(12) UK Patent Application (19) GB (11) 2575822 (13) A

(43) Date of A Publication 29.01.2020

(21) Application No: 1812029.5

(22) Date of Filing: 24.07.2018

(71) Applicant(s):
iTireAir Ltd
(Incorporated in the United Kingdom)
Unit 8, Queens Drive, Burntwood, Staffordshire, WS7 4QF, United Kingdom

(72) Inventor(s):
Gary Broadfield

(74) Agent and/or Address for Service:
Marks & Clerk LLP
Alpha Tower, Suffolk Street Queensway, BIRMINGHAM, B1 1TT, United Kingdom

(51) INT CL:
B60C 23/04 (2006.01)

(56) Documents Cited:
GB 2264360 A
EP 0301443 A1
JP 2015089716 A
US 20070193349 A1

(58) Field of Search:
INT CL **B60C**
Other: **EPODOC, WPI, Patent Fulltext**

(54) Title of the Invention: **Tyre pressure sensor module positioning with respect to a mobile elctronic device**
Abstract Title: **Mobile tyre pressure reading using short range telecoms and locating feature**

(57) A mobile electronic device 102, a sensor module 100, a locating feature (304, fig. 3a; 400, figs 4-6), and a tyre pressure gauge system and method for obtaining a tyre pressure reading from the sensor module 100 when fitted to a valve 104 of a pneumatic tyre 106. The mobile device and sensor each comprise a transmitter and receiver to communicate via telecommunications signals with each other over a distance of up to 4 cm, e.g. over a short range telecommunication protocol via near-field communication (NFC). The mobile device instructs the sensor to measure and transmit a pressure reading and may also power the sensor by induction. The device also provides an indication to the user, e.g. audio, visual or haptic, when it is located within 4cm or less of the sensor. The locating feature may include a keyed recess (408, fig. 4) to cooperate with a keyed portion of the sensor (e.g. octagonal, see figure 8) to locate the two within the correct distance range. The locating feature may also include an adhesive coating for sticking to the housing of the mobile device, which may be a smartphone (i.e. as shown in figure 5).

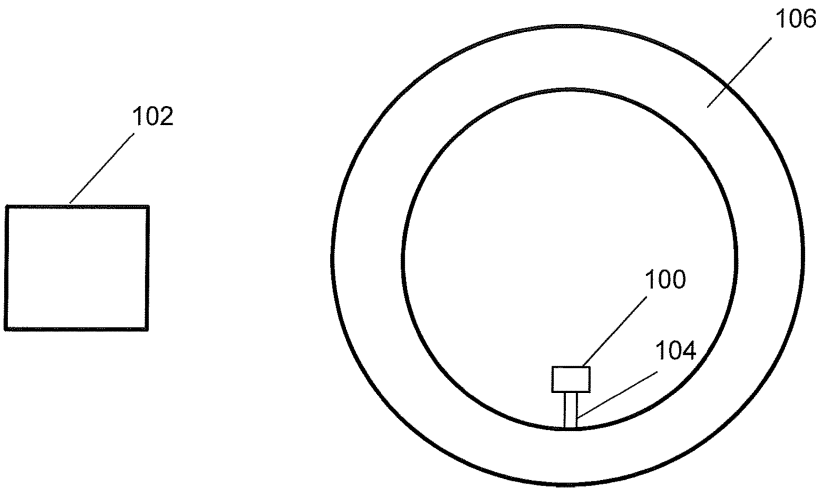

Fig. 1

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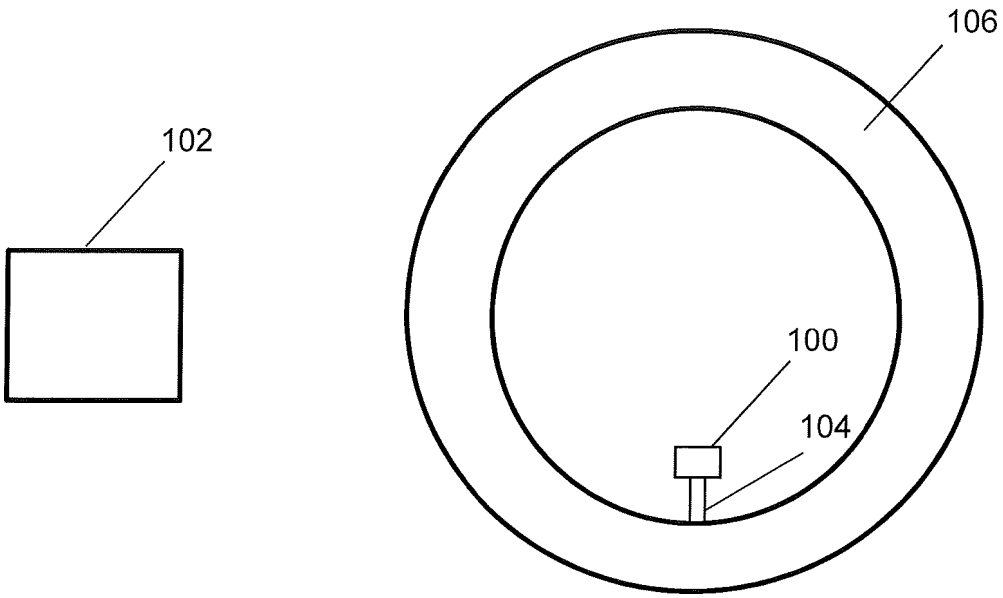

106
102
100
104

Fig. 1

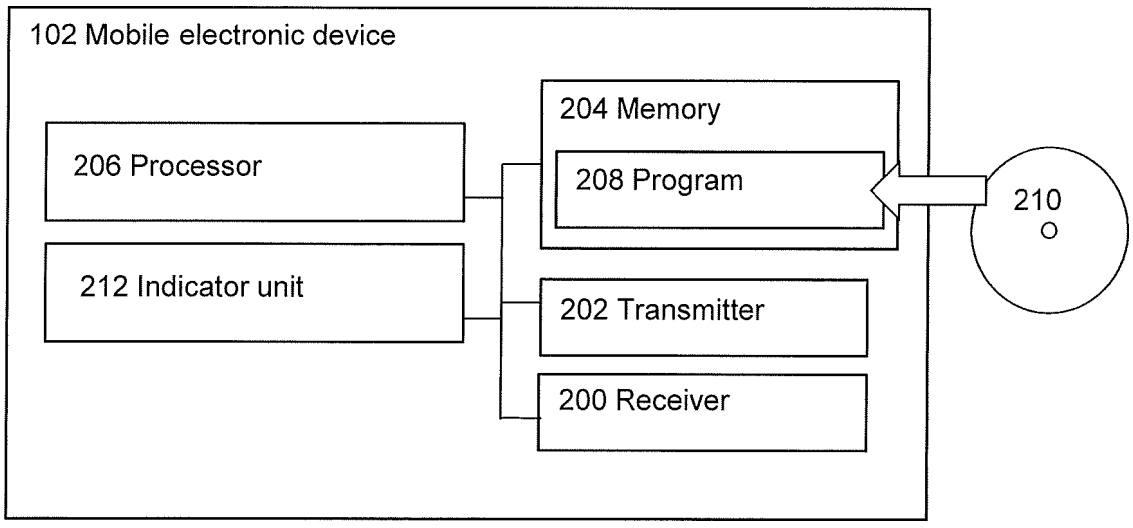

102 Mobile electronic device
204 Memory
206 Processor
208 Program
210
212 Indicator unit
202 Transmitter
200 Receiver

Fig. 2

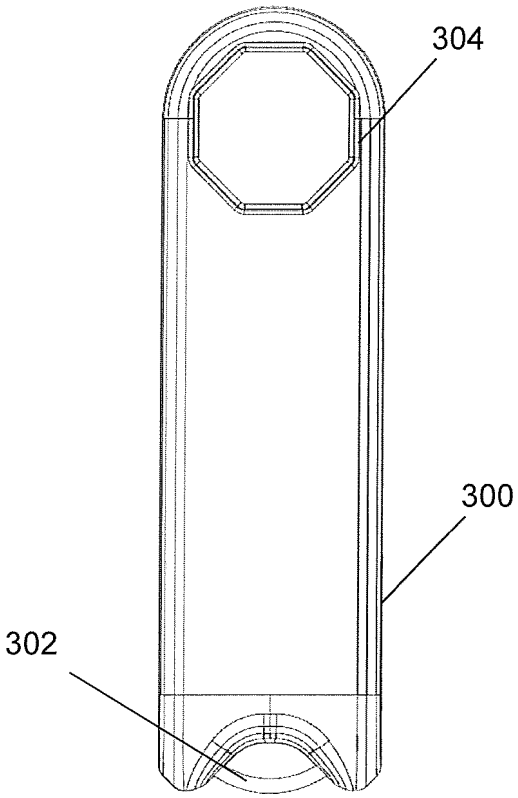


Fig. 3a

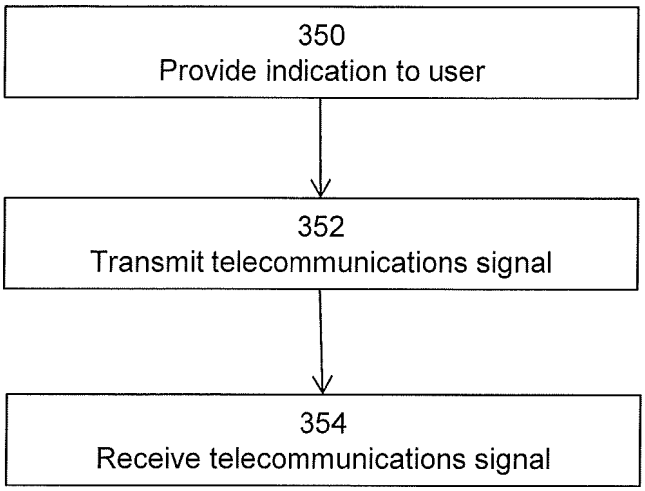

350
Provide indication to user
352
Transmit telecommunications signal
354
Receive telecommunications signal

Fig. 3b

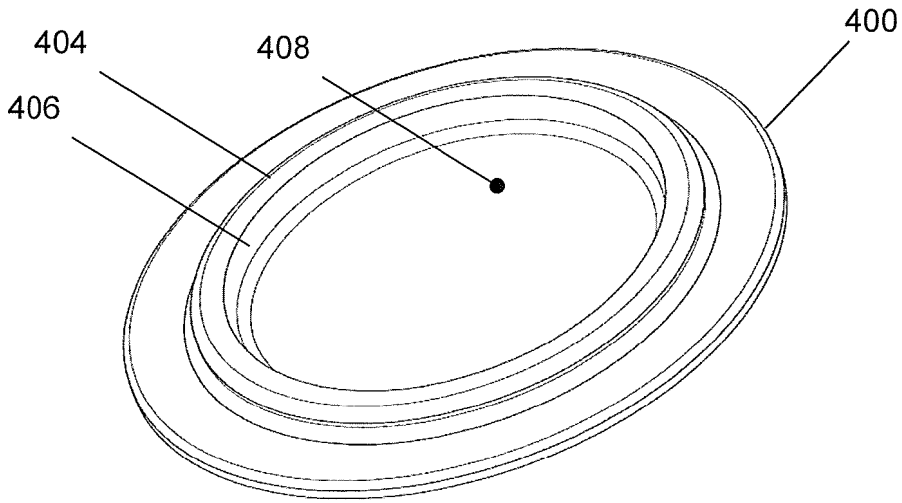

400
404
408
406

Fig. 4

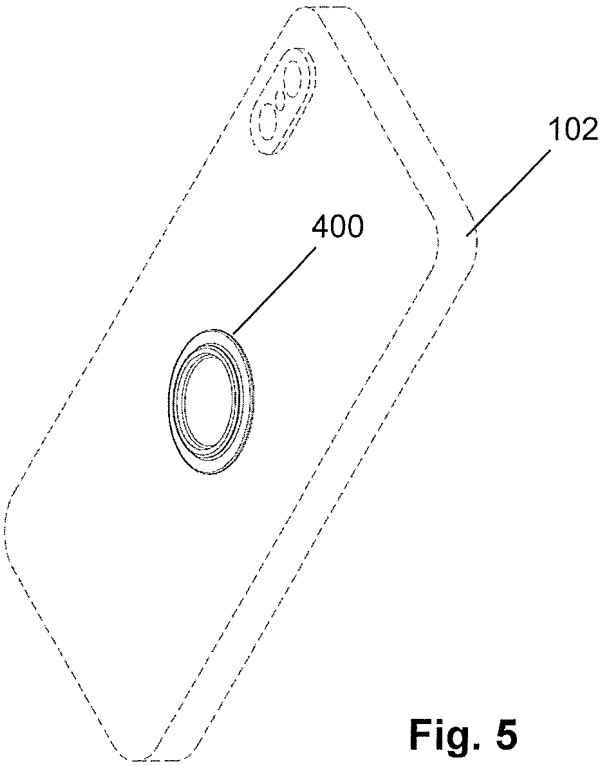


Fig. 5

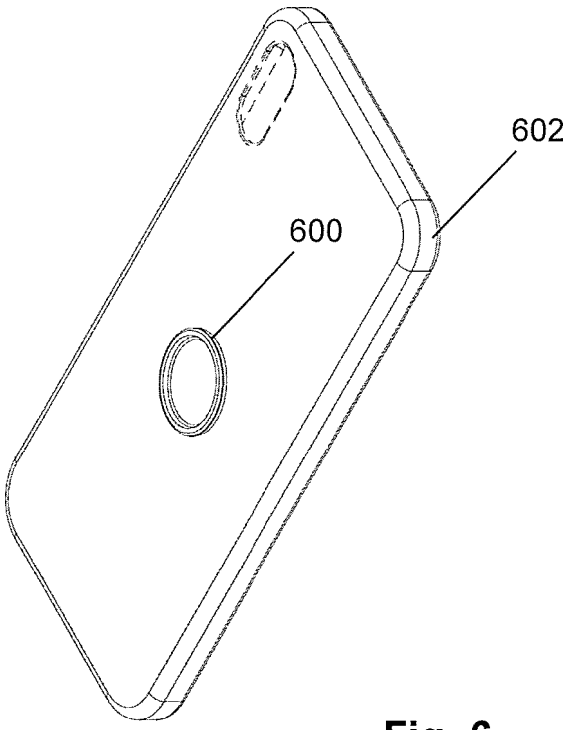


Fig. 6

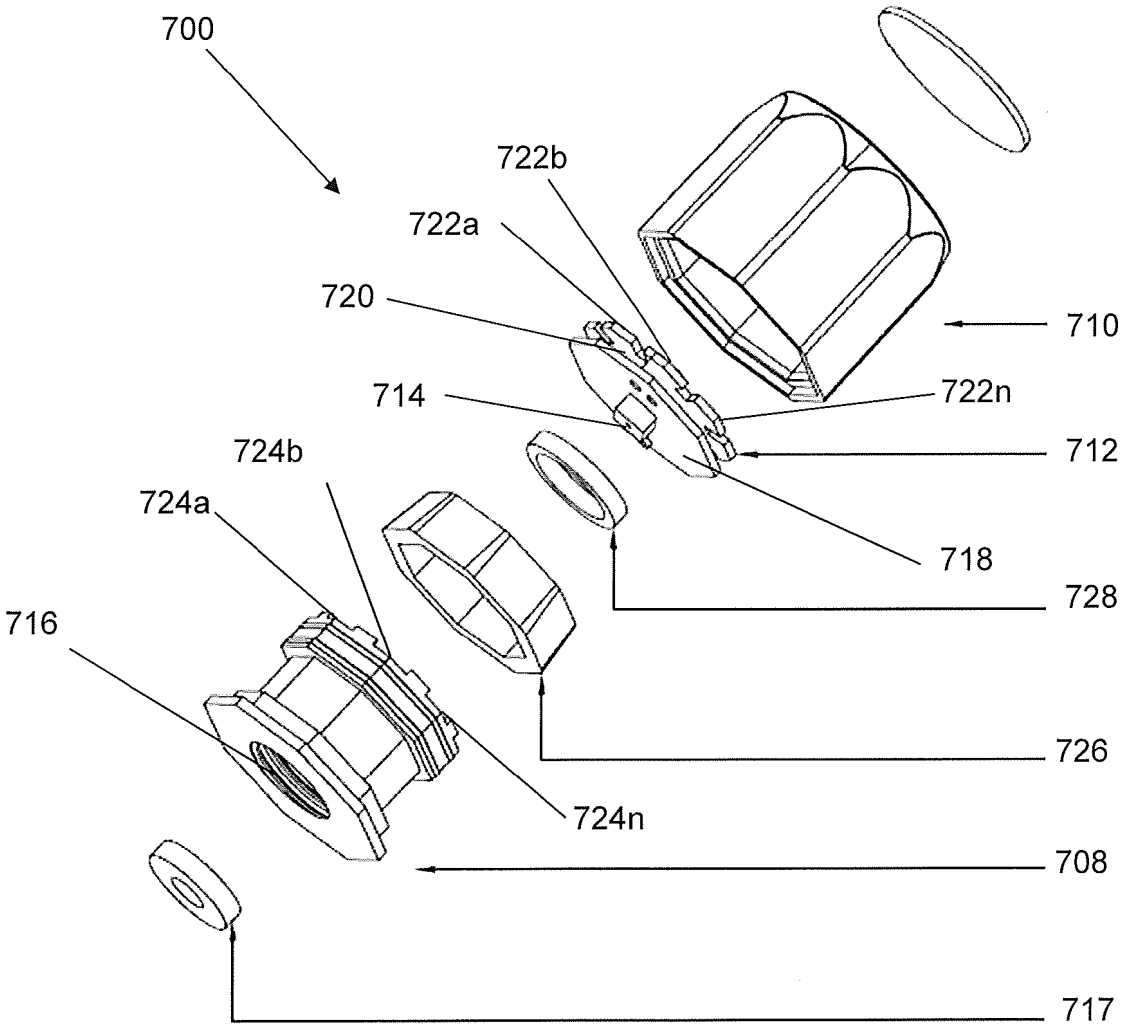

700
722b
722a
720
710
714
722n
712
724b
724a
718
728
716
726
724n
708
717

Fig. 7

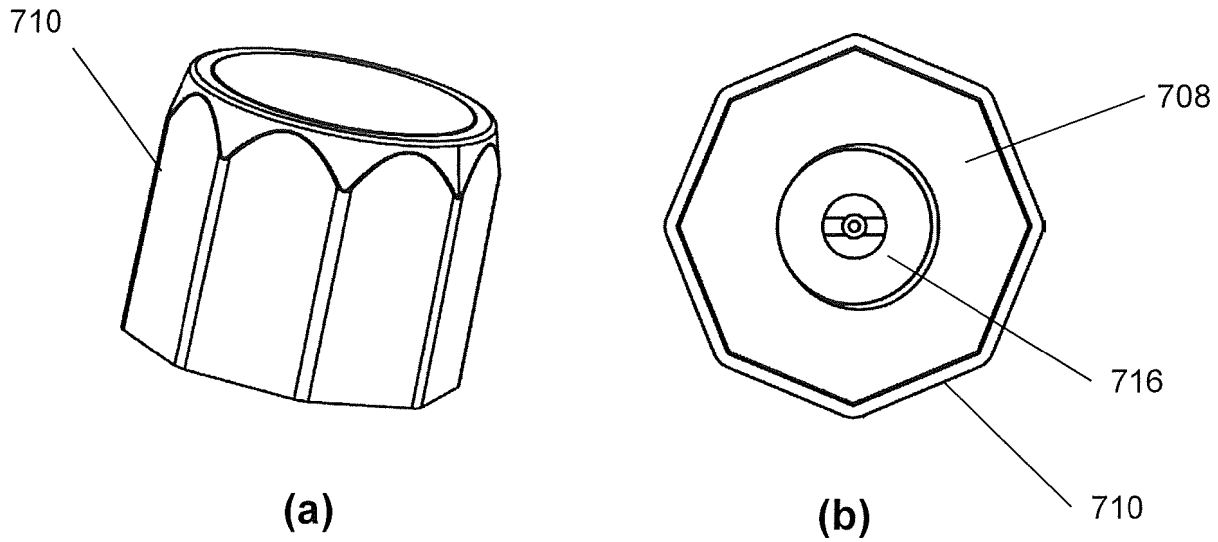

710
708
716
710
(a)
(b)

Fig. 8

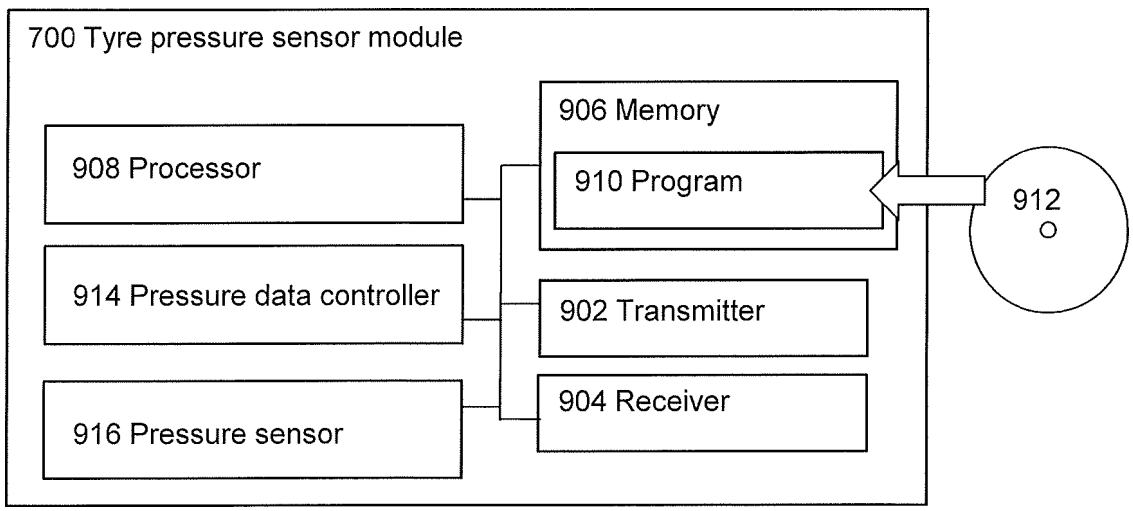
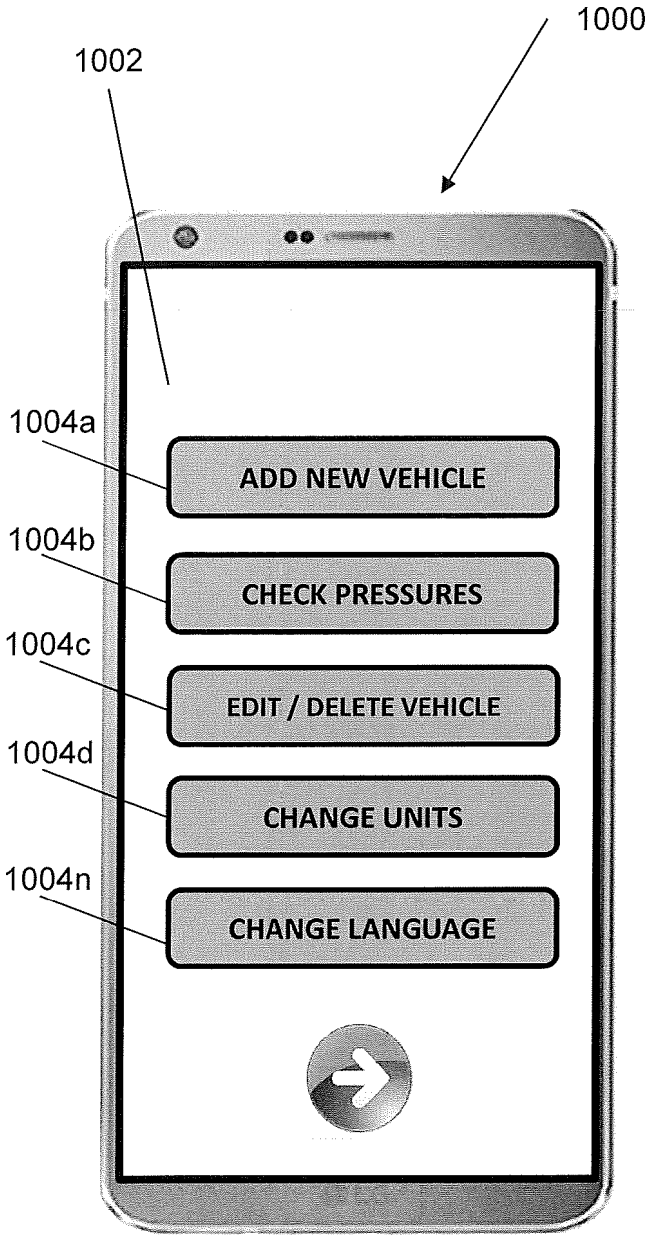

700 Tyre pressure sensor module
906 Memory
908 Processor
910 Program
912
914 Pressure data controller
902 Transmitter
916 Pressure sensor
904 Receiver

Fig. 9


1000
1002
1004a
ADD NEW VEHICLE
1004b
CHECK PRESSURES
1004c
EDIT / DELETE VEHICLE
1004d
CHANGE UNITS
1004n
CHANGE LANGUAGE

(a)

Fig. 10

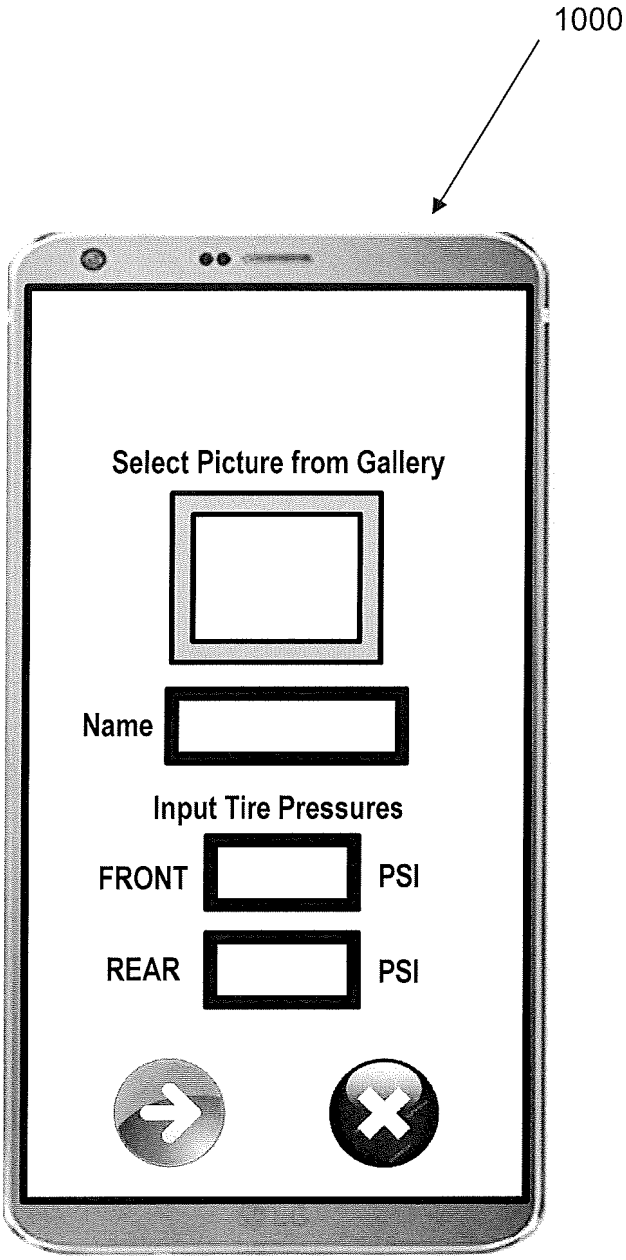

1000
Select Picture from Gallery
Name
Input Tire Pressures
FRONT
PSI
REAR
PSI

Fig. 11

The following terms are registered trade marks and should be read as such wherever they occur in this document:

Schrader
Blu-ray

TYRE PRESSURE SENSOR MODULE POSITIONING WITH RESPECT TO A MOBILE ELCTRONIC DEVICE

Technical field

The invention relates to tyre pressure gauge systems. More specifically, the invention relates to methods and apparatus for obtaining a tyre pressure reading from a tyre pressure sensor module.

Background

Exemplary tyre pressure sensor modules may be fitted to a valve or other inlet of a pneumatic tyre. In systems comprising such tyre pressure sensor modules, an electronic device may be used to obtain a reading from a tyre pressure sensor module wirelessly.

In such arrangements, the tyre pressure sensor module and the electronic device may be configured to use a short range telecommunications system and protocol, such as Near-field Communication (NFC). Accordingly, the electronic device may transmit a signal to the tyre pressure sensor module requesting a tyre pressure reading. The tyre pressure sensor module may be configured to obtain sufficient electrical power from the transmitted signal through induction to power the electronic equipment necessary to transmit a response to the request.

Short range telecommunications systems are effective only over short distances. In addition, tyre pressure sensor modules are commonly awkwardly located for users of the mobile electronic device because they are low to the ground.

Summary

In view of the above, it is an object of the invention to improve the usability of mobile electronic devices for reading tyre pressure sensor modules using short range telecommunications systems. Accurate positioning of the tyre sensor module with respect to a transmitter and/or receiver of the mobile electronic device is important for correct operation and to allow the tyre pressure to be read. In some exemplary short

range telecommunications systems, the effective range may be less than 5 cm. An object of the invention may therefore be to assist a user of the mobile electronic device to position the transmitter and/or receiver of that device correctly with respect to the tyre pressure sensor module.

In addition, short range telecommunications systems overcome some issues with prior art tyre pressure gauge systems in that it can remove the need to identify signals from different tyre pressure sensor modules. That is, only one signal may be received at any one time due to the short ranges involved. This is particularly useful for multi-wheeled vehicles and more particularly, vehicles having multiple wheels on a one side of a single axle.

It is noted that the term “short range” in respect of telecommunications systems is well known in the art and would not be unclear to a skilled person. It may, for example refer to dedicated short range communications or the like. Exemplary short range telecommunications systems may include NFC and/or may refer to telecommunications systems with a maximum range of 4 cm or less.

According to the invention in one aspect, there is provided a mobile electronic device according to claim 1. Also disclosed is a mobile electronic device for obtaining a tyre pressure reading from a tyre pressure sensor module fitted to a valve of a pneumatic tyre, the mobile electronic device comprising: a transmitter configured to transmit a telecommunications signal to the tyre pressure sensor module over a distance of up to 4 cm, wherein the telecommunications signal is configured to be received by the tyre pressure sensor module and to instruct the tyre pressure sensor module to transmit a tyre pressure reading; a receiver configured to receive a telecommunications signal from the tyre pressure sensor module over a distance of up to 4 cm, the received telecommunications signal comprising the tyre pressure reading; and a locating feature configured to provide an indication to a user of the mobile electronic device when the transmitter and/or receiver are located within 4 cm or less of the tyre pressure sensor module.

Optionally, the locating feature is configured to receive at least part of the tyre pressure sensor module.

Optionally, the locating feature comprises a keyed recess into which a correspondingly keyed portion of the tyre pressure sensor module may be received.

Optionally, the locating feature further comprises an indicator unit configured to provide one or more of an audio, visual or haptic indication to the user.

Optionally, the receiver is configured, upon receiving the telecommunications signal from the tyre pressure sensor module, to control the indicator unit to provide the indication to the user.

Optionally the mobile electronic device comprises a smartphone or tablet computing device.

Optionally, the transmitter and the receiver are configured to transmit and receive telecommunications signals using a short range telecommunications protocol configured to induce a voltage in the tyre pressure sensor module sufficient to power the tyre pressure sensor module to transmit the received telecommunications signal.

Optionally, the short range telecommunications protocol comprises a near-field communication (NFC) telecommunications protocol.

Optionally, the transmitter is configured to transmit the short range telecommunications signal at a frequency of substantially 13.56 MHz

According to the invention in a further aspect, there is provided a method according to claim 10. Also disclosed herein is a method for obtaining a tyre pressure reading from a tyre pressure sensor module fitted to a valve of a pneumatic tyre, the method comprising: providing an indication to a user of a mobile electronic device when a transmitter and receiver of the mobile electronic device are located within 4 cm or less of the tyre pressure sensor module; transmitting a telecommunications signal to the tyre pressure sensor module over a distance of up to 4 cm, wherein the telecommunications signal is received by the tyre pressure sensor module and instructs the tyre pressure sensor module to transmit a tyre pressure reading; and receiving a telecommunications signal from the tyre pressure sensor module over a

distance of up to 4 cm, the received telecommunications signal comprising the tyre pressure reading.

According to an aspect of the invention, there is provided a computer program comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out any suitable method disclosed herein.

According to an aspect of the invention, there is provided a carrier containing the computer program above, wherein the carrier is one of an electronic signal, optical signal, radio signal, or non-transitory computer readable storage medium.

According to the invention in a further aspect, there is provided a locating feature according to claim 13. Also disclosed herein is a locating feature for securing to a housing of a mobile electronic device, the mobile electronic device comprising: a transmitter configured to transmit a telecommunications signal to the tyre pressure sensor module over a distance of up to 4 cm, wherein the telecommunications signal is configured to be received by the tyre pressure sensor module and to instruct the tyre pressure sensor module to transmit a tyre pressure reading; and a receiver configured to receive a telecommunications signal from the tyre pressure sensor module over a distance of up to 4 cm, the received telecommunications signal comprising the tyre pressure reading, wherein the locating feature is securable to the housing of the mobile electronic device such that when at least part of the tyre pressure sensor module is received within the locating feature, the transmitter and receiver are located within 4 cm or less of the tyre pressure sensor module.

Optionally, the locating feature further comprises an adhesive coating on an underside thereof for adhering to the housing of the mobile electronic device.

According to an aspect of the invention, there is provided a mobile electronic device cover for fitting to a mobile electronic device and comprising the locating feature above.

According to the invention in a further aspect, there is provided a tyre pressure gauge system according to claim 16. Also disclosed herein is a tyre pressure gauge system comprising: a mobile electronic device and a tyre pressure sensor module, the mobile electronic device for obtaining a tyre pressure reading from a tyre pressure sensor

module when fitted to a valve of a pneumatic tyre, wherein the mobile electronic device comprises a transmitter configured to transmit a telecommunications signal comprising a request for a tyre pressure reading to the tyre pressure sensor module over a distance of up to 4 cm, wherein the tyre pressure sensor module comprises a receiver configured to receive the telecommunications signal, a pressure sensor configured to obtain the tyre pressure reading and a transmitter configured to transmit data indicative of a tyre pressure reading, and wherein the mobile electronic device further comprises a receiver configured to receive the transmitted data indicative of the tyre pressure reading over a distance of up to 4 cm, and a locating feature configured to provide an indication to a user of the mobile electronic device when the transmitter and receiver are located within 4 cm or less of the tyre pressure sensor module.

Optionally, the tyre pressure sensor module further comprises an antenna configured to detect the short range telecommunications signal from the mobile electronic device over a distance of up to 4 cm, the antenna further configured to obtain, from the short range telecommunications signal through induction, electrical power sufficient to allow measurement of a pressure of a fluid within the pneumatic tyre and transmission of data indicative of the measured pressure to the mobile electronic device.

According to the invention in a further aspect, there is provided a tyre pressure sensor module according to claim 18. Also disclosed herein is a tyre pressure sensor module for fitting to a valve of a pneumatic tyre, the tyre pressure sensor module comprising: an antenna configured to detect a short range telecommunications signal from a mobile electronic device over a distance of up to 4 cm, the antenna further configured to obtain, from the short range telecommunications signal through induction, electrical power sufficient to allow measurement of a pressure of a fluid within the pneumatic tyre and transmission of data indicative of the measured pressure to the mobile electronic device; a receiver configured to receive the short range telecommunications signal, which comprises instructions to obtain a pressure reading; a pressure sensor configured to measure the pressure of the fluid within the pneumatic tyre; and a transmitter configured to transmit data indicative of the measured pressure to the mobile electronic device using a short range telecommunications signal over a distance of up to 4 cm.

Optionally, the antenna is a loop antenna with a diameter of substantially 10 mm, a width of substantially 0.15 mm and substantially 14 turns.

Optionally, the tyre pressure sensor module comprises no sensors for monitoring a parameter of the tyre and/or wheel other than the pressure sensor and optionally specifically not including a temperature sensor and/or a motion sensor.

Optionally, the electronic components of the tyre pressure sensor module consist of the antenna, pressure sensor and transmitter.

Optionally, the tyre pressure sensor module has a weight of 4 grams or less.

Optionally, the tyre pressure sensor module has a length of substantially 15 mm and a width of substantially 18 mm.

Optionally, the tyre pressure sensor module is configured to interact with a mobile electronic device having a locating feature configured to provide an indication to a user of the mobile electronic device when a transmitter and/or receiver of the mobile electronic device are located within 4 cm or less of the tyre pressure sensor module.

Optionally, at least part of the tyre pressure sensor module is configured to be received within the locating feature.

Optionally, the tyre pressure sensor module comprises a keyed recess configured to be received within a correspondingly keyed portion of the locating feature.

According to the invention in a further aspect, there is provided a method according to claim 27. Also disclosed herein is a method for obtaining a tyre pressure reading from a tyre pressure sensor module for fitting to a valve of a pneumatic tyre, the method comprising: detecting, by an antenna, a short range telecommunications signal from a mobile electronic device over a distance of up to 4 cm; obtaining, by the antenna from the short range telecommunications signal through induction, electrical power sufficient to allow measurement of a pressure of a fluid within the pneumatic tyre and transmission of data indicative of the measured pressure to the mobile electronic device; receiving, by a receiver, the short range telecommunications signal, which

comprises instructions to obtain a pressure reading; measuring, by a pressure sensor, the pressure of the fluid within the pneumatic tyre; and transmitting, by a transmitter, data indicative of the measured pressure to the mobile electronic device using a short range telecommunications signal over a distance of up to 4 cm.

According to the invention in a further aspect there is provided a tyre pressure gauge system according to claim 28. Also disclosed herein is a tyre pressure gauge system comprising: a mobile electronic device and a tyre pressure sensor module, the tyre pressure sensor module for fitting to a valve of a pneumatic tyre, wherein the mobile electronic device comprises a transmitter configured to transmit a telecommunications signal comprising a request for a tyre pressure reading to the tyre pressure sensor module over a distance of up to 4 cm, wherein the tyre pressure sensor module comprises an antenna configured to receive the telecommunications signal and obtain therefrom, through induction, electrical power sufficient to allow measurement of a pressure of a fluid within the pneumatic tyre and transmission of data indicative of the measured pressure to the mobile electronic device, the tyre pressure sensor module further comprising a pressure sensor configured to measure the tyre pressure and a transmitter configured to transmit data indicative of the measured pressure to the mobile electronic device, and wherein the mobile electronic device further comprises a receiver configured to receive the transmitted data indicative of the tyre pressure reading over a distance of up to 4 cm.

According to the invention in a further aspect, there is provided a kit of parts according to claim 29. Also disclosed herein is a kit of parts comprising a tyre pressure sensor module according to any of claims 18 to 26 and a mobile electronic device according to any of claims 1 to 8.

According to the invention in a further aspect, there is provided a kit of parts according to claim 30. Also disclosed herein is a kit of parts comprising a tyre pressure sensor module according to any of claims 18 to 26 and a locating feature according to claim 13 or 14 and/or a mobile electronic device cover according to claim 15.

Brief description of drawings

Exemplary embodiments of the invention are described herein with reference to the accompanying drawings, in which:

Figure 1 is a block schematic diagram of a tyre pressure measurement system;
Figure 2 is a schematic representation of an exemplary mobile electronic device including a locating feature;
Figure 3a is an exemplary mobile electronic device including a locating feature;
Figure 3b is a flow diagram showing a method for obtaining a tyre pressure reading
Figure 4 is a locating feature for fixing to a mobile electronic device;
Figure 5 is an exemplary locating feature fixed to a mobile electronic device;
Figure 6 is an exemplary cover for a mobile electronic device comprising a locating feature,
Figure 7 is an exemplary tyre pressure sensor module,
Figure 8a is an isometric view of an exemplary tyre pressure sensor module,
Figure 8b is a bottom view of an exemplary tyre pressure sensor module,
Figure 9 is a schematic representation of an exemplary tyre pressure sensor module,
Figure 10 is an exemplary mobile electronic device, and
Figure 11 is an exemplary mobile electronic device.

Detailed description

Generally, disclosed herein is a means for ensuring correct locating of a tyre pressure sensor module relative to a mobile electronic device to allow establishment of a connection therebetween. In exemplary arrangements where a tyre pressure gauge system comprises a tyre pressure sensor module fitted to a valve of a pneumatic tyre and a mobile electronic device for reading the tyre pressure, a short range telecommunications system may be employed. In such arrangements, it is beneficial to have a means for correctly locating a transmitter and/or receiver of the mobile electronic device and an antenna of the tyre pressure sensor module.

Figure 2 shows an exemplary mobile electronic device, which may be a mobile electronic device 102. The mobile electronic device 102 comprises a transmitter 200 and a receiver 202. The transmitter 200 and receiver 202 may be in data communication with other entities in a telecommunications network and are configured to transmit and receive data accordingly.

The mobile electronic device 102 further comprises a memory 204 and a processor 206. The memory 204 may comprise a non-volatile memory and/or a volatile memory. The memory 204 may have a computer program 208 stored therein. The computer program 208 may be configured to undertake the methods disclosed herein. The computer program 208 may be loaded in the memory 204 from a non-transitory computer readable medium 210, on which the computer program is stored. The processor 206 is configured to undertake one or more of the functions in order to carry out the methods disclosed herein.

Each of the transmitter 200 and receiver 202, memory 204, processor 206 and indicator unit 212 is in data communication with the other features 200, 202, 204, 206, 212 of the mobile electronic device 102. The mobile electronic device 102 can be implemented as a combination of hardware and software. In particular, the steps undertaken in methods disclosed herein may be implemented as software configured to run on the processor 206, or as combinations of hardware and software. The memory 204 stores the various programs/executable files that are implemented by a processor 206, and also provides a storage unit for any required data.

In exemplary arrangements, the mobile electronic device 102 may be configured to transmit and/or receive data using a short range telecommunications system, for example over a range of up to 5 cm, up to 4 cm, up to 3 cm or up to 1 cm. The short range telecommunications system may comprise an antenna at the tyre pressure sensor module 100 that is configured to induce a voltage from a telecommunications signal transmitted by the mobile electronic device 102. Accordingly, the mobile electronic device 102 is configured to transmit a telecommunications signal from which a voltage may be obtained through induction at the antenna of the tyre pressure sensor module 100. The voltage induced at the antenna may be sufficient to power the process required to obtain and transmit the tyre pressure reading.

Figure 3a shows an exemplary mobile electronic device 300, which may be used as a device 102 in Figure 1. The exemplary mobile electronic device 300 may comprise the features of the mobile electronic 102 shown in Figure 2. The exemplary mobile electronic device 300 may be used as a key fob and comprises a retaining feature 302, in this case a bar that may be secured to a clip or ring, for attaching the device 300 to a

key ring. The exemplary mobile electronic device 300 may comprise a locating feature 304 configured to ensure correct positioning of the antenna of the tyre pressure sensor module 100 relative to the transmitter 200 of the mobile electronic device 300. The locating feature 304 may be a mechanical feature (such as a recess or a protrusion) or the locating feature may be electronic (for example, an electronic arrangement configured to produce an electronic indication of correct positioning, such as a vibration or an audio indication). In some arrangements, the locating feature may comprise both a mechanical feature and an electronic feature.

The mobile electronic device 300 may take any shape and in the case of the example of Figure 3a is broadly rectangular with a curved end formed by a semi-circle. The curved end of the device 300 comprises the locating feature 304. The locating feature is configured to cooperate with the tyre pressure sensor module 100 to locate the tyre pressure sensor module 100 in a predetermined orientation and/or range of the transmitter 200 and/or receiver 202 of the mobile electronic device 300.

In the example of Figure 3a, the locating feature 304 comprises a keyed feature (e.g. an octagon, hexagon, triangle or circle) that is configured to receive, at least partially, a correspondingly shaped tyre pressure sensor module 100. In the example of Figure 3, the locating feature 304 comprises an octagonal recess that is configured to receive an octagonal tyre pressure sensor module 100. As the tyre pressure sensor module 100 locates within the locating feature 304, an indication is provided to the user that this has occurred, which signifies the tyre pressure sensor module 100 is located in a position relative to the mobile electronic device 300 such that transmission and reception between the two is possible. In some arrangements this may mean that the antenna of the tyre pressure sensor module 100 is within 4 cm of the transmitter 200 and/or receiver 202 of the mobile electronic device 300. In one example, the indication may be the haptic indication that the user may feel when the tyre pressure sensor module 100 locates within the recess of the locating feature 304.

In some arrangements, alternative and/or additional means for providing an indication to the user may be utilised. For example, magnetic force may be used. That is, at least one magnet may be located in one or both of the mobile electronic device 300 and the tyre pressure sensor module 100 to align the two. The magnetic force

generated by the at least one magnet may provide a haptic indication to the user that the tyre pressure sensor module is correctly located.

In some arrangements, the locating feature comprises an indicator unit 212. The indicator unit 212 may be configured to detect when a telecommunications signal is received by the mobile electronic device 300 from the tyre pressure sensor module 100 and then to produce an indication to the user, such as a visual, audio or haptic indication. The haptic indication may be a vibration of the device 300. The telecommunications signal may comprise a tyre pressure reading such that the indication unit indicates to the user that the tyre pressure reading has been received by the mobile electronic device 300. This indicates to the user when they can bring the mobile electronic device out of alignment with the tyre pressure sensor module, if the position of the tyre pressure sensor module 100 is such that the user cannot see the mobile electronic device 300 is not visible to the user.

The indicator unit 212 may be utilised in addition to the keyed feature as described above. Alternatively, the indicator unit may be used in isolation from the keyed feature, such that the visual, audio or haptic indication generated by the indicator unit provides an indication to the user of correct alignment.

Figure 3b shows a flow diagram for obtaining a tyre pressure reading using a mobile electronic device 102 as disclosed herein. The method comprises a user of a mobile electronic device 102 placing the mobile electronic device 102 in proximity to a tyre pressure sensor module 100. By any of the means disclosed herein, the mobile electronic device 102 is configured to provide 350 an indication to the user that the transmitter 200 and/or receiver 202 of the mobile electronic device 102 are located within 4 cm or less of the tyre pressure sensor module 100.

The transmitter 200 then transmits 352 a telecommunications signal to the tyre pressure sensor module 100. The telecommunications signal is received by the tyre pressure sensor module 100 and instructs the tyre pressure sensor module 100 to transmit a tyre pressure reading.

The receiver 202 receives 354 a telecommunications signal from the tyre pressure sensor module 100, the received telecommunications signal comprising the tyre pressure reading.

Alternatively or additionally, the indicator unit 212 may provide an indication to the user to confirm that the telecommunications signal has been received by the receiver 202. This indication may confirm that the tyre pressure reading has been received by the receiver 202. The indication may occur after the initial indication to the user that the transmitter 200 and/or receiver 202 of the mobile electronic device 102 are located within 4 cm or less of the tyre pressure sensor module 100.

Referring to Figure 4, a locating feature 400 is shown that may adhered or otherwise fixed to an existing mobile electronic device 102. In the example of Figure 4, the locating feature is a sticker 400 with a raised or embossed design thereon to create a locating feature 404. The locating feature 404 may the same or similar to the locating feature 304 described already in respect of Figure 3. In alternative arrangements, the locating feature may be moulded and adhered to the mobile electronic device using a suitable adhesive.

Accordingly, the sticker 400 comprises a raised or embossed feature having sidewalls 406 defining a recess 408. The recess 408 is configured to receive, at least partially, the profile of a tyre pressure sensor module 100. Although the sidewalls 406 define a circular recess 408, any other shaped recess (e.g. an octagon, hexagon, triangle) may be used to correspond to the profile of the tyre pressure sensor module 100. This may produce a keyed recess only receiving the tyre pressure sensor module in a limited number of orientations. The sticker 400 may have an adhesive backing (not shown) for adhering the sticker 400 to an existing mobile electronic device 102.

Figure 5 shows an exemplary sticker 400 adhered to a smart phone 102, although it could be adhered to any other type of mobile electronic device. The sticker 400 is positioned such that when a tyre pressure sensor module 100 is correctly located with respect to the sticker 400, e.g. at least partially received in the recess 408, then the tyre pressure sensor module 100 is within range of the transmitter 200 and/or receiver 202 of the smart phone 102. In the example of Figure 5, the sticker 400 is shown

centrally located on the smart phone 102, although other locations may be used dependent on the structure of the smart phone 102.

Figure 6 shows an alternative arrangement in which a locating feature 600 that is the same or similar to other locating features described herein is positioned on a cover 602 for a mobile electronic device, in this case a smart phone 102. The locating feature 600 is positioned on the cover 600 such that when a tyre pressure sensor module 100 is correctly located with respect to the locating feature 600, e.g. at least partially received in the recess, and the cover is fitted to the mobile electronic device 102 then the tyre pressure sensor module 100 is within range of the transmitter 200 and/or receiver 202 of the mobile electronic device 102. In the example of Figure 6, the locating feature 600 is shown centrally located on cover 602, although other locations may be used dependent on the structure of the mobile electronic device 102 to which the cover is to be fitted. In alternative arrangements, the locating feature 600 may be an aperture in the phone case, the aperture positioned such that when a tyre pressure sensor module 100 is received within the aperture, the tyre pressure sensor module 100 is within range of the transmitter 200 and/or receiver 202 of the mobile electronic device 102. In yet further arrangements, the locating feature may be a recess in the case that does not have raised or embossed sidewalls. That is, the upper edge of the recess may be flush with the outer surface of the case.

In use, a user of the tyre pressure gauge system may walk around the vehicle with the mobile electronic device 102. The user may hold the mobile electronic device 102 in close proximity to the tyre pressure sensor module 100 (this may comprise using a locating feature as described herein). As discussed above, when the mobile electronic device 102 is in close proximity to the tyre pressure sensor module 100, it may transmit a signal that provides power to the tyre pressure sensor module 100. The power may be sufficient to enable determination of the pressure of air in the pneumatic tyre 106 of the vehicle. The determined pressure may be transmitted to the mobile electronic device 102 for display to the user.

In exemplary tyre pressure systems, the mobile electronic device may be configured to transmit a short range telecommunications signal to the tyre pressure module. The short range telecommunications signal may allow an antenna of the tyre pressure sensor unit to obtain sufficient electrical power to allow measurement of a pressure of a

fluid within the pneumatic tyre and transmission of data indicative of the measured pressure to the mobile electronic device. As such, exemplary tyre pressure sensor units may be battery-less, allowing for production of a sensor unit of reduced size, weight, complexity and power consumption.

Additional tyre pressure sensor module size and weight reductions may be achieved by reducing the size of the antenna of the tyre pressure module. Traditionally, this would not be desirable, since reducing the antenna size may affect the transmission range. It may also mean that the mobile electronic device needs to be placed in closer proximity to and more accurately located with respect to the pressure sensor unit to allow a pressure reading to be taken, which may be difficult for the user of the mobile electronics device, particularly if the tyre pressure sensor module is not visible.

However, the inventors have realised that on vehicles having multiple tyres in close proximity, such as those having multiple axles closely located or having multiple tyres on each side of a single axle, a reduced transmission range may be desirable. A reduced transmission range allows separate tyre pressures to be read without the need for the mobile electronic device to identify and distinguish the pressure sensor module it wishes to read from others on the vehicle. Because only pressure sensor modules within a small range can be read, it is clear which sensor module is providing a particular pressure reading.

The tyre pressure sensor module is now described in greater detail.

Referring to Figures 7, 8a and 8b, the tyre pressure sensor module 700 comprises a housing split into a forward portion 708, a rear portion 710 and sensor electronics 712 comprising a pressure sensor 714.

The forward portion 708 comprises an internal thread 716 for screwing onto a threaded portion of the valve 104 of a pneumatic tyre 106. The valve 104 may be of a Schrader valve structure.

The forward portion 708 may also comprise a valve actuation member (not shown) configured to open the tyre valve on attachment of the tyre pressure sensor module 700 thereto. In the example of a Schrader valve, the actuation member protrudes into

the valve structure to depress a valve stem and open the valve. The forward portion 708 is configured to form an airtight seal with the tyre valve by way of interaction between the internal thread 716 and the threaded portion of the valve. In this way, air is only required to be released from the tyre 102 and into the volume surrounding the valve structure on fitting the tyre pressure sensor module. Exemplary tyre pressure sensor modules 700 may also comprise a valve plug 717 configured to provide an airtight seal with the tyre valve 104.

The forward portion 708 may also comprise a fluid communication path (not shown). The fluid communication path may extend from the internal thread 716 to the sensor electronics 712. The fluid communication path is configured to allow air (or other fluid) from within the pneumatic tyre 106 to pass from the open valve 104 to the pressure sensor 714.

The sensor electronics 712 may be mounted on a printed circuit board (PCB) 718. The sensor electronics 712 may comprise the pressure sensor 714, an antenna and a microprocessor. In one exemplary arrangement, the sensor electronics may consist of the pressure sensor 714, the antenna and the microprocessor, which may include a receiver and a transmitter. It is noted that in the context of such arrangements, sensor electronics encompasses electronic apparatus having a defined electronic operation within the context of the device itself, for example the pressure sensor, receiver, transmitter and antenna. The term electronic component as used in that context does not encompass elemental components such as wires, PCB track, resistors, capacitors etc.

In the exemplary tyre pressure sensor module of Figure 2, the antenna may be a loop antenna. The antenna may have a diameter of substantially 10 mm, a width of substantially 0.15 mm and comprise 14 turns. The antenna may additionally have a thickness of substantially 0.35 mm and a track width of substantially 0.15 mm

Exemplary tyre pressure sensor modules may be battery-less. The antenna may be configured to receive a short range telecommunications signal and draw power therefrom such that the pressure sensor 714 can take a pressure reading. Exemplary antennas may be configured to draw sufficient power from the telecommunications

signal over a distance of up to 4cm. The telecommunications signal may be an NFC signal.

The PCB 718 may comprise to a locating member 720 configured to interact with a corresponding locating feature of the forward portion 708 to secure the PCB 718 thereto. In the tyre pressure sensor module 700, the locating member 720 comprises locating lugs 722a-n configured to engage with corresponding locating recesses 724a-n on the forward portion 708. Alternatively, the forward portion may comprise locating lugs configured to engage with locating recesses on the PCB 718. Alternative mounting means may be utilised to secure the PCB 718 to the forward portion 708. The locating member 720 may be configured to ensure that the PCB 718 is mounted to the forward portion 708 such that the pressure sensor 714 is positioned to enable pressure readings to be taken.

The rear portion 710 is of substantially cup-like shape and is configured to surround the sensor electronics and body of the forward portion 708 when secured thereto. As shown in Figures 8a and 8b, which show an isometric view and a bottom view of the tyre pressure sensor unit 700 respectively, the rear portion 710 surrounds substantially all of the body of the forward portion 708 such that only the internal thread 716 and underside of the forward portion 708 are left exposed.

A housing seal 726 may be secured between the forward portion 708 and the rear portion 710 to provide a watertight seal to prevent water ingress to the sensor electronics 712. The watertight seal may comprise an O-ring configured to surround the PCB 718. Alternatively, the forward portion 708 may be secured to the rear portion 710 with an adhesive or ultrasonic weld to form a watertight seal. The tyre pressure sensor module 700 may further comprise a pressure sensor seal 728 configured to surround the pressure sensor 714 and provide further protection against water ingress.

Exemplary tyre pressure sensor modules 100, 700 may have a substantially circular, hexagonal, square or octagonal profile when viewed from the top. Further, exemplary tyre pressure sensor modules 100, 700 may be configured to interact with a locating feature of a mobile electronic device to provide an indication of when the tyre pressure sensor module 100, 700 is aligned with a transmitter and/or receiver of the mobile electronic device to allow telecommunication therebetween. In some examples, tyre

pressure sensor modules 100, 700 may be configured to be at least partially received within a recess formed by the locating feature and may have a profile corresponding to a shape of the recess.

Exemplary tyre pressure sensor modules 100, 700 may have a diameter of substantially 18mm. Further, the length from a forward end of the forward portion 708 to the rearward end of the rear portion 106 may be substantially 15mm. The weight of exemplary sensor units 102 may be 5 grams or less or may be 4 grams or less.

Figure 9 shows a schematic representation of a tyre pressure sensor module 900, which may be the tyre pressure sensor module of Figures 7, 8a and 8b. The tyre pressure sensor module 900 comprises a transmitter 902 and a receiver 904. The receiver 904 may comprise an antenna as discussed above, configured to receive a short range RF signal and configured to draw electrical power therefrom. The transmitter 902 and receiver 904 may be in data communication with other entities in a tyre pressure gauge system, such as a mobile electronic device 102 and are configured to transmit and receive data accordingly. In particular, the transmitter 902 and receiver 904 may be configured to transmit and receive data using a short range radio frequency (RF) signal, such as an NFC signal, as discussed above.

The tyre pressure sensor module further comprises a memory 906 and a processor 908. The memory 906 may comprise a non-volatile memory and/or a volatile memory. The memory 906 may have a computer program 910 stored therein. The computer program 910 may be configured to undertake the methods disclosed herein. The computer program 910 may be loaded in the memory 906 from a non-transitory computer readable media 912, on which the computer program is stored. The tyre pressure sensor module 700 further comprises a pressure sensor 916 configured to determine pressure within a tyre when fitted to a valve thereof. The processor 908 may be configured to undertake the function of a pressure data controller 914 as set out herein.

Each of the transmitter 902 and receiver 904, memory 906, processor 908, pressure data controller 914, pressure sensor 916 may be in data/electrical communication with the other features 902, 904, 906, 908, 910, 914, 916 of the tyre pressure sensor module 700. The tyre pressure sensor module 700 can be implemented as a

combination of computer hardware and software. In particular, pressure data controller 914 may be implemented as software configured to run on the processor 908. The memory 906 stores the various programs/executable files that are implemented by a processor 908, and also provides a storage unit for any required data. The programs/executable files stored in the memory 906, and implemented by the processor 908, can include the pressure data controller 914 but are not limited to such.

As discussed above, exemplary tyre pressure sensor modules are battery-less. This, combined with the use of a smaller antenna allows for the reduced size and weight of exemplary tyre pressure sensor modules.

The use of a smaller antenna also provides for a less complex system by reducing the distance over which the antenna of the tyre pressure sensor module can obtain sufficient power to enable tyre pressure to be determined. As discussed above, because only tyre pressure sensor modules within a small range can be read, it is clear which sensor module is providing a particular pressure reading. This means that there is no requirement for identification of individual tyre pressure sensor modules when transmitting pressure data.

Exemplary tyre pressure sensor modules comprise only sensors for measuring tyre pressure. That is, exemplary tyre pressure sensor modules may not comprise any sensors for monitoring a parameter of the tyre and/or wheel other than the pressure sensor. Specifically, the tyre pressure sensor module may not including a temperature sensor and/or a motion sensor. Again, this provides a much lower power, smaller, lighter and lower cost sensor unit than, for example, a TPMS. It is noted that this is against the direction of innovation in the art, which is towards greater functionality and a greater numbers of features.

It is also against the direction of innovation in the art to reduce the transmission distances between the tyre pressure sensor module and the mobile electronic device. The below table demonstrates the large effects that the width and diameter of a circular loop antenna has on inductance, and therefore transmission range.

	Turns	Antenna Diameter (cm)	Width (cm)	Inductance (μH)
Example	**10**	**2**	**0.8**	**2.34**
Double Turns (20)	20	2	0.8	9.37
Halve Turns (5)	5	2	0.8	0.59
Double antenna Diameter (4)	10	4	0.8	6.35
Halve Antenna Diameter (1)	10	1	0.4	1.17
Halve Antenna Width (4)	10	2	0.4	3.17

As can be seen, reducing the diameter (and therefore surface area) of the antenna significantly reduces the inductance and therefore the transmission range (both laterally and vertically). Similarly, a reduction in the number of turns of the antenna significantly reduces the inductance and therefore the transmission range. It is noted that the term "turns" as used in the context of antennas encompasses concentric, spiralled revolutions of a material forming the antenna. This will be understood by the skilled person.

Reducing the transmission distances means that the transmitter of the mobile electronics device must be more accurately located with respect to the antenna of the tyre pressure sensor module in both the lateral and vertical directions. For many vehicles, the tyre pressure sensor module may be mounted to a tyre in a position such that it is not visible to the user. As such, the user may be unable to position the mobile electronics device relative to the tyre pressure sensor in such a way to allow a pressure reading to be taken and transmitted.

An exemplary method for reading tyre pressure using apparatus disclosed herein is described below.

The mobile electronic device 102 is placed in close proximity to a tyre pressure sensor module 700. In exemplary systems, close proximity may encompass distances up to 4 cm, up to 3 cm, up to 2 cm or up to 1 cm. In many exemplary arrangements, close proximity is a distance sufficiently close to allow an NFC (or other short range telecommunications signals such as an RF signal, including RFID) transmission from the mobile electronic device 102 to be detected by the antenna of the receiver 904 of

the tyre pressure sensor module 700 using one of the transmission means disclosed herein.

The transmitter 202 of the mobile electronic device 102 transmits a short range telecommunications signal, such as NFC or RFID, to the tyre pressure sensor module. The short range telecommunications signal may be a request for a tyre pressure measurement. The transmission may be undertaken using NFC transmission techniques. The short range telecommunications signal may therefore have a range of up to 4 cm, up to 3 cm, up to 2 cm or up to 1 cm. The short range telecommunications signal transmission may be in response to a user input, for example a user pressing a button on the mobile electronic device 102. The transmitter 202 of the mobile electronic device 102 may use a transmission frequency of 13.56 MHz.

In exemplary methods, the mobile electronic device 102 and the tyre pressure module 100 communicate via inductive coupling when the antenna of the tyre pressure sensor module 700 is within range of the transmitter 202 and/or receiver 200 of the mobile electronic device 102.

The receiver 904 of the tyre pressure sensor module 700 detects the short range telecommunications signal transmission from the mobile electronic device 102. In exemplary tyre pressure gauge systems, the telecommunications signal is received at the antenna, which is configured to induce a voltage in the tyre pressure sensor module sufficient to power the tyre pressure sensor module to take a measurement of a pressure of a fluid within the pneumatic tyre and transmission of data indicative of the measured pressure to the mobile electronic device 102. On receipt of the short range telecommunications signal, the pressure sensor 714 therefore determines the pressure of the air in the tyre of the respective wheel of the vehicle.

The pressure data controller 914 controls the transmitter 902 to transmit pressure data indicative of the determined tyre pressure to the mobile electronic device 102. The transmitter may transmit the data via a short range telecommunications signal having a range of less than 4 cm, such as an NFC RF signal or an RFID RF signal. In other arrangements, a different telecommunications protocol may be used to transmit the pressure data.

The receiver 200 of the mobile electronic device 300 receives the tyre pressure data and may display the tyre pressure to the user.The user then moves to the next tyre/wheel of the vehicle and repeats the process to determine the pressure at each tyre pressure sensor module.

In exemplary mobile electronic devices the tyre pressure data received by the mobile electronic device 300 may be compared to a desired tyre pressure in order to determine whether the tyre is at a safe pressure or whether the tyre is in need of inflation. A warning may be displayed to the user if the measured tyre pressure is less than a threshold. The threshold may be defined as a percentage of the desired tyre pressure.

Exemplary mobile electronic devices may comprise a user interface through which the user can programme and/or control the mobile electronic device 300. For example, the user may input into the mobile electronic device, via the user interface, a desired tyre pressure for a particular tyre of a vehicle. The user interface may comprise a display screen configured to display data to the user. The display screen may be a touchscreen configured to display data to the user and to allow a user to make user inputs to the screen to programme and/or control the mobile electronic device 300.

Figure 10 shows an exemplary mobile electronic device 1000, which is a smartphone. The mobile electronic device 1000 comprises a touchscreen 1002, which displays selectable icons 1004a-n. The user may make user inputs to navigate the user interface via the selectable icons 1004a-n. For example, the user may select one of the icons 1004a-n to navigate to the screen as shown in Figure 10b, which allows the user to make a user input to define a desired pressure value that would indicate that a tyre is of a safe pressure. In some arrangements, a desired front tyre pressure and a desired back tyre pressure may be separately definable.

When a pressure reading is taken by the mobile electronic device in the manner described above, the measured tyre pressure may be compared to a threshold to determine whether the tyre is safe or underinflated. If the desired front pressure and the desired back pressure are of different values, once the tyre pressure reading is received by the mobile electronic device 1000 from the tyre pressure sensor module

100, the user may receive a prompt to indicate whether the tyre that the pressure reading is associated with is a front or back tyre.

In exemplary mobile electronic devices, the user may be alerted if the measured tyre pressure is lower than the threshold. The alert could be visual, audio or haptic.

In a particular example, a warning may be displayed to the user if the measured tyre pressure is lower than the threshold. This could be displayed to the user in a traffic-light fashion, with green indicating that the tyre is safe, amber indicating that the tyre needs to be inflated and red indicating that the tyre is unsafe.

The threshold may be user-configurable or alternatively, pre-programmed into the mobile electronic device 1000. In exemplary mobile electronic devices, the threshold may be defined as a percentage of the desired pressure value. For example, the threshold may be defined as approximately 12% of the desired tyre pressure, such that a measured tyre pressure of less than 12% of the desired tyre pressure value indicates that the tyre needs to be inflated. A second threshold may indicate that the tyre is unsafe. For example a second threshold may be set at approximately 18% of the desired tyre pressure, such that a measured tyre pressure of less than 18% of the desired tyre pressure value indicates that the tyre is unsafe.

In exemplary mobile electronic devices 1000, the user may create a plurality of vehicle profiles and input different desired tyre pressure values and thresholds associated with tyres of a particular vehicle. In this way, a single mobile electronic device may be utilised with a number of different vehicles and tyre pressure sensor modules.

The user interface may further allow the user to select the units (psi or bar) that the measured pressure reading should be displayed in and/or the language.

A computer program may be configured to provide at least part of any of the above described methods. The computer program may be provided on a computer readable medium. The computer program may be a computer program product. The product may comprise a non-transitory computer usable storage medium. The computer program product may have computer-readable program code embodied in the medium configured to perform the method. The computer program product may be configured to cause at least one processor to perform some or all of the method.

Various methods and apparatus are described herein with reference to block diagrams or flowchart illustrations of computer-implemented methods, apparatus (systems and/or devices) and/or computer program products. It is understood that a block of the block diagrams and/or flowchart illustrations, and combinations of blocks in the block diagrams and/or flowchart illustrations, can be implemented by computer program instructions that are performed by one or more computer circuits. These computer program instructions may be provided to a processor circuit of a general purpose computer circuit, special purpose computer circuit, and/or other programmable data processing circuit to produce a machine, such that the instructions, which execute via the processor of the computer and/or other programmable data processing apparatus, transform and control transistors, values stored in memory locations, and other hardware components within such circuitry to implement the functions/acts specified in the block diagrams and/or flowchart block or blocks, and thereby create means (functionality) and/or structure for implementing the functions/acts specified in the block diagrams and/or flowchart block(s).

Computer program instructions may also be stored in a computer-readable medium that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable medium produce an article of manufacture including instructions which implement the functions/acts specified in the block diagrams and/or flowchart block or blocks.

A tangible, non-transitory computer-readable medium may include an electronic, magnetic, optical, electromagnetic, or semiconductor data storage system, apparatus, or device. More specific examples of the computer-readable medium would include the following: a portable computer diskette, a random access memory (RAM) circuit, a read-only memory (ROM) circuit, an erasable programmable read-only memory (EPROM or Flash memory) circuit, a portable compact disc read-only memory (CD-ROM), and a portable digital video disc read-only memory (DVD/Blu-ray).

The computer program instructions may also be loaded onto a computer and/or other programmable data processing apparatus to cause a series of operational steps to be performed on the computer and/or other programmable apparatus to produce a

computer-implemented process such that the instructions which execute on the computer or other programmable apparatus provide steps for implementing the functions/acts specified in the block diagrams and/or flowchart block or blocks.

Accordingly, the invention may be embodied in hardware and/or in software (including firmware, resident software, micro-code, etc.) that runs on a processor, which may collectively be referred to as "circuitry," "a module" or variants thereof.

It should also be noted that in some alternate implementations, the functions/acts noted in the blocks may occur out of the order noted in the flowcharts. For example, two blocks shown in succession may in fact be executed substantially concurrently or the blocks may sometimes be executed in the reverse order, depending upon the functionality/acts involved. Moreover, the functionality of a given block of the flowcharts and/or block diagrams may be separated into multiple blocks and/or the functionality of two or more blocks of the flowcharts and/or block diagrams may be at least partially integrated. Finally, other blocks may be added/inserted between the blocks that are illustrated.

The skilled person will be able to envisage other embodiments without departing from the scope of the appended claims.

CLAIMS:

1. A mobile electronic device for obtaining a tyre pressure reading from a tyre pressure sensor module fitted to a valve of a pneumatic tyre, the mobile electronic device comprising:

a transmitter configured to transmit a telecommunications signal to the tyre pressure sensor module over a distance of up to 4 cm, wherein the telecommunications signal is configured to be received by the tyre pressure sensor module and to instruct the tyre pressure sensor module to transmit a tyre pressure reading;

a receiver configured to receive a telecommunications signal from the tyre pressure sensor module over a distance of up to 4 cm, the received telecommunications signal comprising the tyre pressure reading; and

a locating feature configured to provide an indication to a user of the mobile electronic device when the transmitter and/or receiver are located within 4 cm or less of the tyre pressure sensor module.

2. The mobile electronic device according to claim 1, wherein the locating feature is configured to receive at least part of the tyre pressure sensor module.

3. The mobile electronic device according to claim 2, wherein the locating feature comprises a keyed recess into which a correspondingly keyed portion of the tyre pressure sensor module may be received.

4. The mobile electronic device according to any preceding claim, wherein the locating feature further comprises an indicator unit configured to provide one or more of an audio, visual or haptic indication to the user.

5. The mobile electronic device according to claim 4, wherein the receiver is configured, upon receiving the telecommunications signal from the tyre pressure sensor module, to control the indicator unit to provide the indication to the user.

6. The mobile electronic device according to any preceding claim, wherein the mobile electronic device comprises a smartphone or tablet computing device.

7. The mobile electronic device according to any preceding claim, wherein the transmitter and the receiver are configured to transmit and receive telecommunications signals using a short range telecommunications protocol configured to induce a voltage in the tyre pressure sensor module sufficient to power the tyre pressure sensor module to transmit the received telecommunications signal.

8. The mobile electronic device according to any preceding claim, wherein the short range telecommunications protocol comprises a near-field communication (NFC) telecommunications protocol.

9. The mobile electronic device according to claim 8, wherein the transmitter is configured to transmit the short range telecommunications signal at a frequency of substantially 13.56 MHz

10. A method for obtaining a tyre pressure reading from a tyre pressure sensor module fitted to a valve of a pneumatic tyre, the method comprising:

providing an indication to a user of a mobile electronic device when a transmitter and receiver of the mobile electronic device are located within 4 cm or less of the tyre pressure sensor module;

transmitting a telecommunications signal to the tyre pressure sensor module over a distance of up to 4 cm, wherein the telecommunications signal is received by the tyre pressure sensor module and instructs the tyre pressure sensor module to transmit a tyre pressure reading; and

receiving a telecommunications signal from the tyre pressure sensor module over a distance of up to 4 cm, the received telecommunications signal comprising the tyre pressure reading.

11. A computer program comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out the method according to claim 10.

12. A carrier containing the computer program of claim 11, wherein the carrier is one of an electronic signal, optical signal, radio signal, or non-transitory computer readable storage medium.

13. A locating feature for securing to a housing of a mobile electronic device, the mobile electronic device comprising:

a transmitter configured to transmit a telecommunications signal to the tyre pressure sensor module over a distance of up to 4 cm, wherein the telecommunications signal is configured to be received by the tyre pressure sensor module and to instruct the tyre pressure sensor module to transmit a tyre pressure reading; and

a receiver configured to receive a telecommunications signal from the tyre pressure sensor module over a distance of up to 4 cm, the received telecommunications signal comprising the tyre pressure reading,

wherein the locating feature is securable to the housing of the mobile electronic device such that when at least part of the tyre pressure sensor module is received within the locating feature, the transmitter and receiver are located within 4 cm or less of the tyre pressure sensor module.

14. A locating feature according to claim 13, further comprising an adhesive coating on an underside thereof for adhering to the housing of the mobile electronic device.

15. A mobile electronic device cover for fitting to a mobile electronic device and comprising the locating feature according to claim 13.

16. A tyre pressure gauge system comprising:

a mobile electronic device and a tyre pressure sensor module, the mobile electronic device for obtaining a tyre pressure reading from a tyre pressure sensor module when fitted to a valve of a pneumatic tyre,

wherein the mobile electronic device comprises a transmitter configured to transmit a telecommunications signal comprising a request for a tyre pressure reading to the tyre pressure sensor module over a distance of up to 4 cm,

wherein the tyre pressure sensor module comprises a receiver configured to receive the telecommunications signal, a pressure sensor configured to obtain the tyre pressure reading and a transmitter configured to transmit data indicative of a tyre pressure reading,

and wherein the mobile electronic device further comprises a receiver configured to receive the transmitted data indicative of the tyre pressure reading over a distance of up to 4 cm, and a locating feature configured to provide an indication to a

user of the mobile electronic device when the transmitter and receiver are located within 4 cm or less of the tyre pressure sensor module.

17. The tyre pressure gauge system of claim 16, wherein the tyre pressure sensor module further comprises an antenna configured to detect the short range telecommunications signal from the mobile electronic device over a distance of up to 4 cm, the antenna further configured to obtain, from the short range telecommunications signal through induction, electrical power sufficient to allow measurement of a pressure of a fluid within the pneumatic tyre and transmission of data indicative of the measured pressure to the mobile electronic device.

18. A tyre pressure sensor module for fitting to a valve of a pneumatic tyre, the tyre pressure sensor module comprising:

an antenna configured to detect a short range telecommunications signal from a mobile electronic device over a distance of up to 4 cm, the antenna further configured to obtain, from the short range telecommunications signal through induction, electrical power sufficient to allow measurement of a pressure of a fluid within the pneumatic tyre and transmission of data indicative of the measured pressure to the mobile electronic device;

a receiver configured to receive the short range telecommunications signal, which comprises instructions to obtain a pressure reading;

a pressure sensor configured to measure the pressure of the fluid within the pneumatic tyre; and

a transmitter configured to transmit data indicative of the measured pressure to the mobile electronic device using a short range telecommunications signal over a distance of up to 4 cm.

19. A tyre pressure sensor module according to claim 19, wherein the antenna is a loop antenna with a diameter of substantially 10 mm, a width of substantially 0.15 mm and substantially 14 turns.

20. A tyre pressure sensor module according to claim 19 or 20, comprising no sensors for monitoring a parameter of the tyre and/or wheel other than the pressure sensor and optionally specifically not including a temperature sensor and/or a motion sensor.

21. A tyre pressure sensor module according to any of claims 19 to 21, wherein the electronic components of the tyre pressure sensor module consist of the antenna, pressure sensor and transmitter.

22. A tyre pressure sensor module according to any of claims 18 to 22, having a weight of 4 grams or less.

23. A tyre pressure sensor unit according to any of claims 18 to 22, wherein the tyre pressure sensor module has a length of substantially 15 mm and a width of substantially 18 mm.

24. A tyre pressure sensor module according to any of claims 18 to 23, configured to interact with a mobile electronic device having a locating feature configured to provide an indication to a user of the mobile electronic device when a transmitter and/or receiver of the mobile electronic device are located within 4 cm or less of the tyre pressure sensor module.

25. A tyre pressure sensor module according to claim 24 wherein at least part of the tyre pressure sensor module is configured to be received within the locating feature.

26. A tyre pressure sensor module according to claim 25, wherein the tyre pressure sensor module comprises a keyed recess configured to be received within a correspondingly keyed portion of the locating feature.

27. A method for obtaining a tyre pressure reading from a tyre pressure sensor module for fitting to a valve of a pneumatic tyre, the method comprising:

detecting, by an antenna, a short range telecommunications signal from a mobile electronic device over a distance of up to 4 cm;

obtaining, by the antenna from the short range telecommunications signal through induction, electrical power sufficient to allow measurement of a pressure of a fluid within the pneumatic tyre and transmission of data indicative of the measured pressure to the mobile electronic device;

receiving, by a receiver, the short range telecommunications signal, which comprises instructions to obtain a pressure reading;

measuring, by a pressure sensor, the pressure of the fluid within the pneumatic tyre; and

transmitting, by a transmitter, data indicative of the measured pressure to the mobile electronic device using a short range telecommunications signal over a distance of up to 4 cm.

28. A tyre pressure gauge system comprising:

a mobile electronic device and a tyre pressure sensor module, the tyre pressure sensor module for fitting to a valve of a pneumatic tyre,

wherein the mobile electronic device comprises a transmitter configured to transmit a telecommunications signal comprising a request for a tyre pressure reading to the tyre pressure sensor module over a distance of up to 4 cm,

wherein the tyre pressure sensor module comprises an antenna configured to receive the telecommunications signal and obtain therefrom, through induction, electrical power sufficient to allow measurement of a pressure of a fluid within the pneumatic tyre and transmission of data indicative of the measured pressure to the mobile electronic device, the tyre pressure sensor module further comprising a pressure sensor configured to measure the tyre pressure and a transmitter configured to transmit data indicative of the measured pressure to the mobile electronic device,

and wherein the mobile electronic device further comprises a receiver configured to receive the transmitted data indicative of the tyre pressure reading over a distance of up to 4 cm.

29. A kit of parts comprising a tyre pressure sensor module according to any of claims 18 to 26 and a mobile electronic device according to any of claims 1 to 8.

30. A kit of parts comprising a tyre pressure sensor module according to any of claims 18 to 26 and a locating feature according to claim 13 or 14 and/or a mobile electronic device cover according to claim 15.

Application No:	GB1812029.5	**Examiner:**	Monica Wright
Claims searched:	1-12, 16, 17, 24-26 and 29	**Date of search:**	12 December 2018

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-12, 16, 17, 24-26, 29	US2007/193349 A1 (PETRUCELLI), see in particular figure 17 and paragraphs [0081] and [0091], noting programming unit 1700 with area 1740 for placing on valve-cap mounted gauge 2000 such that the two can communicate via NFC to indicate pressure readings to the user.
X	1-12, 16, 17, 24-26, 29	JP2015089716 A (TAIHEIYO KOGYO), see in particular figures and a translation of paragraphs [0023]-[0024] noting portable terminal 4 brought close to NFC tag 14 in sensor 10 triggering pressure data transfer and contactless power supply via NFC, the pressure then outputted on the display unit 4a.
X	1-12, 16, 17, 24-26, 29	GB2264360 A (WESTLAND AEROSPACE), see figures and abstract, noting portable device 20 with sleeve 26 for locating over sensor 10, power and pressure reading transmitted through oscillation of coils 27, 17 and displayed on device 20.
X	1-12, 16, 17, 24-26, 29	EP0301443 A1 (BRIDGESTONE), see in particular the figures, noting mobile tyre inspection device with ring 19 or cylinder 31 for placing oscillating coil 24, 30 over pressure sensor 9 to cause pressure to be sensed, transmitted by resonance and indicated on display 26.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

B60C

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI, Patent Fulltext

International Classification:

Subclass	Subgroup	Valid From
B60C	0023/04	01/01/2006