Here is a solution for a battery charger, configured as a diode bridge driving a series combination of resistance and voltage. It is similar to Fig. 2.24, except for different numbers.

The objective is to determine battery current and charging power. As in Example 2.6.1, we can determine when each device is on.

One pair of diodes will be on when the input voltage exceeds the battery voltage, and the other pair will be on when the input voltage is less than the negative of the battery voltage. We can represent the current conveniently with an absolute value function and an "if": function from the computer:

Use a 120 V rms input at 60 Hz, and deliver to a 150 V battery through a 10Ω resistor.

$w := 120\cdot\pi$ <-- input radian frequency $V0 := 120\cdot\sqrt{2}$ <-- peak input voltage

$Vin(t) := V0\cdot\cos(w\cdot t)$ $R := 10$ <-- resistance, battery --> $Vbat := 150$

Battery current: If the |voltage| is high enough, current flows; otherwise, it is zero.

$$Ibat(t) := if\left(\left|Vin(t)\right| > Vbat, \frac{\left|Vin(t)\right| - Vbat}{R}, 0\right)$$

$T := \frac{1}{120}$ <-- period of I

Battery average power: $Pbat := \frac{1}{T}\cdot\int_0^T Ibat(t)\cdot Vbat\,dt$ $Pbat = 60.812$

^-- about 61 watts

Let's plot Ibat for three cycles of the input:

$i := 0..1000$ $t_i := \frac{\frac{3}{60}}{1000}\cdot i$