NIET Journal of Engineering & Technology (NIETJET)

Volume 13, Issue Winter / Summer 2025 ISSN: 2229-5828 (Print)

The Essential Role of the Lever Combination Switch in a Vehicle's Electrical System

Lovely Mishra[1], Sanjay Kumar[2], Anant Prakash Agrawal[3], Ankur Yadav[4], Anusha Dubey[5]

[1, 2, 3, 4] Department of Mechanical Engineering, Noida Institute of Engineering and Technology, India
[5]Department of Physics, Noida Institute of Engineering and Technology, India

Abstract: *This paper reviews lever combination switches, also known as turn signal switches, used in vehicles. The article discusses the role of the lever combination switch in a vehicle's electrical system, the typical components of a lever combination switch, and the ways in which the lever combination switch is used to control the various electrical functions of a car. Modern vehicles often integrate the lever combination switch with other electrical components, such as the wiper and washer controls, to allow the driver to access and control all of the car's electrical functions from a single location on the steering column. This helps to ensure the safe and efficient operation of the vehicle's electrical system. Recent advances in the design of lever combination switches have focused on addressing the issue of connectivity failure due to wear and tear on the electrical contacts. To overcome this problem, sensors, such as Hall Effect sensors, have been incorporated into the design of the lever combination switch. These sensors detect the position of the lever and send a corresponding electrical signal to the car's electrical system, allowing the relevant functions to be activated accurately and reliably.*

Keywords - Automotive Switch, Contact-less Switch, Copper contacts, Hall effect sensor, Lever Combination Switch, Lever Electrical contacts, Lever position sensor, Magnetic field sensor, Turn signal switch, Vehicle electrical system, Vehicle lighting, Vehicle signaling, Wiper & Washer switch.

1. INTRODUCTION

A lever combination switch, also known as a turn signal switch, is a mechanism used in vehicles to control the various electrical functions of the car. The switch typically consists of a lever operated by the driver and a series of electrical contacts that activate different functions when the lever is moved in different positions [1].

The lever combination switch is typically located near the driver's seat on the steering column. It is used to control the car's turn signals, headlights, and other electrical functions. It is an essential component of a vehicle's electrical system, as it allows the driver to safely and efficiently control the car's lighting and signaling systems. The lever combination switch works by using a series of electrical contacts activated when the lever is moved. When the lever is moved to the left, for example, it activates the left turn signal and deactivates the right turn signal. Similarly, when the lever is moved to the right, it activates the right turn signal and deactivates the left turn signal.

The lever combination switch also typically has additional positions for activating the vehicle's headlights, high beams, and other electrical functions. These positions are typically labelled on the switch, making it easy for the driver to locate and operate the various functions.

In modern vehicles, the lever combination switch is often integrated with other electrical components, such as the wiper, washer controls, and cruise control system. This allows the driver to easily access and control the car's electrical functions from a single location on the steering column.

Overall, the lever combination switch is an essential component of a vehicle's electrical system and is an integral part of which ensures the safe and efficient operation of the car.

2. OVERVIEW OF LEVER COMBINATION SWITCH

A lever combination switch, also known as a turn signal switch, is a mechanism used in vehicles to control the various electrical functions of the car. The switch typically consists of several essential parts, including:

**Publisher: Noida Institute of Engineering & Technology,
19, Knowledge Park-II, Institutional Area, Greater Noida (UP), India.**

i) Lever: This is the main component of the lever combination switch and is operated by the driver to activate different functions.
ii) Electrical contacts: These are located inside the switch and are activated when the lever is moved. The contacts then send electrical signals to the relevant parts of the car's electrical system, such as the headlights or turn signals [2].
iii) Wiring: The lever combination switch is connected to the car's electrical system by a series of wires, which carry the electrical signals from the switch to the relevant parts of the system.
iv) Mounting bracket: The lever combination switch is typically mounted on the steering column, using a bracket to hold it in place.
v) Labels: The lever combination switch is often labeled with the different functions it controls, making it easy for the driver to locate and operate the various functions [1].

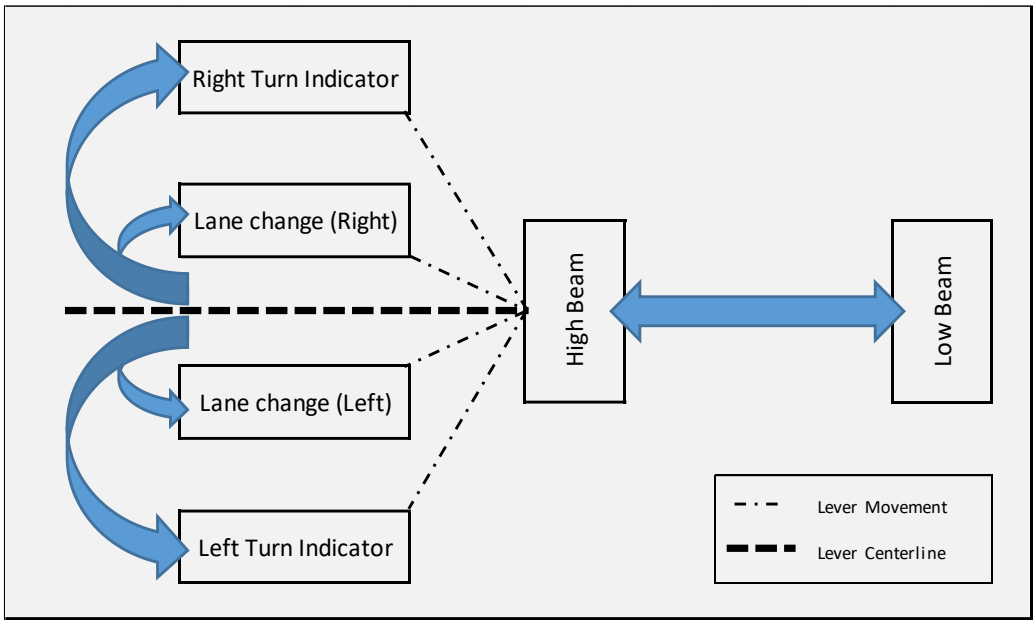

Fig. 1 Light Lever Position & Function

2.1 The function of the Lever Combination Switch

In terms of its function, the lever combination switch is used to control the vehicle's turn signals, headlights, refer Fig, 1 and other electrical functions. The lever combination switch is connected to the car's electrical system by a series of wires. When the driver moves the lever, it activates the relevant electrical contacts, which in turn activates the desired function. In this way, the lever combination switch allows the driver to safely and efficiently control the car's electrical functions and is an essential part of the vehicle's electrical system [3], [4].

2.2 Component manufacturing method and material

In the case of a lever combination switch, the plastic pour process, also known as plastic injection molding, is used to create the housing or casing for the switch. The housing is typically made of durable plastic material, such as polycarbonate or ABS, which can withstand wear and tear due to everyday use in a vehicle. However, the metal pour process is used to create the electrical contacts that are activated when the lever is moved. The contacts are made of a conductive metal, such as copper or brass, which allows them to carry electrical signals from the lever to the car's electrical system [4].

The use of plastic pouring to create the housing for a lever combination switch offers several advantages, including the ability to create complex shapes and the ability to mass-produce the housing quickly and

Publisher: Noida Institute of Engineering & Technology,
19, Knowledge Park-II, Institutional Area, Greater Noida (UP), India.

inexpensively. This helps to make the lever combination switch a reliable and cost-effective component of the vehicle's electrical system.

2.3 What are the potential causes of the failure of a Lever Combination Switch?

The potential cause of failure in a lamp-control switch in a combined switch (such as a lever combination switch) is the accumulation of dirt and debris on the electrical contacts. Over time, dust and other particles can build up on the contacts, reducing their effectiveness and potentially causing problems with the car's electrical system [5].

Another potential cause of failure is mechanical wear and tear on the switch components. The lever, electrical contacts, and other components of the switch are subjected to repeated movement and stress and may become worn or damaged over time. This can cause the switch to malfunction, potentially leading to issues with the car's electrical system.

The disadvantage of copper contacts is that copper is a relatively poor conductor of electricity at high temperatures. If the lever combination switch is subjected to high temperatures, such as when the car is parked in direct sunlight, the contact points may become less effective at conducting electricity. This can cause the switch to malfunction, potentially leading to issues with the car's electrical system.

While copper-based contact mechanisms have some advantages in a lever combination switch, their susceptibility to wear and tear, reduced effectiveness at high temperatures, and higher manufacturing costs can be potential disadvantages [6].

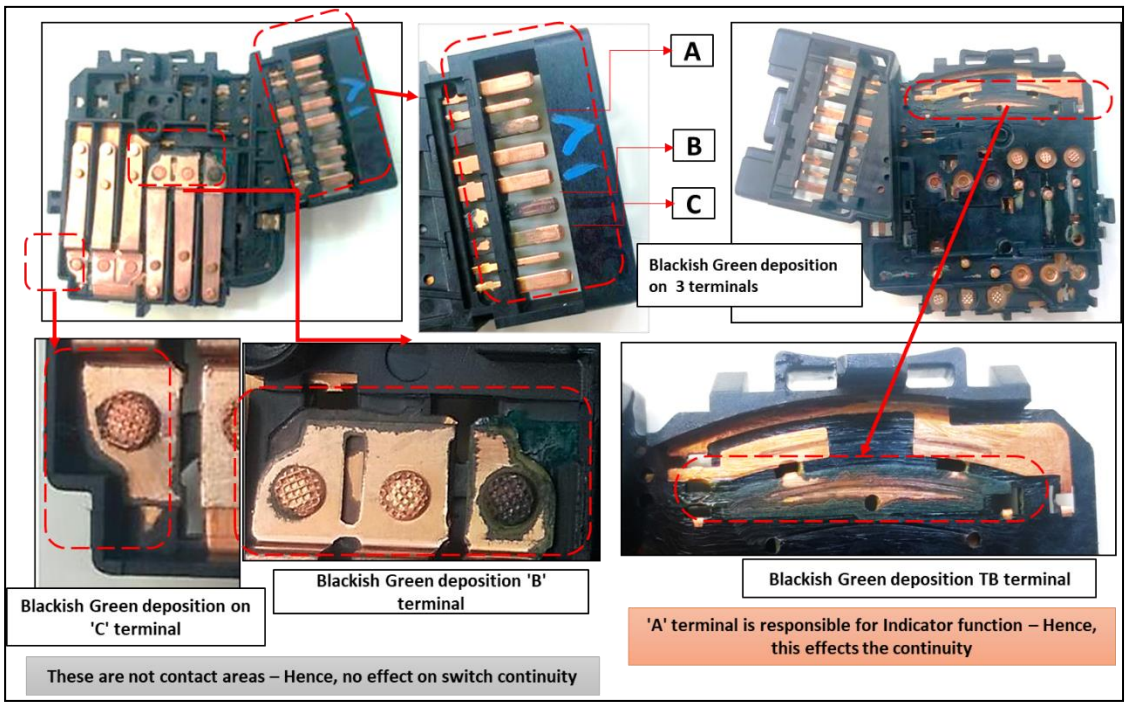

Fig. 2 Corrosion Observed in Lever Combination Switch

2.4 What are the advancement done in Lever Combination Switches to overcome the failures?

To overcome the failures of the existing mechanism of the lever combination switch, different approaches were taken to improve the switch connectivity issues.

For contact wear and tear, different types of greases were incorporated into the design. The grease becomes a barrier between the contacts and controls, arcing the switch but would conduct electricity to complete the circuit. The grease would also help in controlling the wear and tear of contacts due to friction. Nevertheless, the grease did not solve the problem in the long run production and switch working as the grease

Publisher: Noida Institute of Engineering & Technology,
19, Knowledge Park-II, Institutional Area, Greater Noida (UP), India.

would separate its oil at a high temperature leaving behind the solid residue, which is a bit sticky in nature and hinder the motion of lever contacts on the electrical board of lever combination switch. So, different types of sensors, like Hall Effect sensors, were also used to help with this contact connectivity issue.

To prevent dust and debris on the electrical contact tracks, the switches are assembled in a clean room where the temperature and the PPM of the air are maintained.

2.5 Contact-less Lever Combination Switches

Contact-less lever combination switches are a type of lever combination switch that does not use physical or electrical contacts to activate the various functions of a vehicle. Instead, these switches use sensors, such as Hall Effect sensors, to detect the position of the lever and send a corresponding electrical signal to the car's electrical system. This eliminates the potential for wear and tear on the electrical contacts, improving the reliability and durability of the lever combination switch. In addition, contactless lever combination switches can be more accurate and responsive, allowing for precise control of the car's electrical functions. These switches are becoming increasingly common in modern vehicles, as they offer improved performance and durability compared to traditional lever combination switches [6], [7].

2.6 Magnetic Field Sensors in Automotive Lever Combination Switch

A magnetic position sensor is a device that uses a magnet to detect the position of an object. In a lever combination switch, the magnetic position sensor is used to detect the position of the lever and to send a corresponding electrical signal to the car's electrical system. The magnetic position sensor typically consists 33of a magnet and a Hall Effect sensor. The magnet is attached to the lever, and the Hall Effect sensor is located near the magnet. When the lever is moved, the magnet moves with it, causing a change in the magnetic field around the Hall Effect sensor [7].

The Hall Effect sensor detects this change in the magnetic field and sends a corresponding electrical signal to the car's electrical system. The electrical system then uses this signal to activate the relevant functions, such as the turn signals or headlights. In this way, the magnetic position sensor allows the lever combination switch to accurately detect the position of the lever and activate the appropriate functions in response. This helps to ensure the safe and efficient operation of the vehicle's electrical system. Magnetic field sensors are devices used to detect a magnetic field's presence and strength. In automotive applications, these sensors are often used in conjunction with a magnet to detect the position of a moving object, such as the lever in a lever combination switch.

Research on magnetic field sensors for automotive applications typically focuses on improving the accuracy and reliability of these sensors, as well as exploring new applications for the technology. For example, research may involve developing new sensor designs that are more sensitive to changes in the magnetic field or investigating the use of magnetic field sensors in other automotive systems, such as brake pedal position sensors or vehicle speed sensors [8]. Research on magnetic field sensors for automotive applications is an essential area of study, as it has the potential to improve the safety and performance of vehicles by providing more accurate and reliable sensing of magnetic fields.

3. Conclusion

In summary, the lever combination switch is an essential component of a vehicle's electrical system that allows the driver to safely and efficiently control the car's lighting and signaling systems. The manufacturing process for the lever combination switch involves creating the plastic housing and metal electrical contacts, using materials that are durable and effective for their respective purposes. However, these switches can fail due to a number of reasons, including the accumulation of dirt and debris on the electrical contacts, mechanical wear and tear, and reduced effectiveness at high temperatures. To overcome these failures, advancements have been made in the design of lever combination switches. For example, sensors, such as Hall Effect sensors, have been incorporated to detect the position of the lever and send a corresponding electrical signal to the car's electrical system. Additionally, the switches are assembled in clean rooms to prevent the buildup of dust and debris. Recent advancements in the design of the lever combination switch have improved the reliability and

Publisher: Noida Institute of Engineering & Technology,
19, Knowledge Park-II, Institutional Area, Greater Noida (UP), India.

functionality of these switches, ensuring the safe and efficient operation of vehicles. The advantages of using magnetic field sensors in CAN-based connections were discussed in the paper, but its drawback still needs to be addressed.

3.1 Drawbacks of using the Hall Effect Sensor:

The disadvantage of using a Hall Effect sensor in a lever combination switch is that the sensor can be sensitive to temperature changes. This can cause the sensor to malfunction, resulting in inaccurate readings and potentially causing problems with the car's electrical system. Another potential disadvantage is that external magnetic fields can affect the Hall Effect sensor fields. If the sensor is located near a strong magnetic field, prominent as a giant speaker or an electromagnet, it can cause the sensor to malfunction and give inaccurate readings. Additionally, the Hall Effect sensor can be relatively fragile and may be damaged if the lever combination switch is subjected to impact or rough handling. This can lead to costly repairs or replacement of the switch, which can be inconvenient for the vehicle owner. While the Hall Effect sensor has many advantages in a lever combination switch, its sensitivity to temperature, external magnetic fields, and physical impact can be potential disadvantages. After this literature review, it was concluded that there is still a lot of scope for research in the mechanics of Automotive Lever Combination Switches. Much research has yet to be done on lever combination switches using any other type of sensor except the Hall Effect or Magnetic field sensor.
The Hall Effect sensors have already been used in steering angle detection when mounted on the steering column.

3.2 Scope of future research:

- Study the behaviour of the Magnetic field sensor in Lever Combination Switch at high temperatures.
- Use different sensors, such as Optical sensors, for contact-less connectivity in the Lever combination switch and its behaviour at high temperatures.
- Comparing the behaviour of Contact based and Contact-less lever combination switches.

References

[1] Oh Je-hoon and Jo Eun-seong, The switch lever for automobiles (II), 2007.

[2] Sano, Y. (Shizuoka, JP) (2001) “Combination switch device having lever switch unit easily mounted to an electronic control unit.”

[3] Stephen Earl Hoskins, & Joseph E. Cawley (2002). *Multi-function lever stalk switch assembly mounted on the steering column.*

[4] K. Uehira, and S. Kawasaki, Automotive combination switch, 1999.

[5] W. Xin, Failure Cause of Lamp-control Switch in Combined Switch and Solution, *Auto Electric Parts*, 2009.

[6] Dang, Mahesh, Contact Less And Illumination Lever Combination Switch, 2012.

[7] B. Peng and H. Wang, On the contactless combined switch system for vehicles, *Chinese Control and Decision Conference (CCDC)*, 2011, 2218-2222.

[8] J. P. Heremans, Magnetic Field Sensors for Magnetic Position Sensing in Automotive Applications, *MRS Proceedings*, 475, 1997, 63.

Publisher: Noida Institute of Engineering & Technology,
19, Knowledge Park-II, Institutional Area, Greater Noida (UP), India.