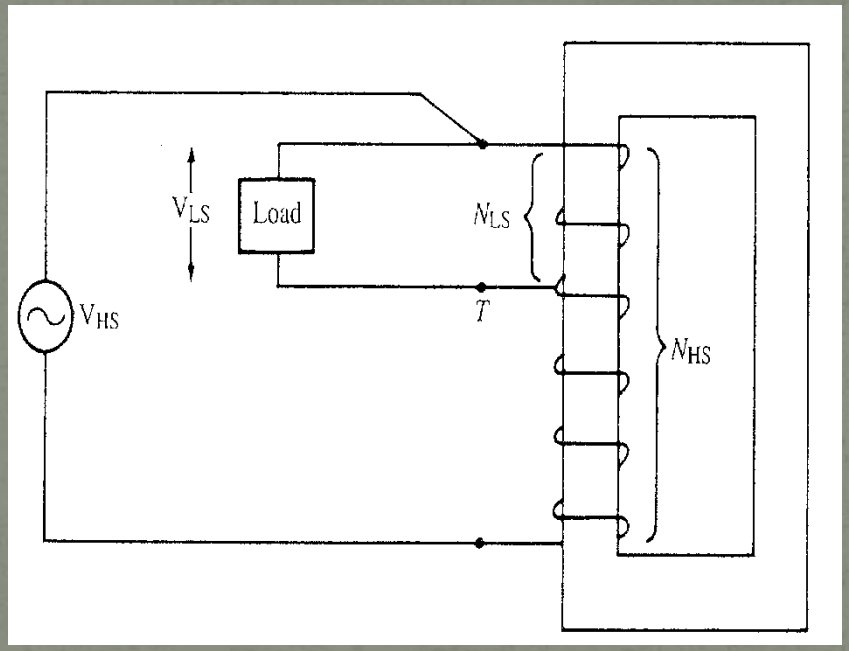
Autotransformer

- A transformer in which a part of winding is common to both of transformer is know as auto transformer.
- Due to common winding there is saving of copper winding

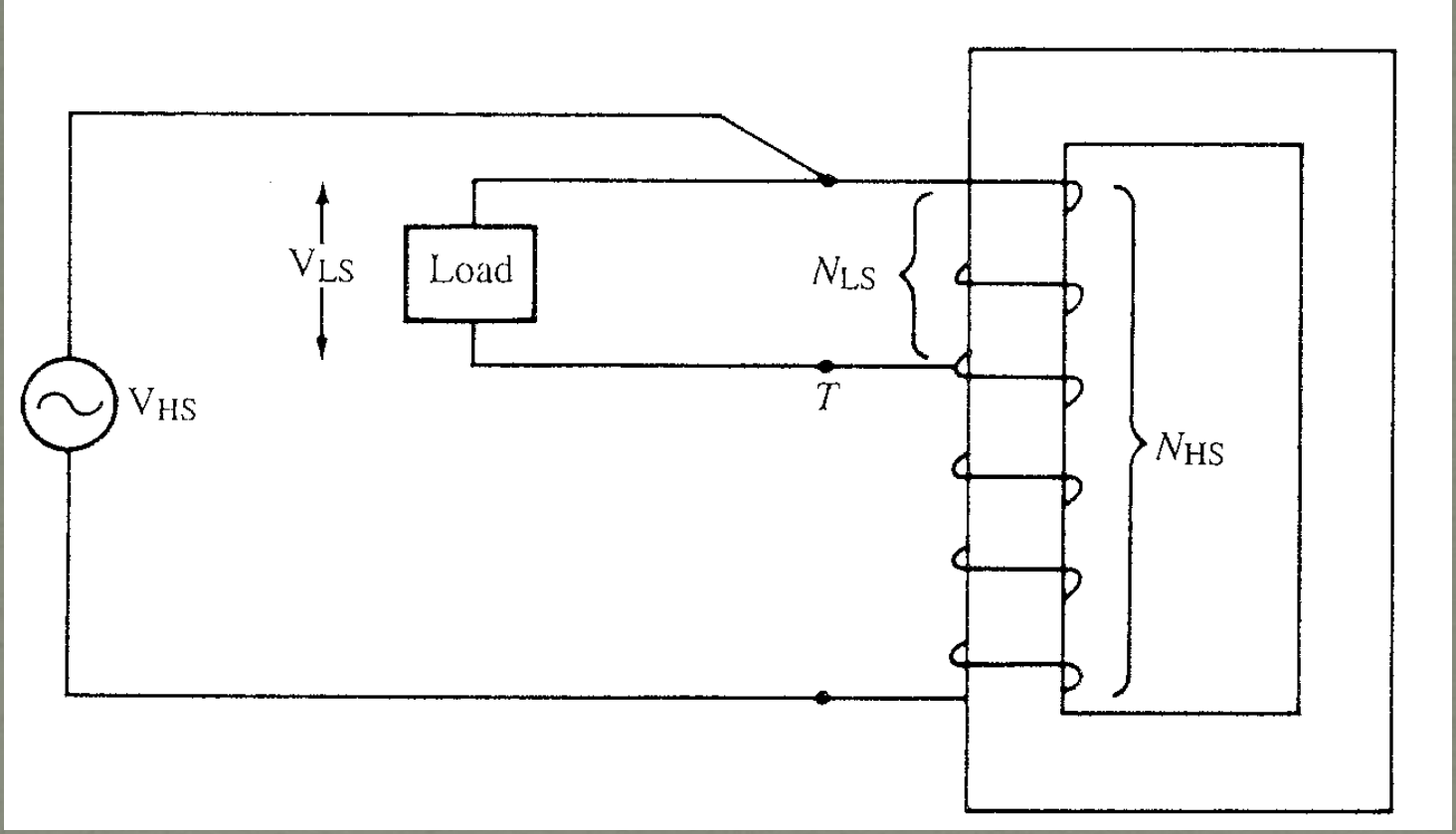
Autotransformer



N_{HS} = # of turns on the High Side

N_{LS} = # of turns “embraced” by the Low Side

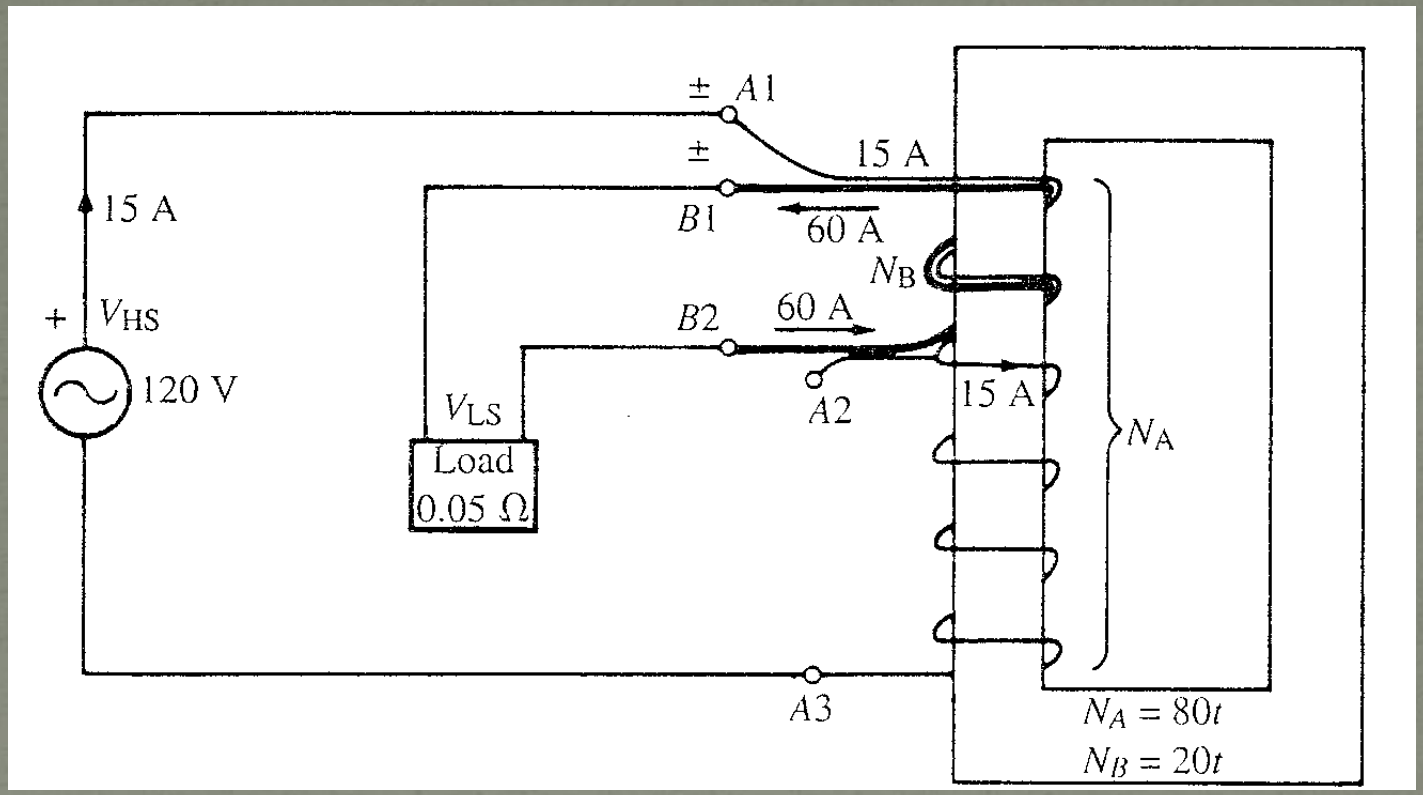
Autotransformer connected for step-down operation



N_{HS} = # of turns on the High Side

N_{LS} = # of turns "embraced" by the Low Side

Autotransformer Example

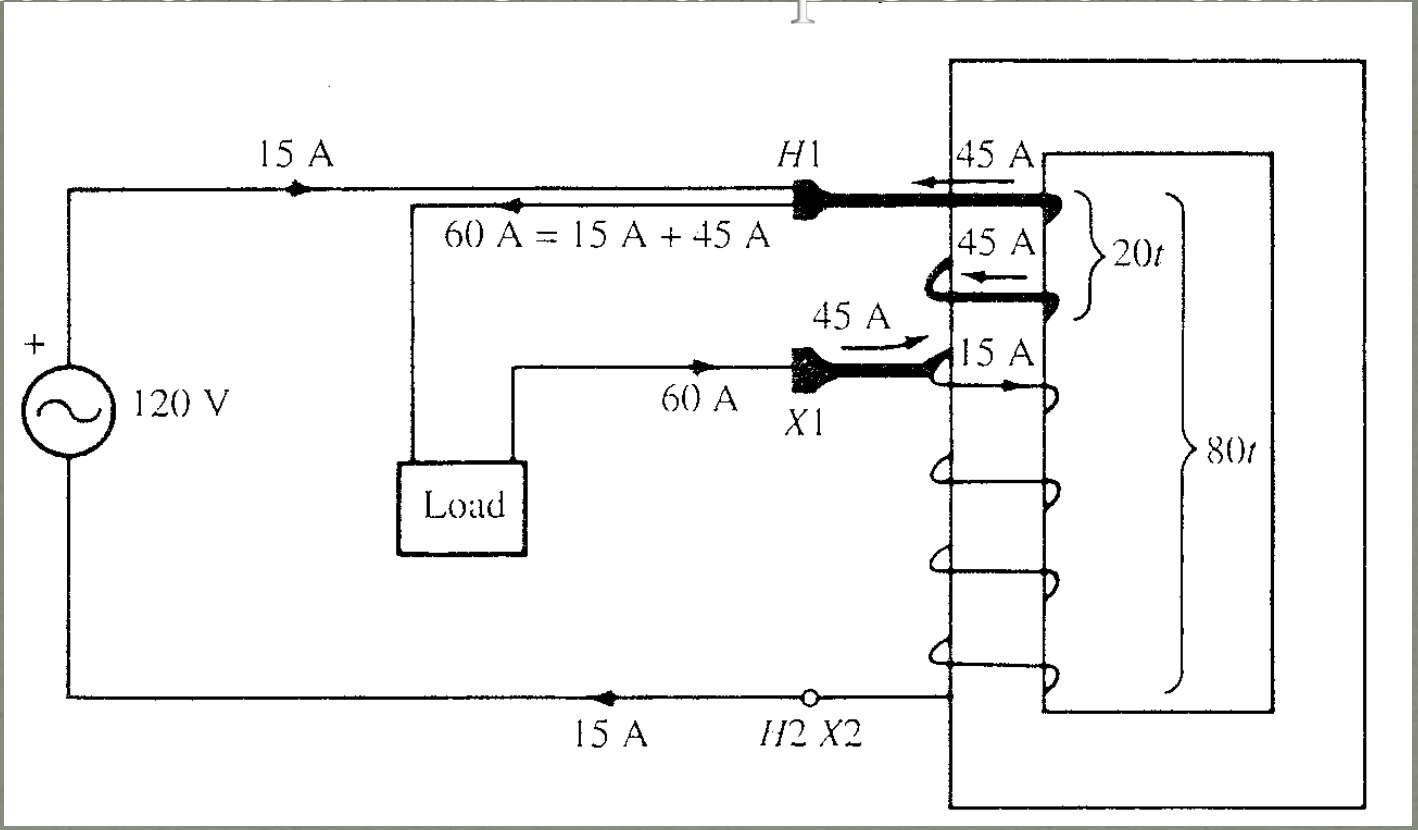


Turns ratio = a = $N_{HS} / N_{Ls} = N_A / N_B = 80 / 20 = 4$

$V_{LS} = V_{HS} / a = 120\ V / 4 = 30\ V$

$I_{LS} = V_{LS} / Z_{LOAD} = 30/0.5 = 60A >> I_{HS} = I_{LS} / a = 60/4 = 15A$

Autotransformer Example continued



How did the load current become 60A?

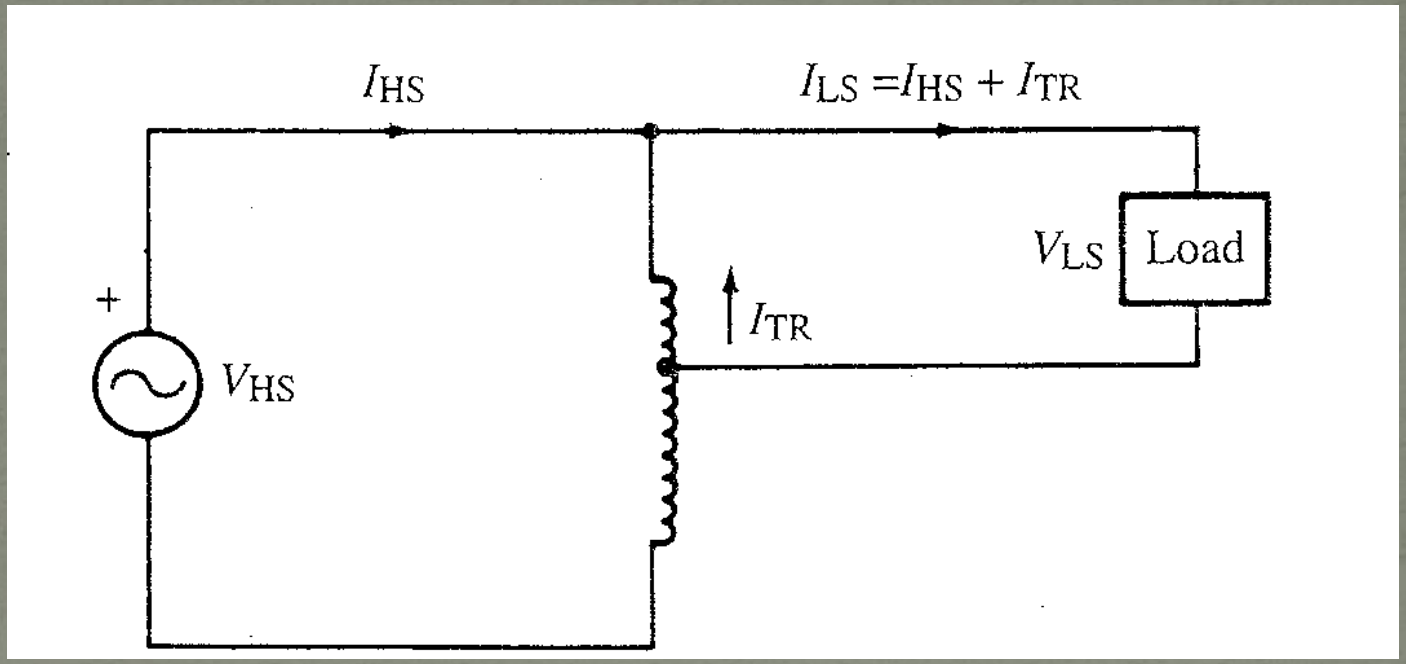
15A provided directly to the load by V_{HS}

45A provided to the load by "transformer action"

Example

- A 400-turn autotransformer, operating in the step-down mode with a 25% tap, supplies a 4.8-kVA, 0.85 F_p lagging load. The input to the transformer is 2400-V, 60-Hz. Neglecting the small losses and leakage effects, determine
  - (a) the load current,
  - (b) the incoming line current,
  - (c) the transformed current,
  - (d) the apparent power conducted and the apparent power transformed.

Example part a

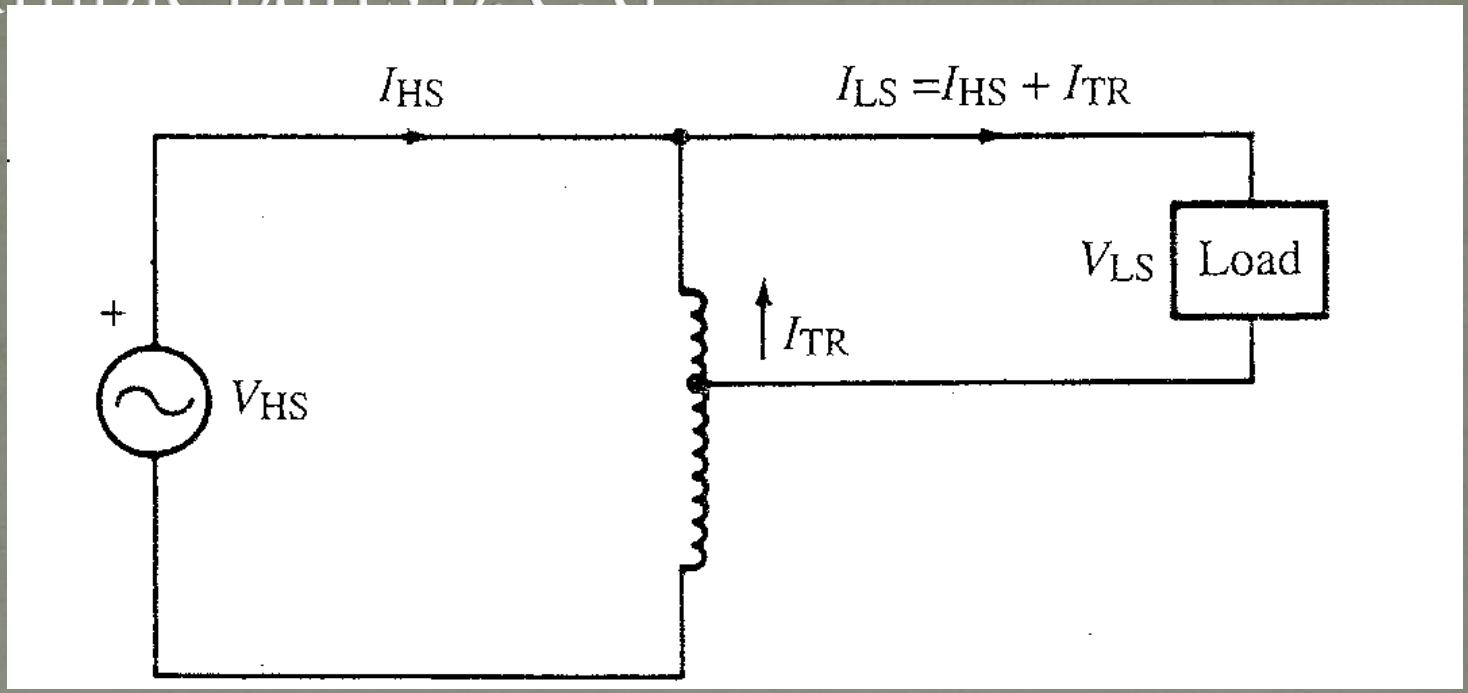


$$a = N_{HS} / N_{LS} = 400/(0.25)(400) = 4$$

$$V_{LS} = V_{HS} / a = 2400 / 4 = 600 \text{ V}$$

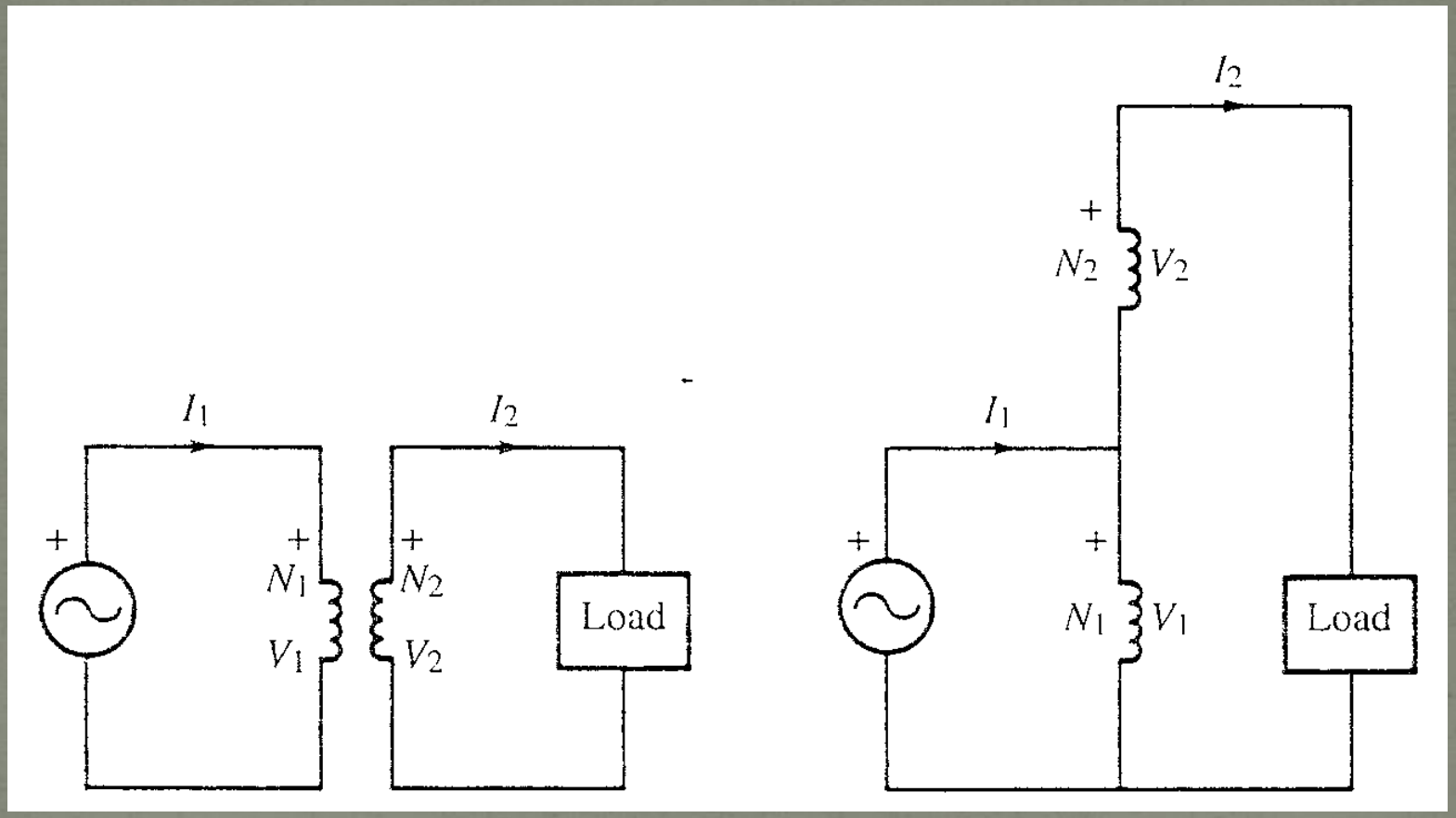
$$I_{LS} = 4800 \text{ VA} / 600 \text{ V} = 8 \text{ A} = I_{LOAD}$$

Example parts b, c, d

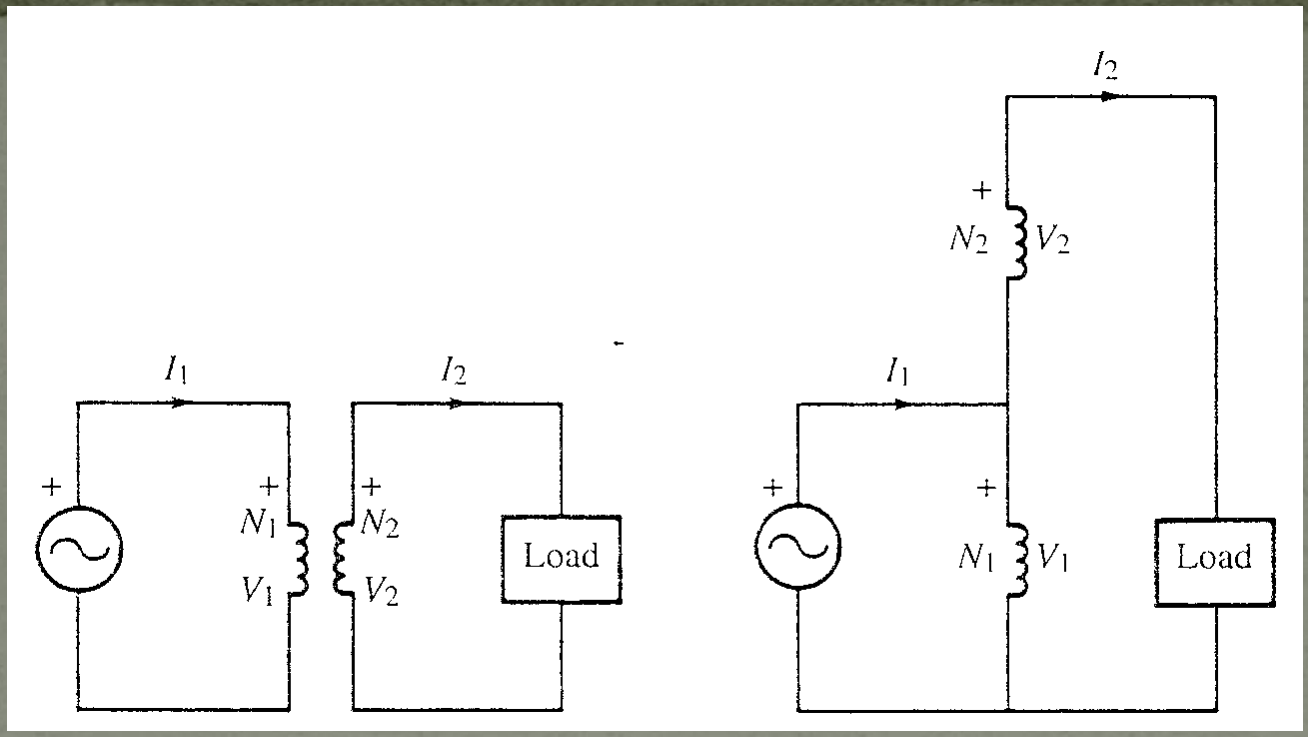


- (b) $I_{LINE} = I_{HS} = I_{LS} / a = 8\ A / 4 = 2\ A$
- (c) $I_{TR} = I_{LS} - I_{HS} = (8 - 2)\ A = 6\ A$
- (d) $S_{cond} = I_{HS}V_{LS} = (2\ A)(600\ V) = 1200\ VA$
  $S_{trans} = I_{TR}V_{LS} = (6\ A)(600\ V) = 3600\ VA$

Two-Winding Transformer connected as an Autotransformer



Two-Winding Transformer Reconnected as Autotransformer



$$S_{at} = (V_1 + V_2) \cdot I_2$$

$$S_{2w} = V_2 I_2$$

. . . . . .

$$S_{at} = (a + 1) \cdot S_{2w}$$