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BRAKING OF DC MOTORS USING ELECTRICAL REVERSE VOLTAGE SUPPLY

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ABSTRACT

This paper presents the electrical performance of DC chopper loaded by large DC motor and large batteries of different sizes or connected with DC supply in series with it. The motor is represented by an inductor where the battery is represented by different values from 12v to 108v. The DC source supplied the load has a value of 110v.The load motor can be connected with a different DC supply series with it in spite of batteries. The aim of this research is the use of an injected DC supply connected in series with the large motor for protection purpose. The results of this research can be applied for the protection of motors at standstill conditions without the interruption of the power supply of the motor. The research illustrates that batteries are preferred than the DC supply. This research is applied in solar energy laboratory on filling machine. It may be used for filling any liquids in bottles automatically. A microcontroller programmed and operates as a control of the filling process. The DC motor under investigation represents the drive of the controlled filling machine. An electronic circuit is designed with microcontroller construct the filling machine controller.

Keywords: Microcontroller, Photovoltaic, Solenoid Valve،DC Motor.

INTRODUCTION

The control of electric power with power electronic devices has become increasingly important over the last 20 years. Whole new classes of motors have been enable by power electronics, and the future offers the possibility of more effective control of the electric power grid using power electronics. The modern of power electronics began with the introduction of thyristors in the late 1950s. Now there are several types of power devices available for high-power and high-frequency application [Skvarenina,T.L 2002].

The most notable power devices are gate turn-off thyristors, power Darlington transistors, power MOSFETs, and insulated-gate bipolar transistors (IGBTs). Power semiconductor devices are the most important functional elements in all power conversion applications. The power devices are mainly used as switches to convert power from one form to another. They are used in motor control systems, uninterrupted power supplies, high-voltage DC transmission, power supplies, induction heating, and in many other power conversion applications(Agrawal J.P 2011- Venkat,R2007).

Through this paper, Different levels of voltage are `supplied to the load using the Chopper. The illustration of the effect of voltage levels to the load is illustrated. The effect of frequency levels upon the performance of the Chopper circuit is presented. The DC Chopper output current is analyzed at different duty cycles is illustrated. The effect of changing frequency is presented through the paper. Chopper drives are used all over the world in traction applications such as battery electric vehicles and mass rapid transit systems. A DC chopper is connected between a fixed-voltage DC source and a DC motor to vary the magnitude of the armature voltage. In addition to armature voltage control, a DC chopper can provide regenerative braking of the motors and can return energy back to the supply [Moghbelli. H. and G. Hanas 2003]. The chopper system can offer several operational benefits over conventional means of rectification. Such benefits include [Urban 2008]:

* Fast dynamic response.
* Low output ripple.
* High line power factor over the entire power range without power factor correction capacitors.
* Minimal harmonic distortion of the AC power Feeder without the use of harmonic filters.
* High system efficiencies over the total output power range.
* Reduction in overall system size and cost. IGBT chopper systems are increasingly being used in high current electrochemical applications (Maniscalco*, et al* 2009].

Chopper system costs are competitive with that of the thyristor rectifier systems. As the market for high current Chopper systems continues to mature, their costs are likely to continue decreasing[Scaini. V and T. Ma 2010]. The output voltage of a buck chopper is determined by:

$$V_o = M \times V_i$$

Where Vo is the output voltage, Vi where is the input voltage and M is the duty cycle of the PWM waveform. If two or more choppers are operated in parallel and are phase shifted from each other, the amplitude of the load current ripples decreases and the ripple frequency increases [Beck. P 2007]. A dc chopper converts directly from dc to dc and also known as a dc to dc converter. It is considered as a dc equivalent of an AC transformer with a continuously variable turn's ratio. It can be used to step down or step up a dc voltage source (Singh, K .B. K. M 2008).

This paper represents how to design a safety electrical break for any DC motor especially the motor used with the DC-DC converter circuit. The effect of *ON* time upon maximum current of the DC-DC converter is illustrated.

Load Specification:

a-Driving Motors:

The DC motor used as a load on the DC control circuit has specification of R= 0.25Ω, L=1mH .The control circuit is supplied from power supply of 110v. The injection supply used for the protection of the DC motor can be used as batteries of another supply of different values in the range of $12 \le V_{inj.} \le 108$.The injection supply must be not increased about power supply value. The previous specifications are used as an example only. The research strategy can be applied with all DC motors and injected supplies of any different values.

b-**Filling Machine**:

The filling machine is mechanical design to achieve the filling of any liquid in bottles. The machine drives by two DC motors have specifications in item (A).

The motors functions are as follows:

- The first motor is required for pumping the liquid from the lower reservoir to the upper one which install upper the bottle levels. The photo of DC motor connected with pump is shown in fig.(1)
- The second motor moves the bottles under the solenoid valve which controlled by electronic circuits to fill the bottles.

The bottles support on the belt designed for this purpose. Fig (2) illustrates the photo of the filling machine.

Fig.(1) : The photo of the DC motor connected with pump.

Fig.(2) : The photo of the filling machine.

Solenoid Valve:

The filling machine contains solenoid valve to control the flow rate of the liquid to the bottles. The control of the solenoid valve is achieved by trigger circuits designed and connected to the valve.

A solenoid valve is an electromechanical device used for controlling liquid or gas flow. The solenoid valve is controlled by electrical current, which is run through a coil. When the coil is energized, a magnetic field is created, causing a plunger inside the coil to move. Depending on the design of the valve, the plunger will either open or close the valve. When electrical current is removed from the coil, the valve will return to its de-energized state. In direct-acting solenoid valves, the plunger directly opens and closes an orifice inside the valve. In pilot-operated valves (also called the servo-type), the plunger opens and closes a pilot orifice. The inlet line pressure, which is led through the pilot orifice, opens and closes the valve seal.

The most common solenoid valve has two ports: an inlet port and an outlet port. Advanced designs may have three or more ports. Some designs utilize a manifold-type design. Solenoid valves make automation of fluid. Modern solenoid valves offer fast operation, high reliability, long service life, and compact design. The photo of the solenoid valve is shown in following figure (3), while the specifications are tabled in table (1).

Fig. (3) : The photo of the solenoid valve .

Table (1): The specifications of the solenoid valve:

Characteristic	**Specifications**
Made (NTC)	Italy
Type	601
DCV	12 /24
Watt	13
Inlet (Inch)	0.5
Outlet (Inch)	0.5

System Connection Diagram:

The block diagram of the DC control system is illustrated in Fig.4. The DC chopper system contains main supply, power switch, load, injected protected supply, blocking diode and the triggering circuits system. The preferable power switch that must be used with the large power motor is a thyristor instead of another. The thyristors have large values of reverse voltage but other switches can be destroyed by very small reverse voltage. The blocking diode is used for discharging the stored energy in the motor coils during the interruption of the power supply of the motor. The injected protected supply can be used as a batteries or DC supply connected in series with the motor. The purpose of using this supply is the protection of the large load motor used. The triggering circuits are used for controlling the load motor. This circuit are analyzed and designed throughout the next chapter where the DC chopper application.

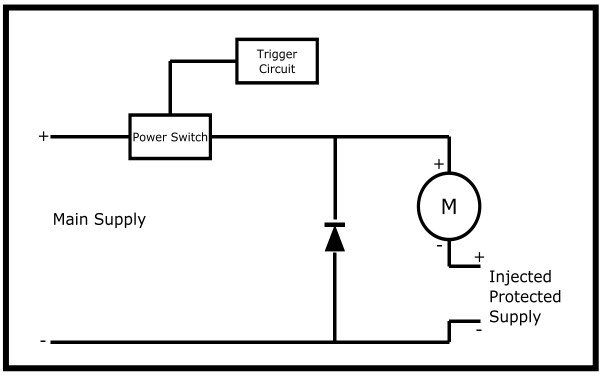

Fig. 4: **Block Diagram of DC chopper system connected with injected protected supply.**

DC Control Circuits Used:

Fig. 5a illustrates the basic principles of a type A chopper, in which both *Vo* and *Io* can only be positive. In that circuit diagram, the thyristor symbol enclosed in a circuit represents a thyristor that my be turned on and commutated by means of circuit elements not included in the diagram; D_1 is a free-wheel diode. Two possible conditions of operation are illustrated in Fig. 2b and c, where it is assumed that the control is by means of frequency modulation.

In Fig. 5b the load current i_o is discontinuous, so that during the interval for which i_o is zero, $\upsilon_o = Vc$. In Fig. 5c, the periodic time *T* has been reduced to such an extent that i_o has not ceased to flow before Q_1 is again turned on. As a consequence, the output voltage υ_o consists of a train of rectangular pulses of magnitude *V*. An increase of load circuit inductance *L* or a reduction of *Vc* would also tend to result in a continuous output current.

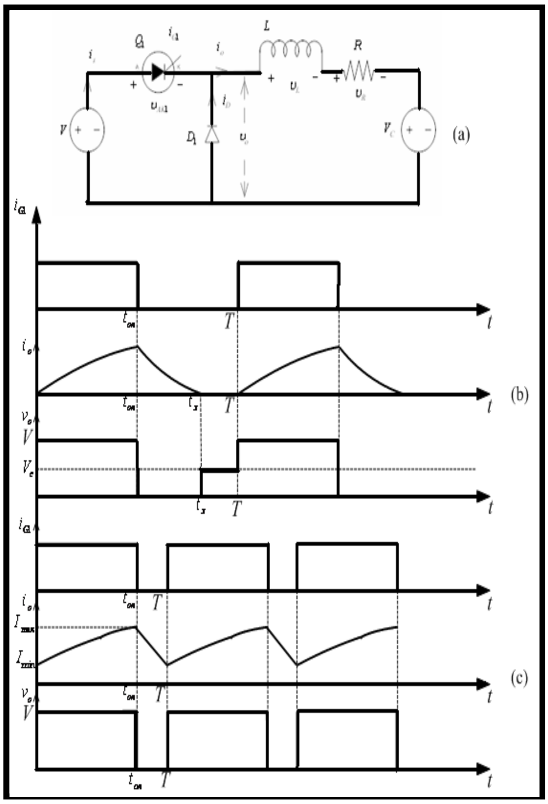

Fig. 5 : Basic of Principle a Type A Chopper.

Power Circuit Analysis of type a DC Chopper:

It convenient to start by considering the case of continuous current operation illustrated in Fig.5c. In the circuit of Fig.5a,

$$-\upsilon_o + \upsilon_L + \upsilon_R + Vc = 0 \qquad \text{.............................. ....(1)}$$

Where

υ_o = output voltage

υ_L = inductance voltage

υ_R = resistance voltage

Vc = DC source

from which

$$\frac{di_o}{dt} + \frac{R}{L} i_o = \frac{\upsilon_o - Vc}{L} \qquad \text{A/s ....(2)}$$

i_o =output current

When thyristor Q_1 is turned on at $t = 0$, then at $t = 0^+$, υ_o =V, and i_o =I_{min}.

From equation 2 and these initial condition,

$$i_o = \frac{V - Vc}{R}\left(1 - \varepsilon^{-t_{on}/\tau}\right) + I_{\min}\varepsilon^{-t_{on}/\tau}$$ A.......................... (3)

$0 \le t \le t_{on}$

$I_{\min}$ =minimum current

t_{on} = on time

$$\tau = \frac{L}{R}$$ ....(4)

At $t=t_{on}$, when Q_1 is commutated.

$$I_{\max} = i_o = \frac{V - Vc}{R}\left(1 - \varepsilon^{-t_{on}/\tau}\right) + I_{\min}\varepsilon^{-t_{on}/\tau}$$ A.........................(5)

$I_{\max}$ = maximum current

and since υ_o then become zero. Due to condition of the free- wheeling diode D_1.

$$\frac{di_o}{dt} + \frac{R}{L}i_o = -\frac{Vc}{L}$$ .... (6)

Where

$$t^{`} = t - t_{on} \text{ s}$$ .... (7)

At $t^{`} = 0^+$, $i_o = I_{\max}$

$$i_o = \frac{-Vc}{R}\left(1 - \varepsilon^{-t^{`}/\tau}\right) + I_{\max}\varepsilon^{-t^{`}/\tau}$$ A: $t_{on} \le t \le T$ ....(8)

T=time period

At $t^{`} = T - t_{on}$, or $t=T$, $i_o = I_{\min}$

$$i_{\min} = -\frac{Vc}{R}\left(1 - \varepsilon^{-(T-t_{on})^{`}/\tau}\right) + I_{\max}\varepsilon^{-(T-t_{on})^{`}/\tau}$$ .... (9)

Solution of previous equations we get

$$I_{\max} = \frac{V}{R}\frac{\left(1 - \varepsilon^{-t_{on}/\tau}\right)}{\left(1 - \varepsilon^{-T/\tau}\right)} - \frac{Vc}{R}$$ A......................................(10)

$$I_{\min} = \frac{V}{R}\frac{\left(\varepsilon^{t_{on}/\tau} - 1\right)}{\left(\varepsilon^{T/\tau} - 1\right)} - \frac{Vc}{R}$$ A ....(11)

From previous two equations ,it will be noted that when Q_1 is continuously turned on ,so that t_{on} =T, then

$$I_{\max} = I_{\min} = \frac{V - Vc}{R}$$ A ....(12)

If t_{on} is decreased to the value $t_{on}{}^{x}$ at which $I_{min}=0$, then the converter is operating at the point of changeover from continuous-current operation, illustrated in Fig. 2b. For this boundary condition, from equation 11

$$\frac{Vc}{V}=\frac{\varepsilon^{(t_{on}^{x}/T)(T/\tau)}-1}{\varepsilon^{(T/\tau)}-1} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (13)$$

or

$$m=\frac{\varepsilon^{\rho\sigma}-1}{\varepsilon^{\sigma}-1} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (14)$$

where

$$m=\frac{Vc}{V} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (15)$$

m is ratio between main supply and DC source.

$$\rho=\frac{t_{on}^{x}}{T} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (16)$$

ρ is ratio between changeover point and time period.
σ is ratio between time period and τ.

$$\sigma=\frac{T}{\tau} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (17)$$

I_{min}=0, then from equation 5.5,

$$I_{max}=\frac{V-Vc}{R}\left(1-\varepsilon^{-t_{on}/\tau}\right) \qquad A:$$

$$0\le t^{`}\le t^{x}{}_{on} \quad s \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\ 8\ )$$

and from equation 5.8 and 5.18

$$i_o=\frac{-Vc}{R}\left(1-\varepsilon^{-t^{`}/\tau}\right)+\frac{V-Vc}{R}\left(1-\varepsilon^{-t_{on}/\tau}\right)\varepsilon^{-t^{`}/\tau} \quad A \quad t_{on}\le t^{`}\le T \text{ s}\ldots\ldots(19)$$

This current will become zero at time $t=t_x$, or $t^{`}=t_x-t_{on}$, and substitution of these and conditions in equation 19 yields

$$t_x=\tau\ln\left\{\varepsilon^{t_{on}/\tau}\left[1+\frac{V-Vc}{Vc}(1-\varepsilon^{-t_{on}/\tau})\right]\right\} \text{ s} \qquad \ldots\ldots\ldots\ldots (20)$$

Proposed Flow Chart:

Fig. 6 illustrates the proposed flow chart constructed to represent the steps of calculation through the computer. The computer software is accomplished according to the steps illustrated in the flow chart. The chart is constructed for obtaining the two mode of operation of the DC chopper, continuous and discontinuous. The effect of the injection voltage upon DC chopper performance is added to the flow chart. The computer program based upon the flow chart is constructed using mathematical program.

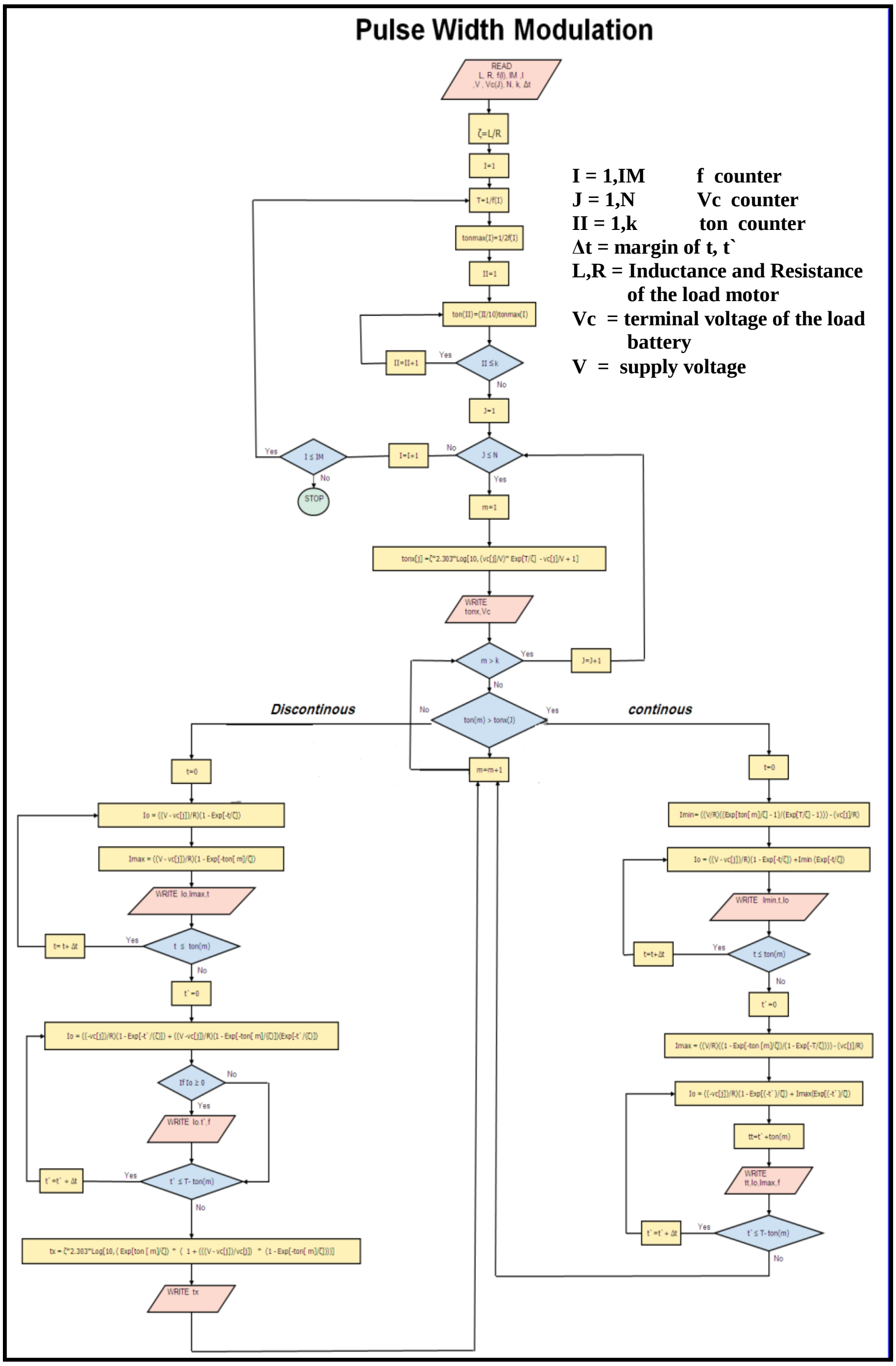

Fig. 6 : Proposed Flow Chart

RESULTS AND DISCUSSION

The results of the designed computer program are determined at chopping frequency of 100Hz. Consequently, *ton* is selected such that;

$$t_{on} < T$$

where T=1/f=0.01 sec.

then at different selected values of t_{on}, which are selected in the range of

$$0.1\frac{T}{2} \le t_{on} \le 0.9\frac{T}{2}$$

The injected protected voltage (V_{inj}) level is selected also in the range of

$$12V \le V_{inj} \le 108V$$

Hence, at one selected level of V_{inj}, t_{on} is changed within its previous range. The results obtained from the program are as follow;

1. I_{max} which represented the maximum value obtained of current at different values of t_{on} at specified level of V_{inj}.

2. *i* the instantaneous values of current at specified value of t_{on} and V_{inj}.

3. Minimum current of DC chopper determined where the chopper current becomes continuous.

t_x which illustrates the time at which the current output of the DC chopper reduces to zero value. At this instant the DC chopper current mode become discontinuous. Families of curves are obtained by using the computer program representing the two modes of operation as follow;

Figs from. 7-1 to Fig. 7- 27 represents the instantaneous DC chopper output currents at different values of t_{on}. Through all charts, the current reduces according to the decaying exponential function. The current decreases from I_{max} to I_{min} or zero. All charts represent the discontinuous current, only Fig. 7.3 illustrates to continuous mode. DC chopper operation at level of injected protected voltage of 12V. The slopes of rising of the instantaneous currents are increased according to the increase of t_{on} upon I_{max}.

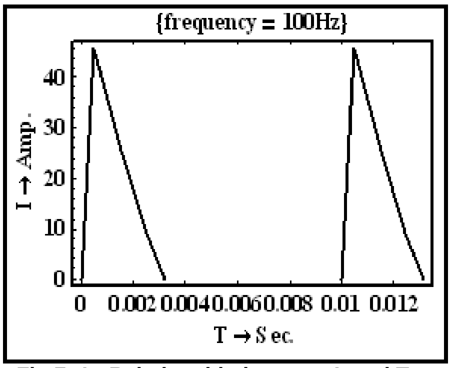

Fig.7. 1 : Relationship between I and T at VB= 12, T= 0.01, ton[m]= 0.0005.

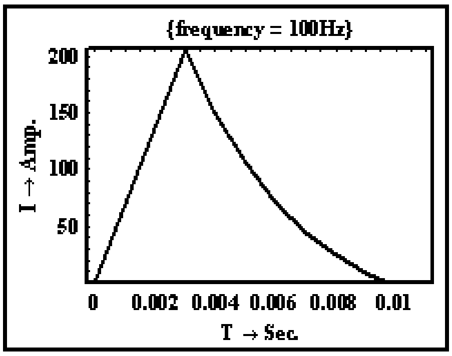

Fig.7. 2: Relationship between I and T at VB= 12, T= 0.01, ton[m]= 0.003.

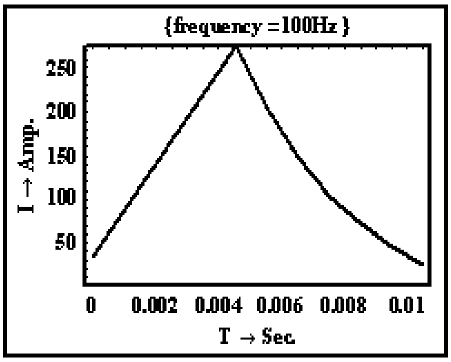

Fig. 7. 3 : Relationship between I and T at VB= 12, T= 0.01, Imin= 33.8507, ton[m]= 0.0045.

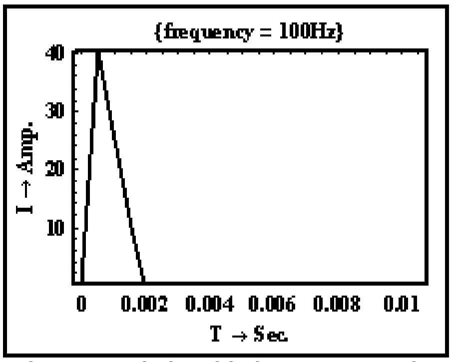

Fig. 7. 4: Relationship between I and T at VB= 24, T= 0.01, ton[m]= 0.0005.

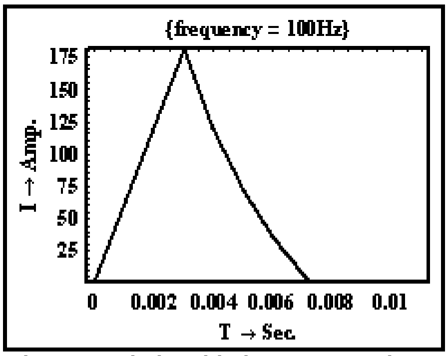

Fig. 7.5 :Relationship between I and V at VB= 24, T= 0.01, ton[m]= 0.003.

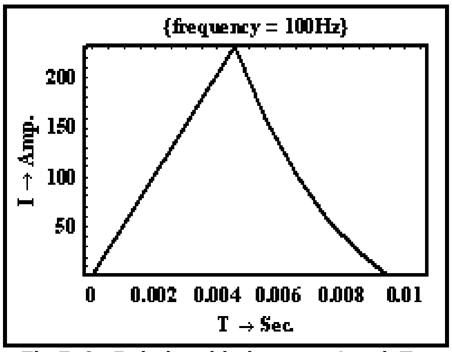

Fig.7. 6 : Relationship between I and T at VB= 24, T= 0.01, ton[m]= 0.0045.

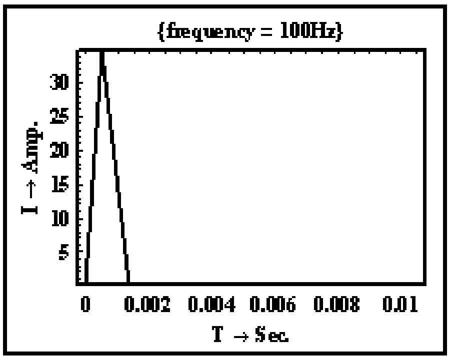

Fig.7. 7 : Relationship between I and T at VB= 36, T= 0.01, ton[m]= 0.0005.

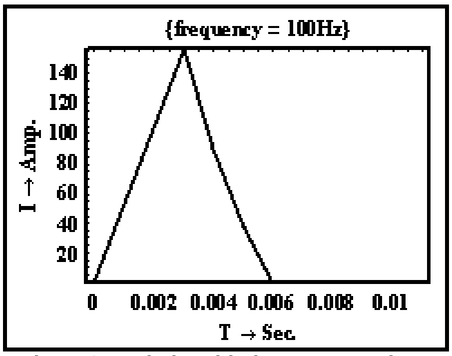

Fig. 7. 8 : Relationship between I and T at VB= 36, T= 0.01, ton[m]= 0.003.

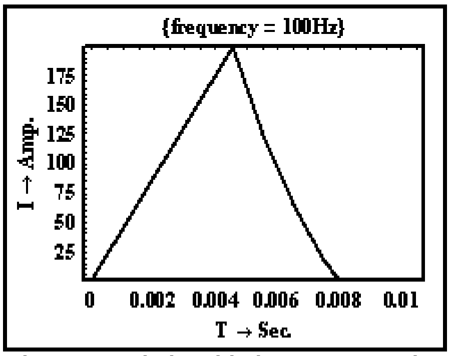

Fig. 7. 9 : Relationship between I and T at VB= 36, T= 0.01, ton[m]= 0.0045.

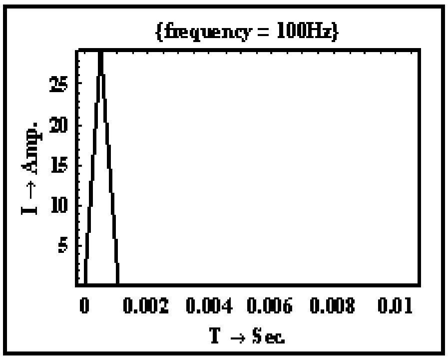

Fig. 7.10 : Relationship between I and T at VB= 48, T= 0.01, ton[m]= 0.0005.

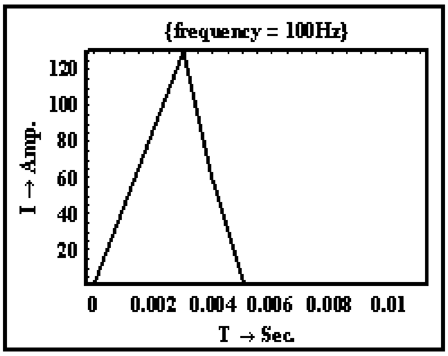

Fig. 7.11 : Relationship between I and T at VB= 48, T= 0.01, ton[m]= 0.003.

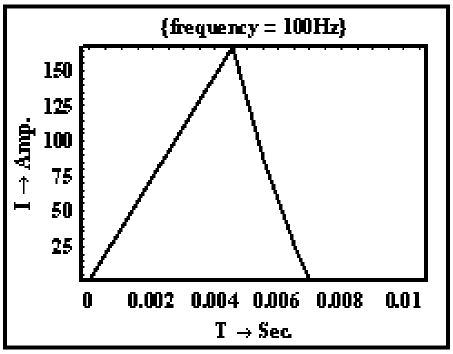

Fig. 7. 12 : Relationship between I and T at VB= 48, T= 0.01, ton[m]= 0.0045.

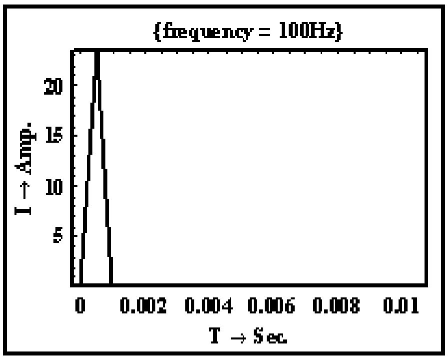

Fig 7.13 : Relationship between I and T at VB= 60, T= 0.01, ton[m]= 0.0005.

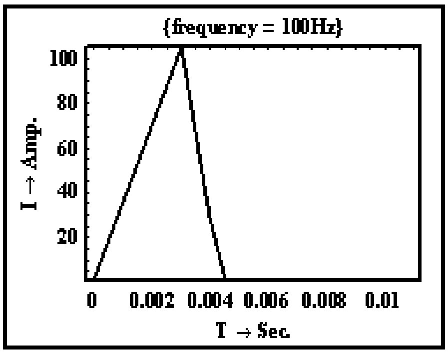

Fig. 7.14 : Relationship between I and T at VB= 60, T= 0.01, ton[m]= 0.003.

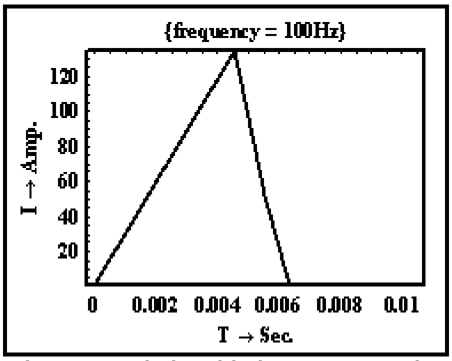

Fig.7. 15: Relationship between I and T at VB= 60 T= 0.01 ton[m]= 0.0045.

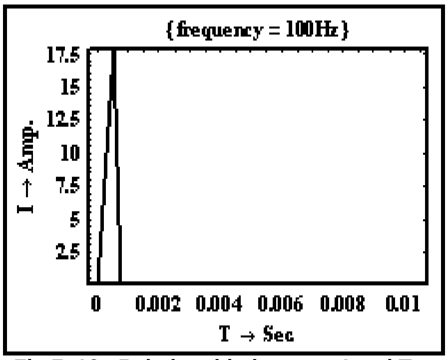

Fig.7. 16 : Relationship between I and T at VB= 72, T= 0.01, ton[m]= 0.0005.

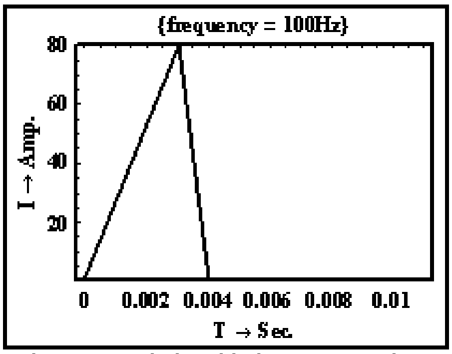

Fig.7. 17 : Relationship between I and T at VB= 72, T= 0.01, ton[m]= 0.003

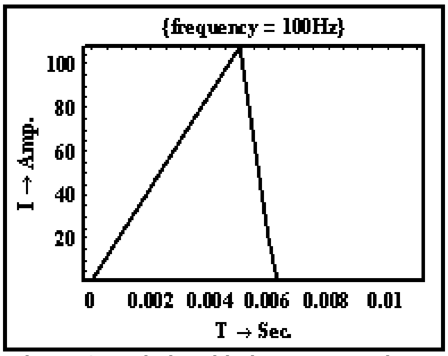

Fig. 7.18 : Relationship between I and T at VB= 72, T= 0.01, ton[m]= 0.0045.

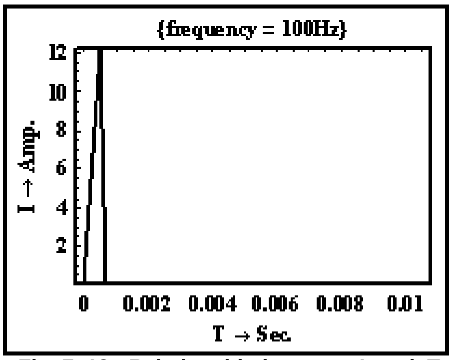

Fig. 7. 19 : Relationship between I and T at VB= 84, T= 0.01, ton[m]= 0.0005.

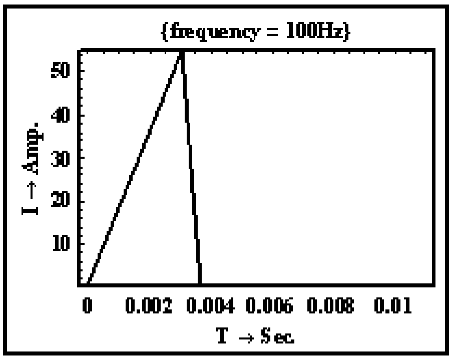

Fig. 7.20 : Relationship between I and T at VB= 84 , T= 0.01, ton[m]= 0.003.

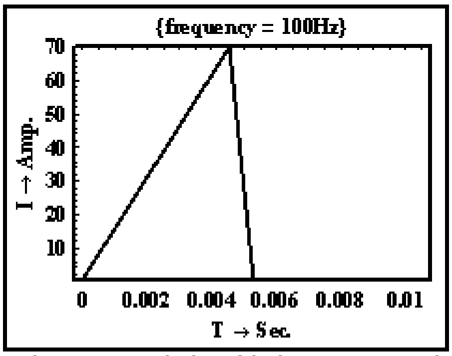

Fig. 7. 21 : Relationship between I and T at VB= 84, T= 0.01, ton[m]= 0.0045.

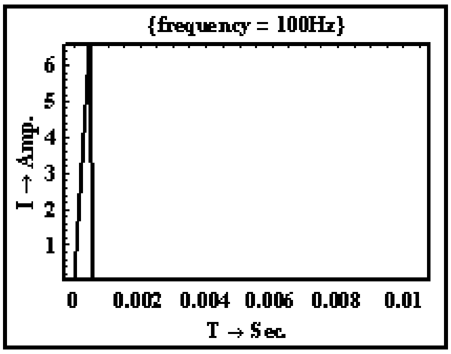

Fig. 7. 22 : Relationship between I and T at VB= 96, T= 0.01, ton[m]= 0.0005.

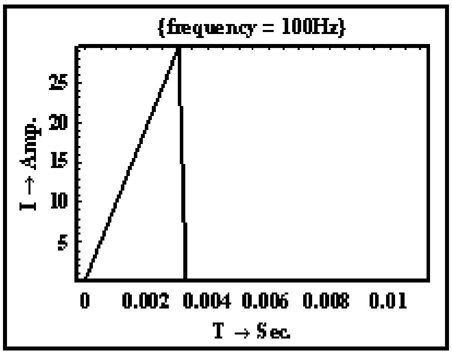

Fig. 7.23 : Relationship between I and T at VB= 96, T= 0.01, ton[m]= 0.003.

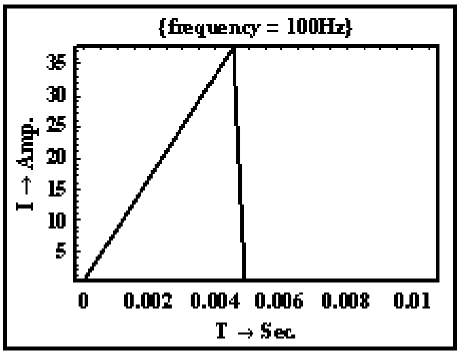

Fig. 7. 24: Relationship between I and T at VB= 96, T= 0.01, ton[m]= 0.0045.

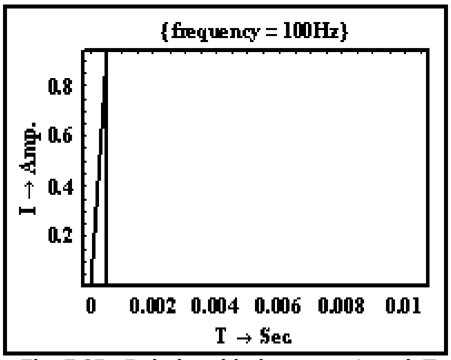

Fig. 7.25 : Relationship between I and T at VB= 108, T= 0.01, ton[m]= 0.0005.

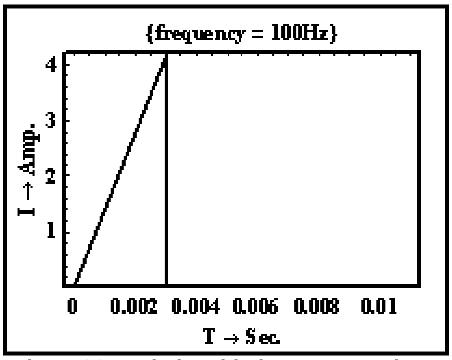

Fig. 7.26 : Relationship between I and T at VB= 108, T= 0.01, ton[m]= 0.003.

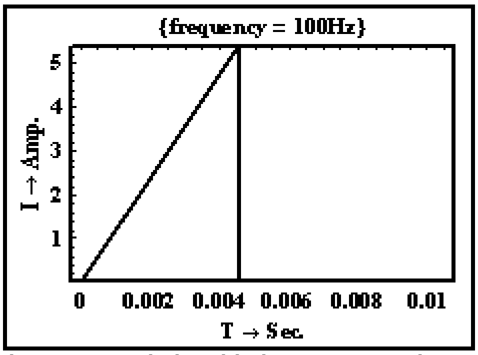

Fig. 7.27 : Relationship between I and T at VB = 108 , T= 0.01, ton[m]= 0.0045.

The figures illustrate the effect of t_{on} upon I_{max} at different values of V_{inj}. Figs.7. 28 to Fig. 7.36 illustrates the effect of t_{on} upon the maximum DC chopper current. Equation 5 illustrates that, the increasing of t_{on} increases I_{max}. The physical analysis of the increasing I_{max} against t_{on} is as follows;

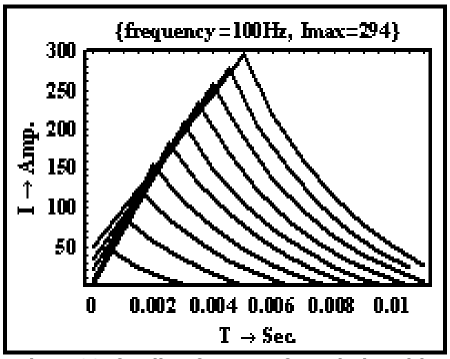

Fig. 7.28: family of curves for relationship between I and T at VB=12V.

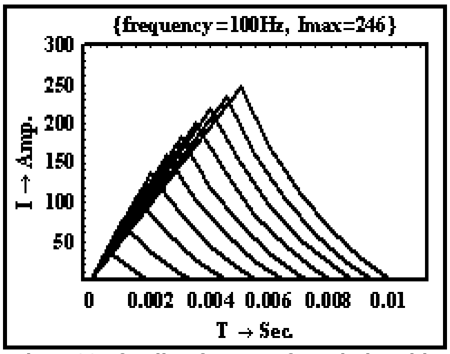

Fig. 7.29 : family of curves for relationship between I and T at VB=24V.

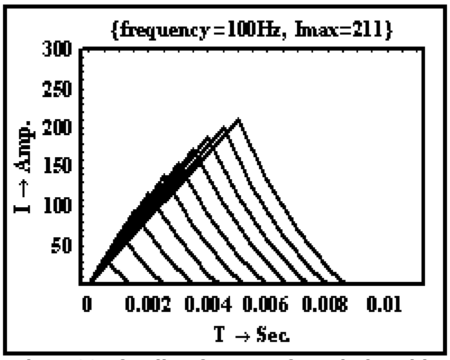

Fig.7. 30 : family of curves for relationship between I and T at VB=36V.

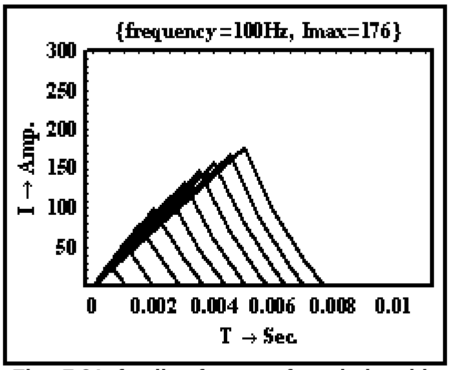

Fig. 7.31: family of curves for relationship between I and T at VB=48V.

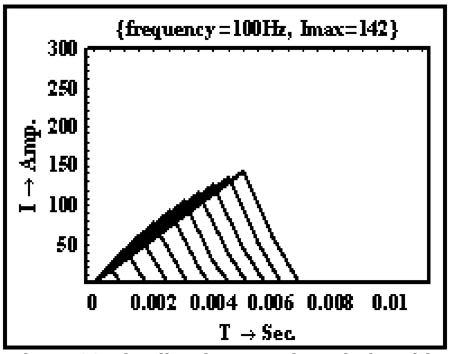

Fig. 7. 32 : family of curves for relationship between I and T at VB=60V.

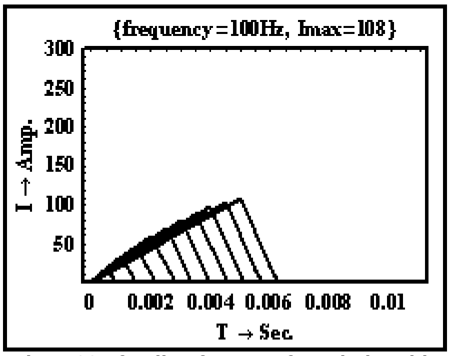

Fig. 7.33 : family of curves for relationship between I and T at VB=72V.

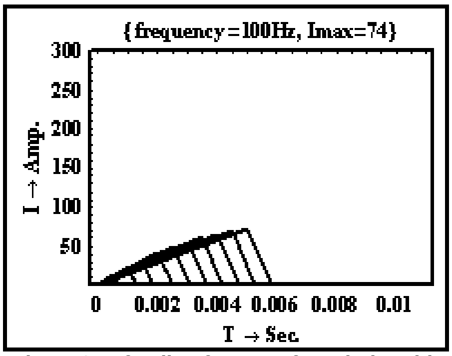

Fig. 7. 34 : family of curves for relationship between I and T at VB=84V.

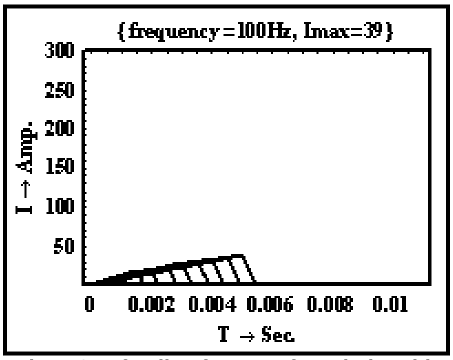

Fig.7. 35 : family of curves for relationship between I and T at V_B=96V.

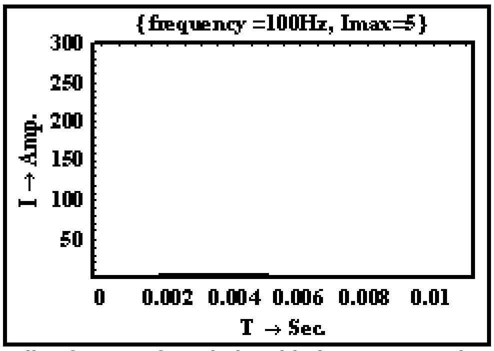

Fig. 7.36 : family of curves for relationship between I and T at VB=108V.

The chopper current load is represented by RL circuit contains DC supply of voltage as shown in Fig. 8a.

The instantaneous current is

$$i = \frac{V}{R}(1 - \varepsilon^{-(R/L)t}) \quad \text{……………………………………………..(21)}$$

This current reaches to its maximum at $t = \tau = L/R$

Hence, I_{max}=V/R

Fig. 8b illustrates the relationship between the instantaneous current *i* against *t*.

The current reaches to maximum value at $t = \tau = L/R$. After $t = \tau$, the current becomes stable at value $i = I_{\max} = V/R$. This means that the effect of the coil is in the range of $0 \le t \le \tau$ only. After that the coil has no any effect upon the current. The previous Figure illustrates that as *ton* increases in the range of $0 \le t_{on} \le \tau$, the DC chopper current is increasing according to rising exponential function. The DC chopper control range $0 \le t \le \tau = L/R$, after this range $t < \tau$, the system loses control. Consequently, the DC motor speed becomes approximately constant. At this point we conclude that, the control range of *ton* must be in the range within the value of τ .Fig. 8c illustrates the current driven by the chopper to the load circuit.

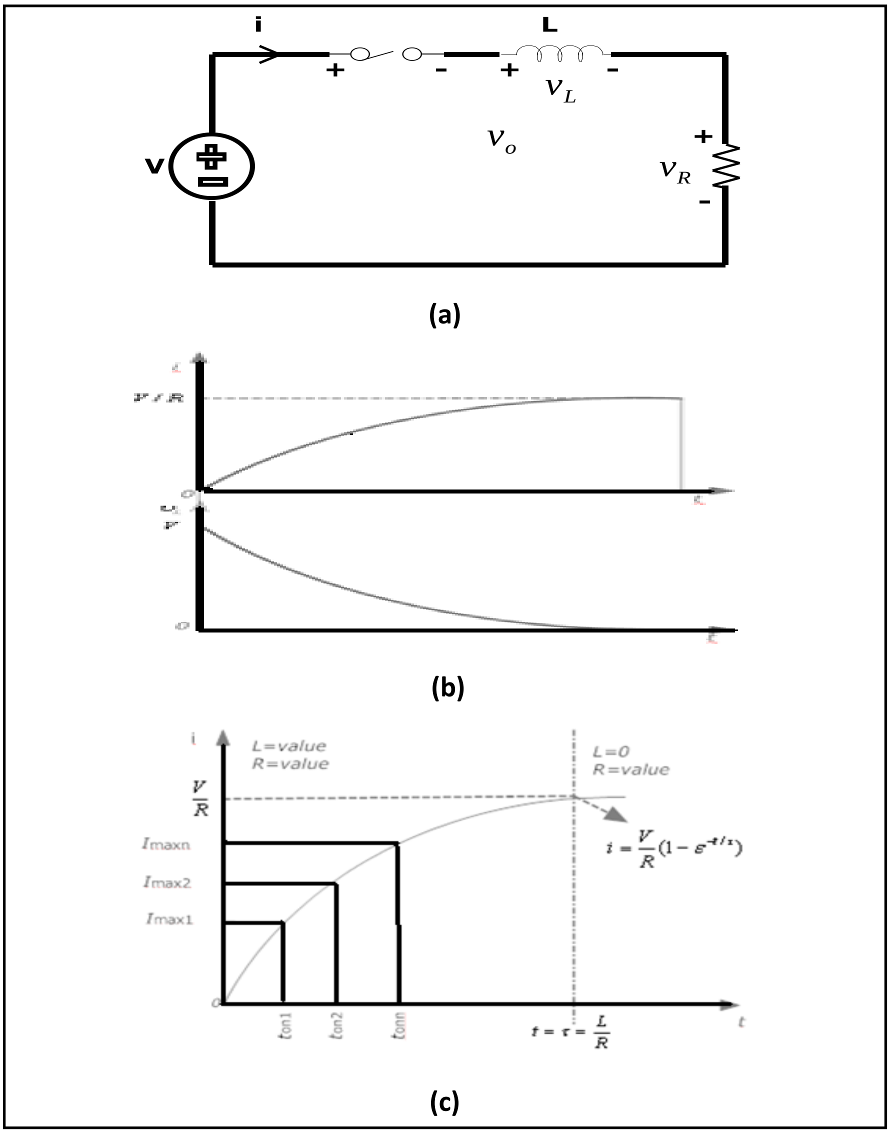

Fig. 8 : DC Source and Coil (RL) Circuit.

Figure 9 illustrate the effect of t_{on} upon maximum I_{max}. and V_{inj} takes as a parameter. Fig.9 illustrate that as *ton* increases, the chopper maximum current increases. As V_{inj} increases I_{max} decreases. The injection of voltage to the DC chopper circuit results of reverse current to the chopper circuit. This current opposes the main current. Hence, the total current passes through the chopper circuit will be decreases. As the power switch used is a thyristor, the reverse current from the injection supply will be reduced the main current. As the current through the chopper circuit reaches to or less than the threshold current, the thyristor will be turned off. To operate the DC chopper power switch, a pulse must trigger the thyristor once again. Consequently, the operation must be designed depending on the load type.

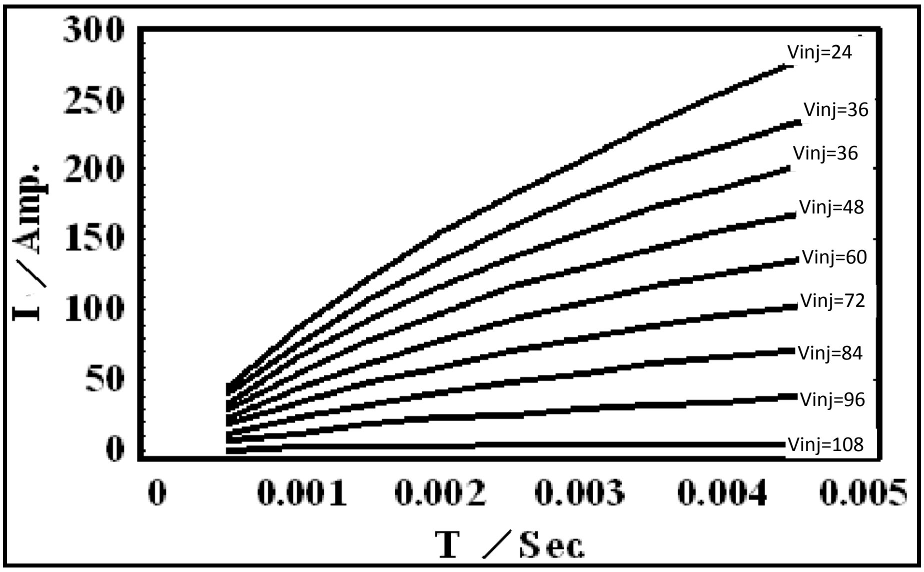

Fig. 9 : The Relationship Between t_x and t_{on} takes V_{inj} as a Parameter.

DC Chopper Mode of Operation:

Effect of on time upon *t_x*:

Fig. 10represents the effect of DC control circuits *ON* time upon t_x at different values of the protected injected voltage. The injected voltage has a pronounced effect on the DC chopper operation. At 12V injection voltage the DC chopper has the two modes of operations, the discontinuous and the continuous mode. Inversely, at other injection voltage level larger than 12V, one mode only of operation will be obtained.

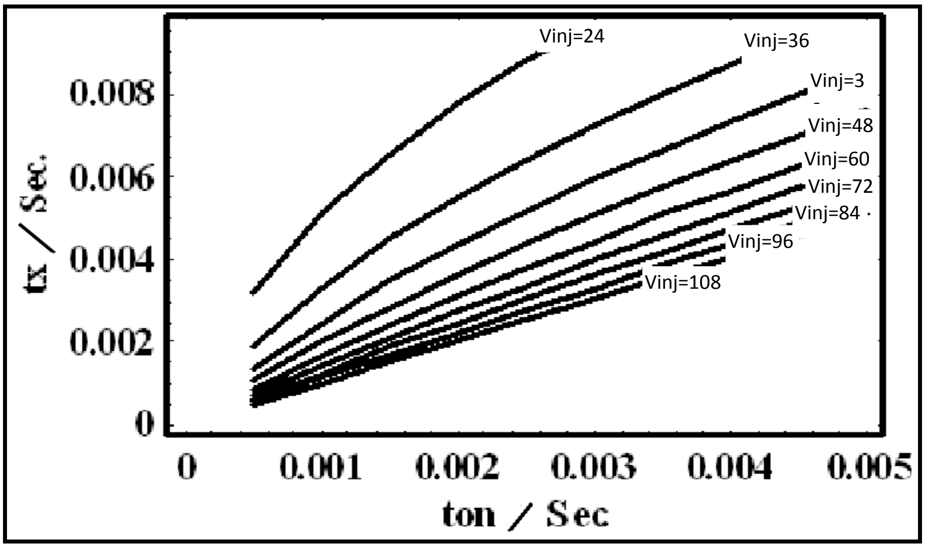

Fig. 10: The Relationship Between and Takes as a Parameter .

CONCLUSIONS

This paper represents how to design a safety electrical break for any DC motor especially the motor used with the DC-DC converter circuit. The effect of *ON* time upon maximum current of the DC-DC converter is illustrated. The previous current increases as the t_{on} increases. The effect of injected voltage upon DC chopper performance is introducing through this chapter. The injection protected voltage has a pronounced effect upon the chopper maximum current. It reduces this current through the chopper till it reaches the threshold current present through the power switch data sheet.

The injection protection voltage has a pronounced effect upon the DC chopper mode of operation. This effect is illustrated through this chapter. The DC control circuit has the two modes of operation when the injection voltage equal to 12V. Inversely, at another levels of V_{inj} the chopper has only one mode of operation. The control circuit operation at the discontinuous mode only.

As the current through the switch decreases to the previous value, the power switch will be turned *OFF* immediately. After that the next pulse must be generated for triggering the switch once again. The operation strategy of the switch is out of this chapter. The electrical break for the DC control circuit motor is safe because the reverse current injected to the DC control circuit is decreased step by step and not rapidly. Hence, the breaking of the motor becomes very safe.

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فرملة محركات التيار المستمر باستخدام مصادر جهود كهربية عكسية

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قسم بحوث القوى والطاقة – معهد بحوث الهندسة الزراعية - دقى- جيزة

حيث أن معظم الآلات الزراعية تدار من خلال آلات الاحتراق الداخلي (المحركات الميكانيكية) التي تسبب التلوث وأيضا سرعتها تكون غير منتظمة مما يؤدي إلي ضعف في أداء هذه الآلات مع تعذر تخفيض سرعتها او التوقف المفاجيء عند الطلب ، او (حيث لوحظ هذا عمليا في تجربة اختبار آلات جمع القطن الأمريكية والروسية بمحطة بحوث الجميزة . لوحظ زيادة سرعة مقدمة آلاله فى بداية التشغيل ومواجه المحصول مما أدي إلي زيادة الفاقد نتيجة سرعة التقدم الأمامية وزيادة سرعة دوران جهاز اللاقط (لاقط القطن) الموجود فى مقدمة الالة).

الهدف من البحث :

الهدف من البحث هو تصميم نظام تحكم الكترونى لمحرك تيار مستمر (موتور كهربي) يتم استخدامه مع الآلات والمعدات الزراعية بغرض ايقاف الحمل (فرملة الحمل) و التحكم فى سرعة دوران الموتور الكهربى المتصل بالات الزراعية كما يمكن من خلال هذا المتحكم فرملة الموتور تدريجيا او فجائيا طبقا لحاجة التشغيل . حيث يتم التحكم فى سرعة دوران الموتور وفرملته باستخدام كمبيوتر متناهى الصغر يتحكم فى الدوائر الالكترونية التى تتصل بالحمل مباشرة .

سسس وتتميز محركات التيار المستمر (DC motor) بسرعتها الثابتة والمنتظمة مع عزم بدء الدوران العالي ، ويمكن تغذيتها مباشرة من مجموعة خلايا شمسية وذلك للمعدات التي تعمل في المناطق المعزولة عن الشبكة اثناء فترة الاشعاع الشمسى ايضا يمكن تشغيلها من خلال بطاريات تستمد طاقتها من الخلايا الشمسية.

فى هذا البحث يتم دراسة الاداء الكهربي للدوائر الالكترونية للتحكم فى الجهد المستمر المحمل بمحرك تيار مستمر وبطاريات كبيرة ذات احجام مختلفة ويمكن الاستعاضة عن البطاريات بمصدر جهد مستمر يوصل على التوالي مع المحرك. و المحرك تهمل مقاومته لأنها صغيرة بالنسبة لمعاوقتة، أما البطاريات فتمثل أيضا على أنها قوة دافعة كهربية معاكسة حيث توصل في اتجاه عكسي بالنسبة لمصدر التغذية لدوائر التحكم واستخدم في هذا البحث مستويات مختلفة للجهود المعاكسة تتراوح قيمتها من 12 فولت إلى 108 فولت. ومصدر الطاقة الذى يغذي المحرك عن طريق المتحكم الالكتروني الذي استخدم في البحث قيمته 110 فولت (DC).

في هذا البحث سيتم توصيل المحرك بمستويات مختلفة من مصدر جهد مستمر دون استخدام البطاريات وقد اتضح في هذا البحث أن هذه الجهود التي سيتم توصيلها على التوالي مع محرك الحمل يمكن استخدامها لحماية المحرك وخاصة عند حالة الثبات دون قطع لمصدر الطاقة عن المحرك وقد أوضح البحث أن استخدام البطاريات مختلفة الجهود مفضلة عن استخدام مصدر تيار مستمر له مستويات مختلفة من الجهود. ويمكن تطبيق نظام التحكم فى محرك الجهد المستمر فى مجال الهندسة الزراعية حيث يتميز المحركات الكهربية ذات التيار المستمر بعزم بدء كبير واستقرار اثناء عملية التشغيل مما يؤهلها للاستخدام الواسع فى مجال الهندسة الزراعية. كما يتميز هذة المحركات بسهولة التحكم فيها باستخدام مقطع التيار المستمر.

ايضا فى هذا البحث يتم استخدام مقطع التيار المستمر فى التحكم فى محرك كهربى (DC) باستخدام الكمبيوتر متناهى الصغر. وباستخدام هذا النظام يمكن تصميم جرار زراعى يدار باستخدام محركات تيار مستمر يتم التحكم فى سرعتها وتوقفها المفاجىء وفرملته كهربيا بنظام مقطع التيار المستمر دون الحاجة الى استخدام الفرملة الميكانيكية. ويمتاز هذا الجرار بصغر حجمه ووزنه حيث ان نظام الفرمله هنا نظام كهربى لايحتاج الى اجزاء ميكانيكية حيث يتم عكس طرفى الجهد على طرفى المحرك .

ويمكن ان يتم تقدير هذا المحرك باستخدام الخلايا الشمسية مما يساعد على عدم تلوث البيئة المحيطة فى اثناء عملية التشغيل نهارا. كما يمكن استخدام نظام التحكم المقترح على نطاق اوسع كاستخدامه فى التحكم فى سرعة درافيل الة جمع القطن مما يؤهلها للاستخدام فى جمع القطن المصرى.

وفى هذا البحث تم عمل تطبيق معملى لهذا البحث بمعمل الطاقة الشمسية بكلية الهندسة جامعة المنصورة واستخدامة فى ادارة نظام ميكانيكى لتعبئة السوائل اوتوماتيكيا وذلك بتصميم نظام كهربى للتحكم فى حركة الة ميكانيكية تم تصميمها لهذا الغرض. ويتكون النظام الميكانيكى المصمم من سير يتم تثبيت الزجاجات المراد تعبئتها عليه ويتحكم فى حركة السير موتور كهربى يعمل بالتيار المستمر (DC) يتم التحكم فى حركته باستخدام دوائر الكترونية صممت لهذا الغرض ، وتحتوى الالة على صمام كهربى يتحكم فى انسياب السائل الى الزجاجات المراد تعبئتها ، وقد تم تصميم دوائر التحكم لهذا الصمام من دوائر الكترونية تم تصميمها بالمعمل . ايضا تشتمل الالة على محرك كهربى اخر (DC) له نفس المواصفات المحرك الاول متصل به طلمبة حيث يقوم برفع السائل المراد تعبئته من الخزان الارضى الى الخزان العلوى يوضع اعلى مستوى سير الحركة ويتم التحكم فى ضخ السائل عن طريق تصميم دوائر الكترونية صممت لهذا الغرض .

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