which they are fastened by means of tarred marlin put on with a spinning jenny.

Where signals are located on the same side of the track as the pole line the wires are run direct from the telegraph poles to the signal, as is plainly illustrated in the view Fig. 8. Similarly in case of relay boxes or indicators on the pole side of the track, these are placed on iron cable-posts and the wires are run directly to these posts. In such cases the lightning arresters are located in a separate compartment provided in the lower part of the relay box. The method followed in cases where the instruments are located across the track from the pole line is clearly illustrated in Fig. 15. The small wooden box, which may be seen at about the middle of the stub pole, contains the lightning arresters, which also serve as terminals. From the lightning arresters the wires are carried in trunking under the track to the instruments.

All lightning arresters used on this installation are the Midget No. 1 type manufactured by Wm. McClintock, St. Paul, Minn. This is a carborundum arrester so arranged that it may be used as a terminal.

In the various illustrations, but especially in Fig. 13, may be seen the method of fastening relay boxes to signal poles. As only two-way relay boxes are used, it is necessary to install two boxes wherever more than two relays are required. Such an application of two boxes may be seen in Fig. 12. Fig. 14 illustrates a signal and a well placed on a fill. In such places sufficient filling is done around them to prevent their settling, and to keep frost from affecting the batteries, and sufficient extra space is allowed to enable the maintainer to place his motor car clear of passing trains.

The various views of the signals also give a good illustration of the number plates which, on the Northern Pacific, are used on all automatic block signals. These plates, which have enameled black letters, six inches high with one-inch bars, on white ground, are made of sheet steel, braced and clamped to the poles.

The arm castings used are of the Loree-Patenall type, with openings for 8⅜-in. roundels. The color indications used are red for "stop", yellow for "caution", and green for "clear". The blades are painted yellow with a black stripe. The signals are all equipped with two Veeder counters, one registering movements from horizontal to 45 deg., and the other registering from 45 deg. to 90 deg., in order that an intelligent record may be had at all times of the performance of each individual signal, as well as of the signal batteries.

The signal lamps are of the Adams & Westlake Company's manufacture, of the "Universal" type designed by Mr. Christofferson. These lamps are provided with openings for two lenses similar to the Adams & Westlake No. 10 lamp for station signals, and are equipped with a shield and glass reflector for one opening and a 5⅜ in. white lens for the other. By simply transposing the lens, shield, and glass reflector, according to requirements, the lamp may be used with the same style of lamp bracket for either upper or lower-quadrant signals, as may be desired. It is fitted with a large-size oil cup and long time socket burner, the chimney for which is made of Corning heat resisting glass.

For maintenance purposes the territory is divided into four maintainer's districts, averaging 25 miles with 44 signals each.

The maintainers are also required to take care of all the signal lamps on their territory, and are furnished with a motor car, and have also a first-class helper to assist them in their work, which arrangement has proved very satisfactory.

During the progress of the work very close inspection was maintained, no piece of apparatus or material being allowed to go in which did not conform to specification requirements. The result is that the installation, both in regard to material and workmanship, is first-class in every respect, and has been borne out by the fact that since these signals were placed in operation practically no failures have occurred, aside from such as are unavoidable on any system.

TRAIN DISPATCHING ON INTERURBAN RAILWAYS

BY C. E. LEWIS.*

The safety of passengers and trains is of the first importance in railroad operation. To accomplish this on single-track, interurban railroads where first-class trains are operated at high speed on frequent schedules, it becomes necessary to have a first-class dispatching system and a book of rules which are plain, brief and cover all points of train movement in such form as to eliminate all chance of doubt as to their interpretation.

Train dispatching covers a wide difference of opinion, and as the American Railway Standard Code is the result of many years of study of experienced and efficient railroad men, it seems to me to be the only one to follow.

Two forms of orders are used on the Rochester interurban lines of the New York State Railways: the train clearance order and the "31" telephone order. Order offices are situated along these lines about 10 miles apart and are positive block stations. Trains cannot pass or leave these stations without obtaining one of these forms of orders. In the absence of other order the train clearance order is used to allow a train to pass a positive block station. It is issued by the dispatcher under a distinct order number and is recorded in the dispatcher's order book with the train number, motor number, time O. K.'d, station receiving and operator's name. The operator, after repeating this order to the dispatcher and receiving the O. K., will hand it to the conductor, who will repeat it to the operator, the operator giving the "complete." Copies are supplied for both conductor and motorman and one is retained by the operator for his record.

When it becomes necessary to make train movements not provided for by the time table the "31" telephone train order is used and is issued in the following manner: The operator at the station where the order is to be placed for the superior train is called and is instructed to copy three or as many as are required. Then the operator at the station where the order is to be placed for the inferior train is called and is given the same instructions. The dispatcher then gives the order number and the addresses of the trains in the order of their superiority. The order is then transmitted and is written in full without abbreviation by the operator. After the dispatcher has transmitted the order and the superintendent's initials, the operator will read it back to the dispatcher without abbreviation. The dispatcher will then O. K. the order if correct and the operator will give his name and order number. The operator will hand the order to the conductor of the train addressed. The conductor will then repeat the order to the dispatcher without abbreviation and when he has finished he will give his name and train number. The dispatcher will complete the order if correct, giving the time and his initials. The order is then in full force and effect, and a copy is given to the motorman by the conductor. The motorman must read his order aloud and without abbreviation to the conductor, the conductor watching closely to see that the motorman repeats it correctly. After the order is fully understood by the conductor and motorman they may proceed.

The requirements where orders are delivered at sidings are the same as the foregoing except that the motorman becomes the operator and receives the order and O. K. from the dispatchers, the conductor getting the "complete" in the usual manner. If, for any reason, the conductor or the motorman does not understand the order, the dispatcher will be notified at once. The responsibility for its correct interpretation must not be assumed and the decision of one must not influence the other.

Twelve different forms with numerous examples and ex-

*Chief Train Dispatcher, New York State Railways, Rochester, N. Y. Paper presented at a meeting called by Public Service Commission, Second District, New York, Syracuse, N. Y., Jan. 19.

planations are given for the transmission of the "31" telephone train order, and these forms must be followed if possible. When a train crew is in doubt as to the correct method of handling an order or wishes to refer to the rules that apply in a particular case, the information is easily found by referring to the forms in the book of rules.

Train dispatching on our lines is a very simple matter when all trains are running on schedule time because our rules prescribe that trains in either direction have no superior rights over trains of the same class in the opposite direction, but that they must meet as per time table unless other orders are issued by the dispatcher.

RECENT IMPROVEMENTS IN SIGNALING*

BY J. S. HOBSON.†

In general, the progress made in this branch of engineering has been more along the lines of developing designs already in general use, than in making radical changes in design or in placing entirely new apparatus on the market. The interlocking and signaling for the new terminal of the Pennsylvania in New York City is a striking example of this, since, while that installation is the very latest development in railway signaling, it differs little in general principles from similar plants installed during the past five years. The most noteworthy features of this installation comprise means for obtaining the positive control of interlocked signals by the actual position of the switches or switch they govern; the automatic control of such signals by track conditions; the automatic locking of all switches in every route by the entrance of trains thereon, and their automatic release immediately the rear end of a train has passed clear of the fouling point of the track including each switch. The special features further comprise means for giving visual indications to the tower operator of every act of a train in actually locking and releasing levers controlling switch and signal operation, and means for permitting the joint use of all tracks for traffic in either direction between adjacent towers, by the co-action of towermen and track conditions.

The foregoing are, however, developments of methods previously in use in other plants, and while, in a sense, improvements, are not radical. There is, however, one somewhat original improvement in the Pennsylvania Terminal installation, used for the first time to any extent; namely, the control of electro-pneumatic valves through magnets actuated by alternating current. The use of alternating current for the operation of signal apparatus has been steadily growing for the past seven years, and the twelve-month just passed represents a more rapid growth of its use than any previous year. Alternating current was first used to any extent in signal apparatus for the operation of track circuits on electric railways, employing either alternating or direct current for propulsion purposes, but now its use has gradually been extended to signals, indicators, locks, etc.

A new field has very lately been opened for signal apparatus on interurban electric railways, the managers of which are taking a very keen interest in this subject, several contracts of this kind having just been closed by this company. Since their conditions differ somewhat from the electrified sections of steam roads, certain modifications have been made in alternating-current signal apparatus, resulting in improvements tending to increase its efficiency. For example, by modifications in the design of alternating-current relays, transformers, etc., the length of track circuits which can be operated without relaying has been materially increased, and the cost of installing alternating-current automatic block systems reduced accordingly.

The only other striking improvement in signal apparatus has been the development of the electro-mechanical interlocking system, in which the switches and their locks are operated manually and controlled electrically, the signals being electrically operated. This system possesses the combined safety features of manual and power operated interlockings at a cost about midway between the two.

Numerous minor developments in products have been made, as, for example, the improving of insulation in electrical material, the standardization of details to fit them for more universal application, and the modification of designs to cheapen the cost of production and expedite delivery of orders, among which may be mentioned the substitution of drop forgings for parts previously made of malleable iron, which from the nature of its manufacture cannot be furnished on short notice.

As an example of the improvement in the design of electrical apparatus, porcelain and insulating moulded material has been substituted, in many instances, for parts previously made of metal and insulated by bushings and washers.

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CAUSTIC SODA SIGNAL BATTERIES

BY A. G. SHAVER.*

Less than a year ago railways were buying their caustic soda battery without a very definite specification. The kind used was generally one selected after a series of experiments with the products of several different manufacturers. That concern whose battery appeared to give the best results in service was usually given the order, and if good service from that make of battery continued, then other orders followed to the same concern. Of course the purchasing agent would get prices and these would be a factor in determining whose goods would be purchased; but after a salesman had the first order, he did not much fear losing the business through competition as to prices if his battery only continued to give reasonably good service. In the absence of a specification, no two concerns were bidding for business on the same basis, and it was easy for a manufacturer, once having established a reputation as to the quality of his goods, to shave on the materials as well as the price.

In March, 1910, a Sub-Committee of Committee No. 4 of the Railway Signal Association first took up the question of a specification, and the result of their efforts is the specification presented at the last annual meeting, and now submitted to the members for adoption by letter ballot.

Considering that thousands of dollars worth of this type of battery is now used yearly by a number of the railways, this specification is one of the most important before the Association at this time, and it is hoped that the various signal engineers will appreciate its value and use it, not only to the benefit of their respective roads, but to the benefit of the manufacturers as well. If the manufacturers have only the one standard to follow, they can produce goods of a better quality at less cost, and keep a stock from which to fill orders promptly.

When the Sub-Committee began the preparation of its specification for caustic soda primary battery, it discovered that, although it was common practice to designate the capacity of the battery in ampere hours, no two manufacturers had the same basis for such a rating, nor were they agreed as to the proper basis to use. As the universal practice seemed to be to use 16 cells of caustic soda battery on each low-voltage electric motor semaphore signal, and as such signals would not operate to give the best service on a current source with an E. M. F. of less than eight volts, the sub-committee decided that the proper basis for determining the capacity of a caustic soda cell would be the number of hours it could be discharged at the rate of one ampere before the voltage, measured across the terminals of the cell with the current flowing, would drop below .5. Further, as some of the manufacturers were putting on the market a cell of practicable and convenient size which, when considered on this basis, had a life of 400 hours, and as in actual service on motor signals, considering the usual current discharges, local action, etc., it appeared the cell of such capacity was about the most efficient, the 400 ampere-hour signal cell was decided upon as standard.

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