



CHAPTER 2

Block

- Can Li @ 12#503A
- lic@jsnu.edu.cn
- https://sslic.cn/speci_eng



Unit 10 Axle Counter

- **Introduction**
- **Advantages**
- **Cables**
- **Disadvantages**
- **Turnouts**
- **Fail Safety**

Introduction

- An **axle counter** is a device on a railway that detects the passing of a train **in lieu of** the more common track circuit.
 - ◆ A **counting head** (or detection point) is installed at each end of the section, and as each axle passes the head **at the start of** the section, a counter **increments**.
 - ◆ A detection point **comprises** two independent sensors, therefore the device can detect the direction of a train by the order in which the sensors are passed.
 - ◆ As the train passes a similar counting head at the end of the section, the counter **decrements**.
 - ◆ If the **net count** is **evaluated** as zero, the section is **presumed** to be clear for a second train. Example as Fig. 10.1.

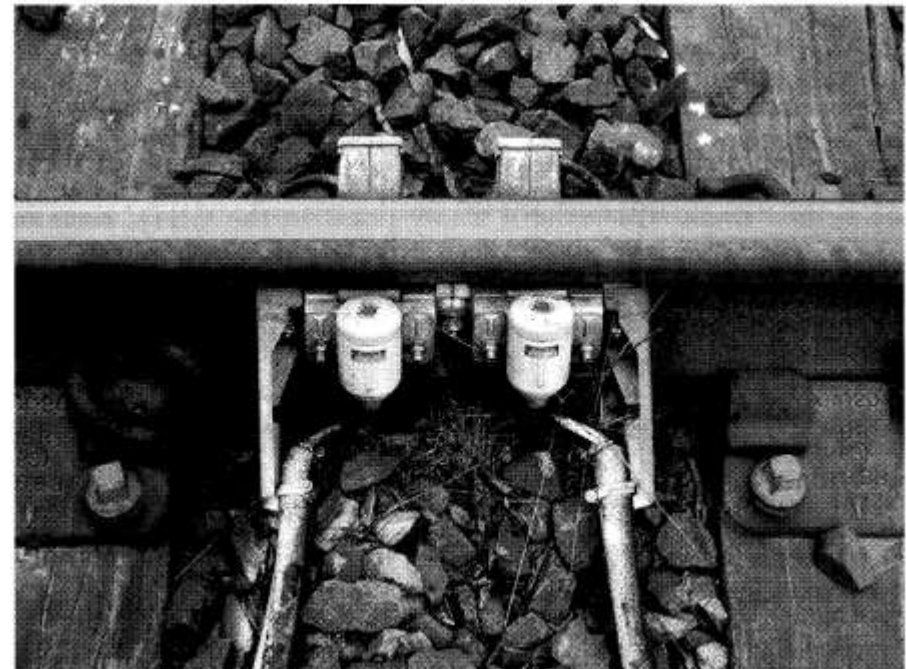


Fig. 10.1 An axle counter detection point in the UK

Introduction

- This is carried out by **safety critical** computers called “**evaluators**” which are centrally located, with the detection points located **at the required sites (位置) in the field (实地)**.
 - ◆ The detection points (Fig. 10.2) are either connected to the evaluator via **dedicated copper cable** or via a telecommunications transmission system.
 - ◆ This allows the detection points to be located significant distances from the evaluator.
 - ◆ This is useful when using **centralized** interlocking equipment *but less so* when signaling equipment is distributed at the line-side in **equipment cabinets**.



Fig. 10. 2 Modern type axle counter detection point

10.1 Advantages

- Unlike track circuits, axle counters do not require **insulated rail joints** to be installed. This avoids breaking the **continuity** of **long welded rails** for insulated joints to be **inserted**.
- Axle counters are particularly useful on electrified railways as they eliminate **traction bonding (牵引接续)** and **impedance bonds (阻抗轨隙连接器)**.
- Axle counters require **no bonding** and less **cabling** in comparison to track circuits, and are therefore generally less expensive to install and maintain.
- Axle counters do not **suffer** problems with **railhead contamination**, e.g. due to **rust** or **compacted leaf residue (肥边)**, that can affect the **correct operation** of track circuits.

10.1 Advantages

- Axle counters are used in places such as wet **tunnels** (such as the Severn Tunnel), where **ordinary** track circuits are **unreliable**.
- Axle counters are also useful on **steel structures** (such as the Forth Bridge), which may prevent the **normal operation** of track circuits if **insulating** the rails from the structure proves impracticable.
- Axle counters are also useful on **long sections** where several intermediate track circuits may be **saved**.
 - ◆ A Frauscher axle counter sensor, for example, can be 8,500 m from the evaluation unit, while the latest ALTPRO axle counter sensor model ZK24 can even go up to 49 km from the unit.

10.2 Cables

- The axle counter **cable** of 8,000 m or 49,000 m would typically be **buried in a plastic conduit**, which can also be used for CBI cables. The conduit would have **termination boxes** every few thousand feet to **assist in fault finding**.
- In the case of Frauscher axle counters, the cables have four **cores**: two for **power** (positive and negative), and **one each** for counting in each direction.
- In case of ALTPRO ZK24 axle counters, where ALTPRO VUR **module** is used, the cable requires only two cores: power (positive and negative) while the signals from the axle counter (from the two sensor's heads) are **sent back modulated** over the very same core used for the power supply.

10.3 Disadvantages

- Axle counters may “forget” how many axles are in a section for various reasons such as a **power failure**. A **manual override** is therefore necessary to **reset** the system.
- An **accident occurred** in the Severn Tunnel and is thought to be due to **improper restoration** of an axle counter.
 - ◆ This, however, was not **proven** during the **subsequent inquiry**.
- In **older installations** the evaluators may use **eight-bit logic**, causing **numerical overflow** when a train with 256 axles passes the axle counter.
 - ◆ As a result, this train will not be detected.
 - ◆ This imposes a length limit of 255 axles on each train.

10.4 Turnouts

- Where there are interlocked turnouts, an **axle counter unit** needs to be provided for each **leg** of that turnout.
- On lines with non-interlocked/hand operated switches, detection of the **switch points** would have to be monitored **separately**, whereas on track circuited lines **misaligned** points can be set to automatically break the track circuit.

10.5 Fail Safety

- Axle counters only provide **intermittent positive** indication of a rail vehicle as it passes a fixed location.
- If the counter unit fails or **becomes disconnected**, a train will pass **undetected** into a block that would otherwise be regarded as unoccupied (列车将在未被检测的情况下经过计轴器，并进入一个空闲的闭塞区间).
- Track circuits provide continuous real time detection over a track **segment** and any **loss of power** or **disconnected wire** results in a **restrictive** signal indication to the train.
- Track circuits also allow for the use of **clips** that instantly **shunt** the circuit and mark the track as occupied.
 - ◆ These can be used by **crews** or **maintenance personnel** to quickly report an unsafe condition or mark a section of track **out of service**.

10.5 Fail Safety

- Modern axle counter equipment transmits data from the track-side **apparatus** [ˌæpə'reɪtəs] to the **indoor equipment** via **telegrams**, across an ISDN line.
- These results in the section of line *being monitored* showing occupied in the event of **persisting** technical fault or loss of telegrams.
 - ◆ The section then requires a **reset command** and further **interaction** to **restore to service**.

10.5 Fail Safety

- Some **manufacturers** provide axle counter equipment which is **failed safe** in design.
 - ◆ **New technology** allows for occupancy detection **if** the axle counter **detaches** or **becomes loose** from the rail, has a **conductor open** or **short condition**, // and *with some designs that use **dual internal sensors** within the axle counter* (New technology) will show occupancy *when only one system is working within the axle counter by activating* based on number of **pulses** detected from the remaining good system inside the axle counter.
 - ◆ 如果计轴器从轨道上脱落或松动，这些新技术仍然允许进行占用检测；新技术具备导体（传导装置）的开路和短路条件；并且对于一些在计轴器中使用双内部传感器的设计，当通过激活后只有一个系统在计轴器内工作时，则会根据从计轴器内其余无故障系统检测到的脉冲数来显示占用情况。

Homework

- Page 86

- ◆ 1
- ◆ 2
- ◆ 4