Characteristics of DC Power Output from an Inverter Driven by Sharp Spike Pulse

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Introduction

The author has developed a number of inverter prototypes which are designed so as to take advantage of the unique property of positive EMF, although it has not yet become a common concept of the conventional electromagnetics. The purpose of the research discussed in this paper, is set on to determine power efficiency of such an inverter system. On the other hand, the phenomenon of positive EMF has been discovered by the author in a series of the research activities made during the last two decades. Almost all information on the research made so far on the related themes, whichever it is theoretical and experimental, is reported in the four references cited in the end of this paper [1,2,3,4].

It is conventionally well known that the phenomenon of so-called "electromagnetic induction" to generate EMF, was discovered by Michael Faraday. It has become one of the basic principles of today's electromagnetism. It is almost impossible to ignore EMF for people who are engaged in the electromagnetics related industries in the world who manufacture electromagnetic units, instruments, devices and so on.

Now, Faraday's EMF is expressed as the term of the first-order time derivative of the magnetic flux equation. The term has a coefficient of negative sign, meaning that it acts in the direction reverse to that of the magnetic flux. This is the reason why it is usually called as "back EMF". In contrast to it, "positive EMF" will be caused when magnetic flux changes very sharply, and it acts in the direction reverse to that of Faraday's EMF. In other words, "Positive EMF" that acts in the positive direction of the magnetic flux, is caused when the value of the second-order time derivative of magnetic flux is not zero. "Positive EMF" is the provisional name that the author currently uses. Because the positive EMF is a phenomenon that is independent of Faraday's EMF, it must be added as a new independent term of the electromagnetic differential equation to express EMF in it (See Eq. 13 in [2]).

Taking it for granted that the phenomenon of "positive EMF" really exists, it is presumed that when very sharp-spike form pulse is input to the primary coil of an inverter, positive EMF will be caused there, and the input current will be accelerated and a considerably higher value of EMF which cannot be explained by Faraday's law, will be resulted.

The author thinks in that way that the phenomenon supposed to be caused by positive EMF, frequently occurs here and there and from time to time on a variety of electromagnetic devices and instruments, including transformers, generators and motors which exist in the real world, although it may be in a negligible small level in most cases. And as the matter of fact, almost all electrical engineers and technicians have been ignoring it so far, as electric noise that is meaningless or of nuisance to be engineered out of the system.

Since the year 2000, the author has been engaged in developing a number of inverters which are designed so as to take advantage of the features of the phenomenon. Finally in the beginning of 2010, the author succeeded in the development of an inverter whose transformer is driven by spike form pulse, to bring about output AC power exceeding that of input. Based on the result, the author realized that it is unexplainable of such a phenomenon to occur on such an inverter, only according to the conventional back EMF that is discovered by Faraday. Namely, the author presumes that there must be another factor involved around there in order to generate the extra current, and that the related factor is very likely to be “positive EMF” [3,4].

The most interesting point of this research would be to check the possibility of development of a self-excited type of inverter which requires no input power to be supplied at all from an outer source, by means of feeding DC output power from the inverter, back as the DC input power of the inverter. The purpose of this paper is to report its possibility. In the experimental results, the value of the power efficiency ratio exceeds 100%, although it is less than that calculated AC output value, it is in the stage before applying the rectification process.

What is written in this paper covers only the matters discovered and performed in the earlier stage of the research series. But, thereafter, as the research stage advances, a number of improvements have been made on the electrical circuits of the inverter system, and the DC power efficiency ratio has been improved step-by-step, getting close to the target value calculated based on AC power output. Consequently, it might be possible to develop a self-exciting inverter.

Experimental circuits and method of research

Figure 1 shows the electrical circuit diagrams used for the experiments. Figure 2 shows an external view of the electrical circuits. The section of the experimental setup, to cover the transformer unit and the output terminals near the coil of the inverter system, is common to that is used in Reference 3 and 4. The transformer unit used for this experiment is common to that described in Reference 4. In order to check reproducibility, two sample transformers A and B which have identical specifications.

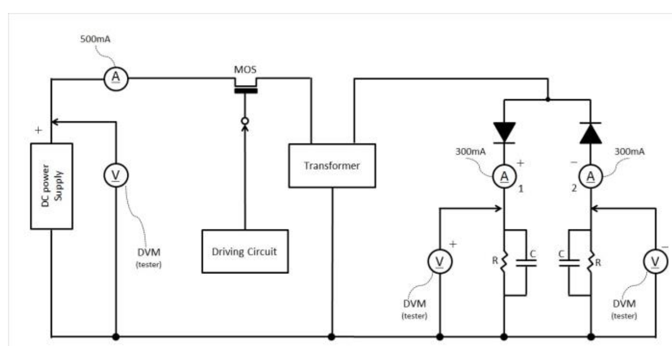

Figure 1. Experimental electrical circuits

Each of the positive and negative components of AC output from the transformer is rectified independently through a half-wave rectifier which is composed of a diode, respectively, and output current of each polarity is consumed on a common load resistance R via an analogue DC ammeter.

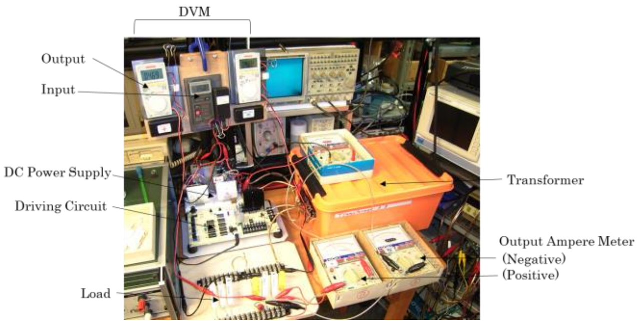

Figure 2 . Overview of the whole experimental setup

Capacitors (C=10 μF) are connected in parallel at the both ends of each load, in order to eliminate the voltage ripple. The output DC voltage is measured between the both ends of the load resistance using a digital voltage meter (DVM). DC output power of the inverter is calculated as the sum of the absolute values of the positive output power and the negative output power. For calculating the value of the input power to the inverter, the value of DC voltage of the DC power source, which is measured using a digital voltage meter, and the value of DC current of the same which is measured using an analog ammeter. The voltage V_{ps} of the DC power source may be set to either of the two values 35.0 V and 45.0 V. Namely, a total of two sets of experimental data is obtained independently for each voltage value.

Results

Figures 3 and Figures 4 show the data obtained after the experiment. Figures 4 shows power efficiency of the inverter, which is calculated based upon the experimentally measured data shown in Figures 3. Figures 3 are the experimentally measured data on DC input power to the said inverter, and DC output power from the inverter. The horizontal axis of the graph corresponds to load resistance R (Ω), and the vertical axis corresponds to DC input power or DC output power. Figures 3 & 4 correspond to measured data on input voltage from the power supply source 35.0 V (a), and 45.0 V (b), respectively.

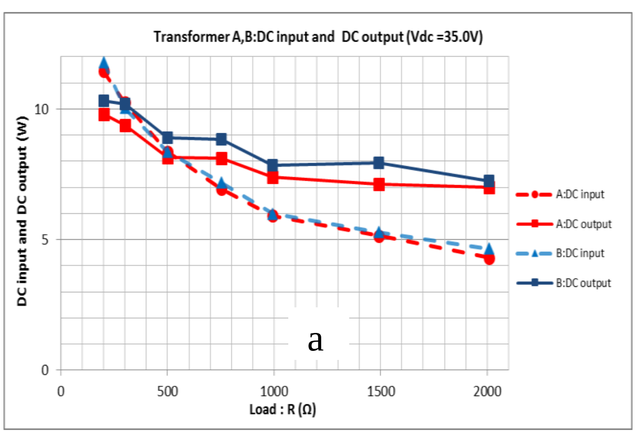

Figure 3(a). DC input power and DC output power (W) versus load resistance (Ω)

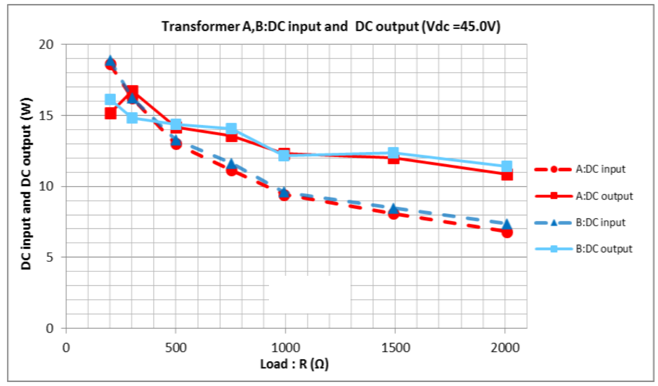

Figure 3 (b). DC input power and DC output power (W) versus load resistance (Ω)

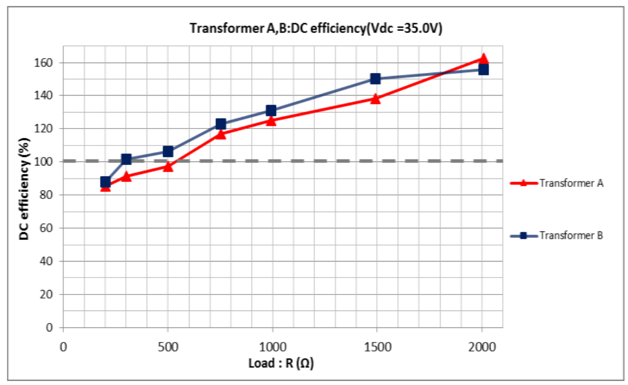

Figure 4 (a) . Power efficiency (%) versus load resistance (Ω)

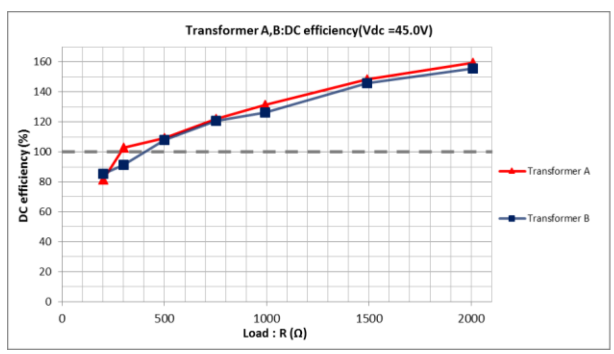

Figure 4 (b) . Power efficiency (%) versus load resistance (Ω)

In order to check that the reproducibility is kept in every aspect of the experiment, a set of two transformer A and transformer B whose engineering specifications are identical, are introduced so that they may replace each other's position. In either case, it is indicated that DC output power exceeds input DC power, when the value of the load resistance becomes larger than a certain value between 300Ω and 500Ω.

Considerations

In reference 3, the data on the power efficiency of an inverter to be driven in the same condition as defined in this paper, although the specifications are different, it is given. In that case [3] the measurement is made using power analyzer PZ4000 (Yokogawa), the DC input power is led to the load resistance in the form of AC. The maximum power efficiency observed is approximately 250% with the load resistance (R) of 1000 ohms.

In contrast to those results, power efficiency due to DC output, which is measured this time for this report, is 130% with the same value of load resistance of 1000 ohms as the above. The difference of the value from that reported in [3], is not small. The power lost in the diode due to rectification, which is caused particularly in the high frequency range, is generally considered the cause. If this supposition is correct, temperature of the diode must increase to a considerable extent. However, such phenomenon has not been observed yet in a series of experiments made for this report. A kind of cold current like proposed in [7], coexisting with the standard electrical current might be induced and flowing in this circuit. The reason why power efficiency calculated based on the value of DC output, is considerably smaller than that is calculated based on the value of AC output, has not yet been identified.

In Figure 5, the horizontal axis corresponds to load resistance R, and the vertical axis corresponds to the absolute value of output current of either positive or negative polarity, each of which is shown independently. In Figure 5, it is observed as a general tendency that absolute values of positive output current at a value of load resistance R, is not equal to that of the counterpart negative output current at the same value of it, in the almost whole range of the horizontal axis. There exists only one point where the absolute value of positive output current becomes equal to that of negative output current, in every case. In another words, there is point where the sign of the difference between the two absolute values is reversed. The reason has not been clarified, but it is empirically known that such a point is likely to exist around the value of the load resistance R where the power efficiency becomes nearly 100% (See Figure 4). We could regard such a value as a kind of threshold. Namely, if the value of load resistance is smaller than the threshold value, the power efficiency corresponding becomes lower than 100%, and if it is greater than it the power efficiency corresponding becomes greater than 100%. Although the reason why such a phenomenon occurs, is unknown again, it is definitely a theme that is too interesting to ignore.

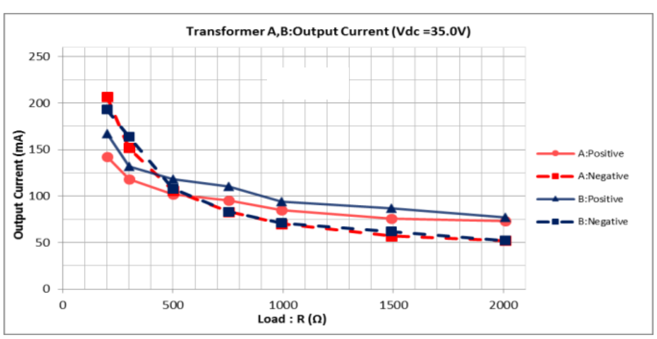

Figure 5 (a). Absolute values of either positive or negative output current (mA) versus load resistance R (Ω)

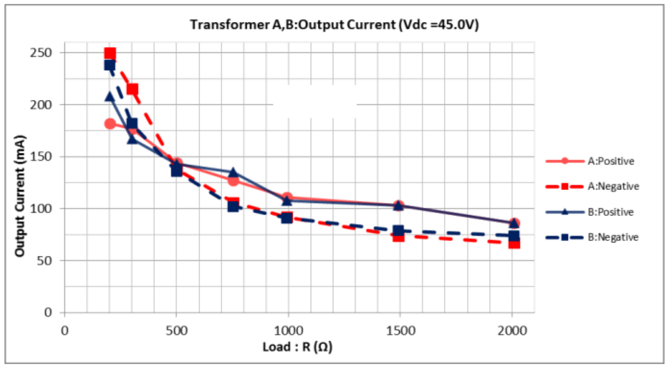

Figure 5 (b). Absolute values of either positive or negative output current (mA) versus load resistance R (Ω)

After an in-depth examination on the reason why there is a difference between the absolute value of positive output current and that of negative output current, it is presumed that AC output having DC component should have been generated in the secondary coil of the transformer. In the case of an ordinary inverter, no DC component will be observed in the output coil of a transformer. The author's very bold speculation is that electric charge of either positive or negative polarity, have been generated in the secondary coil of the transformer, by any reason. In the case that this speculation is correct, it will automatically stand in the situation contradictory to the fundamental laws of the electromagnetics that allows no electric charge to be generated. [8], [9]

Conclusions

After converting AC output from an inverter which is driven by current in the form of spike pulse wave of high repetition rate, to DC current via a rectification circuit, DC output power is measured on a load resistance in which the output DC current runs. Furthermore, the power efficiency is calculated as the ratio of the DC output power to the input DC power supplied to the inverter.

As a result, the followings points have become clear:

1. In the electrical circuits which are integrated in the experimental setup, power efficiency calculated based on DC output is considerably lower than that calculated based on AC output.
2. If the value of load resistance R, which is connected to the secondary coil of the transformer, becomes larger than a certain threshold value of load resistance, the DC power efficiency exceeds 100% to bring about a state of hyper-efficiency.
3. As for the output AC current from the inverter, when

rectified, the absolute values of output DC current of positive polarity will not generally become equal to that of negative polarity, except for a certain range of value of load resistance.

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