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(54) **TIRE CONDITION SENSOR COMMUNICATION WITH TIRE LOCATION PROVIDED VIA MANUALLY INPUTTED UPDATE**

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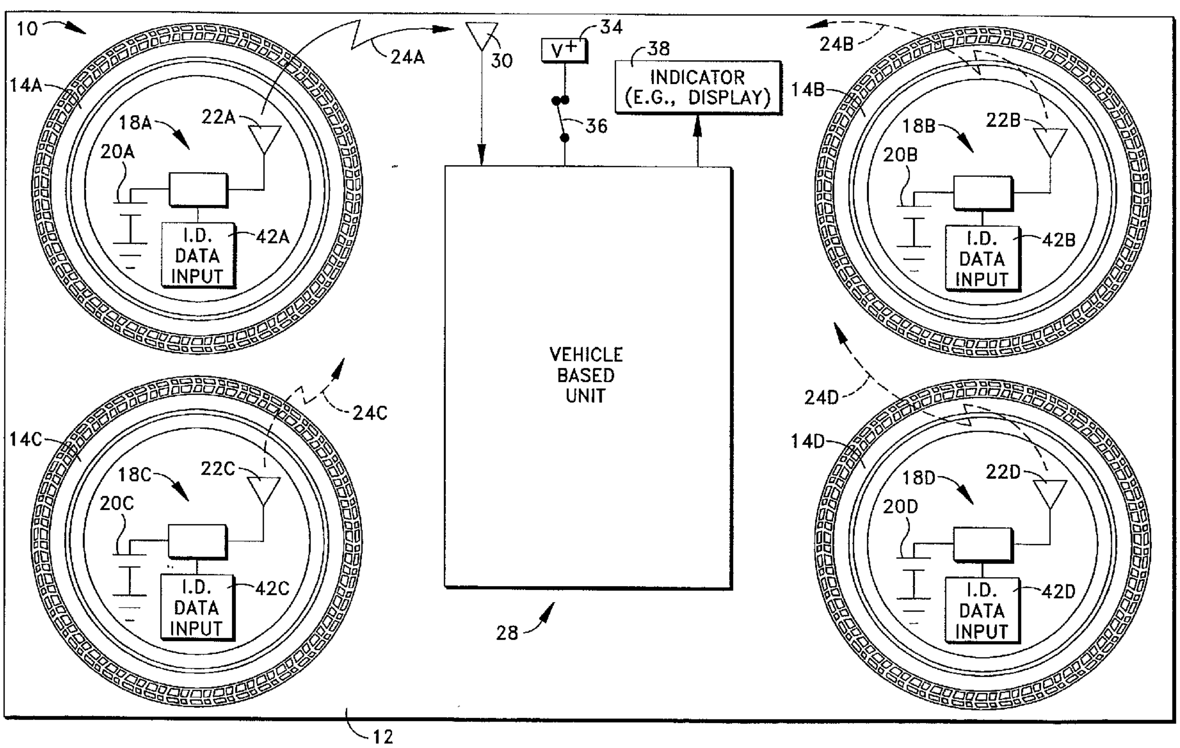
(57) **ABSTRACT**

A tire condition communication system (**10**) and method for a vehicle (**12**) that has a tire (e.g., **14**A). A sensor (**70**), associated with the tire (e.g., **14**A), senses at least one tire condition. A memory (**66**), associated with the tire (e.g., **14**A), holds an identification. A transmitter arrangement (**22** and **74**), associated with the tire (e.g., **14**A), transmits a signal (e.g., **24**A) that indicates the held identification and the sensed tire condition. A receiver arrangement (**28** and **30**), associated with the vehicle (**12**), receives the transmitted signal (e.g., **24**A). An identification update device is associated with the tire and is operatively connected to the memory (**66**). The update device receives an update identification and provides the received location identification to the memory (**66**) to be held as the held identification. An input device is manually actuated to provide the update identification. In one example, a receiver (**46**) at the tire and a manually actuated transmitter (**44**) provided the update and input devices. In another example, a switch (**116**) and a manually actuatable part (e.g., a valve stem part) at the tire provide the update and input devices.



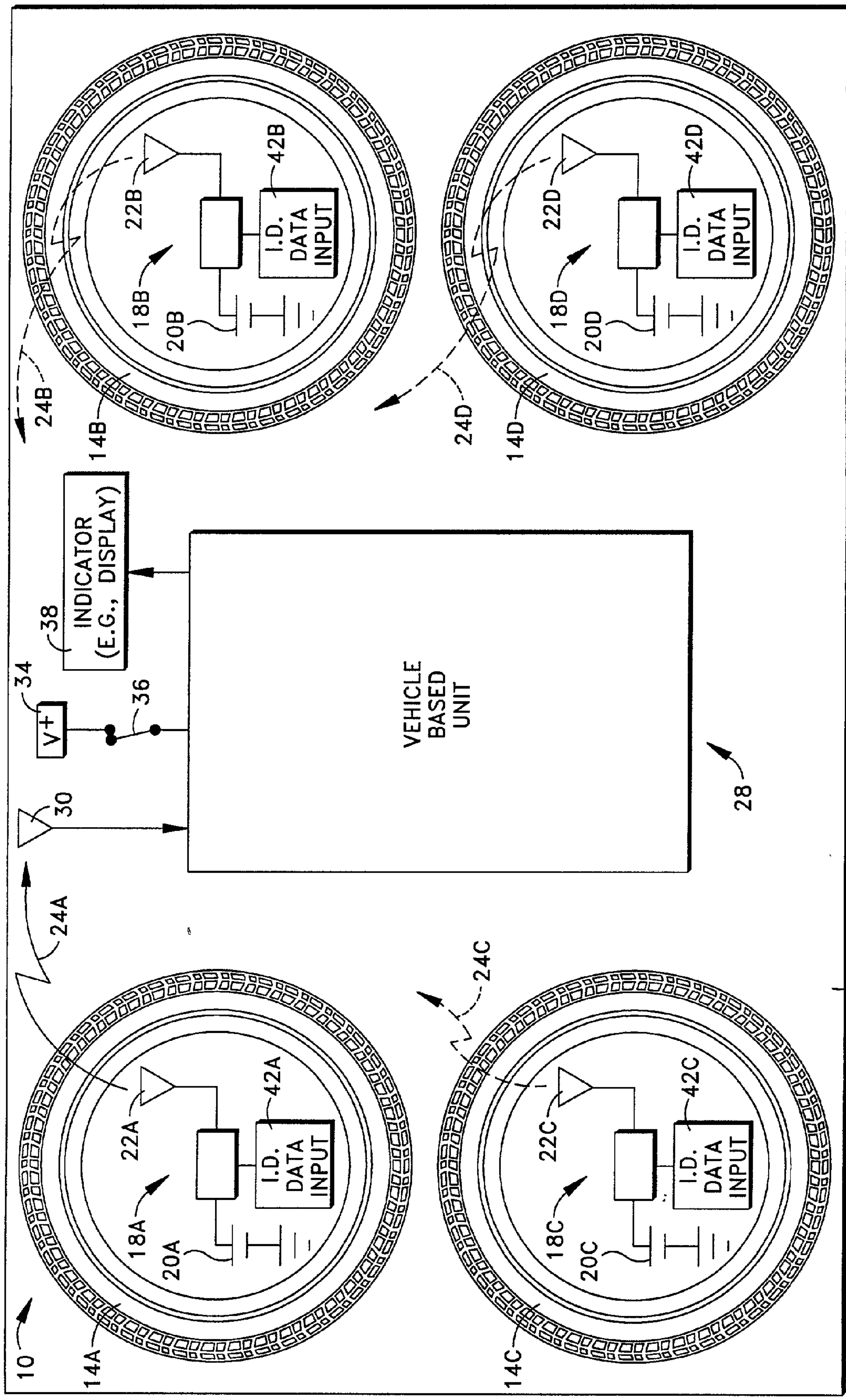

10
12
14A
14B
14C
14D
18A
18B
18C
18D
20A
20B
20C
20D
22A
22B
22C
22D
24A
24B
24C
24D
42A
42B
42C
42D
I.D. DATA INPUT
I.D. DATA INPUT
I.D. DATA INPUT
I.D. DATA INPUT
30
34
V+
36
38
INDICATOR (E.G., DISPLAY)
VEHICLE BASED UNIT
28

Fig. 1

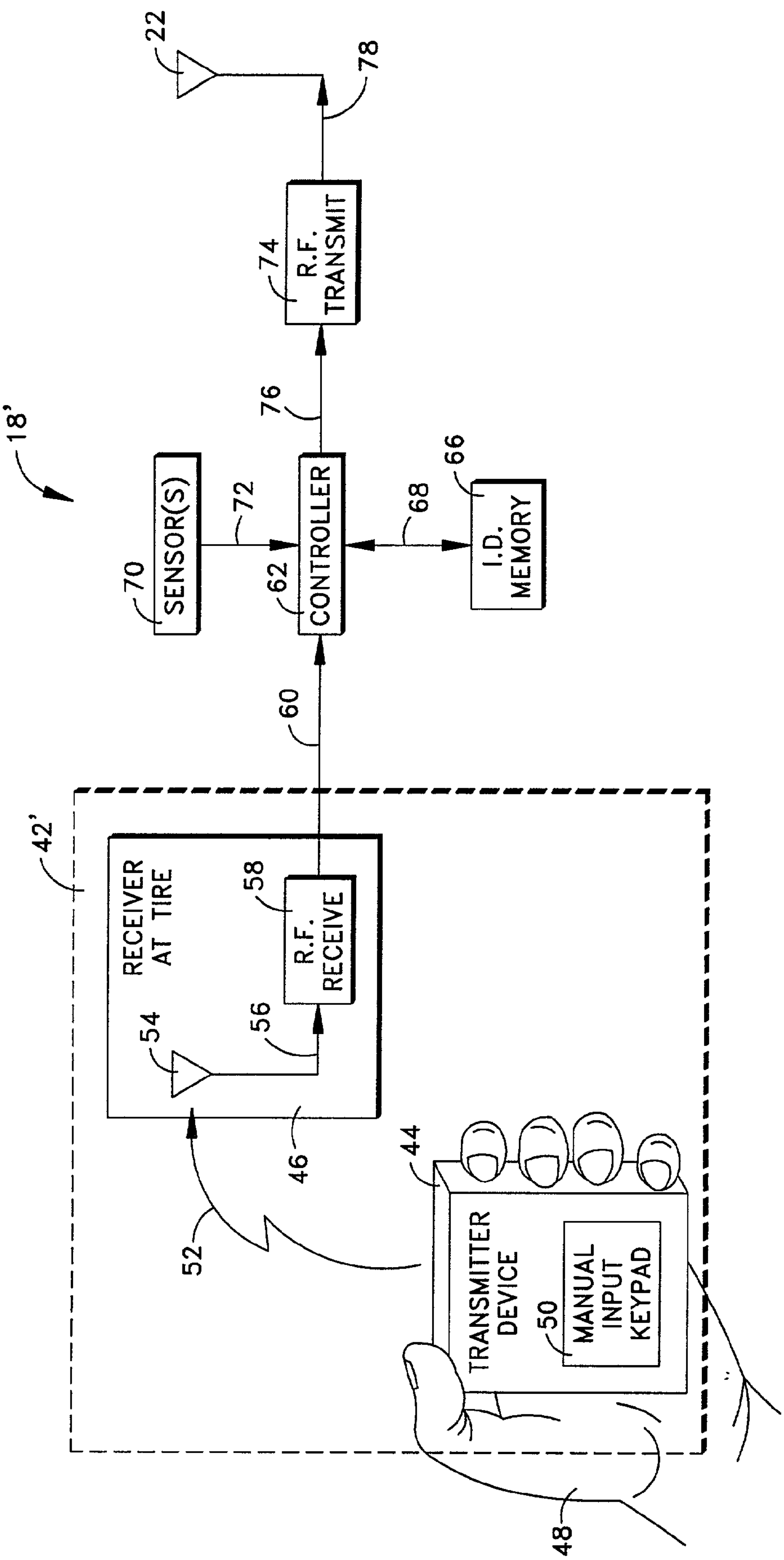

18'
22
78
74
R.F. TRANSMIT
76
70
SENSOR(S)
72
62
CONTROLLER
68
66
I.D. MEMORY
60
42'
RECEIVER AT TIRE
58
R.F. RECEIVE
54
56
46
44
52
TRANSMITTER DEVICE
50
MANUAL INPUT KEYPAD
48

Fig.2

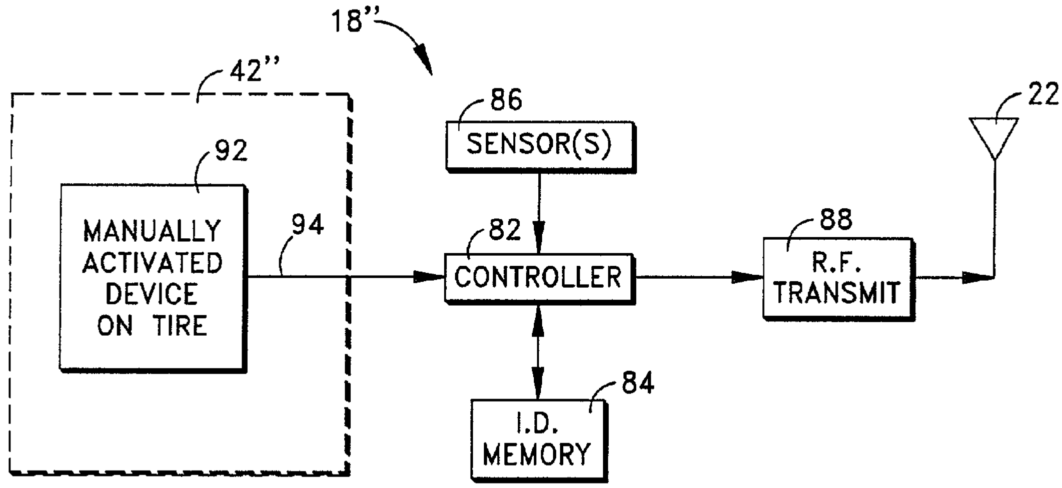

18''
42''
86
SENSOR(S)
22
92
MANUALLY ACTIVATED DEVICE ON TIRE
94
82
CONTROLLER
88
R.F. TRANSMIT
84
I.D. MEMORY

Fig.3

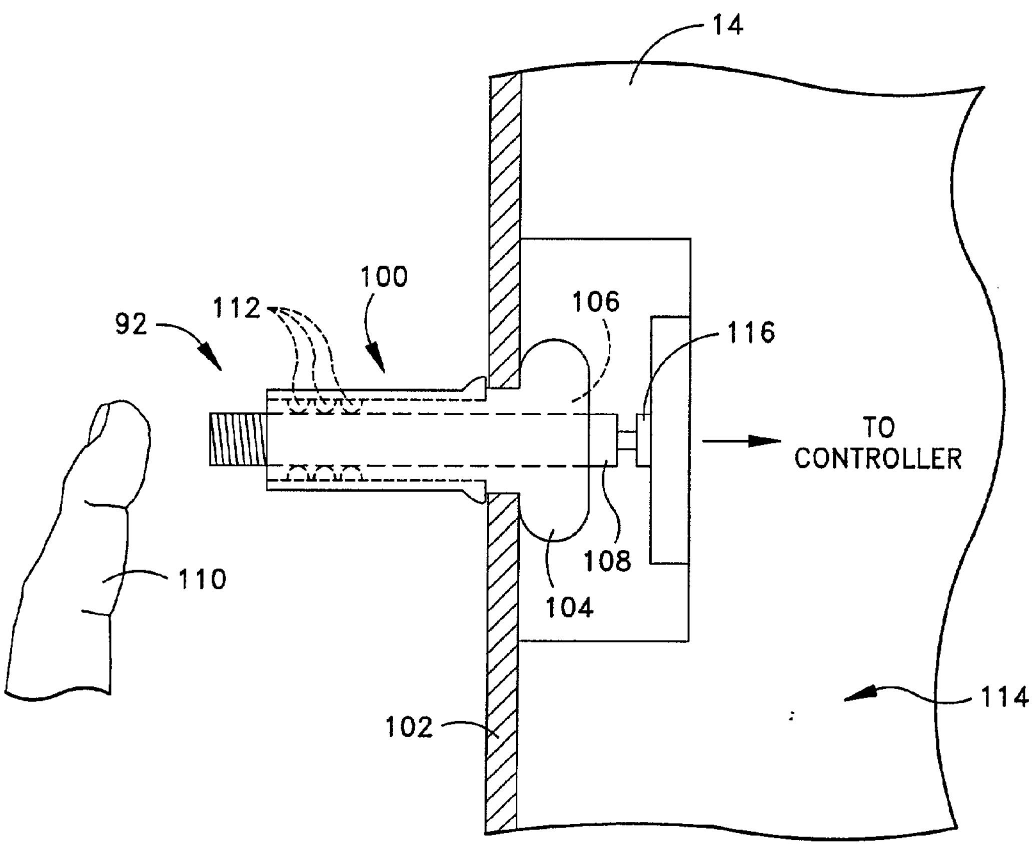

14
100
112
92
106
116
TO CONTROLLER
108
110
104
114
102

Fig.4

TIRE CONDITION SENSOR COMMUNICATION WITH TIRE LOCATION PROVIDED VIA MANUALLY INPUTTED UPDATE

TECHNICAL FIELD

[**0001**] The present invention relates to a tire condition monitoring system for providing indication of a tire operation parameter, such as tire inflation pressure, to a vehicle operator. The present invention relates specifically to a tire condition monitoring system that provides ready identification of a tire providing condition information and avoids misidentification due to previous tire position change via tire position rotation or the like.

BACKGROUND OF THE INVENTION

[**0002**] Numerous tire condition monitoring systems have been developed in order to provide tire operation information to a vehicle operator. One example type of a tire condition monitor system is a tire pressure monitor system that detects when air pressure within a tire drops below a predetermined threshold pressure value.

[**0003**] There is an increasing need for the use of tire pressure monitoring systems due to the increasing use of "run-flat" tires for vehicles such as automobiles. A run-flat tire enables a vehicle to travel an extended distance after significant loss of air pressure within that tire. However, a vehicle operator may have difficulty recognizing the significant loss of air pressure within the tire because the loss of air pressure may cause little change in vehicle handling and visual appearance of the tire.

[**0004**] Typically, a tire pressure monitoring system includes a pressure sensing device, such as a pressure switch, an internal power source, and a communications link that provides the tire pressure information from a location at each tire to a central receiver. The central receiver is typically connected to an indicator or display located on a vehicle instrument panel.

[**0005**] The communications link between each tire and the central receiver is often a wireless link. In particular, radio frequency signals are utilized to transmit information from each of the tires to the central receiver. However, in order for the central receiver to be able to proper associate received tire pressure information with the tire associated with the transmission, some form of identification of the origin of the signal must be utilized. Such a need for identification of the origin of the transmitted tire information signal becomes especially important subsequent to a tire position change, such a routine maintenance tire position rotation.

SUMMARY OF THE INVENTION

[**0006**] In accordance with one aspect, the present invention provides a tire condition communication system for a vehicle that has a tire. Sensor means, associated with the tire, senses at least one tire condition. Memory means, associated with the tire, holds an identification. Transmitter means, associated with the tire and operatively connected to the sensor means and the memory means, transmits a signal that indicates the held identification and the sensed tire condition. Receiver means, associated with the vehicle, for receives the transmitted signal indicative of the held identification and the sensed tire condition. The system includes manually actuated input means, associated with the tire and operatively connected to the memory means, for inputting an update identification to be held by the memory means as the held identification.

[**0007**] In accordance with another aspect, the present invention provides a method of communicating information within tire condition monitoring system for a vehicle that has a tire. An input means is manually actuated to input update identification information for a tire condition sensor unit located at the tire. The input identification is held at the tire condition sensor unit. A tire condition is sensed via operation of the tire condition sensor unit. A signal is transmitted from the tire condition sensor unit, wherein the transmitted the signal indicates the held identification and the sensed tire condition. The transmitted signal is received at a location on the vehicle.

BRIEF DESCRIPTION OF THE DRAWINGS

[**0008**] The foregoing and other features and advantages of the present invention will become apparent to those skilled in the art to which the present invention relates upon reading the following description with reference to the accompanying drawings, in which:

[**0009**] **FIG. 1** is a schematic block diagram of a vehicle that contains a tire condition communication system in accordance with the present invention;

[**0010**] **FIG. 2** is a schematic function block diagram of a first embodiment of a tire condition sensor unit and an associated first embodiment of a manually actuated identification update arrangement;

[**0011**] **FIG. 3** is a schematic function block diagram of a second embodiment of a tire condition sensor unit and an associated second embodiment of a manually actuated identification update arrangement; and

[**0012**] **FIG. 4** is a partial cross-section of a tire that contains an identification input device in accordance with the embodiment the identification update arrangement of **FIG. 3**.

DESCRIPTION OF EXAMPLE EMBODIMENTS

[**0013**] A tire condition communication system **10** is schematically shown within an associated vehicle **12** in **FIG. 1**. The vehicle **12** has a plurality of inflatable tires (e.g., **14**A). In the illustrated example, the vehicle **12** has four tires **14**A-**14**D. It is to be appreciated that the vehicle **12** may have a different number of tires. For example, the vehicle **12** may include a fifth tire (not shown) that is stored as a spare tire.

[**0014**] The system **10** includes a plurality of tire condition sensor units (e.g., **18**A) for sensing one or more tire conditions at the vehicle tires (e.g., **14**A). Preferably, the number of tire condition sensor units **18**A-**18**D is equal to the number of tires **14**A-**14**D provided within the vehicle **12**. In the illustrated example, all of the tire condition sensor units **18**A-**18**D have the same components. Identical components are identified with identical reference numbers, with different alphabetic suffixes. It is to be appreciated that, except as noted, all of the tire condition sensor units **18**A-**18**D function in the same manner. For brevity, operation of one of the tire condition sensor units (e.g., **18**A) is discussed in detail with the understanding that the discussion is generally applicable to the other tire condition sensor units (e.g., **18**B-**18**D).

[**0015**] Each tire condition sensor unit (e.g., **18**A) includes a power supply (e.g., a battery **20**A) that provides electrical energy to various components within the respective sensor unit. The electrical energy enables the tire condition sensor unit (e.g., **18**A) to energize a radio frequency antenna (e.g., **22**A) to emit a radio frequency signal (e.g., **24**A) that conveys one or more sensed conditions along with a fixed identification to a central, vehicle-based unit **28**.

[**0016**] A radio frequency antenna **30** receives the tire condition signal (e.g., **24**A) from the tire condition sensor unit (e.g., **18**A) and the conveyed information is processed. In one example, the system **10** is designed to operate with the tire condition signals **24**A-**24**D in the FM portion of the radio frequency range. Each antenna (e.g., **22**A) in conjunction with the antenna **30** comprises part of a means for communication from the respective tire condition sensor unit (e.g., **18**A) to the vehicle-based unit **28**.

[**0017**] A power supply (e.g., a vehicle battery) **34**, which is operatively connected (e.g., through a vehicle ignition switch **36**) to the vehicle-based unit **28**, provides electrical energy to permit performance of the processing and the like. The vehicle-based unit **28** utilizes the processed information to provide information to a vehicle operator via an indicator device **38**. In one example, the indicator device **38** may be a visual display that is located on an instrument panel of the vehicle **12**. Accordingly, the vehicle operator is apprised of the sensed condition(s) at the tire (e.g., **14**A).

[**0018**] It is to be noted that the sensed condition may be any condition at the tire (e.g., **14**A). For example, the sensed condition may be inflation pressure of the tire (e.g., **14**A), temperature of the tire, motion of the tire, or even a diagnostic condition of the tire condition sensor unit (e.g., **18**A) itself.

[**0019**] It should be noted that a single antenna of the vehicle-based unit **28** receives all of the tire condition signals **24**A-**24**D from a plurality of tire condition sensor units **18**A-**18**D. In order for the vehicle-based unit **28** to accurately "know" which tire (e.g., **14**A), via the associated tire condition sensor unit (e.g., **18**A), is providing the tire condition signal (e.g., **24**A), the tire condition signal conveys an identification of the tire. In order for the tire condition sensor unit (e.g., **18**A) to output the tire condition signal (e.g., **24**A) with an identification of the tire, the identification is provided to the tire condition sensor unit.

[**0020**] The provision of the location identification to the respective tire condition sensor unit is accomplished by the system **10** including a manually actuated identification data input arrangement (e.g., **42**A) for the respective tire condition sensor unit (e.g., **18**A). In the illustrated example of **FIG. 1, a** plurality of manual input arrangements **42**A-**42**D are provided, with each manual input arrangement (e.g., **42**A) being associated with a different tire condition sensor unit (e.g., **18**A).

[**0021**] A different identification value is associated with each specific tire mounting location. Typically, the tire mount locations on a vehicle are identified as right-front, right-rear, left-front, left-rear, and spare mount locations. When a tire (e.g., **14**A) is located at a certain tire mounting location, the identification associated with that location is manually input via the manual input arrangement (e.g., **42**A). For example, when the locations of the tires **14**A-**14**D are changed, such as during a routine maintenance tire rotation, a new location identification is manually input for each tire.

[**0022**] The tire condition sensor unit (e.g., **18**A) utilizes the manually input location identification as the identification that is transmitted within its tire condition signal (e.g., **24**A) sent to the vehicle-based unit **28**. The vehicle-based unit **28** is programmed (e.g., taught) or has learned to recognize the location identifications for the various tire mount locations on the vehicle. Accordingly, when the vehicle-based unit **28** receives a tire condition signal (e.g., **24**A) that contains a certain location identification, the vehicle-based unit will interpret the signal as originating from a tire located at that vehicle mount location.

[**0023**] It is contemplated that the manual input of location identification data for use by the associated tire condition sensor unit(e.g., **18**A) may be accomplished by different methods, formats, etc. **FIG. 2** illustrates a first example of a tire condition sensor unit **18**' and an associated manual input arrangement **42**'.

[**0024**] It is to be noted that the tire condition sensor unit **18**' and the manual input arrangement **42**' are indicated using reference numerals with primes, to signify that the examples are for a first specific discussion. Also, it is to noted that the tire condition sensor unit **18**' and the manual input arrangement **42**' are indicated without use of alphabetic suffixes to signify that the examples are generic to all of the tire condition sensor units and all of the identification provision units, respectively.

[**0025**] The manual input arrangement **42**' includes a manually actuatable radio frequency transmitter device **44**, located remote from the tire (e.g., **14**A), and a radio frequency receiver **46**, located at the tire. In one example, the receiver **46** is located within the tire (e.g., **14**A) with the associated tire condition sensor unit **18**'.

[**0026**] The transmitter device **44** is preferably a hand-held unit that a person **48** (e.g., a service technician) manually operates to inputs an identification code via an input keypad **50** on the hand-held transmitter device. The transmitter device **44** outputs a radio frequency signal **52** that conveys the input identification code and that is intended for reception by an antenna **54** of the receiver **46** at the tire (e.g., **14**A).

[**0027**] The antenna **54** is operatively connected **56** to RF receive circuitry **58** of the receiver **46**. In turn, the RF receive circuitry **58** is operatively connected **60** to a controller **62** of the tire condition sensor unit **18**'. When the antenna **54** receives the radio frequency signal **52** that conveys an update location identification, an electrical stimulus signal is provided by the antenna to the RF receive circuitry **58**. In turn, data bits that represent the location identification are provided to the controller **62**. A location identification memory **66** is operatively connected **68** to the controller **62**. The controller **62** provides the update location identification data to the memory **66** for storage therein.

[**0028**] One or more condition sensors **70** are operatively connected **72** to the controller **62**. RF transmit circuitry **74** is operatively connected **76** to the controller **62** and operatively connected **78** to the associated antenna **22**. In order to provide the tire condition signal (e.g., **24**A) for reception by the vehicle-based unit **28**, the controller **62** receives sensory information from the sensor(s) **70** and receives the location identification from the memory **66**. The controller **62** assembles a message packet that contains the identification location and the sensory information and provides the message packet to the RF transmit circuitry **74**. In turn, the RF transmit circuitry **74** provides a stimulus electrical signal to the antenna **22** such that the tire condition signal (e.g., **24**A) is emitted.

[**0029**] It is to be noted that the hand-held transmitter device **44** may be a device that can sequentially communicate with all of the tire condition sensor units **18**A-**18**D of the system **10** at the vehicle **12**, thus, avoiding the need to have a separate transmitters for each tire condition sensor unit. Moreover, the hand-held transmitter device **44** may be utilized to communicate with tire condition sensor units within different tire condition communication systems at different vehicles. In other words, the transmitter device may be a generic or universal tool used to program location identification to various tire condition sensor units.

[**0030**] **FIG. 3** schematically illustrates another example of a tire condition sensor unit **18**" with an associated manual input arrangement **42**". It is to be noted that the tire condition sensor unit **18**" and the manual input arrangement **42**" are indicated using reference numerals with double primes, to signify that the examples are for a second specific discussion. Also, it is to noted that the tire condition sensor unit **18**" and the manual input arrangement **42**" are indicated without use of alphabetic suffixes to signify that the examples are generic to all of the tire condition sensor units and all of the identification provision units, respectively.

[**0031**] The tire condition sensor unit **18**" includes a controller **82**, a location identification memory **84**, one or more sensors **86**, and RF transmit circuitry **88** similar to the embodiment shown in **FIG. 2**. The identification memory **84**, the sensor(s) **86**, and the RF transmit circuitry **88** are operatively connected to the controller **82** similar to the embodiments shown in **FIG. 2**.

[**0032**] In the embodiment shown in **FIG. 3**, the manual input arrangement **42**" includes a manually actuated device **92** located on the tire (e.g., **14**A) that is operatively connected **94** to the controller **82**. The device **92** may be any device that is manually actuated to input information (e.g., a string of data bits) to the controller **82**.

[**0033**] **FIG. 4** illustrates one example of the manually actuatable device **92** that is utilized to input location information. Specifically, the device **92** is partially integrated into an inflation valve stem assembly **100** utilized to supply air pressure into the tire **14**. The stem assembly **100** is mounted onto a rigid metal wheel side wall **102**. A first portion **104** of the stem assembly **100** provides a mounting arrangement and engages the side wall **102** to provide an air tight sealing arrangement with the side wall. The first portion **104** is hollow and provides a passageway **106** for air flow into the tire **14**.

[**0034**] A second portion **108** of the stem assembly **100** is movable relative to the first portion **104** when the second portion is manually depressed by a person (e.g., a technician) **110**. One or more sealing devices (O-rings) **112** seal against air pressure loss between the first portion **104** of the stem assembly **100** and the second portion **108** of the stem assembly.

[**0035**] In the illustrated example, the second portion **108** extends the length of the stem assembly **100** and protrudes into the pressurized interior **114** of the tire **14**. A micro-switch **116** is engaged with an end of the second portion **108** within the tire interior **114**. When the second portion **108** of the stem assembly **100** is pressed via manual actuation, the second portion moves sufficiently far to toggle the micro-switch **116**. Each push results in one toggling of the micro-switch **116**. The micro-switch **116** is operatively connected to the controller **82** such that the toggling of the micro-switch is supplied as an input to the controller. Accordingly, data is entered by a sequence of pushes on the second portion **108** of the stem assembly **100** to repeatedly toggle the micro-switch **116**. The controller interprets the toggles of the micro-switch to derive an input location identification value, and supplies the value to the memory for storage therein.

[**0036**] From the above description of the invention, those skilled in the art will perceive improvements, changes and modifications. Such improvements, changes and modifications within the skill of the art are intended to be covered by the appended claims.

Having described the invention, the following is claimed:

1. A tire condition communication system for a vehicle that has a tire, said system comprising:

sensor means, associated with the tire, for sensing at least one tire condition;

memory means, associated with the tire, for holding an identification;

transmitter means, associated with the tire and operatively connected to said sensor means and said memory means, for transmitting a signal that indicates the held identification and the sensed tire condition;

receiver means, associated with the vehicle, for receiving the transmitted signal indicative of the held identification and the sensed tire condition;

manually actuated input means, associated with the tire and operatively connected to said memory means, for inputting an update identification to be held by said memory means as the held identification.

2. A system as set forth in claim 1, wherein said input means includes a manually actuatable portion on the tire.

3. A system as set forth in claim 2, wherein said manually actuatable portion on the tire includes a portion of an inflation valve stem assembly.

4. A system as set forth in claim 1, wherein said input means includes a manually actuatable portable transmitter means for transmitting an update signal.

5. A system as set forth in claim 4, wherein said identification update means includes receiver means for receiving the update signal.

6. A method of communicating information within tire condition monitoring system for a vehicle that has a tire, said method comprising:

manually actuating an input means to input update identification information for a tire condition sensor unit located at the tire;

holding the input identification at the tire condition sensor unit;

sensing a tire condition via operation of the tire condition sensor unit;

transmitting a signal from the tire condition sensor unit, the transmitted the signal indicating the held identification and the sensed tire condition; and

receiving the transmitted signal at a location on the vehicle.

7. A method as set forth in claim 6, wherein said step of manually actuating an input means includes a manually actuating a portion of the input means that is located on the tire.

8. A method as set forth in claim 6, wherein said step of manually actuating an input means includes a manually actuating a transmitter portion of the input means that is located remote from the tire.

* * * * *