A NEW SYSTEM OF LAYING OUT RAILWAY TURN-OUTS INSTANTLY, BY INSPECTION FROM TABLES

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JACOB M. CLARK

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1884.

PREFATORY NOTE.

THIS little work is issued in its present form by permission of the Publishing Committee of the American Society of Civil Engineers. The text was written in 1869, at which time the tables had assumed nearly their present extent. The author, with a majority of his colleagues on that committee, regarded the matter as too technical to be published in the "Transactions."

The general principle of *sum* and *difference* has long been understood, and is so obvious that many must have hit upon it independently. In 1878 a tract appeared, by Mr. E. A. Giesler, civil engineer and architect, containing a limited set of tables for single turn-outs on a gauge of 4.7, with a peculiar method of applying corrections for curvature in the main track, and for different lengths of switch-bar. This principle is applied, but in a somewhat different way, by William Findlay Shunk, C.E., in "The Field Engineer." A more distinct allusion appears in the last edition (1883) of

Trautwine's "Civil Engineer's Pocket-Book," page 403; and the principle is treated more *in extenso* by J. R. Stephens, following Trautwine, in *Van Nostrand's Magazine*, August, 1883, pages 89–100. Allusions to it are also found in "Field Engineering," by W. H. Searles, C.E., Member of the American Society of Civil Engineers, recently published. These works, each in its proper sphere, are among the most useful hand-books to be found.

It is obvious that the tables apply to "point-switches," so called, by simply substituting for "head-block" the position where the "point-rail" departs from the "angle-rail" by an amount equal to the "throw" of the switch, according to the old method.

Where the frog-angle is less than three and a half degrees it is scarcely practicable to make a firm frog. In rare cases, however, these lower angles may serve to fix the adjustment where, from any cause, it is necessary for one rail to cross another at a very acute angle by means of a pivoted rail.

JACOB M. CLARK.

NEW YORK, September, 1883.

RAILWAY TURN-OUTS.

THE subject of this monograph claims attention, rather on account of the aggregate amount of industry employed in adjusting the contrivances to which it relates, than from its professional range. Numerous and careful treatises attest how fully this claim has been recognized by the profession; the present paper aims to exhibit, in a systematic form, a method of practice, intended, so far as it differs from others, to save time and abridge labor.

The published solutions extant very uniformly regard the turn-out track as located on a curve which is tangent to a *switched* or deflected rail. This multiplies cases, requiring, for exact determination, the construction of diagrams, much calculation, and in general, the use of logarithmic and circular tables. The valuable tables of frog-angles and distances in existence are based on that method, and do not exhibit the corrections sometimes necessary for turn-outs from tracks which are sharply curved.

It is generally more convenient to locate the turn-out upon a curve which is tangent to the main track at a point not far from the heel of the switch. The head-block is then placed where the departure of the centre lines from each other is equal to the necessary deflection or "throw" of the switch-bar, which, in turn-outs from a straight track, should not be less than half nor more than the entire distance from the head-block back to the tangent-point or point of divergence.

By this device, the exact solutions for all turn-outs (except one of rare occurrence), are reduced to three cases, each of which involves simply the resolution of a right-angle triangle, two of whose parts are known, or of an oblique triangle with three given sides. The same is true of *cross-overs.* They are introduced in this connection to make clear what follows.

TURN-OUTS.

CASE I.—*Turn-out from a Straight Track.*

Let AB (Fig. 1) = the gauge = a,
r' = radius of turn-out track,
m = the degree of curvature of turn-out track,
t = throw of switch,
d = OP = the distance of the head-block from the point of divergence,
D = OF = the distance of the frog,
F = OCF = the frog-angle :

Then,

$$D = \sqrt{2r'a},$$

$$\text{Sin. } F = \frac{r' + \frac{1}{2}a}{\sqrt{2r'a}}, \text{ tang. } \tfrac{1}{2}F = \sqrt{\frac{a}{2r'}},$$

$$d = \sqrt{2r't},$$

and

$$\text{PF} = D - d = \sqrt{2r'}\,(\sqrt{a} - \sqrt{t}).$$

CASE II.—*Interior Turn-out from a Curved Track.*

(Fig. 2) Let r = radius of main track,
r' = radius of turn-out:

Then the frog-angle F and the distance OF are found by solving the triangle CC′F, whose sides are respectively $(r - \frac{1}{2}a)$, $(r' + \frac{1}{2}a)$, and $(r - r')$.

CASE III.—*Exterior Turn-out from a Curved Track.*

(Fig. 3) The sides of the triangle to be solved are respectively $(r + \frac{1}{2}a)$, $(r' - \frac{1}{2}a)$, and $(r + r')$.

OP is practically the same as if one of the tracks were straight, the other having at the same time a degree of curvature equal to the *difference* of the degrees of curvature of the main and turn-out tracks in Case II., or in Case III. to their *sum*. So that generally (Fig. 4), if