COMBAT–A New Block System Using Microwave Balises for Train Detection

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INTRODUCTION

Track circuits that are normally used for train detection sometimes fail to detect a train due to the rust or dirt on the rail surface, and must be adjusted against the changes in the leakage conductance. Therefore, we have developed a non-contact type train detection unit that uses microwaves and used it to compose a train control system that centralizes the interlocking and blocking functions along the entire route as a comprehensive interlocking system, which is called the COMBAT (COmputer and Microwave Balise Aided Train control) system.

SYSTEM COMPOSITION

The train detection unit of COMBAT is composed of a balise detector (interrogator, wayside responder, and onboard responder) and a train detection logic operator that processes the information sent from the interrogator (Fig. 1). The interrogator and wayside responder are installed at the boundary between detection sections. Each train has two onboard responders, one at the head and the other at the tail. As the interlocking and blocking system to control train operation, the train control center is equipped with a central interlocking unit, and each station with interlocking terminals to control signals, turnouts, and other local devices (Fig. 2).

SUMMARY OF FUNCTIONS

Entry of a train into the detection section is detected when the train breaks the closed loop for radio communication between the interrogator and wayside responder. This function ensures safety even when a component has failed, since the failure composes the status that the loop has broken. Entry/exit of a train is judged by the close/open status of the loop, identification of the train based on the information sent from onboard responders, and the detected-train-movement direction. Unlike the conventional track circuits that detect only the existence (0) or non-existence (1) of a train, the new system tracks trains based on the ID specific to each train to improve the safety and reliability of train detection. The interlocking and block functions have also been improved, as the train ID acquired by the train detection unit is used for train operation control.

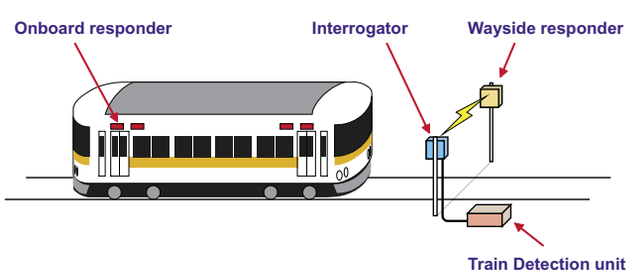

Figure 1. Train detection system.

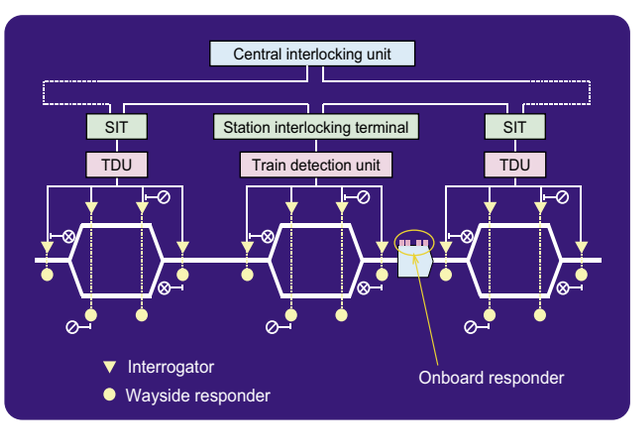

Figure 2. Basic system configuration of COMBAT.

TESTS AND EVALUATION

The COMBAT system has been subjected to long-term monitoring tests on three revenue service lines of Japan Railways (JR) and other railway companies (Figs. 3 and 4). In these tests, it correctly detected about 220,000 trains without exception. It also showed satisfactory performance in safety analyses and tests. A non-JR expert committee also judged that there were no problems in its practical use. Thus, railway operators are now discussing its introduction into service lines.

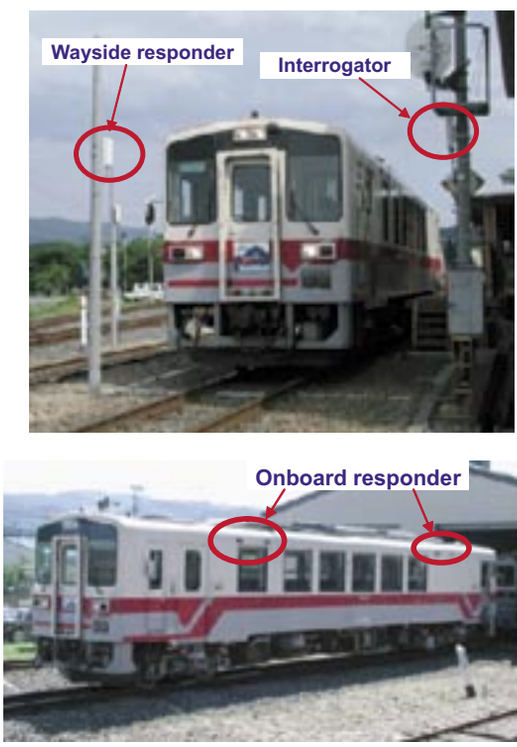

Figure 3. Field test.

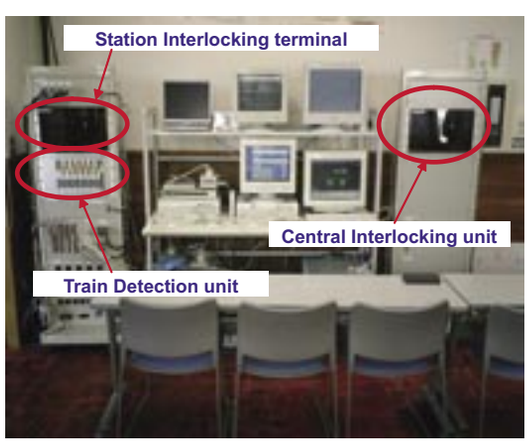

Figure 4. Center and station equipment.