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CURRENT & VOLTAGE CONTROLLED WELDING TRANSFORMER (WITH LOAD SERIES MOTOR)

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I. INTRODUCTION

Generally a welding transformer is a step-down transformer. In welding transformer there are generally current is controlled by using

i)Choke

ii)By using moving core.

In welding transformer choke is connected in series with the secondary circuit in order to control or vary current. Also choke can absorb voltage fluctuations choke is important for stability of arc.

In case of Hand methods of arc welding usually a current range of 60 Amps to the 250Amp at a voltage 30 to 40 Volts for a good welder.

As per standard 100 Volt is maximum open circuit voltage for the welding. By using choke to vary or control current the separate space is required. Now again we can control current by moving core that means we can vary flux linking with secondary ,so current is vary flux in proportion with flux.But

separate mechanism required to move the core specifically. The welding arc characteristics are negative ,by studying the arc characteristics widely,it is known that the different types of rod requires different voltage ranges & also current range.Normal welding rods that are used for steel work required to strike & maintain arc is [40-60 V,60-80,80-100V].

Welding transformer now available in market that has features of control both voltage & current & if we provide tapping to secondary side & current by choke it is too much space is required for that to achive both the feature i.e. current & voltage control following design is suitable.

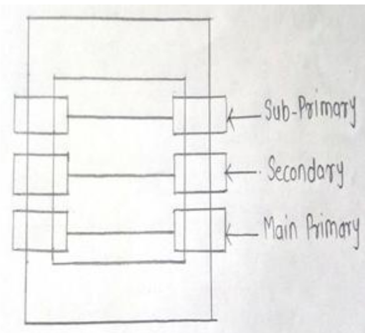

Fig No.1.Construction Diagram

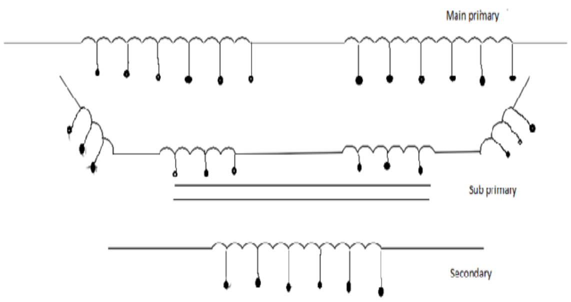

Fig No.2.Winding Diagram

II. CONSTRUCTION & OPERATION

In the construction, we are using two primary coils namely, i) Primary 1 ii) Primary II. These two primary coils are connected in parallel & one tapped reactor is placed between them.This reactor is work as shock absorber.
In that the tappings are provided to the primary(I), through this we can vary the voltage of the primary (II),so we vary the leakage inductance , so that current is varying when we give max voltage to the primary (II) then current is also maximum & vice versa.

Now to control voltage taps are provided to the secondary winding. The voltage is available in ranges :

Sr.no.	Tap No	Voltage Range
1	2-4	49
2	2-5	58
3	3-5	67
4	3-6	76

Table No.1.Output Voltage

When the primary (II) coil is completely out of circuit the minimum current is obtainable for welding because of high reluctance of magnetic circuit and or mutual inductance between two circuits.
There are two types multiway rotary switches used one is six multiway switch this main primary side used to change voltage and another switch is Two multiway switch is used shock absorber or reactor side. As discussed above both the quantities i.e.current & voltage arc controlled in those method.

III. DESIGN ASPECTS

3.1 Design of Core

- V1*I1=V2*I2
- 400*I1=50*300
- I1=50*300/400
- I1=37.5A
- KVA=Q=400*37.5/1000 =15 KVA
- Et=1.74v

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- Et=$4.44 * F * \emptyset m$
- $\emptyset m$=0.007wb
- Bm=1.1 wb/m^2
- Ai=Et/4.44*f*Bm =1.74/(4.44*50*1.1)
- Ai=0.007m^2
- d=$\frac{\sqrt{Ai}}{K} = 0.1247m$
- Agi=0.5*d^2 =0.5*(0.1247)^2
- Agi=0.0062m^2
- Width of core=$\sqrt{Agi} = 0.0062 = 10cm$
- Now Hw*Ww =9.30*10^3=Aw
- Hw(D-d)=9.30*10^3
- Hw=(9.30*10^3)/19.88 =407.8mm

3.2 Window Dimension

- For About 20 KVA transformer
- Kw=8/(30+kv) =8/(30+0.4) =0.264
- $\partial = 5A/mm^2$
- Q=2.22*f*Bm*Kw*Aw*Ai*10^3
- Aw=15*10^3/(2.22*50*1.1*0.264*5*10^6*0.01*10^-3)
- 9.30*10^3 mm^2

3.3 Winding Design

- Hv winding turns= Tp=Vs/Et=50/1.5 =33
- LV winding turns =Ts=Vp/Et
- =400/1.5 =266
- Hv winding current =Ip=KVA*1000/Vs=
- =15*1000/50 =300 Amp
- Lv winding current =Is= KVA*1000/400 =15*1000/400 =37.5 Amp
- Hv winding area ap =Is/2 =300/2 =150mm^2
- Lv winding area as =Ip/2 =65/2 =32.5mm^2

3.4 Yoke Design

- Flux density in yoke =1/1.2= 0.0833 wb/m^2
- Net area of yoke= 1.2*0.007 =0.084m^2
- Gross area of yoke =0.0084/0.9 =0.0093m^2
- Depth of yoke (Dy)=0.85*d =0.85*0.1247 =0.106m
- Height of yoke (Hy)=gross area of yoke /Dy = 0.0093/0.106 =0.087m

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IV. COOLING

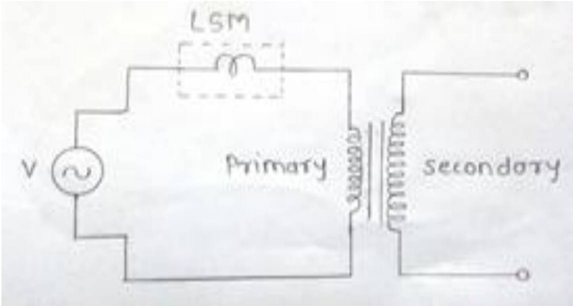

Fig No.3.Connection of Cooling Fan(LSM)

In conventional method, of cooling of welding transformer single phase motor is used. This motor is of shaded pole type or capacitor type.but in this the motor construction is similar to that of shaded pole motor.

The stator is made attaching laminated steel sections. slot is provided to the pole face. shading coil is wound on the slot. very less number of turns are wound on the remainder which is thick conductor which can able to carry the full load current of the equipment.

The motor is run only with load i.e.in proportion with the load current.

Sr.No.	Current(Amp)	Speed (rpm)
1	160	900
2	140	830
3	115	545

Table No.2.Motor Speed

When load increase speed also increase & vice versa, so these motor is very useful for stability & in this heating & cooling is proportionate.

Now, in market some electronics welding machines arc also available, smooth welding is done by that machines,but the major disadvantages of electronics welding machines arc the internal components get short circuited by the conductive dust &repair cost is also high.

Solid voltage &current controlled welding machines is always better.

V. CONCLUSION

A welding transformer 15 KVA, 2 phase, 50 Hz, step down is designed and manufactured for different current ranges. This is suitable for various electrodes required for welding of different metals. Joints are welded using this transformer are electrically and mechanically carry sounds. Designed transformer is having duty cycle of 60% for continuous operation.

If we compare the voltage and current control welding transformer with ordinary welding transformer for same application found that the cost of machine is nearly one-fourth of ordinary machine because one

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voltage and current control welding transformer is equal to four ordinary transformer of different voltages. Therefore cost saving is more.

REFERENCES

[1.] Text book “Welding Transformer” by Mr.S.J.Kulkarni.