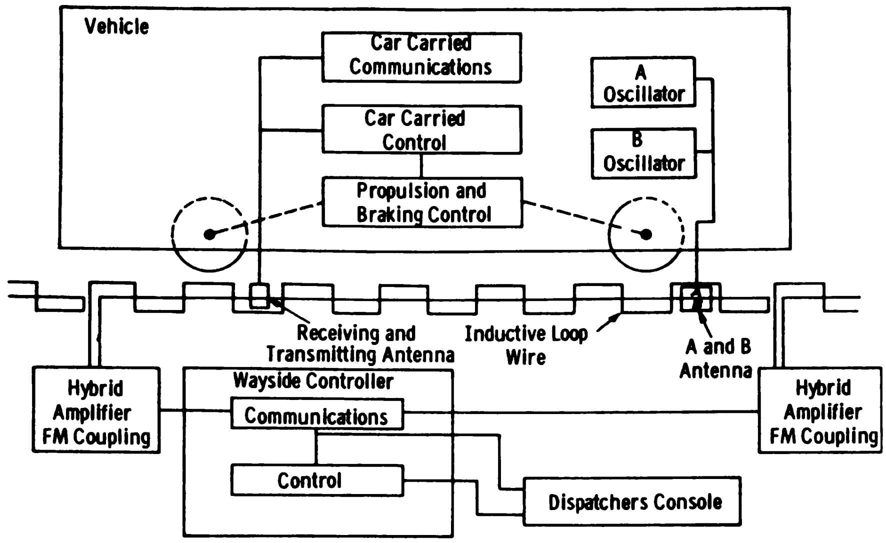
Transit vehicles set for automatic running



Schematic diagram of control system for Transit Expressway system.

Automatically controlled rubber-tired vehicles for medium density mass transit systems may soon be operating on a 9,340 ft loop roadway at South Park, near Pittsburgh, Pa. Known as the Transit Expressway system, it is designed and constructed by Westinghouse Electric Corp., for the Port Authority of Allegheny County, carried out under the Federal Housing and Home Finance Agency's Demonstration Grant Program.

Three vehicles (each about 30 ft long) will be operated, singly or coupled, between two stations on a headway of two minutes. The vehicles have electric propulsion and automotive-type running gear. Rubber tires at ends of single axles on each car run on a concrete roadway. An "I" beam mounted in the center of the roadway guides the axles and keeps the vehicle from overturning or falling off the structure.

Dynamic braking is obtained by reversing the field of the motors using another set of silicon-controlled rectifiers. As dynamic braking fades out at low speed, the air brakes blend in. For a normal service brake, the deceleration is limited to 2.5 mph per second.

The control system consists of circuits and devices located on board the vehicles, along the roadway and at the wayside station. The heart of the system is the wayside controller. The controller includes a digital computer which monitors and controls the operation of all trains (vehicles) within its area on the system.

The vehicle carries a minimum of decision-making or sequencing circuits but is responsive to commands from the wayside controller. The block diagram shows the vehicle oscillators A and B connected to antennas A and B. These oscillators operate continuously at constant audio range frequencies. As the vehicle moves along the roadway, the A and B antennas alternately couple the inductive loop wire which is mounted in a square wave pattern along the roadway. The A and B signals received at the wayside vary as the vehicle moves, dependent on the inductive coupling. These signals are demodulated and operate switches which result in "on" and "off" interrupts into the digital computer.

The track inductive circuits consist of several wire loops of various lengths. At the stations (and for a few feet on either side), the inductive wire square waves are slightly less than 2 ft long. At other places along the roadway, they are approximately 15 ft long. The short square waves afford more precise control of the vehicle during stopping.

On single vehicle trains, both A and B oscillators are energized. When several vehicles are trained, the A oscillator on the lead car and the B oscillator on the tail car are energized. All other oscillators are de-energized.

With either or both A and B tones received at the wayside, the wayside controller has all the information required to control one or more trains on the system according to the speed-distance profiles stored in the controller. The location of the train(s) is known from the loop(s) that are active and the count of the "on" and "off" interrupts. The length of the train is determined from the difference of interrupt counts. The speed is determined from the time to move from one square wave loop to the next. The controller is programmed to compute from the A and/or B inputs, make logical decisions, compare, and output the proper command to the trains to control speeds, stops, safe operating intervals, and vehicle doors.

A command to a train is an encoded signal with three out of six available tones. With six tones, all possible combinations of three tones yield a total of twenty. Therefore, twenty commands may be sent to a train. These are transmitted through the same hybrid unit and roadway mounted inductive wire as the A and B tones and are received on the train via receiving antenna mounted on the vehicle and connected to output a continuous signal. The signals (tones) received on the vehicle are demodulated and amplified. A check is made that three and only three tones are received. After this security check, the decoder unit outputs the command to the propulsion control or door control circuits. Interlocked, redundant and fail-safe circuits are used for maximum reliability and safety.

A safety check tone, the 7th tone, is transmitted from the wayside to the trains at definite intervals. This tone must periodically reset circuits on board the vehicle to prevent the application of emergency brakes. The wayside controller executes an emergency stop of trains by stopping the 7th tone output. **RS&C**