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The Outside Frictionless Rail for Curves.

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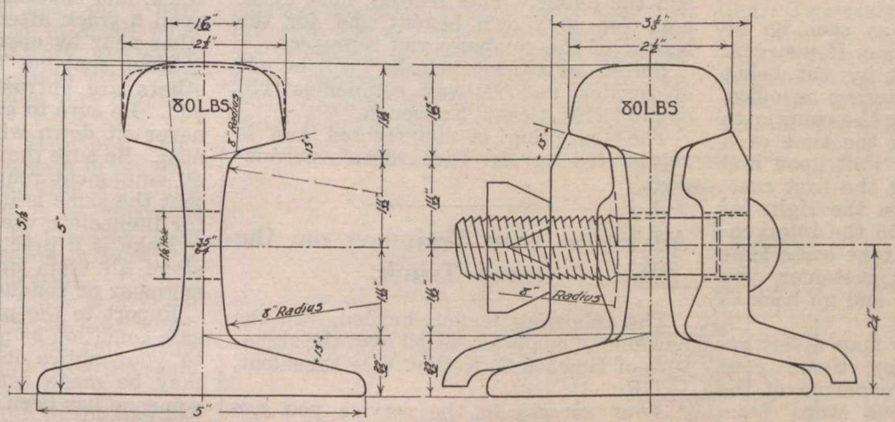
The wheels of a locomotive or car mounted on rigid axles, when rounding a curve tend to travel on a tangent to that curve, but are prevented from doing so by the flange of the foremost wheel coming in contact with the gauge side of the outer rail. This obstruction retards the progress of the outer wheel and momentarily allows the inside wheel to gain in distance until the back flange of the inner wheel is forced against the gauge line of the inner rail; then develops the maximum resistance in friction on curves. The inner flange in traversing the inside rail meets with no resistance to its progress from that rail except of a secondary character, the friction being first developed and transmitted from the forward edge of the front wheel traversing the outer rail. This at first permits the inner wheel to get slightly ahead of the outer wheel, until the inner flange is forced against the inner rail. It should be noted here, that the flange of the outer wheel first meets obstruction several feet in advance of the back flange of the inner wheel of truck, but the inner flange meets with no obstruction to its progress until after the former has been transmitted to it in a secondary way. The inner wheel having the lesser distance to travel, it is obvious it should be slightly retarded rather than relieved of friction. If we keep the two wheels directly opposite each other continually, and the axle at right angles to tangent of curve, the friction due to curvature is practically eliminated, provided the proper superelevation is given to overcome centrifugal force. To illustrate, we will take a 4 degree curve about 1,400 ft. long. The exact distance the outer wheel will travel is 1,409 ft., that of the inner wheel 1,404 ft. Now it is clear that if these wheels are on a rigid axle the inner wheel must either slip and lose, or the outer must jump and gain, 5 ft. in distance. It is this compensating movement on rails of same area which causes most of the friction on curves over that of the tangent.

The width of head of a standard 80 lb. rail is 2 9/16 in. With two such rails laid to standard gauge on a tangent the adhesive resistance of each should be practically the same. For our present purpose we will assume that with equal surfaces the adhesive resistance will be the same for curves. It follows that some compensating action must take place to enable the outer wheel to keep pace with the inner wheel. This is accomplished either by a slipping movement of the inner wheel, or a jumping forward of the outer wheel. Investigations have been made, the results of which make it quite feasible to practically eliminate this most difficult feature of friction due to curvature. The solution is known as the frictionless rail. This frictionless rail is a section of same weight as the standard sections, designed to meet the exigencies of the case, covering all sections, and being quite equal to the physical requirements of the companion rail, the main features being a narrower head, giving less surface to tread of wheel; a flat, rounded gauge line, and angular side to reduce the contact surface against the flange of outer wheel. It is slightly higher than the standard section, to permit of the use of the standard or usual fishing plate or bar. At points where it joins the standard rail a slight modification of the fishing bar may be necessary.

The advantages of the frictionless rail will be to eliminate friction due to curvature on train loads, also on locomotives, thereby greatly increasing the hauling capacity of the latter on sharp curves, and further reducing the number of rail breakages, as returns show conclusively that the number of rail failures is nearly 100% higher on curves than tangents. It will also reduce to some material extent, compensation for grades on curves—thereby reducing the cost of construction of railway.

This frictionless rail is laid outside the curve to the customary gauge with its companion rail of the standard section. As previously described, the outer wheel in traversing a 4 degree curve revolves or jumps over 5 ft. greater distance than the inner wheel. It is clear then that the object should be to remove every obstacle in the way of friction that would in any way retard the movement of this wheel. This is accomplished by decreasing the contact area of the top of outer rail, allowing the outside wheel to perform its ordinary revolutions with less friction, and gain slightly over its companion wheel on the same axle. The inner wheel, having a greater grip or contact surface on the rail, meets with just a little more resistance to its revolution, tending to retard its progress. This retarding, or slip, of the inner wheel, is sufficiently uniform and effective to keep the wheels opposite each other, with the axle on a line at right angles to tangent of curve, provided of course the superelevation is not neglected. These two influences working in conjunction effect a balance or compensating action upon each pair of wheels, the result of which is that each axle will under ordinary conditions tend to traverse a curve on radii lines.

From the foregoing it is clear that the outer frictionless rail, to develop the desired results, must have, as a companion or inner rail, one with a greater area for wheel contact; in other words two rails of similar section will not permit that compensating action which gives the desired results. Further, rails on tangent or the inside of curves, with track conditions good, wear horizontally, and do not show a great percentage of wear on the upper corner of head, nor at the gauge side, but they they do invariably show that much of the upper corner of rail-head is worn off the outer rail on curves. **This is done by the forward edge of flange and not by the collar of wheel.** The design of the outside frictionless rail for curves, in addition to reducing the horizontal contact surface, also reduces the projecting angle of head, which in the standard rail offers the greatest obstruction to the revolution of the outer wheel. Briefly, this frictionless rail is a new design—applied to a new purpose, to accomplish new and much desired economic results.



Section of frictionless rail; outline of standard section shown by dotted line. Standard bar connection, fitting frictionless rail.

It is not necessary to go with minute details into calculations to show the exact theoretical friction or adhesion to overcome, as no two trucks are exactly the same, neither are the speeds uniform; and with other varying conditions of weather etc., it would be impossible to work out theoretical formulae to meet all conditions. Suffice it to say that the fundamental principles, if followed as outlined, will, it is confidently expected, overcome in a great measure and in an economical way one of the greatest difficulties railway companies have so long had to contend with, in that most obstinate feature, friction on curves.

The accompanying sketch shows a section of 80 lb. frictionless rail, the other sections being designed in accordance.

The writer has not considered it necessary to recognize the effect of coning on wheels, as investigations show this to be an uncertain factor and only temporary.