

the dumping location to control the speed of loaded cars as they are processed through the facility. This has virtually eliminated dangerous manual car handling operation using car riders.

Once again, the principles of this type of remote and automatic operation can be applied to similar small scale facilities.

I would now like to briefly describe another installation in which we have been involved and which very definitely reflects future trends.

Union Switch & Signal, along with the Westinghouse Air Brake Division, has installed automation equipment on a five-unit diesel-electric locomotive to pull up to 95-130 ton ore cars between terminals on a privately owned rail line approximately 80 miles in length, with no one at the controls.

Automation rides in the lead unit of the locomotive in the form of electrical-electronic train control equipment which receives commands concerning speed rates for level territory, grades and curves from wayside intelligence units, or decision-making devices. Train speed is checked continuously by a digital control speed sensing system.

In addition to the digital system, a fail-safe analog overspeed protective system assures safe operation of the train at all times. Brake pipe integrity is automatically checked prior to the beginning of each run and also continuously checked throughout the run from one terminal to another.

Additional wayside equipment informs the electronic brain when the train is approaching highway crossings and causes the locomotive horn and bell to sound. All wayside apparatus which monitors and guards the safe passage of the train is inert. Once installed it requires no maintenance, except for occasional repair of physical damage.

A brake control center also is installed in the lead unit of the locomotive. Electric and electronic equipment provides continuous indications of train speeds to this brake control center which interprets this intelligence in terms of required brake application. Three separate braking systems are automatically controlled, as required to maintain required speed on level track, reduce speed in approach to curves and downhill grades, and permit increased speed in advance of uphill grades. Brakes are applied automati-

cally in the same manner as they would be with conventional manual control.

The train-carried equipment is designed for three modes of operation: manual, remote control and fully automatic. A three-position switch on a small control console in the cab of the lead locomotive determines which mode of operation is to be used.

While the train is enroute from one terminal to the other, it operates fully automatically. When the train reaches its destination at either terminal it automatically decelerates, applies brakes and comes to a stop at a predetermined location. An attendant who rides in the cab of the locomotive switches the operating mode to manual or remote control. At the mine site an operator from a control tower uses space radio to control remotely the required movements of the train to ready it for its return trip.

In case of a bad order car which must be set out on a siding, the attendant switches to manual or remote control and operates the train in this fashion to make the necessary operations. The locomotive is then returned to automatic operation and the train resumes its run.

While it is a relatively new idea to automate completely a heavy freight train, the basic principles and engineering techniques involved in doing so are not new to Union Switch, having previously designed and manufactured the automation equipment which was installed on the New York subway shuttle train between Times Square and Grand Central Station. Beginning revenue runs in January 1962 this train, operating completely automatically, made tens of thousands of successful round trips before being taken out of service in mid-1963. The shuttle train proved to be a successful rolling laboratory and the apparatus is now being updated and refined as a result of this long testing period.

Union Switch & Signal is nationally recognized as a pioneer and leader in the design, manufacture and installation of signaling, communications and braking equipment for railroads and mass transit for about 80 years.

Our company has engineered more rail control systems than any other company in the world. In fact, our equipment is in use on about 75 per cent of all American transit systems today. And it was just about 15