## *Chicago & North Western Has . . .*

# Unique Hump Cab Signal Controls

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**Three hump engines at C&NW's Proviso yard near Chicago are equipped with cab signals that are controlled by alternating current fed into the rails toward the rear of the engines. Equipment is the same as that in the continuously controlled train control system in service on the 488-mile, double-track, Chicago-Omaha mainline.**

ON MAINLINE TRACKS, on many railroads including the C&NW, cab signals are controlled by energy in the rails, fed toward the locomotive in the direction opposite to that in which the train is headed. Obviously this practice cannot be used to control cab signals on "hump" engines which are being used to push cars from receiving yards up to the hump in gravity classification yards, because the cars are shunting the track ahead of the locomotive.

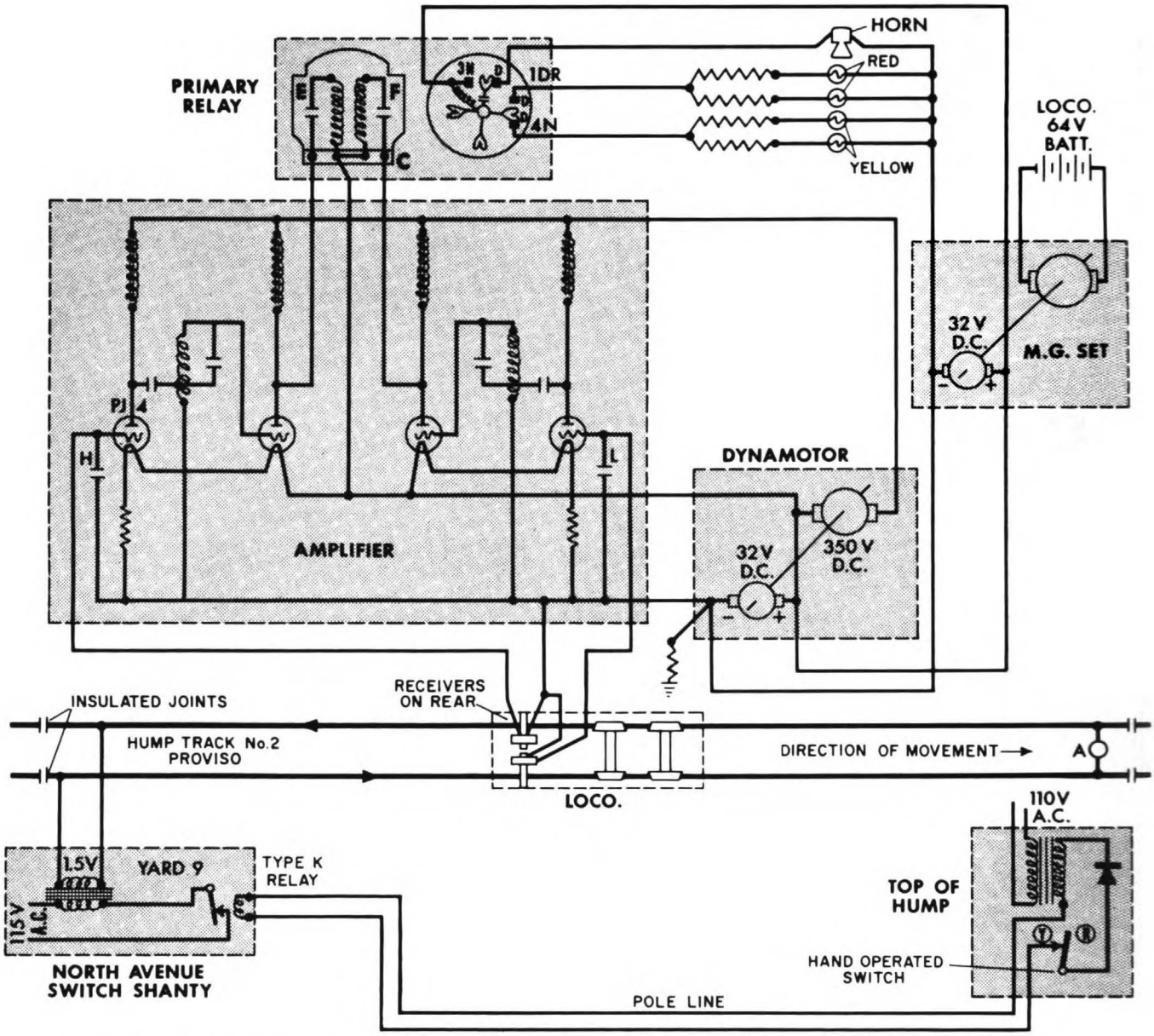
In some yards, cab signals, used for directing operation of the hump engine, are controlled by a wayside-to-engine inductive system, in which frequencies, in a wire along the wayside near the track, are used inductively to control receiving equipment on the locomotive, thus controlling the cab signals without the use of track circuits.

Since 1925, the C&NW has had General Railway Signal Co. continuously controlled train control, including cab signals and automatic application of brakes, on 488 miles of double-track main line between Chicago and Omaha. On three locomotives used to push cars eastward from the receiving yard up to the hump at Proviso yard near Chicago, we have applied cab signaling, using equipment which in part is the same as that on the main line. An important exception is that the receiver coils are mounted behind the rear wheels of the locomotive, rather than ahead of the leading wheels. Also, a new feature is that these coils are

**YARDS WITH CAB SIGNAL EQUIPPED HUMP ENGINES**

| Railroad | Location | Name of Yard | Year Installed |
|---|---|---|---|
| IC | Hazelcrest, Ill. | S. B. Markham | 1950 |
| L&N | Nashville, Tenn. | Radnor | 1954 |
| PRR | Conway, Pa. | E. B. Conway | 1955 |
| SAL | Hamlet, N.C. | Hamlet | 1955 |
| CMStP&P | St. Paul, Minn. | St. Paul | 1956 |
| SP | Eugene, Ore. | Eugene | 1956 |
| PRR | Conway, Pa. | W. B. Conway | 1956 |
| CB&Q | Chicago, Ill. | Cicero | 1957 |
| L&N | Atlanta, Ga. | Hills Park | 1957 |
| P&LE | Youngstown, Ohio | Gateway | 1957 |
| StL-SF | Memphis, Tenn. | Tennessee | 1957 |
| SOU | Atlanta, Ga. | Inman | 1957 |
| NYC | Elkhart, Ind. | Robert R. Young | 1957 |
| AT&SF | Chicago, Ill. | Corwith | 1958 |
| L&N | Birmingham, Ala. | Boyles | 1958 |
| StL-SF | Tulsa, Okla. | Cherokee | 1959* |
| B&O | Cumberland, Md. | Westbound | * |
| B&O | Cumberland, Md. | Eastbound | * |
| MP | Kansas City, Mo. | East | * |
| MP | Kansas City, Mo. | West | * |
| CN | Montreal, Que. | Cote de Liesse (primary) | * |
| CN | Montreal, Que. | Cote de Liesse (local) | * |

* Under construction




**Circuit diagram for hump engine cab signal controls at C&NW's Proviso yard near Chicago.**

fed by a.c. energy in the rails to the rear of the locomotive. This track circuit energy is fed eastward toward the rear of the locomotive from a wayside location at Yard 9, about one mile west of the hump. This distance is more than the length of the locomotive plus the maximum number of the cars to be pushed up to the hump. While the locomotive is pushing cars up to the hump no other locomotive or cars occupy the section of track on this lead track between the track circuit feed location and the hump.

The cab signal on the hump engine normally indicates "red" for "Stop" or "Stand." It can be controlled to indicate "yellow" for "Start humping" or "Continue humping at normal speed." This cab signal is controlled by the hump conductor at the crest of the hump. On his desk he has a circuit controller, which has a handle that operates to two positions. When the handle is in the normal position the circuit is open, which indirectly causes the cab signal to display the red aspect.

### *Humpmaster Controls*

When the humpmaster throws the handle to the reverse position a circuit is thus closed to put 6 volts d.c. on a line circuit extending west one mile to the wayside instrument case at Yard 9. This energizes a 50-ohm type K, 4-point neutral relay in the wayside case. Through front contacts of this relay, a.c. is fed eastward on the rails toward the hump. This is 60-cycle a.c., adjusted to give about 1 volt, 0.8 amp at the crest of the hump, when no locomotive or car is on the track circuit between the feed end and the hump. An a.c. ammeter is installed permanently at the hump to read this current periodically. The rail joints on this track are bonded, and insulated rail joints are in service

at the two ends and at one crossover.

When the humpmaster throws his controller handle to the reverse position, a.c. feeds eastward on the rails from the Yard 9 wayside location to the rear of the locomotive. This energy in the rails is picked up by coils mounted on the locomotive. This detected energy is amplified and used to operate relays that indirectly cause the yellow aspect to be displayed in the cab of the locomotive. This is the indication to the engineer to proceed at normal humping speed. The locomotive equipment described was originally furnished by the General Railway Signal Co. for use in conjunction with a continuous inductive single-phase train control installation.

### *Circuits on Locomotive*

The locomotive circuit consists of two receivers, an amplifier, a dynamotor and a primary relay. Each receiver consists of a coil with its laminated core and pole pieces. One receiver is mounted over each rail, at the rear of the locomotive and approximately six inches above the rail. In this position each receiver is in the field of the rail alternating current.

The amplifier has four PJ4 tubes and has two distinct phases, each phase having two stages of amplification. The amplifier assembly is mounted in the equipment case and has a suitable terminal board. It is supported on four corner posts bolted into the bottom of equipment case. Two condensers H and L are used for tuning the receiver coils, the terminals of which are brought to the amplifier board and applied to the grid circuits of the pliotron tubes. Briefly, the operation of this type of amplifier depends upon the well known characteristics of the vaccum tube or pliotron. This device consists of an evacuated glass bulb containing three elements, namely, a filament, a grid and a plate.

The amplifying characteristic of such a device is due to the fact that a relatively small voltage and practically no energy applied between the grid and filament will control, through a wide range, the current in the plate circuit. Since the plate circut current is supplied from a plate battery or generator, it can thus furnish a useful current, fluctuating in response to the variations in voltage impressed on the grid circuit. Therefore a device such as a relay coupled to a plate circuit can be made to respond to the voltage impressed on the grid circuit.

Each receiver is arranged to excite one phase of the two-phase amplifier. Each phase of the amplifier energizes one phase of the two-phase primary relay.

Thus, when 60-cycle current flows down one rail and back the other under the receivers, each phase of the primary relay is properly energized so as to cause clockwise rotation of the moving element and thus display a yellow indication.

It is to be noted that current down one rail only, or down both rails in parallel will not operate the primary relay and, therefore, will not display a yellow indication.

The primary relay comprises a case or housing which contains the two-phase induction motor element. The rotor of this motor element is mounted on a vertical shaft, and by suitable gearing operates the contact bar or cross so that the contact tips are made to engage or disengage the fixed contact members carried in the upper portion of the relay.

The moving elements of the relay are designed to be immune from such vibration as may reach the relay. By means of compression springs, the moving element is biased to assume the deenergized position, in which position the relay enforces a restrictive indication.

### *Energy for Primary Relay*

The energy for operating the relay is brought from the amplifier to the four terminals on terminal block C. The upper pair of terminals supply one phase and the lower pair supply the other phase of the relay winding. Condensers E and F, mounted on the relay case, are provided to tune each phase of the relay.

The circuits to be controlled by the relay are brought to the terminals D, which are internally connected to the various portions of the contacting elements. The d.c. energy used in connection with the amplifying apparatus is supplied primarily from the locomotive battery which lights the filaments of the pliotrons and drives a dynamotor.

This piece of apparatus operates on 32 volts d.c. and furnishes the energy for the plate circuits of the amplifier at approximately 350 volts d.c. The dynamotor is mounted on a bracket in the mechanism case and is removable as a unit.

The locomotive secondary circuit begins at the contacts of the primary relay. When the moving element of the primary relay is in the deenergized position, contact 1DR is made, feeding 32 volts d.c. out through two resistors and globes. The lamps are behind a red glass which provides a red indication in the cab meaning to "stop" or "stand." When the moving element is in the energized position, contact 1DR is opened and the red light goes out and contact 4N is made, feeding 32 volts d.c. out through two resistors and lamps. These lamps are behind a yellow glass which provides a yellow indication in the cab which means to "start humping." When the moving element moves to the energized position from the deenergized position or vice versa, contact 3N makes momentarily which feeds 32 volts d.c. out to an audible horn. Therefore any time the indication changes, attention is called to the engineer by this audible means. This eliminates the necessity of his watching the visual indicator continuously.

## About the Author

Mr. Legg, a native of Chewelah, Wash., is a graduate of Iowa State College. He began with the Chicago & North Western in 1928 as an electrician. In 1947 he was appointed electrical supervisor, automatic train control, for the system and in 1951 electrical engineer—equipment. Mr. Legg designed the automatic train control system used on C&NW Budd RDC cars and is the inventor of a number of electrical and safety devices for railroads. He is vice-chairman of the Committee on Application of Radio and Communication Systems to Rolling Stock, Electrical Section, AAR.