

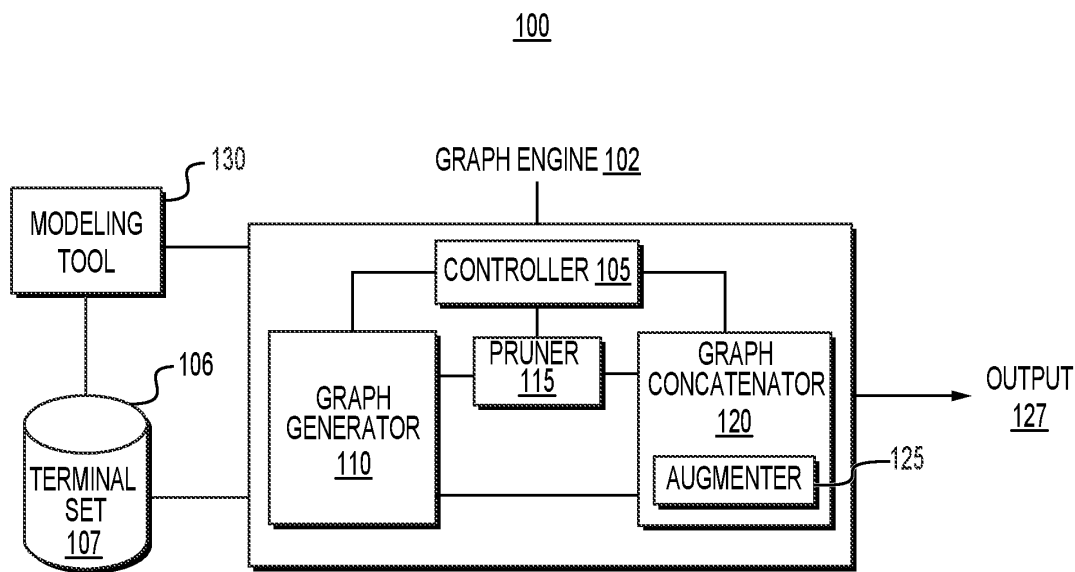


FIG. 1A

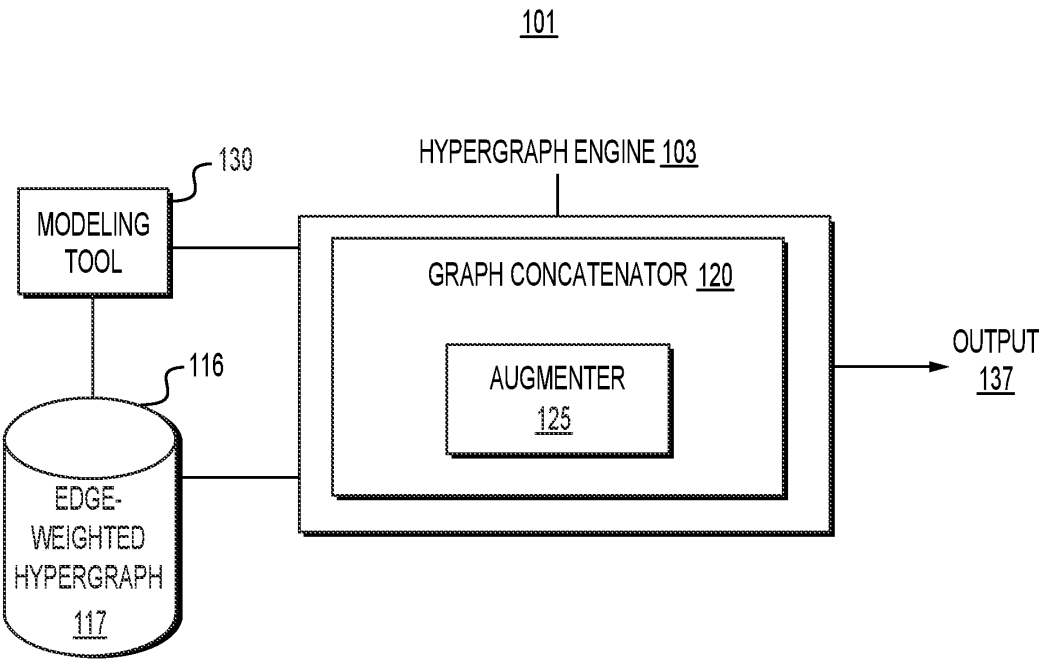
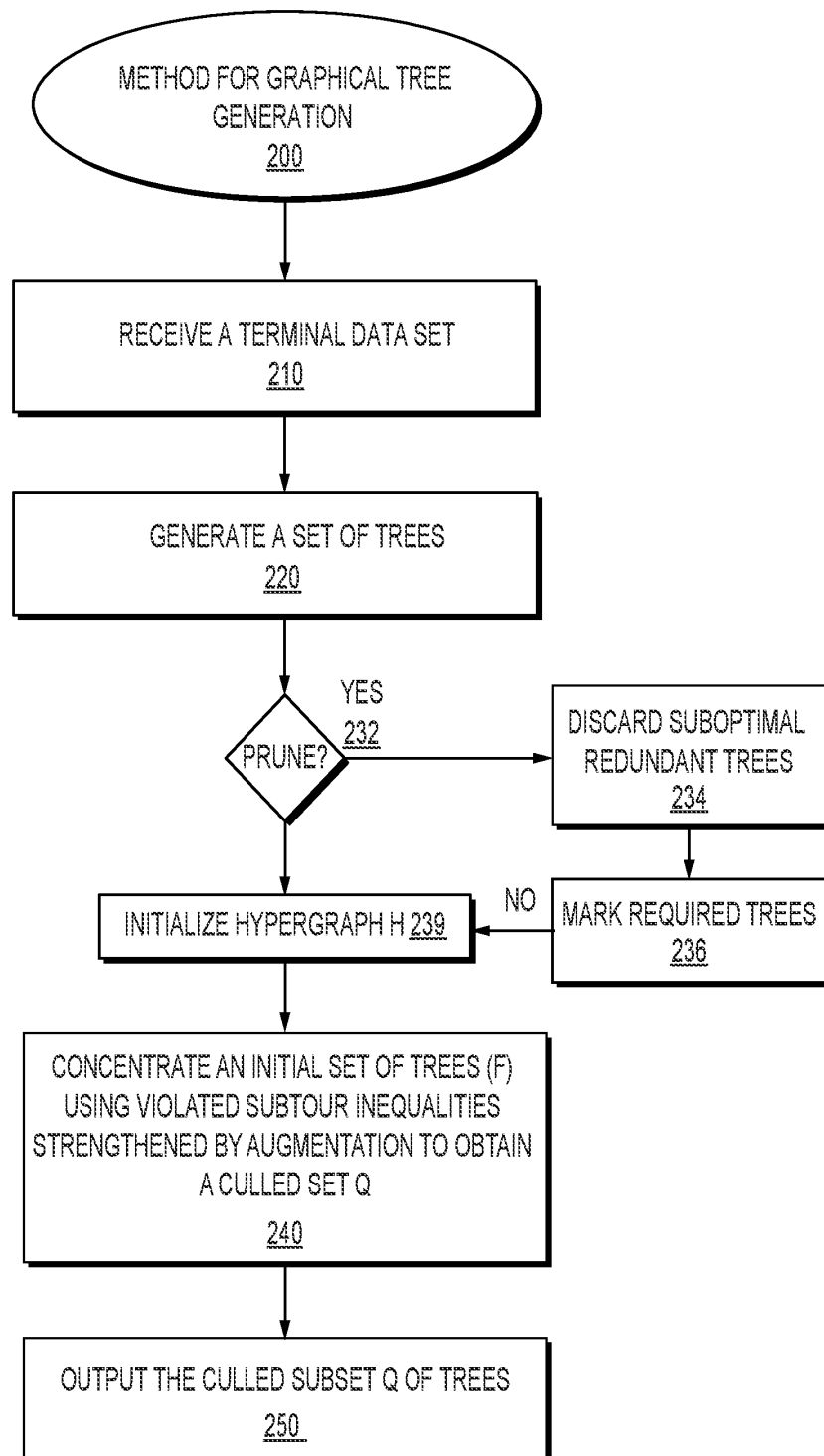
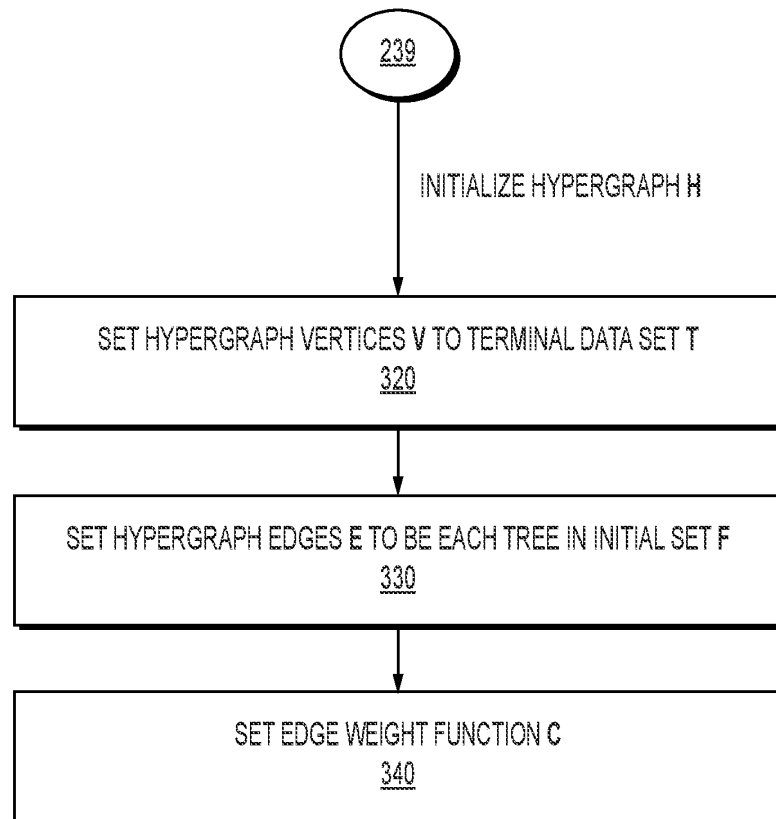


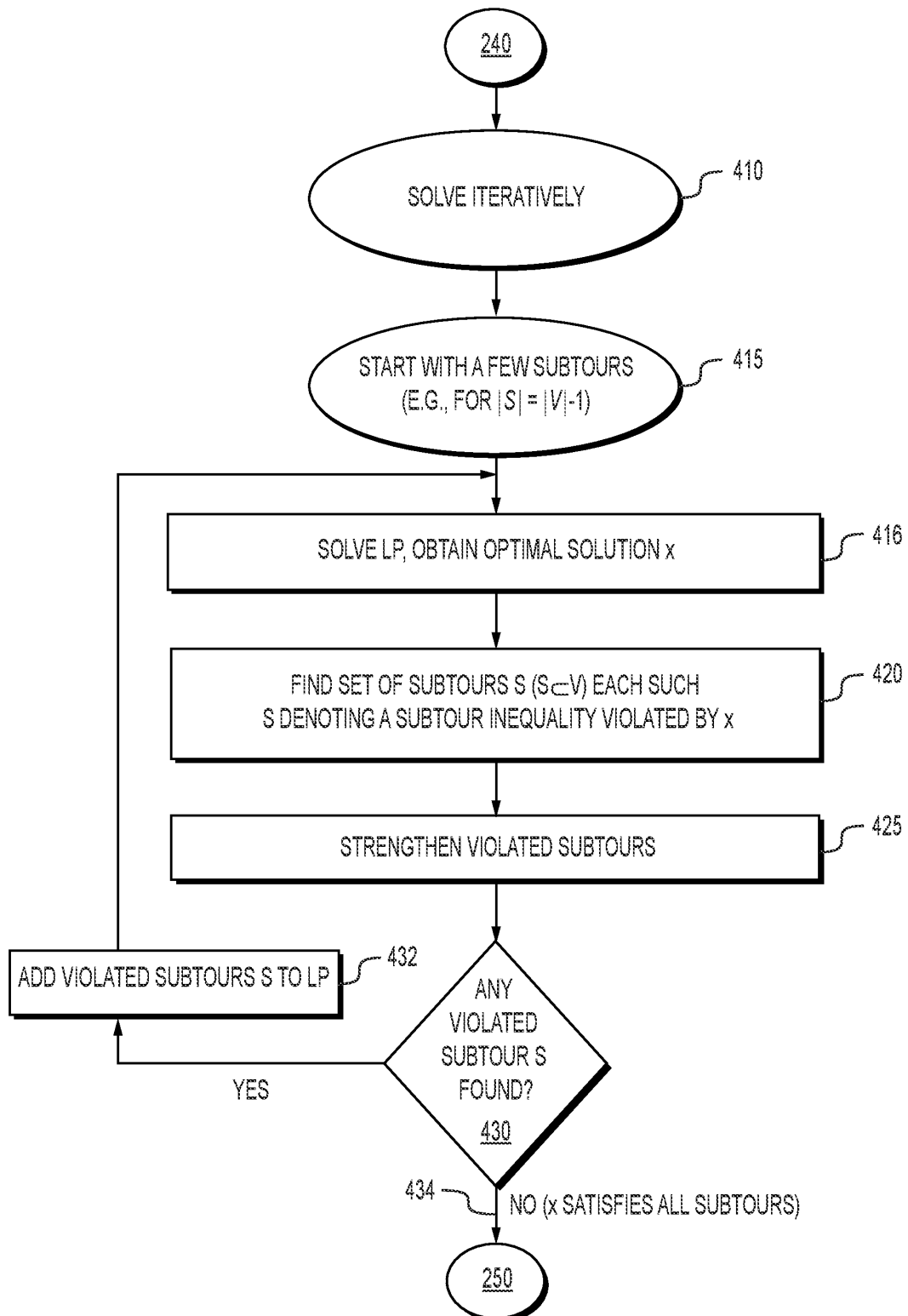
FIG. 1B

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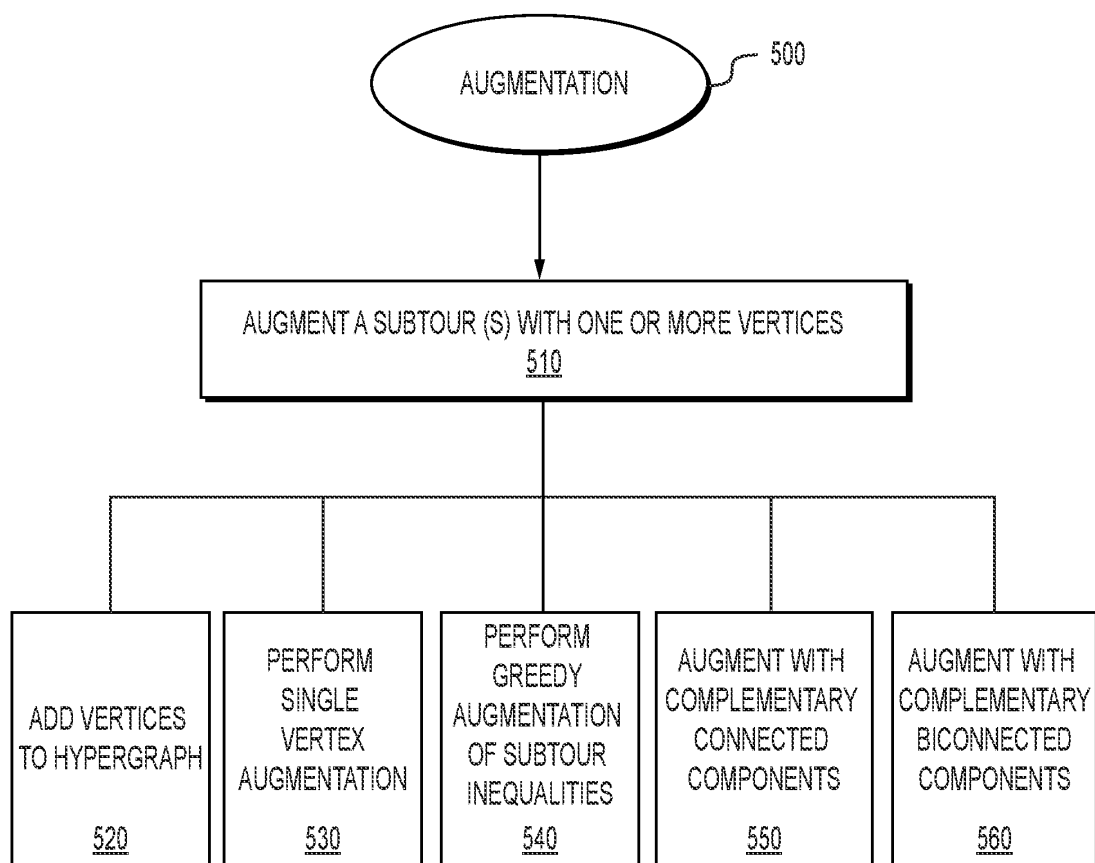
**FIG. 2**

**FIG. 3**

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**FIG. 4**

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**FIG. 5A**

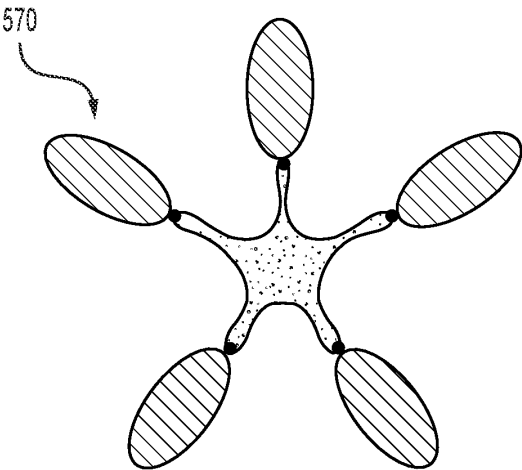


FIG. 5B

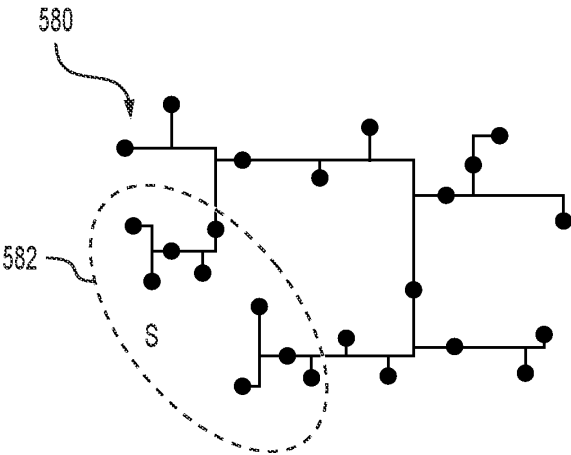
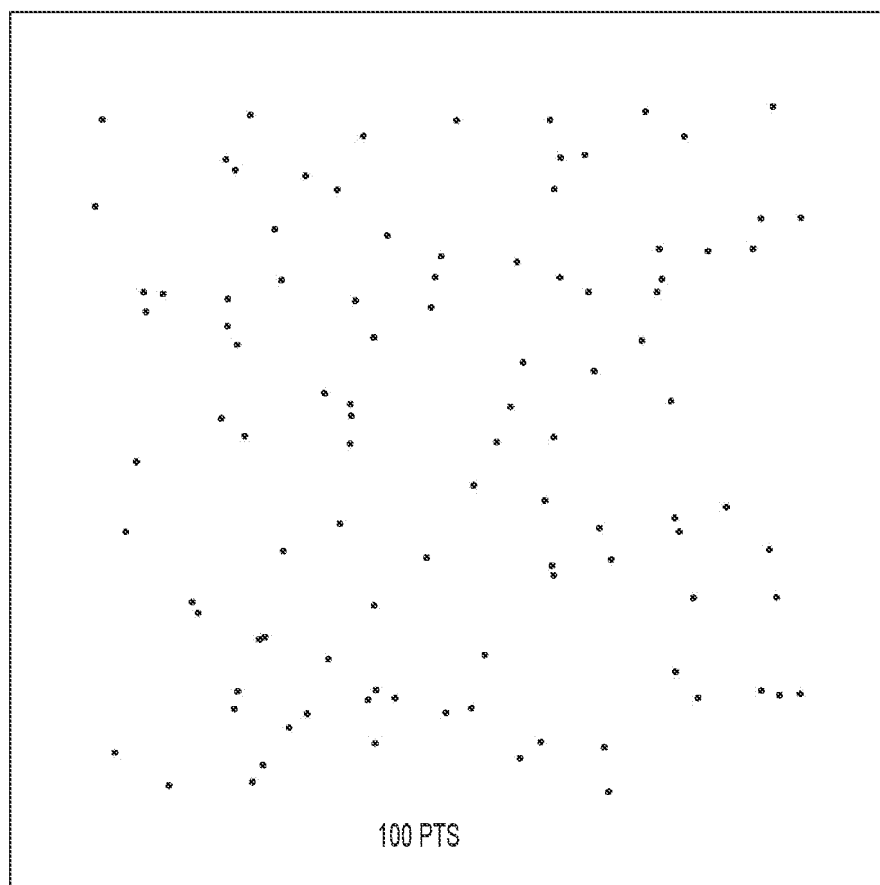


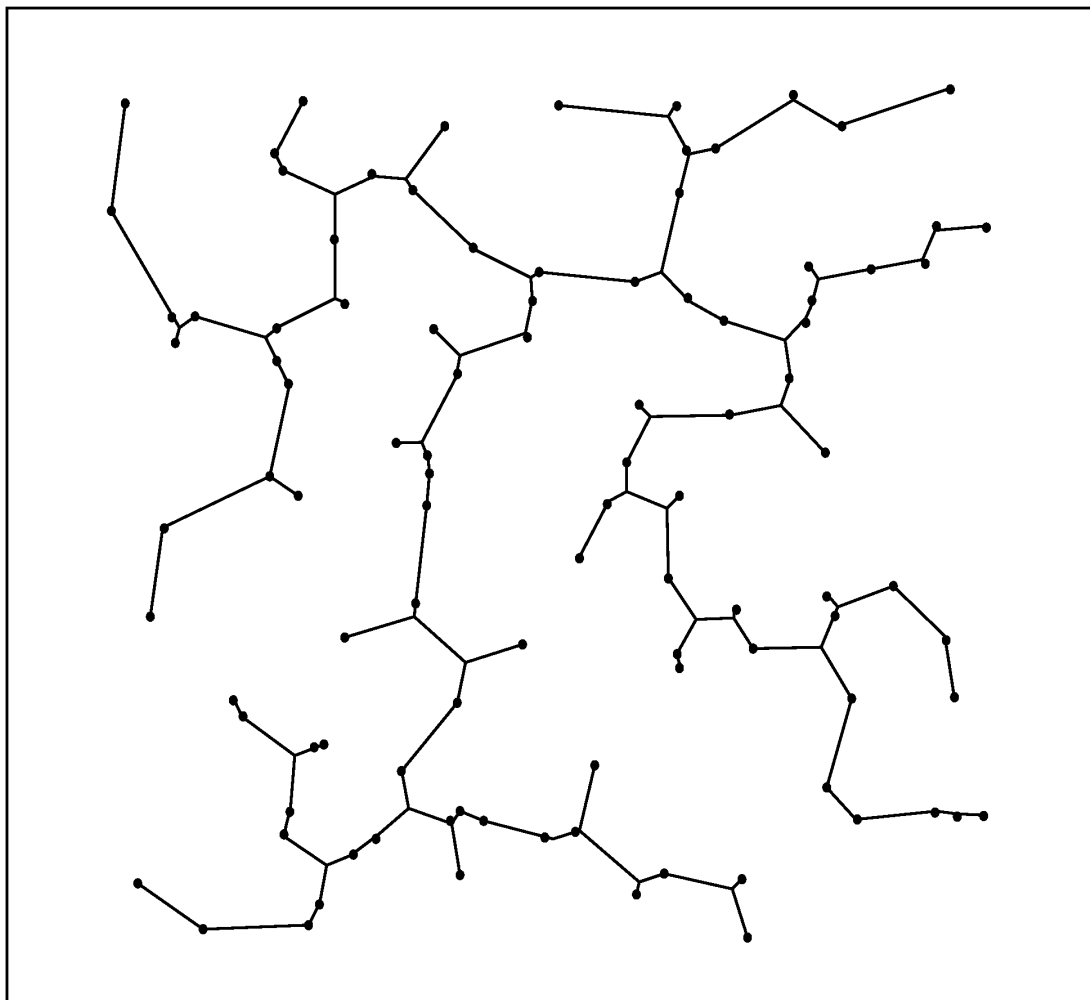
FIG. 5C



EXAMPLE TERMINAL POINT SET

FIG. 6

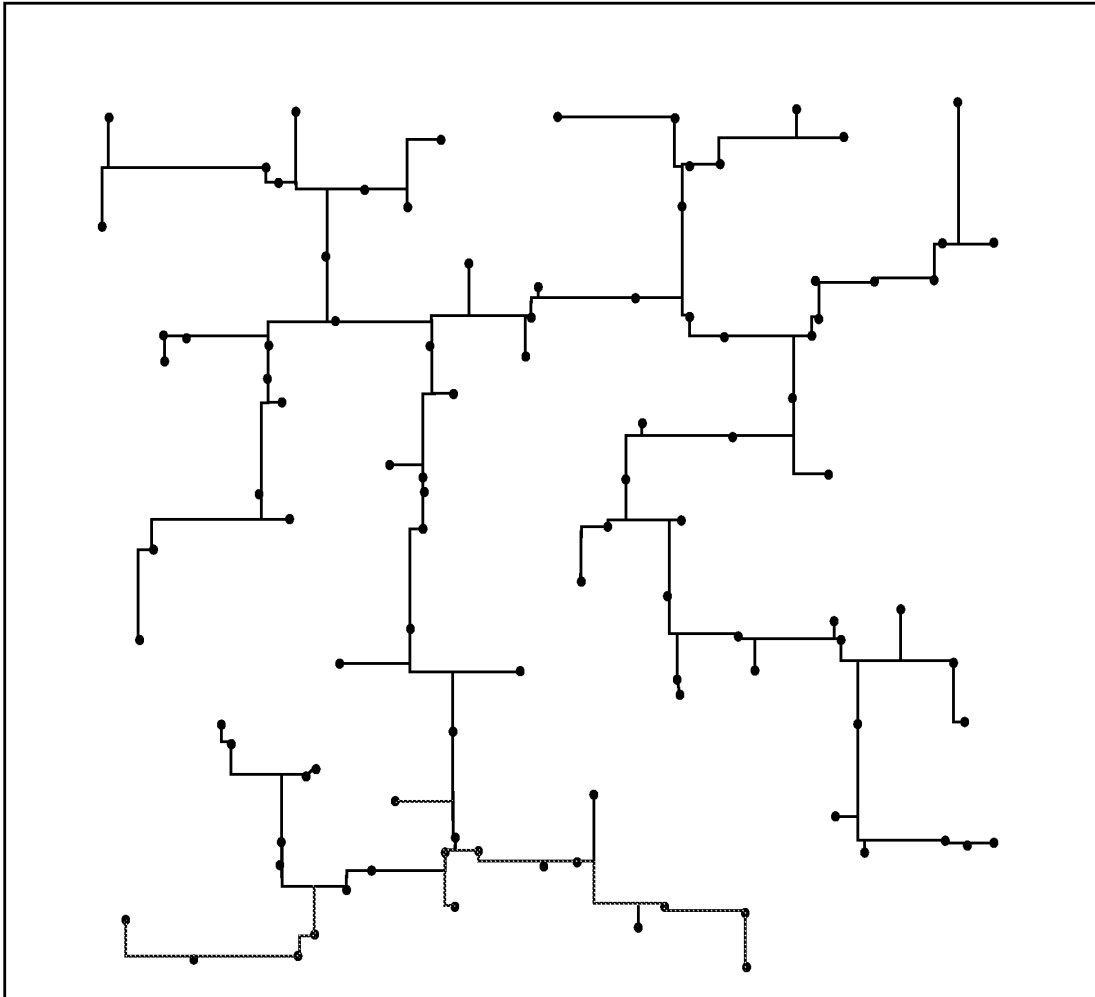
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700

EUCLIDEAN SMT: 100 POINTS, LENGTH = 6.665750289411368, 0.50 SECONDS

FIG. 7

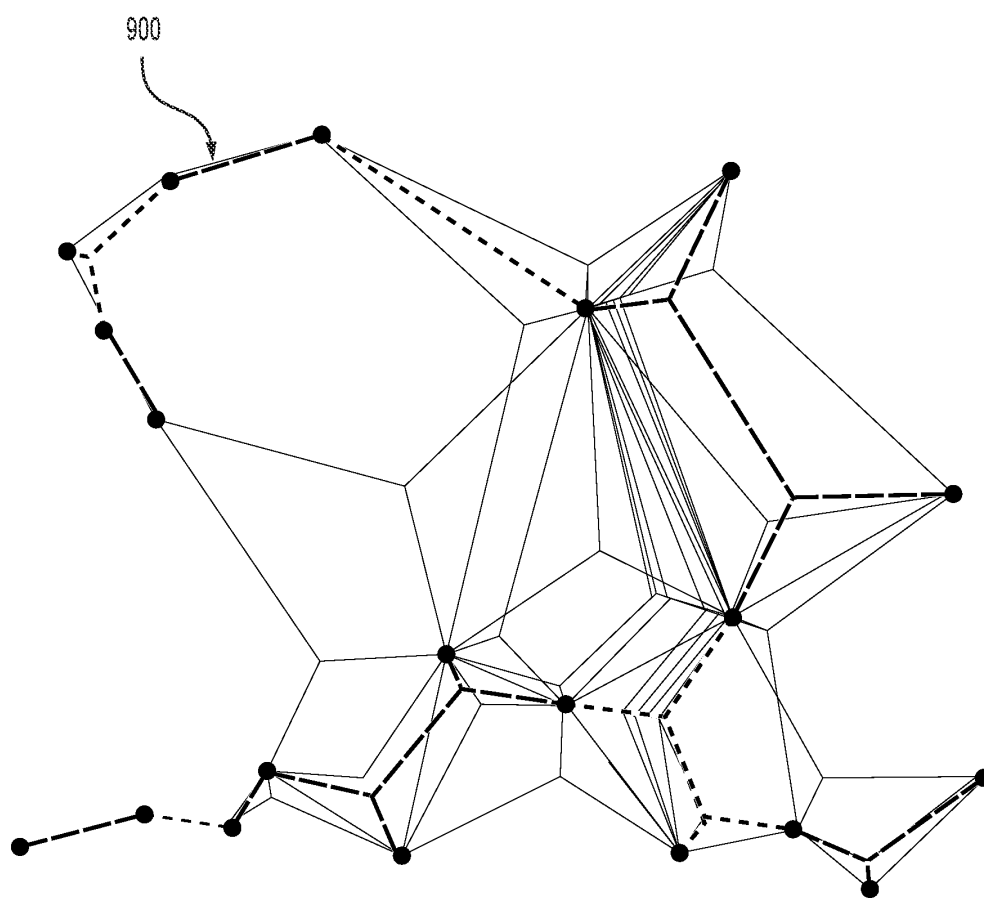
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800

RECTILINEAR SMT: 100 POINTS, LENGTH = 7.5270366, 0.03 SECONDS

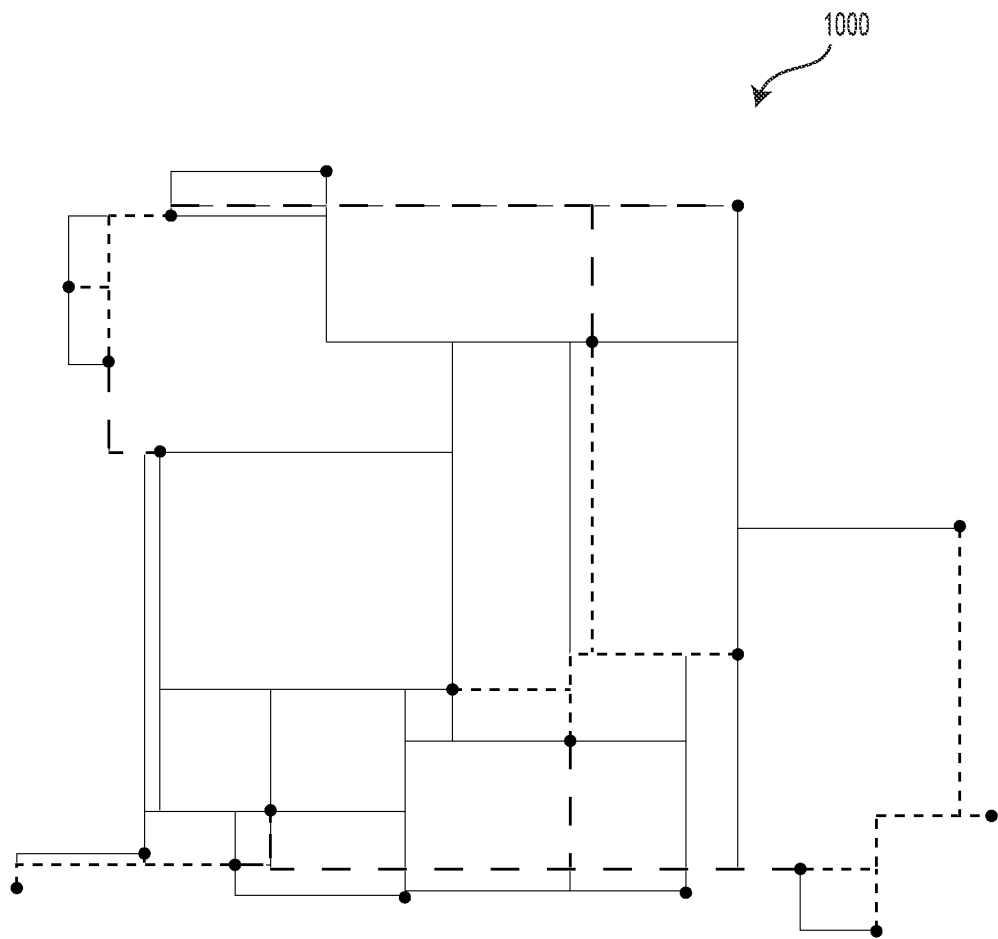
FIG. 8

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EXAMPLE EUCLIDEAN STEINER TREE COMPUTATION

FIG. 9



EXAMPLE RECTILINEAR STEINER TREE COMPUTATION

FIG. 10

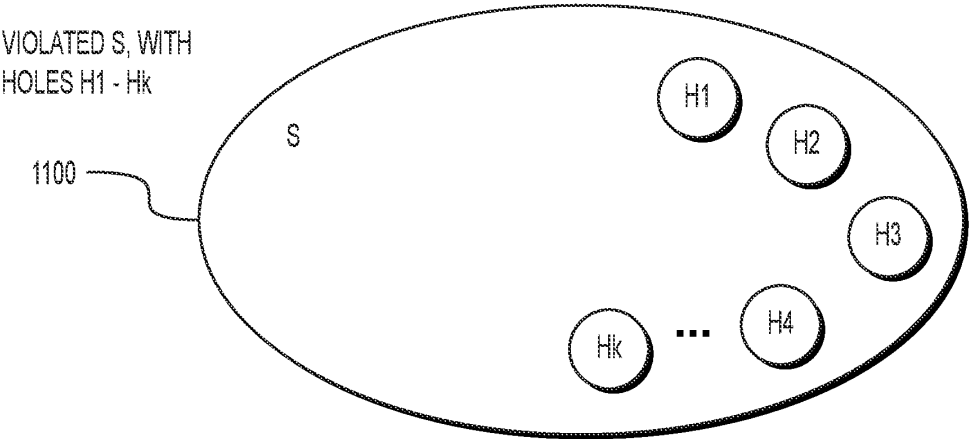
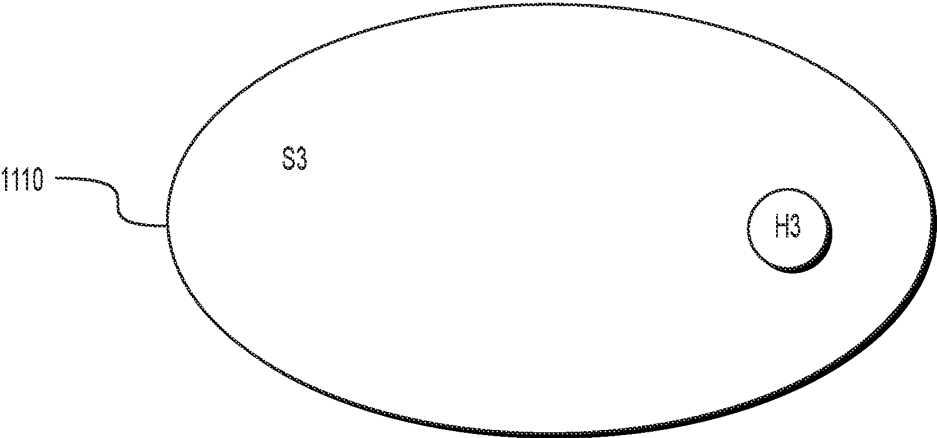
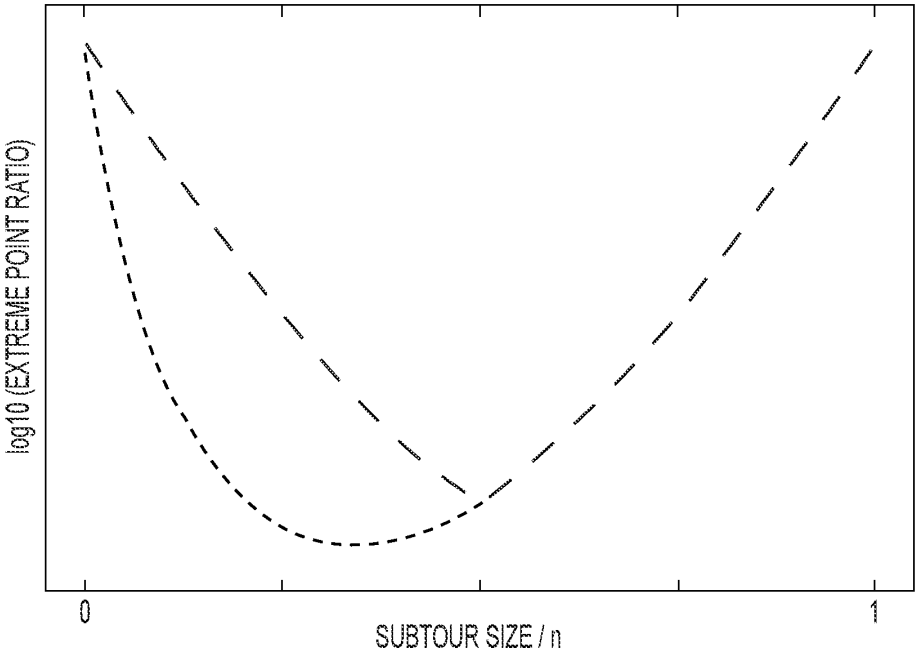


FIG. 11A



LARGER VIOLATED S3

FIG. 11B



EXTREME POINT RATIO (LARGER = STRONGER)

FIG. 12A

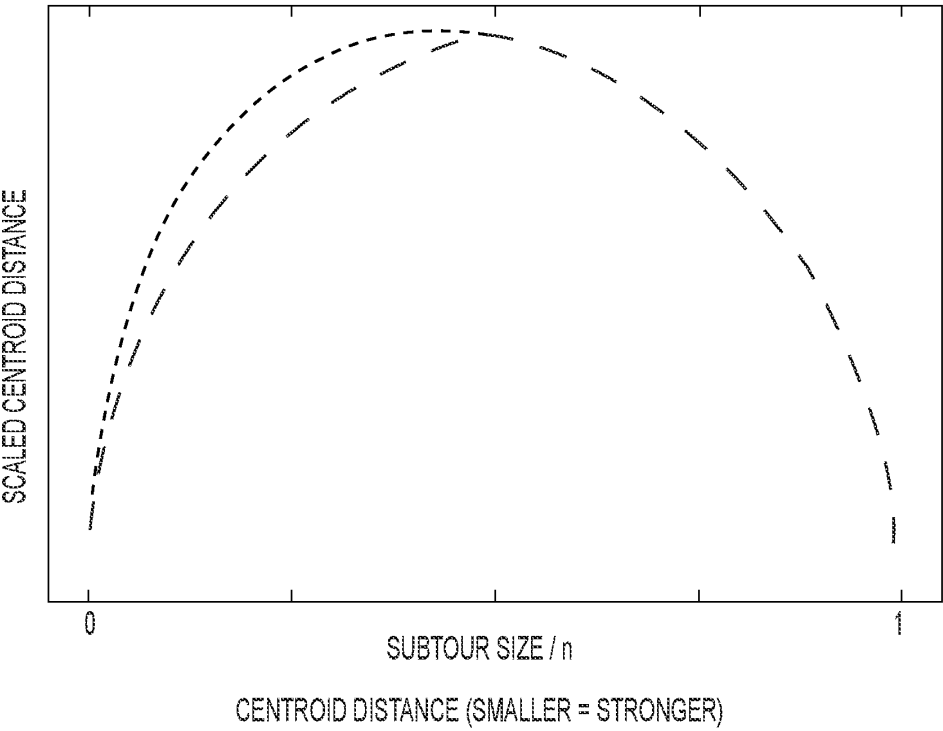
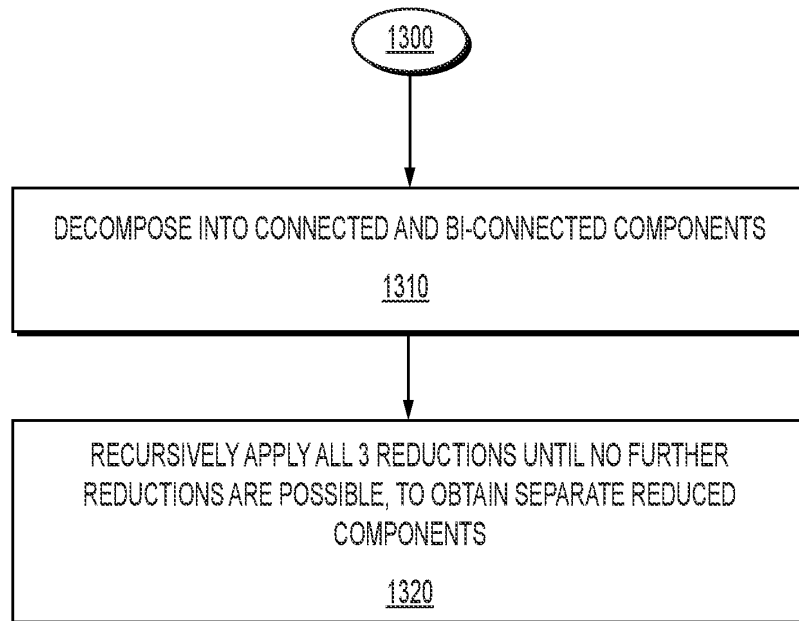
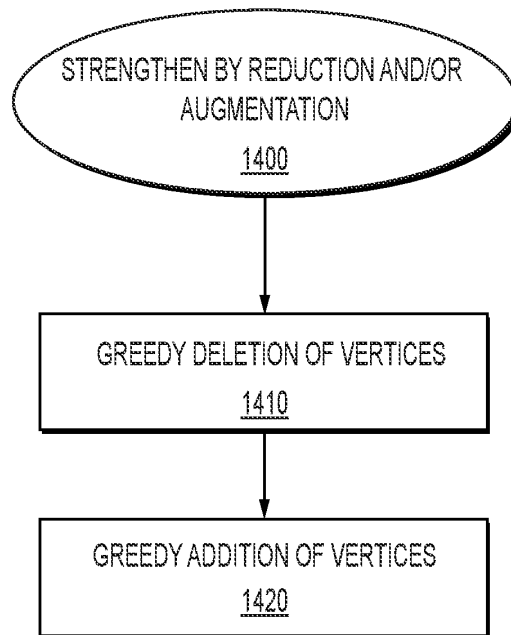


FIG. 12B

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**FIG. 13**

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**FIG. 14**

```
SOS_HEURISTIC (X)
{
    L = L | ST OF ALL CONSTRAINTS IN POOL VIOLATED BY X;
    B = L | ST OF ALL CONSTRAINTS IN POOL BINDING FOR AT LEAST 1 ACTIVE NODE;
    L = L - B;
    SORT L FROM LEAST NUMBER OF NON-ZEROS TO MOST NON-ZEROS;
    C =  $\emptyset$ ;
    REPEAT AT MOST k TIMES WHILE L IS NON-EMPTY :
        D =  $\emptyset$ ;
        FOR EACH CONSTRAINT i IN L DO
            IF NONZEROCOLUMNS (i)  $\cap$  NONZEROCOLUMNS (D)  $\neq \emptyset$ 
            THEN MOVE CONSTRAINT i FROM L INTO SET D;
            ENDF
        END
        C = C  $\cup$  D;
    END
    RETURN (C);
}
```

FIG. 15

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```

GREEDY_AUGMENTATION (S,  $\chi$ )
{
    TOTAL =  $\chi(S)$ ; SSIZE =  $|S| - 1$ ; VIOLATION = TOTAL - SSIZE;
    FATAL_ERROR_IF (VIOLATION  $\leq$  0); /* S MUST BE VIOLATED. */
    HEAP.INIT (V, S,  $\chi$ ); /* SEE FIGURE 5.3 */
    HEAP.MAKE_HEAP ();
    WHILE HEAP.NHEAP > 0 DO
        v = HEAP.HEAP.TOP ();
        wv = HEAP.VWEIGHT [v];
        NEWV = VIOLATION + wv - 1.0;
        IF NEWV  $\leq$  0 THEN
            EXITLOOP; /* VIOLATION WOULD DISAPPEAR IF WE ADD v. */
        ENDIF
        VIOLATION = NEWV;
        /* REMOVE VERTEX v FROM THE HEAP. */
        HEAP.REMOVE_TOP ();
        S = S  $\cup$  {v};
        TOTAL = TOTAL + wv;
        SSIZE = SSIZE + 1;
        HEAP.VINDEX [v] = -2;
        /* UPDATE THE FRONTIER AND WEIGHTS. */
        FOR EACH EDGE e SUCH THAT v  $\in$  e DO
            IF  $\chi_e \leq$  0 THEN SKIP;
            IF  $|e \cap S| \neq 1$  THEN SKIP;
            /* VERTEX v IS THE FIRST (AND CURRENTLY ONLY) VERTEX OF EDGE e IN S, MAKING */
            /* EDGE e A NEW EDGE CROSSING THE CUT. ADD ITS WEIGHT TO ITS VERTICES NOT IN */
            /* S, ADDING THESE VERTICES TO THE HEAP IF NOT ALREADY PRESENT. */
            FOR EACH VERTEX u  $\in$  e DO
                IF u = v THEN SKIP;
                k = HEAP.VINDEX [u];
                IF k < 0 THEN
                    FATAL_ERROR_IF (k  $\neq$  -1);
                    k = HEAP.NHEAP;
                    HEAP.HEAP [k] = u;
                    HEAP.VINDEX [u] = k;
                    HEAP.VWEIGHT [u] = 0.0;
                    HEAP.NHEAP = k + 1;
                ENDIF
                HEAP.VWEIGHT [u] +=  $\chi_e$ ;
                HEAP.ADJUST_KEY (k);
            END
        END
    END
    RETURN (S);
}

```

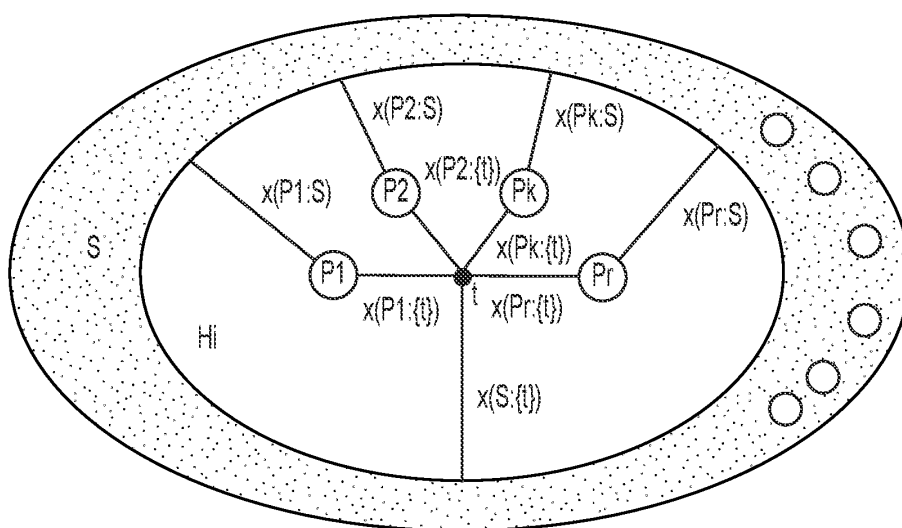
FIG. 16

```

HEAP.INIT (V, S,  $\chi$ )
{
    n = |V|;
    HEAP = NEW INT [n];
    VINDEX = NEW INT [n];
    VWEIGHT = NEW DOUBLE [n];
    FOR EACH VERTEX  $v \in V$  DO
        HEAP [v] = 0;
        VWEIGHT [v] = 0.0;
        IF  $v \in S$  THEN
            VINDEX [v] = -2;
        ELSE
            VINDEX [v] = -1;
        ENDIF
    END
    nHEAP = 0;
    nVERTS = n;
    FOR EACH EDGE  $e \in E$  DO
        IF  $\chi_e \leq 0$  THEN SKIP;
        k = | $S \cap e$ |;
        IF ( $k \leq 0$ ) OR ( $k \geq |e|$ ) THEN SKIP;
        /* EDGE E CROSSES CUT (S : V - S). */
        FOR EACH VERTEX  $v \in e$  DO
            IF  $v \in S$  THEN SKIP;
            /* EDGE e CROSSES CUT TO VERTEX  $v \notin S$ . */
            k = HEAP.VINDEX [v];
            If k < 0 Then
                FATAL_ERROR_IF (k  $\neq$  -1);
                k = HEAP.NHEAP;
                HEAP.HEAP [k] = v;
                HEAP.VINDEX [v] = k;
                HEAP.VWEIGHT [v] = 0.0;
                HEAP.NHEAP = k + 1;
            ENDIF
            HEAP.VWEIGHT [v] +=  $\chi_e$ ;
        END
    END
END
}

```

FIG. 17

**FIG. 18**

```

UPDATE_PSEUDO_COSTS (NODE)
{
    F = {e ∈ E :  $\lambda_e$  IS FRACTIONAL};
    U = {e ∈ F : PSEUDO COSTS FOR  $\lambda_e$  UNDEFINED.};
    R = F - U;
    SORT R BY PSEUDO COST AGE, NEWEST TO OLDEST;
    k =  $\lfloor \sqrt{|R|/4} \rfloor$ ;
    O = OLDEST K ELEMENTS OF R;
    R = R - O;
    STRIDE =  $\lfloor |R|/k \rfloor$ ;
    OFFSET = HASH (NODE) MOD STRIDE;
    S =  $\emptyset$ ;
    i = OFFSET;
    WHILE i < |R| DO
        S = S ∪ R[i];
        i = i + STRIDE;
    END
    L = U ∪ O ∪ S;
    FOR EACH e ∈ L DO
        RE-CALCULATE PSEUDO COSTS FOR  $\lambda_e$ ;
    END
}

```

FIG. 19

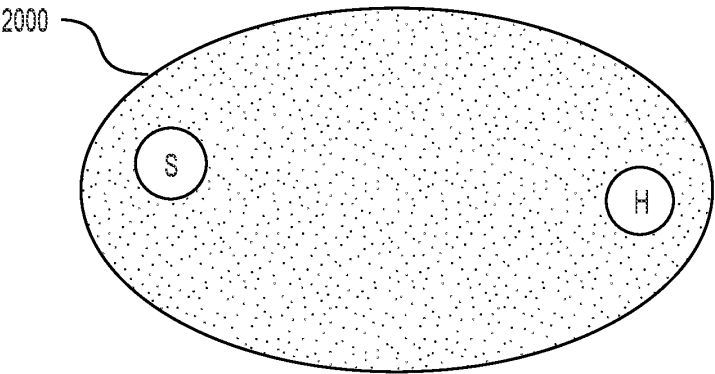


FIG. 20

SIZE	EUCLIDEAN				RECTILINEAR			
	ORIGINAL		NEW		ORIGINAL		NEW	
1000	17.2	±1.2	6.52	±0.458	16.1	±2.3	5.25	±0.889
2000	44.3	±4.2	16.86	±1.603	312.3	±792.6	20.62	±3.516
3000	79.7	±6.1	30.4	±1.55	637.2	±961.8	175.30	±459.69
4000	132.5	±27.6	48.2	±3.80	6469.4	±11663.1	89.23	±26.28
5000	170.6	±7.0	66.9	±3.26			150.43	±35.25
6000	248.9	±22.7	96.57	±6.30			463.39	±807.09
7000	372.0	±257.1	122.74	±8.03			381.24	±265.99
8000	417.7	±102.7	154.81	±8.44			517.12	±310.75
9000	502.0	±109.3	186.28	±8.25			1394.47	±2718.65
10,000	1083.5	±1843.3	222.19	±34.68			988.56	±436.37
15,000			482.15	±31.37			9372.23	±0.00
20,000			858.20	±50.75			5253.58	±0.00
25,000	3827.32	±1476.47	1331.31	±53.29			191186.24	±0.00
30,000			1932.40	±91.81			349902.45	±0.00
40,000			3509.02	±113.94			3704699.44	±0.00
50,000	(44022.5)	(±40424.7)	6919.57	±1165.54				
100,000	(90483.6)	(±7499.5)	38602.2	±4123.69				
250,000			318710.73	±0.00				
500,000			1268678.36	±0.00				
1,000,000			9736711.80	±0.00				

RANDOMLY GENERATED INSTANCES. TOTAL COMPUTATION TIME (SECONDS).

FIG. 21A

SIZE	EUCLIDEAN				RECTILINEAR			
	ORIGINAL		NEW		ORIGINAL		NEW	
1000	0.1	±0.0	0.0587	±0.0257	2.3	±1.4	0.723	±0.648
2000	0.5	±0.4	0.216	±0.0558	264.7	±790.7	2.698	±1.458
3000	2.3	±3.0	0.447	±0.146	537.1	±963.5	135.759	±460.023
4000	10.7	±23.0	0.579	±0.108	4200.9	±11666.0	20.680	±19.810
5000	3.0	±3.0	1.019	±0.391			41.021	±32.895
6000	14.4	±16.0	2.291	±2.76			305.480	±804.475
7000	73.5	±259.6	1.943	±0.439			168.183	±245.448
8000	41.6	±100.9	2.528	±0.662			221.909	±301.675
9000	43.1	±502.0	3.319	±0.937			1023.01	±2718.590
10,000	550.0	±1833.5	4.030	±1.195			542.575	±407.984
15,000			9.839	±2.978			8267.23	±0.00
20,000			20.975	±8.011			2744.69	±0.00
25,000	666.91	±1513.85	30.573	±7.133			187483.58	±0.00
30,000			43.336	±7.849			344275.03	±0.00
40,000			97.039	±28.557			3693808.24	±0.00
50,000	(28959.4)	(±40133.4)	188.395	±34.608				
100,000	(10369.5)	(±4813.9)	984.647	±178.662				
250,000			11511.04	±0.00				
500,000			86717.77	±0.00				
1,000,000			† 4476306.69	±0.00				

† FST CONCATENATION PHASE WAS RUN ON A 5.0 GHZ AMD 9590 WITH 32 GB OF 1600 MHZ DDR3 (HALF SPEED OF AMD 2950X PLATFORM).

RANDOMLY GENERATED INSTANCES. CONCATENATION TIME (SECONDS)

FIG. 21B

INSTANCE	EUCLIDEAN		RECTILINEAR		HEXAGONAL		OCTILINEAR	
500 (1)	7.58	2.83	5.93	1.79	138.53	17.27	165.36	17.87
500 (2)	8.07	3.19	7.31	2.41	162.74	20.62	121.16	17.10
500 (3)	7.48	2.76	6.35	1.90	126.65	15.46	118.92	16.33
500 (4)	7.76	2.86	4.56	1.30	179.02	20.27	129.88	16.99
500 (5)	5.67	2.12	11.59	4.80	79.26	11.37	74.70	11.25
500 (6)	8.74	3.25	5.93	1.78	188.56	21.54	151.77	17.26
500 (7)	6.64	2.65	4.70	1.33	116.62	14.49	91.91	13.11
500 (8)	6.58	2.45	6.24	1.55	208.03	20.21	94.09	13.25
500 (9)	7.04	2.60	9.93	2.92	127.08	17.77	94.60	13.41
500 (10)	7.19	2.60	4.59	1.22	189.43	23.91	103.71	13.59
500 (11)	9.14	3.39	6.10	1.87	218.62	20.94	164.62	19.25
500 (12)	7.25	2.74	6.27	2.03	117.39	12.84	93.29	12.67
500 (13)	5.50	1.98	4.33	1.21	69.22	10.17	74.50	11.07
500 (14)	9.12	3.26	6.38	1.92	190.45	22.53	141.24	17.58
500 (15)	7.71	2.90	5.45	1.60	215.53	22.69	142.38	19.83
1000 (1)	16.12	5.98	18.60	5.66	571.81	86.03	325.51	52.34
1000 (2)	15.72	5.83	17.31	4.31	446.69	81.73	261.01	47.91
1000 (3)	19.33	7.19	15.43	5.16	431.20	67.27	467.03	63.02
1000 (4)	17.61	6.50	15.38	5.03	383.44	65.21	318.13	55.89
1000 (5)	16.05	6.02	39.08	11.53	388.20	62.43	320.30	53.69
1000 (6)	17.16	6.65	53.67	7.44	580.75	97.01	292.66	49.75
1000 (7)	16.75	6.20	13.85	4.51	341.06	53.09	322.12	51.08
1000 (8)	17.45	6.52	28.85	6.36	776.37	103.91	880.55	77.17
1000 (9)	19.16	7.21	20.57	6.95	905.91	125.83	355.17	56.47
1000 (10)	15.14	5.68	448.24	9.50	395.08	56.59	288.01	49.79
1000 (11)	16.73	6.19	17.83	5.56	635.48	86.13	324.29	54.16
1000 (12)	18.72	6.96	33.67	12.29	501.75	85.77	391.90	66.12
1000 (13)	16.29	6.09	13.80	4.57	368.30	59.52	332.06	47.68
1000 (14)	17.35	6.50	88.92	6.72	604.34	105.77	376.69	62.39
1000 (15)	17.85	6.65	18.39	5.82	642.14	105.83	322.99	54.67
10000 (1)	555.66	224.15	1924.18	546.92	33120.68	11504.70	29403.61	12657.88

OR-LIBRARY INSTANCES. TOTAL COMPUTATION TIME (SECONDS, ORIG / NEW).

FIG. 21C

INSTANCE	EUCLIDEAN		RECTILINEAR		HEXAGONAL		OCTILINEAR	
500 (1)	0.04	0.02	0.43	0.11	0.07	0.03	0.06	0.03
500 (2)	0.10	0.04	0.28	0.19	0.11	0.04	0.10	0.03
500 (3)	0.04	0.01	0.50	0.16	0.08	0.03	0.07	0.02
500 (4)	0.05	0.01	0.23	0.09	0.10	0.07	0.06	0.02
500 (5)	0.06	0.02	7.54	3.72	0.08	0.03	0.06	0.02
500 (6)	0.04	0.04	0.30	0.10	0.43	0.05	0.08	0.02
500 (7)	0.06	0.04	0.23	0.09	0.09	0.04	0.04	0.02
500 (8)	0.04	0.02	1.15	0.15	0.08	0.03	0.06	0.02
500 (9)	0.04	0.01	4.71	1.44	0.08	0.03	0.35	0.05
500 (10)	0.05	0.02	0.16	0.07	0.08	0.07	0.07	0.03
500 (11)	0.03	0.00	0.33	0.18	0.13	0.05	0.06	0.02
500 (12)	0.03	0.01	0.34	0.19	0.12	0.05	0.04	0.02
500 (13)	0.04	0.01	0.20	0.10	0.09	0.06	0.16	0.08
500 (14)	0.18	0.02	0.69	0.25	0.16	0.05	0.06	0.03
500 (15)	0.06	0.02	0.40	0.19	0.11	0.04	9.69	4.06
1000 (1)	0.08	0.04	2.63	0.38	0.28	0.12	0.29	0.06
1000 (2)	0.11	0.05	4.74	0.36	0.32	0.13	0.19	0.08
1000 (3)	0.11	0.04	0.59	0.44	0.48	0.12	0.24	0.07
1000 (4)	0.11	0.09	1.16	0.40	0.36	0.16	0.13	0.05
1000 (5)	0.07	0.04	23.36	6.25	0.36	0.15	0.14	0.05
1000 (6)	0.11	0.07	35.65	1.22	0.36	0.18	0.36	0.08
1000 (7)	0.13	0.07	0.83	0.27	0.23	0.08	0.58	0.19
1000 (8)	0.18	0.06	11.49	0.58	86.65	0.16	540.03	21.89
1000 (9)	0.12	0.04	1.25	0.51	0.46	0.17	0.35	0.16
1000 (10)	0.09	0.04	435.76	5.54	0.63	0.15	0.17	0.06
1000 (11)	0.07	0.03	2.73	0.53	0.20	0.11	0.15	0.06
1000 (12)	0.13	0.06	6.90	2.45	0.35	0.14	0.17	0.10
1000 (13)	0.07	0.02	0.57	0.23	0.23	0.11	0.10	0.04
1000 (14)	0.12	0.05	71.14	0.70	0.30	0.13	0.16	0.07
1000 (15)	0.07	0.03	2.75	0.64	0.31	0.11	0.15	0.06
10000 (1)	31.99	4.14	738.66	56.84	33.92	11.59	30.10	5.54

OR-LIBRARY INSTANCES. CONCATENATION TIME (SECONDS, ORIG / NEW).

FIG. 21D

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INSTANCE	EUCLIDEAN		RECTILINEAR		HEXAGONAL		OCTILINEAR	
D198	23.87	9.08	0.06	0.01	52.97	3.30	13.08	0.87
LIN318	17.00	5.75	2696.21	35.78	314.23	34.72	161.36	12.11
FL417	265.56	75.59	63.77	2.70	649.77	57.10	263.02	17.26
PCB442	40419.37	16653.30	0.15	0.06	16234.02	1096.67	33.83	2.60
ATT532	14.82	5.51	90.93	2.68	292.51	26.98	280.26	23.93
ALI535	20.20	7.50	4.49	1.23	456.97	48.31	306.86	24.01
U574	14.22	4.19	1.75	0.44	178.56	13.18	152.01	12.13
RAT575	17.62	4.28	14.18	4.87	497.07	80.04	109.01	15.90
P654	-	-	0.48	0.20	NO FSTs	-	3432.11	579.86
D657	54.02	18.43	9.41	2.13	843.44	61.24	472.38	33.70
GR666	58.37	17.07	57.60	3.89	825.36	60.71	768.90	55.30
U724	14.87	4.40	2.09	0.46	150.02	17.29	60.03	7.90
RAT783	21.39	5.80	17.40	5.60	617.56	88.55	191.78	25.38
DSJ1000	75.20	25.19	16.27	5.50	1570.70	125.88	1344.78	109.64
PR1002	49.52	11.33	2.71	0.66	1098.18	75.76	396.05	29.23
U1060	146.48	41.63	779.43	272.59	-	-	93264.13	259.62
VM1084	12.32	4.24	3.08	0.87	124.94	13.87	113.89	15.61
PCB1173	48.91	17.58	4.02	1.04	3031.35	252.93	792.03	59.82
D1291	356432.66	168759.07	0.53	0.21	5367.26	544.85	-	80.23
RL1304	18.11	5.43	1.26	0.35	126.59	10.37	168.47	14.84
RL1323	25.08	7.35	1.30	0.38	246.00	18.41	177.93	15.84
NRW1379	50.10	16.25	116.35	44.38	6359.02	1422.64	982.46	151.61
FL1400	-	-	-	-	-	-	-	-
U1432	-	-	0.30	0.19	NO FSTs	-	1490.48	923.83
FI1577	884577.18	397278.90	7.19	2.29	44431.85	7404.72	3924.28	242.28
D1655	83960.19	28636.62	1.53	0.52	16981.86	222.97	2498.08	121.56
VM1748	26.76	9.19	10.14	2.66	487.71	54.20	357.16	46.78
U1817	490984.62	231193.97	0.52	0.25	97329.87	7511.93	-	221.74
RL1889	33.78	10.32	2.58	0.82	164.68	18.58	281.28	30.24
D2103	NO FSTs	NO FSTs	1.11	0.45	6497.88	416.48	3851.22	235.02
U2152	69994.28	24577.63	0.67	0.35	102927.22	14565.63	246.14	30.56
U2319	NO FSTs	NO FSTs	0.73	0.35	NO FSTs	NO FSTs	-	-
PR2392	78.16	18.58	5.25	1.73	933.81	141.11	361.52	91.91
PCB3038	904.62	327.25	16479.79	16.33	-	20310.42	13930.84	1173.29
FL3795	NO FSTs	-	-	-	NO FSTs	-	NO FSTs	-
FNL4461	392.89	100.70	-	1445.11	-	8006.08	11992.40	3745.48
RL5915	3167.23	967.53	12.76	4.18	2038.17	280.32	2259.03	379.34
RL5934	1961.03	360.60	13.20	4.66	3183.34	376.46	4491.01	551.17
PLA7397	NO FSTs	-	32.48	10.66	NO FSTs	-	-	-
RL11849	-	20659.76	195.54	34.84	NO FSTs	68348.85	30041.93	3929.94
USA13509	695226.17	1099.84	-	610570.06	NO FSTs	28969.46	-	23257.89
BRD14051	40560.30	13611.19	-	-	NO FSTs	120997.40	NO FSTs	49528.72
D15112	-	3251.92	-	-	NO FSTs	115982.49	NO FSTs	57740.71
D18512	135097.41	3496.75	-	-	NO FSTs	205551.21	NO FSTs	75283.79
PLA33810	NO FSTs	NO FSTs	6070.71	195.68	NO FSTs	NO FSTs	NO FSTs	-
PLA85900	NO FSTs	NO FSTs	-	-	NO FSTs	NO FSTs	NO FSTs	NO FSTs

TSPLIB INSTANCES. TOTAL COMPUTATION TIME (SECONDS, ORIG / NEW).

FIG. 21E

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INSTANCE	EUCLIDEAN		RECTILINEAR		HEXAGONAL		OCTILINEAR	
D198	0.03	0.01	0.00	0.00	1.08	0.09	0.02	0.00
LIN318	0.07	0.03	2694.71	35.46	0.11	0.03	0.80	0.05
FL417	0.25	0.07	62.01	2.22	1.31	0.08	0.22	0.04
PCB442	2.54	0.90	0.03	0.01	0.88	0.33	0.69	0.13
ATT532	0.14	0.03	83.95	0.39	0.72	0.10	0.09	0.04
ALI535	0.06	0.02	0.81	0.19	0.69	0.13	1.74	0.07
U574	0.09	0.03	0.13	0.05	0.17	0.06	0.16	0.03
RAT575	0.14	0.05	0.72	0.26	0.15	0.06	1.14	0.33
P654	-	-	0.05	0.02	NO FSTs	-	3204.50	564.91
D657	0.07	0.02	4.61	0.69	0.40	0.10	0.11	0.04
GR666	0.09	0.04	47.52	0.51	0.50	0.27	0.19	0.08
U724	0.05	0.01	0.50	0.06	0.23	0.08	0.17	0.03
RAT783	0.12	0.05	1.51	0.17	0.45	0.12	0.12	0.05
DSJ1000	0.14	0.06	1.10	0.37	0.42	0.21	0.14	0.08
PR1002	0.09	0.04	0.86	0.17	0.57	0.16	0.18	0.04
U1060	19.31	4.50	774.91	271.19	-	-	91427.58	141.85
VM1084	0.09	0.04	0.34	0.13	0.25	0.11	0.27	0.08
PCB1173	0.21	0.08	0.40	0.09	0.29	0.13	0.17	0.06
D1291	177.48	43.89	0.06	0.03	1.69	0.61	-	2.73
RL1304	0.15	0.06	0.14	0.05	0.55	0.20	0.16	0.05
RL1323	0.08	0.04	0.13	0.04	0.31	0.10	0.15	0.04
NRW1379	0.39	0.24	25.81	7.34	19.13	1.23	4.67	0.41
FL1400	-	-	-	-	-	-	-	-
U1432	-	-	0.03	0.00	NO FSTs	-	1423.10	916.88
FI1577	17.35	5.44	1.29	0.61	3.91	1.20	6.15	0.84
D1655	5809.52	54.93	0.32	0.07	13426.57	9.40	873.80	24.40
VM1748	0.23	0.20	3.15	0.42	1.43	0.33	0.79	0.12
U1817	109.59	8.43	0.05	0.01	15653.42	3.57	-	169.74
RL1889	0.19	0.08	0.31	0.14	0.63	0.34	0.43	0.11
D2103	NO FSTs	-	0.08	0.05	1.45	0.46	1.48	0.41
U2152	59.50	25.03	0.06	0.02	26.97	4.43	22.80	3.61
U2319	NO FSTs	-	0.02	0.00	NO FSTs	-	-	-
PR2392	0.40	0.25	1.01	0.40	2.56	0.83	1.30	0.35
PCB3038	85.85	36.85	16448.87	5.02	-	41.74	46.90	14.40
FL3795	NO FSTs	NO FSTs	-	-	NO FSTs	-	NO FSTs	-
FNL4461	44.95	3.97	-	1127.28	-	55.81	556.04	20.09
RL5915	4.57	2.04	4.55	1.27	5.38	1.27	5.19	1.23
RL5934	661.40	14.53	2.85	0.87	5.13	1.96	35.64	2.49
PLA7397	NO FSTs	NO FSTs	11.61	3.08	NO FSTs	-	-	-
RL11849	-	2376.90	143.68	13.38	NO FSTs	3463.01	257.75	19.61
USA13509	691445.94	125.21	-	609758.27	NO FSTs	506.46	-	363.43
BRD14051	3660.68	157.75	-	-	NO FSTs	2418.51	NO FSTs	617.32
D15112	-	956.77	-	-	NO FSTs	4511.37	NO FSTs	3956.49
D18512	122217.99	342.67	-	-	NO FSTs	5269.18	NO FSTs	9657.54
PLA33810	NO FSTs	NO FSTs	5644.07	26.48	NO FSTs	NO FSTs	NO FSTs	-
PLA85900	NO FSTs	NO FSTs	-	-	NO FSTs	NO FSTs	NO FSTs	NO FSTs

TSPLIB INSTANCES. CONCATENATION TIME (SECONDS, ORIG / NEW).

FIG. 21F