Middle East Journal of Applied Science & Technology
Vol.5, Iss.4, Pages 18-23, Oct-Dec 2022

Design and Implementation of Engine Oil Pressure Switch Indicator

Gautham Prathap[1*] & Mr. Mohammad Sameer Baig[2]

[1]*Student, Level-5 Higher Diploma in Automobile Engineering, ASTI Academy, Dubai, UAE.*
[2]*Academic Coordinator In-charge, ASTI Academy, Dubai, UAE.*
*Corresponding Author (Gautham Prathap) - a30620051@astiacademy.ac.ae**

DOI: https://doi.org/10.46431/MEJAST.2022.5404

Article Received: 17 November 2022 *Article Accepted: 12 December 2022* *Article Published: 16 December 2022*

ABSTRACT

An incorrect engine oil pressure gauge and an incorrect engine oil pressure sensor will provide false indications of low engine oil pressure or high engine oil pressure. Standard oil pressure sensors work by displaying a warning signal when the oil pressure falls outside of the set range. Two important components to the oil pressure sensor include the spring-loaded switch and a diaphragm. The spring-loaded switch is connected to the diaphragm that is exposed to the oil pressure. Pressure switch indicator can be diagnosed using DMM and inspect visually on the engine block. Good type of switch helps the ECU of Automobile engine to understand the oil pressure and actuate the moving parts or actuators accordingly.

Keywords: *Oil pressure; Oil indicator; Dashboard warning light; Mechanical gauge.*

1. INTRODUCTION

In modern cars, trucks and buses, oil pressure sensors monitor the oil pressure in the motor oil and transmission oil circuit. The measured pressures are recorded in real time in the control unit of the vehicle, evaluated and used to optimise engine parameters. The result is fuel-saving, low emission and more efficient engine operation.

Figure 1. Diaphragm pressure switches with positive lead connector

The purpose of the internal combustion engine lubrication system is to provide optimal conditions for the oil film formation in all friction couples, such as a piston-cylinder, piston rings-cylinder, main bearings, etc. The oil film is designed to minimize the wear of the elements while ensuring the smallest possible friction losses. Lack of continuity of the oil film, and thus boundary or mixed friction conditions, obviously have a negative effect on the friction losses. However, the continuous oil film, depending on the conditions of its formation, may be characterized by different values of friction losses. One of the factors that may affect the conditions of formation of the oil film is the value of oil pressure in the lubrication system.

Oil pressure switches are typically used as an actuator which directly activates the oil warning light in driver dashboard when the oil pressure in the engine will fall below the preset critical level or brings a signal to the ECU (engine control unit), so to be warned about low pressure of engine oil and prevent damage to the engine. Depending on the engine construction, the oil pressure switch usually can be found in one of the most common

locations: in the cylinder block of the engine or in the oil filter housing as well as at some engine types can be found in the engine head.

The pressure switch is mounted onto the side of an engine block and wired to an oil gallery. As the force of the oil pressure starts to build on the diaphragm, this force overcomes the switch spring pressure, which then pulls apart the electrical contacts to turn on the warning light. If the oil pressure falls below the set limit, the diaphragm releases pressure off the springs to close the switch contacts that would normally result in the display of a warning sign to the driver

2. WORKING PRINCIPLE

The switch is operated by a self-elastic diaphragm or movable diaphragm with fitted hairspring, whose position is determined by the pressure applied to it. The required critical pressure for moving up the diaphragm and activating (switching ON or switching OFF) the switch contacts is determined by the oil pressure of the engine. This critical value of oil pressure is individual for every engine type and can vary. Usual value is between 0.25 and 0.75 bar (3.5 – 11 psi).

If the oil pressure falls below this critical value, the switch directly activates the oil warning light in driver dashboard or in some engine management systems the switch returns a signal to the ECU, so to be warned about low pressure of engine oil and prevent damage to the engine. The switch contacts can be either normally open or normally closed.

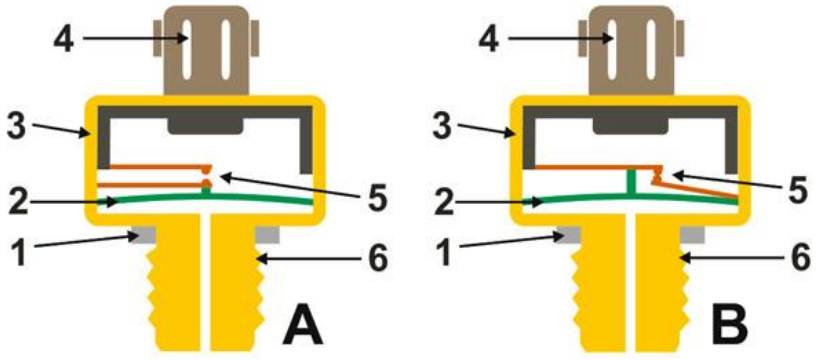

Figure 2. Cut-section view of pressure switch and its parts: 1. Washer for sealing, 2. Diaphragm, 3. Switch housing, 4. Connector, 5. Switch contacts (A normally open, B normally closed), 6. Thread for tightness

The figure 2, under (A) shows illustrative drawing of one type of oil pressure switch with normally open contacts, and under (B) one type of switch with normally closed contacts. The operation of these types of switches is fundamentally similar in all instances, although the type, size and construction can vary upon the manufacturer application or requirement of a used system.

At the switches with normally open contacts, when the engine oil pressure reaches the preset critical level, produces movement of the diaphragm and activates the contacts of the switch, so the contacts are connected together, i.e. the switch is closed (switched ON). The switches with normally closed contacts works opposite, when the engine oil pressure reaches the preset critical level, deactivates the already connected contacts of the switch, so now the contacts are disconnected, i.e. the switch is open (switched OFF).

2.1. Pressure Gauge Sensor

A low oil pressure warning light is one method used to alert the driver to fluctuations in the oil pressure levels. An alternative system for this purpose is known as a mechanical type pressure gauge component. There is a Bourdon tube inside a pressure gauge that tends to straighten out upon receiving pressure via a copper tubular component. The Bourdon tube is attached to a needle on the gauge, which moves as the tube begins to take a different shape. Movement of the needle across a scale on the gauge is used as a reference point to indicate changes in oil pressure inside the engine to a vehicle.

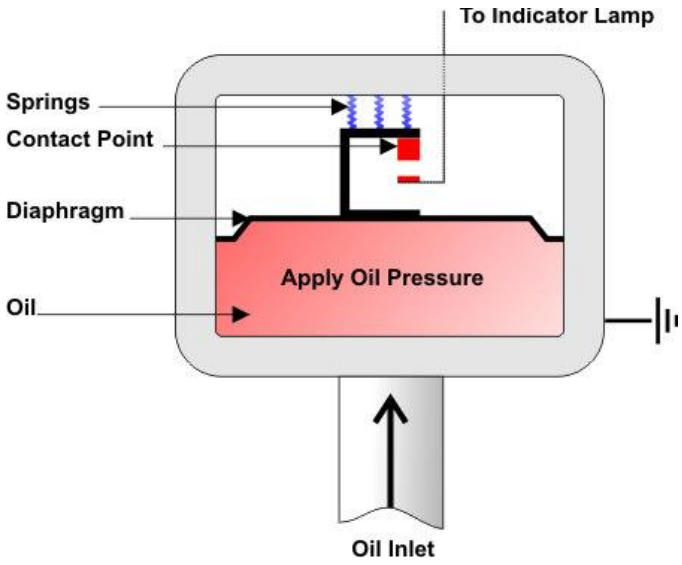

Figure 3. Switch positive to indicator lamp and Negative grounded on engine body

3. RESULTS

3.1. Diagnostics and Testing Procedures

3.1.1. Switch with Normally Open Contacts

(1) Check that there is an open circuit between the contacts when the engine is not running.

(2) Check that there is a short circuit (continuity) between the contacts when the engine is running.

(3) Check the continuity and condition of the pins, terminals and wires.

3.1.2. Switch with Normally Closed Contacts

(1) Check that there is a short circuit (continuity) between the contacts when the engine is not running.

(2) Check that there is an open circuit between the contacts when the engine is running.

(3) Check the continuity and condition of the pins, terminals and wires.

3.2. Testing Procedures with Multimeter

(1) Unplug the connector from oil pressure switch and check the connectivity between the contacts. If the switch is with two pins, the check should be between the pins. In case when the switch is with only one pin, then the check should be between the pin and mass (negative pole).

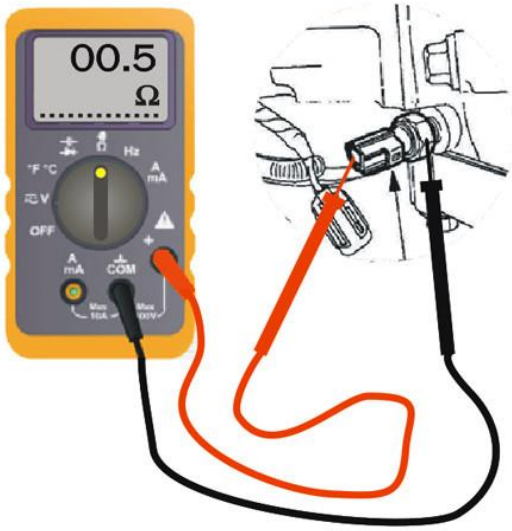

Figure 4. Multimeter probe connections for testing switch

(2) When the engine is not running, the read value of the electrical resistance from a multimeter in case of switch with normally open contacts should be infinite (contacts are disconnected – switched OFF), and in case of switch with normally closed contacts should be zero (contacts are connected – switched ON).

(3) When the engine is running, the read value of the electrical resistance from a multimeter in case of switch with normally open contacts should be zero (contacts are connected – switched ON), and in case of switch with normally closed contacts should be infinite (contacts are disconnected – switched OFF).

4. CONCLUSION

In conclusion, an incorrect engine oil pressure gauge and an incorrect engine oil pressure sensor will provide false indications of low engine oil pressure or high engine oil pressure which will breakdown the whole engine due to poor lubrication in the moving parts. Standard oil pressure sensors work by displaying a warning signal when the oil pressure falls outside of the set range. As mentioned in the results this can be diagnosed with proper automotive tools and specific procedures. When the engine is not running, the read value of the electrical resistance from a multimeter in case of switch with normally open contacts should be infinite (contacts are disconnected – switched OFF), and in case of switch with normally closed contacts should be zero (contacts are connected – switched ON). Similarly, when the engine is running, the read value of the electrical resistance from a multimeter in case of switch with normally open contacts should be zero (contacts are connected – switched ON), and in case of switch with normally closed contacts should be infinite (contacts are disconnected – switched OFF). Thus helps the ECU of Automobile engine to understand the oil pressure and actuate the moving parts accordingly. In future modification this oil pressure should also be controlled with engine speed with further enhancement of key programming of ECU.

Declarations

Source of Funding

This research work did not receive any grant from funding agencies in the public or not-for-profit sectors.

Competing Interests Statement

The authors declare no competing financial, professional, or personal interests.

Consent for publication

The authors declare that they consented to the publication of this research work.

Authors' Contributions

All authors equally contributed to research and paper drafting.

References

[1] Jim Halderman, (2022). Automotive Technology: Principles, Diagnosis, and Service, 6th edition Published by Pearson (September 21st 2021).

[2] Roman Zinko, Oleh Polishchuk, (2021). Vehicle diagnostic system of the car engine MATEC Web of Conferences 351, 01014 20th International Conference Diagnostics of Machines and Vehicles.

[3] Martin W Stockel, Martin T Stockel, James E Duffy, Chris Johanson, (2021). Auto Fundamentals, Goodheart-Wilcox Publisher; 13th Twelfth Edition, Revised Workbook Ed.

[4] A Self-Diagnostic Method for Automobile Faults in Multiple Working Conditions Based on SOM-BPNN Published online - 2021 Nov 3. DOI: 10.1155/2021/6801161.

[5] James Halderman, (2018). Automotive Engines : Theory and Servicing, Pearson Education (US), 19th ed ISBN: 13 9780134654003.

[6] Niu H. (2021). Fault diagnosis of automobile engine based on improved BP neural network. Modular Machine Tool and Automatic Processing Technology.

[7] William B. Ribbens and Normassssn P. Mansour, (2003). Understanding automotive electronics and electrical (6th ed.). Newnes. ISBN: 9780750675994.

[8] Hamrock, Bernard J. (2004). Fundamentals of fluid film lubrication. Steven R. Schmid, Bo O. Jacobson (2nd ed.). New York: Marcel Dekker. ISBN: 0-8247-5120-5. OCLC 55739786.

[9] Bela G. Liptak (Ed), (2003). Instrument Engineers' Handbook, Fourth Edition CRC Press, ISBN: 1420064029, Pages 790-793.

[10] Taskos Nikolaos, (2020). Pressure Sensing 101 – Absolute, Gauge, Differential & Sealed pressure. ES Systems, Retrieved 2020-09-16.

[11] Stephen A. Dyer, (2004). Wiley Survey of Instrumentation and Measurement, John Wiley & Sons, ISBN: 0471221651.

[12] Safety requirements for electrical equipment for measurement, control and laboratory. General requirements. 1993. ISBN: 0-580-22433-3.

[13] Ribbens, W.B., Mansour, N.P. (2003). Understanding Automotive Electronics. USA, Massachusetts: Elsevier Science.

[14] Schwaller, A.E. (2005). Total Automotive Technology. USA, New York: Thomson and Delmar Learning.

[15] Hillier, V., Coombes, P. (2004). Fundamentals of Motor Vehicle Technology. UK, Cheltenham: Nelson Thornes Ltd.

[16] Knowles, D., Erjavec, J. (2005). Tech One: Basic Automotive Service and Maintenance. USA, New York: Thomson Delmar Learning.

[17] Inside a Car oil https://www.azosensors.com/article.aspx?ArticleID=44.

Appendix-A

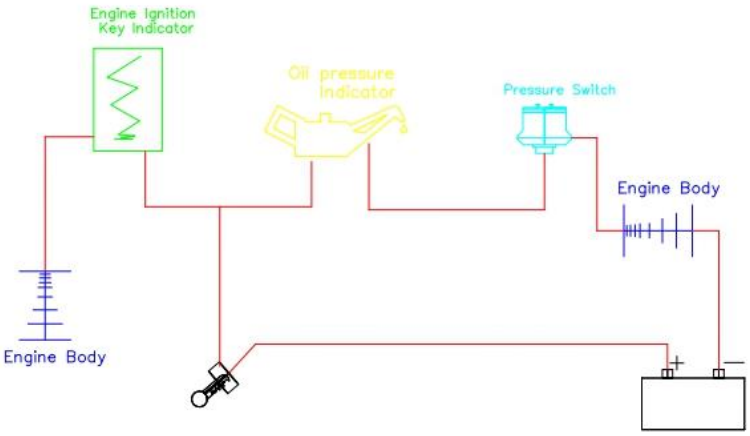

Figure 5. Engine oil pressure switch design implementation wiring diagram using AutoCAD