Effects of Stationary Coil Size on Capability of Electricity Generation of Bedini Generator

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Abstract. *A Bedini generator is one of electrical generators that can restore some energy from the running motor or rotating parts of machines. There are a number of public papers on this generator type; however, effects of stationary coil size on the capability of power generation have not properly studied. This paper presents the effects of 4 different coil sizes on electric power generation of the conventional Bedini generator. The most commonly used insulated copper coils, no. 20, 21, 22 and 23 AWG were used in the experimental tests. The results showed that the copper coil no. 20 that is the largest size among the group could generate significantly higher electric voltage by 1.96-1.72 times, current by 5-10 times and power by 9.25-10.24 times compared to other copper sizes of 21-23, where the size of copper coil no. 20 has diameter of 0.812 mm compared to 0.723-0.573 of nos. 21-23 (12.3-41.7% larger). These results showed a non-relationship between generated electric properties and no. of copper coils in terms of diameters when using these coils as stationary coils of the Bedini generator.*

Keywords:

Bedini generator, copper coil size, electric power generation capability

1. Introduction

The Bedini generator is the kind of electrical generator that utilize moving parts of working machines to regenerate electricity for other electric devices or save as the backup power sources. John Bedini is the first person who proposed this kind of generator called Bedini Simplified School Girl (SSG) in 2001 [1]-[3], then further developed by Peter Lindemann [4]-[5] and more researchers [6]. Figs. 1 and 2 present two most basic structures of the Bedini generators based SSG: original design and replication design, respectively.

The original design generator has advantage over the replication design in terms of simple design, application for larger power generation generator but would has some drawbacks in terms of larger area of installation for the same amount of generated electric power. These two structures are currently selected to be used in industrial and applications depending on available space and power level required. However, the replication design one would be more attractive for low power applications such as for backup power storage in vehicles or motors and rotating machine applications [3], which is the main focus for this research project.
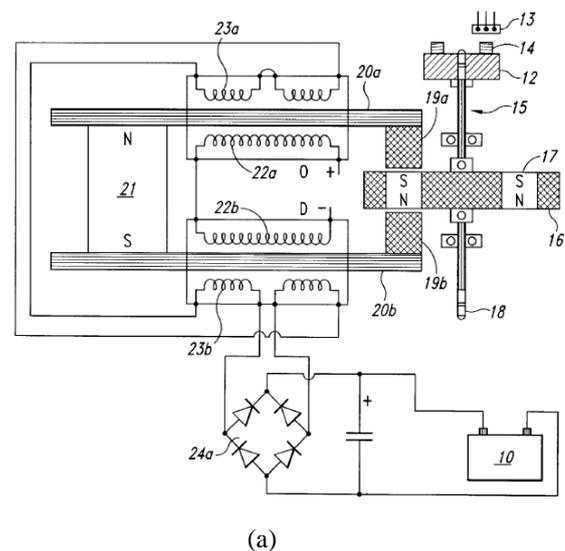

(a)

(b)

Fig. 1 Bedini generator based original design: (a) circuit diagram [1] and (b) example [3]
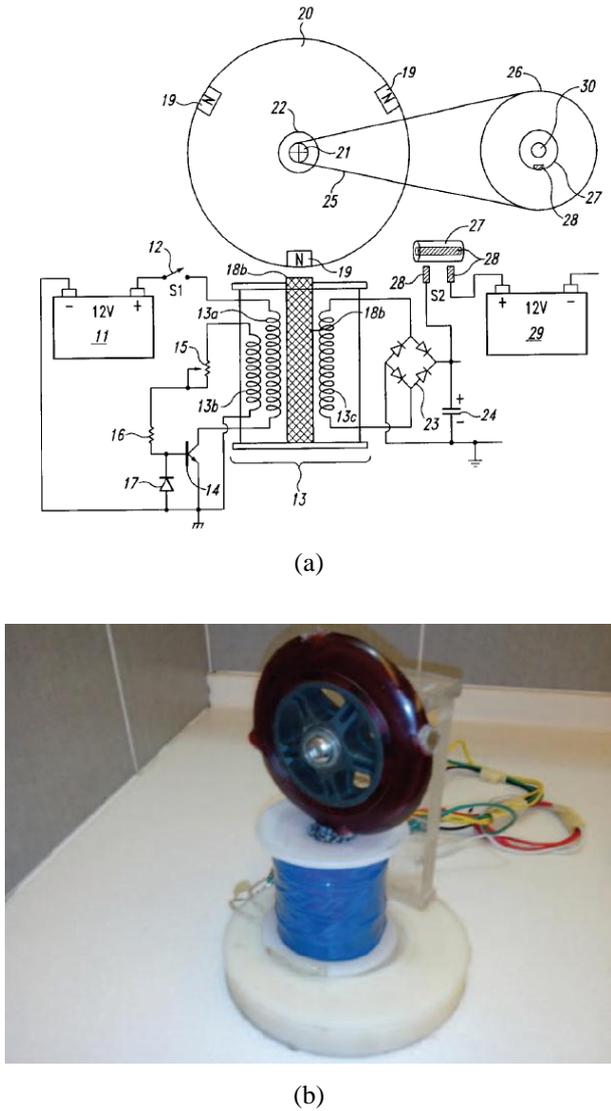
(a)

(b)

Fig. 2 Bedini generator based replication design: (a) circuit diagram [2] and (b) an example [3]

The concept used to describe operation of the Bedini generator is a principle of Nikolas Tesla [7]. The principle utilizes the use of resonance inductive coupling effect; where magnetic fields generated from one electric system can induce electric power in closed loop inductive coils of one other system [8]. The produced ac electric power then could be used to supply the other system, or else could be converted into dc power and then stored in the backup battery. This principle can describe the operation of the Bedini generator shown in Figures 1 and 2 as follows:

1. There are some magnetic sources (e.g. magnets) mounted on the wheel in suitable polarity location. These magnetic sources will generate magnetic fields.

2. When the wheel rotates, these generated magnetic fields that are close to the stationary copper coil(s) will induce electric ac current in the coil.

3. The induced electric ac current from the stationary coil then will flow to the load or convert into dc current via a rectifying electronic circuit (ac-dc rectifier) and thus is kept in the energy storage devices such as battery.

4. As long as the wheel rotates, the coil will continue generating electricity for the load/battery.

Amount of electricity generated from Bedini generators can be different dependent on several factors. In principle, electric voltage that is generated from the coil should be simply formulated from (1) and (2); which gives a result of (3).

$$v(t) = -\frac{d\phi(t)}{dt} = \frac{dL \cdot i(t)}{dt} = L\frac{di(t)}{dt} \qquad (1)$$

$$L = \frac{N^2 \mu_o \mu_r A}{l} \qquad (2)$$

$$v(t) = \frac{N^2 \mu_o \mu_r A}{l} \cdot \frac{di(t)}{dt} \qquad (3)$$

; where

$v(t)$ = instant voltage in V

$\phi(t)$ = instant magnetic flux in webers

$i(t)$ = instant current in A

L = static inductance of the coil in Henry

N = number of turns of the coil (unit in Turns)

μ_o = absolute permeability of free space

$\qquad (4\pi \times 10^{-7}$ T-M/At)

μ_r = relative permeability of the coil in T-M/At

A = area of the coil in square meters

l = average length of the coil in meters

A number of research works on efforts to understand effects of those factors in (3) on capability of electricity generation have been widely studied for the generators [9]-[12]. However, the studies on the factors for the Bedini generators are in fact very limited; especially, the study on the other parameter such as the coil size (diameter of wires) has not been existed. This paper therefore presents effects of stationary coil size on capability of electric power generation for the replication design Bedini generator. Detailed structure and operation of the constructed generator are firstly proposed in the Methodology section (Section 2). The description on experimental test scenarios, the test results and discussion on the results then are shown in the Results section (Section 3). Finally, the core findings and important notes on this research are summarized in the Conclusions section (Section 4).

2. Research Methodology

2.1 Construction of Bedini Generator Test-Rig

In order to study effects of stationary coil size on capability of electric power generation of the Bedini generator, a Bedini generator test-rig based the replication design configuration proposed in [2] was reconstructed; having photograph as shown in Fig. 3. The generator test-rig consists of 6 parts: (1) base, (2) rotating wheel, (3) stationary coil, (4) rectifier circuit, (5) control circuit, (6) regulating circuit and (7) two batteries.
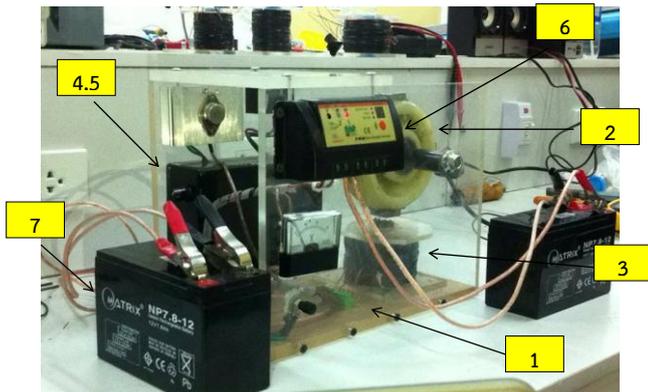

Fig. **3** Constructed Bedini generator used for this research

2.2 Operation of Test-Rig

According to Fig. 3, most of the test-rig's components were mounted on the base (1) which covering with a safety guard. When the rotating wheel (2) that contained magnetic bars mounted on it rotated, the stationary coil (3) will generate electricity. The rectifier (4) then converted the generated ac power into dc using control signal from the control circuit (5). The output dc power then was regulated by the regulating circuit (6) that provided suitable output voltage level for the battery (7). It is noted that one of batteries was used as the electric sources and the other was used as the energy storage.

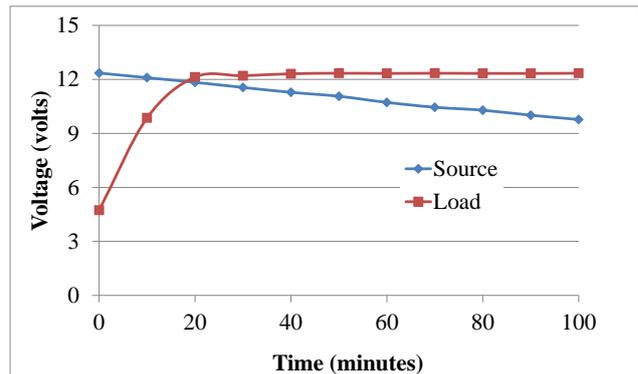## 3. Results and Discussions

3.1 Characteristics of Electrical Outputs

Figs. 4 (a)-(c) show the characteristics of the electrical output voltage, current and power of the generator test-rig, respectively. It can be seen from the figures that:

1. The output voltage of the battery source decreased (12.35 to 9.77V) with respect to the increase of operating time (0 to 100 minutes) while output voltage of the battery load increased rapidly (4.73 to 12 V) during the start time interval (0 to 20 minutes) and then stayed constant at around 12 V.

2. The output current of the battery source decreased (2.30 to 1.51 A) with respect to the increase of operating time (0 to 100 minutes) while output current of the battery load increased continuously (0.77 to 1.00 A)
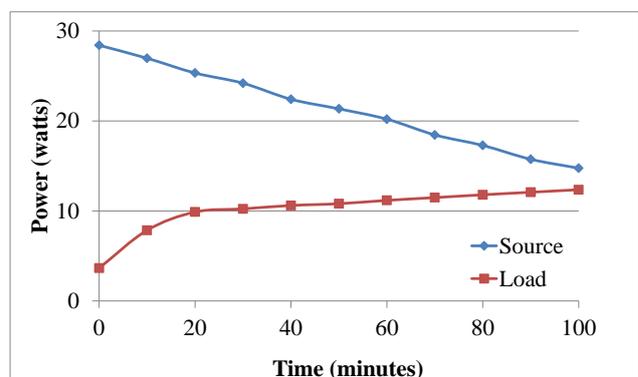
3. The characteristics of the power generated by the generator were similar to one of the output current. The output power of the battery source decreased (28.4 to 14.8 watts) with respect to the increase of operating time (0 to 100 minutes) while output power of the battery load increased continuously (3.7 to 12.4 A).


(a)
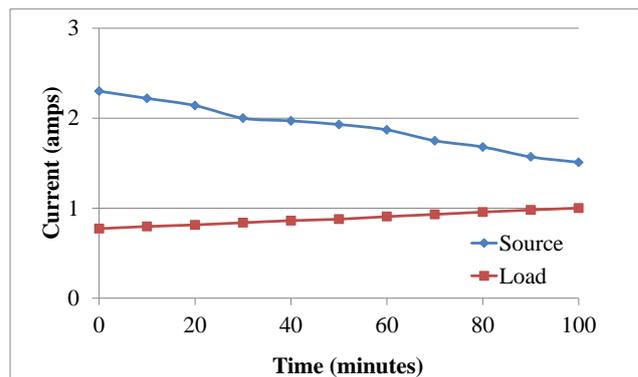
(b)

(c)

Fig. 4 Characteristics of electrical outputs of the Bedini generator test-rig: (a) output voltage, (b) output current and (c) output power

### 3.2 Comparison of Electric Power Generation for Different Coil Sizes

Fig. 5(a)-(c) show comparison of electric voltage, current and power generated from the generator test-rig, respectively, when most commonly used insulated copper coils, AWG 20, 21, 22 and 23 (diameters of 0.812, 0.723, 0.644 and 0.573 mm) were used in the experimental tests while number of turns (N) for all the coils were the same (520 turns).
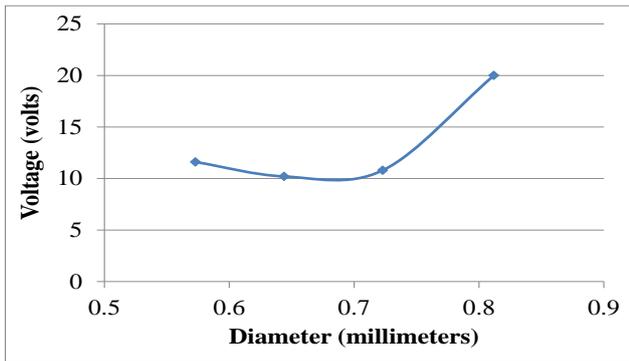
(a)
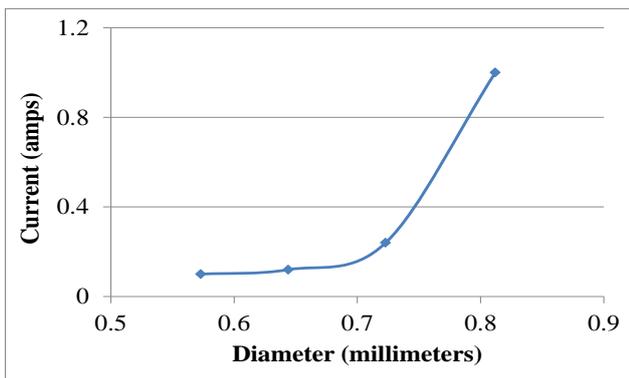
(b)
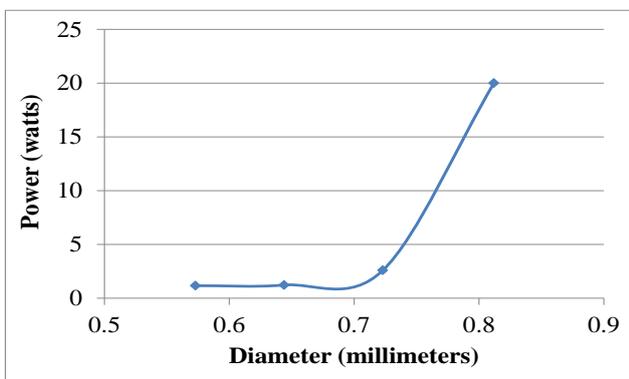
(c)

Fig. 5 Comparison of outputs for different sizes (diameters) of induction coil: (a) output voltage, (b) output current and (c) output power

It would be concluded from the results shown in Figs. 5 that:

1. Coil AWG20 generated significantly high electric voltage (20V) compared to coil AWG21-23 (10.2-11.6 V); which was approximately 1.96-1.72 times higher.

2. Coil AWG20 generated significantly high electric current (1.0A) compared to coil AWG21-23 (0.1-0.24 A); which was approximately 5-10 times higher.

3. The output power curve profile of the coils are similar to the output current, where the coil AWG20 generated significantly high electric power (20W) compared to coil AWG21-23 (1.16-2.59 A); which was approximately 9.25-10.24 times higher.

4. Conclusion

Effects of stationary coil size on electricity generation of the Bedini generator based replication design have been presented in this paper. Different sizes of the coils with insulated copper coils no. 20, 21, 22 and 23 AWG (diameters of 0.812, 0.723, 0.644 and 0.573 mm) were used in the experimental tests. The results showed that the copper coil no. 20 that is the largest size among the group generated highest output voltage, current and power by 1.96-1.72, 5-10 and 9.25-10.24 times higher when compared to coil no. 21-23. These results showed a non-relationship between generated electric properties and no. of copper coils in terms of diameters when using these coils as stationary coils of the Bedini generator. Deeper consideration in terms of physical behaviors of the induction process due to the size of the stationary coil should be therefore noted for the future work.

5. Acknowledgement

6. References

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Bibliography

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