

The adoption of the overhead system for heavy main-line railway traffic is as yet largely in the experimental stage, and there is very little practical information available on the application of this system to such purposes. It is, however, worthy of note that several large installations are now in progress in America, the results of which are being anxiously awaited.

Up to the present, where existing railways have been converted from steam to electric traction, the third-rail system has been adopted in nearly every case.

The chief disadvantage in the use of a third-rail system is the liability to personal accident through contact with the live rail. This, however, has of late been reduced to a minimum by the adoption of improved methods of protection.

CURRENTS, ETC.

The kinds of current used are,—

- (1.) Continuous, or direct current.
- (2.) Alternating current, three-phase.
- (3.) „ „ single-phase.

The only system, up to the present, adopted in England is the continuous or direct current, but a suburban portion of the London-Brighton line is now being installed with the single-phase alternating-current system.

In America and some places in Europe each of the three systems is being tried. The opinions of experts are divided as to the best system of supply of current for heavy railway traction.

The following remarks indicate some of the advantages and disadvantages of the various methods:—

(1.) *The Continuous Current System.*

Has proved extremely successful for tram-lines, tubes, and short railways. On tram-lines the current can be conveyed to the cars through a trolley-wire, but with heavier traffic a third rail is required to carry the larger currents necessary. There are three drawbacks to the use of continuous currents on railways, and particularly on main lines,—

- (a.) The third rail is very much in the way, very difficult to find room for, and, unless fully protected, is dangerous.
- (b.) Rotary converters for converting the high-tension distribution-current into low-tension working-current used in the third rail have to be distributed along the line. This adds to the cost of supervision, and there is a greater possibility of breakdown.
- (c.) The expense of the distribution system.

(2.) *Three-phase.*

This system has the advantage over the continuous-current system in that high-tension currents conveyed by trolley-wires can be used, the third rail is avoided, and there is no running machinery along the line. There are, however, two drawbacks to the three-phase,—

- (a.) The motor has an uneconomical start. Either resistance must be used up to full speed, or the rather troublesome “cascade system” adopted, with which half the motors are idle at full speed.
- (b.) Two trolley-wires are needed, which make all junctions, &c., complicated, and nearly double the difficulty of overhead construction.

(3.) *Single-phase.*

This is the newest system, and appears to be the most suitable for railway traction. It has none of the disadvantages mentioned above as appertaining to the continuous-current and three-phase systems.

There is no third rail, no running machinery along the line, and the distribution is the simplest possible. The motor gives a good starting tractive force, and starts more economically than continuous-current or three-phase motors. Only one trolley-wire is used, and there is therefore no difficulty at the junctions.

Power.

The power used in the generation of electric current for tramways and railways is obtained in different ways—viz., by water, steam, and oil or gas engines.

EXAMPLES OF INSTALLATIONS.

Lancashire and Yorkshire Railway.

The electrical energy is generated at three-phase alternating current of 7,500 volts pressure, and transmitted to substations, where the voltage is stepped down by statics, and transformed by rotary converters into direct current of 650 volts pressure, the maximum voltage at the train being 600.

New York—New Haven and Hartford Railroad.

The New York Central part of the New Haven system is operated on the direct-current system; the remainder of the line is on the alternating-current system.

Electric Railway connecting Bonn and Cologne.

This railway, which has recently been opened, is of special interest in that it affords an example of the use of high-pressure continuous direct currents for electric traction. The length of the line is about seventeen miles, and at Bonn and Cologne it connects with the tramway systems