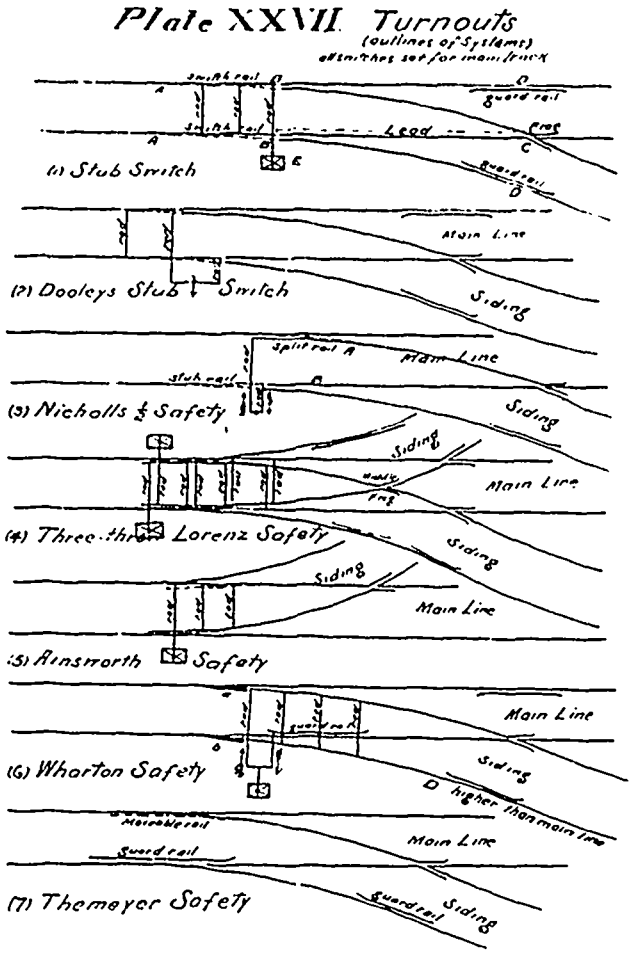
(1) The Stub switch consists of two movable rails, A B, with the ends B supported, and free to slide on plates for a lateral distance of five inches, called "throw." These switch rails or points are from 10 to 25 feet long, depending on the frog distance, B C, and the angle of the frog C. The guard rails, D D, prevent derailment at the



throat of the frog. The stub switch works for a three-throw as easily as for a two-throw turnout, and can be made into a safety switch (see Cook Switch, Plate XXVII., and Dunn Switch, *Engineering News*, Vol. II., 1890, page 174), and is considered to be more durable and easily kept in working order with snow and ice than are the many forms of split rail switches.

(2) Dooley's stub switch is a modification which makes easier riding by having one point longer than the other, substituting two jolts for one severer one, but it is not as rigid as the ordinary stub switch.

(3) Nicoll half-safety switch is a compromise between the stub switch and a split or Lorenz switch. It is not at all a strong or secure switch, as the two rails are not opposite each other. Its advantages are not very obvious.

(4) Lorenz safety switch is the model of various split switches. Both rails are feathered down so as to fit close up against solid rails. One is a main line rail, the other for the siding, connected so as to act together. This switch is adapted to position where the traffic is considerable on the branch line, or turnout, and in climates not troubled with ice or snow, but the split rails or points wear out rapidly, and it is more complicated when applied to three-throw turnouts, necessitating two sets of switch rails, stands, etc., set one ahead of the other, in which case neither of the main line rails are solid. The Stewart switch (*Engineering News*, Vol. I., 1895, page 59) has a special feature in making the switch rails by bending over solid-headed rails, instead of planing them down to a point. It is claimed this will give durability and rigidity.

(5) Ainsworth safety switch is made by giving the solid siding rail a sharp bend or recess, and the corresponding switch rail is left square ended, thus providing a more solid track for the main line, and a more durable switch rail. This form is adapted to branch lines having little traffic.

(6) Wharton safety switch is used for heavy main line traffic. It gives a solid main track. The siding rails lead the wheels onto blocks (a.b.) higher than the main line rails, and fall down on to the main line, while in facing the switch the wheels are first lifted by the blocks (a.b.) and then carried over the main line rails by the wheel tread riding on the high rail D.

The Macpherson switch (Plate XXVIII.) is a modified Wharton coming into use on the Can. Pac. Ry. The main line is solid, and the train is thrown onto the siding by having the outside movable rail higher than the main line, and a movable guard rail which is also higher than the main line, but which is thrown into position only when the switch is set for the siding. This design also includes a special form of frog, which is a sliding plate brought into position by means of bell-crank levers and rods operated from the switch stand, when set for siding; when set for main line the plate is clear of the main line, leaving the main line solid at this point also. This design has been in use since 1892, and it has proven itself very satisfactory and durable.

(7) The Themeyer safety switch has one movable split rail, and a stationary split rail or half-frog and guard rail. The movable rail and guard rail guide the wheels onto the siding when set for it. It is successfully used on the B. & O. R. R.

The main object of safety switches is to make it safe for a train to trail through a switch from the siding, when it is set for the main line, or vice versa, and this is accomplished, with split switches, by using springs which allow the movable rails to be forced aside just enough to pass the wheel flanges through. The springs then force the switch points back to the position for which the stand and signal are set.

Other special switches of tried merit are the cam automatic, in which the split rails are fixed, and the solid ones move horizontally (see *Eng. News*, vol. I., 1890, page 489), and the Duggan switch, which has two knuckle-jointed vertical moving split rails. (See *Eng. News*, vol. I., 1893, page 390.)

Frogs.—Formerly cast steel solid frogs were common, but as they were more liable to crack, and when worn in one part were unfit for use, they were soon supplanted by frogs made up of pieces of steel rail fitted and bolted together onto a flat steel base plate—any worn part can be easily replaced. Such solid or stiff frogs are in most general use, but on main lines having heavy traffic, those turnouts with light traffic are now generally fitted with spring frogs (see Plate XXVIII.) in which either the "point" or the guard rail are movable, and the main line is normally a solid track. A train to or from the siding forces the frog open momentarily, and a spring brings it back again as soon as the train has passed, leaving the main line again solid. The defect in many of these spring frogs is the tendency to derail wheels with worn treads and flanges, by forcing open the spring frog when a train is on the main line. It is claimed that the Vaughan spring frog, used on the Penn. R. R., overcomes this difficulty by blocking up the tread. Other spring frogs of special features of merit are the Monarch, Ramapo and Pegram, described in the *Engineering News* since 1890.

Turnout Calculations.—The "lead" is the distance