

DC POWER RECTIFICATION

Thomas H. Young of the Ohio Brass Company discussed DC power rectification systems. The evolution of power rectifier equipment includes added safety features designed to deenergize the overhead system in the event of faults. It was pointed out that rate-of-rise detection was difficult and not totally reliable when applied to a two-wire trolley overhead system. It was strongly recommended that a backup system be provided if the rate-of-rise approach was taken.

SUPERVISORY CONTROL

Thomas Margro of the Southeastern Pennsylvania Transportation Authority outlined some supervisory control systems. Systems to obtain supervisory control of the power distribution network range from one-on-one in which each substation has an individual master control to more sophisticated systems (either controlled by computers or microprocessors) in which one master control can handle up to 60 or 70 substations. It was emphasized that cost is usually the controlling factor in the selection of a supervisory control system.

OTHER FACTORS

Relating back to the Seattle experience, it was

pointed out that one innovation not seen in other U.S. systems but used in Seattle was the feederless power distribution system. Rather than large substations feeding out to the overhead in heavy cable through long runs, Seattle has small 500-kW substations 1.25 miles apart that directly feed the overhead. The overhead wires are 4/0 hard-drawn, high-conductivity copper and serve as their own feeders.

Conflicts, too, with other utilities are likely to be myriad. The requirement for close coordination and accepted ground rules for the solution of these problems must be worked out and understood by all parties early in the design stage.

An important part of the system approach is early input from the maintenance organization. It is then up to the design team to keep the degree of maintainability decided on in the detailed design. Performance specifications are an effective tool to ensure system maintainability.

The construction of an overhead system has a broad impact on all the citizens in the area served. It is ideally suited to a turnkey contract, a type of contract that is not seen in public works in the United States. The advantages, though, of a single contractor who designs, builds, and starts up the system point toward lower costs and closer adherence to the construction schedule.

SELECTED MATERIALS

Modern Trolley Bus Overhead Contact Lines

Gilbert de Steffani

In general, construction of overhead contact lines for trolley buses is a little-noticed technical field. Vehicles are built for high speeds, and there are slow and quick overhead contact lines. The quality of the overhead contact line depends on the uninterrupted receipt of electric current. The resultant static and dynamic problems are discussed here.

Most overhead contact lines used for urban mass transit have not kept pace with the development and technical progress related to the higher speeds associated with other forms of mass transit. The old rigid overhead contact line not only causes greater wear and tear but also extensive sparking at high speeds. This, in turn, produces radio disturbances. In the case of trolley buses, dewirement of the current receiver is a frequent result.

Kummler and Matter developed a fully elastic overhead contact line that meets the requirements of rapid transit for electric vehicles and eliminates the disadvantages of the old, rigid suspension system.

If a contact wire is suspended from two points, it produces an approximately parabolic line. In the middle, between the two points of suspension, the line is horizontal and then climbs on either side toward these points at an increasing angle. The deviation from the horizontal is therefore greatest in the immediate vicinity of the suspension points. This ascent of the contact wire depends on the distance between the suspension points and the specific tension of the wire.

If a trolley shoe slides along the wire, the pressure of this sliding contact displaces the wire

from its basic position into its so-called working position. The working position is greatest in the middle of the span and slightest at the suspension points. The curve of the working position is of the same order as that of the basic position, i.e., horizontal in the middle of the span and steepest at the suspension points.

ELASTIC OVERHEAD CONTACT LINE

Another type of suspension system involves the choice of a slanting pendulum. This allows for speeds in excess of 50 mph, minimizes dewirement potential and radio disturbances, decreases wire wear, and results in lower maintenance costs (see Figure 1).

It should be noted that if the vertical component is changed ever so slightly by the pressure of the sliding contact, the obliquity of the pendulum is changed immediately. As a result, the height of the contact wire at the suspension point is affected.

To economically build a trolley bus overhead contact line, as few suspension points as possible should be used. To accomplish this, the angle of the contact wire at the suspension points must be as great as possible.

To prevent detrimental side hits of the trolley shoe on the contact wire, this angle is rounded off. The head of the contact wire is clamped between two elastic rails, the length of which depends on the angle of the contact wire. These curve rails are attached to the cross suspension by a parallelogram pendulum (see Figure 2). Depending on the angle of the curve, the curve rail can have one, two, or three oscillating pull-offs. The curve rails are mounted so that the curve of the contact wire at the suspension point is a parabola. This curve form ensures the proper augmentation and diminution of the centrifugal powers of the current receiver shoe, eliminating sudden moves to the side, which cause dewirements.

Comparison of the rigid and elastic trolley bus

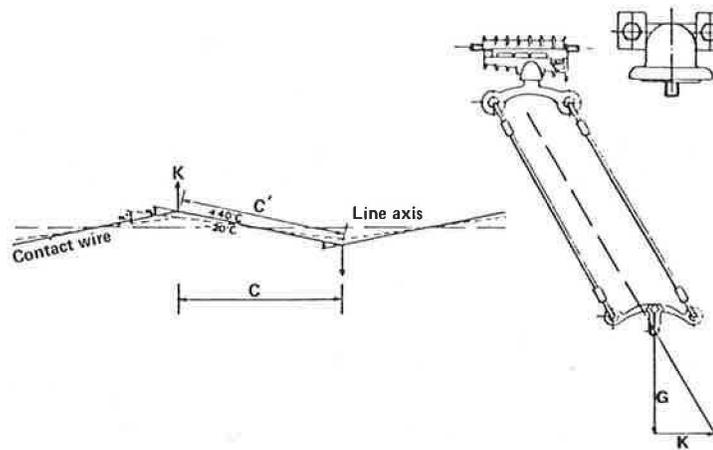


Figure 1. Suspension system that involves slanting pendulum.

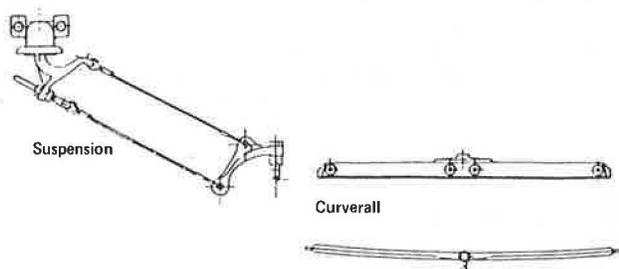


Figure 2. Parallelogram pendulum.

overhead contact lines has shown that dewirements are fewer with the elastic type than with the rigid type. On the straight angle and on curves, considerably greater speeds are possible with the elastic system. In view of the technical advantages of the elastic system, the life cycle of the sliding contact carbon is considerably longer. This cycle varies depending on supplier and time of the year, but sliding contact carbons have been known to last 2,500 miles or more.

Supervisory Control Systems

Thomas E. Margo

The traction power substation is one of the vital elements in an electrified transit system because it must provide power in an efficient, safe, and reliable manner. These features are provided in the design of the power conversion equipment installed in the substation. However, a key element in any transit system operation is the ability to know what is going on and to effectively respond to that situation.

For traction power substations, this information and control function can be provided efficiently by a supervisory control system—generally referred to as a supervisory control and data acquisition (SCADA) system. A SCADA system provides three basic functions: (a) control (e.g., trip or close a circuit breaker or other controllable device), (b) indication (e.g., report of the status of a device or function), and (c) telemetry (e.g., reporting the

quantitative measurement of an item such as voltage or current). With this capability, efficiency and flexibility in traction power substation operation can be achieved.

BACKGROUND

Almost all electrified transit systems have adopted the principle of automatic traction power substations. This includes the newer transit systems designed and constructed over the past several years as well as the older transit systems that date back to the early 1900s. An automatic substation can be defined as an unmanned substation in which the equipment is designed with automatic features (protective circuits, load-measuring circuits, etc.) that provide for safe operation of the substation in response to the demands of the electrified traction power system.

The Southeastern Pennsylvania Transportation Authority (SEPTA), the transit operator in Philadelphia and the surrounding counties, has had an ongoing program of renovating old traction power substations and adding new substations where system changes or expansion dictate. All such substations become automatic substations and SEPTA has adopted the policy that all automatic substations will incorporate supervisory control. The supervisory control system concept provides complete optional, overriding control of the automatic substations from a centralized location. The advantages offered by this centralized supervisory control system concept include economy of operation (because the substations are unmanned); continuous real-time update and display of electrical system status; prompt operation of equipment in response to dispatcher's commands; and greatly increased flexibility of operations in response to operational problems (accidents, electrical faults, etc.). These items are all of vital importance to the transit system operators.

Many years ago, SEPTA had used electromechanical supervisory control systems at several substations. These were of the single-master, single-remote type; the master was installed in an existing manned substation and one other substation via the supervisory set. This afforded some economy of operation and provided some of the other advantages noted above.

To realize more fully the benefits and advantages of the substation supervisory control system, a centralized supervisory control facility was established at SEPTA's operation headquarters for all new substations that were added or existing ones that