Color-Light Signals Replace Semaphores on Union Pacific

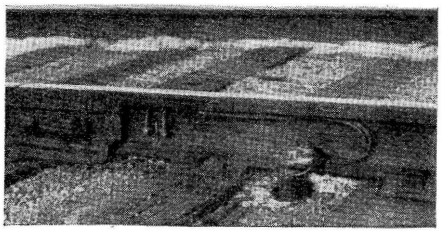
The color-light signaling is, in effect, practically a new installation

Change made on 45 miles of double-track involves replacement of two-position lower-quadrant signals with three-aspect light signals respaced to provide adequate braking distances—Special two-yellow grade signals used

ON THREE separate sections of double-track main line, totaling 45 miles, the Union Pacific has reconstructed the automatic block signaling by replacing the two-position lower-quadrant semaphore signals with three-aspect color-light signals and respacing the locations to provide adequate braking distances.

The first two sections, where the signaling has been reconstructed, are located between Waterloo, Neb., and Ames, 20.5 miles, and Richland, Neb., and Columbus, 7.0 miles. The traffic on this territory includes 18 passenger and about 18 freight trains daily, and some of the passenger trains are scheduled to follow on comparatively close headway. These sections are on territories of the Union Pacific where second track was first constructed, the two-position, single-arm, lower-quadrant signals having been installed in 1905. These single-arm signals were spaced on the average for a block length of 1.25 miles, a single-arm distant signal being located 2,700 ft. in approach to each home signal. In the years following 1905, when the second track was extended on the remainder of the line between Omaha, Neb., and Ogden, Utah, two-arm lower-quadrant semaphore signals were installed with the blocks a mile or more in length, the distant signal arm for a signal arm thus being full-block length from its home signal.

As the distant signals were only 2,700 ft. from the home signals on the three sections installed prior to 1905, it was decided during 1936 that this distance of 2,700 ft. was not adequate to provide proper train stopping distance for some of the faster schedules of passenger as well as freight trains, especially during stormy weather when the enginemen did not get much pre-view of the signals as they approached.



Special construction of rail connections

It would have been possible to install a second arm on each home signal and then eliminate the distant signals as separate locations. However, the estimated expense for such a change closely approached the cost of installing color-light signals throughout to replace the semaphores, and furthermore, the new light signals gave the advantage of better indications as well as more reliable operation with less maintenance.

Making the Change-Over

The changes were so extensive that the color-light installation, when completed, represented practically new construction throughout; in fact, more work was involved than installing signals on a line not previously equipped, because considerable temporary work was required to keep the old signals in operation until the new signals could be cut in for each block.

On account of the respacing, a total of 18 new signal locations were established. The concrete foundations required at these locations were pre-cast in the shop at Omaha and set in place

with a power derrick. The instrument cases, masts and signal heads required at these locations were readily installed and wired complete with no interference with the existing semaphore signals. However, where an existing semaphore location was to be converted to a color-light signal location, the task was not so easy. At such a location, a new mast of the proper length was assembled together with the color-light signal head. Relays for the control of the signal were set up temporarily in a portable box outside the case or on a platform on the ground, and then connected into the circuits, at the same time cutting off the wires and removing the old relays. A gin pole and tackle were then used to remove the old mast complete with semaphores, and the new mast with the light signal head was set in place and the wires were then connected to cut it in service. Such a change-over usually required about 30 min. and was timed so as not to interfere with any of the train movements.

The old Style B mechanism was then removed from the upper section of the case, which left this compartment to be cleaned, painted and completely rewired as the relay housing for the new light signal location, the lower section, formerly used for relays, being used now for battery only. The program was co-ordinated so that the signals between certain stations could all be changed over from semaphores to color lights on a certain date, and then several days were allowed to complete the case wiring, painting, etc., before proceeding to the next section.

The new color-light signals are the Union Type P-5, using 8-volt, 18-watt lamps, with approach lighting control. A Style L10 light-out relay is connected in series with the lamp in the green unit and is so connected that if the filament in the green unit burns out, the lamp in the yellow unit is lighted. In order to make a distinct difference between interlocking home signals and automatic block signals, searchlight type signals are used for the home and distant signals at interlockings. These searchlight signals are equipped with double-filament lamps 13-3.5 watt ratings at 8 volts. The line relays are 250-ohm and the track relays 4-ohm. All the new relays are the DN-12 type.

As a part of the reconstruction, underground cable was installed. For track connections, No. 10 single-conductor was used, with a Raco parkway bootleg No. 420-1 and No. 712 Keystone rail connectors. For rail connections at switch shunts, No. 6 single-conductor was used. The conductors in these cables have a 5/64-in. wall of insulation and the outer cable protection includes tape, two layers of jute and underground finish, no metal being used. The control circuits extending under the track from one case to another are in standard No. 10 bronze-taped cable.

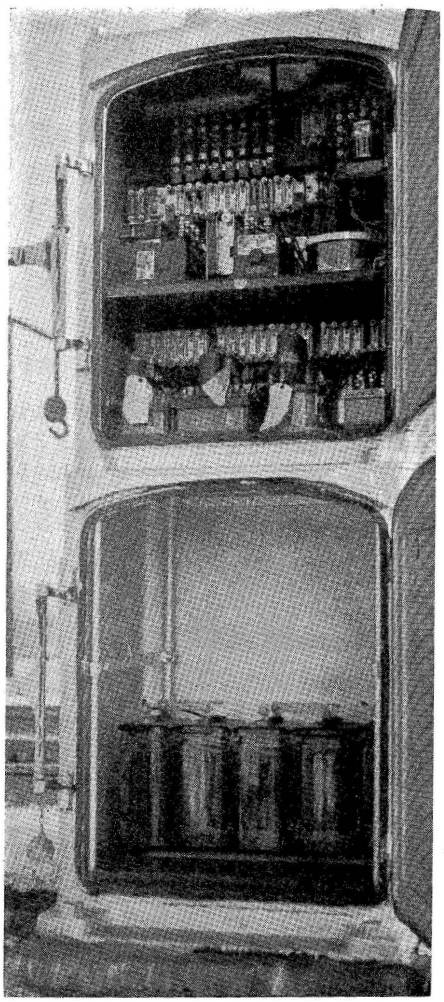
Pole Line Construction

With the old single-arm signaling, distant signals only were line controlled; so that a pole line was in service only on the sections from each distant signal to its home signal. Furthermore, in the previous arrangement, the signals and line circuits were fed from a portable storage battery, which was changed out at regular intervals and charged at a central station. Each track circuit was operated by three cells of Edison primary battery.

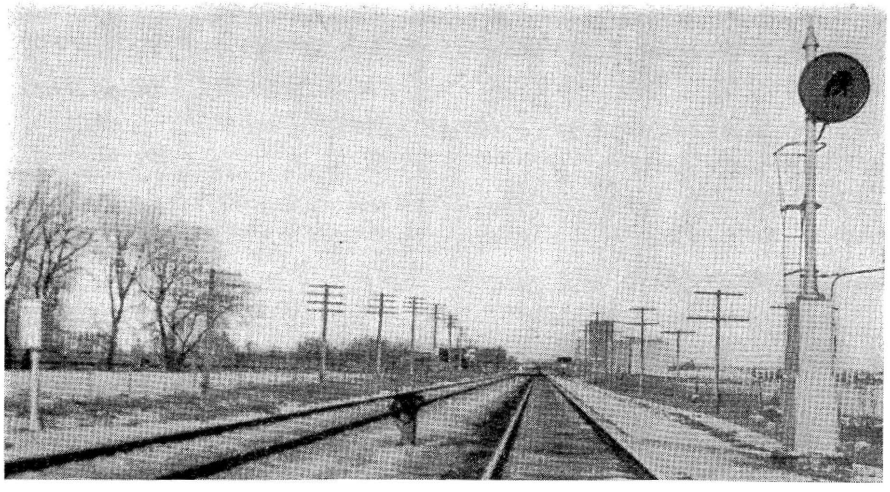
The new color-light signals are controlled by relayed track sections for the control of the immediate block, that is, for the control of the red aspect. The control of the green and yellow aspects are accomplished by a line control relay, thus requiring sections of new pole line from each home signal to the next distant signal. Furthermore, it was considered that an a-c. power line was necessary to feed the color-light signals. Therefore, in order to provide for line control circuits and an a-c. feed distribution circuit, a pole line was constructed. Such portions of the old short sections of line as were in good repair were left in place.

New 25-ft., Class 5ASA, 6-in. to 7-in. top, poles were set 36 to the mile for the new line. These poles are southern pine treated with creosote, 8-lb. retention to the cubic foot, using the Rueping process. A 4-pin upper crossarm is used for the a-c. power line and an 8-pin lower arm for the control circuits. Bare copper wire, No. 6, run on O-B top groove porcelain insulators, is used for the 2,300-volt power distribution circuit. The control line circuits are on No. 9 bare Bethanized galvanized iron wire, on porcelain insulators.

Through the yards at Fremont, Neb., there was no right of way space available for a new pole line and, therefore, 1,500 ft. of standard under-



The old mechanism cases were used for housing relays



Searchlight type signals are used for interlocking home and distant signals to distinguish them from automatic blocks

ground nine-conductor No. 14 bronze-taped cable was installed.

At each signal location or track cut, a 2,300-110 volt, 100-v.a. General Electric air-cooled line transformer is mounted on the pole, together with G.E. low-altitude arresters. Western Railroad Supply Company neon arresters, mounted in the instrument cases, are used for the protection of incoming line circuits. Copperweld ground rods, 5/8 in. by 6 ft., are used at the line poles as well as at the cases.

A set of 4 cells of lead storage battery rated at 84 a.h., on an 8-hr. rate, is used at each location to feed line and lighting circuits. This battery is on floating charge through an RT-21 rectifier. Each track circuit is fed by 3 cells of Edison 500-a.h. primary battery across which an RT-A10 rectifier is connected, adjustment being made so that the battery normally discharges at only about 18 m.a. Under the previous arrangement with no rectifier, the track battery in this territory had an average life of about five months, but with the automatic rectifier connected as explained above, the estimated life, based on tests made at other locations, will be four years or more.

The reconstruction work on the 20.5 miles from Waterloo, Neb., to Ames, and the 7 miles from Richland, Neb., to Columbus, was handled by signal forces of the Union Pacific, a line crew of 18 men being employed about one month and a signal crew of 21 men about 13 weeks.

Rawlins to Riner Territory

On the 18 miles of double-track main line between Rawlins, Wyo., and Riner, single-arm lower-quadrant signals were replaced with color-light signals, following the same methods of construction as explained above, with some few exceptions. Ruling ascending grades range up to 0.82 per cent, extend throughout the major portion of this Rawlins to Riner territory. For this reason, it was decided that the signals located on ascending grades of more than 0.5 per cent should be equipped with a special aspect to authorize trains to proceed past such signals at restricted speed, although the signal was displaying its most restrictive aspect as displayed in normal operation. Under such conditions, the Union Pacific did not consider it advisable to use a grade marker to qualify the red aspect of the signal because this road did not want its enginemen to learn to disregard a red light or in any way to impair the significance of a red light as a stop aspect. In line with this reasoning, the Union Pacific installed an additional Style R2 color-light unit with a 20-in. background, mounted on the mast of the signal about 18 in. below the main color-light signal.

This extra light unit is equipped with a yellow roundel, the lamp being normally extinguished, when the main signal is displaying the green aspect indicating that two or more blocks are unoccupied. Likewise, the lamp in this extra unit is extinguished when the main signal displays yellow, indicating that the second block is occupied. However, if the immediate block ahead of the signal is occupied, the lamp in the yellow unit of the main signal is lighted in combination with the lamp in the extra yellow unit, thus giving an aspect of yellow over yellow, which indicates to the engineman that the immediate block is occupied, a rail is broken or a switch misplaced, etc., but that he is authorized to proceed past the signal without stopping and to continue at slow speed prepared to stop short of train or obstruction. A light-out relay is connected in series with the lamp in the green unit, so that if the green light burns out, the upper yellow lamp will be lighted. If the filament in either lamp of the yellow units is burned out, the lamp in the red unit of the main signal will be lighted and the remaining yellow lamp will be extinguished, thus leaving a single red light as a stop aspect requiring the train to stop before proceeding, the same as applies on automatic block territory on double-track where grades are not involved.

The signal work explained in this entire article was planned and installed by signal department forces of the Union Pacific, the major items of signal equipment being furnished by the Union Switch & Signal Company.

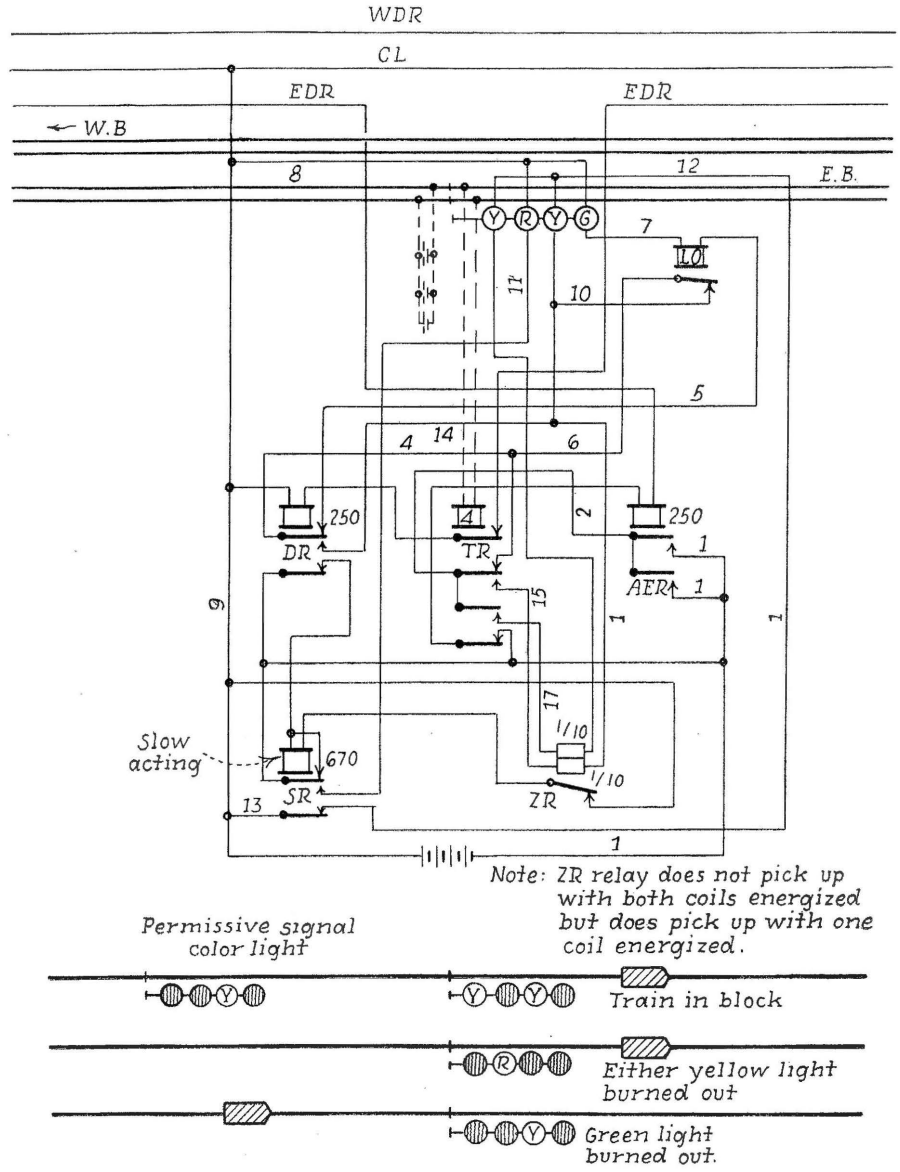


Diagram of circuits for the special control of the grade-signals using double-yellow aspect