Design & Development of Parking Brake Lever Testing Machine (EOL Machine)

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Abstract— The testing of the various parameters of a parking brake lever are checked manually in the industry which is not proving to be an efficient method of testing, resulting in an increase in the product rejection. So the development of this testing rig will ensure to minimize the gap between customer expectation and actual product.

Key words: Parking Braking Lever, Sensors, RVDT, LVDT, Pneumatics, Mechanism

I. Introduction

Automated end of line testing rig is an automated device which is used to check the design parameters of the industrial products. Automated End of Line Testing system can stimulate, measure, and validate the functionality of automotive electronic control units, mechanical parts, and systems. This system accurately and repeatedly provides reliable test results in a production line environment that is enhanced by the existence of an integrated test rig.

In order to recognize and correct possible errors at an early stage, the components must be tested after the final assembly. End of line testing machines are used to do final tests on completed products to ensure that they have been assembled correctly and work within designated parameters.

The key with such testing rests in accuracy, repeatability and ease of use, in order to successfully discover issues while keeping the pace with the production line. Depending on the product, the test machine can have many requirements and functions which can include: force and load measurement, displacement measurement, Dimension measurement, etc.

The system can feature simple pass/fail indication, test report, full data acquisition, data logging and product marking. The software‟s intuitive user interface makes it fast and easy for operators at all skill levels to set up and run tests, while having the flexibility to easily switch between the test inputs. The Human Machine Interface and PLC logic encoded will ensure proper testing of each parameter.

II. Experimentation

In cars, the parking brake, also called hand brake, emergency brake, or e-brake, is a latching brake usually used to keep the vehicle stationary. It is sometimes also used to prevent a vehicle from rolling when the operator needs both feet to operate the clutch and throttle pedals.

Automobile hand brakes usually consist of a cable directly connected to the brake mechanism on one end and to a lever or foot pedal at the driver's position. The mechanism is often a hand-operated lever, on the floor on either side of the driver, or a pull handle located below and near the steering wheel column, or a (footoperated) pedal located far apart from the other pedals.

The most common use for a parking brake is to keep the vehicle motionless when it is parked. Parking brakes have a ratchet locking mechanism that will keep them engaged until a release button is pressed. A parking brake controls the rear brakes and is a completely separate device from the vehicle‟s regular hydraulic brakes. It is in charge of keeping a parked vehicle stationary; it will prevent the car from rolling down a hill or moving. The emergency brake name comes from the brake‟s ability to stop the car if the regular hydraulic brakes totally fail.

Most vehicles have drum brakes on their rear wheels; so, when the parking brake is pulled, the cables will pull a lever that compress the brake shoes to stop the vehicle. If the vehicle has rear disc brakes and the parking brake is pulled, then the cables engage a corkscrew device that pushes a piston into the brake pads, which stop the vehicle. In both instances, the parking brake bypasses the regular hydraulic brakes to stop the vehicle. Parking brakes also have a self-locking system, which means that the brake won‟t be released unless the lever or foot brake is released.

The parking brake levers under consideration of this project have pawl and ratchet mechanism.

Pawl and Rachet Mechanism is a mechanical device that allows continuous linear or rotary motion in only one direction while preventing motion in the opposite direction. Ratchets are widely used in machinery and tools.Though something of a misnomer "ratchet" is also often used to refer to ratcheting socket wrenches, a common tool with a ratcheting handle.

A ratchet consists of a round gearor linear rack with teeth, and a pivoting, spring-loaded finger called a pawl that engages the teeth. The teeth are uniform but asymmetrical, with each tooth having a moderate slope on one edge and a much steeper slope on the other edge.

When the teeth are moving in the unrestricted direction, the pawl easily slides up and over the gently sloped edges of the teeth, with a spring forcing it (often with an audible 'click') into the depression between the teeth as it passes the tip of each tooth. When the teeth move in the opposite (backward) direction, however, the pawl will catch against the Pimpri Chinchwad College Of Engineering and Research, B.E. (Mechanical) 9 steeply sloped edge of the first tooth it encounters, thereby locking it against the tooth and preventing any further motion in that direction.

Testing Parameters of Parking Brake levers are to be tested after their final assembly to examine the following parameters:

- Switch continuity
- Button operating force
- Sliding force (user effort)
- Linear displacement

- Angular displacement
- Degree of travel

Design concept of an end of line testing rig for parking brake lever

A. Parameters to be Checked Switch Continuity Must be disconnected at First Notch Engagement

- Maximum load during travel
- < 15N Degree of movement.
- Button operating force at start / button operating force at end
- Lateral play 1 mm at force of 10N at point as per drawing
- Button stroke.
- Pawl and Ratchet slippage
- Engraving facility of part no., date and shift.
- I. Poka – yoke
  - Air pressure poka yoke (digital air pressure switch)
  - Rejection chute with sensor (for last rejected part)

III. OTHER

- Colour HMI required.
- Two hand safety switch with time control (operator should press both switch simultaneously)
- Error indicators and error acknowledgement.
- Quick Tool Change Over (SMED) III. Work station requirement
- SOP board to be designed for accommodation with acrylic sheets and name plate.
- Stand and bin for child part on station. Pimpri Chinchwad College Of Engineering and Research, B.E. (Mechanical) 53
- Rubber sheet on work table.
- Safety guards on movable parts
- Safety curtains (photo guard)
- Place to keep master and defect sample separately.
- Tube light to provide 600 lux light on workstation, 3 pin extension board.

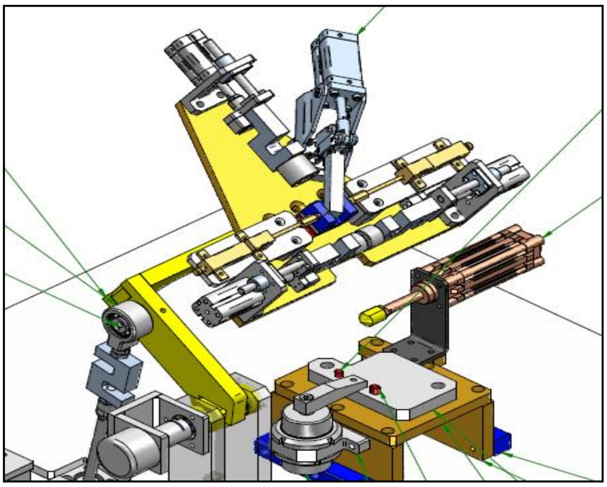

Fig: Rotating Arm

Linear Variable Differential Transformer is an absolute position/displacement transducer that converts a position or linear displacement from a mechanical reference (zero, or null position) into a proportional electrical signal containing phase (for direction) & amplitude (for distance) information.

The LVDT operation does not require an electrical contact between the moving part (probe or coreassembly) and the coil assembly, but instead relies on electromagnetic coupling; this and the fact that LVDTs can operate without any built-in electronic circuitry are the primary reasons why they have been widely used in applications where long life and high reliability under very severe environments are a required, such as in Military/Aerospace, process controls, automation, robotics, nuclear, chemical plants, hydraulics, power turbines, and many others.

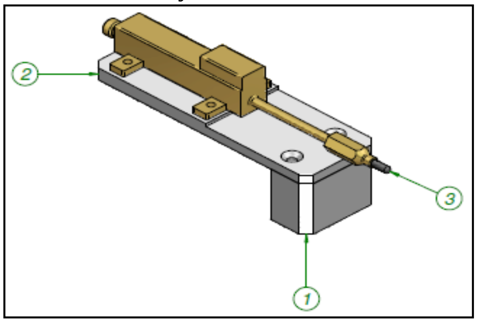

Fig. 2: LVDT

Single Acting Cylinder use the pressure imparted by compressed air to create a driving force in one direction (usually out), and a spring to return to the "home" position. More often than not, this type of cylinder has limited extension due to the space the compressed spring takes up. Another downside to SACs is that part of the force produced by the cylinder is lost as it tries to push against the spring.

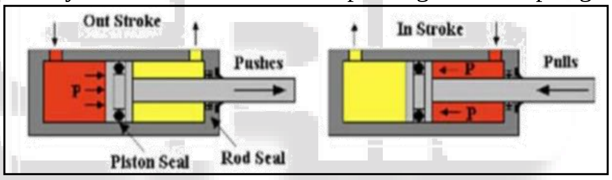

Fig. 3: Single Acting Cylinder

Double Acting Cylinders use the force of air to move in both extract and retract strokes. They have two ports to allow air in, one for outstroke and one for in stroke. In order to have a better idea of what type of equipment would be necessary, some base level calculations were performed.

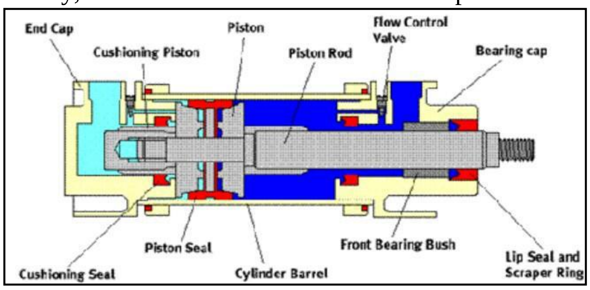

Fig. 4: Double Acting Cylinder

IV. FUTURE SCOPE

- End of Line Test Rigs will be used to improve the performance curve and the function of the parking brake lever (PBL).
- Development of Test Rigs to evaluate the displacements, switch continuity and the various forces applied on a parking brake lever.

The concept of End of Line Testing rig can also be applied to following applications:

- Head Lamp aiming tester
- Wheel Alignment machine
- Universal test system
- Brake inertia testing
- Driveline balance system
- Antilock braking system

V. Conclusion

Development and implementation of END OF LINE TEST RIG FOR PBL in the industry will help us to minimize the human intervention, failures and improve the measurement accuracy.

- The HMI (Human Machine Interface) provided on the testing rig makes it user friendly.
- The PLC logic encoded will ensure proper testing of each parameter to be tested in a parking brake lever.
- End of Line Test Rigs will be used to improve the performance curve and the function of the parking brake lever (PBL).
- Development of Test Rigs to evaluate the displacements, switch continuity and the various forces applied on a parking brake lever.

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