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NASA CASE NO. LAR 14160-1PRINT FIG. 1 P-9**NOTICE**

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Serial No.: 08/111,321
08/23/93

LaRC

(NASA-Case-LAR-14160-1) REMOTE
TIRE PRESSURE SENSING TECHNIQUE
Patent Application (NASA) 9 p

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AWARDS ABSTRACT

REMOTE TIRE PRESSURE SENSING TECHNIQUE

One of the most widely used and relatively simple devices for measuring tire air pressure is a calibrated manual tire pressure gage. The tire pressure gage fits over the stem of the tire and allows the user to read the pressure measurement directly. Oftentimes, however, reading the pressure of a tire directly becomes exceedingly impractical or impossible. This is true when the stem of the tire is inaccessible or when the tire is rotating.

A remote tire pressure sensing technique is provided which uses vibration frequency to determine tire pressure. A vibration frequency measuring device is attached to the external surface of a tire which is then struck with an object, causing the tire to vibrate. The frequency measuring device measures the vibrations and converts the vibrations into corresponding electrical impulses. The electrical impulses are then fed into the frequency analyzing system which uses the electrical impulses to determine the relative peaks of the vibration frequencies as detected by the frequency measuring device. The measured vibration frequency peaks are then compared to predetermined data describing the location of vibration frequency peaks for a given pressure, thereby determining the air pressure of the tire.

The novelty of this method is found in providing a method for remotely sensing tire pressure which may be automated.

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REMOTE TIRE PRESSURE SENSING TECHNIQUE

Origin of the Invention

5 The invention described herein was made by employees of the United States Government and may be used by or for the Government for governmental purposes without payment of any royalties thereon or therefor.

10 Technical Field of the Invention

 The invention relates to a tire air pressure sensing technique, and more particularly, to a mechanism for remotely sensing the pressure of an inflatable tire by measuring tire vibration frequency.

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Background of the Invention

 Since the invention of inflatable tires and their application to motor vehicles, many techniques have evolved for measuring pneumatic tire air pressure. One of the most widely used and relatively simple devices for measuring tire air pressure is a calibrated manual tire pressure gage. The tire pressure gage fits over the stem of the tire and allows the user to read the pressure measurement directly.

 Oftentimes, however, reading the pressure of a tire directly becomes exceedingly impractical or impossible. This is true when the stem of the tire is inaccessible or when the tire is rotating. The importance of developing a reliable means for remotely measuring tire air pressure has been heightened with the advent of the Space Age. In particular, the need for a remote tire air pressure sensing technique for use on stationary vehicles has become of great importance with the development of the

Space Shuttle. When the Space Shuttle is secured onto a launch pad, the stems of the tires of the Shuttle are inaccessible. Consequently, if the air pressure of a tire of the Shuttle is suspected of being outside tolerance limits, the Shuttle has to be dismantled from the launch pad and the tire pressure checked directly. Such a procedure can cause considerable delay of a scheduled launch.

Several methods for remotely sensing tire air pressure have been disclosed. For example, U.S. 4,742,712 (Kokubu) discloses a method for detecting low tire pressure. Kokubu locates a pressure switch on a tire wheel side. When the tire pressure falls below a predetermined value, the pressure switch is turned on, thereby causing a vibration to be produced. The vibration, detected by a vibration detecting device, indicates low tire pressure.

Another device, disclosed in U.S. 4,630,470 (Brooke et al), determines relative tire pressure using vibration frequency. The device disclosed requires each tire of a vehicle to transverse corrugated sections of a roadway, thereby causing each tire to vibrate. Any variation in vibration among tires is indicative of abnormal pressure. This device, because it requires a vehicle to transverse corrugated sections, is inapplicable for use on stationary vehicles. Furthermore, it only detects relative tire pressure, not absolute tire pressure.

Other methods for detecting low tire air pressure have been developed which involve attaching pressure sensors to the rotating part of each wheel which transmits electronic signals to a signal processing means. Generally, these methods measure tire pressure indirectly by measuring stress exerted on a wheel by various air pressures in a tire. These indirect pressure measurements tend to lack accuracy; for example, moving a Shuttle from a hanger to a launch pad can cause a change in wheel stress without any appreciable change in tire air pressure.

Consequently, particularly in view of such innovations as the Space

Shuttle, there is a need for a remote tire pressure detection means for use on a stationary vehicle.

5 An object of the present invention is to provide an apparatus and a method for remotely sensing and measuring air pressure of an inflatable object.

A further object of the present invention is use of pre-determined data correlating vibration frequency with air pressure, thereby allowing the use of vibration frequency to indirectly determine air pressure.

10 Summary of the Invention

To meet the foregoing and additional objects, this invention discloses a process and an apparatus for remotely sensing air pressure of inflatable objects. The new apparatus consists of a vibration inducing means, a vibration detecting means, an attachment means to secure the vibration detecting means to a surface of an inflatable object, and a vibration measuring means to measure the frequency peaks of the vibrations detected by the vibration detecting means.

15 An especially beneficial means for inducing vibration is a hammer. An accelerometer attached to the surface of an inflatable object with two-sided tape is an effective means of measuring vibrations induced by the vibration inducing means. Finally, a computer frequency analyzer is an effective means for converting the vibration data from the vibration detection means into data which can indicate pneumatic pressure of the inflatable object.

Description of the Preferred Embodiment

30 The present invention is a new apparatus and method for remotely sensing pneumatic pressure of an inflatable object.

Preferably, the apparatus consists of a hammer 14, an accelerometer 18 temporarily attached to the inflatable object 42, and a frequency analyzer 20 attached to the accelerometer 48 via a coaxial cable 22.

5 The use of the apparatus involves attaching the accelerometer 48 to the inflatable object 12 in such a way as to measure radial acceleration. For example, in the case of a tire 12, the best location to attach the accelerometer 18 is the tread area. Any suitable temporary attachment means, such as two-sided tape 16, can accomplish the attachment.

10 The accelerometer 18 then is connected electrically to a frequency analyzer which, on the basis of predetermined data, correlates vibration frequency peaks to tire pressure. The connection of the accelerometer 18 to the frequency analyzer 20 preferably is via a coaxial cable 22.

15 Practically any device can be used to strike the inflatable object and cause the object to vibrate. An especially preferred device for a vibration inducing means is a hammer 14 which cues the frequency analyzer 20 to begin taking data. The cue hammer 14 strikes the inflatable object 12 causing an electrical impulse to travel through an attached coaxial cable 24 connected to the frequency analyzer 20. The frequency analyzer 20 then receives vibration signals from the accelerometer 18.

20 In an alternative embodiment, the vibration inducing means could be permanently attached to a vehicle and, upon an appropriate signal, be caused to strike the inflatable object. Such a device would allow the vibration inducing means to be controlled remotely.

What is claimed is:

REMOTE TIRE PRESSURE SENSING TECHNIQUE

Abstract

5 A remote tire pressure sensing technique is provided which uses vibration frequency to determine tire pressure. A vibration frequency measuring device is attached to the external surface of a tire which is then struck with an object, causing the tire to vibrate. The frequency measuring device measures the vibrations and converts the vibrations into
10 corresponding electrical impulses. The electrical impulses are then fed into the frequency analyzing system which uses the electrical impulses to determine the relative peaks of the vibration frequencies as detected by the frequency measuring device. The measured vibration frequency peaks are then compared to predetermined data describing the location of vibration
15 frequency peaks for a given pressure, thereby determining the air pressure of the tire.

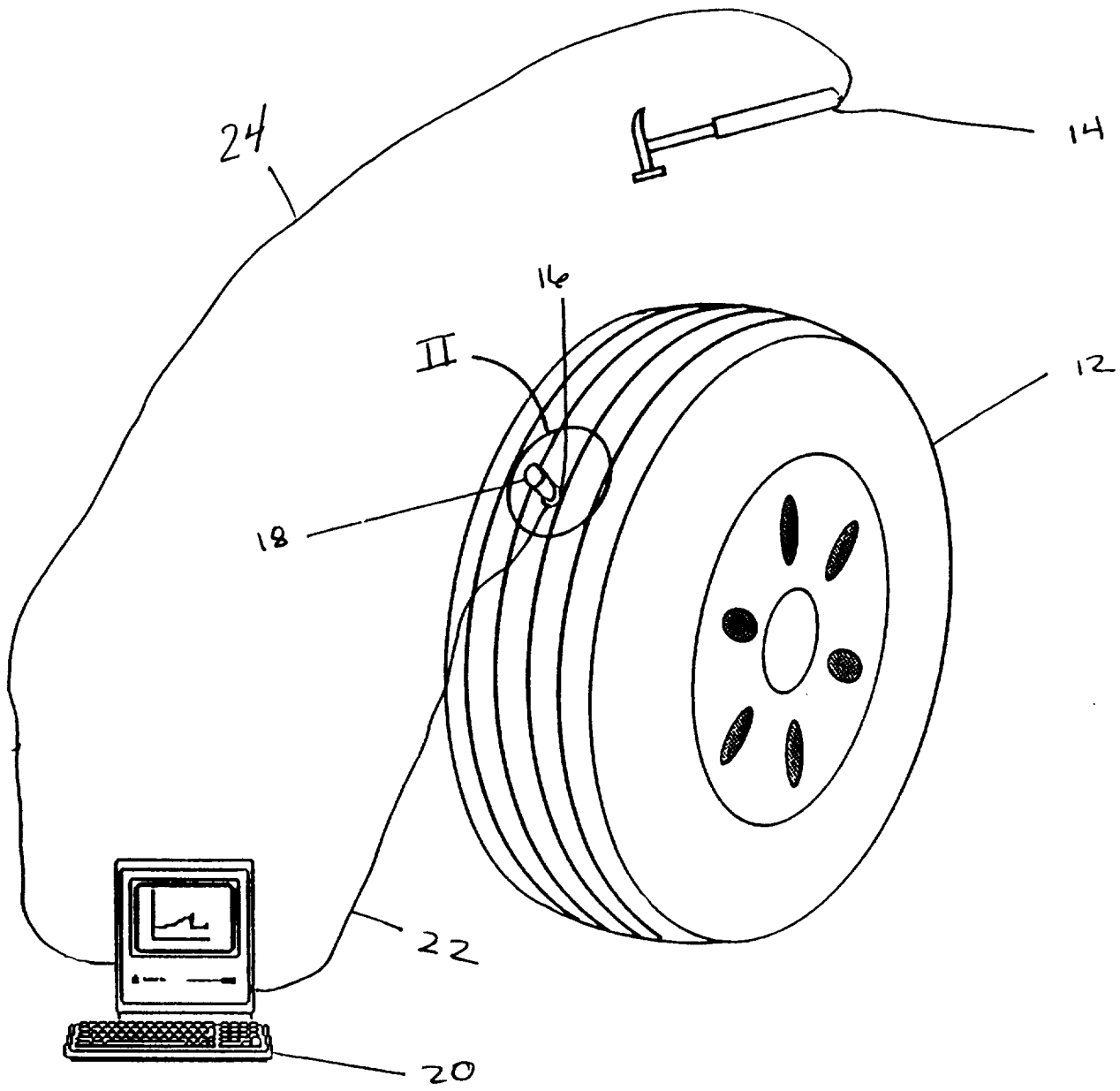


Fig. 1

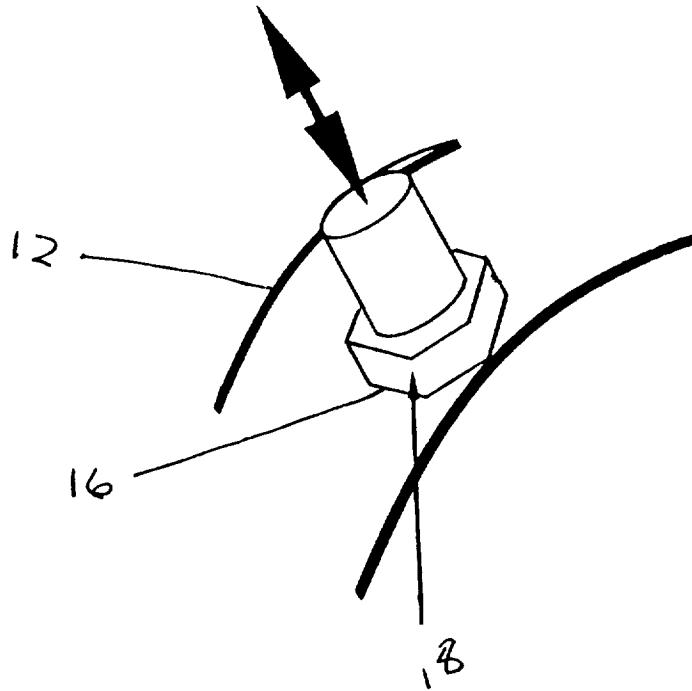


Fig. 2