

## Pre-Grouping Points and Crossings

Previous: Vol 16(8) p285, N Lee and Vol 15(1) pp18-25, PA Millard

This article replies to Norman Lee's letter, presents some new information about pre-grouping points and crossings and clarifies some details in Philip Millard's article.

Switches can be categorised into four types; straight, semi-curved, curved and improved curved.

Straight switches (also known as straight type switches) were used by most railways prior to grouping. Straight switches were straight from the tip (toe) of the switch (tongue) rail to the position where the closed switch rail had diverged from the stock rail by the heel clearance gap (typically 1¾in to 2in) plus the width of the rail (typically 2½in to 2¾in). This position was known as the heel of heel switches or the virtual heel of heel-less switches. A constant radius curve, tangential to the straight part, began at the heel or virtual heel and extended to the crossing. Heel switches were entirely straight and pivoted at a fishplated joint at the heel. Heel-less straight switches (also known as spring switches) had a longer switch rail which began to curve at the virtual heel; the switch rail flexed over its movable length and had its back end fixed.

Semi-curved switches were used by the LNER, LMSR and SR, and their BR successors, from immediately after grouping to the 1960s. By 1971 they were rarely used <sup>1</sup>. Semi-curved switches were straight from the tip of the switch rail to the end of the planing, where the closed switch rail had diverged from the stock rail by the width of the rail (2¾in). From this position a constant radius curve extended to the crossing. There were two designs of semi-curved switches, named undercut switches and straightcut switches, which differed only in the way that the switch and stock rails mated. The LNER Permanent Way Standards included drawings of undercut switches in sizes A to E and straightcut switches in sizes A to E, which were drawn and approved in July 1926. Undercut switches were designed for use on passenger lines; they gave a smoother ride but were weaker. The head of the switch rail was planed very narrow at the tip of the switch and the web of the switch rail fitted between the head and foot of the stock rail. Straightcut switches were designed for goods lines and sidings and were sometimes called joggle switches. They were stronger but gave a rougher ride because the stock rails were joggled outwards so that the tips of the switch rails could be wider. In exceptional cases, where maximum strength was important, straightcut switches were allowed on passenger lines.

Curved switches were used by the GWR and its successors from c.1900 <sup>2</sup>. They were used by other regions of BR from c.1960. Curved switches had the switch rail curved for the whole of its length, including the planed part.

Improved curved switches were first used in 1968 <sup>1</sup>. They had a slightly different geometry to curved switches and used vertical rather than inclined rails throughout switches and crossings. Full details are given in <sup>1</sup>.

The term "straight planed" is used for both straight and semi-curved switches. Some changes in details were made over the years; for example longer switches became available, switch anchors and chairs changed, and in 1957 the position of set (where the switch rail twisted from vertical to inclined) for B straightcut switches was changed.

The dates of use given above are when these designs were used for new trackwork. It is important to remember that permanent way sometimes had a long life and was often reused on branch lines and in sidings. In 1976 I saw sidings where pre-grouping NER turnouts were still in use and others

where some inside-keyed S&DR chairs from the 1860s were still in use. The most reliable guide to what was used is contemporary photographs.

Prior to 1865, Midland Railway switches were crudely made. In 1858 John Taylor founded Taylor Brothers (Sandiacre) Limited which became a major manufacturer of permanent way. In 1865 he observed workmen in Nottingham station shaping switches from 12 feet lengths of wrought iron rail, by cutting them with a hot set and then finishing them with a hammer and chisel. He proposed to the engineer in charge that he could make better switches by using his planing machine. He did this successfully and from that time onwards regular orders were placed with Taylor Brothers<sup>3</sup>.

At the turn of the century the design of points and crossings varied considerably between different railway companies. This can be seen on a set of 40 contemporary drawings which appear to have been prepared for the Railway Engineers' Association work on Standardization of Permanent Way which was done in 1905. I have a copy of these drawings and hope to make them available through the HMRS. They provide exact details of some of the points and crossings used by many companies. 10 of the companies used heel switches, the other 7 used heel-less switches. All the drawings show straight type switches, except for the GWR and possibly the Caledonian (the drawing is ambiguous). Most switches had the fishplate joint at the back end of the tongue rail suspended between two sleepers in the normal way, but some designs used a supported joint, with this joint on a chair at a sleeper. Table 1 gives details extracted from the 1905 drawings.

Prior to 1908 the North Eastern Railway used 9ft, 12ft, 15ft and 18ft heel switches. They started to use heel-less switches from 1908 and then had 9ft and 10ft heel switches and 12ft 6in, 15ft, 17ft 6in, 20ft and 22ft 6in heel and heel-less switches. Details of these are given in the NER Permanent Way Standards, now published by the NERA. Table 2 gives the lengths of NER heel-less switches which used 95 lbs per yard British Standard rails. The length from front of stock rail to tip of switch was 3ft 10in. These switches were straight from the tip of the switch to the virtual heel (at the nominal switch length eg. 12ft 6in) and then curved to suit the turnout radius through the remaining movable length and the fixed length. The exact value of the movable length depended on the sleeper spacings at the fixed end of the tongue rail, which depended on the turnout radius (so that the gaps between the switch and stock rails suited the available chairs). Table 3 gives the lengths and radii of turnouts from straight track using these straight type switches.

In referring to Philip Millard's article the following points should be noted. The article is not applicable to the GWR. Semi-curved switches were introduced c.1926. The article uses the term "straight-cut switches" to refer to straight type switches, not straightcut switches (which were semi-curved). The straight type switches it details in figure 1 are not those used by the NER. I do not know which pre-grouping companies used those figure 1 dimensions. Normal practice was for the tongue rail of straight type switches to be curved between the virtual heel and its back end.

## References

1. *British Railway Track*, 4th edition, 1971.
2. *Cole's Permanent Way*, 10<sup>th</sup> edition, 1940.
3. Allen, C J, *One hundred years of railway permanent way manufacture, The centenary of Taylor Brothers (Sandiacre) Limited*, 1958.

Table 2. Dimensions of NER heel-less switches, used from 1908.

Switch size	Tongue rail length	Movable length	Stock rail length
12' 6"	26' 0"	17' 4" to 17' 11¼"	27' 6"
15' 0"	26' 0"	19' 5¾" to 20' 4⅛"	32' 9"
17' 6"	31' 6"	22' 2⅞" to 23' 0½"	32' 9"
20' 0"	31' 6"	22' 2" to 22' 11¾"	32' 9"
22' 6"	31' 6"	24' 10¼" to 25' 4¾"	27' 6"

Table 3. Dimensions of NER turnouts from straight track using heel or heel-less (straight type) switches.

Switch size	Crossing angle	Turnout radius	Tip of switch to nose of crossing
10' 0"	1 in 5	235' 6"	43' 7½"
10' 0"	1 in 5¼	259' 6"	45' 3¾"
10' 0"	1 in 5½	285' 0"	47' 0"
10' 0"	1 in 5¾	311' 3"	48' 8¼"
10' 0"	1 in 6	339' 0"	50' 4½"
12' 6"	1 in 6¼	368' 0"	54' 6¾"
12' 6"	1 in 6½	398' 0"	56' 3"
12' 6"	1 in 6¾	429' 0"	57' 11¼"
12' 6"	1 in 7	461' 6"	59' 7½"
12' 6"	1 in 7¼	495' 0"	61' 3½"
15' 0"	1 in 7½	529' 9"	65' 6"
15' 0"	1 in 7¾	565' 6"	67' 2¼"
15' 0"	1 in 8	602' 9"	68' 10½"
15' 0"	1 in 8½	680' 6"	72' 2¾"
17' 6"	1 in 9	762' 9"	78' 1¼"
17' 6"	1 in 9½	850' 0"	81' 5¾"
17' 6"	1 in 10	941' 9"	84' 10¼"
17' 6"	1 in 10½	1038' 0"	88' 2¾"
20' 0"	1 in 11	1139' 6"	94' 1"
20' 0"	1 in 11½	1245' 6"	97' 5½"
20' 0"	1 in 12	1356' 0"	100' 10"
22' 6"	1 in 13	1591' 6"	110' 1"
22' 6"	1 in 14	1845' 6"	116' 9¾"
22' 6"	1 in 15	2119' 0"	123' 6½"
22' 6"	1 in 16	2410' 6"	130' 3½"

Table 1. Switch designs in use in 1905.

Railway company	Weight of rail (lbs per yard)	Rail inclination	Size	Type	Tongue rail length	Movable length	Flangeway at end of tongue rail	Tongue rail back end joint	Stock rail length	Front of stock rail to tip of switch	Notes
Caledonian	90	-	32'	Heel-less	32' 0"	About 25' 6"	3½"	Suspended	-	-	(a)
Furness	-	-	12'	Heel	12' 0"	12' 0"	1¾"	Supported	-	-	
Glasgow and South Western	90	-	22'	Heel-less	22' 0"	About 20'	1¾"	Suspended	30' 0"	5' 0"	
Great Central	86	1 in 20	24'	Heel-less	24' 0"	17' 6"	2" at 15'	Suspended	24' 0"	2' 3"	(b)
Great Eastern	-	-	15'	Heel	15' 0"	15' 0"	2"	Suspended	20' 2"	3' 0"	
Great Northern	96	1 in 24	12'	Heel	12' 0"	12' 0"	2"	Suspended	21' 0"	5' 0"	
Great Northern, Ireland	85	1 in 20	15'	Heel	15' 0"	15' 0"	2"	Suspended	26' 0"	6' 3"	
Great Southern and Western, Ireland	83	-	15'	Heel	15' 0"	15' 0"	2"	Supported	24' 0"	3' 5"	(c)
Great Western	-	1 in 20	14'	Heel-less	16' 0"	14' 0"	See notes	Suspended	28' 4"	5' 0"	(d)
Hull and Barnsley	88	1 in 22	12'	Heel	12' 0"	12' 0"	1 <sup>7</sup> / <sub>8</sub> "	Suspended	-	6' 0"	(e)
Lancashire and Yorkshire	86	1 in 20	24'	Heel-less	24' 0"	About 22' 6"	See notes	Suspended	30' 0"	3' 7"	(f)
London, Brighton and South Coast	95	1 in 24	14'	Heel	14' 0"	14' 0"	1¾"	Suspended	19' 4½"	3' 1"	
London and North Western	90	1 in 20	20'	Heel-less	20' 0"	About 18'	1¾"	Suspended	30' 0"	4' 6"	(g)
London and South Western	87	1 in 20	13' 6"	Heel	13' 6"	13' 6"	-	Supported	30' 0"	11'	
North British	92	-	16'	Heel	16' 0"	16' 0"	-	Suspended	22' 0"	4' 0"	
North Eastern	90	-	18'	Heel	18' 0"	18' 0"	2"	Supported	24' 0"	3' 0"	(h)

(a) Tongue and turnout on 20 chains radius to 1 in 11 crossing. Tip of switch to nose of crossing = 108'.

(b) Drawing appears to show curve at least over back 6' 6" of tongue rail.

(c) Flat bottom rail, 5' 3" gauge.

(d) 950' radius for front 14' of tongue, then 720' radius for back 2' of tongue. Flangeway = 4½" minus rail thickness, at 14'.

(e) 18' points also mentioned.

(f) Planed for 14' 0". Flangeway = 4½" minus rail thickness, at end of tongue rail.

(g) Very unusual slide chair used at tip of switches. 103 lbs per yard rail also shown.

(h) Very unusual slide chair used at tip of switches on 20" wide timber.