CHAPTER

10

Track Fittings and Fastenings

Introduction

The purpose of providing fittings and fastenings in railway tracks is to hold the rails in their proper position in order to ensure the smooth running of trains. These fittings and fastenings are used for joining rails together as well as fixing them to the sleepers, and they serve their purpose so well that the level, alignment, and gauge of the railway track are maintained within permissible limits even during the passage of trains. The important fittings and fastenings commonly used in India are listed in Table 10.1.

Table 10.1 Types of track fittings

Purpose and type	*Details of fittings and fastenings*
Joining rail to rail	Fish plates, combination fish plates, bolts, and nuts
Joining rail to wooden sleepers	Dog spikes, fang bolts, screw spikes, and bearing plates
Joining rail to steel trough sleepers	Loose jaws, keys, and liners
Joining rail to cast iron sleepers	Tie bars and cotters
Elastic fastenings to be used with concrete, steel, and wooden sleepers	Elastic or Pandrol clip, IRN 202 clip, HM fastening, MSI insert, rubber pads, and nylon liners

The number of various fittings and fastenings required per sleeper for ordinary or conventional fastening as well as elastic fastening for different types of sleepers are summarized in Table 10.2.

Table 10.2 Number of fastenings

Type of sleeper	*Ordinary fastenings per sleeper*	*Number*	*Elastic fastening per sleeper*	*Number*
Wooden	Dog spikes or	8	CI bearing plates	2
	Screw spikes	8	Plate screws	8
	Keys for CI bearing plates	4	Pandrol clips	4
			Rubber pads	2

(*contd*)

Table 10.2 (*contd*)

Type of sleeper	*Ordinary fastenings per sleeper*	*Number*	*Elastic fastening per sleeper*	*Number*
Concrete	No ordinary fastening	–	Pandrol clips	4
			Nylon liners	4
			Rubber pads	2
			MCI inserts	4
Steel trough	Keys	4	Modified loose jaws	4
	Loose jaws	4	Pandrol clips	4
			Rubber pads	2
CST-9	Plates	2	Pandrol clips	4
	Tie bar	1	Rubber pads	2
	Cotters	4		
	Keys	4		

All these fittings and fastenings together with other ancillary features, are discussed in this chapter.

10.1 Rail-to-Rail Fastenings

Rail-to-rail fastenings involve the use of fish plates and bolts for joining rails in series. Detailed descriptions of these are given in the following sections.

10.1.1 Fish Plates

The name 'fish plate' derives from the fish-shaped section of this fitting (Fig. 10.1). The function of a fish plate is to hold two rails together in both the horizontal and vertical planes. Fish plates are manufactured using a special type of steel (Indian Railways specification T-1/57) with composition given below:

Carbon: 0.30–0.42%
Manganese: not more than 0.6%
Silicon: not more than 0.15%
Sulphur and phosphorous: not more than 0.06%

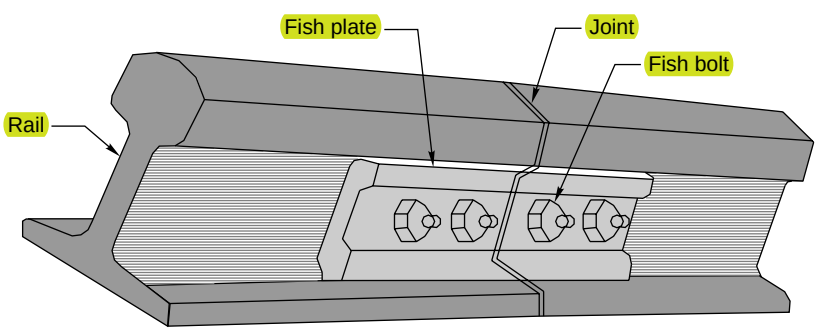

Fig. 10.1 Fish plate

The steel used for fish plates should have a minimum tensile strength of 5.58 to 6.51 t/cm^2 with a minimum elongation of 20%. Fish plates are designed to have roughly the same strength as the rail section, and as such the section area of two fish plates connecting the rail ends is kept about the same as that of the rail section. As fish plates do not go as deep as the rail, the strength of a pair of fish plates is less than that of the rail section, about 55%, when only vertical bending is taken into consideration. Fish plates are so designed that the fishing angles at the top and bottom surface coincide with those of the rail section so as to allow perfect contact with the rail as shown in Fig. 10.2. The details of standard fish plates used on Indian Railways for different rail sections are given in Table 10.3.

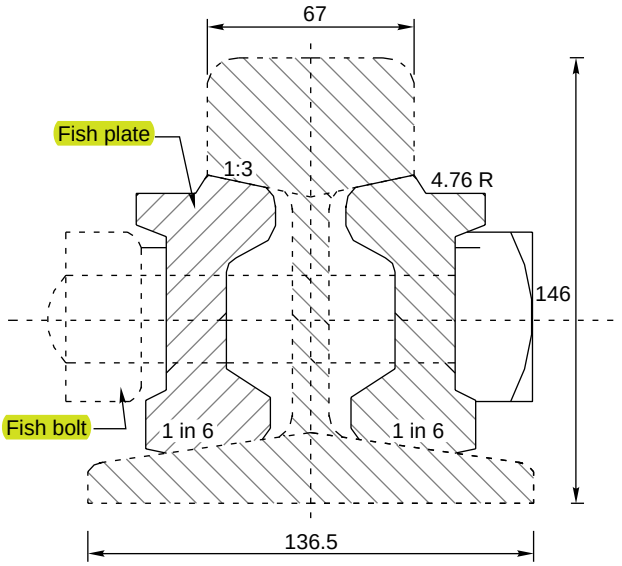

Fig. 10.2 Fish plate for 90 R rails

Table 10.3 Details of standard fish plates

Rail section	*Drawing number*	*Weight per pair (kg)*	*Total length of fish plate [mm (in.)]*	*Length from centre to centre of hole [mm (in.)]*	*Diametre of fish bolt holes (mm)*
52 kg	090 M	28.71	610 (24)	166 (6.5)	27
90 R	071 M	26.11	610 (24)	166 (6.5)	27
90 R	059 M	19.54	460 (18)	114 (4.5)	27
75 R	060 M	13.58	420 (16.5)	102 (4)	27
60 R	961 M	9.98	410 (16)	102 (4)	24
50 R	1898 M	8.31	410 (16)	102 (4)	20

10.1.2 Combination Fish Plates

Combination or junction fish plates (Fig. 10.3) are used to connect rails of two differential sections. These are designed to cover the rail section at either end adequately up to the point in the centre where the rail section changes. Another design feature in these junction fish plates is the elimination of the expansion gap in order to give them more strength. In spite of the varying depths of the combination fish plates used in the fitting of 52 kg/90 R, 90 R/75 R, 75 R/60 R, etc. rail sections, the use of junction fish plates provides a common top table for the two rail sections they join. A uniform system of marking and exact nomenclature is adopted for each junction fish plate for proper identification. Fish plates are marked right in, right out, left in, and left out depending upon their position with respect to the direction from the lighter rail to the heavier rail (as shown in Fig. 10.4). In the case of any difficulty in obtaining a combination fish plate, the following alternate arrangement can be made.

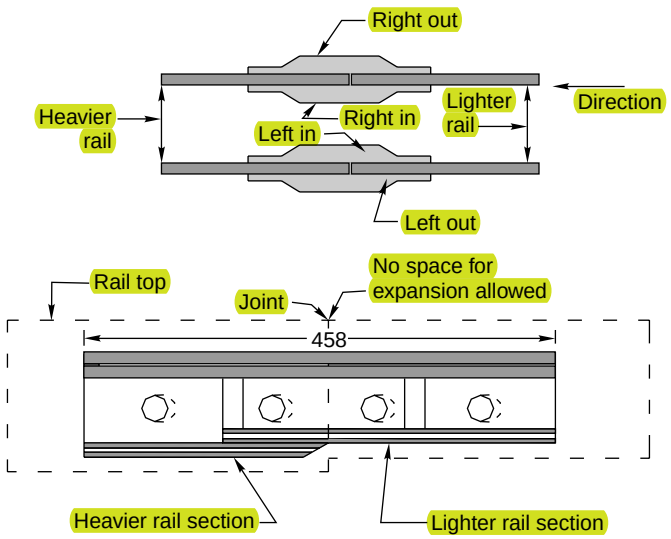

Fig. 10.3 Combination fish plate (dimensions in mm)

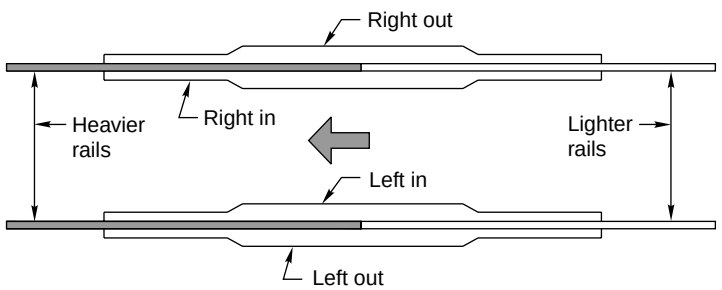

Fig. 10.4 Marking of combination fish plates

1. First the composite rail, normally of a length not less than 4 m, is prepared by welding together two rail pieces of different rail sections.
2. This composite rail piece is then inserted at the joint in lieu of the combination fish plate.
3. Normal fish plates are then used to join the composite rail piece to the rail lengths on either side, which have a rail section identical to that of the composite rail piece.

10.2 Fittings for Wooden Sleepers

Rails are fixed to wooden sleepers with the help of simple types of fastenings such as spikes, screws, and bearing plates.

10.2.1 Dog Spikes

This fastening is named dog spike (Fig. 10.5) because the head of this spike looks like the ear of a dog. Dog spikes are used for fixing rails to wooden sleepers. The number of dog spikes normally used is as follows:

Location	*Number of dog spikes*
• On straight track	2 (1 on either side and duly staggered)
• On curved track	3 (2 outside and 1 inside)
• Joint sleepers, bridges	4 (2 outside and 2 inside)

The dog spike has a 16-mm square section and its length varies depending upon the location at which it is placed, as given in Table 10.4.

Table 10.4 Details of dog spikes

Location of dog spike	*Length of dog spike*	
	mm	*in.*
BG points and crossings	160	6.5
BG track with canted bearing plates; MG points and crossings	135	5.375
MG track with canted bearing plates; NG points and crossings	120	4.75
MG track without bearing plates; NG track with or without bearing plates	110	4.5
BG track without bearing plates	120	4.75

10.2.2 Round Spikes

Round spikes (Fig. 10.5) are used along with anticreep bearing plates for fixing rails to sleepers. These are also used for fixing assemblies of switches onto wooden sleepers. The round spike has a round section of a diameter of 18 mm, and its length depends upon the purpose it serves. Round spikes have become obsolete now.

10.2.3 Fang Bolts

Fang bolts (Fig. 10.5) are employed under the switches for fastening slide chairs to the sleepers. These are used in locations where the gauge is to be preserved.

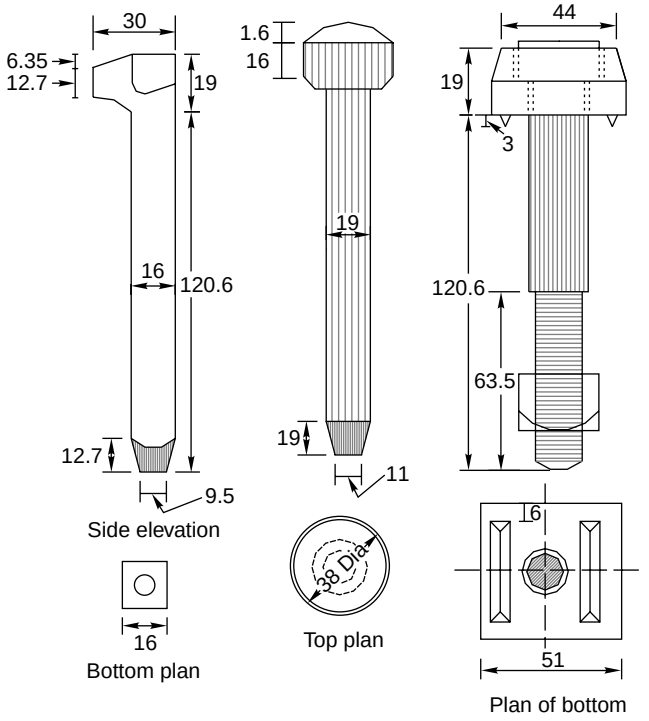

Fig. 10.5 Dog spike, round spike, and fang bolt

10.2.4 Screw Spikes

Indian Railways has developed screw spikes with diameters of 20 mm and 22 mm (Fig. 10.6) to be used on high-speed, main, and trunk routes in order to increase the lifespan of wooden sleepers. Screw spikes with a diameter of 20 mm are called 'plate screws' and are used in place of round spikes for fixing rails to sleepers with the help of anticreep bearing plates while screw spikes with a diameter of 22 mm are called 'rail screws' and are used to directly fasten the rails to the sleepers with or without the use of bearing plates. They are also used on bridges and platform lines. Plate and rail screws should be preferred to round and dog spikes in order to conserve the life of wooden sleepers.

10.2.5 Bearing Plates

Bearing plates are used for fixing wooden sleepers to rails. The different types of bearing plates in use on Indian Railways are described below.

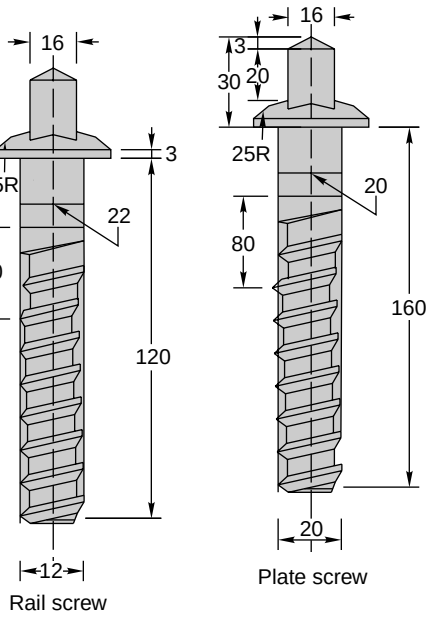

Fig. 10.6 Screw spikes

Mild steel canted bearing plates Mild steel canted bearing plates are used on all joints and curves to provide a better bearing area to the rails. They have a cant of 1 in 20 and a groove in the centre to prevent rocking. Mild steel (MS) canted bearing plates with only round holes are sanctioned for use on the Railways. The normal size of this kind of bearing plate is 260 mm × 220 mm × 18 mm for 52 kg and 90 R rails (Fig. 10.7).

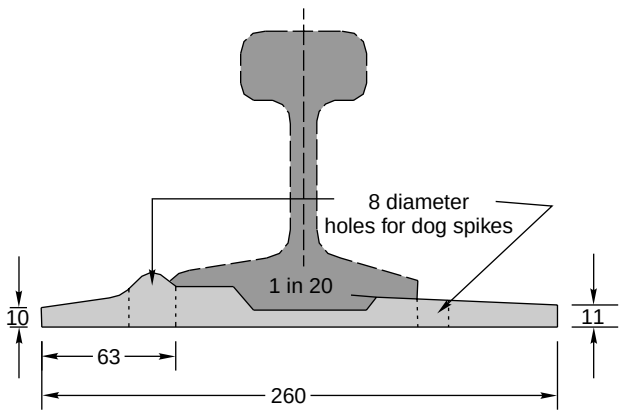

Fig. 10.7 Canted MS bearing plate for 90 R

Flat MS bearing plates Flat MS bearing plates are used at points and crossings in the lead portion of a turnout. No cant is provided in these bearing plates. The size of this bearing plate is 260 mm × 220 mm × 19 mm for 52 kg and 90 R rails (Fig. 10.8).

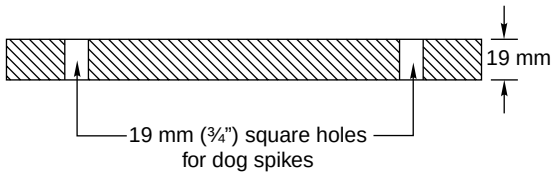

Fig. 10.8 Flat MS bearing plate

Cast iron anticreep bearing plates Cast iron (CI) anticreep bearing plates are provided with wooden sleepers at locations where the rails are likely to develop creep. These bearing plates have a cant of 1 in 20 and can be fixed using normal round spikes. The size of this bearing plate is 285 mm × 205 mm for BG tracks (Fig. 10.9).

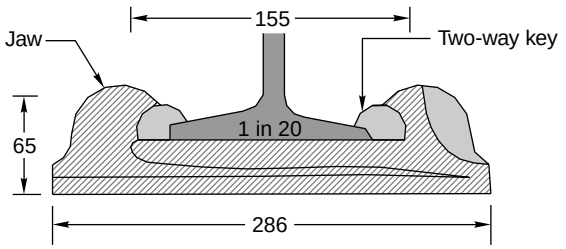

Fig. 10.9 CI anticreep bearing plate

Special CI bearing plates for BH rails Special cast iron bearing plates are used for fixing bull headed (BH) rails. The rail is held in position with the help of a spring key (Fig. 10.10).

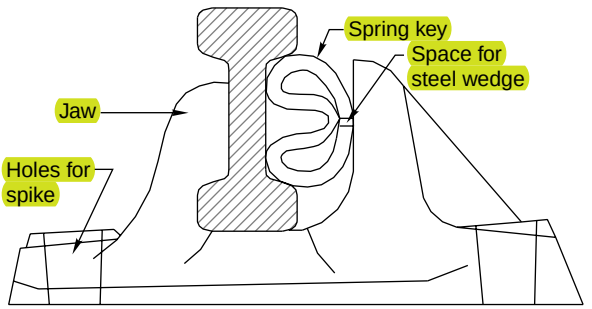

Fig. 10.10 CI bearing plate for BH rail

10.3 Fittings of Steel Trough Sleepers

The fittings required for metal sleepers are different form those used for wooden sleepers. Loose jaws, keys, and rubber pads are used to fix rails to steel sleepers.

Loose jaws

Loose jaws (Fig. 10.11) and keys are used for holding the rail and the steel trough sleeper together. The older type of trough sleepers were easily damaged, cracked, or deformed due to the provision of pressed-up lugs. There problems have been solved by introducing spring steel loose jaws, which have been standardized on Indian Railways. These jaws can be easily replaced whenever necessary. They are manufactured using spring steel and the weight of 100 loose jaws is approximately 28.8 kg.

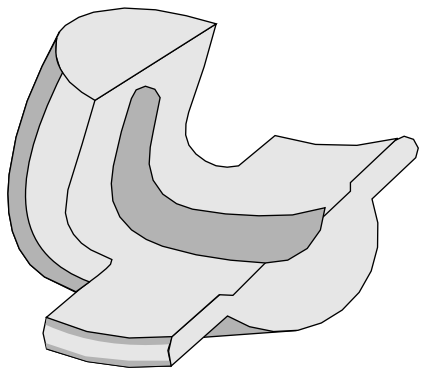

Fig. 10.11 Spring steel loose jaw

Two-way keys

Two-way keys (Fig. 10.12) are universally used for fixing trough sleepers, pot sleepers, and CST-9 sleepers. A two-way taper is provided at both ends of a two-way key and as such the key can be driven in either direction. These keys are manufactured using a special rolled section. The length of the keys for BG is about 190 mm with a taper of 1 in 32. A gauge variation of ±3 mm can be adjusted by altering the extent to which these keys are driven in.

The various methods of driving keys for different types of sleepers are listed in Table 10.5.

Rubber-coated and epoxy-coated fish plates

Some time back, rubber-coated fish plates were used at insulated joints on Indian Railways on a trial basis. The results indicated that these fish plates get damaged early in service, thereby limiting their life. Therefore, epoxy-coated fish plates are now being tried.

10.3.4 Mota Singh Liner

The holes in trough sleepers get elongated during service due to the wear and tear caused on account of moving loads. The Mota Singh liner (Fig. 10.13) is liner used effectively with loose jaws for overcoming the problem of elongated holes.

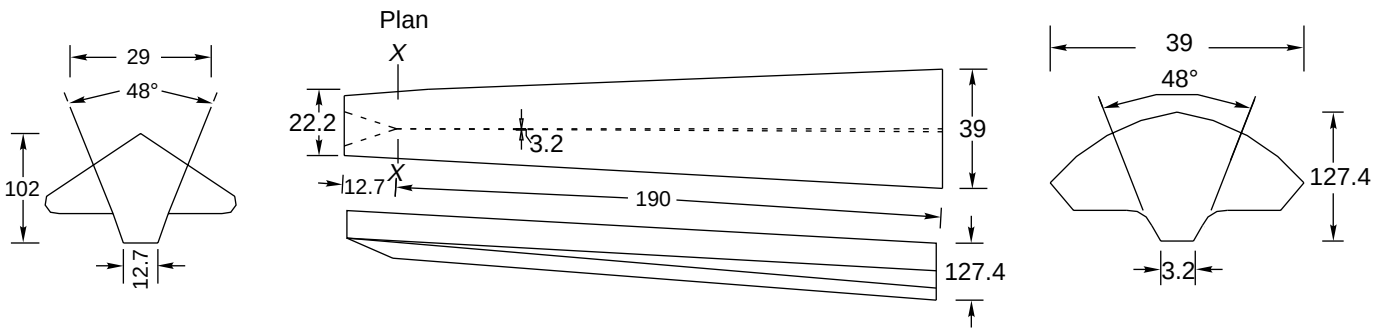

Fig. 10.12 Two-way keys

Table 10.5 Methods of driving keys

Type of sleeper and track	*Direction of driving*
Single line	
CST-9 sleeper (fish-plated, SWR, and LWR tracks)	All the keys in one sleeper should be driven in the same direction. Keys on alternate sleepers should be driven in the reverse direction.
Steel trough sleeper (all types of tracks)	The outer keys on the sleeper should be driven in one direction and the inner keys in alternate sleepers should be driven in the opposite direction.
Wooden sleeper	
▸ Anticreep bearing plates with single-key configuration	All keys should be driven in the same direction. Keys should be driven in reverse direction in alternate sleepers.
▸ Anticreep bearing plates with double-key configuration	The outer keys on a sleeper should be in one direction and the inner keys in the opposite direction. The pattern of driving keys should be reversed in alternate sleepers.
Double line	
CST-sleeper	
▸ Fish-plated and SWR track	The direction of 75% of the keys should be in the direction of the traffic and that of 25% should be in the opposite direction.
▸ LWR track in non-breathing length	75% of the keys should be driven in the direction of traffic and 25% should be driven in the opposite direction.
▸ LWR track in breathing length	All keys should be driven in one direction on one sleeper and in the opposite direction on the next sleeper. The same scheme should be followed up in subsequent sleepers.
ST sleeper	
▸ Fish-plated and SWR track	75% of the sleepers should have all four keys driven in the direction of the traffic and 25% of the sleepers should have the keys driven in the direction opposite to that of the traffic.
▸ LWR track in non-breathing length	75% of the sleepers should have all four keys driven in the direction of traffic and 25% of the sleepers should have all the keys driven in the direction opposite to that of the traffic.
▸ LWR track in breathing length	Two inner keys should be driven in one direction and the other keys in the other direction. Also, the direction of the keys should be reversed in alternate sleepers so as to prevent relative movement between the rail and the sleeper.

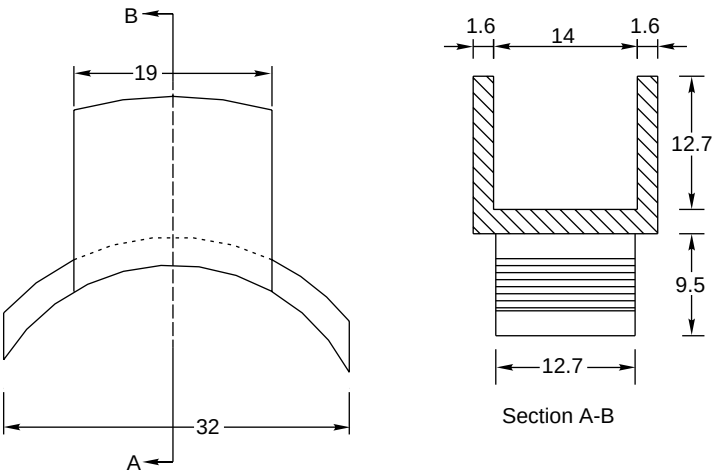

Fig. 10.13 Mota Singh liner (all dimensions are in milimetres)

10.4 Fittings of CI Sleepers

Rails are fixed to cast iron sleepers using cotters and tie bars. These fittings are described below.

Cotters

Cotters (Fig. 10.14) are used for fixing tie bars to CI sleepers. Cotters are classified according to their methods of splitting. The four different types of cotters being used on Indian Railways are as follows.

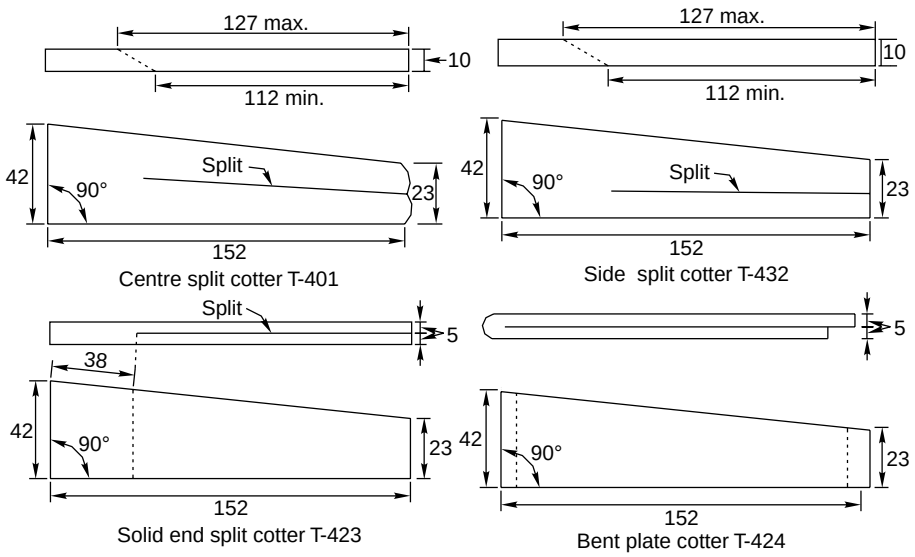

Fig. 10.14 MS cotters (all dimensions are in milimetres)

(a) Centre split cotter
(b) Side split cotter
(c) Solid end split cotter
(d) Bent plate cotter

The overall dimensions, taper, etc. of these four cotters are by and large identical; they only differ in their methods of splitting. The length of a cotter is 152 mm and the approximate weight is 0.80 lb per piece.

MS tie bars

MS tie bars are used for holding the two plates of CST-9 sleepers together. The normal length of a tie bar is 2720 mm for BG and 1870 mm for MG. The section of a BG tie bar measures 50 mm × 13 mm and that of an MG tie bar measures 45 mm × 10 mm.

10.5 Elastic Fastenings

The primary purpose of a fastening is to fix the rail to the sleeper. The rail may be fixed either directly or indirectly with the help of fastenings. In the process, the fastening gets subjected to strong vertical, lateral, and longitudinal forces. The forces, which are predominantly dynamic, increase rapidly with increasing loads and speeds. In addition, vibrations are generated by moving loads mainly on account of geometrical irregularities in the track and due to the forces set up by the imbalance in the rolling stock. The traditional rigid fastening, which so far has fulfilled its task to a certain extent, is no longer able to effectively meet the present challenge of heavy dynamic forces and, therefore, becomes loose under the impact of high-frequency vibrations of the order of 800 to 1000 cycles per second, even at a moderate speed of 100 kmph. In fact, this type of fastening is unable to hold the rail to the sleeper firmly for a satisfactory length of time because of the constant pressure exerted by moving loads. Due to the shocks and vibrations caused by moving loads, the rigid fastenings become loose, an interplay between the components of the track develops, track parameters get affected, and rapid deterioration of the track begins. To solve these problems a fastening which could safeguard track parameters and dampen the vibrations is required. This has led to the development of the elastic fastening.

10.5.1 Requirements of an Elastic Fastening

The ideal elastic fastening should meet the following requirements.

(a) It should hold the gauge firmly in place.
(b) It should have an adequate toe load which should not reduce under service.
(c) It should provide sufficient elasticity to absorb the vibrations and shocks caused by moving loads.
(d) It should help in keeping the track well maintained.
(e) It should offer adequate resistance to lateral forces in order to maintain the stability of the track.

(f) It should provide adequate resistance to the longitudinal forces that are a result of the acceleration of moving loads and other miscellaneous factors. These longitudinal forces tend to cause the development of creep in the track.
(g) It should be of the 'fit and forget' type so that it requires least maintenance.
(h) It should not lose its properties even when it is used over and over.
(i) It should have as few parts as possible and these parts should be easy to manufacture, lay, and maintain.
(j) It should be irremovable so that once fitted it cannot be taken out and as such it should not be vulnerable to sabotage or theft.
(k) It should be universally applicable so that it can be used with wooden, steel, or concrete sleepers.
(l) It should be cheap and long lasting.

10.5.2 Types of Elastic Fastenings

An elastic fastening is usually in the form of a clip. Various types of clips have been developed over the years; these are discussed here in detail.

Pandrol clip or elastic rail clip

The Pandrol PR 401 clip (also known as an elastic rail clip) (Fig. 10.15) is a standard type of elastic fastening used on Indian Railways, earlier manufactured by Messrs Guest, Keens & Williams. It is a 'fit and forget' type of fastening that requires very little attention towards its maintenance. The clip is made of a silico–manganese spring steel bar with a diameter of 20.6 mm and is heat treated. It exerts a toe load of 710 kg for a nominal deflection of 11.4 mm. The toe load is quite adequate to ensure that no relative movement is possible between the rail and the sleeper. Pandrol clips can be driven with the help of an ordinary 4-pound hammer and require no special tools. In order to ensure that the correct toe load is exerted, the Pandrol clip should be driven to such an extent that the outer leg of the clip is flush with the outer face of the CI insert. Figure 10.16 shows an isometric view of the clip fixed on the rail while Fig. 10.17 shows the clip fixed to a rail seat.

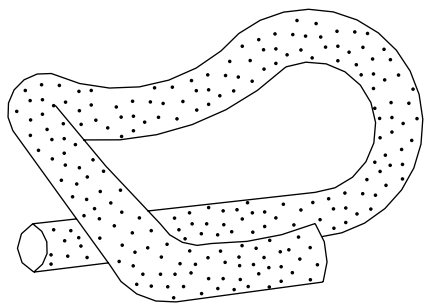

Fig. 10.15 Pandrol clip or elastic rail clip

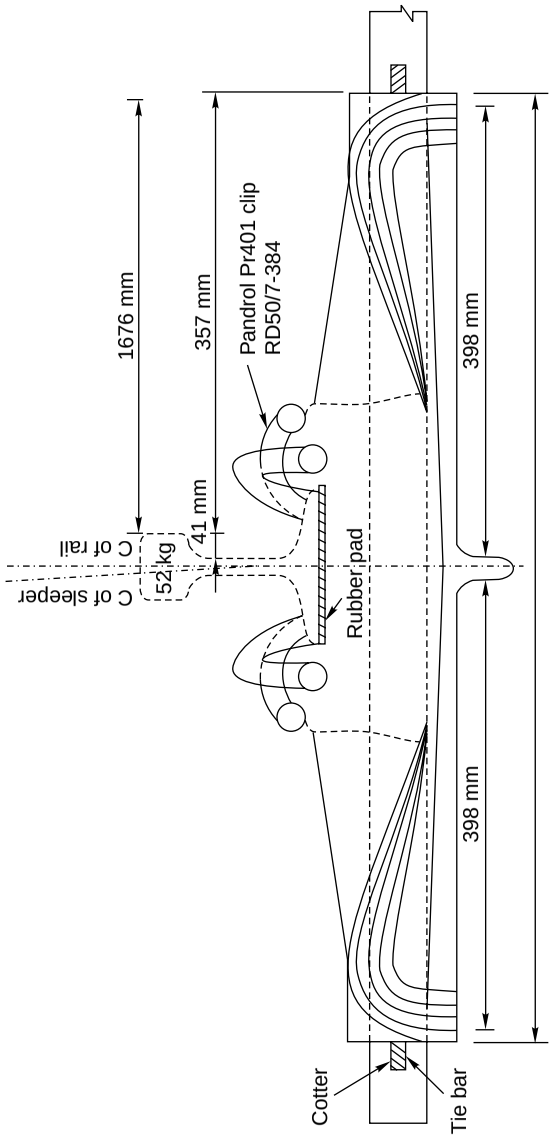

Fig. 10.16 Isometric view of Pandrol clip

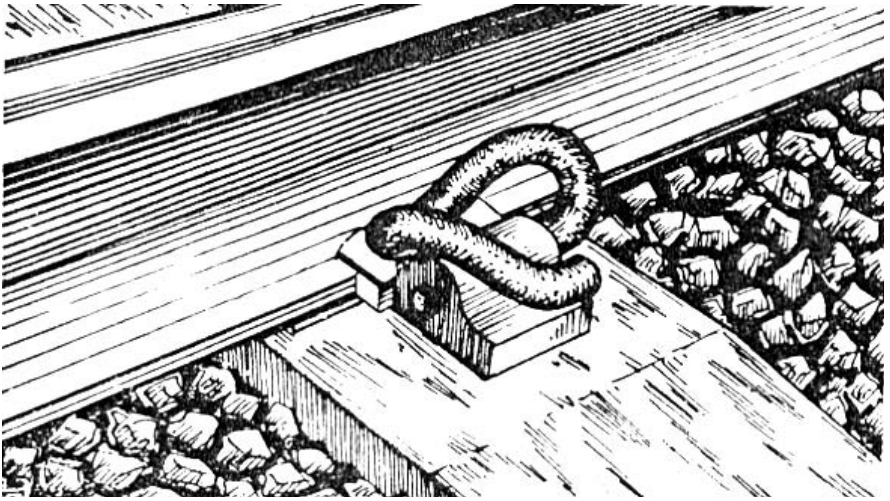

Fig. 10.17 Pandrol clip fixed to the rail seat

The Pandrol or elastic clip can be fixed on wooden, steel, cast iron, and concrete sleepers with the help of a base plate and some other ancillary fittings. Pandrol clips are the most widely used clips with concrete sleepers on Indian Railways. Therefore, it becomes imperative that a detailed account of the same be given.

Concrete sleepers with Pandrol/elastic clips In the case of concrete sleepers, malleable cast iron inserts are punched directly into the sleepers during manufacture. The Pandrol clip is fixed in the holes of the CI insert. A 4.5-mm-thick grooved rubber pad is provided under the rail seat to make it doubly elastic. Insulated liners provide the necessary insulation (Fig. 10.18).

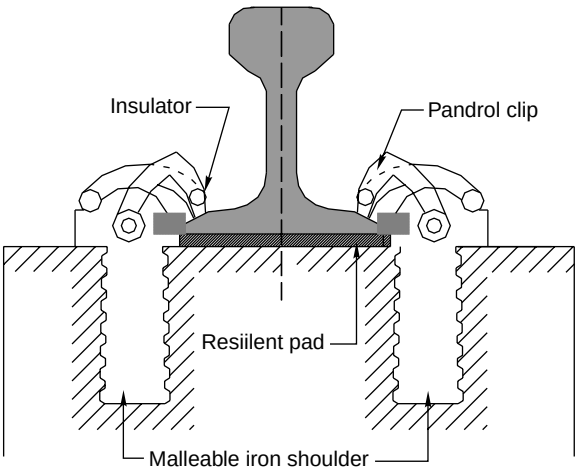

Fig. 10.18 Pandrol clip with concrete sleeper

Drawbacks of Pandrol clip The Pandrol clip suffers from the following drawbacks

1. Their use makes the adjustment of the gauge impossible.
2. The Pandrol clip has a point contact and this causes indentation on the foot of the rail due to a heavy toe load and a small contact area.
3. It does not provide enough safeguard from theft or sabotage because it can easily be taken out using an ordinary hammer.
4. It gets caught inside the malleable cast iron (MCI) insert during service.

Toe load measuring device This device consists of a lever made of silico–manganese steel and is designed to grip the Pandrol rail slip toe. It is used in conjunction with a suitable block which is fitted on the rail head and acts as the fulcrum. To operate the device, a force is gradually applied to the handle and the reading of the dial gauge at which the Pandrol clip toe is just lifted above the rail seat is noted. The reading of the dial gauge indicates the toe load, which is pre-calibrated in the laboratory.

IRN 202 clip

The IRN 202 clip (Fig. 10.19) is an elastic fastening designed by RDSO to suit two-block reinforced cement concrete (RCC) sleepers. The clip is manufactured by the Republic Forge of Hyderabad using a silico–manganese spring steel bar of diameter of 18 mm, suitably heat treated to Brinel hardness number (BHN) 375–415. The assembly is designed for a toe load of 1000 kg and a toe deflection of 18.5 mm. The assembly has a creep resistance generally equal to 50% of the total toe load of the rail.

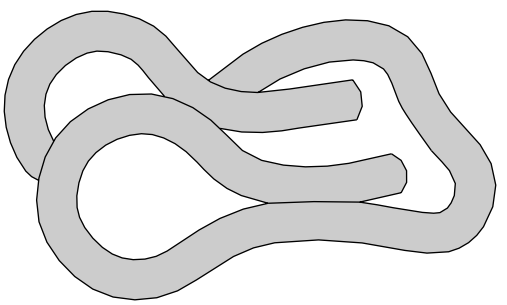

Fig. 10.19 IRN 202 clip

The clip essentially consists of outer legs connected by means of two coils. It is held in position by a bolt and clamp arrangement. The clamp is made up of the same material as the clip. The bolt, which has a diameter of 19 mm, is made of mild steel. The clip holds the track gauge easily and effectively. The inner legs rest against the bottom flange of the rail to provide an elastic gauge check. After the clip is placed in position, the nut is tightened to depress the inner legs with respect to the toe till these touch the sleeper surface. This stage depends on the designed toe load and the toe load deflection. At this stage, it is not possible to tighten the nut any further. The nut will remain in position for quite some time, as the tension in the bolt does not vary much during summer.

The advantage of the IRN 202 clip is that the rail can be changed without removing the fastening simply by loosening the bolt and pushing the rail out. However, the IRN 202 clip suffers from the following drawbacks.

1. The corrosion of the highly stressed part (heel) of the assembly can lead to the development cracks.
2. It is not a fit and forget type of fastening and requires frequent attention such as oiling and tightening of the nuts to maintain the required toe load.
3. It is a comparatively costlier and heavier clip.

Lock spikes

Lock spikes (Fig. 10.20) are manufactured by Messrs Lock Spike Ltd, London for use with wooden sleepers. The lock spike type LG-20 has been tried on Indian Railways. It is a 165-mm- (6.5-in.) long spike with a round section of diameter 16 mm (5/8″). The sizes of the holes bored into the sleeper are 14 mm and 12 mm for hard wood, and soft wood respectively. The spike, which appears to have a good future, is still under trial.

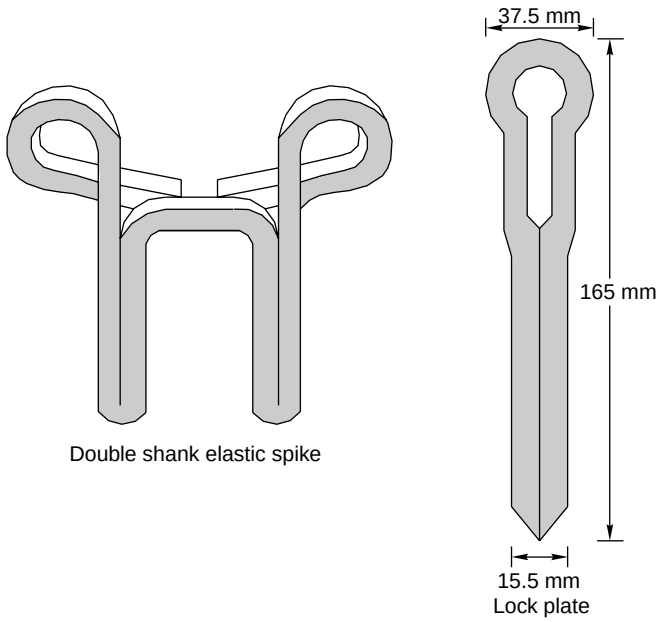

Fig. 10.20 Lock spike

Spring steel clip

A large number of spring steel clips (Fig. 10.21), supplied mostly by Messrs Guest, Keens & Williams, have been tried on Indian Railways. The assembly consists of a double elastic fastening used on a prestressed concrete sleeper. In this assembly, the rail rests on a grooved rubber pad and is held vertically by a pair of spring clips at each rail seat. The clip is pressed with the help of a nut tightened on a 22-mm

bolt, which is inserted from the underside of the sleeper. The clip is manufactured using EN-48 steel. The nut is tightened to a torque of 100 ft lb to obtain a resistance of 1 t per pair of clips. The clip is still in its experimental stage on Indian Railways.

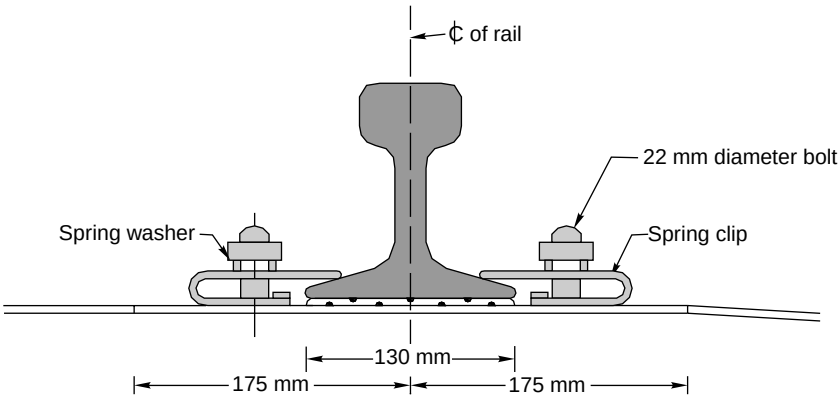

Fig. 10.21 Spring steel clip

Elastic rail clip MK-III

The RDSO has designed a new type of elastic rail clip known as ERC MK-III (Fig. 10.22) which suits both 52-kg and 60-kg rails along with 6-mm-thick rubber pads. In the case of 60-kg rails, two liners of 16 mm thickness are used, whereas in the case of 52-kg rails, one liner of 16 mm thickness is used on the non-gauge side and another liner of 10 mm thickness is used on the gauge side. The clip can also be used with 6-mm-thick rubber pads in place of the usual 4.5-mm-thick rubber pads on the existing 52-kg PRC sleeper.

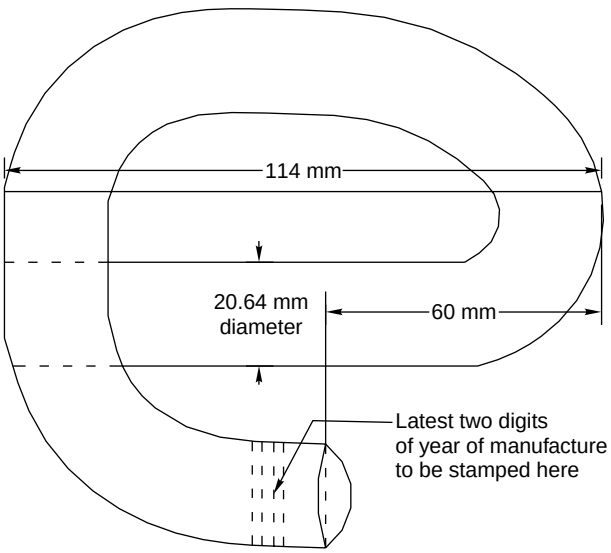

Fig. 10.22 Pandrol clip (ERC rail clip) MK III

The ERC MK-III clip has been modified from the standard elastic rail clip to the extent that the distance of the toe of the clip has increased with respect to the centre leg. The space curves of the clip have also been modified to achieve a higher toe load. The diameter of the standard ERC has been retained, i.e., 20.6 mm.

The new ERC MK-III has a toe load of 900–1100 kg with a toe deflection of 15.5 mm. The clip is still under trial.

Limitations of elastic rail clip The elastic clip (or Pandrol clip) presently being used on Indian Railways has the following limitations.

1. The elastic rail clip (ERC) does not permit 52-kg rails to be interchangd with 60-kg rails. Therefore, whenever traffic requirements demand the replacement of 52-kg rails with 60-kg rails, the sleepers also have to be replaced or costlier special steel alloy rails have to be used.
2. The ERC can be easily removed from the track.
3. The ERC gets jammed/rusted in the insert and tends to lose the designed toe load.

The only fastenings in the world proven to permit the interchangeability of 52-kg rails with 60-kg rails are the HM fastenings of German design and the NABLA fastenings of French design. The RDSO has recently designed an elastic rail clip (mark III) which also permits interchangeability of the two types of rails, but it is still in its trial stage.

Herbert Meir fastening

The Herbert Meir (HM) fastening (Fig. 10.23) basically consists of four coach screws which are tightened against the plastic dowels of the PRC sleepers and press the HM clip assembly to give the desired toe load. Each clip weighs about 510 g and can give a toe load of about 1 t. The gauge is maintained with the help of an angled guide plate. A thin insulated shim is placed between the angled plate and the concrete sleepers. A grooved rubber pad is placed below the seat to provide the necessary dampening effect and resistance to the lateral movement of rails.

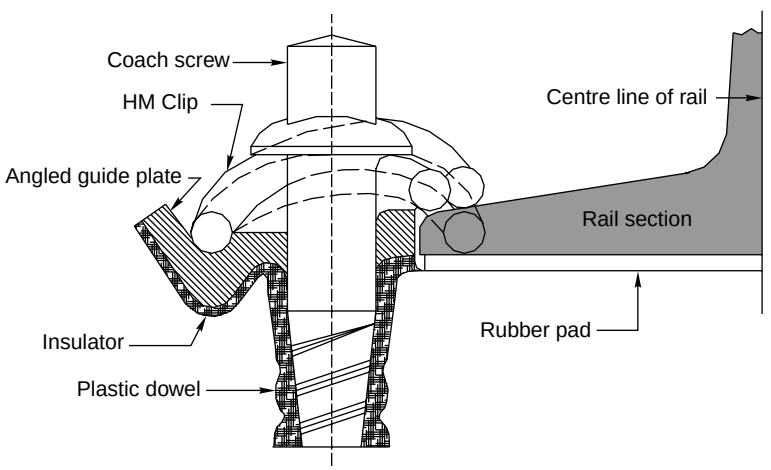

Fig. 10.23 HM fastening

The HM fastening can be used for 52-kg as well as 60-kg rails by using a suitable size of angled guide plates and insulating shims.

10.6 Other Fittings and Fastenings

This section discusses malleable cast iron inserts, rubber pads, composite liners, and pilfer-proof elastic fastenings.

10.6.1 MCI Inserts

Malleable cast iron inserts are directly fixed onto concrete sleepers during manufacture. MCI inserts are manufactured according to the Indian Railway Standard (IRS) specification T-32-76. These inserts are of two types.

(a) Stem-type MCI insert for use in normal pre-tension concrete sleepers. This insert is provided in concrete sleepers being manufactured in all the concrete sleeper factories in India except the one located at Allahabad. The weight of the stem-type insert is about 1.6 kg per piece.

(b) Gate-type MCI insert for use in the post-tension concrete sleepers being manufactured at Allahabad. The approximate weight of the gate-type MCI insert is 1.7 kg per piece.

10.6.2 Rubber Pads

A rubber pad (Fig. 10.24) is an integral part of an elastic fastening. It is provided between the rails and the sleepers and has the following functions.

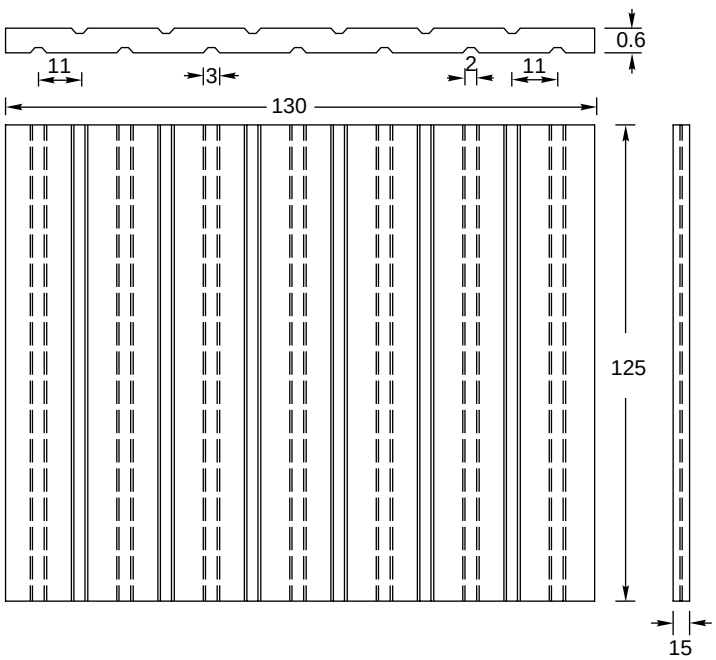

Fig. 10.24 Rubber pad

(a) It absorbs shocks.
(b) It dampens and absorbs vibrations.
(c) It resists the lateral movements of the rails.
(d) It prevents the abrasion of the bottom surface of the rail, which would otherwise come in direct contact with the sleepers.
(e) It provides electrical insulation between the rails in an electrified area.

Indian Railways uses grooved rubber pads of 4.5 mm thickness made of special quality rubber. The grooves aid in the uniform distribution of the load on sleepers and help to limit the lateral expansion of the rubber under the pressure of dynamic loads.

The RDSO has recently designed 6-mm-thick grooved rubber pads with horns (Drg. No. RDSO/T-37) for use on 60-kg rails (Fig. 10.25). It was noticed that normal 4.5-mm-thick rubber pads (IRST-37-1982) got crushed wihtin 6–7 years and, therefore, thicker, grooved rubber pads with a service life of 15–20 years were designed particularly for use on 60-kg UIC rails. These rubber pads are still under trial.

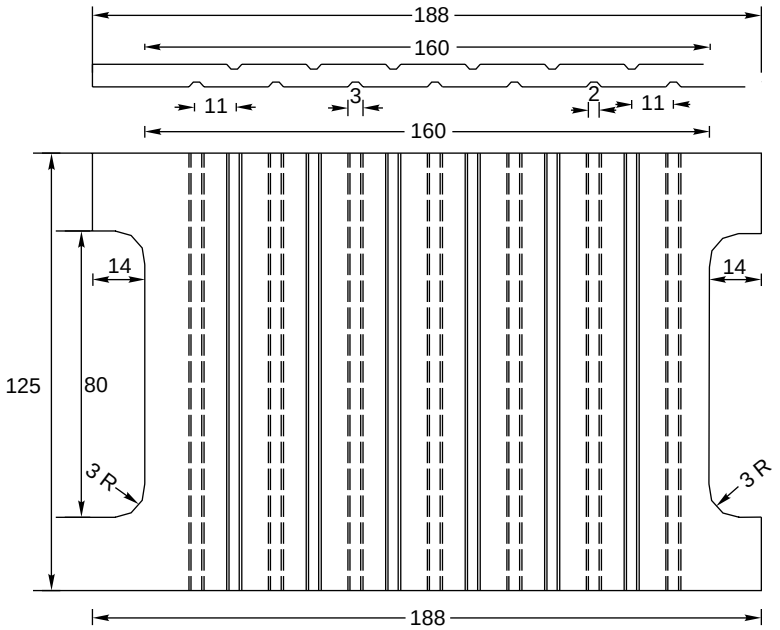

Fig. 10.25 6-mm-thick grooved rubber pad

10.6.3 Composite Liners

The Indian Railways mostly uses nylon insulating liners. These liners, however, get crushed under the toe load exerted by Pandrol clips. To eliminate such premature failure, the following two types of composite liners have been evolved by RDSO.

(a) Composite liner with malleable cast iron and nylon components (Drg. No. RDSO/T653/1)

(b) Composite liners with MS and nylon components (Drg. No. RDSO/T-1895)

These liners have been developed on the basis of the designs of the liners adopted on British Railways, which have been reported to provide trouble-free service. Composite liners have been used on Indian Railways for the last few years and are serving the railways well.

Glass-filled nylon liners

The RDSO has developed glass-filled nylon liners (Fig. 10.26) (GFN-66) of 4 mm thickness particularly for track-circuited areas and sections subject to server corrosion. These glass-filled nylon liners are considered to be technically superior to other liners because they are single piece, have a longer life, and are free from corrosion. These liners are used extensively on Indian Railways particularly with the ERC clip assembly on 60-kg and 52-kg rails and PRC sleepers.

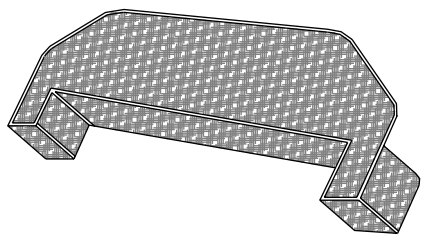

Fig. 10.26 Glass-filled nylon liner

It has been noticed that the GFN-66 liners tend to break, particularly in yards where these liners have been fitted in the ERC clip assembly on concrete sleepers. This happens due to the rusting of the rail surface and uneven seating. To avoid breakage of GFN-66 liners, it is necessary that proper precautions be taken during initial laying to ensure that the rail surface is free from rust, etc. and that the liners are fitted evenly on the 1 in 6 sloping surface of the rail flange.

A new design of GFN-66 liners with a thickness of 6 mm (Drg. No. DSO/T-2505 Alt II) has recently been developed and is expected to be sturdier and provide a better service life.

10.6.4 Pilfer-proof Elastic Fastenings for Concrete Sleepers

The present design of elastic fastenings (Pandrol clips) is such that they can be easily removed by a single stroke of a hammer. A new type of elastic rail clip, which is pilfer-proof, has been recently developed by RDSO. A pilfer-proof elastic fastening may be defined as an elastic fastening system which is easy to fit in the assembly but is difficult to remove without damaging the system.

The design of a pilfer-proof elastic rail fastening consists of clip of almost the same design as that of the normal elastic fastening as well as a new fitting known as the *pilfer-proof circlip*. The circlip is a standard mechanical component manufactured according to IS specifications and is generally used for restraining the axial movements of the components mounted on shafts.

10.7 Testing of Fastenings

Both elastic and rigid fastenings are tested in the laboratory for their suitability in the field. The vibrogir and pulsator are used to test these fastenings.

The vibrogir is used in laboratories for checking the effectiveness of various fastenings. With the help of this equipment it is possible to produce high-frequency vibrations in the laboratory, very similar to those produced on a real track. By applying a frequency of 50 Hz, the rail and sleeper are made to vibrate at a rate of 700–800 Hz with an acceleration of 70 g and an amplitude of the order of 0.1–0.3 mm. One hour of working of a vibrogir corresponds to almost 4.05 GMT of traffic and 300 hours of its working creates the same effect on a fastening as 20 years of service under normal track conditions.

The pulsator not only simulates vibrations just like the vibrogir, but also applies vertical and lateral pressure on the rail fastening at a frequency of 250–500 cycles/minute.

Tests carried out with the help of vibrogirs and pulsators clearly establish the superiority of elastic fastenings over rigid fastenings.

Summary

Fittings hold rails in position and thus help provide a smooth ride. Fish plates and bolts are used to join the rails in series while different types of fastenings are used to fix the rails to the sleepers. The traditional rigid types of fastenings are not able to meet the challenges posed by heavy dynamic forces and become loose under high-frequency vibrations. Elastic fastenings are found to be very suitable for high-speed tracks. New design of elastic fastenings are being developed to overcome as many drawbacks as possible.

Review Questions

1. With the help of a suitable sketch explain the assembly of the Pandrol clip in elastic fastenings for concrete sleepers.
2. Illustrate with sketches the various fastenings used to fasten rails to sleepers. Discuss their merits and demerits.
3. Explain briefly the functions of the following in a railway track.
   (a) Hook bolt
   (b) Fish plate
   (c) Tie bar
   (d) Cotters
   (e) Screw spike
4. What do you understand by anchors and what are their functions in railways? What are the advantages and disadvantages of bearing plates?
5. Name the different types of track fittings. Name the different types of spikes generally used and draw a sketch of any one of them.
6. Draw the details of a rail held to a wooden sleeper by the following.
   (a) Dog spikes on an MS bearing plate

(b) Anticreep keys on a CI bearing plate
(c) Pandrol clip on a CI bearing plate

What are the advantages and disadvantages of these fastenings?

7. What is the difference between an ordinary fish plate and a combination fish plate?
8. What are the requirements of an elastic fastening? Briefly describe the various elastic fastenings being used on Indian Railways.
9. Describe the various type of fittings used for wooden sleepers and steel trough sleepers.
10. What are the requirements of an elastic fastening? Draw a sketch of an elastic rail clip and explain how it is fixed to a concrete sleeper.
11. Describe the functions of a rubber pad. Draw a dimensioned sketch of the same.
12. Differentiate between the following.
    (a) Fat bearing plate and canted bearing plate
    (b) Dog spike and screw spike
    (c) Ordinary fish plate and combination fish plate
    (d) Cotters and liners
    (e) Elastic rail clip and spring steel clip
    (f) Glass-filled nylon liners and Mota Singh liners
13. Write short notes on the following.
    (a) Loose jaw
    (b) HM fastening
    (c) Pilfer-proof elastic fastening
    (d) Vibrogir and pulsator