The two triangles I c b and A b d are similar, and it is necessary to find c b and b A, the perpendicular and the hypotenuse, respectively, the base c I or d A and the angles c b I and d b A being known.

$$c\,b = \tan \frac{c\,I}{c\,b\,I} \qquad b\,A = \sin \frac{d\,A}{d\,b\,A}$$

$c\,I = \frac{g}{2} = 2.354$ .... log 10.371806

$c\,b\,I = 8^\circ\ 10'\ 16''$ ....log tan 9.157116

$c\,b = 16.394$ .... log 1.214690

$d\,A = \frac{g}{2}\ 2.354$ .... log 10.371806

$d\,b\,A = 8^\circ\ 10'\ 16''$ ....log sin 9,152685

$b\,A = 16.563$ .... log 1.219121

$16.394 + 16.563 = 32.957 = c\,A.$

To this distance must be added the difference between the actual and the theoretical point of the frog. Frogs are usually ½-inch thick at the point, which would make this distance in a No. 7 to be 3½ inches, or .292 of a foot.

$32.957 + .292 — 33.249$, or 33.25.

This distance was set off on the centre line and the rail marked at right angles for the first frog on the ladder track, numbered A. The next frog to be set was that for the engine track, No. B, which was parallel to and 15 feet distant from the ladder track.

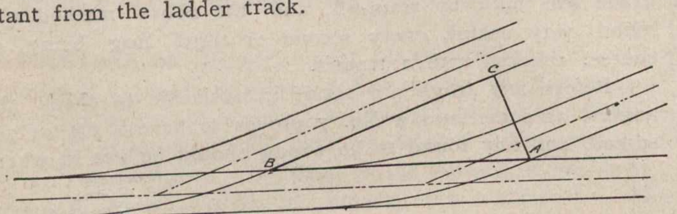

Fig. 3.

In the triangle A B c, A is the frog of the ladder track and B that of the engine track, c A being the distance between the tracks and A B the distance required.

$$A\,B = \frac{A\,c}{\sin c\,B\,A}$$

$A\,c = 15'$ .... log 11.176091

$c\,B\,A = 8^\circ\ 10'\ 16''$ ....log sin 9.152685

$A\,B = 105.54$ 2.023406

Which distance was laid off and a stake placed at B.

The next proceeding was to lay out the frogs on the ladder track, lettered C to H. The first method was to set up the transit over the point of frog A, deflect the angle, and lay off the various distances. This was found to be rather unpracticable, owing to the difficulty in measuring with a chain over piles of ties, rails, and other material,

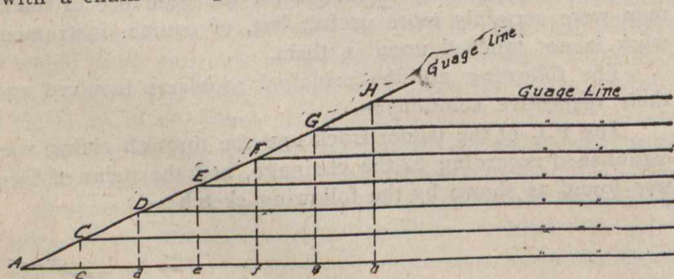

Fig. 4.

which also partially obstructed the line of sight. The corresponding distances were, therefore, laid out on the through siding and offsets taken out to the ladder track as in sketch No. 4.

The frog angle C A c, C c, D d, E e, the distances from the respective sidings being given—

$$A\,C = \frac{C\,c}{\sin C\,A\,c} \qquad A\,c = \frac{C\,c}{\tan C\,A\,c}$$

The similar triangles D A d, E A c, etc., being likewise solved, each one separately to avoid cumulative errors. Points were thus easily found with a fifty-foot tape.

The following table gives the distances as laid out:—

No. of frog.	Cs.	Distance from through siding.	Distance along through siding.	Distance along ladder track.
C	14	14	97.5	98.5
D	13	27	188.0	189.9
E	13	40	278.6	281.4
F	13	53	369.1	372.9
G	13	66	459.6	464.4
H	13	79	550.2	555.8

The south ladder track was staked out in similar fashion.

Opposite the end of the ladder track the turntable track turned off to the roundhouse, making an angle of 9° 31′ with the engine track, and at the heel of the frog (I) about 25 feet of 3° curve is shown on the plan. This was rather a puzzler, but was solved in the following manner:—

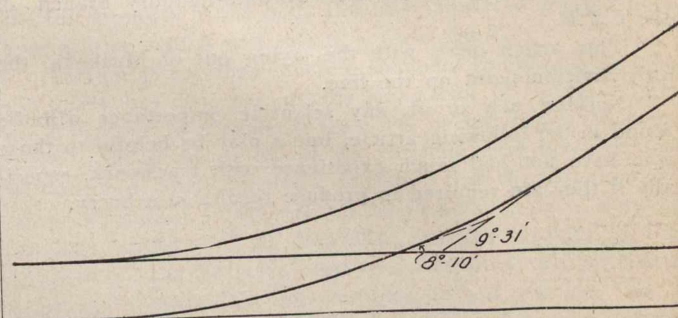

Fig. 5.

In this figure is shown the engine track and the angle of 9° 31′ turning towards the turntable. It is obvious that if the frog be moved back that the line of the frog will intersect the line of the track, and the intersecting angle will be the difference between the frog-angle and the total angle between the two tracks.

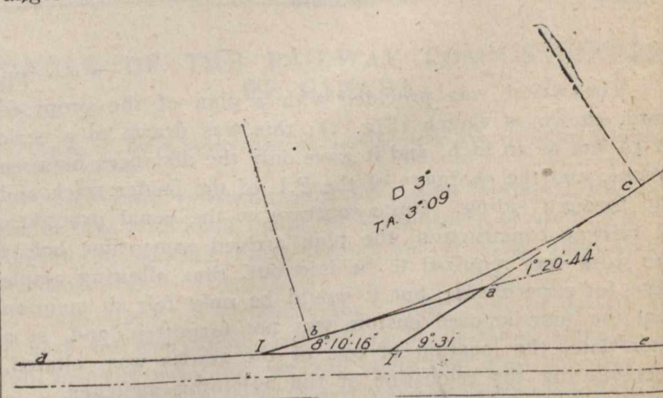

Fig. 6.

In the above figure d e is the line of rail of the engine track, c I′ that of the turntable track, the point of intersection I′ being found on the ground, which angle a I′ d is 9° 31′. Let I be the position of the frog; then the angle I a I′ = 1° 20′ 44″.

We find from the tables that the sub-tangent for a 3° curve with a central angle of 1° 20′ 44″ is 22.43 feet. To this distance add the length of the frog from point to heel, which in the present instance was 7.25 + .29, the difference between actual and theoretical points, which total is 29.97