to him—there will result a total error in the position of the two frogs of 10 in., resulting in a gauge of only 4 ft. 7½ in. in the straight track between the frogs. This is no hypothetical case, but along with other mistakes of its kind is almost of constant occurrence with young and inexperienced engineers. To avoid such trouble, stakes marking position of frog should be set for actual point and plainly marked to that effect. When the location of a frog in the existing track

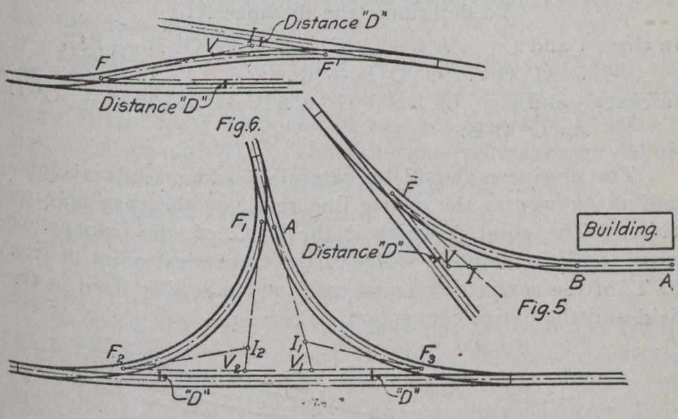


Fig. 7.

is not definitely fixed by conditions, the point of the frog should be so located as to bring the heel or the toe at a rail joint. If this is done, only one rail cutting is necessary and no short rails are required.

Graphical Solution of Track Problems.—A great many track problems can be readily solved by graphical methods. With careful and accurate drafting on a large scale—say 10 or 20 ft. to the inch—many complicated problems are readily solved with all the accuracy usually required in track work. In a great many problems a solution can be easily and quickly effected by making a few trials in the field. In such cases it has been the writer's practice to carry with him in the field a few curve templets, scale, triangle and drawing paper, and by locating the critical or determining points and plotting them to scale, he has generally been able to decrease the number of trials necessary for a solution to one or two.

In staking out tracks to and around existing structures the young and inexperienced engineer may not appreciate the importance of proper clearance and many a track has been staked and afterwards built 6 in. to a foot or more too close to an existing structure.

General Methods.—The ordinary method of locating turnouts where the position of the frog in the main or body track is not a critical feature is as follows: Set up the instrument at A (Fig. 2), this point being in the centre line of the turnout track opposite the point of the frog. Foresight is taken on point B gauge distance from the centre line of main or body track, with the vernier set at minus the frog angle so that when the reading is turned to zero the line of sight is in the centre line A-C of the turnout track. If, now, the turnout track is to proceed on a curved alinement, deflections may be turned either right or left and the curve located. A stake set back a distance from A equal to the length of the lead locates the switch point and the track foreman lines the curve between the heel of the switch and the toe of the frog, either by eye or by using a series of ordinates from the main track rail. If the main or body track is curved (Fig. 3), a backsight D and a foresight B are set, making the distance A-D equal the distance A-B. The angle between the line A-B and the line D-A extended is bisected to obtain a line parallel to the tangent to the main track rail at the point of frog and the frog angle F is then turned off from this tangent line. The work of locating the turnout track is thus done with one set up of the instrument, entirely independent of any theoretical assumption regarding the curve in the lead.

To make the curve (if any) in the turnout track tangent at the heel of the frog instead of at the point, which many would consider better practice, it is only necessary to have a table as in Fig. 4, and using the offset D, proceed as before.

In locating close connections between tracks and sharply curved branch tracks running into or along buildings where the exact position of the frog is a critical feature of the work, this position may usually be obtained as follows: Let A-B (Fig. 5) be the centre line of a branch track whose position for the distance A-B is determined by the building. Extend line A-B towards the main track to point V at distance D from the centre line of the main track. Measure the angle V and the distance VB. Let I be the point of intersection of the line AV with the line FI, angle IFV being the frog angle. Now the criterion for the minimum degree of curvature in the curve FB is that the point of intersection I shall be equally distant from the points F and B. This makes the curve FB a simple circular curve. To solve the problem, let FI = IB = T and let measured distance BV = M.

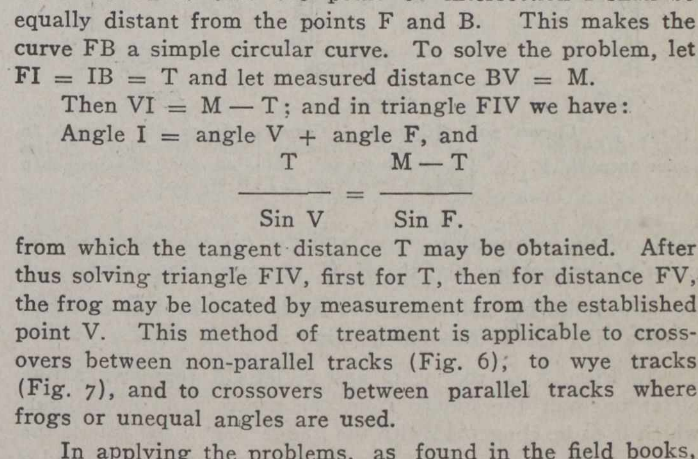
Then VI = M — T; and in triangle FIV we have:

Angle I = angle V + angle F, and

$$\frac{T}{\text{Sin V}} = \frac{M - T}{\text{Sin F.}}$$

from which the tangent distance T may be obtained. After thus solving triangle FIV, first for T, then for distance FV, the frog may be located by measurement from the established point V. This method of treatment is applicable to crossovers between non-parallel tracks (Fig. 6), to wye tracks (Fig. 7), and to crossovers between parallel tracks where frogs or unequal angles are used.

In applying the problems, as found in the field books, where a turnout from a curved track is to form a connection with an established tangent, the engineer is restricted to the use of but one curve, the degree of which is that of the theoretical curve of the turnout, which equals the degree of curve of turnout from a straight track, plus or minus the degree of the curve of the track from which the turnout springs. The use of this one curve will rarely prove desirable on account of its being either too sharp or too flat.



[Case 1. Curves in Opposite Directions. Δ less than 90°.]

[Case 2a. Curves in Opposite Directions. Δ greater than 90°, R^1 greater than R cos Δ.]

[Case 2b. Curves in Opposite Directions. Δ greater than 90°, R^1 less than R cos Δ.]

Four general cases of the problem present themselves, as shown in the illustrations, Figs. 8, 9, 10, 11, 12, 13. The necessary field work in each case consists in measuring the angle between the centre line of tangent and the tangent to the centre line of the curve at the point of intersection; or better yet, the angle between a line offset one-half the gauge from the centre line of the tangent and the rail which will