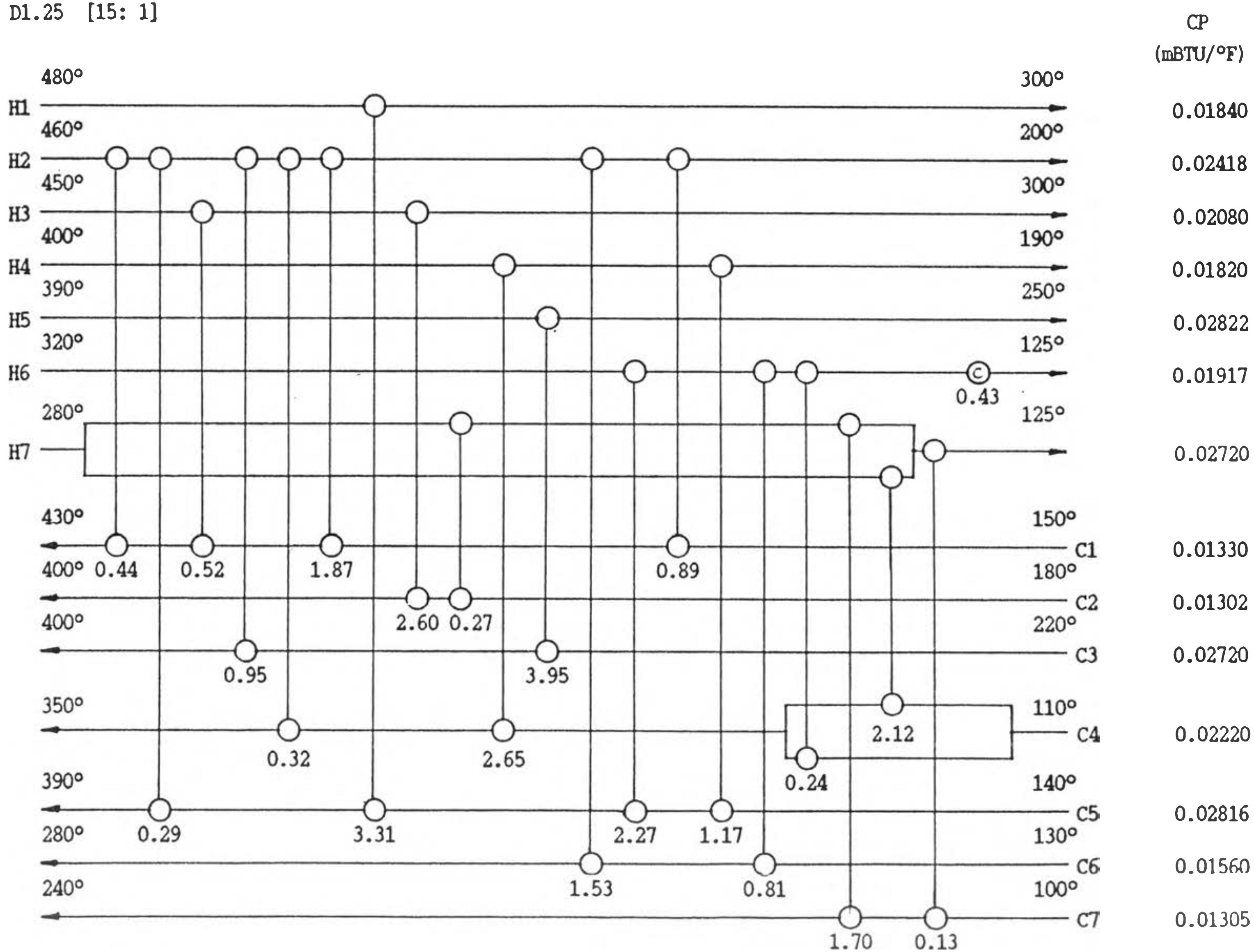
D1.23 [25: 201]


CP
(kW/°C)
349° 53.65 23.77 8.76 24.61 90°
H1 0.4278
341° 21.99 10.15 19.14 65°
H2 0.1858
268° 8.30 10.79 38°
H3 0.0830
251° 12.11 13.27 77°
H4 0.1459
235° 0.68 1.31 38°
H5 0.0101
168° 24.73 28.87 71°
H6 0.9639
136° 26.50 71°
H7 0.4077
121° 15.6°
C1 0.3785
39.89
194° 120°
C2 1.1959
368° 189°
C3 0.9190
88.8

D1.24 [15: 1]

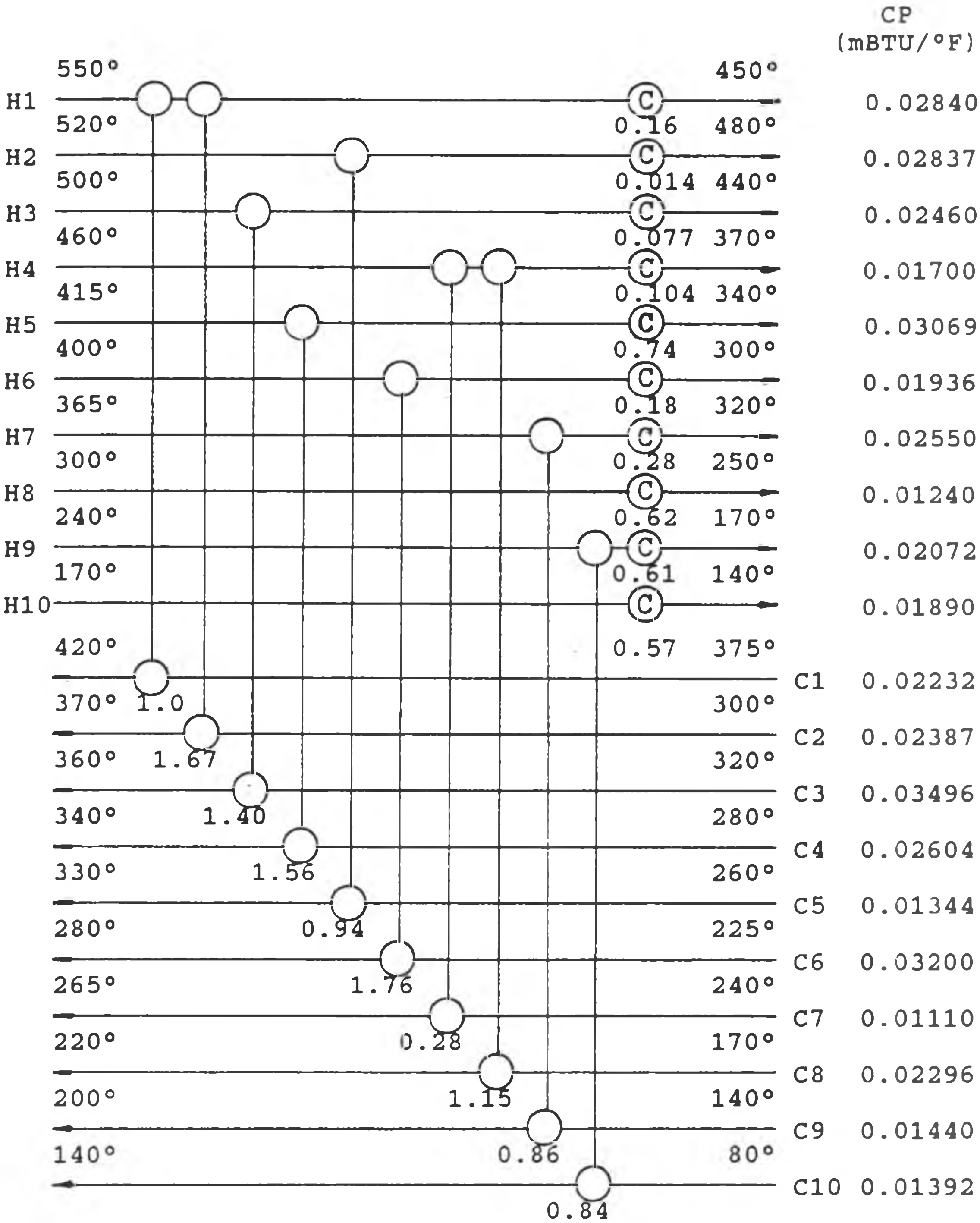

CP
(mBTU/°F)
668° 64.1 100.1 24.2 200°
H1 0.402678
596° 41.1 34.0 258°
H2 0.222318
434° 59.3 6.9 240°
H3 0.341260
301° 44.8 220°
H4 0.553660
490° 12.8 150°
H5 0.037725
460° 4.1 415°
H6 0.090645
405° 20.3 150°
H7 0.079546
323° 3.0 290°
H8 0.092034
290° 11.9 150°
H9 0.085303
240° 40°
C1 0.620198
695° 240°
H
C2 0.822659
105.5
354° 108°
C3 0.138299

D1.25 [15: 1]


CP
(mBTU/°F)
H1
480°
300°
0.01840
H2
460°
200°
0.02418
H3
450°
300°
0.02080
H4
400°
190°
0.01820
H5
390°
250°
0.02822
H6
320°
125°
0.01917
0.43
H7
280°
125°
0.02720
C1
430°
150°
0.01330
0.44
0.52
1.87
0.89
C2
400°
180°
0.01302
2.60
0.27
C3
400°
220°
0.02720
0.95
3.95
C4
350°
110°
0.02220
0.32
2.65
2.12
0.24
C5
390°
140°
0.02816
0.29
3.31
2.27
1.17
C6
280°
130°
0.01560
1.53
0.81
C7
240°
100°
0.01305
1.70
0.13

187

D1.26 [15: 1]

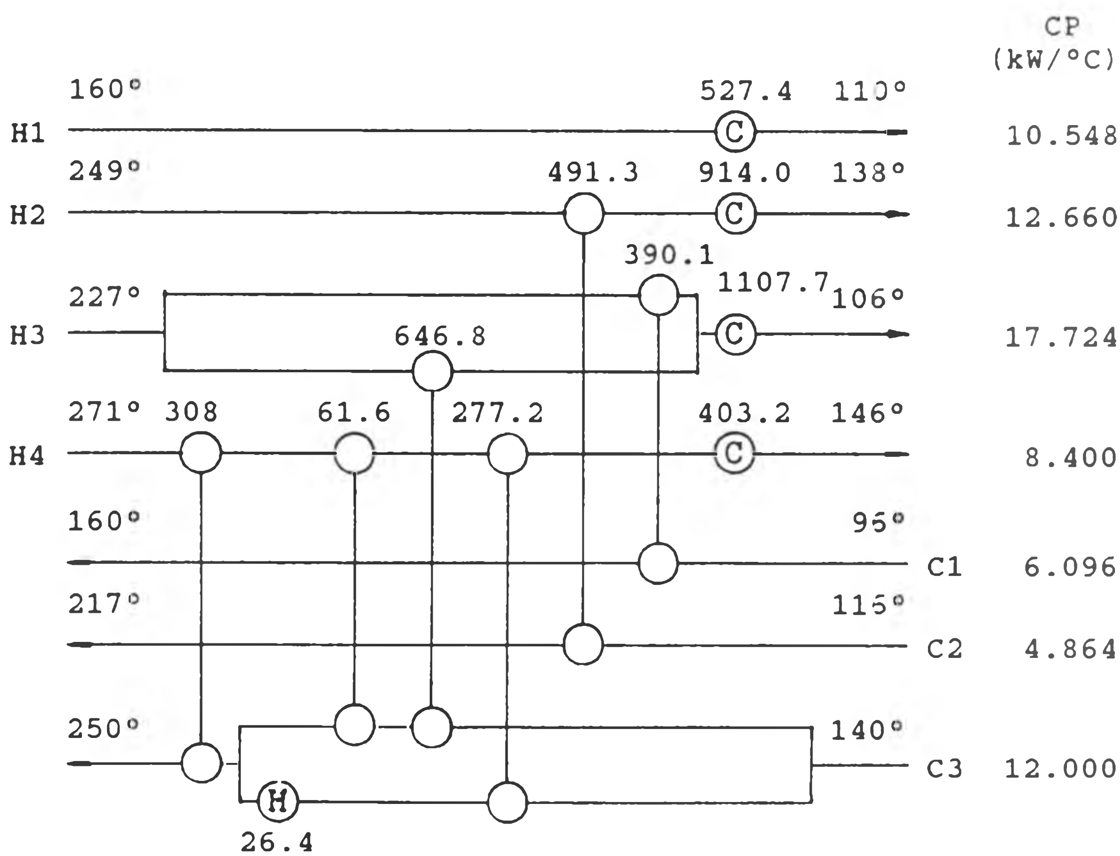


CP
(mBTU/°F)
H1 550° 450° 0.16 0.02840
H2 520° 480° 0.014 0.02837
H3 500° 440° 0.077 0.02460
H4 460° 370° 0.104 0.01700
H5 415° 340° 0.74 0.03069
H6 400° 300° 0.18 0.01936
H7 365° 320° 0.28 0.02550
H8 300° 250° 0.62 0.01240
H9 240° 170° 0.61 0.02072
H10 170° 140° 0.57 0.01890
C1 420° 375° 1.0 0.02232
C2 370° 300° 1.67 0.02387
C3 360° 320° 1.40 0.03496
C4 340° 280° 1.56 0.02604
C5 330° 260° 0.94 0.01344
C6 280° 225° 1.76 0.03200
C7 265° 240° 0.28 0.01110
C8 220° 170° 1.15 0.02296
C9 200° 140° 0.86 0.01440
C10 140° 80° 0.84 0.01392
C

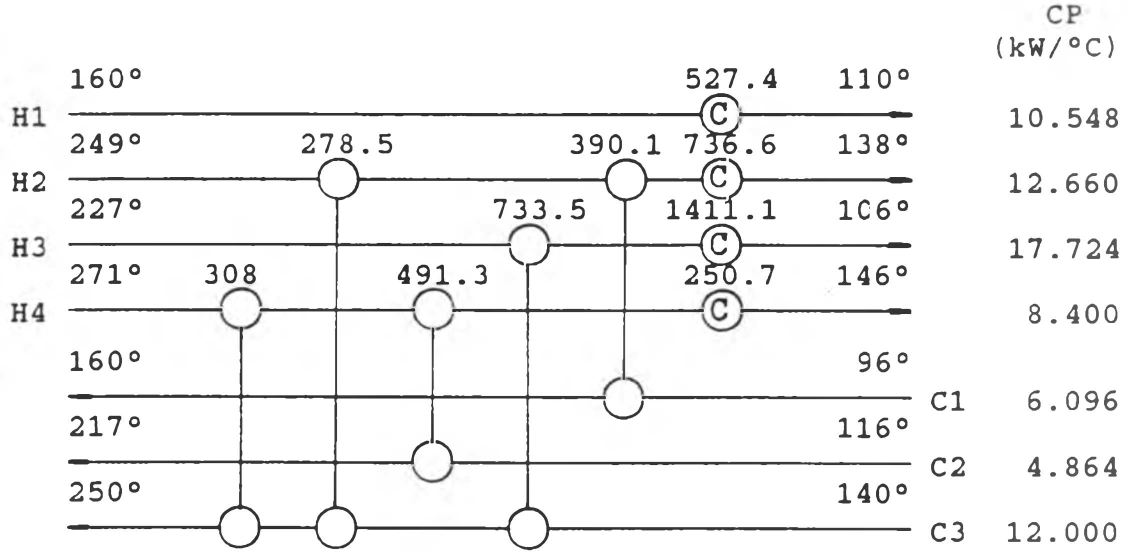
D2. Restricted matching

Taking problem D1.17 as an example, the minimum utility requirements are 2925.8 kW hot and nil cold. The matching of hot and cold stream pairs are (2,3), (3,2), (4,1) and (4,3). If one of these stream pairs becomes forbidden, the corresponding extra-utility requirement will be 26.4, 0, 0 and 132 units, respectively. The network structures for these restricted conditions are shown below.

D2.1 Matching of H2 and C3 is forbidden.



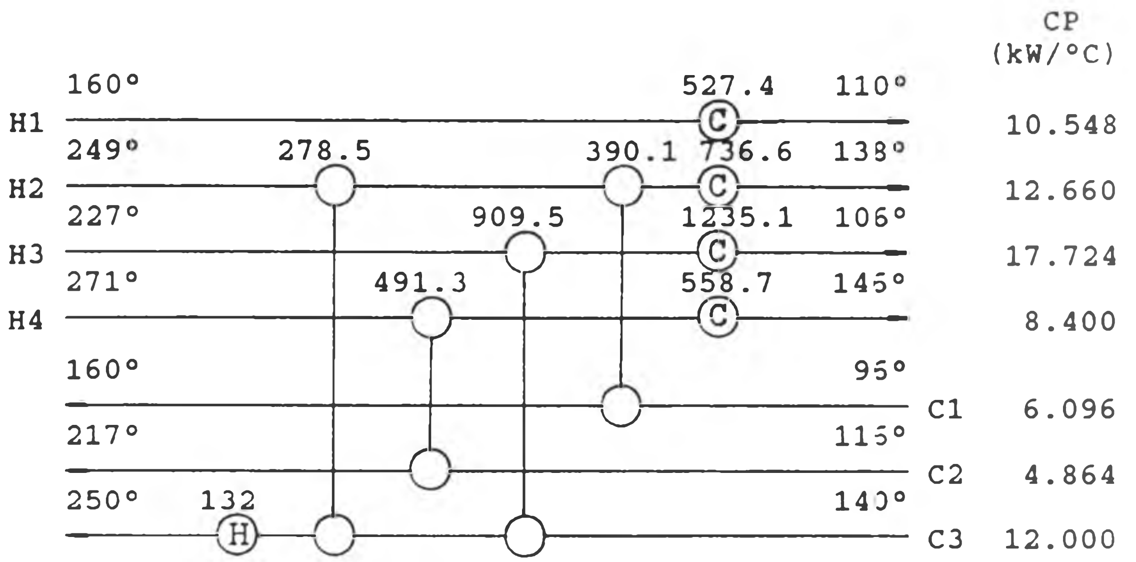
D2.2 Matching of H3 and C2 is forbidden.



D2.3 Matching of H4 and C1 is forbidden.

The designed network is identical to that obtained in D2.2

D2.4 Matching of H4 and C3 is forbidden.



Biography

Mr. Boonliang Simsrisakul was born on March 30th, 1959 at Yala. He recieved a Bachelor Degree of Science in Mechanical Engineering (2nd Class Hons.) from Prince of Songkla University in 1981.