Consider this case:

For \( 0 < t < T = \frac{l}{v_p} \)

The "turn on" event has not reached the load yet. So, it doesn't know anything about \( R_L \).

The transmission line feels like infinitely long.

Therefore, the equivalent circuit is

In other words, there's no reflection yet.

\[
V_t^+ = \frac{V_g Z_0}{R_g + Z_0} \\
I_t^+ = \frac{V_g}{R_g + Z_0}
\]

The textbook uses a different convention here.

The source is \( 2 \) \( z = \infty \)

and the load \( 2 \) \( z = l \).

I follow it to minimize your confusion.
The front edge hits the load at $t = T$.

The reflection voltage

$$V_i^- = \Gamma_l V_i^+$$

The reflection current

$$I_i^- = -\Gamma_l I_i^+.$$  
Here the superscript indicates the direction and the subscript $i$ means the 1st roundtrip.

$$\Gamma_l = \frac{R_L - Z_0}{R_L + Z_0}$$

assuming $R_L > Z_0$.

---

\[ \begin{align*}
V(3, \frac{3}{2}T) &= V_1^- + V_1^+ \\
V(3, \frac{3}{2}T) &= V_1^- + V_1^+ \\
\end{align*} \]

\[ \begin{align*}
\Delta V_1^- + V_1^+ \\
\Delta V_1^- + V_1^+ \\
\end{align*} \]

$\Gamma_l > 0$  
$\Gamma_g < 1$
At $t = 2T$, the front hits the source.

There's reflection by the source.

\[ \Gamma_g = \frac{R_g - Z_0}{R_g + Z_0} \]

\[ V_2^+ = \Gamma_g V_1^- = \Gamma_g \Gamma_L V_1^+ \]

\[ I_2^+ = -\Gamma_g I_1^- = \Gamma_g \Gamma_L I_1^+ \]

Again, the subscripts indicate direction.

+ means from source to load.

- means from load to source.

The subscript \( \cdot 2 \) means the 2nd round trip.

\[ V_2^- = \Gamma_L V_2^+ \]

\[ I_2^- = -\Gamma_L I_2^+ \]

\[ V_2^+ + V_2^- = V_2^+ (1 + \Gamma_L) \]

\[ I_2^+ + I_2^- = I_2^- (1 - \Gamma_L) \]

Actually, for \( i \)th round trip.
\[ V_{i}^+ + V_{i}^- = V_{i}^+ (1 + \Gamma_L) \]
\[ I_{i}^+ + I_{i}^- = I_{i}^+ (1 - \Gamma_L) \]

\[ u(x=\infty) = V_{1}^+ + V_{1}^- + V_{2}^+ + V_{2}^- + V_{3}^+ + V_{3}^- + \cdots \]
\[ = \sum_{i=1}^{\infty} (V_{i}^+ + V_{i}^-) \]
\[ = V_{1}^+ (1 + \Gamma_L) + V_{2}^+ (1 + \Gamma_L) + \cdots = (1 + \Gamma_L) \left[ V_{1}^+ + V_{2}^+ + \cdots \right] \]
\[ = (1 + \Gamma_L) \sum_{i=1}^{\infty} V_{i}^+ \]

\[ V_{2}^+ = \Gamma_g \Gamma_L V_{1}^+ \quad V_{i+1} = \Gamma_g \Gamma_L V_{i}^+ \]

\[ u(x=\infty) = V_{1}^+ (1 + \Gamma_L) \left[ 1 + \Gamma_g \Gamma_L + (\Gamma_g \Gamma_L)^2 + \cdots \right] \]
\[ = V_{1}^+ (1 + \Gamma_L) \sum_{i=0}^{\infty} (\Gamma_g \Gamma_L)^i \]

\[ 1 + x + x^2 + \cdots = \sum_{i=0}^{\infty} x^i = \frac{1}{1 - x} \]

\[ \therefore \quad u(x=\infty) = V_{1}^+ (1 + \Gamma_L) \cdot \frac{1}{1 - \Gamma_g \Gamma_L} \]

\[ V_{i}^+ = \frac{V_g Z_0}{R_g + Z_0} \]
\[ \Gamma_g = \frac{R_g - Z_0}{R_g + Z_0} \]
\[ \Gamma_L = \frac{R_g - Z_0}{R_g + Z_0} \]
\[ u(x = \infty) = \frac{V_o R_L}{R_g + R_L} \]

— Exactly what we expected for dc voltage division.

Similarly,

\[ i_x (t = \infty) = I_0^+ \left( 1 - \Gamma_L \right) \sum_{i=0}^{\infty} \left( \Gamma_g \Gamma_L \right)^i \]

\[ = I_0^+ \frac{1 - \Gamma_L}{1 - \Gamma_g \Gamma_L} \]

\[ = \frac{V_o}{R_g + R_L} \]

It's pretty tedious to trace where the front is a certain time, and calculate the instantaneous values \( v(t) \) and \( i(t) \).

We now introduce a graphical tool to help us do that, tracking the bouncing back & forth of the front.

— It's called the bouncing front diagram.