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**PROJECT REPORT ON
STEP-UP AUTO TRANSFORMER**

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INTRODUCTION

Transformers are used in power supply circuit are known as power transformers. They consist of two coils or sets of coils in the case of all transformers. They differ from other transformers in at to assist coupling between them and thus improve their mutual inductance; and secondary, they are operated at comparatively high power ratings.

We shall now consider the power transformers used in AC mains circuits. In our country the A.C main supply is 220V 50 Hz per phase. The frequency of the supply is also important. Remember that a transformer designed to operate on a particular frequency must not be used on a lower frequency. But the same transformer could be used on a higher frequency. For example a power transformer design to be operated on 50 Hz should not be operate on a frequency of 25Hz but it can safely be used on a 100Hz supply.

Power from A.C is supplied to one coil or set of coils and the magnetic flux set up in the iron core and around the coil induces currents in the second set of coil, the voltage across these coils being either higher (step- up) or lower (step- down) then the voltage supplied.

The coil to which the power is fed is known as the primary and those from which power is taken as secondary.

The number of each coil of the transformer varies inversely as the size of the core.

WHY LAMINATED CORES ARE USED?

The rapidly varying magnetic flux will induce currents in the core as well as in the windings around it and if in the core were one mass of metal with a very low resistance; the current so induced would be very high. This current represents a waste of electrical energy which serves only to heat up the core. This current is known as eddy current after the name of the scientists who discovered it. In order to reduce the eddy currents to a negligible value, the electrical resistance of the core is increased by splitting it to thin sheets and insulating each sheet from the next. Eddy current will still flow but the total loss of power so caused will be far less than otherwise it would be because the current in the laminated sheets is divided down into very narrow areas.

Laminations are insulated from one another many ways: by chemical treatment of the metal surface, by varnish, by thin cemented paper etc.

There are two main shapes of laminations; (1) the E and I type and (2) the T and U type. Both types form a three legged core.

AUTO TRANSFORMER

In an auto transformer, there is on primary or secondary coil separately but a single wire coil is wound through the whole wire. The iron core has a resistance twice of the original watt.

Step- up transformer can mathematically be described as follows;

$$\frac{E_1}{E_2} = \frac{N_1}{N_2} = \frac{I_1}{I_2}$$

E_1 = Input Voltage

E_2 = Output Voltage

N_1 = Primary turn

N_2 = Secondary turn

I_1 = Input current

I_2 = Output current

The material included on step up transformer are

- (a) EI core
- (b) Enamel wire (S.W.G 19)
- (c) Regulator (8 position)
- (d) Fuse (15A)
- (e) Two poles switch (15A)
- (f) Volt meter (0-300V)
- (g) Output socket (15 A)
- (h) Pilot Lamp
- (i) Alarm Circuit

Related Equation of power and area of a Transformer

In making a transformer, the main mathematic point is "power" or "watt" to be used. If the amount of watt is known as the thickness and area of the overlapped iron sheets can be found.

According to the equation:

The area of core

$$A = X \times Y$$

$$A = \frac{\sqrt{W}}{5.58} \quad (\text{or}) \quad A = 0.17 \sqrt{W}$$

A = cross-sectional area of iron sheet

W = amount of power

Coil - Former

In systematically winding wire on the iron core of a Transformer, the Base "Former" can be made either of thick paper card or five proof cards.

Number of turn to be wound

To wind the wire coil in a transformer, "turn per volt" must be known, first. T/V means number of turn of coil to gain one volt. Thus the following equation must be used.

$$E = \frac{4.44BNFA}{10^8} \text{ volt}$$

E = One volt

B = Flux density

N = Turn per volt

F = Frequency

A = Cross-sectional area

Basic to with flux density

$$N = \frac{8}{A} \quad (\text{or}) \quad N = \frac{10}{A} \quad (\text{or}) \quad N = \frac{12}{A} \text{ are using.}$$

Common Auto Transformer

- (1) Manual system with Rotary Switch.
- (2) Semi- Auto system
- (3) Transformer made in china

An Auto Transformer if used to increase the voltage to 220V when the voltage decreases this helps us light the electric bulbs regularly. Sometimes, water pump motor is used with the help of a transformer. An auto transformer using motor can well be operated only if current quality and power factor of motor, etc: have been calculated and wound. An ordinary Auto, transformer is used, it can be burnt. The Auto-transformer mentioned above is based an domestic electrical devices power and it is manual system.

500W Step-Up Auto Transformer

$$A = \frac{\sqrt{W}}{5.58} \text{ (or) } A = 0.17 \sqrt{W}$$

$$A = \frac{\sqrt{550}}{5.58}$$

$$= 4 \text{ Sq in}$$

$$I = \frac{P}{V}$$

$$= \frac{550W}{220V}$$

$$= 2.5 \text{ Amp SWG No. 19 (see Table 1(a))}$$

$$\frac{T}{V} = \frac{8}{A}$$

$$N = \frac{8}{4} = 2T$$

$$220V \text{ turn} = 220 \times 2$$

$$= 440 \text{ turn}$$

Volt drop 100V for

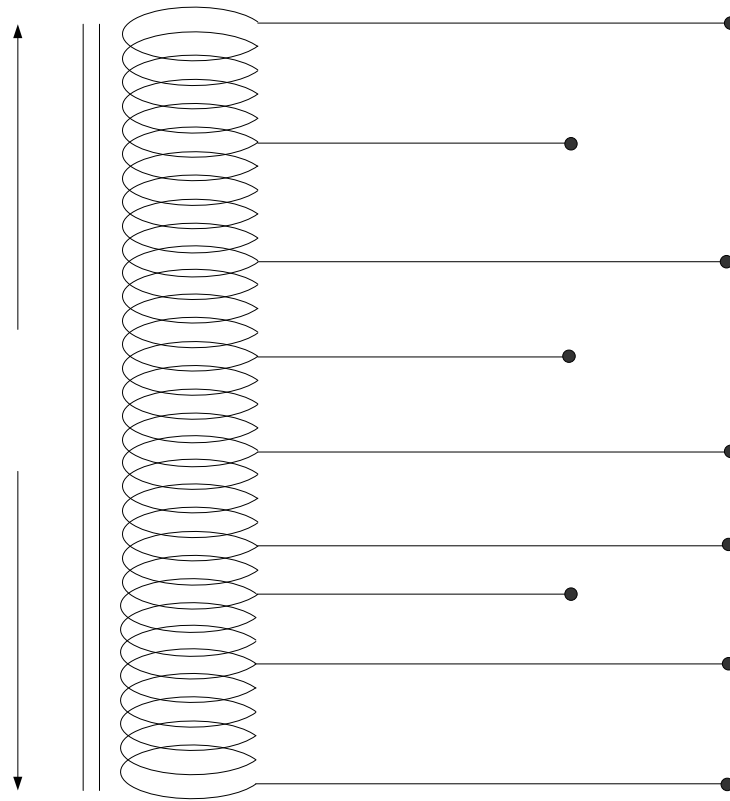
$$N = 100 \times 2$$

$$= 200 \text{ N}$$

$$\text{Tapping turn} = 440-200$$

$$\begin{aligned} &= 240 \text{ N} \\ \text{For 6 tapping} &= 240 \text{ N} \\ \text{1 tapping} &= 240 \div 6 \\ &= 40 \text{ N} \end{aligned}$$

For using regulator switch 8 points.



Winding Circuit

40T

List of the required material to build a body

40T

The required material to assemble the body are:

- (1) A body wide enough to contain the wire coil.
- (2) Volt- meters.
- (3) A regulator with 8
- (4) A set of fuse
- (5) A output socket
- (6) Regulator switch
- (7) Power on / off switch
- (8) Pilot Lamp

440T

40T

40T

40T

20T

(9) An alarm.

(1) Body

Either iron body or teak body can be used. It must be stiff and tough as well as wide enough to keep in the wound coil easily. In order to insert a voltmeter in front of the body, there must be a hole wide enough to hold a voltmeter. Nowadays, the bodies made of iron can easily be bought. If it is an iron body, it is necessary to use an earth wire.

(2) Voltmeter

Excellent voltmeter should be used voltage must be made up (or) down. The scale of voltmeter is between 0 and 300 volt. It is wise to use a voltmeter with a clear scale.

(3) Regulator

A regulator contains 8 to 10 (or) 12 steps switch. Depending on numbers of terminals of auto- transformer any suitable current resistance can be used. It is wise to test whether the switch is good or not before it is bought. It can be tested with multi- tester.

(4) Fuse

Fuse is used to cut off phase and neutral in the supply current. Possible electric fault can be prevented by using fuse.

(5) Socket

Socket is used in output voltage. 15A socket is preferable to be used.

(6) Power switch

In order to cut off the phase, power switch is used.

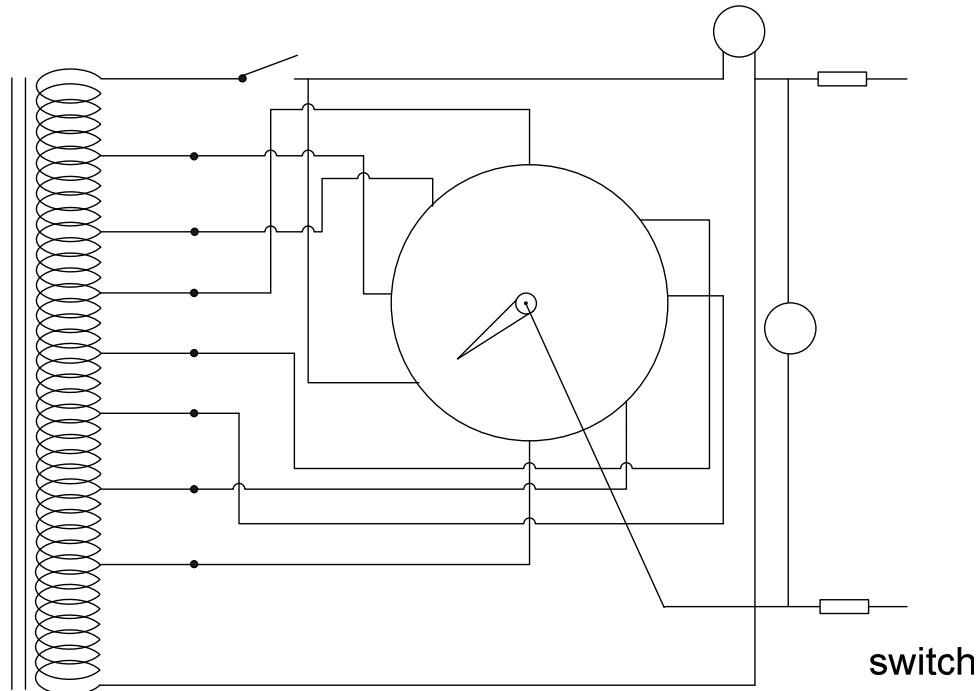
(7) Pilot Lamp

Pilot Lamp is set up in an auto- transformer. A small neon bulb can be used as a pilot lamp which can directly supply AC current. It can commonly be seen in any rice cooker.

(8) Alarm

An alarm is essential to reduce the voltage. It is more than the required voltage. Either electric alarm or buzzer can be used you may set it up yourself.

Complete circuit diagram 500W step-up auto transformer



Complete circuit diagram 1000W step-up auto transformer 1

Function

The output watt of step-up transformer to be used, must be known. If output ampere is needed the output watts must be divided by the voltage to be used.

If input watt is equal to the product of output watt. 3

$$\text{Input ampere} = \frac{\text{Input watt}}{\text{Input volt}}$$

If input Ampere and SWG number are seen in relation table wire guage size can be got. 4

If C.S.A of core is need the equation 5

$$A = \frac{\sqrt{W}}{5.58} \text{ must be used}$$

$$T/V = 8/A$$

Relationship Ampere and Wire Gauge (S.W.G)

Table - 1 (a)

S.W.G	Amp	Turn per Ft	Turn per Sq: in
1	141.4	3.1	-
2	119.6	3.6	-
3	99.8	4.0	-
4	48.6	4.3	-
5	70.6	4.7	-
6	58.0	5.2	-
7	48.6	5.6	-
8	40.2	6.0	-
9	32.6	6.7	44.89
10	25.8	7.6	57.76
11	21.2	8.5	72.25
12	17.0	9.2	84.64
13	13.2	10.8	116.64
14	10.0	12.1	146.41
15	8.140	13.7	176.00
16	6.440	14.8	219.00
17	4.920	16.9	285.61
18	3.620	19.7	388.00
19	2.520	23.5	550.00
20	2.040	26.0	676.00
21	1.608	29.2	852.00
22	1.240	33.0	1089.00
23	0.904	38.3	1513.00
24	0.760	42.4	1789.00
25	0.628	46.5	2070.00
26	0.510	51.5	2650.00
27	0.422	56.5	3190.00
28	0.344	62.5	3900.00
29	0.290	67.6	4550.00

30	0.242	74.6	5550.00
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Table - 1 (b)

S.W.G	Amp	Turn per Ft	Turn per Sq: in
31	0.212	79.4	6300.00
32	0.184	85.7	7300.00
33	0.156	91.7	8400.00
34	0.132	100.0	10000.00
35	0.110	109.0	12000.00
36	0.090	120.0	14500.00
37	0.072	135.0	18200.00
38	0.056	151.0	22900.00
39	0.042	175.0	30600.00
40	0.036	180.0	35600.00
41	0.030	2.0	43000.00
42	0.024	227.0	51000.00
43	0.020	256.0	65000.00
44	0.016	285.0	81000.00
45	0.0122	322.0	104000.00
46	0.0090	377.0	142000.00

Using the Cable Size

Sr. No	Cable Size	Amp	Watt
1	1/.044	5	1000W
2	3/.029	10	2000W
3	3/.036	15	3000W
4	7/.029	20	4000W
5	7/.036	28	5000W
6	7/.044	36	6000W
7	7/.052	43	8000W
8	7/.064	53	10000W

Table - 2