

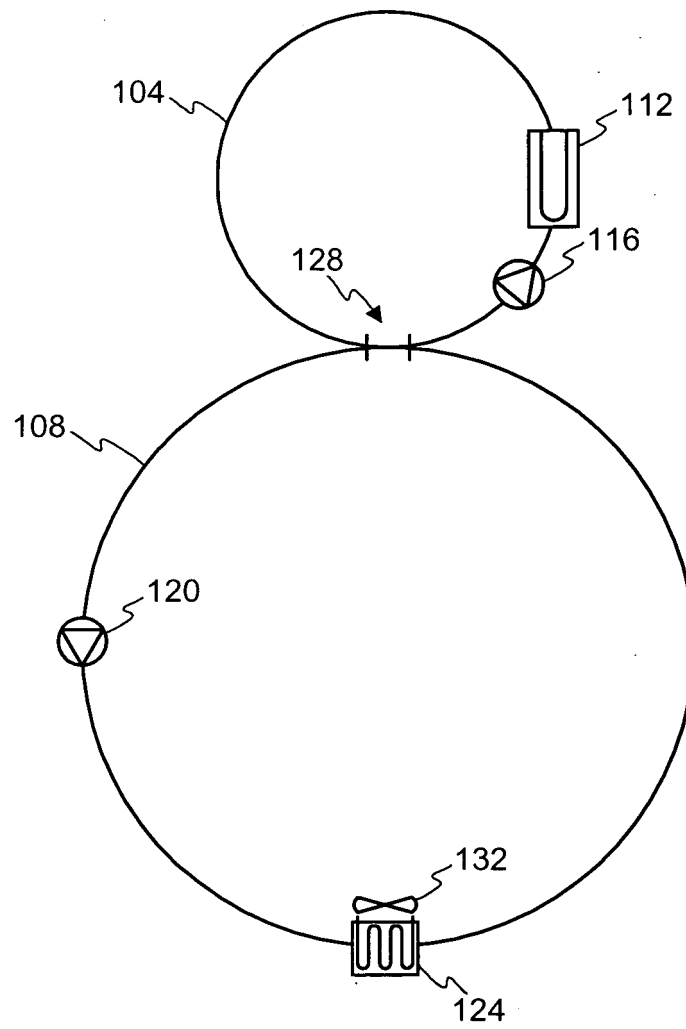
Fig. 1

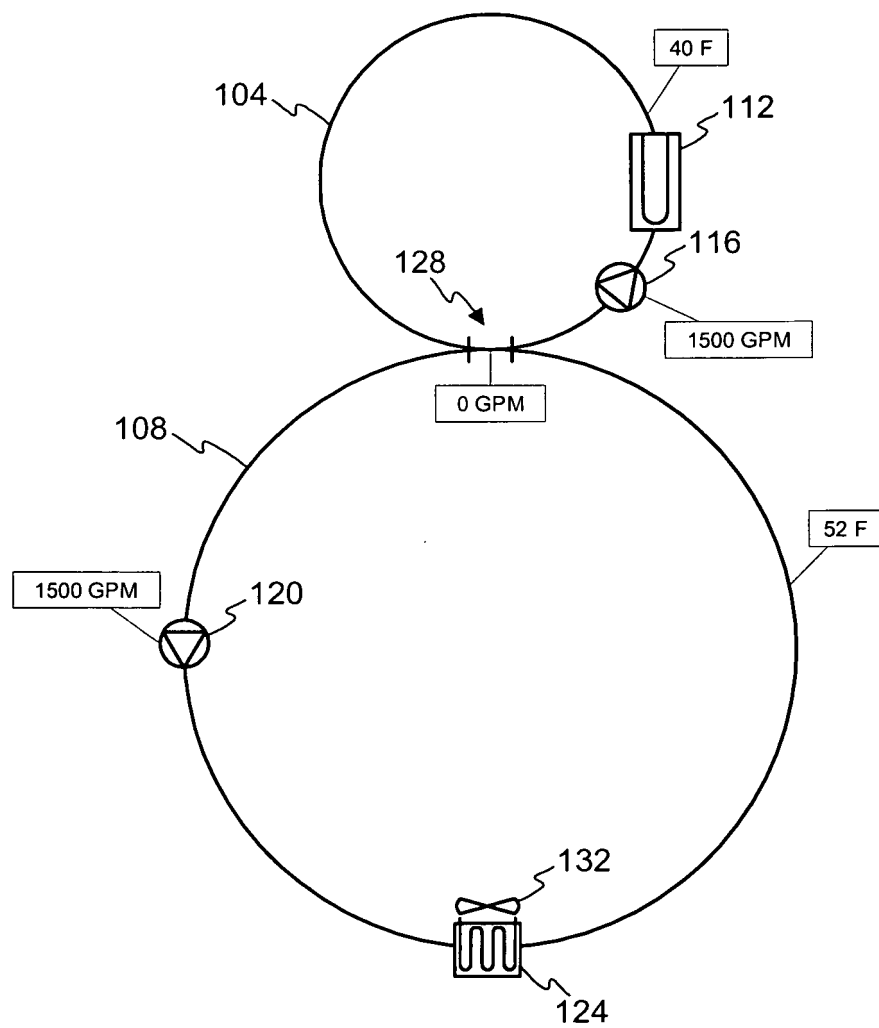
Fig. 2

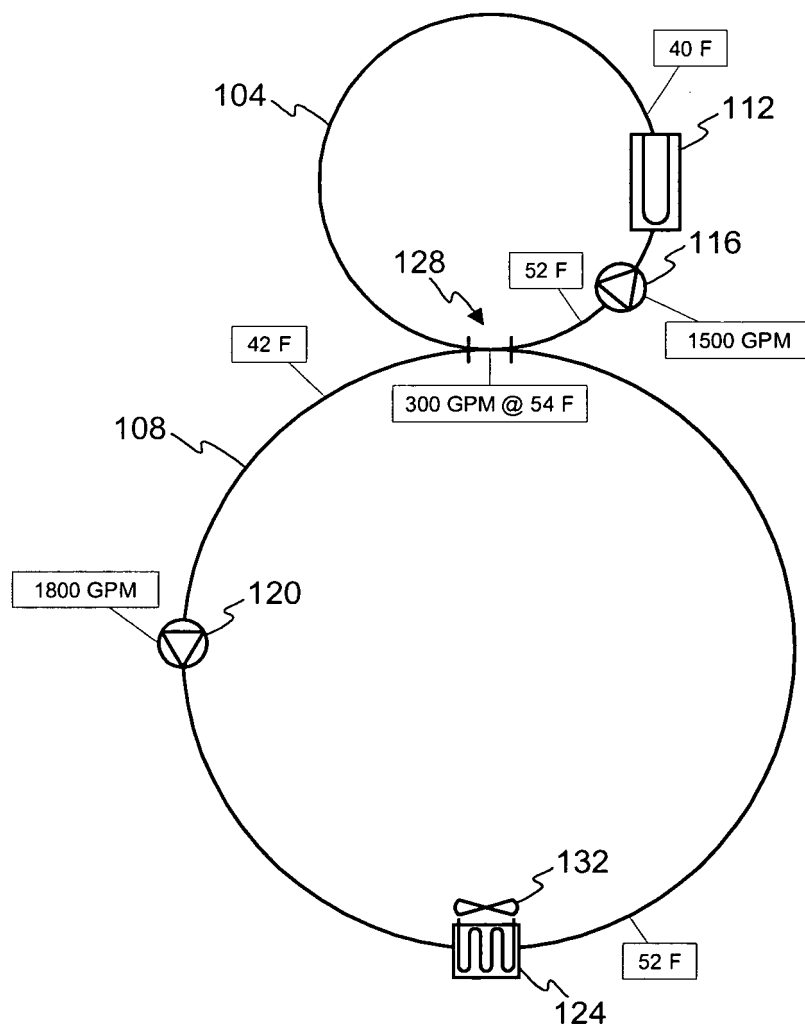
Fig. 3

Fig. 4

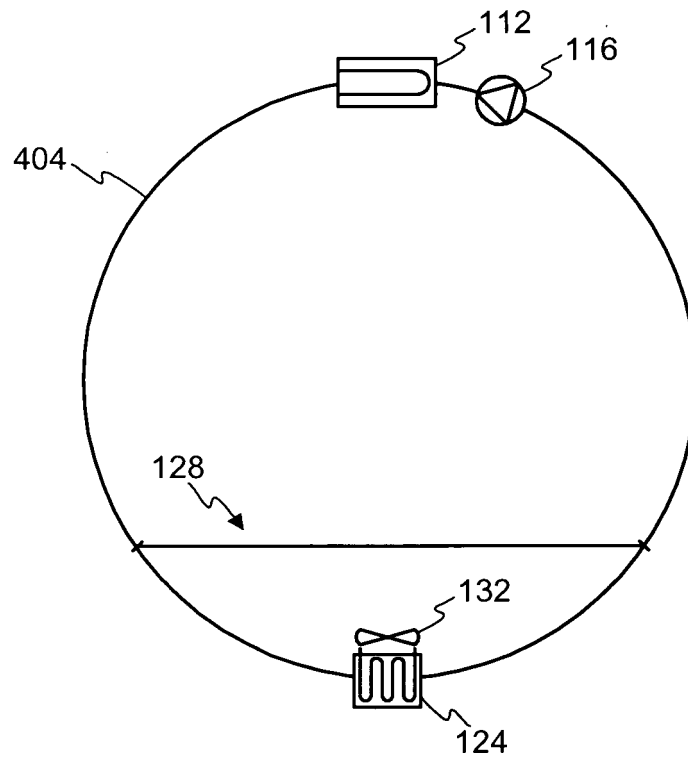


Fig. 5

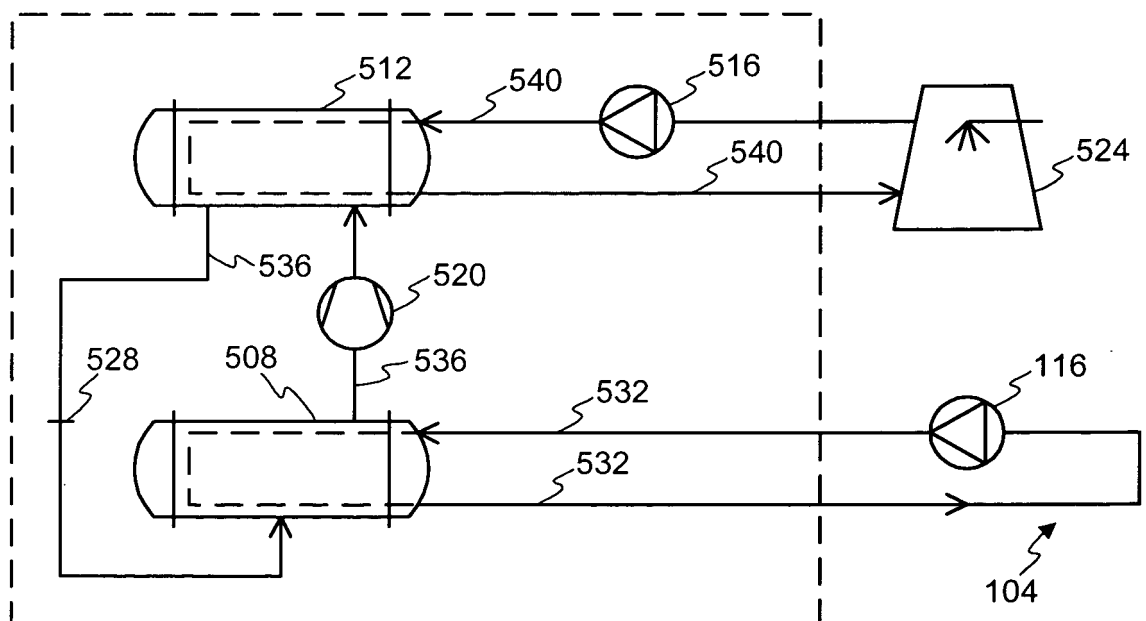


Fig. 6A

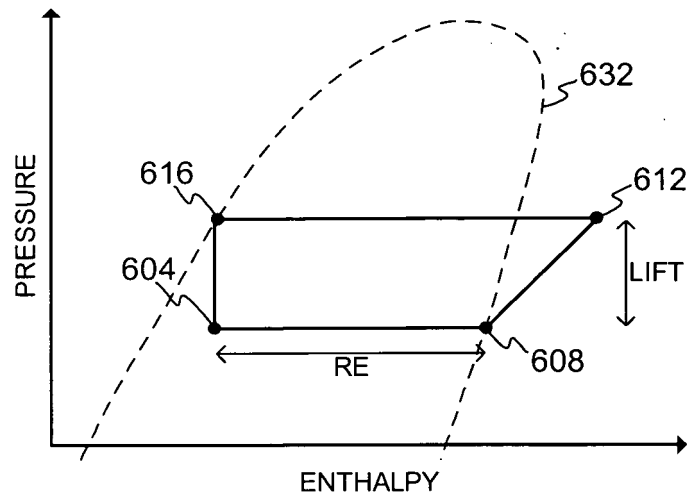


Fig. 6B

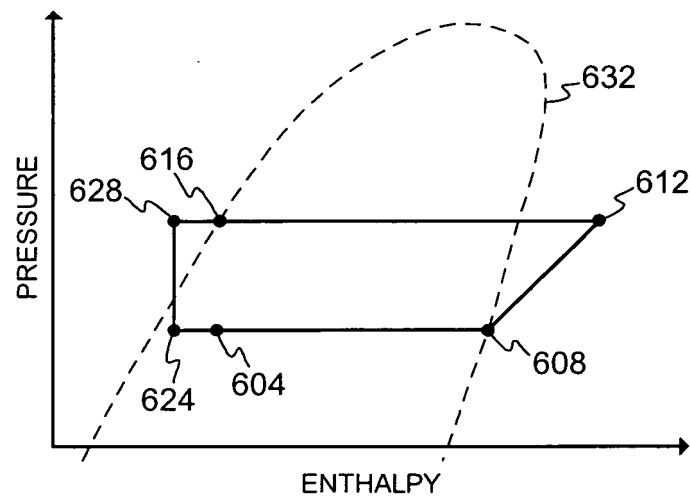


Fig. 6C

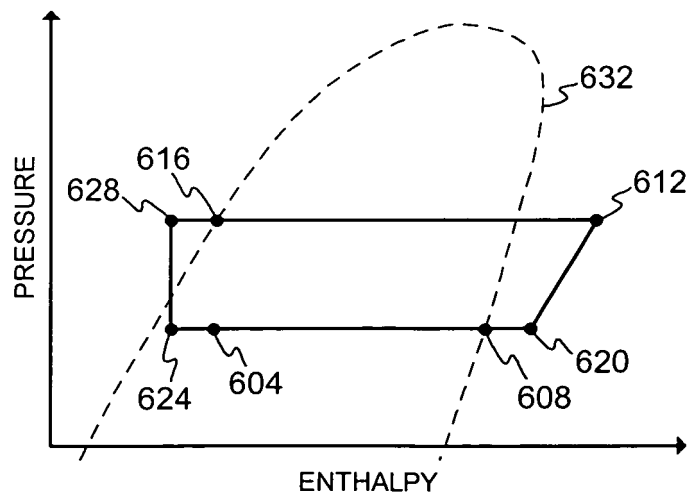


Fig. 7

CWE Temperature	61.00	64.97	67.20	75.00	78.00	80.00	83.00
CWL Temperature	75.00	79.59	81.20	89.00	92.00	94.00	97.00
Chilled Water Pump KW	46	54	65	49	55	59	48
Condenser Water Pump KW	26	27	31	27	28	29	29
Chiller KW	1027	1217	1321	1423	1555	1605	1571
Tower Fan KW	228	198	118	57	33	23	18
Total Plant KW	1327	1496	1535	1556	1671	1696	1666
System Tons	2130	2364	2408	2193	2353	2356	2201
System KW/Ton	0.623	0.633	0.640	0.680	0.710	0.720	0.757
Chiller KW/Ton	0.482	0.515	0.549	0.649	0.661	0.681	0.714
CWP KW/Ton	0.012	0.011	0.013	0.012	0.012	0.012	0.013
CHWP KW/Ton	0.022	0.023	0.027	0.022	0.023	0.025	0.022
CT Fan KW/Ton	0.107	0.084	0.049	0.026	0.014	0.010	0.008
System KW/Ton	0.623	0.633	0.637	0.710	0.710	0.728	0.757
Online Chiller Capacity %	59%	70%	75%	81%	87%	91%	93%
Online Chiller Capacity Tons	3641	3401	3232	2724	2705	2603	2367
Increased System Efficiency	18%	16%	16%	6%	6%	4%	0%
Increased Chiller Efficiency	32%	28%	23%	9%	7%	5%	0%
Increased Chiller Capacity	54%	44%	37%	15%	14%	10%	0%

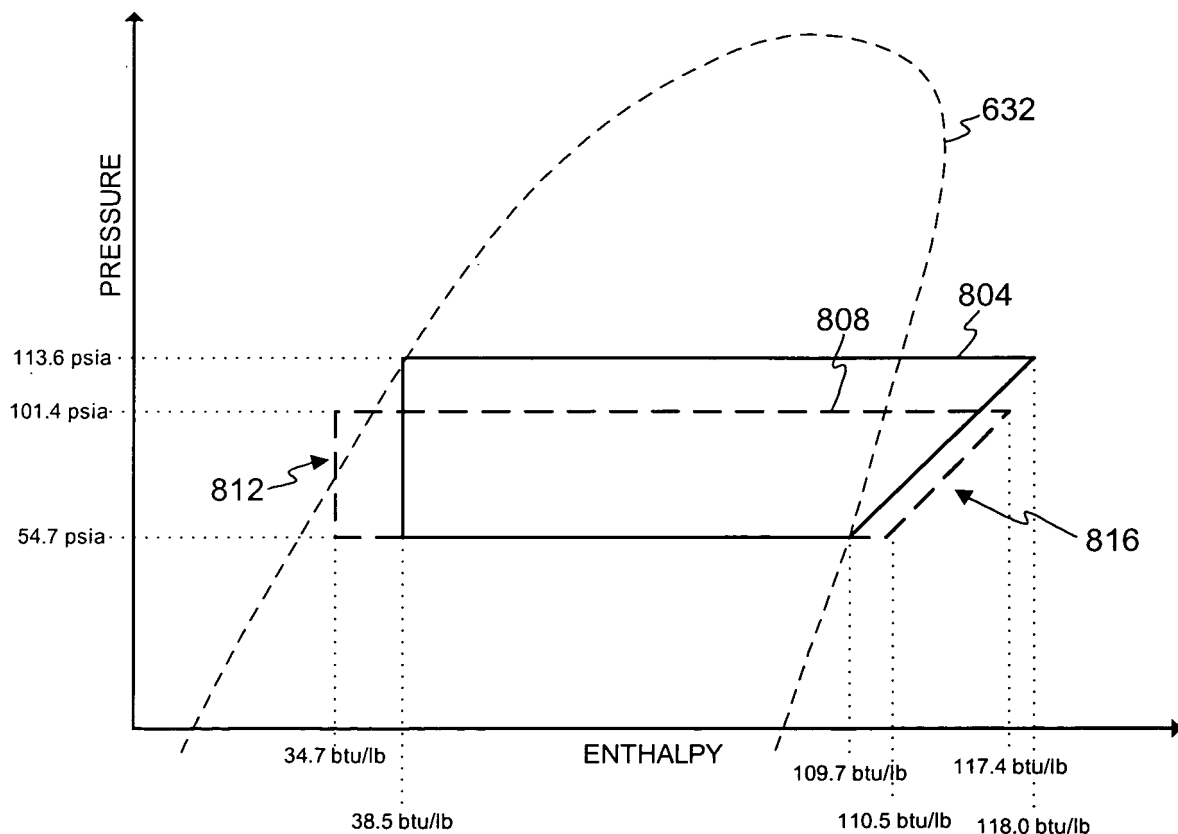
Fig. 8

Fig. 9A

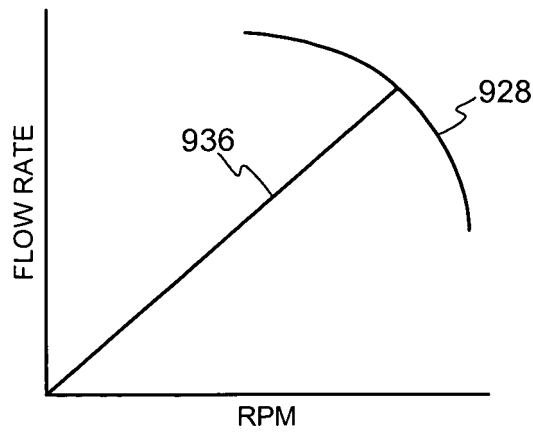


Fig. 9B

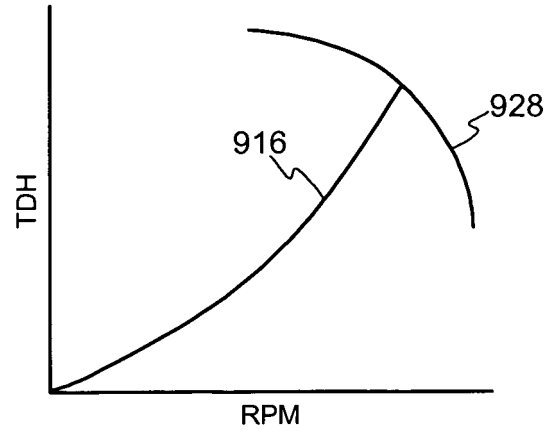


Fig. 9C

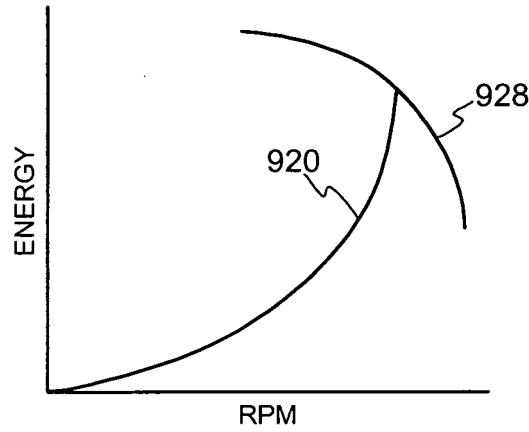


Fig. 9D

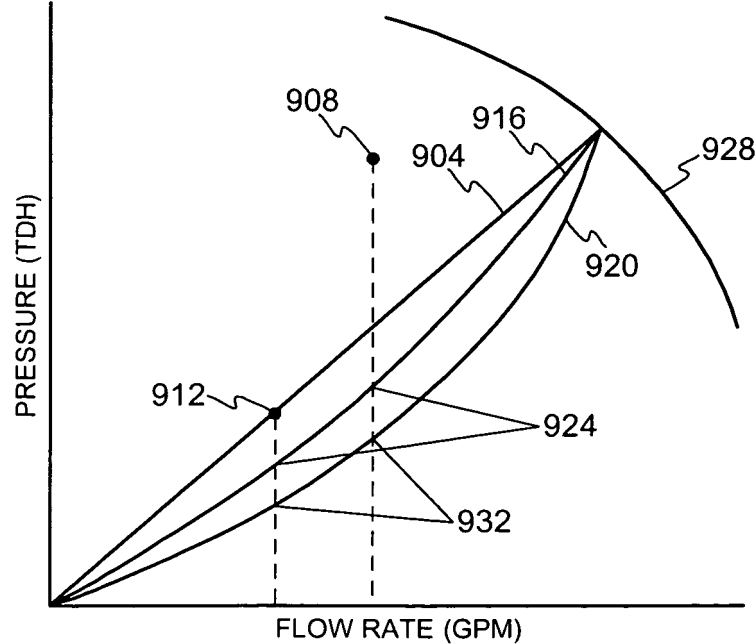


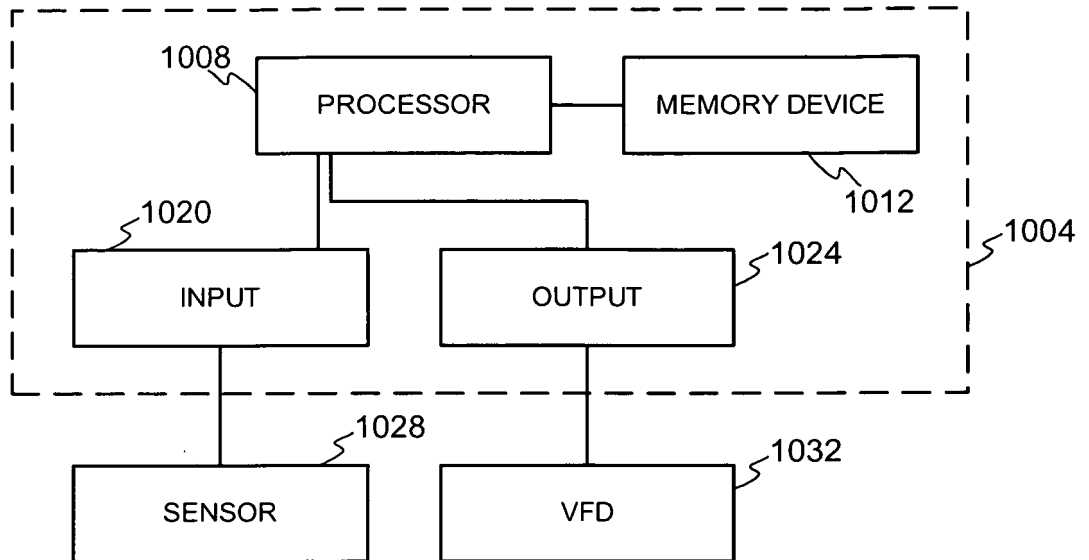
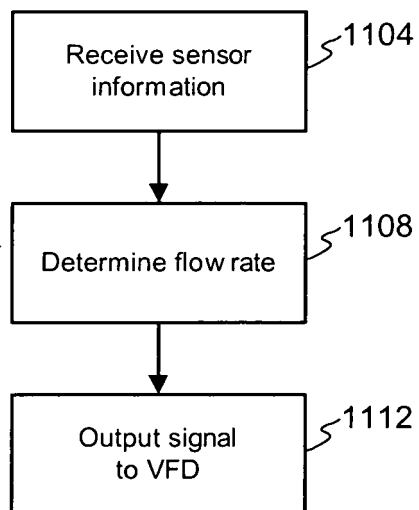
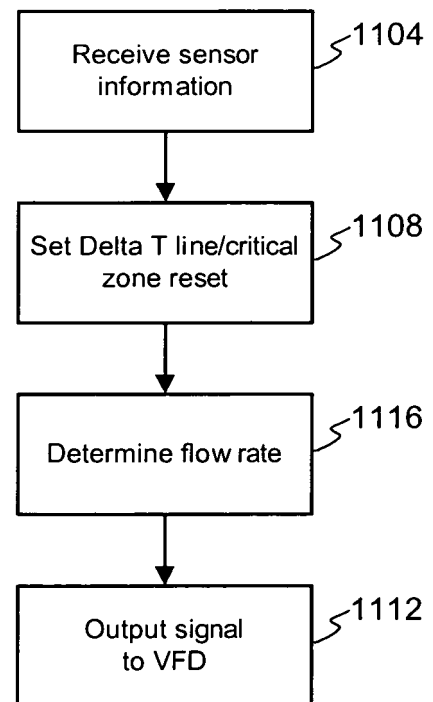
Fig. 10**Fig. 11A****Fig. 11B**

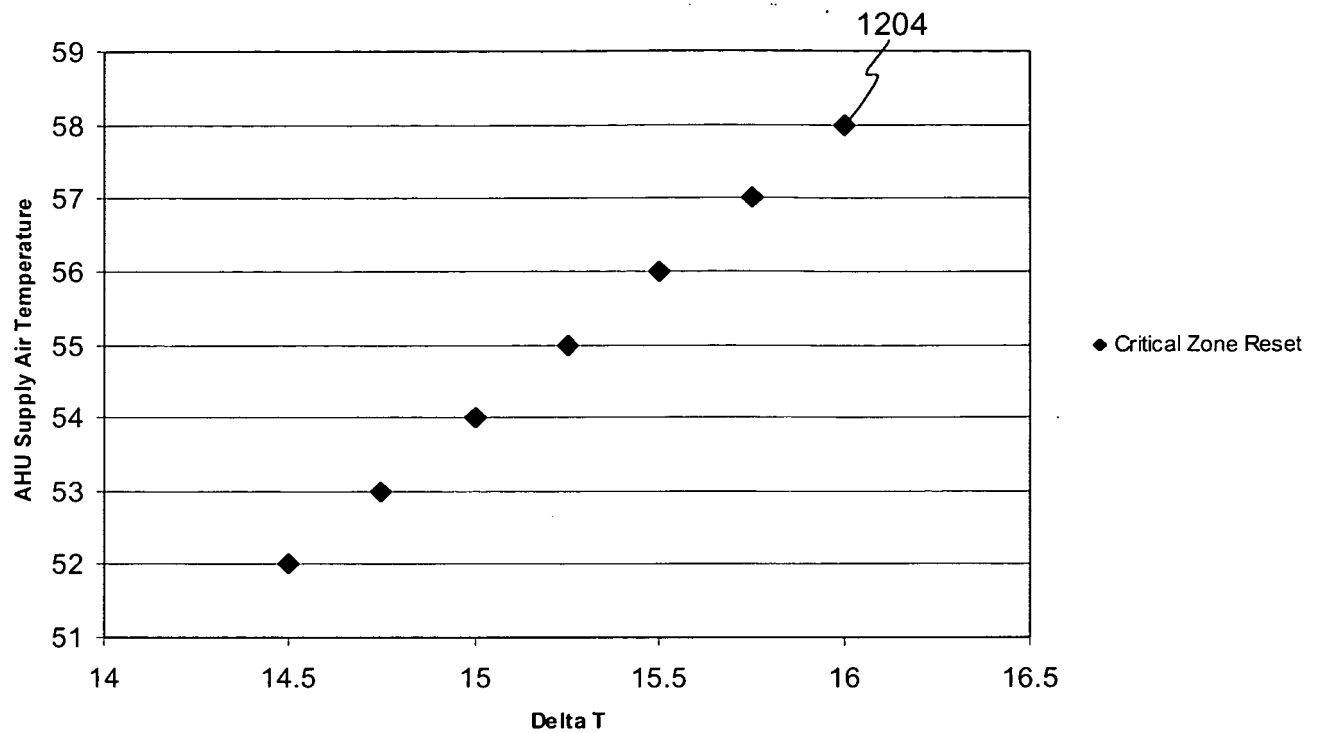
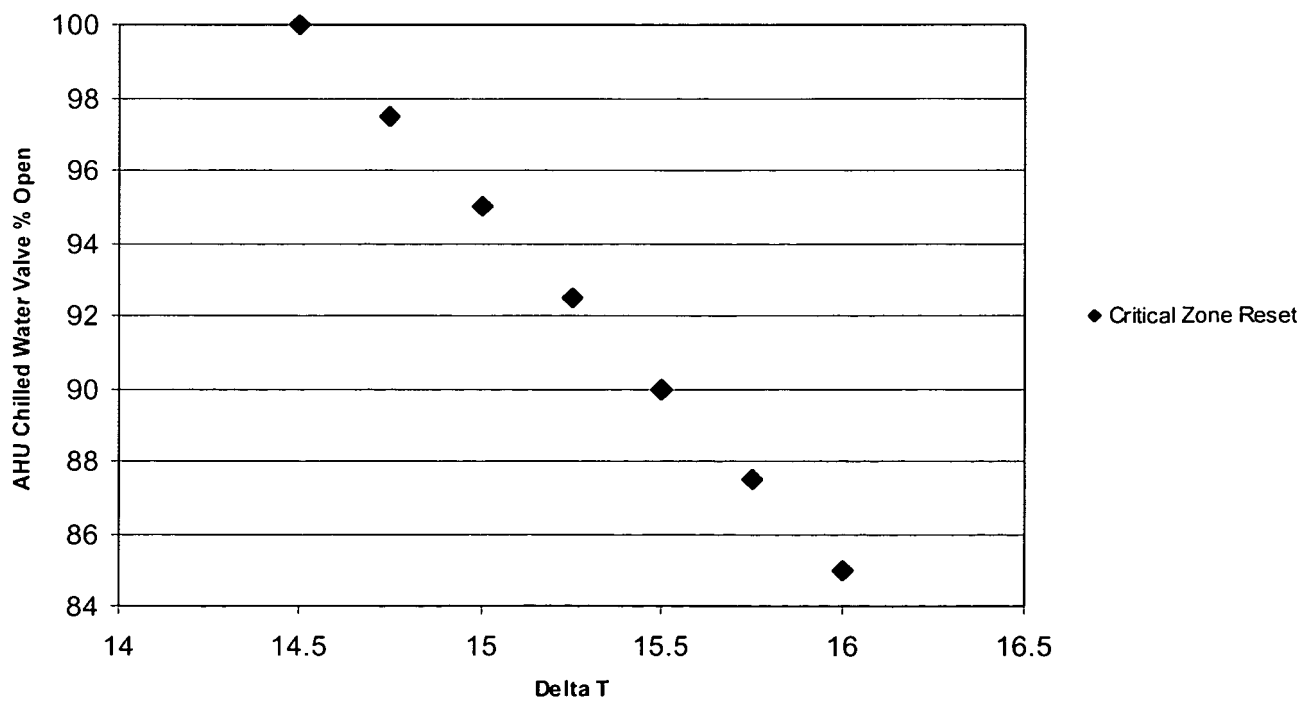
Fig. 12**Fig. 13**

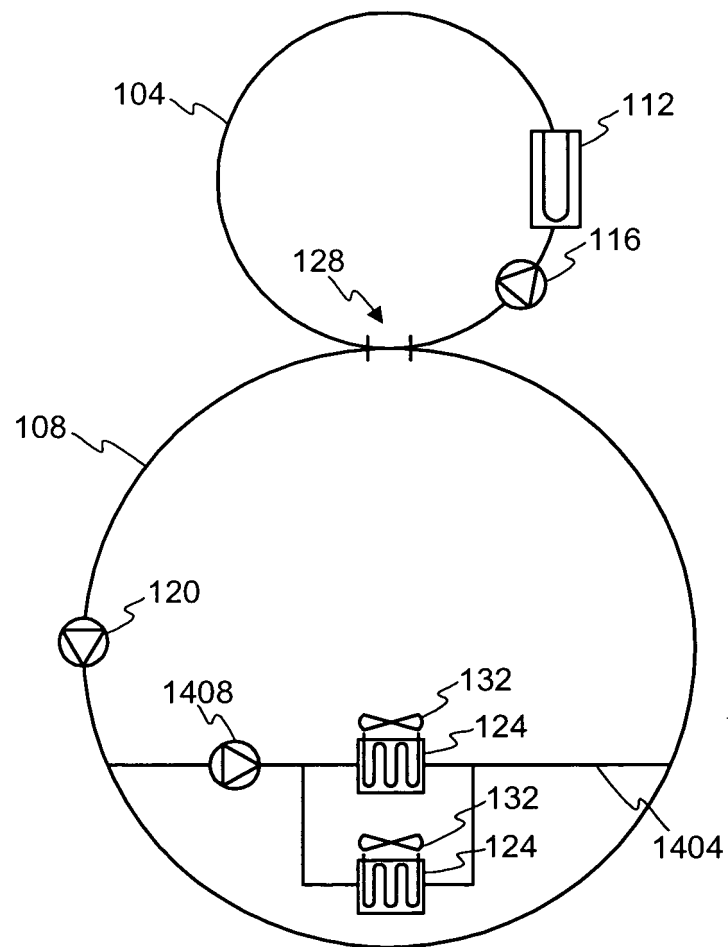
Fig. 14

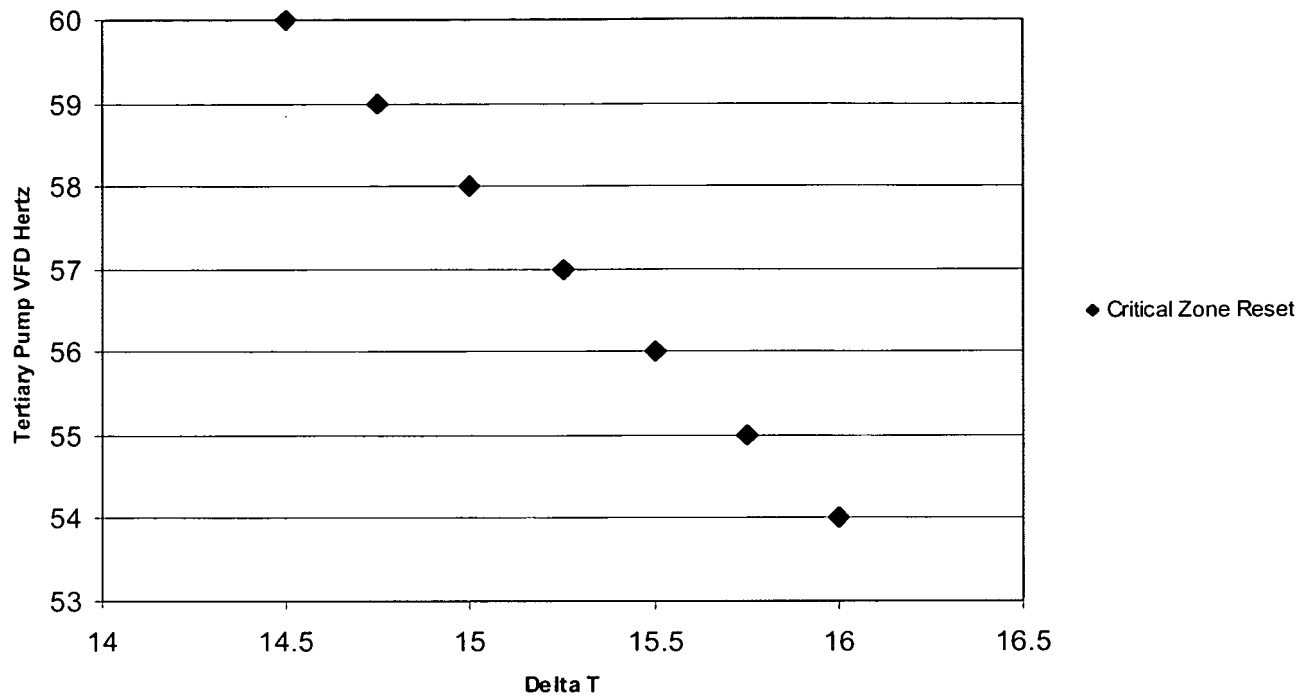
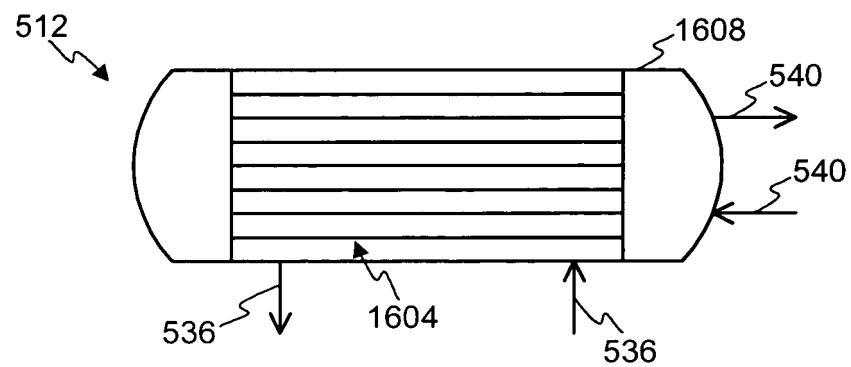
Fig. 15**Fig. 16**

Fig. 17

comp kw/ton	Evaporator					superheat enthalpy	Condenser					sub cool enthalpy	RE btu/lb	disc temp	d temp enthalpy
	chws temp	chwr temp	e sat temp	e sat psia	cws temp		cwr temp	csat temp	csat psia						
0.700	43	54	45	55		110.50	85	95	97	133		40.50	70.00	127	118.90
0.680	43	48	B 45 b	55		C 109.70 c	79	85	E 87 e	114		A 38.50 a	71.20	117	D 118.00 D
0.531	43	54	45	55		110.50	68	78	80	101		34.70	75.80	110	117.40
0.341	38	54	40	50		110.50	49	59	61	73		28.40	82.10	91	115.30

Fig. 18

CONSTANT FLOW CONDENSER WATER				
TONS	GPM	CWET	CWLT	DELTA T
1000	2400	85	95	10
900	2400	80	89	9
800	2400	75	83	8
700	2400	70	77	7
600	2400	65	71	6
500	2400	60	65	5
400	2400	55	59	4
300	2400	50	53	3
200	2400	45	47	2

Fig. 19

		Evaporator					Condenser					Refrigerant Properties					
	comp kw/ton	chw temp	chw temp	esat temp	esat psia	superheat enthalpy	cws temp	cwr temp	c sat temp	c sat psia	sub cool enthalpy	RE btu /lb	disc temp	d temp enthalpy	heat of comp	CoP (Ref)	Tons
Design	0.700	43	54	45	55	110.50	85	95	97	133	40.50	70.00	127	118.90	8.40	8.33	440
				B		C			E		A			D			
Pre	0.680	43	48	45	55	109.70	79	85	87	114	38.50	71.20	117	118.00	8.30	8.58	239
				b		c			e		a			D			
Post	0.531	43	54	45	55	110.50	68	78	80	101	34.70	75.80	110	117.40	6.90	10.99	297
Best	0.341	38	54	40	50	110.50	49	59	61	73	28.40	82.10	91	115.30	4.80	17.10	641

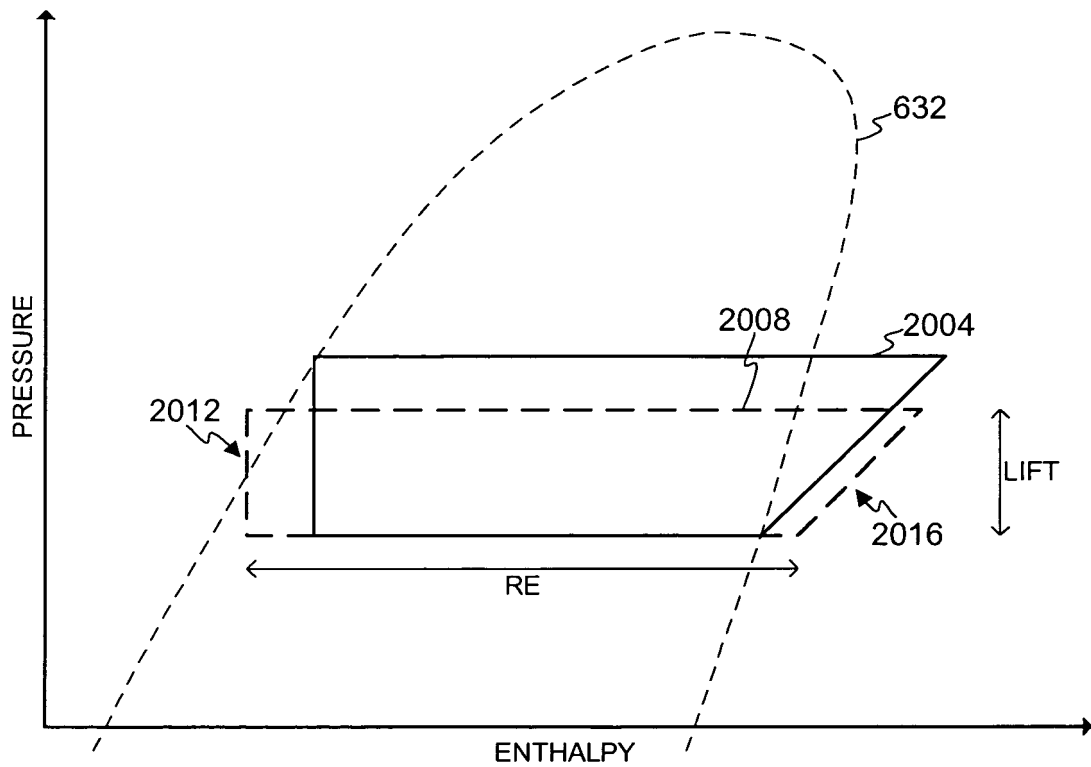
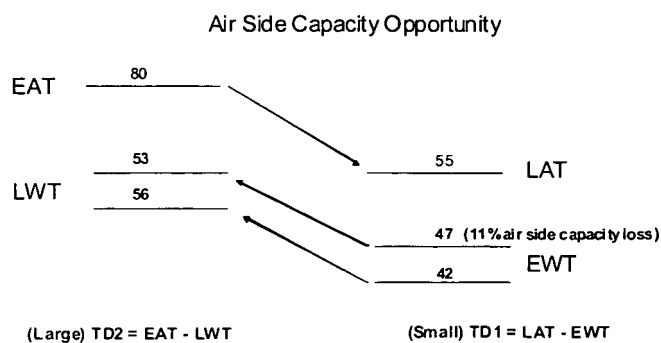
Fig. 20

Fig. 21Effect on Energy and Capacity by Lowering CWET at a Constant Delta T

CWE Temperature	61.00	64.97	67.20	75.00	78.00	80.00	83.00
CWL Temperature	75.00	79.59	81.20	89.00	92.00	94.00	97.00
Chilled Water Pump KW	46	54	65	49	55	59	48
Condenser Water Pump KW	26	27	31	27	28	29	29
Chiller KW	1027	1217	1321	1423	1555	1605	1571
Tower Fan KW	228	198	118	57	33	23	18
Total Plant KW	1327	1496	1535	1556	1671	1696	1666
System Tons	2130	2364	2408	2193	2353	2356	2201
System KW /Ton	0.623	0.633	0.640	0.680	0.710	0.720	0.757
Chiller KW /Ton	0.482	0.515	0.549	0.649	0.661	0.681	0.714
CWP KW /Ton	0.012	0.011	0.013	0.012	0.012	0.012	0.013
CHWP KW /Ton	0.022	0.023	0.027	0.022	0.023	0.025	0.022
CT Fan KW /Ton	0.107	0.084	0.049	0.026	0.014	0.010	0.008
System KW /Ton	0.623	0.633	0.637	0.710	0.710	0.728	0.757
Online Chiller Capacity %	59%	70%	75%	81%	87%	91%	93%
Online Chiller Capacity Tons	3641	3401	3232	2724	2705	2603	2367
Increased System Efficiency	18%	16%	16%	6%	6%	4%	0%
Increased Chiller Efficiency	32%	28%	23%	9%	7%	5%	0%
Increased Chiller Capacity	54%	44%	37%	15%	14%	10%	0%

(3) 100 HP CHWP Online	(300 HP)
(2) 200 HP CWP Online	(400 HP)
(2) CVHE Trane 1250 Online	(320 HP)
(4) Evapco CT / 8 fans online	

Fig. 22

8 degree Delta T water Side, 25 degree air side

16 degree Delta T water side, 25 degree air side

$$\text{LMTD} = \frac{25 - 8}{\ln(25/8)} = 14.92$$

$$\text{LMTD} = \frac{24 - 13}{\ln(24/13)} = 17.94$$

25 % Capacity Increase

Fig. 23A

A	B	C	D	E
1	Tons	GPM	CHWS	CHWR
2	42	100	45	55
3	38	100	45	54
4	33	100	45	53
5	29	100	45	52
6	25	100	45	51
7	21	100	45	50
8	17	100	45	49
9	13	100	45	48
10	8	100	45	47
11	4	100	45	46

Fig. 23B

F	G	H	I	J
1	Tons	GPM	CHWS	CHWR
2	42	100	45	55
3	42	92	44	55
4	42	84	43	55
5	42	78	42	55
6	42	72	41	55
7	42	67	40	55
8	42	63	39	55
9	42	59	38	55
10	42	56	37	55
11	42	53	36	55

Fig. 23C

K	L	M	N	O
1	Tons	GPM	CHWS	CHWR
2	42	100	45	55
3	46	100	44	55
4	50	100	43	55
5	54	100	42	55
6	58	100	41	55
7	63	100	40	55
8	67	100	39	55
9	71	100	38	55
10	75	100	37	55
11	79	100	36	55

Fig. 24

A	B	C	D	E	F	G	H	I	J	K	L	M	N
2	VAV AIR HANDLER DESIGN DATA	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
5	Monthly Average AHU CFM	110250	126000	157500	189000	220500	252000	283500	315000	252000	189000	126000	110250
6	Base Line AHU SAT	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
7	AHU SAT Wet Bulb Assumption	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9
8	AHU SAT Enthalpy Assumption	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1
9	Monthly Average AHU Q _t	300	400	500	600	700	800	900	1000	800	600	400	300
10	Approximate AHU Fan Energy	6	10	19	32	51	76	109	149	76	32	10	6
15	Minimum CFM %	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%
16	Minimum SAT	55	54	53	52	52	52	50	50	52	53	54	55
17	AHU SAT Wet Bulb Assumption	54.9	53.9	52.9	51.9	51.9	51.9	49.9	49.9	51.9	52.9	53.9	54.9
18	AHU SAT Enthalpy Assumption	23.1	22.5	21.9	21.3	21.3	21.3	20.1	20.1	21.3	21.9	22.5	23.1
19	Base Line KW	6	8	13	18	29	43	44	60	43	22	8	6
20	h ₂ calculation	30.4	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	31.6	30.4
22	DF AHU CFM	110250	117531	137946	156012	182014	208016	209578	232864	208016	165535	117531	110250
23	Monthly Average AHU Q _t	300	400	500	600	700	800	900	1000	800	600	400	300