The selection of flying roller as an effort to increase the power of scooter-matic as the main power of centrifugal pump for fire fighter motor cycle

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Abstract. In densely populated settlements, fires often occur and cause losses. In some instances, the process of the occurrence of fires takes place so quickly that to reduce and avoid the occurrence of a fire disaster effort is required in accordance with the existing environmental condition. Fire fighter motorcycle by using motorcycle scooter-matic is considered suitable as one alternative to combating fire hazard in densely populated residential settlements. The use of motorcycle engines as the driving force of the pump often leads to unstable and not optimum power. Thus, the water spray on the centrifugal pump also becomes not maximum. To increase the engine power at scooter-matic engine idle rotation (700-2000 rpm), then the flying roller replacement with certain mass weight becomes an option. By selecting a 10 to 14 gram flying roller mass, the power analysis using a dynotest engine produces several variations. Of the calculation, the mass of a 14 gram flying roller provides a significant increase in motor power on the upper rotation. Meanwhile, on the lower power rotation using a flying roller with a mass of 10 grams provides an increase in power compared to a standard flying roller on a scooter matic motor engine. As a reference to the use of scooter-matic motor power as the pump power, the result of use of the flying roller with a mass of 10 grams becomes the best option.

Keyword: fire fighter motor cycle, dynotest, CVT

1. Introduction
The occurrence of fire disasters often comes and causes huge losses[1], especially in the big cities like Jakarta. Fire incidents recorded until the end of 2017 has reached 281 events with the period at the beginning of 2017 until mid of 2017 (source http://www.jakartafire.net/statistic). With a narrow road condition that does not allow fire trucks to enter the point of fire, the fire fighter motor cycle is one of the solutions that continues to be developed[2]. Under certain conditions, handling and countermeasure of fire hazard are still an interesting topic[3, 4].

This scooter-matic (scootic) is a motorcycle that uses automatic transmission, thus, it is very easy to drive. Automatic transmission or known as Continuously Variable Transmission (CVT) is a transmission that can make us feel comfortable driving because we only need to pull the gas without moving the transmission[5, 6], by the shifting of paradigm about this type, urban society preferable driving scooter matic than manual vehicle[7]. In the design of fire fighter motor cycle manufacture[2], automatic scooter is a main option. In addition to providing ease in operation, this type of motor can utilize engine rotation as the driving force of the centrifugal pump. In a variety of needs, this type of vehicle can adjust the engine power generated to the need of the rider[8]. By replacing the flying roller with a certain mass weight. For example, when a motor requires a large torque at high speed, the installation of a flying roller with a mass weight of above a standard flying roller will trigger engine motor power. For the utilization of a scooter-matic engine as the main power of centrifugal pump for a fire fighter motor cycle, research of the flying roller which produces a big torque for lower rotation between 700rpm until 2,000rpm will be presented in this paper. In the following sub-chapter, we will describe the method of data retrieval and the result achieved.

2. Research Method
In this study, the selected flying roller is set with the weight of 10 to 14 grams. Each flying roller is selected, mounted on the CVT replacing the innate standard flying roller of the motor specification. Every installed flying roller, the torque of power generated is measured from 600 rpm to the highest rotation of 8,000 rpm. The flying roller used is a flying roller product of variations existing in the market. Specification of engine performance test describe in table 1 below.

| Dynotest Specification |    |
|------------------------|--|
| Type                   | Model 250i |
| L x W x H              | 246 x 213 x 167 cm |
| Diameter of tube       | 18 in / 45.72 cm |
| Max Horse Power        | 750 Hp |
| Maximum speed          | 200 Mph |
| Maximum torque         | 750 Ft/Lbs |
| Temperature            | 0° – 70° C |
| Hardware               | Dynoware EX, CPU module, Dyno module, Atmospheric |

At the time of torque measurement on the dynotest machine used, the position of the motor is placed on the measuring instrument and the engine is switched on at various engine rotation positions from low rotation to the highest rotation. Position the motor as shown below.

Figure 1. Flowchart

Meanwhile, the measuring instrument in the form of dynotest directly measures the performance of rotation produced by a scooter-matic motor engine. The measuring instrument data used is as follows:

| Dynotest Data | Conclusion |
|---------------|--|
| Start | Flying roller selection (10 gr, 11 gr, 12 gr, 13 gr, 14 gr) |
| | Flying roller replacement on CVT |
| | Dytest testing |
| | Compared to a standard flying roller |
| | Dytest data |
| End |

Figure 2. The position of motor power testing on the dynotest engine

Each type of the flying roller mounted on the CVT machine is tested 3 times with the engine heating time of 15 minutes.

3. Test Result
Data from the dynotest machine used, the engine power generated by replacing flying roller of various sizes of weight can be seen in the table 1 below.

Table 2. The Flying Roller Machine Power Data
The above table shows that scooter-matic motor engine power has a maximum value under different conditions. In the rotation between 700 rpm to 2,000 rpm, the power generated by a 10 gram flying roller has a relatively large power stability compared to the power generated by other flying rollers. But at this size, the maximum power is only at 6,750 rpm engine rotation. As for other flying rollers, the highest power is at 7,750 rpm rotation for the weight of 11 grams, 8,000 rpm for 12 grams, 8,750 rpm for 13 grams and 9,500 rpm for 14 flying roller. For more details, the difference in power generated at the lower rotation and the maximum power generated can be seen in Figure 3 below.

As for the data about torque generated by a scooter-matic motor engine on each replacement of the flying roller is described in table 2 below. In each replacement of the flying roller, the data retrieved starts from the minimum engine rotation (250 rpm) to the maximum rotation (9,750 rpm).

Of the data above, at minimum rotation to 750 rpm rotation, the largest generated torque is recorded at the flying roller size of 11 grams, whereas in the 1,000 rpm to 2,000 rpm, the largest torque is generated by a flying roller size of 10 grams. At high rotation (5,000 rpm) to a maximum rotation of

| RPM | POWER (HP) |
|-----|------------|
|     | I FR 10GR  | II FR 11GR | III FR 12GR | IV FR 13GR | V FR 14GR |
| 250 | 0.8        | 0.7        | 0.7         | 0.6        | 0.7        |
| 593 | 1.7        | 1.6        | 1.7         | 1.6        | 1.7        |
| 769 | 2.2        | 2.1        | 2.2         | 2.1        | 2.1        |
| 1000| 2.9        | 2.8        | 2.8         | 2.7        | 2.7        |
| 1250| 3.6        | 3.5        | 3.5         | 3.4        | 3.5        |
| 1500| 4.3        | 4.0        | 4.0         | 4.1        |            |
| 1750| 4.9        | 4.7        | 4.7         | 4.7        |            |
| 2000| 4.7        | 4.9        | 5.0         | 4.9        | 4.9        |
| 2250| 4.9        | 4.9        | 5.2         | 5.0        | 4.9        |
| 2500| 5.4        | 5.2        | 5.5         | 5.4        | 5.2        |
| 2750| 5.8        | 5.5        | 5.7         | 5.7        | 5.2        |
| 3000| 6.1        | 5.8        | 6.0         | 5.7        | 5.2        |

Table 3 The Flying Roller Engine Torque Data

| RPM | I FR 10GR | II FR 11GR | III FR 12GR | IV FR 13GR | V FR 14GR |
|-----|-----------|------------|-------------|------------|-----------|
| 250 | 13.95     | 15.36      | 15.76       | 14.87      | 14.86     |
| 500 | 18.21     | 20.13      | 20.20       | 19.77      | 19.47     |
| 769 | 20.60     | 19.69      | 20.40       | 19.67      | 19.64     |
| 1000| 20.38     | 19.11      | 19.98       | 19.23      | 19.11     |
| 1250| 20.26     | 19.32      | 19.65       | 19.26      | 19.43     |
| 1500| 20.41     | 18.86      | 20.08       | 19.06      | 18.94     |
| 1750| 19.69     | 18.70      | 19.57       | 18.95      | 19.05     |
| 2000| 16.63     | 17.26      | 17.59       | 17.36      | 17.25     |
| 2250| 15.54     | 15.63      | 16.34       | 15.69      | 15.46     |
| 2500| 15.24     | 14.83      | 15.65       | 15.33      | 14.75     |
| 2750| 15.01     | 14.20      | 14.65       | 14.61      | 13.39     |
| 3000| 14.53     | 14.34      | 13.77       | 13.53      | 12.35     |
9,750 rpm, the resulting torque decreases. This is due to the increase in the scooter-matic motor engine rotation. To illustrate the difference between each flying roller selected, the merging of data is presented on the following figure 4 chart.

![Figure 4 Chart of Resulting Increased Flying Roller Torque](image)

Torque increase is generated only at 250 rpm rotation to 750 rpm rotation, while at 750 rpm to 2,250 rpm the resulting torque is relatively stable. On lap rotation of 2,250 rpm to maximum rotation of 9,750 rpm, the torque of all variations of the flying roller replacement has decreased.

4. Discussion

Engine power is useful when the motor is moving at a certain speed to achieve a higher and corrected speed against time. Meanwhile, torque is the ability of the engine to move or transfer the car or motor from idle to start.

Regarding to scootermatic engine utilization as the main driving force of the centrifugal pump for the fire fighter motor cycle, the greatest power and torque to drive the pump at 700 rpm to 2000 rpm are selected. From the results above, 10 gram flying roller has a great advantage of power and torque generated compared with the size of another flying roller.

In figure 5 below, we will illustrate the usage of scooter matic engine power as the driving force of the centrifugal pump. Then, the picture 6 is the initial test of centrifugal pump performance which is coupled with scooter matic machine.

![Figure 5. usage of scooter matic engine as centrifugal pump power](image)

| Table 4. Specification of centrifugal pump |
|------------------------------------------|
| **Centrifugal pump Specification**       |
| Power                                    | 2.2 KW / 2.9 HP |
| Rotation                                 | 1450 rpm       |
| pressure                                 | 3.2 bar (max)  |
| Q max                                    | 500 l/minute    |
| H max                                    | 18.5 m          |
| Shead                                    | 9 m             |
The centrifugal pump specification which coupled with the scooter matic engine is as follows (see table 4 above) the selected pump has the minimum required power of Hp. and the rotation at 1500 rpm. It is normal rotation for scooter matic, where the lower rotation is 500 rpm and 9000 rpm is maximum rotation. The performance of centrifugal pump as for fire fighter motor cycle can be seen in the table 5 below.

| Motorcycle Rotation (rpm) | Pressure (bar) | Thrust average (m) |
|--------------------------|----------------|--------------------|
| 750                      | 1,05           | 1                  |
| 1000                     | 1,18           | 1                  |
| 1250                     | 1,31           | 3                  |
| 1500                     | 1,39           | 4                  |
| 2000                     | 1,69           | 6                  |

5. Conclusion
By utilizing the scooter matic engine as the main driving force of the centrifugal pump in the fire fighter motor cycle, the replacement of the flying roller as an effort to increase the power and engine torque becomes very useful. But, the consequences of 10 gram flying roller to the engine effect need continuously research.

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