

Development of a new pump through modifying a conventional automotive spark plug

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This study presents development of a new pump by modifying existing automotive spark plug, which is generally used for providing an electrode gap to produce an ignition in fuel-air mixture. Compressed air trapped between upper piston surface and spark plug was utilized by modifying spark plug design by implementing Pugh's method.

Keyword: Automotive spark plug, Pugh's method

Introduction

A spark plug ignites air/fuel mixture and removes heat from combustion chamber¹. Spark plug is positioned in combustion chamber at the point most suitable for igniting compressed air-fuel mixture. It must, under all operating conditions, introduce ignition energy into combustion without developing a leak and without overheating². Reciprocating motion of piston in combustion engine generates compressed air in the engine. Compressed air trapped between upper piston surface and spark plug in combustion chamber can be utilized by modifying spark plug design. This study presents design and development of a new pump by modifying existing spark plug in order to encounter difficulties faced by motorists with flat tire by pushing motorbike to nearest workshop.

Experimental

Design and Development of a New Pump

Design and development of a new pump by modifying existing spark plug is based on Pugh's method³, which comprises six stages [market (user need), product design specification (PDS), conceptual design, detail design, manufacture and sales]. However, in this paper, design process implemented to develop a new pump starts from PDS to conceptual design stage. PDS is a document prepared early in product development process

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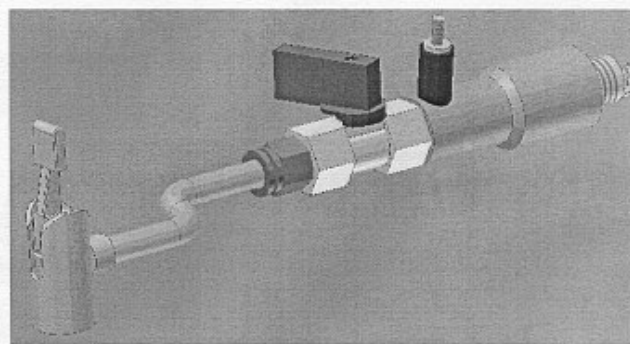


Fig. 1—Modified spark plug design

that controls design and manufacture of a product³. PDS is very important to the success of product development process because it is so influential in describing requirement of final component⁴.

Conceptual Design of a New Pump

A new pump was designed and developed based on following concept: i) Reciprocating movement of piston in internal combustion engine, in which fuels are being burnt and generates compressed air in engine; ii) Compressed air in engine is channeled out through a modified spark plug, which acts as a medium of delivery from engine to any inflatable items; and iii) A valve controls air delivered into an inflatable item. In order to use modified spark plug or new pump (Fig. 1), engine must be kept on running.

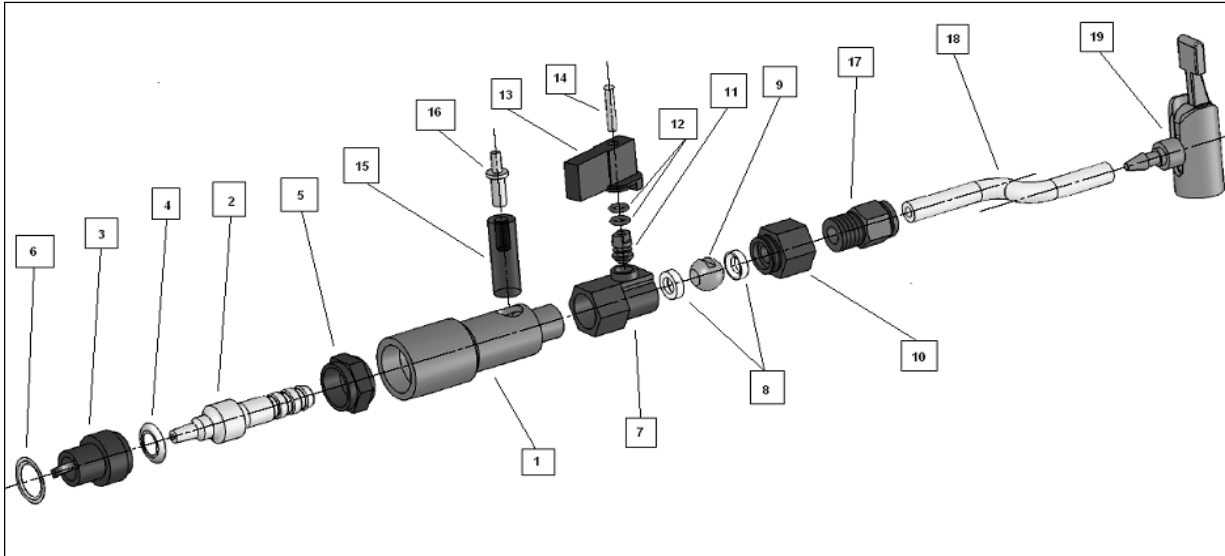


Fig. 2—Components of modified spark plug [housing (1), insulator (2), head case (3), gasket (4), bottom case (5), flat washer (6), body (7), bush (8), ball (9), male connector (10), shaft (11), O ring (12), handle (13), screw (14), wire (15), connector (16), fitting (17), air hose (18), and clip (19)]

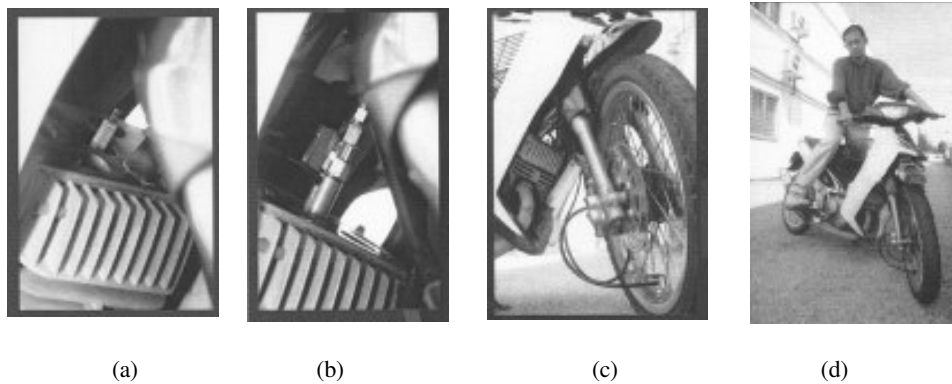


Fig. 3—Use of modified spark plug

Detail Design of a New Pump

Based on conceptual design, new pump was developed (Fig. 1). New pump or modified spark plug has 19 different parts (Fig. 2). There are 2 pieces of each bush and O ring required for the product. Concept of invention can be used for any internal combustion engine (2-strokes and 4 strokes engine). Current design of product has a total of 21 components.

Results and Discussion

Operation Process of a New Pump

Firstly, an already connected spark plug is removed from a block engine of a motorcycle (Fig. 3a). Then, a new pump or modified spark plug is connected to engine

by conventional trading mechanism until it is securely held (Fig. 3b). Spark plug connector of engine block is then connected to modified spark plug. This unique configure will allow engine of motorcycle to operate in normal condition. Air clip is then connected to an inlet valve of any inflatable items (Fig. 3c). In order to inflate an inflatable item, motorcycle is started by conventional method. This will result in piston within engine block to move conventionally to create air pressure. Air is then flowed through hose to inflatable item. Modified spark plug is required to ensure that engine could be started easily. Amount of air or pressure flowing into inflatable item can be either increased or decreased by increasing stalled speed of motorcycle. It must be noted that during

this operation, motorcycle is not in a moving position (Fig. 3d). Some advantages of modified spark plug design are as follows: i) It can deliver compressed air in a very short time based on the size of inflatable items; ii) It is portable and flexible due to its small size and lightweight and can even be put inside pocket; and iii) It can be fitted in 4-stroke and 2-stroke engines.

Conclusions

Pugh's method has been used to develop and modify automotive spark plug (new pump). Modified spark plug was implemented to inflate an inflatable item such as tyre, etc. Main advantages of a new pump are its small size, and lightweight with material used such as copper, and Teflon. New pump has a potential to be commercialized due to inexistence of similar products in the market that offers small and lightweight product of inflating the inflatable items. A similar concept of

invention can be used for other vehicles (car, truck, van, and recreational vehicles).

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