

VEHICLE DIAGNOSTICS INTERFACE APPARATUS

TECHNICAL FIELD

- 5 The present invention relates to automotive testing equipment, and in particular to a vehicle diagnostics interface apparatus for interfacing with a vehicle diagnostics unit having one of more vehicle fault indicator lights.

BACKGROUND ART

- 10 In most modern vehicles there is a fault indicator light/s which has the ability to flash out codes if something is wrong with the vehicle.

Current diagnostic tools "plug in" to diagnostic connectors in the vehicle to extract the electrical signals ready for processing by a vehicle diagnostic information decoding device, referred to hereunder simply as a decoding device. A typical decoding device is as described in U.S. Patent No. 4,694,408.

- 15 Tools to extract the fault codes from vehicles, use many different types of connectors for each make and model of vehicle.

This makes these tools complicated to use and expensive. The user must use the correct connector for the particular vehicle under test. As a result these tools only support a small portion of the market.

- 20 Many vehicles do not have a diagnostic connector for the current tools to be connected to them and must be read manually by watching and counting the number of flashes of light on the fault indicator light/s within the vehicle.

- 25 One problem with this system is that it is prone to human error, by miss counting or miss interpretation. Another problem is that the light flashes on the vehicle fault indicator light can take up to a few minutes to read, without the person looking away. This prevents the person doing anything else. It also requires the person to have a fault code chart to be able to reference the code to a useful meaning. Fault code charts are generally found in books, which are often expensive, plus the person would require an extensive range of books to cover the present variety of vehicles on the market.

DISCLOSURE OF THE INVENTION

It is an object of the present invention to provide a vehicle diagnostics interface apparatus for interfacing with a vehicle diagnostics unit having one or more vehicle fault indicator lights, and a method of reading information from one or more vehicle fault indicator lights, which addresses the above problems or which at least provides the public with a useful choice.

According to one aspect of the present invention there is provided vehicle diagnostics interface apparatus for interfacing with a vehicle diagnostics unit having one or more vehicle fault indicator lights, the apparatus comprising; a light sensing device for receiving light from at least one of the vehicle fault indicator lights of the diagnostics unit and converting the received light into electrical signals, a signal processing device for converting the electrical signals into output electrical signals suitable for processing by a vehicle diagnostic information decoding device, and a connection device for connection to the decoding device.

According to another aspect of the present invention there is provided a vehicle diagnostics interface apparatus substantially as described above further comprising; a vehicle diagnostic information decoding device connected to the signal processing device by the connection device, for decoding the output electrical signals into vehicle diagnostic information, and an output device for outputting the vehicle diagnostic information.

According to yet another aspect of the present invention there is provided a vehicle diagnostics interface apparatus substantially as described above, wherein the light sensing device is provided separate from the signal processing device and is connected thereto by a cable, and the signal processing device is housed within the connection device.

According to yet another aspect of the present invention there is provided a vehicle diagnostics interface apparatus substantially as described above, wherein the connection device comprises a remote transmission device for transmitting the output electrical signals from the signal processing device to the vehicle diagnostic information decoding device.

Such a transmission device may involve a transmitter for producing radio frequency signals, which are received at a radio frequency receiver/s connected to a decoding

device/s. Alternatively this may involve a modem and telephone connection to a remote decoding device. With such an arrangement, an operator need not have a decoding device on site, the information to be decoded being sent to the remote decoding device by radio transmission, or telephone transmission.

- 5 According to yet another aspect of the invention there is provided a method of reading information from one or more vehicle fault indicator lights, involving detecting changes in properties such as light including the infra red and ultra violet spectrums from one or more fault indicator lights and converting these changes into electrical signals. converting the electrical signals into output electrical signals suitable for
10 processing by a vehicle diagnostic information decoding device, decoding the output electrical signals into vehicle diagnostic information, and outputting the vehicle diagnostic information.

The light sensing device may involve any suitable sensor for detecting changes in properties of light including heat from one or more fault indicator lights of the
15 vehicle, so as to be able to detect part or all of the information output from the vehicle fault indicator light/s. This may comprise a photo-sensitive medium which is sensitive to radiation over a sufficiently wide spectrum, for example covering from the infrared to the ultraviolet, to enable reading of the appropriate information. The information may be in the form of on and off pulses, or in the case of ultraviolet
20 radiation for example, in the form of frequency changes. Moreover the light may be sensed directly, or by reflection or refraction via an intermediate medium.

BRIEF DESCRIPTION OF THE DRAWINGS

Further aspects of the present invention will become apparent from the ensuing description which is given by way of example only and with reference to the
25 accompanying drawings in which:

FIG. 1 shows a first embodiment of a vehicle diagnostics interface apparatus according to the invention;

FIG. 2 shows a second embodiment of a vehicle diagnostics interface apparatus according to the invention;

FIG. 3 shows a third embodiment of a vehicle diagnostics interface apparatus according to the invention; and

FIG. 4 is a flow chart for explaining the operation of the vehicle diagnostics interface apparatus of the invention.

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BEST MODES FOR CARRYING OUT THE INVENTION

Referring to FIG. 1 it can be seen that the vehicle diagnostics interface apparatus according to the present invention generally indicated by arrow 1, for interfacing with a vehicle diagnostics unit having one or more vehicle fault indicator lights 2, comprises; a sensing device 3 for receiving light from the fault indicator light 2 and producing electrical signals, a signal processing section 4 (shown in the dotted box) for converting the electrical signals into an output voltage 6 (output electrical signals) suitable for processing by a decoding device, and a connection device 8, for connection to a decoding device 9 connected to an output device such as a display screen 10 or printer for outputting the vehicle diagnostic information.

15 In FIG. 1, the connection device 8 is shown separate to the signal processing section 4 and is connected thereto by a lead 7. However, with certain types of connection devices such as a standard computer printer connector the signal processing section 4 may be housed inside a casing of the connection device 8.

20 A positioning device 12 holds the sensing device 3 in the vicinity of the vehicle fault indicator light/s 2.

The sensing device 3 may be any suitable sensor that can detect any change in the fault indicator light 2 output, such as an optical electronic device to detect changes in any part of the light spectrum, or a mechanical or chemical sensor to detect changes in heat or light in any part of their respective spectrums.

25 The positioning device 12 may comprise a suction cup with a purposely bent piece of wire, or a hole through a "non-sealing" part of the suction cup to enable the sensing device 3 to be positioned close to the fault indicator light/s 2.

30 The positioning device 12 may also comprise a base which can be fixed into position and a swivel arrangement and a pivot arm/s attached to it (similar to a desk lamp), to allow the sensing device 3, to be positioned close to the fault indicator light/s 2.

Changes in properties such as heat and light 14 emitted from the vehicle fault indicator light/s 2 are converted to electrical signals through the medium of the sensing device 3, and then travel along electrical wires 16 to the signal processing section 4.

- 5 To prevent light or heat other than from the vehicle fault indicator light/s 2 from affecting the readings, a shielding material 18 can be fixed in position by attaching for example to the electrical wires 16, the positioning device 12, or the sensing device 3. The shielding material 18 may be any suitable material such as cloth, paper, cardboard, wood, plastic or metal. Moreover the sheilding material 18 may comprise a
10 plastic block which has been drilled out in one axis to accomdate the sensing device 3. The sheilding material 18 may also comprise a cloth designed to be placed for example, over the vehicle dashboard or vehicle computer LED. There may be several separate sheilding materials 18 used as necessary for the particular vehicle under test.

- The shielding material 18 may also be a separate non attached device which can be
15 used to prevent the influence of external light or heat.

The signal processing section 4 being one example of a suitable circuit, will now be described.

- Numeral 20 denotes a power supply to the circuit, which may comprise a computer parallel or serial port or an external battery and switch or an AC mains derived power
20 source. The external battery may be the vehicles own battery or a separate battery. When the vehicles own battery is used, connections such as a "cigarette lighter" adapter or alligator clips can be used to connect to the vehicle battery, and the vehicle ignition switch may be used as a switch.

- Changes in any property such as light 14 from the vehicle fault indicator light/s 2 are
25 transmitted to the sensing device 3, which is referenced to the circuit supply voltage by a resistor 22.

The sensing device 3 may be any suitable optical electronic sensor, for any part of the light spectrum that can detect any change in the fault indicator light 2 output.

- A capacitor 24, prevents a voltage present at a positive input of an operational
30 amplifier 26 from falling as quickly as a voltage at a negative input of the operational amplifier 26. A capacitor 27 serves as a filtering capacitor to minimize interference from noise.

The operational amplifier 26 is configured as a comparator by using resistors 28 and 29 to set the reference voltage for the negative input, and resistors 30, 31 and 32 to set the reference voltage for the positive input of the operational amplifier 26. The output voltage 6 from the operational amplifier 26 will swing to its maximum high and low voltage thresholds at approximately the same rate as the changes in a property such as light on the vehicle fault indicator light/s 2. In this embodiment, the output voltage 6 is connected via the connection device 8 to the decoding device 9 to determine the codes from the voltage fluctuations. It should be noted however that the novelty of this embodiment of the invention is found in the configuration of the sensing device 3, the signal processing section 4 and the connection device 8, and is not limited to the whole configuration including the decoding device 9 and the output device 10 as shown in FIG. 1.

The decoding device 9 may be any suitable device. This may involve a program based on the program used in U.S. Patent No. 4,694,408. A suitable decoding device may be a Personal Computer (PC) having a display screen 10, with wires between the connection device 8 and the parallel or serial port of the PC, and software written to decode the output voltage swings of the output voltage 6. The decoding device 9 may also be a customised microprocessor with pre-programmed memory, and a display screen 10, all encased in a suitable hand held casing.

A resistor 33 limits the current to an LED 34, which can be used to display the output voltage swings of the operational amplifier 26 visually to the user.

Suitable values for the various components mentioned above are given in Table 1 below:

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Table 1. Component specifications

Component	Description and value
3	Sensing device - Photo Darlington Transistor PT381
22	Resistor 100k Ω
24	Capacitor 1 μ F
26	Operational amplifier TLC27L2D
27	Filtering capacitor 0.1 μ F

28	Resistor 1M Ω
29	Resistor 1M Ω
30	Resistor 1M Ω
31	Resistor 820k Ω
32	Resistor 150k Ω
33	Resistor 1k Ω
34	LED

In the embodiment of FIG. 1, the sensing device 3 for receiving light from the fault indicator light 2 and producing an electrical output, is provided outside of the signal processing section 4 and connected by electrical wires 16 thereto.

FIG. 2 shows a second embodiment of the present invention generally indicated by arrow 35. In FIG. 2 components having a similar function to those of the embodiment of FIG. 1 are denoted by the same symbols and description thereof is omitted. With the second embodiment of FIG. 2, the sensing device 3 is housed inside (or close to) the signal processing section 4, and a light transmitting cable 36 such as a fibre optic cable employing glass, plastic or a nylon material, is used to transfer the light 14 from the fault indicator light/s 2 to the sensing device 3. An adapter 37 suitable for optical connection to the sensing device 3 is provided on a casing of the signal processing section 4. The positioning device 12 is adapted for positioning the light transmitting cable 36 near a fault indicator light/s 2 in the vehicle, and may be of a similar construction that used for positioning the sensing device 3 in the arrangement of FIG. 1. Similarly a shielding material 18 similar to that used in the arrangement of FIG. 1 may be employed.

The operation of the electronic circuit 4 in FIG. 2 is similar to that of the electronic circuit 4 in FIG. 1 and description thereof is omitted.

FIG. 3 shows a third embodiment of a vehicle diagnostics interface apparatus according to the present invention generally indicated by arrow 40. In FIG. 3, components having a similar function to those of the embodiment of FIG. 1 are denoted by the same symbols, and description thereof is omitted.

With this embodiment, the connection device 8 comprises a remote transmission device in the form of a radio transmitter 42 for transmitting the electrical output signals 6 to a radio receiver 44.

The frequency of the radio transmitter 42 can be any frequency allowed in the particular location of use.

Alternatively instead of a radio transmitter 42 for the connection device 8, other suitable transmission means may be employed to transfer the output signals 6 of the electronic circuit 4, such as using an optical coupling covering any suitable frequency spectrum including the infra-red spectrum.

The operation of the electronic circuit 4 in FIG. 3 is similar to that of the electronic circuit 4 in FIG. 1 and description thereof is omitted. The output of the electronic circuit 4 is connected by electrical wires 7 to the radio transmitter 42 of the connection device 8. The radio receiver 44 detects radio waves 43 from the radio transmitter 42. The output of the radio receiver 44 is connected by electrical wires 46 to a decoding device 9 similar to that of the first embodiment of FIG. 1.

Decoding of the output voltage swings of output voltage 6 from the respective diagnostics interface apparatuses 1, 35 and 40 of the above described embodiments involves comparing the output pulses with prestored codes for various vehicles. Typical methods for achieving this are disclosed in US. Patent No. 4,694,408.

An example of one of many trouble code charts used in a program stored in the decoding device 9 is shown in Table 2.

Table 2. Diagnostic Codes

Code No.	Location Problem
02	Air flow meter
03	Water thermo sensor
04	Intake air temperature sensor
05	Oxygen sensor
06	Throttle sensor
07	Boost sensor
09	Atmospheric pressure sensor
12	Coil with igniter
15	Intake air temperature sensor

Operation of the respective diagnostics interface apparatuses 1, 35 and 40 of the first second and third embodiments will now be described with reference to the flow chart

of FIG. 4, which shows the main steps of a typical computer program used for decoding vehicle diagnostic information.

In preparation for reading information from one or more vehicle fault indicator lights 2, the sensing device 3 is positioned in the vicinity of the vehicle fault indicator light/s 2 using the positioning device 12, the area shielded by the shielding material 18 to prevent external light or heat other than from the vehicle fault indicator light/s 2 from affecting the readings, and the electrical wires 16 (or cable 36) connected to the signal processing section 4 (or adapter 37). Moreover, the connector 8 of the signal processing section 4 is connected to an input port of the decoding device 9, such as a computer, using for example the printer port connector. A computer program for executing the decoding, is loaded beforehand into computer memory from a floppy disk or CD ROM or the like.

Then in step 1 (denoted by S1 in FIG. 4, with subsequent steps similarly denoted), the computer is switched on to start the program. Switching on the computer also provides power to the signal processing section 4, thereby starting the signal processing to read information from the vehicle fault indicator light 2. That is, changes in properties such as heat or light from the fault indicator light 2 are converted into electrical signals through the medium of the sensing device 3 and these electrical signals then converted into output electrical signals by the signal processing section 4 suitable for processing by the decoding device 9.

After this, in step 2, information such as the vehicle make, type of connector, or model is selected from a display screen 10 of the decoding device 9 (computer).

Then in step 3, information on the selected vehicle is displayed on the screen. Such information may include details of any connections to be made to the vehicle diagnostics unit, such as shorting between pins on the diagnostics unit connector to make the indicator lights function in diagnostic mode. Moreover this may include instructions for preparing the vehicle, such as turning on the key. Furthermore, since with the present embodiments a computer display screen can be used for the output device 10, a vast amount of information can be clearly displayed. Hence books containing fault chart codes and operating instructions and the like can be obviated, this information being stored in the computer 9.

Subsequently in step 4, once set up has been completed, the program reads the output electrical signals 6 from the signal processing section 4 which are input to the input port of the computer 9.

Decoding of the electrical signals into vehicle information is then commenced.

In step 5, if after a specified time there is no data at the port, then in step 6 a time out message is output and the program is terminated.

5 In step 5, if there is data at the port, control proceeds to step 7 where the timing of the data at the port, that is for example the duration and sequence of pulse information, is decoded according to a prestored algorithm for the particular vehicle.

Then in step 8, a code number is generated for the data, and in step 9 the code number is compared with prestored code numbers. For example this involves using a prestored table such as shown in Table 2.

10 After this, in step 10 the corresponding code such as shown in Table 2, is output for example to a computer screen, or printed out. If no faults are present a no fault code message is printed.

Control then proceeds to step 11 where it is judged if there are any more fault codes. If so, control returns to step 4 to repeat the process. If not, a last fault code message is
15 output in step 12 and the program terminated.

With the embodiments, the sensing device 3 may be of any suitable type of sensor such as a mechanical, electrical, chemical, optical, or any combination of these sensor types.

20 The term light used herein refers to any part of the light spectrum including the infra red and ultra violet spectrums.

The term vehicle used herein refers to any type of vehicle that runs on any type of fuel, such as cars, vans, utilities, trucks, boats, planes, trains, motorcycles, tractors, heavy industrial earth moving machinery, fork lifts and recreational vehicles.

25 The term fault indicator light used herein is often called a "Check Engine Light (CEL)", or a "Malfunction Indicator Light" (MIL) by automotive trades people. The term fault indicator light used herein may also refer to LEDS which are used by many manufacturers to visually convey fault codes.

30 Further the invention is not restricted to the examples and the circuit described but may use combinations of these examples and/or variations of these examples and the circuit to achieve similar results.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope of the invention as defined by the appended claims.



What I claim is:

1. A vehicle diagnostics interface apparatus for interfacing with a vehicle diagnostics unit having one of more vehicle fault indicator lights, said apparatus comprising;
 - 5 light sensing means for receiving light from at least one of said vehicle fault indicator lights of said diagnostics unit and converting the received light into electrical signals,
 - signal processing means for converting the electrical signals into output electrical signals suitable for processing by vehicle diagnostic information decoding means, and
 - connection means for connection to the decoding means.
- 10 2. A vehicle diagnostics interface apparatus according to claim 1, further comprising;
 - vehicle diagnostic information decoding means connected to said signal processing means by said connection means, for decoding said output electrical signals into vehicle diagnostic information, and
 - 15 output means for outputting said vehicle diagnostic information.
3. A vehicle diagnostics interface apparatus according to claim 2, wherein said decoding means comprises a pre-programmed microprocessor.
4. A vehicle diagnostics interface apparatus according to claim 2, wherein said decoding means comprises a computer programmed with diagnostic software.
- 20 5. A vehicle diagnostics interface apparatus according to any one of claim 1 through claim 4, further comprising light transmission means for transmitting light from at least one of said vehicle fault indicator lights of said diagnostics unit, to said light sensing means.
6. A vehicle diagnostics interface apparatus according to claim 5, wherein said
- 25 light transmission means comprises a fibre optics device.

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7. A vehicle diagnostics interface apparatus according to any one of claim 1 through claim 4, wherein said light sensing means is provided separate from said signal processing means and is connected thereto by a cable, and said signal processing means is housed within said connection means.

5 8. A vehicle diagnostics interface apparatus according to any one of claim 1 through claim 7, wherein said connection means comprises remote transmission means for transmitting said output electrical signals from said signal processing means to the vehicle diagnostic information decoding means.

9. A vehicle diagnostics interface apparatus according to claim 8, wherein said
10 remote transmission means comprises wireless signal transmission means.

10. A vehicle diagnostics interface apparatus according to claim 8, wherein said remote transmission means comprises an optically coupled link.

11. A vehicle diagnostics interface apparatus according to any one of claim 1
15 through claim 10 further comprising sheilding means surrounding said light sensing means.

12. A method of reading information from one or more vehicle fault indicator lights, involving detecting changes in properties such as heat or light from said one or more fault indicator lights and converting these changes into electrical signals, converting the electrical signals into output electrical signals suitable for processing by
20 vehicle diagnostic information decoding means, decoding the output electrical signals into vehicle diagnostic information, and outputting the vehicle diagnostic information.

13. A vehicle diagnostics interface apparatus substantially as described herein with reference to the accompanying drawings.

14. A method of reading information from one or more vehicle fault indicator
25 lights substantially as described herein with reference to the accompanying drawings.



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