TABLE 1—PRIMARY ID ASSIGNMENTS
BYTE 2 OF MESSAGE TYPES 0, 1, 2, 8, 9, 10, 11

Command	Status	Function
00	00	Reserved - SAE
01	01	Reserved - MFG
02	02	Reserved - MFG
03	03	Reserved - MFG
04	04	Engine Torque
05	05	Engine Air Intake
06	06	Reserved - MFG
07	07	Reserved - MFG
08	08	Reserved - SAE
09	09	Throttle
0A	0A	A/C Clutch
0B	0B	Reserved - MFG
0C	0C	Reserved - MFG
0D	0D	Engine RPM
0E	0E	Reserved - MFG
0F	0F	Reserved - MFG
10	10	Reserved - SAE
11	11	Reserved - MFG
12	12	Wheels
13	13	Reserved - MFG
14	14	Vehicle Speed
15	15	Traction Control
16	16	Reserved - MFG
17	17	Reserved - MFG
18	18	Reserved - SAE
19	19	Brakes
1A	1A	Steering / Steering Wheel
1B	1B	Reserved - SAE
1C	1C	Reserved - MFG
1D	1D	Transmission / Transaxle / PRNDL
1E	1E	Reserved - MFG
1F	1F	Reserved - MFG
20	20	Reserved - SAE
21	21	Reserved - MFG
22	22	Reserved - MFG
23	23	Engine Sensors
24	24	Engine Coolant

TABLE 1—PRIMARY ID ASSIGNMENTS
BYTE 2 OF MESSAGE TYPES 0, 1, 2, 8, 9, 10, 11 (CONTINUED)

Command	Status	Function
25	25	Engine Oil
26	26	Reserved - MFG
27	27	Reserved - MFG
28	28	Reserved - SAE
29	29	Engine Systems Other
2A	2A	Reserved - MFG
2B	2B	Reserved - SAE
2C	2C	Suspension
2D	2D	Non-Legislated Diagnostics
2E	2E	Reserved - MFG
2F	2F	Reserved - MFG
30	30	Reserved - SAE
31	31	Vehicle Speed Control
32	32	Reserved - MFG
33	33	Reserved - MFG
34	34	Reserved - SAE
35	35	Reserved - MFG
36	36	Legislated Diagnostics
37	37	Reserved - MFG
38	38	Reserved - MFG
39	39	Reserved - SAE
3A	3A	Charging System
3B	3B	Electrical Energy Management
3C	3C	Reserved - SAE
3D	3D	Reserved - MFG
3E	3E	Odometer
3F	3F	Reserved - MFG
40	40	Reserved - MFG
41	41	Reserved - SAE
42	42	Fuel System
43	43	Vehicle Motion
44	44	Ignition Switch / Starter
45	45	Tail Tales
46	46	Reserved - MFG
47	47	Reserved - MFG
48	48	Reserved - MFG
49	49	Reserved - SAE
4A	4A	Security
4B	4B	Audio Control
4C	4C	Audible Warnings
4D	4D	Reserved - MFG
4E	4E	Compact Disc
4F	4F	Reserved - MFG
50	50	Reserved - MFG

continued

TABLE 1—PRIMARY ID ASSIGNMENTS
BYTE 2 OF MESSAGE TYPES 0, 1, 2, 8, 9, 10, 11 (CONTINUED)

Command	Status	Function
A0	A0	Reserved - SAE
A1	A1	Digital Audio Tape
A2	A2	Audio Tuner / Receiver
A3	A3	Cassette Tape
A4	A4	Reserved - MFG
A5	A5	Reserved - MFG
A6	A6	Reserved - SAE
A7	A7	Climate Control (HVAC)
A8	A8	Reserved - MFG
A9	A9	Reserved - SAE
AA	AA	Window Wiper / Washer
AB	AB	Reserved - MFG
AC	AC	Reserved - MFG
AD	AD	Reserved - MFG
AE	AE	Reserved - SAE
AF	AF	Mirrors
B0	B0	Door Locks
B1	B1	External Access
B2	B2	Seat Motion / Control
B3	B3	Windows
B4	B4	Steering Column
B5	B5	Reserved - MFG
B6	B6	Seat Switches
B7	B7	Restraints
B8	B8	Reserved - MFG
B9	B9	Reserved - MFG
BA	BA	External Lamp Outage
BB	BB	External Lamps
BC	BC	Interior Lamp Outage
BD	BD	Interior Lamps
BE	BE	Reserved - SAE
BF	BF	Reserved - MFG
C0	C0	Time
C1	C1	Electric Defrost
C2	C2	Keyfobbing
C3	C3	Displays
C4	C4	Reserved - MFG
C5	C5	Reserved - MFG
C6	C6	Reserved - SAE
C7	C7	Exterior Environment
C8	C8	Interior Environment
C9	C9	Reserved - SAE
CA	CA	Time
CB	CB	Vehicle ID (VIN)
CC	CC	Reserved - MFG
FE	FE	Network Control

6. *Function Read Target Address Assignments*—Function Read IDs are used to address a specific function in a type 3 message. The second byte of the three byte header contains this function read ID. In a type 3 message (Function Read) the data is returned to the transmitting node in the In-Frame Response (IFR) portion of the message. The data returned is identified by a Parameter Reference Number (PRN). Table 3 lists the function read ID assignments, description, and PRN. Those IDs labeled as "Reserved - SAE" are reserved for the SAE to define at a later time while those labeled "Reserved - MFG" are left for the individual manufacturers to use.

TABLE 3—FUNCTION READ ID ASSIGNMENTS
BYTE 2 OF MESSAGE TYPE 3

ID	Function
00 - 0F	Reserved - MFG
10 - 1F	Reserved - SAE
20 - 2F	Reserved - MFG
30 - 3F	Reserved - SAE
40 - 4F	Reserved - MFG
50 - 5F	Reserved - SAE
60 - 6F	Reserved - MFG
70 - 7F	Reserved - SAE
80 - 8F	Reserved - MFG
90 - 9F	Reserved - SAE
FE - FF	Reserved - MFG

7. *Message Assignments*—The following tables contain the message assignments associated with the primary IDs for message types 0, 1, 2, 8, 9, 10, and 11. A separate table is included for each primary ID pair that has at least one secondary ID currently defined. Table 3 is an example of how to interpret the tables to follow.

TABLE 3—EXAMPLE OF MESSAGE TABLES TO FOLLOW

Secondary ID Name	Sec ID	Msg Op	Q	C	Ext Addr	PRN
Secondary ID Name #1	xx	?	?	?	?	?
Secondary ID Name #2	xx	?	?	?	?	?
...	...	...	...	...	...	...
Secondary ID Name #n	xx	?	?	?	?	?

Each primary ID pair can have up to 64 secondary IDs. If a secondary ID is not defined here, it is assumed to be manufacturer specific. Future definitions of secondary IDs can be brought to the attention of the SAE J2178 task force and if all manufacturers agree, a new secondary ID can be defined. Following each secondary ID name is the 6-bit hexadecimal secondary ID. The secondary ID byte is made up of the Q bit (bit 7), C bit (bit 6), and 6-bit ID as listed in the table. Following the secondary ID is the message operation column. Up to three operations can be defined for any secondary ID. Table 4 lists the valid message operations and the appropriate primary ID (i.e., command or status) and C bit definitions for the operation.

TABLE 4—MESSAGE OPERATIONS

Operation	Msg Op	Primary ID	C-bit (bit 6)
Report Data	R	Status	0
Load Data	L	Command	0
Modify State	M	Command	1

Each secondary ID can support one or more of the operations listed above. Typically, a secondary ID will support report data only (R), report and load data (L / R), or report data, load data, and modify state (L / R / M). The other combinations are very unlikely.

Following the operation column is Q bit usage. Each secondary ID will have an entry under Q bit = "1" and Q bit = "0" indicating how the Q bit (bit 7) is used in the message. Table 5 lists the valid options.

TABLE 5—Q BIT DEFINITIONS

Q bit = "1"	Q bit = "0"	Meaning
--	x	Q bit not used, Defaults to logic "0"
x	--	Q bit not used, Defaults to logic "1"
Set	--	Q bit must be logic "1" and means Set
E	D	Enable(d) / Disable(d)
Inc	Dec	Increment / Decrement
O	C	Open(ed) / Close(d)
L	U	Lock(ed) / Unlock(ed)
On	Off	On / Off
R	-R	Reset / Not Reset
Y	N	Yes / No

The next column after the Q bit definitions is the Extended Address column. If extended addressing is used for a particular secondary ID, the paragraph number (in Section 8) which defines the valid extended addresses is listed. Otherwise, "--" is found.

The final column is used for those secondary IDs which contain data (e.g., coolant temperature, vehicle speed, etc.) that cannot be encoded in the Q bit (i.e., non-boolean). The PRN number is essentially a lookup into SAE J2178/2 where the complete data encoding, size, resolution, etc., can be found.

The specific message tables can be found as follows:

Table 6 - Engine Torque
Table 7 - Engine Air Intake
Table 8 - Throttle
Table 9 - Air Conditioning Clutch
Table 10 - Engine RPM
Table 11 - Wheels
Table 12 - Vehicle Speed
Table 13 - Traction Control
Table 14 - Brakes
Table 15 - Steering / Steering Wheel
Table 16 - Transmission / Transaxle / PRNDL
Table 17 - Engine Sensors - Other
Table 18 - Engine Coolant
Table 19 - Engine Oil
Table 20 - Engine Systems - Other
Table 21 - Suspension
Table 22 - Vehicle Speed Control
Table 23 - Charging System
Table 24 - Electrical Energy Management
Table 25 - Odometer
Table 26 - Fuel System
Table 27 - Ignition Switch / Starter
Table 28 - Tell Tales
Table 29 - Climate Control (HVAC)
Table 30 - Window Wiper / Washer
Table 31 - Mirrors
Table 32 - Door Locks
Table 33 - External Access
Table 34 - Seat Motion / Control
Table 35 - Windows
Table 36 - Steering Column
Table 37 - Seat Switches
Table 38 - Restraints
Table 39 - Exterior Lamps Outage
Table 40 - Exterior Lamps
Table 41 - Interior Lamps Outage
Table 42 - Interior Lamps
Table 43 - Time
Table 44 - Defrost
Table 45 - Displays
Table 46 - Exterior Environment
Table 47 - Interior Environment
Table 48 - Time / Date
Table 49 - Vehicle Identification
Table 50 - Network Control

7.1 Engine Torque—(See Table 6.)
Primary ID: Engine Torque
Command ID: $08
Status ID: $09

7.2 Engine Air Intake—(See Table 7.)
Primary ID: Engine Air Intake
Command ID: $0A
Status ID: $0B

7.3 Throttle—(See Table 8.)
Primary ID: Throttle
Command ID: $12
Status ID: $13

7.4 Air Conditioning Clutch—(See Table 9.)
Primary ID: Air Conditioning Clutch
Command ID: $14
Status ID: $15

7.5 Engine RPM—(See Table 10.)
Primary ID: Engine RPM
Command ID: $1A
Status ID: $1B

TABLE 6—ENGINE TORQUE MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q0	Ext Addr	PRN
Crankshaft Torque - Percent	01	L/R	--	x	--	1026
Crankshaft Torque - Absolute	02	L/R	--	x	--	1018
Maximum Crankshaft Torque	10	R	--	x	--	1033

7.6 Wheels—(See Table 11.)
Primary ID: Wheels
Command ID: $24
Status ID: $25

7.7 Vehicle Speed—(See Table 12.)
Primary ID: Vehicle Speed
Command ID: $28
Status ID: $29

7.8 Traction Control—(See Table 13.)
Primary ID: Traction Control
Command ID: $2A
Status ID: $2B

7.9 Brakes—(See Table 14.)
Primary ID: Brakes
Command ID: $32
Status ID: $33

TABLE 5—ENGINE AIR INTAKE MESSAGES

Secondary ID Name	ID	Qty	Qty	Qty	Qty	Qty	Qty
Sound On / Off	01	1/8	00	00	-	-	-
Sound Value	02	01	-	1	-	-	1001
Mass Air Flow Rate	03	01	-	1	-	-	0000
Manifold Absolute Pressure	11	01	-	1	-	-	0000
Intake Air Temperature	00	01	-	1	-	-	0000

TABLE 6—THROTTLE MESSAGES

Secondary ID Name	ID	Qty	Qty	Qty	Qty	Qty	Qty
Sensor 1 Position	01	01	-	1	-	-	0011
Sensor 2 Position	02	01	-	1	-	-	0000
Sensor 3 Position	03	01	-	1	-	-	0000
Throttle Kicker	10	1/8	0	0	-	-	-
Pedal Position	11	01	-	1	-	-	0000

TABLE 9—AIR CONDITIONING CLUTCH MESSAGES

Secondary ID Name	ID	Qty	Qty	Qty	Qty	Qty	Qty
Enable	01	1/8	0	0	-	-	-
Enable Pending	02	1/8	1	0	-	-	-
Load	03	01	-	1	-	-	0000
Required	04	1/8	1	0	-	-	-

TABLE 10—ENGINE RPM MESSAGES

Secondary ID Name	ID	Qty	Qty	Qty	Qty	Qty	Qty
Low Resolution	01	01	-	1	-	-	0000
High Resolution	02	01	-	1	-	-	0000
Idle Speed	10	1/8	0	0	-	-	0000

TABLE 11—WHEELS MESSAGES

Secondary ID Name	ID	Qty	Qty	Qty	Qty	Qty	Qty
Wheel Speed - Low Resolution	01	01	-	1	01	-	0000
Wheel Slip	02	01	-	1	01	-	0000
Wheel Load	04	01	-	1	01	-	0000
Wheel Speed - High Resolution	11	01	-	2	01	-	0000

TABLE 12—VEHICLE SPEED MESSAGES

Secondary ID Name	ID	Qty	Qty	Qty	Qty	Qty	Qty
Low Resolution	01	01	-	1	-	-	0000
High Resolution	02	01	-	2	-	-	0000

TABLE 13—TRACTION CONTROL MESSAGES

Secondary ID Name	ID	Qty	Qty	Qty	Qty	Qty	Qty
Engine Traction Active	01	01	1	0	-	-	-
Brake Traction Active	02	01	1	0	-	-	-
System Control	03	1/8	00	00	-	-	-
System Active	04	01	1	0	-	-	-
System Faulted	05	01	1	0	-	-	-
System Engine Inv. Active	06	01	1	0	-	-	-

TABLE 14—BRAKES MESSAGES

Secondary ID Name	ID	Qty	Qty	Qty	Qty	Qty	Qty
ABS Active	01	01	1	0	-	-	-
ABS System On / Off	02	1/8	00	00	-	-	-
Pedal Low Power	03	1/8	00	00	-	-	-
System Faulted	04	01	1	0	-	-	-
Pedal Temperature	05	01	-	1	-	-	0000
Brake Pump Motor Pressure	11	01	-	1	-	-	0000
Pedal Level - Percent	12	01	-	1	-	-	0000
Pedal Level - Volume	13	01	-	1	-	-	0000
Pedal Remaining Life	14	01	-	1	-	-	0000
Pedal Capacity	15	01	-	1	-	-	0000
Parking Brake Inv. Active	00	01	1	0	-	-	-
Torque Converter Clutch -	01	01	-	1	-	-	0000
Brake Inv. Active			1	0			
Brake Lamp - Brake Inv. Active	00	01	1	0	-	-	-
Pedal Low Power Inv. Active	00	01	1	0	-	-	-

7.10 Steering / Steering Wheel---(See Table 15.)
Primary ID: Steering / Steering Wheel
Command ID: $34
Status ID: $35
7.11 Transmission / Transaxle / PRNDL---(See Table 16.)
Primary ID: Transmission / PRNDL
Command ID: $3A
Status ID: $3B
7.12 Engine Sensors - Other---(See Table 17.)
Primary ID: Engine Sensors - Other
Command ID: $46
Status ID: $47
7.13 Engine Coolant---(See Table 18.)
Primary ID: Engine Coolant
Command ID: $48
Status ID: $49
7.14 Engine Oil---(See Table 19.)
Primary ID: Engine Oil
Command ID: $4A
Status ID: $4B

TABLE 15--STEERING / STEERING WHEEL MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q2	Ext Addr	PRN
Fluid Life Reset	00	L/R	R	-S	-	-
Fluid Temperature	10	S	-	x	-	9005
Fluid Pressure	11	S	-	x	-	9006
Fluid Level - Percent	12	S	-	x	-	9007
Fluid Level - Volume	13	S	-	x	-	9008
Fluid Remaining Life	14	S	-	x	-	9009
Fluid Capacity	15	S	-	x	-	900A
Steering Wheel Angle	16	S	-	x	-	9001
Steering Wheel Rate	18	S	-	x	-	900C
Steering Wheel Torque	1A	S	-	x	-	900D
Wheel Steer Angle	20	S	-	x	8.1	900E
Fluid Life Reset Sw. Active	38	S	Y	N	-	-

TABLE 16--TRANSMISSION / PRNDL MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q2	Ext Addr	PRN
Torque Converter Locked	01	L/R	Y	N	-	-
Clutch Enable	02	L/R	E	D	-	-
Actual Gear Position w/ Shift in Progress	03	R	Y	N	-	180E
Range Selected (PRNDL position)	04	R	-	x	-	1809
Transfer Case (2WD)	06	R	-	x	-	180A
Commanded Gear	06	L/R	-	x	-	180D
Range Actual (PRNDL sensed at transmission)	07	R	-	x	-	1808
Transmission Kickdown	08	L/R	Y	N	-	-
Fluid Life Reset	09	L/R	R	-S	-	-
Fluid Temperature	10	S	-	x	-	1805
Fluid Pressure	11	S	-	x	-	180C
Fluid Level - Percent	12	S	-	x	-	1801
Fluid Level - Volume	13	S	-	x	-	1802
Fluid Remaining Life	14	S	-	x	-	1804
Fluid Capacity	15	S	-	x	-	1803
Park / Neutral Sw. Active	20	S	Y	N	-	-
Fluid Life Reset Sw. Active	29	S	Y	N	-	-

TABLE 17--ENGINE SENSORS--OTHER MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q2	Ext Addr	PRN
Converter Bank 1, Sensor 1 Heater	01	L/R	On	Off	-	-
Converter Bank 1, Sensor 2 Heater	02	L/R	On	Off	-	-
Converter Bank 2, Sensor 1 Heater	03	L/R	On	Off	-	-
Converter Bank 2, Sensor 2 Heater	04	L/R	On	Off	-	-
Converter Bank 1, Sensor 1 Temperature	11	S	-	x	-	1037
Converter Bank 1, Sensor 2 Temperature	12	S	-	x	-	1038
Converter Bank 2, Sensor 1 Temperature	13	S	-	x	-	1039
Converter Bank 2, Sensor 2 Temperature	14	S	-	x	-	103A

TABLE 18--ENGINE COOLANT MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q2	Ext Addr	PRN
Fan 1 Speed	01	L/R	On	Off	-	102A
Fan 2 Speed	02	L/R	On	Off	-	1028
Fan 1 Clutch	05	L/R	E	D	-	-
Fan 2 Clutch	07	L/R	E	D	-	-
Fluid Life Reset	09	L/R	R	-S	-	-
Fluid Temperature	10	S	-	x	-	0005
Fluid Pressure	11	S	-	x	-	1029
Fluid Level - Percent	12	S	-	x	-	1028
Fluid Level - Volume	13	S	-	x	-	1027
Fluid Remaining Life	14	S	-	x	-	1020
Fluid Capacity	15	S	-	x	-	1026
Fluid Life Reset Sw. Active	38	S	Y	N	-	-
Fluid Temperature High	35	S	Y	N	-	-
Low Coolant Level	36	S	Y	N	-	-

7.16 Engine Systems - Other---(See Table 20.)
Primary ID: Engine Systems - Other
Command ID: $52
Status ID: $53

7.17 Suspension---(See Table 21.)
Primary ID: Suspension
Command ID: $58
Status ID: $59

7.17 Vehicle Speed Control---(See Table 22.)
Primary ID: Vehicle Speed Control
Command ID: $62
Status ID: $63

7.18 Charging System---(See Table 23.)
Primary ID: Charging System
Command ID: $72
Status ID: $73

TABLE 19--ENGINE OIL MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q2	Ext Addr	Page
Fluid Life Reset	00	L/R	R	-R	-	-
Fluid Temperature	10	R	-	x	-	1028
Fluid Pressure	11	R	-	x	-	1029
Fluid Level - Percent	12	R	-	x	-	1030
Fluid Level - Volume	13	R	-	x	-	1031
Fluid Remaining Life	14	R	-	x	-	1032
Oil Viscosity	15	R		x	-	1033
Fluid Capacity	16	R	-	x	-	1034
Fluid Life Reset Sw. Active	20	R	Y	R	-	-
Fluid Temperature High	30	R	Y	R	-	-
Low Oil Level	32	R	Y	R	-	-

TABLE 20--ENGINE SYSTEMS--OTHER MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q2	Ext Addr	Page
Engine Redline - Low Resolution	01	R	-	x	-	1040
Number Engine Cylinders	02	R	-	x	-	1040
Number Valves / Cylinder	03	R	-	x	-	1041
Engine Running	04	R	Y	R	-	-
Engine Displacement	05	R	-	x	-	1042
Engine Redline - High Resolution	10	R	-	x	-	1043
Engine Accelerating	20	R	Y	N	-	-

TABLE 21--SUSPENSION MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q2	Ext Addr	Page
Ride Setting	01	L/R	-	x	-	1044
Fluid Life Reset	00	L/R	R	-R	-	-
System Faulted	04	R	Y	N	-	-
Fluid Temperature	10	R	-	x	-	1045
Fluid Pressure	11	R	-	x	-	1046
Fluid Level - Percent	12	R	-	x	-	1047
Fluid Level - Volume	13	R	-	x	-	1048
Fluid Remaining Life	14	R	-	x	-	1049
Fluid Capacity	15	R	-	x	-	1050
Fluid Life Reset Sw. Active	20	R	Y	N	-	-

TABLE 22--VEHICLE SPEED CONTROL MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q2	Ext Addr	Page
System On / Off	01	L/R	On	Off	-	-
Set Speed	02	L/R	E	D	-	1051
Coast Mode	03	L/R	E	D	-	-
Resume Mode	04	L/R	E	D	-	-
Accelerate Mode	05	L/R	E	D	-	-
Speed Control Active	06	R	Y	N	-	-
On / Off Sw. Active	21	R	Y	N	-	-
Set Speed Sw. Active	22	R	Y	N	-	-
Coast Sw. Active	23	R	Y	N	-	-
Resume Sw. Active	24	R	Y	N	-	-
Accelerate Sw. Active	25	R	Y	N	-	-

TABLE 23--CHARGING SYSTEM MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q2	Ext Addr	Page
Charging Voltage	01	R	-	x	-	1052
Charging Current	02	R	-	x	-	1053
Battery Voltage	03	R	-	x	-	1054
Battery Current	04	R	-	x	-	1055
Battery Temperature	10	R	-	x	-	-
Charging System Faulted	21	R	Y	N	-	-

7.19 Electrical Energy Management---(See Table 24.)
Primary ID: Electrical Energy Management
Command ID: $74
Status ID: $75
7.20 Odometer---(See Table 25.)
Primary ID: Odometer
Command ID: $7A
Status ID: $7B
7.21 Fuel System---(See Table 26.)
Primary ID: Fuel System
Command ID: $82
Status ID: $83
7.22 Ignition Switch / Starter---(See Table 27.)
Primary ID: Ignition Switch / Starter
Command ID: $86
Status ID: $87
7.23 Tell Tales---(See Table 28.)
Primary ID: Tell Tales
Command ID: $88
Status ID: $89

TABLE 24--ELECTRICAL ENERGY MANAGEMENT MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q0	Ext Addr	PRN
Delayed Accessory	01	L/R	R	D	-	-
Short Term Storage	02	L/R	R	D	-	-
Long Term Storage	03	L/R	R	D	-	-

TABLE 25--ODOMETER MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q0	Ext Addr	PRN
Vehicle Odometer	01	R	-	x	-	8004
Trip Reset	03	L/R	R	-R	-	-
Trip Odometer	04	R	-	x	-	8039
Trip Reset Sw. Active	20	R	Y	N	-	-

TABLE 26--FUEL SYSTEM MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q0	Ext Addr	PRN
Average Fuel Economy	01	R	-	x	-	8020
Instant. Fuel Economy	06	R	-	x	-	803A
Average Fuel Economy Reset	08	L/R	R	-R	-	-
Fuel Used - Percent	08	R	-	x	-	8036
Fuel Used - Volume	0C	R	-	x	-	803C
Fuel Used Reset	0E	L/R	R	-R	-	-
Fuel Temperature	10	R	-	x	-	1044
Fuel Pressure	11	R	-	x	-	000A
Fuel Level - Percent	12	R	-	x	-	8005
Fuel Level - Volume	13	R	-	x	-	8006
Fuel Capacity	16	R	-	x	-	8007
Fuel Pump Low Speed	18	L/R	R	D	-	-
Fuel Pump High Speed	19	L/R	R	D	-	-
Fuel Economy Reset Sw. Active	28	R	Y	N	-	-
Fuel Used Reset Sw. Active	2F	R	Y	N	-	-
Low Fuel Level	32	R	Y	N	-	-

TABLE 27--IGNITION SWITCH / STARTER MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q0	Ext Addr	PRN
Ignition Switch Position	34	R	-	x	-	1087
Key In Ignition	76	R	Y	N	-	-

TABLE 28--TELL TALES MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q0	Ext Addr	PRN
Seatbelt	01	L/R	On	Off	-	-
Service Engine Soon	02	L/R	On	Off	-	-
Check Engine (MIL)	03	L/R	On	Off	-	-
High Beam Indicator	04	L/R	On	Off	-	-
Left Turn Indicator	05	L/R	On	Off	-	-
Right Turn Indicator	06	L/R	On	Off	-	-
Airbag	07	L/R	On	Off	-	-
Anti-Lock Brake System Failed	08	L/R	On	Off	-	-
Traction Control System Failed	09	L/R	On	Off	-	-
Security	0A	L/R	On	Off	-	-
Low Fuel	0B	L/R	On	Off	-	-
Low Coolant	0C	L/R	On	Off	-	-
Low Oil	0D	L/R	On	Off	-	-
Low Voltage	0E	L/R	On	Off	-	-
Upshift	0F	L/R	On	Off	-	-
Low Washer Fluid	10	L/R	On	Off	-	-
Traction Control Active	11	L/R	On	Off	-	-
Alternator Failure	12	L/R	On	Off	-	-
Low Brake Fluid	13	L/R	On	Off	-	-
Overdrive	14	L/R	On	Off	-	-
Traction Control Disabled	15	L/R	On	Off	-	-
Convertible Latch Warning	21	L/R	On	Off	-	-
Super Lock System Warning	22	L/R	On	Off	-	-
Catalyst Overtemperature	23	L/R	On	Off	-	-
Vehicle Speed Control	24	L/R	On	Off	-	-

7.24 Climate Control (HVAC) ---(See Table 29.)
Primary ID: Climate Control (HVAC)
Command ID: $B2
Status ID: $B3
7.25 Window Wiper / Washer ---(See Table 30.)
Primary ID: Window Wiper / Washer
Command ID: $B8
Status ID: $B9

7.26 Mirrors---(See Table 31.)
Primary ID: Mirrors
Command ID: $C2
Status ID: $C3
7.27 Door Locks---(See Table 32.)
Primary ID: Door Locks
Command ID: $C4
Status ID: $C5
7.28 External Access---(See Table 33.)
Primary ID: External Access
Command ID: $C6

STATUS ID: $C7

TABLE 29---CLIMATE CONTROL (HVAC) MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q2	Ext Addr	Pos
Blower Fan Speed	02	L / R	-	x	-	-
Multi-Zone Mode	06	L / R	E	D	-	-
Low Refrigerant	07	R	Y	N	-	-
Fluid Life Reset	08	L / R	R	R	-	-
HVAC Set Temperature	0A	L / R	-	x	82	0A0
		M	R	0xC		-
High Side Fluid Temperature	10	R	-	x	-	0A6
High Side Fluid Pressure	11	R	-	x	-	0A7
Fluid Charge - Percent	12	R	-	x	-	0A8
Fluid Charge - Weight	13	R	-	x	-	0A9
Fluid Remaining Life	14	R	-	x	-	0AA
Fluid Capacity - Weight	16	R	-	x	-	0AB
Low Side Fluid Temperature	20	R	-	x	-	0AC
Low Side Fluid Pressure	21	R	-	x	-	0AD
Fan Increment Speed Sw. Active	22	R	Y	N	-	-
Fan Decrement Speed Sw. Active	23	R	Y	N	-	-
Multi-Zone Mode Sw. Active	26	R	Y	N	-	-
Fluid Life Reset Sw. Active	28	R	Y	N	-	-
Increment Temp Sw. Active	2A	R	Y	N	-	-
Decrement Temp Sw. Active	2B	R	Y	N	-	-

TABLE 30---WINDOW WIPER / WASHER MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q2	Ext Addr	Pos
Wiper Mode	01	L / R	-	x	8.3	A00
Washer On / Off	02	L / R	0x	0x	8.3	-
Wiper Delay	03	L / R	E	D	8.3	A04
Wiper Pulse	04	L / R	E	D	8.3	-
Fluid Temperature	10	R	-	x	8.3	A06
Fluid Pressure	11	R	-	x	8.3	A07
Fluid Level - Percent	12	R	-	x	8.3	A08
Fluid Level - Volume	13	R	-	x	8.3	A09
Fluid Capacity	16	R	-	x	8.3	A0A
Washer On/Off Sw. Active	22	R	Y	N	8.3	-
Wiper Pulse Sw. Active	24	R	Y	N	8.3	-

TABLE 31---MIRRORS MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q2	Ext Addr	Pos
Up Motion	01	L / R	E	D	8.4	-
Down Motion	02	L / R	E	D	8.4	-
Right Motion	03	L / R	E	D	8.4	-
Left Motion	04	L / R	E	D	8.4	-
Retract Motion	05	L / R	E	D	8.4	-
Extend Motion	06	L / R	E	D	8.4	-
Horizontal Position	10	L / R	-	x	8.4	A00
Vertical Position	11	L / R	-	x	8.4	A08
Heater On / Off	12	L / R	0x	0x	8.4	-
Nightlime On / Off	13	R	0x	0x	8.4	-
Dimming Level	18	L / R	-	x	8.4	A00
Up Sw. Active	21	R	Y	N	8.4	-
Down Sw. Active	22	R	Y	N	8.4	-
Right Sw. Active	23	R	Y	N	8.4	-
Left Sw. Active	24	R	Y	N	8.4	-
Retract Sw. Active	25	R	Y	N	8.4	-
Extend Sw. Active	26	R	Y	N	8.4	-
Heater Sw. Active	27	R	Y	N	8.4	-

7.29 Seat Motion / Control---(See Table 34.)
Primary ID: Seat Motion / Control
Command ID: $C8
Status ID: $C9
7.30 Windows---(See Table 35.)
Primary ID: Windows
Command ID: $CA
Status ID: $CB
7.31 Steering Column---(See Table 36.)
Primary ID: Steering Column
Command ID: $CC
Status ID: $CD
7.32 Seat Switches---(See Table 37.)
Primary ID: Seat Switches
Command ID: $D0
Status ID: $D1
7.33 Restraints---(See Table 38.)
Primary ID: Restraints
Command ID: $D2
Status ID: $D3

TABLE 32--DOOR LOCKS MESSAGES

Secondary ID Name	Sec ID	Msg Op	D1	D0	Ext Addr	PRN
Lock	01	L/R	L	U	8.5	--
Unlock Enable	02	L/R	E	D	8.5	--
Lock Cylinder Secure	03	R	Y	N	8.5	--
Key-in-Lock Cylinder	04	R	Y	N	8.5	--
Master Controller Lock	05	L/R	L	N	8.5	--
Lock Cylinder State	06	R	--	x	8.5	A010
Super / Double Lock	07	L/R	L	U	8.5	
Remote Lock w/ Transmitter ID	08	L/R	L	U	8.5	C001
Remote Lock	09	L/R	L	U	8.5	
Lock Sw. Active	20	R	Y	N	8.5	--
Unlock Sw. Active	21	R	Y	N	8.5	--
Unlock Enable Sw. Active	22	R	Y	N	8.5	--
Master Controller Lock Sw. Active	25	R	Y	N	8.5	--
Master Controller Unlock Sw. Active	26	R	Y	N	8.5	--

TABLE 33--EXTERNAL ACCESS MESSAGES

Secondary ID Name	Sec ID	Msg Op	D1	D0	Ext Addr	PRN
Open	01	L/R	Y	N	8.5	--
Close	02	L/R	Y	N	8.5	--
Remote Open / Close w/ Transmitter ID	11	L/R	O	C	8.5	C001
Remote Open / Close	12	L/R	O	C	8.5	--
Ajar Sw. Active	21	R	Y	N	8.5	--
Door Handle Sw. Active	22	R	Y	N	8.5	--
Door Jamb Sw. Active	23	R	Y	N	8.5	--

TABLE 34--SEAT MOTION / CONTROL MESSAGES

Secondary ID Name	Sec ID	Msg Op	D1	D0	Ext Addr	PRN
Horiz. Forward Motion	01	L/R	E	D	8.6	--
Horiz. Rearward Motion	02	L/R	E	D	8.6	--
Vert. Up Motion	03	L/R	E	D	8.6	--
Vert. Down Motion	04	L/R	E	D	8.6	--
Front Vert. Up Motion	05	L/R	E	D	8.6	--
Front Vert. Down Motion	06	L/R	E	D	8.6	--
Rear Vert. Up Motion	07	L/R	E	D	8.6	--
Rear Vert. Down Motion	08	L/R	E	D	8.6	--
Recline Forward Motion	09	L/R	E	D	8.6	--
Recline Rearward Motion	0A	L/R	E	D	8.6	--
Lumbar Up Motion	0B	L/R	E	D	8.6	--
Lumbar Down Motion	0C	L/R	E	D	8.6	--
Lumbar In Motion	0D	L/R	E	D	8.6	--
Lumbar Out Motion	0E	L/R	E	D	8.6	--
Headrest Up Motion	0F	L/R	E	D	8.6	--
Headrest Down Motion	10	L/R	E	D	8.6	--
Heater On / Off	11	L/R	On	Off	8.6	--
Heater Temperature	12	L/R	--	x	8.6	A001
		M	Hot	Cold		
Occupied	13	R	Y	x	8.6	--
Upper Bolster In Motion	14	L/R	E	D	8.6	--
Upper Bolster Out Motion	15	L/R	E	D	8.6	--
Lower Bolster In Motion	16	L/R	E	D	8.6	--
Lower Bolster Out Motion	17	L/R	E	D	8.6	--

TABLE 35--WINDOWS MESSAGES

Secondary ID Name	Sec ID	Msg Op	D1	D0	Ext Addr	PRN
Open	01	L/R	E	D	8.7	--
Close	02	L/R	E	D	8.7	--
Operation Enable	03	L/R	E	D	8.7	--
Master Controller Open	04	L/R	E	D	8.7	--
Master Controller Close	05	L/R	E	D	8.7	--
Position	1A	L/R	--	x	8.7	A00F
Open Sw. Active	21	R	Y	N	8.7	--
Close Sw. Active	22	R	Y	N	8.7	--
Lockout Sw. Active	23	R	Y	N	8.7	--
Master Controller Open Sw. Active	24	R	Y	N	8.7	--
Master Controller Close Sw. Active	25	R	Y	N	8.7	--

OMEGA EXHIBIT 2037

TABLE 36—STEERING COLUMN MESSAGES

Secondary ID Name	Sec ID	Msg Cyc	Q1	Q6	Est Accy	PRN
Up Motion	01	L/R	E	D	"	"
Down Motion	02	L/R	E	D	"	"
In Motion	03	L/R	E	D	"	"
Out Motion	04	L/R	E	D	"	"
Vertical Position	1A	L/R	"	x	"	A012
Horizontal Position	1B	L/R	"	x	"	A011
Up Sw. Active	21	R	Y	N	"	"
Down Sw. Active	22	R	Y	N	"	"
In Sw. Active	23	R	Y	N	"	"
Out Sw. Active	24	R	Y	N	"	"

TABLE 37—SEAT SWITCHES MESSAGES

Secondary ID Name	Sec ID	Msg Cyc	Q1	Q6	Est Accy	PRN
Horz. Forward Sw. Active	01	R	Y	N	8.8	"
Horz. Rearward Sw. Active	02	R	Y	N	8.8	"
Vert. Up Sw. Active	03	R	Y	N	8.8	"
Vert. Down Sw. Active	04	R	Y	N	8.8	"
Front Vert. Up Sw. Active	05	R	Y	N	8.8	"
Front Vert. Down Sw. Active	06	R	Y	N	8.8	"
Rear Vert. Up Sw. Active	07	R	Y	N	8.8	"
Rear Vert. Down Sw. Active	08	R	Y	N	8.8	"
Recline Forward Sw. Active	09	R	Y	N	8.8	"
Recline Rearward Sw. Active	0A	R	Y	N	8.8	"
Lumbar Up Sw. Active	0B	R	Y	N	8.8	"
Lumbar Down Sw. Active	0C	R	Y	N	8.8	"
Lumbar In Sw. Active	0D	R	Y	N	8.8	"
Lumbar Out Sw. Active	0E	R	Y	N	8.8	"
Headrest Up Sw. Active	0F	R	Y	N	8.8	"
Headrest Down Sw. Active	10	R	Y	N	8.8	"
Heater On / Off Sw. Active	11	R	Y	N	8.8	"
Increment Temp. Sw. Active	12	R	Y	N	8.8	"
Decrement Temp. Sw. Active	13	R	Y	N	8.8	"
Upper Bolster In Sw. Active	14	R	Y	N	8.8	"
Upper Bolster Out Sw. Active	15	R	Y	N	8.8	"
Lower Bolster In Sw. Active	16	R	Y	N	8.8	"
Lower Bolster Out Sw. Active	17	R	Y	N	8.8	"

TABLE 38—RESTRAINTS MESSAGES

Secondary ID Name	Sec ID	Msg Cyc	Q1	Q6	Est Accy	PRN
Passive Restraint Engaged	01	L/R	Y	N	8.8	"
Passive Restraint Retracted	02	L/R	Y	N	8.8	"
Passive Restraint Attached	03	R	Y	N	8.8	"
Seatbelt Attached	04	R	Y	N	8.8	"
Shoulder Adjustment Up Motion	1E	L/R	E	D	8.8	"
Shoulder Adjustment Down Motion	2E	L/R	E	D	8.8	"
Air Bag Deployed	07	R	Y	N	8.8	"
Shoulder Position	1A	L/R	"	x	8.8	B801
Shoulder Adjustment Up Sw. Active	25	R	Y	N	8.8	"
Shoulder Adjustment Down Sw. Active	26	R	Y	N	8.8	"

TABLE 39—EXTERIOR LAMPS OUTAGE MESSAGES

Secondary ID Name	Sec ID	Msg Cyc	Q1	Q6	Est Accy	PRN
Headlamp OK	01	R	Y	N	8.8	"
Tail Lamp OK	02	R	Y	N	8.8	"
Brake Lamp OK	03	R	Y	N	8.8	"
Park Lamp OK	04	R	Y	N	8.8	"
Turn Lamp OK	05	R	Y	N	8.8	"
High Beam Lamp OK	06	R	Y	N	8.8	"
Hazard Lamp OK	07	R	Y	N	8.8	"
Reverse Lamp OK	08	R	Y	N	8.8	"
Fog Lamp OK	09	R	Y	N	8.8	"
Daytime Running Lamp OK	0A	R	Y	N	8.8	"
Spot Lamp OK	0B	R	Y	N	8.8	"
Cargo Lamp OK	0C	R	Y	N	8.8	"
Cornering Lamp OK	0D	R	Y	N	8.8	"
Driving Lamp OK	0E	R	Y	N	8.8	"
Cabin Lamp OK	0F	R	Y	N	8.8	"

7.34 Exterior Lamps Outage---(See Table 39.)
Primary ID: Exterior Lamps Outage
Command ID: $D8
Status ID: $D9
7.35 Exterior Lamps---(See Table 40.)
Primary ID: Exterior Lamps
Command ID: $DA
Status ID: $DB
7.36 Interior Lamps Outage---(See Table 41.)
Primary ID: Interior Lamps Outage
Command ID: $DC
Status ID: $DD
7.37 Interior Lamps---(See Table 42.)
Primary ID: Interior Lamps
Command ID: $DE
Status ID: $DF
7.38 Tires---(See Table 43.)
Primary ID: Tires
Command ID: $E4
Status ID: $E5

TABLE 40--EXTERIOR LAMPS MESSAGES

Secondary ID Name	Sec ID	Msg Qe	Q1	Q6	Ext Addr	PRN
Headlamp On / Off	01	L/R	S	OF	8.8	-
Tail Lamp On / Off	02	L/R	S	OF	8.8	-
Brake Lamp On / Off	03	L/R	S	OF	8.8	-
Park Lamp On / Off	04	L/R	S	OF	8.8	-
Turn Lamp On / Off	05	L/R	S	OF	8.8	-
High Beam Lamp On / Off	06	L/R	S	OF	8.8	-
Hazard Lamp On / Off	07	L/R	S	OF	8.8	-
Reverse Lamp On / Off	08	L/R	S	OF	8.8	-
Fog Lamp On / Off	09	L/R	S	OF	8.8	-
Daytime Running Lamp On / Off	0A	L/R	S	OF	8.8	-
Spot Lamp On / Off	0B	L/R	S	OF	8.8	-
Cargo Lamp On / Off	0C	L/R	S	OF	8.8	-
Comering Lamp On / Off	0D	L/R	S	OF	8.8	-
Driving Lamp On / Off	0E	L/R	S	OF	8.8	-
Coach Lamp On / Off	0F	L/R	S	OF	8.8	-
Autolamp Delay	10	L/R	W	O	8.8	A014
Flash-to-Pass	11	L/R	W	O	8.8	-
Remote Headlamp On / Off w/ Transmitter ID	12	L/R	S	OF	8.8	C001
Remote Headlamp On / Off	13	L/R	S	OF	8.8	-
Headlamp Sw. Active	21	S	Y	N	8.8	-
Right Turn Sw. Active	22	S	Y	N	8.8	-
Park Lamp Sw. Active	24	S	Y	N	8.8	-
Left Turn Sw. Active	25	S	Y	N	8.8	-
High Beam Sw. Active	26	S	Y	N	8.8	-
Hazard Sw. Active	27	S	Y	N	8.8	-
Fog Lamp Sw. Active	28	S	Y	N	8.8	-
Driving Lamp Sw. Active	29	S	Y	N	8.8	-

TABLE 41--INTERIOR LAMPS OUTAGE MESSAGES

Secondary ID Name	Sec ID	Msg Qe	Q1	Q6	Ext Addr	PRN
Courtesy Lamp OK	01	S	Y	N	8.8	-
Dome Lamp OK	02	S	Y	N	8.8	-
Puddle Lamp OK	03	S	Y	N	8.8	-
Vanity Mirror Lamp OK	04	S	Y	N	8.8	-
Opera Lamp OK	05	S	Y	N	8.8	-
Reading Lamp OK	06	S	Y	N	8.8	-
Hood Lamp OK	07	S	Y	N	8.8	-
Trunk Lamp OK	08	S	Y	N	8.8	-
Glove Box Lamp OK	09	S	Y	N	8.8	-

TABLE 42--INTERIOR LAMPS MESSAGES

Secondary ID Name	Sec ID	Msg Qe	Q1	Q6	Ext Addr	PRN
Courtesy Lamp On / Off	01	L/R	S	OF	8.8	-
Dome Lamp On / Off	02	L/R	S	OF	8.8	-
Puddle Lamp On / Off	03	L/R	S	OF	8.8	-
Vanity Mirror Lamp On / Off	04	L/R	S	OF	8.8	-
Opera Lamp On / Off	05	L/R	S	OF	8.8	-
Reading Lamp On / Off	06	L/R	S	OF	8.8	-
Hood Lamp On / Off	07	L/R	S	OF	8.8	-
Trunk Lamp On / Off	08	L/R	S	OF	8.8	-
Glove Box Lamp On / Off	09	L/R	S	OF	8.8	-
Illuminated Entry	10	L/R	S	OF	8.8	-
Display Brightness & External Lamps On / Off	11	L/R	W	O	-	8028
Courtesy Lamp Sw. Active	21	S	Y	N	8.8	-
Dome Lamp Sw. Active	22	S	Y	N	8.8	-
Puddle Lamp Sw. Active	23	S	Y	N	8.8	-
Vanity Mirror Sw. Active	24	S	Y	N	8.8	-
Opera Lamp Sw. Active	25	S	Y	N	8.8	-
Reading Lamp Sw. Active	26	S	Y	N	8.8	-
Hood Lamp Sw. Active	27	S	Y	N	8.8	-
Trunk Lamp Sw. Active	28	S	Y	N	8.8	-
Glove Box Lamp Sw. Active	29	S	Y	N	8.8	-

7.39 Defrost---(See Table 44.)
Primary ID: Defrost
Command ID: $E6
Status ID: $E7
7.40 Displays---(See Table 45.)
Primary ID: Displays
Command ID: $EA
Status ID: $EB
7.41 Exterior Environment---(See Table 46.)
Primary ID: Exterior Environment
Command ID: $F2
Status ID: $F3
7.42 Interior Environment---(See Table 47.)
Primary ID: Interior Environment
Command ID: $F4
Status ID: $F5
7.43 Time / Date---(See Table 48.)
Primary ID: Time / Date
Command ID: $F8
Status ID: $F9

TABLE 43--TIRES MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q6	Ext Addr	PSM
Temperature	10	R	-	x	8.1	2548
Pressure	11	R	-	x	8.1	2551
Wear Level	14	R	-	x	8.1	2561
Spare Present	15	R	Y	N	--	-

TABLE 44--DEFROST MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q6	Ext Addr	PSM
Defrost On / Off	01	L/R	On	Off	8.3	-
Defrost Pending	02	L/R	Y	N	8.3	-
Defrost Switch	01	R	Y	N	8.3	--

TABLE 45--DISPLAYS MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q6	Ext Addr	PSM
Metric Display	06	L/R	Y	N	--	--

TABLE 46--EXTERIOR ENVIRONMENT MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q6	Ext Addr	PSM
Outside Air Temperature	10	R	-	x	-	8035
Barometric Pressure	11	R	-	x	-	1035
Sun Load	13	R	-	x	8.3	8017
Photo Cell Dark	15	R	Y	N	8.3	--

TABLE 47--INTERIOR ENVIRONMENT MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q6	Ext Addr	PSM
Air Filtration On / Off	02	L/R	On	Off	8.2	-
Interior Air Temperature	10	L/R	-	x	8.2	8020
Humidity Level	12	R	-	x	-	8016
Air Filter Remaining Life	14	R	--	x	--	8016

TABLE 48--TIME / DATE MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q6	Ext Addr	PSM
Alarm Time	03	R	-	x	-	8047
		L	-	x		8047
Time of Day	05	R	-	x	-	8018
		L	-	x		8018
Hour of Day	06	R	-	x	-	8017
		L	-	x		8017
		W	On		-	-
Minute of Hour	07	R	-	x	-	8018
		L	-	x		8018
		W	On		-	-
Second of Minute	08	R	-	x	-	8019
		L	-	x		8019
		W	On		-	-
Date	10	R	-	x	-	8020
		L	-	x		8020
Day of Week	11	R	-	x	-	8018
		L	-	x		8018
		W	On		-	-
Day of Month	12	R	-	x	-	8018
		L	-	x		8018
		W	On		-	-
Month of Year	13	R	-	x	-	8021
		L	-	x		8021
		W	On		-	-
Year	14	R	-	x	-	8006
		L	-	x		8006
		W	On		-	-
Set Time Sw. Active	08	R	Y	N	--	--

7.44 Vehicle Identification---(See Table 49.)
Primary ID: Vehicle Identification
Command ID: $FA
Status ID: $FB

7.45 Network Control---(See Table 50.)
Primary ID: Network Control
Command ID: $FB
Status ID: $FF

TABLE 49--VEHICLE IDENTIFICATION MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q2	Ext Addr	PGN
VIN Packet 1 (First digit)	01	R	-	x	-	E001
VIN Packet 2 (digits 2 - 5)	02	R	-	x	-	E002
VIN Packet 3 (digits 6 - 9)	03	R	-	x	-	E003
VIN Packet 4 (digits 10 - 13)	04	R	-	x	-	E004
VIN Packet 5 (digits 14 - 17)	05	R	-	x	-	E005
VIN Packet 6 (reserved for future)	06	R	-	x	-	E006
VIN Packet 7 (reserved for future)	07	R	-	x	-	E007

TABLE 50--NETWORK CONTROL MESSAGES

Secondary ID Name	Sec ID	Msg Op	Q1	Q2	Ext Addr	PGN
Bus Wake-up	00	L / R	Y	R	-	-
Node Alive	03	R	Y	R	-	-
Node Sleep	04	L / R	Y	R	-	-

8. Extended Address Assignments---The following tables contain the extended address assignments categorized by function. These table are referenced by paragraph number in the message tables on the previous pages.

8.1 Brakes, Tires, and Wheels---The extended address assignments for brakes, tires, and wheels are in Table 51.

TABLE 51--EXTENDED ADDRESS ASSIGNMENTS FOR BRAKES, TIRES, AND WHEELS

Address	Description
00	ALL
10	All Front
11	Left Front
12	Right Front
30	All Rear
31	Left Rear
32	Right Rear
80	Brake Tire

8.2 HVAC Zones---The extended address assignments for HVAC zones are in Table 52.

TABLE 52--EXTENDED ADDRESS ASSIGNMENTS FOR HVAC ZONES

Address	Description
00	ALL
20	All Front
22	Driver Side Front
28	Passenger Side Front
38	All Rear
39	Driver Side Rear
3E	Passenger Side Rear

8.3 Window Wiper/Washer, Defrost, and Photocell---The extended address assignments for window wiper/washer, defrost, and photocell are in Table 53.

TABLE 53--EXTENDED ADDRESS ASSIGNMENTS FOR WINDOW WIPER/WASHER, DEFROST, AND PHOTOCELL

Address	Description
00	All
1C	Front
34	Rear

8.4 Mirrors---The extended address assignments for mirrors are in Table 54.

TABLE 54--EXTENDED ADDRESS ASSIGNMENTS FOR MIRRORS

Address	Description
00	ALL
1A	Driver Side
1C	Rear View
1E	Passenger Side

8.5 Doors and Door Locks---The extended address assignments for doors and door locks are in Table 55.

TABLE 55--EXTENDED ADDRESS ASSIGNMENTS FOR DOORS AND DOOR LOCKS

Address	Description
00	ALL
14	Hood
1E	Passenger Side Glove Box
20	All Front
22	Driver Side Front
24	Convertible Top
26	Passenger Side Front
38	All Rear
3A	Driver Side Rear
3E	Passenger Side Rear
41	Left Side Fuel Door
44	Trunk
47	Right Side Fuel Door
4C	Only or Rear Center Fuel Door

8.6 Seats and Restraints---The extended address assignments for seats and restraints are in Table 56.

TABLE 56--EXTENDED ADDRESS ASSIGNMENTS FOR SEATS AND RESTRAINTS

Address	Description
00	ALL
20	All Front
22	Driver Side Front
24	Front Center
26	Passenger Side Front
38	All Rear
3A	Driver Side Rear
3C	Rear Center
3E	Passenger Side Rear
80	All Rear - Rear (Van)
82	Driver Side Rear - Rear (Van)
86	Passenger Side Rear - Rear (Van)

8.7 Windows---The extended address assignments for windows are in Table 57.

TABLE 57--EXTENDED ADDRESS ASSIGNMENTS FOR WINDOWS

Address	Description
00	ALL
20	All Front
22	Driver Side Front
24	Front Sun Roof
26	Passenger Side Front
38	All Rear
3A	Driver Side Rear
3C	Rear Sun Roof
3E	Passenger Side Rear
74	Rear Windshield

7.44 Vehicle Identification---(See Table 49.)
Primary ID: Vehicle Identification
Command ID: $FA
Status ID: $FB

7.45 Network Control---(See Table 50.)
Primary ID: Network Control
Command ID: $FE
Status ID: $FF

TABLE 48--VEHICLE IDENTIFICATION MESSAGES

Secondary ID Name	Sec ID	Msg Dir	Q1	Q6	Ext Addr	PRN
VIN Packet 1 (First digit)	01	R	--	x	--	E001
VIN Packet 2 (Digits 2 - 5)	02	R	--	x	--	E002
VIN Packet 3 (Digits 6 - 9)	03	R	--	x	--	E003
VIN Packet 4 (Digits 10 - 13)	04	R	--	x	--	E004
VIN Packet 5 (Digits 14 - 17)	05	R	--	x	--	E005
VIN Packet 6 (reserved for future)	06	R	--	x	--	E006
VIN Packet 7 (reserved for future)	07	R	--	x	--	E007

TABLE 49--IGNITION CONTROL MESSAGES

Secondary ID Name	Sec ID	Msg Dir	Q1	Q6	Ext Addr	PRN
Bus Wake-up	02	L/R	Y	N	--	--
Node Alive	03	R	Y	N	--	--
Node Sleep	04	L/R	Y	N	--	--

8. Extended Address Assignments---The following tables contain the extended address assignments categorized by function. These table are referenced by paragraph number in the message tables on the previous pages.

8.1 Brakes, Tires, and Wheels---The extended address assignments for brakes, tires, and wheels are in Table 51.

TABLE 51--EXTENDED ADDRESS ASSIGNMENTS FOR BRAKES, TIRES, AND WHEELS

Address	Description
00	ALL
10	All Front
11	Left Front
17	Right Front
30	All Rear
31	Left Rear
37	Right Rear
3C	Spare Tire

8.2 HVAC Zones---The extended address assignments for HVAC zones are in Table 52.

TABLE 52--EXTENDED ADDRESS ASSIGNMENTS FOR HVAC ZONES

Address	Description
00	ALL
20	All Front
22	Driver Side Front
28	Passenger Side Front
38	All Rear
3A	Driver Side Rear
3E	Passenger Side Rear

8.3 Window Wiper/Washer, Defrost, and Photocell---The extended address assignments for window wiper/washer, defrost, and photocell are in Table 53.

TABLE 53--EXTENDED ADDRESS ASSIGNMENTS FOR WINDOW WIPER/WASHER, DEFROST, AND PHOTOCELL

Address	Description
00	All
1C	Front
34	Rear

8.4 Mirrors---The extended address assignments for mirrors are in Table 54.

TABLE 54--EXTENDED ADDRESS ASSIGNMENTS FOR MIRRORS

Address	Description
00	ALL
1A	Driver Side
1C	Rear View
1E	Passenger Side

8.5 Doors and Door Locks---The extended address assignments for door and door locks are in Table 55.

TABLE 55--EXTENDED ADDRESS ASSIGNMENTS FOR DOORS AND DOOR LOCKS

Address	Description
00	ALL
14	Hood
1E	Passenger Side Glove Box
20	All Front
22	Driver Side Front
24	Convertible Top
28	Passenger Side Front
30	All Rear
3A	Driver Side Rear
3E	Passenger Side Rear
31	Left Side Fuel Door
34	Trunk
37	Right Side Fuel Door
3C	Only or Rear Center Fuel Door

8.6 Seats and Restraints---The extended address assignments for seat and restraints are in Table 56.

TABLE 56--EXTENDED ADDRESS ASSIGNMENTS FOR SEATS AND RESTRAINTS

Address	Description
00	ALL
20	All Front
22	Driver Side Front
24	Front Center
28	Passenger Side Front
30	All Rear
3A	Driver Side Rear
3C	Rear Center
3E	Passenger Side Rear
80	All Rear - Rear (Van)
82	Driver Side Rear - Rear (Van)
86	Passenger Side Rear - Rear (Van)

8.7 Windows---The extended address assignments for windows are in Table 57.

TABLE 57--EXTENDED ADDRESS ASSIGNMENTS FOR WINDOWS

Address	Description
00	ALL
20	All Front
22	Driver Side Front
24	Front Sun Roof
28	Passenger Side Front
30	All Rear
3A	Driver Side Rear
3C	Rear Sun Roof
3E	Passenger Side Rear
34	Rear Window

3.504

8.8 External Lamps—The extended address assignments for external lamps are in Table 58.

TABLE 58—EXTENDED ADDRESS ASSIGNMENTS FOR EXTERNAL LAMPS

Address	Description
00	ALL
01	Left Side (Turn Signal)
07	Right Side (Turn Signal)
08	All Front
09	Left Front
0F	Right Front
38	All Rear
39	Left Rear
3C	CHMSL
3F	Right Rear

8.9 Internal Lamps—The extended address assignments for internal lamps are in Table 59.

TABLE 59—EXTENDED ADDRESS ASSIGNMENTS FOR INTERNAL LAMPS

Address	Description
00	ALL
20	All Front
22	Driver Side Front
28	Passenger Side Front
38	All Rear
2A	Driver Side Rear
2C	Dome Lamp
2E	Passenger Side Rear

OMEGA EXHIBIT 2037

Bibliography of Related SAE Technical Papers

SAE Technical Paper 960621, Soliman, Ahmed; Rizzoni, Giorgio; Krishnaswami, Vasanth, "Integrated Powertrain Diagnostic System (IPDS): Linking On- and Off-Board Diagnostic Strategies."

SAE Technical Paper 960342, Shimasaki, Yuichi; Kato, Hiroaki; Muramatsu, Hiroaki; Teshirogi, Tetsu; Aoki, Takuya; Saito, Akihisa; Rodrigues, Greg, "Study on Conformity Technology With ULEV Using EHC System."

SAE Technical Paper 960338, Katsuki, Nobuharu; Tamai, Takashi; Saito, Masahiro; LeGare, Joe; Yoshida, Sumitake, "Exhaust Gas High Temperature Sensor for LEV/ULEV and OBD Systems."

SAE Technical Paper 960333, Kato, Nobuhide; Ikoma, Nobukazu; Nishikawa, Satoshi, "Exhaust Gas Temperature Sensor for OBD-II Catalyst Monitoring."

SAE Technical Paper 960332, Edwards, William E.; Danstrom, Eric; Beiser, Mitchell, "Single Chip Power System for Engine Controllers."

SAE Technical Paper 952424, Beck, Donald D.; Short, William A., "Vehicle Testing of the OBD-II Catalyst Monitor on a 2.2 L Corsica TLEV."

SAE Technical Paper 952423, Hepburn, Jeffrey S.; Meitzler, Allen H., "Calculating the Rate of Exothermic Energy Release for Catalytic Converter Efficiency Monitoring."

SAE Technical Paper 952422, Browning, Louis H.; Moyer, Carl B., "Sulfur Effects on California OBD-II Systems."

SAE Technical Paper 951947, Stepper, Mark R.; Butler, Steven R.; Zhu, George R., "On-Board Diagnostics, a Heavy-Duty Perspective."

SAE Technical Paper 960391, Lindgren, Matts; Persson, Per-Henrik, "The Multiplexed Vehicle--A Maintenance Time Bomb!?"

SAE Technical Paper 960125, Riley, Michael; Moyer, Raymond, "J1850 Compatible Node Development."

SAE Technical Paper 951887, Powers, Chuck; Huetti, Tom, "Using Existing Multiplex Communication Technology to Implement an Electric Vehicle Communication Network."

SAE Technical Paper 960126, Misbahuddin, Syed; Al-Holou, Nizar, "Reliability Evaluation of Hierarchical Distributed Processing System for Automotive Applications."

SAE Technical Paper 960120, Kopetz, Hermann; Hexel, Rene; Kruger, Andreas; Millinger, Dietmar; Schedl, Anton, "A Synchronization Strategy for a TTP/C Controller."

SAE Technical Paper 952042, Bedoya, Carlos A., "Fly-by-Light Advanced Systems Hardware (FLASH) Program."

SAE Technical Paper 952580, Buczko, Gary A.; Hein, Julie, "The Need for a Flight Recorder Within a J1850 Networked Vehicle, and the Potential of Information Retrieved From On-Board Devices."

SAE Technical Paper 961035, Hambaum, Mark D., "Service Bay Productivity and Technician Training--The Connection."

SAE Technical Paper 961019, Woermann, R. J.; Klages, B.; Theuerkauf, H. J., "CARTS--A Hardware in the Loop Simulator for Test and Development of Automotive Control Units."

SAE Technical Paper 961002, Kayes, David; Hochgreb, Simone, "Development of a Time and Space Resolved Sampling Probe Diagnostic for Engine Exhaust Hydrocarbons."

SAE Technical Paper 960849, Kim, Sung Soo; Kim, Chang Gi; Kim, Chang Up; Pang, Hyo Sun; Han, Jeong Ok; Cho, Yang Soo, "A Study on Efficiency and Emission Enhancements in a 4-Stroke Natural Gas Lean Burn Engine."

SAE Technical Paper 960837, Jackson, N. S.; Stokes, J.; Lake, T. H.; Sapsford, S. M.; Heikal, M.; Denbratt, I., "Understanding the CCVS Stratified EGR Combustion System."

SAE Technical Paper 960831, Dec, John E.; Coy, Edward B., "OH Radical Imaging in a DI Diesel Engine and the Structure of the Early Diffusion Flame."

SAE Technical Paper 960658, Kress, Tyler A.; Porta, David J.; Duma, Stefan M.; Snider, John N.; Nino, Nury M., "A Discussion of the Air Bag System and Review of Induced Injuries."

SAE Technical Paper 960463, Zhang, Limei; Liu, Weiguo; Zhang, Feng; Wu, Bo, "Diagnosis of the Working Unevenness of Each Cylinder By the Transient Crankshaft Speed."

SAE Technical Paper 960194, van der Linden, P. J. G.; Varet, Ph., "Experimental Determination of Low-Frequency Noise Contributions of Interior Vehicle Body Panels in Normal Operation."

SAE Technical Paper 960123, Boehmer, David S., "Integrated J1850 Protocol Provides for a Low-Cost Networking Solution."

SAE Technical Paper 960092, Glover, Edward L.; Mickelsen, Jan; McClement, Dennis, "Evaluation of Methods to Determine Catalyst Efficiency in the Inspection/Maintenance Process."

SAE Technical Paper 960091, Glover, Edward L.; Croy, Ben; Hall, Brian, "Can Auto Technicians be Trained to Repair IM240 Emission Failures?"

SAE Technical Paper 960090, Walter, Richard, "PC-Based Data Acquisition Plus On-Board Diagnostics: Tools for Faster Development of Passenger Car Systems."

SAE Technical Paper 960042, Watanabe, Satoru; Machida, Kenichi; Iijima, Katsuyoshi; Tomisawa, Naoki, "A Sophisticated Engine Control System Using Combustion Pressure Detection."

SAE Technical Paper 960039, Williams, Jeremy, "An Overview of Misfiring Cylinder Engine Diagnostic Techniques Based on Crankshaft Angular Velocity Measurements."

SAE Technical Paper 960012, Mantey, Creighton A.; Oldani, John P., "1996 GM 7.4 Liter Engine Upgrade."

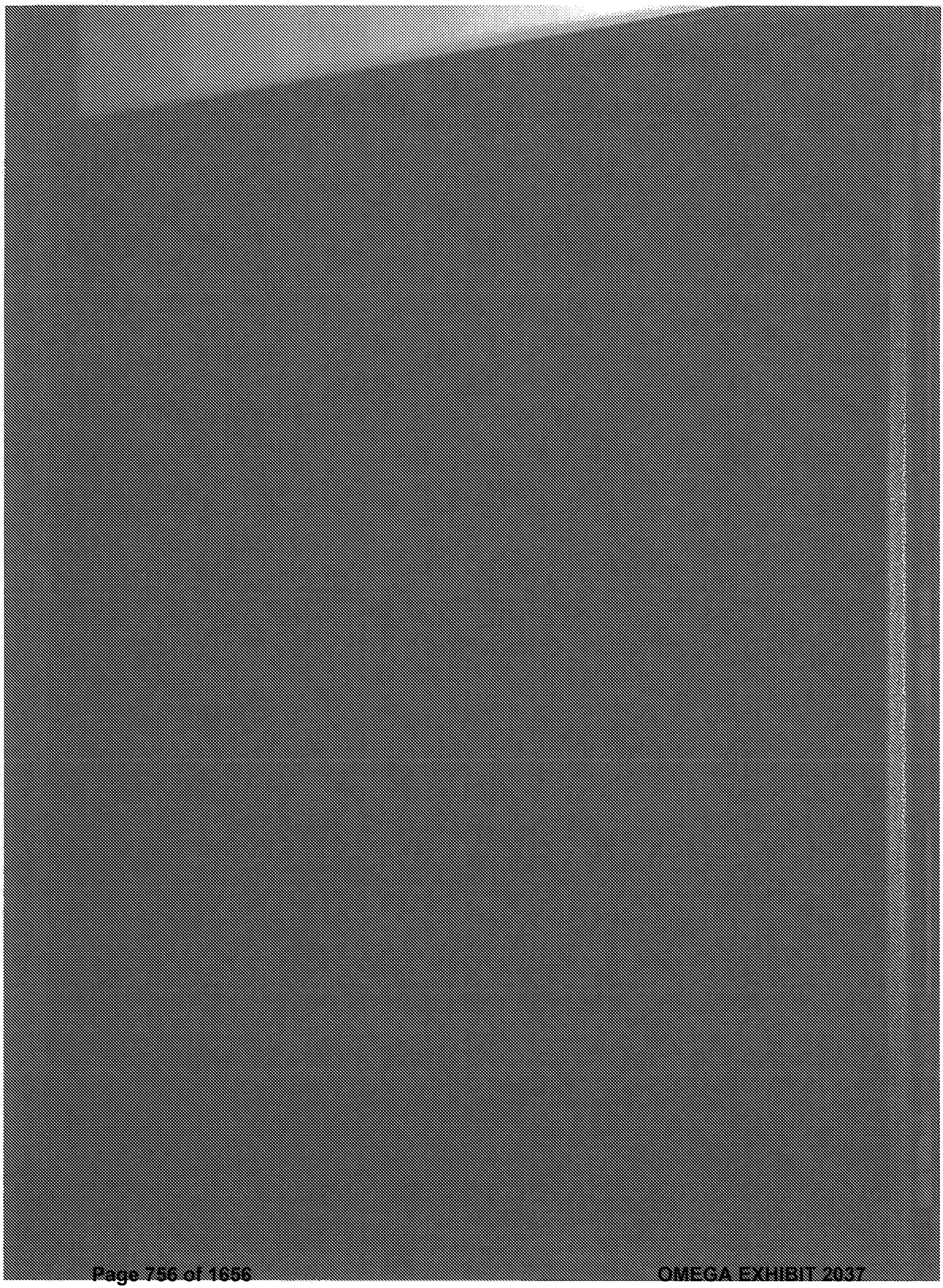
SAE Technical Paper 958472, Miyata, Tatsuji; Notsu, Ikurou; Watanabe, Yoshito, "Development of a CNG Engine Electronic Control System for Commercial Vehicles."

SAE Technical Paper 954137, Zakrajsek, J.J.; Townsend, D.P.; Lewicki, D.G.; Decker, H.J.; Handschuh, R.F., "Transmission Diagnostic Research at NASA Lewis Research Center."

SAE Technical Paper 952682, Riling, James J., "Sensing and Diagnostic Module for Airbags."

SAE Technical Paper 952346, Inagaki, Hideto; Saito, Akinori; Murakami, Motoichi; Konomi, Toshiaki, "Development of Two-Dimensional Oil Film Thickness Distribution Measuring System."

SAE Technical Paper 951944, Patel, Dilip; Carlock, Mark A., "A Study of the Relative Benefits of On-Board Diagnostics and Inspection and Maintenance in California."



SAE On-Board Diagnostics for Light and Medium Duty Vehicles Standards Manual

1997 Edition

HS-3000

SAE INTERNATIONAL

TL272
S34
1997

OMEGA EXHIBIT 2037

US007720597B2

(12) **United States Patent**
Flick

(10) **Patent No.: US 7,720,597 B2**
(45) **Date of Patent: May 18, 2010**

(54) **VEHICLE TRACKER INCLUDING INPUT/OUTPUT FEATURES AND RELATED METHODS**

(75) Inventor: **Kenneth E. Flick**, Douglasville, GA (US)

(73) Assignee: **Omega Patents, L.L.C.**, Douglasville, GA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1430 days.

(21) Appl. No.: **11/076,259**

(22) Filed: **Mar. 9, 2005**

(65) **Prior Publication Data**

US 2005/0156716 A1 Jul. 21, 2005

Related U.S. Application Data

(63) Continuation of application No. 10/383,496, filed on Mar. 7, 2003, now Pat. No. 7,149,623, which is a continuation of application No. 09/859,972, filed on May 17, 2001, now Pat. No. 6,606,561.

(60) Provisional application No. 60/264,811, filed on Jan. 29, 2001, provisional application No. 60/258,005, filed on Dec. 22, 2000, provisional application No. 60/251,552, filed on Dec. 6, 2000, provisional application No. 60/252,125, filed on Nov. 20, 2000, provisional application No. 60/236,890, filed on Sep. 29, 2000, provisional application No. 60/246,463, filed on Nov. 7, 2000, provisional application No. 60/222,777, filed on Aug. 3, 2000, provisional application No. 60/205,178, filed on May 17, 2000.

(51) **Int. Cl.**
G01C 21/00 (2006.01)

(52) **U.S. Cl.** **701/207**; 701/213; 701/36; 340/466; 340/988; 342/357.07

(58) **Field of Classification Search** 340/989, 340/825.72, 988, 825.6, 5.2, 5.22, 5, 7, 5.23, 340/426.18, 426.19, 825.31, 425.5, 426, 340/852.72, 5.7, 5.71, 5.72, 5.3, 5.33, 466; 180/287; 455/456.5; 701/207, 213, 36; 307/10.3, 307/10.6, 9.1, 10.2; 342/357.07
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,886,553 A * 5/1975 Bates 342/465

(Continued)

FOREIGN PATENT DOCUMENTS

CA 2133673 4/1996

(Continued)

OTHER PUBLICATIONS

Motion tracking: no silver bullet, but a respectable arsenal; Welch, G.; Foxlin, E.; Computer Graphics and Applications, IEEE vol. 22, Issue 6, Nov.-Dec. 2002 pp. 24-38; Digital Object Identifier 10.1109/MCG.2002.1046626.*

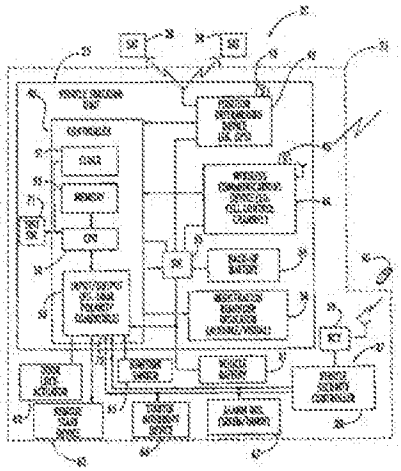
(Continued)

Primary Examiner—Cuong H Nguyen
(74) *Attorney, Agent, or Firm*—Allen, Dyer, Doppelt, Milbrath & Gilchrist, P.A.

(57) **ABSTRACT**

A vehicle control system includes a tracking unit and a function unit cooperating therewith. The tracking unit may include a vehicle position determining device, a wireless communications device, and a tracking controller cooperating with the vehicle position determining device and the wireless communications device to send vehicle position information to a user. Further, the function unit may include at least one uniquely coded transmitter to be carried by a user, a receiver at the vehicle for receiving signals from the at least one uniquely coded transmitter, and a function controller at the vehicle and connected to the receiver for learning the at least one uniquely coded transmitter to permit control of a vehicle function by the user. The function controller may advantageously cooperate with the wireless communications device of the tracking unit for sending an alert indication of whether at least one new uniquely coded transmitter has been learned.

29 Claims, 10 Drawing Sheets



U.S. PATENT DOCUMENTS

4,837,709	A		6/1989	Ando et al.
4,843,377	A	*	6/1989	Fuller et al.
4,901,058	A	*	2/1990	Comeau et al.
4,902,628	A	*	2/1990	Blair
4,912,458	A	*	3/1990	Comeau et al.
4,914,038	A	*	4/1990	Jewitt
4,996,161	A	*	2/1991	Conners et al.
5,024,186	A		6/1991	Long et al.
5,043,736	A		8/1991	Darnell et al.
5,055,851	A		10/1991	Sheffer
5,177,490	A		1/1993	Ando et al.
5,223,844	A		6/1993	Mansell et al.
5,262,774	A		11/1993	Kawahara et al.
5,334,986	A		8/1994	Fernhout
5,365,450	A		11/1994	Schuchman et al.
5,398,190	A		3/1995	Wortham
5,483,455	A		1/1996	Lay et al.
5,515,043	A		5/1996	Berard et al.
5,515,285	A		5/1996	Garrett, Sr. et al.
5,570,087	A		10/1996	Lemelson
5,572,204	A		11/1996	Timm et al.
5,587,715	A		12/1996	Lewis
5,588,038	A		12/1996	Snyder
5,650,774	A		7/1997	Drori
5,673,305	A		9/1997	Ross
5,682,133	A		10/1997	Johnson et al.
5,686,904	A	*	11/1997	Brewer
5,777,580	A		7/1998	Janky et al.
5,825,283	A	*	10/1998	Camhi
5,895,436	A		4/1999	Savoie et al.
5,939,975	A		8/1999	Tsuria et al.
5,940,007	A	*	8/1999	Brinkmeyer et al.
5,944,768	A		8/1999	Ito et al.
5,952,933	A		9/1999	Issa et al.
5,969,433	A		10/1999	Maggiora et al.
5,983,161	A		11/1999	Lemelson et al.
5,986,543	A		11/1999	Johnson
6,018,657	A		1/2000	Kennedy, III et al.
6,021,319	A		2/2000	Tigwell
6,025,744	A		2/2000	Bertolet et al.
6,028,537	A		2/2000	Suman et al.
6,049,269	A		4/2000	Byrd et al.
6,055,426	A		4/2000	Beasley
6,067,007	A		5/2000	Gioia
6,069,570	A		5/2000	Herring
6,075,458	A		6/2000	Ladner et al.
6,101,443	A		8/2000	Kato et al.
6,116,639	A		9/2000	Breed et al.
6,128,571	A		10/2000	Ito et al.
6,131,067	A		10/2000	Girerd et al.
6,133,855	A		10/2000	Kim
6,140,938	A	*	10/2000	Flick
6,140,939	A	*	10/2000	Flick
6,140,956	A		10/2000	Hillman et al.
6,144,315	A	*	11/2000	Flick
6,148,212	A		11/2000	Park et al.
6,151,531	A		11/2000	Geier et al.
6,154,648	A		11/2000	Comer
6,166,626	A		12/2000	Janky et al.
6,166,630	A	*	12/2000	Brewer
6,167,255	A		12/2000	Kennedy, III et al.
6,169,497	B1		1/2001	Robert
6,191,701	B1	*	2/2001	Brewer
6,195,597	B1		2/2001	Yamada
6,211,818	B1		4/2001	Zach, Sr.
6,236,365	B1		5/2001	LeBlanc et al.
6,240,365	B1		5/2001	Bunn et al.
6,259,381	B1		7/2001	Small
6,275,773	B1		8/2001	Lemelson et al.
6,298,306	B1		10/2001	Suarez et al.
6,313,791	B1		11/2001	Klanke
6,314,366	B1		11/2001	Farmakis et al.
6,320,514	B1	*	11/2001	Flick
6,320,535	B1		11/2001	Hillman et al.
6,321,091	B1		11/2001	Holland
6,330,499	B1		12/2001	Chou et al.
6,331,825	B1		12/2001	Ladner et al.
6,339,745	B1		1/2002	Novik
6,400,996	B1	*	6/2002	Hoffberg et al.
6,411,217	B1	*	6/2002	Gabbard
6,452,483	B2		9/2002	Chen et al.
6,473,794	B1	*	10/2002	Guheen et al.
6,474,683	B1	*	11/2002	Breed et al.
6,512,461	B1		1/2003	Beazie et al.
6,519,571	B1	*	2/2003	Guheen et al.
6,536,037	B1	*	3/2003	Guheen et al.
6,567,013	B1		5/2003	Matsubara et al.
6,615,166	B1	*	9/2003	Guheen et al.
6,629,081	B1	*	9/2003	Cornelius et al.
6,771,188	B2	*	8/2004	Flick
6,992,562	B2	*	1/2006	Fuks et al.
7,069,234	B1	*	6/2006	Cornelius et al.
7,138,904	B1	*	11/2006	Dutu
7,139,999	B2	*	11/2006	Bowman-Amuah
7,165,041	B1	*	1/2007	Guheen et al.
7,167,844	B1	*	1/2007	Leong et al.
7,312,696	B2	*	12/2007	Flick
7,315,826	B1	*	1/2008	Guheen et al.
7,343,244	B2	*	3/2008	Flick
7,451,005	B2	*	11/2008	Hoffberg et al.
7,502,687	B2	*	3/2009	Flick
2001/0045886	A1		11/2001	Minown
2003/0154027	A1	*	8/2003	Flick
2004/0121756	A1	*	6/2004	Griffin et al.
2005/0156716	A1	*	7/2005	Flick
2005/0156717	A1	*	7/2005	Flick
2005/0156718	A1	*	7/2005	Flick
2005/0156719	A1	*	7/2005	Flick
2005/0174220	A1	*	8/2005	Flick
2005/0179526	A1	*	8/2005	Flick
2005/0255833	A1	*	11/2005	Shimoji et al.
2007/0279283	A1	*	12/2007	Flick
2008/0030316	A1	*	2/2008	Flick

FOREIGN PATENT DOCUMENTS

EP	1640727	A1 *	3/2006
JP	2006148842	A *	6/2006
KR	20060011267	A *	2/2006
KR	20070011035	A *	1/2007
WO	WO 2004001550	A2 *	12/2003
WO	WO 2009122290	A2 *	10/2009

OTHER PUBLICATIONS

Data Fusion Architectures for Sensor Platforms, Mirza, Atif R.; Aerospace Conference, 2008 IEEE; Mar. 1-8, 2008 pp. 1-13; Digital Object Identifier 10.1109/AERO.2008.4526434.*

Security Challenges of Location-Aware Mobile Business; Tatly, E.I.; Stegemann, D.; Lucks, S.; Mobile Commerce and Services, 2005. WMCS '05. The Second IEEE International Workshop on; 19-19 Jul. 2005 pp. 84-95; Digital Object Identifier 10.1109/WMCS.2005.23.*

Submarine cable infrastructure defense against terrorist aggression, Bannon, R.; Burnett, D.; Oceans 2003. Proceedings vol. 4, Sep. 22-26, 2003 pp. 1850-1861 vol. 4; Digital Object Identifier 10.1109/Oceans.2003.1282710.*

A Study on Predicting Hazard Factors for Safe Driving; Takahashi, H.; Ukishima, D.; Kawamoto, K.; Hirota, K.; Industrial Electronics, IEEE Transactions on; vol. 54, Issue 2, Apr. 2007 pp. 781-789; Digital Object Identifier 10.1109/TIE.2007.891651.*

A self-organizing hybrid sensor system with distributed data fusion for intruder tracking and surveillance; Palaniappan, R.; Clarke, T.;

Wahid, P.; Behdad, N.; Kincaid, P.; Antennas and Propagation Society International Symposium, 2008. AP-S 2008. IEEE; Jul. 5-11, 2008 pp. 1-4; Digital Object Identifier 10.1109/APS.2008.4619564.*
Localization of ahead vehicles with on-board stereo cameras; Zania, M.; Image Analysis and Processing, 2007. ICIAP 2007. 14th International Conference on; Sep. 10-14, 2007 pp. 111-116; Digital Object Identifier 10.1109/ICIAP.2007.4362766 *
On distributed fault-tolerant detection in wireless sensor networks; Luo, X.; Dong, M.; Huang, Y.;Computers, IEEE Transactions on; vol. 55, Issue 1, Jan. 2006 pp. 58-70; Digital Object Identifier 10.1109/TC.2006.13.*
Omega Research and Development, Inc., "GPS 2000", distributed at Consumer Electronics Show in Las Vegas, NV, Jan. 2001, pp. 1-4; cited by other.*
Omega Research and Development, Inc., "GPS 2000", distributed at Consumer Electronics Show in Las Vegas, NV, Jan. 2001, pp. 1-4.
Omega Research and Development, Inc., "Omega Thinks Customers Don't Know Jack!", distributed at Consumer Electronics Show in Las Vegas, NV, Jan. 2001, one page.

* cited by examiner

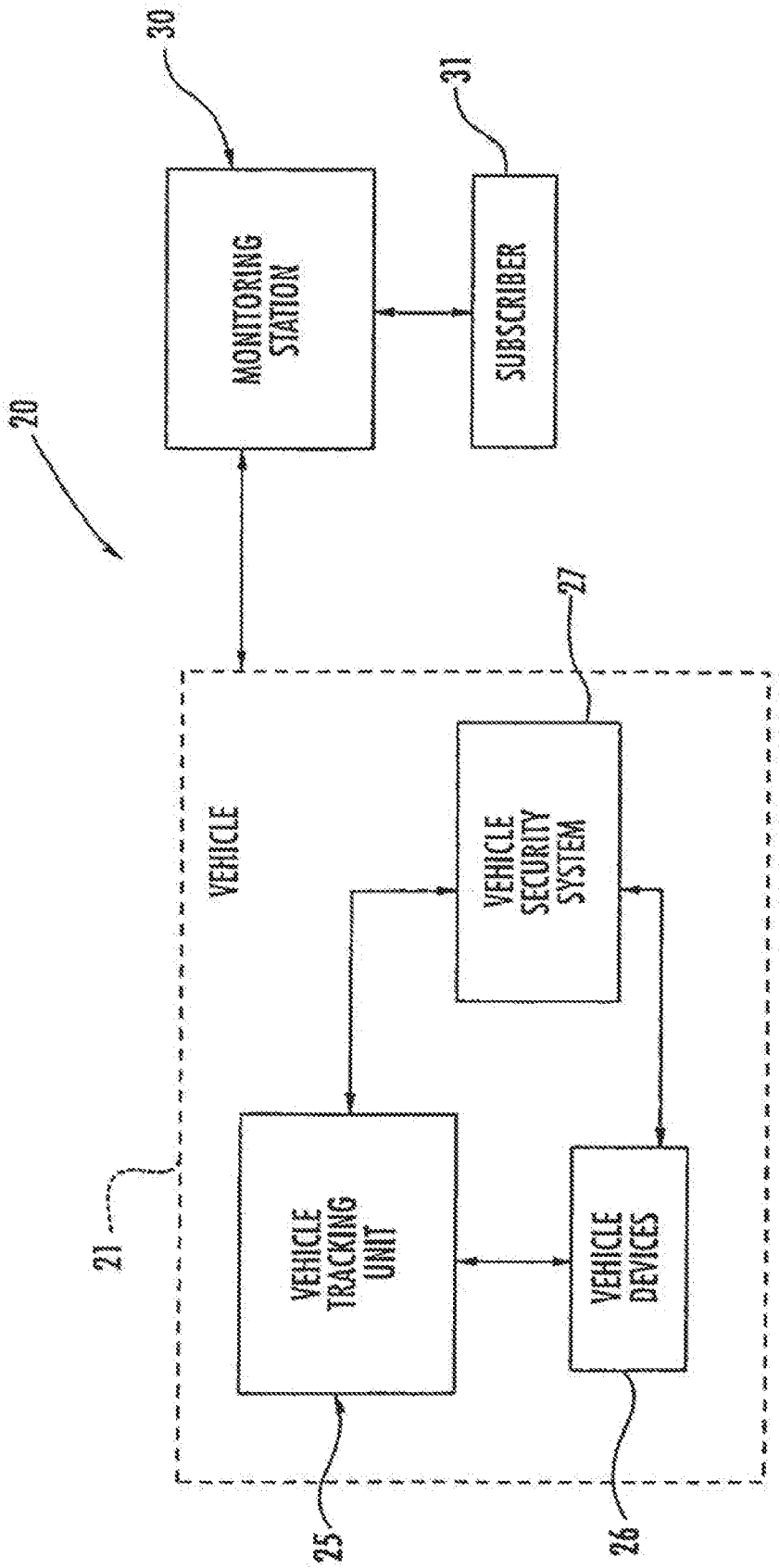

30
31
MONITORING STATION
SUBSCRIBER
20
27
VEHICLE
VEHICLE SECURITY SYSTEM
21
VEHICLE TRACKING UNIT
VEHICLE DEVICES
25
26

FIG. 1.

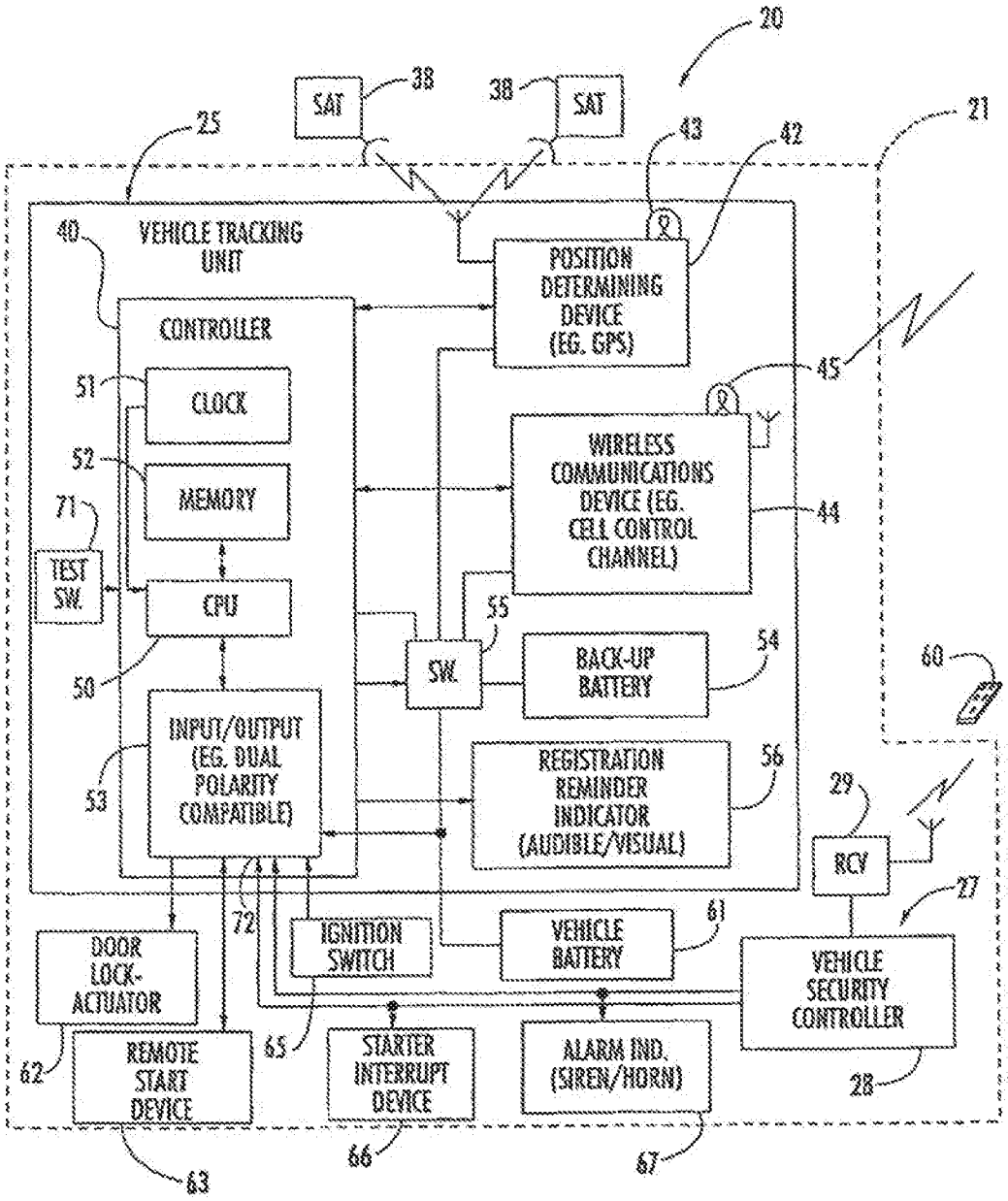

20
SAT
38
38
SAT
25
21
43
42
40
VEHICLE TRACKING UNIT
POSITION DETERMINING DEVICE (EG. GPS)
CONTROLLER
45
51
CLOCK
WIRELESS COMMUNICATIONS DEVICE (EG. CELL CONTROL CHANNEL)
52
MEMORY
44
71
TEST SW.
CPU
55
60
50
SW.
BACK-UP BATTERY
54
INPUT/OUTPUT (EG. DUAL POLARITY COMPATIBLE)
53
REGISTRATION REMINDER INDICATOR (AUDIBLE/VISUAL)
56
29
RCV
27
72
IGNITION SWITCH
VEHICLE BATTERY
61
DOOR LOCK-ACTUATOR
VEHICLE SECURITY CONTROLLER
62
REMOTE START DEVICE
65
STARTER INTERRUPT DEVICE
ALARM IND. (SIREN/HORN)
28
63
66
67

FIG. 2.

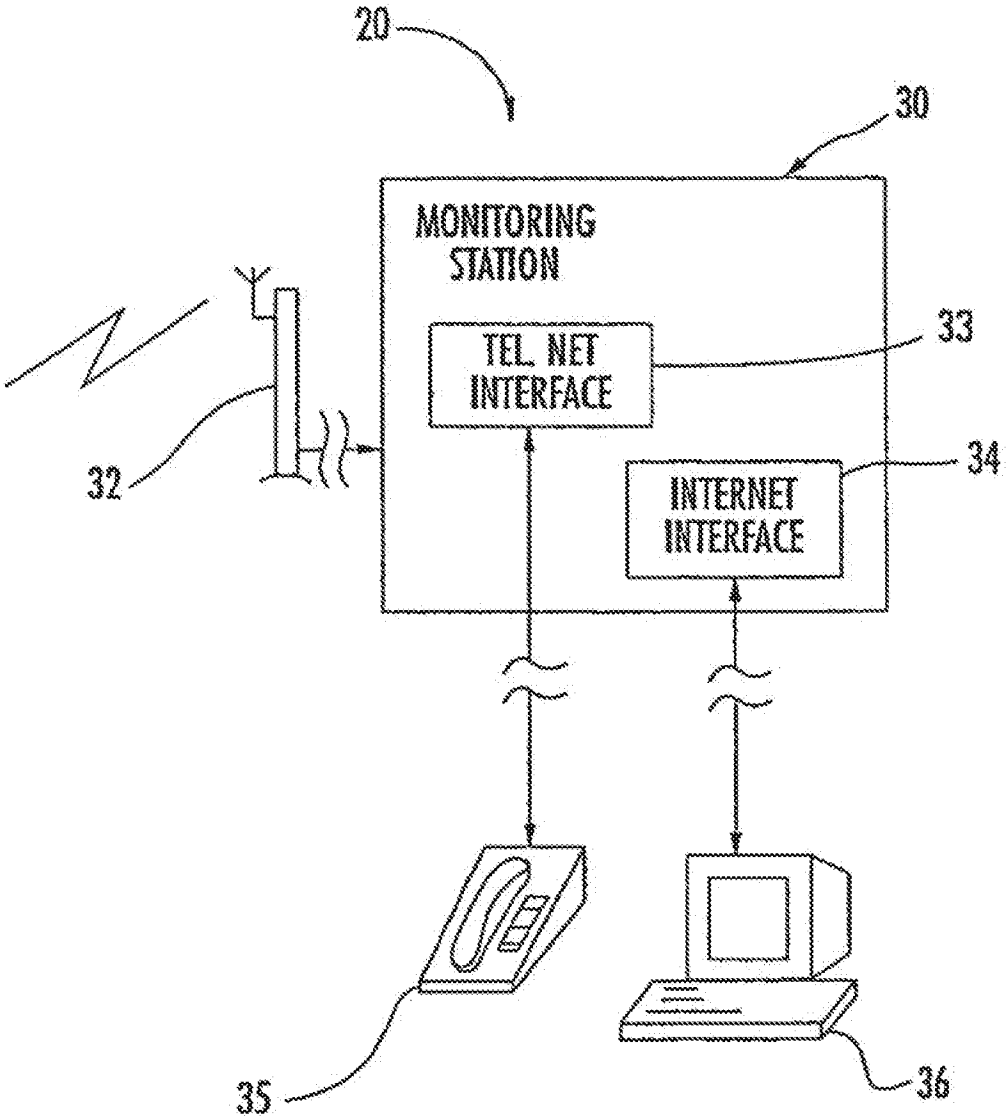

20
30
MONITORING STATION
TEL. NET INTERFACE
33
INTERNET INTERFACE
34
32
35
36

FIG. 3.

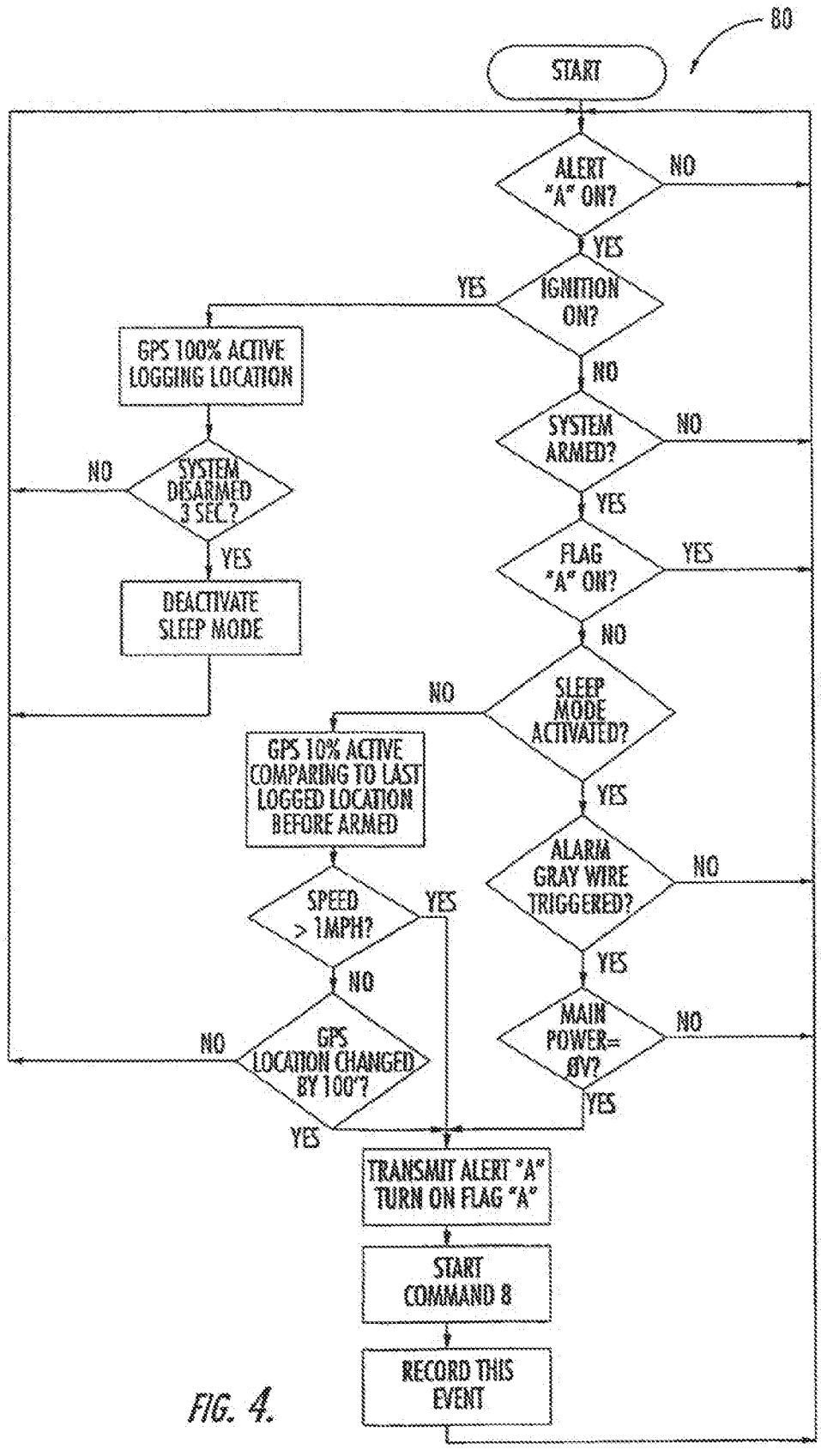

80
START
ALERT "A" ON?
NO
YES
IGNITION ON?
YES
GPS 100% ACTIVE LOGGING LOCATION
NO
SYSTEM ARMED?
NO
YES
SYSTEM DISARMED 3 SEC.?
NO
YES
FLAG "A" ON?
YES
DEACTIVATE SLEEP MODE
NO
SLEEP MODE ACTIVATED?
NO
YES
GPS 10% ACTIVE COMPARING TO LAST LOGGED LOCATION BEFORE ARMED
ALARM GRAY WIRE TRIGGERED?
NO
YES
SPEED > 1MPH?
YES
NO
MAIN POWER= 0V?
NO
YES
GPS LOCATION CHANGED BY 100'?
NO
YES
TRANSMIT ALERT "A" TURN ON FLAG "A"
START COMMAND 8
RECORD THIS EVENT

FIG. 4.

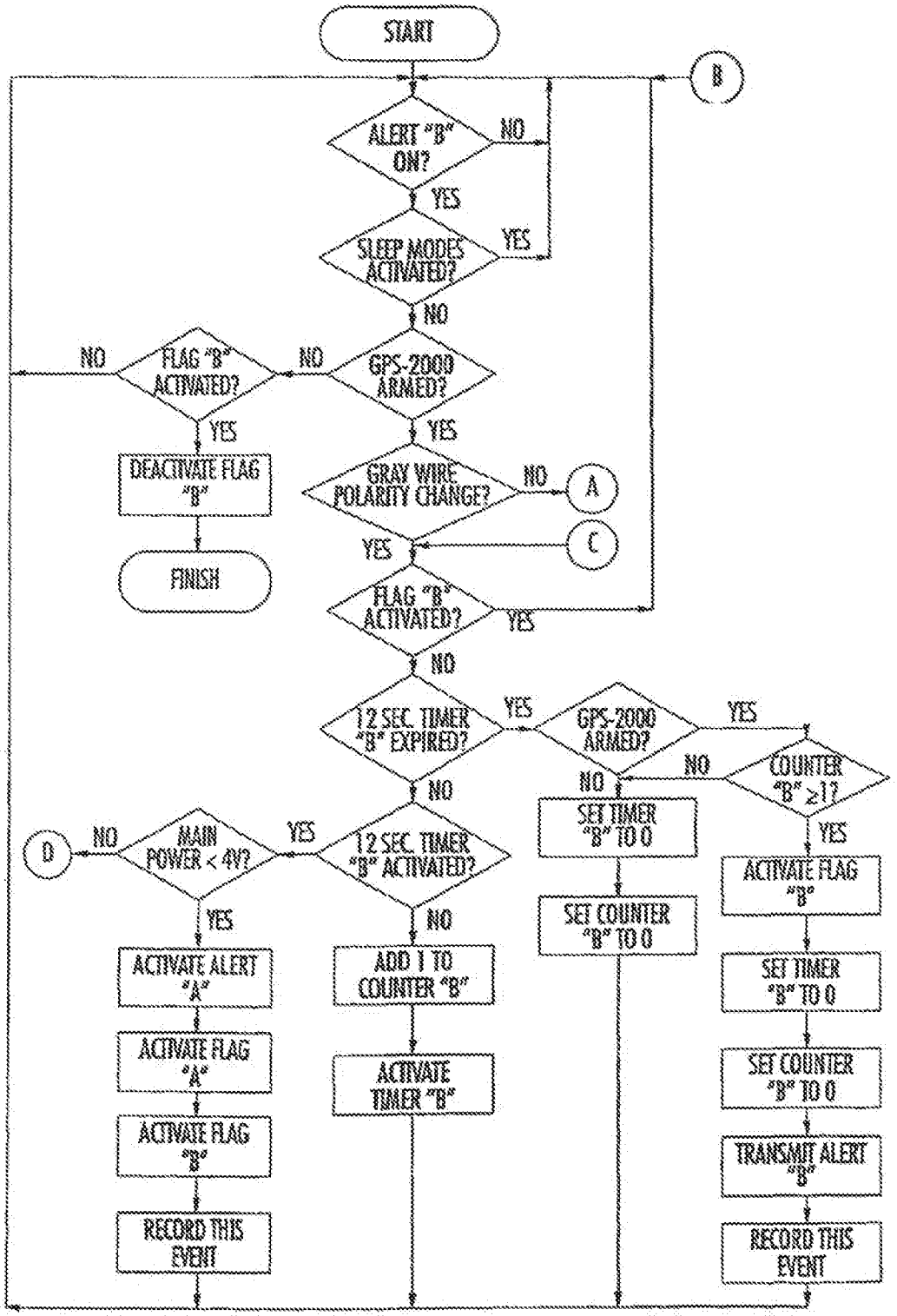

START
B
ALERT "B" ON?
NO
YES
SLEEP MODES ACTIVATED?
YES
NO
NO
FLAG "B" ACTIVATED?
NO
GPS-2000 ARMED?
YES
YES
DEACTIVATE FLAG "B"
GRAY WIRE POLARITY CHANGE?
NO
A
C
YES
FINISH
FLAG "B" ACTIVATED?
YES
NO
12 SEC. TIMER "B" EXPIRED?
YES
GPS-2000 ARMED?
YES
NO
NO
COUNTER "B" ≥1?
NO
SET TIMER "B" TO 0
YES
D
NO
MAIN POWER < 4V?
YES
12 SEC. TIMER "B" ACTIVATED?
ACTIVATE FLAG "B"
YES
NO
SET COUNTER "B" TO 0
ACTIVATE ALERT "A"
ADD 1 TO COUNTER "B"
SET TIMER "B" TO 0
ACTIVATE FLAG "A"
ACTIVATE TIMER "B"
SET COUNTER "B" TO 0
ACTIVATE FLAG "B"
TRANSMIT ALERT "B"
RECORD THIS EVENT
RECORD THIS EVENT

FIG. 5A.

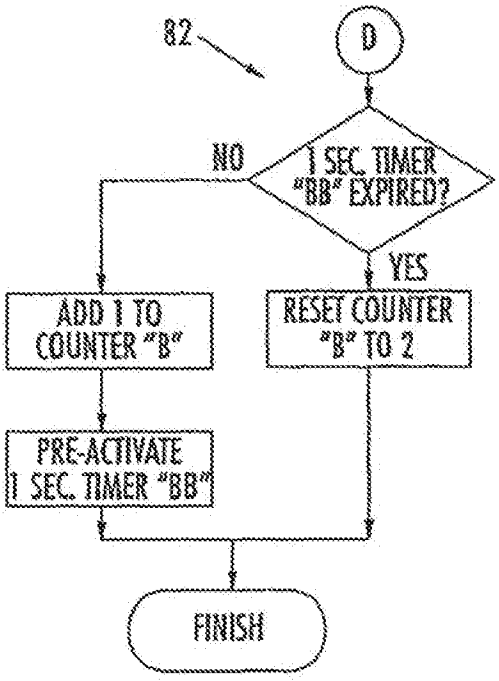

82
D
1 SEC. TIMER "BB" EXPIRED?
NO
YES
ADD 1 TO COUNTER "B"
RESET COUNTER "B" TO 2
PRE-ACTIVATE 1 SEC. TIMER "BB"
FINISH

FIG. 5B.

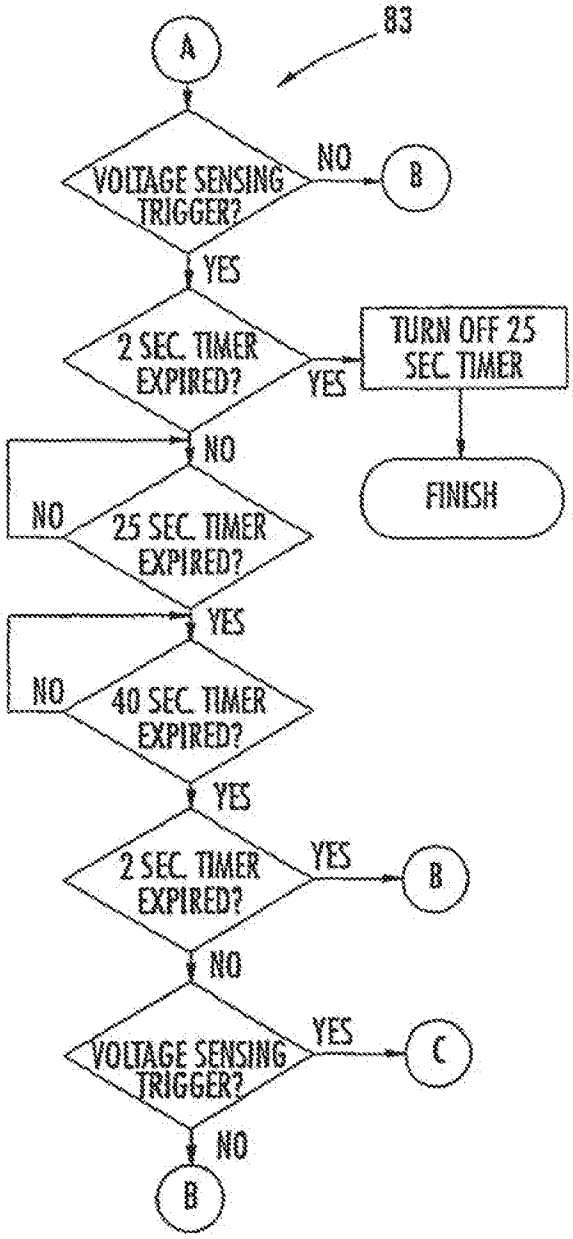

83
A
VOLTAGE SENSING TRIGGER?
NO
B
YES
2 SEC. TIMER EXPIRED?
YES
TURN OFF 25 SEC. TIMER
FINISH
NO
NO
25 SEC. TIMER EXPIRED?
YES
NO
40 SEC. TIMER EXPIRED?
YES
2 SEC. TIMER EXPIRED?
YES
B
NO
VOLTAGE SENSING TRIGGER?
YES
C
NO
B

FIG. 5C.

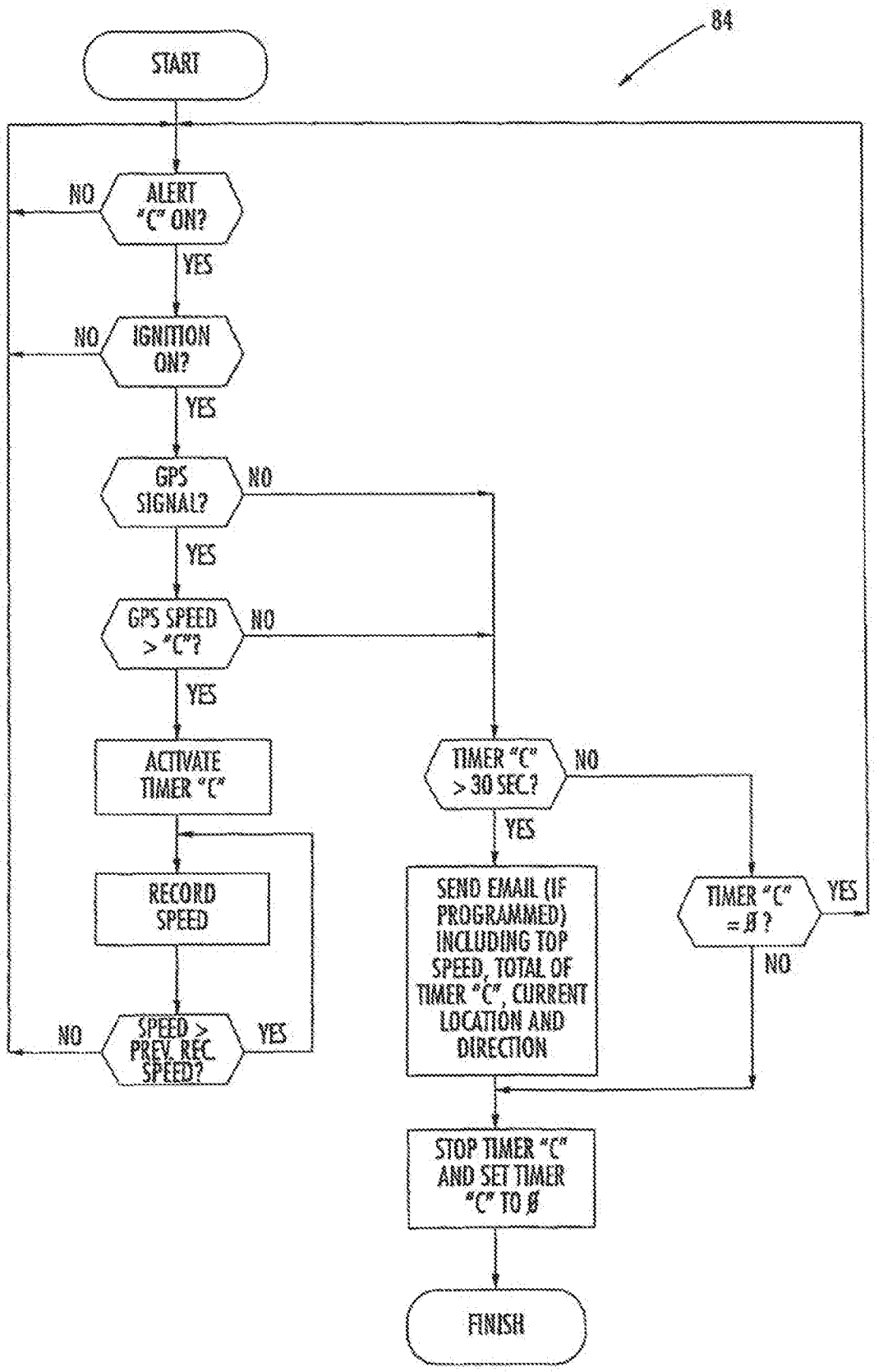

84
START
ALERT "C" ON?
NO
YES
IGNITION ON?
NO
YES
GPS SIGNAL?
NO
YES
GPS SPEED > "C"?
NO
YES
ACTIVATE TIMER "C"
RECORD SPEED
SPEED > PREV. REC. SPEED?
NO
YES
TIMER "C" > 30 SEC.?
NO
YES
SEND EMAIL (IF PROGRAMMED) INCLUDING TOP SPEED, TOTAL OF TIMER "C", CURRENT LOCATION AND DIRECTION
TIMER "C" = Ø ?
YES
NO
STOP TIMER "C" AND SET TIMER "C" TO Ø
FINISH

FIG. 6.

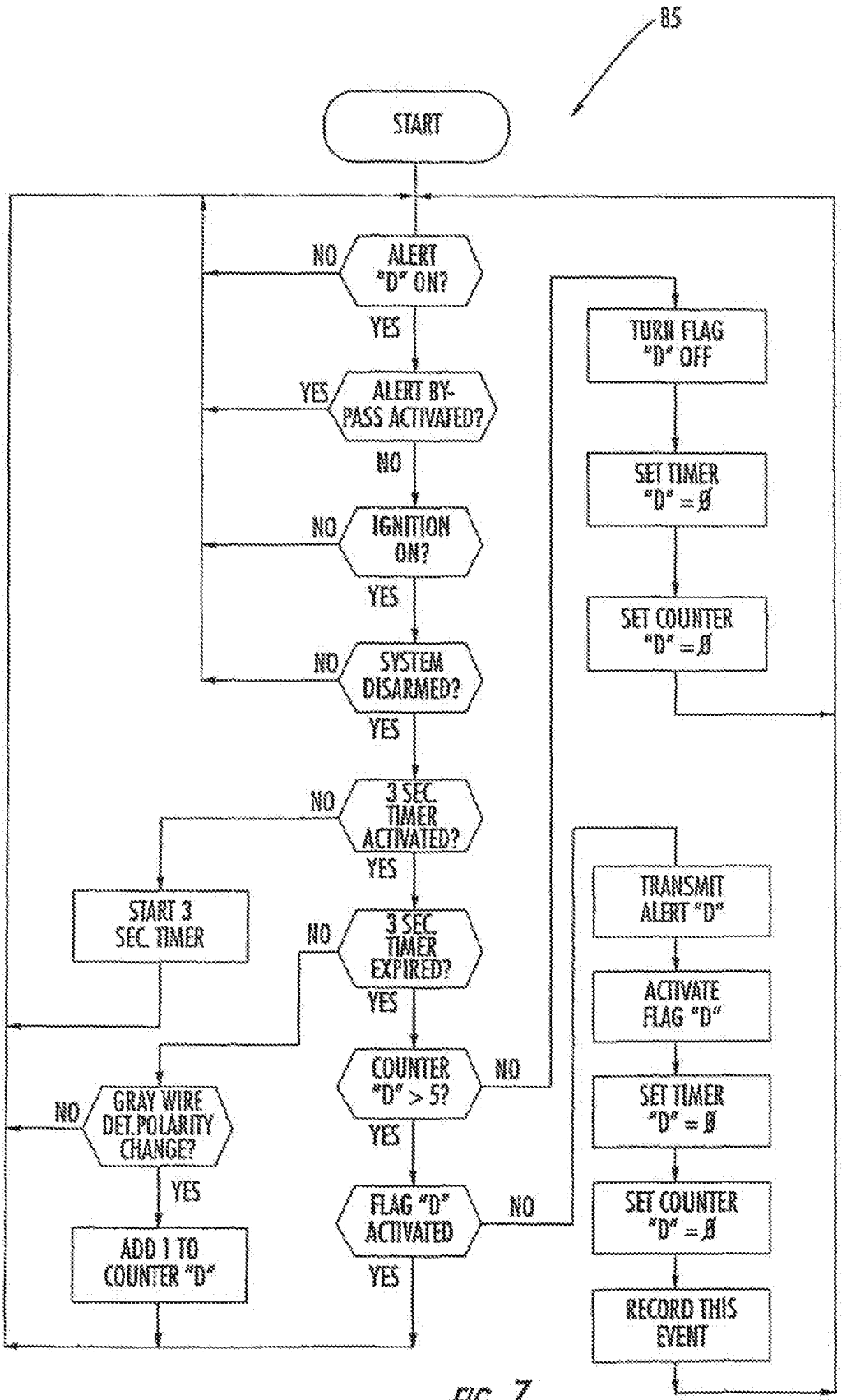

85
START
ALERT "D" ON?
NO
YES
ALERT BY-PASS ACTIVATED?
YES
NO
IGNITION ON?
NO
YES
SYSTEM DISARMED?
NO
YES
3 SEC. TIMER ACTIVATED?
NO
YES
START 3 SEC. TIMER
3 SEC. TIMER EXPIRED?
NO
YES
COUNTER "D" > 5?
NO
YES
GRAY WIRE DET. POLARITY CHANGE?
NO
YES
ADD 1 TO COUNTER "D"
FLAG "D" ACTIVATED
NO
YES
TURN FLAG "D" OFF
SET TIMER "D" = Ø
SET COUNTER "D" = Ø
TRANSMIT ALERT "D"
ACTIVATE FLAG "D"
SET TIMER "D" = Ø
SET COUNTER "D" = Ø
RECORD THIS EVENT

FIG. 7.

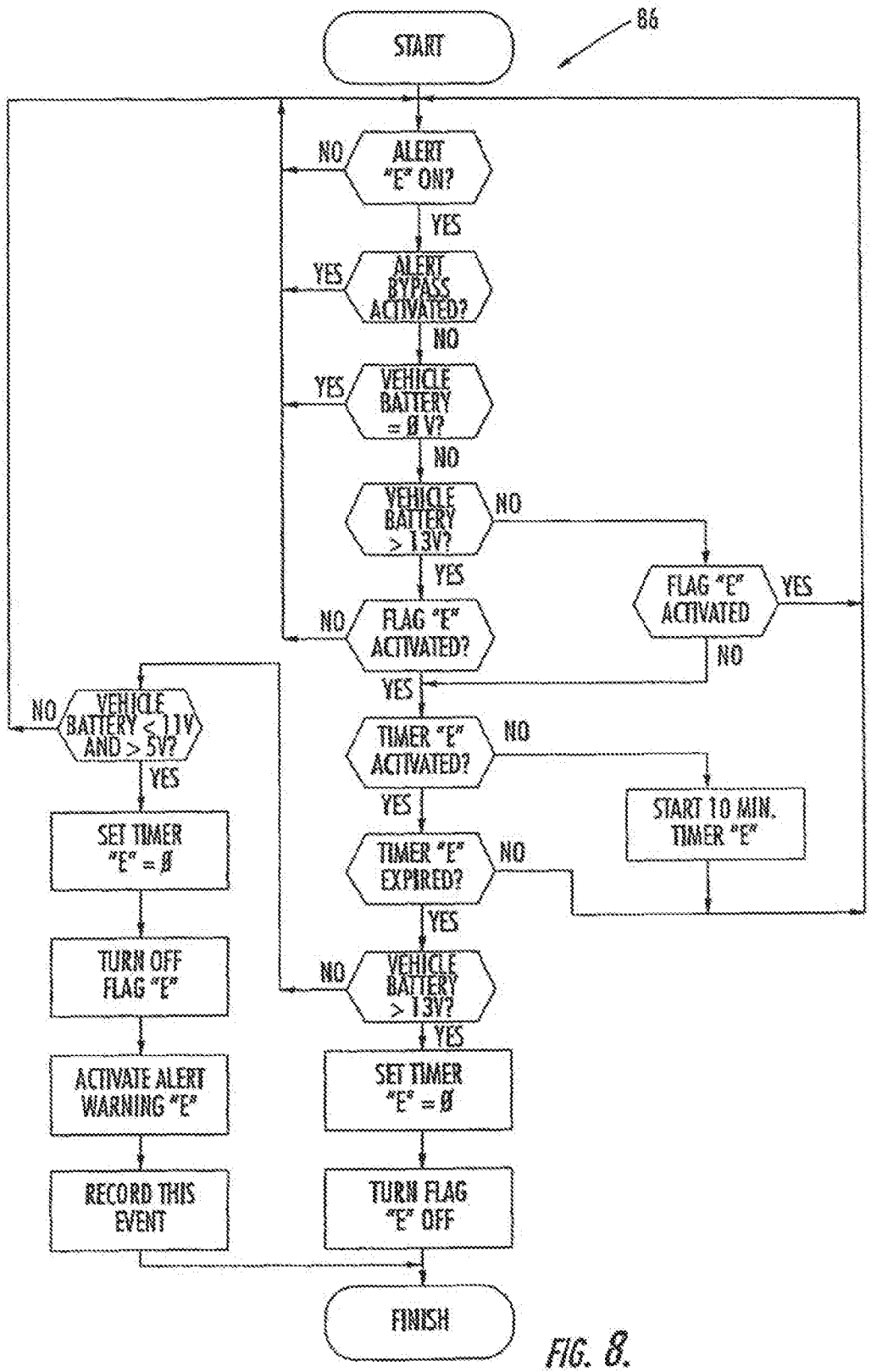

86
START
ALERT "E" ON?
NO
YES
ALERT BYPASS ACTIVATED?
YES
NO
VEHICLE BATTERY = Ø V?
YES
NO
VEHICLE BATTERY > 13V?
NO
YES
FLAG "E" ACTIVATED?
NO
YES
FLAG "E" ACTIVATED
YES
NO
TIMER "E" ACTIVATED?
NO
YES
START 10 MIN. TIMER "E"
TIMER "E" EXPIRED?
NO
YES
VEHICLE BATTERY > 13V?
NO
YES
SET TIMER "E" = Ø
TURN FLAG "E" OFF
VEHICLE BATTERY < 11V AND > 5V?
NO
YES
SET TIMER "E" = Ø
TURN OFF FLAG "E"
ACTIVATE ALERT WARNING "E"
RECORD THIS EVENT
FINISH

FIG. 8.

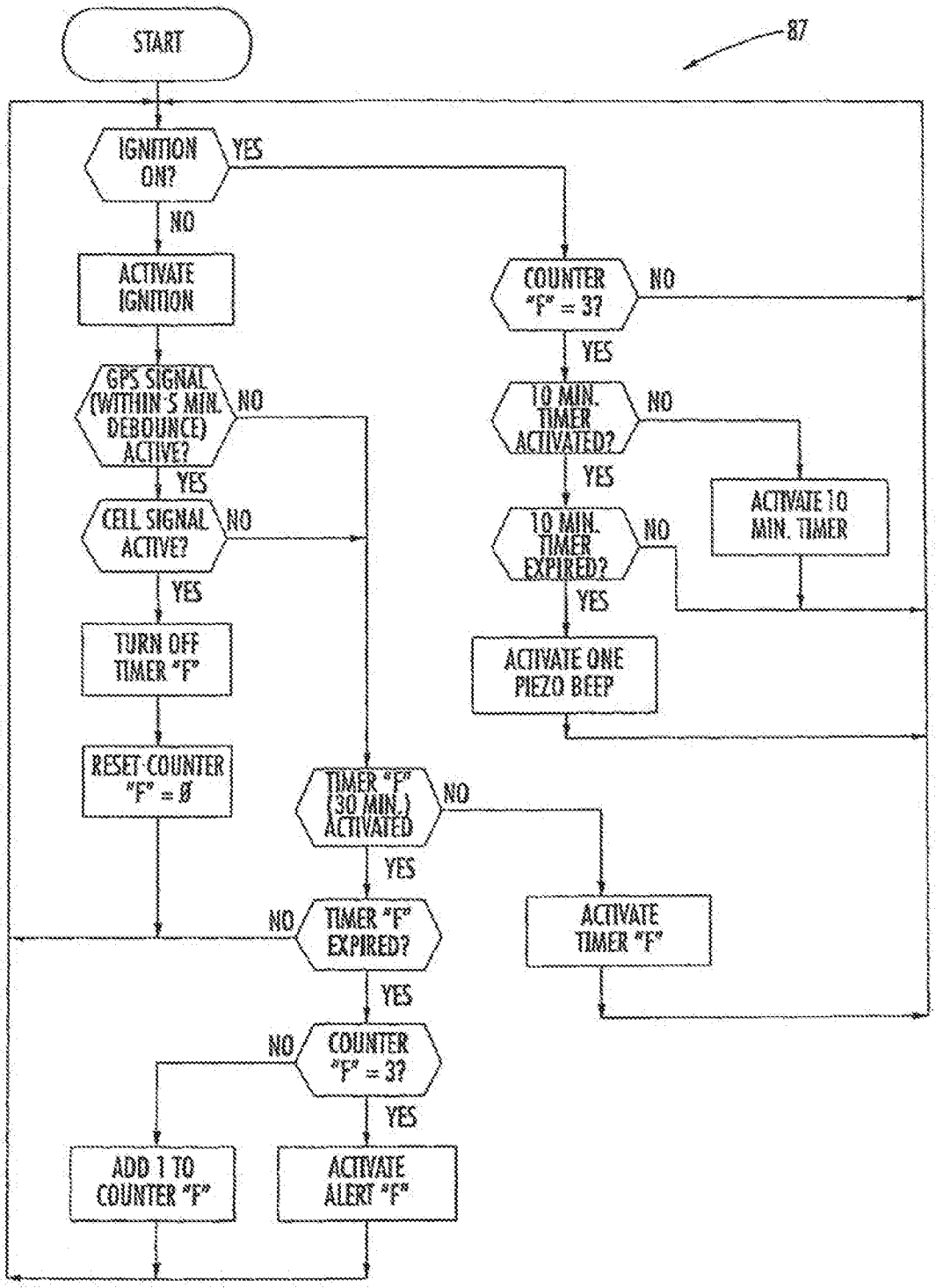

87
START
IGNITION ON?
YES
NO
ACTIVATE IGNITION
GPS SIGNAL (WITHIN 5 MIN. DEBOUNCE) ACTIVE?
NO
YES
CELL SIGNAL ACTIVE?
NO
YES
TURN OFF TIMER "F"
RESET COUNTER "F" = 0
COUNTER "F" = 3?
NO
YES
10 MIN. TIMER ACTIVATED?
NO
YES
ACTIVATE 10 MIN. TIMER
10 MIN. TIMER EXPIRED?
NO
YES
ACTIVATE ONE PIEZO BEEP
TIMER "F" (30 MIN.) ACTIVATED
NO
YES
ACTIVATE TIMER "F"
TIMER "F" EXPIRED?
NO
YES
COUNTER "F" = 3?
NO
YES
ADD 1 TO COUNTER "F"
ACTIVATE ALERT "F"

FIG. 9.

VEHICLE TRACKER INCLUDING INPUT/OUTPUT FEATURES AND RELATED METHODS

RELATED APPLICATIONS

The present application is a continuation of U.S. patent application Ser. No. 10/383,496 filed Mar. 7, 2003 now U.S. Pat. No. 7,149,623, which is a continuation of U.S. patent application Ser. No. 09/859,972 filed on May 17, 2001 now U.S. Pat. No. 6,606,561 which, in turn, was based upon provisional patent application Ser. Nos. 60/264,811 filed on Jan. 29, 2001; 60/258,005, filed Dec. 22, 2000; 60/251,552, filed Dec. 6, 2000; 60/252,125, filed Nov. 20, 2000, 60/236,890, filed Sep. 29, 2000; 60/246,463, filed Nov. 7, 2000; 60/222,777, filed Aug. 3, 2000; 60/205,178, filed May 17, 2000; and non-provisional U.S. patent application Ser. No. 09/859,972, the entire contents of each of which are incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to the field of vehicle devices, and, more particularly, to a tracking and alerting system for a vehicle.

BACKGROUND OF THE INVENTION

Motor vehicles, such as passenger cars, trucks, busses, fleet vehicles, etc. are widely used and knowing the locations of such vehicles is often desired. For example, should a vehicle be stolen, it would be beneficial to know the vehicle's location so that authorities could be promptly and accurately directed to retrieve the vehicle. Indeed, the tracking system could plot the getaway path of the thief.

For a company with hired drivers, it may be desirable to know the driver's whereabouts during the course of the day. Similarly, a rental car agency or other fleet operator, for example, may wish to know the whereabouts of its fleet of vehicles.

It may also be desirable to track the location of a vehicle as it is used throughout the course of a normal day. For parents of younger or older drivers, for example, knowledge of the vehicle's location may provide some assurance that the driver is at designated locations and following a prescribed route.

A number of patents disclose various systems and approaches to tracking vehicles. For example, U.S. Pat. No. 5,223,844 discloses a tracking system including a control center and a mobile unit installed in the vehicle. The mobile unit may send security warnings to the command center via a wireless transceiver. Position information for the vehicle is determined using a GPS receiver at the vehicle.

U.S. Pat. No. 5,515,043 discloses a similar system which may send one or more preprogrammed telephone messages to a user when away from the vehicle. The user may remotely access location information or cause certain commands to be carried out by entering a personal identification number (PIN).

The widespread availability and use of the Internet has prompted a number of vehicle tracking systems to also make use of the Internet. For example, TeliEvoke, Inc. proposed such a system in combination with Clifford Electronics. The system was to provide notification, control and tracking services via the telephone or the Internet. Users could be notified via phone, e-mail, or pager of events such as a car alarm being triggered. Users could control the vehicle remote devices via phone, web, or PDA such as unlocking car doors. Additionally, users could track TeliEvoke-enabled vehicles on the Internet or via the telephone. An Internet map could be viewed by the user showing the actual and prior vehicle locations. TeliEvoke offered its services via a centralized fully automated Network Operations Center. To reduce the communications costs, it was proposed to use the control channel of the cellular telephone network.

There are, of course, a number of vehicles which come from the manufacturer with some form of security system already installed. In addition, a number of vehicles are also equipped with aftermarket security systems. Many conventional vehicle tracking units may not be readily installed in vehicles, particularly those vehicles already including a vehicle security system. In addition, complexity of installation may significantly increase the system costs.

SUMMARY OF THE INVENTION

In view of the foregoing background, it is therefore an object of the present invention to provide a vehicle control system that provides vehicle tracking and function control capabilities.

This and other objects, features, and advantages in accordance with the present invention are provided by a vehicle control system including a tracking unit and a function unit cooperating therewith. The tracking unit may include a vehicle position determining device, a wireless communications device, and a tracking controller cooperating with the vehicle position determining device and the wireless communications device to send vehicle position information to a user. Further, the function unit may include at least one uniquely coded transmitter to be carried by a user, a receiver at the vehicle for receiving signals from the at least one uniquely coded transmitter, and a function controller at the vehicle and connected to the receiver for learning the at least one uniquely coded transmitter to permit control of a vehicle function by the user. The function controller may advantageously cooperate with the wireless communications device of the tracking unit for sending an alert indication of whether at least one new uniquely coded transmitter has been learned.

More particularly, the vehicle control system may further include a local indicator connected to the function controller for providing a local indication of whether at least one uniquely coded transmitter has been learned. Also, the vehicle function may be associated with starting of a vehicle engine, vehicle door locks, and/or vehicle security.

The function controller may be switchable to a learning mode to permit learning of the at least one uniquely coded transmitter, and the function controller may cooperate with the wireless communications device for sending the alert indication when the learning mode has been entered. Moreover, the function controller may cooperate with the wireless communications device for sending the alert indication when the learning mode has last been entered.

Additionally, the function controller may cooperate with the wireless communications device for sending the alert indication for a passage of time since the learning mode has last been entered. Similarly, the function controller may cooperate with the wireless communications device for sending the alert indication for a number of learned uniquely coded transmitters, as well as for sending the alert indication for a change in a number of learned uniquely coded transmitters, and/or for sending the alert indication for a change in a code of at least one learned uniquely coded transmitter.

Further, the at least one uniquely coded transmitter may include at least one uniquely coded remote transmitter, as well as at least one uniquely coded transponder transmitter,

for example. The vehicle position determining device may be a Global Positioning System (GPS) device, and the wireless communications device may be a cellular telephone communications device, for example.

The function unit may also include a biometric characteristic sensor for sensing a unique biometric characteristic of a user, and a function controller at the vehicle and connected to the biometric characteristic sensor for learning the unique biometric characteristic to permit control of a vehicle function by the user. Moreover, the function controller may cooperate with the wireless communications device of the tracking unit for sending an alert indication of whether at least one new unique biometric characteristic has been learned.

A vehicle control method aspect of the invention for a vehicle including a vehicle tracking unit for sending vehicle position information to a user may include receiving signals from at least one uniquely coded transmitter at a receiver at the vehicle, and learning the at least one uniquely coded transmitter to permit control of a vehicle function by the user using a function controller at the vehicle and connected to the receiver. Furthermore, the method may also include sending an alert indication of whether at least one new uniquely coded transmitter has been learned using the vehicle tracking unit.

Similarly, a unique biometric characteristic of a user may be sensed using a biometric characteristic sensor at the vehicle, and the unique biometric characteristic may be learned to permit control of a vehicle function by the user using a function controller at the vehicle and connected to the biometric characteristic sensor. In addition, an alert indication may be sent of whether at least one new unique biometric characteristic has been learned using the vehicle tracking unit.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a simplified block diagram of a vehicle tracking system in accordance with the present invention.

FIG. **2** is a more detailed block diagram of the vehicle tracking unit as shown in FIG. **1**.

FIG. **3** is a more detailed block diagram of the monitoring station as shown in FIG. **1**.

FIG. **4** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a vehicle stolen alert.

FIGS. **5**A-**5**C are a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a vehicle alarm sounding alert.

FIG. **6** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a vehicle speeding alert.

FIG. **7** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating an unauthorized transmitter learned alert.

FIG. **8** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a low battery alert.

FIG. **9** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a GPS or cellular unit failure alert.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will now be described more fully hereinafter with reference to the accompanying drawings in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the illustrated embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

Referring to FIGS. **1-3**, the vehicle tracking system **20** in accordance with the invention is now initially described. The vehicle system **20** illustratively includes a vehicle tracking unit **25** to be mounted in the vehicle **21** and a monitoring station **30** which is remote from the vehicle and which is typically in a fixed location. In the illustrated embodiment, the vehicle tracking unit **25** interfaces with various vehicle devices, such as may include security sensors, door locks, etc. as will be appreciated by those skilled in the art.

The vehicle tracking unit **25** is also illustratively connected to a separate vehicle security system **27** as may already be installed in the vehicle **21**, from the factory or installed as an aftermarket product. Those of skill in the art will appreciate that in some embodiments of the vehicle tracking system **20** a separate vehicle security system **27** may not be needed, and/or various features thereof can be readily incorporated in the vehicle tracking unit **25**.

The monitoring station **30** may typically service a number of subscribers **31**. As shown perhaps best in FIG. **3**, the monitoring station **30** may include a user interface, such as the schematically illustrated telephone network interface **33** and the internet interface **34** which are schematically coupled to a telephone **35**, and a computer **36**, respectively. Of course in other embodiments, other interfaces may be used and only one of the illustrated interfaces may be needed. Those of skill in the art will also recognize that messages may be sent to a subscriber or user via preprogrammed voice messages, e-mail messages, facsimile messages, pager alerts, etc. In addition commands or instructions from the subscriber can also be input to the monitoring station **30** via the telephone network interface **33** and/or the internet interface **34**, from the subscribers telephone **35** or computer **36**.

The monitoring station **30** is illustratively connected to a cellular telephone tower **32** which, in turn, may communicate with the vehicle tracking unit **25** in some embodiments. Of course, in other embodiments other communications approaches are also contemplated, such as, for example, including satellite communications.

The monitoring station **30** may typically include the necessary modems, and other communications electronics, and computers for its functions which are described in greater detail below. The configuration of such components and their details will be readily apparent to those skilled in the art. Accordingly, no further discussion of these details is needed.

Referring now more specifically to FIG. **2**, additional details of the vehicle tracking unit **25** and devices at the vehicle are now further described. The vehicle tracking unit **25** illustratively includes a controller **40**, a vehicle position determining device **42**, and a wireless communications device **44** connected together. The vehicle position determining device **42** may be provided by a GPS receiver, for example. The GPS receiver typically operates by receiving multiple signals from spaced apart satellites **38** as will be appreciated by those skilled in the art.

In other embodiments, the vehicle position determining device **42** may be provided based upon communications with the cellular telephone network, or based upon other satellite transmissions, for example. As a particular example, time of arrival techniques are available based upon multiple reception paths to determine position via the cellular telephone network as will be appreciated by those skilled in the art. The vehicle position determining device **42** also illustratively includes an indicator **43** associated therewith, such as for indicating an

operating mode, or proper operation of the device as will be addressed in greater detail below.

The wireless communications device **44** may be provided by a cellular telephone transceiver configured to operate on a control channel of the cellular network. Such a control channel may provide nearly universal coverage for the tracking system **20** as will be appreciated by those skilled in the art. In addition, the control channel may offer relatively inexpensive communications between the monitoring station **30** and the vehicle tracking unit **25** as will be appreciated by those skilled in the art. The wireless communications device **44** also illustratively includes an optional status indicator **45** with a similar function as the indicator **43** for the vehicle position determining device.

The wireless communications device **44** in other embodiments, may transmit in the voiceband of the cellular network. Alternately, the wireless communications device may communicate over other networks, such as over satellite, or via wireless internet services, as will be appreciated by those skilled in the art.

The controller **40** illustratively includes a central processing unit (CPU) **50** or other logic circuitry which is connected to a clock signal generator **51** and a memory **52**. In other embodiments, the memory **52** may be an embedded memory in the CPU **50**. The controller **40** also includes schematically illustrated input/output circuitry **53** to interface with various vehicle devices. In particular the input/output circuitry **53** may provide dual polarity compatibility for one or more inputs or outputs as will be described in greater detail below. One or more of the terminals of the input/output circuitry **53** may also provide both input and output functions as will also be described in greater detail below. This may significantly simplify and accelerate installation of the vehicle tracking unit **25** in the vehicle **21**.

Also illustratively shown as part of the vehicle tracking unit **25** are a back-up battery **54**, and switch **55** connected thereto for selectively powering certain of the components based upon the controller **40**. Of course, the vehicle **21** also includes an electrical system including the vehicle battery **61**. Powering of the vehicle tracking unit **25** is described in greater detail below.

The vehicle **21** also includes a number of other components that may relate to vehicle tracking, security, and/or convenience features provided by the vehicle tracking system **20**. For example, the vehicle **21** may include one or more door lock actuators **62**, an optional remote starting device **63**, a starter interrupt device **66** and an alarm indicator **67**. For example, the alarm indicator may be provided by a vehicle horn or vehicle siren, and/or flashing of the lights.

The optional separate security system **27** illustratively includes a vehicle security controller **28** and a receiver **29** connected thereto. As is conventional, the vehicle security system **27** may be switched between armed and disarmed modes, for example, by one or more uniquely coded remote transmitters **60**. The vehicle security controller **28** may also be capable of learning a new uniquely coded remote transmitter **60** as will be appreciated by those skilled in the art. The vehicle security controller **28** also illustratively is connected to the starter interrupt device **66** and the alarm indicator **67**.

For ease of explanation, a number of the features of the vehicle tracking system **20** are now described. The vehicle tracking system **20** includes a number of features that may simplify installation and maintenance. For example, as shown in FIG. **2**, the vehicle tracking unit **25** may have a test switch **71** connected to the controller **40**.

In normal operation, the controller **40** may be called upon to operate at least one vehicle device. Of course, the controller **40** also cooperates with the wireless communications device **44** and the vehicle position determining device **42** to determine and send vehicle position information to the monitoring station **30**. Moreover, the controller **40** may be switchable to a test mode for test operation of the at least one vehicle device responsive to activation of the test switch **71**.

In some embodiments, the at least one vehicle device may be a plurality of vehicle devices that are tested by operation in sequence. For example, the at least one vehicle device may comprise at least one door lock actuator **62**. The at least one vehicle device may also comprise the starter interrupt device **66**, or the engine remote starter **63** if remote starting is an implemented feature. The at least one vehicle device which is tested, may also be the alarm indicator **67**. Accordingly, an installer, for example, can quickly check that the tracking unit has been properly installed.

To further provide for ready determination of proper operation of the vehicle tracking unit **25**, one or both of the position determining and wireless communications devices **42**, **44** may include associated indicators **43**, **45** as mentioned briefly above, and which provide an indication relating to proper operation. Each indicator **43**, **45** may indicate a mode of operation of the device, its proper operation, or a partial or complete failure of the device.

Another aspect of the invention is that the controller **40** may provide a selectable polarity for the at least one vehicle device based upon sensing thereof. Accordingly, a predetermined activation of the test switch **71** may cause the controller **40** to sense and select the proper polarity. Pressing the test switch **71** for a predetermined time or in a predetermined pattern may sense and set the polarity.

Another feature of the vehicle tracking unit **25** and vehicle tracking system **20** relates to conservation of the number of codes or messages that need to be sent to the vehicle tracking unit. In particular, the controller **40** may have a plurality of different controller states and respond differently to a same message from the monitoring station **30** at different times depending upon the controller state at a given time. Accordingly, a number of codes or messages used by the system can be conserved. Various messages are described in greater detail below.

A controller state may change based upon several different occurrences or events. For example the controller may change states in response to a change in at least one vehicle device, or based upon a message received by the wireless communications device **44** from the monitoring station **30**, and/or based upon elapsed time. The controller states, for example, may include an alert sent state based upon an alert message being sent from the wireless communications device **44**. Thereafter, receipt of a predetermined message by the wireless communications device **44** when the controller **40** is in the alert sent state may confirm receipt of the alert message by the monitoring station.

Receipt of the predetermined message by the wireless communications device **44** when the controller **40** is in another state different than the alert sent state may thus cause a different response by the controller. The alert sent state may comprise at least one of a vehicle stolen alert sent state, a vehicle alarm sounding alert sent state, a vehicle speeding alert sent state, an unauthorized remote transmitter alert sent state, a low vehicle battery alert sent state, and a device malfunction alert sent state. The various alert messages and confirmation thereof are described in greater detail below.

The code or message conservation aspects of the vehicle tracking system **20** also permit sending a sequence of codes or messages within a predetermined time to also cause a different response at the vehicle tracking unit **25**. In other words,

the plurality of controller states may comprise a received first message state based upon a first message being received by the wireless communications device **44** from the monitoring station **30**. Receipt of a second message by the wireless communications device **44** when the controller **40** is in the received first message state, such as within a predetermined time window, for example, may thus cause a different response by the controller than does receipt of the second message when the controller is in another state than the received first message state.

The plurality of controller states may comprise a vehicle finder state sounding an audible signal via the alarm indicator **67** at the vehicle **21**. In this state the controller **40** would bypass sending a vehicle alarm sounding alert to the monitoring station **30**.

Another aspect of the vehicle tracking system **20** is the provision of certain power conservation and management techniques, such as to permit extended periods where the vehicle **21** is not in operation. During such extended periods, the vehicle battery **61** provides power to the vehicle tracking unit **25** as well as other vehicle devices. Accordingly, the voltage of the vehicle battery **61** drops over time. The vehicle tracking unit **25** may provide a significant drain on the vehicle battery **61** because of the power consumed by the wireless communications device **44** during transmission as will be appreciated by those skilled in the art.

The vehicle position determining device **42**, the wireless communications device **44** and the controller **40** may be considered as defining a power load of the vehicle tracking unit **25**. The controller **40** may operate the schematically illustrated power switch **55** to isolate the back-up battery **54** from the power load as a voltage of the vehicle battery **61** drops until reaching a threshold. After or below the threshold the controller **40** may cause the back-up battery **54** to selectively power only a first portion of the power load while a second portion of the power load remains powered by the vehicle battery.

For example, the wireless communications device **44** may have a higher operating voltage than the vehicle position determining device **42**. The first portion of the power load that is selectively powered despite the low vehicle battery voltage may thus be the wireless communications device **44**. In particular, the wireless communications device **44** may be powered for transmission. Accordingly, the back-up battery **54** can be saved for limited communication using the higher voltage wireless communications device **44**. This provides useful features even after an extended period during which the vehicle **21** is left unattended and the vehicle battery **61** gradually discharges.

To further conserve power, the controller **40** may reduce operation of the power load as vehicle battery voltage falls. Conversely, the controller **40** may restore operation of the power load based upon the voltage of the vehicle battery **61** rising again, such as upon being recharged.

Also relating to power consumption, the controller **40** further causes transmission of a low vehicle battery voltage alert to the monitoring station **30** based upon the voltage of the vehicle battery **61** falling below the threshold. The user or subscriber may cause the monitoring station **30** to issue a remote start command. The controller **40** may then generate a remote start output to the remote start device **63** to thereby start the engine and recharge the vehicle battery.

Another feature of the vehicle tracking system **20** is that the vehicle tracking unit **25** may be readily installed and connected to a vehicle **21**, such as in the illustrated embodiment where the vehicle includes a starter interrupt device **66** and a separate vehicle security controller **28**. More particularly, the controller **40** may switch between an armed mode and a disarmed mode based upon operation of the engine starter interrupt device **66**. The controller **40** when in the armed mode may cooperate with the wireless communications device **44** to send an alert message to the monitoring station **30** and including vehicle position information, for example, based upon the vehicle position determining device **42**. The controller **40** is also for selectively operating the engine starter interrupt device **66** to provide additional security features.

In one advantageous embodiment, the controller **40** preferably comprises a combination input and output terminal for connection to the engine starter interrupt device. This terminal is at the input/output circuitry **53** and is schematically illustrated by reference numeral **72**. The controller **40** may switch to the armed mode when in the disarmed mode and based upon the engine starter interrupt device **66** being operated to disable engine starting. Conversely, the controller **40** may switch to the disarmed mode based upon the engine starter interrupt device **66** being operated to enable engine starting. In other words, the vehicle tracking unit **25** can piggyback its arming and disarming off the existing vehicle security system **27**, for example.

The controller **40** may also selectively operate the engine starter interrupt device **66** based upon a command message from the monitoring station **30**. The controller **40** may selectively operate the engine starter interrupt device **66** based upon a command message from the monitoring station **30**. Alternately, or in addition thereto, the controller **40** may selectively operate the engine starter interrupt device **66** based upon the ignition switch **65**.

The following descriptive portions relate to various user or subscriber notifications and features provided by the vehicle tracking system **20**. Of course, the controller **40** preferably cooperates with the wireless communications device **44** to send an alert message. The monitoring station **30** may comprise a user interface, such as one or both of the telephone network or internet interfaces **33**, **34**, respectively (FIG. **3**), for generating a sequence of alert message notifications based upon receiving the alert message sent from the vehicle tracking unit **25**. More particularly, the monitoring station interface permits canceling any remaining alert message notification based upon a cancellation command response from a user or subscriber having already received the alert message notification. The user may send the cancellation response via the telephone **35** or computer **36** (FIG. **3**), for example. Thus, if the user may be reached at different telephone numbers or different users are desirably notified of the alert, this aspect of the vehicle tracking system **20** can make the notifications efficiently and without making unnecessary notifications.

The vehicle tracking system **20** may provide any of a number of very useful alerts, as discussed herein. For example, the alert message sent from the vehicle tracking unit may comprise at least one of a vehicle stolen alert message, and a vehicle alarm sounding alert message. The alert message may be one of a vehicle speeding alert message, and a vehicle acceleration alert message. In addition, the alert message may comprise an unauthorized remote transmitter alert message. Also, the alert message may be at least one of a low vehicle battery alert message, and a device malfunction alert message.

The speeding alert may be based upon exceeding a speed threshold for greater than a certain time, which may be user selectable. The acceleration alert may also be useful as such is also indicative of aggressive driving along with the speeding alert. The unauthorized remote transmitter alert increases overall security since a user will be notified if a would-be thief

learns an unauthorized transmitter to operate the controller. These alerts are described in greater detail below.

The vehicle tracking system **20** may be implemented as a service to a subscriber. In other words, the subscriber pays a monthly fee for the service. Accordingly, it may be important to encourage a user to register. Similar subscriber or registrations systems in the past have suffered revenue losses since some users would wait to activate the system until the vehicle was stolen. In other words, the user would only subscribe or register and pay a single month's fee.

In accordance with this aspect of the vehicle tracking system **20** prompt user registration is encouraged. In particular, the vehicle tracking unit **25** may include the user registration reminder indicator **56** and the controller **40** may be switchable from an unregistered mode to a registered mode. In the registered mode, the controller **40** may cooperate with the wireless communications device **44** and the vehicle position determining device **42** to determine and send vehicle position information to the monitoring station **30**. In the unregistered mode, the controller **40** may activate the user registration reminder indicator **56** to encourage registration by the user.

The controller **40** may be switchable to the registered mode based upon an activation message from the monitoring station **30**. For example, when the registration payment has been received, the monitoring station can send one or more messages to the vehicle tracking unit **25** to stop activation of the registration reminder indicator **56**. The indicator **56** may be audible, visual or both. For example, the registration reminder indicator **56** could be a beeping sound generated by a small piezoelectric transducer every ten minutes or so when the ignition **65** is on.

In other words, the user registration reminder indicator **56** may provide a minor but irritating annoyance to the user to encourage registration. Upon successfully registering, the annoyance is abated. Accordingly, a relatively straightforward approach is provided to encourage user registration.

Along these lines, the controller **40** when in the unregistered mode may have reduced features compared to the registered mode. For example, the controller **40** when in the unregistered mode may be restricted or limited in sending messages with the wireless communications device **44**. Accordingly, usage of the wireless communications network may be reduced. Transmissions from the vehicle tracking unit **25** may also be beneficially suppressed during original installation, for example.

Returning again to features of the vehicle tracking unit **25** which facilitate installation, the controller **40** may send an alarm indication alert responsive to a continuous activation of the alarm indicator **67** for greater than a predetermined time. Alternately, or in addition thereto, the controller **40** may send an alarm indication alert responsive to a repetitive pattern of alarm indicator **67** activations. In other words, the controller may be configured to distinguish between normal operation of a vehicle horn by the driver, and activation of the horn by the security system **27**. As mentioned above, the controller **40** may also monitor signals of at least one of a first and second polarity. The controller **40** thus advantageously piggybacks off the alarm indication generated by the vehicle security system **27** to determine and send a vehicle alarm sounding alert to the monitoring station **30**.

In one variation, the controller **40** may monitor signals delivered directly to the vehicle alarm indicator by the vehicle security controller **28**. In another variation, the controller **40** monitors signals of voltage dips of the vehicle battery **61**. Circuitry is conventionally and readily available for both such functions, as will be readily appreciated by those skilled in the art.

The controller **40** may also include a dual polarity compatible output in the input/output circuitry **53** for a vehicle device, such as the vehicle alarm indicator **67**. The controller **40** may further monitor signals relating to activation of the vehicle alarm indicator **67** and send an alarm indication alert with position information from the vehicle position determining device and using the wireless communication device.

For the dual polarity output compatibility, the controller **40** may generate a first polarity output pulse followed by a second polarity output pulse. The controller **40** may also generate a repeating pattern of a first polarity output pulse followed by a second polarity output pulse on the dual polarity compatible output. In yet other embodiments, the controller **40** may sense an actual polarity of the device and thereafter use the actual polarity for the dual polarity compatible output.

Where the vehicle device is a vehicle horn, the controller **40** may typically be configured to generate a negative polarity output on the dual polarity compatible output. Conversely, wherein the vehicle device is a vehicle alarm indicator siren, the controller **40** may be configured to generate a positive polarity output on the dual polarity compatible output.

Another aspect of the vehicle tracking system **20** relates to conserving memory space and/or reducing transmission time over the communications network. In accordance with this advantageous feature, the controller **40** may determine the vehicle position information including a vehicle location and an associated stationary period for each occurrence of the vehicle remaining stationary for greater than a predetermined period. In one embodiment, the controller **40** may cooperate with the wireless transmission device **44** to send the vehicle position information to the monitoring station based upon each occurrence of the vehicle remaining stationary for greater than the predetermined period. In this embodiment, the monitoring station **30** may associate a time with each occurrence of the vehicle remaining stationary for greater than the predetermined period. In other words, the monitoring station **30** may time stamp the received information.

In another embodiment, the controller **40** cooperates with the wireless transmission device **44** to send the vehicle position information to the monitoring station **30** for a plurality of occurrences of the vehicle remaining stationary for greater than the predetermined period. In this embodiment, the controller **40** may associate a time with each occurrence of the vehicle remaining stationary for greater than the predetermined period. In other words, the controller time stamps the position and stationary period information.

As an example, the predetermined time which determines whether the vehicle **21** is stationary and the position should be determined, may be less than about three minutes. This time may filter out vehicle stops in normal traffic, but which will keep track of stops where the driver likely leaves the vehicle **21**. Accordingly, only the important information necessary to track the vehicle need be stored and/or transmitted thereby reducing the system costs. If the vehicle **21** is stationary overnight, for example, unnecessary position information need not be determined, stored, and/or transmitted to the monitoring station **30**.

The controller **40** may comprise the memory **52** for storing the vehicle position information therein. In one configuration, the controller **40** downloads the vehicle position information from the memory **52** to the monitoring station **30** based upon a predetermined schedule. In another configuration, the controller **40** downloads the vehicle position information from the memory **52** to the monitoring station **30** based upon a predetermined event. In yet another configuration, the controller **40** downloads the vehicle position information from

the memory **52** to the monitoring station **30** based upon a predetermined percentage of memory usage.

Having now described certain general features and advantages of the vehicle tracking system **20**, this description now turns to additional specific details which are provided as examples. In particular, vehicle tracking system **20** preferably implements one or more of the following features:

a. Detects the vehicle being stolen and transmits a signal to the monitoring station to contact up to 3 people, for example, predetermined by the user, of theft of the vehicle and then starts tracking the vehicle. The contact may be by one or more of the following: an e-mail message, a pager alert, a cellular telephone call, or other telephone call.

b. Detects an optional vehicle security or alarm system activation and transmits a signal to the monitoring station to contact up to 3 predetermined people to inform them the vehicle's alarm is being activated.

c. Detects an optional vehicle alarm system's remote PANIC activation and transmits a signal to the monitoring station to contact up to 3 predetermined people to inform them of the vehicle's PANIC being activated.

d. Detects a vehicle being programmed to operate from an unauthorized remote transmitter, key transponder, other transponder, or other device that has a unique coding, and the vehicle unit transmits a signal to the monitoring station to contact up to 3 predetermined people to inform them of this occurrence. The system can also make available information relating to a number of such coded devices, or a change therein, or when a change occurred. A message can be sent to the user or the information can be available to the user on the website. The vehicle would be equipped with a security system as disclosed in U.S. Pat. No. 5,654,688, for example, which determines an unauthorized transmitter and provides an alert feature. This patent is incorporated herein in its entirety by reference.

e. Detects the vehicle traveling over a predetermined speed, such as for a predetermined time, and transmits a signal to the monitoring station to send a message, such as an e-mail informing the user (and/or others) of this occurrence. Of course, the message could also be sent via a telephone call or page, should additional urgency be required. The vehicle's predetermined maximum speed limit and duration thereof can be selected by the user.

f. Detects a low battery voltage such as for a predetermined time and transmits a signal to the monitoring station to contact up to 3 predetermined people to inform them of vehicle's low battery voltage. This is especially advantageous during winter so that the vehicle could be started, for example, to prevent a problem before it happens. The time setting is preferably selectable by the user.

g. Detects the vehicle not moving for a predetermined time and transmits a signal to the monitoring station to send, for example, a nightly e-mail informing the user of all the vehicle's location and stationary time occurrences. The stationary time length is also selectable. This may be advantageous to encourage patrolling personnel not to remain for a long time in a same location.

h. The vehicle unit preferably includes a back-up battery system making it more reliable.

The vehicle unit may be relatively inexpensive. In addition, the monitoring fee that includes sending up to 60 e-mails and making up to 6 phone calls per month, may also be relatively low. The relatively low monitoring fee is based, at least in part, on the current relatively low rates charged for use of the control channel of the cellular telephone network. It is also noted that access to the control channel provides coverage for almost the entire U.S., for example.

The user or subscriber also preferably has access to an Internet site that will display a map and silently contact the vehicle to acquire its current location, speed, direction of travel, and previous multiple locations with speeds, for example, the user's personal identification number (PIN) can be quickly activated by a telephone call. No additional installation may be required.

Certain annual pre-pay package arrangements may be available. For example, up to 10 access entries per month can be provided on a low monthly billing. Up to 30 access entries could be provided also for a relatively low monthly fee.

The present invention provides a number of other significant advantages including optional access from any phone or from any computer to access the monitoring station internet site. The user may control various vehicle functions remotely via the telephone or the internet site. The only charge may be for additional equipment and installation.

Additional features can also be included with the system and subscribed to by the user in accordance with the invention. For example, these include Hijack, Car Finding, Unlock Doors and Unauthorized Transmitter Alert Features. The equipment and installation is relatively inexpensive. For the hijack feature: from any phone or computer, the user may activate vehicle starter interrupt and sound the horn until the vehicle is retrieved (Command 4).

For the Car Finding feature: from any phone or computer, the user may activate the vehicle's horn, or siren and sound same for 30 seconds. This allows the user to find his vehicle in a crowded parking lot (Command 5).

For the Lock/Unlock vehicle doors feature: from any phone or computer a predetermined command (Command 7) activates unlocking of vehicle doors to retrieve keys, for example, that may have been accidentally locked inside the vehicle. Of course, the system can also be used to lock vehicle doors if this was forgotten (Command 6). The unauthorized transmitter alert feature is similarly selected as described above.

In addition, a remote vehicle start feature may also be provided, such as to start the vehicle's engine to heat or cool the vehicle prior to entry. The equipment and installation for remote starting may be relatively low. Some further details of a specific embodiment of the vehicle tracking unit **25** are provided below as relating to use of red and green LED indicators as may be coupled to the controller **40** and operated thereby. Also various representative wires, designated by color, are provided as an example embodiment.

The red LED verifies the GPS receiving signal. With a yellow wire having positive 12 volts, the red LED blinking indicates searching GPS location, constant indicates found location, and off indicates no GPS signal found. With the yellow wire not having positive 12 volts, if the red LED is off, the LED is not functioning.

The green LED verifies receiving the cell tower signal. With the yellow wire having positive 12 volts, blinking indicates the cell control channel signal is detectal, constant indicates sending a micro burst signal (LED stays on 5 seconds after each transmission), and off indicates no cell tower signal received. With the yellow wire not having positive 12 volts, off indicates the green LED is not functioning.

An example of representative DIP switch feature selection is as follows. A first switch may be used for adding the orange wire for controlling arm/disarming of the system. When on, the orange wire controls arm/disarm as follows: to arm, the orange wire is grounded and the yellow wire does not have 12

volts positive. To disarm, the orange wire is not grounded. When the first switch is off, then only the yellow wire controls arm/disarm as follows: to arm, the yellow wire is without 12 volts positive, and 30 seconds after continued arm mode then the orange wire activates a constant 500 ma grounded output to operate an external starter interrupt relay until the system is disarmed. To disarm, the yellow wire is connected to 12 volts positive.

A main 5-pin plug may be provided on the vehicle unit and connected as follows:

a. The Red Wire is connected to the 12 vdc power. An alert warning "E" is given if the system is armed and the battery voltage becomes lower than 11 volts for longer than ## minutes. This alert feature "E" will not operate again until the voltage is above 12 volts to re-set this feature.

b. The-black wire is connected to ground.

c. The yellow wire is connected to the ignition 12 volts so that if the key is on, 12 volts is supplied thereto and if the key is off, the yellow wire is connected to ground. Further: if the system is in an armed mode and the Lat/Long changes, then Alert "A" is given. If the system is disarmed and within 2.5 seconds after the yellow wire receives 12 volts and the gray wire detects 3 or more positive pulses the system activates Alert "D". If the first DIP switch is in the off position then: if 12 volts is on yellow wire, the system is disarmed and the orange wire discontinues from the 500 ma ground, and if the yellow wire sees ground or neutral, then the system is armed and 30 seconds after the continued arm mode the orange wire activates a constant 500 ma grounded output to operate an external starter interrupt relay until the system is disarmed.

d. The gray wire is for input and output, and can be connected to an alarm siren or horn positive terminal. In addition:

i. With the system armed and if the gray wire detects +12 v pulsing on/off or on constant for more than 10 seconds from an alarm siren or horn honking activation, then alert warning "B" alarm activation is given.

ii. With system disarmed and if the gray wire detects +12 v pulsing on/off or on constant for more than 10 seconds from an alarm siren or horn honking activation, then alert warning "C" panic activation is given.

iii. With system disarmed and if the Gray wire detects 3 or more 12 volt positive-pulses within 2.5 seconds of yellow wire receiving +12 v and the gray wire by-pass not being activated, then alert warning "D" is given.

iv. The gray wire bypass operates as follows:

1. After alert warning "B" bypass all future alert "B" signals until system is disarmed.
2. After alert warning "C" bypass all future alert "C" signals until system is armed.
3. After alert warning "D" bypass all future alert "D" signals until no 12 volt pulses are detected on the gray wire within 3 seconds of the yellow wire having 12 volts.

v. With the system armed or disarmed. The Output: Internal +12 v, 1 amp transistor with pulses 1 second on and 1 seconds off to activate siren or honk car horn or flashing light relay.

1. Non-stop activation from (Command "4")
2. 30-second activation from (Command "5")

vi. Turn off the above alert "A" from (Command "1").

e. The orange wire is for the starter interrupt and arm/disarm system, and operates as follows:

i. If first DIP switch is in the:

1. On position and: the orange wire has 12 volts or neutral, the system switches to the disarmed mode; the orange wire is grounded, then the system is switched to the armed mode; and the starter interrupt output will not automatically operate. It can only be activated from "Command 4"
2. Off position and the orange wire does not effect the arming or disarming of the system; 30 seconds after system arms the orange wire will automatically activate constant 500 ma ground until the system is disarmed. And from "command #4". Connect to Starter interrupt relay output.

ii. Command 4 activates Orange wire to have 500 ma. negative until Command 1 is received.

iii. After alert warning "B" is activated the first time it is thereafter bypassed while the orange wire remains grounded. Alert warning "B" is re-set to operate again 3 seconds after orange-wire becomes ungrounded.

The vehicle unit may also include a Door Lock Plug configured as follows, for example. A green wire provides a 250 ma, negative 1 second pulse for Lock Doors. (Command "6"). A red wire provides a constant 12 v output from the red power wire. A blue wire provides a 250 ma., negative 1 second pulse for Unlock Doors (Command "7"). A pink wire provides a 250 ma., negative 1 second pulse for remote Car Starter (Command "2").

An installation test button may also be provided to work as follows. Pressing the button activates the orange wire for 10-seconds (starter interrupt), with these circuits in sequence. First, it activates the gray wire for 1-second (siren/horn). After the first stops, it activates the green wire for 1 second to lock the doors. After the second stops, it activates the blue wire for 1 second to unlock the doors. After the third stops, it activates the pink wire for 1 second to activate an optional item.

Representative warning alerts are as follows:

a. Alert Warning "A" (FIG. **4**): Automatic activation of "Command 8" and the vehicle unit contacts monitoring station to instantly call 3 phone numbers with the message "Your vehicle is stolen please confirm then call 911 to advise police of website and your pin # so police can locate the vehicle". This is detected with the system armed and the GPS indicating movement. Bypasses all future alert warning "A" signals until the system is re-armed.

b. Alert Warning "B" (FIGS. **5**A-**5**C): the vehicle unit contacts the monitoring station to instantly call 3 phone numbers with the following message "Vehicle alarm activated please confirm". This is with the system armed and detecting gray wire having 12 volts pulsing or on constant for longer than 10-seconds. After alert warning "B" is activated the first time, it is thereafter bypassed while the orange wire remains grounded. Alert warning "B" is re-set to operate again 3 seconds after orange wire becomes ungrounded.

c. Alert Warning "C" (FIG. **6**): the vehicle unit contacts the monitoring station to instantly send e-mail message "vehicle was traveling faster than your preset amount of "###" and time limit of "##" seconds. Indicates the vehicle speed and location that the speeding started and how long speeding accrued" (Detected from GPS). This aspect is further understood with reference to the enclosed flowchart **84** of FIG. **6**.

d. Alert Warning "D" (FIG. **7**): the vehicle unit contacts the monitoring station to instantly call 3 phone numbers with the message "Unauthorized remote transmitter was

just programmed to operate your vehicle." This is with the system disarmed and the Gray wire detecting three or more 12 volt pulses within 2.5 seconds of the yellow wire having seen 12 volts positive. All future alerts "D" are bypassed until no 12 volt pulses are detected on the gray wire within 3 seconds of the yellow wire seeing 12 volts. This aspect is further understood with reference to the enclosed flowchart **85** of FIG. **7**.

e. Alert Warning "E" (FIG. **8**): the vehicle unit contacts the monitoring station to instantly call 3 phone numbers with the message "Vehicle has low battery voltage and system has changed to low voltage mode". This is with the system armed and detecting the red wire with lower than 11 volts for ## minutes. All future alerts "E" are bypassed until, first, more than 13.5 volts are detected on the red wire and, second, after the yellow wire stops having positive voltage the red wire then must detect more than 12 volts.

The following are representative commands for use in the system:

Command 1: Reset all circuits and system remains asleep until the ignition key is turned on. Resets the triggered mode and unit is asleep to prevent power drain on vehicle battery.

Command 2: (Accessory activation) monitoring station Command to the system to activate Pink wire to pulse 250 ma negative for 1 second.

Command 3: (Vehicle Location) website to indicate present location and past events in memory.

Command 4: (Hijack or Stolen) monitoring station Command to vehicle system to activate:

i. Gray wire to pulse 1 sec on/1 sec off with 1 amp positive output and which continues until receive command # 1.

ii. Orange wire to have 500 ma ground and which continues until receive command # 1.

Command 5: (Car Find) monitoring station Command to system activating Gray wire for 30 seconds pulsing 1 sec on/1 sec off with 1 amp positive output.

Command 6: (Lock Doors) monitoring station Command to system activating Green wire to pulse 1 second with 250 ma negative.

Command 7: (Unlock Doors) monitoring station Command to system to activate Blue wire to pulse 1 second with 250 ma negative.

Command 8: (Start Constant Vehicle Tracking) sends previous 2 events in memory and then every 120 seconds get update of location information sent to the Web site.

The system is also operable in a battery saver mode which operates as follows:

a. With the ignition key off, if the battery voltage drops below 11.5 volts for more than 5 seconds, the GPS verification wakes up to look:

i. Once instantly.

ii. Once in 1 hour if at the same location.

iii. Once in 6 hours if at the same location.

iv. Once in 12 hours if at the same location.

v. Once every 24 hours if at the same location.

vi. Activate alert "E" when the battery saver mode is activated, and bypass sending all future Alert "E" until the battery voltage goes above 13 volts for 10 minutes to reset this feature.

Another aspect of the invention relates to automatic vehicle alert e-mails sent containing some or all of the previous system events. This sending can be triggered as follows:

a. At a user selected predetermined time ## (01-24) of each day, or

b. At a predetermined memory fill level, such as full or near full.

In addition, each system event may contain one or more of the following:

a. Vehicle Location

b. Vehicle total time at location

c. Time of day

d. Mph traveling

e. Total time traveling above MPH

f. Direction traveling

g. Delta

h. Special Alert messages, if any, including:

i. GPS signal not received for longer than 5 minutes.

ii) Traveling above ###MPH for ## minutes.

iii) Vehicle is stolen.

iv) Alarm activated.

v) Unauthorized remote transmitter alert.

vi) Battery saver mode activated

vii) Command 1: Reset all circuits and system remains asleep until the ignition key is turned on.

viii) Command 2: (Accessory activation)

ix) Command 3: (Vehicle Location was retrieved)

x) Command 4: (Hijack or Stolen mode activated)

xi) Command 5: (Car Find mode activated)

xii) Command 6: (Locked Doors)

xiii) Command 7: (Unlocked Doors)

xiv) Command 8: (Started 2-second incremental Vehicle Tracking)

Another feature of the invention relates to the selectable threshold conditions causing an event to be recorded into the memory of the vehicle unit. For example, this may include: while the yellow wire has 12 volts, record events every "?" default 15 minutes time if the GPS location has changed. If the GPS location is the same then only update stationary total time. If the GPS antenna is not receiving any signal then enter last known GPS location and with an indication that this was the last known GPS location before the GPS signal stopped, how long no GPS signal was received, and the GPS location in the on-hold file, when the vehicle is traveling above ### MPH for ##-minutes.

The monitoring station may also provide a number of automated phone calls as described above. These may include:

The user's vehicle has issued a stolen alert:

If vehicle is stolen, after receiving the phone message the user then calls 911 to advise police of the theft, and gives the police the website address and an identification number, such as the user's PIN, to allow the police to locate where your vehicle has been, where it is now and keep tracking it until the police can retrieve the vehicle.

If this is a false alert due to vehicle being towed away for service, for example, then the user may press "1" to put the vehicle in an off mode. Once the ignition key is turned on again the system will reset back to its normal operation mode.

The user's vehicle has issued an alarm activated for more than 10 seconds alert. The system will not respond to this alert again until ignition key is turned on again to reset this feature.

The vehicle battery voltage is low or has been disconnected. The tracking system is in low voltage mode. The system will not respond to this alert again until the battery voltage goes above 13 volts for 10 minutes to reset this feature.

The backup battery may be sized according to the GPS receiver and processing power draw. In addition, the battery may also be sized based upon estimated micro burst transmitting power draw. Such transmissions are typically at about 3 watts power to the antenna.

The system according to the invention including the vehicle unit and monitoring station provides a number of significant advantages and features. For example, the police

may be directly contacted by the user when the vehicle is stolen. The user receives the telephone message from the monitoring station, and this is done without requiring the intervention of a manual security monitoring operator, such as an ADT operator, for example. In addition, once in the stolen mode, the vehicle unit will periodically continue to send out its location, so that the police may track the vehicle via the WEB, for example. This location sending feature may begin immediately, that is, without requiring the user to contact the vehicle to begin tracking. Having the vehicle contacting the monitoring station is considerably less expensive than other schemes where the vehicle is periodically polled via the cellular network, for example.

The system may also be interfaced to a breath alcohol sensor at the vehicle, for example, and this information recorded in memory. The information could be passed along to the monitoring station, which, in turn, could send out a notification message (e-mail or telephone) that the vehicle is being operated by a driver who may be impaired by alcohol. The vehicle's location could then be tracked to permit the police to detain the driver.

Another aspect of the unit is that it may be able to recognize the desirability to bypass certain security breach triggers or other events. For example, a car finding feature can be provided that will allow the user to sound the horn or siren when near the vehicle to help locate the vehicle, as in a crowded parking area. Without the bypass feature, the unit could recognize the horn or siren as a security breach and transmit such information to the monitoring center. In accordance with this aspect of the invention, the unit would recognize the car finding feature was activated and thereby bypass sending a security breach transmission, for example. Again, false alarms and unneeded usage and expense of the communications

infrastructure would be avoided.

Yet another aspect of the invention relates to thwarting a would-be thief who attempts to disable the alarm by cutting the battery cable or power supplied to the system. The unit preferably includes a back-up battery. More particularly, upon being in an armed mode and sensing a breach of security, such as the hood opening, for example, the unit will send out a signal indicating the alarm or security breach and while the alarm is indicated, if the battery is disconnected then the unit will send out a message indicating the vehicle is stolen, and also providing the vehicle's current position. Accordingly, the would-be thief is not able to defeat the security system by quickly disrupting power to the unit during an alarm indication or security breach. Also, to prevent additional alerts, this message is prevented from being transmitted again until the user returns to the vehicle to disarm the system and/or turn on the ignition so that the unit sees a voltage above 13 volts, indicating the vehicle has started using the owner's ignition key. This aspect is further understood with reference to the enclosed flowchart **80** (FIG. **4**).

Still another aspect of the invention relates to how the unit can discriminate between ordinary usage or honking of the horn as compared to a security system triggered alarm. Most vehicle security systems will provide a pattern of horn soundings as an alarm indication, and this can be determined and used to reduce false alarm transmissions from the unit. For example, the unit can look at the number of leading and trailing edges of the power pulse used to sound the horn. A single pressing of the horn switch by the user will cause two edges within a predetermined time, such as about 10 to 12 seconds. Accordingly, the unit can be configured to not send a security breach transmission to the control center based upon detecting two transitions. Since a number of vehicle security systems may have a continuous sounding of the horn within the predetermined time, the unit can send the transmission upon detecting only a single transition.

A number of other vehicle security systems provide a series of pulses or horn soundings within the predetermined time. Accordingly, the unit may also be configured to send a security breach transmission upon detecting greater than a predetermined number of transitions, such as greater than nine, for example. This number is also typically higher than a user would generate honking the horn several times within the predetermined time. In other terms, the number of transitions of the horn pulses can be counted, and if equal to one, or greater than nine, for example, the transmission is triggered, and otherwise the sounding of the horn is ignored. Also, to prevent additional alerts, this message is prevented from being transmitted again until the user returns to the vehicle to disarm the system and/or turn on the ignition so that the unit sees a voltage above 13 volts, indicating the vehicle has started using the owner's ignition key. This aspect is further understood with reference to the enclosed flowcharts **81-83** (FIGS. **5A-5C**).

Yet another feature of the invention relates to a low vehicle battery alert. For example, the unit may monitor the battery voltage over a predetermined time such as ten minutes. The ten minute window prevents false tripping, for example, when the voltage dips during engine cranking. In particular, the voltage can be sensed and it can be determined whether it is greater than zero (e.g. greater than six volts) and less than a high value (e.g. eleven or twelve volts), and, if so, a low battery voltage transmission can be communicated to the monitoring station, and ultimately to the vehicle user when away from the vehicle. If the vehicle is being serviced and the battery is disconnected, this will cause the battery voltage to be equal to zero. Then, the low battery voltage transmission will not be communicated to the monitoring station. Also, to prevent additional alerts, this message is prevented from being transmitted again until the user returns to the vehicle to disarm the system and/or turn on the ignition so that the unit sees a voltage above 13 volts, indicating the vehicle has started using the owner's ignition key. Again, false triggerings are reduced. This aspect is further understood with reference to the enclosed flowchart **86** (FIG. **8**).

Yet another advantageous feature of some embodiments of the invention relates to the ability to conserve electrical power. More particularly, when the vehicle is stopped and in the armed mode, the GPS receiver may be periodically operated to determine the vehicle position. If the vehicle position changes, this is indicative that the vehicle is being moved or stolen. For example, the GPS receiver may be operated to generate new vehicle position information every 29 seconds. These relatively quick successive position determinations or readings are generally termed hot start. These are relatively less complicated than a cold start position determination which takes longer, since the cold start position determination requires greater time to acquire and receive data from multiple satellites, as will be appreciated by those skilled in the art.

Unfortunately, this relatively high repeated usage of the GPS receiver may cause unnecessary battery drain, especially when the vehicle is left armed and unattended by the user for an extended period. Accordingly, the power conserving feature of the invention permits the GPS receiver to be turned off when the vehicle is in the armed mode, and the GPS receiver is turned on only when needed. For example, a vehicle sensor, such as a shock sensor, motion sensor, ignition sensor, door sensor, or other sensor, or combinations thereof could be used to start the GPS receiver. This sensor could also be used to

trigger an alarm if desired; however it need not be so used in all embodiments. The GPS receiver, once turned on, could operate in the normal periodic fashion as described above, or for a fixed period of time. The GPS receiver could also be turned off again after some predetermined time if no further sensor signal is received, or if the position fails to change on subsequent position readings or determinations.

Yet another feature relates to permitting more colorful audible alert messages to be generated for the user. The user can, in some embodiments, access an internet site to type or enter the text for a message to be sent, such as to alert the user that his vehicle is being stolen. The audible message then communicated by a telephone call to the user is generated by a speech message synthesizer based upon the entered text. In accordance with this aspect of the invention, the user could type in phonetically spelled words or phrases, such as to create more colorful messages including slang terms, various accents, and/or to mimic various dialects, for example. The speech synthesizer would then generate the desired message customized for the user. Of course, the system could also permit the user to test or preview the pronunciation generated by the speech message synthesizer based on the entered text message prior to its adoption.

Another aspect relates to requesting GPS position information from a vehicle. If a command is sent downstream to the vehicle requesting that GPS information in turn be sent upstream from the vehicle, and the GPS information is not received within a predetermined time, such as about four minutes, then another command may be sent to the vehicle requesting the GPS information. This may keep repeating until GPS information is received, for a predetermined number of tries, or until a user instructs stopping of the requests. This helps to ensure and confirm the activation and reception of GPS tracking coordinates from the vehicle.

Yet another aspect relates to reducing a frequency with which GPS information is sent from the vehicle. More particularly, the unit may be configured to activate GPS information transmission upstream every 2 minutes. To reduce system usage expense and power consumption at the vehicle, this rate of transmission of GPS information could be progressively decreased over time. For example, in one embodiment, upon activation the GPS location signals could be sent every 2 minutes during the first hour, then once an hour for the next 23 hours, after which only one signal would be sent per day.

Turning now to the flowchart **87** of FIG. **9**, still another aspect relates to warning the user of an inoperable or malfunctioning GPS or cellular telephone section. More particularly, if the GPS or cellular telephone antenna wire is cut or the mounting position of either is changed causing the antenna to stop receiving the signal the user would not ordinarily know of this problem quickly. In accordance with one embodiment, if the ignition is turned on a predetermined number of times, such as about three, and each time ignition turns on if no GPS or no cell signal is received for a minimum time, such as about 15 to 30 minutes or longer, an audible warning beeper may be activated in the vehicle. This beeper may be sounded once every 15-minutes. At anytime if the GPS or cell signal is received properly then the system re-sets automatically stopping the beeper sound.

As an example, if the ignition key is turned on and no GPS or no Cell signal is being received for 15-minutes, and the vehicle ignition stays on for 45-minutes and there is still no GPS or no cell signal, the unit counts one. Thereafter, if the ignition key is turned on and no GPS or no cell signal is being received for 15-minutes, and the vehicle ignition stays on for 60-minutes and there is still no GPS or no cell signal, a second count is determined. Thereafter, if the ignition is turned on and no GPS or no cell signal is received for 10-minutes, and the vehicle ignition stays on for only 10-minutes and there is still no GPS or no cell signal, no count is determined. Thereafter, if the ignition is turned on and no GPS or no cell signal is being received for 15-minutes, a third count is determined and the beeper is activated as described above. This beeping may continue every 15-minutes while the vehicle ignition stays on as long as the vehicle ignition stays on for 16-minutes and still no GPS or no Cell signal is being received. If thereafter, the ignition is turned on and no GPS or no cell signal is being received, the beeper beeps once and again beeps once every 15-minutes while vehicle ignition stays on. If in 10-minutes both GPS or cell signal is being received, the beeper system is turned off and the warning count is reset.

By way of example, if the ignition key is turned on and no GPS or no cell signal is being received for only 5, 10 or 12 minutes (with the threshold set at 15 minutes), then no count is determined.

In certain circumstances, the GPS signal may fail, but the cell signal may still be working. Accordingly, it may be desirable to send an indication of the failure of the GPS signal to the central monitoring station to thereby alert the user as described above. If the cell signal also failed, or if the cell signal failed by itself, in other embodiments a separate paging device would transmit the failure or loss of the cell signal information to the central monitoring station, to thereby alert the user.

Yet another feature is directed to efficient use of a relatively small number of codes available to communicate with the tracking unit from the cellular network and central station. More particularly, a typical arrangement may provide eight basic codes and two Awildcard@ codes. The two wildcard codes are reserved for future or other uses. A particular tracking device will respond directly to any of the eight basic codes. For example, the doors could be locked or unlocked, a present location downloaded from the vehicle, etc.

In accordance with this feature, the tracking device may respond differently to the same code or command depending upon the state or condition of the tracking device. For example, if an alarm is triggered at the vehicle, it may be desired that the tracking device continue to send the alarm signal until confirmation is received that the central monitoring station has received the alarm signal. This confirmation can be sent using the same code as may provide another function if the device were not indicating an alarm. Any of a number of such tracking device conditions may trigger a different message to be interpreted from the received code. For example, if any of the above Alerts A-E were triggered, the receipt of a predetermined code, such as code eight, would confirm receipt of the alert by the central station, and this receipt of code eight would not cause the other response (no alarm triggered) in the tracking device. Of course this concept can be extended to other features as will be appreciated by those skilled in the art.

In accordance with another feature, the rate of sending the location or position data (or change in position data) from the vehicle may be varied to reduce system usage and thereby reduce expenses. More particularly, in one embodiment, the rate of sending may be based upon how long the vehicle has remained stationary. This time period may be selected by the user. For example, the selected time may be in the range of 15 minutes to six hours. If the vehicle has been stationary for the selected time period, then the rate of transmission may be reduced. This reduces or eliminates the need to send home position data and send all the over 15-minute stops made that day. Otherwise, that is when the vehicle is moving, the device

may send data at a faster rate. Of course, a system user would not likely be interested in quick updates, especially where the position information is not changing. Conversely, if the vehicle is being moved, it may be desirable to receive more frequent position updates.

Another variation of this transmission rate conservation feature bases the rate of transmission on the vehicle position. For example, a reduced rate of transmission may be selected if the vehicle is in a predetermined area where the user has a lesser interest in quickly updated position information. The user may also have a reduced interest in an area that can be defined outside of a predetermined distance from a reference point.

Yet another variation of the vehicle position transmission rate conservation feature is based upon the vehicle's speed, such as the vehicle's average or maximum speed, for example. Accordingly, if the vehicle is traveling above a preset speed, the rate of transmission may be increased.

In accordance with another aspect of the invention, the tracking device may send the alert indication a predetermined number of times without receiving an acknowledgment as described above, and then wait until the vehicle position has changed before trying again or the cell re-registers or its RSS (received signal strength) changes. Thus, power is conserved. When the vehicle has moved to a new position, any obstructions may no longer be present thereby increasing the likelihood of a successful communication. In addition, the change in position may be determined when the vehicle is sensed to be moving about a predetermined relatively small speed, such as greater than 1 mph, for example.

In all of the embodiments and variations described herein, the tracking device may communicate with one or more other vehicle devices via a vehicle data communications bus. Further aspects of interfacing with a vehicle data communications bus are described in U.S. Pat. Nos. 5,719,551 and 6,011,460 assigned to the assignee of the present invention.

Yet another aspect relates to efficient use of available codes on the cellular telephone control channel. In one particular example, ten codes may be available to be transmitted from the monitoring station to the vehicle trackers. The first eight or nine codes are command codes that will cause a specific action by the tracking device at the vehicle. The other one or two codes may be wildcard codes as mentioned above, that may set a stand-by mode for one or a group of vehicles, for example.

It may be desirable to provide more than eight commands at the vehicle responsive to the corresponding eight available codes. For example, it may be desirable to set a feature on or off, or to set a different feature setting or threshold. In accordance with this aspect of the invention, the commands at the tracker are determined based upon a series of different command codes being received within a predetermined time window.

For example, the monitoring station may send code 9 that switches the tracker in the car into a stand-by mode for a predetermined time and which causes the tracker to respond with an upstream confirmation code 7 or 9 indicating receiving code 9. During the predetermined time of the stand-by mode another code follows that causes a system programmable feature or setting to change. Note that the second code would otherwise cause a different function at the vehicle. Note that system might operate a function 9 if another code 1-9 is not received in the predetermined time. The following list is exemplary for features resulting from second codes 1-9:

Code 1—Tracker will turn off feature of upstream code caused by vehicle alert being detected.

Code 2—Tracker will turn on feature of upstream code caused by vehicle alert being detected.

Code 3—Tracker deactivates cell receiver from operating due to a non-paying customer for monitoring service. That phone number can then be allocated to another customer.

Code 4—Turn on audio buzzer feature that will sound once each 10 minutes. The monitoring station need only send the command to activate the feature, as the tracker will time the period and drive the buzzer thereafter. The monitoring station will normally not need to send this command because the tracker will be configured out of the box with this feature activated to sound the buzzer every 10 minutes until the next command is received.

Code 5—Turn off the audio buzzer. This is to be sent by the monitoring station after a user has successfully activated his account.

Code 6—Turn on the 80 mph speed limit reporting. This will normally not be sent as this feature will be the default setting of the tracker.

Code 7—Turn off the 80 mph speed limit reporting.

Code 8—Increase speed limit 5 mph and increase the time 5 minutes.

Code 9—Decrease speed limit 5 mph and decrease the time 5 minutes, and wait 5 minutes if another code number follows. It could operate this way to allow another set of codes to change more features.

In this example, in response to the tracker receiving the system code 1-9, the tracker sends an upstream code 7 to acknowledge receipt of the system code 1-9. Upon receipt of code 9 the tracker waits up to 5 minutes to determine if another system code is received. If no code is received, then the tracker performs the code 9 operation. Of course, in other embodiments other features or settings can be selected. In general, it may be preferred that the first code sent in a series of two codes, for example, be a code that causes only a minor function to be performed at the vehicle. This is so because if the second code is sent from the monitoring station, but not received at the tracker, only a minor function is performed. For example, the first code may switch between armed and disarmed modes. This is in contrast to using a remote engine starting code or engine shutdown code as the first code. The vehicle may be moving or positioned in a marginal reception area, and the second command may not be received by the tracker within the predetermined time window. As will be appreciated by those skilled in the art, this concept of multiple digit codes, can be extended beyond two digits to three or more.

To further conserve cellular transmissions and as described above, the tracker may be set to record a position based upon a determined event. Only this recorded position information may be downloaded either by user request or at set times. It is desired that such events be relatively few, but that the information still be helpful to the user.

For example, an event for recording of position may be determined based upon the vehicle being stopped for greater than a first time and less than a second time. For example, the first time may be 15 minutes and the second time may be 6 hours. Determination of the vehicle being stopped can be made based upon one or both of the GPS position or the vehicle ignition being turned off. The second time prevents the recording of position information when the vehicle is stopped at the owner's home during the evening, for example. Accordingly, the important information of the vehicle stops being made is recorded and made available to the user, while system communications resources are conserved.

In another example, if the mode is selected to send the vehicle's location every 10 min and the vehicle is in the same

location for greater than a set time, then no more vehicle locations are sent until the vehicle location has changed to start the every 10 min reporting again.

Other features relating to vehicle control systems are disclosed in copending patent applications entitled VEHICLE TRACKER INCLUDING STATIONARY TIME DETERMINATION AND ASSOCIATED METHODS, Ser. No. 09/859,727 filed May 17, 2001, now U.S. Pat. No. 6,512,465; VEHICLE TRACKER CONSERVING CODES AND RELATED METHODS, Ser. No. 09/859,673 filed May 17, 2001, now U.S. Pat. No. 6,522,267; VEHICLE TRACKER WITH POWER SAVING FEATURES AND RELATED METHODS, Ser. No. 09/859,728 filed May 17, 2001, now U.S. Pat. No. 6,512,466; VEHICLE TRACKER COOPERATING WITH A STARTER INTERRUPT AND RELATED METHODS, Ser. No. 09/859,973 filed May 17, 2001; VEHICLE TRACKER WITH USER NOTIFICATIONS AND ASSOCIATED METHODS, Ser. No. 09/859,733 filed May 17, 2001, now U.S. Pat. No. 6,509,868; VEHICLE TRACKER WITH USER REGISTRATION REMINDER AND RELATED METHODS, Ser. No. 09/859,971 filed May 17, 2001, now U.S. Pat. No. 6,507,786; VEHICLE TRACKER INCLUDING INPUT/OUTPUT FEATURES AND RELATED METHODS, Ser. No. 09/859,972 filed May 17, 2001, now U.S. Pat. No. 6,606,561; and VEHICLE TRACKER WITH TEST FEATURES AND RELATED METHODS, Ser. No. 09/859,729 filed May 17, 2001, now U.S. Pat. No. 6,809,659, the entire disclosures of which are incorporated herein by reference.

Many modifications and other embodiments of the invention will come to the mind of one skilled in the art having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Accordingly, it is understood that the invention is not to be limited to the embodiments disclosed, and that other modifications and embodiments are intended to be included within the spirit and scope of the appended claims.

That which is claimed is:

1. A vehicle control system comprising:

a tracking unit and a function unit cooperating therewith, said tracking unit comprising a vehicle position determining device, a wireless communications device, and a tracking controller configured to cooperate with said vehicle position determining device and said wireless communications device to send vehicle position information to a user;

said function unit comprising at least one uniquely coded transmitter to be carried by a user, a receiver at the vehicle for receiving signals from said at least one uniquely coded transmitter, and a function controller at the vehicle and connected to said receiver for learning the at least one uniquely coded transmitter to permit control of a vehicle function by the user;

said function controller configured to cooperate with said wireless communications device of said tracking unit to send an alert indication of whether at least one new uniquely coded transmitter has been learned.

2. The vehicle control system according to claim 1 further comprising a local indicator connected to said function controller for providing a local indication of whether at least one uniquely coded transmitter has been learned.

3. The vehicle control system according to claim 1 wherein the vehicle function is associated with at least one of starting of a vehicle engine, vehicle door locks, and vehicle security.

4. The vehicle control system according to claim 1 wherein said function controller is configured to switch to a learning mode to permit learning of the at least one uniquely coded transmitter, and wherein said function controller is configured to cooperate with said wireless communications device for sending the alert indication when the learning mode has been entered.

5. The vehicle control system according to claim 1 wherein said function controller is configured to cooperate with said wireless communications device for sending the alert indication for a passage of time since the learning mode has last been entered.

6. The vehicle control system according to claim 1 wherein said function controller is configured to cooperate with said wireless communications device for sending the alert indication for a number of learned uniquely coded transmitters.

7. The vehicle control system according to claim 1 wherein said function controller is configured to cooperate with said wireless communications device for sending the alert indication for a change in a number of learned uniquely coded transmitters.

8. The vehicle control system according to claim 1 wherein said function controller is configured to cooperate with said wireless communications device for sending the alert indication for a change in a code of at least one learned uniquely coded transmitter.

9. The vehicle control system according to claim 1 wherein said at least one uniquely coded transmitter comprises at least one of a uniquely coded remote transmitter, and a uniquely coded transponder transmitter.

10. The vehicle control system according to claim 1 wherein said vehicle position determining device comprises a Global Positioning System (GPS) device; and wherein said wireless communications device comprises a cellular telephone communications device.

11. A vehicle control system comprising:

a tracking unit and a function unit cooperating therewith, said tracking unit comprising a vehicle position determining device, a wireless communications device, and a tracking controller configured to cooperate with said vehicle position determining device and said wireless communications device to send vehicle position information to a user;

said function unit comprising a biometric characteristic sensor for sensing a unique biometric characteristic of a user, and a function controller at the vehicle and connected to said biometric characteristic sensor for learning the unique biometric characteristic to permit control of a vehicle function by the user;

said function controller configured to cooperate with said wireless communications device of said tracking unit to send an alert indication of whether at least one new unique biometric characteristic has been learned.

12. The vehicle control system according to claim 11 further comprising a local indicator connected to said function controller for providing a local indication of whether the unique biometric characteristic has been learned.

13. The vehicle control system according to claim 11 wherein the vehicle function is associated with at least one of starting of a vehicle engine, vehicle door locks, and vehicle security.

14. The vehicle control system according to claim 11 wherein said function controller is configured to switch to a learning mode to permit learning of the unique biometric characteristic; and wherein said function controller is configured to cooperate with said wireless communications device for sending the alert indication when the learning mode has been entered.

15. The vehicle control system according to claim 11 wherein said function controller is configured to cooperate

with said wireless communications device for sending the alert indication for a passage of time since the learning mode has last been entered.

16. The vehicle control system according to claim 11 wherein said function controller is configured to cooperate with said wireless communications device for sending the alert indication for a change in a number of learned unique biometric characteristics.

17. The vehicle control system according to claim 11 wherein said vehicle position determining device comprises a Global Positioning System (GPS) device; and

wherein said wireless communications device comprises a cellular telephone communications device.

18. A vehicle control method for a vehicle comprising a vehicle tracking unit for sending vehicle position information to a user, the method comprising:

receiving signals from at least one uniquely coded transmitter at a receiver at the vehicle;

learning the at least one uniquely coded transmitter to permit control of a vehicle function by the user using a function controller at the vehicle and connected to the receiver; and

sending an alert indication of whether at least one new uniquely coded transmitter has been learned using the vehicle tracking unit.

19. The method according to claim 18 further comprising providing a local indication at the vehicle of whether at least one uniquely coded transmitter has been learned.

20. The method according to claim 18 wherein the vehicle function is associated with at least one of starting of a vehicle engine, vehicle door locks, and vehicle security.

21. The method according to claim 18 wherein the function controller is configured to switch to a learning mode to permit learning of the at least one uniquely coded transmitter; and wherein sending comprises sending the alert indication when the learning mode has been entered.

22. The method according to claim 18 wherein sending comprises sending the alert indication for a number of learned uniquely coded transmitters.

23. The method according to claim 18 wherein sending comprises sending the alert indication for a change in a number of learned uniquely coded transmitters.

24. The method according to claim 18 wherein sending comprises sending the alert indication for a change in a code of at least one learned uniquely coded transmitter.

25. A vehicle control method for a vehicle comprising a vehicle tracking unit for sending vehicle position information to a user, the method comprising:

sensing a unique biometric characteristic of a user using a biometric characteristic sensor at the vehicle;

learning the unique biometric characteristic to permit control of a vehicle function by the user using a function controller at the vehicle and connected to the biometric characteristic sensor; and

sending an alert indication of whether at least one new unique biometric characteristic has been learned using the vehicle tracking unit.

26. The method according to claim 25 further comprising providing a local indication of whether the unique biometric characteristic has been learned.

27. The method according to claim 25 wherein the vehicle function is associated with at least one of starting of a vehicle engine, vehicle door locks, and vehicle security.

28. The method according to claim 25 wherein the function controller is configured to switch to a learning mode to permit learning of the unique biometric characteristic; and wherein sending comprises sending the alert indication when the learning mode has been entered.

29. The method according to claim 25 wherein sending comprises sending the alert indication for a change in a number of learned unique biometric characteristics.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,720,597 B2
APPLICATION NO. : 11/076259
DATED : May 18, 2010
INVENTOR(S) : Flick et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 1, Line 13	Delete: "flied" Insert: --filed--
Column 4, Line 35	Delete: ".""
Column 8, Line 22	Delete: "off" Insert: --of--
Column 19, Line 54	Delete: "time ignition" Insert: --time the ignition--

Signed and Sealed this

Seventeenth Day of August, 2010

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

US008032278B2

(12) **United States Patent**
Flick

(10) **Patent No.: US 8,032,278 B2**
(45) **Date of Patent: Oct. 4, 2011**

(54) **VEHICLE TRACKING UNIT WITH DOWNLOADABLE CODES AND ASSOCIATED METHODS**

(75) Inventor: **Kenneth E. Flick**, Douglasville, GA (US)

(73) Assignee: **Omega Patents, L.L.C.**, Douglasville, GA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 840 days.

(21) Appl. No.: **11/773,272**

(22) Filed: **Jul. 3, 2007**

(65) **Prior Publication Data**

US 2007/0279283 A1 Dec. 6, 2007

Related U.S. Application Data

(63) Continuation-in-part of application No. 11/076,259, filed on Mar. 9, 2005, now Pat. No. 7,720,597, which is a continuation of application No. 10/383,496, filed on Mar. 7, 2003, now Pat. No. 7,149,623, which is a continuation of application No. 09/859,972, filed on May 17, 2001, now Pat. No. 6,606,561.

(60) Provisional application No. 60/264,811, filed on Jan. 29, 2001, provisional application No. 60/258,005, filed on Dec. 22, 2000, provisional application No. 60/251,552, filed on Dec. 6, 2000, provisional application No. 60/252,125, filed on Nov. 20, 2000, provisional application No. 60/236,890, filed on Sep. 29, 2000, provisional application No. 60/246,463, filed on Nov. 7, 2000, provisional application No. 60/222,777, filed on Aug. 3, 2000, provisional application No. 60/205,178, filed on May 17, 2000.

(51) **Int. Cl.**
G01C 21/00 (2006.01)

(52) **U.S. Cl.** **701/36**; 701/33; 382/104; 382/988; 455/575.9

(58) **Field of Classification Search** 701/36, 701/207–209; 340/500, 506, 515, 531, 533–534
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,223,844 A 6/1993 Mansell et al. 342/357
(Continued)

FOREIGN PATENT DOCUMENTS

DE 19607017 A1 * 8/1997
(Continued)

OTHER PUBLICATIONS

Intelligent Object-Tracking using Sensor Networks; Sridhar, R.; Madni, A.M.; Jamshidi, M.; Sensors Applications Symposium, 2007. SAS '07. IEEE; Feb. 6-8, 2007 pp. 1-5; Digital Object Identifier 10.1109/SAS.2007.374384.*

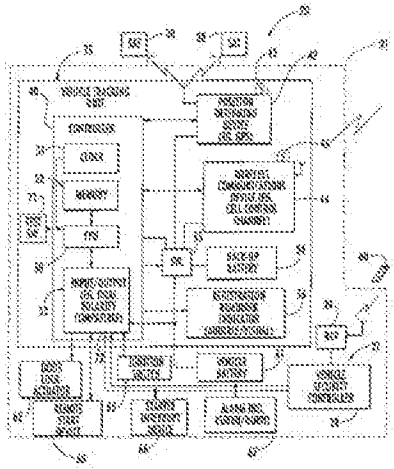
(Continued)

Primary Examiner — Cuong H Nguyen
(74) *Attorney, Agent, or Firm* — Allen, Dyer, Doppelt, Milbrath & Gilchrist, P.A.

(57) **ABSTRACT**

A multi-vehicle compatible tracking unit is for a vehicle including a vehicle data bus extending throughout the vehicle. The vehicle tracking unit may include a vehicle position determining device, a wireless communications device, and a multi-vehicle compatible controller for cooperating with the vehicle position determining device and the wireless communications device to send vehicle position information. The multi-vehicle compatible controller may be coupled to the vehicle data bus for communication thereover with at least one vehicle device using at least one corresponding vehicle device code from among a plurality thereof for different vehicles. A downloading interface may be included for permitting downloading of enabling data related to the at least one corresponding vehicle device code for use by the multi-vehicle compatible controller.

22 Claims, 13 Drawing Sheets



U.S. PATENT DOCUMENTS

5,515,043	A	5/1996	Berard et al.	340/988
5,635,693	A *	6/1997	Benson et al.	340/10.33
5,654,688	A	8/1997	Flick et al.	340/426
5,719,551	A	2/1998	Flick	340/426
5,940,007	A *	8/1999	Brinkmeyer et al.	340/825.69
6,011,460	A	1/2000	Flick	340/426
6,253,064	B1 *	6/2001	Monroe	455/66.1
6,611,755	B1 *	8/2003	Coffee et al.	701/213
6,628,233	B2 *	9/2003	Knockeart et al.	342/357.31
6,657,587	B1 *	12/2003	Mohan	342/357.75
6,756,885	B1	6/2004	Flick	340/426.1
6,859,831	B1 *	2/2005	Gelvin et al.	709/224
6,888,495	B2 *	5/2005	Flick	342/357.07
7,015,830	B2 *	3/2006	Flick	340/989
7,085,775	B2 *	8/2006	Short et al.	1/1
7,149,623	B2 *	12/2006	Flick	701/207
7,196,621	B2 *	3/2007	Kochis	340/539.13
7,305,293	B2 *	12/2007	Flick	701/45
7,308,341	B2 *	12/2007	Schofield et al.	701/1
7,343,244	B2 *	3/2008	Flick	701/207
7,366,892	B2 *	4/2008	Spaur et al.	713/161
7,502,687	B2 *	3/2009	Flick	701/213
7,526,367	B2 *	4/2009	Schofield et al.	701/1
7,725,253	B2 *	5/2010	Foxlin	701/207
7,734,392	B2 *	6/2010	Schofield et al.	701/36
7,873,593	B2 *	1/2011	Schofield et al.	701/1
2002/0152033	A1 *	10/2002	Roy et al.	702/185
2002/0188702	A1 *	12/2002	Short et al.	709/220
2004/0066330	A1 *	4/2004	Knockeart et al.	342/357.07
2004/0073440	A1 *	4/2004	Garbers et al.	705/1
2006/0173601	A1 *	8/2006	Bassiere et al.	701/53
2006/0187026	A1 *	8/2006	Kochis	340/539.13
2008/0051957	A1 *	2/2008	Breed et al.	701/36
2008/0221752	A1 *	9/2008	Jager et al.	701/35
2009/0240397	A1 *	9/2009	Schofield et al.	701/36
2010/0010706	A1 *	1/2010	Gormley	701/33
2010/0222963	A1 *	9/2010	Schofield et al.	701/36
2011/0029196	A1 *	2/2011	Escott	701/36

FOREIGN PATENT DOCUMENTS

DE	19607017	C2 *	6/2000
EP	725377	A2 *	8/1996
JP	3019952	B2 *	6/2003
TW	275083	A *	5/1996

OTHER PUBLICATIONS

Energy efficient sleep scheduling based on moving directions in target tracking sensor network; Bo Jiang; Kai Han; Ravindran, B.; Hyeonjoong Cho; Parallel and Distributed Processing, 2008. IPDPS 2008. IEEE International Symposium on; Apr. 14-18, 2008 pp. 1-10; Digital Object Identifier 10.1109/IPDPS.2008.4536336 *

A self-organizing hybrid sensor system with distributed data fusion for intruder tracking and surveillance; Palaniappan, R.; Clarke, T.; Wahid, P.; Belidad, N.; Kincaid, F., Antennas and Propagation Society International Symposium, 2008. AP-S 2008. IEEE; Jul. 5-11, 2008 pp. 1-4; Digital Object Identifier 10.1109/APS.2008.4619564.*

SVATS: A Sensor-Network-Based Vehicle Anti-Theft System; Hui Song; Sencun Zhu; Guohong Cao; INFOCOM 2008. The 27th Conference on Computer Communications. IEEE; Apr. 13-18, 2008 pp. 2128-2136; Digital Object Identifier 10.1109/INFOCOM.2008.279.*

Omega Research and Development, Inc., "GPS 2000", distributed at Consumer Electronics Show in Las Vegas, NV. Jan. 2001. pp. 1-4.*

Security Challenges of Location-Aware Mobile Business; Tarly, E.I.; Stegemann, D.; Lucks, S.; Mobile Commerce and Services, 2005. WMCS '05. The Second IEEE International Workshop on; Jul. 19, 2005 pp. 84-95, Digital Object Identifier 10.1109/WMCS.2005.23.*

Motion tracking: no silver bullet, but a respectable arsenal; Welch, G.; Foxlin, E.; Computer Graphics and Applications, IEEE vol. 22, Issue 6, Nov.-Dec. 2002 pp. 24-38; Digital Object Identifier 10.1109/MCG.2002.1046626.*

Localization of ahead vehicles with on-board stereo cameras; Zanin, M.; Image Analysis and Processing, 2007. ICIAP 2007. 14th International Conference on; Sep. 10-14, 2007 pp. 111-116; Digital Object Identifier 10.1109/ICIAP.2007.4362766.*

* cited by examiner

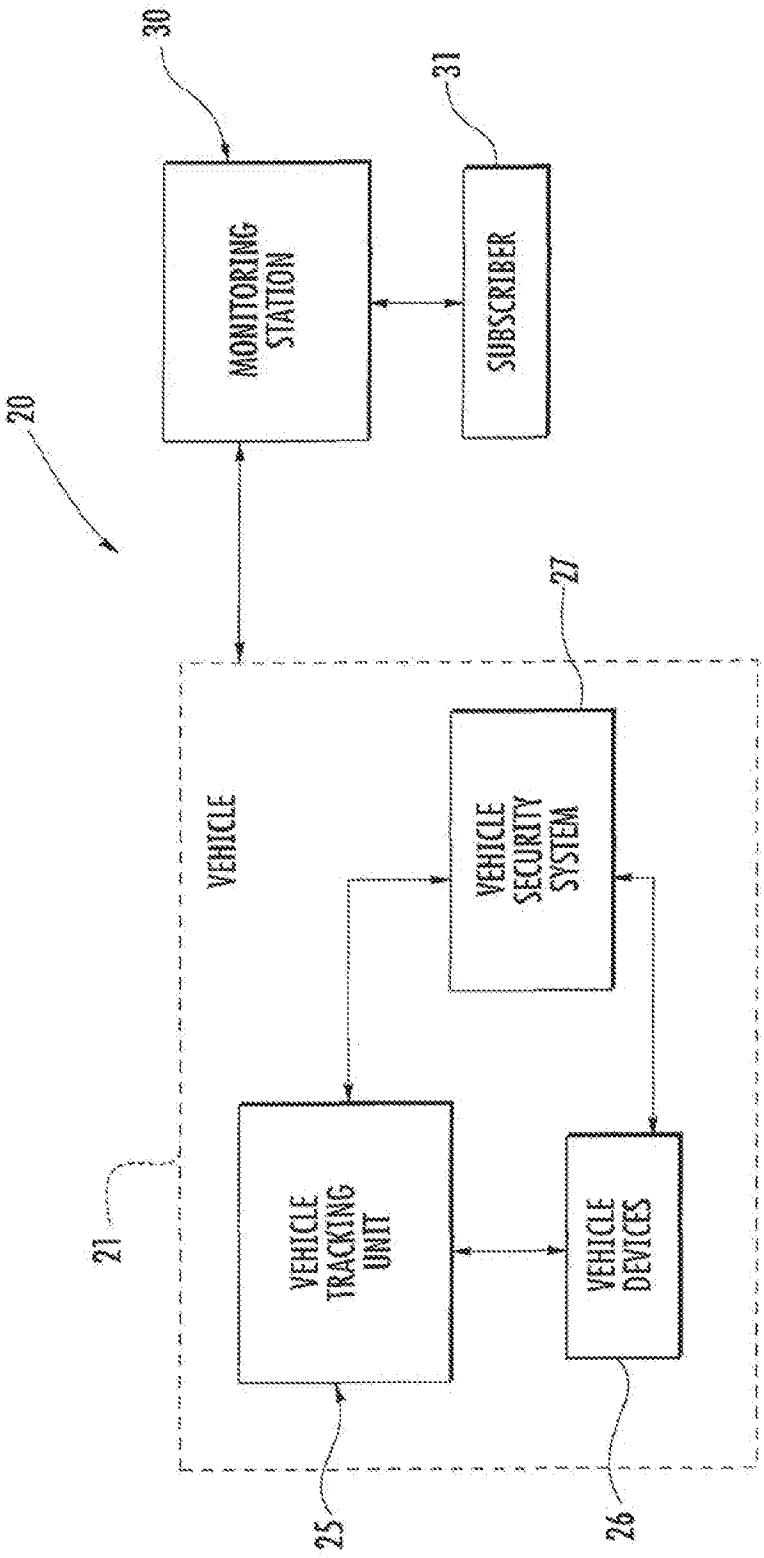

30
31
MONITORING STATION
SUBSCRIBER
20
27
VEHICLE
VEHICLE SECURITY SYSTEM
21
VEHICLE TRACKING UNIT
VEHICLE DEVICES
25
26

FIG. 1

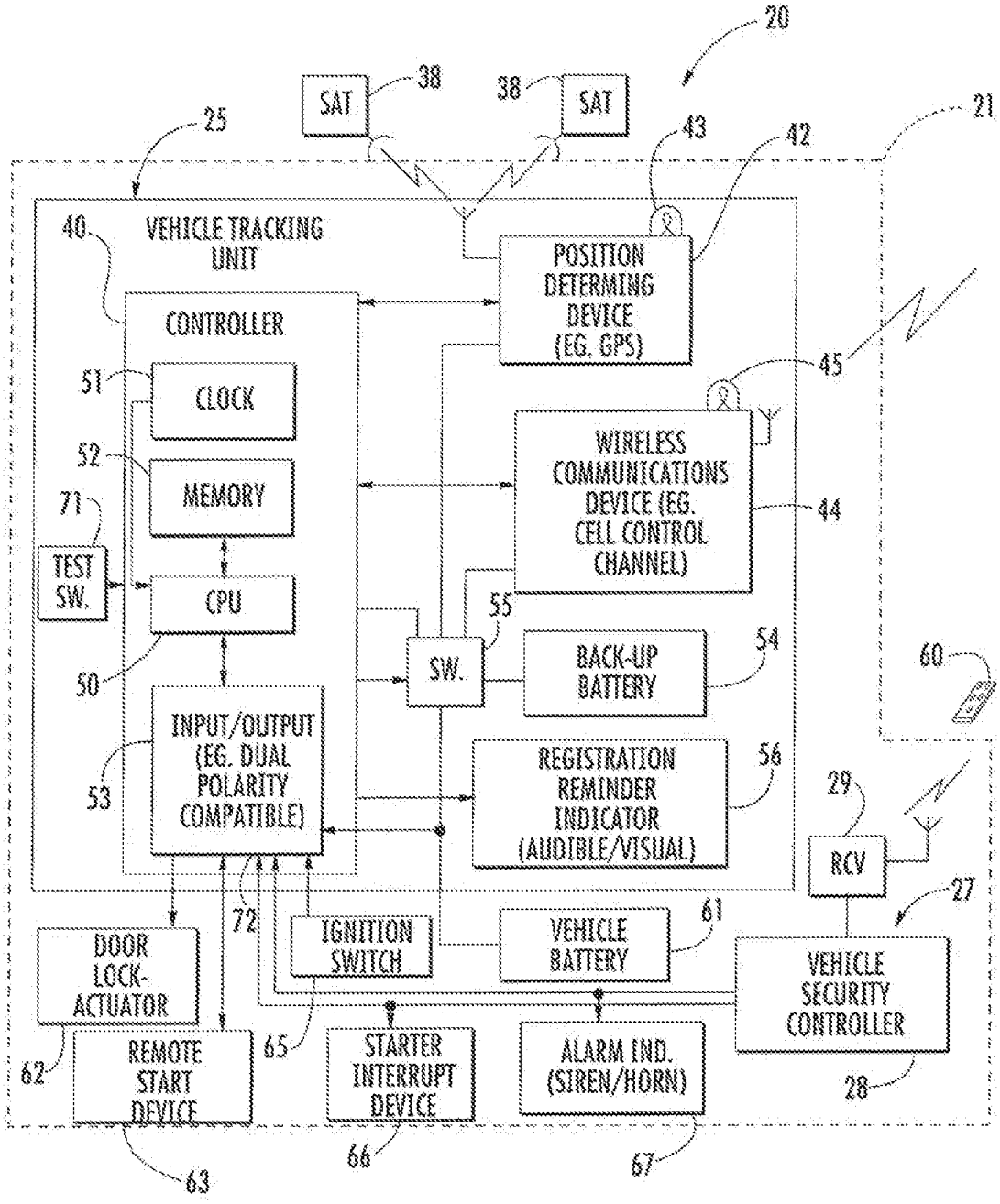

20
SAT
38
38
SAT
25
21
43
42
40
VEHICLE TRACKING UNIT
POSITION DETERMING DEVICE (EG. GPS)
CONTROLLER
45
51
CLOCK
WIRELESS COMMUNICATIONS DEVICE (EG. CELL CONTROL CHANNEL)
52
MEMORY
44
71
TEST SW.
CPU
55
SW.
BACK-UP BATTERY
54
60
50
INPUT/OUTPUT (EG. DUAL POLARITY COMPATIBLE)
53
REGISTRATION REMINDER INDICATOR (AUDIBLE/VISUAL)
56
29
RCV
27
72
IGNITION SWITCH
VEHICLE BATTERY
61
DOOR LOCK-ACTUATOR
VEHICLE SECURITY CONTROLLER
62
REMOTE START DEVICE
65
STARTER INTERRUPT DEVICE
ALARM IND. (SIREN/HORN)
28
63
66
67

FIG. 2

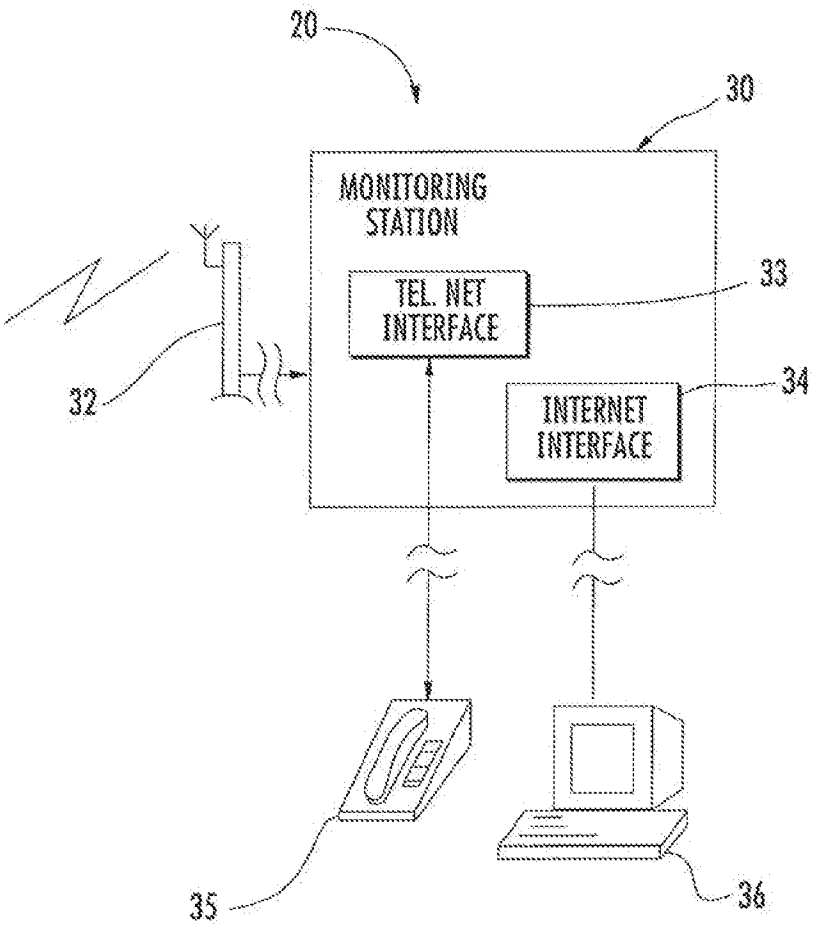

20
30
MONITORING STATION
TEL. NET INTERFACE
33
INTERNET INTERFACE
34
32
35
36

FIG. 3

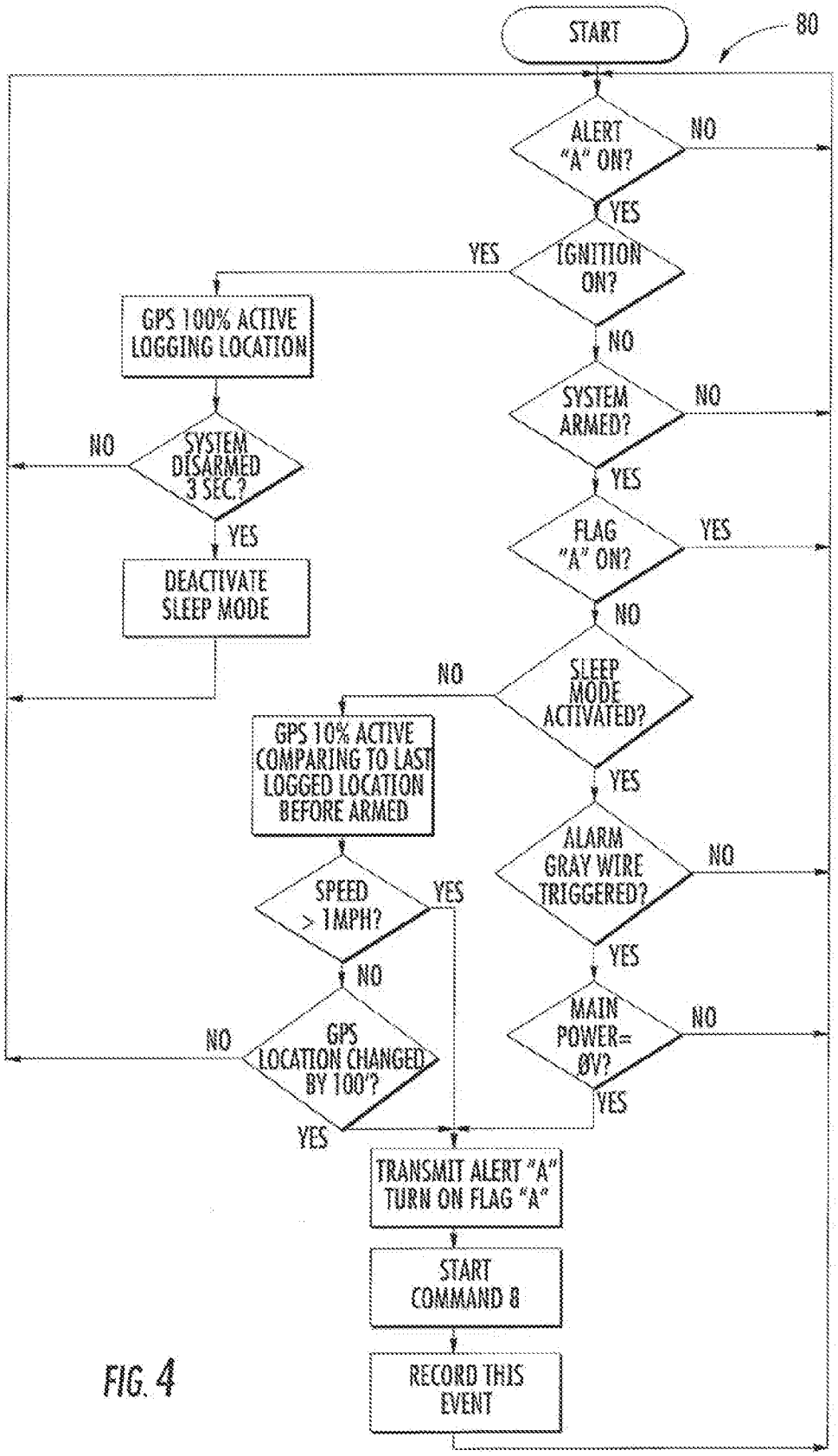

START
80
ALERT "A" ON?
NO
YES
IGNITION ON?
YES
GPS 100% ACTIVE LOGGING LOCATION
NO
SYSTEM ARMED?
NO
YES
SYSTEM DISARMED 3 SEC?
NO
YES
FLAG "A" ON?
YES
DEACTIVATE SLEEP MODE
NO
SLEEP MODE ACTIVATED?
NO
GPS 10% ACTIVE COMPARING TO LAST LOGGED LOCATION BEFORE ARMED
YES
ALARM GRAY WIRE TRIGGERED?
NO
SPEED > 1MPH?
YES
YES
NO
MAIN POWER= 0V?
NO
NO
GPS LOCATION CHANGED BY 100'?
YES
YES
TRANSMIT ALERT "A" TURN ON FLAG "A"
START COMMAND 8
RECORD THIS EVENT

FIG. 4

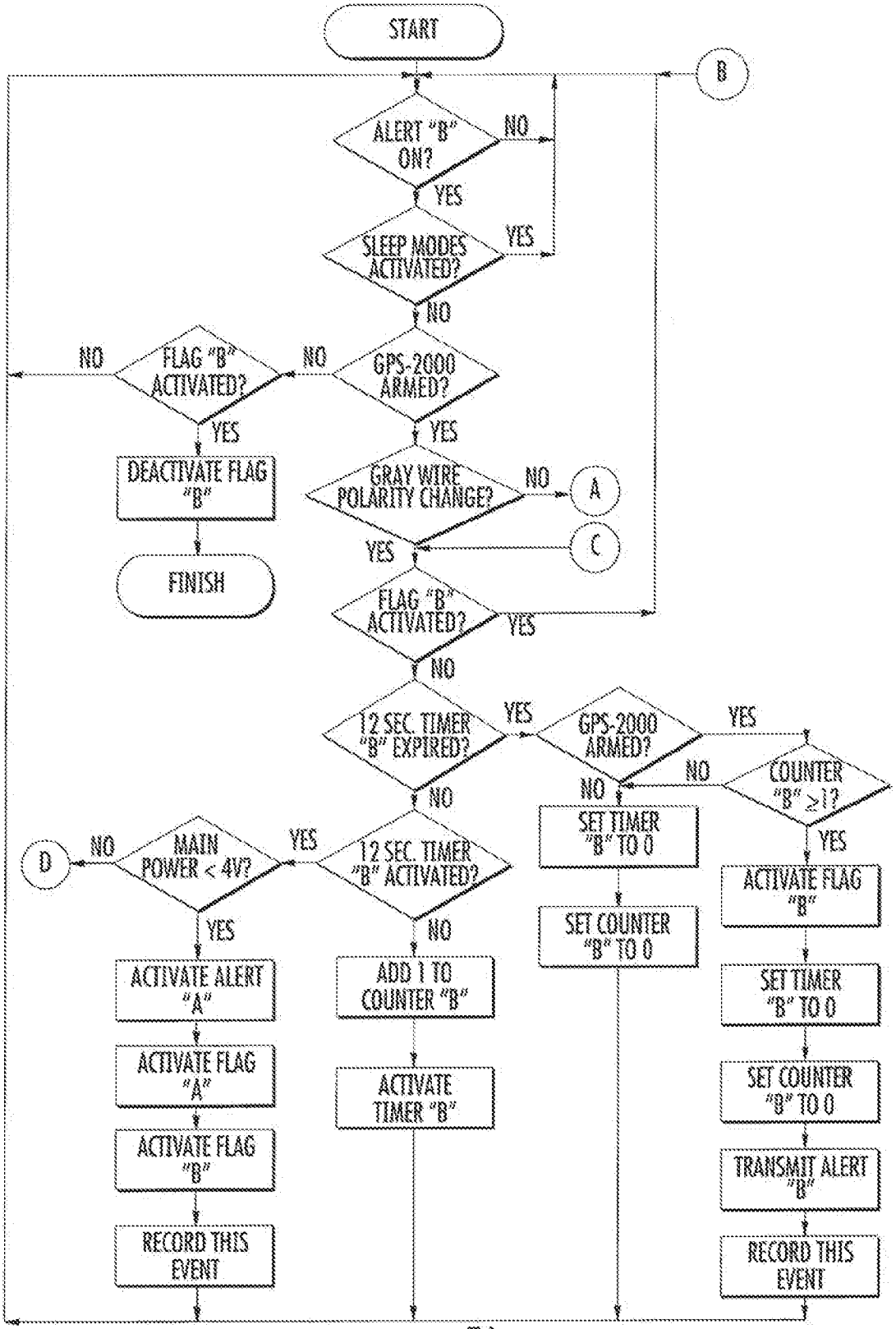

START
B
ALERT "B" ON?
NO
YES
SLEEP MODES ACTIVATED?
YES
NO
NO
FLAG "B" ACTIVATED?
NO
GPS-2000 ARMED?
YES
YES
DEACTIVATE FLAG "B"
GRAY WIRE POLARITY CHANGE?
NO
A
C
YES
FINISH
FLAG "B" ACTIVATED?
YES
NO
12 SEC. TIMER "B" EXPIRED?
YES
GPS-2000 ARMED?
YES
NO
NO
COUNTER "B" ≥1?
NO
SET TIMER "B" TO 0
YES
D
NO
MAIN POWER < 4V?
YES
12 SEC. TIMER "B" ACTIVATED?
ACTIVATE FLAG "B"
YES
NO
SET COUNTER "B" TO 0
ACTIVATE ALERT "A"
ADD 1 TO COUNTER "B"
SET TIMER "B" TO 0
ACTIVATE FLAG "A"
ACTIVATE TIMER "B"
SET COUNTER "B" TO 0
ACTIVATE FLAG "B"
TRANSMIT ALERT "B"
RECORD THIS EVENT
RECORD THIS EVENT

FIG. 5A

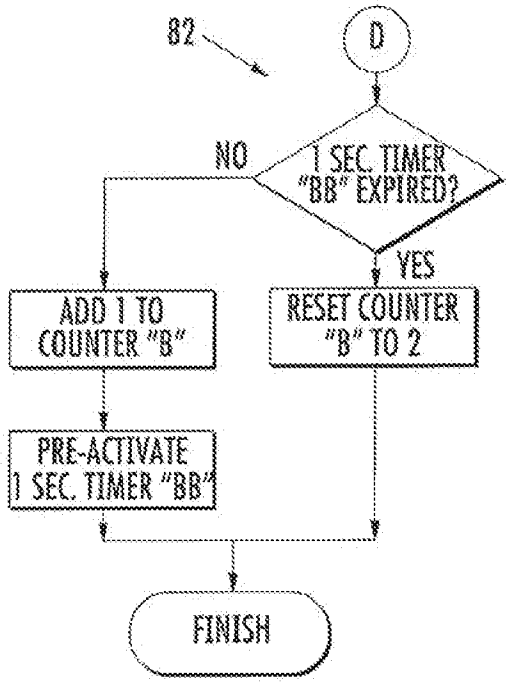

82
D
1 SEC. TIMER "BB" EXPIRED?
NO
YES
ADD 1 TO COUNTER "B"
RESET COUNTER "B" TO 2
PRE-ACTIVATE 1 SEC. TIMER "BB"
FINISH

FIG. 5B

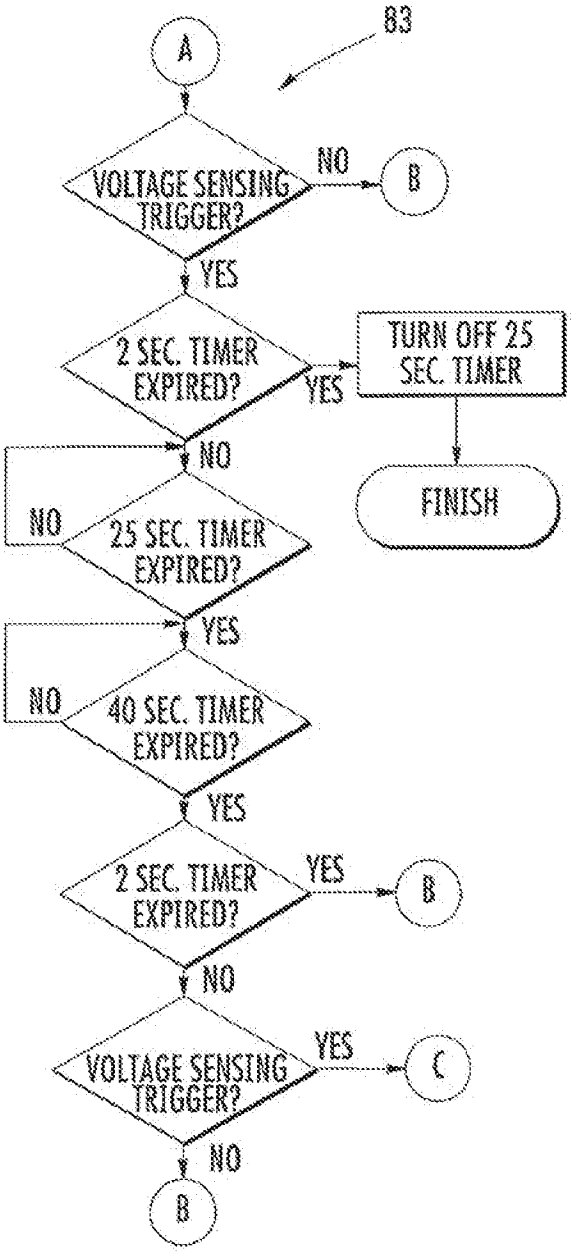

83
A
VOLTAGE SENSING TRIGGER?
NO
B
YES
2 SEC. TIMER EXPIRED?
YES
TURN OFF 25 SEC. TIMER
FINISH
NO
NO
25 SEC. TIMER EXPIRED?
YES
NO
40 SEC. TIMER EXPIRED?
YES
2 SEC. TIMER EXPIRED?
YES
B
NO
VOLTAGE SENSING TRIGGER?
YES
C
NO
B

FIG. 5C

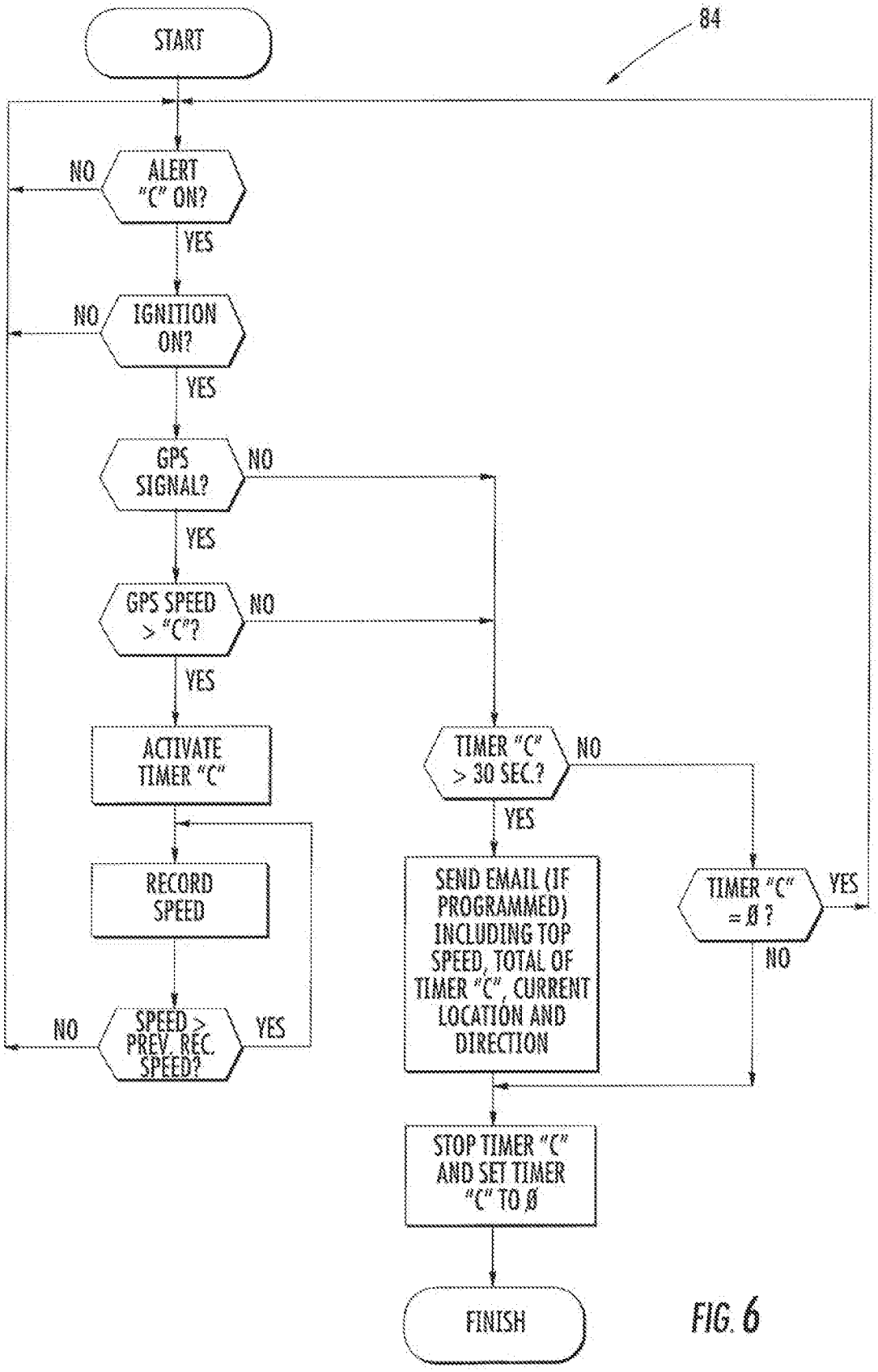

84
START
ALERT "C" ON?
NO
YES
IGNITION ON?
NO
YES
GPS SIGNAL?
NO
YES
GPS SPEED > "C"?
NO
YES
ACTIVATE TIMER "C"
RECORD SPEED
SPEED > PREV. REC. SPEED?
NO
YES
TIMER "C" > 30 SEC.?
NO
YES
SEND EMAIL (IF PROGRAMMED) INCLUDING TOP SPEED, TOTAL OF TIMER "C", CURRENT LOCATION AND DIRECTION
TIMER "C" ≈ Ø ?
YES
NO
STOP TIMER "C" AND SET TIMER "C" TO Ø
FINISH

FIG. 6

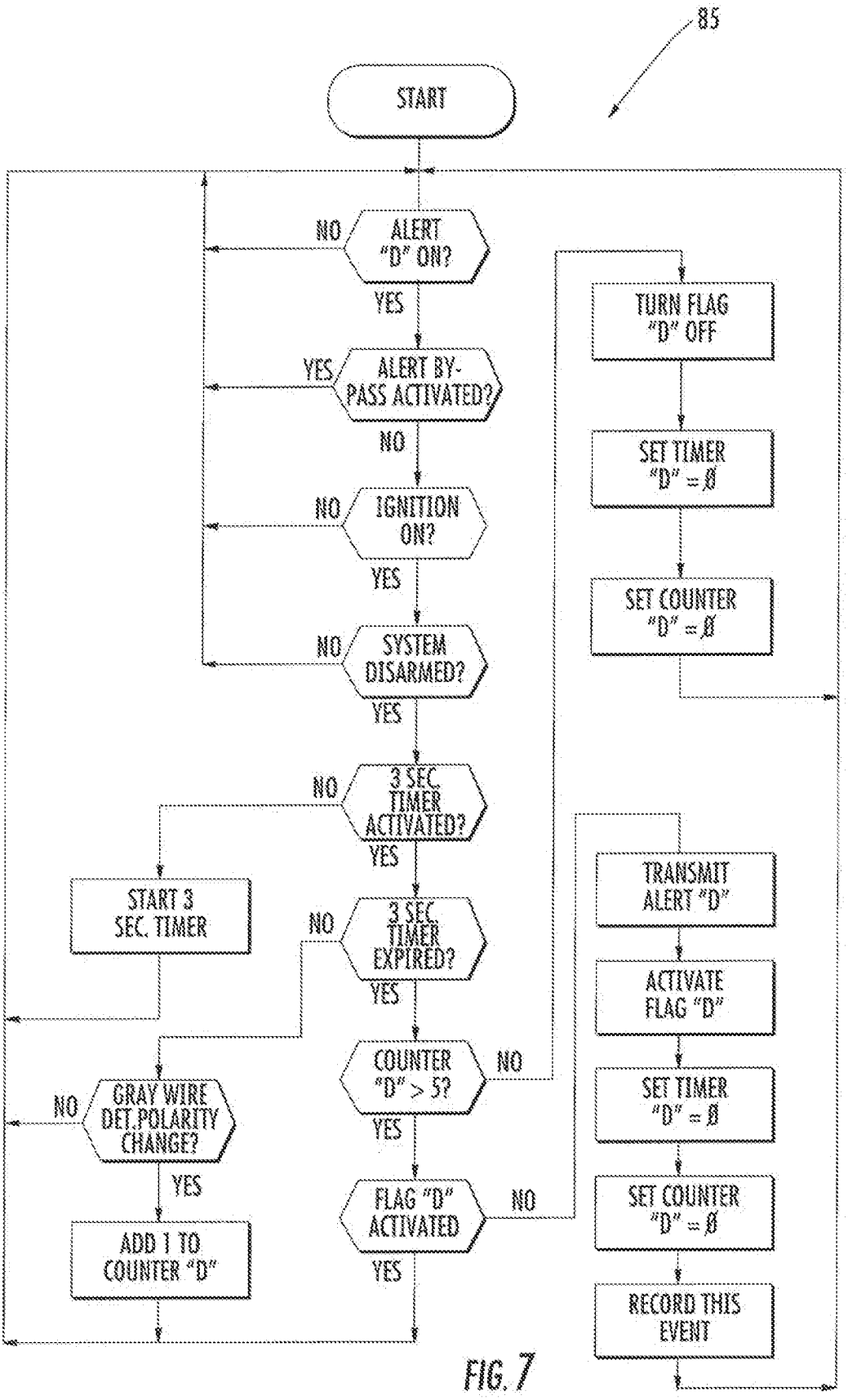

85
START
ALERT "D" ON?
NO
YES
ALERT BY-PASS ACTIVATED?
YES
NO
IGNITION ON?
NO
YES
SYSTEM DISARMED?
NO
YES
3 SEC. TIMER ACTIVATED?
NO
YES
START 3 SEC. TIMER
3 SEC. TIMER EXPIRED?
NO
YES
COUNTER "D" > 5?
NO
YES
GRAY WIRE DET.POLARITY CHANGE?
NO
YES
ADD 1 TO COUNTER "D"
FLAG "D" ACTIVATED
NO
YES
TURN FLAG "D" OFF
SET TIMER "D" = Ø
SET COUNTER "D" = Ø
TRANSMIT ALERT "D"
ACTIVATE FLAG "D"
SET TIMER "D" = Ø
SET COUNTER "D" = Ø
RECORD THIS EVENT

FIG. 7

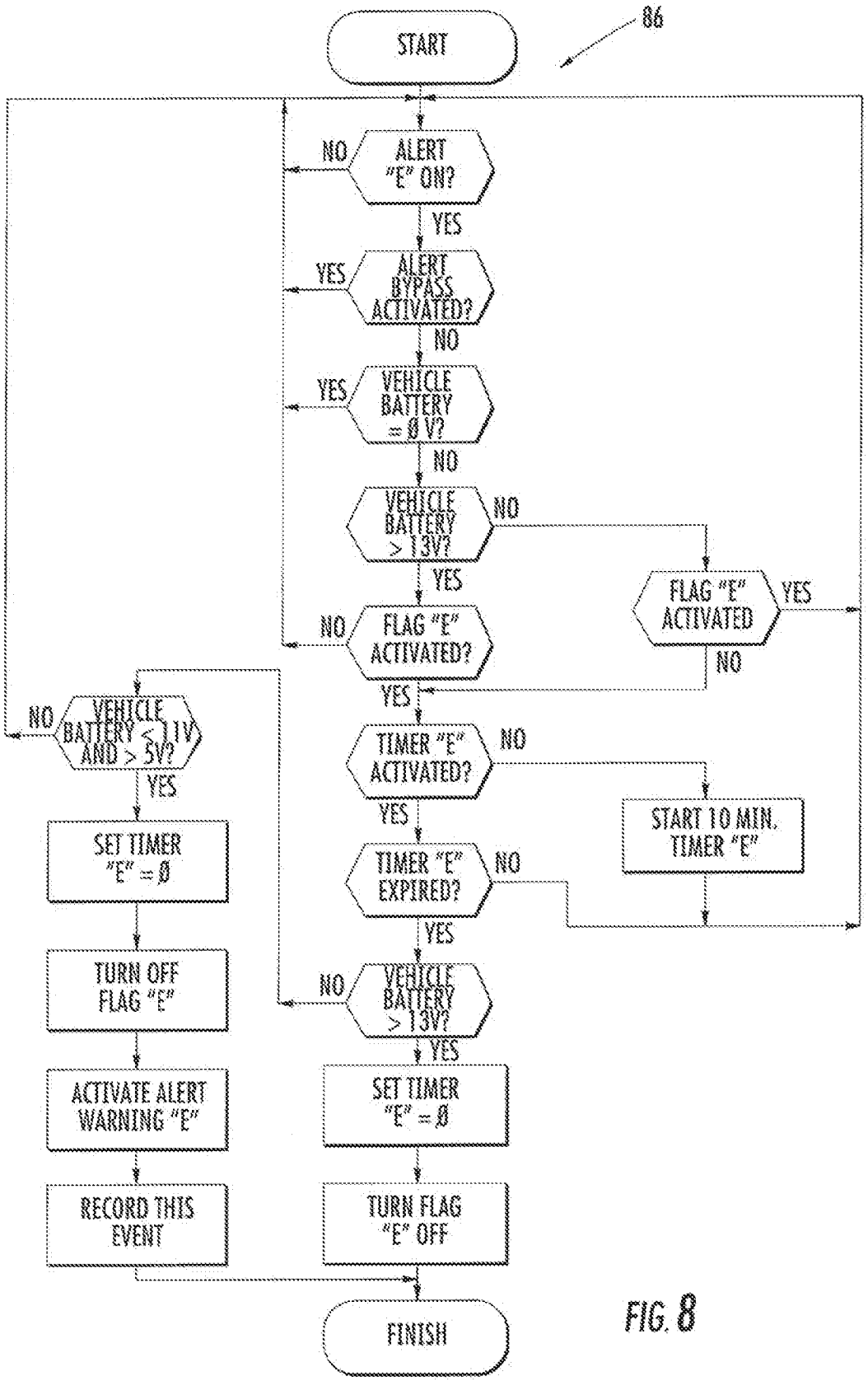

86
START
ALERT "E" ON?
NO
YES
ALERT BYPASS ACTIVATED?
YES
NO
VEHICLE BATTERY = Ø V?
YES
NO
VEHICLE BATTERY > 13V?
NO
YES
FLAG "E" ACTIVATED?
NO
YES
FLAG "E" ACTIVATED
YES
NO
TIMER "E" ACTIVATED?
NO
YES
START 10 MIN. TIMER "E"
TIMER "E" EXPIRED?
NO
YES
VEHICLE BATTERY > 13V?
NO
YES
SET TIMER "E" = Ø
TURN FLAG "E" OFF
VEHICLE BATTERY ≤ 11V AND > 5V?
NO
YES
SET TIMER "E" = Ø
TURN OFF FLAG "E"
ACTIVATE ALERT WARNING "E"
RECORD THIS EVENT
FINISH

FIG. 8

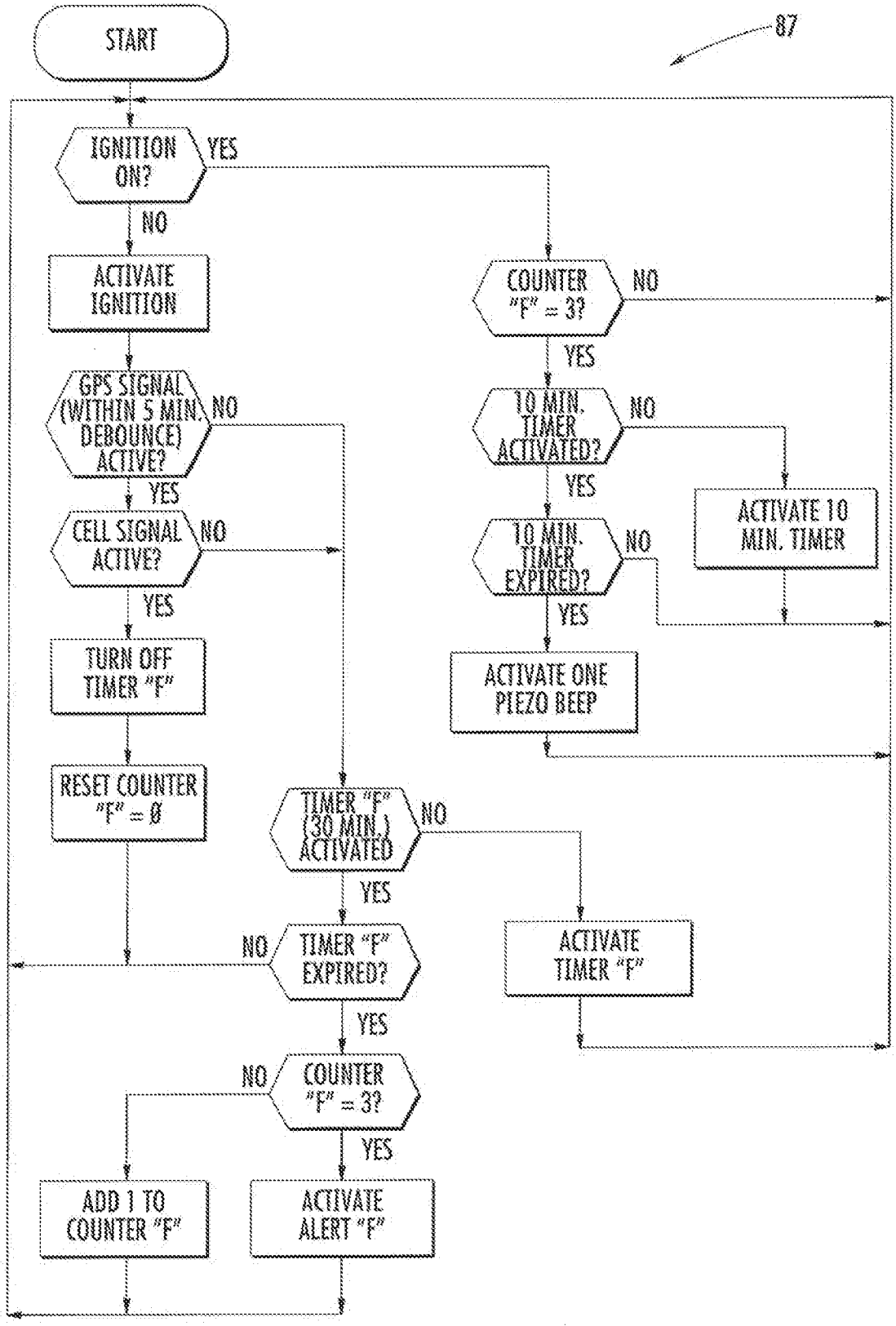

87
START
IGNITION ON?
YES
NO
ACTIVATE IGNITION
GPS SIGNAL (WITHIN 5 MIN. DEBOUNCE) ACTIVE?
NO
YES
CELL SIGNAL ACTIVE?
NO
YES
TURN OFF TIMER "F"
RESET COUNTER "F" = 0
TIMER "F" (30 MIN.) ACTIVATED
NO
YES
TIMER "F" EXPIRED?
NO
YES
COUNTER "F" = 3?
NO
YES
ADD 1 TO COUNTER "F"
ACTIVATE ALERT "F"
COUNTER "F" = 3?
NO
YES
10 MIN. TIMER ACTIVATED?
NO
YES
ACTIVATE 10 MIN. TIMER
10 MIN. TIMER EXPIRED?
NO
YES
ACTIVATE ONE PIEZO BEEP
ACTIVATE TIMER "F"

FIG. 9

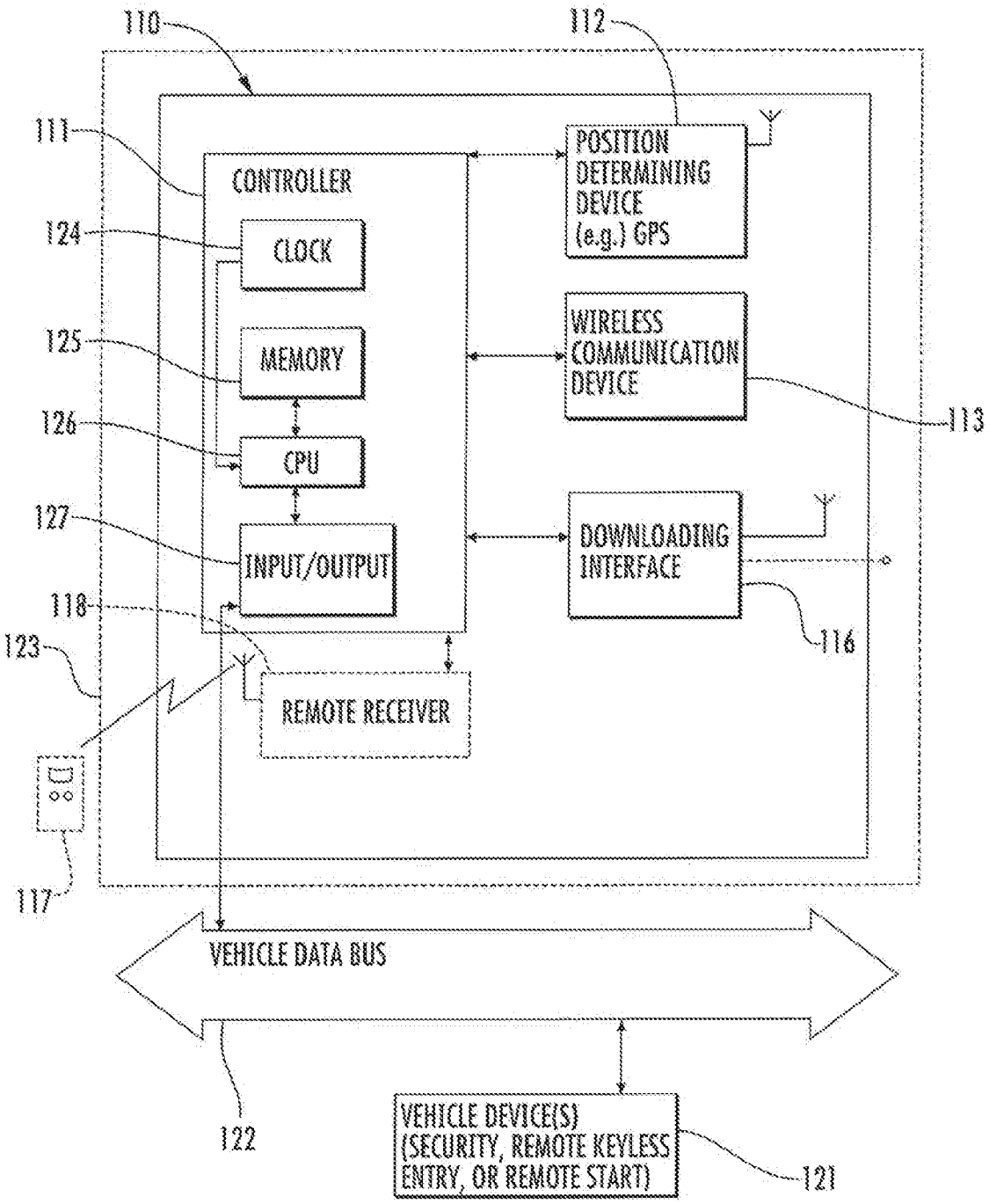

110
112
111
CONTROLLER
POSITION DETERMINING DEVICE (e.g.) GPS
124
CLOCK
125
MEMORY
WIRELESS COMMUNICATION DEVICE
113
126
CPU
127
INPUT/OUTPUT
DOWNLOADING INTERFACE
118
116
123
REMOTE RECEIVER
117
VEHICLE DATA BUS
122
VEHICLE DEVICE(S) (SECURITY, REMOTE KEYLESS ENTRY, OR REMOTE START)
121

FIG. 10

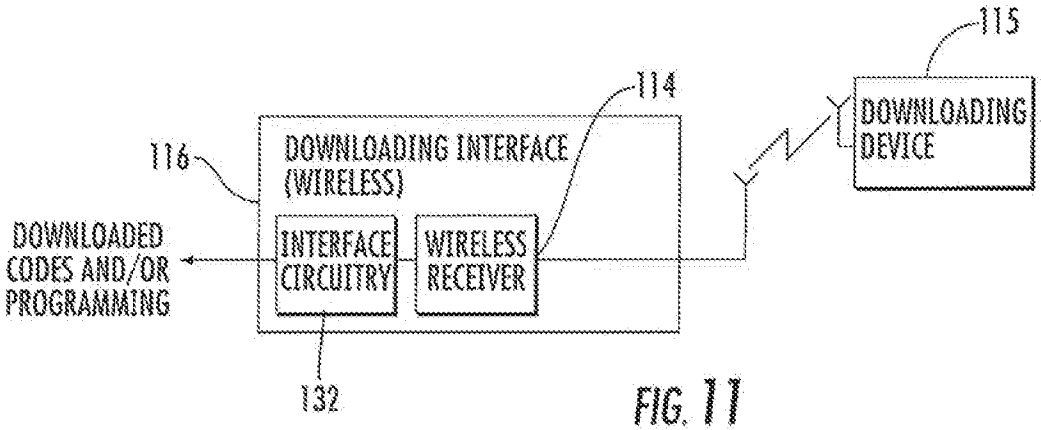


FIG. 11

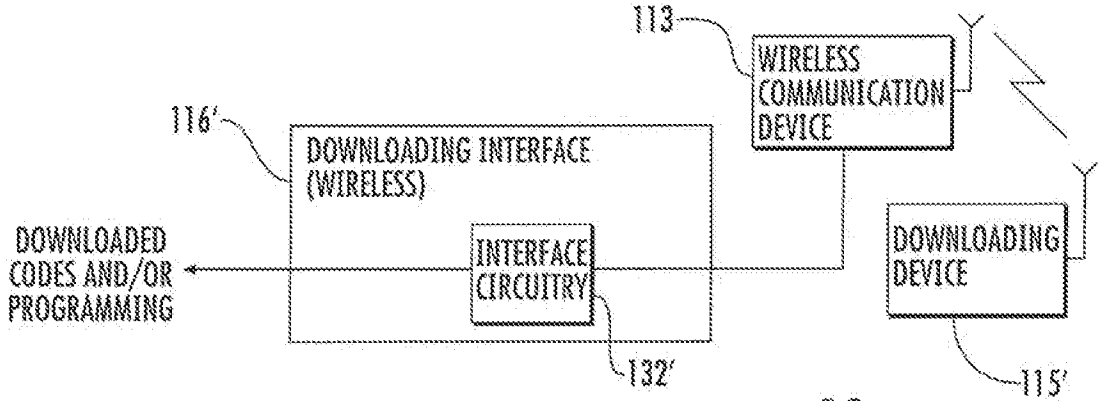


FIG. 12

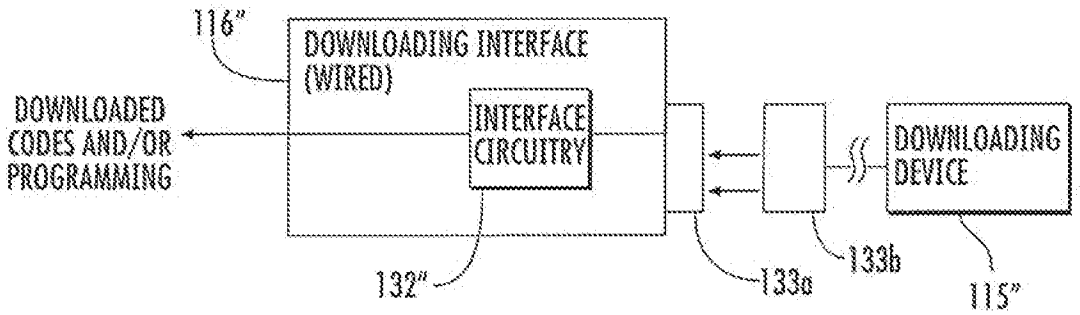


FIG. 13

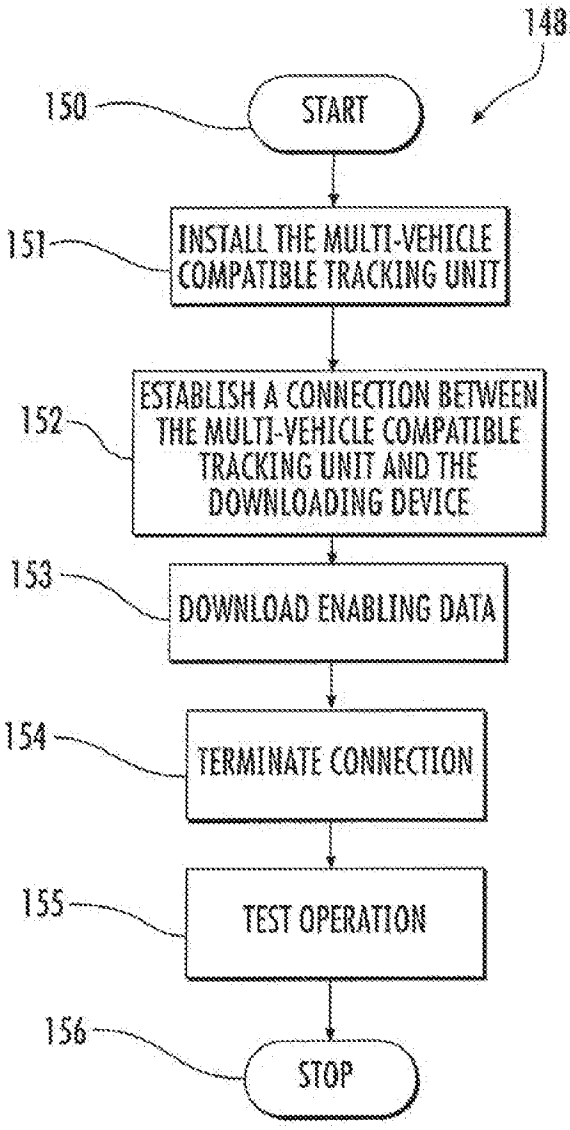

148
150
START
151
INSTALL THE MULTI-VEHICLE COMPATIBLE TRACKING UNIT
152
ESTABLISH A CONNECTION BETWEEN THE MULTI-VEHICLE COMPATIBLE TRACKING UNIT AND THE DOWNLOADING DEVICE
153
DOWNLOAD ENABLING DATA
154
TERMINATE CONNECTION
155
TEST OPERATION
156
STOP

FIG. 14

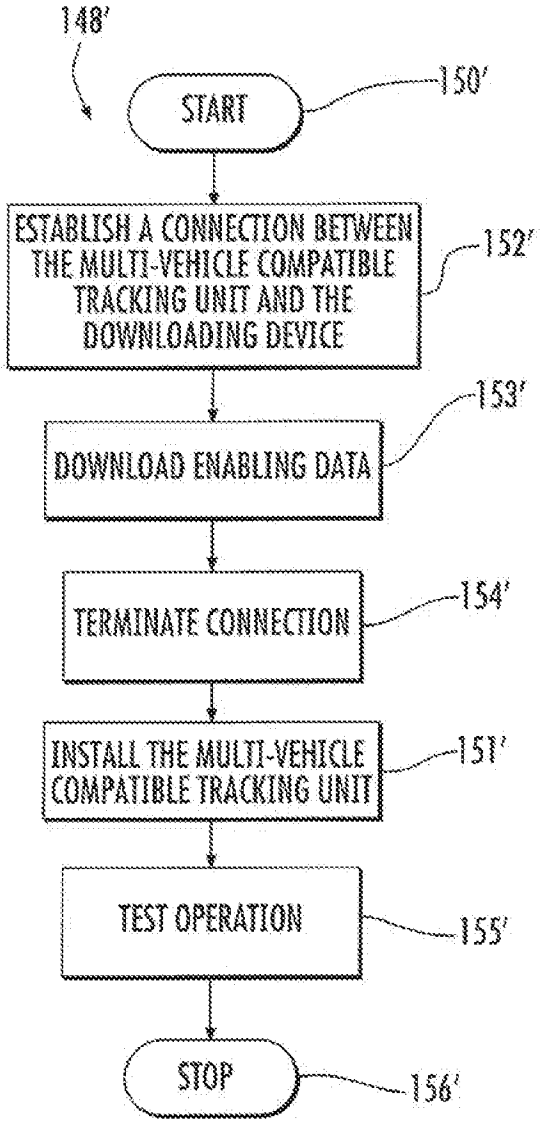

148'
150'
START
ESTABLISH A CONNECTION BETWEEN THE MULTI-VEHICLE COMPATIBLE TRACKING UNIT AND THE DOWNLOADING DEVICE
152'
153'
DOWNLOAD ENABLING DATA
154'
TERMINATE CONNECTION
151'
INSTALL THE MULTI-VEHICLE COMPATIBLE TRACKING UNIT
155'
TEST OPERATION
156'
STOP

FIG. 15

VEHICLE TRACKING UNIT WITH DOWNLOADABLE CODES AND ASSOCIATED METHODS

RELATED APPLICATIONS

The present application is a continuation-in-part of U.S. patent application Ser. No. 11/076,259 filed Mar. 9, 2005 now U.S. Pat. No. 7,720,597, which is a continuation of U.S. patent application Ser. No. 10/383,496 filed Mar. 7, 2003 now U.S. Pat. No. 7,149,623, which is a continuation of U.S. patent application Ser. No. 09/859,972 filed on May 17, 2001 now U.S. Pat. No. 6,606,561 which, in turn, was based upon provisional patent application Ser. Nos. 60/264,811 filed on Jan. 29, 2001; 60/258,005, filed Dec. 22, 2000; 60/251,552, filed Dec. 6, 2000; 60/252,125, filed Nov. 20, 2000; 60/236,890, filed Sep. 29, 2000; 60/246,463, filed Nov. 7, 2000; 60/222,777, filed Aug. 3, 2000; and 60/205,178, filed May 17, 2000, the entire contents of each of which are incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to the field of vehicle devices, and, more particularly, to a tracking system for vehicles, and related methods.

BACKGROUND OF THE INVENTION

Motor vehicles, such as passenger cars, trucks, busses, fleet vehicles, etc. are widely used and knowing the locations of such vehicles is often desired. For example, should a vehicle be stolen, it would be beneficial to know the vehicle's location so that authorities could be promptly and accurately directed to retrieve the vehicle. Indeed, the tracking system could plot the getaway path of the thief.

For a company with hired drivers, it may be desirable to know the driver's whereabouts during the course of the day. Similarly, a rental car agency or other fleet operator, for example, may wish to know the whereabouts of its fleet of vehicles.

It may also be desirable to track the location of a vehicle as it is used throughout the course of a normal day. For parents of younger or older drivers, for example, knowledge of the vehicle's location may provide some assurance that the driver is at designated locations and following a prescribed route.

A number of patents disclose various systems and approaches to tracking vehicles. For example, U.S. Pat. No. 5,223,844 discloses a tracking system including a control center and a mobile unit installed in the vehicle. The mobile unit may send security warnings to the command center via a wireless transceiver. Position information for the vehicle is determined using a GPS receiver at the vehicle.

U.S. Pat. No. 5,515,043 discloses a similar system which may send one or more preprogrammed telephone messages to a user when away from the vehicle. The user may remotely access location information or cause certain commands to be carried out by entering a personal identification number (PIN).

The widespread availability and use of the Internet has prompted a number of vehicle tracking systems to also make use of the Internet. For example, TelEvoke, Inc. proposed such a system in combination with Clifford Electronics. The system was to provide notification, control and tracking services via the telephone or the Internet. Users could be notified via phone, e-mail, or pager of events such as a car alarm being triggered. Users could control the vehicle remote devices via phone, web, or PDA such as unlocking car doors. Additionally, users could track TelEvoke-enabled vehicles on the Internet or via the telephone. An Internet map could be viewed by the user showing the actual and prior vehicle locations. TelEvoke offered its services via a centralized fully automated Network Operations Center. To reduce the communications costs, it was proposed to use the control channel of the cellular telephone network.

There are, of course, a number of vehicles which come from the manufacturer with some form of security system already installed. In addition, a number of vehicles are also equipped with aftermarket security systems. Many conventional vehicle tracking units may not be readily installed in vehicles, particularly those vehicles already including a vehicle security system. In addition, complexity of installation may significantly increase the system costs.

A number of patents disclose various security and control systems that address data bus interoperability. For example, U.S. Pat. No. 5,719,551, assigned to Omega Patents, LLC, the assignee of the present invention, discloses a vehicle security system for a vehicle including a data bus connecting a plurality of vehicle devices. A signal enabling circuit enables the alarm controller to operate using a set of desired signals selected from a plurality of possible sets for different vehicles. U.S. Pat. No. 6,011,460, assigned to Omega Patents, LLC, discloses a similar system where the set of desired signals from the plurality of different sets of signals for different vehicles is obtained, such as by connection and communication with a downloading device. Additionally, U.S. Pat. No. 6,756,885, also assigned to Omega Patents, LLC, discloses a multi-vehicle control system whereby a multi-vehicle compatible controller stores a set of device codes for a given vehicle device for a plurality of different vehicles. Device codes are read from the data communications bus, and a match between a read device code and the stored device codes is determined to provide compatibility with different vehicles.

Unfortunately, such advanced techniques for dealing with multiple device codes for a vehicle having a data communications bus have not yet been developed for vehicle tracking units.

SUMMARY OF THE INVENTION

In view of the foregoing background, it is therefore an object of the present invention to provide a multi-vehicle compatible tracking unit which may be used to control operable vehicle devices, and/or read information therefrom via the vehicle data communications bus and related methods.

This and other objects, features, and advantages in accordance with the present invention are provided by a multi-vehicle compatible tracking unit for a vehicle comprising a vehicle data bus extending throughout the vehicle. The multi-vehicle compatible tracking unit may include a vehicle position determining device, a wireless communications device, and a multi-vehicle compatible controller for cooperating with the vehicle position determining device and the wireless communications device to send vehicle position information. The multi-vehicle compatible controller may be coupled to the vehicle data bus for communication therewith at least one vehicle device. The at least one vehicle device may use at least one corresponding vehicle device code from among a plurality thereof for different vehicles. The tracking unit may also include a downloading interface for permitting downloading of enabling data related to the at least one corresponding vehicle device code for use by the multi-vehicle compatible controller. Accordingly, the multi-vehicle compatible

tracking unit may be used to control operable vehicle devices, and/or read information therefrom via the vehicle data communications bus.

The downloading interface may comprise either a wired or wireless signal downloading interface. The wired signal downloading interface may comprise a connector for temporary connection to a downloading device, for example. The wireless signal downloading interface may include a wireless receiver for temporary connection to a downloading device. The wireless signal downloading interface may also be in the form of a connection to the wireless communications device used for sending position information. The downloading interface may also be for permitting downloading of at least one programming instruction for the multi-vehicle compatible controller, in some embodiments.

The corresponding at least one vehicle code may be for reading from the at least one vehicle device, and/or for writing to the at least one vehicle device. Further, the multi-vehicle compatible tracking unit may comprise a remote transmitter. At least one vehicle remote control function responsive to the remote transmitter may be performed by the multi-vehicle compatible controller. For example, the at least one vehicle remote control function may include at least one of a vehicle security function, a remote keyless entry function, and a remote engine starting function. Also, the wireless position determining device may comprise a Global Positioning System (GPS) receiver. A tracking unit may also include a common housing for its various components.

A method aspect is for using a multi-vehicle compatible tracking unit for a vehicle comprising a vehicle data bus extending throughout the vehicle. The multi-vehicle compatible tracking unit may include a vehicle position determining device, a wireless communications device, and a multi-vehicle compatible controller for cooperating with the vehicle position determining device and the wireless communications device to send vehicle position information. The multi-vehicle compatible controller may be coupled to the vehicle data bus for connection thereover with at least one vehicle device using at least one corresponding vehicle device code from among a plurality of thereof for different vehicles. The method may include downloading the enabling data related to at least one corresponding vehicle device code for use by the multi-vehicle compatible controller via a downloading interface.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a simplified block diagram of a vehicle tracking system in accordance with the present invention.

FIG. **2** is a more detailed block diagram of the vehicle tracking unit as shown in FIG. **1**.

FIG. **3** is a more detailed block diagram of the monitoring station as shown in FIG. **1**.

FIG. **4** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a vehicle stolen alert.

FIGS. **5A-5C** are a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a vehicle alarm sounding alert.

FIG. **6** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a vehicle speeding alert.

FIG. **7** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating an unauthorized transmitter learned alert.

FIG. **8** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a low battery alert.

FIG. **9** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a GPS or cellular unit failure alert.

FIG. **10** is a simplified block diagram of a multi-vehicle compatible tracking unit in accordance with the invention.

FIG. **11** is a more detailed block diagram of an embodiment of the downloading interface as shown in FIG. **10**.

FIG. **12** is a more detailed block diagram of another embodiment of a downloading interface as shown in FIG. **10**.

FIG. **13** is a more detailed block diagram of yet another embodiment of the downloading interface as shown in FIG. **10**.

FIG. **14** is a flowchart showing a method in accordance with the invention.

FIG. **15** is a flowchart showing another embodiment of a method in accordance with the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will now be described more fully hereinafter with reference to the accompanying drawings in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the illustrated embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout, and prime notation and multiple prime notation are used to indicate similar elements in alternate embodiments.

Referring to FIGS. **1-3**, the vehicle tracking system **20** in accordance with the invention is now initially described. The vehicle system **20** illustratively includes a vehicle tracking unit **25** to be mounted in the vehicle **21** and a monitoring station **30** which is remote from the vehicle and which is typically in a fixed location. In the illustrated embodiment, the vehicle tracking unit **25** interfaces with various vehicle devices, such as may include security sensors, door locks, etc. as will be appreciated by those skilled in the art.

The vehicle tracking unit **25** is also illustratively connected to a separate vehicle security system **27** as may already be installed in the vehicle **21**, from the factory or installed as an aftermarket product. Those of skill in the art will appreciate that in some embodiments of the vehicle tracking system **20** a separate vehicle security system **27** may not be needed, and/or various features thereof can be readily incorporated in the vehicle tracking unit **25**.

The monitoring station **30** may typically service a number of subscribers **31**. As shown perhaps best in FIG. **3**, the monitoring station **30** may include a user interface, such as the schematically illustrated telephone network interface **33** and the internet interface **34** which are schematically coupled to a telephone **35**, and a computer **36**, respectively. Of course in other embodiments, other interfaces may be used and only one of the illustrated interfaces may be needed. Those of skill in the art will also recognize that messages may be sent to a subscriber or user via preprogrammed voice messages, e-mail messages, facsimile messages, pager alerts, etc. In addition commands or instructions from the subscriber can also be input to the monitoring station **30** via the telephone network interface **33** and/or the internet interface **34**, from the subscribers telephone **35** or computer **36**.

The monitoring station **30** is illustratively connected to a cellular telephone tower **32** which, in turn, may communicate with the vehicle tracking unit **25** in some embodiments. Of course, in other embodiments other communications

approaches are also contemplated, such as, for example, including satellite communications.

The monitoring station **30** may typically include the necessary modems, and other communications electronics, and computers for its functions which are described in greater detail below. The configuration of such components and their details will be readily apparent to those skilled in the art. Accordingly, no further discussion of these details is needed.

Referring now more specifically to FIG. **2**, additional details of the vehicle tracking unit **25** and devices at the vehicle are now further described. The vehicle tracking unit **25** illustratively includes a controller **40**, a vehicle position determining device **42**, and a wireless communications device **44** connected together. The vehicle position determining device **42** may be provided by a GPS receiver, for example. The GPS receiver typically operates by receiving multiple signals from spaced apart satellites **38** as will be appreciated by those skilled in the art.

In other embodiments, the vehicle position determining device **42** may be provided based upon communications with the cellular telephone network, or based upon other satellite transmissions, for example. As a particular example, time of arrival techniques are available based upon multiple reception paths to determine position via the cellular telephone network as will be appreciated by those skilled in the art. The vehicle position determining device **42** also illustratively includes an indicator **43** associated therewith, such as for indicating an operating mode, or proper operation of the device as will be addressed in greater detail below.

The wireless communications device **44** may be provided by a cellular telephone transceiver configured to operate on a control channel of the cellular network. Such a control channel may provide nearly universal coverage for the tracking system **20** as will be appreciated by those skilled in the art. In addition, the control channel may offer relatively inexpensive communications between the monitoring station **30** and the vehicle tracking unit **25** as will be appreciated by those skilled in the art. The wireless communications device **44** also illustratively includes an optional status indicator **45** with a similar function as the indicator **43** for the vehicle position determining device.

The wireless communications device **44** in other embodiments, may transmit in the voiceband of the cellular network. Alternately, the wireless communications device may communicate over other networks, such as over satellite, or via wireless internet services, as will be appreciated by those skilled in the art.

The controller **40** illustratively includes a central processing unit (CPU) **50** or other logic circuitry which is connected to a clock signal generator **51** and a memory **52**. In other embodiments, the memory **52** may be an embedded memory in the CPU **50**. The controller **40** also includes schematically illustrated input/output circuitry **53** to interface with various vehicle devices. In particular the input/output circuitry **53** may provide dual polarity compatibility for one or more inputs or outputs as will be described in greater detail below. One or more of the terminals of the input/output circuitry **53** may also provide both input and output functions as will also be described in greater detail below. This may significantly simplify and accelerate installation of the vehicle tracking unit **25** in the vehicle **21**.

Also illustratively shown as part of the vehicle tracking unit **25** are a back-up battery **54**, and switch **55** connected thereto for selectively powering certain of the components based upon the controller **40**. Of course, the vehicle **21** also includes an electrical system including the vehicle battery **61**. Powering of the vehicle tracking unit **25** is described in greater detail below.

The vehicle **21** also includes a number of other components that may relate to vehicle tracking, security, and/or convenience features provided by the vehicle tracking system **20**. For example, the vehicle **21** may include one or more door lock actuators **62**, an optional remote starting device **63**, a starter interrupt device **66** and an alarm indicator **67**. For example, the alarm indicator may be provided by a vehicle horn or vehicle siren, and/or flashing of the lights.

The optional separate security system **27** illustratively includes a vehicle security controller **28** and a receiver **29** connected thereto. As is conventional, the vehicle security system **27** may be switched between armed and disarmed modes, for example, by one or more uniquely coded remote transmitters **60**. The vehicle security controller **28** may also be capable of learning a new uniquely coded remote transmitter **60** as will be appreciated by those skilled in the art. The vehicle security controller **28** also illustratively is connected to the starter interrupt device **66** and the alarm indicator **67**.

For ease of explanation, a number of the features of the vehicle tracking system **20** are now described. The vehicle tracking system **20** includes a number of features that may simplify installation and maintenance. For example, as shown in FIG. **2**, the vehicle tracking unit **25** may have a test switch **71** connected to the controller **40**.

In normal operation, the controller **40** may be called upon to operate at least one vehicle device. Of course, the controller **40** also cooperates with the wireless communications device **44** and the vehicle position determining device **42** to determine and send vehicle position information to the monitoring station **30**. Moreover, the controller **40** may be switchable to a test mode for test operation of the at least one vehicle device responsive to activation of the test switch **71**.

In some embodiments, the at least one vehicle device may be a plurality of vehicle devices that are tested by operation in sequence. For example, the at least one vehicle device may comprise at least one door lock actuator **62**. The at least one vehicle device may also comprise the starter interrupt device **66**, or the engine remote starter **63** if remote starting is an implemented feature. The at least one vehicle device which is tested, may also be the alarm indicator **67**. Accordingly, an installer, for example, can quickly check that the tracking unit has been properly installed.

To further provide for ready determination of proper operation of the vehicle tracking unit **25**, one or both of the position determining and wireless communications devices **42**, **44** may include associated indicators **43**, **45** as mentioned briefly above, and which provide an indication relating to proper operation. Each indicator **43**, **45** may indicate a mode of operation of the device, its proper operation, or a partial or complete failure of the device.

Another aspect of the invention is that the controller **40** may provide a selectable polarity for the at least one vehicle device based upon sensing thereof. Accordingly, a predetermined activation of the test switch **71** may cause the controller **40** to sense and select the proper polarity. Pressing the test switch **71** for a predetermined time or in a predetermined pattern may sense and set the polarity.

Another feature of the vehicle tracking unit **25** and vehicle tracking system **20** relates to conservation of the number of codes or messages that need to be sent to the vehicle tracking unit. In particular, the controller **40** may have a plurality of different controller states and respond differently to a same message from the monitoring station **30** at different times depending upon the controller state at a given time. Accord-

ingly, a number of codes or messages used by the system can be conserved. Various messages are described in greater detail below.

A controller state may change based upon several different occurrences or events. For example the controller may change states in response to a change in at least one vehicle device, or based upon a message received by the wireless communications device **44** from the monitoring station **30**, and/or based upon elapsed time. The controller states, for example, may include an alert sent state based upon an alert message being sent from the wireless communications device **44**. Thereafter, receipt of a predetermined message by the wireless communications device **44** when the controller **40** is in the alert sent state may confirm receipt of the alert message by the monitoring station.

Receipt of the predetermined message by the wireless communications device **44** when the controller **40** is in another state different than the alert sent state may thus cause a different response by the controller. The alert sent state may comprise at least one of a vehicle stolen alert sent state, a vehicle alarm sounding alert sent state, a vehicle speeding alert sent state, an unauthorized remote transmitter alert sent state, a low vehicle battery alert sent state, and a device malfunction alert sent state. The various alert messages and confirmation thereof are described in greater detail below.

The code or message conservation aspects of the vehicle tracking system **20** also permit sending a sequence of codes or messages within a predetermined time to also cause a different response at the vehicle tracking unit **25**. In other words, the plurality of controller states may comprise a received first message state based upon a first message being received by the wireless communications device **44** from the monitoring station **30**. Receipt of a second message by the wireless communications device **44** when the controller **40** is in the received first message state, such as within a predetermined time window, for example, may thus cause a different response by the controller than does receipt of the second message when the controller is in another state than the received first message state.

The plurality of controller states may comprise a vehicle finder state sounding an audible signal via the alarm indicator **67** at the vehicle **21**. In this state the controller **40** would bypass sending a vehicle alarm sounding alert to the monitoring station **30**.

Another aspect of the vehicle tracking system **20** is the provision of certain power conservation and management techniques, such as to permit extended periods where the vehicle **21** is not in operation. During such extended periods, the vehicle battery **61** provides power to the vehicle tracking unit **25** as well as other vehicle devices. Accordingly, the voltage of the vehicle battery **61** drops over time. The vehicle tracking unit **25** may provide a significant drain on the vehicle battery **61** because of the power consumed by the wireless communications device **44** during transmission as will be appreciated by those skilled in the art.

The vehicle position determining device **42**, the wireless communications device **44** and the controller **40** may be considered as defining a power load of the vehicle tracking unit **25**. The controller **40** may operate the schematically illustrated power switch **55** to isolate the back-up battery **54** from the power load as a voltage of the vehicle battery **61** drops until reaching a threshold. After or below the threshold the controller **40** may cause the back-up battery **54** to selectively power only a first portion of the power load while a second portion of the power load remains powered by the vehicle battery.

For example, the wireless communications device **44** may have a higher operating voltage than the vehicle position determining device **42**. The first portion of the power load that is selectively powered despite the low vehicle battery voltage may thus be the wireless communications device **44**. In particular, the wireless communications device **44** may be powered for transmission. Accordingly, the back-up battery **54** can be saved for limited communication using the higher voltage wireless communications device **44**. This provides useful features even after an extended period during which the vehicle **21** is left unattended and the vehicle battery **61** gradually discharges.

To further conserve power, the controller **40** may reduce operation of the power load as vehicle battery voltage falls. Conversely, the controller **40** may restore operation of the power load based upon the voltage of the vehicle battery **61** rising again, such as upon being recharged.

Also relating to power consumption, the controller **40** further causes transmission of a low vehicle battery voltage alert to the monitoring station **30** based upon the voltage of the vehicle battery **61** falling below the threshold. The user or subscriber may cause the monitoring station **30** to issue a remote start command. The controller **40** may then generate a remote start output to the remote start device **63** to thereby start the engine and recharge the vehicle battery.

Another feature of the vehicle tracking system **20** is that the vehicle tracking unit **25** may be readily installed and connected to a vehicle **21**, such as in the illustrated embodiment where the vehicle includes a starter interrupt device **66** and a separate vehicle security controller **28**. More particularly, the controller **40** may switch between an armed mode and a disarmed mode based upon operation of the engine starter interrupt device **66**. The controller **40** when in the armed mode may cooperate with the wireless communications device **44** to send an alert message to the monitoring station **30** and including vehicle position information, for example, based upon the vehicle position determining device **42**. The controller **40** is also for selectively operating the engine starter interrupt device **66** to provide additional security features.

In one advantageous embodiment, the controller **40** preferably comprises a combination input and output terminal for connection to the engine starter interrupt device. This terminal is at the input/output circuitry **53** and is schematically illustrated by reference numeral **72**. The controller **40** may switch to the armed mode when in the disarmed mode and based upon the engine starter interrupt device **66** being operated to disable engine starting. Conversely, the controller **40** may switch to the disarmed mode based upon the engine starter interrupt device **66** being operated to enable engine starting. In other words, the vehicle tracking unit **25** can piggyback its arming and disarming off the existing vehicle security system **27**, for example.

The controller **40** may also selectively operate the engine starter interrupt device **66** based upon a command message from the monitoring station **30**. The controller **40** may selectively operate the engine starter interrupt device **66** based upon a command message from the monitoring station **30**. Alternately, or in addition thereto, the controller **40** may selectively operate the engine starter interrupt device **66** based upon the ignition switch **65**.

The following descriptive portions relate to various user or subscriber notifications and features provided by the vehicle tracking system **20**. Of course, the controller **40** preferably cooperates with the wireless communications device **44** to send an alert message. The monitoring station **30** may comprise a user interface, such as one or both of the telephone

network or internet interfaces **33**, **34**, respectively (FIG. **3**), for generating a sequence of alert message notifications based upon receiving the alert message sent from the vehicle tracking unit **25**. More particularly, the monitoring station interface permits canceling any remaining alert message notification based upon a cancellation command response from a user or subscriber having already received the alert message notification. The user may send the cancellation response via the telephone **35** or computer **36** (FIG. **3**), for example. Thus, if the user may be reached at different telephone numbers or different users are desirably notified of the alert, this aspect of the vehicle tracking system **20** can make the notifications efficiently and without making unnecessary notifications.

The vehicle tracking system **20** may provide any of a number of very useful alerts, as discussed herein. For example, the alert message sent from the vehicle tracking unit may comprise at least one of a vehicle stolen alert message, and a vehicle alarm sounding alert message. The alert message may be one of a vehicle speeding alert message, and a vehicle acceleration alert message. In addition, the alert message may comprise an unauthorized remote transmitter alert message. Also, the alert message may be at least one of a low vehicle battery alert message, and a device malfunction alert message.

The speeding alert may be based upon exceeding a speed threshold for greater than a certain time, which may be user selectable. The acceleration alert may also be useful as such is also indicative of aggressive driving along with the speeding alert. The unauthorized remote transmitter alert increases overall security since a user will be notified if a would-be thief learns an unauthorized transmitter to operate the controller. These alerts are described in greater detail below.

The vehicle tracking system **20** may be implemented as a service to a subscriber. In other words, the subscriber pays a monthly fee for the service. Accordingly, it may be important to encourage a user to register. Similar subscriber or registrations systems in the past have suffered revenue losses since some users would wait to activate the system until the vehicle was stolen. In other words, the user would only subscribe or register and pay a single month's fee.

In accordance with this aspect of the vehicle tracking system **20** prompt user registration is encouraged. In particular, the vehicle tracking unit **25** may include the user registration reminder indicator **56** and the controller **40** may be switchable from an unregistered mode to a registered mode. In the registered mode, the controller **40** may cooperate with the wireless communications device **44** and the vehicle position determining device **42** to determine and send vehicle position information to the monitoring station **30**. In the unregistered mode, the controller **40** may activate the user registration reminder indicator **56** to encourage registration by the user.

The controller **40** may be switchable to the registered mode based upon an activation message from the monitoring station **30**. For example, when the registration payment has been received, the monitoring station can send one or more messages to the vehicle tracking unit **25** to stop activation of the registration reminder indicator **56**. The indicator **56** may be audible, visual or both. For example, the registration reminder indicator **56** could be a beeping sound generated by a small piezoelectric transducer every ten minutes or so when the ignition **65** is on.

In other words, the user registration reminder indicator **56** may provide a minor but irritating annoyance to the user to encourage registration. Upon successfully registering, the annoyance is abated. Accordingly, a relatively straightforward approach is provided to encourage user registration.

Along these lines, the controller **40** when in the unregistered mode may have reduced features compared to the registered mode. For example, the controller **40** when in the unregistered mode may be restricted or limited in sending messages with the wireless communications device **44**. Accordingly, usage of the wireless communications network may be reduced. Transmissions from the vehicle tracking unit **25** may also be beneficially suppressed during original installation, for example.

Returning again to features of the vehicle tracking unit **25** which facilitate installation, the controller **40** may send an alarm indication alert responsive to a continuous activation of the alarm indicator **67** for greater than a predetermined time. Alternately, or in addition thereto, the controller **40** may send an alarm indication alert responsive to a repetitive pattern of alarm indicator **67** activations. In other words, the controller may be configured to distinguish between normal operation of a vehicle horn by the driver, and activation of the horn by the security system **27**. As mentioned above, the controller **40** may also monitor signals of at least one of a first and second polarity. The controller **40** thus advantageously piggybacks off the alarm indication generated by the vehicle security system **27** to determine and send a vehicle alarm sounding alert to the monitoring station **30**.

In one variation, the controller **40** may monitor signals delivered directly to the vehicle alarm indicator by the vehicle security controller **28**. In another variation, the controller **40** monitors signals of voltage dips of the vehicle battery **61**. Circuitry is conventionally and readily available for both such functions, as will be readily appreciated by those skilled in the art.

The controller **40** may also include a dual polarity compatible output in the input/output circuitry **53** for a vehicle device, such as the vehicle alarm indicator **67**. The controller **40** may further monitor signals relating to activation of the vehicle alarm indicator **67** and send an alarm indication alert with position information from the vehicle position determining device and using the wireless communication device.

For the dual polarity output compatibility, the controller **40** may generate a first polarity output pulse followed by a second polarity output pulse. The controller **40** may also generate a repeating pattern of a first polarity output pulse followed by a second polarity output pulse on the dual polarity compatible output. In yet other embodiments, the controller **40** may sense an actual polarity of the device and thereafter use the actual polarity for the dual polarity compatible output.

Where the vehicle device is a vehicle horn, the controller **40** may typically be configured to generate a negative polarity output on the dual polarity compatible output. Conversely, wherein the vehicle device is a vehicle alarm indicator siren, the controller **40** may be configured to generate a positive polarity output on the dual polarity compatible output.

Another aspect of the vehicle tracking system **20** relates to conserving memory space and/or reducing transmission time over the communications network. In accordance with this advantageous feature, the controller **40** may determine the vehicle position information including a vehicle location and an associated stationary period for each occurrence of the vehicle remaining stationary for greater than a predetermined period. In one embodiment, the controller **40** may cooperate with the wireless transmission device **44** to send the vehicle position information to the monitoring station based upon each occurrence of the vehicle remaining stationary for greater than the predetermined period. In this embodiment, the monitoring station **30** may associate a time with each occurrence of the vehicle remaining stationary for greater

than the predetermined period. In other words, the monitoring station **30** may time stamp the received information.

In another embodiment, the controller **40** cooperates with the wireless transmission device **44** to send the vehicle position information to the monitoring station **30** for a plurality of occurrences of the vehicle remaining stationary for greater than the predetermined period. In this embodiment, the controller **40** may associate a time with each occurrence of the vehicle remaining stationary for greater than the predetermined period. In other words, the controller time stamps the position and stationary period information.

As an example, the predetermined time which determines whether the vehicle **21** is stationary and the position should be determined, may be less than about three minutes. This time may filter out vehicle stops in normal traffic, but which will keep track of stops where the driver likely leaves the vehicle **21**. Accordingly, only the important information necessary to track the vehicle need be stored and/or transmitted thereby reducing the system costs. If the vehicle **21** is stationary overnight, for example, unnecessary position information need not be determined, stored, and/or transmitted to the monitoring station **30**.

The controller **40** may comprise the memory **52** for storing the vehicle position information therein. In one configuration, the controller **40** downloads the vehicle position information from the memory **52** to the monitoring station **30** based upon a predetermined schedule. In another configuration, the controller **40** downloads the vehicle position information from the memory **52** to the monitoring station **30** based upon a predetermined event. In yet another configuration, the controller **40** downloads the vehicle position information from the memory **52** to the monitoring station **30** based upon a predetermined percentage of memory usage.

Having now described certain general features and advantages of the vehicle tracking system **20**, this description now turns to additional specific details which are provided as examples. In particular, vehicle tracking system **20** preferably implements one or more of the following features:

a. Detects the vehicle being stolen and transmits a signal to the monitoring station to contact up to 3 people, for example, predetermined by the user, of theft of the vehicle and then starts tracking the vehicle. The contact may be by one or more of the following: an e-mail message, a pager alert, a cellular telephone call, or other telephone call.

b. Detects an optional vehicle security or alarm system activation and transmits a signal to the monitoring station to contact up to 3 predetermined people to inform them the vehicle's alarm is being activated.

c. Detects an optional vehicle alarm system's remote PANIC activation and transmits a signal to the monitoring station to contact up to 3 predetermined people to inform them of the vehicle's PANIC being activated.

d. Detects a vehicle being programmed to operate from an unauthorized remote transmitter, key transponder, other transponder, or other device that has a unique coding, and the vehicle unit transmits a signal to the monitoring station to contact up to 3 predetermined people to inform them of this occurrence. The system can also make available information relating to a number of such coded devices, or a change therein, or when a change occurred. A message can be sent to the user or the information can be available to the user on the website. The vehicle would be equipped with a security system as disclosed in U.S. Pat. No. 5,654,688, for example, which determines an unauthorized transmitter and provides an alert feature. This patent is incorporated herein in its entirety by reference.

e. Detects the vehicle traveling over a predetermined speed, such as for a predetermined time, and transmits a signal to the monitoring station to send a message, such as an e-mail informing the user (and/or others) of this occurrence. Of course, the message could also be sent via a telephone call or page, should additional urgency be required. The vehicle's predetermined maximum speed limit and duration thereof can be selected by the user.

f. Detects a low battery voltage such as for a predetermined time and transmits a signal to the monitoring station to contact up to 3 predetermined people to inform them of vehicle's low battery voltage. This is especially advantageous during winter so that the vehicle could be started, for example, to prevent a problem before it happens. The time setting is preferably selectable by the user.

g. Detects the vehicle not moving for a predetermined time and transmits a signal to the monitoring station to send, for example, a nightly e-mail informing the user of all the vehicle's location and stationary time occurrences. The stationary time length is also selectable. This may be advantageous to encourage patrolling personnel not to remain for a long time in a same location.

h. The vehicle unit preferably includes a back-up battery system making it more reliable.

The vehicle unit may be relatively inexpensive. In addition, the monitoring fee that includes sending up to 60 e-mails and making up to 6 phone calls per month, may also be relatively low. The relatively low monitoring fee is based, at least in part, on the current relatively low rates charged for use of the control channel of the cellular telephone network. It is also noted that access to the control channel provides coverage for almost the entire U.S., for example.

The user or subscriber also preferably has access to an Internet site that will display a map and silently contact the vehicle to acquire its current location, speed, direction of travel, and previous multiple locations with speeds, for example, the user's personal identification number (PIN) can be quickly activated by a telephone call. No additional installation may be required.

Certain annual pre-pay package arrangements may be available. For example, up to 10 access entries per month can be provided on a low monthly billing. Up to 30 access entries could be provided also for a relatively low monthly fee.

The present invention provides a number of other significant advantages including optional access from any phone or from any computer to access the monitoring station internet site. The user may control various vehicle functions remotely via the telephone or the internet site. The only charge may be for additional equipment and installation.

Additional features can also be included with the system and subscribed to by the user in accordance with the invention. For example, these include Hijack, Car Finding, Unlock Doors and Unauthorized Transmitter Alert Features. The equipment and installation is relatively inexpensive. For the hijack feature: from any phone or computer, the user may activate vehicle starter interrupt and sound the horn until the vehicle is retrieved (Command 4).

For the Car Finding feature: from any phone or computer, the user may activate the vehicle's horn, or siren and sound same for 30 seconds. This allows the user to find his vehicle in a crowded parking lot (Command 5).

For the Lock/Unlock vehicle doors feature: from any phone or computer a predetermined command (Command 7)

activates unlocking of vehicle doors to retrieve keys, for example, that may have been accidentally locked inside the vehicle. Of course, the system can also be used to lock vehicle doors if this was forgotten (Command 6). The unauthorized transmitter alert feature is similarly selected as described above.

In addition, a remote vehicle start feature may also be provided, such as to start the vehicle's engine to heat or cool the vehicle prior to entry. The equipment and installation for remote starting may be relatively low. Some further details of a specific embodiment of the vehicle tracking unit **25** are provided below as relating to use of red and green LED indicators as may be coupled to the controller **40** and operated thereby. Also various representative wires, designated by color, are provided as an example embodiment.

The red LED verifies the GPS receiving signal. With a yellow wire having positive 12 volts, the red LED blinking indicates searching GPS location, constant indicates found location, and off indicates no GPS signal found. With the yellow wire not having positive 12 volts, if the red LED is off, the LED is not functioning.

The green LED verifies receiving the cell tower signal. With the yellow wire having positive 12 volts, blinking indicates the cell control channel signal is detected, constant indicates sending a micro burst signal (LED stays on 5 seconds after each transmission), and off indicates no cell tower signal received. With the yellow wire not having positive 12 volts, off indicates the green LED is not functioning.

An example of representative DIP switch feature selection is as follows. A first switch may be used for adding the orange wire for controlling arm/disarming of the system. When on, the orange wire controls arm/disarm as follows: to arm, the orange wire is grounded and the yellow wire does not have 12 volts positive. To disarm, the orange wire is not grounded. When the first switch is off, then only the yellow wire controls arm/disarm as follows: to arm, the yellow wire is without 12 volts positive, and 30 seconds after continued arm mode then the orange wire activates a constant 500 ma grounded output to operate an external starter interrupt relay until the system is disarmed. To disarm, the yellow wire is connected to 12 volts positive.

A main 5-pin plug may be provided on the vehicle unit and connected as follows:

a. The Red Wire is connected to the 12 vdc power. An alert warning "E" is given if the system is armed and the battery voltage becomes lower than 11 volts for longer than ## minutes. This alert feature "E" will not operate again until the voltage is above 12 volts to re-set this feature.

b. The black wire is connected to ground.

c. The yellow wire is connected to the ignition 12 volts so that if the key is on, 12 volts is supplied thereto and if the key is off, the yellow wire is connected to ground. Further: if the system is in an armed mode and the Lat/Long changes, then Alert "A" is given. If the system is disarmed and within 2.5 seconds after the yellow wire receives 12 volts and the gray wire detects 3 or more positive pulses the system activates Alert "D". If the first DIP switch is in the off position then: if 12 volts is on yellow wire, the system is disarmed and the orange wire discontinues from the 500 ma ground, and if the yellow wire sees ground or neutral, then the system is armed and 30 seconds after the continued arm mode the orange wire activates a constant 500 ma grounded output to operate an external starter interrupt relay until the system is disarmed.

d. The gray wire is for input and output, and can be connected to an alarm siren or horn positive terminal. In addition:

i. With the system armed and if the gray wire detects +12 v pulsing on/off or on constant for more than 10 seconds from an alarm siren or horn honking activation, then alert warning "T" alarm activation is given.

ii. With system disarmed and if the gray wire detects +12 v pulsing on/off or on constant for more than 10 seconds from an alarm siren or horn honking activation, then alert warning "C" panic activation is given.

iii. With system disarmed and if the Gray wire detects 3 or more 12 volt positive pulses within 2.5 seconds of yellow wire receiving +12 v and the gray wire by-pass not being activated, then alert warning "D" is given.

iv. The gray wire bypass operates as follows:

1. After alert warning "B" bypass all future alert "B" signals until system is disarmed.

2. After alert warning "C" bypass all future alert "C" signals until system is armed.

3. After alert warning "D" bypass all future alert "D" signals until no 12 volt pulses are detected on the gray wire within 3 seconds of the yellow wire having 12 volts.

v. With the system armed or disarmed. The Output: Internal +12 v, 1 amp transistor with pulses 1 second on and 1 seconds off to activate siren or honk car horn or flashing light relay.

1. Non-stop activation from (Command "4")

2. 30-second activation from (Command "5")

vi. Turn off the above alert "A" from (Command "1").

i. The orange wire is for the starter interrupt and arm/disarm system, and operates as follows:

i. If first DIP switch is in the:

1. On position and: the orange wire has 12 volts or neutral, the system switches to the disarmed mode; the orange wire is grounded, then the system is switched to the armed mode; and the starter interrupt output will not automatically operate. It can only be activated from "Command 4"

2. Off position and the orange wire does not effect the arming or disarming of the system; 30 seconds after system arms the orange wire will automatically activate constant 500 ma ground until the system is disarmed. And from "command #4", Connect to Starter interrupt relay output.

ii. Command 4 activates Orange wire to have 500 ma. negative until Command 1 is received.

iii. After alert warning "B" is activated the first time it is thereafter bypassed while the orange wire remains grounded. Alert warning "B" is re-set to operate again 3 seconds after orange wire becomes ungrounded.

The vehicle unit may also include a Door Lock Plug configured as follows, for example. A green wire provides a 250 ma, negative 1 second pulse for Lock Doors. (Command "6"). A red wire provides a constant 12 v output from the red power wire. A blue wire provides a 250 ma., negative 1 second pulse for Unlock Doors (Command "7"). A pink wire provides a 250 ma., negative 1 second pulse for remote Car Starter (Command "2").

An installation test button may also be provided to work as follows. Pressing the button activates the orange wire for 10-seconds (starter interrupt), with these circuits in sequence. First, it activates the gray wire for 1-second (siren/horn). After the first stops, it activates the green wire for 1 second to lock the doors. After the second stops, it activates the blue

wire for 1 second to unlock the doors. After the third stops, it activates the pink wire for 1 second to activate an optional item.

Representative warning alerts are as follows:

a. Alert Warning "A" (FIG. **4**): Automatic activation of "Command 8" and the vehicle unit contacts monitoring station to instantly call 3 phone numbers with the message "Your vehicle is stolen please confirm then call 911 to advise police of website and your pin # so police can locate the vehicle". This is detected with the system armed and the GPS indicating movement. Bypasses all future alert warning "A" signals until the system is re-armed.

b. Alert Warning "B" (FIGS. **5**A-**5**C): the vehicle unit contacts the monitoring station to instantly call 3 phone numbers with the following message "Vehicle alarm activated please confirm". This is with the system armed and detecting gray wire having 12 volts pulsing or on constant for longer than 10-seconds. After alert warning "B" is activated the first time, it is thereafter bypassed while the orange wire remains grounded. Alert warning "B" is re-set to operate again 3 seconds after orange wire becomes ungrounded.

c. Alert Warning "C" (FIG. **6**): the vehicle unit contacts the monitoring station to instantly send e-mail message "vehicle was traveling faster than your preset amount of "###" and time limit of "##" seconds. Indicates the vehicle speed and location that the speeding started and how long speeding accrued" (Detected from GPS). This aspect is further understood with reference to the enclosed flowchart **84** of FIG. **6**.

d. Alert Warning "D" (FIG. **7**): the vehicle unit contacts the monitoring station to instantly call 3 phone numbers with the message "Unauthorized remote transmitter was just programmed to operate your vehicle." This is with the system disarmed and the Gray wire detecting three or more 12 volt pulses within 2.5 seconds of the yellow wire having seen 12 volts positive. All future alerts "D" are bypassed until no 12 volt pulses are detected on the gray wire within 3 seconds of the yellow wire seeing 12 volts. This aspect is further understood with reference to the enclosed flowchart **85** of FIG. **7**.

e. Alert Warning "E" (FIG. **8**): the vehicle unit contacts the monitoring station to instantly call 3 phone numbers with the message "Vehicle has low battery voltage and system has changed to low voltage mode". This is with the system armed and detecting the red wire with lower than 11 volts for ## minutes. All future alerts "E" are bypassed until, first, more than 13.5 volts are detected on the red wire and, second, after the yellow wire stops having positive voltage the red wire then must detect more than 12 volts.

The following are representative commands for use in the system:

Command 1: Reset all circuits and system remains asleep until the ignition key is turned on. Resets the triggered mode and unit is asleep to prevent power drain on vehicle battery.

Command 2: (Accessory activation) monitoring station Command to the system to activate Pink wire to pulse 250 ma negative for 1 second.

Command 3: (Vehicle Location) website to indicate present location and past events in memory.

Command 4: (Hijack or Stolen) monitoring station Command to vehicle system to activate:

iv. Gray wire to pulse 1 sec on/1 sec off with 1 amp positive output and which continues until receive command # 1.

v. Orange wire to have 500 ma ground and which continues until receive command # 1.

Command 5: (Car Find) monitoring station Command to system activating Gray wire for 30 seconds pulsing 1 sec on/1 sec off with 1 amp positive output.

Command 6: (Lock Doors) monitoring station Command to system activating Green wire to pulse 1 second with 250 ma negative.

Command 7: (Unlock Doors) monitoring station Command to system to activate Blue wire to pulse 1 second with 250 ma negative.

Command 8: (Start Constant Vehicle Tracking) sends previous 2 events in memory and then every 120 seconds get update of location information sent to the Web site.

The system is also operable in a battery saver mode which operates as follows:

i. With the ignition key off, if the battery voltage drops below 11.5 volts for more than 5 seconds, the GPS verification wakes up to look:

ii. Once instantly.

iii. Once in 1 hour if at the same location.

iv. Once in 6 hours if at the same location.

v. Once in 12 hours if at the same location.

vi. Once every 24 hours if at the same location.

vii. Activate alert "E" when the battery saver mode is activated, and bypass sending all future Alert "E" until the battery voltage goes above 13 volts for 10 minutes to reset this feature.

Another aspect of the invention relates to automatic vehicle alert e-mails sent containing some or all of the previous system events. This sending can be triggered as follows:

a. At a user selected predetermined time ## (01-24) of each day, or

b. At a predetermined memory fill level, such as full or near full.

In addition, each system event may contain one or more of the following:

a. Vehicle Location

b. Vehicle total time at location

c. Time of day

d. Mph traveling

e. Total time traveling above MPH

f. Direction traveling

g. Delta

h. Special Alert messages, if any, including:

i. GPS signal not received for longer than 5 minutes.

ii) Traveling above ###MPH for ## minutes.

iii) Vehicle is stolen.

iv) Alarm activated.

v) Unauthorized remote transmitter alert.

vi) Battery saver mode activated

vii) Command 1: Reset all circuits and system remains asleep until the ignition key is turned on.

viii) Command 2: (Accessory activation)

ix) Command 3: (Vehicle Location was retrieved)

x) Command 4: (Hijack or Stolen mode activated)

xi) Command 5: (Car Find mode activated)

xii) Command 6: (Locked Doors)

xiii) Command 7: (Unlocked Doors)

xiv) Command 8: (Started 2-second incremental Vehicle Tracking)

Another feature of the invention relates to the selectable threshold conditions causing an event to be recorded into the memory of the vehicle unit. For example, this may include: while the yellow wire has 12 volts, record events every "?" default 15 minutes time if the GPS location has changed. If the GPS location is the same then only update stationary total

time. If the GPS antenna is not receiving any signal then enter last known GPS location and with an indication that this was the last known GPS location before the GPS signal stopped, how long no GPS signal was received, and the GPS location in the on-hold file, when the vehicle is traveling above ### MPH for ##-minutes.

The monitoring station may also provide a number of automated phone calls as described above. These may include:

The user's vehicle has issued a stolen alert:

If vehicle is stolen, after receiving the phone message the user then calls 911 to advise police of the theft, and gives the police the website address and an identification number, such as the user's PIN, to allow the police to locate where your vehicle has been, where it is now and keep tracking it until the police can retrieve the vehicle.

If this is a false alert due to vehicle being towed away for service, for example, then the user may press "1" to put the vehicle in an off mode. Once the ignition key is turned on again the system will reset back to its normal operation mode.

The user's vehicle has issued an alarm activated for more than 10 seconds alert. The system will not respond to this alert again until ignition key is turned on again to reset this feature.

The vehicle battery voltage is low or has been disconnected. The tracking system is in low voltage mode. The system will not respond to this alert again until the battery voltage goes above 13 volts for 10 minutes to reset this feature.

The backup battery may be sized according to the GPS receiver and processing power draw. In addition, the battery may also be sized based upon estimated micro burst transmitting power draw. Such transmissions are typically at about 3 watts power to the antenna.

The system according to the invention including the vehicle unit and monitoring station provides a number of significant advantages and features. For example, the police may be directly contacted by the user when the vehicle is stolen. The user receives the telephone message from the monitoring station, and this is done without requiring the intervention of a manual security monitoring operator, such as an ADT operator, for example. In addition, once in the stolen mode, the vehicle unit will periodically continue to send out its location, so that the police may track the vehicle via the WEB, for example. This location sending feature may begin immediately, that is, without requiring the user to contact the vehicle to begin tracking. Having the vehicle contacting the monitoring station is considerably less expensive than other schemes where the vehicle is periodically polled via the cellular network, for example.

The system may also be interfaced to a breath alcohol sensor at the vehicle, for example, and this information recorded in memory. The information could be passed along to the monitoring station, which, in turn, could send out a notification message (e-mail or telephone) that the vehicle is being operated by a driver who may be impaired by alcohol. The vehicle's location could then be tracked to permit the police to detain the driver.

Another aspect of the unit is that it may be able to recognize the desirability to bypass certain security breach triggers or other events. For example, a car finding feature can be provided that will allow the user to sound the horn or siren when near the vehicle to help locate the vehicle, as in a crowded parking area. Without the bypass feature, the unit could recognize the horn or siren as a security breach and transmit such information to the monitoring center. In accordance with this aspect of the invention, the unit would recognize the car finding feature was activated and thereby bypass sending a security breach transmission, for example. Again, false alarms and unneeded usage and expense of the communications infrastructure would be avoided.

Yet another aspect of the invention relates to thwarting a would-be thief who attempts to disable the alarm by cutting the battery cable or power supplied to the system. The unit preferably includes a back-up battery. More particularly, upon being in an armed mode and sensing a breach of security, such as the hood opening, for example, the unit will send out a signal indicating the alarm or security breach and while the alarm is indicated, if the battery is disconnected then the unit will send out a message indicating the vehicle is stolen, and also providing the vehicle's current position. Accordingly, the would-be thief is not able to defeat the security system by quickly disrupting power to the unit during an alarm indication or security breach. Also, to prevent additional alerts, this message is prevented from being transmitted again until the user returns to the vehicle to disarm the system and/or turn on the ignition so that the unit sees a voltage above 13 volts, indicating the vehicle has started using the owner's ignition key. This aspect is further understood with reference to the enclosed flowchart **80** (FIG. **4**).

Still another aspect of the invention relates to how the unit can discriminate between ordinary usage or honking of the horn as compared to a security system triggered alarm. Most vehicle security systems will provide a pattern of horn soundings as an alarm indication, and this can be determined and used to reduce false alarm transmissions from the unit. For example, the unit can look at the number of leading and trailing edges of the power pulse used to sound the horn. A single pressing of the horn switch by the user will cause two edges within a predetermined time, such as about 10 to 12 seconds. Accordingly, the unit can be configured to not send a security breach transmission to the control center based upon detecting two transitions. Since a number of vehicle security systems may have a continuous sounding of the horn within the predetermined time, the unit can send the transmission upon detecting only a single transition.

A number of other vehicle security systems provide a series of pulses or horn soundings within the predetermined time. Accordingly, the unit may also be configured to send a security breach transmission upon detecting greater than a predetermined number of transitions, such as greater than nine, for example. This number is also typically higher than a user would generate honking the horn several times within the predetermined time. In other terms, the number of transitions of the horn pulses can be counted, and if equal to one, or greater than nine, for example, the transmission is triggered, and otherwise the sounding of the horn is ignored. Also, to prevent additional alerts, this message is prevented from being transmitted again until the user returns to the vehicle to disarm the system and/or turn on the ignition so that the unit sees a voltage above 13 volts, indicating the vehicle has started using the owner's ignition key. This aspect is further understood with reference to the enclosed flowcharts **81-83** (FIGS. **5A-5C**).

Yet another feature of the invention relates to a low vehicle battery alert. For example, the unit may monitor the battery voltage over a predetermined time such as ten minutes. The ten minute window prevents false tripping, for example, when the voltage dips during engine cranking. In particular, the voltage can be sensed and it can be determined whether it is greater than zero (e.g. greater than six volts) and less than a high value (e.g. eleven or twelve volts), and, if so, a low battery voltage transmission can be communicated to the monitoring station, and ultimately to the vehicle user when away from the vehicle. If the vehicle is being serviced and the battery is disconnected, this will cause the battery voltage to

be equal to zero. Then, the low battery voltage transmission will not be communicated to the monitoring station. Also, to prevent additional alerts, this message is prevented from being transmitted again until the user returns to the vehicle to disarm the system and/or turn on the ignition so that the unit sees a voltage above 13 volts, indicating the vehicle has started using the owner's ignition key. Again, false triggerings are reduced. This aspect is further understood with reference to the enclosed flowchart **86** (FIG. **8**).

Yet another advantageous feature of some embodiments of the invention relates to the ability to conserve electrical power. More particularly, when the vehicle is stopped and in the armed mode, the GPS receiver may be periodically operated to determine the vehicle position. If the vehicle position changes, this is indicative that the vehicle is being moved or stolen. For example, the GPS receiver may be operated to generate new vehicle position information every 29 seconds. These relatively quick successive position determinations or readings are generally termed hot start. These are relatively less complicated than a cold start position determination which takes longer, since the cold start position determination requires greater time to acquire and receive data from multiple satellites, as will be appreciated by those skilled in the art.

Unfortunately, this relatively high repeated usage of the GPS receiver may cause unnecessary battery drain, especially when the vehicle is left armed and unattended by the user for an extended period. Accordingly, the power conserving feature of the invention permits the GPS receiver to be turned off when the vehicle is in the armed mode, and the GPS receiver is turned on only when needed. For example, a vehicle sensor, such as a shock sensor, motion sensor, ignition sensor, door sensor, or other sensor, or combinations thereof could be used to start the GPS receiver. This sensor could also be used to trigger an alarm if desired; however it need not be so used in all embodiments. The GPS receiver, once turned on, could operate in the normal periodic fashion as described above, or for a fixed period of time. The GPS receiver could also be turned off again after some predetermined time if no further sensor signal is received, or if the position fails to change on subsequent position readings or determinations.

Yet another feature relates to permitting more colorful audible alert messages to be generated for the user. The user can, in some embodiments, access an internet site to type or enter the text for a message to be sent, such as to alert the user that his vehicle is being stolen. The audible message then communicated by a telephone call to the user is generated by a speech message synthesizer based upon the entered text. In accordance with this aspect of the invention, the user could type in phonetically spelled words or phrases, such as to create more colorful messages including slang terms, various accents, and/or to mimic various dialects, for example. The speech synthesizer would then generate the desired message customized for the user. Of course, the system could also permit the user to test or preview the pronunciation generated by the speech message synthesizer based on the entered text message prior to its adoption.

Another aspect relates to requesting GPS position information from a vehicle. If a command is sent downstream to the vehicle requesting that GPS information in turn be sent upstream from the vehicle, and the GPS information is not received within a predetermined time, such as about four minutes, then another command may be sent to the vehicle requesting the GPS information. This may keep repeating until GPS information is received, for a predetermined number of tries, or until a user instructs stopping of the requests. This helps to ensure and confirm the activation and reception of GPS tracking coordinates from the vehicle.

Yet another aspect relates to reducing a frequency with which GPS information is sent from the vehicle. More particularly, the unit may be configured to activate GPS information transmission upstream every 2 minutes. To reduce system usage expense and power consumption at the vehicle, this rate of transmission of GPS information could be progressively decreased over time. For example, in one embodiment, upon activation the GPS location signals could be sent every 2 minutes during the first hour, then once an hour for the next 23 hours, after which only one signal would be sent per day.

Turning now to the flowchart **87** of FIG. **9**, still another aspect relates to warning the user of an inoperable or malfunctioning GPS or cellular telephone section. More particularly, if the GPS or cellular telephone antenna wire is cut or the mounting position of either is changed causing the antenna to stop receiving the signal the user would not ordinarily know of this problem quickly. In accordance with one embodiment, if the ignition is turned on a predetermined number of times, such as about three, and each time ignition turns on if no GPS or no cell signal is received for a minimum time, such as about 15 to 30 minutes or longer, an audible warning beeper may be activated in the vehicle. This beeper may be sounded once every 15-minutes. At anytime if the GPS or cell signal is received properly then the system re-sets automatically stopping the beeper sound.

As an example, if the ignition key is turned on and no GPS or no Cell signal is being received for 15-minutes, and the vehicle ignition stays on for 45-minutes and there is still no GPS or no cell signal, the unit counts one. Thereafter, if the ignition key is turned on and no GPS or no cell signal is being received for 15-minutes, and the vehicle ignition stays on for 60-minutes and there is still no GPS or no cell signal, a second count is determined. Thereafter, if the ignition is turned on and no GPS or no cell signal is received for 10-minutes, and the vehicle ignition stays on for only 10-minutes and there is still no GPS or no cell signal, no count is determined. Thereafter, if the ignition is turned on and no GPS or no cell signal is being received for 15-minutes, a third count is determined and the beeper is activated as described above. This beeping may continue every 15-minutes while the vehicle ignition stays on as long as the vehicle ignition stays on for 16-minutes and still no GPS or no Cell signal is being received. If thereafter, the ignition is turned on and no GPS or no cell signal is being received, the beeper beeps once and again beeps once every 15-minutes while vehicle ignition stays on. If in 10-minutes both GPS or cell signal is being received, the beeper system is turned off and the warning count is reset.

By way of example, if the ignition key is turned on and no GPS or no cell signal is being received for only 5, 10 or 12 minutes (with the threshold set at 15 minutes), then no count is determined.

In certain circumstances, the GPS signal may fail, but the cell signal may still be working. Accordingly, it may be desirable to send an indication of the failure of the GPS signal to the central monitoring station to thereby alert the user as described above. If the cell signal also failed, or if the cell signal failed by itself, in other embodiments a separate paging device would transmit the failure or loss of the cell signal information to the central monitoring station, to thereby alert the user.

Yet another feature is directed to efficient use of a relatively small number of codes available to communicate with the tracking unit from the cellular network and central station.

More particularly, a typical arrangement may provide eight basic codes and two Awildcard@ codes. The two wildcard codes are reserved for future or other uses. A particular tracking device will respond directly to any of the eight basic codes. For example, the doors could be locked or unlocked, a present location downloaded from the vehicle, etc.

In accordance with this feature, the tracking device may respond differently to the same code or command depending upon the state or condition of the tracking device. For example, if an alarm is triggered at the vehicle, it may be desired that the tracking device continue to send the alarm signal until confirmation is received that the central monitoring station has received the alarm signal. This confirmation can be sent using the same code as may provide another function if the device were not indicating an alarm. Any of a number of such tracking device conditions may trigger a different message to be interpreted from the received code. For example, if any of the above Alerts A-E were triggered, the receipt of a predetermined code, such as code eight, would confirm receipt of the alert by the central station, and this receipt of code eight would not cause the other response (no alarm triggered) in the tracking device. Of course this concept can be extended to other features as will be appreciated by those skilled in the art.

In accordance with another feature, the rate of sending the location or position data (or change in position data) from the vehicle may be varied to reduce system usage and thereby reduce expenses. More particularly, in one embodiment, the rate of sending may be based upon how long the vehicle has remained stationary. This time period may be selected by the user. For example, the selected time may be in the range of 15 minutes to six hours. If the vehicle has been stationary for the selected time period, then the rate of transmission may be reduced. This reduces or eliminates the need to send home position data and send all the over 15-minute stops made that day. Otherwise, that is when the vehicle is moving, the device may send data at a faster rate. Of course, a system user would not likely be interested in quick updates, especially where the position information is not changing. Conversely, if the vehicle is being moved, it may be desirable to receive more frequent position updates.

Another variation of this transmission rate conservation feature bases the rate of transmission on the vehicle position. For example, a reduced rate of transmission may be selected if the vehicle is in a predetermined area where the user has a lesser interest in quickly updated position information. The user may also have a reduced interest in an area that can be defined outside of a predetermined distance from a reference point.

Yet another variation of the vehicle position transmission rate conservation feature is based upon the vehicle's speed, such as the vehicle's average or maximum speed, for example. Accordingly, if the vehicle is traveling above a preset speed, the rate of transmission may be increased.

In accordance with another aspect of the invention, the tracking device may send the alert indication a predetermined number of times without receiving an acknowledgment as described above, and then wait until the vehicle position has changed before trying again or the cell re-registers or its RSS (received signal strength) changes. Thus, power is conserved. When the vehicle has moved to a new position, any obstructions may no longer be present thereby increasing the likelihood of a successful communication. In addition, the change in position may be determined when the vehicle is sensed to be moving about a predetermined relatively small speed, such as greater than 1 mph, for example.

In all of the embodiments and variations described herein, the tracking device may communicate with one or more other vehicle devices via a vehicle data communications bus. Further aspects of interfacing with a vehicle data communications bus are described in U.S. Pat. Nos. 5,719,551 and 6,011,460 assigned to the assignee of the present invention, the entire contents of which are incorporated herein by reference.

Yet another aspect relates to efficient use of available codes on the cellular telephone control channel. In one particular example, ten codes may be available to be transmitted from the monitoring station to the vehicle trackers. The first eight or nine codes are command codes that will cause a specific action by the tracking device at the vehicle. The other one or two codes may be wildcard codes as mentioned above, that may set a stand-by mode for one or a group of vehicles, for example.

It may be desirable to provide more than eight commands at the vehicle responsive to the corresponding eight available codes. For example, it may be desirable to set a feature on or off, or to set a different feature setting or threshold. In accordance with this aspect of the invention, the commands at the tracker are determined based upon a series of different command codes being received within a predetermined time window.

For example, the monitoring station may send code 9 that switches the tracker in the car into a stand-by mode for a predetermined time and which causes the tracker to respond with an upstream confirmation code 7 or 9 indicating receiving code 9. During the predetermined time of the stand-by mode another code follows that causes a system programmable feature or setting to change. Note that the second code would otherwise cause a different function at the vehicle. Note that system might operate a function 9 if another code 1-9 is not received in the predetermined time. The following list is exemplary for features resulting from second codes 1-9:

Code 1—Tracker will turn off feature of upstream code caused by vehicle alert being detected.

Code 2—Tracker will turn on feature of upstream code caused by vehicle alert being detected.

Code 3—Tracker deactivates cell receiver from operating due to a non-paying customer for monitoring service. That phone number can then be allocated to another customer.

Code 4—Turn on audio buzzer feature that will sound once each 10 minutes. The monitoring station need only send the command to activate the feature, as the tracker will time the period and drive the buzzer thereafter. The monitoring station will normally not need to send this command because the tracker will be configured out of the box with this feature activated to sound the buzzer every 10 minutes until the next command is received.

Code 5—Turn off the audio buzzer. This is to be sent by the monitoring station after a user has successfully activated his account.

Code 6—Turn on the 80 mph speed limit reporting. This will normally not be sent as this feature will be the default setting of the tracker.

Code 7—a Turn off the 80 mph speed limit reporting.

Code 8—Increase speed limit 5 mph and increase the time 5 minutes.

Code 9—Decrease speed limit 5 mph and decrease the time 5 minutes, and wait 5 minutes if another code number follows. It could operate this way to allow another set of codes to change more features.

In this example, in response to the tracker receiving the system code 1-9, the tracker sends an upstream code 7 to acknowledge receipt of the system code 1-9. Upon receipt of code 9 the tracker waits up to 5 minutes to determine if

another system code is received. If no code is received, then the tracker performs the code 9 operation. Of course, in other embodiments other features or settings can be selected. In general, it may be preferred that the first code sent in a series of two codes, for example, be a code that causes only a minor function to be performed at the vehicle. This is so because if the second code is sent from the monitoring station, but not received at the tracker, only a minor function is performed. For example, the first code may switch between armed and disarmed modes. This is in contrast to using a remote engine starting code or engine shutdown code as the first code. The vehicle may be moving or positioned in a marginal reception area, and the second command may not be received by the tracker within the predetermined time window. As will be appreciated by those skilled in the art, this concept of multiple digit codes, can be extended beyond two digits to three or more.

To further conserve cellular transmissions and as described above, the tracker may be set to record a position based upon a determined event. Only this recorded position information may be downloaded either by user request or at set times. It is desired that such events be relatively few, but that the information still be helpful to the user.

For example, an event for recording of position may be determined based upon the vehicle being stopped for greater than a first time and less than a second time. For example, the first time may be 15 minutes and the second time may be 6 hours. Determination of the vehicle being stopped can be made based upon one or both of the GPS position or the vehicle ignition being turned off. The second time prevents the recording of position information when the vehicle is stopped at the owner's home during the evening, for example. Accordingly, the important information of the vehicle stops being made is recorded and made available to the user, while system communications resources are conserved.

In another example, if the mode is selected to send the vehicle's location every 10 min and the vehicle is in the same location for greater than a set time, then no more vehicle locations are sent until the vehicle location has changed to start the every 10 min reporting again.

Now referring to FIGS. **10** and **11**, in yet another embodiment the potential difficulties of interfacing to a vehicle data bus and devices connected thereto are further discussed. The multi-vehicle compatible tracking unit **110** is for a vehicle comprising a vehicle data bus **122** extending throughout the vehicle. The multi-vehicle compatible tracking unit **110** includes a vehicle position determining device **112**, a wireless communications device **113**, and a multi-vehicle compatible controller **111** for cooperating with the vehicle position determining device and the wireless communications device to send vehicle position information. The vehicle position determining device **112** may be provided by a GPS receiver, for example, or any of the other such devices described in detail above.

The wireless communications device **113** may be provided by a cellular telephone transceiver configured to operate on a control channel of the cellular network, or any of the other such devices described in detail above.

The multi-vehicle compatible controller **111** is coupled to the vehicle data bus **122** for communication therewith with a vehicle device **121**. The controller **111** illustratively includes a central processing unit (CPU) **126** or other logic circuitry which is connected to a clock signal generator **124**, a memory **125**, and input/output circuitry **127** to interface with the vehicle device **121** using at least one corresponding vehicle device code from among a plurality thereof for different vehicles. The corresponding vehicle code may be for reading from the vehicle device **121**. Similarly, the corresponding vehicle code may be additionally or alternatively for writing to the vehicle device **121**.

The multi-vehicle compatible tracking unit **110** also illustratively includes a downloading interface **116** for permitting downloading of enabling data related to the at least one corresponding vehicle device code for use by the multi-vehicle compatible controller **111**. The enabling data may be the vehicle device code or codes, an instruction to select a code or codes from among those already stored, or the data or sequence to allow the controller **111** to generate the vehicle device code or codes, for example.

In the embodiment as shown in FIG. **11**, the downloading interface **116** is a category of wireless signal downloading interfaces that illustratively include a wireless receiver **114**, such as for temporary connection to the downloading device **115**. The wireless downloading interface **116** may communicate with the downloading device **115** via any one or more of a number of wireless technologies, such as cellular, satellite, IR, Bluetooth or WiFi technologies for example, as will also be appreciated by those skilled in the art. Interface circuitry **132** is included in the wireless signal downloading interface **116** for controlling communication with the downloading device **115**. The interface circuitry **132** may be logic circuitry or other control circuitry along with switching components.

In other embodiments, for example as shown in FIG. **12**, the wireless downloading interface **116'** does not include the wireless receiver **114**, as a temporary wireless communication link is instead provided by sharing the wireless communications device **113** that sends position data as described above.

The downloading interface may also be in the form of a wired signal downloading interface **116"** as shown in FIG. **13**. The wired signal downloading interface **116"** comprises a connector **133***a* for temporary connection to a downloading device **115"** with a mating connector **133***b*. Interface circuitry **132"** is provided for controlling communication with the downloading device **115"**. The wired downloading interface **116"** may connect directly to a downloading device **115"**, such as a laptop computer, via RS232/429 protocol, USB, FireWire, TCP/IP (Internet), or any other wired protocol as will be appreciated by those skilled in the art. The connector **133***a* of the wired downloading interface **116"** may alternatively be in the form of a socket to accept a memory card or other data storage medium capable of transferring data. The downloading interfaces **116**, **116'** and **116"**, may also advantageously be for permitting downloading of programming instructions for the multi-vehicle compatible controller **111**, to allow remote programming, for example, as will also be appreciated by those skilled in the art.

Referring again briefly to FIG. **10**, the multi-vehicle compatible tracking unit **110** further comprises a remote transmitter **117**, such as typically in the form of a small handheld device to be carried by a user when away from the vehicle. The multi-vehicle compatible controller **111** also performs at least one vehicle remote control function responsive to the remote transmitter **117**. The remote transmitter **117** illustratively communicates with the remote receiver **118**, which is coupled to the multi-vehicle compatible controller **111**. The vehicle remote control functions may include a vehicle security function, a remote keyless entry function, and a remote engine starting function, for example, implemental via the data bus **122** using one or more vehicle devices **121**. Such a vehicle device **121** may also include another vehicle controller, as well as a sensor, or actuator as will be appreciated by those skilled in the art.

The multi-vehicle compatible tracking unit **110** illustratively includes a common housing **123** for its various components. In other embodiments, more than one housing may be used for the various components.

Referring additionally to FIGS. **14** and **15**, several methods for using a multi-vehicle compatible tracking unit **110** for a vehicle comprising a vehicle data bus **122** extending throughout the vehicle are described with reference to the respective flowcharts **148**, **148'**. Beginning at Block **150**, the multi-vehicle compatible tracking unit **110** is installed in vehicle (Block **151**). At Block **152** a connection is then established between the multi-vehicle compatible tracking unit **110** and a downloading device **115** using a downloading interface **116**. Enabling data related to at least one corresponding vehicle device code for use by the multi-vehicle compatible controller **111** is downloaded via a downloading interface **116** (Block **153**). Once the enabling data is downloaded, the connection between the multi-vehicle tracking unit **110** and the downloading device **115** is terminated at Block **154**. Of course the multi-vehicle compatible tracking unit **110** may be optionally programmed via the downloading interface while the connection is established. The operation of the tracking unit may be tested at Block **155** before stopping at Block **156**. With particular reference to the flowchart **148'** of FIG. **15**, the multi-vehicle compatible tracking unit **110** may be connected to the downloading device **115** (Block **152'**), etc., before installation in the vehicle (Block **151'**) and testing (Block **155'**).

Other features relating to vehicle control systems are disclosed in copending patent applications entitled VEHICLE TRACKER INCLUDING STATIONARY TIME DETERMINATION AND ASSOCIATED METHODS, Ser. No. 09/859,727 filed May 17, 2001, now U.S. Pat. No. 6,512,465; VEHICLE TRACKER CONSERVING CODES AND RELATED METHODS, Ser. No. 09/859,673 filed May 17, 2001, now U.S. Pat. No. 6,522,267; VEHICLE TRACKER WITH POWER SAVING FEATURES AND RELATED METHODS, Ser. No. 09/859,728 filed May 17, 2001, now U.S. Pat. No. 6,512,466; VEHICLE TRACKER COOPERATING WITH A STARTER INTERRUPT AND RELATED METHODS, Ser. No. 09/859,973 filed May 17, 2001; VEHICLE TRACKER WITH USER NOTIFICATIONS AND ASSOCIATED METHODS, Ser. No. 09/859,733 filed May 17, 2001, now U.S. Pat. No. 6,509,868; VEHICLE TRACKER WITH USER REGISTRATION REMINDER AND RELATED METHODS, Ser. No. 09/859,971 filed May 17, 2001, now U.S. Pat. No. 6,507,786; VEHICLE TRACKER INCLUDING INPUT/OUTPUT FEATURES AND RELATED METHODS, Ser. No. 09/859,972 filed May 17, 2001, now U.S. Pat. No. 6,606,561; and VEHICLE TRACKER WITH TEST FEATURES AND RELATED METHODS, Ser. No. 09/859,729 filed May 17, 2001, now U.S. Pat. No. 6,809,659, the entire disclosures of which are incorporated herein by reference.

Many modifications and other embodiments of the invention will come to the mind of one skilled in the art having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Accordingly, it is understood that the invention is not to be limited to the embodiments disclosed, and that other modifications and embodiments are intended to be included within the spirit and scope of the appended claims.

That which is claimed is:

1. A multi-vehicle compatible tracking unit for a vehicle comprising a vehicle data bus extending throughout the vehicle, the multi-vehicle compatible tracking unit comprising:

a vehicle position determining device;

a wireless communications device;

a multi-vehicle compatible controller for cooperating with said vehicle position determining device and said wireless communications device to send vehicle position information;

said multi-vehicle compatible controller to be coupled to the vehicle data bus for communication thereover with at least one vehicle device using at least one corresponding vehicle device code from among a plurality thereof for different vehicles; and

a downloading interface for permitting downloading of enabling data related to the at least one corresponding vehicle device code for use by said multi-vehicle compatible controller.

2. The multi-vehicle compatible tracking unit according to claim **1** wherein said downloading interface comprises a wired signal downloading interface.

3. The multi-vehicle compatible tracking unit according to claim **2** wherein said wired signal downloading interface comprises a connector for temporary connection to a downloading device.

4. The multi-vehicle compatible tracking unit according to claim **1** wherein said downloading interface comprises a wireless signal downloading interface.

5. The multi-vehicle compatible tracking unit according to claim **4** wherein said wireless signal downloading interface comprises a wireless receiver for temporary connection to a downloading device.

6. The multi-vehicle compatible tracking unit according to claim **1** wherein the corresponding at least one vehicle code is for reading from the at least one vehicle device.

7. The multi-vehicle compatible tracking unit according to claim **1** wherein the corresponding at least one vehicle code is for writing to the at least one vehicle device.

8. The multi-vehicle compatible tracking unit according to claim **1** wherein said downloading interface is also for permitting downloading of at least one programming instruction for said multi-vehicle compatible controller.

9. The multi-vehicle compatible tracking unit according to claim **1** further comprising a remote transmitter; and wherein said multi-vehicle compatible controller also performs at least one vehicle remote control function responsive to said remote transmitter.

10. The multi-vehicle compatible tracking unit according to claim **9** wherein the at least one vehicle remote control function comprises at least one of a vehicle security function, a remote keyless entry function, and a remote engine starting function.

11. The multi-vehicle compatible tracking unit according to claim **1** wherein said wireless position determining device comprises a Global Positioning System (GPS) receiver.

12. The multi-vehicle compatible tracking unit according to claim **1** further comprising a housing containing said vehicle position determining device, said wireless communications device, said multi-vehicle compatible controller, and said downloading interface.

13. A multi-vehicle compatible tracking unit for a vehicle comprising a vehicle data bus extending throughout the vehicle, the multi-vehicle compatible vehicle tracking unit comprising:

a vehicle position determining device;

a wireless communications device;

a multi-vehicle compatible controller for cooperating with said vehicle position determining device and said wireless communications device to send vehicle position information;

said multi-vehicle compatible controller to be coupled to the vehicle data bus for communication thereover with at least one vehicle device using at least one corresponding vehicle device code from among a plurality thereof for different vehicles; and

a downloading interface for permitting downloading of enabling data related to the at least one corresponding vehicle device code for use by said multi-vehicle compatible controller;

said downloading interface comprising a connector for temporary connection to a downloading device.

14. The multi-vehicle compatible tracking unit according to claim **13** wherein the corresponding at least one vehicle code is for reading from the at least one vehicle device.

15. The multi-vehicle compatible tracking unit according to claim **13** wherein the corresponding at least one vehicle code is for writing to the at least one vehicle device.

16. The multi-vehicle compatible tracking unit according to claim **13** wherein said downloading interface is also for permitting downloading of at least one programming instruction for said multi-vehicle compatible controller.

17. The multi-vehicle compatible tracking unit according to claim **13** further comprising a remote transmitter; and wherein said multi-vehicle compatible controller also performs at least one vehicle remote control function responsive to said remote transmitter.

18. A multi-vehicle compatible tracking unit for a vehicle comprising a vehicle data bus extending throughout the vehicle, the multi-vehicle compatible vehicle tracking unit comprising:

a vehicle position determining device;

a wireless communications device;

a multi-vehicle compatible controller for cooperating with said vehicle position determining device and said wireless communications device to send vehicle position information;

said multi-vehicle compatible controller to be coupled to the vehicle data bus for communication thereover with at least one vehicle device using at least one corresponding vehicle device code from among a plurality thereof for different vehicles; and

a downloading interface for permitting downloading of enabling data related to the at least one corresponding vehicle device code for use by said multi-vehicle compatible controller;

said downloading interface comprising a wireless receiver for temporary connection to a downloading device.

19. The multi-vehicle compatible tracking unit according to claim **18** wherein the corresponding at least one vehicle code is for reading from the at least one vehicle device.

20. The multi-vehicle compatible tracking unit according to claim **18** wherein the corresponding at least one vehicle code is for writing to the at least one vehicle device.

21. The multi-vehicle compatible tracking unit according to claim **18** wherein said downloading interface is also for permitting downloading of at least one programming instruction for said multi-vehicle compatible controller.

22. The multi-vehicle compatible tracking unit according to claim **18** further comprising a remote transmitter; and wherein said multi-vehicle compatible controller also performs at least one vehicle remote control function responsive to said remote transmitter.

* * * * *

US008032278C1

(12) EX PARTE REEXAMINATION CERTIFICATE (11018th)
United States Patent
Flick

(10) Number: US 8,032,278 C1
(45) Certificate Issued: Dec. 28, 2016

(54) VEHICLE TRACKING UNIT WITH DOWNLOADABLE CODES AND ASSOCIATED METHODS

(75) Inventor: Kenneth E. Flick, Douglasville, GA (US)

(73) Assignee: OMEGA PATENTS, L.L.C., Douglasville, GA (US)

Reexamination Request:
No. 90/013,587, Sep. 14, 2015

Reexamination Certificate for:

Patent No.:	8,032,278
Issued:	Oct. 4, 2011
Appl. No.:	11/773,272
Filed:	Jul. 3, 2007

Related U.S. Application Data

(63) Continuation-in-part of application No. 11/076,259, filed on Mar. 9, 2005, now Pat. No. 7,720,597, which is a continuation of application No. 10/383,496, filed on Mar. 7, 2003, now Pat. No. 7,149,623, which is a continuation of application No. 09/859,972, filed on May 17, 2001, now Pat. No. 6,606,561.

(60) Provisional application No. 60/264,811, filed on Jan. 29, 2001, provisional application No. 60/258,005, filed on Dec. 22, 2000, provisional application No. 60/251,552, filed on Dec. 6, 2000, provisional application No. 60/252,125, filed on Nov. 20, 2000, provisional application No. 60/236,890, filed on Sep. 29, 2000, provisional application No. 60/246,463, filed on Nov. 7, 2000, provisional application No. 60/222,777, filed on Aug. 3, 2000, provisional application No. 60/205,178, filed on May 17, 2000.

(51) **Int. Cl.**

G01C 21/00	(2006.01)
B60R 25/04	(2013.01)
G07C 5/00	(2006.01)
B60R 25/102	(2013.01)
B60R 25/104	(2013.01)
G08G 1/00	(2006.01)
B60R 25/045	(2013.01)
G08G 1/127	(2006.01)
B60R 25/33	(2013.01)

(52) **U.S. Cl.**
CPC ***B60R 25/04*** (2013.01); ***B60R 25/045*** (2013.01); ***B60R 25/102*** (2013.01); ***B60R 25/104*** (2013.01); ***B60R 25/33*** (2013.01); ***G07C 5/008*** (2013.01); ***G08G 1/127*** (2013.01); ***G08G 1/20*** (2013.01); ***G08G 1/205*** (2013.01); *B60R 2325/202* (2013.01); *B60R 2325/203* (2013.01); *B60W 2550/402* (2013.01)

(58) **Field of Classification Search**
CPC B60R 25/04
See application file for complete search history.

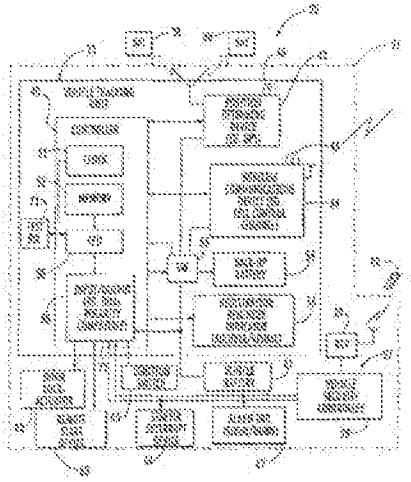
(56) **References Cited**

To view the complete listing of prior art documents cited during the proceedings for Reexamination Control Numbers 90/013,587, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

Primary Examiner — Matthew C Graham

(57) **ABSTRACT**

A multi-vehicle compatible tracking unit is for a vehicle including a vehicle data bus extending throughout the vehicle. The vehicle tracking unit may include a vehicle position determining device, a wireless communications device, and a multi-vehicle compatible controller for cooperating with the vehicle position determining device and the wireless communications device to send vehicle position information. The multi-vehicle compatible controller may be coupled to the vehicle data bus for communication thereover with at least one vehicle device using at least one corresponding vehicle device code from among a plurality thereof for different vehicles. A downloading interface may be included for permitting downloading of enabling data related to the at least one corresponding vehicle device code for use by the multi-vehicle compatible controller.



EX PARTE REEXAMINATION CERTIFICATE

NO AMENDMENTS HAVE BEEN MADE TO THE PATENT

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

The patentability of claims 1-22 is confirmed.

* * * * *

US008032278C2

(12) EX PARTE REEXAMINATION CERTIFICATE (11454th)

United States Patent
Flick

(10) **Number: US 8,032,278 C2**
(45) **Certificate Issued: Feb. 6, 2019**

(54) **VEHICLE TRACKING UNIT WITH DOWNLOADABLE CODES AND ASSOCIATED METHODS**

(75) Inventor: **Kenneth E. Flick**, Douglasville, GA (US)

(73) Assignee: **OMEGA PATENTS, L.L.C.**, Douglasville, GA (US)

Reexamination Request:
No. 90/013,851, Oct. 28, 2016

Reexamination Certificate for:

Patent No.:	**8,032,278**
Issued:	**Oct. 4, 2011**
Appl. No.:	**11/773,272**
Filed:	**Jul. 3, 2007**

Reexamination Certificate C1 8,032,278 issued Dec. 28, 2016

Related U.S. Application Data

(63) Continuation-in-part of application No. 11/076,259, filed on Mar. 9, 2005, now Pat. No. 7,720,597, which is a continuation of application No. 10/383,496, filed on Mar. 7, 2003, now Pat. No. 7,149,623, which is a continuation of application No. 09/859,972, filed on May 17, 2001, now Pat. No. 6,606,561.

(60) Provisional application No. 60/264,811, filed on Jan. 29, 2001, provisional application No. 60/258,005, filed on Dec. 22, 2000, provisional application No. 60/251,552, filed on Dec. 6, 2000, provisional application No. 60/252,125, filed on Nov. 20, 2000, provisional application No. 60/236,890, filed on Sep. 29, 2000, provisional application No. 60/246,463, filed on Nov. 7, 2000, provisional application No. 60/222,777, filed on Aug. 3, 2000, provisional application No. 60/205,178, filed on May 17, 2000.

(51) **Int. Cl.**

G01C 21/00	(2006.01)
H03F 3/45	(2006.01)
B60R 25/045	(2013.01)
G08G 1/127	(2006.01)
B60R 25/04	(2013.01)
G07C 5/00	(2006.01)
B60R 25/104	(2013.01)
B60R 25/33	(2013.01)
B60R 25/102	(2013.01)
G08G 1/00	(2006.01)

(52) **U.S. Cl.**
CPC ***H03F 3/45*** (2013.01); ***B60R 25/04*** (2013.01); ***B60R 25/045*** (2013.01); ***B60R 25/102*** (2013.01); ***B60R 25/104*** (2013.01); ***B60R 25/33*** (2013.01); ***G07C 5/008*** (2013.01); ***G08G 1/127*** (2013.01); ***G08G 1/20*** (2013.01); ***G08G 1/205*** (2013.01); *B60R 2325/202* (2013.01); *B60R 2325/205* (2013.01); *B60W 2550/402* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

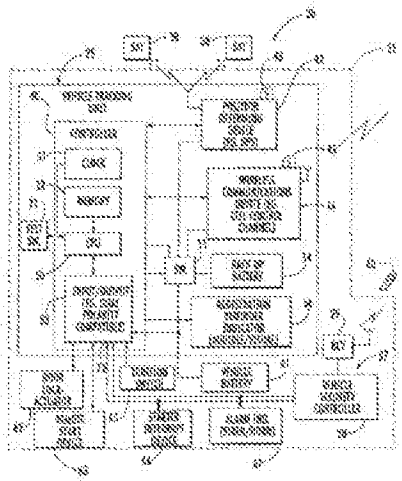
(56) **References Cited**

To view the complete listing of prior art documents cited during the proceeding for Reexamination Control Number 90/013,851, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

Primary Examiner — Karin Reichle

(57) **ABSTRACT**

A multi-vehicle compatible tracking unit is for a vehicle including a vehicle data bus extending throughout the vehicle. The vehicle tracking unit may include a vehicle position determining device, a wireless communications device, and a multi-vehicle compatible controller for cooperating with the vehicle position determining device and the wireless communications device to send vehicle position information. The multi-vehicle compatible controller may be coupled to the vehicle data bus for communication thereover with at least one vehicle device using at least one corresponding vehicle device code from among a plurality thereof for different vehicles. A downloading interface may be included for permitting downloading of enabling data related to the at least one corresponding vehicle device code for use by the multi-vehicle compatible controller.



EX PARTE REEXAMINATION CERTIFICATE

NO AMENDMENTS HAVE BEEN MADE TO THE PATENT

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

The patentability of claims 1-22 is confirmed.

* * * * *

US008032278C2

(12) EX PARTE REEXAMINATION CERTIFICATE (11454th)

United States Patent
Flick

(10) **Number: US 8,032,278 C2**
(45) **Certificate Issued: Feb. 6, 2019**

(54) **VEHICLE TRACKING UNIT WITH DOWNLOADABLE CODES AND ASSOCIATED METHODS**

(75) Inventor: **Kenneth E. Flick**, Douglasville, GA (US)

(73) Assignee: **OMEGA PATENTS, L.L.C.**, Douglasville, GA (US)

Reexamination Request:
No. 90/013,851, Oct. 28, 2016

Reexamination Certificate for:

Patent No.:	**8,032,278**
Issued:	**Oct. 4, 2011**
Appl. No.:	**11/773,272**
Filed:	**Jul. 3, 2007**

Reexamination Certificate C1 8,032,278 issued Dec. 28, 2016

Related U.S. Application Data

(63) Continuation-in-part of application No. 11/076,259, filed on Mar. 9, 2005, now Pat. No. 7,720,597, which is a continuation of application No. 10/383,496, filed on Mar. 7, 2003, now Pat. No. 7,149,623, which is a continuation of application No. 09/859,972, filed on May 17, 2001, now Pat. No. 6,606,561.

(60) Provisional application No. 60/264,811, filed on Jan. 29, 2001, provisional application No. 60/258,005, filed on Dec. 22, 2000, provisional application No. 60/251,552, filed on Dec. 6, 2000, provisional application No. 60/252,125, filed on Nov. 20, 2000, provisional application No. 60/236,890, filed on Sep. 29, 2000, provisional application No. 60/246,463, filed on Nov. 7, 2000, provisional application No. 60/222,777, filed on Aug. 3, 2000, provisional application No. 60/205,178, filed on May 17, 2000.

(51) **Int. Cl.**

G01C 21/00	(2006.01)
H03F 3/45	(2006.01)
B60R 25/045	(2013.01)
G08G 1/127	(2006.01)
B60R 25/04	(2013.01)
G07C 5/00	(2006.01)
B60R 25/104	(2013.01)
B60R 25/33	(2013.01)
B60R 25/102	(2013.01)
G08G 1/00	(2006.01)

(52) **U.S. Cl.**
CPC ***H03F 3/45*** (2013.01); ***B60R 25/04*** (2013.01); ***B60R 25/045*** (2013.01); ***B60R 25/102*** (2013.01); ***B60R 25/104*** (2013.01); ***B60R 25/33*** (2013.01); ***G07C 5/008*** (2013.01); ***G08G 1/127*** (2013.01); ***G08G 1/20*** (2013.01); ***G08G 1/205*** (2013.01); *B60R 2325/202* (2013.01); *B60R 2325/205* (2013.01); *B60W 2550/402* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

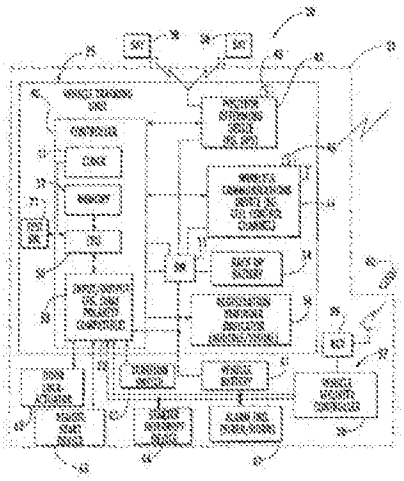
(56) **References Cited**

To view the complete listing of prior art documents cited during the proceeding for Reexamination Control Number 90/013,851, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

Primary Examiner — Karin Reichle

(57) **ABSTRACT**

A multi-vehicle compatible tracking unit is for a vehicle including a vehicle data bus extending throughout the vehicle. The vehicle tracking unit may include a vehicle position determining device, a wireless communications device, and a multi-vehicle compatible controller for cooperating with the vehicle position determining device and the wireless communications device to send vehicle position information. The multi-vehicle compatible controller may be coupled to the vehicle data bus for communication thereover with at least one vehicle device using at least one corresponding vehicle device code from among a plurality thereof for different vehicles. A downloading interface may be included for permitting downloading of enabling data related to the at least one corresponding vehicle device code for use by the multi-vehicle compatible controller.



EX PARTE REEXAMINATION CERTIFICATE

NO AMENDMENTS HAVE BEEN MADE TO THE PATENT

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

The patentability of claims 1-22 is confirmed.

* * * * *

US008032278C1

(12) EX PARTE REEXAMINATION CERTIFICATE (11018th)
United States Patent
Flick

(10) Number: US 8,032,278 C1
(45) Certificate Issued: Dec. 28, 2016

(54) **VEHICLE TRACKING UNIT WITH DOWNLOADABLE CODES AND ASSOCIATED METHODS**

(75) Inventor: **Kenneth E. Flick**, Douglasville, GA (US)

(73) Assignee: **OMEGA PATENTS, L.L.C.**, Douglasville, GA (US)

Reexamination Request:
No. 90/013,587, Sep. 14, 2015

Reexamination Certificate for:

Patent No.:	**8,032,278**
Issued:	**Oct. 4, 2011**
Appl. No.:	**11/773,272**
Filed:	**Jul. 3, 2007**

Related U.S. Application Data

(63) Continuation-in-part of application No. 11/076,259, filed on Mar. 9, 2005, now Pat. No. 7,720,597, which is a continuation of application No. 10/383,496, filed on Mar. 7, 2003, now Pat. No. 7,149,623, which is a continuation of application No. 09/859,972, filed on May 17, 2001, now Pat. No. 6,606,561.

(60) Provisional application No. 60/264,811, filed on Jan. 29, 2001, provisional application No. 60/258,005, filed on Dec. 22, 2000, provisional application No. 60/251,552, filed on Dec. 6, 2000, provisional application No. 60/252,125, filed on Nov. 20, 2000, provisional application No. 60/236,890, filed on Sep. 29, 2000, provisional application No. 60/246,463, filed on Nov. 7, 2000, provisional application No. 60/222,777, filed on Aug. 3, 2000, provisional application No. 60/205,178, filed on May 17, 2000.

(51) **Int. Cl.**

G01C 21/00	(2006.01)
B60R 25/04	(2013.01)
G07C 5/00	(2006.01)
B60R 25/102	(2013.01)
B60R 25/104	(2013.01)
G08G 1/00	(2006.01)
B60R 25/045	(2013.01)
G08G 1/127	(2006.01)
B60R 25/33	(2013.01)

(52) **U.S. Cl.**
CPC ***B60R 25/04*** (2013.01); ***B60R 25/045*** (2013.01); ***B60R 25/102*** (2013.01); ***B60R 25/104*** (2013.01); ***B60R 25/33*** (2013.01); ***G07C 5/008*** (2013.01); ***G08G 1/127*** (2013.01); ***G08G 1/20*** (2013.01); ***G08G 1/205*** (2013.01); *B60R 2325/202* (2013.01); *B60R 2325/205* (2013.01); *B60W 2550/402* (2013.01)

(58) **Field of Classification Search**
CPC B60R 25/04
See application file for complete search history.

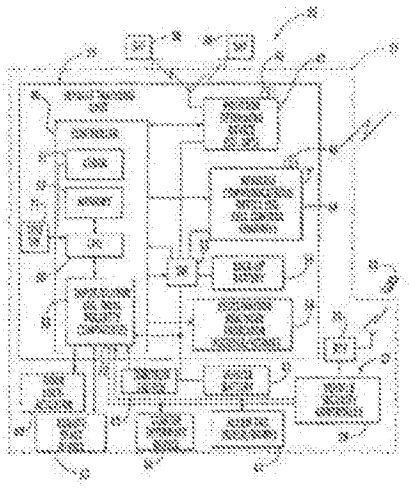
(56) **References Cited**

To view the complete listing of prior art documents cited during the proceedings for Reexamination Control Numbers 90/013,587, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

Primary Examiner — Matthew C Graham

(57) **ABSTRACT**

A multi-vehicle compatible tracking unit is for a vehicle including a vehicle data bus extending throughout the vehicle. The vehicle tracking unit may include a vehicle position determining device, a wireless communications device, and a multi-vehicle compatible controller for cooperating with the vehicle position determining device and the wireless communications device to send vehicle position information. The multi-vehicle compatible controller may be coupled to the vehicle data bus for communication thereover with at least one vehicle device using at least one corresponding vehicle device code from among a plurality thereof for different vehicles. A downloading interface may be included for permitting downloading of enabling data related to the at least one corresponding vehicle device code for use by the multi-vehicle compatible controller.



EX PARTE REEXAMINATION CERTIFICATE

NO AMENDMENTS HAVE BEEN MADE TO THE PATENT

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

The patentability of claims 1-22 is confirmed.

* * * * *

Electronic Acknowledgement Receipt

EFS ID:	36104575
Application Number:	90014309
International Application Number:	
Confirmation Number:	8724
Title of Invention:	Vehicle Tracking Unit with Downloadable Codes and Associated Methods
First Named Inventor/Applicant Name:	Kenneth E. Flick
Customer Number:	150739
Filer:	David J. Bailey/Melissa Yee
Filer Authorized By:	David J. Bailey
Attorney Docket Number:	C13-03896.RE3
Receipt Date:	24-MAY-2019
Filing Date:	
Time Stamp:	17:07:01
Application Type:	Reexam (Third Party)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$12000
RAM confirmation Number	052819INTEFSW17072900
Deposit Account	504407
Authorized User	Melissa Yee

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Copy of patent for which reexamination is requested	pat8032278.pdf	7412131 9afb72830d0f12585bfe41510011c98eb4935307	no	33
Warnings:					
Information:					
2	Receipt of Orig. Ex Parte Request by Third Party	US6430164B1.pdf	5295177 94b2382abd1ed887e13764d99c3d35aca11b5f88	no	18
Warnings:					
Information:					
3	Receipt of Orig. Ex Parte Request by Third Party	US6606561B2.pdf	6182794 5aab86a92281d584a33c4f82e884d6dbacbb07ad	no	30
Warnings:					
Information:					
4	Receipt of Orig. Ex Parte Request by Third Party	US7149623B2.pdf	6004637 69c30e1a4a9aa3dc351008e11ff874acd0f26ba5	no	26
Warnings:					
Information:					
5	Receipt of Orig. Ex Parte Request by Third Party	US7720597B2.pdf	6292189 db242dbdff6bec13d390f636e7aa3b2080eed99c	no	27
Warnings:					
Information:					
6	Receipt of Orig. Ex Parte Request by Third Party	US8032278B2.pdf	7412209 27d47a19961ff0c1296ce606ea10b45cde0bd4ff	no	33
Warnings:					
Information:					

7	Receipt of Orig. Ex Parte Request by Third Party	US8032278C2.pdf	513965 944a989c575c2d5e0d9f716fe45a79390f17b277	no	2
Warnings:					
Information:					
8	Non Patent Literature	cellport.pdf	42398 9bdb637ecf469fc67ca0c622344ed9a6d7a7bfa0	no	3
Warnings:					
Information:					
9	Other Reference-Patent/App/Search documents	FLICKusprov60205178.pdf	3103721 3a607b5382e2b7a6f3698786f5a28e42956fb7fe	no	23
Warnings:					
Information:					
10	Other Reference-Patent/App/Search documents	FLICKusprov60222777.pdf	4192491 c47766b218a4691ffe3bcbae327af8075849fb5d	no	29
Warnings:					
Information:					
11	Other Reference-Patent/App/Search documents	FLICKusprov60236890.pdf	4756431 a8423533bcc77520660cd0e069b472f4adbf4186	no	32
Warnings:					
Information:					
12	Other Reference-Patent/App/Search documents	FLICKusprov60252125.pdf	5598715 253203d138da3736d6ebbf18242d2ea63f72c970	no	36
Warnings:					
Information:					
13	Other Reference-Patent/App/Search documents	FLICKusprov60251552.pdf	6100605 802cbe33ef5da7f5c8d1d28a2a80c17dc9089e54	no	40
Warnings:					
Information:					

14	Other Reference-Patent/App/Search documents	FLICKusprov60258005.pdf	6834466 85c63c6964f0537991fa5d08adb2e30cb25e6c25	no	42
Warnings:					
Information:					
15	Other Reference-Patent/App/Search documents	FLICKusprov60264811.pdf	7380810 aaabac0724f268e56798adf00056a451cc9072ea	no	45
Warnings:					
Information:					
16	Other Reference-Patent/App/Search documents	OMEGAvCALAMP.pdf	231604 60d9ef799a711be09e5dd74707700313555 3daff	no	30
Warnings:					
Information:					
17	Receipt of Orig. Ex Parte Request by Third Party	US8032278C1r.pdf	539810 fd9dd805ceb3de4c2984cee72dc12bc277277e3d	no	2
Warnings:					
Information:					
18	Non Patent Literature	SPELTademonstration.pdf	1345058 4b8c3af31dac937926353bfa5b1c96b19ef02002	no	6
Warnings:					
Information:					
19	Other Reference-Patent/App/Search documents	WITHAMETALusprov20246463.pdf	6489089 0bb58b521c55e6a42458ae7f7f9abdc05f5760d2	no	30
Warnings:					
Information:					
20	Non Patent Literature	WRIGHTprepforamultimedia.pdf	179791 7031459360734cbc1694366f022da8775e111682	no	7
Warnings:					
Information:					

21	Non Patent Literature	SAE1994edition.pdf	20547108 e0b4f53e23f142a8e639fa2effcdcab46604e784	no	259
Warnings:					
Information:					
22	Non Patent Literature	SAE1997edition.pdf	25399220 9c8b6b306b8c63b6dc5372b8891c8b0870966a80	no	172
Warnings:					
Information:					
23	Reexam - Info Disclosure Statement Filed by 3rd Party	03896re3ids1449r.pdf	217787 ef419003001d2acd22251671ef4d1f2b98ce5990	no	3
Warnings:					
Information:					
24	Transmittal Letter	03896re3reqexpartereexamxmtl.pdf	166611 7e314ca0913e4e09bf8f67a6dc8e56801abb6d9c	no	3
Warnings:					
Information:					
25		03896re3reexanrequest.pdf	1899526 7ae02c9975839d7f24447c4e7e19f8bea512e389	yes	92

Multipart Description/PDF files in .zip description

Document Description	Start	End
Receipt of Orig. Ex Parte Request by Third Party	1	91
Reexam Certificate of Service	92	92

Warnings:					
Information:					
26	Receipt of Orig. Ex Parte Request by Third Party	ExhibitD-ClaimChart-CellPortPressRelease.pdf	2415947 bb92968aa767912f575c2afaacb637e2f53ad8ab	no	30
Warnings:					
Information:					

27	Receipt of Orig. Ex Parte Request by Third Party	ExhibitEClaimChart-164Jones.pdf	2898827 f5cb307f26cd3cee2e054274bba62ffa5d9d0523	no	23
Warnings:					
Information:					
28	Fee Worksheet (SB06)	fee-info.pdf	30329 3c5de04ec74899c3df8261c87766f31c0f7d2f5e	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	139483446	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

US006430164B1

(12) **United States Patent**
Jones et al.

(10) **Patent No.: US 6,430,164 B1**
(45) **Date of Patent: Aug. 6, 2002**

(54) **COMMUNICATIONS INVOLVING DISPARATE PROTOCOL NETWORK/BUS AND DEVICE SUBSYSTEMS**

(75) Inventors: **Marc T. Jones**, Longmont; **Charles W. Spaur**, Aurora; **Michael A. Tibbetts**, Longmont; **Patrick J. Kennedy**, Boulder, all of CO (US)

(73) Assignee: **Cellport Systems, Inc.**, Boulder, CO (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/430,850**

(22) Filed: **Nov. 1, 1999**

Related U.S. Application Data

(60) Provisional application No. 60/139,820, filed on Jun. 17, 1999.

(51) **Int. Cl.**[7] **H04Q 7/00**; G06F 9/40

(52) **U.S. Cl.** **370/313**; 370/389; 709/310; 455/99

(58) **Field of Search** 370/389, 392, 370/401, 466, 329, 349, 338, 313, 465; 701/29, 33, 36, 213; 713/168, 200, 201; 455/456, 410, 423, 67.1, 72, 99; 709/205, 202, 217, 310, 311, 313, 230, 201

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,280,378	A		2/1994	Miller et al. 364/424.04
5,491,693	A		2/1996	Britton et al. 370/85.13
5,673,322	A	*	9/1997	Pepe et al. 370/466
5,717,737	A		2/1998	Doviak et al. 379/58
5,732,074	A	*	3/1998	Spaur et al. 370/401
5,732,216	A	*	3/1998	Logan et al. 348/7
5,778,189	A		7/1998	Kimura et al. 395/200.66
5,809,415	A	*	9/1998	Rossmann 370/352
5,856,976	A		1/1999	Rinne 730/401
6,023,232	A	*	2/2000	Elizenberger 340/988
6,031,904	A	*	2/2000	An et al. 370/352
6,070,099	A	*	6/2000	Chen et al. 709/202
6,104,711	A	*	8/2000	Voit 370/352

FOREIGN PATENT DOCUMENTS

WO PCT/US00/16657 6/1999

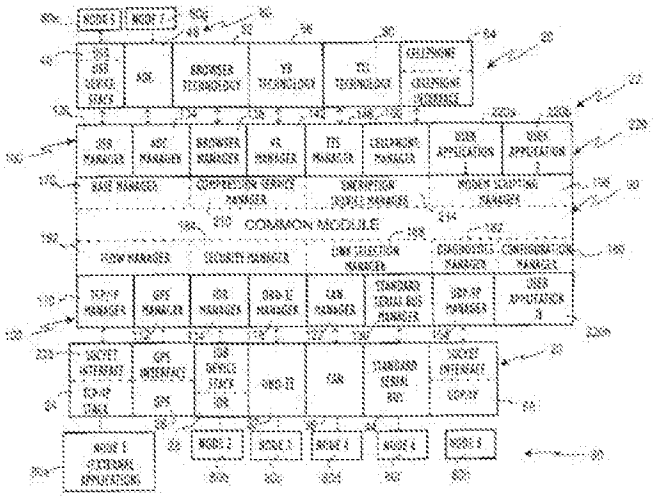
* cited by examiner

Primary Examiner—Chau Nguyen
Assistant Examiner—Andy Lee
(74) *Attorney, Agent, or Firm*—Sheridan Ross P.C.

(57) **ABSTRACT**

A communications apparatus for enabling communications among networks, buses, devices and other subsystems having different communication requirements is provided. The communications apparatus offers an open architecture for interoperability among diverse subsystems. The communications apparatus is particularly applicable in a vehicle. In one embodiment, a portal apparatus located remote from the vehicle facilitates communications with the communications apparatus, particularly where the vehicle is part of a vehicle fleet. The communications apparatus includes a common module that has at least one protocol by which disparate subsystems can communicate with each other. One or more managers can be defined as being part of the common module. The disparate subsystem managers provide the necessary interfacing to enable the disparate subsystems to communicate between and among each other using the common module. Each such manager has dedicated functionalities to facilitate communications. Managers associated with the common module may include managers for use in configuration and diagnostic tasks, encryption/decryption, compression/de-compression, controlling data flow, security regulation, and selecting an acceptable link for outside communications. The common module also includes a base manager for registering disparate subsystem managers including associating a name with each of them.

30 Claims, 3 Drawing Sheets



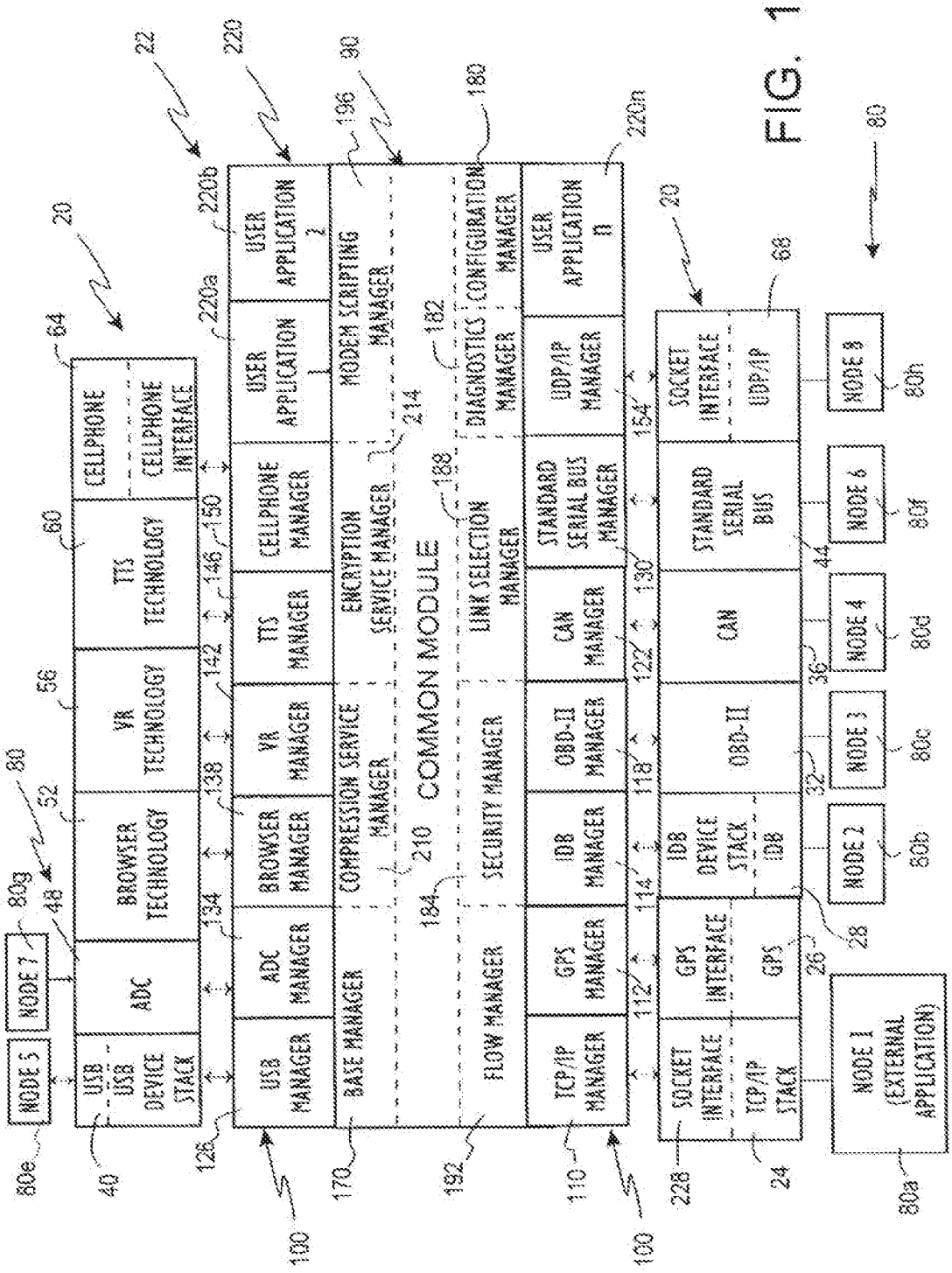
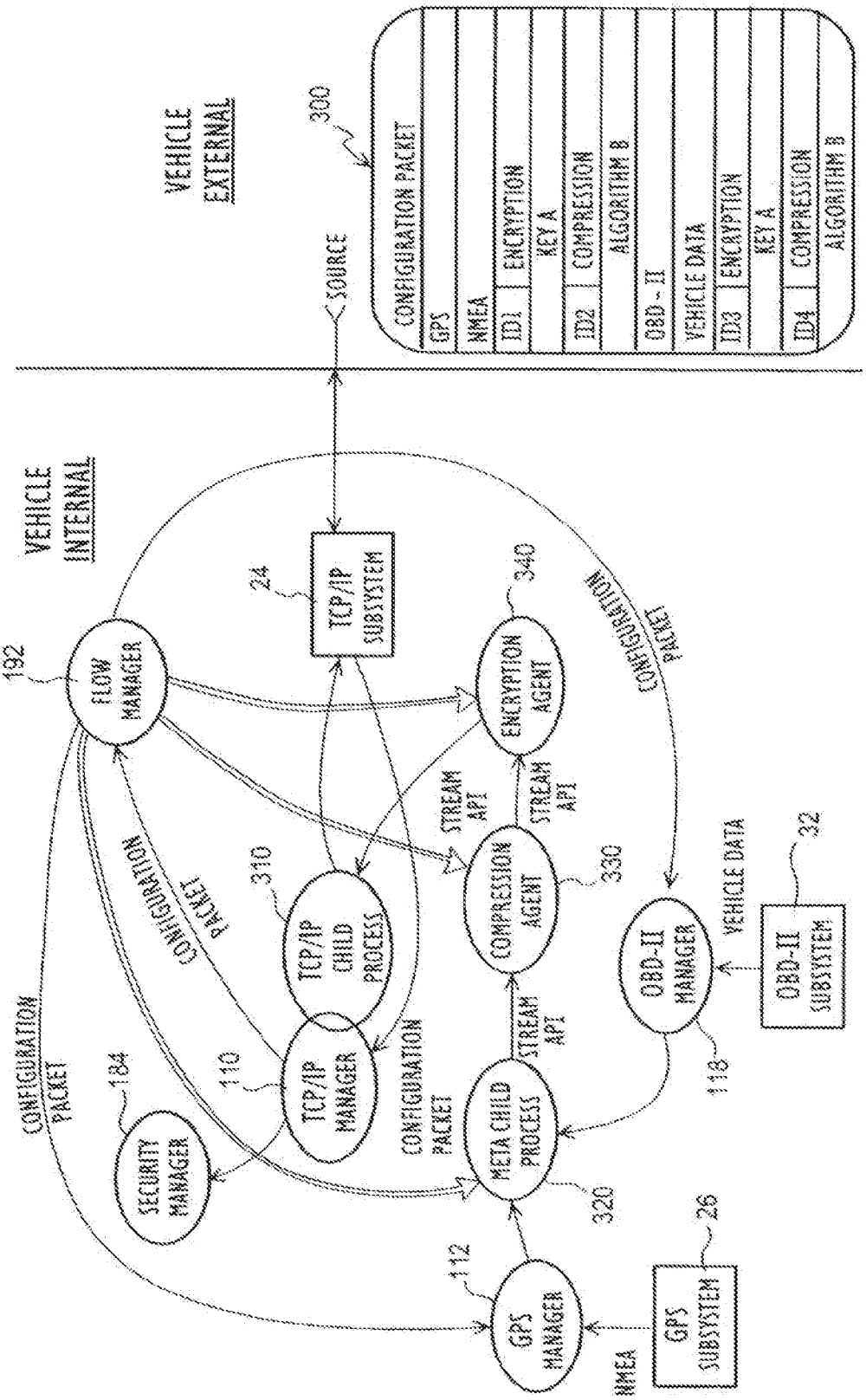

COMMON MODULE
210
USB MANAGER
ADC MANAGER
BROWSER MANAGER
VR MANAGER
TTS MANAGER
CELLPHONE MANAGER
USER APPLICATION 1
USER APPLICATION 2
USER APPLICATION n
BASE MANAGER
COMPRESSION SERVICE MANAGER
ENCRYPTION SERVICE MANAGER
MODEM SCRIPTING MANAGER
FLOW MANAGER
SECURITY MANAGER
LINK SELECTION MANAGER
DIAGNOSTICS MANAGER
CONFIGURATION MANAGER
TCP/IP MANAGER
GPS MANAGER
IDB MANAGER
OBD-II MANAGER
CAN MANAGER
STANDARD SERIAL BUS MANAGER
UDP/IP MANAGER
USB - USB DEVICE STACK
ADC
BROWSER TECHNOLOGY
VR TECHNOLOGY
TTS TECHNOLOGY
CELLPHONE
CELLPHONE INTERFACE
SOCKET INTERFACE
TCP/IP STACK
GPS
GPS INTERFACE
IDB DEVICE STACK
IDB
OBD-II
CAN
STANDARD SERIAL BUS
SOCKET INTERFACE
UDP/IP
NODE 1 (EXTERNAL APPLICATION)
NODE 2
NODE 3
NODE 4
NODE 5
NODE 6
NODE 7
NODE 8
20
22
24
26
28
30
32
36
40
44
46
48
52
56
60
64
68
80
80a
80b
80c
80d
80e
80f
80g
80h
100
110
112
114
118
122
126
130
134
138
142
146
150
154
170
180
182
184
188
192
196
214
220
220a
220b
220n
228

FIG. 1

FIG. 2


VEHICLE EXTERNAL
VEHICLE INTERNAL
SOURCE
300
CONFIGURATION PACKET
GPS
NMEA
ID1 ENCRYPTION
KEY A
ID2 COMPRESSION
ALGORITHM B
OBD-II
VEHICLE DATA
ID3 ENCRYPTION
KEY A
ID4 COMPRESSION
ALGORITHM B
192
FLOW MANAGER
24
TCP/IP SUBSYSTEM
340
ENCRYPTION AGENT
CONFIGURATION PACKET
STREAM API
310
TCP/IP CHILD PROCESS
330
COMPRESSION AGENT
OBD-II MANAGER
VEHICLE DATA
32
OBD-II SUBSYSTEM
184
SECURITY MANAGER
110
TCP/IP MANAGER
META CHILD PROCESS
320
118
112
GPS MANAGER
26
GPS SUBSYSTEM
NMEA

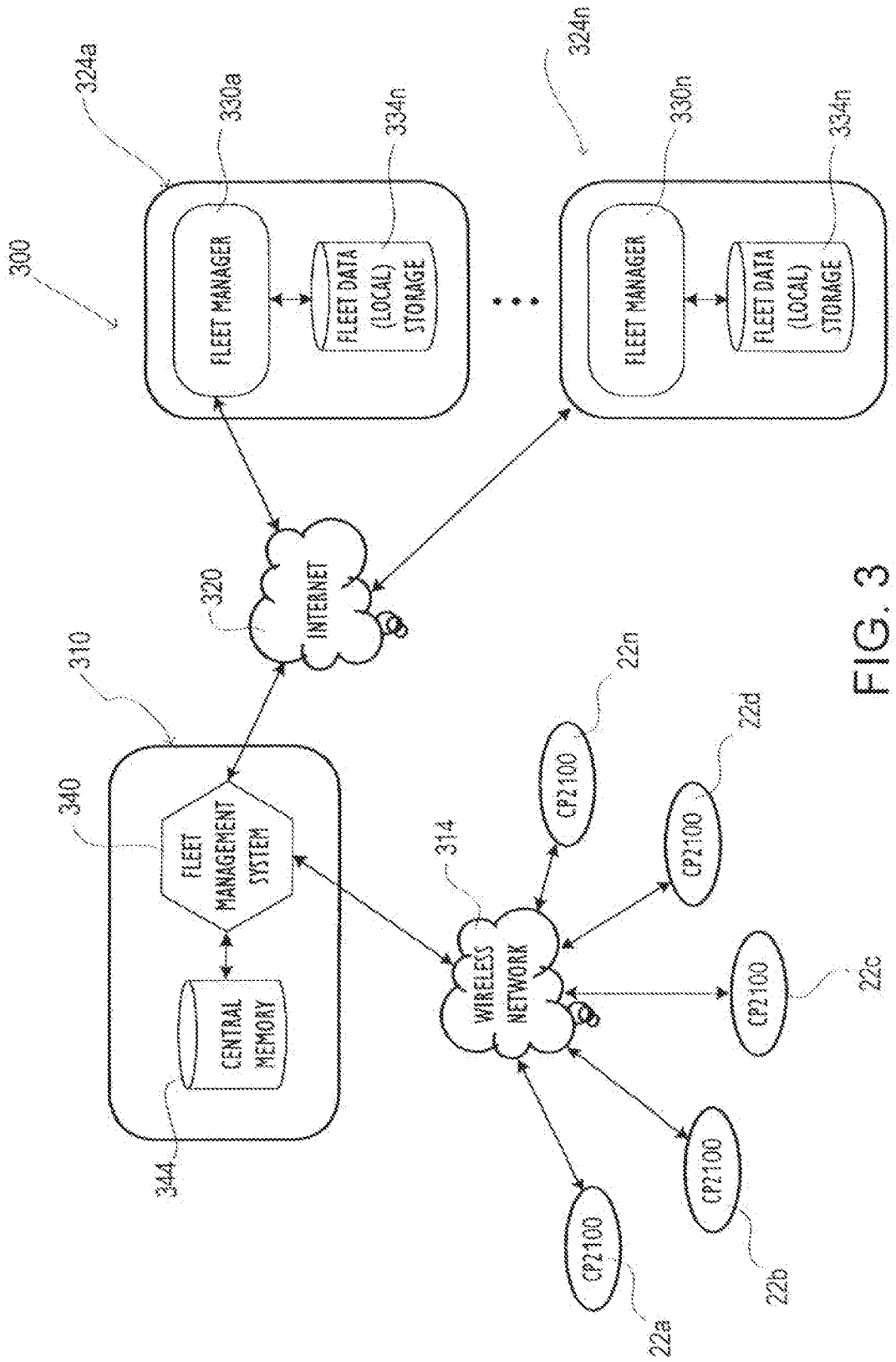

300
324a
330a
334n
FLEET MANAGER
FLEET DATA (LOCAL) STORAGE
324n
330n
334n
FLEET MANAGER
FLEET DATA (LOCAL) STORAGE
320
INTERNET
310
340
FLEET MANAGEMENT SYSTEM
CENTRAL MEMORY
344
314
WIRELESS NETWORK
CP2100
22n
CP2100
22d
CP2100
22c
CP2100
22b
CP2100
22a

FIG. 3

COMMUNICATIONS INVOLVING DISPARATE PROTOCOL NETWORK/BUS AND DEVICE SUBSYSTEMS

This application is related to and claims priority from Provisional Patent Application No. 60/139,820 filed Jun. 17, 1999.

FIELD OF THE INVENTION

The present invention relates to enabling communications between or among different operably interconnected devices and, in particular, to providing communications internally and externally of a vehicle, involving disparate subsystems using a common module and appropriate managers.

BACKGROUND OF THE INVENTION

Communications hardware and associated operations in different makes and models of vehicles continue to expand. There are currently, however, no standards or common procedures by which each of a number of disparate hardware devices can be operatively connected together for common purposes. This lack of effective connectivity inhibits desired communications between and among disparate networks, buses, devices and any other subsystems that might be found in a vehicle. This connectivity deficiency also negatively impacts the ability of one or more remote stations to communicate with such nodes in the vehicle.

Information transfers involving a remote station with hardware subsystems located in a vehicle have been enhanced with the availability of the Internet and wireless systems. A computer or other intelligent device located in the vehicle can communicate with one or more remote stations using the Internet and wireless technology. U.S. Pat. No. 5,732,074 issued Mar. 24, 1998 entitled "Mobile Portable Wireless Communication System", which is assigned to the assignee of the present application, describes a system by which a network in the vehicle including a number of devices associated with the network can send and receive information relative to the Internet.

With respect to multiple vehicle disparate subsystems in a vehicle, it is desirable to further facilitate communications both within and outside the vehicle. This can be effectively accomplished by an open architecture that can be responsible for enabling communications among a plethora of present and potential subsystems for use in a vehicle. Such a communications apparatus must be able to handle different communications requirements and facilitate interconnection of the disparate subsystems.

SUMMARY OF THE INVENTION

In accordance with the present invention, a communications apparatus is provided to enable information and data transfers between or among disparate subsystems. In an exemplary embodiment, the communications apparatus is contained within a vehicle having a number of disparate subsystems. The disparate subsystems include protocol based units and close-ended devices. The protocol based units can include networks and buses having associated components or peripherals that are interconnected. The close-ended devices are referred to herein as devices that do not have International Standards Organization (ISO) network layering and typically constitute a terminating communication node in the context of data flow ending or originating from such a device, and not typically acting as a link or pass through device for information or data transfers.

An example of such a close-ended device might be a global positioning system (GPS) that is useful in providing vehicle location information or a hardware device, such as a vehicle sensor from which data can be obtained for a particular vehicle component to which the sensor is operably connected.

In addition to the GPS, disparate subsystems may include an Internet protocol (IP) stack comprised of a number of network layers that are commonly involved in transfers using the Internet, a controller area network (CAN) found in at least some vehicles and which includes a bus along which a number of vehicle elements, communicate for supplying information concerning such elements. The disparate subsystems can also include an intelligent transportation system data bus (IDB) and/or an onboard diagnostics (OBD) that are involved with monitoring and providing information related to vehicle components. Voice recognition (VR) technology and text-to-speech (TTS) technology can also be part of the group of disparate subsystems and which are involved in facilitating speech control and response communications in the vehicle. Other disparate subsystems may include an analog/digital converter (ADC), a standard serial bus, a universal serial bus (USB), a user datagram packet/Internet protocol stack and a cellphone, as well as one or more other customer proprietary devices.

In conjunction with enabling communications between and among the disparate subsystems, as well as communications outside the vehicle, the communications apparatus includes a common module and a number of disparate subsystem managers. The common module is defined as being comprised of a number of common module managers, which may include one or more of the following: a base manager for handling registration and de-registration of disparate subsystem managers, as well as other components or component processes that perform communication tasks; a configuration manager for use in downloading applications, configuring routing tables, reviewing error logs and other assigned tasks; a diagnostics manager for collecting and relaying diagnostic data; a security manager for use in, among other things, monitoring external applications attempting to connect to the communications apparatus for security purposes; a flow manager having the ability, to interconnect children (child processes) of managers in order to perform operations on data passing through them; compression/decompression managers involved with compressing and de-compressing data being communicated; and encryption/de-encryption managers for encrypting/de-encrypting data, as well as user-defined services, that can process, filter or otherwise act on available data.

The disparate subsystem managers can communicate with each other involving the common module functionalities using at least one common protocol. In a preferred embodiment, two communication protocols are available. These are identified as a bus applications programming interface (API) and a stream API. The bus communication is useful in applications in which a number of independent components are involved in the communication, while, stream communication is useful for unstructured stream data between two components.

With respect to the number of disparate subsystem managers, a dedicated one disparate subsystem manager is defined as communicating with a particular disparate subsystem. Accordingly, the number of disparate subsystem managers is equal to at least the number of disparate subsystems. For example, a TCP/IP stack operably communicates with a TCP/IP manager in order to participate in the functionalities and features associated with the communica-

tions apparatus. Each disparate subsystem manager provides functions that are common, namely: providing a native interface to the specific disparate subsystem with which it communicates, providing an interface to the common module, and performing a number of management functions. Conversely, because of the dissimilarities among the disparate subsystems, many of the disparate subsystem managers have different software capabilities that are unique to the particular disparate subsystem for which it has responsibility.

With respect to the interoperability among the disparate subsystems and the communications apparatus, an exemplary operation is next described. A request for data or other information might originate from a source or site external to a vehicle having a communications apparatus. This request for information is communicated wirelessly using the Internet and its TCP/IP communication protocol and in which at least the vehicle has an Internet address, although components in the vehicle may also have separate Internet addresses. Wireless technology in the vehicle receives this Internet communication and it is routed or received by the TCP/IP disparate subsystem or protocol stack. The request for information is handled by the TCP/IP manager that is in direct communication with the TCP/IP disparate subsystem. Based on its recognition of the contents of the request for information, such as a configuration packet, the TCP/IP manager creates a first child process for establishing a stream API (application programmer's interface) for transferring the requested information in stream form. In one embodiment, from the contents of the request, for information, the TCP/IP manager is involved with at least some, if not all, of the request to a second manager that will be involved in obtaining the requested information. By way of example, the second manager might be the GPS manager, where the requested information includes NMEA data from a GPS disparate subsystem. In such a case, the informations related to the request received by the GPS manager is utilized by it to manage or otherwise control the obtaining of data from the GPS subsystem. In that regard, a second child process associated with obtaining the data from the GPS subsystem by a stream API is created. The second child process cooperates with the first child process to transmit the requested information from the GPS subsystem to the requesting source external to the vehicle. As part of creating each child process, the common module also is involved, through its base manager, in the registration of the dynamically created first and second child processees. When the request for information is satisfied, such child processees can be de-registered using the base manager. Utilization of such child processees enables the managers to function with multiple requests that are simultaneously satisfied or have overlapping needs for the same services using the same managers. The child processees may be spawned through the responsibility or management of other managers, such as the flow manager. Additionally, services associated with the obtaining of the data might be employed including compression of the obtained information and encryption thereof, as well as reliance on the security manager to insure that the request for information has authorized access to the communications apparatus.

In one embodiment, data gathering and other communications are facilitated involving a fleet of vehicles, with each having an embedded communications apparatus. Instead of the owner/operator of the vehicle fleet directly accessing each of communications apparatuses in the vehicles of its fleet, a portal apparatus acts as a communications link between vehicle fleets and the fleet managing subsystem. The portal apparatus facilitates downloading of software configurations and updates to each communications apparatus in the vehicles of the particular fleet, as well as facilitating the obtaining of vehicle operational data and other information including diagnostic data and status information including fault-related data.

Based on the foregoing summary, a number of salient aspects of the present invention are readily identified. Transfers of information including data relative to different devices, buses and/or networks are substantially seamlessly achieved. Such transfers can be accomplished among these different subsystems without requiring that they be modified, thereby achieving a "plug and play" result. The disparate subsystems include protocol dependent components as well as close-ended devices at which data flow originates or is terminated, such as a GPS. Consequently, the communications apparatus of the present invention handles communications among devices that are not characterized by ISO network layering. The disparate subsystems communicate with each other using a common communications protocol involving a common module. Communications can occur involving the common module, both externally and internally of a vehicle. Such communication transfers can include: data logging, application program downloading, vehicle component or sensor monitoring and vehicle location information. In one embodiment, management of fleet vehicles is augmented by a portal apparatus located intermediate a number of communications apparatuses embedded in fleet vehicles and fleet management subsystems.

Additional advantages of the present invention will become readily apparent from the following discussion, particularly when taken together with the accompanying drawings

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram, of the present invention illustrating the common module, disparate subsystems and disparate subsystem managers that interface between them; and

FIG. **2** is a flow diagram related to exemplary communications among disparate subsystems involving the communications apparatus; and

FIG. **3** is a block diagram illustrating a portal apparatus for use with vehicle fleet subsystems.

DETAILED DESCRIPTION

With reference to FIG. **1**, a system is illustrated for enabling communications among disparate technologies. Although the system has particular application in a vehicle and will be described in the context of a vehicle application, it may be beneficial in other environments, such as manufacturing facilities or other industrial complexes, offices and homes.

The system includes a plurality of disparate subsystems **20** and a communications apparatus **22**. The disparate subsystems **20** in a vehicle can include one or more of the following components: Internet protocol (IP) stacks **24**; a global positioning system (GPS) **26**; an intelligent transportation system data bus (IDB) **28**; an onboard diagnostics (OBD-II) **32**; a controller area network (CAN) **36**; a universal serial bus (USB) **40**; a standard serial bus **44**; an analog/digital converter (ADC) **48**; browser technology **52**; voice recognition (VR) technology **56**; text-to-speech (TTS) technology **60**; a cellphone **64**; user datagram packets/Internet protocol stack(s) (UDP/IP), one or more custom or

proprietary units or components, as well as any other presently or later devised subsystem that may be useful in a vehicle or another environment in which the system is operating.

The disparate subsystems **20** are usually characterized by the differences in their interfaces including how they communicate with other components. For example, an IP stack disparate subsystem **24** is characterized by International Standards Organization (ISO) network layering including a socket interface at the higher layer. In contrast, the OBD disparate subsystem **32** does not follow the ISO network layering but could be characterized as a single layer disparate subsystem having different interface requirements in order to properly communicate with it.

With regard to identifying these disparate subsystems **20**, the IP stack(s) **24** include(s) a number of network layers typically involved in transmissions or information transfers over the Internet. The GPS **26** provides vehicle location related information, such as longitude, latitude, altitude. The OBD-II **32** is available in at least certain vehicles for use in providing engine related information, such as engine speed, pressure of certain components, etc., using sensors that may be useful in diagnosing-vehicle engine faults. The IDB **28** is a relatively new standard bus found in vehicles that has a number of vehicle elements that send/receive data or other vehicle-related information, such as fuel management or other vehicle device data, using a protocol analogous to TCP/IP. These vehicle elements can include vehicle windows, doors, air bags, lights, etc. The CAN **36** is another communications network within the vehicle for providing information from vehicle elements, such as automotive electronics including engine sensors, lamps, electric windows, etc. The USB **40** is a PC centric network that includes a bus for enabling communications among PC hardware, e.g., mouse, keyboard, printer, memory. The standard serial bus **44** accommodates information transfers from/to and among devices or components that are not presently known or not specific (e.g., unlike RS232, RS485 compatible devices). The ADC **48** can be used to output necessary digital signals for providing useful information from devices connected thereto such as automotive electronic elements that may be separate from and not associated with a particular bus. The VR technology **56** enables the vehicle driver or passenger to provide commands or other information verbally to achieve desired results including obtaining information. The TTS technology, **60** provides the user or operator with a verbal output that can be readily heard. The browser technology **52** can access and provide desired information, particularly in combination with the VR and TTS technologies, and is dependent on an Internet related external connection to satisfy the web-based request. The cellphone **64** is a useful communications tool in sending/receiving analog voice or digital data.

A number of the disparate subsystems **20** are electrically connected to one or more nodes **80** that are associated with a particular sender and/or receiver of the data/information in association with or part of the disparate subsystems **20**. Representative of the nodes **80** are nodes **80***a*-**80***g*. The node**1** **80***a* can include an external application that is located outside of the vehicle and is wirelessly connected to the disparate subsystem IP stack **24**. By way of example, an application running on a computer station remote from a vehicle may receive vehicle data that it processes for providing a desired report. The node**2** **80***b* may be defined as including one or more vehicle elements connected to the disparate subsystem IDB **28**. The node**3** **80***c* may also be characterized as one or more vehicle elements associated with vehicle engine functions that are connected to the OBD **32**. The node**4** **80***d* may define a number of vehicle devices connected to the CAN **36**. The node**5** **80***e* may also comprise a number of nodes, with each node associated with different PC centric hardware and/or software in communication with the bus of the USB **40**. The node**6** **80***f* can also comprise or define a number of nodes, with each communicating with at least one component in the vehicle and with all of them electrically connected to the standard serial bus **44**. The node**7** **80***g* can include one or more separate nodes communicating with such vehicle components as sensors or other elements that may not be part of a particular vehicle network or bus and which require the ADC **48** for providing the necessary digital signal acceptable to the communications apparatus **24**. The node**8** **80***h* can include applications that communicate using the UDP protocol.

In conjunction with enabling communications between and among each of the disparate subsystems **20** including, where applicable, their associated one or more nodes, the communications apparatus **22** can be defined as including a common module or interface **90** and a plurality of disparate subsystem managers **100**. Generally, among the plurality of disparate subsystem managers **100**, each disparate subsystem **20** is in communication with a different, specific one manager of the plurality of managers **100**. In the illustrated embodiment, there are disparate subsystem managers **110**-**154** in direct communication with disparate subsystems **24**-**68**, respectively. Each of the disparate subsystem managers **100** has common responsibilities or functions. These functions include: (1) providing a native interface to the specific disparate subsystem **20** with which it communicates; (2) providing an interface to the common module **90**; and (3) performing a number of management functions. Although having similarities, each manager **100** has different software for handling the native interface since the disparate subsystems **20** usually have different requirements. For each disparate subsystem **20**, the management functions can include: initiating and responding to messages relative to other disparate subsystem managers **100** for the purpose of providing desired communications including those involving the transfer of data or other information between or among them; and creating connections or links between other disparate subsystem managers **20** that result in a communications path using a selected common communications protocol associated with the common module **90**. In that regard, the common module **90**, in one embodiment, can include two communication protocols for selection. A first communication protocol essentially involves use of request and response messaging, while the second common communications protocol essentially involves unstructured data transfer.

The common module **90** has a number of functions in operating with the disparate subsystem managers **100** including a registration procedure by which disparate subsystems **20** and other components or component processees are registered by the common module **90**. As part of the registration procedure, a name or identifier is assigned to each such registered component and a message queue is established for each such component. As an example of a component process being registered, other than a disparate subsystem manager **100**, once a connection is established for communication purposes between two disparate subsystem managers **100** that are connected to the common module **90**, such a component process indicative of this connection is registered and such component process is assigned a dynamic name. The dynamic name is discontinued or de-registered upon completion of the particular component

process, such as completion of a data transfer that involves a connection between two disparate subsystem managers **100**.

With respect to registration, the common module **90** includes a base manager **170** that can be a software module for handling the registration and de-registration of disparate subsystem managers **100** and other components or component processees performing tasks or involved with communications using the common module **90**. The common module **90** may also have a configuration manager **180** as part thereof. The configuration manager **180** can be a web-based configuration tool that operates using hypertext transport protocol (HTTP). The configuration manager **180** utilizes a browser interface for configuration, i.e. downloading applications, configuring routing tables, reviewing error logs and other assigned tasks. Because of HTTP usage, users can configure via a wireless modem connection, through the local Ethernet port or through an available RS232 connection using a suitable protocol, such as SLIP or PPP. Implementation of HTTP provides a way to perform remote debugging as well as perform diagnostics and/or other services.

Other managers that are part of the core platform associated with the common module **90** include a diagnostics manager **182**, a security manager **184**, a link selection manager **188**, a flow manager **192** and a modem scripting manager **196**. The diagnostics manager **182** is involved with obtaining and managing diagnostics information. The security manager **184**, oversees managers **100** characterized by their use of particular protocols in communicating with their connected or associated disparate subsystem **20**, as well as being characterized as being connected to disparate subsystems **20** that are not close-ended, i.e., are not disparate subsystems **20** where data or other information flow terminates or originates, such as a GPS disparate subsystem **26**. In overseeing such managers **100**, the security manager **184** monitors the connections made from sources outside the environment of the communications apparatus **22**, such as external to a vehicle having the communications apparatus **22**. The key security feature to be realized relates to monitoring external applications attempting to connect to the communications apparatus **22**. The link selection manager **188** functions to provide an acceptable network link for transmitting and/or receiving information wirelessly relative to the vehicle. The flow manager **192** provides the ability to string managers together to perform, operations on the data flowing through them. The flow manager **192** mediates between an application and available services by setting up a communications pipe that can contain one or more services. The pipe exists between the application and the intended recipient of data, without the application having any knowledge that the data is being modified through the process. As an example, the communications apparatus **24** can be considered as a data flow machine in which data flows through a network of data processors that perform some action on the data. These actions are negotiated before hand by the mediator such that there is no delay in processing the data to be moved to an external site. The flow manager **192** can mediate a managed flow to a physical link. Once service agents are selected and the flow is established, the data flows through the architecture and through each of the selected service agents. In one example, the data is first compressed and then encrypted prior to being exported out of the unit via the selected physical link. Conversely, data originating from an external source can be decrypted and decompressed after being imported to an internal process which allows for bi-directional functionality that is dependent on the direction of flow of the data. The modem scripting manager **196** is responsible for initializing connections through available modems through a standard setup package.

In addition to such identified managers involved in the operation of the common module **90**, service providing managers can also be included, such as a compression service manager **210** and an encryption service manager **214**. The compression service manager **210** provides a service of compressing a stream of data passed from another component, such as through a stream connection. The compression service manager **210** provides the capability to pass its data to another component, typically different from the source application, to support the data flow architecture. The encryption service manager **214** provides a service of encrypting a stream of data passed from another component, such as through a stream connection. The encryption service manager **214** provides the capability to pass its data to another component, that is typically different from the source application, in order to support the data flow architecture.

The common module **90** may also be designed to have the ability to execute user applications that are in direct communication therewith. The configuration manager **180** can provide the ability to load user applications **220** (e.g. **220***a*, . . . **220***n*) into a user applications module in communication with the common module **90** and update necessary initialization files to support their execution when the system is booted up. Such user applications **220** will be provided with the ability to register with the common module **90** and then communicate freely with the operating system, such as RTOS (real time operating system) that constitutes the operating system for the communications apparatus **22**, together with the disparate subsystem managers **100** to satisfy their requirements. The common module **90** also includes a processing subsystem including a processing core that can be a Power PC. The processing subsystem can also include RAM (random access memory) and mutable flash storage. The flash storage can be split into a compressed kernel image and a mutable flash file system.

The combination of the common module **90** and the disparate subsystem managers **100** provides a reliable transparent foundation for communications between disparate subsystems **20** within a mobile unit through the use of a selected common protocol that permits seamless integration among all disparate subsystems **20**. The communication apparatus **22** utilizes operating system features that promote portability (POSIX), so that the communications apparatus **22** is portable to any POSIX-compliant operating system.

Processes attach to the communications apparatus **22** as "components" providing services (access to a protocol, application performing data-reduction, interface to data input device, etc.). Each component provides an interface using the communications apparatus **22** API (application programmer's interface) and, for a particular disparate subsystem **20**, an interface to a native protocol or interface.

The communications apparatus **22** also promotes dynamic operation. As a new component is executed (either at boot-time or any time thereafter), it registers itself with the common module **90**. This registration allows other components to know who is connected and to some extent what services they provide. When a disparate subsystem **20** or other, component wishes to be removed from the communications apparatus **22**, de-registration occurs to remove its name from the common module **90** name-space.

The combination of the common module **90** and disparate subsystem managers **100** creates a common denominator for

communications such that all components speak at least one common language (common protocol) and thus provide the capability to communicate to one another. The communications apparatus **22**, which must support dynamic operation and transparency, provides a naming facility to achieve these goals.

The name-space within the communications apparatus **22** is split into three distinct regions. A physical name is defined as a 10-bit value (0–1023 possibilities).

Region	Name sub-space	Description
System Names	0000–0127	system names (reserved for core platform name.
Dynamic Names	0128/0511	dynamic names (allocated through the system dynamically)
User Names	0512–1023	user name space available for OEM use.
Broadcast	1024	all registered names

Names can be either static or dynamic, which is defined by the method used to attain them. Static names are simply defined to the system during registration, where dynamic names are requested from the common module **90**. As a general rule, names should be dynamic unless they are required to be static An advantage to static names is that they are always known (the mapping from name to component remains fixed) which is why servers are typically static. Dynamic names are useful for client components that do not export functionality (do not require a component to asynchronously communicate with it). An exception to this rule is made possible by a services API. The primary goal of the services API is to limit the static usage of the software bus naming service.

One of the primary uses of dynamic names are the dynamically created children of server components that manage specific communications. These children register with a dynamic name, since the child communicates only with components that requested information from the server.

One special name is the broadcast name. This name results in the message to be sent being distributed to all other registered components except for the original sender. Multicast communication is also available where components are permitted to subscribe to a particular "list." Whenever a message is sent to the identifier representing the list, each member associated with the list receives a copy of the message.

The services API provides the means to identify functionality exported by dynamically named components. A service is a simple string that defines some unique information about the component to the communications apparatus **22** and to other components. For example, the GPS manager **112** could register itself with a dynamic name (received through the communications apparatus **22**) and then identify its service to the bus using the publicly available key "GPS". Other components looking for the GPS manager **112** could perform a simple lookup using the "GPS" public key, which would result in the return of the component's physical name. The ability to wait for a service name is also provided which introduces the capability of component synchronization.

Communication among components connected to the communications apparatus **22** requires a definition of rules, called protocols, to govern the manner in which communication is allowed to take place. A protocol is a formal set of rules and conventions governing the format of message exchange between two or more communicating components. The communications apparatus **22** provides two protocols through two APIs, identified as bus API and stream API.

The bus API is the lowest level of communication. It provides packet level communication between components registered with the common module **90**. The next level up is the stream API that uses the bus API as its base. Each of the bus and stream APIs are part of the common module **90**. The stream API provides point-to-point stream data communication. Bus communication is useful in applications where communication must be performed to a number of independent components. Stream communication is useful for unstructured stream data between two components (such as an audio stream).

The communications apparatus **22** utilizes messages in communicating with components connected thereto. A message is a typed collection of data objects consisting of a fixed size header and a variable length body that is managed by a component. A type is associated with a message to provide structural information on how the message should be used. Messages provide the basic object for communication over the common module **90** and representative message content is provided below:

Message Header	Source	the sending component
	Destination	the destination component
	Type	the message type (structural id)
	Length	the length of the data portion
Message Buffer	Variable Data	

Each registered component is assigned a message queue for the receipt of messages. The component should manage this resource carefully to be a good neighbor on the bus (respond in a timely manner, etc.). Every time a message is sent using one of the available send primitives, it is placed on the queue defined by the component destination (the message queue owned by the destination component). In some cases, a component may register more than once. Therefore it is important to note that a component identifier may not refer to a component but instead of a specific queue of a component.

Communications apparatus **22** communication primitives operate in either blocking or non-blocking modes. In blocking mode, the sender blocks (sender waits until the message has been placed on the receivers message queue). In non-blocking mode, the sender returns immediately with an indication of whether the message was placed on the queue or not. Conversely, receiving messages operates using the same semantics. In blocking-mode, a receiver blocks if no message is available for read. In non-blocking mode, the receiver is returned an indication of whether a message was received or not.

Messages are owned by each component and are allocated from the process-specific address-space (rather than system-owned messages).

Since the communications apparatus **22** is a networking product, communications with entities that differ in processing architecture are inevitable. Issues that arise here are byte-endianess, structure packing issues and data representation issues. Not all of these problems can be completely resolved (unless a single unified architecture exists) so standards are defined here.

The byte-endian issue is resolved through the standard networking practice of network byte order. The Power PC provides this by default, so extra computing is not required to provide the byte swapping.

Structure packing issues come into play when an external process sends a message to a component of the communications apparatus **22** using a structure cast to a void pointer. For efficiency, packing is performed on 33-bit boundaries.

Finally, representation issues manifest themselves through the fundamental types of a particular architecture (for example, floating point). Numerous floating point representations exist and since the system cannot understand them all, floating point will be disseminated in the Power PC format. Knowing this information, external applications can provide conversion functions to convert the floating-point data to their specific representation. Applications may convert floating-point data to scalars or simply pass ASCII-based representations to further simplify this problem.

The lowest level of communication offered by the communications apparatus **22** is the packet-level (or bus-level since it is the bus-native format). Communication at this level is direct in that a recipient is defined for each message that is sent by a component. Addressing at this level is symmetric given a recipient is defined for each message and also a recipient handle is defined for a bus-level receive operation for a component.

Prior to a component communicating over the common module **90**, it must first register. The registration occurs with the base manager **170**. Once registration has occurred, the component may send and/or receive messages over the communications apparatus **22**. When communication is no longer necessary, de-registration occurs. This process is again managed with the base manager **170** through the bus API.

The bus-level also provides other useful functions such as dynamic name request, name lookup and a default message handler.

The communications apparatus **22** can provide different messaging functions including broadcast messaging and multicast messaging. Broadcast messaging is achieved by sending a message to a special destination name, which results in the message being sent to all registered components. Broadcast is a useful mechanism on the communications apparatus **22** for synchronized start and shutdown.

In some applications there is the need for multicasting, which allows a subset of the communications apparatus **22** to receive messages of the same type. Multicasting is provided by the communications apparatus **22** through the registration of a dynamic name that represents the list of multicast members. A multicast list may be defined as a service. Therefore, other components may identify a multicast address by a particular name and/or wait-for it using the service API synchronization.

Above the bus-level of communication are stream communications. Streams, as the name implies, are point-to-point connections between two components where unstructured data is moved between them. The primary difference between streams and the bus-level API is that streams permit a connection to another component and then one-to-one communication. The stream API provides communication primitives (such as send and receive) but also server-specific primitives for developing information servers. Stream level communication utilizes simple streams of byte-data rather than structured messages. Once the connection occurs, byte-data is streamed between the two end-points. Stream primitives may be configured for blocking or non-blocking operations based upon parameters passed at stream connect.

Since the communications apparatus **22** is an open architecture and, depending upon the particular application, highly available through a number of links, security is a key issue. Security can be established on three fronts. The first is external user access, the second is application and the third is data. Each level is dependent on the next for security. Communication security comes into play when external entities desire connectivity to or from the communications apparatus **22**. Basic security mechanisms protect against access through telnet, ftp or tftp (standard UNIX® mechanisms).

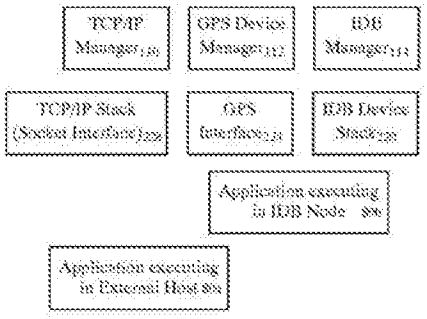
Application security is required for external applications that wish to connect to the communications apparatus **22**. When an external application wishes to connect to the communications apparatus **22**, the security manager **184** of the communications apparatus **22** is consulted first to identify if the connection is authorized (through its internal security directives). For example, when an external application connects through the TCP/IP manager **110**, the security manager **184** will define whether the connection is legal by identifying the host of the external application. The security manager **184** defines not only whether a connection is legal by identifying the host of the external applications but also whether the particular destination of the connection is acceptable. By way of further example, the security manager **184** may define that the TCP/IP connections are approved from a first host to the USB manager **126**, but not to the OBD manager **118** or a second host associated with the IDB **28** may access the GPS **26**, but not the TCP/IP **24**.

Data security is provided through the use of the encryption service manager **214** that encrypts data prior to being shipped through the link. Conversely, decryption managers of the common module **90** function to decrypt data from an outside source into the communication apparatus **22**.

The communications apparatus **22** operates in two basic functional modes. These are identified as the "pure bridge" mode and the "application" mode.

In pure bridge mode, the communications apparatus **22** operates using two protocol managers (e.g. IP/TCP manager **110** and IDB manager **114**) to create and maintain connections essentially controlled by a source or application located outside the environment of the communications apparatus **22**. One such manager acts as the source protocol manager for the incoming connection and the other such manager acts as the destination protocol manager. The transferred data or other information is not destined for use internally but is to be moved from one subsystem (e.g. bus) to another subsystem. Applications running in external nodes operating over different buses force the creation of connections which bridge the available buses or links within the vehicle or other environment.

For example, consider the communications apparatus **22** providing connectivity to TCP/IP **24**, IDB **28** and GPS **26**. The TCP/IP **24** and IDB **28** are provided through the TCP/IP and IDB managers **110**, **114** and the GPS **26** is provided through the GPS manager **112**. These software components execute as part of the communications apparatus



Consider a node connected to an IDB device stack **220** that wishes to gather vehicle location data and then communicate this data to the external node**1 80***a* on the Internet.

The IDB application connects to the communications apparatus **22** node using the IDB device stack **220** and the IDB manager **114** with a packet header defining the action to take (connect to the GPS manager **112** utilizing the GPS interface **224**). The IDB manager **114** would create a child component (along with the GPS manager **112**) to provide the read-only data through the IDB device stack **220** back to the requesting application. This connection could be stream-based (data would stream to the IDB-based external application when updated, or could be asynchronous in a request/response mode) The IDB application next connects to the TCP/IP manager **110** (utilizing the socket interface **228**) with another packet header (specifying the requested connection to the TCP/IP manager **110** along with the external host for which the connection should be made). The TCP/IP manager **110** would then make the connection to the external host, and bind a child process to handle the particular connection.

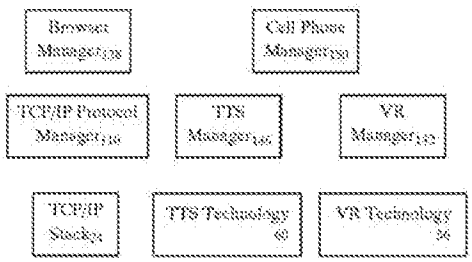
This process is identical regardless of the particular network being used by the connecting application, for example the USB **40** would use the same process. Applications can also create connections through TCP/IP **24** thereby providing Internet-based enterprise level access to devices connected to the communications apparatus **22**. The security manager **184** limits access to only appropriate hosts.

Stream modes of communication (for unstructured data) and packet modes (for structured data) are provided through the communications apparatus **22**.

The previous section defined a mode whereby a protocol (TCP/IP **24**) and a device manager (GPS **26**) provided the necessary functionality to bridge a device and route between protocols for externally controlled applications (external applications are in control of data flow through the communications apparatus **22**). The application mode differs in that the users of the data can be maintained on the communications apparatus **22**.

The communications apparatus **22** provides an open architecture for the development of onboard applications. A developer can link the communications apparatus **22** libraries to gain access to the communications apparatus **22** to connect to any manager (protocol, device or other). The APIs are consistent among all components, the data simply differs to change the behavior of the communication.

Consider the following example utilizing voice recognition and text-to-speech in a vehicle application. The voice recognition (VR) manager **142** provides a server using existing VR technology **36**. The VR manager **142** accepts the recognized speech in terms of grammatical tokens that identify the parsed sentence. The VR manager **142**, in this application, requires that any voice command be preceded by a destination entity (for example, browser, GPS, etc.). For example, "browser, search for X". This prefix identifies to the VR **142** manager the destination of the particular speech unit.



Applications connect to the VR manager **142** defining their particular name such as "browser" or "cellphone". A speech is recognized and parsed, the speech tokens are passed to the particular manager.

In this application, the browser manager **138** would notify the VR manager **142** that it is available and its name is "browser". This defines the browser **52** as a user of the VR manager **142** and a destination for speech preceded by the name. When the VR manager **142** (using the available driver) parses the sentence "browser what is the nasdaq doing?", the word-tokens are passed to the browser **52** (or more likely through a parser which identifies the semantics of the request who then passes the raw information to the browser **52**). If the sentence is not understood by either entity, the text-to-speech (TTS) **146** manager is provided with a canned "I do not understand your request" statement. Otherwise, the browser **52** tries to satisfy the request (likely through the TCP/IP manager **110**) and then returns the result back through the TTS manager **196**. The TCP/IP manager **110** may involve the TCP/IP disparate subsystem **24** as part of gathering requested information outside of the vehicle, which information is located at a remote site, such as a web site.

This illustrates the application mode of the communications apparatus **22** where data management is essentially under control within the vehicle or other environment in which the communications apparatus **22** is located. It should be noted that the VR manager **142** could be used in bridge mode as well, where an external application could register a name and the speech tokens would be routed to the particular application on its bus (IDB **28**, USB **40**, etc.).

An additional description related to the components and operations of the system is next provided with reference to FIG. **2**. A flow processing diagram is depicted related to functions, operations and steps associated with obtaining information from inside a vehicle having the communications apparatus **22**, pursuant to a request from an outside source or destination that is external to the vehicle. Generally, in accordance with this representative example, the source or remote stations is seeking vehicle information related to vehicle position and engine speed. Such information is in the form of data obtained from the GPS subsystem **26** and the OBD-II subsystem **32**. The GPS subsystem **26** has position data in the form of latitude, longitude and altitude associated with the vehicle. The OBD-II subsystem **32** includes data related to engine speed.

In this embodiment the source seeking such data develops a configuration packet **300**, which has the necessary request information including a destination, services that might be

invoked, and data or other information being requested. In this example, the configuration packet **300** may be defined as having a number of fields that convey what is being requested by the source. The configuration packet **300** can include information related to the identity of the disparate subsystem from which data is being requested, such as the GPS disparate subsystem **26**. Associated with this particular subsystem, the data being requested is identified in a further field, namely, the NMEA conventionally identified data from the GPS subsystem **26**. As part of the GPS field, it may have a number of sub-fields that particularly identify GPS parameters, such as one or more of latitude, longitude and altitude as part of the data transfer from the vehicle to the source. For one or more reasons including security, the configuration packet **300** also requests that the returned data from the vehicle be encrypted so that this service request is also part of the configuration packet **300** and can have an identifier (Id **1**) associated with it. In conjunction with the encryption request, a key accompanies the configuration packet **300** related to how the data being obtained is to be encrypted. A further service being requested with this data transfer, for one or more reasons such as the amount of the data being requested, the configuration packet **300** also has a compression service request by which the requested data will be compressed before sending from the vehicle to the source. An identifier (Id **2**) can also be associated with this particular service request for any desired identification purpose. As part of this service, the source can perhaps select one or more algorithms that would be utilized in providing the compression and such as identified in one of the fields of the configuration packet **300**.

As previously noted, the data being requested is not only from the GPS subsystem **26** but also from the OBD-II subsystem **32**. Thus, the configuration packet **300** also includes similar fields to identify the particular subsystem from which data is being requested (OBD-II subsystem **32**), together with the particular data, such as engine speed. In this example, this data is also to be encrypted and compressed using the same key and algorithm associated with the GPS data.

After the configuration packet **300** has been prepared, it can be transmitted, including wirelessly, from the source to the vehicle. In a preferred embodiment, the transmission of this configuration packet **300** utilizes the Internet and with at least the vehicle to which the configuration packet **300** is being sent having an Internet address, which accompanies the configuration packet **300**. The recipient device in the vehicle of such a configuration packet is the wireless device or cellphone **64**, as well as a wireless modem associated therewith. The configuration packet **300** from the Internet using TCP/IP is received by the TCP/IP subsystem or protocol stack **24**. This subsystem can handle and act on the received configuration packet **300** including recognition of the associated address. In direct communication is the TCP/IP manager **110** which reads the configuration packet **300**. Upon such reading, among other things, it is recognized that the configuration packet **300**, given its request, is appropriate for functions to be performed by the flow manager **192** of the common module **90**. Hence, the configuration packet is also sent to the flow manager **192**.

As part of this operation description for obtaining such data, the configuration packet **300** is applied to the security manager **184** of the common module **90**. The security manager **184** is used in determining whether or not the source, together with the information being requested, has authorization to use the communications apparatus **22** and obtain the requested information. In that regard, the security manager **184** may utilize a list, which identifies authorized users and/or what information or other accessing this user (source) might be entitled to. Based on this checking, the security manager **184** determines that this request from the identified source is authorized. This determination allows the common module **90** and necessary managers **100** to continue their task in connection with satisfying the contents of the configuration packet **300**.

In view of the data being requested, a stream API is to be employed in transferring, the requested data. In conjunction with that, the TCP/IP manager **110** creates a TCP/IP child process **310** that will be involved in sending the requested data from the vehicle using a socket interface associated with the TCP/IP subsystem **26**. When created, the TCP/IP child process **310** is registered with the common module **90** using the base manager **170**. Thus, for this particular data transfer, this dynamically created process and identifier is involved with the TCP/IP transfer, while other TCP/IP transfers could be accomplished under management/control of the TCP/IP manager **110**.

With respect to the configuration packet **300** being sent to the flow manager **192** and its responsibilities, upon reading the configuration packet **300**, the flow manager **192** recognizes that GPS data and OBD-II data are being requested. The flow manager **192** generates a message including a request to the GPS manager **112** by which the data being requested from the GPS subsystem **26** can be obtained. In that regard, the GPS subsystem **26** is inputting the NMEA data to the GPS manager **112**, which data can be readied for transfer along a determined path. In that regard, the flow manager **192** is also involved with satisfying further requirements related to the data transfer including the compression and the encryption services that were requested. Furthermore, because in this example OBD-II data is also being requested, the flow manager **192** is used in generating a meta-child process **320** for desirably enabling and facilitating the two sets of data transfer. The meta-child process **320** is also registered using the base manager **170** with the common module **90**. The meta-child process **320** acts as a handler and is otherwise responsible for managing the obtaining of GPS data and the OBD-II data. Accordingly, a GPS data stream is provided to the meta-child process **320**. Similarly, the requested engine speed data from the OBD-II subsystem **32**, in the form of a data stream is handled by the meta-child process **320** through the OBD-II manager **118**.

Continuing with a description of this example of operation, the flow manager **192** is also involved with the spawning of a compression agent or child process **330** and an encryption agent or child process **340**. Each of the compression agent/child process and encryption agent/process **330**, **340** are registered with the common module **90**. Like the stream API that is established for transferring the GPS data using the meta-child process **320**, a stream API is utilized in transmitting the combination of GPS and OBD-II data using the compress child process **330** from the meta-child process **320**. The compression child process **330** has responsibility for compressing the GPS and OBD-II data using the compression operation or algorithm identified in the configuration packet **300**. This compressed combination of data can then be encrypted using the encrypt agent or encryption child process **340**, as the compressed data under a stream API connection interface is received by the encryption child process, **340**. This child process **340** encrypts the two sets of data using the supplied key from the configuration packet **300**. The compressed and encrypted GPS and OBD-II data can then be sent wirelessly to the requesting source under the management/control of the TCP/IP child

process **310** through the TCP/IP subsystem **26**, with reliance on the same Internet technology and wireless technology that provided the request from the source in the form of the configuration packet **300**.

As can be appreciated, numerous variations and adaptations can be implemented utilizing the basic architecture of the common module **90** and the managers **100**. For example, instead of the flow manager **192** spawning the compression agent **330** and the encryption agent **340**, the compression service manager **210** and the encryption service manager **214** could take responsibility for the requested compression and encryption functions. Instead of the described usage or reliance on the flow manager **192**, the TCP/IP manager **110** and/or GPS manager **112** could have more managerial responsibility related to the processing and flow of the requested data. The GPS manager **112** might be involved in the spawning of the meta-child process **320**. The TCP/IP manager **110** may send the configuration packet **300** to the GPS manager **112**. Alternatively, instead of the essentially dynamic routing that occurs through the receipt and use of the configuration packet **300** by the communications apparatus **22**, an alternative kind of routing involving the communications apparatus **22** might be based on the use of one or more port numbers. From the identified port number associated with the communications apparatus **22**, the input request may be routed directly to that port. Similarly, a communications apparatus destination identification may be provided to the communications apparatus **22**, which is mappable to a particular component of the communications apparatus **22**.

In further understanding and/or disclosing the inventions, particularly as related to selection of desired communication links or channels, U.S. Ser. No. 08/778,897 filed Jan. 3, 1997 is hereby incorporated by reference in its entirety.

Based on the foregoing description, it is seen that the communications apparatus **22** provides a software framework for the development of complex communication systems. It provides a set of core APIs that provide communication primitives and also service advertisement, data broadcast and multi-cast and event synchronization. The communications apparatus **22** permits dynamic plug-and-play registration and de-registration from it which provides for a completely dynamic and run-time configurable architecture. The architecture provides a simple set of APIs for communication systems development. The architecture may be easily extended with new drivers and applications. The communications apparatus **22** has a dynamic feature in that software components may engage and disengage from it when desired. The communications apparatus **22** has a transparency feature in that components are decoupled through the message-passing architecture. The architecture promotes software reuse through standard components that provide intergrowth functionality. The communications apparatus **22** enhances platform independence, particularly by the use of the POSIX layer of a RTOS so it is portable to different operating system and hardware architectures. The communications apparatus **22** provides a framework to simplify development by providing a common interface to a variety of protocols and interfaces. A plug-and-play building block approach to systems development allows developers to quickly bring products to market using the communications apparatus **22** in addition to reducing their overall development cost. The communications apparatus **22** provides two modes of operation. An application mode allows applications connected to the communications apparatus **22** to utilize connected interfaces by means of common protocols. The second is a bridge mode that allows external applications connected to the communications apparatus **22** through one of the defined common protocols and then connect to another protocol or device to communicate. The second mode provides a bridging and routing function between different protocols where essential control exists outside the communications apparatus **22**. The communications apparatus **22** has particular applicability in a vehicular environment and serves as a router/server. In a vehicle, the communications apparatus **22** provides the ability to route between a number of different protocols and buses as well as manage one or more wireless links. Fundamentally, in the vehicular environment, the communications apparatus **22** bridges disparate vehicular buses to permit resource and information sharing, bridges vehicular buses and one or more wireless links, allows for dynamic selection of wireless links and bridges between consumer/entertainment buses. Particularly in the context of vehicle applicability, the communications apparatus **22** of the present invention facilitates the following applications: data logging/reduction, vehicle diagnostics, fuel management, engineering data gathering and/or processing, vehicle location and mobile office features. The communications apparatus **22** has enhanced the interoperability in the communications field by enabling communications among non-standard and standards-based technologies. The communications apparatus **22** not only interprets the variety of protocols used within a vehicle but allows Internet protocol capability to be conveyed over a variety of wireless network standards. Applications for the communications apparatus **22** can be developed using software libraries associated with the communications apparatus **22**.

The communications apparatus **22** allows direct connection to vehicular signals such as by way of the CAN, RS232 and Ethernet. Application software can be developed to poll, filter, collect, process and store data collected from the vehicular network. The communications apparatus **22** can issue commands to such bus interfaces for interrogation and control of peripheral bus-connected devices, such as the GPS or an engine control module. Almost any local bus can be accommodated using suitable hardware and software. Proprietary bus or data-gateway interfaces can be developed for special applications. The communications apparatus **22** can also be configured as a gateway between multiple vehicular local buses to allow the various elements that communicate with each other. Some examples of vehicular data sources are transponders, sensors, timers, engine control components, operator data interfaces, as well as the GPS. Data from the host sent to the vehicle to communicate with the operator, provide GPS information, run diagnostic routines, reconfigure data collection routines, download code and run executable software. Analog and digital signals are acquired using vehicular networks or common serial interfaces. Some vehicular networks also include short range wireless LANs for data collection and user interface requirements.

A further enhancement of the present invention is next described with reference to FIG. **3**. In an embodiment utilizing the technology of FIG. **3**, communications involving a number of communication apparatuses **22** located, for example, in a number of vehicles are facilitated. Such an embodiment has particular utility in the context of a number of vehicles owned/operated by the same entity. This application may involve a vehicle fleet entity having a number of vehicles, with each of the vehicles being monitored, as well as supplying information to them.

Functions and objectives related to managing such embedded computer apparatuses **22** within a fleet of vehicles

include: properly and securely reconfiguring software on the communications apparatus **22**; properly and securely updating software on each such apparatus **22**; diagnosing problems associated with each communications apparatus **22**; and monitoring operation and routinely providing status information associated with each computer apparatus **22**.

To achieve these objectives and functionalities, FIG. **3** illustrates a system **300** characterized by a management portal apparatus or module **310**. The portal apparatus **310** is separate and remote from each of a plurality of communications apparatuses **22***a*, **22***b* . . . **22***n*. The portal apparatus **310** communicates with each of the communications apparatuses **22***a*–**22***n*, which may be embedded in different vehicles and constitute a fleet of vehicles, by means of a wireless network **314**. The wireless network **314** can include the Internet **320** and its associated technology.

The system **300** also includes one or more vehicle fleet subsystems **324***a* . . . **324***n*. Each of these fleet subsystems **324** is typically located at the facility of a particular vehicle fleet owner/operator. Each fleet subsystem **324***a* . . . **324***n* can include fleet manager hardware and software (processing and controlling capabilities). **330***a*–**330***n*, respectively. Such hardware and software is involved with managing the communications, such as requests and commands, or otherwise controlling the flow of information related to the member/vehicles in the vehicle fleet or set. By way of example only, the fleet manager **330***a* may manage one or more of the vehicles having some of the communications apparatuses **22***a* . . . **22***n*, while the fleet manager **330***n* may be involved in managing others of the vehicles having different ones of the communications apparatuses **22***a*–**22***n*. With regard to maintaining or storing data or other information related to the vehicles that they manage using the respective communication apparatuses **22**, each fleet subsystem **324** communicates with and has responsibility over a fleet data memory or storage **334**, which is part of the particular fleet subsystem **324**. Each such fleet data memory **334***a* . . . **334***n* can store data obtained from the vehicles in the fleet for later access and use, particularly evaluation and analysis, such as in the context of monitoring vehicle data related to proper operation of the vehicle.

With respect to communications with one or more fleet vehicles of a particular fleet subsystem **324**, the Internet **320** is preferably involved by which each such fleet subsystem **324** can access the portal apparatus **310**. In providing services and functionalities requested by the fleet subsystems **324**, the portal apparatus **310** acts as a web-based interface or middle-ware component useful in managing one or more devices in each vehicle of the fleet and monitoring them for proper operation. Generally, the services and functions of the portal apparatus **310** can be construed as involving data management or system management. The tasks and operational steps associated with data management that can be conducted involving the portal apparatus **310** can be as varied and ubiquitous as necessary for the fleet entity's requirements. Since system management is less diverse (customization for a particular fleet subsystem **324** not as prevalent), the system operation of the portal apparatus **310** can be described more completely.

The portal apparatus **310** is a "port-of-entry" for access to fleet information. The portal apparatus **310** provides a web-based interface to a particular set of information and allows authorized personnel to review information on their respective communications apparatuses **22**. Additionally, updated and/or new software can be identified that is of relevance to the particular fleet (new or updated managers, more than trivial software bug-fixes, etc.). The portal apparatus **310** provides a web-based interface such that the communications apparatuses **22** in the field can be scheduled for remote maintenance whether software and/or configurations are updated based on the desires of the particular fleet owner/operator. The portal apparatus **310** can also act as a notification service provided such that fleet managers **330***a* . . . **330***n* are notified of issues when they occur. This is in addition to the previously noted functionalities such that managers can browse assets as well as set triggers for automatic notification. The portal apparatus **310** includes a fleet management system **340** in the form of appropriate hardware and software involved in managing or controlling communications with the communications apparatuses **22** in vehicles of one or more fleets, together with communications involving the one or more fleet subsystems **324**. The portal apparatus **310** also includes a central fleet data memory or storage **334** that contains parsed information received from the numerous communications apparatuses **22**. The information is received in a variety of forms, depending upon the link device used within the communications apparatus **22**, such as e-mail via pager, stream socket via CSC, etc.

With regard to reconfiguration updates, each communications apparatus **22** is a highly configurable unit that permits the execution of numerous applications satisfying a number of different requirements. The ability to reconfigure applications at any time is a challenge since vehicles can be located anywhere in the country, depending upon the customer. Hence, there is a need to remotely reconfigure and/or update software on one or more communications apparatuses **22** safely without creating the need for hands-on access to the particular communications apparatus **22**. In conjunction with achieving this objective, a "transaction-based" solution is utilized to insure the integrity of the particular communications apparatus **22** after any change has occurred. In providing a new configuration or software update, it is preferably sent as a single file from the portal apparatus **310** to the one or more selected communications apparatuses **22** through the wireless network **314**. The single transfer involving all updates for a particular communications apparatus **22** better avoids missing one or more files due to communication or user error. Once the updated information (different configuration of software) arrives at the particular communications apparatus **22**, it is verified. Such a verification can be accomplished using a checksum or other integrity checks. After doing so, the update is applied to the particular communications apparatus **22**. Applying the new configuration or update is performed in a secure fashion whereby changes are not immediately applied to active files in the communications apparatus **22** but instead to mirrors of the targeted files. In that regard, the configuration manager **180** is responsible for updating software and/or a configuration for a particular communications apparatus **22**. Upon receiving the new configuration or software update, the configuration manager **180** is responsible for extracting changes from the configuration in the file and applying them to the communications apparatus **22** in a shadow or mirror form. Once application of the file is complete, the configuration manager **180** performs a post update check and then notifies the portal apparatus **310** that the operation was successful. More particularly, when the new configuration or software update arrives from the portal apparatus **310**, the configuration manager **180** updates, shadow files in the particular communications apparatus **22**. Once the configuration update is approved, the configuration manager **180** migrates the shadow files to the active or current file. A post update check is made. The portal appa-

ratus **310** is notified of the successful updating. Once notified, the portal apparatus **310** is aware of the new configuration or update.

An unsuccessful reconfiguration results in file histories and checksums being sent back to the portal apparatus **310** in order to reconstruct the update process and provide another configuration to bring the particular communications apparatus **22** up to the desired revision. The update process can be customer driven, based on updated software for new requirements, or by the recommendation of the portal apparatus **310**. The portal apparatus **310** is aware of which communications apparatuses **22** use a particular revision of software. In that regard, the configuration manager **180** has the capability to interrogate a communications apparatus **22** and identify the revision(s) of software and configuration being used by that particular communications apparatus **22**.

The system **300** also has the capability where components thereof may be applied with an indication of their priority or need for update. With that information, the portal apparatus **310** can automatically notify the fleet owner/operator of changes that were incorporated. Such notification could include what needs to be changed and the objectives sought to be served by making the changes, such as bug-fixes, new functions, etc. Based on the notification, the fleet manager **330** of a particular fleet subsystem **324** could then direct the portal apparatus **310** to update one or more communications apparatuses **22** within the domain of that fleet subsystem **324**. Such a process involving automated updating and notification would require dependency analysis to understand the dependencies among components for proper operation, but the process could also be automated to integrate customers into the evolution of the software.

Further functionality associated with the portal apparatus **310** involves the gathering of diagnostic and operational data from the communications apparatuses **22**. Such data enables the system and its users to understand how the communication apparatuses **22** are used and under what conditions, which information is beneficial in optimizing and enhancing its operation and functionality. Diagnostic data for such purposes can be emitted in a special compressed form to the portal apparatus **310** whereby the operations of the communications apparatuses **22** in the field are monitored and corrective actions can be taken when data indicates that such corrections are necessary or appropriate.

In connection with taking responsibility for handling diagnostics data, the diagnostics manager **182** is involved in collecting and relaying diagnostic data from the communications apparatus **22** to the portal apparatus **310**. More particularly, within the communications apparatus **22** as the managers are made aware of activities that are not normal or need to be reported (time-outs expired, resources unavailable, etc.), they notify the diagnostics manager **182**. At the same time, the diagnostics manager **182** is collecting secondary data such as current available memory, temperature of the communications apparatus **22**, process load, altitude, current time, as well as other relevant information. This data is compressed such that its transmission does not overload the available communications link. In that regard, the diagnostics manager **182** must also be configurable to limit data and emission when links, such as pager devices, are used. Each data piece can be accompanied by a severity indicator (informational, warning, error, etc.) so that the diagnostics manager can limit their emission when desired.

Diagnostic data can come in many forms and the diagnostics manager **182** receives data from operating managers as well as collecting parameters itself from pertinent parts or components of the communications apparatus **22**. Collected events or other information are compressed to do a stream that, on a periodic basis or depending upon severity of the event, are transmitted to the portal apparatus **310**. The diagnostics manager **182** based upon the configuration of the particular communications apparatus **22** also filters the events. For example, in a communications apparatus **24** that has routine access to a CDPD connection, all events may be emitted including informational and warning messages. In a communications apparatus **22** that has only access to a two-way pager device, only critical and error events are emitted to reserve bandwidth for actual applications.

The result from the particular communications apparatus **22** is a fusion of data from numerous applications into a compressed stream of data that can be later decompressed and automatically parsed and archived at the fleet data memory **334** or central storage **344** of the portal apparatus **310**. The stream represents a history of the operation of the particular communications apparatus **22** that can be used to reconstruct the occurrence of a failure or intermittent problem within the communications apparatus **22** to identify its cause. The benefit relates to the ability to correlate an error that appears in one communications apparatus **22** with other such communication apparatuses **22** that function similarly. Based on such a mass of information, errors or other unwanted functioning can be better handled

Related to obtaining diagnostics data from one or more communications apparatuses **22** is the handling of such received data by the portal apparatus **310**. The majority of such data represents informational events that are simply logged within the portal apparatus central memory or database **344**. An error of one or more events can be flagged for review or e-mail could be generated to inform a recipient through event filtering and notification of a critical event that requires immediate attention. The particular fleet subsystem **324** could also be notified so that it is up-to-date on the status of its fleet. The portal apparatus database **344** is both hierarchical and temporal in nature. At an upper level are the identified fleets. At lower levels and associated therewith are the particular vehicles within the fleet and their specific configuration information. For each vehicle, the event stream represents a temporal line identifying the activities of the particular communications apparatus **22** during its life. Data mining could also be employed to identify relationships within the data to better understand the causes of intermittent problems. A further aspect related to the portal apparatus **310** could include providing developer access to software assets of one or more communications apparatuses **22**. The assets might include updated software, new APIs, technical notes and errata. Developers could browse publicly available lists that identify problems for use in arriving at solutions, as well as download new managers and interface header files for their internal development. The portal apparatus **310** could also provide technical information for the development of communications apparatus software to globally spread and share useful information.

The foregoing discussion of the invention has been presented for purposes of illustration and description. Further, the description is not intended to limit the invention to the form disclosed herein. Consequently, variations and modifications commensurate with the above teachings, within the skill and the knowledge of the relevant art, are within the scope of the present invention. The embodiments discussed hereinabove are further intended to explain the best mode known of practicing the inventions and to enable others skilled in the art to utilize the inventions in such, or in other

embodiments and with the various modifications required by their particular applications or uses of the inventions. It is intended that the appended claims be construed to include alternative embodiments to the extent permitted by the prior art.

What is claimed is:

1. A method involving the transmission of information, comprising:

providing a communications apparatus located in a vehicle and that includes:

a plurality of common module managers including: a flow manager that manages data flow using components, a security manager that monitors connections outside said communications apparatus, a configuration manager that performs configuration tasks including downloading applications and also including at least one of: a compression manager that compresses information and an encryption manager that encrypts information; and

at least first, second, third and fourth disparate subsystem managers;

providing at least first, second, third and fourth disparate subsystems;

conducting a first operation including:

sending a first message from said first disparate subsystem to said first disparate subsystem manager, said first message including identification information of said second disparate subsystem manager and a first request for first information involving said second disparate subsystem manager;

receiving said first request by said first disparate subsystem manager;

providing at least information related to said first request to said second disparate subsystem manager;

accessing said first information from said second disparate subsystem in communication with said second disparate subsystem manager;

transmitting said first information using said second disparate subsystem manager;

wherein said first operation is conducted using at least two of said common module managers and in which each of said at least two common module managers are different from said compression manager;

conducting a second operation including:

sending a second message from said third disparate subsystem to said third disparate subsystem manager, said second message including a second request and identification information of said fourth disparate subsystem manager;

receiving said second request by said third disparate subsystem manager;

providing at least information related to said second request to said fourth disparate subsystem manager;

responding to said second request by said fourth disparate subsystem in communication with said fourth disparate subsystem manager;

wherein said second operation is conducted using at least two of said common module managers and in which each of said at least two common module managers is different from said encryption manager;

wherein said first disparate subsystem is required to communicate with said first disparate subsystem manager related to said first message, said second disparate subsystem is required to communicate with said second disparate subsystem manager related to said first information, said third disparate subsystem is required to communicate with said third disparate subsystem manager related to said second message and said fourth disparate subsystem is required to communicate with said fourth disparate subsystem manager related to responding to said second request and each of said first, second, third and fourth disparate subsystem managers has a native interface that is different from the others to enable communications with said first, second, third and fourth disparate subsystems, respectively, and in which said common module managers are located in the vehicle, said at least four disparate subsystem managers are located in the vehicle and said at least four disparate subsystems are located in the vehicle.

2. A method, as claimed in claim 1, wherein:

said step of sending said first message includes sending said first message from a site outside of the vehicle and said first disparate subsystem utilizes TCP/IP in communicating over the Internet using wireless technology located in the vehicle.

3. A method, as claimed in claim 1, wherein:

said first message relates to a configuration packet including packet information related to a destination of said configuration packet from a source, a service related to said second disparate subsystem and said first information relates to data being obtained from said second disparate subsystem.

4. A method, as claimed in claim 1, further including:

receiving at least portions of said first request by said flow manager for managing performance of a first function related to said first information.

5. A method, as claimed in claim 4, wherein:

said managing performance step includes generating a child process that is involved with one of the following: encryption of said first information by said encryption manager and compression of said first information by said compression manager.

6. A method, as claimed in claim 3, further including:

receiving by said security manager said configuration packet and said security manager for use in determining access availability of the source associated with said configuration packet.

7. A method, as claimed in claim 1, wherein:

said step of receiving said first request includes checking for a request for service related to at least one of the following: encryption of information using said encryption manager, compression of information using said compression manager, and access to said communications apparatus related to said first message using said security manager.

8. A method, as claimed in claim 7, wherein:

said checking step includes reading a configuration packet associated with said first message.

9. A method, as claimed in claim 1, further including:

producing a child process by said flow manager related to one of: encrypting said first information using said encryption manager and compressing said first information using said compression manager.

10. A method, as claimed in claim 1, wherein:

said producing step includes providing a metachild process that is involved in obtaining said first information from said second disparate subsystem and also obtaining second information from a fifth disparate subsystem.

11. A method, as claimed in claim 10, wherein:

said step of providing said metachild process includes creating said metachild process using said flow manager of said communications apparatus.

12. A method, as claimed in claim 1, further including:

creating a first child process that is part of a communications connection related to receiving said first information using said second disparate subsystem manager;

producing a second child process; and

registering said first and second child processes using abase manager and de-registering said first and second child processes.

13. A method, as claimed in claim 1, further including:

registering said first and second disparate subsystems before said step of sending said first message.

14. A method for providing information among a plurality of disparate subsystems using a plurality of managers and a common module, comprising:

registering at least first, second and third disparate subsystem managers using a base manager of said common module, said first disparate subsystem manager being in communication with a first disparate subsystem, said second disparate subsystem manager being in communication with a second disparate subsystem and said third disparate subsystem manager being in communication with a third disparate subsystem, said first, second and third disparate subsystems include: a wireless communications device, transmission control protocol/Internet protocol (TCP/IP) and one of the following: a security manager that monitors external applications attempting to connect to at least one of said first, second and third disparate subsystem managers, a flow manager that enables communications involving at least one of said disparate subsystem managers, and a configuration manager that performs configuration tasks;

obtaining first information from said first disparate subsystem using said first disparate subsystem manager, said obtaining step includes creating a first child component process using at least said second disparate subsystem manager and registering said first child component process using said base manager;

sending said first information from said first disparate subsystem;

transmitting second information using said third disparate subsystem manager to an external application; and

creating a second child component process and registering said second child component process using said base manager;

wherein each of said registering steps includes associating an identifier with each of said first, second and third disparate subsystem managers and associating an identifier with each of said first and second child component processes.

15. A method, as claimed in claim 14, wherein:

said obtaining step includes requesting said first information from said first disparate subsystem using a first common communications protocol associated with said common module.

16. A method, as claimed in claim 14, wherein:

said sending step includes sending said first information continuously using a stream application programming interface (API) substantially independent of request and response messaging.

17. A method, as claimed in claim 14, wherein:

said second information includes said first information.

18. A method, as claimed in claim 14, further including:

gathering information by a portal apparatus from a number of vehicles associated with a fleet of vehicles operated by a first entity, each of said number of vehicles having a communications apparatus and said portal apparatus communicating with each said communications apparatus using a first communications network and said portal apparatus being located remotely from each of said number of vehicles.

19. A method, as claimed in claim 14, wherein:

said second child component process is related to said second information.

20. A system for providing communications in a vehicle, comprising:

a plurality of disparate subsystems located in the vehicle and including a protocol stack, a global positioning system (GPS), voice recognition (VR) and at least one of: an intelligent transport system data bus (IDB) and a controller area network (CAN); and

a communications apparatus operatively connected to each of said disparate subsystems that enables communications between them, said communications apparatus including:

at least four disparate subsystem managers and each of said disparate subsystems being dedicated to one of said at least four disparate subsystem managers, wherein each of said disparate subsystems communicates with its dedicated disparate subsystem manager and any communication involving a particular one of said disparate subsystems requires communication with said disparate subsystem manager to which said particular one disparate subsystem is dedicated, at least some of said disparate subsystem managers provide messages to others of said disparate subsystem managers, respond to messages from others of said disparate subsystem managers and create connections with others of said disparate subsystem managers; and

at least four common module managers, wherein each of said at least four disparate subsystem managers uses a common communications protocol when communicating with each of said at least four common module managers and each of said disparate subsystems communicates with its dedicated disparate subsystem manager using a native interface that is different from native interfaces of the others of said at least four disparate subsystem managers, and in which each of said at least four disparate subsystem managers, each of said disparate subsystems and each of said at least four common module managers is located with the vehicle.

21. A system, as claimed in claim 20, wherein:

said disparate subsystems further include a plurality of the following: an analog-to-digital converter in communication with at least one hardware device, a standard serial bus in communication with a plurality of devices located in the vehicle and a universal serial bus (USB) in communication with computer hardware.

22. A system, as claimed in claim 20, wherein:

said at least four common module managers are part of a common module, including a processor core, that is involved with registering components, including said at least four disparate subsystem managers.

23. A system, as claimed in claim 20, wherein:

said common communications protocol includes at least one of the following: a stream mode of operation in which a stream applications programming interface (API) is used to send data continuously and a request/response mode of operation using a bus applications

programming interface (API) in which information is transmitted by responding to a request from at least one of said disparate subsystem managers.

24. A system, as claimed in claim **20**, wherein:

said communications apparatus includes a bridge mode of operation in which control of information transfer resides substantially externally of the vehicle and an application mode of operation in which control of information transfer resides substantially within the vehicle.

25. A system, as claimed in claim **20**, wherein:

said at least four disparate subsystem managers includes a first disparate subsystem manager and a second disparate subsystem manager and in which a first child component process is created using at least one of said first and second disparate subsystem managers to establish a connection between them.

26. A system, as claimed in claim **20**, wherein:

said at least four common module managers include four of the following: a base manager used in registering said disparate subsystems, said at least four disparate subsystem managers and said a least four common module managers, a security manager for monitoring external applications attempting to connect to said communications apparatus, a link selection manager for providing an acceptable network link for transmitting and/or receiving information wirelessly relative to the vehicle, a flow manager for enabling communications involving three of said at least four disparate subsystem managers, a compression manager for compressing data for transfer, and an encryption manager for encrypting data before transfer.

27. A system, as claimed in claim **20**, further including:

a portal apparatus located remotely from the vehicle and in communication with said communications apparatus using wireless technology.

28. A method for communicating with a number of vehicles, comprising:

providing a plurality of communications apparatuses including a first communication apparatus and a second communications apparatus, each of the number of vehicles having a different one of said plurality of communications apparatuses;

providing at least a first fleet management subsystem that manages at least a plurality of the number of vehicles in the fleet;

providing a portal apparatus located remotely from each of said fleet management subsystem and each of said plurality of communications apparatuses;

providing a first communications network by which said portal apparatus communicates with each of said plurality of communications apparatuses and a second communications network by which said portal apparatus communicates with said fleet management subsystem;

maintaining information by said portal apparatus related to an identity of software being used by each of said communications apparatuses and in which said identity of software for said first communications apparatus is different from said identity of software for said second communications apparatus;

updating software in each of said plurality of communications apparatuses by said portal apparatus;

obtaining vehicle operational data from each of said plurality of communications apparatuses by said portal apparatus;

storing said vehicle operational data in memory of said portal apparatus;

gathering diagnostic data from each of said communications apparatuses by said portal apparatus;

storing said diagnostic data in said memory of said portal apparatus;

notifying said first fleet management subsystem by said portal apparatus of said identity of software being used by at least said first and second communications apparatuses; and

sending at least some of said vehicle operational data and said diagnostic data to said first fleet management subsystem by said portal apparatus.

29. A method, as claimed in claim **28**, wherein:

at least said first communications network includes the Internet.

30. A method, as claimed in claim **28**, further including:

providing a number of fleet management subsystems including said at least first fleet management subsystem and in which said at least first fleet management subsystem is notified related to said software being used by less than all of said plurality of communications apparatuses.

* * * * *

US006606561B2

(12) **United States Patent**
Flick

(10) **Patent No.: US 6,606,561 B2**
(45) **Date of Patent: Aug. 12, 2003**

(54) **VEHICLE TRACKER INCLUDING INPUT/OUTPUT FEATURES AND RELATED METHODS**

(75) Inventor: **Kenneth E. Flick**, Douglasville, GA (US)

(73) Assignee: **Omega Patents, L.L.C.**, Douglasville, GA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 42 days.

(21) Appl. No.: **09/859,972**

(22) Filed: **May 17, 2001**

(65) **Prior Publication Data**

US 2002/0016673 A1 Feb. 7, 2002

Related U.S. Application Data

(60) Provisional application No. 60/264,811, filed on Jan. 29, 2001, provisional application No. 60/258,005, filed on Dec. 22, 2000, provisional application No. 60/251,552, filed on Dec. 6, 2000, provisional application No. 60/252,125, filed on Nov. 20, 2000, provisional application No. 60/246,463, filed on Nov. 7, 2000, provisional application No. 60/236,890, filed on Sep. 29, 2000, provisional application No. 60/222,777, filed on Aug. 3, 2000, and provisional application No. 60/205,178, filed on May 17, 2000.

(51) **Int. Cl.**[7] **G01C 21/00**
(52) **U.S. Cl.** **701/213**; 340/988
(58) **Field of Search** 701/213, 207, 701/209, 24, 33, 35, 36; 340/901, 989, 988, 991, 992, 993

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,043,736	A	8/1991	Darnell et al.	342/357
5,055,851	A	10/1991	Sheffer	342/457
5,177,490	A	1/1993	Ando et al.	342/357
5,223,844	A	6/1993	Mansell et al.	342/357
5,262,774	A	11/1993	Kuwahara et al.	340/988
5,334,986	A	8/1994	Fernhout	342/357
5,365,450	A	11/1994	Schuchman et al.	364/449
5,515,043	A	5/1996	Berard et al.	340/988
5,673,305	A	9/1997	Ross	379/58
5,777,580	A	7/1998	Janky et al.	342/457
5,939,975	A *	8/1999	Tsuda et al.	307/10.5
5,944,768	A *	8/1999	Ito et al.	340/990
5,969,433	A	10/1999	Maggiora et al.	307/10.5
5,983,161	A *	11/1999	Lemelson et al.	340/436
6,018,657	A	1/2000	Kennedy, III et al.	455/426
6,025,774	A	2/2000	Forbes	340/426
6,049,269	A	4/2000	Byrd et al.	340/426
6,055,426	A	4/2000	Beasley	455/432

(List continued on next page.)

OTHER PUBLICATIONS

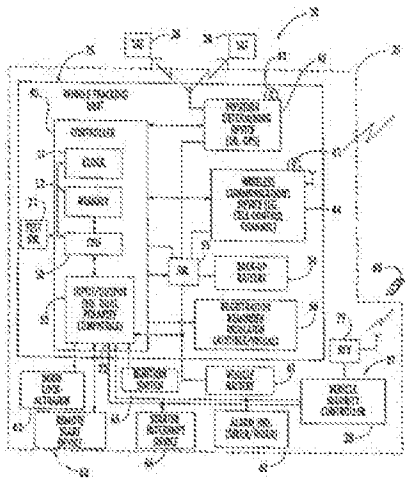
Omega Research and Development, Inc., Installation Instructions for AVV-1000 Model Car Alarm, 2002 This patent has been sold in U.S. for approximately five years.

Primary Examiner—William A. Cuchlinski, Jr.
Assistant Examiner—Olga Hernandez
(74) *Attorney, Agent, or Firm*—Allen, Dyer, Doppelt, Milbrath & Gilchrist, P.A.

(57) **ABSTRACT**

A tracking system includes a vehicle tracking unit for a vehicle of a type including an alarm indicator, and a monitoring station receiving the alarm indication alert from the vehicle tracking unit. The vehicle tracking unit may include a vehicle position determining device, a wireless communications device, and a controller connected to the wireless communications device and the vehicle position determining device. The controller may cooperate with the wireless communications device to send an alarm indication alert responsive to at least one of activation of the vehicle alarm indicator continuously for greater than a predetermined time and activation of the vehicle alarm indicator in a repetitive pattern. The controller may also include a dual polarity compatible output for a vehicle device, such as the vehicle alarm indicator.

53 Claims, 10 Drawing Sheets



U.S. PATENT DOCUMENTS

6,069,570	A	5/2000	Herring	340/825.49
6,075,458	A	6/2000	Ladner et al.	340/825.49
6,133,855	A	10/2000	Kim	340/932.2
6,148,212	A	11/2000	Park et al.	455/456
6,151,551	A	11/2000	Geier et al.	701/207
6,154,648	A	11/2000	Comer	455/426
6,166,626	A	12/2000	Janky et al.	340/426
6,169,497	B1	1/2001	Robert	340/988
6,195,597	B1	2/2001	Yamada	701/1
6,240,365	B1 *	5/2001	Bunn	340/988
6,275,773	B1 *	8/2001	Lemelson et al.	340/436
6,320,535	B1 *	11/2001	Hillman et al.	342/357.06
6,330,499	B1 *	12/2001	Chou et al.	701/32

* cited by examiner

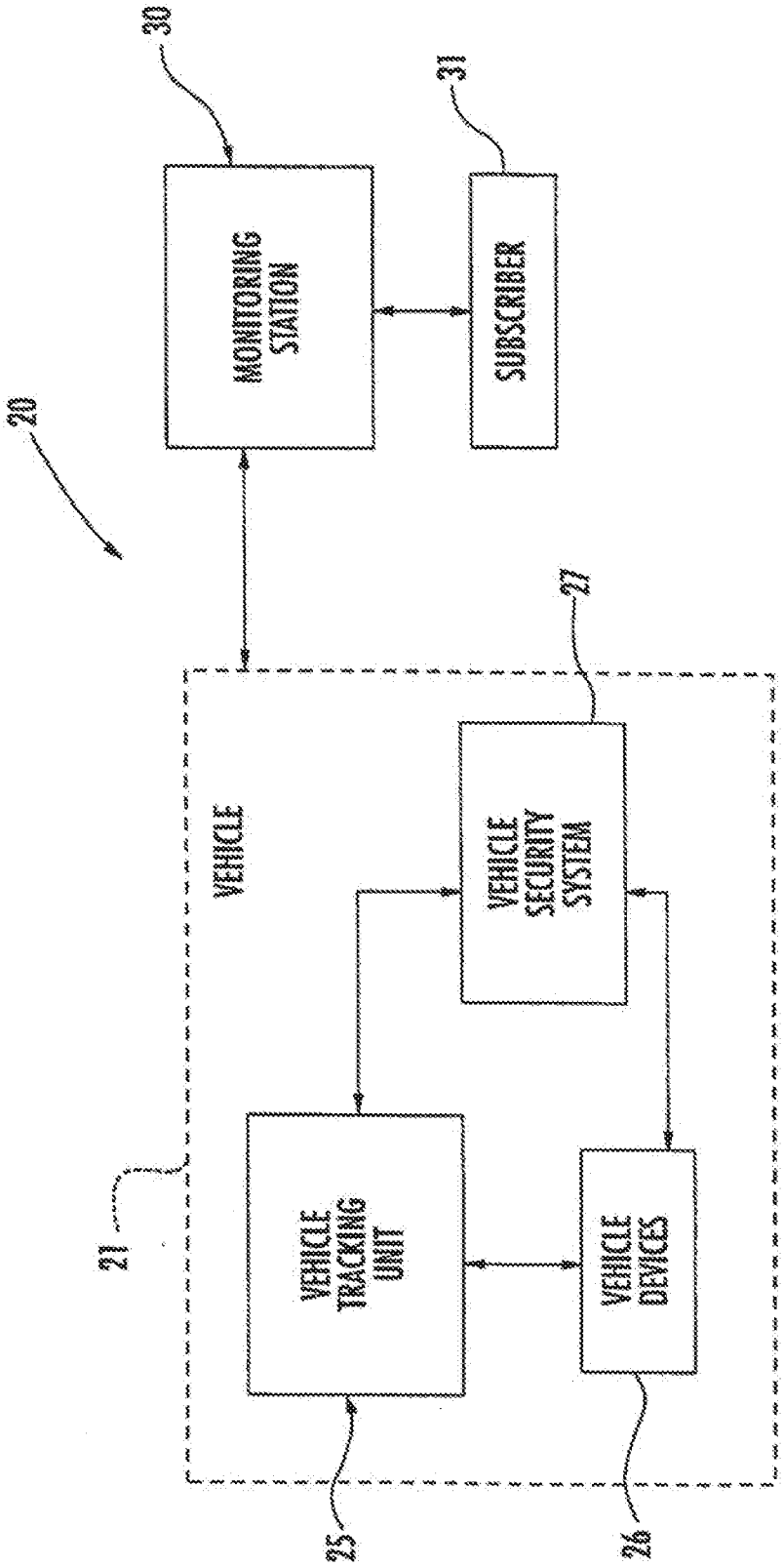

30
31
MONITORING STATION
SUBSCRIBER
20
27
VEHICLE
VEHICLE SECURITY SYSTEM
21
VEHICLE TRACKING UNIT
VEHICLE DEVICES
25
26

FIG. 1.

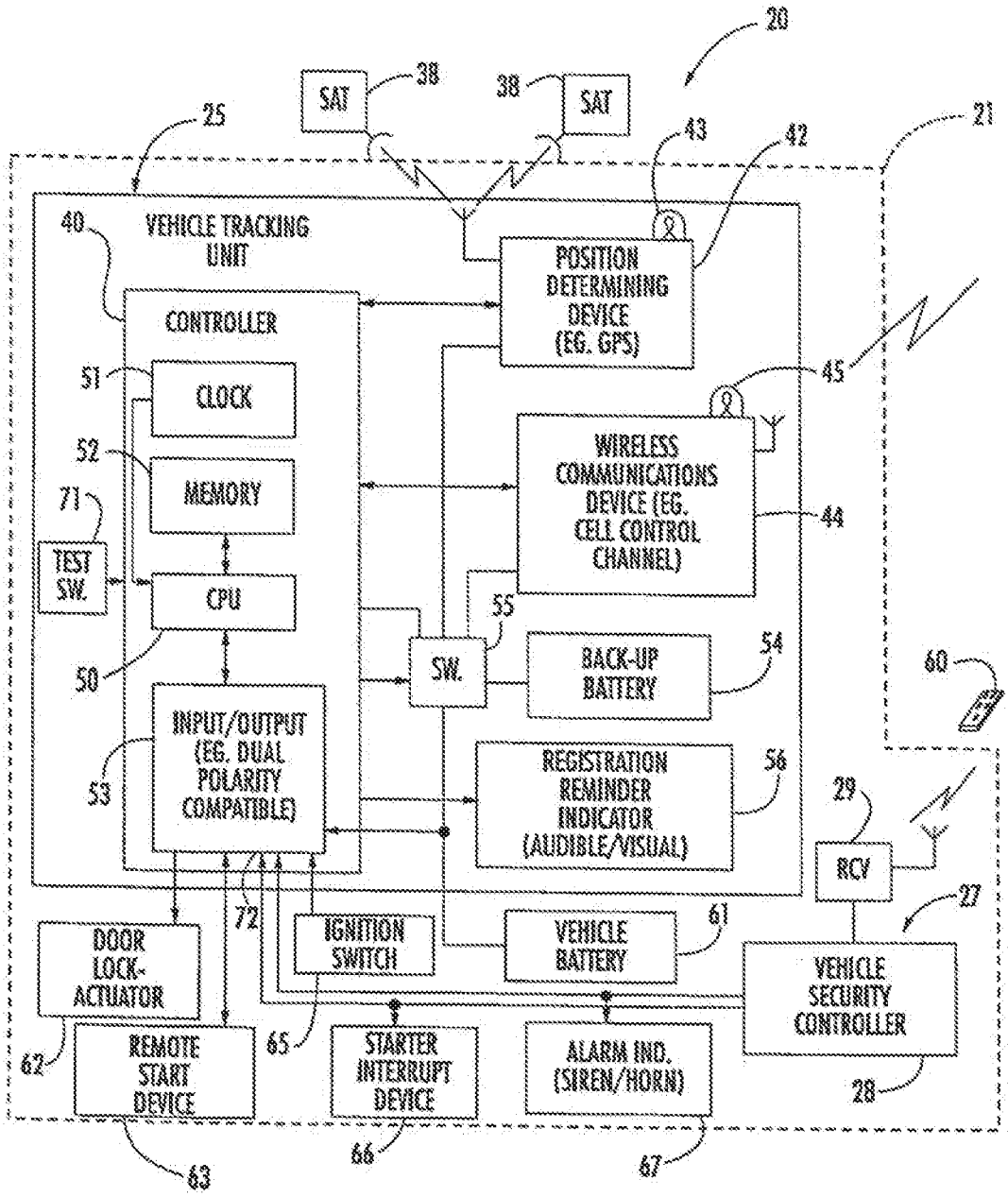

20
SAT
38
38
SAT
25
21
43
42
40
VEHICLE TRACKING UNIT
POSITION DETERMINING DEVICE (EG. GPS)
CONTROLLER
51
CLOCK
45
52
MEMORY
WIRELESS COMMUNICATIONS DEVICE (EG. CELL CONTROL CHANNEL)
44
71
TEST SW.
CPU
55
50
SW.
BACK-UP BATTERY
54
60
INPUT/OUTPUT (EG. DUAL POLARITY COMPATIBLE)
53
REGISTRATION REMINDER INDICATOR (AUDIBLE/VISUAL)
56
29
RCV
27
72
DOOR LOCK-ACTUATOR
IGNITION SWITCH
VEHICLE BATTERY
61
VEHICLE SECURITY CONTROLLER
62
65
REMOTE START DEVICE
STARTER INTERRUPT DEVICE
ALARM IND. (SIREN/HORN)
28
63
66
67

FIG. 2.

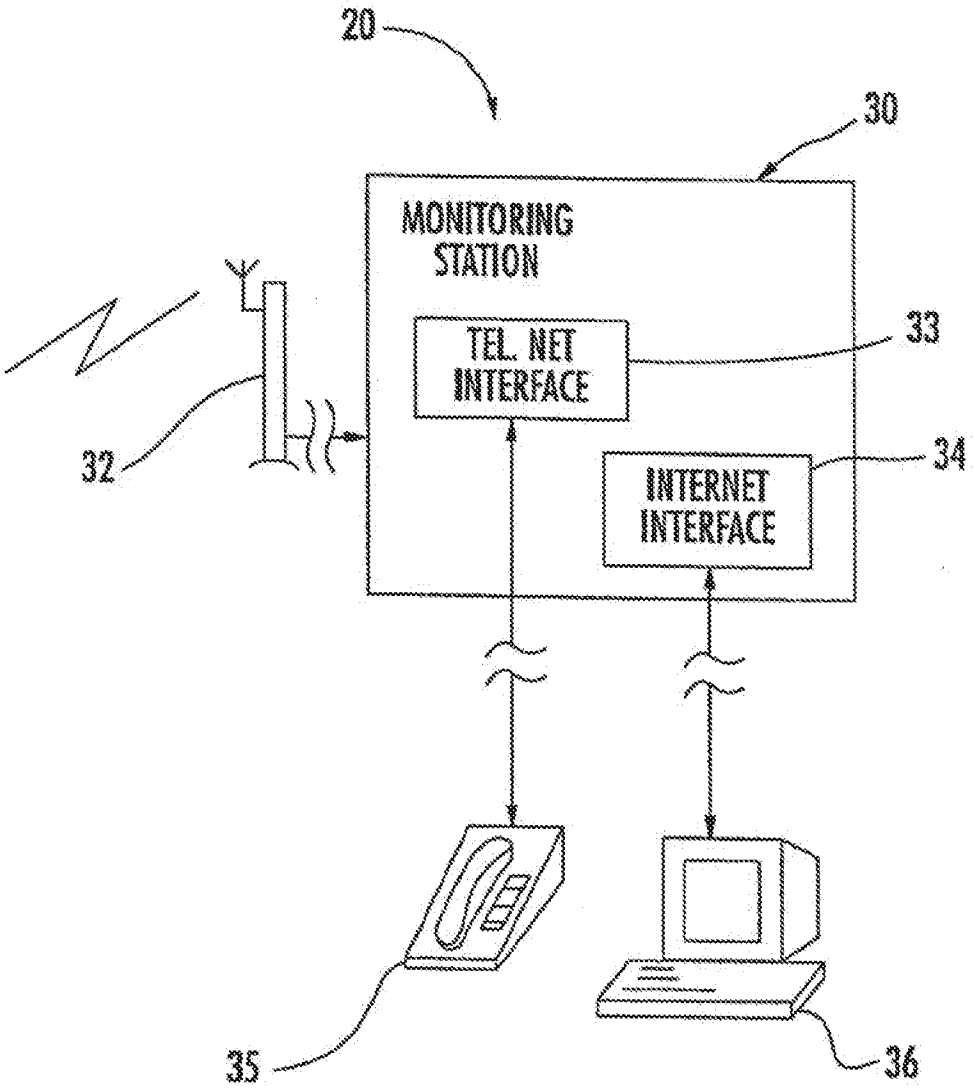

20
30
MONITORING STATION
TEL. NET INTERFACE
33
32
INTERNET INTERFACE
34
35
36

FIG. 3.

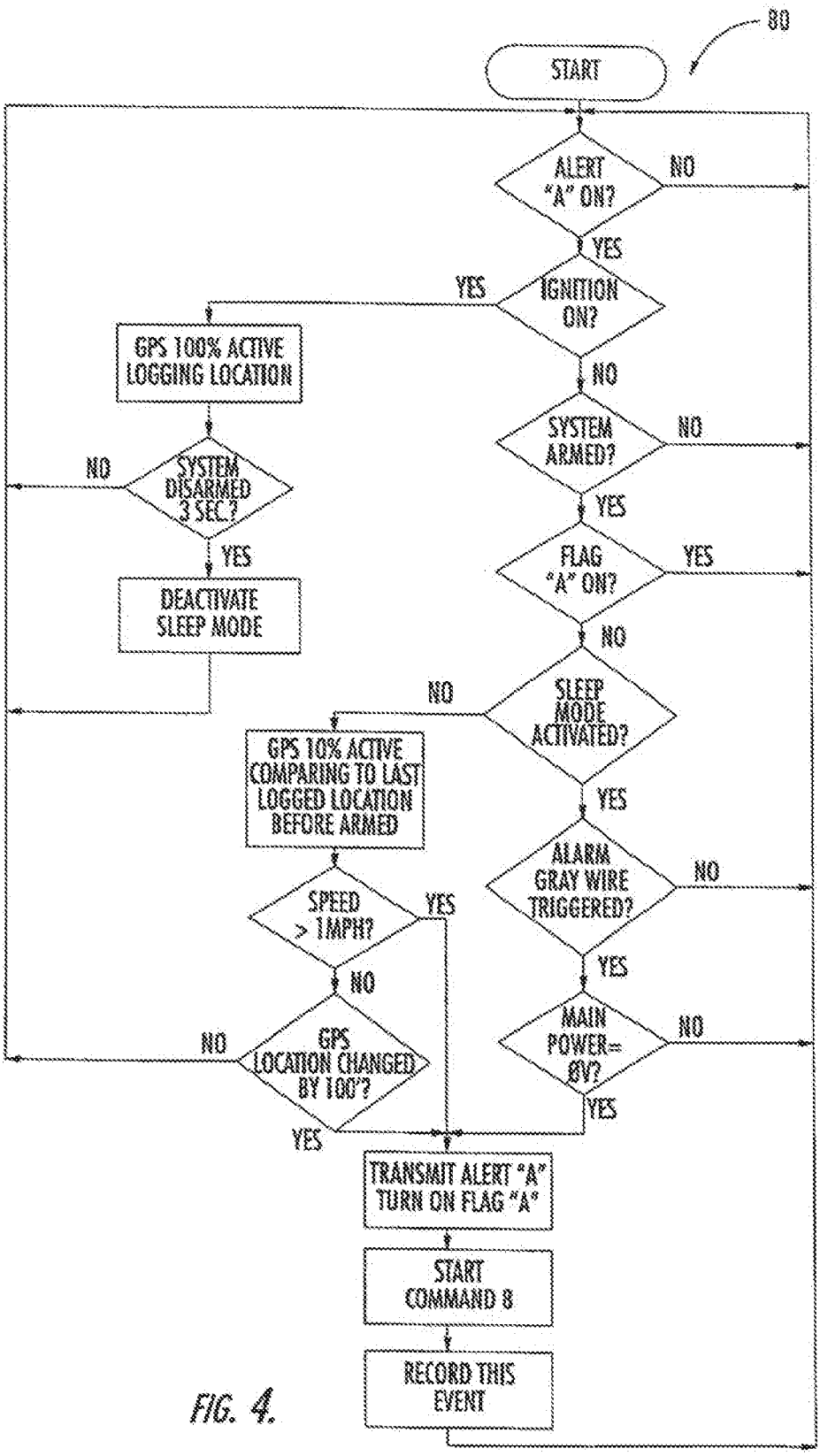

80
START
ALERT "A" ON?
NO
YES
IGNITION ON?
YES
GPS 100% ACTIVE LOGGING LOCATION
NO
SYSTEM ARMED?
NO
YES
NO
SYSTEM DISARMED 3 SEC.?
YES
DEACTIVATE SLEEP MODE
FLAG "A" ON?
YES
NO
NO
SLEEP MODE ACTIVATED?
GPS 10% ACTIVE COMPARING TO LAST LOGGED LOCATION BEFORE ARMED
YES
ALARM GRAY WIRE TRIGGERED?
NO
SPEED > 1MPH?
YES
YES
NO
MAIN POWER= 0V?
NO
NO
GPS LOCATION CHANGED BY 100'?
YES
YES
TRANSMIT ALERT "A" TURN ON FLAG "A"
START COMMAND 8
RECORD THIS EVENT

FIG. 4.

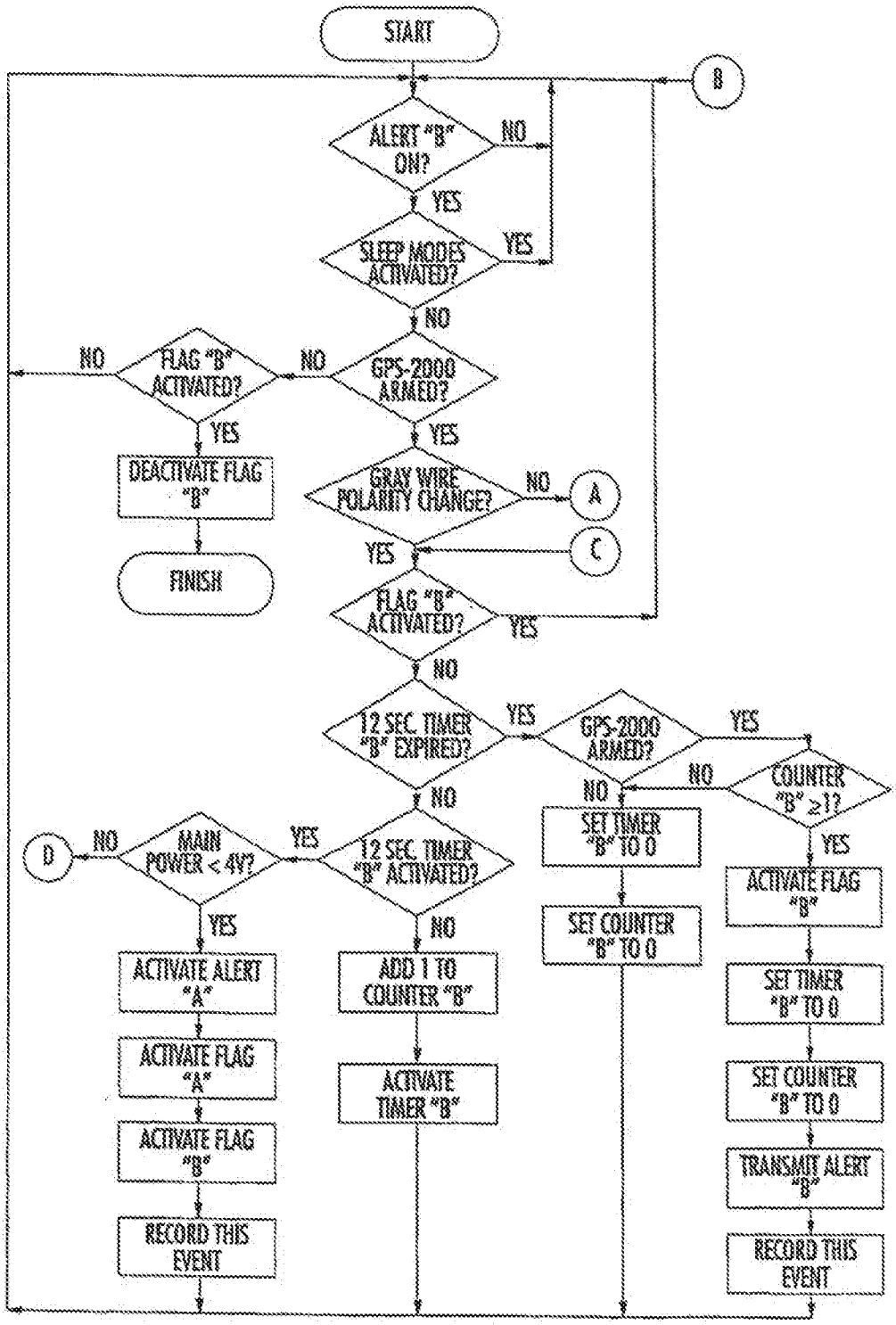

START
B
ALERT "B" ON?
NO
YES
SLEEP MODES ACTIVATED?
YES
NO
NO
FLAG "B" ACTIVATED?
NO
GPS-2000 ARMED?
YES
YES
DEACTIVATE FLAG "B"
GRAY WIRE POLARITY CHANGE?
NO
A
C
YES
FINISH
FLAG "B" ACTIVATED?
YES
NO
12 SEC. TIMER "B" EXPIRED?
YES
GPS-2000 ARMED?
YES
NO
NO
COUNTER "B" ≥1?
D
NO
MAIN POWER < 4V?
YES
12 SEC. TIMER "B" ACTIVATED?
SET TIMER "B" TO 0
YES
ACTIVATE FLAG "B"
YES
NO
SET COUNTER "B" TO 0
ACTIVATE ALERT "A"
ADD 1 TO COUNTER "B"
SET TIMER "B" TO 0
ACTIVATE FLAG "A"
ACTIVATE TIMER "B"
SET COUNTER "B" TO 0
ACTIVATE FLAG "B"
TRANSMIT ALERT "B"
RECORD THIS EVENT
RECORD THIS EVENT

FIG. 5A.

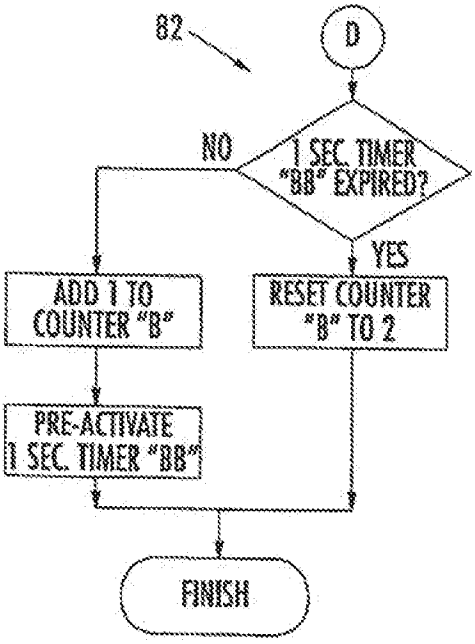

82
D
1 SEC. TIMER "BB" EXPIRED?
NO
YES
ADD 1 TO COUNTER "B"
RESET COUNTER "B" TO 2
PRE-ACTIVATE 1 SEC. TIMER "BB"
FINISH

FIG. 5B.

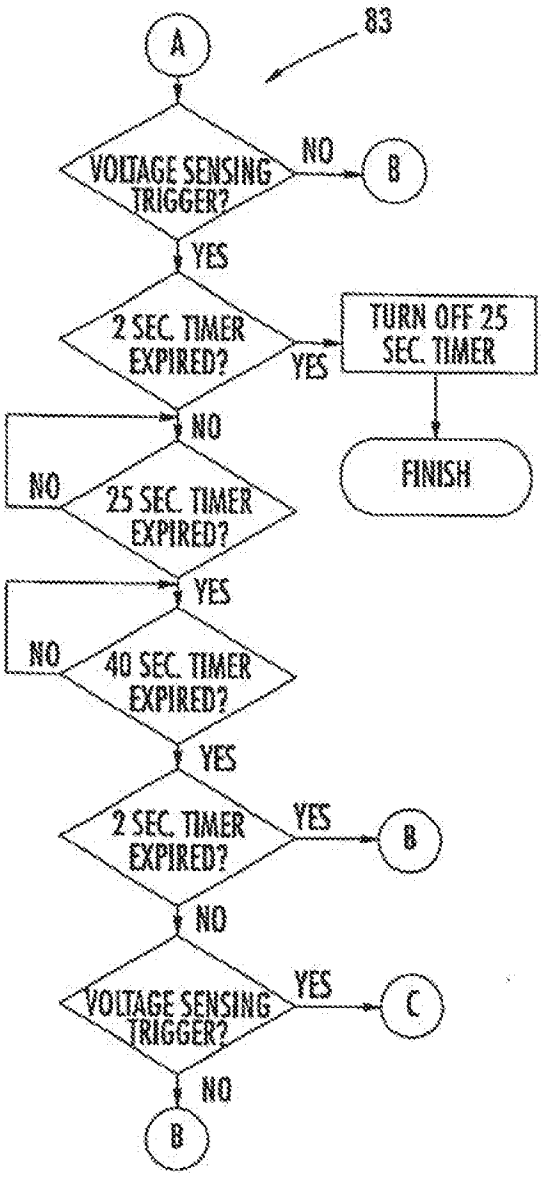

83
A
VOLTAGE SENSING TRIGGER?
NO
B
YES
2 SEC. TIMER EXPIRED?
YES
TURN OFF 25 SEC. TIMER
FINISH
NO
NO
25 SEC. TIMER EXPIRED?
YES
NO
40 SEC. TIMER EXPIRED?
YES
2 SEC. TIMER EXPIRED?
YES
B
NO
VOLTAGE SENSING TRIGGER?
YES
C
NO
B

FIG. 5C.

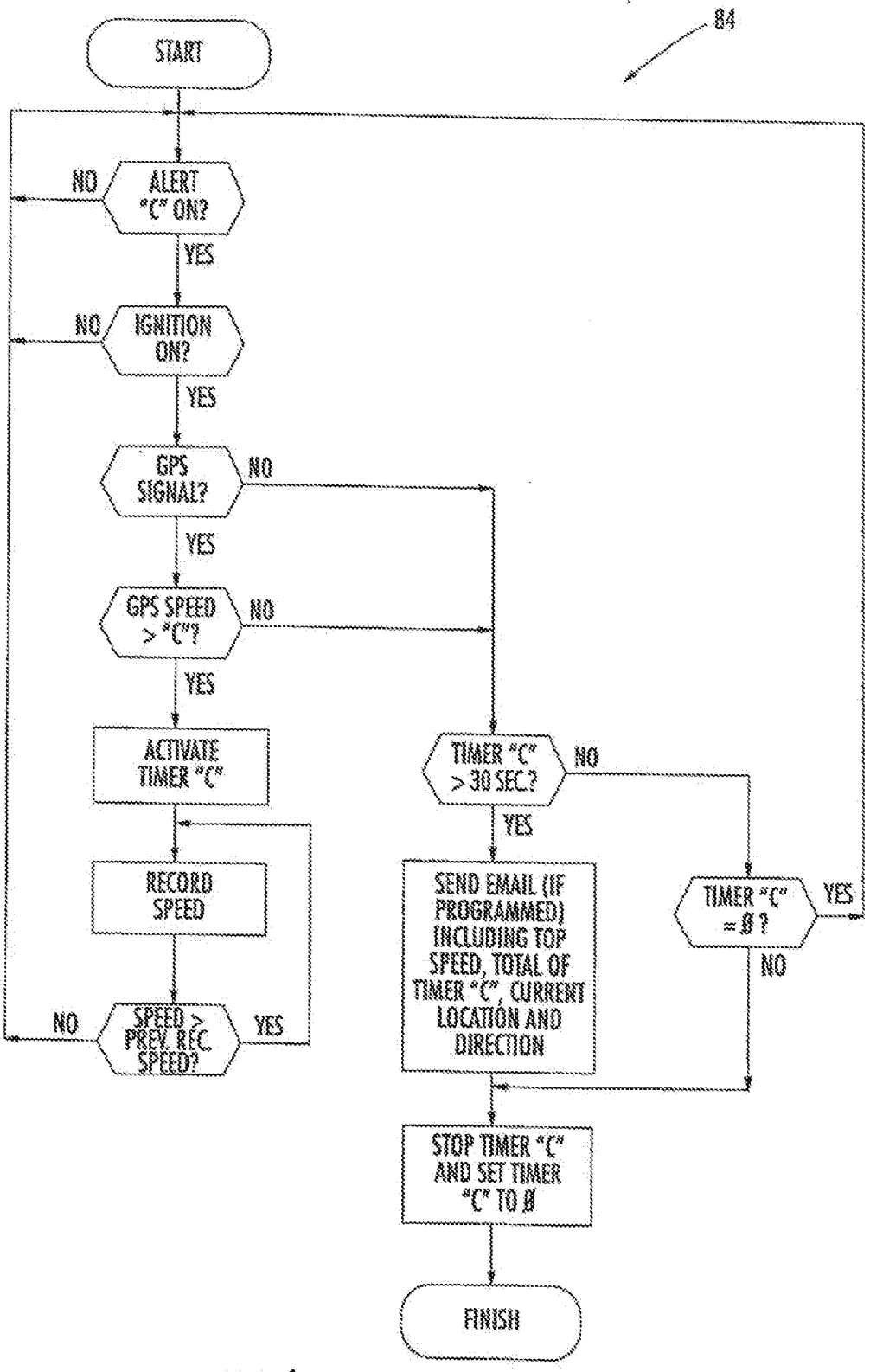

84
START
ALERT "C" ON?
NO
YES
IGNITION ON?
NO
YES
GPS SIGNAL?
NO
YES
GPS SPEED > "C"?
NO
YES
ACTIVATE TIMER "C"
RECORD SPEED
SPEED > PREV. REC. SPEED?
NO
YES
TIMER "C" > 30 SEC.?
NO
YES
SEND EMAIL (IF PROGRAMMED) INCLUDING TOP SPEED, TOTAL OF TIMER "C", CURRENT LOCATION AND DIRECTION
TIMER "C" = Ø ?
YES
NO
STOP TIMER "C" AND SET TIMER "C" TO Ø
FINISH

FIG. 6.

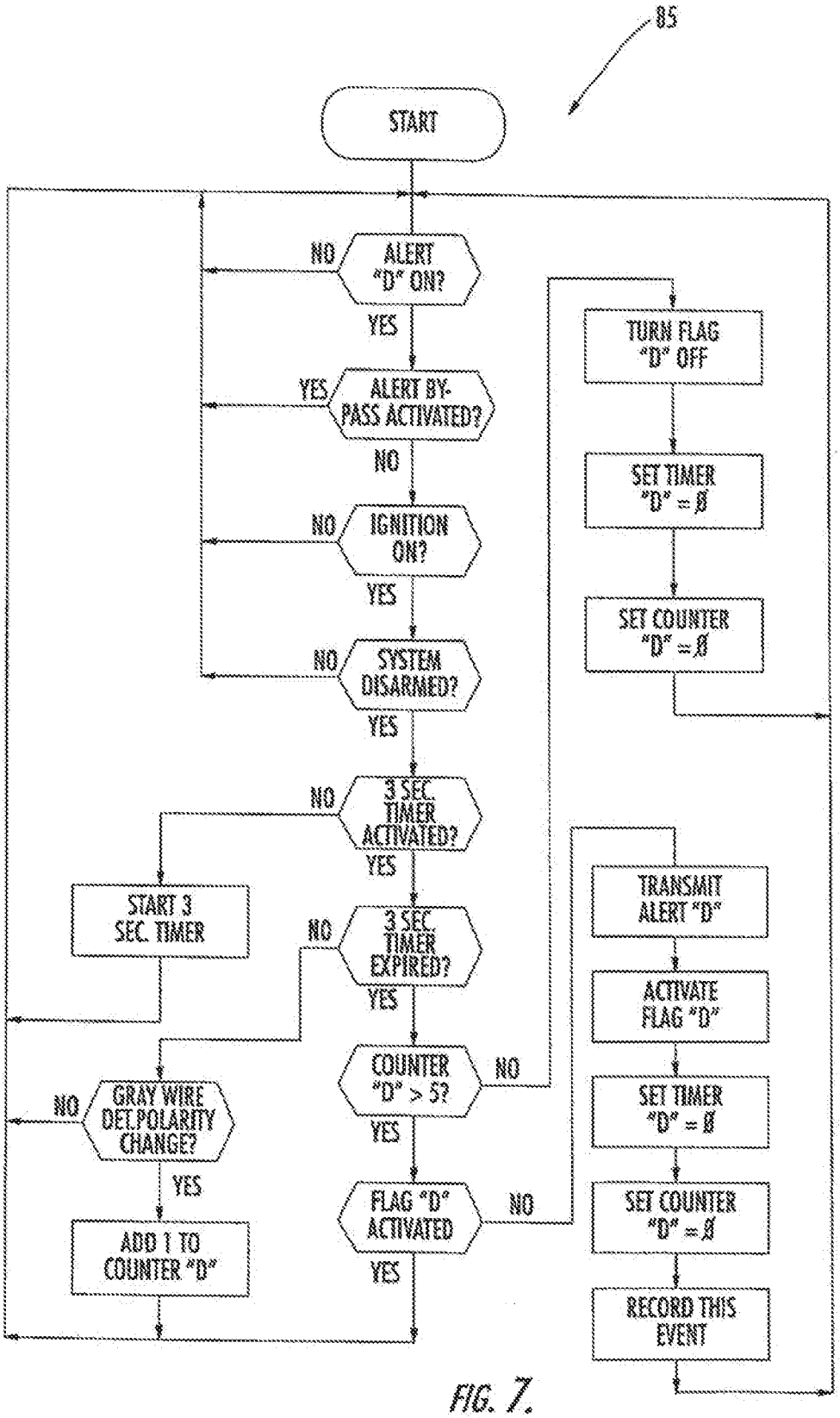

85
START
ALERT "D" ON?
NO
YES
ALERT BY-PASS ACTIVATED?
YES
NO
IGNITION ON?
NO
YES
SYSTEM DISARMED?
NO
YES
3 SEC. TIMER ACTIVATED?
NO
YES
START 3 SEC. TIMER
3 SEC. TIMER EXPIRED?
NO
YES
COUNTER "D" > 5?
NO
YES
GRAY WIRE DET. POLARITY CHANGE?
NO
YES
ADD 1 TO COUNTER "D"
FLAG "D" ACTIVATED
NO
YES
TURN FLAG "D" OFF
SET TIMER "D" = Ø
SET COUNTER "D" = Ø
TRANSMIT ALERT "D"
ACTIVATE FLAG "D"
SET TIMER "D" = Ø
SET COUNTER "D" = Ø
RECORD THIS EVENT

FIG. 7.

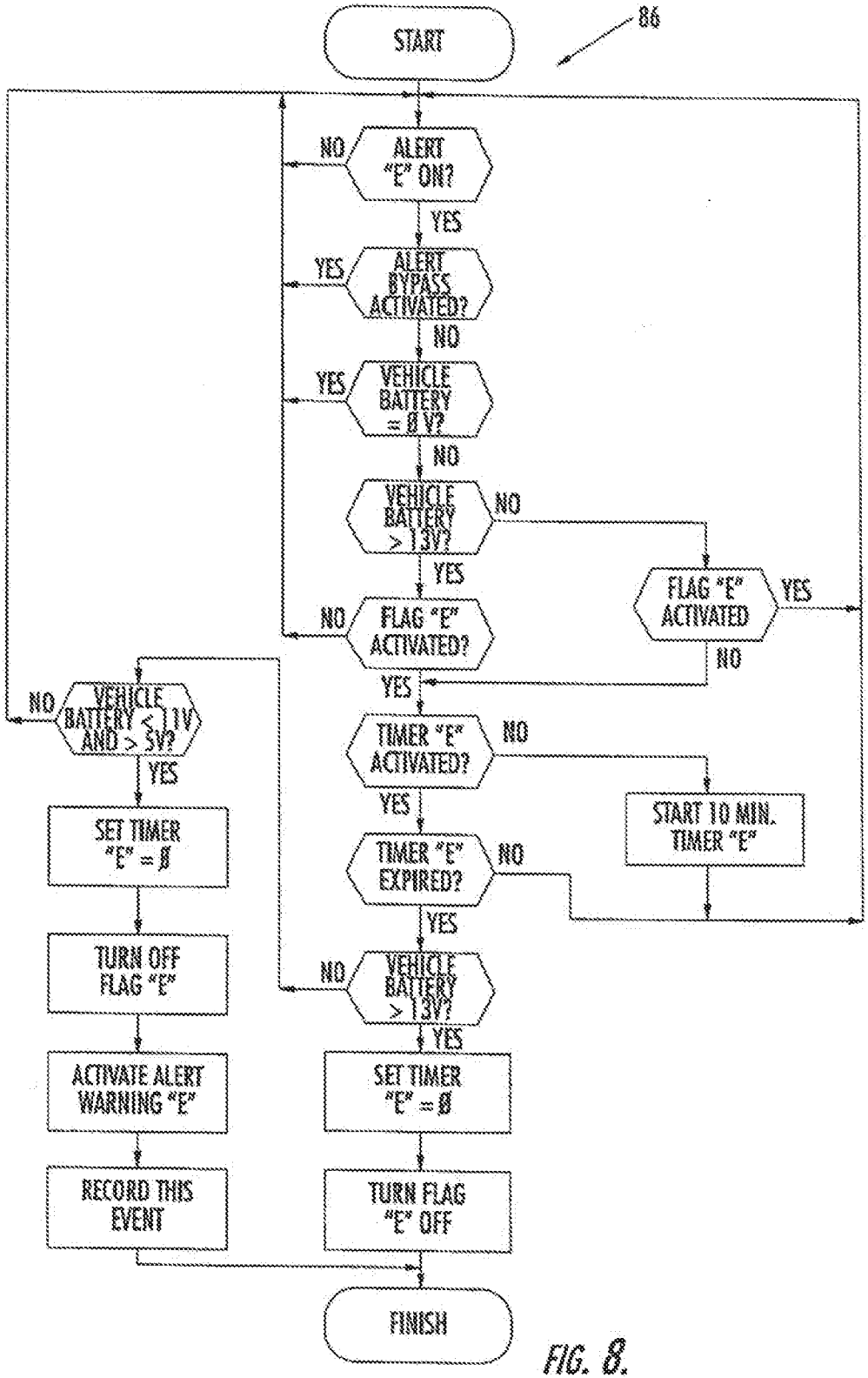

86
START
ALERT "E" ON?
NO
YES
ALERT BYPASS ACTIVATED?
YES
NO
VEHICLE BATTERY = Ø V?
YES
NO
VEHICLE BATTERY > 13V?
NO
YES
FLAG "E" ACTIVATED
YES
NO
FLAG "E" ACTIVATED?
NO
YES
VEHICLE BATTERY ≤ 11V AND > 5V?
NO
YES
TIMER "E" ACTIVATED?
NO
YES
START 10 MIN. TIMER "E"
SET TIMER "E" = Ø
TIMER "E" EXPIRED?
NO
YES
TURN OFF FLAG "E"
VEHICLE BATTERY > 13V?
NO
YES
ACTIVATE ALERT WARNING "E"
SET TIMER "E" = Ø
RECORD THIS EVENT
TURN FLAG "E" OFF
FINISH

FIG. 8.

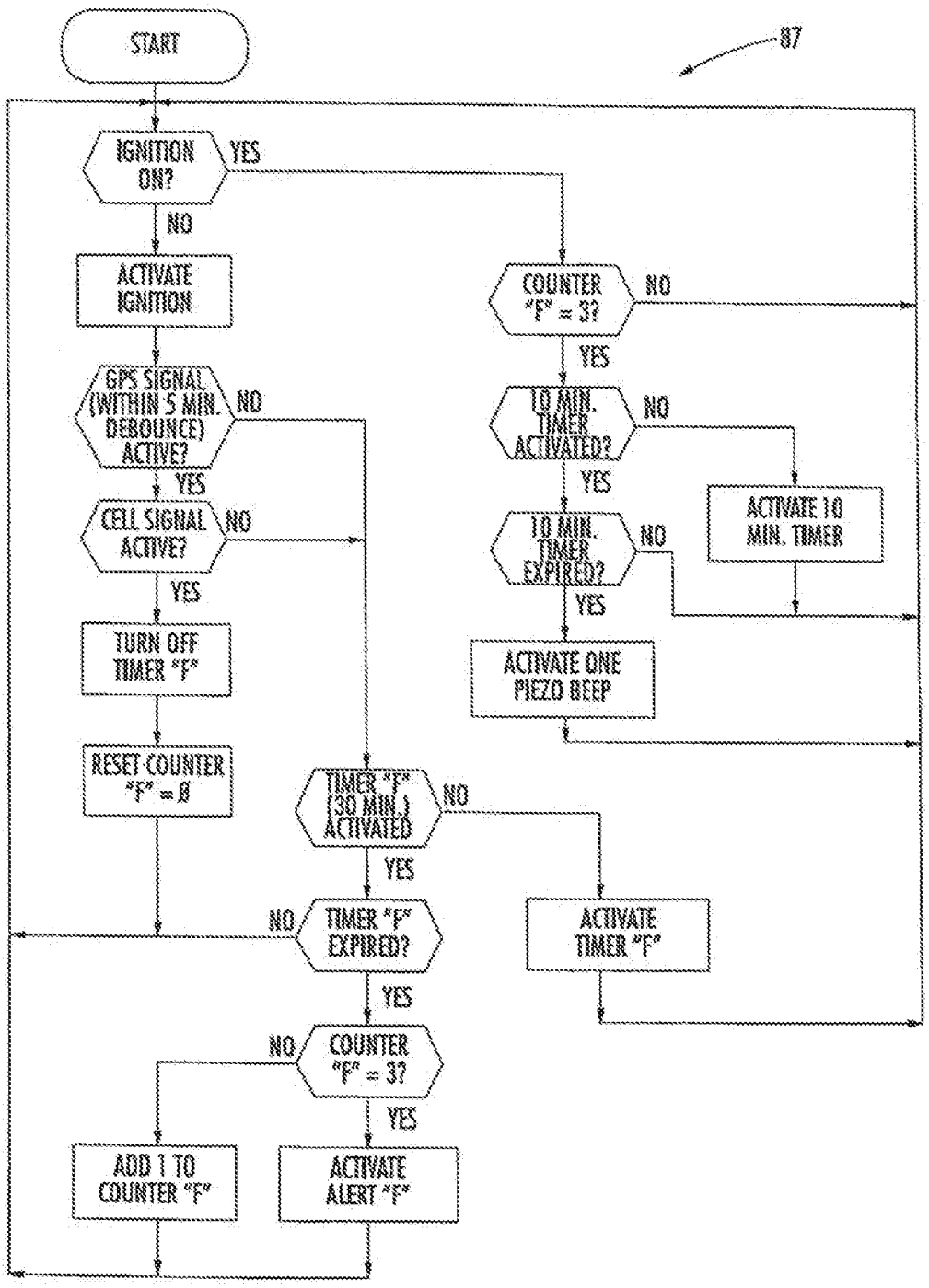

START
87
IGNITION ON?
YES
NO
ACTIVATE IGNITION
GPS SIGNAL (WITHIN 5 MIN. DEBOUNCE) ACTIVE?
NO
YES
CELL SIGNAL ACTIVE?
NO
YES
TURN OFF TIMER "F"
RESET COUNTER "F" = 0
COUNTER "F" = 3?
NO
YES
10 MIN. TIMER ACTIVATED?
NO
YES
ACTIVATE 10 MIN. TIMER
10 MIN. TIMER EXPIRED?
NO
YES
ACTIVATE ONE PIEZO BEEP
TIMER "F" (30 MIN.) ACTIVATED
NO
YES
ACTIVATE TIMER "F"
TIMER "F" EXPIRED?
NO
YES
COUNTER "F" = 3?
NO
YES
ADD 1 TO COUNTER "F"
ACTIVATE ALERT "F"

FIG. 9.

VEHICLE TRACKER INCLUDING INPUT/OUTPUT FEATURES AND RELATED METHODS

RELATED APPLICATIONS

The present application is based upon copending provisional application serial nos. 60/264,811 filed on Jan. 29, 2001; Ser. No. 60/258,005, filed Dec. 22, 2000; Ser. No. 60/251,552, filed Dec. 6, 2000; Ser. No. 60/252,125, filed Nov. 20, 2000; Ser. No. 60/236,890, filed Sep. 29, 2000; Ser. No. 60/246,463, filed Nov. 7, 2000; Ser. No. 60/222,777, filed Aug. 3, 2000; and Ser. No. 60/205,178, filed May 17, 2000, the entire contents of each of which are incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to the field of vehicle devices, and, more particularly, to a tracking and alerting system for a vehicle.

BACKGROUND OF THE INVENTION

Motor vehicles, such as passenger cars, trucks, busses, fleet vehicles, etc. are widely used and knowing the locations of such vehicles is often desired. For example, should a vehicle be stolen, it would be beneficial to know the vehicle's location so that authorities could be promptly and accurately directed to retrieve the vehicle. Indeed, the tracking system could plot the getaway path of the thief.

For a company with hired drivers, it may desirable to know the driver's whereabouts during the course of the day. Similarly, a rental car agency or other fleet operator, for example, may wish to know the whereabouts of its fleet of vehicles.

It may also be desirable to track the location of a vehicle as it is used throughout the course of a normal day. For parents of younger or older drivers, for example, knowledge of the vehicle's location may provide some assurance that the driver is at designated locations and following a prescribed route.

A number of patents disclose various systems and approaches to tracking vehicles. For example, U.S. Pat. No. 5,223,844 discloses a tracking system including a control center and a mobile unit installed in the vehicle. The mobile unit may send security warnings to the command center via a wireless transceiver. Position information for the vehicle is determined using a GPS receiver at the vehicle.

U.S. Pat. No. 5,515,043 discloses a similar system which may send one or more preprogrammed telephone messages to a user when away from the vehicle. The user may remotely access location information or cause certain commands to be carried out by entering a personal identification number (PIN).

The widespread availability and use of the Internet has prompted a number of vehicle tracking systems to also make use of the Internet. For example, TelEvoke, Inc. proposed such a system in combination with Clifford Electronics. The system was to provide notification, control and tracking services via the telephone or the Internet. Users could be notified via phone, e-mail, or pager of events such as a car alarm being triggered. Users could control the vehicle remote devices via phone, web, or PDA such as unlocking car doors. Additionally, users could track TelEvoke-enabled vehicles on the Internet or via the telephone. An Internet map could be viewed by the user showing the actual and prior vehicle locations. TelEvoke offered its services via a centralized fully automated Network Operations Center. To reduce the communications costs, it was proposed to use the control channel of the cellular telephone network.

There are, of course, a number of vehicles which come from the manufacturer with some form of security system already installed. In addition, a number of vehicles are also equipped with aftermarket security systems. Many conventional vehicle tracking units may not be readily installed in vehicles, particularly those vehicles already including a vehicle security system. In addition, complexity of installation may significantly increase the system costs.

SUMMARY OF THE INVENTION

In view of the foregoing background, it is therefore an object of the invention to provide a vehicle tracking unit and related methods that permit ready interface to devices in the vehicle, such as those devices which may be part of an existing vehicle security system.

This and other objects, features and advantages in accordance with the present invention are provided by a vehicle tracking system comprising a vehicle tracking unit for a vehicle of a type including an alarm indicator, and a monitoring station receiving the alarm indication alert from the vehicle tracking unit. The vehicle tracking unit may include a vehicle position determining device, a wireless communications device, and a controller connected to the wireless communications device and the vehicle position determining device. The controller may monitor signals relating to activation of the vehicle alarm indicator and send an alarm indication alert, such as with position information from the vehicle position determining device, and using the wireless communication device.

More particularly, the controller may send an alarm indication alert responsive to a continuous activation of the alarm indicator for greater than a predetermined time. Alternately, or in addition thereto, the controller may send an alarm indication alert responsive to a repetitive pattern of alarm indicator activations. In other words, the controller may be configured to distinguish between normal operation of a vehicle horn by the driver, and activation of the horn by a security system. The controller may also monitor signals of at least one of a first and second polarity. Accordingly, the tracking unit may be readily interfaced to vehicles including security systems.

In one variation, the controller monitors signals to the vehicle alarm indicator. In another variation, the controller monitors signals of voltage dips of the vehicle battery. The vehicle alarm indicator may comprise a vehicle horn, and/or a vehicle siren.

The vehicle position determining device may include a Global Positioning System (GPS) device. The wireless communications device may comprise a cellular telephone communications device, such as operating over a cellular control channel.

The monitoring station may comprise a user interface for accepting at least one command from a user and sending at least one alert to the user. For example, the user interface may include an Internet interface, and/or a telephone network interface.

Another advantageous aspect of the invention relates to compatibility of the outputs of the vehicle tracking unit. More particularly, the controller may include a dual polarity compatible output for a vehicle device, such as the vehicle alarm indicator. The controller may further monitor signals relating to activation of the vehicle alarm indicator and send an alarm indication alert with position information from the

vehicle position determining device and using the wireless communication device.

The controller may generate a first polarity output pulse followed by a second polarity output pulse on the dual polarity compatible output. The controller may also generate a repeating pattern of a first polarity output pulse followed by a second polarity output pulse on the dual polarity compatible output. In yet other embodiments, the controller may sense an actual polarity of the device and thereafter use the actual polarity for the dual polarity compatible output.

Where the vehicle device is a vehicle horn, the controller may typically be configured to generate a negative polarity output on the dual polarity compatible output. Conversely, wherein the vehicle device is a vehicle alarm indicator siren, the controller may be configured to generate a positive polarity output on the dual polarity compatible output.

One method aspect of the invention is for operating a vehicle tracking unit for a vehicle of a type comprising a vehicle alarm indicator. The vehicle tracking unit may include a vehicle position determining device, and a wireless communications device. The method preferably includes determining position information of the vehicle using the vehicle position determining device, determining an alarm condition based upon at least one of activation of the vehicle alarm indicator continuously for greater than a predetermined time and activation of the vehicle alarm indicator in a repetitive pattern, and sending an alarm indication alert from the wireless communications device responsive to determining the alarm condition.

Another method aspect also relates to operating such a vehicle tracking device. The method preferably includes using the controller to generate a dual polarity compatible output for the vehicle device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a simplified block diagrams of a vehicle tracking system in accordance with the present invention.

FIG. **2** is a more detailed block diagram of the vehicle tracking unit as shown in FIG. **1**.

FIG. **3** is more detailed block diagram of the monitoring station as shown in FIG. **1**.

FIG. **4** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a vehicle stolen alert.

FIGS. **5**A–**5**C are a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a vehicle alarm sounding alert.

FIG. **6** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a vehicle speeding alert.

FIG. **7** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating an unauthorized transmitter learned alert.

FIG. **8** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a low battery alert.

FIG. **9** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a GPS or cellular unit failure alert.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will now be described more fully hereinafter with reference to the accompanying drawings in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the illustrated embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

Referring to FIGS. **1**–**3**, the vehicle tracking system **20** in accordance with the invention is now initially described. The vehicle system **20** illustratively includes a vehicle tracking unit **25** to be mounted in the vehicle **21** and a monitoring station **30** which is remote from the vehicle and which is typically in a fixed location. In the illustrated embodiment, the vehicle tracking unit **25** interfaces with various vehicle devices, such as may include security sensors, door locks, etc. as will be appreciated by those skilled in the art.

The vehicle tracking unit **25** is also illustratively connected to a separate vehicle security system **27** as may already be installed in the vehicle **21**, from the factory or installed as an aftermarket product. Those of skill in the art will appreciate that in some embodiments of the vehicle tracking system **20** a separate vehicle security system **27** may not be needed, and/or various features thereof can be readily incorporated in the vehicle tracking unit **25**.

The monitoring station **30** may typically service a number of subscribers **31**. As shown perhaps best in FIG. **3**, the monitoring station **30** may include a user interface, such as the schematically illustrated telephone network interface **33** and the internet interface **34** which are schematically coupled to a telephone **35**, and a computer **36**, respectively. Of course in other embodiments, other interfaces may be used and only one of the illustrated interfaces may be needed. Those of skill in the art will also recognize that messages may be sent to a subscriber or user via preprogrammed voice messages, e-mail messages, facsimile messages, pager alerts, etc. In addition commands or instructions from the subscriber can also be input to the monitoring station **30** via the telephone network interface **33** and/or the internet interface **34**, from the subscribers telephone **35** or computer **36**.

The monitoring station **30** is illustrated connected to a cellular telephone tower **32** which, in turn, may communicate with the vehicle tracking unit **25** in some embodiments. Of course, in other embodiments other communications approaches are also contemplated, such as, for example, including satellite communications.

The monitoring station **30** may typically include the necessary modems, and other communications electronics, and computers for its functions which are described in greater detail below. The configuration of such components and their details will be readily apparent to those skilled in the art. Accordingly, no further discussion of these details is needed.

Referring now more specifically to FIG. **2**, additional details of the vehicle tracking unit **25** and devices at the vehicle are now further described. The vehicle tracking unit **25** illustratively includes a controller **40**, a vehicle position determining device **42**, and a wireless communications device **44** connected together. The vehicle position determining device **42** may be provided by a GPS receiver, for example. The GPS receiver typically operates by receiving multiple signals from spaced apart satellites **38** as will be appreciated by those skilled in the art.

In other embodiments, the vehicle position determining device **42** may be provided based upon communications with the cellular telephone network, or based upon other satellite transmissions, for example. As a particular example,

time of arrival techniques are available based upon multiple reception paths to determine position via the cellular telephone network as will be appreciated by those skilled in the art. The vehicle position determining device **42** also illustratively includes an indicator **43** associated therewith, such as for indicating an operating mode, or proper operation of the device as will be addressed in greater detail below.

The wireless communications device **44** may be provided by a cellular telephone transceiver configured to operate on a control channel of the cellular network. Such a control channel may provide nearly universal coverage for the tracking system **20** as will be appreciated by those skilled in the art. In addition, the control channel may offer relatively inexpensive communications between the monitoring station **30** and the vehicle tracking unit **25** as will be appreciated by those skilled in the art. The wireless communications device **44** also illustratively includes an optional status indicator **45** with a similar function as the indicator **43** for the vehicle position determining device.

The wireless communications device **44** in other embodiments, may transmit in the voiceband of the cellular network. Alternately, the wireless communications device may communicate over other networks, such as over satellite, or via wireless internet services, as will be appreciated by those skilled in the art.

The controller **40** illustratively includes a central processing unit (CPU) **50** or other logic circuitry which is connected to a clock signal generator **51** and a memory **52**. In other embodiments, the memory **52** may be an embedded memory in the CPU **50**. The controller **40** also includes schematically illustrated input/output circuitry **53** to interface with various vehicle devices. In particular the input/output circuitry **53** may provide dual polarity compatibility for one or more inputs or outputs as will described in greater detail below. One or more of the terminals of the input/output circuitry **53** may also provide both input and output functions as will also be described in greater detail below. This may significantly simplify and accelerate installation of the vehicle tracking unit **25** in the vehicle **21**.

Also illustratively shown as part of the vehicle tracking unit **25** are a back-up battery **54**, and switch **55** connected thereto for selectively powering certain of the components based upon the controller **40**. Of course, the vehicle **21** also includes an electrical system including the vehicle battery **61**. Powering of the vehicle tracking unit **25** is described in greater detail below.

The vehicle **21** also includes a number of other components that may relate to vehicle tracking, security, and/or convenience features provided by the vehicle tracking system **20**. For example, the vehicle **21** may include one or more door lock actuators **62**, an optional remote starting device **63**, a starter interrupt device **66** and an alarm indicator **67**. For example, the alarm indicator may be provided by a vehicle horn or vehicle siren, and/or flashing of the lights.

The optional separate security system **27** illustratively includes a vehicle security controller **28** and a receiver **29** connected thereto. As is conventional, the vehicle security system **27** may be switched between armed and disarmed modes, for example, by one or more uniquely coded remote transmitters **60**. The vehicle security controller **28** may also be capable of learning a new uniquely coded remote transmitter **60** as will be appreciated by those skilled in the art. The vehicle security controller **28** also illustratively is connected to the starter interrupt device **66** and the alarm indicator **67**.

For ease of explanation, a number of the features of the vehicle tracking system **20** are now described. The vehicle tracking system **20** includes a number of features that may simplify installation and maintenance. For example, as shown in FIG. **2**, the vehicle tracking unit **25** may have a test switch **71** connected to the controller **40**.

In normal operation, the controller **40** may be called upon to operate at least one vehicle device. Of course, the controller **40** also cooperates with the wireless communications device **44** and the vehicle position determining device **42** to determine and send vehicle position information to the monitoring station **30**. Moreover, the controller **40** may be switchable to a test mode for test operation of the at least one vehicle device responsive to activation of the test switch **71**.

In some embodiments, the at least one vehicle device may be a plurality of vehicle devices that are tested by operation in sequence. For example, the at least-one vehicle device may comprise at least one door lock actuator **62**. The at least one vehicle device may also comprise the starter interrupt device **66**, or the engine remote starter **63** if remote starting is an implemented feature. The at least one vehicle device which is tested, may also be the alarm indicator **67**. Accordingly, an installer, for example, can quickly check that the tracking unit has been properly installed.

To further provide for ready determination of proper operation of the vehicle tracking unit **25**, one or both of the position determining and wireless communications devices **42**, **44** may include associated indicators **43**, **45** as mentioned briefly above, and which provide an indication relating to proper operation. Each indicator **43**, **45** may indicate a mode of operation of the device, its proper operation, or a partial or complete failure of the device.

Another aspect of the invention is that the controller **40** may provide a selectable polarity for the at least one vehicle device based upon sensing thereof. Accordingly, a predetermined activation of the test switch **71** may cause the controller **40** to sense and select the proper polarity. Pressing the test switch **71** for a predetermined time or in a predetermined pattern may sense and set the polarity.

Another feature of the vehicle tracking unit **25** and vehicle tracking system **20** relates to conservation of the number of codes or messages that need to be sent to the vehicle tracking unit. In particular, the controller **40** may have a plurality of different controller states and respond differently to a same message from the monitoring station **30** at different times depending upon the controller state at a given time. Accordingly, a number of codes or messages used by the system can be conserved. Various messages are described in greater detail below.

A controller state may change based upon several different occurrences or events. For example the controller may change states in response to a change in at least one vehicle device, or based upon a message received by the wireless communications device **44** from the monitoring station **30**, and/or based upon elapsed time. The controller states, for example, may include an alert sent state based upon an alert message being sent from the wireless communications device **44**. Thereafter, receipt of a predetermined message by the wireless communications device **44** when the controller **40** is in the alert sent state may confirm receipt of the alert message by the monitoring station.

Receipt of the predetermined message by the wireless communications device **44** when the controller **40** is in another state different than the alert sent state may thus cause a different response by the controller. The alert sent state may comprise at least one of a vehicle stolen alert sent state,

a vehicle alarm sounding alert sent state, a vehicle speeding alert sent state, an unauthorized remote transmitter alert sent state, a low vehicle battery alert sent state, and a device malfunction alert sent state. The various alert messages and confirmation thereof are described in greater detail below.

The code or message conservation aspects of the vehicle tracking system **20** also permit sending a sequence of codes or messages within a predetermined time to also cause a different response at the vehicle tracking unit **25**. In other words, the plurality of controller states may comprise a received first message state based upon a first message being received by the wireless communications device **44** from the monitoring station **30**. Receipt of a second message by the wireless communications device **44** when the controller **40** is in the received first message state, such as within a predetermined time window, for example, may thus cause a different response by the controller than does receipt of the second message when the controller is in another state than the received first message state.

The plurality of controller states may comprise a vehicle finder state sounding an audible signal via the alarm indicator **67** at the vehicle **21**. In this state the controller **40** would bypass sending a vehicle alarm sounding alert to the monitoring station **30**.

Another aspect of the vehicle tracking system **20** is the provision of certain power conservation and management techniques, such as to permit extended periods where the vehicle **21** is not operation. During such extended periods, the vehicle battery **61** provides power to the vehicle tracking unit **25** as well as other vehicle devices. Accordingly, the voltage of the vehicle battery **61** drops over time. The vehicle tracking unit **25** may provide a significant drain on the vehicle battery **61** because of the power consumed by the wireless communications device **44** during transmission as will be appreciated by those skilled in the art.

The vehicle position determining device **42**, the wireless communications device **44** and the controller **40** may be considered as defining a power load of the vehicle tracking unit **25**. The controller **40** may operate the schematically illustrated power switch **55** to isolate the back-up battery **54** from the power load as a voltage of the vehicle battery **61** drops until reaching a threshold. After or below the threshold the controller **40** may cause the back-up battery **54** to selectively power only a first portion of the power load while a second portion of the power load remains powered by the vehicle battery.

For example, the wireless communications device **44** may have a higher operating voltage than the vehicle position determining device **42**. The first portion of the power load that is selectively powered despite the low vehicle battery voltage may thus be the wireless communications device **44**. In particular, the wireless communications device **44** may be powered for transmission. Accordingly, the back-up battery **54** can be saved for limited communication using the higher voltage wireless communications device **44**. This provides useful features even after an extended period during which the vehicle **21** is left unattended and the vehicle battery **61** gradually discharges.

To further conserve power, the controller **40** may reduce operation of the power load as vehicle battery voltage falls. Conversely, the controller **40** may restore operation of the power load based upon the voltage of the vehicle battery **61** rising again, such as upon being recharged.

Also relating to power consumption, the controller **40** further causes transmission of a low vehicle battery voltage alert to the monitoring station **30** based upon the voltage of the vehicle battery **61** falling below the threshold. The user or subscriber may cause the monitoring station **30** to issue a remote start command. The controller **40** may then generate a remote start output to the remote start device **63** to thereby start the engine and recharge the vehicle battery.

Another feature of the vehicle tracking system **20** is that the vehicle tracking unit **25** may be readily installed and connected to a vehicle **21**, such as in the illustrated embodiment where the vehicle includes a starter interrupt device **66** and a separate vehicle security controller **28**. More particularly, the controller **40** may switch between an armed mode and a disarmed mode based upon operation of the engine starter interrupt device **66**. The controller **40** when in the armed mode may cooperate with the wireless communications device **44** to send an alert message to the monitoring station **30** and including vehicle position information, for example, based upon the vehicle position determining device **42**. The controller **40** is also for selectively operating the engine starter interrupt device **66** to provide additional security features.

In one advantageous embodiment, the controller **40** preferably comprises a combination input and output terminal for connection to the engine starter interrupt device. This terminal is at the input/output circuitry **53** and is schematically illustrated by reference numeral **72**. The controller **40** may switch to the armed mode when in the disarmed mode and based upon the engine starter interrupt device **66** being operated to disable engine starting. Conversely, the controller **40** may switch to the disarmed mode based upon the engine starter interrupt device **66** being operated to enable engine starting. In other words, the vehicle tracking unit **25** can piggyback its arming and disarming off the existing vehicle security system **27**, for example.

The controller **40** may also selectively operate the engine starter interrupt device **66** based upon a command message from the monitoring station **30**. The controller **40** may selectively operate the engine starter interrupt device **66** based upon a command message from the monitoring station **30**. Alternately, or in addition thereto, the controller **40** may selectively operate the engine starter interrupt device **66** based upon the ignition switch **65**.

The following descriptive portions relate to various user or subscriber notifications and features provided by the vehicle tracking system **20**. Of course, the controller **40** preferably cooperates with the wireless communications device **44** to send an alert message. The monitoring station **30** may comprise a user interface, such as one or both of the telephone network or internet interfaces **33**, **34**, respectively (FIG. **3**), for generating a sequence of alert message notifications based upon receiving the alert message sent from the vehicle tracking unit **25**. More particularly, the monitoring station interface permits canceling any remaining alert message notification based upon a cancellation command response from a user or subscriber having already received the alert message notification. The user may send the cancellation response via the telephone **35** or computer **36** (FIG. **3**), for example. Thus, if the user may be reached at different telephone numbers or different users are desirably notified of the alert, this aspect of the vehicle tracking system **20** can make the notifications efficiently and without making unnecessary notifications.

The vehicle tracking system **20** may provide any of a number of very useful alerts, as discussed herein. For example, the alert message sent from the vehicle tracking unit may comprise at least one of a vehicle stolen alert message, and a vehicle alarm sounding alert message. The

alert message may be one of a vehicle speeding alert message, and a vehicle acceleration alert message. In addition, the alert message may comprise an unauthorized remote transmitter alert message. Also, the alert message may be at least one of a low vehicle battery alert message, and a device malfunction alert message.

The speeding alert may be based upon exceeding a speed threshold for greater than a certain time, which may be user selectable. The acceleration alert may also be useful as such is also indicative of aggressive driving along with the speeding alert. The unauthorized remote transmitter alert increases overall security since a user will be notified if a would-be thief learns an unauthorized transmitter to operate the controller. These alerts are described in greater detail below.

The vehicle tracking system **20** may be implemented as a service to a subscriber. In other words, the subscriber pays a monthly fee for the service. Accordingly, it may be important to encourage a user to register. Similar subscriber or registrations systems in the past have suffered revenue losses since some users would wait to activate the system until the vehicle was stolen. In other words, the user would only subscribe or register and pay a single month's fee.

In accordance with this aspect of the vehicle tracking system **20** prompt user registration is encouraged. In particular, the vehicle tracking unit **25** may include the user registration reminder indicator **56** and the controller **40** may be switchable from an unregistered mode to a registered mode. In the registered mode, the controller **40** may cooperate with the wireless communications device **44** and the vehicle position determining device **42** to determine and send vehicle position information to the monitoring station **30**. In the unregistered mode, the controller **40** may activate the user registration reminder indicator **56** to encourage registration by the user.

The controller **40** may be switchable to the registered mode based upon an activation message from the monitoring station **30**. For example, when the registration payment has been received, the monitoring station can send one or more messages to the vehicle tracking unit **25** to stop activation of the registration reminder indicator **56**. The indicator **56** may be audible, visual or both. For example, the registration reminder indicator **56** could be a beeping sound generated by a small piezoelectric transducer every ten minutes or so when the ignition **65** is on.

In other words, the user registration reminder indicator **56** may provide a minor but irritating annoyance to the user to encourage registration. Upon successfully registering, the annoyance is abated. Accordingly, a relatively straightforward approach is provided to encourage user registration.

Along these lines, the controller **40** when in the unregistered mode may have reduced features compared to the registered mode. For example, the controller **40** when in the unregistered mode may be restricted or limited in sending messages with the wireless communications device **44**. Accordingly, usage of the wireless communications network may be reduced. Transmissions from the vehicle tracking unit **25** may also be beneficially suppressed during original installation, for example.

Returning again to features of the vehicle tracking unit **25** which facilitate installation, the controller **40** may send an alarm indication alert responsive to a continuous activation of the alarm indicator **67** for greater than a predetermined time. Alternately, or in addition thereto, the controller **40** may send an alarm indication alert responsive to a repetitive pattern of alarm indicator **67** activations. In other words, the controller may be configured to distinguish between normal operation of a vehicle horn by the driver, and activation of the horn by the security system **27**. As mentioned above, the controller **40** may also monitor signals of at least one of a first and second polarity. The controller **40** thus advantageously piggybacks off the alarm indication generated by the vehicle security system **27** to determine and send a vehicle alarm sounding alert to the monitoring station **30**.

In one variation, the controller **40** may monitor signals delivered directly to the vehicle alarm indicator by the vehicle security controller **28**. In another variation, the controller **40** monitors signals of voltage dips of the vehicle battery **61**. Circuitry is conventionally and readily available for both such functions, as will be readily appreciated by those skilled in the art.

The controller **40** may also include a dual polarity compatible output in the input/output circuitry **53** for a vehicle device, such as the vehicle alarm indicator **67**. The controller **40** may further monitor signals relating to activation of the vehicle alarm indicator **67** and send an alarm indication alert with position information from the vehicle position determining device and using the wireless communication device.

For the dual polarity output compatibility, the controller **40** may generate a first polarity output pulse followed by a second polarity output pulse. The controller **40** may also generate a repeating pattern of a first polarity output pulse followed by a second polarity output pulse on the dual polarity compatible output. In yet other embodiments, the controller **40** may sense an actual polarity of the device and thereafter use the actual polarity for the dual polarity compatible output.

Where the vehicle device is a vehicle horn, the controller **40** may typically be configured to generate a negative polarity output on the dual polarity compatible output. Conversely, wherein the vehicle device is a vehicle alarm indicator siren, the controller **40** may be configured to generate a positive polarity output on the dual polarity compatible output.

Another aspect of the vehicle tracking system **20** relates to conserving memory space and/or reducing transmission time over the communications network. In accordance with this advantageous feature, the controller **40** may determine the vehicle position information including a vehicle location and an associated stationary period for each occurrence of the vehicle remaining stationary for greater than a predetermined period. In one embodiment, the controller **40** may cooperate with the wireless transmission device **44** to send the vehicle position information to the monitoring station based upon each occurrence of the vehicle remaining stationary for greater than the predetermined period. In this embodiment, the monitoring station **30** may associate a time with each occurrence of the vehicle remaining stationary for greater than the predetermined period. In other words, the monitoring station **30** may time stamp the received information.

In another embodiment, the controller **40** cooperates with the wireless transmission device **44** to send the vehicle position information to the monitoring station **30** for a plurality of occurrences of the vehicle remaining stationary for greater than the predetermined period. In this embodiment, the controller **40** may associate a time with each occurrence of the vehicle remaining stationary for greater than the predetermined period. In other words, the controller time stamps the position and stationary period information.

As an example, the predetermined time which determines whether the vehicle **21** is stationary and the position should be determined, may be less than about three minutes. This time may filter out vehicle stops in normal traffic, but which will keep track of stops where the driver likely leaves the vehicle **21**. Accordingly, only the important information necessary to track the vehicle need be stored and/or transmitted thereby reducing the system costs. If the vehicle **21** is stationary overnight, for example, unnecessary position information need not be determined, stored, and/or transmitted to the monitoring station **30**.

The controller **40** may comprise the memory **52** for storing the vehicle position information therein. In one configuration, the controller **40** downloads the vehicle position information from the memory **52** to the monitoring station **30** based upon a predetermined schedule. In another configuration, the controller **40** downloads the vehicle position information from the memory **52** to the monitoring station **30** based upon a predetermined event. In yet another configuration, the controller **40** downloads the vehicle position information from the memory **52** to the monitoring station **30** based upon a predetermined percentage of memory usage.

Having now described certain general features and advantages of the vehicle tracking system **20**, this description now turns to additional specific details which are provided as examples. In particular, vehicle tracking system **20** preferably implements one or more of the following features:

1. Detects the vehicle being stolen and transmits a signal to the monitoring station to contact up to 3 people, for example, predetermined by the user, of theft of the vehicle and then starts tracking the vehicle. The contact may be by one or more of the following: an e-mail message, a pager alert, a cellular telephone call, or other telephone call.
2. Detects an optional vehicle security or alarm system activation and transmits a signal to the monitoring station to contact up to 3 predetermined people to inform them the vehicle's alarm is being activated.
3. Detects an optional vehicle alarm system's remote PANIC activation and transmits a signal to the monitoring station to contact up to 3 predetermined people to inform them of the vehicle's PANIC being activated.
4. Detects a vehicle being programmed to operate from an unauthorized remote transmitter, key transponder, other transponder, or other device that has a unique coding, and the vehicle unit transmits a signal to the monitoring station to contact up to 3 predetermined people to inform them of this occurrence. The system can also make available information relating to a number of such coded devices, or a change therein, or when a change occurred. A message can be sent to the user or the information can be available to the user on the WEB site. The vehicle would be equipped with a security system as disclosed in U.S. Pat. No. 5,654,688, for example, which determines an unauthorized transmitter and provides an alert feature. This patent is incorporated herein in its entirety by reference.
5. Detects the vehicle traveling over a predetermined speed, such as for a predetermined time, and transmits a signal to the monitoring station to send a message, such as an e-mail informing the user (and/or others) of this occurrence. Of course, the message could also be sent via a telephone call or page, should additional urgency be required. The vehicle's predetermined maximum speed limit and duration thereof can be selected by the user.
6. Detects a low battery voltage such as for a predetermined time and transmits a signal to the monitoring station to contact up to 3 predetermined people to inform them of vehicle's low battery voltage. This is especially advantageous during winter so that the vehicle could be started, for example, to prevent a problem before it happens). The time setting is preferably selectable by the user.
7. Detects the vehicle not moving for a predetermined time and transmits a signal to the monitoring station to send, for example, a nightly e-mail informing the user of all the vehicle's location and stationary time occurrences. The stationary time length is also selectable. This may be advantageous to encourage patrolling personnel not to remain for a long time in a same location.
8. The vehicle unit preferably includes a back-up battery system making it more reliable.

The vehicle unit may be relatively inexpensive. In addition, the monitoring fee that includes sending up to 60 e-mails and making up to 6 phone calls per month, may also be relatively low. The relatively low monitoring fee is based, at least in part, on the current relatively low rates charged for use of the control channel of the cellular telephone network. It is also noted that access to the control channel provides coverage for almost the entire U.S., for example.

The user or subscriber also preferably has access to an Internet site that will display a map and silently contact the vehicle to acquire it's current location, speed, direction of travel, and previous multiple locations with speeds, for example, the user's personal identification number (PIN) can be quickly activated by a telephone call. No additional installation may be required.

Certain annual pre-pay package arrangements may be available. For example, up to 10 access entries per month can be provided on a low monthly billing. Up to 30 access entries could be provided also for a relatively low monthly fee.

The present invention provides a number of other significant advantages including optional access from any phone or from any computer to access the monitoring station internet site. The user may control various vehicle functions remotely via the telephone or the internet site. The only charge may be for additional equipment and installation.

Additional features can also be included with the system and subscribed to by the user in accordance with the invention. For example, these include Hijack, Car Finding, Unlock Doors and Unauthorized Transmitter Alert Features. The equipment and installation is relatively inexpensive. For the hijack feature: from any phone or computer, the user may activate vehicle starter interrupt and sound the horn until the vehicle is retrieved (Command 4).

For the Car Finding feature: from any phone or computer, the user may activate the vehicle's horn, or siren and sound same for 30 seconds. This allows the user to find his vehicle in a crowded parking lot (Command 5).

For the Lock/Unlock vehicle doors feature: from any phone or computer a predetermined command (Command 7) activates unlocking of vehicle doors to retrieve keys, for example, that may have been accidentally locked inside the vehicle. Of course, the system can also be used to lock vehicle doors if this was forgotten (Command 6). The unauthorized transmitter alert feature is similarly selected as described above.

In addition, a remote vehicle start feature may also be provided, such as to start the vehicle's engine to heat or cool the vehicle prior to entry. The equipment and installation for

remote starting may be relatively low. Some further details of a specific embodiment of the vehicle tracking unit **25** are provided below as relating to use of red and green LED indicators as may be coupled to the controller **40** and operated thereby. Also various representative wires, designated by color, are provided as an example embodiment.

The red LED verifies the GPS receiving signal. With a yellow wire having positive 12 volts, the red LED blinking indicates searching GPS location, constant indicates found location, and off indicates no GPS signal found. With the yellow wire not having positive 12 volts, if the red LED is off, the LED is not functioning.

The green LED verifies receiving the cell tower signal. With the yellow wire having positive 12 volts, blinking indicates the cell control channel signal is detected, constant indicates sending a micro burst signal (LED stays on 5 seconds after each transmission, and off indicates no cell tower signal received. With the yellow wire not having positive 12 volts, off indicates the green LED is not functioning.

An example of representative DIP switch feature selection is as follows. A first switch may be used for adding the orange wire for controlling arm/disarming of system. When on, the orange wire controls arm/disarm as follows: to arm, the orange wire is grounded and the yellow wire does not have 12 volts positive. To disarm, the orange wire is not grounded. When the first switch is off, then only the yellow wire controls arm/disarm as follows: to arm, the yellow wire is without 12 volts positive, and 30 seconds after continued arm mode then the orange wire activates a constant 500 ma grounded output to operate an external starter interrupt relay until the system is disarmed. To disarm, the yellow wire is connected to 12 volts positive.

A main 5-pin plug may be provided on the vehicle unit and connected as follows:

1. The Red Wire is connected to the 12 vdc power. An alert warning "E" is given if the system is armed and the battery voltage becomes lower than 11 volts for longer than ## minutes. This alert feature "E" will not operate again until the voltage is above 12 volts to re-set this feature.
2. The black wire is connected to ground.
3. The yellow wire is connected to the ignition 12 volts so that if the key is on, 12 volts is supplied thereto and if the key is off, the yellow wire is connected to ground. Further: if the system is in an armed mode and the Lat/Long changes, then Alert "A" is given. If the system is disarmed and within 2.5 seconds after the yellow wire receives 12 volts and the gray wire detects 3 or more positive pulses the system activates Alert "D". If the first DIP switch is in the off position then: if 12 volts is on yellow wire, the system is disarmed and the orange wire discontinues from the 500 ma ground, and if the yellow wire sees ground or neutral, then the system is armed and 30 seconds after the continued arm mode the orange wire activates a constant 500 ma grounded output to operate an external starter interrupt relay until the system is disarmed
4. The gray wire is for input and output, and can be connected to an alarm siren or horn positive terminal. In addition:
   a. With the system armed and if the gray wire detects +12 v pulsing on/off or on constant for more than 10 seconds from an alarm siren or horn honking activation, then alert warning "B" alarm activation is given.
   b. With system disarmed and if the gray wire detects +12 v pulsing on/off or on constant for more than 10 seconds from an alarm siren or horn honking activation, then alert warning "C" panic activation is given.
   c. With system disarmed and if the Gray wire detects 3 or more 12 volt positive pulses within 2.5 seconds of yellow wire receiving 12 v+ and the gray wire by-pass not being activated, then alert warning "D" is given.
   d. The gray wire bypass operates as follows:
      i. After alert warning "B" bypass all future alert "B" signals until system is disarmed.
      ii. After alert warning "C" bypass all future Alert "C" signals until system is armed.
      iii. After alert warning "D" bypass all future alert "D" signals until no 12 volt pulses are detected on the gray wire within 3 seconds of the yellow wire having 12 volts.
   e. With the system armed or disarmed. The Output: Internal +12 v, 1 amp transistor with pulses 1 second on and 1 seconds off to activate siren or honk car horn or flashing light relay.
      i. Non-stop activation from (Command "4")
      ii. 30-second activation from (Command "5")
   f. Turn off the above alert "A" from (Command "1").
5. The orange wire is for the starter interrupt and arm/disarm system, and operates as follows:
   a. If first DIP switch is in the:
      i. On position and: the orange wire has 12 volts or neutral, the system switches to the disarmed mode; the orange wire is grounded, then the system is switched to the armed mode; and the starter interrupt output will not automatically operate. It can only be activated from "Command #4"
      ii. Off position and the orange wire does not effect the arming or disarming of the system; 30 seconds after system arms the orange wire will automatically activate constant 500 ma ground until the system is disarmed. And from "command #4". Connect to Starter interrupt relay output.
   b. Command 4 activates Orange wire to have 500 ma. negative until Command 1 is received.
   c. After Alert warning "B" is activated the first time it is thereafter bypassed while the orange wire remains grounded. Alert warning "B" is re-set to operate again 3 seconds after orange wire becomes ungrounded.

The vehicle unit may also include a Door Lock Plug configured as follows, for example. A green wire provides a 250 ma, negative 1 second pulse for Lock Doors. (Command "6"). A red wire provides a constant 12 v output from the red power wire. A blue wire provides a 250 ma., negative 1 second pulse for Unlock Doors (Command "7"). A pink wire provides a 250 ma., negative 1 second pulse for remote Car Starter (Command "2").

An installation test button may also be provided to work as follows. Pressing the button activates the orange wire for 10-seconds (starter interrupt), with these circuits in sequence. First, it activates the gray wire for 1-second (siren/horn). After the first stops, it activates the green wire for 1 second to lock the doors. After the second stops, it activates the blue wire for 1 second to unlock the doors. After the third stops, it activates the pink wire for 1 second to activate an optional item.

Representative warning alerts are as follows:

1. Alert Warning "A" (FIG. **4**): Automatic activation of "Command 8" and the vehicle unit contacts monitoring

station to instantly call 3 phone numbers with the message "Your Vehicle is stolen please confirm then call 911 to advise police of web site and your pin # so police can locate the vehicle". This is detected with the system armed and the GPS indicating movement. Bypasses all future alert warning "A" signals until the system is re-armed.

2. Alert Warning "B" (FIGS. 5A-5C): the vehicle unit contacts the monitoring station to instantly call 3 phone numbers with the following message "Vehicle alarm activated please confirm". This is with the system armed and detecting gray wire having 12 volts pulsing or on constant for longer than 10-seconds. After alert warning "B" is activated the first time, it is thereafter bypassed while the orange wire remains grounded. Alert warning "B" is re-set to operate again 3 seconds after orange wire becomes ungrounded.
3. Alert Warning "C" (FIG. 6): the vehicle unit contacts the monitoring station to instantly send e-mail message "vehicle was traveling faster than your preset amount of "###" and time limit of "##" seconds. Indicates the vehicle speed and location that the speeding started and how long speeding accrued" (Detected from GPS). This aspect is further understood with reference to the enclosed flowchart **84** of FIG. **6**.
4. Alert Warning "D" (FIG. 7): the vehicle unit contacts the monitoring station to instantly call 3 phone numbers with the message "Unauthorized remote transmitter was just programmed to operate your vehicle." This is with the system disarmed and the Gray wire detecting three or more 12 volt pulses within 2.5 seconds of the yellow wire having seen 12 volts positive. All future alerts "D" are bypassed until no 12 volt pulses are detected on the gray wire within 3 seconds of the yellow wire seeing 12 volts. This aspect is further understood with reference to the enclosed flowchart **85** of FIG. **7**.
5. Alert Warning "E" (FIG. **8**): the vehicle unit contacts the monitoring station to instantly call 3 phone numbers with the message "Vehicle has low battery voltage and system has changed to low voltage mode". This is with the system armed and detecting the Red wire with lower than 11 volts for ## minutes. All future alerts "E" are bypassed until, first, more than 13.5 volts are detected on the red wire and, second, after the yellow wire stops having positive voltage the red wire then must detect more than 12 volts.

The following are representative commands for use in the system:

Command 1: Reset all circuits and system remains asleep until the ignition key is turned on. Resets the triggered mode and unit is asleep to prevent power drain on vehicle battery.

Command 2: (Accessory activation) monitoring station Command to the system to activate Pink wire to pulse 250 ma negative for 1 second.

Command 3: (Vehicle Location) Web site to indicate present location and past events in memory.

Command 4: (Hijack or Stolen) monitoring station Command to vehicle system to activate:

a. Gray wire to pulse 1 sec on/1 sec off with 1 amp positive output and which continues until receive command #1.

b. Orange wire to have 500 ma ground and which continues until receive command #1.

Command 5: (Car Find) monitoring station Command to system activating Gray wire for 30 seconds pulsing 1 sec on/1 sec off with 1 amp positive output.

Command 6: (Lock Doors) monitoring station Command to system activating Green wire to pulse 1 second with 250 ma. negative.

Command 7: (Unlock Doors) monitoring station Command to system to activate Blue wire to pulse 1 second with 250 ma. negative.

Command 8: (Start Constant Vehicle Tracking) sends previous 2 events in memory and then every 120 seconds get update of location information sent to the Web site.

The system is also operable in a battery saver mode which operates as follows:

1. With the ignition key off, if the battery voltage drops below 11.5 volts for more than 5 seconds, the GPS verification wakes up to look:
   a. Once instantly.
   b. Once in 1 hour if at the same location.
   c. Once in 6 hours if at the same location.
   d. Once in 12 hours if at the same location.
   e. Once every 24 hours if at the same location.
   f. Activate alert "E" when the battery saver mode is activated, and bypass sending all future Alert "E" until the battery voltage goes above 13 volts for 10 minutes to reset this feature.

Another aspect of the invention relates to automatic vehicle alert e-mails sent containing some or all of the previous system events. This sending can be triggered as follows:

a) At a user selected predetermined time ## (01-24) of each day, or

b) At a predetermined memory fill level, such as full or near full.

In addition, each system event may contains one or more of the following:

a) Vehicle Location

b) Vehicle total time at location

c) Time of day

d) Mph traveling

e) Total time traveling above MPH

f) Direction traveling

g) Delta

h) Special Alert messages, if any, including:

i) GPS signal not received for longer than 5 minutes.

ii) Traveling above ###MPH for ## minutes.

iii) Vehicle is stolen.

iv) Alarm activated.

v) Unauthorized remote transmitter alert.

vi) Battery saver mode activated

vii) Command 1: Reset all circuits and system remains asleep until the ignition key is turned on.

viii) Command 2: (Accessory activation)

ix) Command 3: (Vehicle Location was retrieved)

x) Command 4: (Hijack or Stolen mode activated)

xi) Command 5: (Car Find mode activated)

xii) Command 6: (Locked Doors)

xiii) Command 7: (Unlocked Doors)

xiv) Command 8: (Started 2-second incremental Vehicle Tracking)

Another feature of the invention relates to the selectable threshold conditions causing an event to be recorded into the memory of the vehicle unit. For example, this may include: while the yellow wire has 12 volts, record events every "?" default 15 minutes time if the GPS location has changed. If the GPS location is the same then only update stationary total time. If the GPS antenna is not receiving any signal

then enter last known GPS location and with an indication that this was the last known GPS location before the GPS signal stopped, how long no GPS signal was received, and the GPS location in the on-bold file, when the vehicle is traveling above ### MPH for ##-minutes.

The monitoring station may also provide a number of automated phone calls as described above. These may include:

1. The user's vehicle has issued a stolen alert:
   a. If vehicle is stolen, after receiving the phone message the user then calls 911 to advise police of the theft, and gives the police the Web site address and an identification number, such as the user's PIN, to allow the police to locate where your vehicle has been, where it is now and keep tracking it until the police can retrieve the vehicle.
   b. If this is a false alert due to vehicle being towed away for service, for example, then the user may press "1" to put the vehicle in an off mode. Once the ignition key is turned on again the system will reset back to its normal operation mode.
2. The user's vehicle has issued an alarm activated for more than 10 seconds alert. The system will not respond to this alert again until ignition key is turned on again to reset this feature.
3. The vehicle battery voltage is low or has been disconnected. The tracking system is in low voltage mode. The system will not respond to this-alert again until the battery voltage goes above 13 volts for 10 minutes to reset this feature.

The backup battery may be sized according to the GPS receiver and processing power draw. In addition, the battery may also be sized based upon estimated micro burst transmitting power draw. Such transmission are typically at about 3 watts power to the antenna.

The system according to the invention including the vehicle unit and monitoring station provides a number of significant advantages and features. For example, the police may be directly contacted by the user when the vehicle is stolen. The user receives the telephone message from the monitoring station, and this is done without requiring the intervention of a manual security monitoring operator, such as an ADT operator, for example. In addition, once in the stolen mode, the vehicle unit will periodically continue to send out its location, so that the police may track the vehicle via the WEB, for example. This location sending feature may begin immediately, that is, without requiring the user to contact the vehicle to begin tracking. Having the vehicle contacting the monitoring station is considerably less expensive than other schemes where the vehicle is periodically polled via the cellular network, for example.

The system may also be interfaced to a breath alcohol sensor at the vehicle, for example, and this information recorded in memory. The information could be passed along to the monitoring station, which, in turn, could send out a notification message (e-mail or telephone) that the vehicle is being operated by a driver who may be impaired by alcohol. The vehicle's location could then be tracked to permit the police to detain the driver.

Another aspect of the unit is that it may be able to recognize the desirability to bypass certain security breach triggers or other events. For example, a car finding feature can be provided that will allow the user to sound the horn or siren when near the vehicle to help locate the vehicle, as in a crowded parking area. Without the bypass feature, the unit could recognize the horn or siren as a security breach and transmit such information to the monitoring center. In accordance with this aspect of the invention, the unit would recognize the car finding feature was activated and thereby bypass sending a security breach transmission, for example. Again, false alarms and unneeded usage and expense of the communications infrastructure would be avoided.

Yet another aspect of the invention relates to thwarting a would-be thief who attempts to disable the alarm by cutting the battery cable or power supplied to the system. The unit preferably includes a back-up battery. More particularly, upon being in an armed mode and sensing a breach of security, such as the hood opening, for example, the unit will send out a signal indicating the alarm or security breach and while the alarm is indicated, if the battery is disconnected then the unit will send out a message indicating the vehicle is stolen, and also providing the vehicle's current position. Accordingly, the would-be thief is not able to defeat the security system by quickly disrupting power to the unit during an alarm indication or security breach. Also, to prevent additional alerts, this message is prevented from being transmitting again until the user returns to the vehicle to disarm the system and/or turn on the ignition so that the unit sees a voltage above 13 volts, indicating the vehicle has started using the owner's ignition key. This aspect is further understood with reference to the enclosed flowchart **80** (FIG. **4**).

Still another aspect of the invention relates to how the unit can discriminate between ordinary usage or honking of the horn as compared to a security system triggered alarm. Most vehicle security systems will provide a pattern of horn soundings as an alarm indication, and this can be determined and used to reduce false alarm transmissions from the unit. For example, the unit can look at the number of leading and trailing edges of the power pulse used to sound the horn. A single pressing of the horn switch by the user will cause two edges within a predetermined time, such as about 10 to 12 seconds. Accordingly, the unit can be configured to not send a security breach transmission to the control center based upon detecting two transitions. Since a number of vehicle security systems may have a continuous sounding of the horn within the predetermined time, the unit can send the transmission upon detecting only a single transition.

A number of other vehicle security systems provide a series of pulses or horn soundings within the predetermined time. Accordingly, the unit may also be configured to send a security breach transmission upon detecting greater than a predetermined number of transitions, such as greater than nine, for example. This number is also typically higher than a user would generate honking the horn several times within the predetermined time. In other terms, the number of transitions of the horn pulses can be counted, and if equal to one, or greater than nine, for example, the transmission is triggered, and otherwise the sounding of the horn is ignored. Also, to prevent additional alerts, this message is prevented from being transmitted again until the user returns to the vehicle to disarm the system and/or turn on the ignition so that the unit sees a voltage above 13 volts, indicating the vehicle has started using the owner's ignition key.

This aspect is further understood with reference to the enclosed flowcharts **81**-**83** (FIGS. **8**A-8C).

Yet another feature of the invention relates to a low vehicle battery alert. For example, the unit may monitor the battery voltage over a predetermined time such as ten minutes. The ten minute window prevents false tripping, for example, when the voltage dips during engine cranking. In particular, the voltage can be sensed and it can be determined whether it is greater than zero (e.g. greater than six volts) and less than a high value (e.g. eleven or twelve volts),

and, if so, a low battery voltage transmission can be communicated to the monitoring station, and ultimately to the vehicle user when away from the vehicle. If the vehicle is being serviced and the battery is disconnected, this will cause the battery voltage to be equal to zero. Then, the low battery voltage transmission will not be communicated to the monitoring station. Also, to prevent additional alerts, this message is prevented from being transmitted again until the user returns to the vehicle to disarm the system and/or turn on the ignition so that the unit sees a voltage above 13 volts, indicating the vehicle has started using the owner's ignition key. Again, false triggerings are reduced. This aspect is further understood with reference to the enclosed flowchart **86** (FIG. **8**).

Yet another advantageous feature of some embodiments of the invention relates to the ability to conserve electrical power. More particularly, when the vehicle is stopped and in the armed mode, the GPS receiver may be periodically operated to determine the vehicle position. If the vehicle position changes, this is indicative that the vehicle is being moved or stolen. For example, the GPS receiver may be operated to generate new vehicle position information every 29 seconds. These relatively quick successive position determinations or readings are generally termed hot start. These are relatively less complicated than a cold start position determination which takes longer, since the cold start position determination requires greater time to acquire and receive data from multiple satellites, as will be appreciated by those skilled in the art.

Unfortunately, this relatively high repeated usage of the GPS receiver may cause unnecessary battery drain, especially when the vehicle is left armed and unattended by the user for an extended period. Accordingly, the power conserving feature of the invention permits the GPS receiver to be turned off when the vehicle is in the armed mode, and the GPS receiver is turned on only when needed. For example, a vehicle sensor, such as a shock sensor, motion sensor, ignition sensor, door sensor, or other sensor, or combinations thereof could be used to start the GPS receiver. This sensor could also be used to trigger an alarm if desired; however it need not be so used in all embodiments. The GPS receiver, once turned on, could operate in the normal periodic fashion as described above, or for a fixed period of time. The GPS receiver could also be turned off again after some predetermined time if no further sensor signal is received, or if the position fails to change on subsequent position readings or determinations.

Yet another feature relates to permitting one colorful audible alert messages to be generated for the user. The user can, in some embodiments, access an internet site to type or enter the text for a message to be sent, such as to alert the user that his vehicle is being stolen. The audible message then communicated by a telephone call to the user is generated by a speech message synthesizer based upon the entered text. In accordance with this aspect of the invention, the user could type in phonetically spelled words or phrases, such as to create more colorful messages including slang terms, various accents, and/or to mimic various dialects, for example. The speech synthesizer would then generate the desired message customized for the user. Of course, the system could also permit the user to test or preview the pronunciation generated by the speech message synthesizer based on the entered text message prior to its adoption.

Another aspect relates to requesting GPS position information from a vehicle. If a command is sent downstream to the vehicle requesting that GPS information in turn be sent upstream from the vehicle, and the GPS information is not received within a predetermined time, such as about four minutes, then another command may be sent to the vehicle requesting the GPS information. This may keep repeating until GPS information is received, for a predetermined number of tries, or until a user instructs stopping of the requests. This helps to ensure and confirm the activation and reception of GPS tracking coordinates from the vehicle.

Yet another aspect relates to reducing a frequency with which GPS information is sent from the vehicle. More particularly, the unit may be configured to activate GPS information transmission upstream every 2 minutes. To reduce system usage expense and power consumption at the vehicle, this rate of transmission of GPS information could be progressively decreased over time. For example, in one embodiment, upon activation the GPS location signals could be sent every 2 minutes during the first hour, then once an hour for the next 23 hours, after which only one signal would be sent per day.

Turning now to the flowchart **87** of FIG. **9**, still another aspect relates to warning the user of an inoperable or malfunctioning GPS or cellular telephone section. More particularly, if the GPS or cellular telephone antenna wire is cut or the mounting position of either is changed causing the antenna to stop receiving the signal the user would not ordinarily know of this problem quickly. In accordance with one embodiment, if the ignition is turned on a predetermined number of times, such as about three, and each time ignition turns on if no GPS or no cell signal is received for a minimum time, such as about 15 to 30 minutes or longer, an audible warning beeper may be activated in the vehicle. This beeper may be sounded once ever 15-minutes. At anytime if the GPS or cell signal is received properly then the system re-sets automatically stopping the beeper sound.

As an example, if the ignition key is turned on and no GPS or no Cell signal is being received for 15-minutes, and the vehicle ignition stays on for 45-minutes and there is still no GPS or no cell signal, the unit counts one. Thereafter, if the ignition key is turned on and no GPS or no cell signal is being received for 15-minutes, and the vehicle ignition stays on for 60-minutes and there is still no GPS or no cell signal, a second count is determined. Thereafter, if the ignition is turned on and no GPS or no cell signal is received for 10-minutes, and the vehicle ignition stays on for only 10-minutes and there is still no GPS or no cell signal, no count is determined. Thereafter, if the ignition is turned on and no GPS or no cell signal is being received for 15-minutes, a third count is determined and the beeper is activated as described above. This beeping may continue every 15-minutes while the vehicle ignition stays on as long as the vehicle ignition stays on for 16-minutes and still no GPS or no Cell signal is being received. If thereafter, the ignition is turned on and no GPS or no cell signal is being received, the beeper beeps once and again beeps once every 15-minutes while vehicle ignition stays on. If in 10-minutes both GPS or cell signal is being received, the beeper system is turned off and the warning count is reset.

By way of example, if the ignition key is turned on and no GPS or no cell signal is being received for only 5, 10 or 12 minutes (with the threshold set at 15 minutes), then no count is determined.

In certain circumstances, the GPS signal may fail, but the cell signal may still be working. Accordingly, it may be desirable to send an indication of the failure of the GPS signal to the central monitoring station to thereby alert the user as described above. If the cell signal also failed, or if the cell signal failed by itself, in other embodiments a separate paging device would transmit the failure or loss of the cell

signal information to the central monitoring station, to thereby alert the user.

Yet another feature is directed to efficient use of a relatively small number of codes available to communicate with the tracking unit from the cellular network and central station. More particularly, a typical arrangement may provide eight basic codes and two "wildcard" codes. The two wildcard codes are reserved for future or other uses. A particular tracking device will respond directly to any of the eight basic codes. For example, the doors could be locked or unlocked, a present location downloaded from the vehicle, etc.

In accordance with this feature, the tracking device may respond differently to the same code or command depending upon the state or condition of the tracking device. For example, if an alarm is triggered at the vehicle, it may be desired that the tracking device continue to send the alarm signal until confirmation is received that the central monitoring station has received the alarm signal. This confirmation can be sent using the same code as may provide another function if the device were not indicating an alarm. Any of a number of such tracking device conditions may trigger a different message to be interpreted from the received code. For example, if any of the above Alerts A–E were triggered, the receipt of a predetermined code, such as code eight, would confirm receipt of the alert by the central station, and this receipt of code eight would not cause the other response (no alarm triggered) in the tracking device. Of course this concept can be extended to other features as will be appreciated by those skilled in the art.

In accordance with another feature, the rate of sending the location or position data (or change in position data) from the vehicle may be varied to reduce system usage and thereby reduce expenses. More particularly, in one embodiment, the rate of sending may be based upon how long the vehicle has remained stationary. This time period may be selected by the user. For example, the selected time may be in the range of 15 minutes to six hours. If the vehicle has been stationary for the selected time period, then the rate of transmission may be reduced. This reduces or eliminates the need to send home position data and send all the over 15-minute stops made that day. Otherwise, that is when the vehicle is moving, the device may send data at a faster rate. Of course, a system user would not likely be interested in quick updates, especially where the position information is not changing. Conversely, if the vehicle is being moved, it may be desirable to receive more frequent position updates.

Another variation of this transmission rate conservation feature, bases the rate of transmission on the vehicle position. For example, a reduced rate of transmission may be selected if the vehicle is in a predetermined area where the user has a lesser interest in quickly updated position information. The user may also have a reduced interest in an area that can be defined outside of a predetermined distance from a reference point.

Yet another variation of the vehicle position transmission rate conservation feature is based upon the vehicle's speed, such as the vehicle's average or maximum speed, for example. Accordingly, if the vehicle is traveling above a preset speed, the rate of transmission may be increased.

In accordance with another aspect of the invention, the tracking device may send the alert indication a predetermined number of times without receiving an acknowledgment as described above, and then wait until the vehicle position has changed before trying again or the cell re-registers or its RSS (received signal strength) changes. Thus, power is conserved. When the vehicle has moved to a new position, any obstructions may no longer be present thereby increasing the likelihood of a successful communication. In addition, the change in position may be determined when the vehicle is sensed to be moving about a predetermined relatively small speed, such as greater than 1 mph, for example.

In all of the embodiments and variations described herein, the tracking device may communicate with one or more other vehicle devices via a vehicle data communications bus. Further aspects of interfacing with a vehicle data communications bus are described in U.S. Pat. Nos. 5,719,551 and 6,011,460 assigned to the assignee of the present invention.

Yet another aspect relates to efficient use of available codes on the cellular telephone control channel. In one particular example, ten codes may be available to be transmitted from the monitoring station to the vehicle trackers. The first eight or nine codes are command codes that will cause a specific action by the tracking device at the vehicle. The other one or two codes may be wildcard codes as mentioned above, that may set a stand-by mode for one or a group of vehicles, for example.

It may be desirable to provide more than eight commands at the vehicle responsive to the corresponding eight available codes. For example, it may be desirable to set a feature on or off, or to set a different feature setting or threshold. In accordance with this aspect of the invention, the commands at the tracker are determined based upon a series of different command codes being received within a predetermined time window.

For example, the monitoring station may send code 9 that switches the tracker in the car into a stand-by mode for a predetermined time and which causes the tracker to respond with an upstream confirmation code 7 or 9 indicating receiving code 9. During the predetermined time of the stand-by mode another code follows that causes a system programmable feature or setting to change. Note that the second code would otherwise cause a different function at the vehicle. Note that system might operate a function 9 if another code 1–9 is not received in the predetermined time. The following list is exemplary for features resulting from second codes 1–9:

(1) Code 1—Tracker will turn off feature of upstream code caused by vehicle alert being detected.

(2) Code 2—Tracker will turn on feature of upstream code caused by vehicle alert being detected.

(3) Code 3—Tracker deactivates cell receiver from operating due to a non-paying customer for monitoring service. That phone number can then be allocated to another customer.

(4) Code 4—Turn on audio buzzer feature that will sound once each 10 minutes. The monitoring station need only send the command to activate the feature, as the tracker will time the period and drive the buzzer thereafter. The monitoring station will normally not need to send this command because the tracker will be configured out of the box with this feature activated to sound the buzzer every 10 minutes until the next command is received.

(5) Code 5—Turn off the audio buzzer. This is to be sent by the monitoring station after a user has successfully activated his account.

(6) Code 6—Turn on the 80 mph speed limit reporting. This will normally not be sent as this feature will be the default setting of the tracker.

(7) Code 7—Turn off the 80 mph speed limit reporting.

(8) Code 8—Increase speed limit 5 mph and increase the time 5 minutes.

(9) Code 9—Decrease speed limit 5 mph and decrease the time 5 minutes, and wait 5 minutes if another code number follows. It could operate this way to allow another set of codes to change more features.

In this example, in response to the tracker receiving the system code 1–9, the tracker sends an upstream code 7 to acknowledge receipt of the system code 1–9. Upon receipt of code 9 the tracker waits up to 5 minutes to determine if another system code is received. If no code is received, then the tracker performs the code 9 operation. Of course, in other embodiments other features or settings can be selected.

In general, it may be preferred that the first code sent in a series of two codes; for example, be a code that causes only a minor function to be performed at the vehicle. This so because if the second code is sent from the monitoring station, but not received at the tracker, only a minor function is performed. For example, the first code may switch between armed and disarmed modes. This is in contrast to using a remote engine starting code or engine shutdown code as the first code. The vehicle may be moving or positioned in a marginal reception area, and the second command may not be received by the tracker within the predetermined time window. As will be appreciated by those skilled in the art, this concept of multiple digit codes, can be extended beyond two digits to three or more.

To further conserve cellular transmissions and as described above, the tracker may be set to record a position based upon a determined event. Only this recorded position information may be downloaded either by user request or at set times. It is desired that such events be relatively few, but that the information still be helpful to the user.

For example, an event for recording of position may be determined based upon the vehicle being stopped for greater than a first time and less than a second time. For example, the first time may be 15 minutes and the second time may be 6 hours. Determination of the vehicle being stopped can be made based upon one or both of the GPS position or the vehicle ignition being turned off. The second time prevents the recording of position information when the vehicle is stopped at the owner's home during the evening, for example. Accordingly, the important information of the vehicle stops being made is recorded and made available to the user, while system communications resources are conserved.

In another example, if the mode is selected to send the vehicles location every 10 min and the vehicle is in the same location for greater than a set time, then no more vehicle locations are sent until the vehicle location has changed to start the every 10 min reporting again.

Other features relating to vehicle control systems are disclosed in copending patent applications entitled VEHICLE TRACKER INCLUDING STATIONARY TIME DETERMINATION AND ASSOCIATED METHODS, application Ser. No. 09/859,727; VEHICLE TRACKER CONSERVING CODES AND RELATED METHODS, application Ser. No. 09/859,673; VEHICLE TRACKER WITH POWER SAVING FEATURES AND RELATED METHODS, application Ser. No. 09/859,728; VEHICLE TRACKER COOPERATING WITH A STARTER INTERRUPT AND RELATED METHODS, application Ser. No. 09/859,973; VEHICLE TRACKER WITH USER NOTIFICATIONS AND ASSOCIATED METHODS, application Ser. No. 09/859,733; VEHICLE TRACKER WITH USER REGISTRATION REMINDER AND RELATED METHODS, application Ser. No. 09/859,971; and VEHICLE TRACKER WITH TEST FEATURES AND RELATED METHODS, application Ser. No. 09/859,729, the entire disclosures of which are incorporated herein by reference.

Many modifications and other embodiments of the invention will come to the mind of one skilled in the art having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Accordingly, it is understood that the invention is not to be limited to the embodiments disclosed, and that other modifications and embodiments are intended to be included within the spirit and scope of the appended claims.

That which is claimed is:

1. A vehicle tracking system comprising:

a vehicle tracking unit for a vehicle of a type comprising a vehicle alarm indicator, said vehicle tracking unit comprising

a vehicle position determining device,

a wireless communications device, and

a controller connected to said wireless communications device and said vehicle position determining device;

said controller cooperating with said wireless communications device to send an alarm indication alert based upon at least one of an activation of the vehicle alarm indicator continuously for greater than a predetermined time and an activation of the vehicle alarm indicator in a repetitive pattern; and

a monitoring station receiving the alarm indication alert from said vehicle tracking unit.

2. A vehicle tracking system according to claim 1 wherein said controller also cooperates with said vehicle position determining device and said wireless communications device to send vehicle position messages.

3. A vehicle tracking system according to claim 1 wherein said controller monitors drive signals to the vehicle alarm indicator.

4. A vehicle tracking system according to claim 3 wherein the drive signals have at least one of a first and second polarity.

5. A vehicle tracking system according to claim 1 wherein the vehicle alarm indicator comprises at least one of a vehicle horn, and a vehicle siren.

6. A vehicle tracking system according to claim 1 wherein said vehicle position determining device comprises a Global Positioning System (GPS) device.

7. A vehicle tracking system according to claim 1 wherein said wireless communications device comprises a cellular telephone communications device.

8. A vehicle tracking system according to claim 7 wherein said cellular telephone communications device communicates over a cellular control channel.

9. A vehicle tracking system according to claim 1 wherein said monitoring station comprises a user interface for accepting at least one command from a user and sending at least one alert to the user.

10. A vehicle tracking system according to claim 9 wherein said user interface comprises an Internet interface.

11. A vehicle tracking system according to claim 9 wherein said user interface comprises a telephone network interface.

12. A vehicle tracking unit for use with a vehicle comprising a vehicle alarm indicator, the vehicle tracking unit comprising:

a vehicle position determining device;

a wireless communications device; and

a controller connected to said wireless communications device and said vehicle position determining device;

said controller cooperating with said wireless communications device to send an alarm indication alert responsive to an activation of the vehicle alarm indicator continuously for greater than a predetermined time.

13. A vehicle tracking unit according to claim 12 wherein said controller further sends an alarm indication alert responsive to activation of the vehicle alarm indicator in a repetitive pattern.

14. A vehicle tracking unit according to claim 12 wherein said controller monitors drive signals to the vehicle alarm indicator.

15. A vehicle tracking unit according to claim 14 wherein the drive signals have at least one of a first and second polarity.

16. A vehicle tracking unit according to claim 12 wherein the vehicle alarm indicator comprises at least one of a vehicle horn, and a vehicle siren.

17. A vehicle tracking unit according to claim 12 wherein said vehicle position determining device comprises a Global Positioning System (GPS) device.

18. A vehicle tracking unit according to claim 12 wherein said wireless communications device comprises a cellular telephone communications device.

19. A vehicle tracking unit according to claim 18 wherein said cellular telephone communications device communicates over a cellular control channel.

20. A vehicle tracking unit for use with a vehicle comprising a vehicle alarm indicator, the vehicle tracking unit comprising:

a vehicle position determining device;

a wireless communications device; and

a controller connected to said wireless communications device and said vehicle position determining device;

said controller cooperating with said wireless communications device to send an alarm indication alert responsive to an activation of the vehicle alarm indicator in a repetitive pattern.

21. A vehicle tracking unit according to claim 20 wherein said controller monitors drive signals to the vehicle alarm indicator.

22. A vehicle tracking unit according to claim 21 wherein the drive signals have at least one of a first and second polarity.

23. A vehicle tracking unit according to claim 20 wherein the vehicle alarm indicator comprises at least a vehicle horn, and a vehicle siren.

24. A vehicle tracking unit according to claim 20 wherein said vehicle position determining device comprises a Global Positioning System (GPS) device.

25. A vehicle tracking unit according to claim 20 wherein said wireless communications device comprises a cellular telephone communications device.

26. A vehicle tracking unit according to claim 25 wherein said cellular telephone communications device communicates over a cellular control channel.

27. A vehicle tracking system comprising:

a vehicle tracking unit for a vehicle of a type comprising a vehicle device, said vehicle tracking unit comprising:

a vehicle position determining device,

a wireless communications device, and

a controller connected to said wireless communications device and said vehicle position determining device for sending messages relating to vehicle position;

said controller comprising a dual polarity compatible output for the vehicle device; and

a monitoring station communicating with said vehicle tracking unit.

28. A vehicle tracking system according to claim 27 wherein the vehicle device comprises a vehicle alarm indicator; and wherein said controller further monitors signals relating to activation of the vehicle alarm indicator and sends an alarm indication alert with position information from said vehicle position determining device and using said wireless communication device.

29. A vehicle tracking system according to claim 27 wherein said controller generates a first polarity output pulse followed by a second polarity output pulse on said dual polarity compatible output.

30. A vehicle tracking system according to claim 27 wherein said controller generates a repeating pattern of a first polarity output pulse followed by a second polarity output pulse on said dual polarity compatible output.

31. A vehicle tracking system according to claim 27 wherein said controller senses an actual polarity of the device and uses the actual polarity for the dual polarity compatible output.

32. A vehicle tracking system according to claim 27 wherein the vehicle device comprises a vehicle horn; and wherein said controller generates a negative polarity output on said dual polarity compatible output.

33. A vehicle tracking system according to claim 27 wherein the vehicle device comprises a vehicle alarm indicator siren; and wherein said controller generates a positive polarity output on said dual polarity compatible output.

34. A vehicle tracking system according to claim 27 wherein said vehicle position determining device comprises a Global Positioning System (GPS) device.

35. A vehicle tracking system according to claim 27 wherein said wireless communications device comprises a cellular telephone communications device.

36. A vehicle tracking system according to claim 35 wherein said cellular telephone communications device communicates over a cellular control channel.

37. A vehicle tracking system according to claim 27 wherein said monitoring station comprises a user interface for accepting at least one command from a user and sending at least one alert to the user.

38. A vehicle tracking system according to claim 37 wherein said user interface comprises an Internet interface.

39. A vehicle tracking system according to claim 27 wherein said user interface comprises a telephone network interface.

40. A vehicle tracking unit for a vehicle of a type comprising a vehicle device, the vehicle tracking unit comprising:

a vehicle position determining device;

a wireless communications device; and

a controller connected to said wireless communications device and said vehicle position determining device for sending messages relating to vehicle position;

said controller comprising a dual polarity compatible output for the vehicle device.

41. A vehicle tracking unit according to claim 40 wherein the vehicle device comprises a vehicle alarm indicator; and wherein said controller further monitors signals relating to activation of the vehicle alarm indicator and sends an alarm indication alert with position information from said vehicle position determining device and using said wireless communication device.

42. A vehicle tracking unit according to claim 40 wherein said controller generates a first polarity output pulse followed by a second polarity output pulse on said dual polarity compatible output.

43. A vehicle tracking unit according to claim 40 wherein said controller generates a repeating pattern of a first polarity output pulse followed by a second polarity output pulse on said dual polarity compatible output.

44. A vehicle tracking unit according to claim 40 wherein said controller senses an actual polarity of the device and uses the actual polarity for the dual polarity compatible output.

45. A vehicle tracking unit according to claim 40 wherein the vehicle device comprises a vehicle horn; and wherein said controller generates a negative polarity output on said dual polarity compatible output.

46. A vehicle tracking unit according to claim 40 wherein the vehicle device comprises a vehicle alarm indicator siren; and wherein said controller generates a positive polarity output on said dual polarity compatible output.

47. A method for operating a vehicle tracking-unit for a vehicle of a type comprising a vehicle device, the vehicle tracking unit comprising a vehicle position determining device, a wireless communications device, and a controller connected to the wireless communications device and the vehicle position determining device, the method comprising:

using the controller to generate a dual polarity compatible output for the vehicle device.

48. A method according to claim 47 wherein the vehicle device comprises a vehicle alarm indicator; and wherein using the controller comprises using the controller to monitor signals relating to an activation of the vehicle alarm indicator and to send an alarm indication alert with position information from the vehicle position determining device and using the wireless communication device.

49. A method according to claim 47 wherein using the controller comprises using the controller to generate a first polarity output pulse followed by a second polarity output pulse as the dual polarity compatible output.

50. A method according to claim 47 wherein using the controller comprises using the controller to generate a repeating pattern of a first polarity output pulse followed by a second polarity output pulse as the dual polarity compatible output.

51. A method according to claim 47 wherein using the controller comprises using the controller to sense an actual polarity of the device and to use the actual polarity as the dual polarity compatible output.

52. A method according to claim 47 wherein the vehicle device comprises a vehicle horn; and wherein using the controller comprises using the controller to generate a negative polarity output as the dual polarity compatible output.

53. A method according to claim 47 wherein the vehicle device comprises a vehicle alarm indicator siren; and wherein using the controller comprises using the controller to generate a positive polarity output as the dual polarity compatible output.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,606,561 B2
DATED : August 12, 2003
INVENTOR(S) : Kenneth E. Flick

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,
Item [56], **References Cited**, OTHER PUBLICATIONS, insert -- * -- between "2002" and "This"

Column 3,
Line 37, delete "diagrams" insert -- diagram --
Line 41, insert -- a -- between "is" and "more"

Column 4,
Line 41, delete "illustrated" insert -- illustratively --

Column 5,
Line 35, insert -- be -- between "will" and "described"

Column 7,
Line 28, insert -- in -- between "not" and "operation"
Line 43, delete "61." insert -- 61 --

Column 16,
Line 34, delete "contains" insert -- contain --

Column 17,
Line 28, delete "this-alert" insert -- this alert --
Line 34, delete "transmission" insert -- transmissions --

Column 18,
Line 20, delete "transmitting" insert -- transmitted --
Line 58, delete "This aspect is further understood with reference to the enclosed flowcharts **81-83**(FIGS. 5A-5C)." insert at the end of line 57 -- This aspect is further understood with reference to the enclosed flowcharts **81-83**(FIGS. 5A-5C). --

Column 19,
Line 35, delete "ore" insert -- more --

Column 20,
Line 31, delete "ever" insert -- every --

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,606,561 B2
DATED : August 12, 2003
INVENTOR(S) : Kenneth E. Flick

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

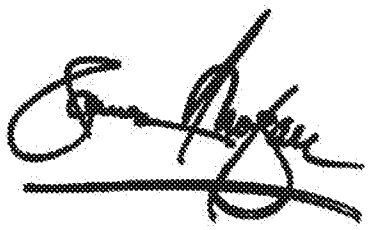
Column 24,
Line 12, insert -- and a vehicle battery -- after "indicator"
Line 23, insert -- said controller monitoring voltage dips of the vehicle battery; and -- after "and"
Line 58, insert -- and a vehicle battery -- after "indicator"
Line 67, delete "time." insert -- time, and for monitoring voltage dips of the vehicle battery. --

Column 25,
Line 24, insert -- and a vehicle battery -- after "indicator"
Line 33, delete "pattern." insert -- pattern, and for monitoring voltage dips the vehicle battery. --
Line 42, insert -- one of -- between "least" and "a"
Line 55, delete ";"
Line 57, delete "and"

Column 27,
Line 13, delete "tracking-unit" insert -- tracking unit --

Signed and Sealed this

Twenty-third Day of December, 2003



JAMES E. ROGAN
Director of the United States Patent and Trademark Office

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,606,561 B2 Page 1 of 2
DATED : August 12, 2003
INVENTOR(S) : Kenneth E. Flick

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,
Item [56], **References Cited**, OTHER PUBLICATIONS, insert -- * -- between "2002" and "This"

Column 3,
Line 37, delete "diagrams" insert -- diagram --
Line 41, insert -- a -- between "is" and "more"

Column 4,
Line 41, delete "illustrated" insert -- illustratively --

Column 5,
Line 35, insert -- be -- between "will" and "described"

Column 7,
Line 28, insert -- in -- between "not" and "operation"
Line 43, delete "61." insert -- 61 --

Column 16,
Line 34, delete "contains" insert -- contain --

Column 17,
Line 28, delete "this-alert" insert -- this alert --
Line 34, delete "transmission" insert -- transmissions --

Column 18,
Line 20, delete "transmitting" insert -- transmitted --
Line 58, delete "This aspect is further understood with reference to the enclosed flowcharts **81-83**(FIGS. 5A-5C)." insert at the end of line 57 -- This aspect is further understood with reference to the enclosed flowcharts **81-83**(FIGS. 5A-5C). --

Column 19,
Line 35, delete "ore" insert -- more --

Column 20,
Line 31, delete "ever" insert -- every --

Column 21,
Line 64, delete "hen" and insert -- then --.

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,606,561 B2
DATED : August 12, 2003
INVENTOR(S) : Kenneth E. Flick

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 24,
Line 12, insert -- and a vehicle battery -- after "indicator"
Line 23, insert -- said controller monitoring voltage dips of the vehicle battery; and -- after "and"
Line 58, insert -- and a vehicle battery -- after "indicator"
Line 67, delete "time." insert -- time, and for monitoring voltage dips of the vehicle battery. --

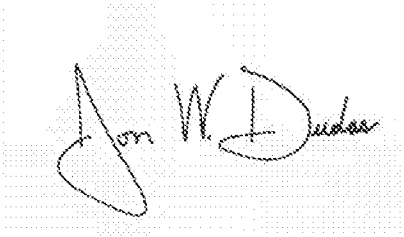
Column 25,
Line 24, insert -- and a vehicle battery -- after "indicator"
Line 33, delete "pattern." insert -- pattern, and for monitoring voltage dips of the vehicle battery. --
Line 42, insert -- one of -- between "least" and "a"
Line 55, delete ":"
Line 57, delete "and"

Column 27,
Line 13, delete "tracking-unit" insert -- tracking unit --

This certificate supersedes Certificate of Correction issued December 23, 2003.

Signed and Sealed this

Thirteenth Day of July, 2004



JON W. DUDAS
Acting Director of the United States Patent and Trademark Office

US007149623B2

(12) **United States Patent**
Flick

(10) **Patent No.: US 7,149,623 B2**
(45) **Date of Patent: Dec. 12, 2006**

(54) **VEHICLE TRACKER INCLUDING INPUT/OUTPUT FEATURES AND RELATED METHODS**

(75) Inventor: **Kenneth E. Flick**, Douglasville, GA (US)

(73) Assignee: **Omega Patents, L.L.C.**, Douglasville, GA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 277 days.

(21) Appl. No.: **10/383,496**

(22) Filed: **Mar. 7, 2003**

(65) **Prior Publication Data**

US 2003/0154027 A1 Aug. 14, 2003

Related U.S. Application Data

(63) Continuation of application No. 09/859,972, filed on May 17, 2001, now Pat. No. 6,606,561.

(60) Provisional application No. 60/264,811, filed on Jan. 29, 2001, provisional application No. 60/258,005, filed on Dec. 22, 2000, provisional application No. 60/251,552, filed on Dec. 6, 2000, provisional application No. 60/252,125, filed on Nov. 20, 2000, provisional application No. 60/246,463, filed on Nov. 7, 2000, provisional application No. 60/236,890, filed on Sep. 29, 2000, provisional application No. 60/222,777, filed on Aug. 3, 2000, provisional application No. 60/205,178, filed on May 17, 2000.

(51) **Int. Cl.**
G01C 21/26 (2006.01)

(52) **U.S. Cl.** **701/207**; 340/506; 340/531; 340/500; 340/515

(58) **Field of Classification Search** 701/213, 701/36, 211, 200, 207; 340/853.2, 901, 988, 340/989, 991, 992, 993, 425.5, 506, 531, 340/500, 515
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,868,497	A *	2/1975	Victor	701/121
3,875,379	A *	4/1975	Victor	701/121
4,591,823	A *	5/1986	Horvat	340/396
4,754,255	A *	6/1988	Sanders et al.	307/10.4
4,884,055	A *	11/1989	Memmola	340/426.28
5,043,736	A	8/1991	Darnell et al.	342/357
5,055,851	A	10/1991	Sheffer	342/457
5,081,667	A *	1/1992	Drori et al.	455/404.1
5,177,490	A	1/1993	Ando et al.	342/357

(Continued)

OTHER PUBLICATIONS

P Kronborg, "Highway Helpers"—Field trials with traffic inside Stockholm, Proc. of 6th world congress on intelligent journal, 1999 (from DialogEclassic Web(tm) file 63, acc. No. 00819154).*

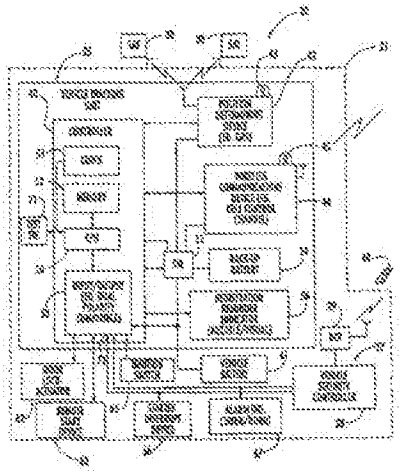
(Continued)

Primary Examiner—Cuong Nguyen
(74) *Attorney, Agent, or Firm*—Allen, Dyer, Doppelt, Milbrath & Gilchrist, P.A.

(57) **ABSTRACT**

A tracking system includes a vehicle tracking unit for a vehicle of a type including an alarm indicator, and a monitoring station receiving the alarm indication alert from the vehicle tracking unit. The vehicle tracking unit may include a vehicle position determining device, a wireless communications device, and a controller connected to the wireless communications device and the vehicle position determining device. The controller may cooperate with the wireless communications device to send an alarm indication alert responsive to at least one of activation of the vehicle alarm indicator continuously for greater than a predetermined time and activation of the vehicle alarm indicator in a repetitive pattern. The controller may also include a dual polarity compatible output for a vehicle device, such as the vehicle alarm indicator.

34 Claims, 10 Drawing Sheets



U.S. PATENT DOCUMENTS

5,195,126	A *	3/1993	Carrier et al.	379/45
5,223,844	A *	6/1993	Mansell et al.	342/357.07
5,347,564	A *	9/1993	Zicker	379/40
5,262,774	A	11/1993	Kuwahara et al.	340/988
5,334,986	A	8/1994	Fernhout	342/357
5,365,450	A	11/1994	Schuchman	364/449
5,513,244	A *	4/1996	Joao et al.	455/404.1
5,515,043	A	5/1996	Berard et al.	340/988
5,559,491	A *	9/1996	Stadler	340/426.25
5,559,529	A *	9/1996	Barzegar et al.	342/357.1
5,673,305	A *	9/1997	Ross	455/517
5,677,666	A *	10/1997	Stallbohm	340/426.27
5,740,047	A *	4/1998	Pilley et al.	701/120
5,777,580	A	7/1998	Janky et al.	342/457
5,857,986	A *	1/1999	Moriyasu	601/49
5,939,975	A	8/1999	Tsuria et al.	307/10.5
5,944,768	A	8/1999	Ito	340/999
5,969,433	A *	10/1999	Maggiora et al.	307/10.5
5,983,161	A *	11/1999	Lemelson et al.	701/301
6,018,657	A	1/2000	Kennedy, III et al.	455/426
6,025,774	A	2/2000	Forbes	340/426
6,049,269	A	4/2000	Byrd et al.	340/426
6,055,426	A	4/2000	Beasley	455/432
6,069,570	A	5/2000	Herring	340/825.49
6,075,458	A	6/2000	Ladner et al.	340/825.49
6,087,942	A *	7/2000	Sleichter et al.	340/576
6,133,855	A	10/2000	Kim	340/932.2
6,148,212	A	11/2000	Park et al.	455/456
6,151,551	A	11/2000	Geier et al.	701/207
6,154,648	A	11/2000	Comer	455/426
6,166,626	A	12/2000	Janky et al.	340/426
6,169,497	B1	1/2001	Robert	340/988
6,195,597	B1	2/2001	Yamada	701/1
6,240,365	B1	5/2001	Bunn	340/988
6,275,773	B1	8/2001	Lemelson et al.	340/436
6,320,535	B1	11/2001	Hillman et al.	342/357
6,330,499	B1	12/2001	Chou et al.	701/32
6,507,786	B1 *	1/2003	Flick	701/213
6,509,833	B1 *	1/2003	Tate	340/539.1
6,509,868	B1 *	1/2003	Flick	342/357.07
6,512,465	B1 *	1/2003	Flick	340/989
6,522,267	B1 *	2/2003	Flick	340/989
6,542,077	B1 *	4/2003	Joao	340/426.16
6,581,961	B1 *	6/2003	Bowers	280/735
6,611,229	B1 *	8/2003	Muramatsu et al.	342/357.07
6,661,340	B1 *	12/2003	Saylor et al.	340/517
6,703,946	B1 *	3/2004	Flick	340/989
6,744,370	B1 *	6/2004	Sleichter et al.	340/576

OTHER PUBLICATIONS

Unknown author, 2003 Chevy Express and GMC Savana build for work new full-major strong, smart and surprising features, General Motors—Press Release, Mar. 6, 2002 (from DialogClassic Web(tm) file 81, acc. No. 184143).*

Z. Juda, In-vehicle networking for intelligent vehicle, ISATA 2000—Body Structures/Chassis Engineering, Sep. 25, 2000 (from DialogClassic Web(tm) file 81, acc. No. 163956).*

SK Gehrig et al., System architecture for an intersection assistant fusing in GPS information, IEEE Intelligent Vehicles Symp., 2003 (from DialogClassic Web(tm) file 95, acc. No. 01839210).*

Omega Research and Development, Inc., Installation Instructions for ATV-1000 Model Car Alarm, 2002. This product has been sold in the U.S. for approximately five years.

* cited by examiner

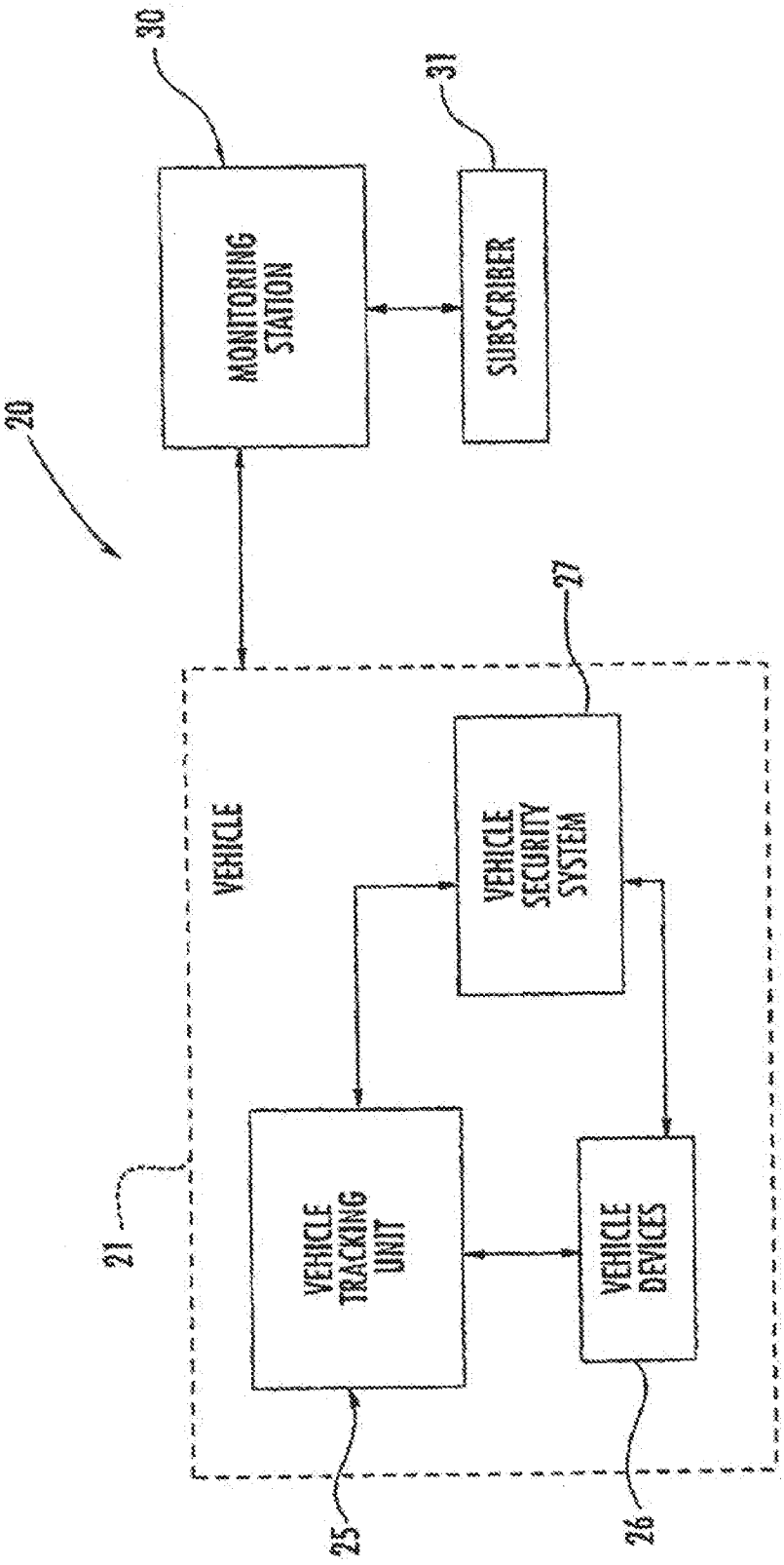

30
31
MONITORING STATION
SUBSCRIBER
20
27
VEHICLE
VEHICLE SECURITY SYSTEM
21
VEHICLE TRACKING UNIT
VEHICLE DEVICES
25
26

FIG. 1.

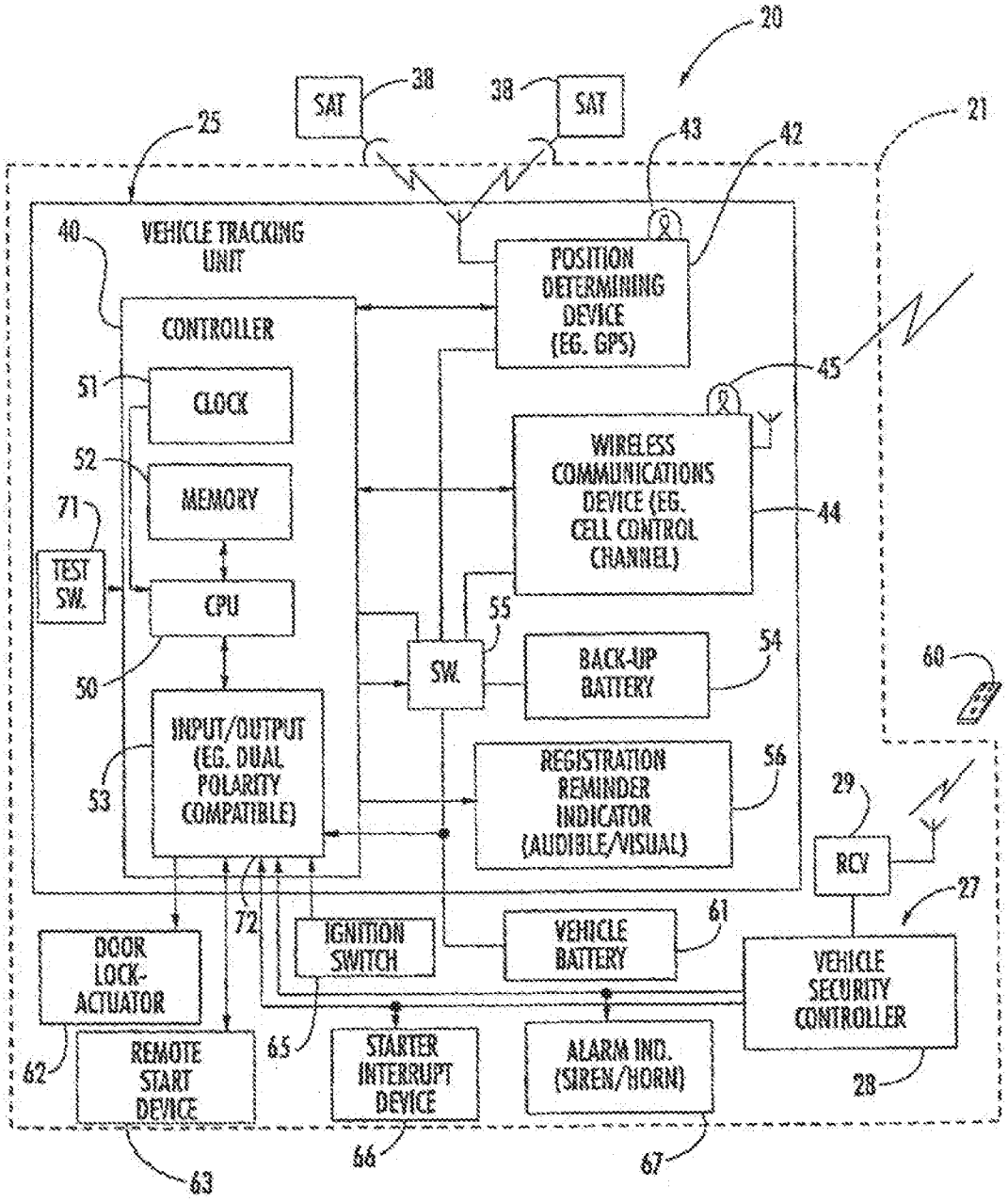

20
SAT
38
38
SAT
25
43
42
21
40
VEHICLE TRACKING UNIT
POSITION DETERMINING DEVICE (EG. GPS)
CONTROLLER
45
51
CLOCK
WIRELESS COMMUNICATIONS DEVICE (EG. CELL CONTROL CHANNEL)
52
MEMORY
44
71
TEST SW.
CPU
55
60
50
SW.
BACK-UP BATTERY
54
INPUT/OUTPUT (EG. DUAL POLARITY COMPATIBLE)
53
REGISTRATION REMINDER INDICATOR (AUDIBLE/VISUAL)
56
29
RCV
27
72
IGNITION SWITCH
VEHICLE BATTERY
61
DOOR LOCK-ACTUATOR
VEHICLE SECURITY CONTROLLER
62
REMOTE START DEVICE
65
STARTER INTERRUPT DEVICE
ALARM IND. (SIREN/HORN)
28
63
66
67

FIG. 2.

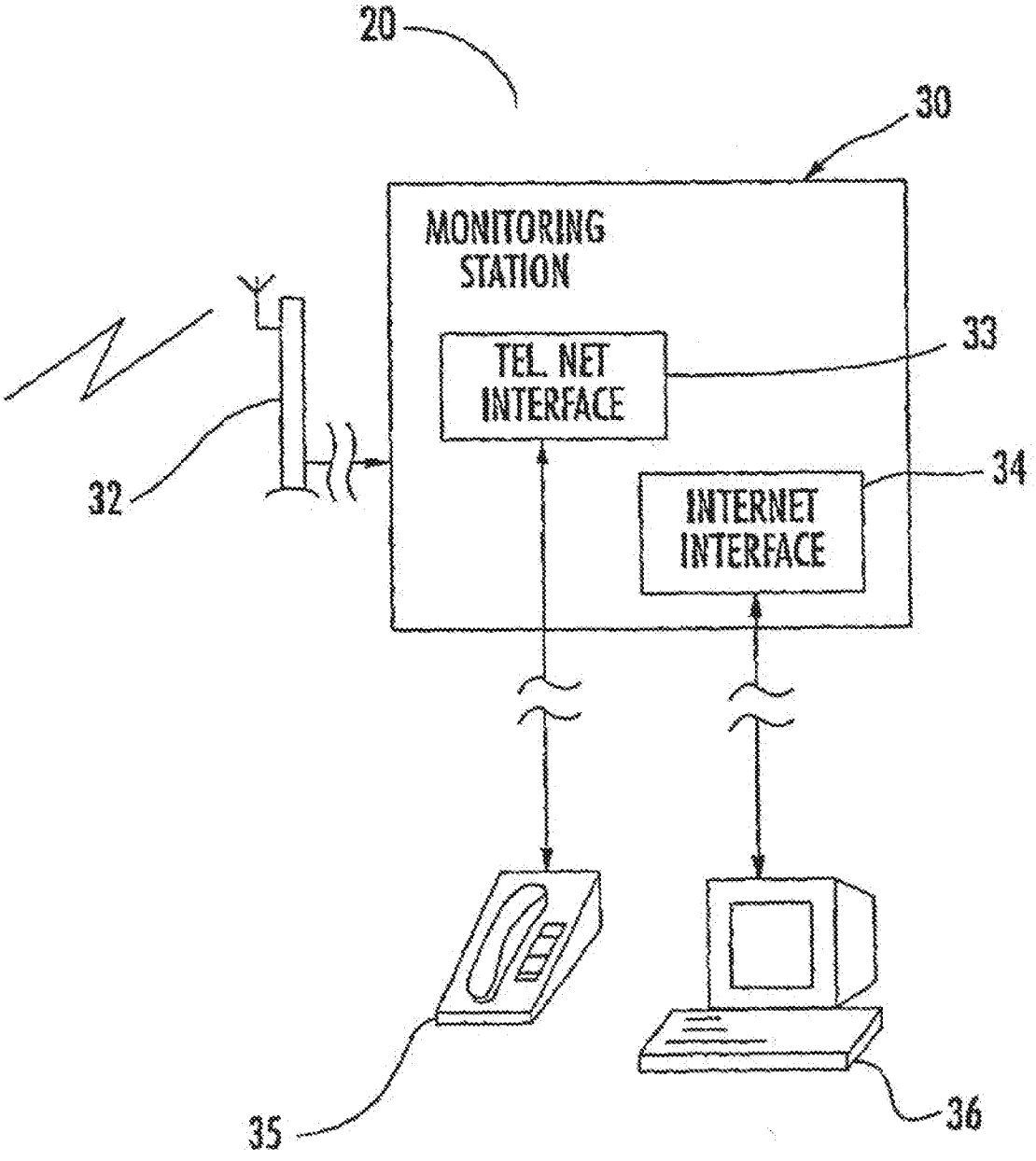

20
30
MONITORING STATION
TEL. NET INTERFACE
33
INTERNET INTERFACE
34
32
35
36

FIG. 3.

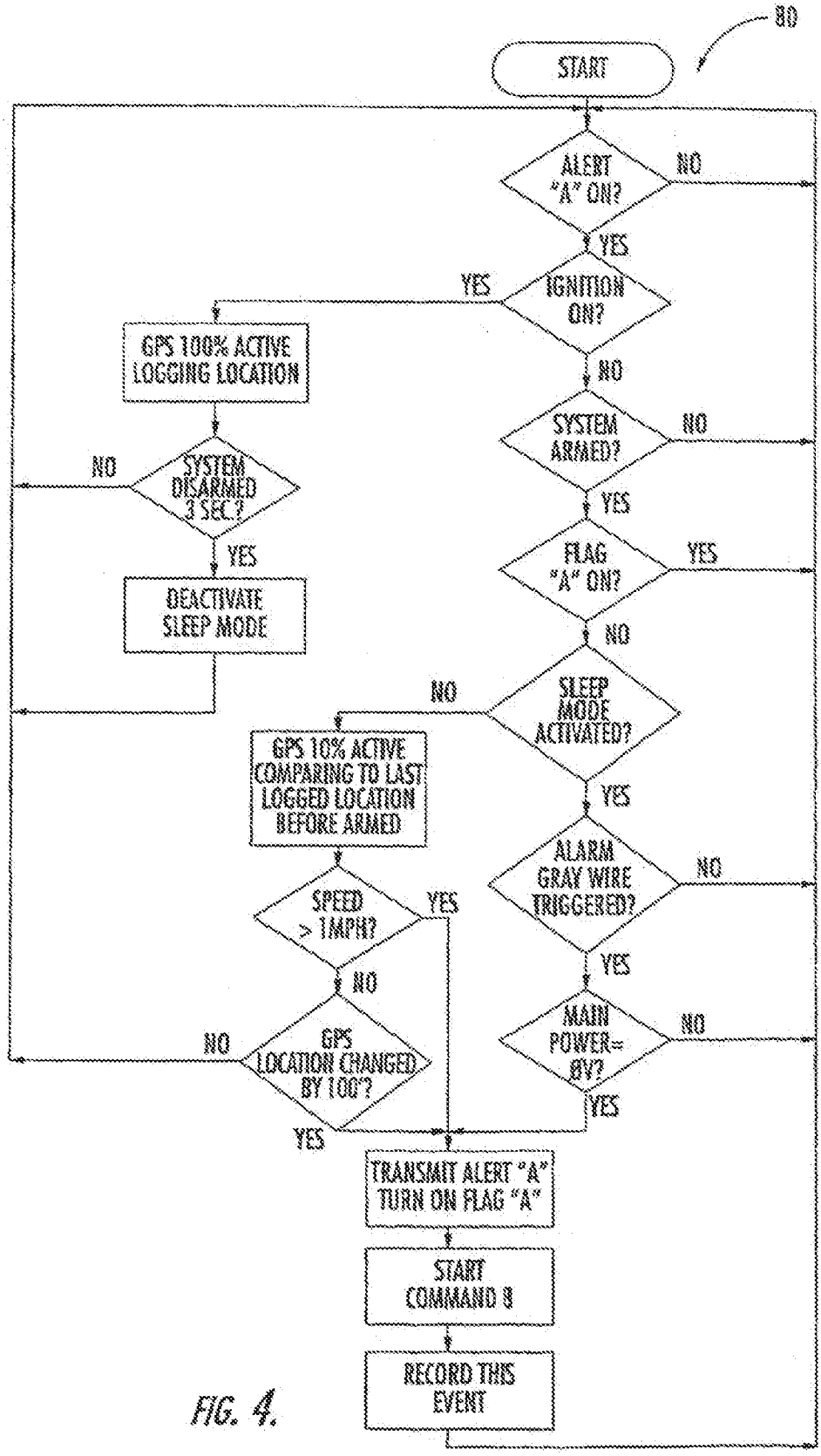

80
START
ALERT "A" ON?
NO
YES
IGNITION ON?
YES
NO
GPS 100% ACTIVE LOGGING LOCATION
SYSTEM ARMED?
NO
YES
NO
SYSTEM DISARMED 3 SEC.?
YES
FLAG "A" ON?
YES
NO
DEACTIVATE SLEEP MODE
NO
SLEEP MODE ACTIVATED?
GPS 10% ACTIVE COMPARING TO LAST LOGGED LOCATION BEFORE ARMED
YES
ALARM GRAY WIRE TRIGGERED?
NO
YES
SPEED > 1MPH?
YES
NO
MAIN POWER= 0V?
NO
YES
NO
GPS LOCATION CHANGED BY 100'?
YES
TRANSMIT ALERT "A" TURN ON FLAG "A"
START COMMAND 8
RECORD THIS EVENT

FIG. 4.

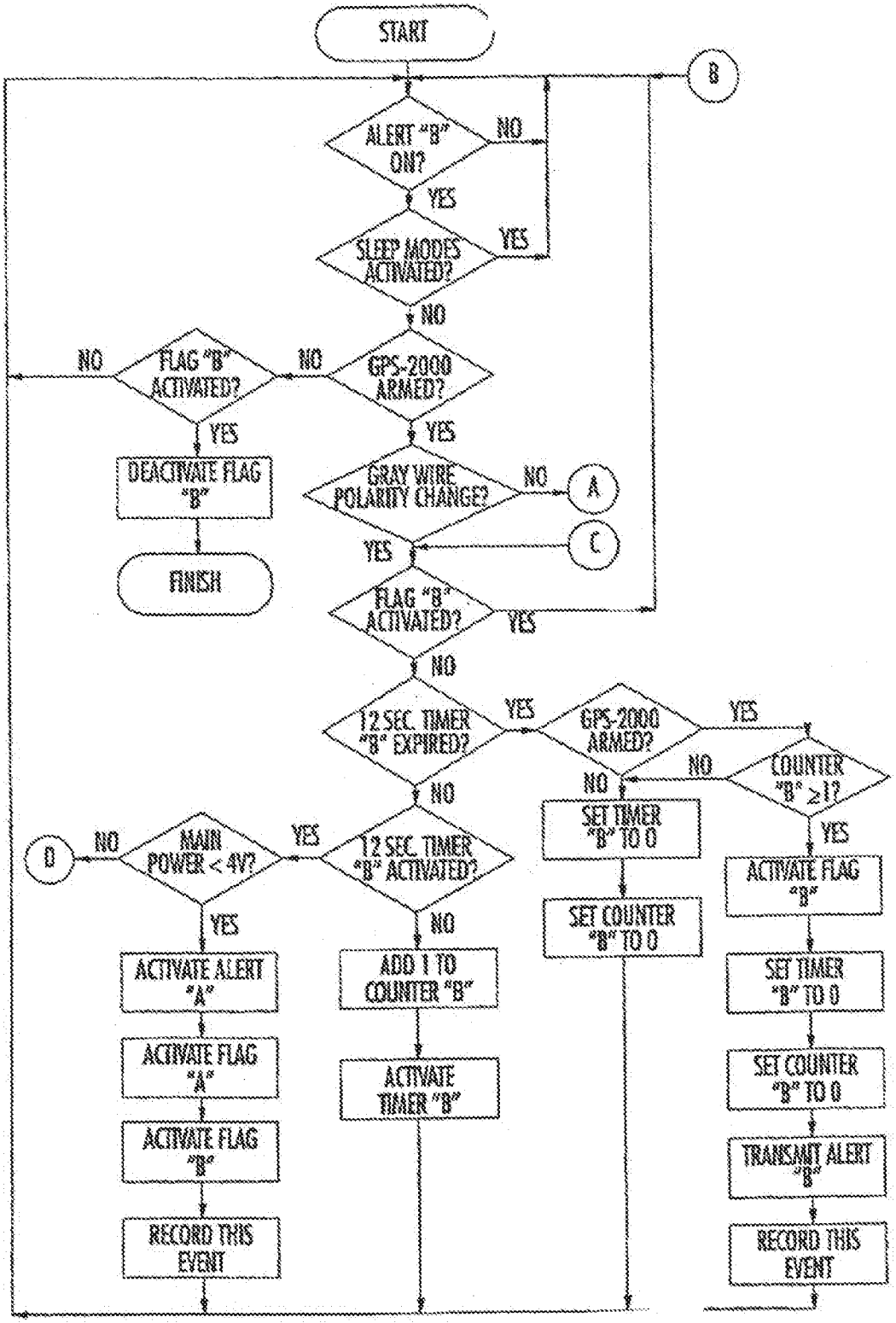

START
B
ALERT "B" ON?
NO
YES
SLEEP MODES ACTIVATED?
YES
NO
FLAG "B" ACTIVATED?
NO
GPS-2000 ARMED?
NO
YES
YES
DEACTIVATE FLAG "B"
GRAY WIRE POLARITY CHANGE?
NO
A
C
YES
FINISH
FLAG "B" ACTIVATED?
YES
NO
12 SEC. TIMER "B" EXPIRED?
YES
GPS-2000 ARMED?
YES
NO
NO
COUNTER "B" ≥1?
NO
YES
SET TIMER "B" TO 0
ACTIVATE FLAG "B"
D
NO
MAIN POWER < 4V?
YES
12 SEC. TIMER "B" ACTIVATED?
YES
NO
SET COUNTER "B" TO 0
SET TIMER "B" TO 0
ACTIVATE ALERT "A"
ADD 1 TO COUNTER "B"
SET COUNTER "B" TO 0
ACTIVATE FLAG "A"
ACTIVATE TIMER "B"
TRANSMIT ALERT "B"
ACTIVATE FLAG "B"
RECORD THIS EVENT
RECORD THIS EVENT

FIG. 5A.

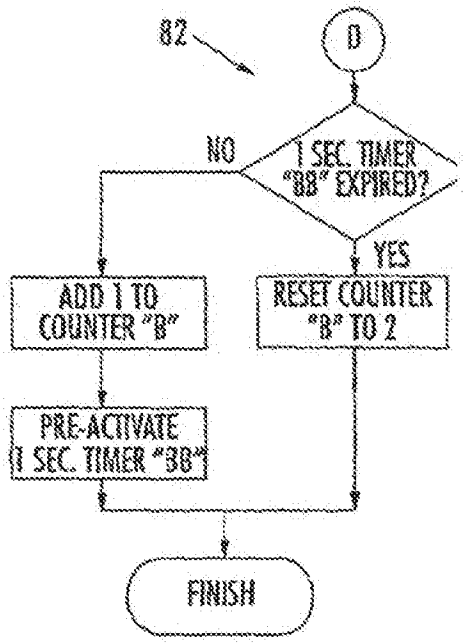

82
D
1 SEC. TIMER "8B" EXPIRED?
NO
YES
ADD 1 TO COUNTER "B"
RESET COUNTER "B" TO 2
PRE-ACTIVATE 1 SEC. TIMER "3B"
FINISH

FIG. 5B.

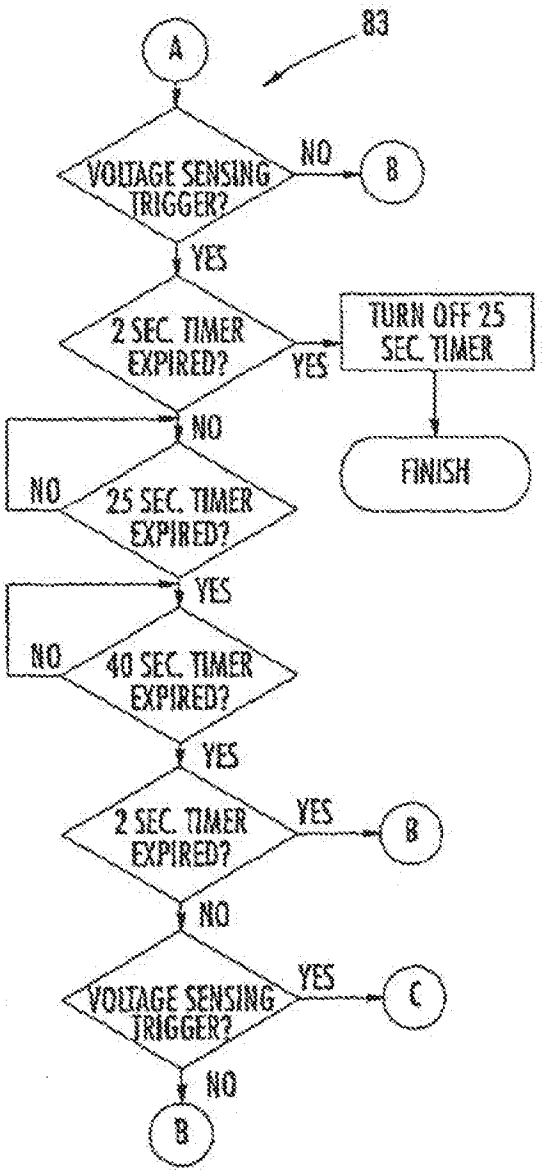

83
A
VOLTAGE SENSING TRIGGER?
NO
B
YES
2 SEC. TIMER EXPIRED?
YES
TURN OFF 25 SEC. TIMER
FINISH
NO
NO
25 SEC. TIMER EXPIRED?
YES
NO
40 SEC. TIMER EXPIRED?
YES
2 SEC. TIMER EXPIRED?
YES
B
NO
VOLTAGE SENSING TRIGGER?
YES
C
NO
B

FIG. 5C.

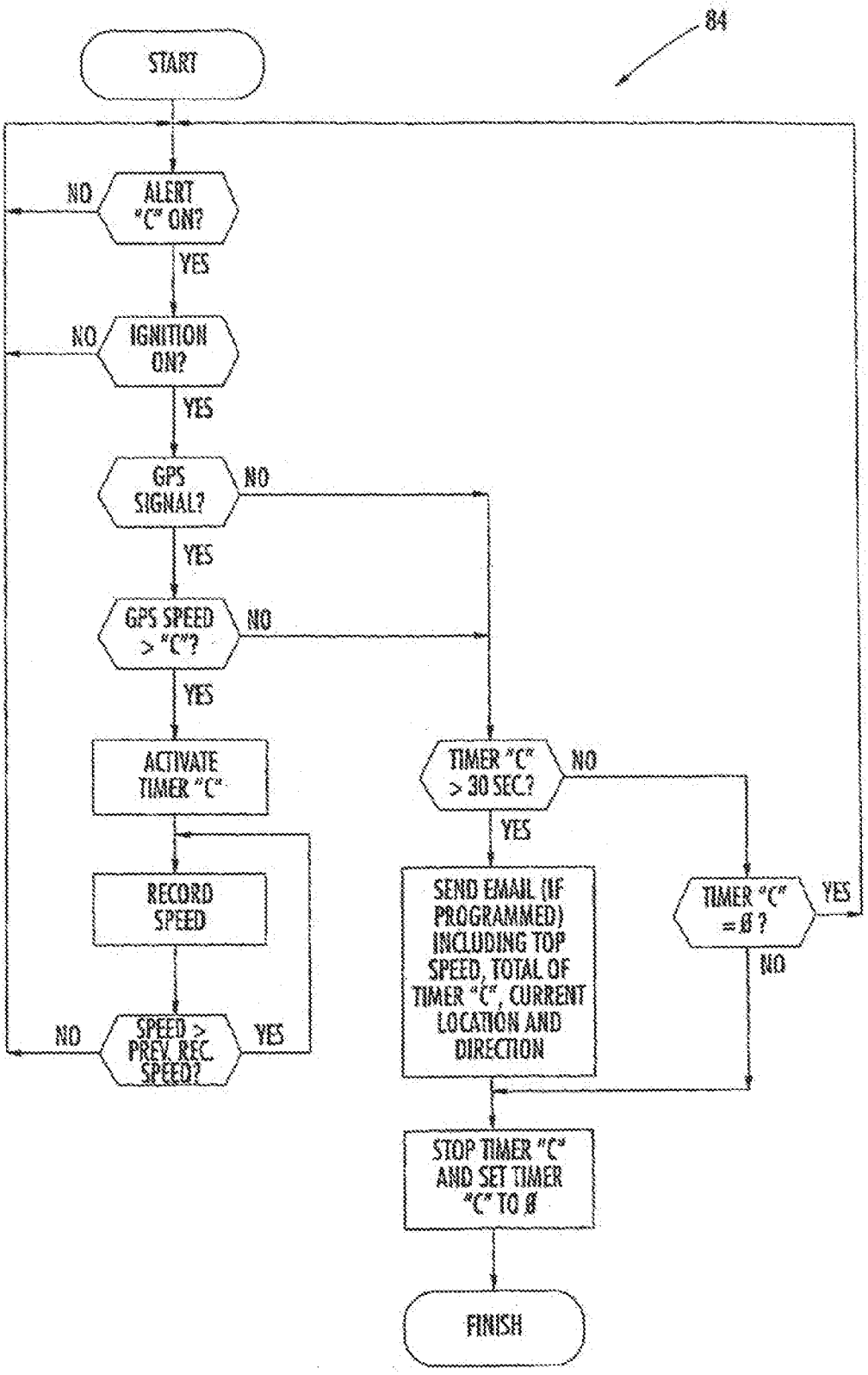

84
START
ALERT "C" ON?
NO
YES
IGNITION ON?
NO
YES
GPS SIGNAL?
NO
YES
GPS SPEED > "C"?
NO
YES
ACTIVATE TIMER "C"
RECORD SPEED
SPEED > PREV. REC. SPEED?
NO
YES
TIMER "C" > 30 SEC?
NO
YES
SEND EMAIL (IF PROGRAMMED) INCLUDING TOP SPEED, TOTAL OF TIMER "C", CURRENT LOCATION AND DIRECTION
TIMER "C" = 0 ?
YES
NO
STOP TIMER "C" AND SET TIMER "C" TO 0
FINISH

FIG. 6.

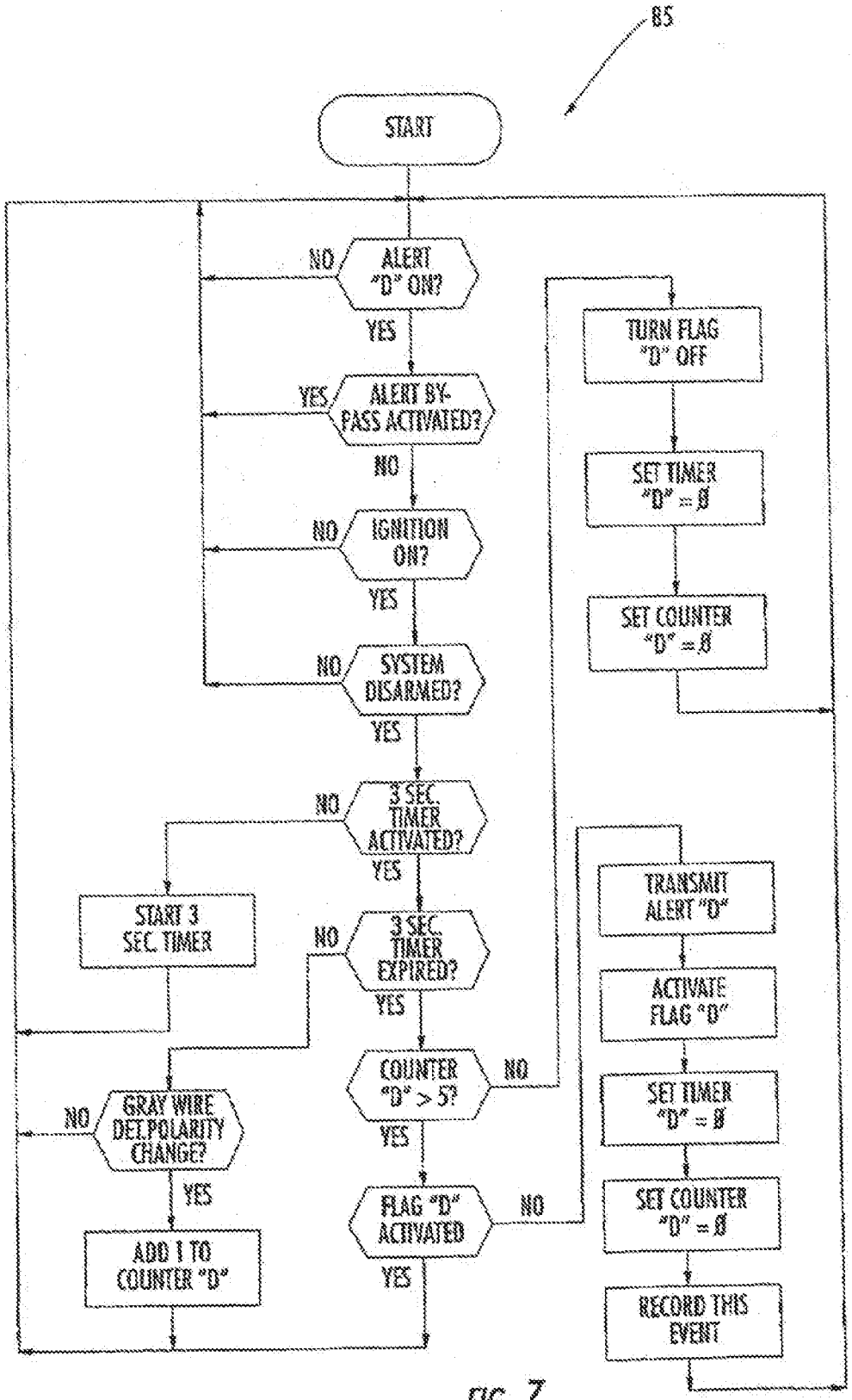

85
START
ALERT "D" ON?
NO
YES
ALERT BY-PASS ACTIVATED?
YES
NO
IGNITION ON?
NO
YES
SYSTEM DISARMED?
NO
YES
3 SEC. TIMER ACTIVATED?
NO
YES
START 3 SEC. TIMER
3 SEC. TIMER EXPIRED?
NO
YES
COUNTER "D" > 5?
NO
YES
GRAY WIRE DET. POLARITY CHANGE?
NO
YES
ADD 1 TO COUNTER "D"
FLAG "D" ACTIVATED
NO
YES
TURN FLAG "D" OFF
SET TIMER "D" = Ø
SET COUNTER "D" = Ø
TRANSMIT ALERT "D"
ACTIVATE FLAG "D"
SET TIMER "D" = Ø
SET COUNTER "D" = Ø
RECORD THIS EVENT

FIG. 7.

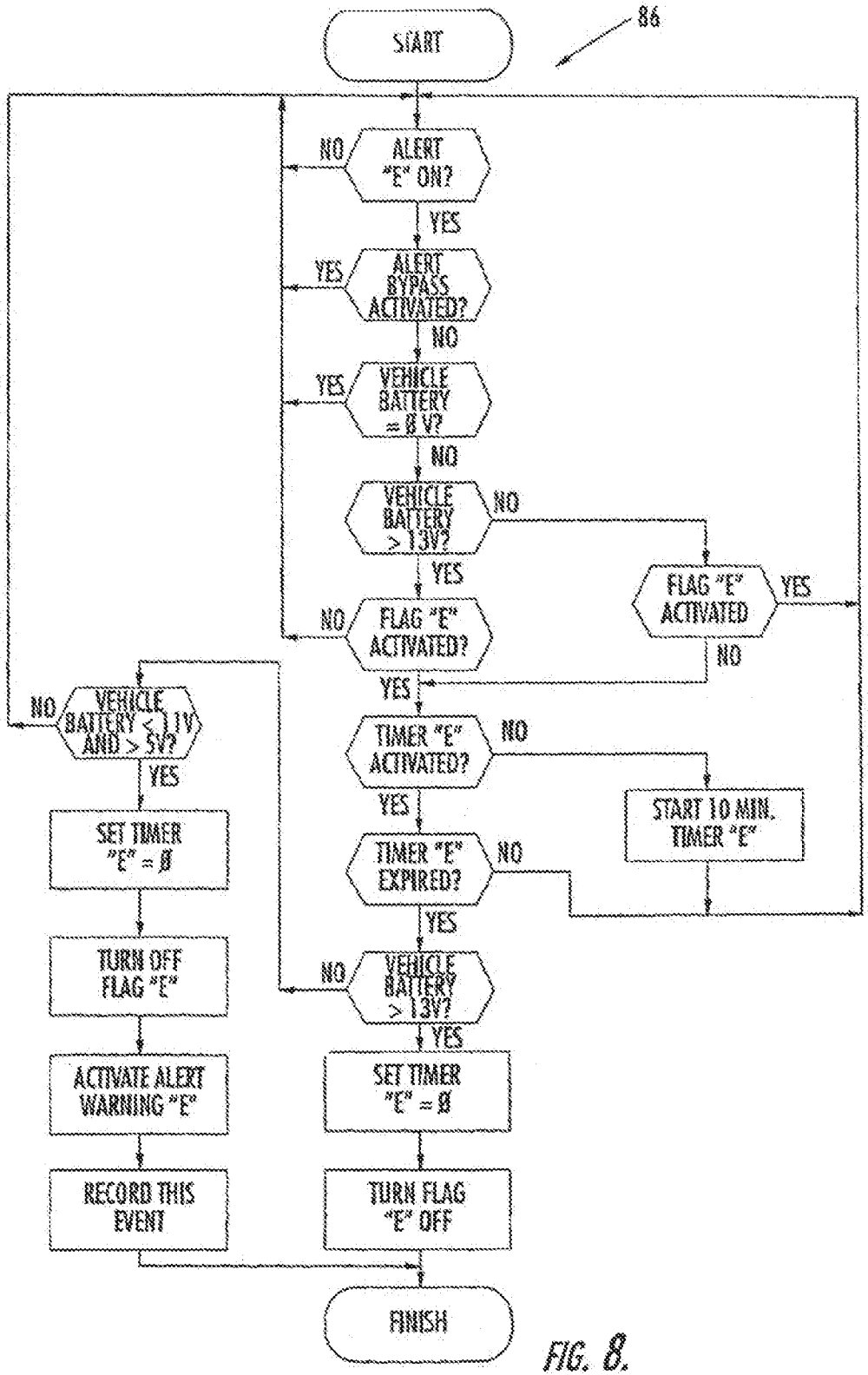

86
START
ALERT "E" ON?
NO
YES
ALERT BYPASS ACTIVATED?
YES
NO
VEHICLE BATTERY = Ø V?
YES
NO
VEHICLE BATTERY > 13V?
NO
YES
FLAG "E" ACTIVATED
YES
NO
FLAG "E" ACTIVATED?
NO
YES
VEHICLE BATTERY < 11V AND > 5V?
NO
YES
TIMER "E" ACTIVATED?
NO
YES
START 10 MIN. TIMER "E"
SET TIMER "E" = Ø
TIMER "E" EXPIRED?
NO
YES
TURN OFF FLAG "E"
VEHICLE BATTERY > 13V?
NO
YES
ACTIVATE ALERT WARNING "E"
SET TIMER "E" = Ø
RECORD THIS EVENT
TURN FLAG "E" OFF
FINISH

FIG. 8.

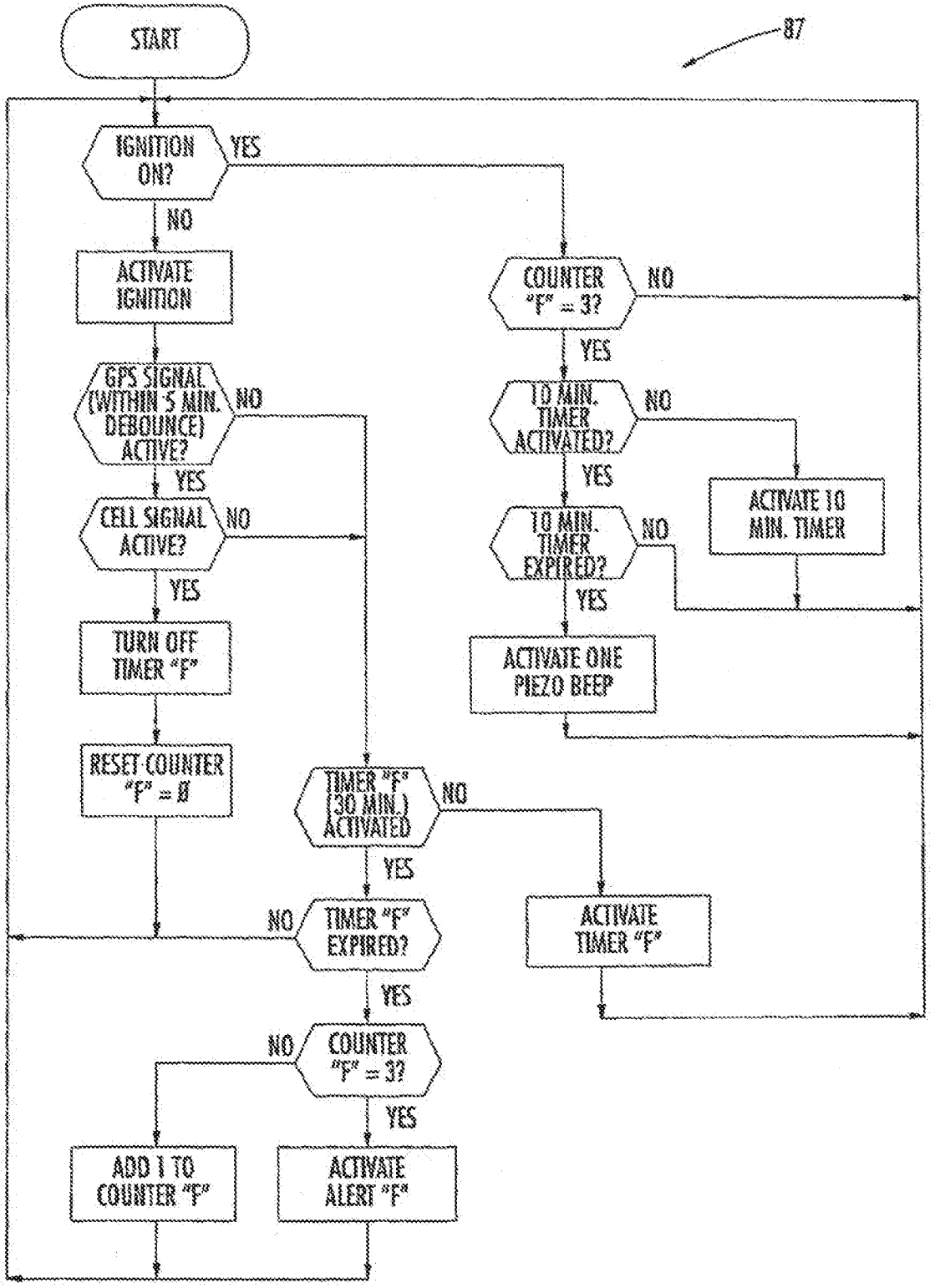

START
87
IGNITION ON?
YES
NO
ACTIVATE IGNITION
GPS SIGNAL (WITHIN 5 MIN. DEBOUNCE) ACTIVE?
NO
YES
CELL SIGNAL ACTIVE?
NO
YES
TURN OFF TIMER "F"
RESET COUNTER "F" = 0
COUNTER "F" = 3?
NO
YES
10 MIN. TIMER ACTIVATED?
NO
YES
ACTIVATE 10 MIN. TIMER
10 MIN. TIMER EXPIRED?
NO
YES
ACTIVATE ONE PIEZO BEEP
TIMER "F" (30 MIN.) ACTIVATED
NO
YES
ACTIVATE TIMER "F"
NO
TIMER "F" EXPIRED?
YES
NO
COUNTER "F" = 3?
YES
ADD 1 TO COUNTER "F"
ACTIVATE ALERT "F"

FIG. 9.

VEHICLE TRACKER INCLUDING INPUT/OUTPUT FEATURES AND RELATED METHODS

This application is a continuation of Ser. No. 09/859,972 filed on May 17, 2001.

RELATED APPLICATIONS

The present application is based upon copending provisional application serial NOs. 60/264,811 filed on Jan. 29, 2001; 60/258,005, filed Dec. 22, 2000; 60/251,552, filed Dec. 6, 2000; 60/252,125, filed Nov. 20, 2000; 60/236,890, filed Sep. 29, 2000; 60/246,463, filed Nov. 7, 2000; 60/222,777, filed Aug. 3, 2000; and 60/205,178, filed May 17, 2000, the entire contents of each of which are incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to the field of vehicle devices, and, more particularly, to a tracking and alerting system for a vehicle.

BACKGROUND OF THE INVENTION

Motor vehicles, such as passenger cars, trucks, busses, fleet vehicles, etc. are widely used and knowing the locations of such vehicle is often desired. For example, should a vehicle be stolen, it would be beneficial to know the vehicle's location so that authorities could be promptly and accurately directed to retrieve the vehicle. Indeed, the tracking system could plot the getaway path of the thief.

For a company with hired drivers, it may desirable to know the driver's whereabouts during the course of the day. Similarly, a rental car agency or other fleet operator, for example, may wish to know the whereabouts of its fleet of vehicles.

It may also be desirable to track the location of a vehicle as it used throughout the course of a normal day. For parents of younger or older drivers, for example, knowledge of the vehicle's location may provide some assurance that the driver is at designated locations and following a prescribed route.

A number of patents disclose various systems and approaches to tracking vehicles. For example, U.S. Pat. No. 5,223,844 discloses a tracking system including a control center and a mobile unit installed in the vehicle. The mobile unit may send security warnings to the command center via a wireless transceiver. Position information for the vehicle is determined using a GPS receiver at the vehicle.

U.S. Pat. No. 5,515,043 discloses a similar system which may send one or more preprogrammed telephone messages to a user when away from the vehicle. The user may remotely access location information or cause certain commands to be carried out by entering a personal identification number (PIN).

The widespread availability and use of the Internet has prompted a number of vehicle tracking systems to also make use of the Internet. For example, TelEvoke, Inc. proposed such a system in combination with Chilford Electronics. The system was to provide notification, control and tracking services via the telephone or the Internet. Users could be notified via phone, e-mail, or pager of events such as a car alarm being triggered. Users could control the vehicle remote devices via phone, web, or PDA such as unlocking car doors. Additionally, users could track TelEvoke-enabled vehicles on the Internet or via the telephone. An Internet map could be viewed by the user showing the actual and prior vehicle locations. TelEvoke offered its services via a centralized fully automated Network Operations Center. To reduce the communications costs, it was proposed to use the control channel of the cellular telephone network.

There are, of course, a number of vehicles which come from the manufacturer with some form of security system already installed. In addition, a number of vehicles are also equipped with aftermarket security systems. Many conventional vehicle tracking units may not be readily installed in vehicles, particularly those vehicles already including a vehicle security system. In addition, complexity of installation may significantly increase the system costs.

SUMMARY OF THE INVENTION

In view of the foregoing background, it is therefore an object of the invention to provide a vehicle tracking unit and related methods that permit ready interface to devices in the vehicle, such as those devices which may be part of an existing vehicle security system.

This and other objects, features and advantages in accordance with the present invention are provided by a vehicle tracking system comprising a vehicle tracking unit for a vehicle of a type including an alarm indicator, and a monitoring station receiving the alarm indication alert from the vehicle tracking unit. The vehicle tracking unit may include a vehicle position determining device, a wireless communications device, and a controller connected to the wireless communications device and the vehicle position determining device. The controller may monitor signals relating to activation of the vehicle alarm indicator and send an alarm indication alert, such as with position information from the vehicle position determining device, and using the wireless communication device.

More particularly, the controller may send an alarm indication alert responsive to a continuous activation of the alarm indicator for greater than a predetermined time. Alternately, or in addition thereto, the controller may send an alarm indication alert responsive to a repetitive pattern of alarm indicator activations. In other words, the controller may be configured to distinguish between normal operation of a vehicle horn by the driver, and activation of the horn by a security system. The controller may also monitor signals of at least one of a first and second polarity. Accordingly, the tracking unit may be readily interfaced to vehicles including security systems.

In one variation, the controller monitors signals to the vehicle alarm indicator. In another variation, the controller monitors signals of voltage dips of the vehicle battery. The vehicle alarm indicator may comprise a vehicle horn, and/or a vehicle siren.

The vehicle position determining device may include a Global Positioning System (GPS) device. The wireless communications device may comprise a cellular telephone communications device, such as operating over a cellular control channel.

The monitoring station may comprise a user interface for accepting at least one command from a user and sending at least one alert to the user. For example, the user interface may include an Internet interface, and/or a telephone network interface.

Another advantageous aspect of the invention relates to compatibility of the outputs of the vehicle tracking unit. More particularly, the controller may include a dual polarity compatible output for a vehicle device, such as the vehicle

alarm indicator. The controller may further monitor signals relating to activation of the vehicle alarm indicator and send an alarm indication alert with position information from the vehicle position determining device and using the wireless communication device.

The controller may generate a first polarity output pulse followed by a second polarity output pulse on the dual polarity compatible output. The controller may also generate a repeating pattern of a first polarity output pulse followed by a second polarity output pulse on the dual polarity compatible output. In yet other embodiments, the controller may sense an actual polarity of the device and thereafter use the actual polarity for the dual polarity compatible output.

Where the vehicle device is a vehicle horn, the controller may typically be configured to generate a negative polarity output on the dual polarity compatible output. Conversely, wherein the vehicle device is a vehicle alarm indicator siren, the controller may be configured to generate a positive polarity output on the dual polarity compatible output.

One method aspect of the invention is for operating a vehicle tracking unit for a vehicle of a type comprising a vehicle alarm indicator. The vehicle tracking unit may include a vehicle position determining device, and a wireless communications device. The method preferably includes determining position information of the vehicle using the vehicle position determining device, determining an alarm condition based upon at least one of activation of the vehicle alarm indicator continuously for greater than a predetermined time and activation of the vehicle alarm indicator in a repetitive pattern, and sending an alarm indication alert from the wireless communications device responsive to determining the alarm condition.

Another method aspect also relates to operating such a vehicle tracking device. The method preferably includes using the controller to generate a dual polarity compatible output for the vehicle device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a simplified block diagrams of a vehicle tracking system in accordance with the present invention.

FIG. **2** is a more detailed block diagram of the vehicle tracking unit as shown in FIG. **1**.

FIG. **3** is more detailed block diagram of the monitoring station as shown in FIG. **1**.

FIG. **4** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a vehicle stolen alert.

FIG. **5** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a vehicle alarm sounding alert.

FIG. **6** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a vehicle speeding alert.

FIG. **7** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating an unauthorized transmitter learned alert.

FIG. **8** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a low battery alert.

FIG. **9** is a flowchart for operation of the vehicle tracking system as shown in FIG. **1** illustrating a GPS or cellular unit failure alert.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will now be described more fully hereinafter with reference to the accompanying drawings in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the illustrated embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

Referring to FIGS. **1–3**, the vehicle tracking system **20** in accordance with the invention is now initially described. The vehicle system **20** illustratively includes a vehicle tracking unit **25** to be mounted in the vehicle **21** and a monitoring station **30** which is remote from the vehicle and which is typically in a fixed location. In the illustrated embodiment, the vehicle tracking unit **25** interfaces with various vehicle devices, such as may include security sensors, door locks, etc. as will be appreciated by those skilled in the art.

The vehicle tracking unit **25** is also illustratively connected to a separate vehicle security system **27** as may already be installed in the vehicle **21**, from the factory or installed as an aftermarket product. Those of skill in the art will appreciate that in some embodiments of the vehicle tracking system **20** a separate vehicle security system **27** may not be needed, and/or various features thereof can be readily incorporated in the vehicle tracking unit **25**.

The monitoring station **30** may typically service a number of subscribers **31**. As shown perhaps best in FIG. **3**, the monitoring station **30** may include a user interface, such as the schematically illustrated telephone network interface **33** and the internet interface **34** which are schematically coupled to a telephone **35**, and a computer **36**, respectively. Of course in other embodiments, other interfaces may be used and only one of the illustrated interfaces may be needed. Those of skill in the art will also recognize that messages may be sent to a subscriber or user via preprogrammed voice messages, e-mail messages, facsimile messages, pager alerts, etc. In addition commands or instructions from the subscriber can also be input to the monitoring station **30** via the telephone network interface **33** and/or the internet interface **34**, from the subscribers telephone **35** or computer **36**.

The monitoring station **30** is illustrated connected to a cellular telephone tower **32** which, in turn, may communicate with the vehicle tracking unit **25** in some embodiments. Of course, in other embodiments other communications approaches are also contemplated, such as, for example, including satellite communications.

The monitoring station **30** may typically include the necessary modems, and other communications electronics, and computers for its functions which are described in greater detail below. The configuration of such components and their details will be readily apparent to those skilled in the art. Accordingly, no further discussion of these details is needed.

Referring now more specifically to FIG. **2**, additional details of the vehicle tracking unit **25** and devices at the vehicle are now further described. The vehicle tracking unit **25** illustratively includes a controller **40**, a vehicle position determining device **42**, and a wireless communications device **44** connected together. The vehicle position determining device **42** may be provided by a GPS receiver, for example. The GPS receiver typically operates by receiving multiple signals from spaced apart satellites **38** as will be appreciated by those skilled in the art.

In other embodiments, the vehicle position determining device **42** may be provided based upon communications with the cellular telephone network, or based upon other

satellite transmissions, for example. As a particular example, time of arrival techniques are available based upon multiple reception paths to determine position via the cellular telephone network as will be appreciated by those skilled in the art. The vehicle position determining device **42** also illustratively includes an indicator **43** associated therewith, such as for indicating an operating mode, or proper operation of the device as will be addressed in greater detail below.

The wireless communications device **44** may be provided by a cellular telephone transceiver configured to operate on a control channel of the cellular network. Such a control channel may provide nearly universal coverage for the tracking system **20** as will be appreciated by those skilled in the art. In addition, the control channel may offer relatively inexpensive communications between the monitoring station **30** and the vehicle tracking unit **25** as will be appreciated by those skilled in the art. The wireless communications device **44** also illustratively includes an optional status indicator **45** with a similar function as the indicator **43** for the vehicle position determining device.

The wireless communications device **44** in other embodiments, may transmit in the voiceband of the cellular network. Alternately, the wireless communications device may communicate over other networks, such as over satellite, or via wireless internet services, as will be appreciated by those skilled in the art.

The controller **40** illustratively includes a central processing unit (CPU) **50** or other logic circuitry which is connected to a clock signal generator **51** and a memory **52**. In other embodiments, the memory **52** may be embedded memory in the CPU **50**. The controller **40** also includes schematically illustrated input/output circuitry **53** to interface with various vehicle devices. In particular the input/output circuitry **53** may provide dual polarity compatibility for one or more inputs or outputs as will described in greater detail below. One or more of the terminals of the input/output circuitry **53** may also provide both input and output functions as will also be described in greater detail below. This may significantly simplify and accelerate installation of the vehicle tracking unit **25** in the vehicle **21**.

Also illustratively shown as part of the vehicle tracking unit **25** are a back-up battery **54**, and switch **55** connected thereto for selectively powering certain of the components based upon the controller **40**. Of course, the vehicle **21** also includes an electrical system including the vehicle battery **61**. Powering of the vehicle tracking unit **25** is described in greater detail below.

The vehicle **21** also includes a number of other components that may relate to vehicle tracking, security, and/or convenience features provided by the vehicle tracking system **20**. For example, the vehicle **21** may include one or more door lock actuators **62**, an optional remote starting device **63**, a starter interrupt device **66** and an alarm indicator **67**. For example, the alarm indicator may be provided by a vehicle horn or vehicle siren, and/or flashing of the lights.

The optional separate security system **27** illustratively includes a vehicle security controller **28** and a receiver **29** connected thereto. As is conventional, the vehicle security system **27** may be switched between armed and disarmed modes, for example, by one or more uniquely coded remote transmitters **60**. The vehicle security controller **28** may also be capable of learning a new uniquely coded remote transmitter **60** as will be appreciated by those skilled in the art. The vehicle security controller **28** also illustratively is connected to the starter interrupt device **66** and the alarm indicator **67**.

For ease of explanation, a number of the features of the vehicle tracking system **20** are now described. The vehicle tracking system **20** includes a number of features that may simplify installation and maintenance. For example, as shown in FIG. **2**, the vehicle tracking unit **25** may have a test switch **71** connected to the controller **40**.

In normal operation, the controller **40** may be called upon to operate at least one vehicle device. Of course, the controller **40** also cooperates with the wireless communications device **44** and the vehicle position determining device **42** to determine and send vehicle position information to the monitoring station **30**. Moreover, the controller **40** may be switchable to a test mode for test operation of the at least one vehicle device responsive to activation of the test switch **71**.

In some embodiments, the at least one vehicle **15** device may be a plurality of vehicle devices that are tested by operation in sequence. For example, the at least one vehicle device may comprise at least one door lock actuator **62**. The at least one vehicle device may also comprise the starter interrupt device **66**, or the engine remote starter **63** if remote starting is an implemented feature. The at least one vehicle device which is tested, may also be the alarm indicator **67**. Accordingly, an installer, for example, can quickly check that the tracking unit has been properly installed.

To further provide for ready determination of proper operation of the vehicle tracking unit **25**, one or both of the position determining and wireless communications devices **42**, **44** may include associated indicators **43**, **45** as mentioned briefly above, and which provide an indication relating to proper operation. Each indicator **43**, **45** may indicate a mode of operation of the device, its proper operation, or a partial or complete failure of the device.

Another aspect of the invention is that the controller **40** may provide a selectable polarity for the at least one vehicle device based upon sensing thereof. Accordingly, a predetermined activation of the test switch **71** may cause the controller **40** to sense and select the proper polarity. Pressing the test switch **71** for a predetermined time or in a predetermined pattern may sense and set the polarity.

Another feature of the vehicle tracking unit **25** and vehicle tracking system **20** relates to conservation of the number of codes or messages that need to sent to the vehicle tracking unit. In particular, the controller **40** may have a plurality of different controller states and respond differently to a same message from the monitoring station **30** at different times depending upon the controller state at a given time. Accordingly, a number of codes or messages used by the system can be conserved. Various messages are described in greater detail below.

A controller state may change based upon several different occurrences or events. For example the controller may change states in response to a change in at least one vehicle device, or based upon a message received by the wireless communications device **44** from the monitoring station **30**, and/or based upon elapsed time. The controller states, for example, may include an alert sent state based upon an alert message being sent from the wireless communications device **44**. Thereafter, receipt of a predetermined message by the wireless communications device **44** when the controller **40** is in the alert sent state may confirm receipt of the alert message by the monitoring station.

Receipt of the predetermined message by the wireless communications device **44** when the controller **40** is in another state different than the alert sent state may thus cause a different response by the controller. The alert sent state may comprise at least one of an vehicle stolen alert sent state, a vehicle alarm sounding alert sent state, a vehicle

speeding alert sent state, an unauthorized remote transmitter alert sent state, a low vehicle battery alert sent state, and a device malfunction alert sent state. The various alert messages and confirmation thereof are described in greater detail below.

The code or message conservation aspects of the vehicle tracking system **20** also permit sending a sequence of codes or messages within a predetermined time to also cause a different response at the vehicle tracking unit **25**. In other words, the plurality of controller states may comprise a received first message state based upon a first message being received by the wireless communications device **44** from the monitoring station **30**. Receipt of a second message by the wireless communications device **44** when the controller **40** is in the received first message state, such as within a predetermined time window, for example, may thus cause a different response by the controller than does receipt of the second message when the controller is in another state than the received first message state.

The plurality of controller states may comprise a vehicle finder state sounding an audible signal via the alarm indicator **67** at the vehicle **21**. In this state the controller **40** would bypass sending a vehicle alarm sounding alert to the monitoring station **30**.

Another aspect of the vehicle tracking system **20** is the provision of certain power conservation and management techniques, such as to permit extended periods where the vehicle **21** is not operation. During such extended periods, the vehicle battery **61** provides power to the vehicle tracking unit **25** as well as other vehicle devices. Accordingly, the voltage of the vehicle battery **61** drops over time. The vehicle tracking unit **25** may provide a significant drain on the vehicle battery **61** because of the power consumed by the wireless communications device **44** during transmission as will be appreciated by those skilled in the art.

The vehicle position determining device **42**, the wireless communications device **44** and the controller **40** may be considered as defining a power load of the vehicle tracking unit **25**. The controller **40** may operate the schematically illustrated power switch **55** to isolate the back-up battery **54** from the power load as a voltage of the vehicle battery **61** drops until reaching a threshold. After or below the threshold the controller **40** may cause the back-up battery **54** to selectively power only a first portion of the power load while a second portion of the power load remains powered by the vehicle battery.

For example, the wireless communications device **44** may have a higher operating voltage than the vehicle position determining device **42**. The first portion of the power load that is selectively powered despite the low vehicle battery voltage may thus be the wireless communications device **44**. In particular, the wireless communications device **44** may be powered for transmission. Accordingly, the back-up battery **54** can be saved for limited communication using the higher voltage wireless communications device **44**. This provides useful features even after an extended period during which the vehicle **21** is left unattended and the vehicle battery **61** gradually discharges.

To further conserve power, the controller **40** may reduce operation of the power load as vehicle battery voltage falls. Conversely, the controller **40** may restore operation of the power load based upon the voltage of the vehicle battery **61** rising again, such as upon being recharged.

Also relating to power consumption, the controller **40** further cause transmission of a low vehicle battery voltage alert to the monitoring station **30** based upon the voltage of the vehicle battery **61** falling bellow the threshold. The user or subscriber may cause the monitoring station **30** to issue a remote start command. The controller **40** may then generate a remote start output to the remote start device **63** to thereby start the engine and recharge the vehicle battery.

Another feature of the vehicle tracking system **20** is that the vehicle tracking unit **25** may be readily installed and connected to a vehicle **21**, such as in the illustrated embodiment where the vehicle includes a starter interrupt device **66** and a separate vehicle security controller **28**. More particularly, the controller **40** may switch between an armed mode and a disarmed mode based upon operation of the engine starter interrupt device **66**. The controller **40** when in the armed mode may cooperate with the wireless communications device **44** to send an alert message to the monitoring station **30** and including vehicle position information, for example, based upon the vehicle position determining device **42**. The controller **40** is also for selectively operating the engine starter interrupt device **66** to provide additional security features.

In one advantageous embodiment, the controller **40** preferably comprises a combination input and output terminal for connection to the engine starter interrupt device. This terminal is at the input/output circuitry **53** and is schematically illustrated by reference numeral **72**. The controller **40** may switch to the armed mode when in the disarmed mode and based upon the engine starter interrupt device **66** being operated to disable engine starting. Conversely, the controller **40** may switch to the disarmed mode based upon the engine starter interrupt device **66** being operated to enable engine starting. In other words, the vehicle tracking unit **25** can piggyback its arming and disarming off the existing vehicle security system **27**, for example.

The controller **40** may also selectively operate the engine starter interrupt device **66** based upon a command message from the monitoring station **30**. The controller **40** may selectively operate the engine starter interrupt device **66** based upon a command message from the monitoring station **30**. Alternately, or in addition thereto, the controller **40** may selectively operate the engine starter interrupt device **66** based upon the ignition switch **65**.

The following descriptive portions relate to various user or subscriber notifications and features provided by the vehicle tracking system **20**. Of course, the controller **40** preferably cooperates with the wireless communications device **44** to send an alert message. The monitoring station **30** may comprise a user interface, such as one or both of the telephone network or internet interfaces **33**, **34**, respectively (FIG. **3**), for generating a sequence of alert message notifications based upon receiving the alert message sent from the vehicle tracking unit **25**. More particularly, the monitoring station interface permits canceling any remaining alert message notification based upon a cancellation command response from a user or subscriber having already received the alert message notification. The user may send the cancellation response via the telephone **35** or computer **36** (FIG. **3**), for example. Thus, if the user may be reached at different telephone numbers or different users are desirably notified of the alert, this aspect of the vehicle tracking system **20** can make the notifications efficiently and without making unnecessary notifications.

The vehicle tracking system **20** may provide any of a number of very useful alerts, as discussed herein. For example, the alert message sent from the vehicle tracking unit may comprise at least one of an vehicle stolen alert message, and a vehicle alarm sounding alert message. The alert message may be one a vehicle speeding alert message, and a vehicle acceleration alert message. In addition, the

alert message may comprise an unauthorized remote transmitter alert message. Also, the alert message may be at least one of a low vehicle battery alert message, and a device malfunction alert message.

The speeding alert may be based upon exceeding a speed threshold for greater than a certain time, which may be user selectable. The acceleration alert may also be useful as such is also indicative of aggressive driving along with the speeding alert. The unauthorized remote transmitter alert increases overall security since a user will be notified if a would-be thief learns an unauthorized transmitter to operate the controller. These alerts are described in greater detail below.

The vehicle tracking system **20** may be implemented as a service to a subscriber. In other words, the subscriber pays a monthly fee for the service. Accordingly, it may be important to encourage a user to register. Similar subscriber or registrations systems in the past have suffered revenue losses since some users would wait to activate the system until the vehicle was stolen. In other words, the user would only subscriber or register and pay a single month's fee.

In accordance with this aspect of the vehicle tracking system **20** prompt user registration is encouraged. In particular, the vehicle tracking unit **25** may include the user registration reminder indicator **56** and the controller **40** may be switchable from an unregistered mode to a registered mode. In the registered mode, the controller **40** may cooperate with the wireless communications device **44** and the vehicle position determining device **42** to determine and send vehicle position information to the monitoring station **30**. In the unregistered mode, the controller **40** may activate the user registration reminder indicator **56** to encourage registration by the user.

The controller **40** may be switchable to the registered mode based upon an activation message from the monitoring station **30**. For example, when the registration payment has been received, the monitoring station can send one or more messages to the vehicle tracking unit **25** to stop activation of the registration reminder indicator **56**. The indicator **56** may be audible, visual or both. For example, the registration reminder indicator **56** could be a beeping sound generated by a small piezoelectric transducer every ten minutes or so when the ignition **65** is on.

In other words, the user registration reminder indicator **56** may provide a minor but irritating annoyance to the user to encourage registration. Upon successfully registering, the annoyance is abated. Accordingly, a relatively straightforward approach is provided to encourage user registration.

Along these lines, the controller **40** when in the unregistered mode may have reduced features compared to the registered mode. For example, the controller **40** when in the unregistered mode may be restricted or limited in sending messages with the wireless communications device **44**. Accordingly, usage of the wireless communications network may be reduced. Transmissions from the vehicle tracking unit **25** may be also be beneficially suppressed during original installation, for example.

Returning again to features of the vehicle tracking unit **25** which facilitate installation, the controller **40** may send an alarm indication alert responsive to a continuous activation of the alarm indicator **67** for greater than a predetermined time. Alternately, or in addition thereto, the controller **40** may send an alarm indication alert responsive to a repetitive pattern of alarm indicator **67** activations. In other words, the controller may be configured to distinguish between normal operation of a vehicle horn by the driver, and activation of the horn by the security system **27**. As mentioned above, the controller **40** may also monitor signals of at least one of a first and second polarity. The controller **40** thus advantageously piggybacks off the alarm indication generated by the vehicle security system **27** to determine and send a vehicle alarm sounding alert to the monitoring station **30**.

In one variation, the controller **40** may monitor signals delivered directly to the vehicle alarm indicator by the vehicle security controller **28**. In another variation, the controller **40** monitors signals of voltage dips of the vehicle battery **61**. Circuitry is conventionally and readily available for both such functions as be readily appreciated by those skilled in the art.

The controller **40** may also include a dual polarity compatible output in the input/output circuitry **53** for a vehicle device, such as the vehicle alarm indicator **67**. The controller **40** may further monitor signals relating to activation of the vehicle alarm indicator **67** and send an alarm indication alert with position information from the vehicle position determining device and using the wireless communication device.

For the dual polarity output compatibility, the controller **40** may generate a first polarity output pulse followed by a second polarity output pulse. The controller **40** may also generate a repeating pattern of a first polarity output pulse followed by a second polarity output pulse on the dual polarity compatible output. In yet other embodiments, the controller **40** may sense an actual polarity of the device and thereafter use the actual polarity for the dual polarity compatible output.

Where the vehicle device is a vehicle horn, the controller **40** may typically be configured to generate a negative polarity output on the dual polarity compatible output. Conversely, wherein the vehicle device is a vehicle alarm indicator siren, the controller **40** may be configured to generate a positive polarity output on the dual polarity compatible output.

Another aspect of the vehicle tracking system **20** relates to conserving memory space and/or reducing transmission time over the communications network. In accordance with this advantageous feature, the controller **40** may determine the vehicle position information including a vehicle location and an associated stationary period for each occurrence of the vehicle remaining stationary for greater than a predetermined period. In one embodiment, the controller **40** may cooperate with the wireless transmission device **44** to send the vehicle position information to the monitoring station based upon each occurrence of the vehicle remaining stationary for greater than the predetermined period. In this embodiment, the monitoring station **30** may associate a time with each occurrence of the vehicle remaining stationary for greater than the predetermined period. In other words, the monitoring station **30** may time stamp the received information.

In another embodiment, the controller **40** cooperates with the wireless transmission device **44** to send the vehicle position information to the monitoring station **30** for a plurality of occurrences of the vehicle remaining stationary for greater than the predetermined period. In this embodiment, the controller **40** may associate a time with each occurrence of the vehicle remaining stationary for greater than the predetermined period. In other words, the controller time stamps the position and stationary period information.

As an example, the predetermined time which determines whether the vehicle **21** is stationary and the position should be determined, may be less than about three minutes. This time may filter out vehicle stops in normal traffic, but which will keep track of stops where the driver likely leaves the

vehicle **21**. Accordingly, only the important information necessary to track the vehicle need be stored and/or transmitted thereby reducing the system costs. If the vehicle **21** is stationary overnight, for example, unnecessary position information need not be determined, stored, and/or transmitted to the monitoring station **30**.

The controller **40** may comprise the memory **52** for storing the vehicle position information therein. In one configuration, the controller **40** downloads the vehicle position information from the memory **52** to the monitoring station **30** based upon a predetermined schedule. In another configuration, the controller **40** downloads the vehicle position information from the memory **52** to the monitoring station **30** based upon a predetermined event. In yet another configuration, the controller **40** downloads the vehicle position information from the memory **52** to the monitoring station **30** based upon a predetermined percentage of memory usage.

Having now described certain general features and advantages of the vehicle tracking system **20**, this description now turns to additional specific details which are provided as examples. In particular, vehicle tracking system **20** preferably implements one or more of the following features:

1. Detects the vehicle being stolen and transmits a signal to the monitoring station to contact up to 3 people, for example, predetermined by the user, of theft of the vehicle and then starts tracking the vehicle. The contact may be by one or more of the following: an e-mail message, a pager alert, a cellular telephone call, or other telephone call.

2. Detects an optional vehicle security or alarm system activation and transmits a signal to the monitoring station to contact up to 3 predetermined people to inform them the vehicle's alarm is being activated.

3. Detects an optional vehicle alarm system's remote PANIC activation and transmits a signal to the monitoring station to contact up to 3 predetermined people to inform them of the vehicle's PANIC being activated.

4. Detects a vehicle being programmed to operate from an unauthorized remote transmitter, key transponder, other transponder, or other device that has a unique coding, and the vehicle unit transmits a signal to the monitoring station to contact up to 3 predetermined people to inform them of this occurrence. The system can also make available information relating to a number of such coded devices, or a change therein, or when a change occurred. A message can be sent to the user or the information can be available to the user on the WEB site. The vehicle would be equipped with a security system as disclosed in U.S. Pat. No. 5,654,688, for example, which determines an unauthorized transmitter and provides an alert feature. This patent is incorporated herein in its entirety by reference.

5. Detects the vehicle traveling over a predetermined speed, such as for a predetermined time, and transmits a signal to the monitoring station to send a message, such as an e-mail informing the user (and/or others) of this occurrence. Of course, the message could also be sent via a telephone call or page, should additional urgency be required. The vehicle's predetermined maximum speed limit and duration thereof can be selected by the user.

6. Detects a low battery voltage such as for a predetermined time and transmits a signal to the monitoring station to contact up to 3 predetermined people to inform them of vehicle's low battery voltage. This is especially advantageous during winter so that the vehicle could be started, for example, to prevent a problem before it happens). The time setting is preferably selectable by the user.

7. Detects the vehicle not moving for a predetermined time and transmits a signal to the monitoring station to send, for example, a nightly e-mail informing the user of all the vehicle's location and stationary time occurrences. The stationary time length is also selectable. This may be advantageous to encourage patrolling personnel not to remain for a long time in a same location.

8. The vehicle unit preferably includes a back-up battery system making it more reliable.

The vehicle unit may be relatively inexpensive. In addition, the monitoring fee that includes sending up to 60 e-mails and making up to 6 phone calls per month, may also be relatively low. The relatively low monitoring fee is based, at least in part, on the current relatively low rates charged for use of the control channel of the cellular telephone network. It is also noted that access to the control channel provides coverage for almost the entire U.S., for example.

The user or subscriber also preferably has access to an Internet site that will display a map and silently contact the vehicle to acquire it's current location, speed, direction of travel, and previous multiple locations with speeds, for example, the user's personal identification number (PIN) can be quickly activated by a telephone call. No additional installation may be required.

Certain annual pre-pay package arrangements may be available. For example, up to 10 access entries per month can be provided on a low monthly billing. Up to 30 access entries could be provided also for a relatively low monthly fee.

The present invention provides a number of other significant advantages including optional access from any phone or from any computer to access the monitoring station internet site. The user may control various vehicle functions remotely via the telephone or the internet site. The only charge may be for additional equipment and installation.

Additional features can also be included with the system and subscribed to by the user in accordance with the invention. For example, these include Hijack, Car Finding, Unlock Doors and Unauthorized Transmitter Alert Features. The equipment and installation is relatively inexpensive. For the hijack feature: from any phone or computer, the user may activate vehicle starter interrupt and sound the horn until the vehicle is retrieved (Command **4**).

For the Car Finding feature: from any phone or computer, the user may activate the vehicle's horn, or siren and sound same for 30 seconds. This allows the user to find his vehicle in a crowded parking lot (Command **5**).

For the Lock/Unlock vehicle doors feature: from any phone or computer user a predetermined command (Command **7**) activates unlocking of vehicle doors to retrieve keys, for example, that may have been accidentally locked inside the vehicle. Of course, the system can also be used to lock vehicle doors if this was forgotten (Command **6**). The unauthorized transmitter alert feature is similarly selected as described above.

In addition, a remote vehicle start feature may also be provided, such as to start the vehicle's engine to heat or cool the vehicle prior to entry. The equipment and installation for remote starting may be relatively low. Some further details of a specific embodiment of the vehicle tracking unit **25** are provided below as relating to use of red and green LED indicators as may be coupled to the controller **40** and operated thereby. Also various representative wires, designated by color, are provided as an example embodiment.

The red LED verifies the GPS receiving signal. With a yellow wire having positive 12 volts, the red LED blinking indicates searching GPS location, constant indicates found

location, and off indicates no GPS signal found. With the yellow wire not having positive 12 volts, if the red LED is off, the LED is not functioning.

The green LED verifies receiving the cell tower signal. With the yellow wire having positive 12 volts, blinking indicates the cell control channel signal is detected, constant indicates sending a micro burst signal (LED stays on 5-seconds after each transmission, and off indicates no cell tower signal received. With yellow wire not having positive 12 volts, off indicates the green LED is not functioning.

An example of representative DIP switch feature selection is as follows. A first switch may be used for the adding orange wire for controlling arm/disarming of system. When on, the orange wire controls arm/disarm as follows: to arm, the orange wire is grounded and yellow wire does not have 12 volts positive. To disarm, the orange wire is not grounded. When the first switch is off, then only the yellow wire controls arm/disarm as follows: to arm, the yellow wire is without 12 volts positive, and 30 seconds after continued arm mode then orange wire activates a constant 500 ma grounded output to operate an external starter interrupt relay until the system is disarmed. To disarm, the yellow wire is connected to 12 volts positive.

A main 5-pin plug may be provided on the vehicle unit and connected as follows:

1. The Red Wire is connected to the 12 vdc power. An alert warning "E" is given if the system is armed and the battery voltage becomes lower than 11-volts for longer than, ## minutes. This alert feature "E" will not operate again until the voltage is above 12 volts to re-set this feature.

2. The black wire is connected to ground.

3. The yellow wire is connected to the ignition 12 volts so that if the key is on, 12 volts is supplied thereto and if the key is off, the yellow wire is connected to ground. Further: if the system is in an armed mode and the Lat/Long changes, then Alert "A" is given. If the system is disarmed and within 2.5 seconds after the yellow wire receives 12 volts and the gray wire detects 3 or more positive pulses the system activates Alert "D". If the first DIP switch is in the off position then: if 12 volts is on yellow wire, the system is disarmed and the orange wire discontinues from the 500 ma ground, and if the yellow wire sees ground or neutral, then the system is armed and 30 seconds after the continued arm mode the orange wire activates a constant 500 ma grounded output to operate an external starter interrupt relay until system is disarmed

4. The gray wire is for input and output, and can be connected to an alarm siren or horn positive terminal. In addition:

a. With system armed and if the gray wire detects +12 v pulsing on/off or on constant for more than 10 seconds from an alarm siren or horn honking activation, then alert warning "B" alarm activation is given.

b. With system disarmed and if the gray wire detects +12 v pulsing on/off or on constant for more than 10 seconds from an alarm siren or horn honking activation, then alert warning "C" panic activation is given.

c. With system disarmed and if the Gray wire detects 3 or more 12 volt positive pulses within 2.5 seconds of yellow wire receiving 12 v+ and the gray wire by-pass not being activated, then alert warning "D" is given.

d. The gray wire bypass operates as follows:

i. After alert warning "B" bypass all future alert "B" signals until system is disarmed.

ii. After alert warning "C" bypass all future Alert "C" signals until system is armed.

iii. After alert warning "D" bypass all future alert "D" signals until no 12 volt pulses are detected on the gray wire within 3 seconds of the yellow wire having 12 volts.

e. With system armed or disarmed. The Output: Internal +12 v, 1 amp transistor with pulses 1 second on and 1 seconds off to activate siren or honk car horn or flashing light relay.

i. Non-stop activation from (Command "4")

ii. 30-second activation from (Command "5")

f. Turn off the above alert "A" from (Command "1").

5. The orange wire is for the starter interrupt and arm/disarm system, and operates as follows:

a. If first DIP switch is in the:

i. On position and: the orange wire has 12 volts or neutral, the system switches to the disarmed mode; the orange wire is grounded, then the system is switched to the armed mode, and the starter interrupt output will not automatically operate. Can only be activated from "Command #4"

ii. Off position and the orange wire does not effect the arming or disarming of the system; 30 seconds after system arms the orange wire will automatically activate constant 500 ma ground until the system is disarmed. And from "command #4". Connect to Starter interrupt relay output.

b. Command 4 activates Orange wire to have 500 ma. negative until Command 1 is received.

c. After Alert warning "B" is activated the first time it is thereafter bypassed while the orange wire remains grounded. Alert warning "B" is re-set to operate again 3 seconds after orange wire becomes ungrounded.

The vehicle unit may also include a Door Lock Plug configured as follows, for example. A green wire provides a 250 ma. negative 1 second pulse for Lock Doors. (Command "6"). A red wire provides a constant 12 v output from the red power wire. A blue wire provides a 250 ma., negative 1 second pulse for Unlock Doors (Command "7"). A pink wire provides a 250 ma., negative 1 second pulse for remote Car Starter (Command "2").

An installation test button may also be provided to work as follows. Pressing the button activates the orange wire for 10-seconds (starter interrupt), with these circuits in sequence. First, activates gray wire for 1-second. (siren/horn). After the first stops, activates green wire for 1 second to lock the doors. After the second stops, activate the blue wire for 1 second to unlock the doors. After the third stops, activate the pink wire for 1 second to activate optional item.

Representative warning alerts are as follows:

1. Alert Warning "A" (FIG. 4): Automatic activation of "Command 8" and the vehicle unit contacts monitoring station to instantly call 3 phone numbers with the message "Your Vehicle is stolen please confirm then call 911 to advise police of web site and your pin # so police can locate the vehicle". This is detected with the system armed and the GPS indicating movement. Bypasses all future alert warning "A" signals until the system is re-armed.

2. Alert Warning "B" (FIG. 5): the vehicle unit contacts the monitoring station to instantly call 3 phone numbers with the following message "Vehicle alarm activated please confirm". This is with the system armed and detecting gray wire having 12 volts pulsing or on constant for longer than 10-seconds). After alert warning "B" is activated the first time, it is thereafter bypassed while the orange wire remains grounded. Alert warning "B" is re-set to operate again 3 seconds after orange wire becomes ungrounded.

3. Alert Warning "C" (FIG. 6): the vehicle unit contacts the monitoring station to instantly send e-mail message "vehicle was traveling faster than your preset amount of "###" and time limit of "##" seconds. Indicates the vehicle speed and location that the speeding started and how long speeding occrued" (Detected from GPS).

4. Alert Warning "D" (FIG. 7): the vehicle unit contacts the monitoring station to instantly call 3 phone numbers with the this message "Unauthorized remote transmitter was just programmed to operate your vehicle." This is with the system disarmed and the Gray wire detecting three or more 12 volt pulses within 2.5 seconds of yellow wire having seen 12 volts positive. All future alert "D" are bypassed until no 12 volt pulses are detected on the gray wire within 3 seconds of the yellow wire seeing 12 volts.

5. Alert Warning "E" (FIG. 8): the vehicle unit contacts the monitoring station to instantly call 3 phone numbers with the message "Vehicle has low battery voltage and system has changed to low voltage mode". This is with the system armed and detecting the Red wire with lower than 11 volts for ## minutes. All future alert "E" are bypassed until, first, more than 13.5 volts are detected on the red wire and, second, after the yellow wire stops having positive voltage the red wire then must detect more than 12 volts.

The following are representative commands for use in the system:

Command 1: Reset all circuits and system remains asleep until the ignition key is turned on. Resets the triggered mode and unit is asleep to prevent power drain on vehicle battery.

Command 2: (Accessory activation) monitoring station Command to the system to activate Pink wire to pulse 250 ma negative for 1 second.

Command 3: (Vehicle Location) Web site to indicate present location and past events in memory.

Command 4: (Hijack or Stolen) monitoring station Command to vehicle system to activate:

a. Gray wire to pulse 1 sec on/1 sec off with 1 amp positive output and which continues until receive command # 1.

b. Orange wire to have 500 ma ground and which continues until receive command # 1.

Command 5: (Car Find) monitoring station Command to system activating Gray wire for 30 seconds pulsing 1 sec on/1 sec off with 1 amp positive output.

Command 6: (Lock Doors) monitoring station Command to system activating Green wire to pulse 1 second with 250 ma. negative.

Command 7: (Unlock Doors) monitoring station Command to system to activate Blue wire to pulse 1 second with 250 ma. negative.

Command 8: (Start Constant Vehicle Tracking) sends previous 2 events in memory and then every 120 seconds get update of location information sent to the Web site.

The system is also operable in a battery saver mode which operates as follows:

1. With the ignition key off, if the battery voltage drops below 11.5 volts for more than 5 seconds, the GPS verification wakes up to look:

a. Once instantly.

b. Once in 1 hour if at the same location.

c. Once in 6 hours if at the same location.

d. Once in 12 hours if at the same location.

e. Once every 24 hours if at the same location.

f. Activate alert "E" when the battery saver mode is activated, and bypass sending all future Alert "E" until the battery voltage goes above 13 volts for 10 minutes to reset this feature.

Another aspect of the invention relates to automatic vehicle alert e-mails sent containing some or all of the previous system events. This sending can be triggered as follows:

a) At a user selected predetermined time ## (01–24) of each day, or

b) At a predetermined memory fill level, such as full or near full.

In addition, each system event may contains one or more of the following:

a) Vehicle Location

b) Vehicle total time at location

c) Time of day

d) Mph traveling

e) Total time traveling above MPH

f) Direction traveling

g) Delta

h) Special Alert messages, if any, including:

i) GPS signal not received for longer than 5 minutes.

ii) Traveling above ###MPH for ## minutes.

iii) Vehicle is stolen.

iv) Alarm activated.

v) Unauthorized remote transmitter alert.

vi) Battery saver mode activated

vii) Command 1: Reset all circuits and system remains asleep until the ignition key is turned on.

viii) Command 2: (Accessory activation)

ix) Command 3: (Vehicle Location was retrieved)

x) Command 4: (Hijack or Stolen mode activated)

xi) Command 5: (Car Find mode activated)

xii) Command 6: (Locked Doors)

xiii) Command 7: (Unlocked Doors)

xiv) Command 8: (Started 2-second incremental Vehicle Tracking)

Another feature of the invention relates to the selectable threshold conditions causing an event to be recorded into the memory of the vehicle unit. For example, this may include: while the yellow wire has 12 volts, record events every "??" default 15 minutes time if the GPS location has changed. If the GPS location is same then only update stationary total time. If the GPS antenna is not receiving any signal then enter last known GPS location and with indication this was the last known GPS location before GPS signal stopped and how long no GPS signal was received, and enter GPS location in the on-hold file. When vehicle is traveling above ###MPH for ##-minutes.

The monitoring station may also provide a number of automated phone calls as described above. These may include:

1. The user's vehicle has issued a stolen alert:

a. If vehicle is stolen, after receiving the phone message the user then calls 911 to advise police of the theft, and gives the police the Web site address and an identification number, such as the user's PIN, to allows the police to locate where your vehicle has been, where it is now and keep tracking it until the police can retrieve the vehicle.

b. If this is a false alert due to vehicle being towed away for service, for example, then the user may press "1" to put the vehicle in an off mode. Once the ignition key is turned on again the system will reset back to its normal operation mode.

2. The user's vehicle has issued an alarm activated for more than 10 seconds alert. The system will not respond to this alert again until ignition key is turned on again to reset this feature.

3. The vehicle battery voltage is low or has been disconnected. The tracking system is in low voltage mode. The system will not respond to this alert again until the battery voltage goes above 13 volts for 10 minutes to reset this feature.

The backup battery may be sized according to the GPS receiver and processing power draw. In addition, the battery may also be sized based upon estimated micro burst transmitting power draw. Such transmission are typically at about 5 watts power to the antenna.

The system according to the invention including the vehicle unit and monitoring station provides a number of significant advantages and features. For example, the police may be directly contacted by the user when the vehicle is stolen. The user receives the telephone message from the monitoring station, and this is done without requiring the intervention of a manual security monitoring operator, such as an ADT operator, for example. In addition, once in the stolen mode, the vehicle unit will periodically continue to send out its location, so that the police may track the vehicle via the WEB, for example. This location sending feature may begin immediately, that is, without requiring the user to contact the vehicle to begin tracking. Having the vehicle contacting the monitoring station is considerably less expensive than other schemes where the vehicle is periodically polled via the cellular network, for example.

The system may also be interfaced to a breath alcohol sensor at the vehicle, for example, and this information recorded in memory. The information could be passed along to the monitoring station, which, in turn, could send out a notification message (e-mail or telephone) that the vehicle is being operated by a driver who may be impaired by alcohol. The vehicle's location could then be tracked to permit the police to detain the driver.

Another aspect of the unit is that it may be able to recognize the desirability to bypass certain security breach triggers or other events. For example, a car finding feature can be provided that will allow the user to sound the horn or siren when near the vehicle to help locate the vehicle, as in a crowded parking area. Without the bypass feature, the unit could recognize the horn or siren as a security breach and transmit such information to the monitoring center. In accordance with this aspect of the invention, the unit would recognize the car finding feature was activated and thereby bypass sending a security breach transmission, for example. Again, false alarms and unneeded usage and expense of the communications infrastructure would be avoided.

Yet another aspect of the invention relates to thwarting a would-be thief who attempts to disable the alarm by cutting the battery cable or power supplied to the system. The unit preferably includes a back-up battery. More particularly, upon being in an armed mode and sensing a breach of security, such as the hood opening, for example, the unit will send out a signal indicating the alarm or security breach and while the alarm is indicated, if the battery is disconnected then the unit will send out a message indicating the vehicle is stolen, and also providing the vehicle's current position. Accordingly, the would be thief is not able to defeat the security system by quickly disrupting power to the unit during an alarm indication or security breach. Also to prevent additional alerts, this message is prevented from being transmitting again until user returns to the vehicle to disarm the system and/or turn on the ignition so that the unit sees a voltage above 13 volts indicating the vehicle has started using the owner's ignition key. This aspect is further understood with reference to the enclosed flowchart labeled "Alert A" (FIG. 4).

Still another aspect of the invention relates to how the unit can discriminate between ordinary usage or honking of the horn as compared to a security system triggered alarm. Most vehicle security systems will provide a pattern of horn soundings as an alarm indication, and this can be determined and used to reduce false alarm transmissions from the unit. For example, the unit can look at the number of leading and trailing edges of the power pulse used to sound the horn. A single pressing of the horn switch by the user will cause two edges within a predetermined time, such as about 10 to 12 seconds. Accordingly, the unit can be configured to not send a security breach transmission to the control center based upon detecting two transitions. Since a number of vehicle security systems may have a continuous sounding of the horn within the predetermined time, the unit can send the transmission upon detecting only a single transition.

A number of other vehicle security systems provide a series of pulses or horn soundings within the predetermined time. Accordingly, the unit may also be configured to send a security breach transmission upon detecting greater than a predetermined number of transitions, such as greater than nine, for example. This number is also typically higher than a user would generate honking the horn several times within the predetermined time. In other terms, the number of transitions of the horn pulses can be counted, and if equal to one, or greater than nine, for example, the transmission is triggered, and otherwise the sounding of the horn is ignored. Also to prevent additional alerts, this message is prevented from being transmitting again until user returns to the vehicle to disarm the system and/or turn on the ignition so that the unit sees a voltage above 13 volts indicating the vehicle has started using the owner's ignition key. This aspect is further understood with reference to the enclosed flowchart labeled "Alert B" (FIG. 5).

Yet another feature of the invention relates to a low vehicle battery alert. For example, the unit may monitor the battery voltage over a predetermined time such as ten minutes. The ten minute window prevents false tripping, for example, when the voltage dips during engine cranking. In particular, the voltage can be sensed and determined whether it is greater than zero (eg. greater than six volts) and less than a high value (eg. eleven or twelve volts), and, if so, a low battery voltage transmission can be communicated to the monitoring station, and ultimately to the vehicle user when away from the vehicle. If vehicle is being serviced and battery is disconnected this will cause the battery voltage to be equal to zero, then the low battery voltage transmission will not be communicated to the monitoring station. Also to prevent additional alerts, this message is prevented from being transmitting again until user returns to the vehicle to disarm the system and/or turn on the ignition so that the unit sees a voltage above 13 volts indicating the vehicle has started using the owner's ignition key. Again false triggerings are reduced. This aspect is further understood with reference to the enclosed flowchart labeled "Alert E".

Yet another advantageous feature of some embodiments of invention relates to the ability to conserve electrical power. More particularly, when the vehicle is stopped and in the armed mode, the GPS receiver may be periodically operated to determine the vehicle position. If the vehicle position changes, this is indicative that the vehicle is being moved or stolen. For example, the GPS receiver may be operated to generate new vehicle position information every 29 seconds. These relatively quick successive position determinations or readings are generally termed hot start. These are relatively less complicated that a cold start position determination which takes longer, since the cold start posi-

tion determination requires greater time to acquire and receive data from multiple satellites, as will be appreciated by those skilled in the art.

Unfortunately, this relatively high repeated usage of the GPS receiver may cause unnecessary battery drain, especially when the vehicle is left armed and unattended by the user for an extended period. Accordingly, the power conserving feature of the invention permits the GPS receiver to be turned off when the vehicle is in the armed mode, and the GPS receiver is turned on only when needed. For example, a vehicle sensor, such as a shock sensor, motion sensor, ignition sensor, door sensor, or other sensor, or combinations thereof could be used to start the GPS receiver. This sensor could also be used to trigger an alarm if desired; however it need not be so used in all embodiments. The GPS receiver, once turned on, could operate in the normal periodic fashion as described above, or for a fixed period of time. The GPS receiver could also be turned off again after some predetermined time if no further sensor signal is received, or if the position fails to change on subsequent position readings or determinations.

Yet another feature relates to permitting more colorful audible alert messages to be generated for the user. The user can, in some embodiments, access an internet site to type or enter the text for a message to be sent, such as to alert the user that his vehicle is being stolen. The audible message then communicated by a telephone call to the user is generated by a speech message synthesizer based upon the entered text. In accordance with this aspect of the invention, the user could type in phonetically spelled words or phrases, such as to create more colorful messages including slang terms, various accents, and/or to mimic various dialects, for example. The speech synthesizer would then generate the desired message customized for the user. Of course, the system could also permit the user to test or preview the pronunciation generated by the speech message synthesizer based on the entered text message prior to its adoption.

Another aspect relates to requesting GPS position information from a vehicle. If a command is sent downstream to the vehicle requesting that GPS information in turn be sent upstream from the vehicle, and the GPS information is not received within a predetermined time, such as about four minutes, then another command may be sent to the vehicle requesting the GPS information. This may keep repeating until GPS information is received, for a predetermined number of tries, or until a user instructs stopping of the requests. This helps to ensure and confirm the activation and reception of GPS tracking coordinates from the vehicle.

Yet another aspect relates to reducing a frequency with which GPS information is sent from the vehicle. More particularly, the unit may be configured to activate GPS information transmission upstream every 2 minutes. To reduce system usage expense and power consumption at the vehicle, this rate of transmission of GPS information could be progressively decreased over time. For example, in one embodiment, upon activation the GPS location signals could be sent every 2 minutes during the first hour, then once an hour for the next 23 hours, after which only one signal would be sent per day.

Still another aspect relates to warning the user of inoperable or malfunctioning GPS or cellular telephone section. More particularly, if the GPS or cellular telephone antenna wire is cut or the mounting position of either is changed causing the antenna to stop receiving the signal the user would not ordinarily know of this problem quickly. In accordance with one embodiment, if the ignition is turned on a predetermined number of times, such as about three, and each time ignition turns on if no GPS or no cell signal is received for a minimum time, such as about 15 to 30 minutes or longer, an audible warning beeper may be activated in the vehicle. This beeper may be sounded once ever 15-minutes. At anytime if the GPS or cell signal is received properly then the system re-sets automatically stopping the beeper sound.

As an example, if the ignition key is turned on and no GPS or no Cell signal is being received for 15-minutes, and the vehicle ignition stays on for 45 minutes and there is still no GPS or no cell signal, the unit counts one. Thereafter, if the ignition key is turned on and no GPS or no cell signal is being received for 15-minutes, and the vehicle ignition stays on for 60-minutes and there is still no GPS or no cell signal, a second count is determined. Thereafter, if the ignition is turned on and no GPS or no cell signal is received for 10-minutes, and the vehicle ignition stays on for only 10-minutes and there is still no GPS or no cell signal, no count is determined. Thereafter, if the ignition is turned on and no GPS or no cell signal is being received for 15-minutes, a third count is determined and the beeper is activated as described above. This beeping may continue every 15-minutes while the vehicle ignition stays on as long as the vehicle ignition stays on for 16-minutes and still no GPS or no Cell signal is being received. If thereafter, the ignition is turned on and no GPS or no cell signal is being received, the beeper beeps once and again beeps once every 15-minutes while vehicle ignition stays on. If in 10-minutes both GPS or cell signal is being received, the beeper system is turned off and the warning count is reset.

In examples, if the ignition key is turned on and no GPS or no cell signal is being received for only 5, 10 or 12 minutes (with the threshold set at 15 minutes), then no count is determined.

In certain circumstances, the GPS signal may fail, but the cell signal may still be working. Accordingly, it may be desirable to send an indication of the failure of the GPS signal to the central monitoring station to thereby alert the user as described above. If the cell signal also failed, or if the cell signal failed by itself, in other embodiments a separate paging device would transmit the failure or loss of the cell signal information to the central monitoring station, to thereby alert the user.

Yet another feature is directed to efficient use of a relatively small number of codes available to communicate with the tracking unit from the cellular network and central station. More particularly, a typical arrangement may provide eight basic codes and two "wildcard" codes. The two wildcard codes are reserved for future or other uses. A particular tracking device will respond directly to any of the eight basic codes. For example, the doors could be locked or unlocked, a present location downloaded from the vehicle, etc.

In accordance with this feature, the tracking device may respond differently to the same code or command depending upon the state or condition of the tracking device. For example, if an alarm is triggered at the vehicle, it may be desired that the tracking device continue to send the alarm signal until confirmation is received that the central monitoring station has received the alarm signal. This confirmation can be sent using the same code as may provide another function if the device were not indicating an alarm. Any of a number of such tracking device conditions may trigger a different message to be interpreted from the received code. For example, if any of the above Alerts A–E were triggered, the receipt of a predetermined code, such as code eight, would confirm receipt of the alert by the central station, and this receipt of code eight would not cause the other response

(no alarm triggered) in the tracking device. Of course this concept can be extended to other features as will be appreciated by those skilled in the art.

In accordance with another feature, the rate of sending the location or position data (or change in position data) from the vehicle may be varied to reduce system usage and thereby reduce expenses. More particularly, in one embodiment, the rate of sending may be based upon how long the vehicle has remained stationary. This time period may be selected by the user. For example, the selected time may be in the range of 15 minutes to six hours. If the vehicle has been stationary for the selected time period, then the rate of transmission may be reduced. This reduces or eliminates the need to send home position data and send all the over 15-minute stops made that day. Otherwise, that is when the vehicle is moving, the device may send data at a faster rate. Of course, a system user would not likely be interested in quick updates, especially where the position information is not changing. Conversely, if the vehicle is being moved, it may be desirable to receive more frequent position updates.

Another variation of this transmission rate conservation feature, bases the rate of transmission on the vehicle position. For example, a reduced rate of transmission may be selected if the vehicle is in a predetermined area where the user has a lesser interest in quickly updated position information. The user may also have a reduced interest in an area that can be defined outside of a predetermined distance from a reference point.

Yet another variation of the vehicle position transmission rate conservation feature is based upon the vehicle's speed, such as the vehicle's average or maximum speed, for example. Accordingly, if the vehicle is traveling above a preset speed, the rate of transmission may be increased.

In accordance with another aspect of the invention, the tracking device may send the alert indication a predetermined number of times without receiving an acknowledgment as described above, and then wait until the vehicle position has changed before trying again or the cell re-registers or its RSS. (received signal strength) changes. Thus, power is conserved. When the vehicle has moved to a new position, any obstructions may no longer be present thereby increasing the likelihood of a successful communication. In addition, the change in position may be determined when the vehicle is sensed to be moving about a predetermined relatively small speed, such as greater than 1 mph, for example.

In all of the embodiments and variations described herein, the tracking device may communicate with one or more other vehicle devices via a vehicle data communications bus. Further aspects of interfacing with a vehicle data communications bus are described in U.S. Pat. Nos. 5,719,551 and 6,011,460 assigned to the assignee of the present invention.

Yet another aspect relates to efficient use of available codes on the cellular telephone control channel. In one particular example, ten codes may be available to be transmitted from the monitoring station to the vehicle trackers. The first eight or nine codes are command codes that will cause a specific action by the tracking device at the vehicle. The other one or two codes may be wildcard codes as mentioned above, that may set a stand-by mode for one or a group of vehicles, for example.

It may be desirable to provide more than eight commands at the vehicle responsive to the corresponding eight available codes. For example, it may be desirable to set a feature on or off, or to set a different feature setting or threshold. In accordance with this aspect of the invention, the commands at the tracker are determined based upon a series of different command codes being received within a predetermined time window.

For example, the monitoring station may send code **9** that switches the tracker in the car into a stand-by mode for a predetermined time and which causes the tracker to respond with an upstream confirmation code **7** or **9** indicating receiving code **9**. During the predetermined time of the stand-by mode another code follows that causes a system programmable feature or setting to change. Note that the second code would otherwise cause a different function at the vehicle. Note that system might operate a function **9** if another code **1**–**9** is not received in the predetermined time. The following list is exemplary for features resulting from second codes **1**–**9**:

(1) Code **1**—Tracker will turn off feature of upstream code caused by vehicle alert being detected.

(2) Code **2**—Tracker will turn on feature of upstream code caused by vehicle alert being detected.

(3) Code **3**—Tracker deactivates cell receiver from operating due to a non-paying customer for monitoring service. That phone number can then be allocated to another customer.

(4) Code **4**—Turn on audio buzzer feature that will sound once each 10 minutes. The monitoring station need only send the command to activate the feature, as the tracker will time the period and drive the buzzer thereafter. The monitoring station will normally not need to send this command because the tracker will be configured out of the box with this feature activated to sound the buzzer every 10 minutes until the next command is received.

(5) Code **5**—Turn off the audio buzzer. This is to be sent by the monitoring station after a user has successfully activated his account.

(6) Code **6**—Turn on the 80 mph speed limit reporting. This will normally not be sent as this feature will be the default setting of the tracker.

(7) Code **7**—Turn off the 80 mph speed limit reporting.

(8) Code **8**—Increase speed limit 5 mph and increase the time 5 minutes.

(9) Code **9**—Decrease speed limit 5 mph and decrease the time 5 minutes, and wait 5 minutes if another code number follows. It could operate this way to allow another set of codes to change more features.

In this example, in response to the tracker receiving the system code **1**–**9**, the tracker sends an upstream code **7** to acknowledge receipt of the system code **1**–**9**. Upon receipt of code **9** the tracker waits up to 5 minutes to determine if another system code is received. If no code is received, then the tracker performs the code **9** operation. Of course, in other embodiments other features or settings can be selected.

In general, it may be preferred that the first code sent in a series of two codes, for example, be a code that causes only a minor function to be performed at the vehicle. This so because if the second code is sent from the monitoring station, but not received at the tracker, only a minor function is performed. For example, the first code may switch between armed and disarmed modes. This is in contrast to using a remote engine starting code or engine shutdown code as the first code. The vehicle may be moving or positioned in a marginal reception area, and the second command may not be received by the tracker within the predetermined time window. As will be appreciated by those skilled in the art, this concept of multiple digit codes, can be extended beyond two digits to three or more.

To further conserve cellular transmissions and as described above, the tracker may be set to record a position

based upon a determined event. Only this recorded position information may be downloaded either by user request or at set times. It is desired that such events be relatively few, but that the information still be helpful to the user.

For example, an event for recording of position may be determined based upon the vehicle being stopped for greater than a first time and less than a second time. For example, the first time may be 15 minutes and the second time may be 6 hours. Determination of the vehicle being stopped can be made based upon one or both of the GPS position or the vehicle ignition being turned off. The second time prevents the recording of position information when the vehicle is stopped at the owner's home during the evening, for example. Accordingly, the important information of the vehicle stops being made is recorded and made available to the user, while system communications resources are conserved.

In another example, if the mode is selected to send the vehicles location every 10 min and the vehicle is in the same location for greater than a set time, then no more vehicle locations are sent until the vehicle location has changed to start the every 10 min reporting again.

Other features relating to vehicle control systems are disclosed in copending patent applications entitled VEHICLE TRACKER INCLUDING STATIONARY TIME DETERMINATION AND ASSOCIATED METHODS, Ser. No. 09/859727, VEHICLE TRACKER CONSERVING CODES AND RELATED METHODS, Ser. No. 09/859673; VEHICLE TRACKER WITH POWER SAVING FEATURES AND RELATED METHODS, Ser. No. 09/859728; VEHICLE TRACKER COOPERATING WITH A STARTER INTERRUPT AND RELATED METHODS, Ser. No. 09/859973; VEHICLE TRACKER WITH USER NOTIFICATIONS AND ASSOCIATED METHODS, Ser. No. 09/859733; VEHICLE TRACKER WITH USER REGISTRATION REMINDER AND RELATED METHODS, Ser. No. 09/859971; VEHICLE TRACKER INCLUDING INPUT/OUTPUT FEATURES AND RELATED METHODS, Ser. No. 09/859972; and VEHICLE TRACKER WITH TEST FEATURES AND RELATED METHODS, Ser. No. 09/859729, the entire disclosures of which are incorporated herein by reference.

Many modifications and other embodiments of the invention will come to the mind of one skilled in the art having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Accordingly, it is understood that the invention is not to be limited to the embodiments disclosed, and that other modifications and embodiments are intended to be included within the spirit and scope of the appended claims.

That which is claimed is:

1. A vehicle tracking system comprising a vehicle tracking unit for a vehicle of a type comprising a vehicle alarm indicator, said vehicle tracking unit comprising

a vehicle position determining device,

a wireless communications device, and

a controller connected to said wireless communications device and said vehicle position determining device;

said controller cooperating with said wireless communications device to send an alarm indication alert based upon at least one of an activation of the vehicle alarm indicator continuously for greater than a predetermined time and an activation of the vehicle alarm indicator in a repetitive pattern; and

a monitoring station receiving the alarm indication alert from said vehicle tracking unit.

2. A vehicle tracking system according to claim **1** wherein said controller also cooperates with said vehicle position determining device and said wireless communications device to send vehicle position messages.

3. A vehicle tracking system according to claim **1** wherein said controller monitors drive signals to the vehicle alarm indicator.

4. A vehicle tracking system according to claim **1** wherein the drive signals have at least one of a first and second polarity.

5. A vehicle tracking system according to claim **1** wherein the vehicle alarm indicator comprises at least one of a vehicle horn, and a vehicle siren.

6. A vehicle tracking system according to claim **1** wherein said vehicle position determining device comprises a Global Positioning System (GPS) device.

7. A vehicle tracking system according to claim **1** wherein said wireless communications device comprises a cellular telephone communications device.

8. A vehicle tracking system according to claim **7** wherein said cellular telephone communications device communicates over a cellular control channel.

9. A vehicle tracking system according to claim **1** wherein said monitoring station comprises a user interface for accepting at least one command from a user and sending at least one alert to the user.

10. A vehicle tracking system according to claim **9** wherein said user interface comprises an Internet interface.

11. A vehicle tracking system according to claim **9** wherein said user interface comprises a telephone network interface.

12. A vehicle tracking unit for use with a vehicle comprising a vehicle alarm indicator, the vehicle tracking unit comprising:

a vehicle position determining device;

a wireless communications device; and

a controller connected to said wireless communications device and said vehicle position determining device;

said controller cooperating with said wireless communications device to send an alarm indication alert responsive to an activation of the vehicle alarm indicator continuously for greater than a predetermined time.

13. A vehicle tracking unit according to claim **12** wherein said controller further sends an alarm indication alert responsive to activation of the vehicle alarm indicator in a repetitive pattern.

14. A vehicle tracking unit according to claim **12** wherein said controller monitors drive signals to the vehicle alarm indicator.

15. A vehicle tracking unit according to claim **14** wherein the drive signals have at least one of a first and second polarity.

16. A vehicle tracking unit according to claim **12** wherein the vehicle alarm indicator comprises at least one of a vehicle horn, and a vehicle siren.

17. A vehicle tracking unit according to claim **12** wherein said vehicle position determining device comprises a Global Positioning System (GPS) device.

18. A vehicle tracking unit according to claim **12** wherein said wireless communications device comprises a cellular telephone communications device.

19. A vehicle tracking unit according to claim **18** wherein said cellular telephone communications device communicates over a cellular control channel.

20. A vehicle tracking unit for use with a vehicle comprising a vehicle alarm indicator, the vehicle tracking unit comprising:

a vehicle position determining device;

a wireless communications device; and

a controller connected to said wireless communications device and said vehicle position determining device;

said controller cooperating with said wireless communications device to send an alarm indication alert responsive to an activation of the vehicle alarm indicator in a repetitive pattern.

21. A vehicle tracking unit according to claim **20** wherein said controller monitors drive signals to the vehicle alarm indicator.

22. A vehicle tracking unit according to claim **21** wherein the drive signals have at least one of a first and second polarity.

23. A vehicle tracking unit according to claim **20** wherein the vehicle alarm indicator comprises at least one of a vehicle horn, and a vehicle siren.

24. A vehicle tracking unit according to claim **20** wherein said vehicle position determining device comprises a Global Positioning System (GPS) device.

25. A vehicle tracking unit according to claim **20** wherein said wireless communications device comprises a cellular telephone communications device.

26. A vehicle tracking unit according to claim **25** wherein said cellular telephone communications device communicates over a cellular control channel.

27. A method for operating a vehicle tracking unit for a vehicle of a type comprising a vehicle alarm indicator, the vehicle tracking unit comprising a vehicle position determining device, and a wireless communications device, the method comprising:

determining position information of the vehicle using the vehicle position determining device;

determining an alarm condition based upon at least one of an activation of the vehicle alarm indicator continuously for greater than a predetermined time and an activation of the vehicle alarm indicator in a repetitive pattern; and

sending an alarm indication alert from the wireless communications device responsive to determining the alarm condition and including vehicle position information.

28. A method according to claim **27** wherein determining the alarm condition comprises monitoring drive signals to the vehicle alarm indicator.

29. A method according to claim **28** wherein the drive signals have at least one of a first and second polarity.

30. A method according to claim **27** wherein the vehicle includes a vehicle battery; and wherein determining the alarm condition comprises monitoring voltage dips of the vehicle battery.

31. A method according to claim **27** wherein the vehicle alarm indicator comprises at least one of a vehicle horn, and a vehicle siren.

32. A method according to claim **27** wherein the vehicle position determining device comprises a Global Positioning System (GPS) device.

33. A method according to claim **27** wherein the wireless communications device comprises a cellular telephone communications device.

34. A method according to claim **33** wherein the cellular telephone communications device communicates over a cellular control channel.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

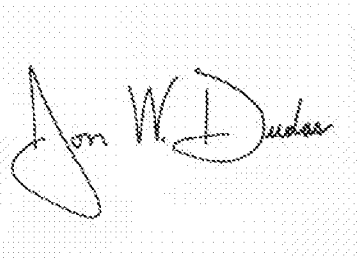
PATENT NO. : 7,149,623 B2
APPLICATION NO. : 10/383496
DATED : December 12, 2006
INVENTOR(S) : Flick

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 1, Line 40	Delete: "it used" Insert: --it is used--
Column 3, Line 40	Delete: "diagrams" Insert: --diagram--
Column 4, Line 42	Delete: "illustrated" Insert: --illustratively--
Column 5, Line 35	Delete: "will described" Insert: --will be described--
Column 6, Line 66	Delete: "of an vehicle" Insert: --of a vehicle--
Column 7, Line 28	Delete: "not operation" Insert: --not in operation--
Column 7, Line 65	Delete: "cause" Insert: --causes--

Signed and Sealed this

Seventh Day of August, 2007



JON W. DUDAS
Director of the United States Patent and Trademark Office

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent No. 8,032,278

Issued:	October 4, 2011	Reexamination Control No.:	Not Yet Assigned
Filed:	July 3, 2007	Examiner:	Nguyen, Cuong H.
Applicant:	Omega Patents, L.L.C.	Art Unit:	3661
Title:	Vehicle Tracking Unit with Downloadable Codes and Associated Methods		

Mail Stop "Ex Parte Re Examination"
Office of Patent Legal Affairs
ATTN: Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Request for *Ex Parte* Reexamination of U.S. Patent 8,032,278

TABLE OF CONTENTS

I. INTRODUCTION 1

II. THE CLAIMS OF THE FLICK '278 PATENT ARE NOT ENTITLED TO THE BENEFIT OF EARLIER PRIORITY DATES 4

A. New Material Added and Claimed in the Flick '278 Patent 4

B. Failure of the Flick '005 Provisional to Disclose Claims 1-22 6

C. Failure of the Flick '811 Provisional to Disclose Claims 1-22 7

D. Failure of Flick '597, Flick '623, and/or Flick '561 Patents to Disclose Claims 1-22 8

III. REEXAMINATION REQUEST SATISFIES REQUIREMENTS OF 37 C.F.R. § 1.510(B) 9

IV. RELATED LITIGATION 10

V. CITATION OF PERTINENT AND APPLICABLE PRIOR ART BELIEVED TO HAVE BEARING ON PATENTABILITY 10

VI. STATEMENTS POINTING OUT EACH SUBSTANTIAL NEW QUESTION OF PATENTABILITY 12

A. The Cell Port Labs Press Release, Spelt, Jones, and the SAE HS-3000 Manuals 13

1. Technological Teaching: A Mobile Network Server that Supports "Plug-and-Play" Multi-Vehicle Compatibility for Different Vehicles with a Downloading Interface and GPS 14

2. The Cell Port Labs Press Release, Spelt, Jones, and the SAE HS-3000 Manuals are Analogous Art to the Flick '278 Patent 20

3. Substantial New Question of Patentability as to Claims 1 through 22 20

B. U.S. Patent No. 6,430,164 to Jones et al. in view of the SAE HS-3000 Manuals 21

1. Technological Teaching: A Communication Apparatus with "Plug-and-Play" Multi-Vehicle Compatibility Embedded in Different Vehicles with a Downloading Interface and GPS 22

2. Jones is Analogous Art to the Flick '278 Patent 28

3. Substantial New Question of Patentability as to Claims 1 through 22 28

VII. PROPOSED REJECTIONS AND DETAILED EXPLANATIONS OF THE PERTINENCY AND MANNER OF APPLYING THE CITED PRIOR ART TO EVERY CLAIM FOR WHICH REEXAMINATION IS REQUESTED 29

A. Claims 1, 13, and 18 are Unpatentable over Cell Port Labs Press Release in combination with the inherent disclosure of Spelt and the SAE HS-3000 Manuals 30

B. Claims 1-22 are Unpatentable over Cell Port Labs Press Release in view of Spelt, Jones, and the SAE HS-3000 Manuals 40

C. Claims 1-22 are Unpatentable over Jones in combination with the inherent disclosure of the SAE HS-3000 Manuals 69

VIII. CONCLUSION 88

I. INTRODUCTION

CalAmp Corp. (hereinafter, "Requester") requests (hereinafter, "this Request") reexamination under 35 U.S.C. §§ 301-307 and 37 C.F.R. § 1.510 *et seq.* of claims 1 through 22 of U.S. Patent No. 8,032,278 (hereinafter, "Flick '278 patent"), a copy of which is attached as Exhibit A. The Flick '278 patent was filed July 3, 2007, and issued on October 4, 2011. Therefore, the Flick '278 patent falls within the pre-AIA statutory provisions[1]. The Flick '278 patent lists Kenneth E. Flick as the sole inventor, and is believed to be currently assigned to Omega Patents, L.L.C. (hereinafter, "Patent Owner"). Requester has previously requested *ex parte* reexamination of the Flick '278 patent. *See ex parte* Reexamination No. 90/013,587 (filed September 14, 2015 and concluding with a Reexamination Certificate being issued on December 28, 2016) (hereinafter, the "'278 First Reexam") and *ex parte* Reexamination No. 90/013,851 (filed October 28, 2016 and concluding with a Reexamination Certificate being issued on February 6, 2019) (hereinafter, the "'278 Second Reexam").

Requester submits that prior art references including the Cell Port Labs Press Release, Spelt, Jones, and others are material and raise substantial new questions regarding the patentability of the Flick '278 patent. Given that the Patent Owner was aware of the Cell Port Labs Press Release, Spelt, and Jones references at least as early as October 2017, Patent Owner's failure to cite the Cell Port Labs Press Release, Spelt, and Jones references in the '278 Second Reexam necessitates the filing of this additional Request. [2]

[1] All references to statutory language in this Request shall reference pre-AIA versions unless explicitly noted.

[2] The USPTO has previously noted Patent Owner's failure to file Information Disclosure Statements in compliance with its duty of disclosure according to MPEP § 2001 in *ex parte* reexaminations. *See* Final Rejection dated July 19, 2017 in the '278 First Reexam ("it is noted that the Chou '499 reference is not of record in any of the related copending reexaminations.").

The Cell Port Labs Press Release, Spelt, and Jones establish that, more than a year prior to the earliest priority date of the Flick '278 patent, the Society of Automotive Engineers was providing demonstrations of multi-vehicle compatibility and hosting competitions for companies to demonstrate the extent of their device's multi-vehicle compatibility. *See generally*, Spelt (disclosing the Demo98 demonstration conducted by the SAE with automotive manufacturers and industry participants, including Cell Port Labs). The materiality of the Cell Port Labs Press Release, Spelt, and Jones references is highlighted by the fact that they were relied upon to issue Final Rejections in the *ex parte* reexamination proceedings of two of Patent Owner's other patents claiming similar subject matter, U.S. Patent No. 6,346,876 (*see* Final Rejection dated November 16, 2018 and subsequent Advisory Actions dated January 29, 2019 and March 29, 2019 in Control No. 90/014,122, filed April 19, 2018) (the "Flick '876 Reexam") and U.S. Patent No. 6,756,885 (*see* Final Rejection dated November 9, 2018 and subsequent Advisory Action dated February 4, 2019 in Control No. 90/014,038, filed October 26, 2017) (the "Flick '885 Reexam").

In addition, Requester notes that the "Background of the Invention" section of the Flick '278 patent acknowledges that the "multi-vehicle compatible controller" and "downloading interface for permitting downloading of enabling data" recited in the claims of the Flick '278 patent were known at the time of the filing of the Flick '278 patent. Specifically, patents including U.S. Patent No. 5,719,551, which issued February 17, 1998, and U.S. Patent No. 6,756,885 are identified as Applicant Admitted Prior Art disclosing the claimed "multivehicle compatible controller" and "downloading interface". The novelty of the Flick '278 patent is asserted as being the incorporation of these prior art techniques into vehicle tracking units:

> "A number of patents disclose various security and control systems that address data bus interoperability. For example, **U.S. Pat No. 5,719,551, assigned**

> **to Omega Patents, LLC, the assignee of the present invention, discloses a vehicle security system for a vehicle including a data bus connecting a plurality of vehicle devices**. A signal enabling circuit enables the alarm controller to operate using a set of desired signals selected from a plurality of possible sets for different vehicles. **U.S. Pat. No. 6,011,460, assigned to Omega Patents, LLC, discloses a similar system where the set of desired signals from the plurality of different sets of signals for different vehicles is obtained, such as by connection and communication with a downloading device**. Additionally, **U.S. Pat. No. 6,756,885, also assigned to Omega Patents, LLC, discloses a multi-vehicle control system whereby a multi-vehicle compatible controller stores a set of device codes for a given vehicle device for a plurality of different vehicles.** Device codes are read from the data communications bus, and a match between a read device code and the stored device codes is determined to provide compatibility with different vehicles.
>
> **Unfortunately, such advanced techniques for dealing with multiple device codes for a vehicle having a data communications bus have not yet been developed for vehicle tracking units**."

Flick '278 patent, col. 2, lines 17-41 (emphasis added).

The Final Rejection of the Flick '885 patent based upon vehicle tracking prior art demonstrates the obviousness of incorporating the previously known "multi-vehicle compatible controller" and "downloading interface" claimed in the Flick '278 patent into vehicle tracking units. Accordingly, the Cell Port Labs Press Release, Spelt, and Jones necessarily present previously-considered prior art references in a new light by conclusively establishing that persons of ordinary skill in the art during the relevant time period were motivated to achieve multi-vehicle compatibility and did in fact incorporate the claimed "multi-vehicle compatible controller" and "downloading interface for permitting downloading of enabling data" into vehicle tracking units. *See, e.g.*, Final Rejection dated November 9, 2018 from the Flick '885 Reexam.

Finally, Requester submits that the Flick '278 patent is not entitled to its priority date, and that the earliest priority date the Flick '278 patent is entitled to is July 3, 2007.

II. THE CLAIMS OF THE FLICK '278 PATENT ARE NOT ENTITLED TO THE BENEFIT OF EARLIER PRIORITY DATES

Before discussing newly identified prior art references that raise additional substantial new questions of patentability with respect to claims 1 - 22 of the Flick '278 patent, Requester observes that claims 1 through 22 of the Flick '278 patent are not entitled to the benefit of the priority dates of any of the applications to which the Flick '278 claims priority.

The Patent Office has previously determined that the priority date of the Flick '278 patent is July 3, 2007 in the '278 First Reexam. *See* Reexam – NonFinal Action, dated May 6, 2016 p. 2 ("The Flick '278 Patent is a continuation in part of application 11/076,259. This parent application did not disclose or claim the multi-vehicle capability and the bus extending throughout the vehicle as described and claimed in the Flick '278. Accordingly, the earliest effective filing date for Flick '278 is July 3, 2007."). This determination of priority date by the Patent Office does not appear to have been disputed by the Patent Owner in any later events in the '278 First Reexam. Subsequently, the Patent Office reaffirmed this priority date in the '278 Second Reexam. *See* Determination – Reexam Ordered, dated December 15, 2016, p. 5 ("The earliest effective filing date the '278 patent is entitled to is July 3, 2007 (see paragraph 2 of the 5/6/2016 non-final rejection of the 90/013,587 discussed infra)."). Accordingly, Requester respectfully agrees for the reasons set out below.

A. *New Material Added and Claimed in the Flick '278 Patent*

MPEP § 201.08 states "[a] continuation-in-part is an application filed during the lifetime of an earlier nonprovisional application, repeating some substantial portion or all of the earlier nonprovisional application and adding matter not disclosed in the said earlier nonprovisional application." MPEP § 211.05(B) states "[o]nly the claims of the continuation-in-part application

that are disclosed in the manner provided by 35 U.S.C. § 112(a) in the prior-filed application are entitled to the benefit of the filing date of the prior-filed application. If there is a continuous chain of copending nonprovisional applications, each copending application must disclose the claimed invention of the later-filed application in the manner provided by 35 U.S.C. § 112(a) in order for the later-filed application to be entitled to the benefit of the earliest filing date." Priority is claimed in the Flick '278 patent as follows (notations added in parenthesis):

> "The present application is a continuation-in-part of U.S. patent application Ser. No. 11/076,259 filed Mar. 9, 2005 now U.S. Pat. No. 7,720,597 (the Flick '597 patent, Exhibit L), which is a continuation of U.S. patent application Ser. No. 10/383,496 filed Mar. 7, 2003 now U.S. Pat. No. 7,149,623 (the Flick '623 patent, Exhibit M), which is a continuation of U.S. patent application Ser. No. 09/859,972 filed on May 17, 2001 now U.S. Pat. No. 6,606,561 (the Flick '561 patent, Exhibit N) which, in turn, was based upon provisional patent application Ser. Nos. 60/264,811 filed on Jan. 29, 2001 (the Flick '811 provisional, Exhibit O); 60/258,005, filed Dec. 22, 2000 (the Flick '005 provisional, Exhibit P); 60/251,552, filed Dec. 6, 2000 (the Flick '552 provisional, Exhibit Q); 60/252, 125, filed Nov. 20, 2000 (the Flick '125 provisional, Exhibit R); 60/236,890, filed Sep. 29, 2000 (the Flick '890 provisional, Exhibit S); 60/246,463, filed Nov. 7, 2000 (the Witham provisional, Exhibit T); 60/222,777, filed Aug. 3, 2000 (the Flick '777 provisional, Exhibit U); and 60/205,178, filed May 17, 2000 (the Flick '178 provisional, Exhibit V), the entire contents of each of which are incorporated herein by reference."

Requester notes that FIGS. 10 - 15 and the accompanying discussion beginning on col. 23, line 41 first appear in the Flick '278 patent. Specifically, claim 1 of the Flick '278 patent requires a "multi-vehicle compatible controller to be coupled to the vehicle data bus **for communication thereover with at least one vehicle device using at least one corresponding vehicle device code** from among a plurality thereof for different vehicles" and further requires "a downloading interface for permitting downloading of **enabling data related to the at least one corresponding vehicle device code** for use by said multi-vehicle compatible controller." Flick '278 patent, claim 1 (emphasis added). Similar language appears in independent claims 13 and 18 of the Flick '278 patent. Requester notes that support for the

cited aspects of claim 1 first appear in FIGS. 10 - 15 and col. 24, line 41 through col. 25, line 13 of the Flick '278 patent. None of the figures or the associated disclosure appears in any of the applications to which the Flick '278 patent claims priority.

B. ***Failure of the Flick '005 Provisional to Disclose Claims 1-22***

The Flick '005 provisional (filed Dec. 22, 2000) contains the following disclosure (notations added in parenthesis):

> "In all of the embodiments and variations described herein, the tracking device may communicate with one or more other vehicle devices via a vehicle data communications bus. Further aspects of interfacing with a vehicle data communications bus are described in U.S. Patent Nos. 5,719,551 and 6,011,460 assigned to the assignee of the present invention." (Flick '005 provisional, p. 35, lines 22 - 29).

To the extent Patent Owner may attempt to utilize the disclosure of the Flick '551 patent or the Flick '460 patent to support the cited claim language, Requester respectfully notes that MPEP § 608.01 states:

> "Mere reference to another application, patent, or publication is not an incorporation of anything therein into the application containing such reference for the purpose of the disclosure required by 35 U.S.C. 112. In re de Seversky, 474 F.2d 671, 177 USPQ 144 (CCPA 1973). 37 CFR 1.57(c)(1) limits a proper incorporation by reference (except as provided in 37 CFR 1.57(b)) to instances only where the perfecting words "incorporated by reference" or the root of the words "incorporate" (e.g., incorporating, incorporated) and "reference" (e.g., referencing) appear."

Accordingly, the disclosures of the Flick '551 patent and the Flick '460 patent do not form part of the disclosure of the Flick '005 provisional. The Flick '005 provisional does not make any statements attempting to incorporate the disclosure of either the Flick '551 patent or the Flick '460 patent by reference in a manner satisfying the requirements of 37 CFR § 1.57.

Despite generally referencing that "the tracking device may communicate with one or more other vehicle devices via a vehicle data communications bus," Applicant respectfully

submits that the Flick '005 provisional does not provide written description support for claims 1 - 22 of the Flick '278 patent. Specifically, the Flick '005 provisional fails to disclose a "multi-vehicle compatible controller to be coupled to the vehicle data bus for communication thereover with at least one vehicle device using at least one corresponding vehicle device code from among a plurality thereof for different vehicles" and "a downloading interface for permitting downloading of enabling data related to the at least one corresponding vehicle device code for use by said multi-vehicle compatible controller." Accordingly, claims 1 - 22 of the Flick '278 patent are not entitled to the benefit of the filing date of the Flick '005 provisional.

C. ***Failure of the Flick '811 Provisional to Disclose Claims 1-22***

The Flick '811 provisional (filed Jan. 29, 2001) makes the following statement regarding communicating via a vehicle data communication bus, similar to that made in the Flick '005 provisional:

> "In all of the embodiments and variations described herein, the tracking device may communicate with one or more other vehicle devices via a vehicle data communications bus. Further aspects of interfacing with a vehicle data communications bus are 15 described in U.S. Patent Nos. 5,719,551 and 6,011,460 assigned to the assignee of the present invention." (Flick '811 provisional, p. 35, lines 10 - 16).

For reasons including those stated above with respect to the Flick '005 provisional, Requester respectfully submits that the '811 provisional fails to provide written description support for claims 1 - 22 of the Flick '278 patent for reasons including that the Flick '811 provisional does not disclose a "multi-vehicle compatible controller to be coupled to the vehicle data bus for communication thereover with at least one vehicle device **using at least one corresponding vehicle device code from among a plurality thereof for different vehicles**" or "a downloading interface for permitting downloading of **enabling data related to the at least**

one corresponding vehicle device code for use by said multi-vehicle compatible controller." Accordingly, claims 1 - 22 of the Flick '278 patent are not entitled to the benefit of the filing date of the Flick '811 provisional.

D. *Failure of Flick '597, Flick '623, and/or Flick '561 Patents to Disclose Claims 1-22*

As outlined above, claims 1 - 22 of the Flick '278 patent are not entitled to the benefit of the priority dates of any of the provisional applications to which the Flick '278 patent claims priority. Requester is also unable to locate any language or support in any of the Flick '597 patent, Flick '623 patent, and/or Flick '561 patent for the language of claims 1 - 22 of the Flick '278 patent. Additionally, Applicant respectfully notes that no attempt to incorporate the Flick '551 or Flick '460 patents by reference is made in the Flick '597 patent, the Flick '623 patent, or the Flick '561 patent.

As noted above, claims 1 - 22 of the Flick '278 patent rely upon new figures and disclosure first added to the Flick '278 patent for support. None of the Flick '597, Flick '623, or Flick '561 patents disclose a "multi-vehicle compatible controller to be coupled to the vehicle data bus for communication thereover with at least one vehicle device using at least one corresponding vehicle device code from among a plurality thereof for different vehicles" or "a downloading interface for permitting downloading of enabling data related to the at least one corresponding vehicle device code for use by said multi-vehicle compatible controller." Accordingly, Requester respectfully submits that claims 1 - 22 of the Flick '278 patent are not entitled to claim priority to the filing dates of the Flick '597 patent, the Flick '623 patent, or the Flick '561 patent. Thus, Requester submits that the earliest priority date to which any of claims 1 - 22 of the Flick '278 patent are entitled to is July 3, 2007 (i.e. the filing date of the Flick '278 patent).

III. REEXAMINATION REQUEST SATISFIES REQUIREMENTS OF 37 C.F.R. § 1.510(B)

37 C.F.R. § 1.510(b)(1): A statement of each substantial new question of patentability with respect to the relevant prior patents and printed publications is provided in Section VI of this Request.

37 C.F.R. § 1.510(b)(2): Reexamination of claims 1 through 22 of the Flick '278 patent is requested as discussed in Section VI. A detailed explanation of the proper application of the prior art to each claim element accompanied with a set of proposed rejections based on such application is provided in Section VII by reference to the claim charts in Exhibits D and E.

37 C.F.R. § 1.510(b)(3): This reexamination request is based on the prior art references listed below and attached as Exhibits listed in Section V of this Request. A copy of every patent or printed publication relied upon is attached as an Exhibit and is listed in a PTO/SB/42 form submitted herewith, with the exception of U.S. Patents which are listed in the PTO/SB/42 form only per "Best Practices and FAQs for filing requests for reexamination complaint with 37 C.F.R. 1.510 and 1.915" dated May 2010.

37 C.F.R. § 1.510(b)(4): A copy of the Flick '278 patent is attached as Exhibit A. A copy of the reexamination certificate from the '278 First Reexam is attached as Exhibit B, and a copy of the reexamination certification from the '278 Second Reexam is attached as Exhibit C.

37 C.F.R. § 1.510(b)(5): A certificate of service confirming service of this reexamination request in its entirety on the attorney of record is provided on the last page of this reexamination request.

37 C.F.R. § 1.510(b)(6): Requester hereby certifies that the statutory estoppel provisions of 35 U.S.C. § 315(e)(1) or 35 U.S.C. § 325(e)(1) do not prohibit the requester from filing the *ex parte* reexamination request.

The fee for this Request has been paid by credit card as part of the EFS-WEB submission.

IV. RELATED LITIGATION

To the best of Requester's knowledge, Patent Owner has asserted the Flick '278 patent in the following related prior or co-pending litigation:

- Omega Patents, LLC v. Enfora, Inc., N.D. Ga, No. 1:13-cv-00646-TWT;
- Omega Patents, LLC v. Enfora, Inc., N.D. Ga, No. 1:17-cv-02769-TWT; and
- Omega Patents, LLC v. CalAmp Corp., M.D. Fla., Orlando Division, No. 6:-13-cv-1950-PGB-DAB ("the CalAmp litigation").

The United States Court of Appeal for the Federal Circuit recently issued its decision on the appeal for the CalAmp litigation on April 8, 2019. *Omega Patents, LLC v. CalAmp Corp.*, No. 2018-1309 (Fed. Cir. Apr. 8, 2019) (attached as Exhibit W). In its decision, the Federal Circuit vacated the judgment of infringement as to all of the asserted claims of the Flick '278 patent[3] as against CalAmp and remanded for a new trial. *See id.* at pp. 18, 26.

V. CITATION OF PERTINENT AND APPLICABLE PRIOR ART BELIEVED TO HAVE BEARING ON PATENTABILITY

As explained in detail in this Request, the following prior art references, as they would have been understood by one of ordinary skill in the art at the time of the invention of the Flick '278 patent, raise substantial new questions of patentability with respect to claims 1 through 22. Reexamination of claims 1 through 22 is therefore respectfully requested. The prior art references relied upon in this Request that raise new questions of patentability are as follows:

[3] The Federal Circuit also reversed the judgment of direct infringement as to all asserted claims of Omega's U.S. Patent No. 6,346,876 and U.S. Patent No. 6,756,885. *Id.* at 26. The Court also set aside the judgment of infringement as to original claims 1 and 10 of Omega's U.S. Patent No. 7,671,727. *Id.*

Title	Hereinafter
U.S. Patent No. 6,430,164 to Jones et al. (issued August 6, 2002)	"Jones" (Exhibit I)
"CellPort Delivers Wireless, Vehicle-Based Applications Platform; Announces CP2100 Mobile Network Server" (published on July 26, 1999)	"Cell Port Labs Press Release" (Exhibit F)
"A Demonstration Project for the ITS Data Bus Prototype" (published in 1998)	"Spelt" (Exhibit G)
"Prep for a Multimedia Future" (published on Aug. 19, 1999)	"Auto Electronics publication" (Exhibit H)
"SAE On-Board Diagnostics for Light and Medium Duty Vehicles Standards Manual" (with 1994 and 1997 publication dates)	"1994 SAE HS-3000 Manual" (Exhibit J) "1997 SAE HS-3000 Manual" (Exhibit K)

Requester submits that the references listed in the table above raise substantial new questions of patentability of the claims of the Flick '278 patent. In particular, the Cell Port Press Release (including its inherent disclosure of Spelt) and Jones, which are prior art patents or publications that have not previously been considered in evaluating the validity of the claims of the Flick '278 patent, disclose each and every limitation of the independent claims of the Flick '278 patent.

The 1994 SAE HS-3000 Manual and the 1997 SAE HS-3000 Manual were considered during the '278 Second Reexam. Aside from these, none of the other references listed in the

table above were considered during either the '278 File History, the '278 First Reexam, or the '278 Second Reexam.

With respect to previously-considered prior art references, MPEP § 2258.01 states: "If the rejection to be made by the examiner will be based on a combination of 'old art' and art newly cited during the reexamination proceeding, the rejection is proper, and should be made. *See In re Hiniker*, 150 F.3d at 1367, 47 USPQ2d at 1527. (Court held the reexamination proceeding was supported by a substantial new question of patentability where the rejection before the court was based on a combination of art that had been before the examiner during the original prosecution, and art newly cited during the reexamination proceeding.)." Accordingly, the 1994 and 1997 SAE HS-3000 Manuals, when viewed with the Cell Port Labs Press Release, Spelt, and the Jones references, are presented in a new light and raise a substantial new question of patentability.

In view of the above, Requester submits that the prior art references submitted herein present substantial new questions as to the patentability of the Flick '278 patent.

VI. STATEMENTS POINTING OUT EACH SUBSTANTIAL NEW QUESTION OF PATENTABILITY

As explained in greater detail below, the references listed in the table above, either alone or in combination, raise substantial new questions of patentability not previously considered or addressed in the prior examination of the Flick '278 patent. More specifically, the Cell Port Labs Press Release (including the inherent disclosure of Spelt) and Jones individually anticipate at least the independent claims of the Flick '278 patent. Thus, the Cell Port Labs Press Release, Spelt, and Jones in combination with the other references listed in the table above, raise

substantial new questions of patentability not previously considered or addressed in the prior examination of the Flick '278 patent.

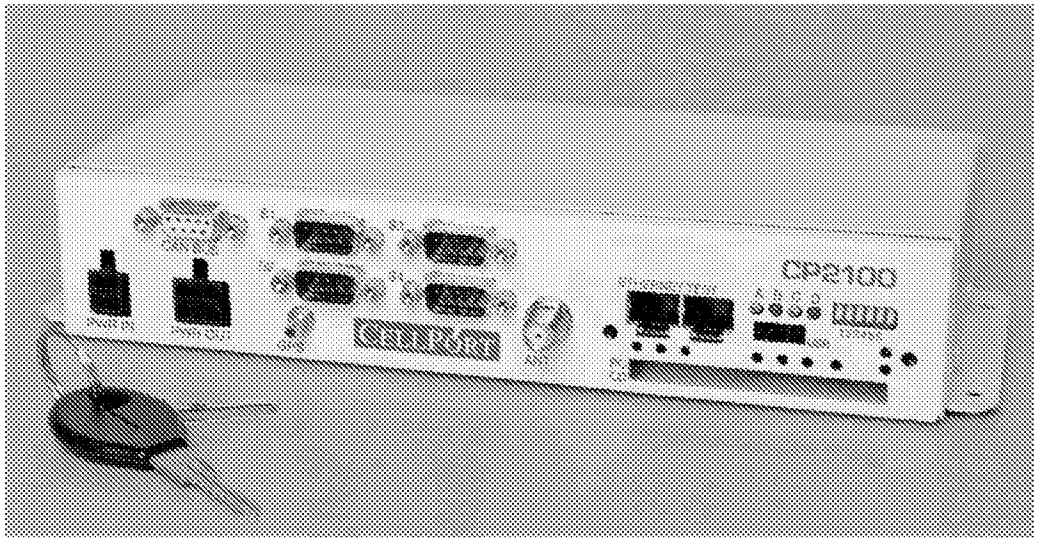
A. ***The Cell Port Labs Press Release, Spelt, Jones, and the SAE HS-3000 Manuals***

The Cell Port Labs Press Release was published on July 26, 1999. Spelt was published in 1998 by Spelt et al. The SAE HS-3000 Manuals (with 1994 and 1997 publication dates) set forth various standards, each under a particular SAE heading number, related to vehicle control systems that communicate with vehicle devices on a vehicle bus to obtain diagnostic information. Therefore, the Cell Port Labs Press Release, Spelt, and the SAE HS-3000 Manuals are prior art to the Flick '278 patent under pre-AIA 35 U.S.C. § 102(a) and (b). U.S. Patent No. 6,430,164 to Jones et al. was filed November 1, 1999, and issued August 6, 2002, and therefore Jones is prior art to the Flick '278 patent under pre-AIA 35 U.S.C. § 102(a), (b), and/or (e).

The Cell Port Labs, Spelt, and Jones references were not considered during the prosecution of the Flick '278 patent or the now-concluded '278 First and Second Reexams. The SAE HS-3000 Manuals were considered during the '278 Second Reexam, but are now being presented in a new light in view of the Cell Port Labs Press Release, Spelt, and Jones. These references provide a new technological teaching that raises a substantial new question of patentability.

1. Technological Teaching: A Mobile Network Server that Supports "Plug-and-Play" Multi-Vehicle Compatibility for Different Vehicles with a Downloading Interface and GPS

Cell Port Labs, Inc. (hereinafter, "Cell Port Labs") developed the CP2100 which was "a mobile network server designed to enable bi-directional data communications and network management functions within vehicles and provide real-time, wireless connectivity between vehicles and remote applications." CellPort Delivers Wireless, Vehicle-Based Applications Platform; Announces CP2100 Mobile Network Server, PRNEWSWIRE, July 26, 1999 (hereinafter, "Cell Port Labs Press Release"). A photo of the CP2100, reproduced below, illustrates the control system is for a vehicle that includes a vehicle data bus extending throughout the vehicle.



Prices for CellPort Labs' CP2100 Mobile Network Server start at $995, including interfaces to vehicle networks, such as CAN and J1850, and to wireless networks, such as cellular, paging, and personal communications systems.

Maury Wright, *Prep for a Multimedia Future*, EDN MAGAZINE, Aug. 19, 1999, at 84 (illustrating photo of CP2100) (hereinafter, "Auto Electronics publication").

As can be seen from the picture above, the CP2100 interfaces to vehicle data buses (vehicle networks) such as the CAN and J1850. Furthermore, the Cell Port Labs Press Release discloses that "CellPort offers the first commercial product designed specifically to manage the growing list of in-vehicle networks, including IDB, CAN, USB and more." Cell Port Labs Press Release. The Cell Port Labs Press Release also discloses that the "CP2100 supports a variety of emerging vehicle bus interfaces, including IDB, J1708, J1850, CAN and ODBII". Cell Port Labs Press Release.

Additionally, the Cell Port Labs Press Release notes that Cell Port Labs was a participant in the IDB Demonstration Program, whereby it "provided connectivity to the Internet for many IDB-based vehicle systems on three IDB demonstration vehicles." Cell Port Labs Press Release. As discussed below, the IDB demonstration involved demonstrating the capability of the CP2100 utilizing the bus discovery protocols contained within the SAE standards disclosed in the 1994 and 1997 SAE HS-3000 Manuals to provide "plug-and-play" connectivity with a Chrysler Concorde LXi, a Cadillac SLS, and a Ford Lincoln Continental via the OBD-II connector contained within each of the vehicles. See Spelt, p. I22-2.

The publication titled "A Demonstration Project for the ITS Data Bus Prototype" published in 1998 by Spelt *et al*. provides details regarding the IDB Demonstration Program noted in the Cell Port Labs Press Release. Philip F. Spelt & Allan M. Kirson, *A Demonstration Project for the ITS DATA Bus Prototype*, DIGITAL AVIONICS SYSTEMS CONFERENCE, 1998. PROCEEDINGS., 17TH DASC. Oct. 31-Nov. 7, 1998, Print ISBN: 0-7803-5086-3 (hereinafter, "Spelt").

Spelt discloses that Cell Port Labs, Inc. was a company participant in the IDB Demo98 project. Spelt, p. I22-3, Table 1. Furthermore, Spelt discloses that the goal of the Demo98 project

was "to demonstrate several of the functional requirements and capabilities of the IDB. These include 'hot plug-and-play of devices, interoperability of a device in different vehicles, and the information-sharing capacity of devices connected to the IDB." Spelt, p. I22-1 (emphasis added). As discussed above, other "[c]ompanies participating in Demo98 include the United States 'Big Three' automobile manufacturers: Chrysler (Concorde LXi), General Motors (Cadillac SLS), and Ford (Lincoln Continental)." Spelt, p. I22-2.

Additionally, Spelt elaborates on one of the important objectives of the Demo98 project: "The Plug-and-Play Scenario is the most fundamental and general of the four scenarios developed for Demo98. It is intended to demonstrate the IDB characteristics of 'hot plug-and-play' and the as can reasonably be shown with the devices provided by the participants. Thus, as the title implies, the hot plug-and-play capabilities of the IDB protocol are shown by inserting and removing devices while the IDB is alive and functioning. This demonstrates the inherent reconfigurability designed into the IDB protocol, by showing that current devices, which may have depended on another no longer available device, will still function on the IDB." Spelt, p. I22-2.

The "SAE On-Board Diagnostics for Light and Medium Duty Vehicles Standards Manual" (with 1994 and 1997 publication dates; hereinafter, "1994 SAE HS-3000 Manual" and "1997 SAE HS-3000 Manual") provides the implementation details and recommended practices of the J1708, J1850 and OBD-II Scan Tool bus interfaces. In particular, the SAE HS-3000 Manual discloses that a device code on the vehicle data bus can be an SAE standard and/or one of seven manufacturer specific version of the device code. *See e.g.*, 1994 SAE HS-3000 Manual, p. 213, Section 4 of SAE J2178/2. Furthermore, the 1994 and 1997 SAE HS-3000 Manuals disclose a bus discovery process involving reading different versions of a mode 1 PID 0 device

code from the data communications bus and determining a match between a read device code and a plurality of stored device codes. *See e.g.*, 1994 SAE HS-3000 Manual, p. 37, section 6.5.2 INITIALIZATION DETAILS of SAE J1978. It is the implementation of this standard that enables the CP2100 to have the "hot plug-and-play" capabilities demonstrated in the SAE IDB Demo98 Demonstration Program in which the ability of the CP2100 to perform bus discovery to connect and communicate with a Chrysler Concorde LXi, a Cadillac SLS, and a Ford Lincoln Continental via the OBD-II connector of each vehicle was demonstrated. *See also*, Final Rejection dated November 9, 2018 of the Flick '885 Reexam, p. 6 (Control No. 90/014038) ("it would have been obvious to add the teaching of the 1994 and 1997 SAE HS-3000 Manuals, which support the J1850 vehicle bus standard and OBD-II bus discovery protocol and which describes a bus discovery process that reads a device code from the data communications bus and determines a match between a read device code and the stored device codes." [citations omitted]; *see also* pp. 12-14).

The Cell Port Labs Press Release also discloses that the CP2100 is a multi-vehicle compatible controller cooperating with a wireless communications device by disclosing that the CP2100 includes "protocol conversion for a variety of vehicle buses and devices, wireless gateway communications independent of wireless links, and embedded application router management capabilities." Cell Port Labs Press Release. The Cell Port Labs Press Release discloses that the CP2100 allows vehicle manufacturers and other entities to "connect a wide range of vehicles to their networks, including Extranets, Intranets, and Internet sites." Cell Port Labs Press Release. Moreover, the CP2100 overcomes a major obstacle – "that of integrating various data management functions within the vehicle and linking them with a centralized application via wireless communication networks." Cell Port Labs Press Release. The Cell Port

Labs Press Release states that the CP2100 "provide[s] real-time, wireless connectivity between vehicles and remote applications" and that the CP2100's "[w]ireless airlink capabilities include cellular, spread spectrum radio, satellite and private radio." *Id.*

The Cell Port Labs Press Release further discloses a vehicle position determining device, stating that "[d]ata from the host can be sent to the vehicle to communicate with the operator, **provide GPS information**, run diagnostic routines, reconfigure data collection routines, download code and run executable software." Cell Port Labs Press Release (emphasis added).

The Cell Port Labs Press Release also discloses a downloading interface for downloading enabling data related to the corresponding vehicle device code by disclosing that "[d]ata from the host can be sent to the vehicle to communicate with the operator, provide GPS information, **run diagnostic routines, reconfigure data collection routines, download code and run executable software**." Cell Port Labs Press Release (emphasis added). This ability to download code and run executable software allows the CP2100 to communicate with multiple types of vehicles. Furthermore, in "run[ning] diagnostic routines" and "reconfigur[ing] data collection routines," the CP2100 necessarily must perform the bus discovery protocol (see, e.g., 1994 SAE HS-3000 Manual, page 37, section 6.5.2 INITIALIZATION DETAILS of SAE J1978) involving inspecting vehicle device codes to identify the particular type of vehicle and vehicle bus protocols that it utilizes. Once the bus discovery protocol is performed, the CP2100 identifies the type of vehicle to the remote host. The remote host then provides enabling data to configure the CP2100 to use appropriate device codes to run diagnostic routines and perform data collection routines for that specific type of vehicle.

Jones discloses the downloading interface for permitting downloading of enabling data related to the vehicle device code by disclosing that "the portal apparatus facilitates downloading

of software configurations and updates to each communications apparatus in the vehicles of the particular fleet, as well as **facilitating the obtaining of vehicle operational data and other information including diagnostic data and status information including fault-related data**." Jones, 4:1-6 (emphasis added). In other words, Jones discloses enabling data and directing which vehicle device codes to use to obtain vehicle operational data, diagnostics data, status and fault related data for a particular type of vehicle. For example, Figure 2 of Jones shows the configuration packet 300 containing an OBD-II field which requires a number of fields "to identify the particular subsystem from which [vehicle operational] data is being requested" from OBD-II subsystem 32, where said fields are configured in configuration packet 300 according to the particular vehicle device codes that are used for that particular vehicle. Jones, 15:32-37.

Jones also discloses that the downloading of updates includes enabling data with respect to specific vehicle devices to enable "plug and play" without any requirement to modify the vehicle device for communication with the CP2100 (i.e. the CP2100 achieves its "plug and play" capability by downloading the device codes and protocols necessary to communicate with the device). For example, Jones discloses that "[b]ased on the foregoing summary, a number of salient aspects of the present invention are readily identified. **Transfers of information including data relative to different devices, buses and/or networks are substantially seamlessly achieved**. Such transfers can be accomplished among these different subsystems without requiring that they be modified, thereby achieving a **"plug and play"** result. The disparate subsystems include protocol dependent components as well as close-ended devices at which data flow originates or is terminated, such as a GPS." Jones, 4:7-15 (emphasis added).

Jones also discloses, generally, a detailed process for maintenance and/or configuration updates for the plurality of vehicle device codes, whereby reconfiguring or updating software on

the communications apparatuses 22 is "preferably sent as a single file from the portal apparatus 310 to one or more selected communications apparatuses 22 through the wireless network 314." Jones, 20:37-39; *see also generally*, 19:60-21:46. Once these vehicle device codes are received, "the configuration manager 180 is responsible for extracting changes from the configuration in the file and applying them to the communications apparatus 22 in a shadow or mirror form." *Id.* at 20:54-58.

2. The Cell Port Labs Press Release, Spelt, Jones, and the SAE HS-3000 Manuals are Analogous Art to the Flick '278 Patent

The Cell Port Labs Press Release, Spelt, Jones, and the SAE HS-3000 Manuals are analogous art because they are in the same field of endeavor as the Flick '278 patent, namely vehicle monitoring and tracking units, and more specifically, vehicle tracking devices that can be installed in vehicles, communicate with vehicle devices via a vehicle bus using vehicle codes from among a plurality of vehicle codes for different vehicles, communicate with vehicle position determining devices, and download data related to the vehicle device codes. *See In re Klein*, 647 F.3d 1343, 1349 (Fed. Cir. 2011) (noting that a reference is analogous when "the art is from the same field of endeavor, regardless of the problem addressed...").

3. Substantial New Question of Patentability as to Claims 1 through 22

Each of claims 1 through 22 require at least: a vehicle data bus, a vehicle position determining device, a wireless communications device, a multi-vehicle compatible controller, and a downloading interface for permitting downloading of enabling data. As shown above, the Cell Port Labs Press Release in combination with Spelt, Jones, and the SAE HS-3000 Manuals disclose these limitations, and more detail is shown in the claim chart attached as Exhibit D.

Accordingly, it is submitted that:

- All aspects of claims 1, 13, and 18 are disclosed by the Cell Port Labs Press Release in view of Spelt and the SAE HS-3000 Manuals.
- All aspects of claims 1-22 are disclosed by the Cell Port Labs Press Release in view of Spelt, Jones, and the SAE HS-3000 Manuals.

As shown above, a reasonable examiner would consider the teachings of the Cell Port Labs Press Release, Spelt, the SAE HS-3000 Manuals, and Jones important in deciding whether or not claims 1 through 22 of the Flick '278 patent are patentable. For these reasons, the Cell Port Labs Press Release (with the inherent disclosure of Spelt) in combination with the SAE HS-3000 Manuals raise a substantial new question of patentability with respect to the claims of the Flick '278 patent. Additionally, the Cell Port Labs Press Release (with the inherent disclosure of Spelt) in combination with Jones and the SAE HS-3000 Manuals raise a substantial new question of patentability with respect to the claims of the Flick '278 patent.

B. ***U.S. Patent No. 6,430,164 to Jones et al. in view of the SAE HS-3000 Manuals***

U.S. Patent No. 6,430,164 to Jones et al. was filed November 1, 1999, and issued August 6, 2002, and therefore Jones is prior art to the Flick '278 patent under 35 U.S.C. § 102(a), (b), and/or (e). This reference was not considered during the prosecution of the Flick '278 patent or the '278 First and Second Reexams. This reference provides a new technological teaching that raises a substantial new question of patentability.

1. Technological Teaching: A Communication Apparatus with "Plug-and-Play" Multi-Vehicle Compatibility Embedded in Different Vehicles with a Downloading Interface and GPS

Jones was filed by inventors Marc Jones, Charles Spaur, Michael Tibbets, and Patrick Kennedy on November 1, 1999, and then assigned to Cell Port Labs on October 26, 1999 (recorded on Nov. 1, 1999, Reel No. 010357, Frame 0498). Jones was issued from a patent application based upon the CP2100 and which was assigned to Cellport Systems, Inc. of Boulder, Colorado (i.e., Cell Port Labs, the company disclosed in the Cell Port Labs Press Release).

Jones teaches a vehicle tracking system for a vehicle comprising a vehicle data bus (e.g., IDB 28, OBD-II 32, CAN 36, and Standard Serial Bus 44) extending throughout the vehicle. Jones also teaches at least one vehicle device (e.g., Nodes 80b-80h).

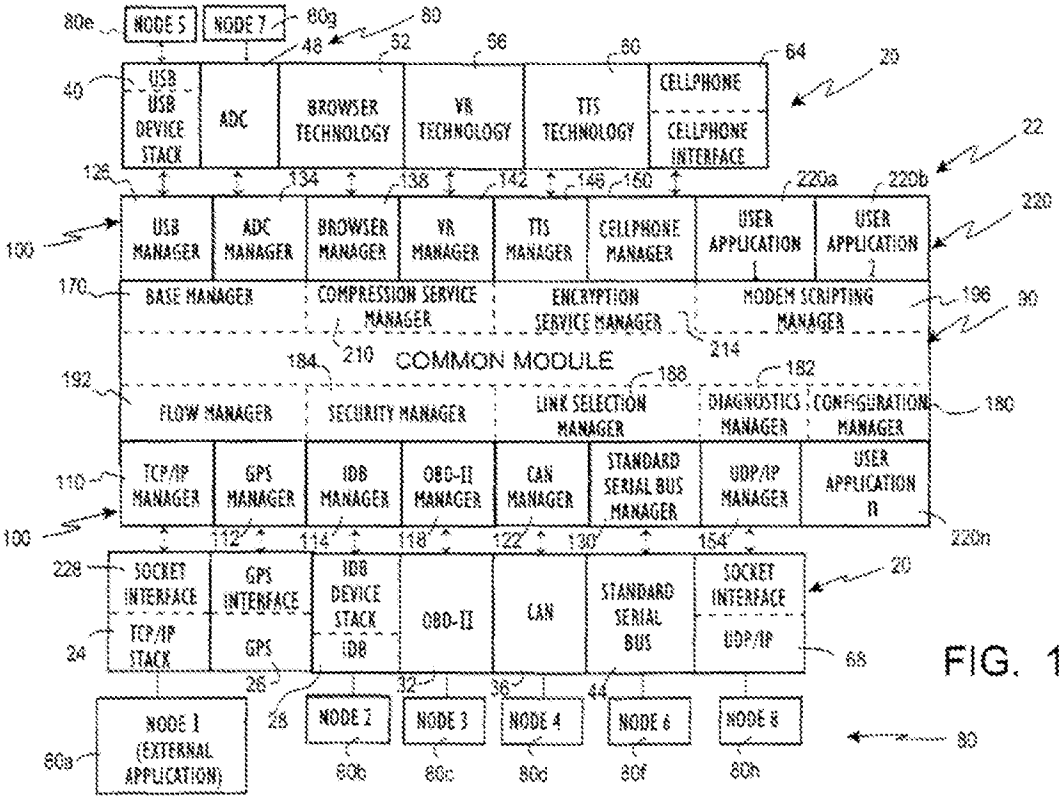


FIG. 1

Jones discloses a communication apparatus "contained within a vehicle having a number of disparate subsystems. The disparate subsystems include protocol based units and close-ended devices." Jones, 1:57-59. Jones further discloses that "[a]n example of such a close-ended device might be a global position system (GPS) that is useful in providing vehicle location information or a hardware device, such as a vehicle sensor from which data can be obtained for a particular vehicle component to which the sensor is operably connected[.]" Jones, 1-6; see also Fig. 1, elements 26 and 112.

Jones discloses a wireless communications device by disclosing a cellphone 64 and wireless network 314. Jones, Fig. 1; see also 5:52-53. Jones further discloses that "[t]he cellphone 64 is a useful communications tool in sending/receiving analog voice or digital data." Jones, 5:52-53.

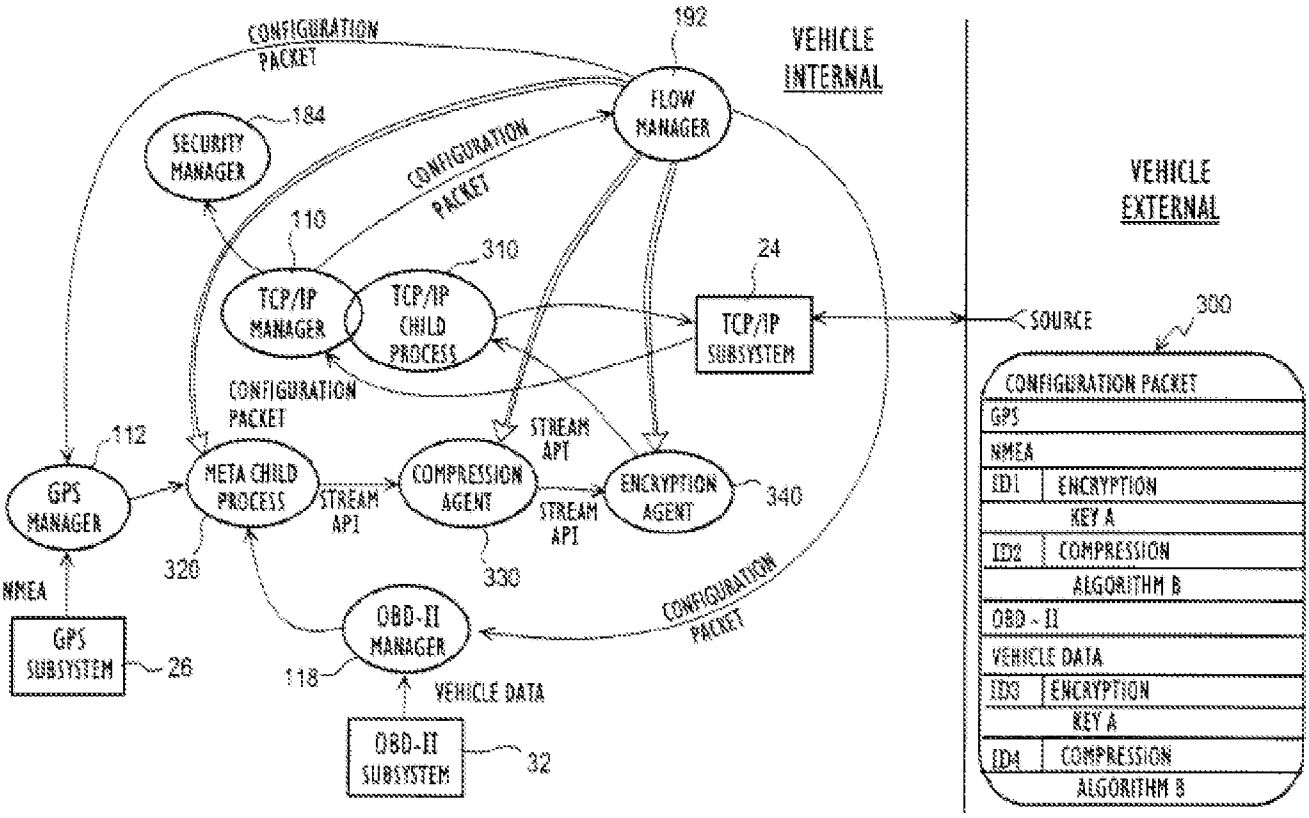
Jones issued from a patent application based upon the CP2100 and which was assigned to Cellport Systems, Inc. of Boulder, Colorado (i.e., Cell Port Labs). Jones discloses a Cell Port Labs CP2100 Mobile Network Server (hereinafter, "CP2100") as an exemplary communication apparatus 22a-22n embedded in different vehicles. Jones, Fig. 3, 19:7-15. The CP2100 is multi-vehicle compatible and includes a controller that cooperates with the transmitter and receiver of the CP2100. *See e.g.*, Fig. 1, the CP2100 multi-vehicle compatible controller compatible with e.g., IDB 28, OBD-II 32, CAN 36, Standard Serial Bus 44. Jones, Fig. 1.

Jones also discloses that "[t]he system includes a plurality of disparate subsystems 20 and a communications apparatus 22. The disparate subsystems 20 in a vehicle can include one or more of the following components: Internet protocol (IP) stacks 24; **a global positioning system (GPS)** 26; ***an intelligent transportation system data bus (IDB) 28; an onboard diagnostics (OBD-II) 32; a controller area network (CAN) 36;*** a universal serial bus (USB) 40; a standard serial bus 44; an analog/digital converter (ADC) 48; browser technology 52; voice recognition (VR) technology 56; text-to-speech (TTS) technology 60; **a cellphone 64; user datagram packets/Internet protocol stack(s) (UDP/IP)**, one or more custom or proprietary units or components, as well as any other presently or later devised subsystem that may be useful in a vehicle or another environment in which the system is operating." Jones, 4:55-67 (emphasis added).

Jones discloses the CP2100 supports a variety of different vehicle busses, including IDB, OBD-II and CAN. *See e.g.*, Jones, 4:57-63 ("The disparate subsystems 20 in a vehicle can include one or more of the following components: Internet protocol (IP) stacks 24; a global positioning system (GPS) 26; an intelligent transportation system data bus (IDB) 28; an onboard diagnostics (OBD-II) 32; a controller area network (CAN) 36.").

Jones discloses a configuration packet 300 which requests OBD-II data from vehicle devices. *See* Jones, Fig. 2.

FIG. 2



Jones discloses that the configuration packet 300 must specify "a destination, services that might be invoked, and data or other information being requested." Jones, 14:67-15:1. In other words, the process described in Figure 2 of Jones implicitly discloses that the multi-vehicle compatible controller must implement the SAE bus discovery process described in SAE J1978. Once the bus discovery protocol is performed, the CP2100 identifies the type of vehicle to the remote host, thereby determining which vehicle codes to use from the plurality of stored vehicle codes. The remote host then provides enabling data to configure the CP2100 to use appropriate device codes to run diagnostic routines and perform data collection routines for that specific type of vehicle.

The "SAE On-Board Diagnostics for Light and Medium Duty Vehicles Standards Manual" with multiple publication dates including 1994 and 1997 (hereinafter the "1994 SAE HS-3000 Manual" and the "1997 SAE HS-3000 Manual"), provides the implementation details and recommended practices of the J1708, J1850 and OBDII bus interfaces.

In particular, the SAE HS-3000 Manual discloses that a device code on the vehicle data bus can be an SAE standard and/or one of seven manufacturer specific version of the device code. *See e.g.*, 1994 SAE HS-3000 Manual, p. 213, Section 4 of SAE J2178/2. Furthermore, the 1994 and 1997 SAE HS-3000 Manuals disclose a bus discovery process involving reading different versions of a mode 1 PID 0 device code from the data communications bus and determining a match between a read device code and a stored device code. *See e.g.*, 1994 SAE HS-3000 Manual, p. 37, section 6.5.2 INITIALIZATION DETAILS of SAE J1978. It is the implementation of this standard that enables the CP2100 to have the "hot plug-and-play" capabilities demonstrated in the SAE IDB Demo98 Demonstration Program in which the ability of the CP2100 to perform bus discovery to connect and communicate with a Chrysler Concorde LXi, a Cadillac SLS, and a Ford Lincoln Continental via the OBD-II connector of each vehicle was demonstrated.

Jones discloses a downloading interface for permitting downloading of enabling data related to the at least one corresponding vehicle device code by disclosing that "the portal apparatus facilitates downloading of software configurations and updates to each communications apparatus in the vehicles of the particular fleet, as well as **facilitating the obtaining of vehicle operational data and other information including diagnostic data and status information including fault-related data**." Jones, 4:1-6 (emphasis added). In other words, Jones discloses enabling data and directing which vehicle device codes to use to obtain

vehicle operational data, diagnostics data, status and fault related data for a particular type of vehicle. For example, Figure 2 of Jones shows the configuration packet 300 containing an OBD-II field which requires a number of fields "to identify the particular subsystem from which [vehicle operational] data is being requested" from OBD-II subsystem 32, where said fields are configured in configuration packet 300 according to the particular vehicle device codes that are used for that particular vehicle. Jones, 15:32-37.

Jones also discloses that the downloading of updates includes enabling data with respect to specific vehicle devices to enable "plug and play" without any requirement to modify the vehicle device for communication with the CP2100 (i.e. the CP2100 achieves its "plug and play" capability by downloading the device codes and protocols necessary to communicate with the device). For example, Jones discloses that "[b]ased on the foregoing summary, a number of salient aspects of the present invention are readily identified. **Transfers of information including data relative to different devices, buses and/or networks are substantially seamlessly achieved**. Such transfers can be accomplished among these different subsystems without requiring that they be modified, thereby achieving a **"plug and play"** result. The disparate subsystems include protocol dependent components as well as close-ended devices at which data flow originates or is terminated, such as a GPS." Jones, 4:7-15 (emphasis added).

Jones also discloses, generally, a detailed process for maintenance and/or configuration updates for the plurality of vehicle device codes, whereby reconfiguring or updating software on the communications apparatuses 22 is "preferably sent as a single file from the portal apparatus 310 to one or more selected communications apparatuses 22 through the wireless network 314." Jones, 20:37-39; *see also generally*, 19:60-21:46. Once these vehicle device codes are received, "the configuration manager 180 is responsible for extracting changes from the

configuration in the file and applying them to the communications apparatus 22 in a shadow or mirror form." *Id.* at 20:54-58.

2. Jones is Analogous Art to the Flick '278 Patent

Jones and the SAE HS-3000 Manuals are analogous art because they are in the same field of endeavor as the Flick '278 patent, namely vehicle monitoring and tracking units, and more specifically, vehicle tracking devices that can be installed in vehicles, communicate with vehicle devices via a vehicle bus using vehicle codes from among a plurality of vehicle codes for different vehicles, communicate with vehicle position determining devices, and download data related to the vehicle device codes. *See In re Klein*, 647 F.3d 1343, 1349 (Fed. Cir. 2011) (noting that a reference is analogous when "the art is from the same field of endeavor, regardless of the problem addressed...").

3. Substantial New Question of Patentability as to Claims 1 through 22

Each of claims 1 through 22 require at least: a vehicle data bus, a vehicle position determining device, a wireless communications device, a multi-vehicle compatible controller, and a downloading interface for permitting downloading of enabling data. As shown above, Jones in combination with the inherent disclosure of the SAE HS-3000 Manuals disclose these limitations, and more detail is shown in the claim chart attached as Exhibit E.

Accordingly, it is submitted that all aspects of claims 1-22 are disclosed by Jones in view of the inherent disclosure of the SAE HS-3000 Manuals.

As shown above, a reasonable examiner would consider the teachings of Jones and the SAE HS-3000 Manuals important in deciding whether or not claims 1 through 22 of the Flick '278 patent are patentable. For these reasons, Jones in combination with the inherent disclosures of

the SAE HS-3000 Manuals submitted in this Request raise a substantial new question of patentability with respect to the claims of the Flick '278 patent.

VII. PROPOSED REJECTIONS AND DETAILED EXPLANATIONS OF THE PERTINENCY AND MANNER OF APPLYING THE CITED PRIOR ART TO EVERY CLAIM FOR WHICH REEXAMINATION IS REQUESTED

The above-referenced prior art raises substantial new questions of patentability with respect to claims 1 through 22 of the Flick '278 patent. Below, Requester sets out proposed rejections that provide a detailed explanation of the pertinence and manner of applying these publications and/or patents to each of these claims. As this is a reexamination under 35 U.S.C. 304, the claims should be "given the broadest reasonable interpretation consistent with the specification and limitations in the specification [should] not [be] read into the claims." MPEP § 2258(I)(G)(citing *In re Yamamoto*, 740 F.2d 1569, 222 USPQ 934 (Fed. Cir. 1984)).

Additionally, although anticipation typically requires that a single prior art reference contain each and every element of the claimed invention, a rejection over multiple references under 35 U.S.C. § 102 has been held to be proper to show that a characteristic not disclosed in the reference is inherent. *See* MPEP 2131.01(III). To elaborate, "[t]o serve as an anticipation when the reference is silent about the asserted inherent characteristic, such gap in the reference may be filled with recourse to extrinsic evidence. Such evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." *Continental Can Co. USA v. Monsanto Co.*, 948 F.2d 1264, 1268, 20 USPQ2d 1746, 1749-50 (Fed. Cir. 1991). Therefore, where indicated in the discussion, a multi-reference rejection under 35 U.S.C. § 102 will refer to the appropriate inherent publication or standard.

SUMMARY OF PROPOSED REJECTIONS	SUPPORTING CLAIM CHART
Claims 1, 13, and 18 are rejected under 35 U.S.C. § 102(a) and (b) as unpatentable over the Cell Port Labs Press Release in combination with the inherent disclosure of Spelt and the SAE HS-3000 Manuals. Claims 1-22 are rejected under 35 U.S.C. § 103(a) as unpatentable over the Cell Port Labs Press Release in in view of Spelt, Jones, and the SAE HS-3000 Manuals.	**Exhibit D**
Claims 1-22 are rejected under 35 U.S.C. § 102(a) and (b) as unpatentable over Jones in combination with the inherent disclosure of the SAE HS-3000 Manuals.	**Exhibit E**

A. ***Claims 1, 13, and 18 are Unpatentable over Cell Port Labs Press Release in combination with the inherent disclosure of Spelt and the SAE HS-3000 Manuals***

Each and every limitation of claims 1, 13, and 18 is disclosed by the Cell Port Labs Press Release in combination with the disclosure of Spelt and the SAE HS-3000 Manuals as shown in detail in the claim chart attached as Exhibit D. Accordingly, the following proposed rejection is appropriate.

Claims 1, 13, and 18 are rejected under 35 U.S.C. § 102(a) and (b) (as a multiple reference 35 U.S.C. § 102 rejection according to MPEP § 2131.01) as being unpatentable over the Cell Port Labs Press Release including its inherent disclosures as explained by extrinsic evidence including the Spelt and the SAE HS-3000 Manuals. If the Patent Office deems that the multi-reference 35 U.S.C. § 102 proposed rejection is not appropriate, Requester submits that these same claims are appropriately rejected under 35 U.S.C. § 103(a) based upon the same combinations of references disclosed herein.

With regard to claim 1, as set out in detail in Exhibit D, the Cell Port Labs Press Release as understood in view of extrinsic evidence including Spelt and the SAE HS-3000 Manuals teaches all limitations of claim 1. Specifically, these references teach:

- *A multi-vehicle compatible tracking unit for a vehicle comprising a vehicle data bus extending throughout the vehicle, the multi-vehicle compatible tracking unit comprising*: Cell Port Labs, Inc. (hereinafter, "Cell Port Labs") developed the CP2100 which was "a mobile network server designed to enable bi-directional data communications and network management functions within vehicles and provide real-time, wireless connectivity between vehicles and remote applications." *CellPort Delivers Wireless, Vehicle-Based Applications Platform; Announces CP2100 Mobile Network Server*, PRNewswire, July 26, 1999 (hereinafter, "Cell Port Labs Press Release").
- In particular, the CP2100 interfaces to a vehicle data bus (i.e. vehicle networks, such as CAN and J1850). *See also* CAN BUS interface illustrated in Maury Wright, *Prep for a Multimedia Future*, EDN Magazine, Aug. 19, 1999, at 84 (hereinafter, "Auto Electronics publication"). Moreover, the Cell Port Labs Press Release states that "CellPort offers the first commercial product designed specifically to manage the growing list of in-vehicle networks, including IDB, CAN, USB and more." Cell Port Labs Press Release. The Cell Port Labs Press Release also states that "[t]he CP2100 supports a variety of emerging vehicle bus interfaces, including **IDB, J1708, J1850,** CAN and **ODBII**." Cell Port Labs Press Release (emphasis added).
- The "SAE On-Board Diagnostics for Light and Medium Duty Vehicles Standards Manual" with multiple publication dates including 1994 and 1997 (hereinafter the

"1994 SAE HS-3000 Manual" and the "1997 SAE HS-3000 Manual"), provides the implementation details and recommended practices of the J1708, J1850 and OBDII bus interfaces.

- The CP2100 is "multi-vehicle compatible" as described in Cell Port Labs Press Release: "[t]he technical features of ***the CP2100 include protocol conversion for a variety of vehicle buses and devices***, wireless gateway communications independent of wireless links, and embedded application router management capabilities." Cell Port Labs Press Release (emphasis added).
- Specifically, the Cell Port Labs Press Release notes in "THE CP2100 IN USE" section that Cell Port Labs was a participant in the IDB Demonstration Program, whereby it "provided connectivity to the Internet for many IDB-based vehicle systems on three IDB demonstration vehicles." *Id.* The IDB demonstration involved demonstrating the capability of the CP2100 utilizing the bus discovery protocols contained within the SAE standards to provide "plug-and play" connectivity with a Chrysler Concorde LXi, a Cadillac SLS, and a Ford Lincoln Continental via the OBDII connector contained within each of the vehicles.
- The publication titled "A Demonstration Project for the ITS Data Bus Prototype" published in 1998 by Spelt et al. (hereinafter, "Spelt") provides details regarding the SAE's IDB Demonstration Program noted in the Cell Port Labs Press Release. Philip F. Spelt & Allan M. Kirson, *A Demonstration Project for the ITS DATA Bus Prototype*, Digital Avionics Systems Conference, 1998. Proceedings., 17th DASC. Oct. 31-Nov. 7, 1998.

- As noted on Table 1 "IDB Devices" on page I22-3 of Spelt, Cell Port Labs was a company that participated in the IDB Demo98 project. As noted on page I22-1, the goal of Demo98 was "to demonstrate several of the functional requirements and capabilities of the IDB. These include 'hot plug-and-play of devices***, interoperability of a device in different vehicles***, and the information-sharing capacity of devices connected to the IDB." Spelt, p. I22-1 (emphasis added). Furthermore, "[c]ompanies participating in Demo98 include the United States 'Big Three' automobile manufacturers: Chrysler (Concorde LXi), General Motors (Cadillac SLS), and Ford (Lincoln Continental)." Id. at I22-2.
- Spelt also emphasized the plug-and-play functionality without the requirement to modify the vehicle device: "The Plug-and-Play Scenario is the most fundamental and general of the four scenarios developed for Demo98. It is intended to demonstrate the IDB characteristics of 'hot plug-and-play' and the as can reasonably be shown with the devices provided by the participants. Thus, as the title implies, the hot plug-and-play capabilities of the IDB protocol are shown by inserting and removing devices while the IDB is alive and functioning. This demonstrates the inherent reconfigurability designed into the IDB protocol, by showing that current devices, which may have depended on another no longer available device, will still function on the IDB." Id. at I22-2.
- *a vehicle position determining device*: the Cell Port Labs Press Release describes the technical functionality of the CP2100, stating that "[d]ata from the host can be sent to the vehicle to communicate with the operator, **provide GPS information**, run diagnostic routines, reconfigure data collection routines, download code and