Flashing-Yellow As A Fourth

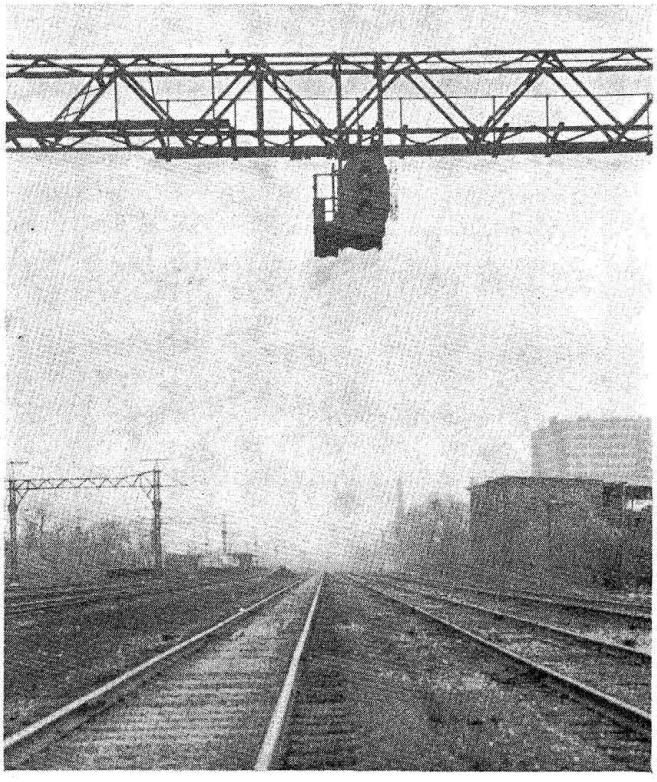
Existing color-light signals at same locations used to form three-block four-aspect system. Minor circuit changes and small amount of additional equipment were required

FOLLOWING tests and developments for more than a year, the Illlinois Central made application and received approval of the Interstate Commerce Commission, Bureau of Safety, to use flashing-yellow as a fourth aspect on automatic block signals. As shown on the accompanying diagram, with automatic block A occupied by a train, the automatic signals, to the rear of the occupied block, display, in the order named, steady burning red for the most restrictive aspect, steady burning yellow for Approach, flashing-yellow for Advance Approach, and steady burning green for Clear. Thus the flashing-yellow aspect is introduced into the existing single-light standard aspect arrangement.

The changes and additions to provide the flashing yellow have been completed and placed in service on 30 miles of double-track signaling between Central Station, Chicago, and Matteson, Ill., and other installations are to be made from time to time as required on other sections of the railroad.

On the Chicago Terminal division of the Illinois Central, new color-light automatic block signaling was installed in 1926. Throughout this territory of 30 miles, extending from the Central Station at Twelfth street to Matteson, Ill., two main tracks are assigned for use by high-speed through passenger trains. The daily traffic includes 27 southbound and 25 northbound passenger trains, and a few high-speed through freight trains. Throughout the greater portion of this territory, the tracks are elevated, so that there is no grade crossing with a street or highway and no crossing with another railroad. Interlockings are in service at several important junctions and crossover layouts, such as at 51st street, 67th street, Kensington and Homewood. As the years passed, train speeds were increased to a maximum of 75 m.p.h., except for a few miles at the south end of the territory where the speed is 80 m.p.h. The train-stopping distance for these trains is 5,280 ft. from 75 m.p.h., and 6,000 ft. from 80 m.p.h.

Throughout the territory, the three-aspect color-light signals, when installed in 1926, were mounted on overhead bridges, which were spaced approximately 4,500 ft., which provided adequate stopping distance for trains operated at 60 m.p.h., the maximum speed at that date. This spacing, however, was not in conformity with stopping distances for trains operated at speeds of 75 m.p.h.



Typical four-aspect color-light bridge signal, governing northbound train movements near 55th street, in Chicago

Why a Fourth Aspect Was Needed

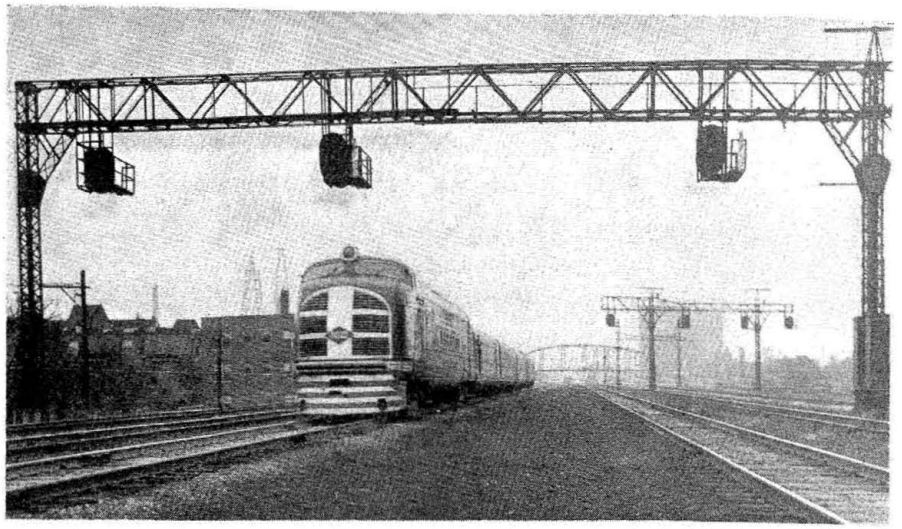
Changes to cause the steady-burning yellow Approach aspect to be displayed on two successive signals in approach to one displaying the red aspect, would, in accordance with the rules, require trains to operate through two blocks in accordance with the Approach indication, thus wasting train time and spacing the trains so far apart as to reduce track capacity and cause needless delays at certain points.

The problem could not be solved by removing every other signal because the blocks would have been too long and would not have been properly arranged to permit adequate track capacity and flexibility of train operation, especially in the vicinity of interlockings and stations such as at Woodlawn, 63rd street. Practically all of the through passenger trains stop at Woodlawn station. For example, if one train has completed its station stop and is just getting under way when a following train is approaching to make its station stop, obviously the block lengths and signaling should be such that the second train can approach closely without needless waste of time in making useless reductions in speed or stops. Likewise, a leading train may have reduced speed to diverge at a junction, and the following train should be allowed to keep moving at the highest speed, consistent with safety rather than being required to reduce speed needlessly at some signal a considerable distance away. The addition of a fourth aspect, therefore, was the only practical solution.

To secure a fourth aspect by adding an additional color-light head to pro-

Aspect

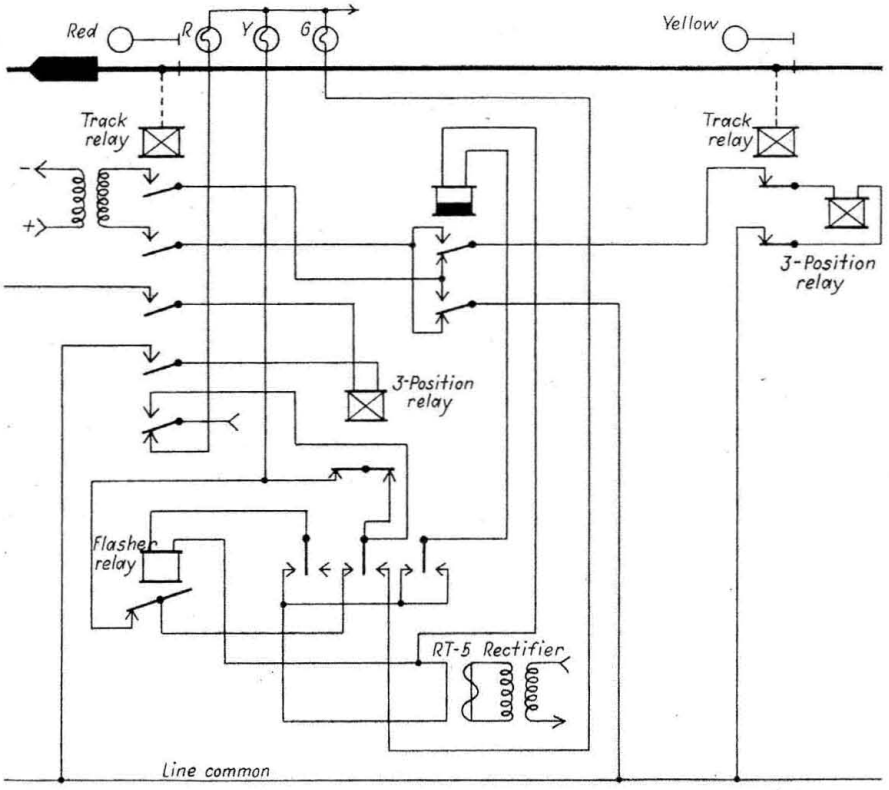
on the I. C.



Northbound "Green Diamond" passing four-aspect signal near 55th street, Chicago

vide aspects, each consisting of a combination of two lights, was not practicable on account of limited clearance and other interference with overhead catenary and power wires of the electrification facilities on this territory. A second reason was that the practice of confining each aspect to one light would facilitate the reactions of enginemen in observing the aspects quickly, minimize confusion on the part of enginemen, and in general simplify the system of signal aspects.

Wherever the distance from a signal to the next one in approach was less than approximately train-stopping distance, the flashing-yellow was provided at the second signal in approach. Checking of the distances showed that the flashing-yellow should be provided at a total of 60 signals on the 30 miles of double track, each track of which is signaled for single-direction operation, right-hand running. The signals are the Style-R with the three-color lamp units mounted in a vertical row. The lenses are of the doublet type, 8⅜ in. in diameter, and each unit is equipped with a double-filament lamp rated at 10 volts, 18 + 3.5 watts.



Control circuits at single location in a-c. territory

Reasons for Advance Approach Rather than Approach-Medium

Code Rule 282A, Advance Approach, shows an aspect of yellow-over-yellow, both lamps being burned constantly. The indication of the new flashing-yellow aspect is Advance Approach according to Code Rule 282A, "Proceed preparing to stop at second signal." What this means to an engineman when immediately in approach to a signal displaying a flashing-yellow aspect, is that he should take action at once to reduce speed sufficiently, so that if he encounters a steady-burning yellow aspect at the next signal he will have adequate distance in which to stop his train before arriving at the second signal which will be displaying a red aspect.

The Advance-Approach indication, Code Rule 282A, "Proceed preparing to stop at second signal" has been applied to this flashing-light aspect, rather than the Approach-Medium indication, Rule 282, "Proceed approaching next signal at medium speed." The flashing-yellow aspect as used on the Illinois Central is, therefore, equivalent to the yellow-over-yellow aspect as shown in the Code and as used on some roads.

One reason for adopting this policy is that the Illinois Central is reserving the yellow-over-green aspect, Approach-Medium indication, Code Rule 282, "Proceed approaching next signal at medium speed," for use on distant signals in approach to home signals displaying the red-over-green aspect, Medium-Clear indication, Code Rule 283, "Proceed; medium speed within interlocking limits." Efficient train operation requires that this arrangement of signaling be used so that trains can be brought up to the home signal and through the interlocking at the maximum speeds for which the high-speed crossovers and turnouts are designed. Use of the Approach aspect rather than the Approach-Medium on the distant signal requires that the engineman be prepared to stop at the home signal, which in such instances introduces unnecessary loss of time or perhaps train stops.

Medium speed is usually defined as

half maximum authorized speed, but not to exceed 30 m.p.h. When braking a train with the conventional service application of brakes, approximately two-thirds of the total stopping distance is required to reduce from maximum authorized speed to medium speed, 30 m.p.h. In order to comply with the requirements of the Approach-Medium, Rule 282, an automatic block governed by an Approach-Medium aspect must be as long as at least two-thirds of the total maximum train-stopping distance.

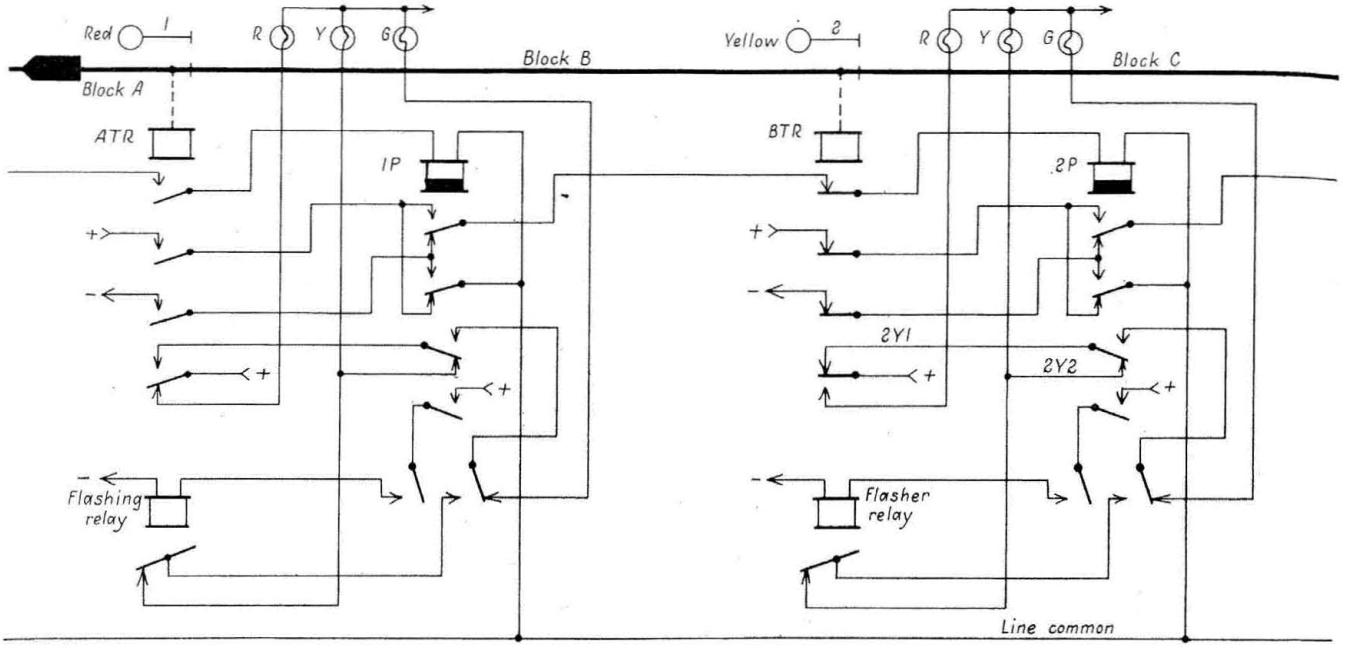
For these reasons and aside from the desire to reserve the Approach-Medium aspect for use only at signals in approach to interlockings, the Advance-Approach has certain advantages are compared with the Approach-Medium for use on straightaway automatic block signaling. Not necessarily as applied to the Chicago Terminal territory, but considering the railroad as a whole, and also looking to the future with ever-increasing train speeds, there may be automatic blocks shorter than two-thirds train-stopping distance, and the signals are required as located to provide protection and flexibility of train operation at locations such as passing tracks, station layouts, etc.

With the Advance-Approach indication, the length of a block need not necessarily equal as much as two-thirds maximum train-stopping distance, but rather the Advance-Approach applies to two successive blocks, the total of which is at least maximum train-stopping distance. Short blocks, where required, can, therefore, be used with safety and with the advantage that trains can be kept moving at the highest speeds consistent with safety without being required to make unnecessary speed reductions or stops. A conclusion, therefore, was that the Advance-Approach indication is more properly applied to straight automatic block signaling than is the Approach Medium, which on the Illinois Central is reserved for use on signals in approach to interlockings.

Circuit Changes and Additions

On the Chicago Terminal territory straight alternating current signaling including a-c. track circuits and relays are used because of the direct-current propulsion system. Where only one track circuit extends for an entire block length, the red signal lamp is lighted through a back contact of the track relay, the yellow through a front contact of the track relay and one polar contact of an a-c. line-controlled 3-position relay, and the green through a front contact of the track relay and the other polar contact of the 3-position line relay. At each location where the flashing yellow aspect was required, the circuits were modified so that the yellow light burns steady through a neutral contact of the 3-position line relay, and flashes through a polar contact of this relay and a contact of a flasher relay. A new slow release d-c. relay, a new FN-16 d-c. flasher relay, and an RT-5 rectifier were required, the rectifier being necessary to convert the a-c. power to direct current for operation of the new flasher relay and the new slow-release d-c. relay. The slow-release type relay is used so there will be no flash of red when a change is made from yellow to green, etc.

Circuits for the control of four-aspect signaling on d-c. territory have been prepared by the Illinois Central. In view of the fact that the basic principles are the same for both a-c. and d-c. signaling, and, furthermore, d-c. signaling is more extensively used and understood by the readers, the large scale circuit diagram shown herewith is based on the control arrangement for four aspects including the flashing yellow, on direct-current signaling territory.



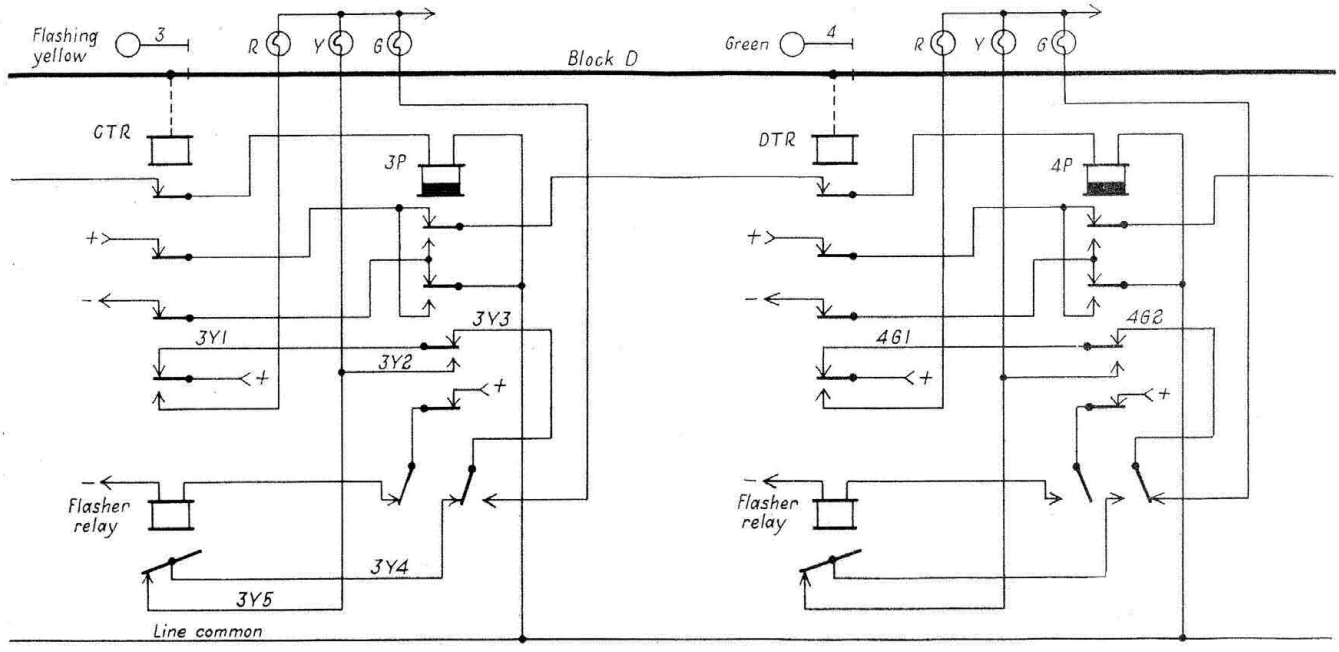
Control circuits at four

This diagram shows one track circuit extending the length of each block, the red lamp of signal No. 1 being lighted by a circuit completed through a back contact of the track relay ATR, for the block A, which is occupied by a train as shown. With track relay ATR released, the control for polar line relay 1P is open, and, therefore, the neutral front contacts of that relay are open, and as a result neither the yellow nor green lamp of signal 1 can receive energy.

At signal 2, the track relay BTR is energized, thus extinguishing the red lamp in that signal. Polar line relay 2P is controlled by a circuit through a front contact of track relay BTR, then energized, then over line, through back contacts of polar relay 1P and through front contacts of track relay ATR, then open because block A is occupied; therefore, relay 2P at signal 2 remains de-energized with a train in block A. Under this condition, the steady-burning yellow lamp in signal 2 is lighted by a circuit from positive battery through a front contact of track relay BTR, wire 2Y1, a back

neutral contact of relay 2P, wire 2Y2 to the filament of the yellow lamp in the signal.

At signal 3, track relay CTR is in the energized position, thus extinguishing the red light. Polar relay 3P is controlled by a circuit through



locations in d-c. territory

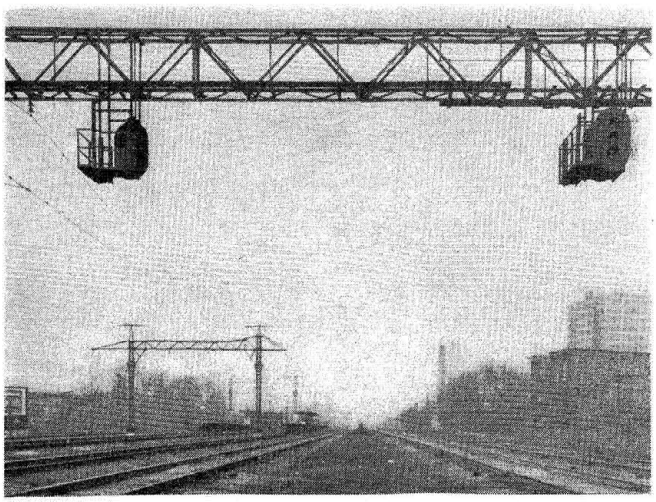
a front contact of track relay CTR, then energized, over line and through back neutral contacts of polar relay 2P, then de-energized, and through front contacts of track relay BTR which is then energized, thus polar relay 3P at signal 3 is energized to close its neutral contacts and to position its polar contacts to the left, as shown in the diagram. The result is that positive battery feeds through a front contact of track relay CTR, on wire 3Y1, through a front neutral contact of relay 3P, wire 3Y3, a left polar contact of relay 3P wire 3Y4 through contacts in the flasher relay, on wire 3Y5 to the filament of the yellow lamp in signal 3. Steady energy cannot feed to the yellow lamp because wire 3Y2 is connected to a back point of the contact in 3P which at that time is energized. Under this setup, if the flasher relay fails to oscillate, steady energy is furnished to the yellow lamp.

At signal 4 track relay DTR is in the energized position, thus extinguishing the red lamp. Polar line relay 4P is controlled by a circuit through a front contact of track relay DTR, over line and through front contacts of relay 3P, then energized, and through front contacts of track relay CTR, then energized. Thus the circuit for polar relay 4P is complete, and the fact that polar relay 3P is energized causes the polarity of the feed to relay 4P to be such that the polar contacts of 4P are positioned to the right and the neutral front conacts are, of course, closed. The result is that the steady-burning green lamp of signal 4 is fed by a circuit starting with positive battery through a front contact of track relay DTR, wire 4G1, a front contact of relay 4P, wire 4G2, a right polar contact of relay 4P, to the filament of the lamp in the green unit.

With respect to the circuits at signal 3, as shown in the diagram, notice should be taken of the fact that the operating circuit for the flasher relay is controlled through a separate "left" polar contact of relay 3P; therefore, the flasher relay operates only when circumstances are such that the flashing-yellow aspect is to be displayed. Where approach lighting control is in effect, the flasher relay would not operate, and the lamps would not be illuminated, unless a train is approaching.

Each flasher relay is adjusted to flash the yellow lamp 40 times each minute, the filament being illuminated 0.7 sec. and extinguished 0.8 sec. for each flash. Up to the present, this timing of the flasher aspect seems to be satisfactory, but further studies are being made to determine whether more frequent flashing, or more "on" time compared with "off" time of each flash would be desirable from the standpoint of enginemen "catching" the aspect more quickly.

On multiple tracks, one flasher relay can be used in the control of the flashing aspect for as many as four signals. In order to avoid the continuous operation of flasher relay as an Advance Approach signal to an interlocking home signal or any other signal normally at Stop, the flasher relay control circuit is operated through an approach track circuit.



Two typical four-aspect automatic signals governing train movements on the two main passenger tracks