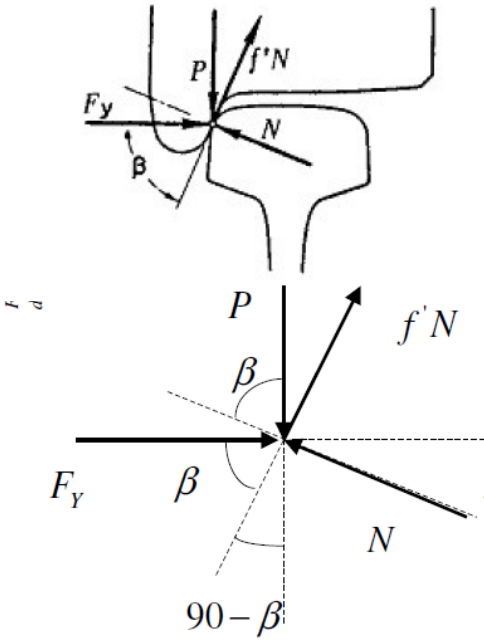
Concepts and effectiveness of Derailment Detection Devices

ITALIAN NATIONAL INVESTIGATION BODY (NIB-IT)

Copenhagen, november 21th 2013

DDD allow to detect anomalous position of the wheel or wheelset on the rail



$$F_Y \cos\beta + f' N \le P\cos(90-\beta)$$

$$N = P\cos\beta + F_Y \cos(90-\beta)$$

$$F_Y \cos\beta + f' (P\cos\beta + F_Y sen\beta) \le P sen\beta$$

$$F_Y(\cos\beta + f' sen\beta) \le P(sen\beta - f'\cos\beta)$$

$$F_Y(1 + f' tg\beta) \le P(tg\beta - f')$$

$$\frac{F_Y}{P} = \frac{\tan\beta - f'}{1 + f'\tan\beta}$$

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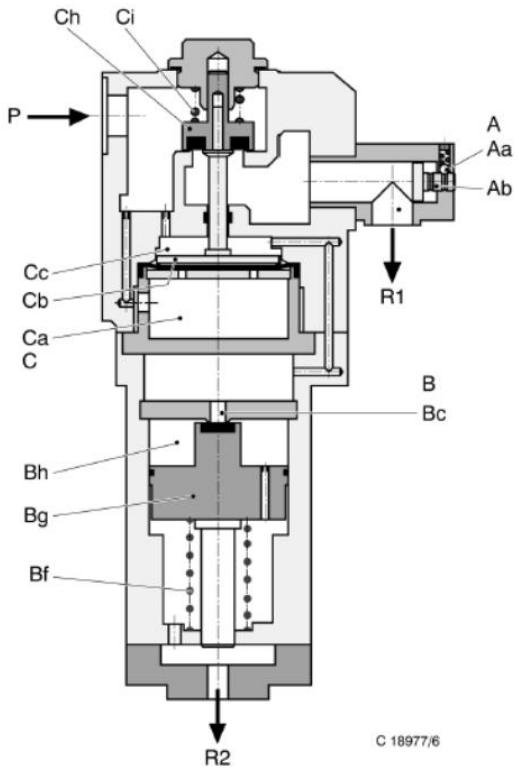
Derailment Detection Devices

Fig. 6 **End position** (schematic)



A	**Indicator**
Aa	Latch
Ab	Indicator pin
B	**Trigger valve**
Bc	Valve
Bf	Spring
Bg	Trigger weight
Bh	Chamber
C	**Emergency brake valve**
Ca	Chamber
Cb	Thrust plate and tappet
Cc	Chamber
Ch	Valve
Ci	Spring
P	Air supply port, brake pipe
R_1	Air outlet, brake pipe
R_2	Air outlet, control air

Operating concepts

Information coming from the DDD - detection derailment device can be used «potentially» in two different ways:

1. Automatic and immediate braking of the train (in each case of detection)

2. a)Immediate reporting of the information to the driver

   b) Immediate trasmission of the information to the «onboard train control systems» and subsequent elaboration of the data

In the case 2 a)information must be used according to specific procedures

In the case 2 b) information must be quickly elaborated : the equipment have to be designed and set up also in the frame of ERTMS in order to activate the most appropriate and modulate braking action

Operating concepts

No doubt on the fact that an immediate braking action reduces the travelled distance in conditions of instability of the wheelset.

This can reduce the probability of impacts towards elements along the railway (i.e. switches) that can lead to overturning of wagons.

Operating concepts

Considering the Italian railway network, the value «average» of the distance between yards (i.e areasa where switches are present) is equal to 7.5 km

In the condition of a wagon travelling in instable conditions, the «theoretical expected average path» to be covered until the next critical element along the railway (i.e. switches) that can lead to overturning is close to 3.8 km.

This distance is greater than an average rapid breaking distance (i.e. 250 m @ 80km/h)

Operating concepts

The DDD effectiveness is self-evident and maximum (complete stop) when the derailment starts in plain line track and therefore away from switches, crosses, etc.

The high probability that the wagon is in conditions of being completely stopped (with DDD intervention) before impacting a rail element that can amplify the nature and the consequences can be easely evaluated

Conclusions

Date	Place	Distance before stop [m]
20/07/2004	Sommacampagna	256
26/05/2004	Genova Brignole	470
27/04/2004	Maddaloni Marcianise	700
16/01/2005	Sesto Calende	140
05/05/2005	Omignano	5000
12/9/2005	Verona P.N. Scalo	660
10/11/2005	Villa S Giovanni Bolano	300
13/02/2006	Artegna	9000
01/03/2006	S. Arcangelo Di Romagna-savignano Sul Rubicone	2000
22/11/2006	Secugnago	12000
04/01/2007	Bivio Pantani-paola	20000
11/2/2007	Cassano Spinola-stazzano Serravalle	500
26/2/2007	Domo Ii	200
8/3/2007	Bari Lamasinata	100
17/4/2007	R.Emilia-rubiera	400
24/7/2007	Arona	250
31/8/2007	Brennero	250
27/11/2007	Oleggio	227
19/12/2007	Domodossola-bivio Toce	130
21/06/2008	Vipiteno	200
25/5/2009	Robilante	3013
6/6/2009	Torre Del Lago-pisa San Rossore	5053
22/6/2009	Vaiano-pba87-133-4	5105
29/6/2009	Viareggio	334
09/10/2009	Maddaloni Marcianise	220
15/10/2010	Cuneo - Bivio Madonna Dell`olmo	520
26/03/2011	Genova Voltri	150
23/08/2011	Cervignano	130
22/12/2011	Domodossola	200
19/04/2012	Bologna San Donato	250
18/05/2012	Calolziocorte	18000
06/06/2012	Bressanone	10000
25/06/2013	Formia	9000

This is a sample of 33 derailments

The average distance covered by the train between the derailment and the stop (no DDD installed) is equal to 3090 m

This result is perfectly coherent with the theoretical approach just described (3750 m)

NIB-IT will complete the study of «plain line track derailments» in mid-2014

Official recommendations n. 10 of the Directorate General for Rail investigations

(Italian National Investigative Body – Italian NIB)

subsequent to the survey conducted by the Ministerial Commission investigation of the accident of Viareggio 06/29/2009

Viareggio accident recommandation

…….the use of Detectors of Derailment Devices (DDD) for all wagons carrying dangerous goods, starting from the older ones.

The application of such devices must make possible to activate automatic actions of brakes, needing an evolution of the detection techniques as much as possible free from false alarms.

These devices should also be installed necessarily on the wagons carrying normal freights when they are in composition with those carrying dangerous goods.

To provide for the production of new wagons, the obligation to adopt such devices taking into account possible technological developments towards more advanced solutions, also in terms of selectivity and modulation of the braking reactions.