Realization of bidirectional response from a part of magnetic circuit due to d.c excitation

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Abstract—**Based on the theory of electromagnetic induction, a new method for obtaining alternating triangular voltage waveform across a secondary winding in a newly designed transformer change in position of core based on mutual induction is proposed when a d.c supply applied across a primary side of a transformer. This paper discusses the calculation of the flux position and the realization of the alternating triangular voltage waveform. The reasonability and validity are verified by the mathematical modulation for a ferromagnetic material is used .This method offers a new thinking for designing and modeling of transformer which is able to provide a secondary voltage.**

*Keywords—**mutual induction; field orientation;*** **alternating triangular voltage waveform; ferromagnetic core.**

I. INTRODUCTION

Within the Power Engineering option of the Electrical Engineering and applied science curriculum, it is quite common to need a power transfer from one circuit to isolated another circuit in a complex a.c/d.c network. In this scenario, a.c power power is transfered in the form of high voltage and low value of current or low voltage and high value of current by transformer. It works on mutual induction principle but it can not provide the response in a secondary side when primary is excited by d.c supply because it violate faraday's law of induction. Transformers are normally designed for operation with a sinusoidal input voltage. Today there is growing concern over the increasing number of cases where primary voltage would be different categories and changes can be made at the secondary.

The purpose of this paper is to describe the Triangular voltage wave form at a secondary when a d.c applied on a primary side of a transformer. The conventional approach of this paper is to design a theoretical model of a transformer. In this approach ferromagnetic material used in a core and it devides into two sections in which one section remains static containing primary winding and other changes the position regularly containing secondary winding, both are physically isolated without fringing effect with fine air gap.

II. MAGNETIC CIRCUIT AND OPERATION

Transformer device is the application of magnetic circuit containing magnetic core of mean length l_C and a cross sectional area A_C as shown in the fig.1 below. The permeability of the core material is μc. Assume that the size of the device and the operation frequency are such that the displacement current in Maxwell's equations are negligible, and that the permeability of the core material is very high so that all magnetic flux will be confined within the core. By Ampere's law

$$\oint H.dl = \oint J.da$$

we can write $H_C l_C = Ni$

where H_C is the magnetic field strength in the core and Ni the magneto motive force. The magnetic flux through the cross section of the core can expressed as $\Phi = B\,A$

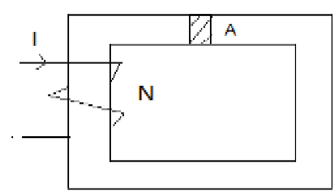

Figure 1. Magnetic Circuit

It is very well known that a transformer is not able to transfer electrical power to the other circuit in case of d.c but in this approach core is devided into two sections shown in fig.2 both will comprise a magnetic circuit in which left part will excited by a d.c voltage source then core will non linearly magnetize upto saturation when core is created by ferromagnetic material no voltage occur across secondary side because in this case flux should be constant but energy stored in the form of magnetic now right section of the core is shifted then during shifting process right section will demagnetize non linearly due to the property of the core it reaches the residual magnetization when second section reaches upto like a fig.3 so flux changes non linearly which is the cause of voltage induced across secondary side after demagnetization of the right section it will again magnetize upto saturation. then again shifted like a fig.2 during shifting process right section will demagnetize non linearly again upto it reaches like a fig.3 so flux changes non linearly which is the cause of voltage induced across secondary side during demagnetization process but this time the appositive polarity will occur at secondary terminal so one cycle of oscillating voltage will get at secondary.

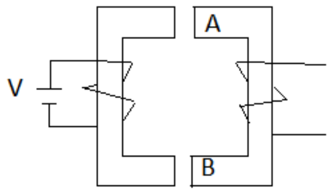

Figure 2. Original position of Second Section of the core

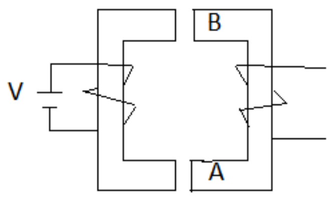

Figure 3. Second position of second section of the core

III. RESULT AND ANALYSIS

The nature of Secondary waveform depends upon time taken the right section of the core to change the position from fig.2 to fig.3 or vice versa. Following types of output waveform may occur at the secondary shown in fig.4 & fig.5 .In fig.4 time of complete demagnetization of the core should be equal to time taken by right section of core to change the position from fig.2 to fig.3 or vice versa but in waveform fig.5 time of complete demagnetization of the core should be less than to time taken by right section of core to change the position from fig.2 to fig.3 or vice versa.

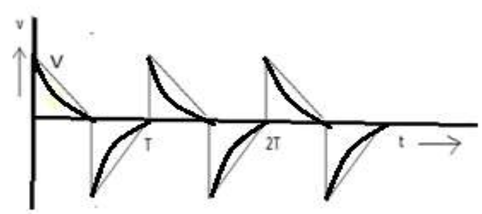

Figure 4. Output wave form

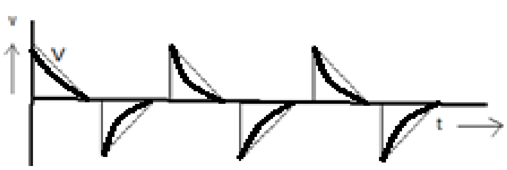

Figure 5. Output wave form

Equivalent circuit diagram of this type of transformer shown in fig.6 and fig.7 both positions.

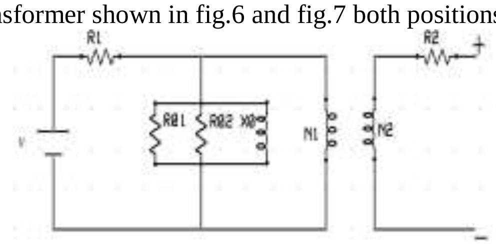

Figure 6. Equivalent circuit diagram of fig.-2

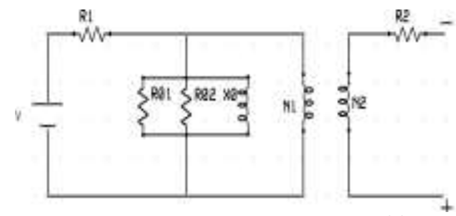

Figure 7. Equivalent circuit diagram of fig.-3

Where
R1 = primary winding resistance
R2 = secondary winding resistance
R01 = core loss component
R02 = air gap loss component
X0 = magnetization component

IV. CONCLUSIONS

This paper has described a bidirectional response at the secondary side if we are applying d.c independent source across primary side if right section of the ferromagnetic core is shifted from one position to other or vice versa. if it is shifted automatically after regular interval of time than bidirectional response more efficient and symmetrically. The package utilizes a primary energy is transformed to the secondary circuit in the form of oscillating.

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REFERENCES

[I] J.D. Laern & Cheung, "A software package for the steady state and dynamic simulation of induction motor drives" IEEE Transactions on Power Systems, Vol. PWRS-1, No. 2, May 1986

[2] Harmonics from SVC Transformer Saturation with Direct Current Offset IEEE – Vol 9 N° 3 , July 1994 – BC Hydro – Canada.