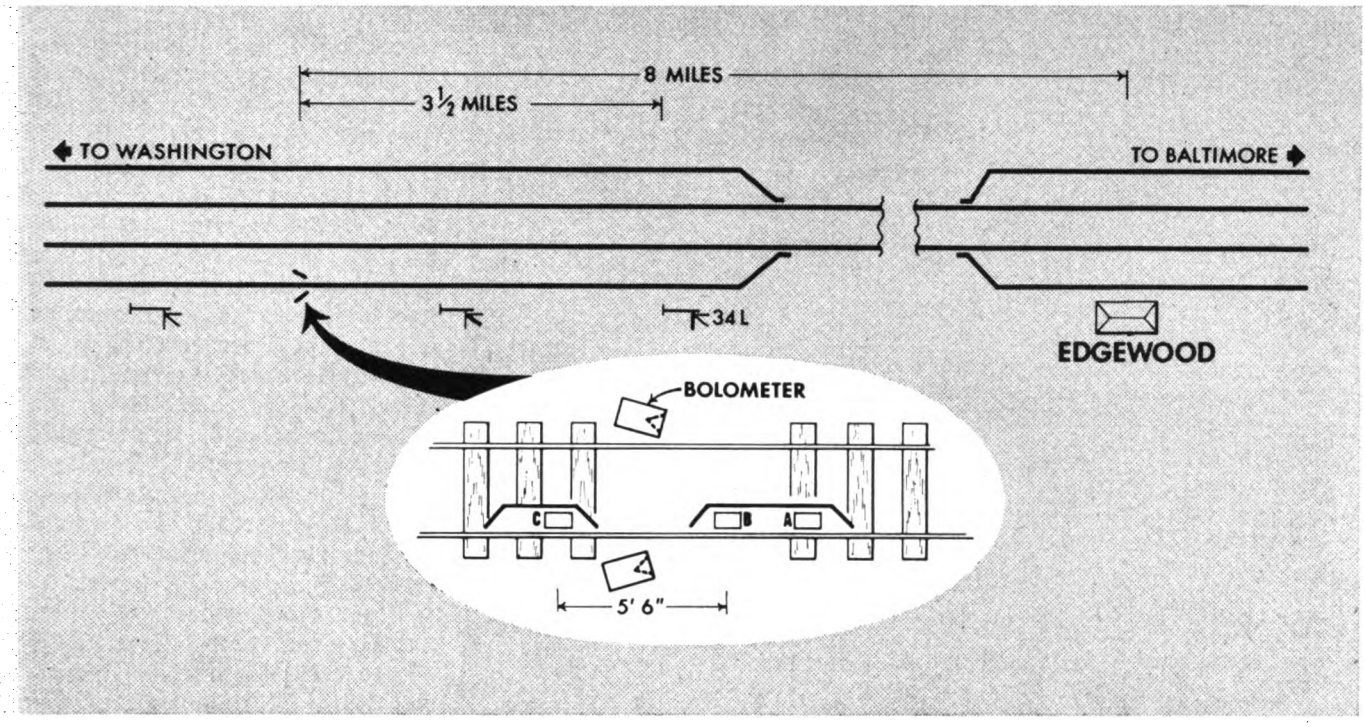


The location of the PRR's latest hot box detector installation. Four track main line reduces to two to bridge river.

Now: Instant Hot Box Location

A number of railroad signal officers saw a demonstration on the Pennsylvania recently of Servo Corporation's new carrier, automatic alarm, and axle counting equipment. In this installation, all computing and recording was done at the office location, with the detector signal being brought to the office by carrier. An automatic alarm indicates when a journal exceeds a predetermined level, and counts axles from the overheated one to the rear of the train.

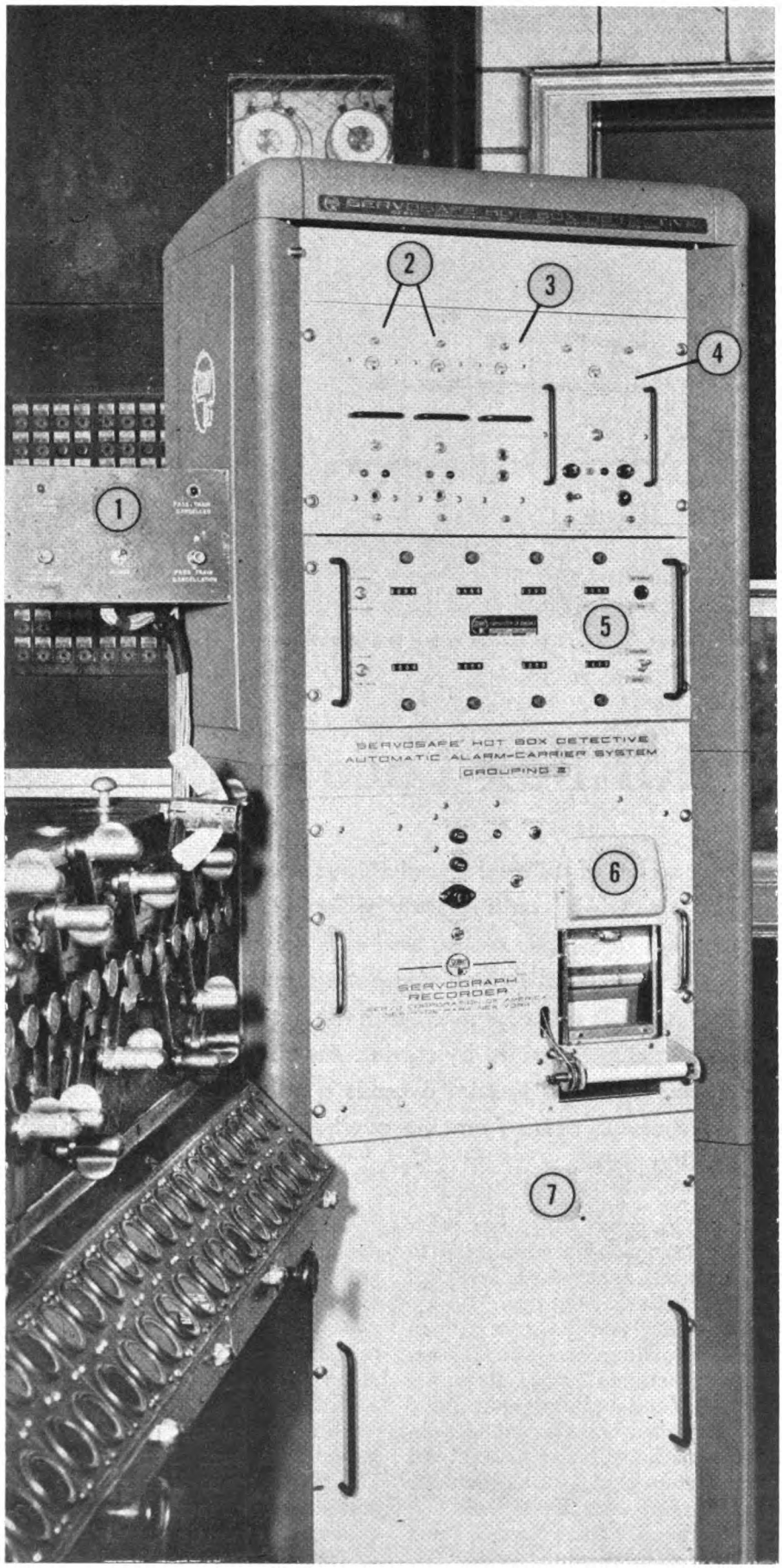
AT EDGEWOOD, MD., just outside of Baltimore on the Pennsylvania's electrified mainline to Washington, a hot box detector has been installed on one of these much used tracks. The installation is unique in that only the bolometers, transducers, and their associated relays, amplifier and power supplies are located at trackside. The signals developed are transmitted by a very linear transistorized carrier to the tower at Edgewood.

Three carrier channels ride one pair of a 54-pair lead cable eight miles from the detector site to the tower. One channel carries the gating signal which serves also to count the axles. (The gating signal is the one that indicates to the system that a journal box is being viewed by the bolometers.) The other two carrier channels carry the left and right-hand rail detector signals. The carrier frequencies used are 2,295 and 2,635 cps for the heat recording and 2,975 cps for the gating signal. The gating frequency is normally on, and is interrupted during the viewing period of each journal. The heat signal frequencies are normally off, being transmitted only during the gating period. The Servo Corp. has other frequencies available from 2,125 to 3,525 cps with separations of 170 cps (except for the highest one).

The carrier modulation is a nominal 45 cps, with a bandpass filter accepting from 2 to 50 cps. By so restricting the bandpass, most noise was eliminated and clean results obtained. Linearity was important for correct interpretation of the detector signals: a 3, 8 and 14-mm deflection in the field is, respectively, a 3, 8 and 14-mm deflection in the office. The carrier will operate without repeaters up to 15 miles over cable and 40 miles over open wire line.

At the office, the carrier signals are demodulated and sent to the computer for comparison. If the difference between the deflection for the two ends of the same axle exceeds a certain preset level, an automatic alarm is initiated. This differential is adjustable, and can be set by the railroad to a value which its experience indicates is best. For this test, a 12-mm difference between the left and right-hand journal readings operates the automatic alarm.

Upon the activation of this alarm, a red light is illuminated, and a counter begins counting axles from this point to the end of the train. If



The detector equipment at Edgewood Tower: 1—the supplemental panel for interconnection with the signal system; 2—the pulse processors; 3—the data control unit; 4—power supply; 5—the alarm and counter chassis; 6—the recorder; 7—computer (rear) and carrier receivers (front). Arrangement was specified by PRR.

a second hot box is encountered, a second red light is illuminated and a second counter counts from that point to the rear of the train. Up to four such alarms may be indicated for each side of the train.

On the counter chassis are eight 4-digit counters, two neon indicator lamps, a fuse and a reset switch. One of the indicator lamps indicates if the fuse in the counter power supply has blown. The other neon lamp indicates that the gating carrier signal is being received and is normally lighted. It flashes off as each axle is viewed. The reset switch, a spring return toggle swtich, cancels all alarm indications and resets all the counters to zero. The counters must be reset after the passage of each train.

The automatic alarm system, but not the recorder, includes a system to eliminate the locomotive. This is accomplished by adding a third transducer, the "C" transducer, 66 in. prior to the normal pair of transducers. The automatic alarm system is disabled until the magnetic flux of both the B and the C transducer is interrupted simultaneously. This 66 in. is the wheel base of the standard freight car truck; locomotive trucks have a longer wheel base. This system also eliminates most passenger car trucks. However, there are a few six-wheel passenger car trucks that have a 66-in. wheel base between the center and end axle. Once the locomotive eliminator is tripped, the alarm system is operative for the rest of the train regardless of truck wheel base. The recorder operates continuously for each train and is not affected by the engine eliminator circuit.

Both front and back contacts are available on the rear of the counter chassis so that the alarm may be connected to any external device the railroad may desire. The PRR has utilized these contacts to interconnect to the signal system. Upon activation of the automatic alarm, a bell rings and signal 34L, which is normally controlled from Edgewood tower, is set to stop. An intermediate signal gives the engineer an approach indication. A light is also illuminated on a small panel which the PRR attached to Servo's office rack. A switch on this panel silences the bell until another hot box is detected, whether in the same or another train. Signal 34L is restored by pushing a button on the PRR panel.

The supplemental panel also contains a passenger train cancellation button and light. This equipment is operated for each passenger train routed over the hot box detector because of spurious response of the equipment to escaping steam and the speed of the passenger trains. The passenger train cancellation will cancel only the hot box detector control of the wayside signal, all other features will operate for passenger trains.

The passenger train cancellation button is to be operated until the associated light is illuminated. While the button is depressed the graph of the hot box detector in the office at Edgewood will indicate a 60-cycle record on both pens. After the associated light is illuminated the button is released. This light indicates that the hot box detector control of the wayside signal is canceled. The signal control cancellation is annulled when the train passes the home signal 34L and the equipment is restored to normal automatically, ready for the next train, the associated light being extinguished.

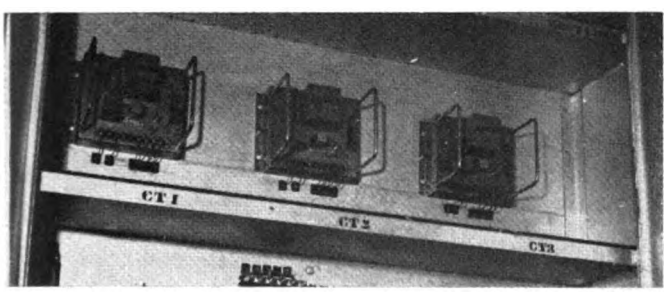
When the hot box detector control of the wayside signal is canceled all the alarm functions will operate, the graph will operate normally, the wheel counters will operate and the audible alarm which the railroad provides will function upon a hot box detection. The decision as to inspection of passenger trains will result from a reading of graph.

The trackside bolometers have been improved with the addition of a thermostatically controlled heater element. By reducing the temperature variation within the housing, more uniform recordings are obtained. The Pennsylvania has designed a foundation for the detector heads made of angle iron. Having a much smaller contact area with the ballast than wood or concrete, the iron foundation is less likely to be moved out of alignment if the ballast shifts. Long bolts extending from the foundation allow for track raises (the PRR is planning one at this location soon) and slots in the boiler plate on which the heads are mounted allow for lateral and angular adjustment.

The arrangement of equipment at Edgewood is that desired by the Pennsylvania. The computer and the recorder could be mounted at the wayside with only the alarm chassis and the carrier receivers at the office location. Another adaptation would be to locate the counters adjacent to a special wayside signal. The automatic alarm would set the signal to stop and the train crew could check for the location of the hot box themselves. In this case, the counters could be reset automatically by a track circuit or transducer as the train resumed movement.

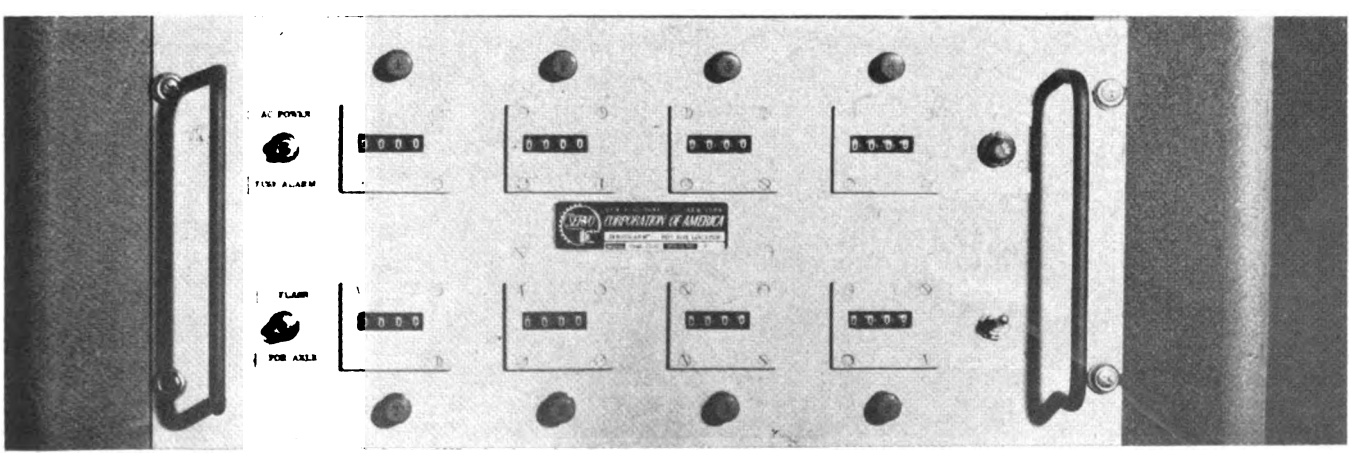
While the alarm could be used without the pen recorder, Servo Corp. engineers strongly recommend that a recorder be included somewhere in the system, if only for occasional checking by maintenance men. The recorder facilitates trouble shooting and preventive maintenance. In this installation, the tape is checked for journal heat abnormalities that have not reached the alarm level.

The hot box detectors continue to prove themselves valuable assets to train operation. One signal engineer attending the demonstration at Edgewood described the following incident: The detector had indicated an overheated journal and the train had been stopped. As the trainmen arrived at the indicated car, but before the journal box lid could be raised, the axle sheared off before their eyes. While braking the train to a stop put an added strain on the bearing, it would be speculative as to how much farther the train would have gone without stopping before a serious derailment would have resulted. This road now has nine detectors in service and four more are on hand ready to be installed.



The three carrier transmitters in the case at the detector site.

The PRR's angle iron foundation. Long bolts allow for track raise.



A close up view of the alarm and counter chassis. Toggle switch at the lower right resets all the counters to zero.