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Automation of Mechanisms in B-Test Fixture for Process Cycle Time Improvement

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***Abstract*—Carburetors are manufactured in large quantity, where it has to be tested for various performance parameters before it proceed for further assembly. There is a Conventional set up of B-test fixture to carryout such tests simultaneously. However, it is observed that testing process leads to bottleneck in production line. The project team had made innovative improvements in conventional B-Test fixture by way of automation which resulted reduction in the process cycle time and fatigue of operator leads to increase in productivity.**
***Keywords*— B-Test Machine, Automation, Time, Productivity.**

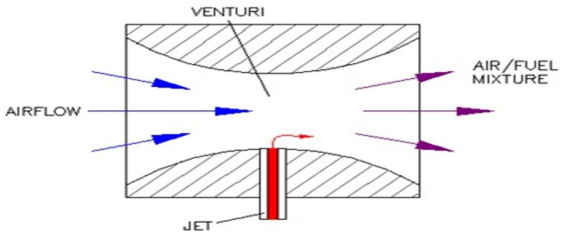
I. INTRODUCTION

Keihin Fie Pvt. Ltd. are world leaders in manufacturing of carburetors for motorcycle industry. At their plant in India a B-Test fixture is used during manufacturing cycle to test four important performance parameters simultaneously in one setting. It checks the flow rate of air-fuel mixture according to the throttle position of a carburetor. It also checks the Boost pressure, Differential pressure and Negative pressure of the carburetor. Whole process on this fixture involves clamping of work piece, testing, marking and unclamping. It creates the bottleneck condition during the process as stock piled up for testing and machines wait down the line leading to longer manufacturing cycle time. Our efforts are to minimize the unproductive time to improve total Process cycle time. Our estimates shows reducing testing time per carburetor from 7 second to 5 second. It overcomes the bottleneck problem, reduces process cycle time and helps to increase the productivity. (Per day 15,000 carburetor tested = saving of 2 sec is equivalent to 8 production hours per day). The testing time can be reduced by innovative low cost automation.

II. OVERVIEW OF CARBURETOR

Fig. 1 Photograph of Carburetor object

Carburetor is a device used for mixing vaporized fuel with air to produce a combustile or explosive mixture for an internal combustion engine.



Boost Pressure

Negative Pressure

Fig. 2 Schematic of Venturi system

Carburetor is works on principle of venturi system "If the pressure is decreased, the velocity increases and if the velocity is decreased, pressure increases." The venturi has less diameter at the centre and more at the two ends. At suction side air is entered where boost pressure is available and other end the air fuel mixture is discharges where negative pressure is available. The difference between boost pressure and negative pressure is called as Differential pressure.

III.B-TEST FIXTURESETUP DETAILS

The B-test machine consists of four processes namely, Clamping, Testing, Marking and Unclamping.

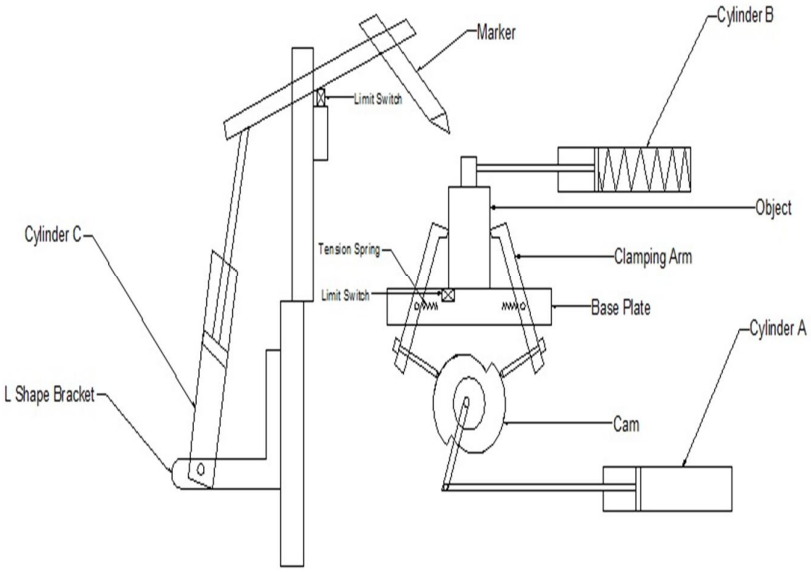


Fig. 3 Schematic of Modified B-Test fixture

A. Clamping

Clamping Fixture consist of Cam, two clamping arm, two helical tension springs, pivots, one pneumatic cylinder and limit switch. Carburetor is placed on the fixture on which limit switch is fixed. Due to self-weight of carburetor, the strip of limit switch is pressed which pushes a button to activate pneumatic cylinder. Piston rod is connected to elliptical cam by using ball joint. Due to the rotation of elliptical cam, the two clamping arms hold the object while compressing the springs.

IV. TESTING

Testing consists of three pressure parameters as Boost pressure, Differential pressure and Negative pressure and also Flow rate of air-fuel mixture.

V. MARKING

Marking is needed for whether the carburetor object testing is accepted or rejected. When all the testing parameters are achieved desired values then the carburetor object is accepted and marked. The marking pen is held on inclined square bar is moved by a linkage operated by pneumatic cylinder. A solenoid valve gets ok signal from the test consol &Switch mode power supply (SMPS), to actuate pneumatic cylinder.

VI. UNCLAMPING

The inclined square bar and vertical square bar are pivoted. In between these two bars the solenoid operated limit switch is placed when the square bar moves downward side that is for marking purpose on the carburetor object at that time the square bar makes contact with the limit switch and instantly the two clamping arms are get retracted due to release of spring pressure and object will be unclamped.

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VII. SPECIFICATIONS OF COMPONENT

TABLE I SPECIFICATIONS

Sr. No.	Name of Component	Specification
1.	Double acting pneumatic cylinder	DSNU-10-40-P-A cylinder
2.	Coil	24 V DC coil
3.	Solenoid Valve	MEH-5-1/8

VIII. CASE STUDY

A. *Conventional B-Test fixture*

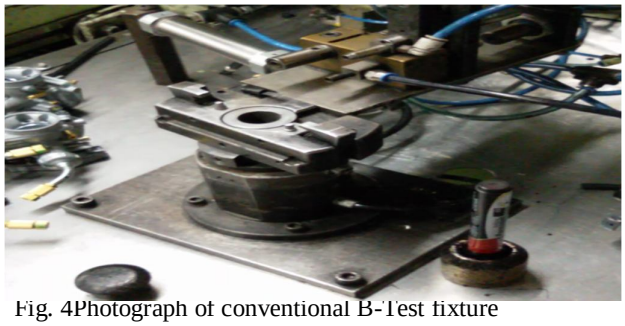

Fig. 4Photograph of conventional B-Test fixture

Conventional B-test fixture consists of Base plate, two clamping arms, manually operated push button for clamping and unclamping of carburetor object on fixture, manually operated marker for marking purpose, elliptical cam and one Single acting pneumatic cylinder and one Double acting pneumatic cylinder as shown in Fig. 4.

In Conventional set up, first of all carburetor object is come for testing on B-Test fixture then operator will keep it on fixture and press the push button which actuate the double acting cylinder. This cylinder is connected with cam by ball joint. The elliptical cam will rotates with the help of piston of actuating double acting cylinder then two clamping arms are retracted with compressing the spring, thus carburetor object is clamped. Further, the three parameters of testing such as differential pressure, boost pressure and negative pressure testing is done with the help of single acting cylinder actuate and makes contact with carburetor object. After testing again operator press the push button and elliptical cam is rotates as reverse at the time of clamping, the two clamping arms moves outwards against spring force and object will unclamped. When object is accepted then it marks by marker pen with manual handling.

IX.PNEUMATIC CIRCUIT OF CONVENTIONAL B-TEST FIXTURE

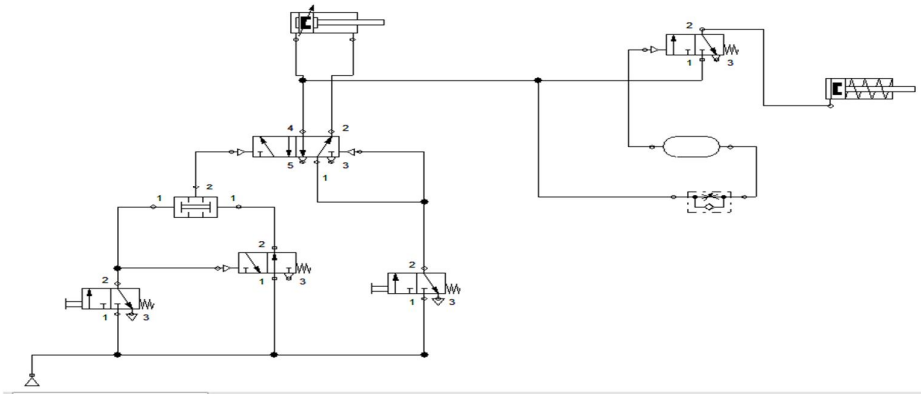

Fig. 5 Schematic of Conventional B-Test fixture pneumatic circuit.

Pneumatic circuit of Conventional B-Test fixture consists one Single acting cylinder, one Double acting cylinder, two 3/2 Direction Control Valve with push button operated, two 3/2 Direction Control Valve with pneumatic operated, one 5/2 Direction control valve with pneumatic operated, timer assembly FRL unit, variable flow control valve and compressor.

Single acting cylinder is used for testing purpose and Double acting cylinder is used for clamping and unclamping of carburettor object on fixture. Variable flow control valve are used for controlling the speed of cylinder. FRL unit gives filtered and lubricated air from compressor to entire circuit.

X. IMPROVED B-TEST FIXTURE

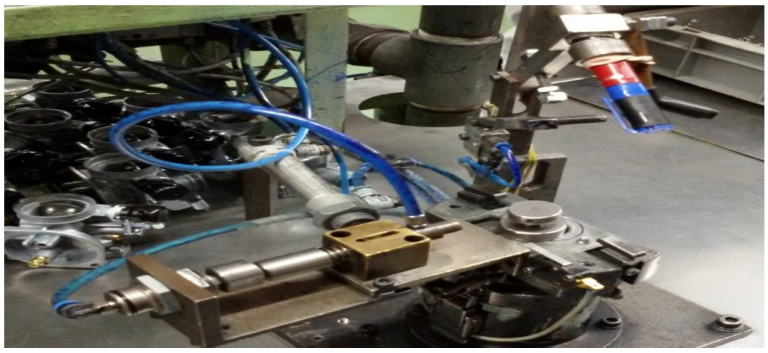

Fig.6 Photograph of Improved Conventional B-Test fixture by Automation

The intention behind Improvement in B-Test fixture is saving process cycle time, reduce fatigue of operator, reduce operator cost and increases productivity. In this fixture Electro pneumatic limit switch is replaces the push button in conventional B-Test fixture. This switch is placed on fixture corner as shown in Fig.6.

When carburetor object is keep it on fixture then the strip of electro pneumatic limit switch makes contact with push button due to self-weight of carburetor and actuates double acting pneumatic cylinder which is connected to the elliptical cam and it rotates then clamping is done with the help of two clamping arm. Switch mode power supply (SMPS) is used for converting 230 Volts power into 24 Volt power. From SMPS the negative signal given directly to 5/2 direction control valve with solenoid operated and positive signal is given to test consol where performance parameter will test and then signal passes from test consol to these 5/2 direction control valve. Here also single acting pneumatic cylinder is replaced by double acting cylinder which are actuated with the help of 5/2 direction control valve. The desired values of testing is come on the screen then signal is passes to 5/2 DCV and the cylinder is actuates which is connected to one end of inclined square bar on which marker is fitted, marker is moves and mark on carburetor object.

XI.PNEUMATIC CIRCUIT OF IMPROVED B-TEST FIXTURE

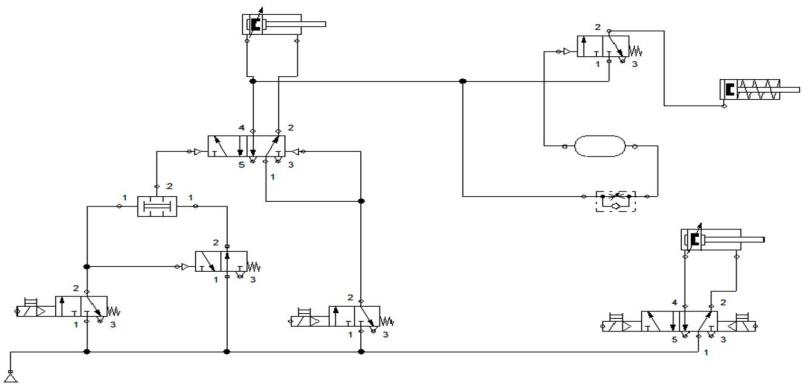

Fig.7 Schematic of Improved Conventional B-Test fixture pneumatic circuit

In pneumatic circuit of improved conventional B-Test fixture the push button operated limit switch is replaced by electro pneumatic operated limit switch and also uses the solenoid operated direction control valves.

XII. FOLLOWING CHANGES/IMPROVEMENTS MADE

A. Automatic Clamping.
B. Automatic Marking.
C. Automatic Unclamping.
D. Reduces process cycle time.
E. Increases Productivity.
F. Reduces Fatigue of Operator.

XIII. CONCLUSIONS

The automated in mechanism of B-Test fixture can be used in testing to achieve better process cycle time. It is concluded that with automation in process which increases the productivity, reduce fatigue of operator and to achieve economic benefit. As the trials of the modified B-test fixture on production line were highly encouraging with respect to testing time reduction and the satisfaction by the operator as well as management as less events of bottlenecks. The time reduced from 7 sec to average 5 sec in initial trials, but with little refinements and improving test station layout it will stabilise to 5 sec.

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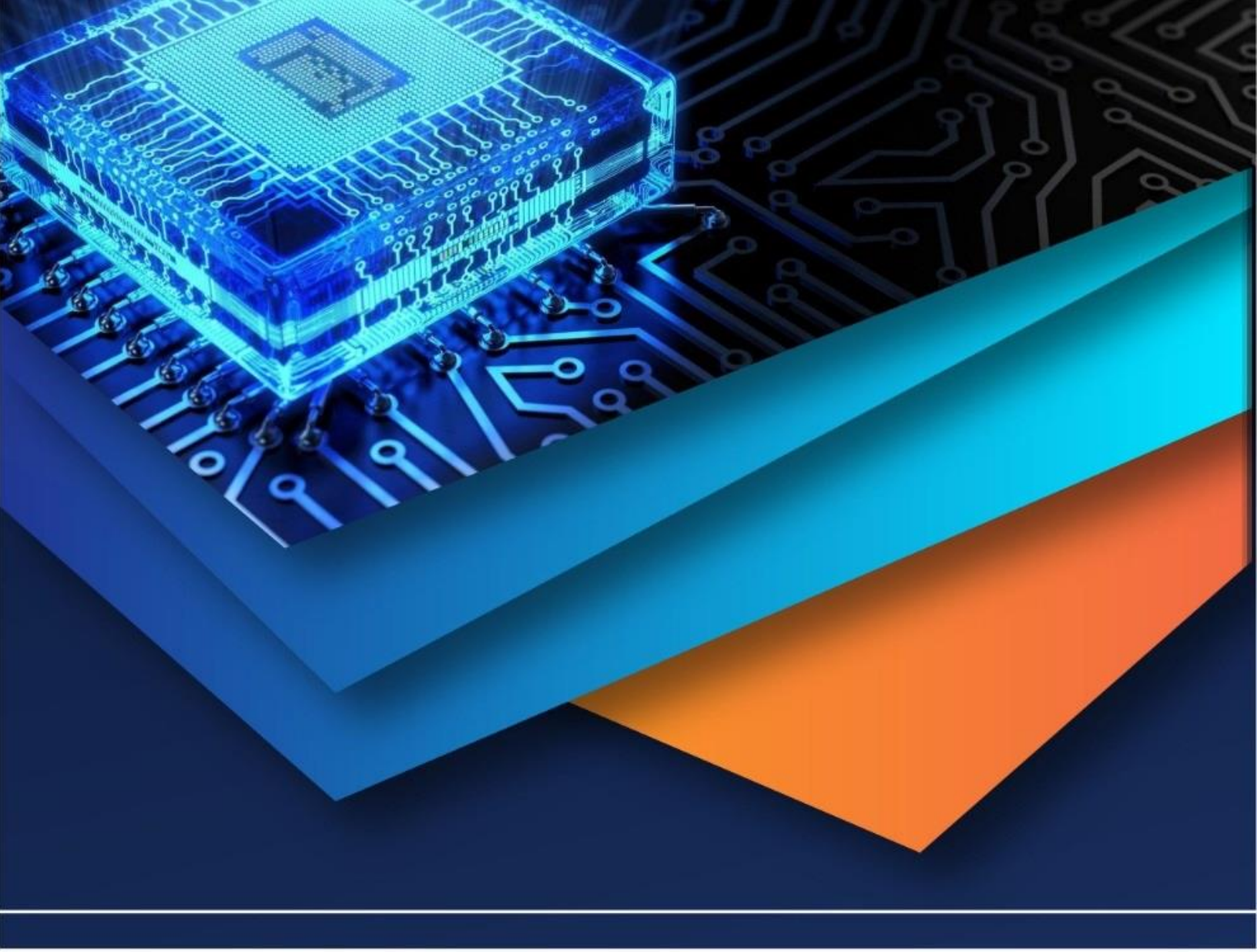

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