Trains Meeting

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This is a puzzle from Boris Kordemsky's 1972 *Moscow Puzzles* ([1]).

Two freight trains, each 1/6 mile long and traveling 60 miles per hour, meet and pass each other. How many seconds is it between when the locomotives pass each other and the cabooses pass each other?

My Solution

I am going to proceed more generally, showing the trains don't have to be the same length or traveling at the same speed. Let the first train have a length of L_1 and a speed of v_1, and similarly for the second train: a length of L_2 and a speed of v_2.

Consider Figure 1 where the first train is shown in blue and the second in red. The engines are shown as circles and the cabooses as squares. When the trains meet (their engines "coincide"), the cabooses are $L_1 + L_2$ apart. When the cabooses meet after some time T, which we trying to determine, the first has traveled v_1T and the second v_2T, or a total distance $L_1 + L_2$. That is,

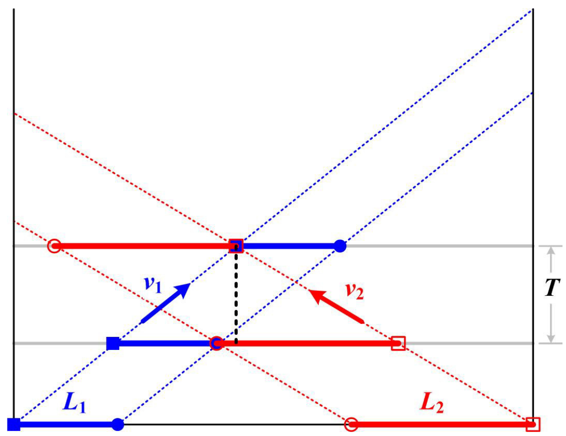

Figure 1

$$v_1T + v_2T = (v_1 + v_2)T = L_1 + L_2.$$

So

$$T = \frac{L_1 + L_2}{v_1 + v_2}.$$

Now in our case $L_1 + L_2 = ⅙ + ⅙ = ⅓$ mile, and $v_1 + v_2 = 1 + 1 = 2$ mi/min = 2 mi / 60 sec. Therefore

$$T = (⅓\text{ mile}) / (2\text{ mi} / 60\text{ sec}) = 60/6\text{ sec} = 10\text{ sec}.$$

As a non-equal example, suppose $L_1 = ⅙$ mile and $L_2 = ⅓$ mile and that $v_1 = 60$ mph and $v_2 = 40$ mph. Then

$$T = (½\text{ mile}) / (100\text{ mi} / 3600\text{ sec}) = 36/2\text{ sec} = 18\text{ sec}.$$

Kordemsky's Solution

Kordemsky's solution is essentially the same as mine.

When the locomotives meet, the cabooses are 2/6 = 1/3 mile apart, and their net approaching speed is 120 miles per hour. It takes them 1/360 hour = 10 seconds to meet.

References

[1] Kordemsky, Boris A., *The Moscow Puzzles, 359 Mathematical Recreations,* (1972) edited with introduction by Martin Gardner, trans. Albert Perry, Dover Publications, Garden City, New York, 1992. Problem 221.