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Design and Fabrication of Universal fixture for Engine of Bikes

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Abstract - *Fixture is a device for holding a work piece during any operation. For different machines different fixtures are available. Engine of bikes also has their own fixture. But engine of different manufacturer has their own fixture and it seems impossible to hold them in other kind of fixture. For a mechanic in garage it become a tedious task to do the maintenance of every engine for specific operation as he cannot afford fixture for every single engine. Thus it is aimed to design and manufacture a universal fixture to hold all types of two wheeler engine for carrying out maintenance of the engine. It will suits to every single engine and an average garage mechanic able to work with.*

Key Words*: *Universal fixture, jigs, engine, maintenance, mechanic

1. INTRODUCTION

In market to carry out the quick maintenance of engine and less effort to human beings, there is use of engine fixture for that according to different types of model of engines. There is special fixture for each company to done the maintenance of engine such as Hero Honda, Honda, Yamaha, Suzuki, Bajaj, TVS having its own engine fixture. These fixtures are available in their Show Rooms only and no one outside garage can use such type of fixture because of high cost.

Every two wheeler has its own fixture, which design for carrying out maintenance of its engine. But for the garage person who has to carry out maintenance of all type of engine faces the problem of holding the engine. In automobile garage engines every time it is not possible to use separate engine fixture for separate engine. Hence we designed and manufactured the fixture to hold all types of two wheeler engine for carrying out maintenance.

2. LITERTAURE REVIEW

There are different type of flexible fixture developed for different application but most of them were dedicated for specific machines or cost of that fixture is too much.

- Warren R Seibert-warren patented a universal engine repair fixture, comprising a base structure having a base plate adapted to be secured to work bench or the like, said plate having a device thereon with a pivot axis disposed substantially parallel thereto and a swinging support having one end thereof pivotally mounted on said pivot device for swinging motion between positions substantially perpendicular and substantially parallel to said base plate, and an engine holder having an engine mounting platform with an engine.

- Matin magwan- An undergraduate form BIT Barshi developed a universal stand for the different type of engine. It was having and Cartesian arrangement to hold the engine and an indexing plate mounted to the column. Due to such construction it was difficult to hold engine effectively as stability of stand was poor due to vertical alignment of the stand.

- Bizin shirinzadeh- Bizin proposed a flexible fixture design. This fixture has a design capable of hold the multiple kind of object and also was capable of guiding the tools. It was able to constraint the work piece and was sensor based system to carry out the task.

- Pratap kairan- He had developed an fixture which was able to hold various type of piston and having ability to assemble the piston in possible shortest time. Nevertheless his design was limited to piston and concept of holding engine was not his area of interest.

3. COMPONENTS

Majority of the component of given fixture are meant to provide stability and support. The universal fixture consists of various parts such as top plate, indexing plate, engine locking plate, shaft, locking pin, supporting column, rotating disc and base plate. On the top plate there is a removable engine locking plate which is used to mount the various types of engines. The top plate is bolted to the vertical circular indexing plates. These plates are connected to supporting columns through a shaft. Supporting columns are tapped on the circular indexing plate by means of nuts. The circular indexing plate is mounted on the base plate by means of bearing to make the smooth rotation of circular indexing plate.

The engine mounted on top plate by means of engine locking plate or slots. After that plate swells horizontally in both directions. The movement of plate locked in each of 20^0 by using locking pin assembly. The vertical indexing plates are fixed on supporting columns which are tapped on circular

base plate. The circular indexing plate can be rotated through 360^0 and it can be locked at each 20^0 by means of locking pin.

4. CALCULATION OF DESIGN

4.1 Design of top plate

Total load on plate (p) =4500 N

σ_b =20N/mm^2

σ_b = P/A

20 = 4500/A

A=225 mm^2

Cross-section area of plate

L=500mm

Thickness of plate= 5mm

Width of plate= 400 mm

500 x 400 = 200000 mm^2

Area under 1 slot **=** 12 x125 =1500 mm^2

There are 2 slots of 125mm = 1500 x 2 = 3000 mm^2

Area under 2 slot = 12 x 175= 2100 mm^2

There are 2 slots of 175mm = 2100 x 2 = 4200 mm^2

Area under total slots = 7200 mm^2

Cross section area of plate under slots

= 200000-7200

CS Area =193000 mm^2

Top plate required area is 225 mm^2

But, our actual area is 193000 mm^2 so **Design is safe.**

4.2 Design of vertical indexing plate

Total Force = 5000 N

$\sigma c = \sigma t = \frac{P}{A}$

$20 = \frac{5000}{A}$

A=250mm^2

(1) Area of half plate

Dia. Of plate = Ø 243 mm

Area of plate = $\frac{\pi d^2}{4}$

$= \frac{\pi (243)^2}{2 \times 4}$

=23188.48mm^2

(2) Area sector of circle

$A = \frac{\theta \pi r^2}{360}$

$= \frac{\theta \pi 121.5^2}{360}$ (Θ=35)

= 4508.87 mm^2

= 4508.87 x 2

A = 9017.74 mm^2

(3) Area of triangle

$(c^2) = (a^2) + (b^2)$

$121.5^2 = 40^2 + (b^2)$

$(b^2) = 14762.25\text{-}1600$

b = 114.72 mm

Area of Δ-TRS= $\frac{1}{2}$ x a x b

$= \frac{1}{2} \times 40 \times 114.72$

= 2294.4 mm^2

= 2294.4 x 2

= 4588.8 mm ^{2}

Area of vertical indexing plate (not including holes)

= (1) + (2) + (3)

= 23188.48 + 9017.74 + 4588.8

= 36795.02 mm^2

Area under holes

(1) $\frac{\pi d^2}{4} = \frac{\pi 30^2}{4}$ = 706.85.13 mm ^{2}

(2) $\frac{\pi d^2}{4} = \frac{\pi 12^2}{4}$ = 113.09 mm^2

For 9 holes = 113.09 X 9

=1017.87 mm^2

Net Area of vertical indexing plate

=36795.02-(706.85+1017.87)

=**35070 mm^2**

Vertical indexing plate required area is 250 mm^2

But, our actual area is 35070 mm^2 so **Design is safe.**

4.3 Design of rotating disc

Total load on rotating disc

$\sigma b = \frac{P}{A}$

$20 = \frac{5500}{A}$

A = 275 mm^2

Dia. Of rotating disc = 400

Thickness of rotating disc =12mm

(1). Area of rotating disc = $\frac{\pi d^2}{4}$
(Not Including Hole)

$= \frac{\pi 400^2}{4}$

$=$ **125663.70 mm²**

(2). Area under hole

(A) $\frac{\pi d^2}{4} = \frac{\pi 12^2}{4} = 113.09$ mm²

There are 18 holes = 18×113.09=2035.75 mm²

Net Area of rotating disc =70685.83-2035.75

=70685.83-416.44

=**68650.08mm²**

Rotating disc required area is 225 mm²

But, our actual area is 68650.08 mm² so **Design is safe**

4.4 Design of base plate

$\sigma b = \frac{P}{A}$

$20 = \frac{6000}{A}$

A =300 mm²

Area of base plate = 500 x 400

(Not Including Holes) = 200000 mm²

For 2 holes =113.09 x 2

= **226.19 mm²**

Net Area of base plate = 200000 – 226.19

= **199773.81 mm²**

Base Plate required area is 300 mm²

But, our actual area is 199773.81 mm² so **Design is safe**

Fig.1 Actual Model of universal fixture

5. COST ESTIMATION

Particulars	Amount (Rs)
Material cost	3850
Machining cost	1925
Overhead cost	2750
Standard parts	750
Other	500
Total	9775

Table1 - Cost Estimation of Universal fixture

6. FUTURE SCOPE

- The gears can be used for giving various mechanical move movements to the engine mounting plate.
- The weight of fixture can be reduced using light weight material.
- The heat treatment can be given to the top mounting plate to increase the strength of plate.
- Color coding will be given to avoid the confusion of mechanic.

7. CONCLUSION

1. Project was having objective to design a universal fixture affordable to local garage owner.
2. Universal fixture has been fabricated and different engine has been mounted over to test the adaptability of fixture.
3. Fixture providing balancing against almost every single engine tested over it.
4. Universal fixture made it easy for a garage mechanic to do the maintenance of engine in an easy way with minimizing the working time.
5. It has unique features like compact in size, requires less maintenance, ease of use for semiskilled mechanic
6. As compared to the available standard fixtures cost of the given fixture is low and this is what makes universal fixture better than other.

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