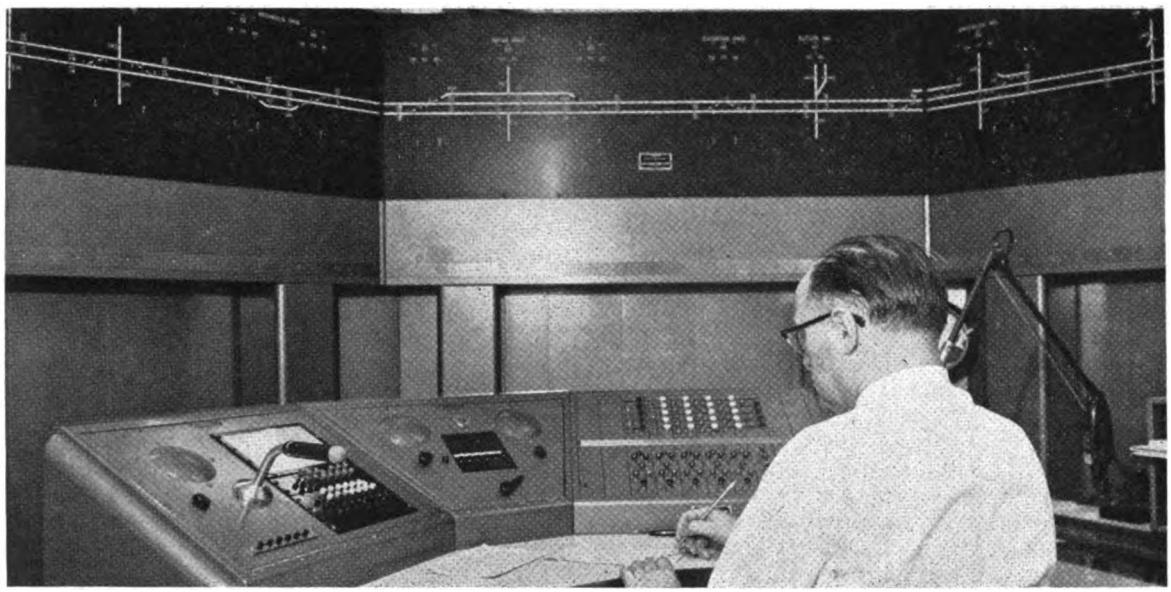

New York Central traffic control system between Toledo and Elkhart, 133 miles, is now completely in service.

CTC Discussed at AIEE Meeting

Four papers dealing with traffic control were presented at the American Institute of Electrical Engineers winter meeting in New York. Talks by signal engineers show importance of traffic control in today's railroading, as well as for the future.

IN A COMPARATIVE CHECK, the New York Central operating department found that one CTC installation produced a 14.7 per cent increase in gross ton-miles per freight train-hour. This installation is between Buffalo, N.Y., and Cleveland, Ohio. The former 4-track mainline was converted to double-track CTC. The average speed of trains over this 163-mile section increased 6.5 per cent. The $6 million project produced $3 million in salvage, according to J. W. Curran, NYC's assistant chief signal engineer. He said that the annual "savings in payroll expense, maintenance of track retired, taxes and miscellaneous would amount to $725,000. This yields a return of 24 per cent on net cost." (*RS&C: December 1955, page 32; March 1957, page 26.*)

Crewless Trains Possible

Centralized traffic control is an important component in the operation of crewless trains, reported G. W. Baughman, vice-president, Union Switch & Signal. "The CTC system transmits the desires of the dispatcher to the signal system and transmits information regarding the signals, switches and trains back to the dispatcher. By the techniques used in cab signaling, the control information from the dispatcher may be applied to the rails and transferred inductively to the cab of the locomotive. Relays on the locomotive controlled in this manner by the dispatcher may have contacts in the locomotive control circuits. Thus the dispatcher would have remote control of the locomotive and safety of operation would be provided by the wayside and cab signaling equipment." (*RS&C: January 1956, page 66; October 1958, page 25.*)

CTC Reverts to ABS

In recent installations of traffic control on the Seaboard Air Line, the signal system automatically reverts to automatic block signaling with approach clearing when the code line fails. Because the train will clear the signal in advance automatically if the route ahead is clear, a large number of delays are eliminated when the code line fails.

Operating over 1,500 road-miles of traffic control, the SAL has installed three distinct types of systems. Continuing his talk before the AIEE, J. R. DePriest, superintendent communications and signals, SAL, said that "full CTC permits trains to follow one another without waiting until the preceding train has reached the next siding. This system is equipped with power operated switches. . . . Modified CTC provides power operated switches, but will not permit trains to follow until the preceding train has reached and passed the entrance switch to the next siding. This system eliminates many wayside signals which are needed when following moves are permitted, as in full CTC.

"The third type of CTC is designated by the SAL as remote controlled automatic block signals. . . . Train operation is by signal indication, same as in modified CTC, except that following trains cannot follow another train until the first train has reached and passed the exit end of the siding ahead. This system has eliminated much apparatus at one end

of each siding. The siding switches are usually hand operated. However, the power operated switches can be added when needed at a minimum of expense. The system can be expanded into modified or full CTC." *(RS&C: June 1942, page 309; May 1943, page 256; October 1946, page 334; September 1948, page 540; May 1953, page 336; November 1956, page 13.)*

Communications Systems for CTC

Traffic control systems require the transmission of data to and from the CTC machine and the field locations. H. C. Sibley, engineer for General Railway Signal, described three systems: control, indication and analog data transmission.

"One type of CTC control is a synchronous system using relays and transmitting a polar code. In this system a control code comprises 15 equal time intervals of direct voltage line energization of either polarity. When the system is at rest the line is held energized with negative polarity. Mechanical oscillators provide the time base for the system. They are mechanically tuned to a frequency of 5½ cycles per second and operate counting relays every half cycle. At the start of a control cycle, the oscillators at the control office and at all field locations are started. A binary counter comprising four relays counts the 15 steps of the code and the period of rest. The duration of a control cycle is approximately 1½ seconds.

"A code repeater is used when the line length and number of field locations exceed the capacity of one line power supply or produce excessive distortion of code pulses. The repeater reshapes the code pulses and keys a line power supply at the repeater location.

"A carrier system employing two-way frequency-shift keying is provided when the system is connected to a line already used for a dc service. The frequency of the carrier transmitter is shifted 100 cycles per second above or below the nominal frequency to provide the carrier equivalent of a polar code."

Indication System

"The indication system used with the control system just described is a continuously scanning, electronic system. The control office continuously calls the roll of all field locations in sequence, using a frequency-shift carrier channel. The field locations respond to this roll call on another frequency-shift carrier channel, time sharing this channel. Each field location transmits carrier pulses to the control office to report the position of all functions at that location. The number of pulses transmitted by a field location on each scan is assigned in multiples of ten, depending on the amount of wayside apparatus to be reported by that location. Each group of ten pulses is called an indication station. Each pulse represents a two-position field function. If a certain pulse represented a signal, it would be transmitted at one edge of the carrier channel if the signal indicated "stop," or at the other edge if the signal indicated "proceed." In general, an open indication contact results in a pulse of high frequency, that is, center frequency plus 250 cycles per second. A closed indication contact results in a pulse of low frequency, center frequency minus 250 cycles per second. The scanning rate is 100 indications per second. The length of a scan, and therefore the repetition rate, depends upon the number of field stations. A typical installation reports each of 600 field functions every six seconds.

"Cold cathode tubes are used for pulse counting and storage. Considerable energy is saved by using these tubes since they have no heaters. The fact that cold cathode tubes glow during conduction enables the maintainer to make routine checks and locate trouble with no more instrumentation than a voltmeter. Operation of these tubes at well below rated current has resulted in long life. Carrier repeaters of the regenerative type, as well as the simple amplifier type, are available when required."

Block Occupancy Reporting

"Railroads having high traffic densities, for example, subways and commuter lines, often require the reporting of train movements over many short track circuits or blocks. A communication system is required which is capable of transmitting many digits of information with only one or two digits originating at any one location. Obviously, this information can be handled by multiconductor cable with dc or power frequency. To conserve line wire some type of multiplexing is desirable.

"A simple tone system is one means of doing the job. Tone transmitters of different frequencies are situated at the various blocks and are keyed when these blocks are occupied. Tone receivers at the dispatcher's office operate relays to energize lamps on a miniature track diagram.

"An extension of the tone system provides two independent digital indications on one tone channel. The pair of line wires over which the tone system operates carries a direct voltage which is pole-changed 75 times per minute. During the time that the line voltage is of one polarity, each tone channel carries one indication. When the line voltage is switched to the opposite polarity, each tone channel carries a different indication.

"The tone transmitters and receivers are transistor operated. The transmitters develop plus 8 dbm output with 0.020 amp input at 12 volts. The receivers draw 0.005 amp with no signal and 0.040 amp when receiving a signal and operating a relay."

Analog Data Transmission

"The trend in railroad operation is toward control of longer lengths of territory from one central location. As consolidation of control occurs, hundreds of miles of railroad are operated with no personnel located directly at the wayside. The two systems just described provide a means to control switches and signals and to receive information concerning train movements over these distances. Sometimes it is necessary to relay analog information from the field to the control office. This information may be any signal which is variable over a continuous range, such as the level of fuel in storage tanks, the water level of a river at flood stage, or pressures and temperatures in some device.

"The analog data system comprises a single-sideband carrier transmitter and receiver with submodulation equipment for FM telemetering. The analog data, in the form of voltages, vary the frequency of subcarriers by amounts proportional to the voltages. At the receiving location, the variable frequency subcarriers are converted to voltages identical to the input signals. Subcarrier equipment is available for two or four analog channels. Two digital channels may be provided for additional on/off indications, timing, or marker signals."