as all three of the tracks are operated in either direction by signal indication.

Next in order is the operation in either direction of both tracks of double-track roads by signal indication. The most notable example of this is the double-track section of 119 miles on the Chicago, Burlington & Quincy, described previously. Both tracks are provided with automatic block signals for operation in either direction. Fast trains may easily run around slow moving trains. Other notable installations are as follows: Chesapeake & Ohio, six double-track sections with a total length of 40 miles; Illionis Central, a 20-mile section adjacent to its three-track section; Pennsylvania, the line between New York and Manhattan Junction, eight miles; and a double-track section on the Tyrone division of five miles. Either-direction operation on double tracks by train orders is not included in this record.

In certain situations on four-track roads, traffic has taxed the capacity of the four tracks to a point where it has been necessary to operate one or all of the four tracks in either direction. On the Pennsylvania, between from the north and northeast enter the station at New Haven, Conn., through a cut only wide enough for four tracks which handle 254 trains a day. The two center tracks are now operated in either direction for a distance of one mile by signal indication. At Jersey City, N. J., the Erie has a four-track approach to the station for a distance of two miles, on which all tracks are arranged for either-direction operation by signal indication.

The Direction of Train Movements by Signal Indication Without Written Train Orders

Train operation on single track by signal indication is not new as that method was put into successful use in 1882 on the Pennsylvania at Louisville, Ky., for handling the trains on four roads over the Ohio river bridge which was then a single-track structure. The trains in and out of Louisville over the bridge totaled over 150 a day and to direct train movements by time-tables and train orders was difficult, if not impossible, because standard time had not come into use and each road had a different time standard. The difficulties of the situation brought the space interval method into use; six manual block sections were established on the 5 ½ mile, of single track and 2 ½ miles of double track covering the bridge and the tracks approaching it. At present the territory controlled by the signals at Louisville handles a daily movement of 325 to 350 trains. The successful operation of the system for nearly half a century has, no doubt, been due to the fact that trains are operated by block signals.

Another early installation of train operation by signal indication was made in 1889 on the Asheville, Chattanooga & St. Louis in the vicinity of Chattanooga, Tenn. The system covered 4.4 miles of single track and 1.6 miles of double track, divided into three manual block sections, all under the control of the dispatcher at Chattanooga. In addition to making a 100 per cent safety record, the system should have credit for having postponed the construction of a second track, thus saving the interest on the cost and the maintenance charges on the upkeep of a second track for 24 years.

The third installation was made in 1907 on 8.6 miles of single track and 1.6 miles of double track, divided into three manual block sections, all under the control of the dispatcher at Chattanooga. In addition to making a 100 per cent safety record, the system should have credit for having postponed the construction of a second track, thus saving the interest on the cost and the maintenance charges on the upkeep of a second track for 24 years.

The fourth installation, made in 1909 on the Central New England between Highland, N. Y., and Maybrook, was notable as it relieved traffic congestion which at times taxed the train dispatchers to the utmost. The installation covered 13.2 miles of single track and 7 miles of double track, divided into nine controlled-manual block sections. Trains were moved by signal indication without train orders.

The total net saving for the five-year period in interest charges and maintenance, by deferring the double tracking, exclusive of any saving in operating expenses, amounted to $315,000, equal to 44 per cent of the total cost of the double tracking. The signals not only paid their own way, but helped pay for the double tracking.

The fifth installation, the second on the Nashville, Chattanooga & St. Louis, was between Cowan, Tenn., and Sherwood. The installation covered 11 miles of single track and 7 miles of double track, divided into four controlled-manual block sections. Trains were moved by signal indication without train orders.

The sixth installation, made in 1919 on the Chesapeake & Ohio between Cotton Hill, W. Va., and Cauley,
covers four miles of single track, divided into three
controlled-manual block sections.

The seventh installation was made in 1925 on the Mis-
souri Pacific in the vicinity of Kansas City, Mo., and
covers 56 miles of single track with 14 passing sidings.
Train movements are directed entirely by signal indica-
tion under a controlled-manual block system with auto-
matic train control. The daily traffic is 32 to 40 trains.

No claim is made that the results accomplished, in the
cases cited, were entirely due to the signaling, as many
factors usually enter into any improvement in train oper-
ation. This is particularly so on single track where co-
cident with signaling provision is made for better siding
facilities and the operation of siding switches.

Summary

The inherent defects in any time interval method and
the value of the space interval method are evident, as are
also the marked advantages of substituting signal indica-
tion for the train order in directing the movement of
trains. Efficient transportation is largely dependent upon
an efficient direction of train movements and much de-
pends upon the kind of instructions used in directing train
movements. Train orders are written instructions and
must be delivered to the conductor and engineman of the
train. They must be correctly prepared, carefully trans-
mitted, and faithfully delivered. Above all, they must be uni-
formly understood by all concerned, and must not be
forgotten. On railroads not equipped with block signals,
safety of operation depends entirely upon the human

Signal indications are instructions given by the aspects
of fixed wayside signals. Instructions given by signal
indications require less effort in preparation and trans-
mittal than do written instructions. They are delivered
to the engineman from block to block through the me-
dium of the signal. The language of the signal is easy
to understand and difficult to forget. The signal aspects
are few in number and may be regarded as instructions
reduced to the minimum in standard form, and hence,
there is little opportunity for misunderstanding. The
instructions conveyed by the signals are given at the
point where they are to be executed and there is no lapse
of time in which to forget them.

In conclusion, the case of signal indication versus the
train order as the method for directing train movements
may be briefly summarized in three points: (1) The
science of signaling has now developed far beyond the
stage of experiment. Abundant experience has proved
that directing train movements by fixed wayside signals
is both practical and efficient. (2) The construction,
maintenance and operation of a signal system for direct-
ing train movements by signal indication can all be

The testing of caustic soda cells is an important aspect
of battery testing. These cells are used in a variety of
applications, including automotive, industrial, and
marine. The testing of caustic soda cells is crucial for
assuring the performance and longevity of these devices.

The testing process typically involves measuring the
voltage, capacity, and internal resistance of the cells. It
is important to test these cells at regular intervals to
ensure they are functioning properly and to identify any
issues early on. The testing process can be done using
proprietary equipment or by following established
standards and guidelines.

In conclusion, testing caustic soda primary cells is a
necessary part of battery maintenance and performance
verification. Regular testing helps ensure that these cells
are functioning as expected and can help extend their
life and performance.