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Attorneys for Plaintiff SPX Corporation

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CLERK U.S. DISTRICT COURT
CENTRAL DIST. OF CALIF.
SANTA ANA

BY ______

UNITED STATES DISTRICT COURT

CENTRAL DISTRICT OF CALIFORNIA

SOUTHERN DIVISION

SPX CORPORATION, **a Delaware Corporation,** **Plaintiff** **vs.** **ATEQ CORPORATION** **a Michigan corporation,** **Defendant.**	**SACV11-0~~1234~~1324 DOC (RNBx)** **Civil Action** **Case No.** **COMPLAINT FOR PATENT INFRINGEMENT AND JURY DEMAND**

COPY

Plaintiff, SPX Corporation ("SPX"), for its Complaint herein, states as follows:

I. JURISDICTION

1. This is an action for patent infringement arising under the Patent Laws of the United States, Title 35, United States Code.

2. The subject matter jurisdiction for this Court is founded upon 28 U.S.C. § 1338 (patents) and 28 U.S.C. § 1331 (federal question).

3. Upon information and belief, defendant, ATEQ Corporation ("defendant"), regularly and continuously engages in substantial sales and other business transactions in the Central District of California, and has sold infringing products and/or committed infringing acts in this district. The United States District Court for the Central District of California therefore has *in personam* jurisdiction over the defendant.

II. THE PARTIES

4. Plaintiff, SPX Corporation ("SPX") is a Delaware corporation, having a place of business at 13515 Ballantyne Corporate Place, Charlotte, North Carolina 28277. SPX's Service Solutions business unit is involved in the subject matter of the present lawsuit and has a place of business at 17815 Newhope Street, Fountain Valley, California 92708.

5. Defendant ATEQ Corporation ("ATEQ" or "Defendant") is a Michigan corporation having a principal place of business at 35980 Industrial

Road, Livonia, Michigan 48150. ATEQ has its California Regional Sales Office located in Los Angeles, California.

III. BACKGROUND

6. On June 14, 2005, U.S. Patent No. 6,904,796 ("the '796 patent"), entitled "Remote Tire Monitoring Systems Tool," was duly and legally issued. (Exhibit A, U.S. Patent No. 6,904,796.)

7. On December 29, 2009, U.S. Patent No. 7,639,122 ("the '122 patent") entitled Tire Pressure Monitor System Tool With Vehicle Entry System," was duly and legally issued. (Exhibit B, U.S. Patent No. 7,639,122.)

8. SPX is the owner of all right, title and interest in the '796 and '122 patents, including all right to recover for any and all past infringement thereof.

9. Defendant has had actual notice of the '796 patent since at least as early as November 2005.

IV. COUNT I - PATENT INFRINGEMENT OF U.S. PATENT NO. 6,904,796

10. Defendant has made, used, offered for sale and sold in the United States, and continues to make, use, offer for sale and sell in the United States remote tire monitoring system tools, including tools sold under the model designators VT-55 and/or TPMS 3; Defendant's activities infringe, induce others to infringe, and/or contributorily infringe the '796 patent.

11. SPX has suffered damages as a result of the infringing activities of the defendant, and will continue to suffer such damage as long as those infringing activities continue.

12. Defendant's infringement of the '796 patent has been and continues to be willful, wanton, and deliberate, and with full knowledge and awareness of SPX's patent rights. Defendant's infringement will continue unless enjoined by this Court.

13. Defendant's infringement of the '796 patent has caused and will continue to cause irreparable injury to SPX.

14. SPX has no adequate remedy at law. Unless enjoined by this Court, the defendant will continue such acts of infringement to SPX's substantial and irreparable damage.

V. COUNT II - PATENT INFRINGEMENT OF U.S. PATENT NO. 7,639,122

15. Defendant has made, used, offered for sale and sold in the United States, and continues to make, use, offer for sale and sell in the United States remote tire monitoring system tools, including tools sold under the model designators VT-55 and/or TPMS 3; Defendant's activities infringe, induce others to infringe, and/or contributorily infringe the '122 patent.

16. SPX has suffered damages as a result of the infringing activities of the defendant, and will continue to suffer such damage as long as those infringing activities continue.

17. To the extent Defendants' infringement continues after the date of this complaint, Defendant's infringement of the '122 patent has been and continues to be willful, wanton, and deliberate, and with full knowledge and awareness of SPX's patent rights. Defendant's infringement will continue unless enjoined by this Court.

18. Defendant's infringement of the '122 patent has caused and will continue to cause irreparable injury to SPX.

19. SPX has no adequate remedy at law. Unless enjoined by this Court, the defendant will continue such acts of infringement to SPX's substantial and irreparable damage.

VI. DEMAND FOR RELIEF

Accordingly, SPX respectfully demands that this Court enter judgment that:

A. Defendant ATEQ has infringed the claims of the '796 and '122 patents.

B. Preliminarily and permanently enjoining and restraining defendant, its officers, directors, employees, agents, servants, successors and assigns, and any and all persons acting in privity or in concert with the defendants, from further infringement of the '796 and '122 patents;

C. Awarding SPX its damages, together with prejudgment interest and costs, and increasing those damages to three times the amount found or assessed as provided by 35 U.S.C. § 284;

D. Declaring this an exceptional case within the meaning of 35 U.S.C. § 285, and awarding SPX its reasonable attorney's fees and costs and disbursements in this action; and

E. Granting to SPX such other and further relief as this Court deems reasonable.

VI. DEMAND FOR JURY TRIAL

SPX respectfully demands a trial by jury of any and all issues triable of right by a jury in the above-captioned action.

Dated: August 31, 2011

Respectfully submitted,

By: [signature]

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Attorneys for Plaintiff

EXHIBIT A

US006904796B2

(12) **United States Patent**
Pacsai et al.

(10) **Patent No.: US 6,904,796 B2**
(45) **Date of Patent: Jun. 14, 2005**

(54) **REMOTE TIRE MONITORING SYSTEMS TOOL**

(75) Inventors: **Ernest Pacsai**, Wixom, MI (US); **Thomas Kenny**, Troy, MI (US); **Carl Szasz**, Ortonville, MI (US); **Robert Gilling**, Caro, MI (US)

(73) Assignee: **G-5 Electronics, LLC**, Troy, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 191 days.

(21) Appl. No.: **10/420,175**

(22) Filed: **Apr. 21, 2003**

(65) **Prior Publication Data**

US 2004/0206167 A1 Oct. 21, 2004

(51) **Int. Cl.**[7] **G01M 17/02**
(52) **U.S. Cl.** **73/146.8**; 73/146
(58) **Field of Search** 73/146, 146.8; 340/442

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6,591,668 B1	*	7/2003	Becherer et al.	73/146
6,662,642 B2	*	12/2003	Breed et al.	73/146

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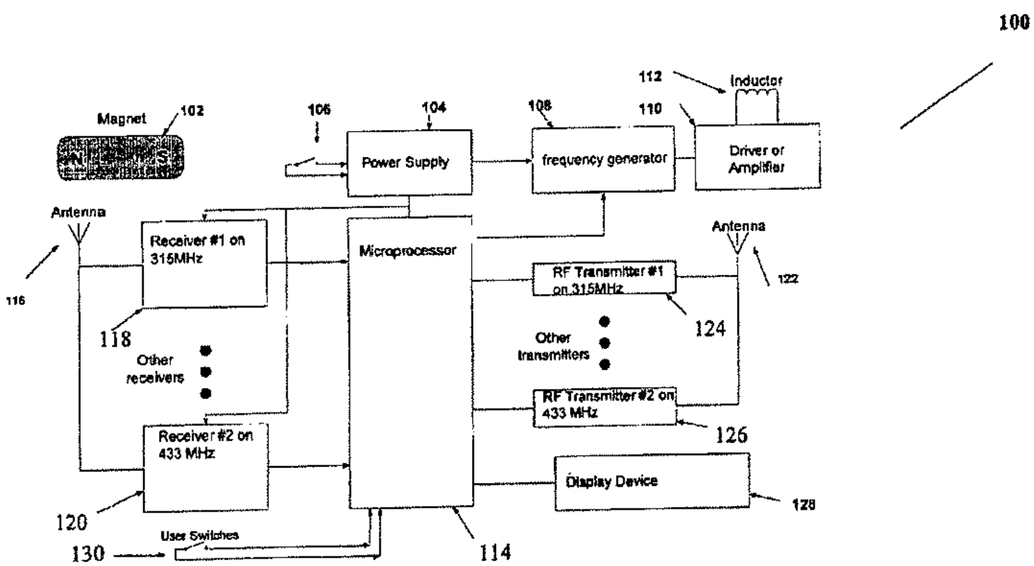
Primary Examiner—Edward Lefkowitz
Assistant Examiner—Andre Allen
(74) *Attorney, Agent, or Firm*—The Law Office of Stanley K. Hill, PLC

(57) **ABSTRACT**

A tire positioning tool is provided that can be utilized to work with remote tire monitoring systems made by different manufacturers. The tire positioning tools are capable of activating RTMS tire sensors using one of a plurality of methods. Tire positioning tools can be manufactured that are cable of receiving signals from RTMS tire sensors using a plurality of different frequencies. Tire positioning tools can be manufactured that are also capable of transmitting data to a RTMS receiving unit and/or receiving data from a RTMS receiving unit using a plurality of signal frequencies. Using the provided tire positioning tool, a technician tasked to install a new tire or to rotate tires can utilize a single tool to work with remote tire monitoring systems made by different manufacturers.

22 Claims, 4 Drawing Sheets



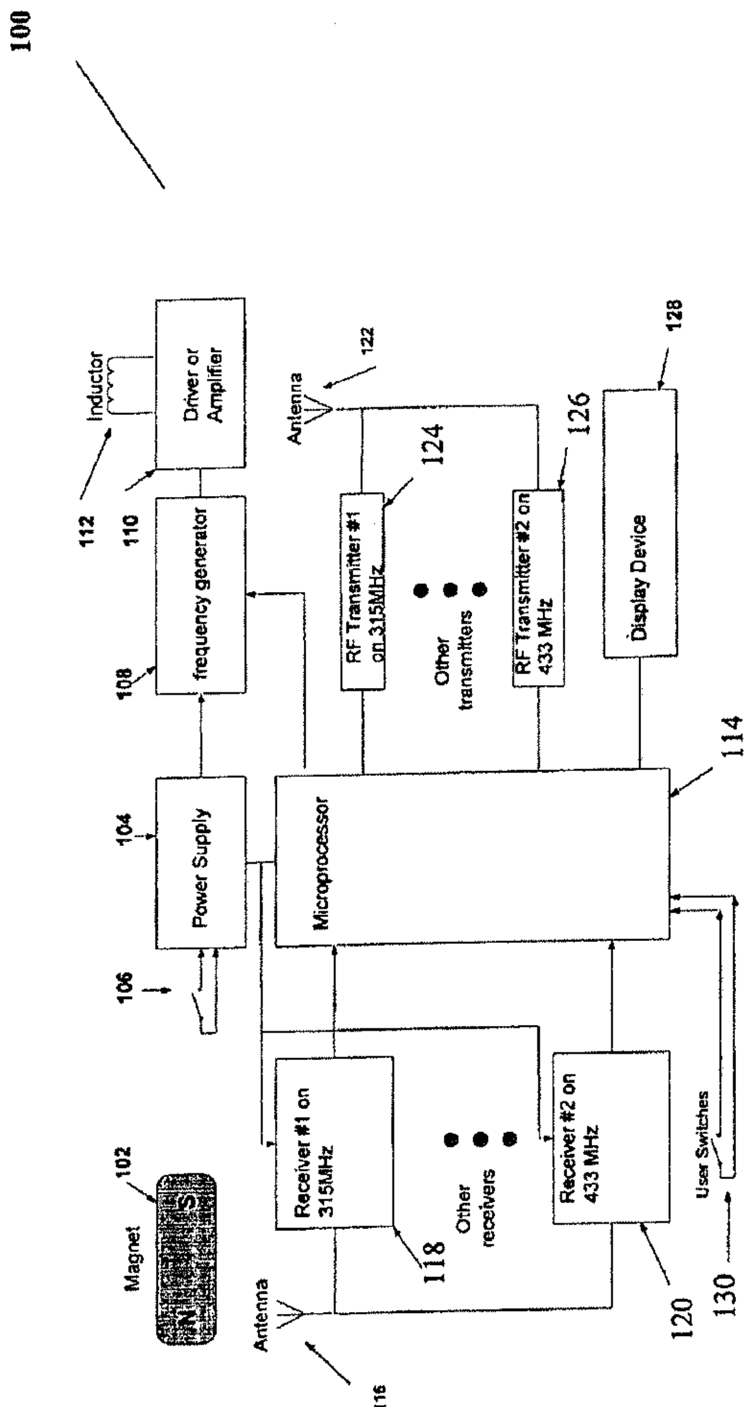
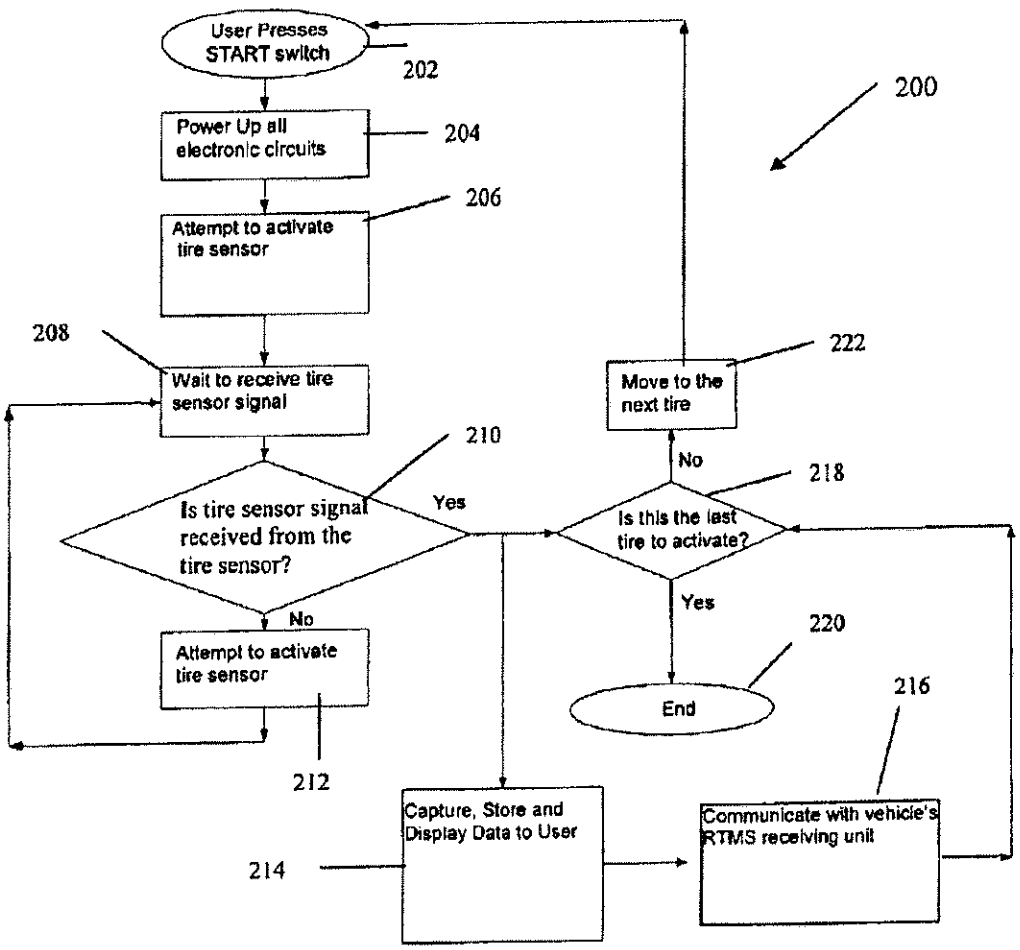

100
Inductor
Driver or Amplifier
112
110
frequency generator
108
Power Supply
104
106
Magnet
102
Antenna
116
Receiver #1 on 315MHz
118
Other receivers
Receiver #2 on 433 MHz
120
User Switches
130
Microprocessor
114
Antenna
122
RF Transmitter #1 on 315MHz
124
Other transmitters
RF Transmitter #2 on 433 MHz
126
Display Device
128

FIG. 1



User Presses START switch
202
200
Power Up all electronic circuits
204
Attempt to activate tire sensor
206
208
Wait to receive tire sensor signal
Move to the next tire
222
210
Is tire sensor signal received from the tire sensor?
Yes
No
218
Is this the last tire to activate?
No
Yes
220
Attempt to activate tire sensor
End
216
212
Capture, Store and Display Data to User
Communicate with vehicle's RTMS receiving unit
214

FIG. 2

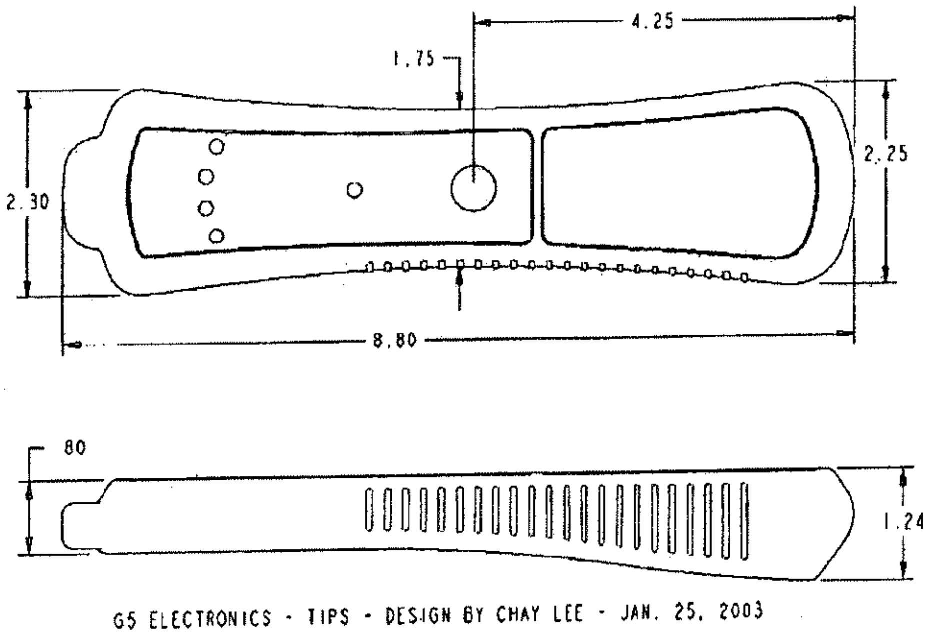

4.25
1.75
2.30
2.25
8.80
80
1.24
G5 ELECTRONICS - TIPS - DESIGN BY CHAY LEE - JAN. 25, 2003

FIG. 3

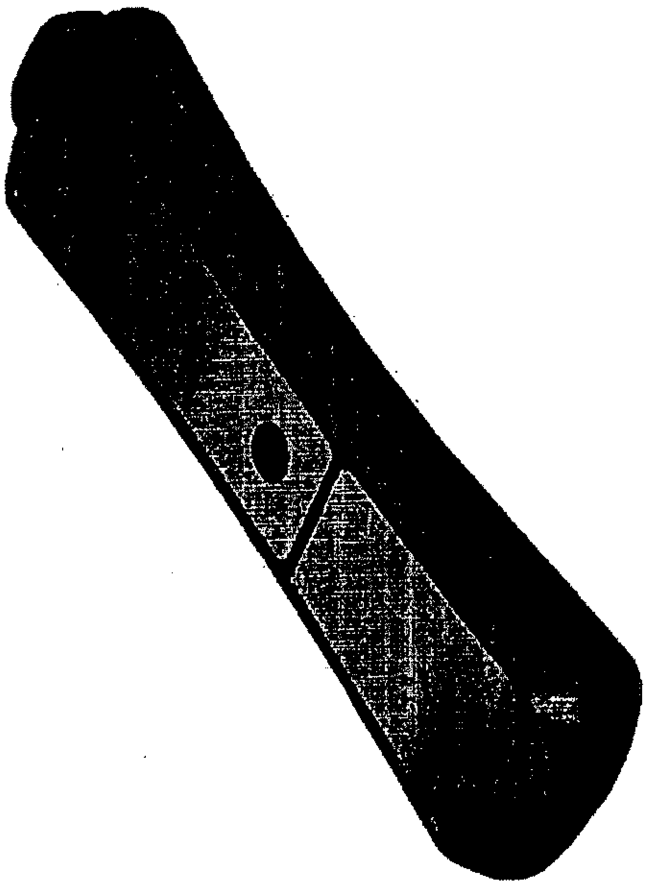


FIG. 4

REMOTE TIRE MONITORING SYSTEMS TOOL

FIELD OF THE INVENTION

The present invention relates to apparatus and methods useful for communicating with remote tire monitoring systems. More specifically, the present invention provides apparatus and methods that are capable of communicating with different remote tire monitoring systems made by different manufacturers.

BACKGROUND OF THE INVENTION

Remote tire monitoring systems ("RTMSs") are known in the art. Such systems typically include a plurality of sensor units or transmitters associated with the tires of a vehicle ("tire sensors"), such as an automobile, truck, or other wheeled vehicle, along with a receiving unit. The sensors measure a tire characteristic, most commonly the air pressure in the associated tire, and communicate data corresponding to the tire characteristic to the receiving unit on the vehicle. The data is typically communicated to the receiving unit via radio frequency ("RF") signals. The RF signals can be modulated and encoded to transmit data such as tire pressure, unique identifier, etc. The receiver typically takes some action in response to receiving the transmitted data, such as providing an alarm or providing a display to the operator of the vehicle indicative of the tire characteristic. Thus, if the air pressure in a tire is too low (or too high), the RTMS tire sensor detects the low air pressure and signals to the RTMS receiving unit, which then indicates to the operator of the vehicle which tire has the low air pressure.

In order for the receiver to reliably indicate the tire characteristic to the vehicle operator, the receiver preferably associates the tire sensor (and therefore, the tire characteristic data) with a tire position on the vehicle. This association is made upon initial installation of tires on the vehicle and must be repeated each time tire positions are changed, such as after tire rotation, or a new tire is installed.

A technician installing new tires on a vehicle or changing the positions of tires (that is, rotating tires) on a vehicle can program the vehicle's RTMS receiving unit to associate the tires on the vehicle with their tire positions by first putting the receiving unit into learn mode or programming mode and then activating the tire sensors in a sequence specified by the manufacturer of the RTMS receiving unit. The methods for putting receiving units into programming mode are typically manufacturer dependent, but are generally known in the ant. For example, it is known in the art that some RTMS receiving units manufactured by Ford Motor Company can be put into programming mode by first turning the ignition on (not in start position) and off three times, followed by depressing the vehicle's brake, followed by again turning the ignition on and off three times.

Once the receiving unit is placed into programming mode it will expect the tire sensors to be activated in a particular sequence. That is, the receiving unit may expect the tire sensor in the right front tire to be activated first, followed by the tire sensor in the left front tire, etc. The precise sequence for activating tire sensors is determined by and readily available from the manufacturer of the RTMS.

As each tire sensor is activated, it transmits a signal ("tire sensor signal") to the receiving unit. The tire sensor signal will typically contain a unique ID that identifies the particular tire (that is, tire sensor) that is transmitting the tire sensor signal. The receiving unit associates this unique ID with the

position of the tire from which the signal is being transmitted. In this manner, the receiving unit learns the position of each tire as it is being activated. After each tire is activated, the receiving unit will typically emit a sound, such as a beeping sound, to indicate to the technician that the receiving unit received a tire sensor signal from the activated tire and that the next tire in the sequence can be then activated.

At any later point in time when a tire sensor is activated, it transmits its unique ID along with pertinent data about the tire (such as tire pressure, for example) and the receiving unit can then display the transmitted data as necessary to the operator of the vehicle, also indicating the tire position to the operator. For example, if while a vehicle is in operation the right front tire starts losing air pressure, the loss of air pressure is detected by the tire sensor in the right front tire, the tire sensor transmits the tire pressure to the receiving unit (along with its unique ID), the receiving unit determines the tire position (that is, right front) of the transmitting tire sensor from the previous association of unique ID to tire position and then indicates to the operator of the vehicle that the right front tire has low tire pressure.

SUMMARY OF THE INVENTION

Remote tire monitoring systems are produced by a plurality of manufacturers. RTMS tire sensors designed by different manufacturers typically utilize different methods for activating the tire sensors. For example, one RTMS manufacturer may build its tire sensors such that they are activated by a magnetic field that can be generated by a magnet. A second way that some tire sensors can be activated is by a change in air pressure in the tire. A third way that some tire sensors can be activated is by the rotation of the tire. A fourth way that some tire sensors can be activated is by temperature. RTMS manufacturers may also build tire sensors such that they are activated by a continuous wave low frequency ("LF") or radio frequency ("RF") signal. Still other RTMS manufacturers may build tire sensors such that they are activated by a modulated low frequency ("LF") or radio frequency ("RF") signal.

Additionally, different manufacturers frequently utilize different methods for transmitting data from the tire sensor (upon activation) to the receiving unit. For example, one manufacturer may build tire sensors such that they transmit, and the receiving units receive, data via a RF signal at a particular frequency, such as 315 MHz. A second manufacturer may build tire sensors such that they transmit data via a RF signal at a different frequency, such as 433 MHz. A third manufacture may build tire sensors such that they transmit data via a RF signal at yet another frequency, such as 916 MHz.

The present invention provides for a tire positioning tool that can be utilized to work with remote tire monitoring systems made by different manufacturers. Tire positioning tools of the present invention are capable of activating RTMS tire sensors using one of a plurality of means. Preferred tire positioning tools of the present invention are capable of receiving signals of a plurality of frequencies transmitted by activated RTMS tire sensors. Preferred tire positioning tools of the present invention are also capable of transmitting data to a RTMS receiving unit and/or receiving data from a RTMS receiving unit using one of a plurality of signal frequencies. In this manner, a technician tasked to install a new tire or to rotate tires can utilize a single tool to work with remote tire monitoring systems made by different manufacturers.

DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example in the following drawings in which like references indicate similar elements. The following drawings disclose various embodiments of the present invention for purposes of illustration only and are not intended to limit the scope of the invention.

FIG. 1 illustrates a block diagram of a tire positioning tool according to the present invention.

FIG. 2 illustrates a flowchart representing an embodiment of a method according to the present invention.

FIG. 3 illustrates an embodiment of a tire positioning tool according to the present invention.

FIG. 4 illustrates an embodiment of a tire positioning tool according to the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT OF THE INVENTION

In the following detailed description of preferred embodiments of the present invention, reference is made to the accompanying Drawings, which form a part hereof, and in which are shown by way of illustration specific embodiments in which the present invention may be practiced. It should be understood that other embodiments may be utilized and structural changes may be made without departing from the scope of the present invention.

The present invention provides for a tire positioning tool that can be utilized to work with a plurality of remote tire monitoring systems made by different manufacturers (that is, different makes of RTMSs). In a first embodiment, tire positioning tools of the present invention comprise a plurality of means for activating tire sensors and are thus capable of activating a plurality of makes of RTMS tire sensors. In a second embodiment, tire positioning tools of the present invention additionally comprise signal receiving circuitry capable of receiving data transmitted from a plurality of makes of activated RTMS tire sensors. In a third embodiment, tire positioning tools of the present invention comprise signal transmitting circuitry capable of transmitting data to a plurality of different makes of RTMS receiving units. In a fourth embodiment, tire positioning tools of the present invention additionally comprise signal receiving circuitry capable of receiving data transmitted from a plurality of makes of activated RTMS receiving units.

Remote tire monitoring systems are produced by a plurality of manufacturers. RTMS tire sensors designed by different manufacturers typically utilize different methods for activating the tire sensors. For example, one manufacturer may build its tire sensors such that they are activated by a magnetic field that can be generated by a magnet. Thus, if a magnet is placed within a short distance (typically, a few inches) of the tire sensor, the tire sensor will activate. A second way that some tire sensors can be activated is by a change in air pressure in the tire. That is, if the air pressure changes by a certain amount (typically about 5 psi) then the tire sensor activates. A third way that some tire sensors can be activated is by the rotation of the tire. Thus, whenever the tire rotates at a certain rate (or higher rate) the tire sensor will activate. A fourth way that some tire sensors can be activated is by temperature. In this manner, if a tire starts to become overheated, the tire sensor is activated. RTMS manufacturers may also build its tire sensors such that they are activated by radio frequency signals. Radio frequency signals having a frequency of less than about 30 MHz are typically referred to as low frequency ("LF") signals and signals having a frequency greater than about 30 MHz are typically referred to as radio frequency ("RF") signals. Accordingly, radio frequency signals having a frequency of less than or equal to 30 MHz are referred to herein as LF signals and radio

frequency signals having a frequency of greater than 30 MHz are referred to herein as RF signals. Thus, a fifth way that some tire sensors may be activated is by a continuous wave LF signal or a continuous wave RF signal. Typically, these tire sensors will activate whenever they receive a continuous wave signal for a certain period of time (commonly, at least 6 seconds). Another RTMS manufacturer may build its tire sensors such that they are activated by a modulated LF or modulated RF signal. A LF or RF signal transmitted for the purpose of activating a RTMS tire sensor, whether continuous or modulated, is referred to herein as an activation signal.

Tire positioning tools of the present invention will comprise a plurality of means for activating tire sensors. Tire positioning tools of the present invention can be manufactured utilizing as few as two different means for activating tire sensors. Producing tire positioning tools of the present invention having as few as two different means for activating tire sensors may be useful, for example, if it is known that the tire positioning tool will only be used in circumstances requiring the tool to be used in conjunction with as few as two different known makes of RTMS. Tire positioning tools of the present invention having fewer different means for activating tire sensors will generally be less expensive to manufacture than tire positioning tools of the present invention having many different means for activating tire sensors. On the other hand, if it is known that the tire positioning tool of the present invention is intended to be utilized in circumstances requiring the tool to be used in conjunction with many different makes of RTMS, then a tire positioning tool according to the present invention can be manufactured with many different means for activating tire sensors.

One means for activating tire sensors that can be incorporated into tire positioning tools of the present invention involves the use of a magnet. Thus, tire positioning tools of the present invention can have a magnet attached to the tire positioning tool, typically being placed inside the tool. Some tire sensors are manufactured such that when the tire sensor is placed within a magnetic field as is generated by a magnet, the sensor becomes activated. Generally, a tire positioning tool containing a magnet will need to be positioned within a few inches of the tire sensor before the tire sensor is activated by the magnet. The types of magnets useful for activating tire sensors are known in the art and an appropriate magnet for inclusion in tire positioning tools of the present invention can be readily determined by one of ordinary skill in the art. When a technician is working with a remote tire monitoring system comprising tire sensors that are activated by a magnet, a technician can first put the RTMS receiving unit into programming mode and then use a tire positioning tool of the present invention on each tire in the appropriate sequence to activate the tire sensor by placing the tire positioning tool sufficiently close to the tire to put the tire sensor within the magnetic field of the magnet.

A second means for activating tire sensors that can be incorporated into tire positioning tools of the present invention involves the use of a valve core depressor. It is well known in the art to lower a tire's air pressure by depressing the valve core and letting air out of the tire. There are tools known in the art that are used to depress valve cores and let air out of a tire. These tools are referred to herein as valve core depressors. Tire positioning tools of the present invention can have a valve core depressor attached to or built into the casing of the tool making it easy for a technician to lower the air pressure in a tire. When a technician is working with a remote tire monitoring system comprising tire sensors that are activated by a change in tire pressure, a technician can first put the RTMS receiving unit into programming mode and then use a tire positioning tool of the present invention on each tire in the appropriate sequence to let out an amount of air sufficient to reduce the tire pressure enough to activate the tire sensor.

A third means for activating tire sensors that can be incorporated into tire positioning tools of the present invention involves the use of a continuous wave ("CW") LF or RF signal. Some tire sensors may be manufactured such that they are activated upon receiving a CW signal of a particular frequency. Means for generating CW signals at a specific frequency are known in the art and any means known in the art can be utilized for generating a CW signal in tire positioning tools of the present invention. One means for producing a CW signal in tire positioning tools of the present invention is to include frequency generating circuitry to generate the CW signal and then amplify the CW signal with an amplifier or a driver circuit. Frequency generating circuitry as well as amplifiers and driver circuitry are known in the art and can readily be incorporated into tire positioning tools of the present invention by one of ordinary skill in the art.

Tire positioning tools of the present invention may comprise frequency generating circuitry capable of generating a single frequency or may comprise frequency generating circuitry capable of generating a plurality of different frequencies. Different makes of RTMS tire sensors may require different frequencies of CW signal to be activated. Thus, each different frequency of CW signal generated constitutes a different means for activating RTMS tire sensors. If a tire positioning tool of the present invention is capable of generating a CW signal of only one frequency, then the tool will also comprise at least one other means of activating a RTMS tire sensor, such as a magnet. Most commonly, tire positioning tools of the present invention will comprise frequency generating circuitry capable of generating a plurality of different frequencies. The frequencies of the CW signals are chosen from frequencies that are known to activate different makes of RTMS tire sensors. Useful signals for CW signals in tire positioning tools of the present invention may include, for example, 125 KHz, 13.56 MHz, 928 MHz, and 2.4 GHz.

A fourth means for activating tire sensors that can be incorporated into tire positioning tools of the present invention involves the use of a modulated signal. Some tire sensors may be manufactured such that they are activated upon receiving a modulated signal of a particular frequency. Means for generating modulated signals at a specific frequency are known in the art and any means known in the art can be utilized for generating a modulated signal in tire positioning tools of the present invention. One means for producing a modulated signal in tire positioning tools of the present invention is to include a microprocessor in addition to frequency generating circuitry. As is known in the art, the microprocessor can provide the modulation to the frequency generator circuitry. An amplifier or driver circuit can also be included to amplify the signal.

Similar to the generated CW signal above, tire positioning tools of the present invention may be capable of generating a modulated signal at only a single frequency or may be capable of generating a modulated signal at one of a plurality of frequencies. Different makes of RTMS tire sensors may require different frequencies of modulated signal to be activated. Thus, each different frequency of modulated signal generated constitutes a different means for activating RTMS tire sensors. If a tire positioning tool of the present invention is capable of generating a modulated signal at only one frequency, then the tool will also comprise at least one other means of activating a RTMS tire sensor, such as a magnet or a means for transmitting a CW signal. Most commonly, tire positioning tools of the present invention will comprise a microprocessor and frequency generating circuitry capable of generating modulated signals at a plurality of different frequencies. The frequencies of the modulated signals are chosen from frequencies that are known to activate different makes of RTMS tire sensors. Useful frequencies for modulated signals in tire positioning tools of the present invention may include, for example, 125 KHz, 13.56 MHz, 928 MHz, and 2.4 GHz.

As mentioned above, tire positioning tools of the present invention comprise a plurality of means for activating RTMS tire sensors. The plurality of means for activating RTMS tire sensors may be any combination of the means discussed above. For example, tire positioning tools of the present invention may only include means for generating CW signals at two or more different frequencies and not include any other means for activating RTMS tire sensors. Similarly, tire positioning tools of the present invention may only include means for generating modulated signals at two or more different frequencies and not include any other means for activating RTMS tire sensors. Alternately, tire positioning tools or the present invention may include means for generating a CW signal at only one specific frequency and also include means for generating a modulated signal at only one specific frequency. Most commonly, tire positioning tools of the present invention will comprise a magnet, a core valve depressor, means for generating CW signals at two or more different frequencies, and means for generating modulated signals at two or more different frequencies.

One advantage of utilizing a plurality of means for activating RTMS tire sensors is that a technician can utilize a single tire positioning tool of the present invention to activate a plurality of makes of RTMS tires sensors. This can be done regardless of whether the technician is aware of the specific make of the RTMS tire sensor. Once a RMTS receiving unit has been put into programming mode, a technician can use a tire positioning tool of the present invention to activate the tire sensors in the appropriate order to indicate the position of each tire to the receiving unit.

Tire positioning tools of the present invention can be advantageously utilized for indicating tire position to a RTMS receiving unit. A technician utilizing a tire positioning tool of the present invention will first put the RTMS receiving unit into programming mode. Then the technician will use the tool to activate each tire sensor in the sequence expected by the receiving unit.

If the technician knows which manufacturer built the RTMS and which means is needed to activate the tire sensors, the technician will use that means to activate each tire. For example, if the technician knows that a CW signal at a particular frequency will activate the tire sensors, the technician approaches each tire in the appropriate sequence, places the tire positioning tool sufficiently close to the tire such that the tire sensor is within range for receiving a CW signal from the tire positioning tool, and then activates the tire position tool in such a manner that is generates a CW signal at the particular frequency desired. When the RTMS receiving unit indicates that a tire sensor signal has been received, the technician proceeds to the next tire in the sequence and activates its tire sensor. The technician similarly activates each tire sensor in the sequence until all tire sensors have been activated.

If the technician does not know which means is needed to activate the tire sensors, the technician can proceed to the first tire after putting the RTMS receiving unit into programming mode and try to activate the tire sensor using different means until the receiving unit indicates that it has received a tire sensor signal. For example, the technician may first attempt to activate the tire sensor by placing the tire sensor within the magnetic field of the tool's magnet. If the tire sensor does not activate (that is, the receiving unit does not indicate that a tire sensor signal has been received), the technician can attempt to activate the tire sensor by having the tool generate a CW signal at a particular frequency. If the tire sensor still does not activate, the technician can attempt to activate the tire sensor by having the tool generate a CW signal at a different frequency or generate a modulated signal at a particular frequency. Attempts to activate the tire sensor continue until either the tire sensor is activated or all available means for activating tire sensors have been attempted unsuccessfully. Once a means for successfully activating the first tire sensor in the sequence is determined, the technician can utilize that means for each of the remaining tires in the sequence without having to first try any other means.

Preferred embodiments of tire positioning tools of the present invention will also comprise means for receiving signals transmitted by activated RTMS tire sensors. Once a RTMS tire sensor has been activated, the tire sensor transmits data to the receiving unit via a LF or RF signal at a particular frequency (that is, a tire sensor signal). Preferred tire positioning tools of the present invention can also receive tire sensor signals. Preferred tire positioning tools of the present invention will comprise an antenna connected to receiving circuitry capable of receiving tire sensor signals. The receiving circuitry may comprise a single receiver capable of receiving a single frequency, a single receiver capable of receiving a plurality of frequencies, or multiple receivers each of which is capable of receiving a single frequency. Preferred tire positioning tools of the present invention will additionally comprise a microprocessor for decoding tire sensors signals. Antennas, receiving circuitry, and microprocessors useful in the present invention are known in the art and can be readily incorporated into tire positioning tools of the present invention by one of ordinary skill in the art. Different makes of RTMS tire sensors may transmit different frequencies of tire sensor signal. Thus, each different frequency of tire sensor signal that tire positioning tools of the present invention arc capable of receiving constitutes a different means for receiving tire sensor signals. That is, if a tire positioning tool of the present invention comprises means for receiving tire sensor signals at a plurality of frequencies then the tire position tool comprises a plurality of means for receiving tire sensor signals.

Typically, preferred tire positioning tools will be capable of receiving a plurality of frequencies of tire sensor signals. This can be accomplished by including a plurality of receivers into tire positioning tools of the present invention, wherein each receiver is designed to receive a signal of a particular frequency. Alternately, this can be accomplished by including a single receiver capable of receiving multiple different frequencies. For each frequency of signal known to be transmitted by a RTMS tire sensor, receiving circuitry can be included into tire position tools of the present invention such that the tire position tool can receive and decode the tire sensor signal at that frequency. Frequencies of RTMS tire sensor signals useful for tire positioning tools of the present invention to receive may include, for example, 125 KHz, 13.56 MHz, 315 MHz, 433 MHz, 848 MHz, 916 MHz, and 2.4 GHz.

Whether to include a single receiver capable of receiving a plurality of frequencies or whether to include a plurality of receiver each of which is capable of receiving a single frequency is more of an economic decision than a technical one. Receivers capable of receiving a plurality of frequencies are generally more expensive to manufacture than receivers capable of receiving a single frequency. If the tire positioning tool is designed to receive only a few different frequencies, it may be more economical to include multiple receivers each receiving a single frequency. However, if the tire positioning tool is designed to receive many different frequencies, then it may be more economical to include a single receiver capable of receiving all the targeted frequencies.

The number of frequencies that tire positioning tools of the present invention are capable of receiving can be adapted to the particular environment in which the tool will be used by a technician. Tire positioning tools capable of receiving a larger number of different frequencies may be used in conjunction with a larger number of makes of remote tire monitoring systems, but tire positioning tools capable of receiving fewer different frequencies will typically be less expensive to manufacture.

RTMS tire sensor signals received by tire positioning tools of the present invention transmit data to the tire positioning tool that can be advantageously displayed. For example, tire sensors may transmit, via tire sensor signals, data such as unique ID, tire pressure, tire temperature, etc. Preferred tire positioning tools of the present invention will include a display apparatus that can be advantageously utilized to display the transmitted data in a manner making it readable to the technician utilizing the tire positioning tool. Display apparatus that can be advantageously incorporated into tire positioning tools of the present invention are known in the art and may include, for example, LED devices, LCD devices, VF devices, or other devices.

Tire positioning tools of the present invention capable of receiving tire sensor signals can be advantageously utilized by a technician in a variety of ways. For example, if a technician simply wants to determine if the tire sensor of a tire is operational, the technician can utilize the tool to activate the tire sensor. If the tire sensor's data (that is, unique ID, tire pressure, etc.) is displayed, the technician knows the tire sensor is operational. A technician may also use tire positioning tools of the present invention to check the air pressure in each of the tires to ensure that the pressure in each tire is at an adequate level. When a technician balances a tire, the technician places the tire on a device that rotates the tire. This rotation may activate the tire sensor, allowing the technician to receive the tire sensor's data while the tire is rotating. Of course, the technician can also use the tool to activate a tire while it is rotating.

Preferred embodiments of tire positioning tools of the present invention will additionally comprise means for transmitting signals to RTMS receiving units. Such means will typically comprise an antenna connected to transmitting circuitry for transmitting signals and a microprocessor for encoding signals. The transmitting circuitry may comprise a single transmitter capable of transmitting a single frequency, a single transmitter capable of transmitting a plurality of frequencies, or multiple transmitters each of which is capable of transmitting a single frequency. Preferred tire positioning tools of the present invention will additionally comprise a microprocessor for signals transmitted to receiving units. Antennas, transmitting circuitry, and microprocessors useful in the present invention are known in the art and can be readily incorporated into tire positioning tools of the present invention by one of ordinary skill in the art. Different makes of RTMS receiving units may receive different frequencies of signal. Thus, each different frequency of signal that tire positioning tools of the present invention are capable of transmitting constitutes a different means for transmitting signals. That is, if a tire positioning tool of the present invention comprises means for transmitting signals at a plurality of frequencies then the tire position tool comprises a plurality of means for transmitting signals.

Typically, preferred tire positioning tools will be capable of transmitting a plurality of frequencies of signals to receiving units. This can be accomplished by including a plurality of transmitters into tire positioning tools of the present invention, wherein each transmitter is designed to transmit a signal of a particular frequency. Alternately, this can be accomplished by including a single transmitter capable of transmitting multiple different frequencies. For each frequency of signal known to be received by a RTMS receiving unit, transmitting circuitry can be included into tire position tools of the present invention such that the tire position tool can encode and transmit a signal at that frequency. Frequencies of signals useful for tire positioning tools of the present invention to transmit may include, for example, 125 KHz, 13.56 MHz, 315 MHz, 433 MHz, 848 MHz, 916 MHz, and 2.4 GHz.

Whether to include a single transmitter capable of transmitting a plurality of frequencies or whether to include a plurality of transmitters each of which is capable of transmitting a single frequency is more of an economic decision than a technical one. Transmitters capable of transmitting a plurality of frequencies are generally more expensive to manufacture than transmitters capable of transmitting a single frequency. If the tire positioning tool is designed to transmit only a few different frequencies, it may be more economical to include multiple transmitters each transmitting a single frequency. However, if the tire positioning tool is designed to transmit many different frequencies, then it may be more economical to include a single transmitter capable of transmitting all the targeted frequencies.

The number of frequencies that tire positioning tools of the present invention are capable of transmitting can be adapted to the particular environment in which the tool will be used by a technician. Tire positioning tools capable of transmitting a larger number of different frequencies may be used in conjunction with a larger number of makes of remote tire monitoring systems, but tire positioning tools capable of transmitting fewer different frequencies will typically be less expensive to manufacture.

In this manner, preferred tire positioning tools of the present invention can receive a signal from an activated RTMS tire sensor, decode the signal, add additional data such as tire position as necessary or desired, encode the data, and transmit the encoded data via a signal to the vehicle's receiving unit. Different makes of RTMS receiving units may be designed to receive different frequencies of signals. Thus, each different frequency of signal that tire positioning tools of the present invention are capable of transmitting to a receiving unit constitutes a different means for transmitting such signals. That is, if a tire positioning tool of the present invention comprises means for transmitting signals to receiving units at a plurality of different frequencies then the tire position tool comprises a plurality of means for transmitting such signals.

Similar to having means for receiving tire sensor signals at multiple different frequencies, preferred embodiments of tire positioning tools of the present invention may also include means for receiving signals transmitted by RTMS receiving units. In this manner, the tire positioning tool can interact with a vehicle's receiving unit by both receiving signals from and transmitting signals to the vehicle's receiving unit. Different makes of RTMS receiving units may transmit different frequencies of signals. Thus, each different frequency of such signal that tire positioning tools of the present invention are capable of receiving constitutes a different means for receiving such signals. That is, if a tire positioning tool of the present invention comprises means for receiving signals from RTMS receiving units at a plurality of different frequencies then the tire position tool comprises a plurality of means for receiving such signals.

FIG. **1** illustrates a block diagram of a preferred embodiment of a tire positioning tool of the present invention **100**. The tool **100** comprises a magnet **102** that can be advantageously utilized to activate RTMS tire sensors that can be activated when placed within a magnetic field generated by a magnet. The tool **100** also comprises a power supply **104** and a switch **106** for providing power to the electronic circuits of tool **100**. The power supply **104** will typically be a battery. When switch **106** is closed the power supply **104** provides power to the tool's electronic circuits. Frequency generator **108**, amplifier **110**, and inductor **112** are used to send signals for activating RTMS tire sensors (that is, activation signals). Microprocessor **114** can be advantageously utilized in various ways known in the art to modulate signals, encode signals, decode signals, etc. For purposes of the present specification the term microprocessor is intended to include devices such as those referred to in the art as microcontollers. Microprocessor **114** can also be advantageously utilized in conjunction with memory devices (not shown) to execute computer programs for controlling tire positioning tools of the present invention.

Antenna **116** is designed to receive signals from either a RTMS tire sensor or a RTMS receiving unit. FIG. **1** illustrates an embodiment of a tire positioning tool comprising two receivers, the first receiver **118** is capable of receiving signals at a frequency of 315 MHz, and the second receiver **120** is capable of receiving signals at a frequency of 433 MHz. The ellipsis between the two receivers is an indication that other embodiments of tire position tools may comprise additional receivers capable of receiving signals at other frequencies. Microprocessor **114** can be utilized to decode signals received by one of the receivers.

Antenna **122** is designed to transmit signals to either a RTMS receiving unit or a RTMS tire sensor. FIG. **1** illustrates an embodiment of a tire positioning tool comprising two transmitters, the first transmitter **124** is capable of transmitting signals at a frequency of 315 MHz, and the second transmitter **126** is capable of transmitting signals at a frequency of 433 MHz. The ellipsis between the two transmitters is an indication that other embodiments of tire position tools may comprise additional transmitters capable of transmitting signals at other frequencies. Microprocessor **114** can be utilized to encode signals transmitted by one of the transmitters.

As is illustrated in FIG. **1**, tire positioning tools of the present invention will typically also comprise a display device for visually communicating information to the operating technician. Display device **128** may be an LED device, an LCD device, a VF device, or any other device known in the art useful for displaying information to an operating technician. The type of information displayed may include, for example, unique tire ID, tire pressure, and tire temperature.

The tire positioning tool embodiment illustrated in FIG. **1** also comprises user switches **130**. User switches **130** can be utilized by a technician to switch between different modes of operation. Different embodiments of the present invention may have different modes of operation. For example, one mode of operation might involve activating RTMS tire sensors and displaying the information on the display device **128**. Another mode of operation might involve a technician inputting information into a tire positioning tool so that the information can be transmitted to a RTMS receiving unit. Another mode of operation might involve a tire positioning tool transmitting information to a vehicle's RTMS receiving unit. The types of information that can be input into a tire positioning tool may include, for example, tire location, warning levels (for example, temperature and/or pressure levels that if reached in a tire should trigger a receiving unit to warn a vehicle operator), brand of tire, brand of sensor, and date of service. In a preferred embodiment of the present invention, a technician can put the tire position tool in one mode to activate and receive information from a tire sensor (unique ID and tire pressure, for example), put the tool in a second mode to allow the technician to input information (tire location, for example), and then put the tool in a third mode to transmit the information received from the tire sensor along with the inputted information to the receiving unit.

FIG. **2** illustrates a flowchart representing an embodiment of a method **200** according to the present invention. Methods such as the method **200** illustrated in FIG. **2** can be implemented in a tire positioning tool's microprocessor by one of ordinary skill in the art of computer programming.

A technician starts the use of the tire positioning tool by pressing a start switch **202**, such as the switch **106** shown in FIG. **1**. Pressing the start switch **202** causes all of the electronic circuits of the tool to power up **204**. Next, the tire positioning tool attempts to activate a tire sensor **206** by utilizing one of the plurality of means capable of activating remote tire monitoring system tire sensors. This can be done, for example, by transmitting an activation signal, by placing the tire positioning tool sufficiently close to the tire sensor to put it within the magnetic field of any magnet present in the tire positioning tool, or by utilizing a tool's valve core depressor (if present). When transmitting an activation signal, the tool attempts to activate the targeted tire sensor by transmitting either a CW signal or a modulated signal at a particular frequency.

In preferred embodiments of the present invention, the tire positioning tool records the most recent means of activation signal that was utilized to successfully activate a tire sensor and the recorded means of activation signal is the first means of activation signal to be used when first attempting to activate the tire sensor **206**. Generally, all tire sensors of a given make use the same means of signal to activate. And generally, all tire sensors on a vehicle will be of the same make. Accordingly, if a technician has already activated one or more tires on a vehicle then the activation signal for the next tire will be the same means of activation signal as was just utilized on the previous tires. Thus, recording the last successful activation signal saves time because after the first tire in a sequence is activated the same means of activation signal can be utilized on the next tire without first having to try many other means of activation signals. The most recent successful type of activation signal can be recorded by any appropriate means. For example, each activation signal means can be associated with a unique number and whenever an activation signal is successful the unique number can be stored by the microprocessor. When attempting to activate a tire sensor **206**, the microprocessor can retrieve the last stored unique number and utilize the associated activation signal means in the attempt to activate a tire sensor **206**.

After the tire positioning tool attempts to activate the tire sensor **206**, the tool waits for a period of time sufficient to receive a tire sensor signal **208**. The tire positioning tool must wait long enough to provide the tire sensor enough time to become activated, to provide enough time to transmit a tire sensor signal, and to provide enough time for the tire positioning tool to receive the tire sensor signal. For example, some tire sensors must receive a continuous wave signal for at least 6 seconds before they will activate. The period of time for which a tire positioning tool will wait to receive a tire sensor signal will typically be no more than about 10 seconds. The tire positioning tool then determines whether a tire sensor signal has been received **210** within the period of time. If not, the tool attempts to activate the tire sensor **212** utilizing a different means of activating remote tire monitoring system tire sensors. For example, if the previous attempt to activate the tire sensor utilized a CW signal at a particular frequency, then the current attempt could transmit a CW signal at a different frequency or could transmit a modulated signal at a particular frequency. After this latest attempt to activate the tire sensor **212**, the tool will again wait to receive a tire sensor signal **208**. This loop of attempting to activate the tire sensor **212**, waiting to receive a tire sensor **208**, and determining whether a tire sensor has been received **210** continues until a tire sensor is received or all means of activating tire sensors have been attempted.

Once a tire sensor signal has been received, preferred embodiments of the present invention can store and display the data **214**. Preferred embodiments of the present invention can also communicate with a vehicle's RTMS receiving unit **216**. The communication with a vehicle's RTMS receiving unit **216** may pass on additional information to the receiving unit, such as tire position, for example. Either or both of the steps **214** and **216** can be skipped in various embodiments of the present invention.

Once steps **214** and **216** are both completed or skipped, the tire position tool determines if the tire sensor just activated was the last tire sensor to be activated **218**. If so, all tire sensors have been activated and the tire positioning tool can be turned off **220** or used on another vehicle to install or rotate tires. If not, the tire positioning tool is moved to the next tire **222** having a tire sensor that needs to be activated and the start switch is pressed **202** to activate the next tire sensor.

The components of tire positioning tools of the present invention can be integrated by one of ordinary skill in the electronic arts to fit in a casing that is sufficiently small to be easily carried and handled by a technician. FIG. **3** illustrates a schematic of an embodiment of the present invention. FIG. **4** illustrates another schematic of an embodiment of the present invention.

While the present invention has been described in detail with respect to specific embodiments thereof, it will be appreciated that those skilled in the art, upon attaining an understanding of the foregoing, may readily conceive of alterations to, variations of and equivalents to these embodiments. Accordingly, the scope of the present invention should be assessed as that of the appended claims and by equivalents thereto.

What is claimed is:

1. A tool comprising a plurality of means for activating remote tire monitoring system tire sensors, the plurality of means selected from the group consisting of a magnet, a valve core depressor, means for generating continuous wave signals, and means for generating modulated signals, wherein the tool is capable of activating a plurality of tire sensors, each of the plurality of tire sensors utilizing a different method for activating the said tire sensor.

2. The tool of claim 1, wherein the tool comprises a magnet and at least one means for generating a continuous wave signal.

3. The tool of claim 1, wherein the tool comprises a magnet and at least one means for generating a modulated signal.

4. The tool of claim 1, wherein the tool comprises at least one means for generating a continuous wave signal and at least one means for generating a modulated signal.

5. The tool of claim 1, wherein the tool comprises a plurality of means for generating continuous wave signals.

6. The tool of claim 1, wherein the tool comprises a plurality of means for generating modulated signals.

7. A tool, comprising:

a plurality of means for activating remote tire monitoring system tire sensors, the plurality of means selected from the group consisting of a magnet, a valve core depressor, means for generating continuous wave signals, and means for generating modulated signals; and

a means for receiving tire sensor signals,

wherein the tool is capable of activating a plurality of tire sensors, each of the plurality of tire sensors utilizing a different method for activating the said tire sensor.

8. The tool of claim 7, wherein the means for receiving tire sensor signals is selected from the group of means capable of receiving tire sensor signals at frequencies of 125 KHz, 13.56 MHz, 315 MHz, 433 MHz, 848 MHz, 916 MHz, and 2.4 GHz.

9. A tool, comprising:

a plurality of means for activating remote tire monitoring system tire sensors, the plurality of means selected from the group consisting of a magnet, a valve core depressor, means for generating continuous wave signals, and means for generating modulated signals; and

a plurality, of means for receiving tire sensor signals,

wherein the tool is capable of activating a plurality of tire sensors, each of the plurality of tire sensors utilizing a different method for activating the said tire sensor.

10. The tool of claim 9, wherein the plurality of means for receiving tire sensor signals is selected from the group of means capable of receiving tire sensor signals at frequencies of 125 KHz, 13.56 MHz, 315 MHz, 433 MHz, 848 MHz, 916 MHz, and 2.4 GHz.

11. A tool, comprising:

a plurality of means for activating remote tire monitoring system tire sensors, the plurality of means selected from the group consisting of a magnet, a valve core depressor, means for generating continuous wave signals, and means for generating modulated signals;

a means for receiving tire sensor signals; and

display apparatus for displaying data received from tire sensor signals,

wherein the tool is capable of activating a plurality of tire sensors, each of the plurality of tire sensors utilizing a different method for activating the said tire sensor.

12. The tool of claim 11, wherein the display apparatus is a LED device, a LCD device, or a VF device.

13. A tool, comprising:

a plurality of means for activating remote tire monitoring system tire sensors, the plurality of means selected from the group consisting of a magnet, a valve core depressor, means for generating continuous wave signals, and means for generating modulated signals;

a means for receiving tire sensor signals; and

a means for transmitting signals to remote tire monitoring system receiving units,

wherein the tool is capable of activating a plurality of tire sensors, each of the plurality of tire sensors utilizing a different method for activating the said tire sensor.

14. The tool of claim 13, wherein the means for transmitting signals to remote tire monitoring receiving units is selected from the group of means capable of transmitting signals at frequencies of 125 KHz, 13.56 MHz, 315 MHz, 433 MHz, 848 MHz, 916 MHz, and 2.4 GHz.

15. A tool, comprising:

a plurality of means for activating remote tire monitoring system tire sensors, the plurality of means selected from the group consisting of a magnet, a valve core depressor, means for generating continuous wave signals, and means for generating modulated signals;

a means for receiving tire sensor signals;

a means for transmitting signals to remote tire monitoring system receiving units; and

a means for receiving signals transmitted by remote tire monitoring system receiving units,

wherein the tool is capable of activating a plurality of tire sensors, each of the plurality of tire sensors utilizing a different method for activating the said tire sensor.

16. A tool, comprising:

a means for receiving tire sensor signals; and

a means for transmitting signals to remote tire monitoring system receiving units,

wherein the tool is capable of adding data to a received tire sensor signal and transmitting the said added data to a remote tire monitoring system receiving unit.

17. A method, comprising the steps of:

attempting to activate a remote tire monitoring system tire sensor using a first means for activating remote tire monitoring system tire sensors;

waiting to receive a tire sensor signal;

attempting to activate the remote tire monitoring system tire sensor using a different means for activating remote tire monitoring system tire sensors if no tire sensor signal has been received; and

repeating the waiting step and the second attempting step until either a tire sensor signal is received or no different means for activating remote tire monitoring system tire sensors is available.

18. A method, comprising the steps of:

attempting to activate a remote tire monitoring system tire sensor using a first means for activating remote tire monitoring system tire sensors;

waiting to receive a tire sensor signal;

attempting to activate the remote tire monitoring system tire sensor using a different means for activating remote tire monitoring system tire sensors if no tire sensor signal has been received;

recording the most recent means used for attempting to activate the remote tire monitoring tire sensor if a tire sensor signal is received; and

repeating the waiting step and the second attempting step until either a tire sensor signal is received or no different means for activating remote tire monitoring system tire sensors is available.

19. A method, comprising the steps of:

attempting to activate a first remote tire monitoring system tire sensor using a first means for activating remote tire monitoring system tire sensors;

waiting to receive a tire sensor signal;

attempting to activate the first remote tire monitoring system tire sensor using a different means for activating remote tire monitoring system tire sensors if no tire sensor signal has been received;

recording the most recent means used for attempting to activate the remote tire monitoring tire sensor if a tire sensor signal is received;

repeating the waiting step and the second attempting step until either a tire sensor signal is received or no different means for activating remote tire monitoring system tire sensors is available; and

activating a second remote tire monitoring system tire sensor using the recorded means.

20. A method, comprising the steps:

activating a remote tire monitoring system tire sensor;

receiving a tire sensor signal containing data from the activated tire sensor; and

transmitting some or all of the data received from the tire sensor to a remote tire monitoring system receiving unit, wherein the activating step, the receiving step, and the transmitting step are all performed by a single tool, and wherein the tool comprises a plurality of means for activating remote tire monitoring system tire sensors.

21. The method of claim **20**, wherein the data transmitted to the remote tire monitoring system includes additional data added to the data received from the remote tire monitoring tire sensor.

22. The method of claim **21**, wherein the additional data includes the tire position of the remote tire monitoring system tire sensor.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,904,796 B2
DATED : June 14, 2005
INVENTOR(S) : Thomas Kenny et al.

Page 1 of 1

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 [57], **ABSTRACT**,
Line 6, delete "cable" and insert -- capable --, therefor.

Column 1,
Line 49, delete "ant" and insert -- art --, therefor.

Column 3,
Line 3, delete "arc" and insert -- are --, therefor.

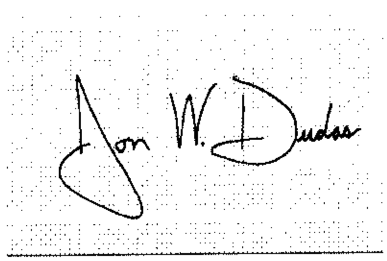
Column 10,
Line 30, delete "microcontollers" and insert -- microcontrollers --, therefor.

Column 13,
Line 41, after "plurality" delete ",".

Column 16,
Line 1, after "steps" insert -- of --.
Line 12, after "system" insert -- receiving unit --.

Signed and Sealed this

Eleventh Day of October, 2005



JON W. DUDAS
Director of the United States Patent and Trademark Office

EXHIBIT B

US007639122B2

(12) **United States Patent**
Kochie et al.

(10) **Patent No.: US 7,639,122 B2**
(45) **Date of Patent: Dec. 29, 2009**

(54) **TIRE PRESSURE MONITOR SYSTEM TOOL WITH VEHICLE ENTRY SYSTEM**

(75) Inventors: **Robert Kochie**, Mantorville, MN (US); **Garret Miller**, Owatonna, MN (US)

(73) Assignee: **SPX Corporation**, Charlotte, NC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 206 days.

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(22) Filed: **Oct. 30, 2006**

(65) **Prior Publication Data**

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(51) **Int. Cl.**
B60C 23/02 (2006.01)

(52) **U.S. Cl.** .... **340/442**; 340/426.33; 73/146.2; 116/34 R

(58) **Field of Classification Search** 340/447
See application file for complete search history.

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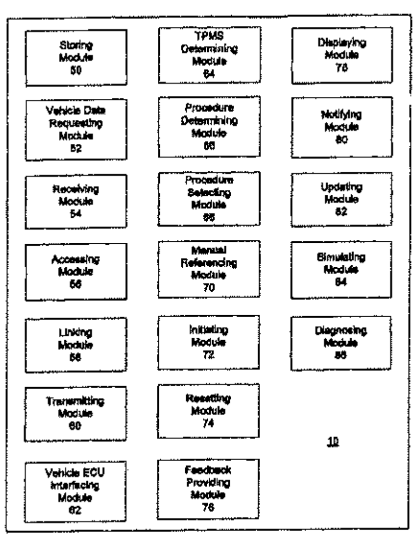
Primary Examiner—George A Bugg
(74) *Attorney, Agent, or Firm*—Baker & Hostetler LLP

(57) **ABSTRACT**

A tire pressure monitor system tool is capable of communicating with a plurality of tire pressure monitor systems. The tool includes a storing module that stores a plurality of communication protocols that are used for enabling the tool to communicate with a tire pressure monitor system. The tool enables a user to input vehicle data for identifying a vehicle having a tire pressure monitor system with which to communicate. Based on the vehicle data input, the tool determines a tire pressure monitor system installed on the vehicle using information stored by the tool. The tool determines a tire pressure monitor system installed on the vehicle. Based on the tire pressure monitor system installed on the vehicle, the tool determines a protocol used by the tire pressure monitor system to communicate with, for example, the tool and an electronic control unit of a vehicle.

24 Claims, 8 Drawing Sheets



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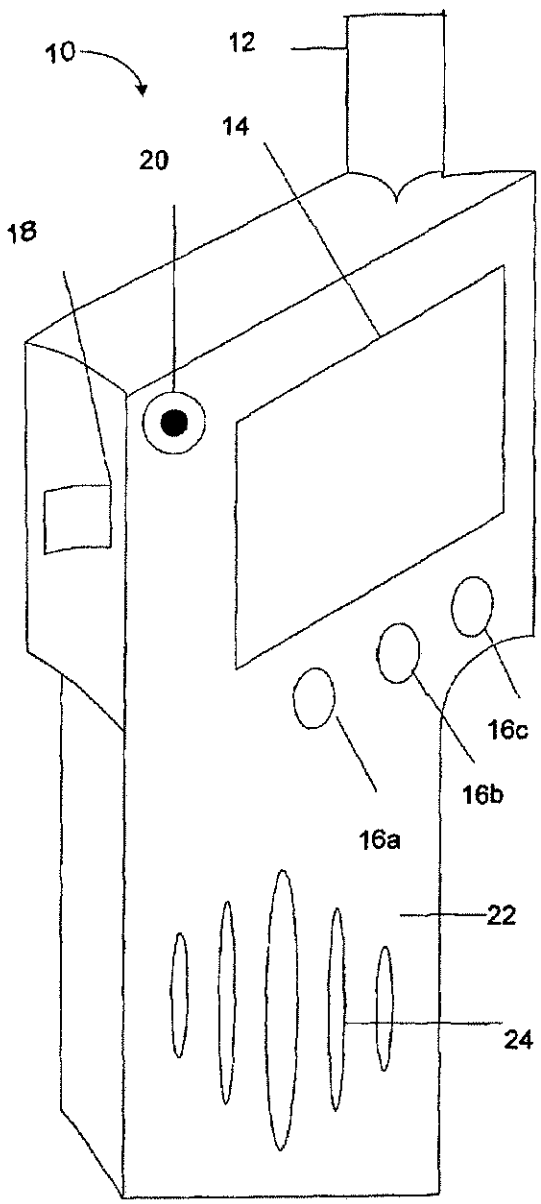


FIG. 1

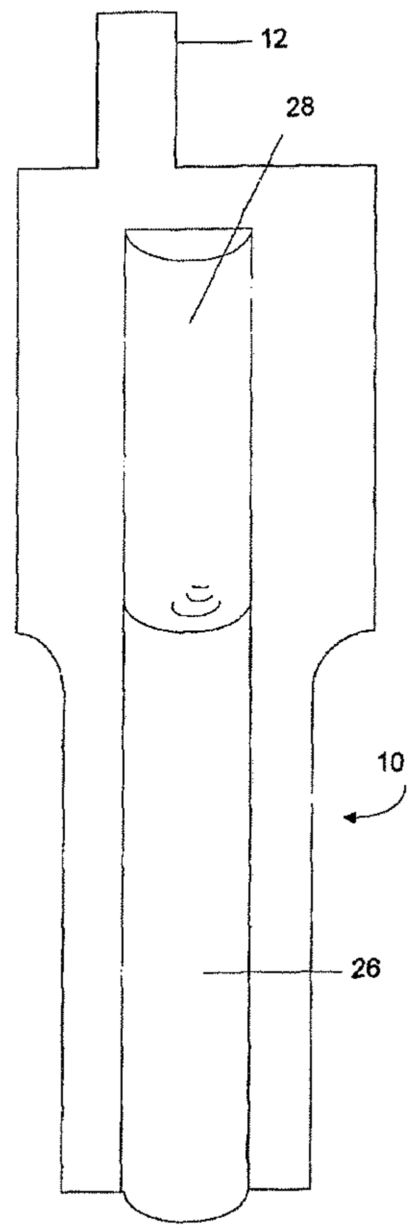


FIG. 2

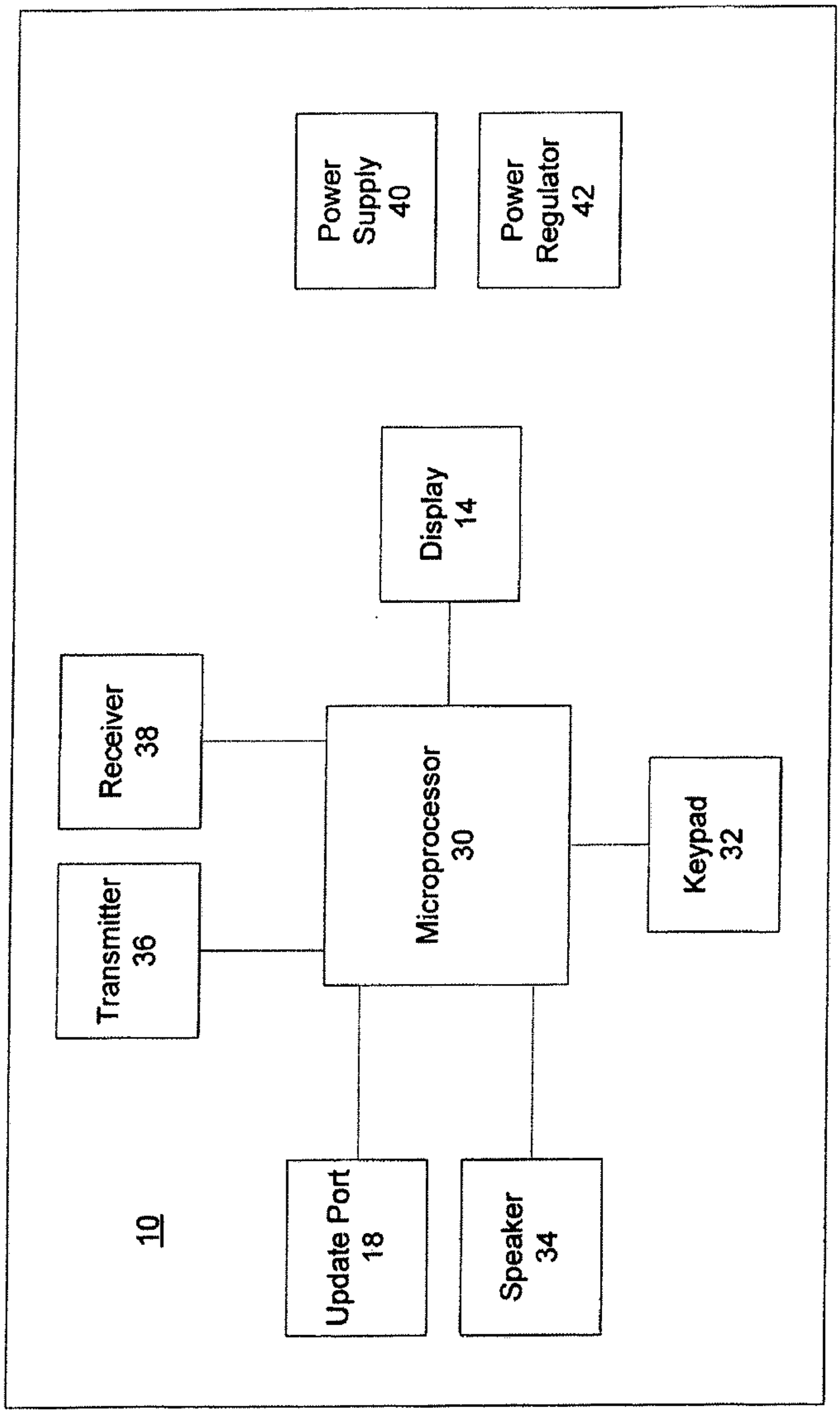

Power Supply 40
Power Regulator 42
Display 14
Receiver 38
Transmitter 36
Microprocessor 30
Keypad 32
10
Update Port 18
Speaker 34

FIG. 3

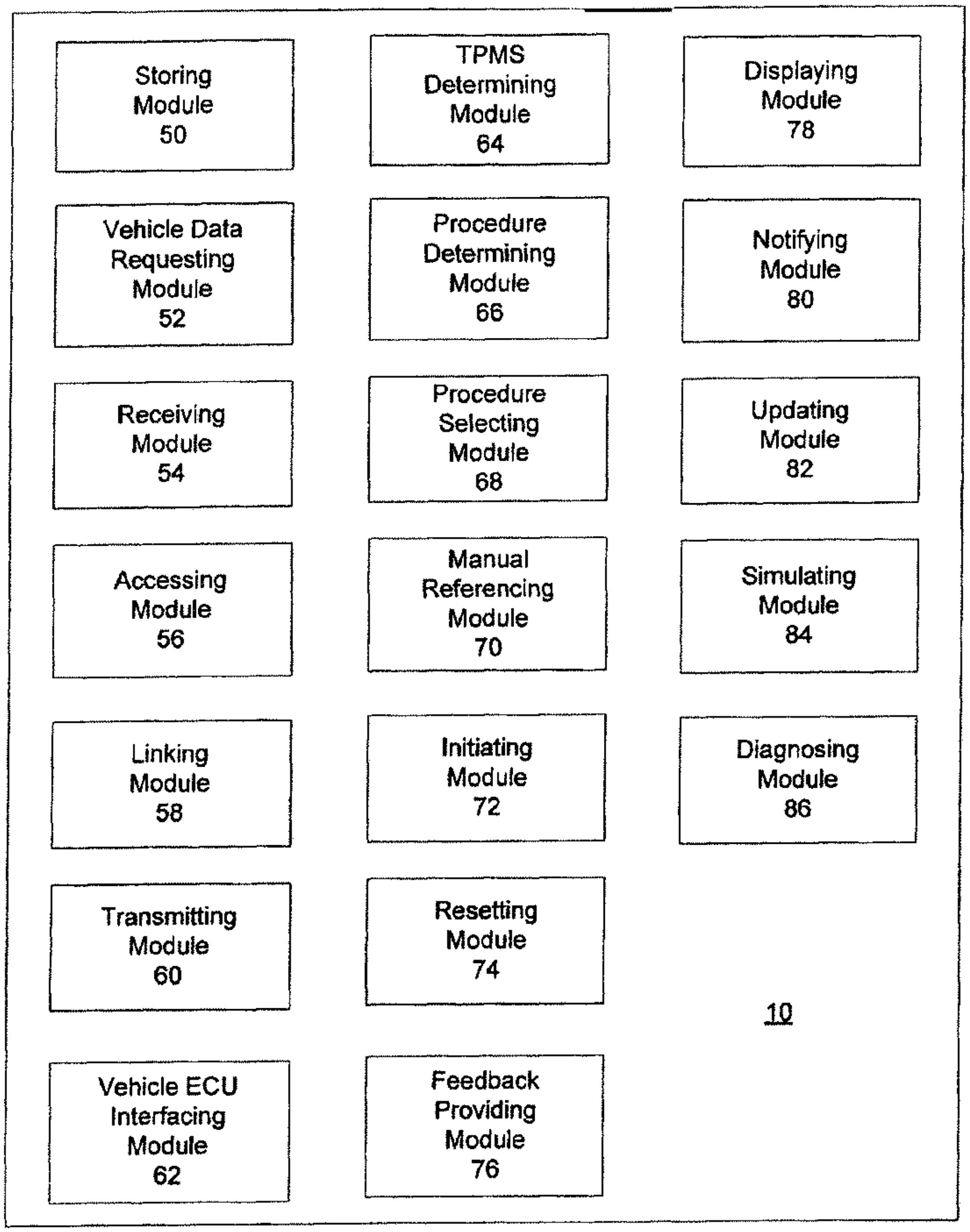
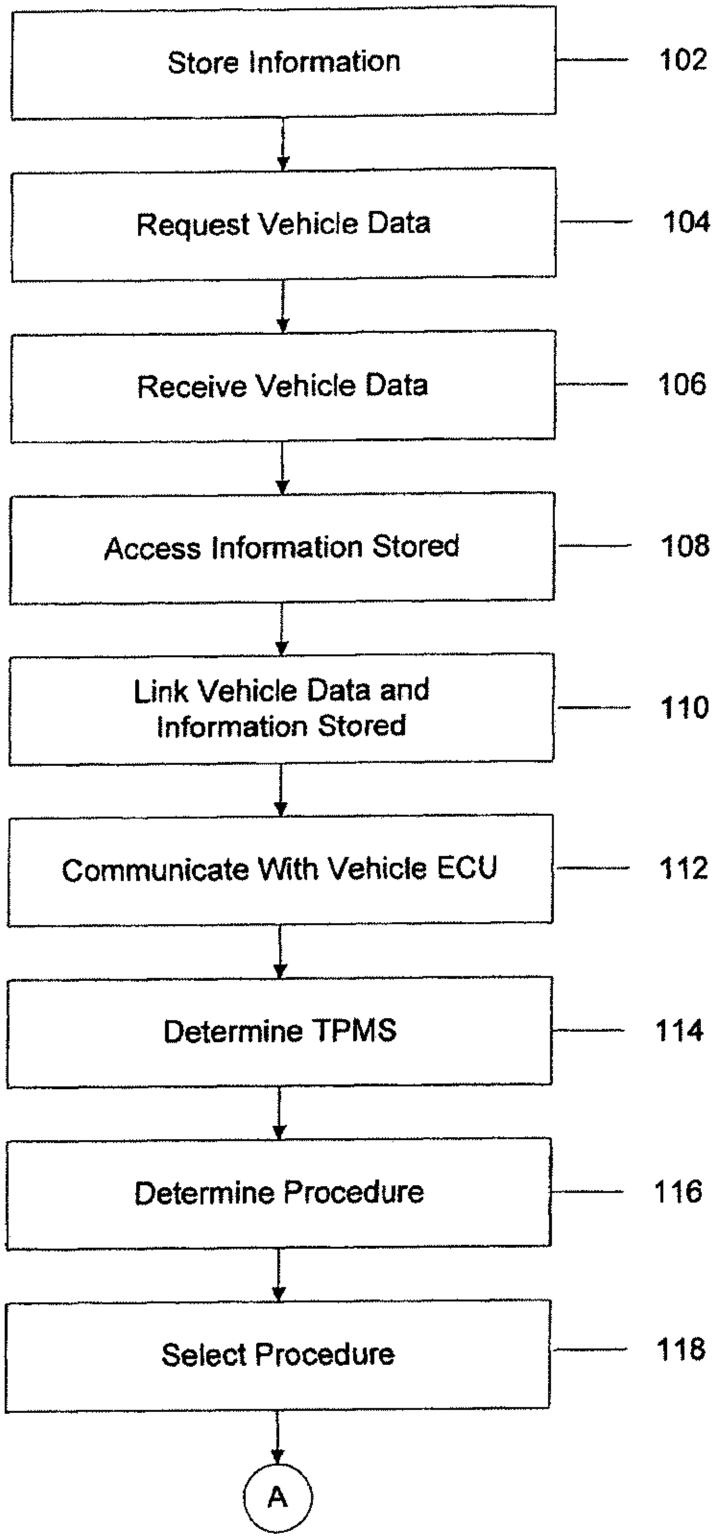

Storing Module 50
TPMS Determining Module 64
Displaying Module 78
Vehicle Data Requesting Module 52
Procedure Determining Module 66
Notifying Module 80
Receiving Module 54
Procedure Selecting Module 68
Updating Module 82
Accessing Module 56
Manual Referencing Module 70
Simulating Module 84
Linking Module 58
Initiating Module 72
Diagnosing Module 86
Transmitting Module 60
Resetting Module 74
10
Vehicle ECU Interfacing Module 62
Feedback Providing Module 76

FIG. 4



Store Information
102
Request Vehicle Data
104
Receive Vehicle Data
106
Access Information Stored
108
Link Vehicle Data and Information Stored
110
Communicate With Vehicle ECU
112
Determine TPMS
114
Determine Procedure
116
Select Procedure
118
A

FIG. 5

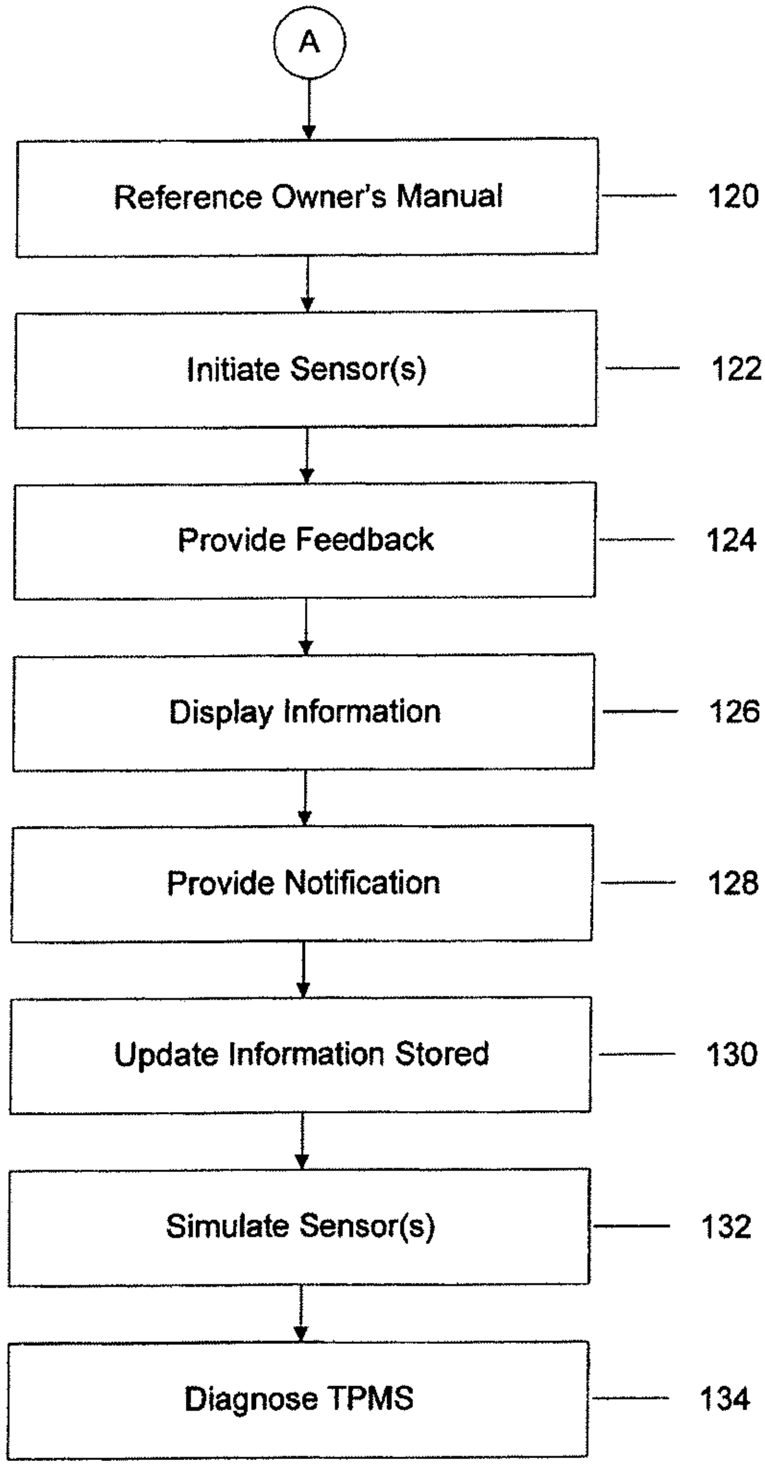

A
Reference Owner's Manual
120
Initiate Sensor(s)
122
Provide Feedback
124
Display Information
126
Provide Notification
128
Update Information Stored
130
Simulate Sensor(s)
132
Diagnose TPMS
134

FIG. 6

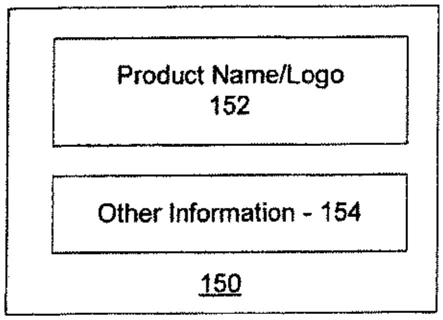


FIG. 7

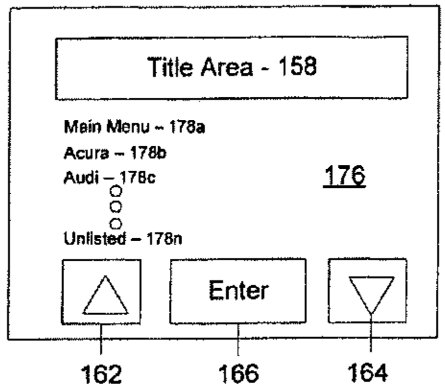


FIG. 10

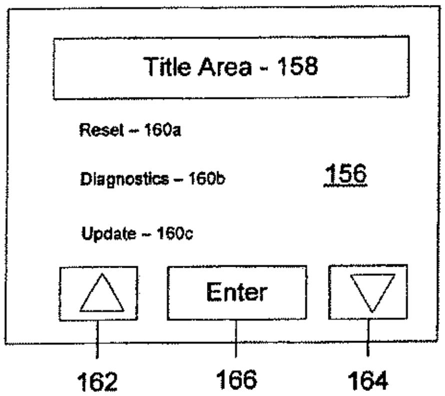


FIG. 8

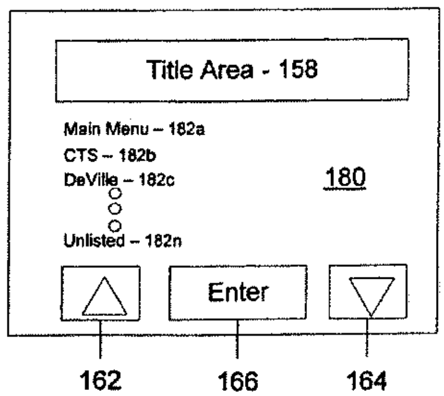


FIG. 11

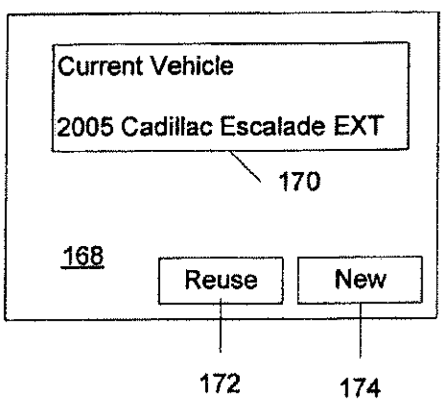


FIG. 9

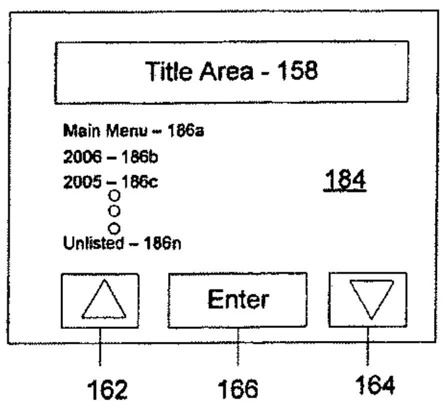


FIG. 12

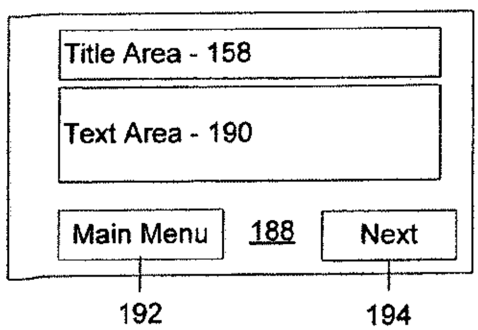


FIG. 13

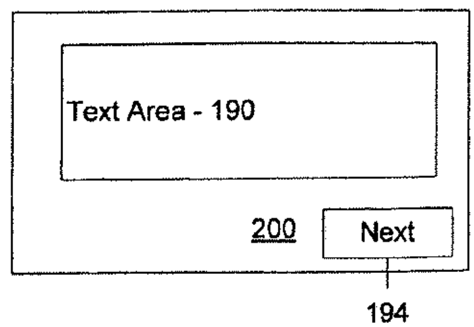


FIG. 15

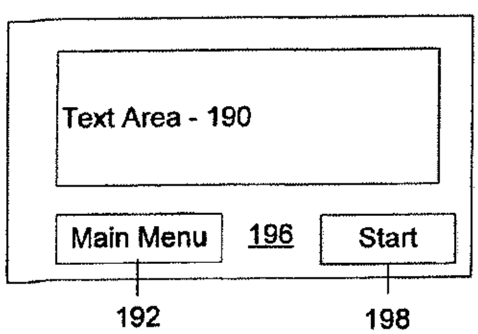


FIG. 14

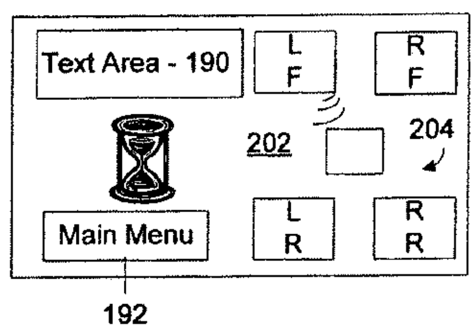


FIG. 16

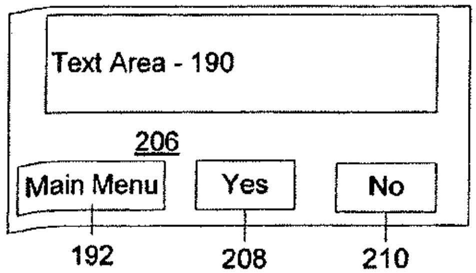


FIG. 17

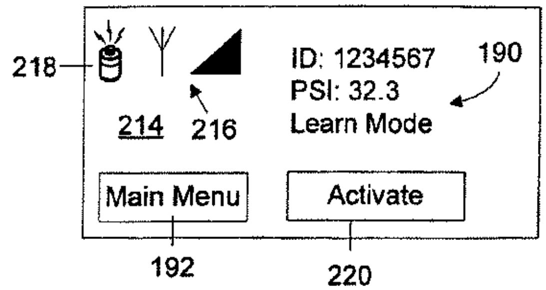


FIG. 19

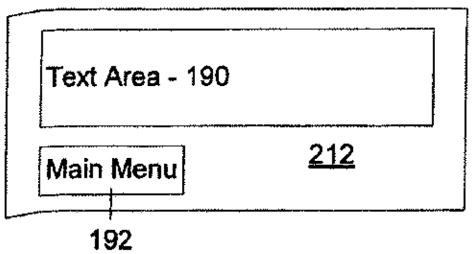


FIG. 18

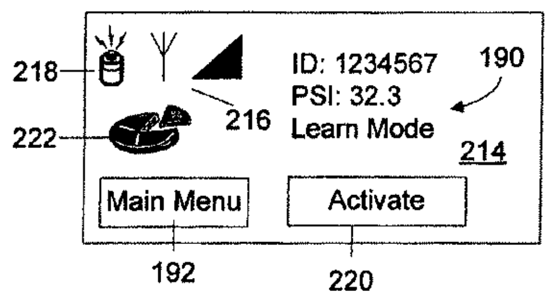


FIG. 20

TIRE PRESSURE MONITOR SYSTEM TOOL WITH VEHICLE ENTRY SYSTEM

RELATED APPLICATIONS

This application is related to co-pending U.S. patent application titled "Tire Pressure Monitor Initiation Tool With Vehicle Data Interface," filed concurrently herewith, co-pending U.S. patent application titled "Tire Pressure Monitor System Module," filed concurrently herewith, and co-pending U.S. patent application titled "Tire Pressure Monitor System Tool With Re-Learn and Diagnostic Procedures," filed concurrently herewith, each of which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

The invention relates generally to tire pressure monitoring systems. More particularly, the invention relates to a hand-held tire pressure monitoring system tool capable of communicating with a plurality of tire pressure monitor systems.

BACKGROUND OF THE INVENTION

Systems have been developed to monitor, for example, vehicle tire pressure, and to report the tire pressure to a receiver at a central monitoring station using radio transmissions. A typical remote automotive tire condition monitoring system includes a plurality of tire-based sensory transponders and a central, vehicle-based arrangement. The sensory transponders include a component that senses a tire condition, such as tire inflation pressure or tire temperature. Each transponder is capable of outputting a coded transmission that conveys sensed tire condition information and an identifier for reception by the vehicle-based arrangement. Within the vehicle-based arrangement, an electronic control unit ("ECU") processes the conveyed information and controls provision of information regarding the sensed tire conditions to a vehicle operator. During operation of such a system, the vehicle operator is readily notified of a current tire condition, such as a low inflation pressure in a tire.

For a vehicle operator to determine which tire has a condition of interest (e.g., a low inflation pressure), information provided to the vehicle operator must unambiguously identify the location (e.g., right front) of the tire that has the condition of interest. In order for the ECU to provide such tire location information, the ECU has a memory that stores tire identification information for comparison with the identification conveyed from the transponder. Also, within the memory, a certain tire location is associated with each stored tire identification. Thus, once a provided identification is matched to a stored identification, a location on the vehicle is associated with the provided tire condition information. Accordingly, the operator is made aware that the tire at a certain location (e.g., right front) has the certain condition (e.g., low inflation pressure).

Changes routinely occur regarding the tires and/or transponders that are associated with a vehicle. The changes can result in new, different transponders being associated with the vehicle, or a rearrangement of the locations of the transponders, via rearrangement of the tires. Examples of such changes occur when one or more new tires with new transponders are mounted on a vehicle (e.g., the placement of the initial set of tires during vehicle manufacture or replacement of one or more tires), when the tires are rotated during routine maintenance, or when a transponder is replaced on an existing tire. It should be readily apparent that new/modified identification and location information regarding the tire must be provided or "taught" to the ECU.

In order to accomplish the "teaching" of the tire identification information to a vehicle-based portion, one known tire identification system is placed in a "learn" mode via actuation of pushbutton(s) on an operator-accessible information panel of the vehicle-based portion. During the learn mode, the vehicle-based portion is in a ready state to receive a distinctive "learn" mode signal transmitted from each of tire-based transmitter of the system. In order to cause each tire-based transmitter to send the "learn" mode signal, a strong magnet is swept over the outside of the associated vehicle tire.

A monitor is located at each tire and periodically takes a measurement of the fire pressure. A pressure signal is generated that corresponds to the pressure within the tire. The monitor transmits the measurement in a radio frequency transmission to the central monitoring station that produces an alarm or a display in response to the measurement. When the tire pressure drops below a predetermined pressure, an indicator is used to signal the vehicle operator of the low pressure.

During assembly and routine maintenance such as tire rotation or tire replacement, the tire pressure system must be calibrated. Calibration involves associating the various tire positions with the pressure transmitters that are located on the tires. One proposed method for calibrating a system uses a magnet device to initiate the calibration. In this system, an internal display panel with locations corresponding to the tire location is activated. When the tire locations are illuminated on the display, the vehicle operator or service technician places the magnet near the indicated tire. The transducer then sends a code corresponding thereto to the central controller. When the indicator indicates another tire location, the magnet must be brought near each tire location until each of the tire locations have a tire registered thereto. One problem with this device is that a separate component such as a magnet must be provided to the vehicle operator that is used only in the calibration process. One problem associated with a separate magnet device is that such a device is subject to loss. Thus, the tire pressure sensing system would be rendered inoperable.

One problem with such systems is the need to program the location of the transmitters at the central station. To be useful, the tire pressure is preferably associated with the tire which originated the measurement when presenting a display or alarm. Each monitor includes identification information that can be transmitted with the measurement. The tire monitor is preferably activated to produce this information and the information is conveyed to the central station and associated with the position of the tire.

In one technique, the tire monitors include a reed switch or other magnetic device. A magnet is passed near the reed switch causing the monitor to transmit a radio frequency transmission that includes identification data. A service technician repeats this process at each wheel and then loads the identification and position information into the central monitoring station.

One drawback with such a system is that because many wheels are made from steel which is a magnetic material, tire pressure sensing systems may not operate properly because the steel wheels may shield the magnetic energy. Therefore, the system may also be rendered inoperable because the pressure transmitter is not activated by the magnet.

Various tire manufacturers have suggested various locations for the pressure sensors. Known systems include coupling a pressure sensor to the valve stem of the tire. Other known systems and proposed systems locate the pressure sensors in various locations within the tire wall or tread.

These previous techniques have been limited in effectiveness. The magnetic programming technique may be subject to interference and crosstalk, for example in a factory where many such tire monitors are being assembled with tires and vehicles. Also, users of modular products are required to purchase a separate tool to interface with tire pressure monitor systems.

SUMMARY OF THE INVENTION

In accordance with one embodiment of the invention, a tire pressure monitor system tool is provided that communicates with a plurality of tire pressure monitor systems. The tool includes a storing module that stores a plurality of communication protocols that are used for enabling the tool to communicate with a tire pressure monitor system. The tool enables a user to input vehicle data for identifying a vehicle having a tire pressure monitor system with which to communicate. Based on the vehicle data input, the tool determines a tire pressure monitor system installed on the vehicle using information stored by the tool. The tool determines a tire pressure monitor system installed on the vehicle by, for example, associating the vehicle data input by the user with vehicle data stored in a lookup table by the tool. The vehicle data provided in the table is related to tire pressure monitor system information that indicates the tire pressure monitor system installed on the vehicle. Based on the tire pressure monitor system installed on the vehicle, the tool determines a protocol used by the tire pressure monitor system to communicate with, for example, the tool and the vehicle's electronic control unit.

There has thus been outlined, rather broadly, certain embodiments of the invention in order that the detailed description thereof herein may be better understood, and in order that the present contribution to the art may be better appreciated. There are, of course, additional embodiments of the invention that will be described below and which will form the subject matter of the claims appended hereto.

In this respect, before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of embodiments in addition to those described and of being practiced and carried out in various ways. For example, although the invention is described in terms of a plurality of modules, it is to be understood that the invention may be implemented using one or more modules. Also, it is to be understood that the phraseology and terminology employed herein, as well as the abstract, are for the purpose of description and should not be regarded as limiting.

As such, those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for the designing of other structures, methods and systems for carrying out the several purposes of the present invention. It is important, therefore, that the claims be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front perspective view of a tire pressure mounting tool according to one embodiment of the invention.

FIG. **2** is a rear view of a tire pressure monitor tool according to one embodiment of the invention.

FIG. **3** is a block diagram of a tire pressure monitor tool according to one embodiment of the invention.

FIG. **4** is a block diagram of a tire pressure monitor tool according to one embodiment of the invention.

FIGS. **5** and **6** illustrate a method of communicating with a tire pressure monitor system of a vehicle according to one embodiment of the invention.

FIGS. **7-9** illustrate initial screens that may be displayed by a tire pressure monitor tool according to one embodiment of the invention.

FIGS. **10-18** illustrate procedure screens that may be displayed by a tire pressure monitor tool according to one embodiment of the invention.

FIGS. **19-20** illustrate diagnostic procedure screens that may be displayed by a tire pressure monitor tool according to one embodiment of the invention.

DETAILED DESCRIPTION

FIG. **1** illustrates a tire pressure monitor tool **10** according to one embodiment of the invention. The tool **10** includes an antenna **12**, display **14**, selector button **16*a*-16*c***, port **18**, a power button **20**, a casing **22**, and passages **24**. The antenna **12** may be used to transmit signals from the tool **10** to an electronic control unit of a vehicle and a fire pressure sensor mounted, for example, on a rim or tire of a vehicle. The display **14** may be used to display information to a user regarding, for example, the tool **10**, a tire pressure monitor system of a vehicle or status information regarding a resetting or diagnostic function of the tool **10**. The selector buttons **16*a*-16*c*** may be used to navigate through the displays presented on the display **14** and select that certain functions be performed. The selector buttons **16*a*-16*c*** may be positioned below select displays presented on the display **14**. The selector buttons **16*a*-16*c*** may be used to select one of the selection displays presented on display **14**. The selection displays may be, for example, up and down arrows, an enter function, a menu function, start, activate, and next operations, yes, no, okay, redo, and stop functions, and reuse or new functions. The selection displays are described in further detail below.

The port **18** may be a port that enables the tool **10** to be connected to, for example, a computer or Internet connection that enables the tool to be updated with modified or additional information. The port **18** may be, for example, an RS232 serial port that connects the tool **10** to the computer or Internet connection using an RS232 serial cable. This is described in further detail below.

The power button **20** may be used to turn the tool **10** on and off. According to one embodiment of the invention, the tool may turn off automatically after, for example, three to four minutes of inactivity.

The casing **22** provides a housing for the tool **10**. The casing may be provided with the passages **24** that may be located in front of a speaker (not shown) that emits audible tones or other notifications while the tool **10** is being used.

FIG. **2** illustrates a rear view of the tool **10** according one embodiment of the invention. The tool **10** may be battery powered. Therefore, the tool **10** may be provided with a battery compartment **26**. The battery compartment **26** may include a removable battery cover **28** that allows removable insertion of batteries within the battery compartment **26**. According to one embodiment of the invention, the tool **10** is powered by three (3) size C batteries.

FIG. **3** illustrates a block diagram of the tool **10** illustrated in FIGS. **1** and **2**. The tool **10** may include a microprocessor **30** that processes software used to operate the tool **10**. According to one embodiment of the invention, the microprocessor is an ATMEGA2561 microprocessor having a clock speed of 8 Mhz. The microprocessor **30** communicates with a keypad **32**. According to one embodiment of the invention, the keypad **32** includes the selector buttons **16***a*-**16***c* illustrated in FIG. **1**. The microprocessor **30** may also be in communication with a speaker **34**. The speaker **34** may be used to provide audible tones or notifications during use of the tool **10**.

The microprocessor **30** may also be in communication with a transmitter **36** and a receiver **38**. The transmitter **36** may be used to transmit signals to a tire pressure sensor mounted on a wheel of a vehicle or an electronic control unit of a vehicle. According to one embodiment of the invention, the transmitter **36** operates at 125 khz. Although only one transmitter is shown, it is to be understood that multiple transmitters including transmitters of different types may be used.

The receiver **38** may be used to receive signals transmitted from a tire pressure sensor mounted on a wheel vehicle and an electronic control unit of a vehicle. According to one embodiment of the invention the receiver **38** may operate at 315 Mhz and have a clock speed of 10.178 Mhz. Alternatively, the receiver **38** may operate at 433 Mhz and have a clock speed of 13.225 Mhz. Although only one receiver is shown, it is to be understood that multiple receivers operating at different frequencies and having different clock speeds may be used.

The tool **10** may also include a power supply **40**. As stated above, the power supply may be, for example, three (3) size C batteries. The power supply **40** may be in communication with a power regulator **42**. The power regulator **42** may be used to regulate the power supplied to each device of the tool **10**.

FIG. **4** illustrates a block diagram of the tire pressure monitor tool **10** shown in FIGS. **1** and **2** according to one embodiment of the invention. The tool **10** may include a storing module **50** that stores information regarding a plurality of tire pressure monitor systems. According to one embodiment of the invention, the information stored relates to a plurality of tire pressure monitor systems from a variety of vehicle manufactures and various models and years of the vehicles. The storing module **50** may be, for example, any suitable storage medium such as a storage module on a microprocessor, a hard disk, a removable storage media such as a flash disk for other suitable storage mechanism. The tool **10** also includes a vehicle data requesting module **52**. The vehicle data requesting module **52** may be used to request data regarding a particular vehicle for which the tool **10** may be used. The vehicle data requesting module **52** may present a user of the tool **10** with a plurality of screens displaying information regarding various vehicle types. For example, the user may be presented with the vehicle data associated with the vehicle for which the tool **10** was most recently used. According to another embodiment, the user may be presented with a series of screens displaying lists of various makes, models, and years of various vehicles. The user may use the selector buttons to navigate the lists and select the make, model, and year of a desired vehicle. A receiving module **54** may be used to receive input provided by the user.

An accessing module **56** may be used to access the information stored in the storing module **50** to determine whether any of the information stored by the storing module **50** is associated with the vehicle data input by the user. If the storing module **50** does not include any information associated with the vehicle data, the user may be notified that no information was located. If information associated with the vehicle data is located, however, a linking module **58** may be used to link the information with the vehicle data. The information may include, for example, communication protocols for communicating with an electronic control unit of the vehicle, procedures for resetting a tire pressure monitor system of the vehicle, diagnosing the tire pressure monitor system of the vehicle or other functions.

A transmitting module **60** may then be used to transmit a signal from the tool **10** to a tire pressure sensor of the vehicle or an electronic control unit of the vehicle. If the signal is transmitted to the electronic control unit of the vehicle, a vehicle electronic control unit interfacing module **62** may be used to interface with the vehicle electronic control unit. The tool **10** may interface with the vehicle electronic control unit to, for example, reset a tire pressure monitor system of the vehicle. As discussed above, tire replacement and rotation requires resetting of the vehicle's tire pressure monitor system. This enables the vehicle electronic control unit to maintain locations of each tire pressure sensor such that accurate information may be displayed to a driver of the vehicle using, for example, a dashboard display of the vehicle.

A tire pressure monitor system determining module **64** may be used to determine a type of tire pressure monitor system provided on the vehicle. This information may be obtained, for example, from the vehicle electronic control unit or by matching the vehicle data with vehicle data provided in a lookup table stored by the tool. The vehicle data may be associated with the particular type of tire pressure monitor system installed on the vehicle. Upon determining the tire pressure monitor system installed on the vehicle, a procedure determining module **66** may determine a procedure to be followed to, for example, reset or diagnose the tire pressure monitor system of the vehicle. Based on instructions input by a user, a procedure selecting module **68** selects the procedure corresponding to the instructions input by the user. Some procedures may require a user to perform procedures specific to a vehicle. These procedures are typically located in an owner's manual of the vehicle. Therefore, a manual referencing module **70** may be used to refer to the owner's manual so that the user may perform this procedure prior to continuing to use the tool **10**.

According to one embodiment of the invention, an initiating module **72** may be used to initiate one or more tire pressure sensors of a vehicle. Initiating the tire pressure sensors places the sensors in a state that enables the sensors to communicate with the tool **10** and the electronic control unit of the vehicle. After initiating the sensors, the tire pressure monitor system of the vehicle may be, for example, reset using resetting module **74**. The resetting module **74** enables the electronic control unit of the vehicle to determine locations, identification numbers, and other information regarding the tire pressure sensors mounted one or more wheels of the vehicle. According to one embodiment of the invention, the antenna **12** of the tool **10** is placed adjacent a valve stem of a wheel of a vehicle. The tool **10** receives, for example, location, identification number, pressure information, and possibly other information from the tire pressure sensor using receiving module **54** and transmits the information to the vehicle electronic control unit using transmitting module **60**.

A feedback providing module **76** may be used to determine whether the tire pressure monitor system has been reset. For example, the feedback providing module **76** may cause symbols, text or other information to be displayed on the display **14** indicating that a reset procedure has been completed. The information may be displayed on the display **14** using displaying module **78**. A notifying module **80** may be used to notify the user that a reset or other procedure has been completed. For example, the notifying module **80** may cause an electronic control unit of a vehicle to sound a horn of the vehicle or flash one or more lights of a vehicle indicating that the reset or other procedure has been completed.

An updating module **82** may be used to update the information stored by the storing module **50**. The updating module **82** may be in communication with the port **18**. The updating module **82** may receive information from a computer, the Internet or other data source using, for example, an RS232 serial cable connected to the port **18** and the computer or other device. The updating module **82** may modify information stored by the storing module **50** or add information to the storing module **50**. Additional information may be, for example, information relating to tire pressure monitor systems installed on newer vehicles.

The tool **10** may also include a simulating module **84**. The simulating module **84** may be used to simulate a tire pressure sensor to validate the functionality of a tire pressure monitor system on a vehicle.

A diagnosing module **86** may also be used to diagnose a tire pressure monitor system on a vehicle. The diagnosing module **86** may be used to obtain, for example, tire pressure and other information from the sensor.

FIGS. **5-6** illustrate a method of communicating with a tire pressure monitor system of a vehicle using a tire pressure monitor tool according to one embodiment of the invention. In step **102**, information regarding tire pressure monitor systems and vehicles using such vehicles may be stored by the tire pressure monitor tool. The tool may be used to obtain tire pressure information from one or more wheels of a vehicle provided with tire pressure sensors. To communicate properly with a tire pressure sensor, the tire pressure tool must be provided with data regarding the vehicle from which tire pressure information is sought. Vehicle data may be requested using the tool as illustrated in step **104**. Vehicle data may be requested by, for example, displaying a make, model, and year of a vehicle and requesting that the user confirm or change the vehicle data.

If the vehicle data displayed is not related to the vehicle from which tire pressure information is sought, the tool may provide a series of displays to the user enabling the user to select a make, model, and year data from among a list of makes, models, and years. This information may be received by the tool in step **106**. The information stored in step **102** is then accessed in step **108** to determine whether tire pressure monitor system information relating to the vehicle data received by the tool is being stored. If information relating to the vehicle data is located, this information is linked with the vehicle data in step **110**.

The tool may use this information to communicate with the electronic control unit of the vehicle, step **112**. Based on the communication with the electronic control unit, a determination may be made regarding a tire pressure monitor system installed on the vehicle **114**. Based on the tire pressure monitor system installed, a determination may be made regarding a procedure to, for example, reset or diagnose the tire pressure monitor system, step **116**. The resetting or diagnosing procedure is then selected based on input provided by a user using the tool **10** as illustrated in step **118**. The resetting or diagnosing procedure may require a user to perform a procedure particular to the vehicle. Therefore, the tool may reference a vehicle owner's manual so that the user may follow the procedure identified in the owner's manual, step **120**. The procedure may be, for example, placing the vehicle in a learn mode such that the vehicle or electronic control unit is able to receive tire pressure monitor system information from tire pressure sensors provided on one or more wheels of the vehicle.

In step **122**, one or more of the tire pressure sensors provided on the wheels of the vehicle may be initiated. Initiating the tire pressure sensors enable the sensors to communicate with the tool **10** and the vehicle electronic control unit. Initiating the sensors may be performed by, for example, placing an antenna of a tire pressure monitor tool adjacent or near a valve stem of a wheel of the vehicle. The tool **10** transmits and receives information between the vehicle electronic control unit and the tire pressure sensor such that the vehicle or the electronic control unit may determine a location, identification number, tire pressure, or other information from the tire pressure sensor.

Feedback may be provided to the user to, for example, indicate that a sensor has been successfully initiated or that the signal has been received by the tire pressure monitor tool, step **124**. This information may be displayed on a display of the tire pressure monitor tool as illustrated in step **126**. The user may also be notified whether a resetting or diagnosing procedure has been completed, step **128**. For example, the tool **10** may cause the electronic control unit of the vehicle to sound a horn of the vehicle or flash one or more lights of the vehicle indicating that the resetting or diagnosing procedure has been completed.

According to one embodiment of the invention, the tool **10** may be updated with modified or additional tire pressure monitor system information, step **130**. For example, the tool may be provided with a port that receives, for example, an RS232 serial cable that may be connected to a computer, the Internet or other data source such that tire pressure monitor system information may be communicated to the tool in step **130** and stored in step **102**. The tire pressure monitor system information may include modifications or additions to the information already stored by the tire pressure monitor tool.

The tool **10** may also simulate a tire pressure sensor of a vehicle, step **132**. The tool **10** may simulate the tire pressure sensor to validate the functionality of a tire pressure monitor system installed on a vehicle. The tool **10** may also be used to diagnose the tire pressure monitor system, step **134**. The tool **10** may be used to obtain information such as tire pressure and sensor identification information. Additionally, the tool **10** may obtain information regarding a battery condition of the batteries provided in the tire pressure monitor tool **10**.

FIGS. **7-9** illustrate initial displays that may be presented to a user of a tire pressure monitor tool according to one embodiment of the invention. FIG. **7** illustrates a display **150** that may be, for example, a start up screen displayed on the tire pressure monitor tool display. The display **150** may include a product name and/or logo **152** and/or other information **154**. FIG. **8** illustrates a display **156** that may be, for example, a main menu of the tool. The display **156** may include a title area **158** for displaying a title of the display. The display **156** may include a plurality of a selectable options **160*a*-160*c*** that may be displayed in a list in the display **156**. The selectable options **160*a*-160*c*** may include, for example, reset **160*a***, diagnostics **160*b***, and update **160*c***. The selectable options **160*a*-160*c*** may be navigated using selection displays presented above selector buttons provided on the tire pressure monitor tool. The selection displays may be, for example, an up arrow **162** and a down arrow **164**. By pressing the selector buttons provided on the tool, a user may navigate up and down the display **156** to select a desired function. The function may be selected by pressing the selector button located beneath selection display Enter **166** provided on the display **156**. The tool may indicate a function to be selected by, for example, highlighting, circling, underlining or other formatting to distinguish the function to be selected among other selectable functions.

FIG. 9 illustrates a vehicle information screen display **168** that displays information regarding a particular vehicle. The display **168** may include an information display area **170** that displays vehicle data regarding a particular vehicle. The display **168** also includes selection displays **172**, **174** that enable a user to either reuse the vehicle data provided on the display **168** or create new vehicle data, respectfully. FIG. **10** illustrates a display **176** that enables a user to select a vehicle make. The display **176** may include a title area **158** that provides a title of the display. The display **176** may also include a list of selectable options **178***a*-**178***n* that a user may use to either select a vehicle make or return to the main menu. The display **176** may also include the selection displays **162**, **164**, and **166** described above. The user may use the selection displays **162**, **164**, and **166** to navigate and select a particular vehicle make or a main menu option for returning to the main menu.

If a user selects a vehicle make, the user may then be presented with a display **180** as shown in FIG. **11**. The display **180** may enable a user to select a particular model associated with the vehicle make selected using the display **176**. The display **180** may include a list of selectable models associated with the vehicle make selected and also enable the user to return to the main menu. The display **180** may also include the selection displays **162**, **164**, and **166** as described. The user may navigate the list provided in the display **180** and select a desired model. If a user selects a desired model, the user may be presented with a display **184** as illustrated in FIG. **12**. The display **184** may include a title area **158** and selection displays **162**, **164**, and **166** as described above. The display **184** may also include a list of years from which a user can select a desired year associated with the vehicle make and model previously selected. The display **184** may include a list having a main menu option **186***a* and a plurality of selectable years **186***b*-**186***n* from which the user may select.

If the user selects a vehicle year, the user may be presented with a display **188** as illustrated in FIG. **13**. The display **188** may include a title area **158** that provides a title of the display. The display **188** may also include a text area **190** providing a user with an instruction to perform a task. For example, the user may be instructed to refer to a particular section of the vehicle's user manual for performing a certain function. The display **188** may also include main menu selection display **192** and next selection display **194** displayed above two of the selector buttons provided on the tire pressure monitor tool. The user may use the selection displays **192**, **194** to return to a main menu of the tire pressure monitor tool or proceed to a next step of, for example, a reset procedure after performing the task instructed in the display **188**.

If the user selects the next selection display **194**, the user may be presented with a display **196** as illustrated in FIG. **14**. The display **196** includes a text area **190** and a main menu selection display **192** as discussed above. The display **196** may also include a start selection display **198** presented above a selector button provided on the tire pressure monitor tool. If the user selects the start selection display **198**, the user may be presented with a display **200** as illustrated in FIG. **15**. The display **200** may include a text area **190** and a next selection display **194** as discussed above. After selecting the next selection display **194** the user may be presented with a display **202** as illustrated in FIG. **16**.

The display **202** may provide text and/or graphics **204** illustrating that the tool is performing a function and may provide details regarding that function. For example, during a reset procedure, the display **202** may indicate that a left front tire pressure sensor is being reset and instructs the user to please wait. The display **202** may also include a main menu selection display **192** as discussed above.

Upon completion of the function, a display **206** as illustrated in FIG. **17** may be presented on the tire pressure monitor tool. The display **206** may include a text area **190** that provides information to the user and may also include an interrogatory. The interrogatory may be, for example, "Did horn sound?". The display **206** may include selection displays Yes **208** and No **210** that enable the user to answer the interrogatory. The selection displays **208**, **210** may be selected using selector buttons provided on the tool and below the selection displays. The selection **206** may also include a main menu selection display **192** as discussed above.

If the user selects Yes selection display **208**, the user may be presented with a display **212** as illustrated in FIG. **18**. The display **212** may include a text area **190** indicating that the procedure has been completed. The display **212** may also include a main menu selection display **192** as discussed above. If the user selects No selection display **210**, however, the tool may present a previous display such as, for example, display **196** as illustrated in FIG. **14**. This enables the user to repeat the procedure to attempt to properly complete the procedure.

FIG. **19** illustrates a diagnostic test screen display **214** according to one embodiment of the invention. The display **214** includes a text area **190** and main menu selection display **192** as described above. The text display **190** may include, for example, an identification number of a tire pressure sensor from which tire pressure information has been received, the tire pressure for that particular tire, and an operating mode of the electronic control unit of the vehicle. The display may also include a signal indicator **216** indicating whether a signal is being received from the tire sensor and a battery level indicator **218** indicating an approximate battery level remaining in the batteries of the tire pressure monitor tool. The display **216** may also include an activate selection display **220** that activates a diagnostic procedure of the tire pressure monitor tool. Upon selection of the activate selection display **220**, a signal transmitting signal symbol **222** may be presented in a display **218** to indicate that the tire pressure monitor tool is transmitting a signal to the tire pressure sensor as illustrated in FIG. **20**.

The many features and advantages of the invention are apparent from the detailed specification, and thus, it is intended by the appended claims to cover all such features and advantages of the invention which fall within the true spirit and scope of the invention. Further, since numerous modifications and variations will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation illustrated and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed is:

1. A tool for use with a tire pressure monitor system comprising:

a storing module configured to store a plurality of communication protocols used by a tire pressure monitor system to interface with a vehicle electronic control unit;

a vehicle data requesting module configured to request vehicle data;

a vehicle data receiving module configured to receive the vehicle data;

an accessing module configured to access the storing module to retrieve at least one communication protocol;

a determining module configured to determine whether a communication protocol is stored for a predetermined vehicle; and a selecting module configured to select the communication protocol based on the vehicle data.

2. The tool of claim 1, wherein the vehicle data comprises at least one of make, model, and year data.

3. The tool of claim 1, further comprising a linking module configured to link the communication protocol with the vehicle data.

4. The tool of claim 1, further comprising a displaying module configured to display at least one of vehicle information and tire pressure monitor system information.

5. The tool of claim 1, further comprising an updating module configured to update the plurality of communication protocols.

6. The tool of claim 1, further comprising a communicating module configured to enable the tool to communicate with the electronic control unit using the at least one communication protocol.

7. The tool of claim 1, further comprising a diagnosing module configured to diagnose the tire pressure monitor system.

8. The tool of claim 1, further comprising a resetting module configured to reset the tire pressure monitor system.

9. A tool for use with a tire pressure monitor system comprising:

storing means for storing a plurality of communication protocols used by a tire pressure monitor system to interface with a vehicle electronic control unit;

vehicle data requesting means for requesting vehicle data;

vehicle data receiving means for receiving the vehicle data;

accessing means for accessing the storing module to retrieve at least one communication protocol;

determining means for determining whether a communication protocol is stored for a predetermined vehicle; and

selecting means for selecting the communication protocol based on the vehicle data.

10. The tool of claim 9, wherein the vehicle data comprises at least one of make, model, and year data.

11. The tool of claim 9, further comprising linking means for linking the communication protocol with the vehicle data.

12. The tool of claim 9, further comprising displaying means for displaying at least one of vehicle information and tire pressure monitor system information.

13. The tool of claim 9, further comprising updating means for updating the plurality of communication protocols.

14. The tool of claim 9, further comprising communicating means for enabling the tool to communicate with the electronic control unit using the at least one communication protocol.

15. The tool of claim 9, further comprising diagnosing means for diagnosing the tire pressure monitor system.

16. The tool of claim 9, further comprising resetting means for resetting the tire pressure monitor system.

17. A method of using a tire pressure monitor system comprising:

storing a plurality of communication protocols used by a tire pressure monitor system to interface with a vehicle electronic control unit in a tire pressure monitor system tool;

requesting vehicle data;

receiving the vehicle data;

accessing the stored plurality of communication protocols to retrieve at least one communication protocol;

determining whether a communication protocol is stored for a predetermined vehicle; and

selecting the communication protocol based on the vehicle data.

18. The method of claim 17, wherein the vehicle data comprises at least one of make, model, and year data.

19. The method of claim 17, further comprising linking the communication protocol with the vehicle data.

20. The method of claim 17, further comprising displaying at least one of vehicle information and tire pressure monitor system information.

21. The method of claim 17, further comprising updating the plurality of communication protocols.

22. The method of claim 17, further comprising enabling the tool to communicate with the electronic control unit using the at least one communication protocol.

23. The method of claim 17, further comprising diagnosing the tire pressure monitor system.

24. The method of claim 17, further comprising resetting the tire pressure monitor system.

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