The following fig. 5 is not quite so simple, but it is probably a better arrangement because no two frogs come opposite one other, and there is no point on the main line unprotected by a guard rail as there is in fig. 4.

The frog in north rail, fig. 4, being 1 in 8 from equation (2), we get:

$$F = 2\ Ng = 2 \times 8 \times 4.7 = 75.2 \text{ ft.}$$

from (4) $S = 29\ F = 75.2 \times .29 = 21.8$, say 22 ft.

$$(5)\ L = F - S = 75.2 \times 22 = 53.2$$

$$(7)\ D = 87\ \frac{a^2}{g} = \frac{.87 \times (7.16)^2}{4.7} = 9.°49 \text{ or } 9° 30' \text{ nearly.}$$

Now, to determine the position of the third frog, which is not now in the centre of track. The tangential offset for the south curve is as above, 5.3, for the north 8.3. If F be the frog distance on the north line, F + 6 will be that on the south, the switch being 6 ft. longer. This we may say, before going further, involves no difficulty in practice, the spikes on the north side being driven 6 ft., or 3 ties, nearer the toe than on the south.

Now we have for the distance of the frog from the north rail the expression $\left(\frac{F+6}{100}\right)^2 \times 5.3$

from the south rail the expression $\left(\frac{F}{100}\right)^2 \times 8.3$

But the sum of these two is the gauge.

Whence we get the equation :—

$$\left(\frac{F+6}{100}\right)^2 \times 5.3 + \left(\frac{F}{100}\right)^2 \times 8.3 = 4.7$$

$$\text{Simplifying}—(F^2 + 12\ F + 36)\ 5.3 + 8.3\ F^2 = 47000$$

$$13.6\ F^2 + 63.6\ F = 47000 — 191 = 46809$$

$$F^2 + 4.68\ F + (2.34)^2 = 3442 + 5.5 = 3447.5$$

$$F + 2.34 = 58.71$$

$$F = 56.4$$

$$F + 6 = 62.4$$

$$L = 34.4$$

This determines the longitudinal position—substituting the above values in the expressions

$\left(\frac{F+6}{100}\right)^2 \times 5.3$ and $\left(\frac{F}{100}\right)^2 \times 8.3$—we get the values.

Distance from North Rail.....	2.06
" " South "	2.64
	4.70

The angle of the frog will be the sum of the deflections of the two turnouts.

$$a = \frac{F}{100} \times 9.5 + \frac{F+6}{100} \times 6.12$$

$$= \frac{15.6\ F + 36.6}{100} = 9.°16 \text{ or } 9°10'$$

A No. 6 frog, pinched a little with the crow or rail bender and with the point set back a trifle from the theoretical as obtained above, will fit the place quite well in practice; but if we wish to be very exact about it, the following analysis of the problem in Fig. 6 a double throw both on same side of main line will suggest a means of calculating. This is not a common combination, but it actually, or rather one almost identical with it, occurred in the writer's practice. One turnout was for a main siding and the other for a Y, and in order to save room and switch frames and unnecessary complication it was decided to start both from the same headblock. The main turnout was already laid with a 67 ft. lead and a 1 in 10 frog, as in Fig 3. We had on hand a No. 6 and a No. 10 frog, which we desired to use. Putting the 1 in 6 first in the main line we get from equation (2)

$$F = 2g \times N = 9.4 \times 6 = 56.4,$$