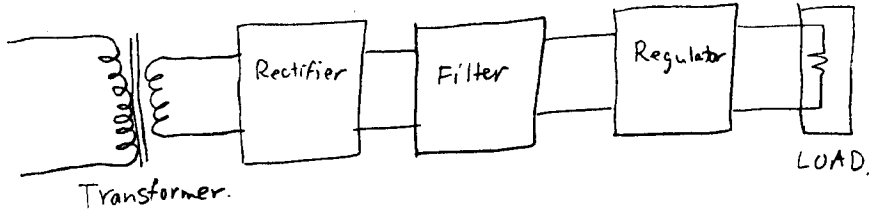
"Rectifier" circuits

(Diodes in Power supplies)

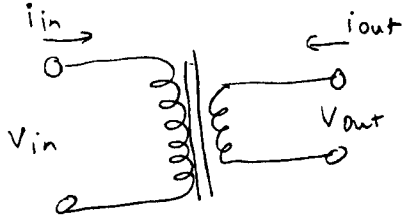
Design requirement:

We need to supply DC power at a particular voltage, but we have only AC (60Hz).

Idea:



A transformer converts one voltage (review)? to another, determined by the turns ratio



$$\frac{V_{in}}{V_{out}} = \frac{\text{primary turns}}{\text{secondary turns}}$$

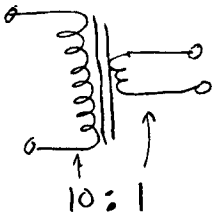
$$\frac{i_{in}}{i_{out}} = \frac{\text{secondary turns}}{\text{primary turns}}$$

Example: We need 12 volts
we have 120 volts.

Turns ratio $= \frac{120}{12} = 10$ $\left(\frac{\text{primary}}{\text{secondary}}\right)$

10:1 ← usually specified this way.

No standard on which goes first!



(We didn't say exactly how many turns – just the ratio).

Current ratio – suppose the secondary current is 1 Amp.
What is the primary current? _____

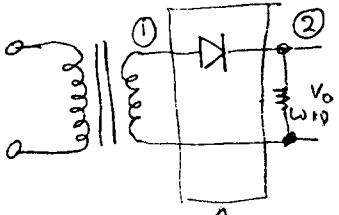
For 1 Amp, the resistance of the load must be 12 ohms.

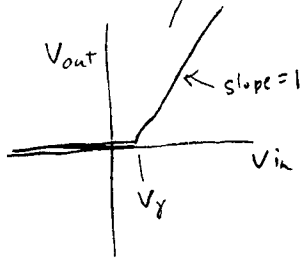
What do I see looking into the primary? _____

For a turns ratio of N:1
What is "impedance" ratio? _____

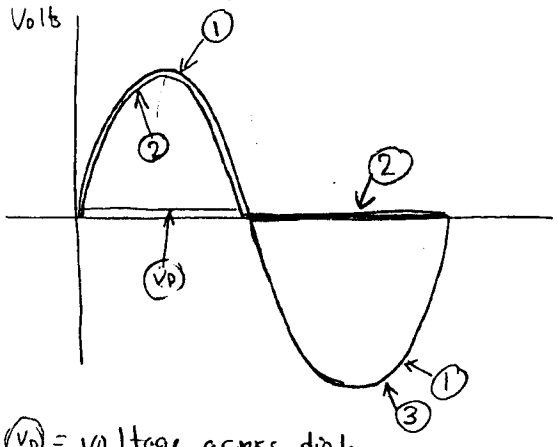
(This should be 313 review).

Half wave rectifier (2.1.1)



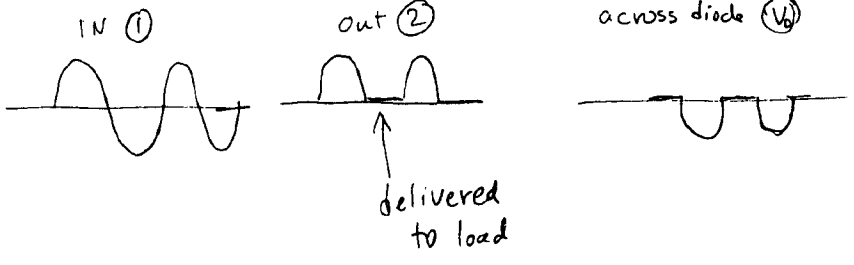


Voltage at ① ② One graph:



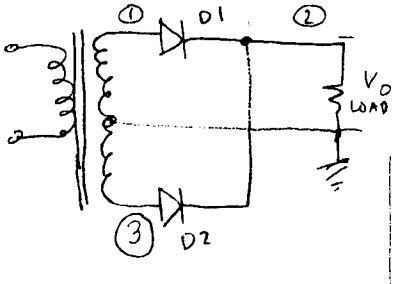
V_D = voltage across diode

3 graphs:

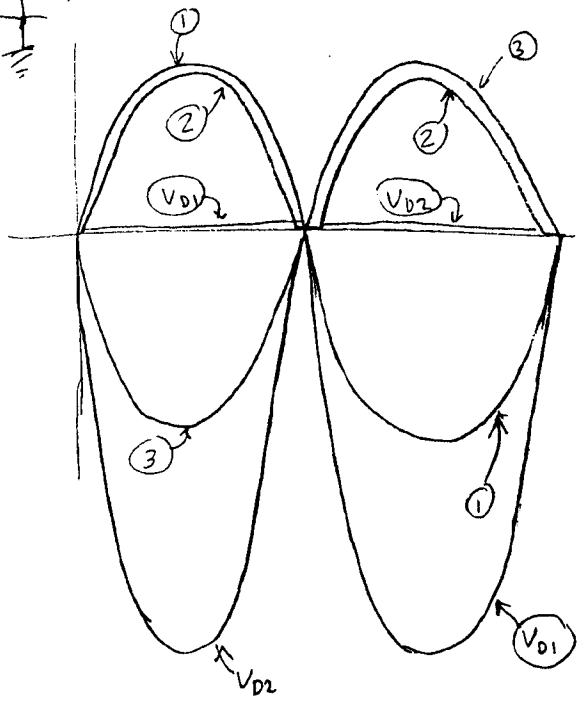


Full wave rectifier (2.1.2)

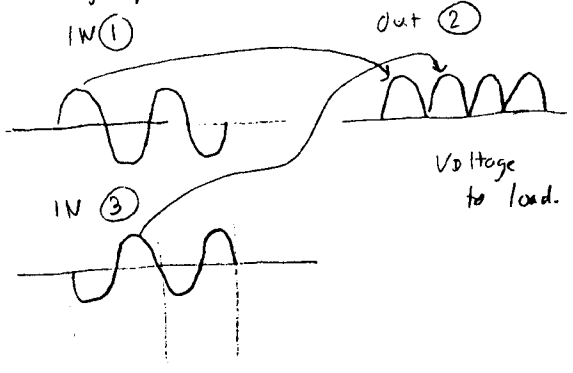
By adding another secondary, we can get both sides.



One graph:



5 graphs



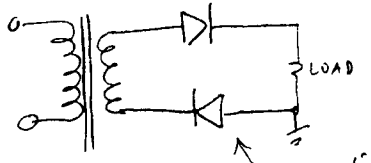
Advantages:
- Twice the frequency
- Smoother
- Easier to filter.

Disadvantages:
- Twice the reverse diode voltage

Bridge rectifier

Instead of the extra secondary, use an extra pair of diodes;

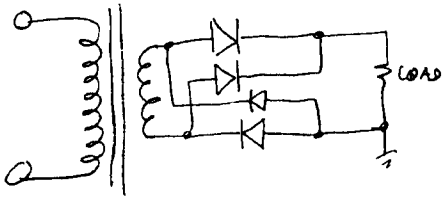
Half wave:



Works like the old half wave rectifier

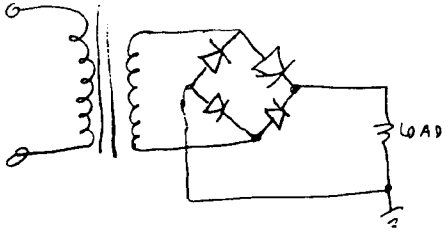
Two diodes in series are redundant, but leads to an idea;

Full wave.



Works almost like the other full wave, without the extra winding.

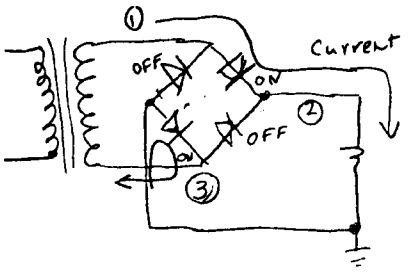
Usually draw it like this:

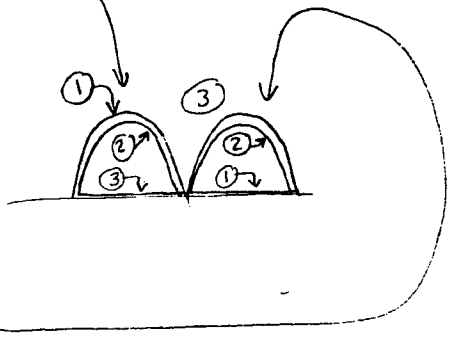


Advantages:
Like other full wave
Same reverse voltage as half wave

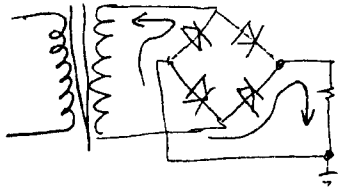
Disadvantages
Twice the diode loss.

Positive half:





Negative half



Using a bridge for both positive and negative voltages