The distance from the actual toe of the switch to the point of frog is sometimes called the **practical lead.** The distance, in inches, from the theoretical to the real nose of the frog is 0.5 *n*.

H or D is {Toe of stub switch. / Heel of split switch.}
B or A is {Heel of stub switch. / Toe of split switch.}

DK is the throw of the switch.
BF is the theoretical lead or "total lead."
HF is the practical lead or "lead" for a stub switch.
BF and AF are the lead rails.

In the following discussion the **general case** is assumed to be the turnout from a curve whose radius is greater than the radius of the turnout, both centers lying on the same side. On this assumption **there are three other cases** which may be considered special: First, when the radius of a turnout curve is greater than the radius of the mainline curve, but its center is on the same side of the main line as the center of the main-line curve; second, when the center of the turnout curve is on the opposite side to that of the main-line curve; and third, when the main line is a tangent, i. e., its radius is infinite.

128. Fig. 92 illustrates the general case considered.

$R = Oa$ = radius of the main-line curve.
$r = Ca$ = radius of turnout.
θ = angle of main-line curve subtended by BF.
$F = CFO$ = angle of frog.

$$n = \text{No. of frog} = \frac{1}{2}\cot\frac{1}{2}F.$$

At the point G, the line AF, produced, cuts the other rail of the main line.

$$\text{Then, } \tan\frac{1}{2}\theta = \frac{g}{2R}\cot\frac{1}{2}F = \frac{gn}{R},$$

$$r + \frac{1}{2}g = \left(R - \frac{1}{2}g\right)\frac{\sin\theta}{\sin(F+\theta)},$$

$$\text{and } BF = 2\left(R - \frac{1}{2}g\right)\sin\frac{1}{2}\theta,$$

$$\text{and } af = 2r\sin\frac{1}{2}(F+\theta).$$

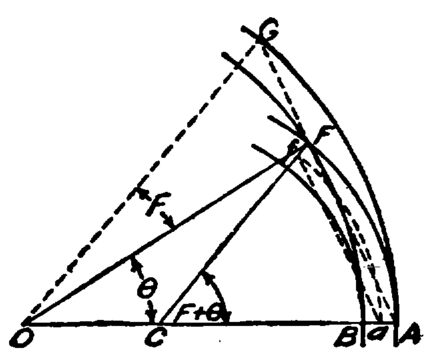

FIG. 92

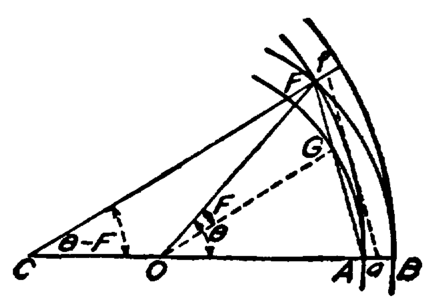

FIG. 93.

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When R is greater than 500 ft. and n is a standard frog number, the degree of curvature of the turnout will be equal to the sum of the degree of curvature of the main track and the degree of curvature for the turnout from a tangent corresponding to n in Table XVIII or XIX.

$AD = \sqrt{\frac{10000\ DK}{t-t'}}$ (approx.), fig. 91, t and t' are the offsets from the tangent for 100 ft. on curves with R and r, respectively, as radii (see par. 61). Therefore, knowing radius of curvature of main line and of turnout and the throw of the switch, the switch length, AD, can readily be found.

In deducing the foregoing formulæ, R, r, θ, t', and F have been considered positive.

129. **First special case.**—$R < r$, t' positive, and F negative (fig. 93).

$$\text{Then, } BF = 2\left(R + \tfrac{1}{2}g\right)\sin\tfrac{1}{2}\theta \text{ (sign not considered).}$$

$$af = 2r\sin\tfrac{1}{2}(\theta - F) \text{ (numerically).}$$

$$AD = \sqrt{\frac{10000\ DK}{t-t'}}.$$

$$r - \frac{1}{2}g = \left(R + \frac{1}{2}g\right)\frac{\sin\theta.}{\sin(\theta - F)}.$$

130. **Second special case.**—θ and F opposite signs, t' negative (fig. 94).

$$\theta = FOA;\ F = FOG;\ F - \theta = FCA.$$

$$\text{Then, } BF = 2\left(R + \tfrac{1}{2}g\right)\sin\tfrac{1}{2}\theta \text{ (sign not considered).}$$

$$af = 2r\sin\tfrac{1}{2}(F - \theta) \text{ (sign not considered).}$$

$$AD = \sqrt{\frac{10000\ DK}{t+t'}}.$$

$$r + \frac{1}{2}g = \left(R + \frac{1}{2}g\right)\frac{\sin\theta}{\sin(F - \theta)} \text{ (sign not considered).}$$

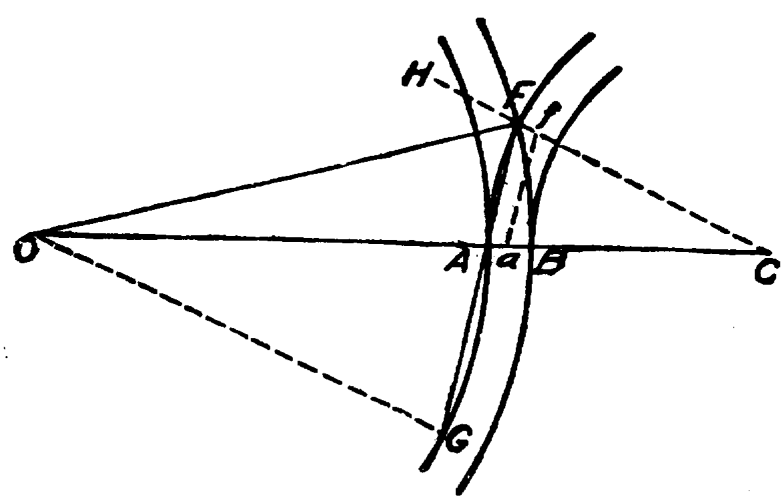

FIG. 94.

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131. Third special case.—R = infinity, $\theta = 0, t = 0$ (fig. 91).

Then, $BF = g \cot \frac{1}{2} F = 2gn.$

$af = 2r \sin \frac{1}{2} F.$

$$AD = \sqrt{\frac{10000\ DK}{t}}.$$

$$AD = 100\sqrt{\frac{DK}{t}} = BF\sqrt{\frac{DK}{AB}} = \sqrt{2rDK}.$$

$$r + \frac{1}{2}g = \frac{g}{\text{vers } F}.$$

132. **To lay out a turnout.**—In laying out a turnout, the first thing to be determined is the point from which the turnout is to start, or else the location of the point of frog (P. F.). Having decided on one of these, and upon the number of the frog, the other may be found by laying off the distance BF (Table XIV).

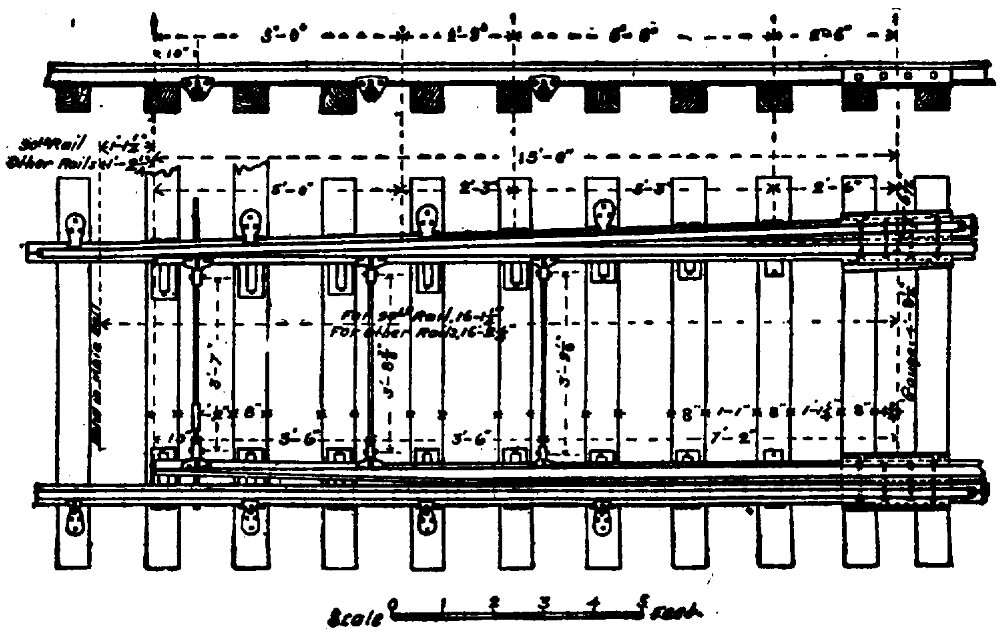

FIG. 95.—STANDARD SPLIT SWITCH.

133. **For a split switch,** locate F so that the end of the main point of the frog will be at a rail joint and lay off the distance to H, equal to (BF−AD), (Table XIV). From H lay off a distance equal to the length of the switch point (15 to 20 feet) plus about 1.25 ft. (see fig. 95). This is the actual P. C. of the switch where the rail begins to bend. From F and B, *a* and *f* can be located and the center line of the switch laid out. A quicker way is to locate the quarter points of the theoretical lead BF from F along the main rail; call these quarter points 1, 2, and 3, respectively, from F and mark them on the rail. The lead rail, AF, having been curved by use of the ordinates of Table XX, can then be laid, the inner side of the head of the rail being $\frac{7g}{16}$, $\frac{12g}{16}$, and (g−DK−width of rail head), from points 1, 2, and H, respectively. These gage distances must be measured very carefully. The head block and switch stand should be about 1 ft. from the toe of the switch, toward F. Remember that F is not the actual nose of the frog.

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134. For a stub switch, fix H at a rail joint, then locate F by measuring a distance (BF−AD) from H. Then mark the quarter points and proceed as for a split switch. If the joints are square, this saves cutting one rail. If the joints are not square, either H or F may be located first. The head block and switch stand should be about 1 ft. from the toe of the switch away from F. In case the throw of the switch is not that shown in the tables, the length of AD can readily be figured from the formulæ and will not affect the method. Be sure to leave room at HD for **expansion of rails.**

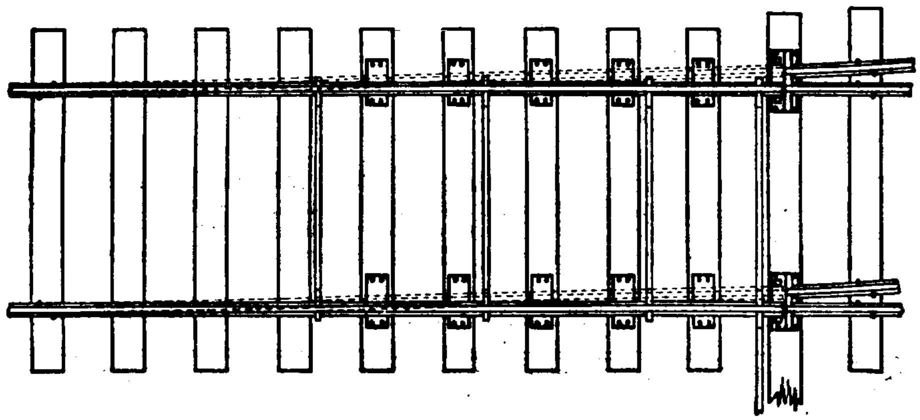

FIG. 96.—STUB SWITCH.

TABLE XIV.—**Switch leads and distances** (circular throughout).

Gage, 4 ft. 8½ ins.=4.708 ft. Throw, 5 ins.=0.417 ft.

No., *n.*	Angle, F.			Distance, BF.	Chord, *af.*	Switch, AD.	Radius, *r.*	Degree of curve.		
	°	′	″					°	′	″
4	14	15	00	37.664	37.373	11.209	150.656	38	45	57
4½	12	40	49	42.372	42.113	12.610	190.674	30	24	09
5	11	25	16	47.080	46.846	14.012	235.400	24	31	36
5½	10	23	20	51.788	51.575	15.413	284.834	20	13	13
6	9	31	39	56.496	56.301	16.814	338.976	16	57	52
6½	8	47	51	61.204	61.024	18.215	397.826	14	26	25
7	8	10	16	65.912	65.744	19.616	461.384	12	26	34
7½	7	37	41	70.620	70.464	21.017	529.650	10	50	02
8	7	09	10	75.328	75.181	22.418	602.624	9	31	07
8½	6	43	59	80.036	79.898	23.820	680.306	8	25	47
9	6	21	35	84.744	84.613	25.221	762.696	7	31	04
9½	6	01	32	89.452	89.328	26.622	849.794	6	44	46
10	5	43	29	94.160	94.043	28.023	941.600	6	05	16
10½	5	27	09	98.868	98.756	29.424	1,038.114	5	31	17
11	5	12	18	103.576	103.469	30.825	1,139.336	5	01	50
11½	4	58	45	108.284	108.182	32.227	1,245.266	4	36	08
12	4	46	19	112.992	112.894	33.628	1,355.904	4	13	36

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Gage, 3 ft. Throw, 4 ins.=0.333 ft.

No., *n*.	Angle, F.	Distance, BF.	Chord, *af*.	Switch, AD.	Radius, *r*.	Degree of curve.
	° ′ ″					° ′ ″
4	14 15 00	24	23.815	8	96.0	62 46 34
4½	12 40 49	27	26.835	9	121.5	48 36 04
5	11 25 16	30	29.851	10	150.0	38 56 33
5½	10 23 20	33	32.865	11	181.5	31 58 55
6	9 31 39	36	35.876	12	216.0	26 46 07
6½	8 47 51	39	38.885	13	253.5	22 45 04
7	8 10 16	42	41.893	14	294.0	19 35 01
7½	7 37 41	45	44.900	15	337.5	17 02 21
8	7 09 10	48	47.906	16	384.0	14 57 48
8½	6 43 59	51	50.912	17	433.5	13 14 47
9	6 21 35	54	53.917	18	486.0	11 48 37
9½	6 01 32	57	56.921	19	541.5	10 35 46
10	5 43 29	60	59.925	20	600.0	9 33 38
10½	5 27 09	63	62.929	21	661.5	8 40 12
11	5 12 18	66	65.932	22	726.0	7 53 54
11½	4 58 45	69	68.935	23	793.5	7 13 32
12	4 46 19	72	71.938	24	864.0	6 38 60

Angle and distance of middle frog, F″.

No., *n*.	No., *n″*.	Angle, F″.	Distance, *a*F″. Gage, 4 ft. 8½ ins.	Distance, *a*F″. Gage, 3 ft.	No., *n*.	No., *n″*.	Angle, F″.	Distance, *a*F″. Gage, 4 ft. 8½ ins.	Distance, *a*F″. Gage, 3 ft.
		° ′ ″					° ′ ″		
4	2.817	20 07 36	26.736	17.037	8½	6.005	9 31 08	56.643	36.094
4½	3.172	17 54 52	30.054	19.151	9	6.359	8 59 30	59.969	38.213
5	3.527	16 08 19	33.374	21.266	9½	6.713	8 31 10	63.296	40.333
5½	3.881	14 40 58	36.695	23.383	10	7.067	8 05 40	66.623	42.453
6	4.235	13 27 57	40.018	25.500	10½	7.420	7 42 35	69.950	44.573
6½	4.589	12 26 07	43.342	27.618	11	7.774	7 21 36	73.277	46.693
7	4.943	11 33 04	46.666	29.736	11½	8.128	7 02 26	76.605	48.813
7½	5.297	10 47 02	49.991	31.855	12	8.482	6 44 51	79.932	50.934
8	5.651	10 06 44	53.317	33.974					

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TABLE XV.—**Switch leads and distances** (circular throughout).

Gage, 2 ft. 6 ins. Throw, 4 ins.=0.333 ft.

Frog No.	Frog angle.			Distance, BF.	Chord, *af*.	Switch length.	Radius.	Logarithm.	Degree of curve.		
	°	′	″	*Ft.*	*Ft.*	*Ft.*	*Ft.*		°	′	″
4	14	15	00	20.0	19.85	7.30	80.00	1.90309	77	20	00
4½	12	40	49	22.5	22.35	8.21	101.25	2.00539	59	11	12
5	11	25	16	25.0	24.88	9.12	125.00	2.09691	47	09	28
5½	10	23	20	27.5	27.38	10.03	151.25	2.18256	38	20	38
6	9	31	39	30.0	29.89	10.94	180.00	2.25527	32	15	20
6½	8	47	51	32.5	32.40	11.86	211.25	2.32480	27	21	56
7	8	10	16	35.0	34.91	12.77	245.00	2.38917	23	33	06
7½	7	37	41	37.5	37.42	13.68	281.25	2.44910	20	28	48
8	7	09	10	40.0	39.92	14.59	320.00	2.50515	17	48	44
8½	6	43	59	42.5	42.43	15.50	361.25	2.55781	15	54	40
9	6	21	35	45.0	44.93	16.42	405.00	2.60746	14	11	00
9½	6	01	32	47.5	47.43	17.33	451.25	2.65442	12	43	22
10	5	43	29	50.0	49.94	18.24	500.00	2.69897	11	28	42
10½	5	27	09	52.5	52.44	19.16	551.25	2.74135	10	24	28
11	5	12	18	55.0	54.94	20.07	605.00	2.78176	9	28	52
11½	4	58	45	57.5	57.44	20.99	661.25	2.82037	8	40	24
12	4	46	19	60.0	59.94	21.90	720.00	2.85733	7	57	50

135. **On curves,** where R and r are both over 500 ft., very little error is made in taking BF and AD from the corresponding table for tangents; but where they are both under 500 ft. there will be considerable error and the values should be computed from the formulæ. These formulæ are also given on account of the great variety of existing gages in tracks in various parts of the world, and the impracticability of making up a table for every such gage, or throw. Turnouts to the inside of sharp curves should be avoided.

136. Having located the point of frog and point of switch, the center of the turnout opposite each of these points may also be fixed by laying off ½ g along the radius r. This locates the points f and a, fig. 91. Having located these two points, the **center line of the turnout** can be located by laying off from the middle of af, a distance equal to $\frac{1}{4}$ g, perpendicular to af, and from the quarter points of af a distance equal to $\frac{3}{16}$ g. The distance AD, taken from Table XIV or XV, is laid off, locating the point D. At this point the distance from center to center of rails must be equal to d, the throw. Having located this point, and knowing the dimensions of the frog to be used, the rails will be cut, the frog put in, the remaining fixed rails spiked in place, and the switch proper is then put in. The first method, described in par. 133, is the better of the two. The **guard rails** are located well in advance of the point of frog so as to protect it from the wheels, the flanges of the rails being cut away, if necessary, to place them close enough together.

137. For each special case, the turnout should be so located as to require the **least amount of rail cutting.** Fig. 97 shows the dimensions of certain **standard frogs** used on the Chicago & North Western Railway. These are built to such dimensions that standard lengths of rail, as shown in the last column of the table in the figure, can be kept on hand, and thus a turnout can be put in without cutting rails at the time.

A similar table should be prepared for any military railroad and a stock of specially cut rails kept on hand.

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Designation	Angle	CURVE Degree	CURVE Radius	P.C. to P.F.	H.B. to P.F.
1 in 5	11°25′16″	24°31′36″	235.4	47.08	
1 in 6	9°31′39″	16°57′52″	338.97	56.5	
9° SPECIAL	(For Double Slip)				
9° (1 in 6.353)	9°00′	15°07′	380.05	59.85	58.75 1-30′ Rail, 15′ Point, 11.75 Wing
1 in 7	8°10′16″	12°27′	461.1	65.92	61.14 1-28′, 1-14.89 Rails, 15′ Point, 3.25 Wing
1 in 8	7°09′10″	9°30′	603.8	75.33	67.75 2-24′ Rails, 15′ Point, 4.75 Wing
1 in 10	5°43′30″	6°05′	942.3	94.16	81.50 2-30′ Rails, 15′ Point, 6.5 Wing
1 in 14	4°05′26″	3°06′	1848.5	131.8	117.27 3-30′ Rails, 20′ Point, 7′3¼″ Wing

Rail	Height	Head	Base
60 lb.	4¼ in.	2 5/16 in.	4 1/16 in.
65 "	4 3/8 "	2 5/16″ 2 13/32	4 7/16 "
72 "	4¾ "	2 3/8 in.	4¾ "
80 "	5 "	2½ "	5 "
90 "	5 3/8 "	2 5/8 "	5 3/8 "

No. 10-72 lb. same as No. 10-80 lb. excepting 6″ bet. theoretical and actual Points.

9° 60 lb. (17 ft. Frog) same as 9° 72 lb.

Present Width of Flangeways adopted 1895.

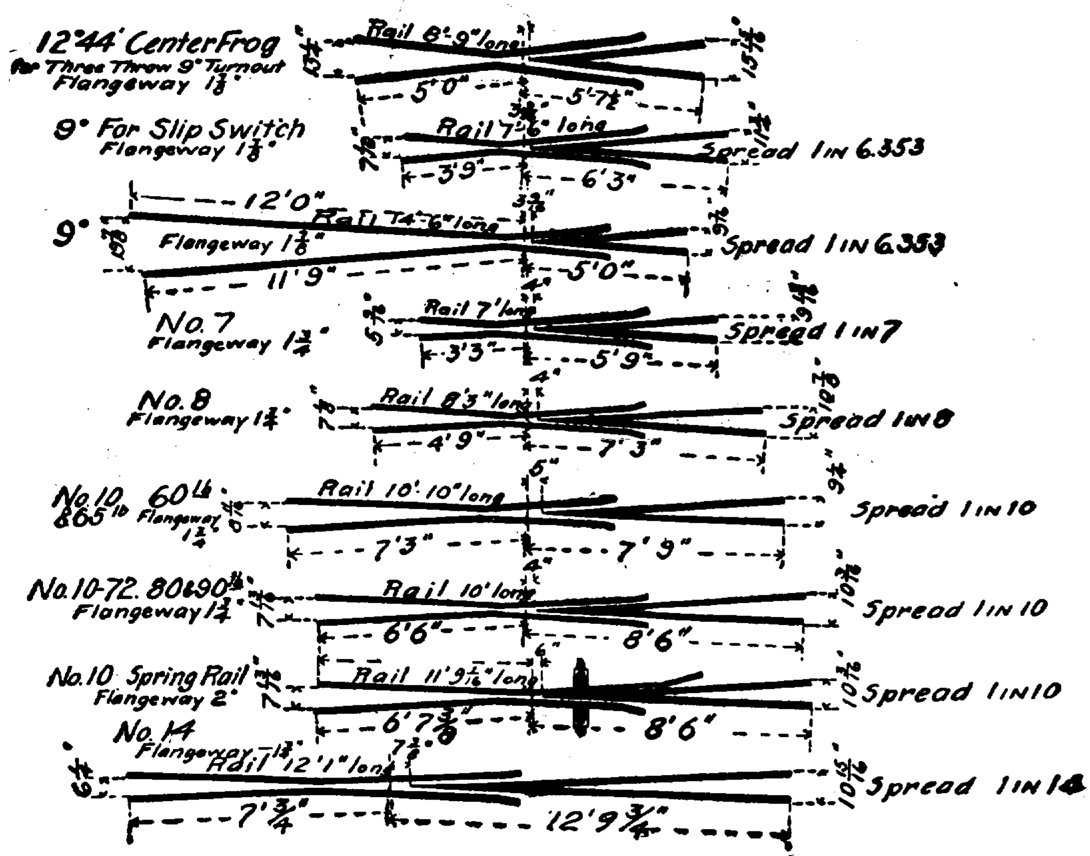

FIG. 97.

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138. The main-line rail, on the side toward which the turnout leads, is not curved from the theoretical point of switch, but the bend begins at a point slightly in front of the toe of switch as determined by the length of the switch rail from the point D (see figs. 91 and 95). The actual turnout as laid out will not be the theoretical one herein described, since the switch rail is straight and is usually fixed at 15 ft. in length, and the frog rail is also straight. This discussion will, however, answer for all military purposes. Most turnouts, in fact, are laid out as herein described and from tables similar to Tables XIV and XV.

139. After passing the frog, the turnout will be located just as any other line is located, but sometimes certain conditions are placed upon a turnout, as in fig. 98. The condition here is that the turnout shall run parallel to the main line at a distance *p* from center to center. Such a siding is then composed of the curve lead, a short tangent, and another curve in the opposite direction leading into the tangent of the siding. (The short tangent *fm* is sometimes omitted.)

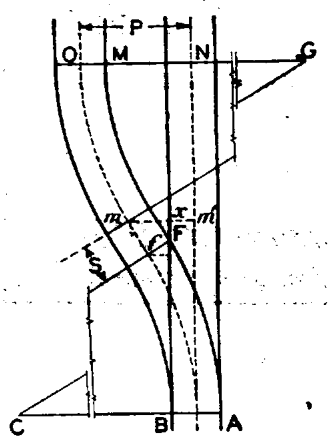

FIG. 98.

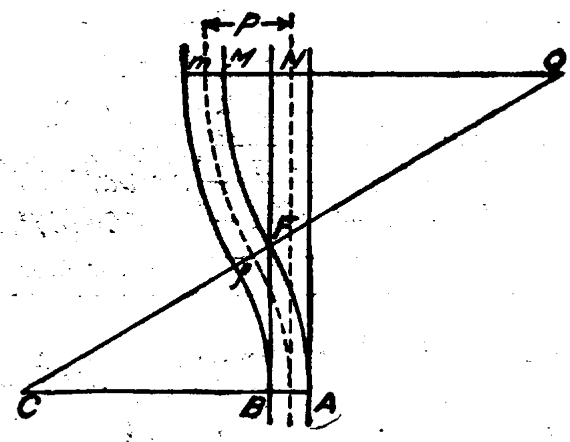

FIG. 99.

140. As a general rule, the second curve of this reverse curve is similar, but opposite in direction, to the first curve, although this is not necessary.

The **length of the tangent** S, fig. 98, is $\frac{p-g}{\sin F} - \frac{g}{\tan F}$, and F*x*, on the main line, is $(p-g)\cot F - \frac{g}{\sin F}$. Lay off this distance, S, from *f*, fig. 98, to *m*, making an angle, F, with the main line. This point, *m*, lies a distance $(p-g)$ from the center of the main line, and a distance *g* from the center of the proposed siding. This point *m*, can be located without an instrument by laying off F*x* from the P. F. along the center of main line to *m'*, and at *m'*, laying off $(p=g)$ perpendicular to the main line to *m*.

From *m'* lay off a distance *m'* N on the main line equal to BF, fig. 98, and from N lay off a distance *p* from the center of the main line and perpendicular to it. This locates the point, *o*, which is the P. T. of the curve leading to the siding.

The line *mo* corresponds to the line *af*, fig. 91, and the center line of the curve can be laid out in the same manner that the first curve lead was laid out.

141. The short tangent S may be omitted and the siding and main line may be connected by a **reverse curve** (fig. 99), *r'* being the radius of the second curve.

$$\text{Then, } p-g=\left(r'-\frac{1}{2}\right)\text{vers F, or } r'-\frac{1}{2}g-\frac{p-g}{\text{vers F}},$$

$$\text{and FN}=\left(r'-\frac{g}{2}\right)\sin F.$$

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142. Another **special case** is where the turnout leads into another track. This is called **a crossover** (fig. 100). In case the lines to be connected are parallel, and p is the distance from center to center, the length of the tangent joining the two curve leads is found, as in par. 140.

The point in the siding opposite to point N is the P. F. of the turnout of the second track.

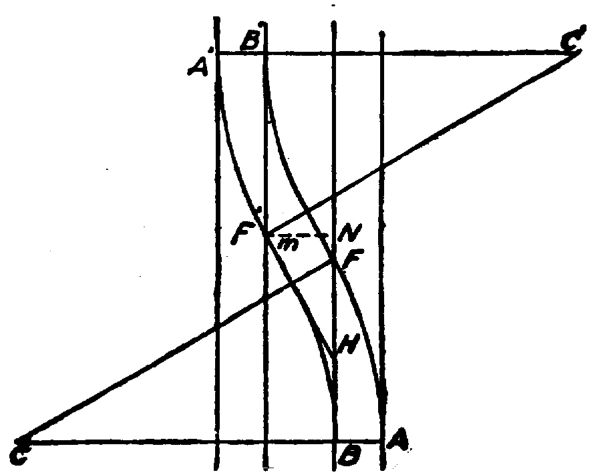

FIG. 100.

143. As in the case of a siding (par. 141), the tangent S may be replaced by a **reverse curve** (fig. 101), in which case, **if both frogs are alike,**

$$\cos C = 1 - \frac{p}{2r}.$$

$$PL = r \sin C = PL'.$$

The distance between points of frog measured along the main line is FN.

$$FN = 2\,(PL - BF).$$

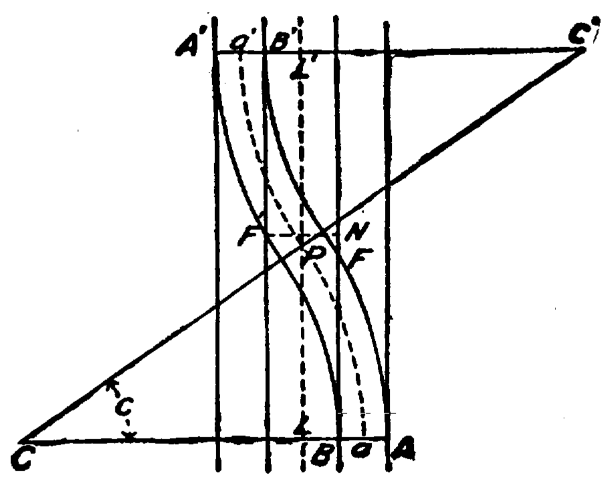

FIG. 101.

If the **frogs** are **different,** vers $C = \frac{p}{(r+r')}$, and $LL'L' = (r+r') \sin C$.

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144. **To connect two parallel curved lines.**—It will be seen from fig. 102, in which O is the center of the main-line curve, C and C′ the centers of the reverse curves of the crossover, that the three sides of the triangle COC′ are known and that the solution depends upon the value of the angle COC′.

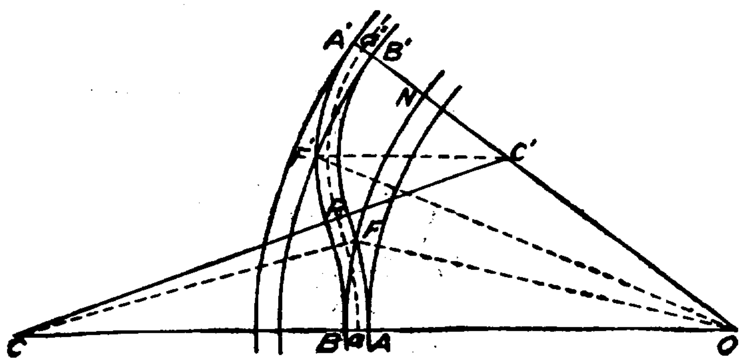

FIG. 102.

Let r=radius aC,
r'=radius a' C′,
p=distance between track centers,
R=radius aO,
α=COC′.

$$\text{Then, vers } \alpha=\frac{p(r+r'-\frac{1}{2}p)}{(R+r)\,(R+p-r')}.$$

The arc BN$=100\frac{\alpha}{D}$ ft., in which D=degree of curvature of the main line.

$$\text{vers C}'\text{ CO}=\frac{p(R-r'+\frac{1}{2}p)}{(R+r')\,(r+r')}.$$

The angle CC′A′$=\alpha+$C′ CO.

Knowing C′CO and CC′A′, the lengths of the arcs aP and Pa' can be found as BN was found above.

Knowing the frogs to be used, r and r' can be found from pars 130 and 128 respectively, as can also BF and B′F′, remembering that the R of this paragraph must be increased by p when used in par. 128.

145. Another special case is found in **laying out a yard** where one distributing track leads from the main line and branches into several parallel sidetracks (see fig. 103). This is called a **yard lead,** or a **ladder track.** In this figure the distance p and the angle φ between the sidings and the distributing track determine the distance between points of frogs on the distributing track where the same numbered frogs are used throughout.

$$FF'=F'F''=\frac{p}{\sin\varphi}.$$

This distance FF′ must be greater than the half length of the frog used plus the length of curve lead (BF, fig. 91).

146. **"Y."**—Fig. 104 shows the layout for a **Y**. This form is most economical of space, though one side of the **Y** is frequently a tangent (fig. 105). A **Y** consists of a combination of turnout and curves, and from the figures can be laid out by an application of the principles heretofore given for curves and turnouts. Figs. 104 and 105 are two of the simplest forms. There are several other combinations, but all of them present simple trigonometrical problems.

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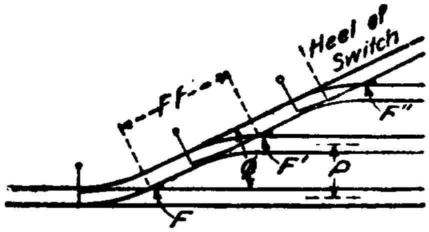

FIG. 103.—LADDER TRACK.

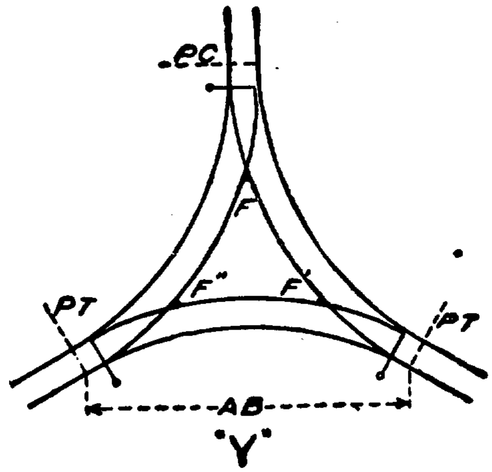

FIG. 104.

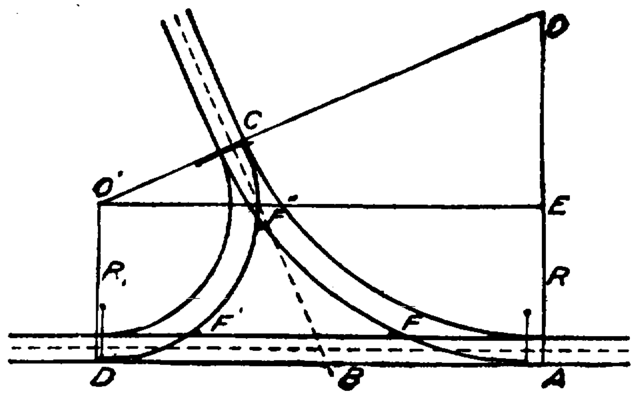

FIG. 105.

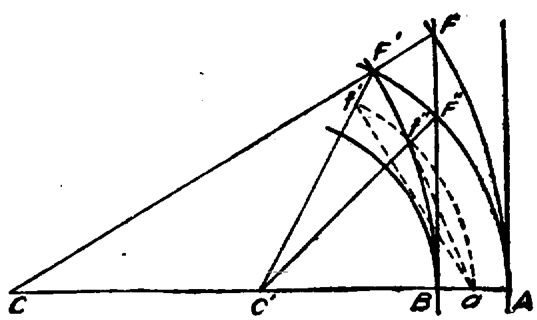

FIG. 106.

147. A double turnout is one where two tracks diverge from the main line, either on the same side or on opposite sides (see figs. 106, 107, 108). In fig. 106 the various distances for the first turnout are figured as in par. 131.

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Ordinarily the frog F′ will be the same as F, and opposite to it. From the figure, then,

$$r'=C'a;\ r=Ca.$$

$$2r'=r-\tfrac{1}{2}g.$$

$$\text{vers } F''=\frac{g}{r'+\frac{1}{2}g}.$$

$$BF''=(r'+\tfrac{1}{2}g)\sin F''=2gn''=g\cot\tfrac{1}{2}F''.$$

$$n''=\sqrt{\frac{r'}{2g}}$$

$$af''=2r'\sin\tfrac{1}{2}F''=\frac{2r'}{\sqrt{1+4n''^2}}$$

$$af'=2r'\sin F.$$

The **throw of the second switch** is double that of the first.

148. When the turnouts are on **opposite sides of the tangent,** as before, E usually equals F′. Then, from fig. 108,

$$\text{vers}\frac{1}{2}F''=\frac{g}{2\left(r+\frac{g}{2}\right)},$$

$$\text{and } aF''=\left(r+\frac{g}{2}\right)\sin\tfrac{1}{2}F'';$$

$$\text{also, } aF''=r\tan\tfrac{1}{2}F''-\frac{r}{2n''}.$$

$$n''=\frac{n}{\sqrt{2}}=0.7071n \text{ (approx.)}$$

For n'' use nearest numbered frog, Table XIV or XV.

Switches for double turnouts are commonly called **"three throw switches."**

149. The data in regard to **three throw switches** apply mainly to stub switches. Owing to the sharp change in direction due to the large throw of the second switch and the short straight switch point, three throw switches usually occur only where the turnouts are on opposite sides of the main line.

Strictly speaking, there is no such thing as a three throw split switch. The name is applied when the points of two split switches are only a few feet apart. Each has its own head block and switch stand. They should be avoided if possible. A rough rule for determining n'' is to divide $n+n'$ by three, using the nearest whole number.

150. Comparing the two values of F″ as found in pars. 147 and 148, it is seen, by assuming the vers ½ F″=¼ vers F″, which is practically true for ordinary values of F″, "that a set of frogs (F=F′, and F″) which is adapted to a double turnout in opposite directions from a straight line (as in fig. 108) is also adaptable to a double turnout on one side (fig. 106), the curves being simple curves in both cases. This being true, the set is also adapted to a double turnout in opposite directions from any curved track, the radius of which is not less than r as given for F, since any such

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case is intermediate between the two cases named."* Therefore, having adopted a frog number, n, for general use in double turnouts, another frog number, n'', should be adopted equal to $0.7071n$ for use as a secondary frog, F'', known as the **crotch frog.**

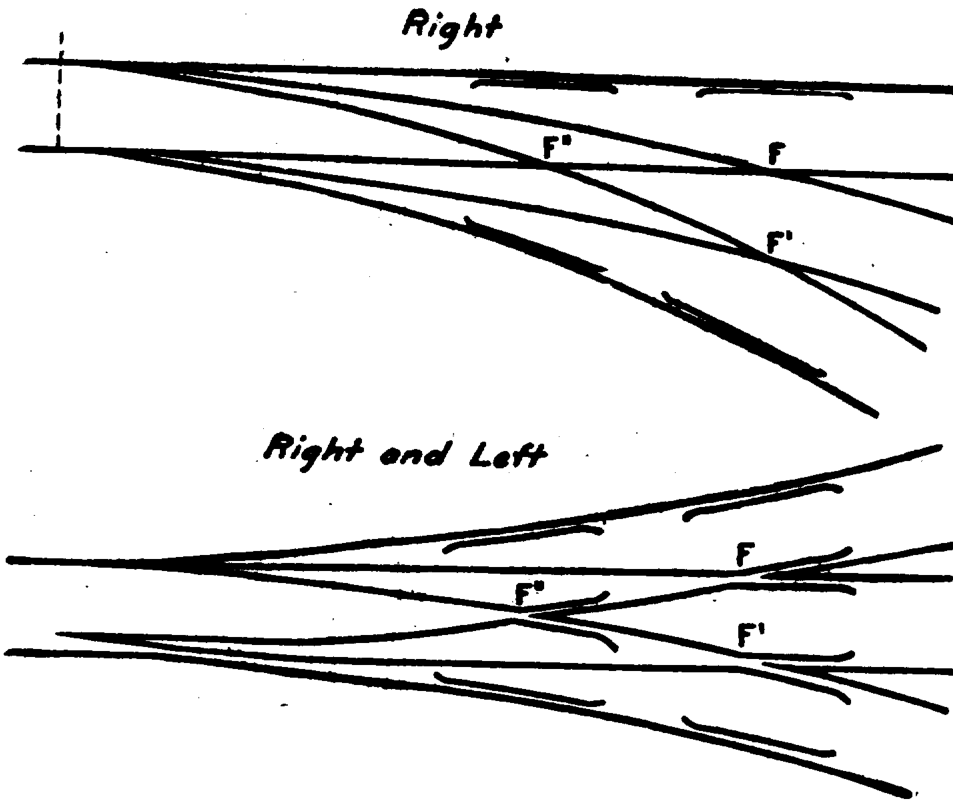

FIG. 107.—DOUBLE TURNOUTS, SHOWING FROGS AND GUARDRAILS.

151. **Frogs.**—The frog in general use for a crossover on standard-gage double track is No. 10. The frogs commonly used for leads to yards are Nos. 6, 7, and 8.

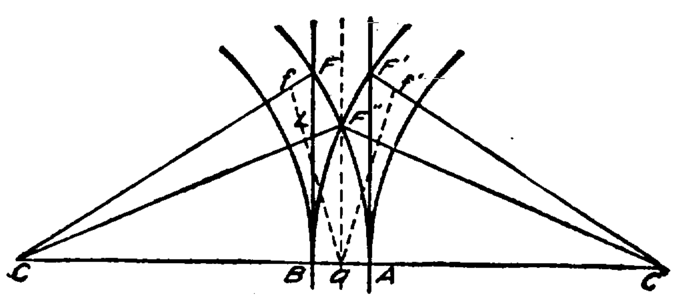

FIG. 108.

The V's in a frog and the openings at the ends of the wing rails should have blocks of wood driven into them. If left without such blocks, they are a great source of danger to switchmen running to throw a switch.

* Searle's Field Engineering, p. 155.

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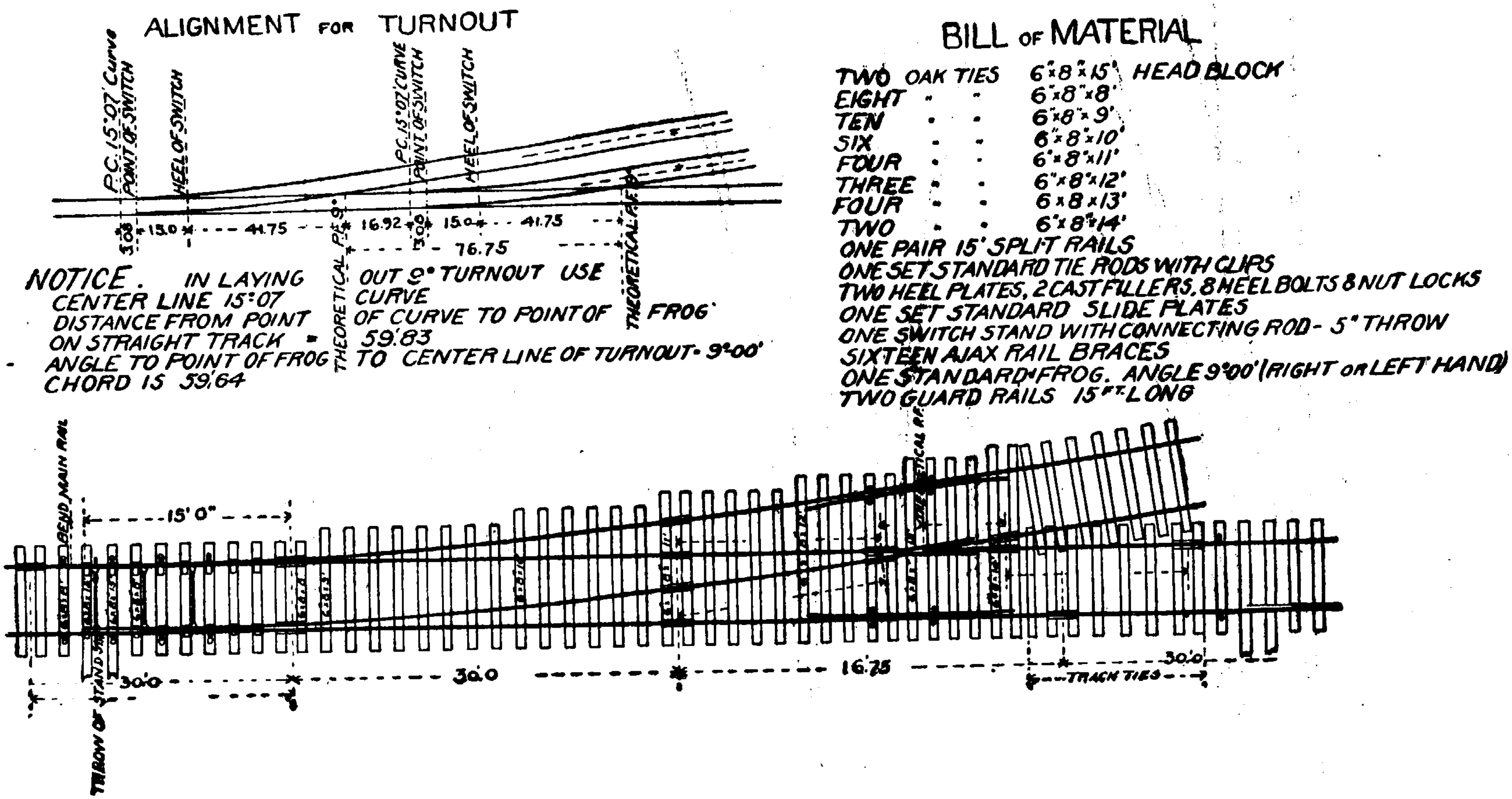

FIG. 109.—ARRANGEMENT OF TIES IN A TURNOUT.

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152. **Rigid frogs** can be used for a turnout either to the right or left. When **spring rail frogs** are used, care should be taken to state in the requisition to which side the turnout leads.

153. **Location of turnouts.**—It has been stated in various places that in turnouts from curves having a large radius, the dimensions given in Tables XIV and XV for turnouts from a tangent can be used with little error. However, in a turnout from a curve, the curvature of the turnout for a given frog is different from the curve of turnout from a tangent, and is equal to the curve of the main line plus the curve of the turnout from a tangent for a corresponding frog. The lengths of rail would not be exactly the same on the turnout from a curve as they would be on a turnout from a tangent. On account of this, and because of the desirability of having a number of turnouts ready for use at any time, it is best to locate all turnouts on tangents, where practicable. These ready-made turnouts should include all material for the turnout, as shown in bill of material, in fig. 109, so that by leaving out an exact number of 30-ft. rails the track laying can be continued; and when the turnout is put in place the opening left will be exactly filled. **Frogs** and **switches** can either be bought outright from equipment companies or can be made in the shops.

154. **Compound curved turnouts.**—The curves used in laying out turnouts and crossovers are ordinarily arcs of circles and are usually simple curves. It may happen that no frog is at hand, in laying out a double turnout, that will permit a simple curve to be run from the heel of the switch to beyond the farthest frog. In this case, use the frog that will require the sharpest curve as the crotch frog, allowing the flatter curve to lie between the two frogs. F″ must not be greater than 2 F.

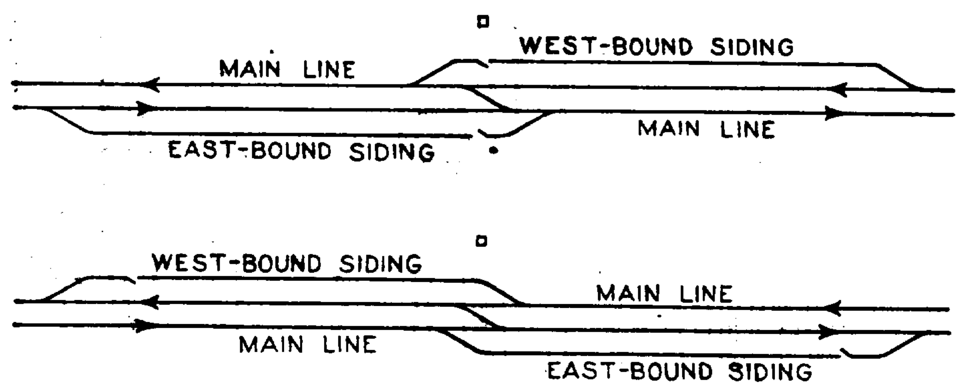

FIG. 110.

155. **Facing and trailing points.**—These terms apply particularly to the switches of crossovers on a double-track line. A trailing point is one which the trains move over from the point of frog to the point of switch; and a facing point is one which the trains move over from the point of switch to the point of frog. A consideration of fig. 110 will show the advantage of trailing points, in that if the switch is set wrong the train will run through it, forcing the switch points aside. This will break the switch, but the train will not be damaged. On some roads the policy is to have all main-line switches trailing points, and although this requires a little more time in switching cars or going into a siding, it is safer.

156. **Switch stands.**—A switch stand is a mechanism by means of which the switch points are moved. Types of these are shown in figs. 111, 112. The largest kind is more readily seen than the smallest one, and would be used in cases where the engineman must be able to note a missetting of the switch. The smallest kind is the kind used in the interlocking plant, where it is next to impossible for a switch to be set wrong and the engineman not be notified of it long before he reaches the switch. The middle type is one that is commonly used in yards. Economy of space and weight might dictate the use of the smallest switch in all cases on a supply

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